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SAANICH PENINSULA WATER COMMISSION
Notice of Meeting on **Thursday, May 20, 2021 at 9:30 a.m.**
Meeting Room #6 Greenglade Community Centre, 2151 Lannon Way, Sidney BC

For members of the **public who wish to listen to the meeting** via telephone please call **1833-353-8610** and enter the **Participant Code 1911461 followed by #.** You will not be heard in the meeting room but will be able to listen to the proceedings.

R. Barnhart (Chair)	Z. King	M. Williams
M. Doehnel (Vice Chair)	C. McNeil-Smith	R. Windsor
S. Duncan	G. Orr	M. Underwood
D. Kelbert	M. Weisenberger	

AGENDA

1. TERRITORIAL ACKNOWLEDGEMENT

2. APPROVAL OF AGENDA

3. ADOPTION OF MINUTES 3

Recommendation: *That the minutes of the March 18, 2021 meeting be adopted.*

4. CHAIR'S REMARKS

5. GENERAL MANAGER'S REPORT

5.1. Water supply Outlook [Verbal]

6. PRESENTATIONS/DELEGATIONS

In keeping with directives from the Province of BC, this meeting will be held without the public present. A phone in number is provided above that will allow the public to listen to the meeting.

Presentation and Delegation requests can be made online or complete this printable form (PDF). Requests must be received no later than 4:30 p.m. two calendar days prior to the meeting.

7. COMMISSION BUSINESS

7.1. Post Disaster Water supply Update...5

Recommendation: *That the Saanich Peninsula Water Commission receive the report for information.*

To ensure a quorum, advise Denise at 250.360.3087 if you or your alternate cannot attend.

IWSS-297445977-6989

Recommendation: *The Saanich Peninsula Water Commission recommends to the Capital Regional District Board:*

1. *That Bylaw No. 4411 cited as "Saanich Peninsula Water Supply Water Works Facilities Loan Authorization Bylaw No. 1, 2021" be introduced and read a first, second and third time; and*
2. *Inspector of Municipalities for approval, and if received, to proceed with elector approval by way of the municipal consent process.*

Recommendation: *That the report be received for information.*

Recommendation: *That the Summary of Recommendations from other water commissions be received for information.*

Recommendation: *That the May 10, 2021 Water Watch Report be received for information.*

8. NEW BUSINESS

9. ADJOURNMENT

Next Meeting: Thursday, July 15, 2021

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MINUTES OF A MEETING OF THE SAANICH PENINSULA WATER COMMISSION
Held Thursday, March 18, 2021 in Meeting Room #6 at Greenglade Community Centre, 2151 Lannon Way, Sidney BC

PRESENT: **Commissioners:** R. Barnhart; M. Doehnel; S. Duncan; D. Kelbert (EP); Z. King (EP); B. Fallot for C. McNeil-Smith; G. Orr; M. Weisenberger; M. Williams; R. Windsor (EP)

Staff: T. Robbins, General Manager, Integrated Water Services; G. Harris, Senior Manager, Environmental Protection; M. Cowley, Manager, Wastewater Engineering & Planning; D. Dionne (recorder); I. Jesney, Senior Manager, Infrastructure Engineering (EP); S. Irg, Infrastructure Water Operations (EP)

REGRETS: M. Underwood

ALSO PRESENT: B. Barnett, Director, Engineering and Public Works, District of Central Saanich

EP = Electronic Participation

The meeting was called to order at 9:30 a.m.

The Chair conducted a roll call.

1. TERRITORIAL ACKNOWLEDGEMENT

Chair Barnhart provided the Territorial Acknowledgement.

2. APPROVAL OF AGENDA

MOVED by Commissioner Orr, **SECONDED** by Commissioner Weisenberger,
That the agenda be approved as circulated.

CARRIED

3. ADOPTION OF MINUTES

MOVED by Alt. Commissioner Fallot, **SECONDED** by Commissioner Weisenberger,
That the minutes of the January 21, 2021 meeting be adopted.

CARRIED

4. CHAIR'S REMARKS

The Chair made no remarks.

5. PRESENTATIONS/DELEGATIONS

There were no presentations or delegations.

6. COMMISSION BUSINESS

6.1. Summary of Recommendations from Other Water Commissions

T. Robbins reported that the Regional Water Supply Commission received a staff report on the Potential Impacts of Climate Change on Regional Water Supply Operations at its March 17, 2021 meeting. Staff will circulate to this Commission for its information.

MOVED by Commissioner Doehnel, **SECONDED** by Commissioner Williams,
That the Summary of Recommendations from other water commissions be received for information.

CARRIED

6.2. Water Watch Report

MOVED by Commissioner Duncan, **SECONDED** by Commissioner Orr,
That the March 8, 2021 Water Watch Report be received for information.

CARRIED

7. NEW BUSINESS

Commissioner Doehnel provided an update on the activities of the Water Advisory Committee, noting that the committee members are engaged and that there are four subcommittees the members are participating in.

Commissioner Orr thanked Commissioner Doehnel for sending out the link to the video *Brining Water to Victoria 1843-1915*.

8. ADJOURNMENT

MOVED by Commissioner Orr, **SECONDED** by Commissioner Williams,
That the meeting be adjourned at 9:37 a.m.

CARRIED

CHAIR **SECRETARY**

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SPWC 21-02

REPORT TO SAANICH PENINSULA WATER COMMISSION
MEETING OF THURSDAY, MAY 20, 2021

SUBJECT **Post Disaster Water Supply Update**

ISSUE SUMMARY

To update the Saanich Peninsula Water Commission on the Post Disaster Water Supply program and related capital projects.

BACKGROUND

The Post Disaster Water Supply program was initiated in 2016 to identify areas of the Regional Water Supply system, including the Saanich Peninsula Water system, that would be susceptible to failure due to seismic activity, identify areas of the system and critical infrastructure that lacked redundancy, establish a plan and acquire materials and equipment, and construct new infrastructure to enable the provision of water following a major disaster.

The ability to provide drinking water to citizens and communities following a natural disaster is critically important to support life, sanitation and personal hygiene, and eventual recovery. Earthquakes pose the largest threat to water infrastructure, particularly older, smaller diameter pipe infrastructure. An earthquake could cause hundreds of breaks in water pipes which would cause a loss of water system pressure, contamination, and drinking water service disruptions or even complete loss of service in some areas.

The vulnerability of water pipes to earthquakes depends on pipe location, age, compatibility with soils, pipe material and joint type. As a result of ground movement, pipes often crack and unrestrained joints pull apart. Many of the water distribution systems across the Region contain older cast iron or asbestos cement pipes and newer ductile iron or polyvinyl chloride (PVC) pipes. Cast iron and asbestos cement pipes are known to have moderate to high vulnerability. The majority of the Regional Water Supply Transmission Mains that convey water to the distribution systems are considered to be more seismically resilient as they are either steel pipes with welded joints, or ductile iron or PVC with fused or mechanically restrained joints.

Distribution pipe failures during an earthquake would immediately cause the system to depressurize and water would flow freely and uncontrolled through the points of failure to the ground surface. Following an earthquake, the goal would be to isolate depressurized portions impacted by pipe failures as quickly as possible, beginning with the distribution systems then the transmission system, in order to maintain pressure (and potability) in as much of the pipe network as possible. In order to stop the flow, the impacted portions of the distribution would need to be isolated with distribution system valves. If pressure could not be maintained in the distribution system, the distribution system would be isolated at the bulk supply point on the Transmission Main. The CRD has prepared a complete transmission system shut-down procedure that sets out the sequence and process to shut down the various transmission mains from the downstream end (municipal supply points) to the upstream end (water treatment plants). Then water in pressurized Transmission Mains can be accessed via the seismically restrained hydrants that are being installed at key locations across the Region. These hydrants can feed emergency water distribution centres directly or be used to fill water tankers that would supply emergency water in population centres impacted by loss of water service.

To date, the program has been focused on the following main components which are further detailed below:

- Transmission Mains – identifying and preparing upgrade plans on the large diameter Regional Water Supply Transmission Mains to ensure consistent seismic resilience throughout the supply system.
- Seismically Restrained Hydrants – identifying locations and installing hydrants directly to transmission mains that are seismically resistant to allow the ability to draw water from the transmission mains to supply portable distribution systems
- Water Distribution Modules – designing and constructing drinking water dispensing units to be connected to the hydrants identified in the Seismically Restrained Hydrant program and identifying locations for emergency water distribution centres.

To fund the program, the Regional Water Supply Commission committed $100,000 in 2016 and $200,000 in 2017 through 2021. The Saanich Peninsula Water Commission and the Juan de Fuca Water Distribution Commission committed program funding in 2018 through 2021 of $150,000 and $50,000 respectively. All amounts are annual commitments. In addition, a number of capital projects have been identified in each Commission’s 5 year capital plan to continue to address seismic resilience and system redundancy.

Transmission Mains (location map – Appendix A)

Transmission main upgrades have been planned in both the Regional Water and Saanich Peninsula Water systems and are referenced in Appendix A. These upgrades are part of each service’s capital plan and are summarized as follows:

- Regional Water – Transmission Main #4 (Goldstream Avenue/Station Avenue) Replacement – replacing approximately 1.9 kilometers (km) of existing concrete pipe with 1,400 millimetre (mm) diameter welded steel pipe from Leigh Road to Veterans Memorial Parkway; and, Transmission Main #1 upgrades (Humpback/Watkiss/PRV Stations). Estimated budget expenditure over the next 5 years is $35.4 million.
- Saanich Peninsula Water – Replacing 3.5 km of existing asbestos cement pipe with 500 mm diameter ductile iron pipe with mechanically restrained joints (Willingdon Road). This pipe is a Sidney and North Saanich supply pipe; and, installing approximately 3 km of new 600 mm diameter ductile iron transmission main with mechanically restrained joints along East Saanich Road (Bear Hill Interconnect) to build redundancy to the Saanich Peninsula water supply, as the current supply main is not seismically restrained and there is no redundant piping. Estimated budget expenditure over the next 5 years is $14.7 million.

In addition to the capital planning expenditures, custom repair collars for all the seismically susceptible concrete mains were purchased out of program funding in the amount of $353,000. These collars would be used to repair the concrete mains in the event of failure and allow a transition to steel replacement pipe.

Seismically Restrained Hydrants (location map – Appendix B)

Seismically restrained hydrants have been designed to be served by seismically restrained transmission mains and have been hardened to resist seismic disturbances. These hydrants feature fully restrained joints including bolted tapping sleeves which provides the connections to the steel transmission mains. The hydrants have been coloured dark blue to distinguish them from municipal hydrants. They can also be used as a regular fire hydrant for local fire departments, however that is not the primary intent.

Status of the hydrant installation is shown on the location map in Appendix B and is summarized as follows:

- To date, 10 seismically restrained hydrants have been installed.
- There are five additional installations being carried out in 2021.
- Beyond 2021, there are an additional 10 installations being proposed as funding allows.

An example of a seismically restrained hydrant installation at Elk Lake:

Water Distribution Modules

In the event of a seismic event that renders local distribution systems unusable, there will be a need to dispense and distribute water to the public. To satisfy this need, both static and mobile Water Distribution Modules were designed and one of each has been procured to date. Details on how these Modules are designed to be used in conjunction with a seismically restrained hydrant. The cost for a static versus mobile unit is virtually identical at $207,000 each in 2018 dollars. The end number and which type are chosen will depend on location requirements still to be determined with local municipalities and budget availability. Two typical water distribution centre layouts are attached as Appendix C and D. Appendix C shows a distribution centre that would utilize a 5,000 gallon ‘pillow tank’ or reservoir that would be filled via a water tanker shuttle. Appendix D shows a distribution centre that would utilize a direct connection to a restrained hydrant.

Photos of the static and mobile distribution modules:

As part of the emergency pre-planning work associated with this initiative, staff have identified suitable locations for emergency water distribution centres across the Region based on:

- population centres
- proximity to Transmission Mains
- proximity to primary transportation routes/post-disaster routes
- suitable sites for distribution centre equipment and supplies and orderly movement of people and traffic
- potential to coordinate with other post-disaster supply distribution (food, medical, shelter)

Reservoir Seismic Isolation Valves

An additional capital project related to seismic disaster mitigation is the design and installation of seismic isolation valves on seven reservoirs in the Saanich Peninsula system: Bear Hill, Dawson, Dean Park Upper, Dean Park Middle, Dean Park Lower, Cloake Hill and McTavish.

This project was identified in the 2017 capital budget and a conceptual design contract was procured with Associated Engineering Ltd. in early 2018. The final report from Associated was delivered in the fall of 2018. The plan at the time was to include the installation of seismic valves with other works going on at the respective reservoirs and the first one was identified in 2019 at the Dean Park Upper reservoir. Detailed design was carried out in 2019 by Stantec, however the contractor doing the other work declined to carry out the additional work for the seismic valve. Enquiries to the general contracting industry were made to find someone to do the seismic valve work and there was no interest from industry at the time. It was tendered as a standalone project in 2020 with one bid of $103,000 which was approximately 60% over Stantec's construction estimate of $65,000. As a result, the tender was closed and not awarded.

Given the reluctance of the general contracting industry to take on work of this type, staff have approached mechanical and electrical contractors (the two major components of the work) to bid the work as a team. This was retendered on April 27, 2021 with a tender close date of May 18. There has been interest shown by six potential bidders. The revised scope for this project is to complete the Dean Park Upper, Dean Park Middle and Dean Park Lower projects with Bear Hill and Cloake Hill as provisional items subject to budget availability. A separate detailed design will be required for McTavish due to piping complexities and Dawson will be recommended to be removed from the list due to its small size. The original budget for this project was $500,000 of which $85,000 has been spent to date on conceptual design, detailed design and tendering efforts.

ALTERNATIVES

Alternative 1
That the Saanich Peninsula Water Commission receive the report for information.

Alternative 2
That the report be referred back to staff for additional information.

CONCLUSION

The Post Disaster Water Supply program began in 2016 with the Regional Water Supply Commission and was joined in 2018 by the Saanich Peninsula Water Commission and the Juan de Fuca Water Distribution Commission. This report provides an update on the program and planned next steps.

RECOMMENDATION

That the Saanich Peninsula Water Commission receive the report for information.

Submitted by:	Ian Jesney, P.Eng., Senior Manager, Infrastructure Engineering
Concurrence:	Ted Robbins, B. Sc., C. Tech., General Manager, Integrated Water Services
Concurrence:	Robert Lapham, MCIP, RPP, Chief Administrative Officer

ATTACHMENTS

Appendix A: Transmission Mains Location Map
Appendix B: Seismically Restrained Hydrants Location Map
Appendix C: Water Distribution Module
Appendix D: Water Distribution Point

Water Transmission Upgrades
Appendix A

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Kilometres
0 0.5 1 2
UTM Zone 10N NAD 1983

N W E S

DISCLAIMER

Important This map is for general information purposes only. The Capital Regional District (**CRD**) makes no representations or warranties regarding the accuracy or completeness of this map or the suitability of the map for any purpose. **This map is not for navigation.** The CRD **will not be liable** for any damage, loss or injury resulting from the use of this map or information on the map and the map may be changed by the CRD at any time.

May 2021 | WaterTransmissionUpgrades_AppendixA.mxd | helpdesk@crd.bc.ca

Existing Supply Main

RWS Supply Main No. 4 – Goldstream Ave
Concrete ⌀1,372mm 1972 ~1,900m

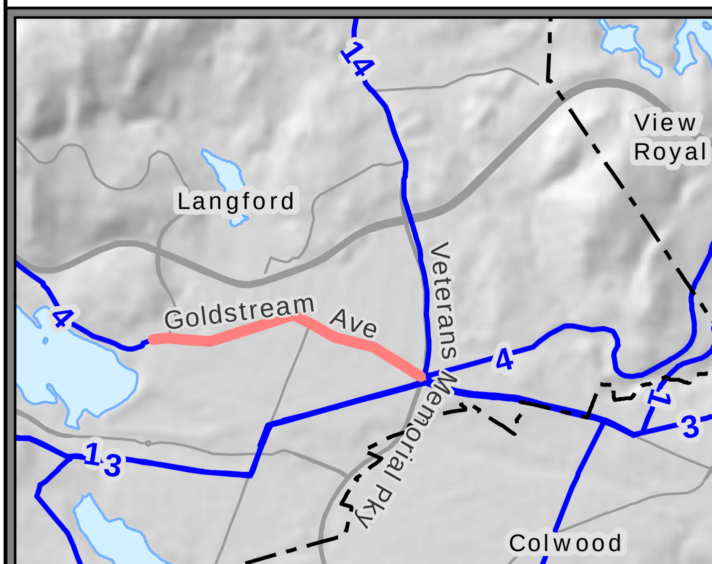
Phase 1 — SPW Water Main – East Saanich Road:
Mt Newton Cross Rd to Dean Park Lower Reservoir
Proposed Interconnect ~3,000m

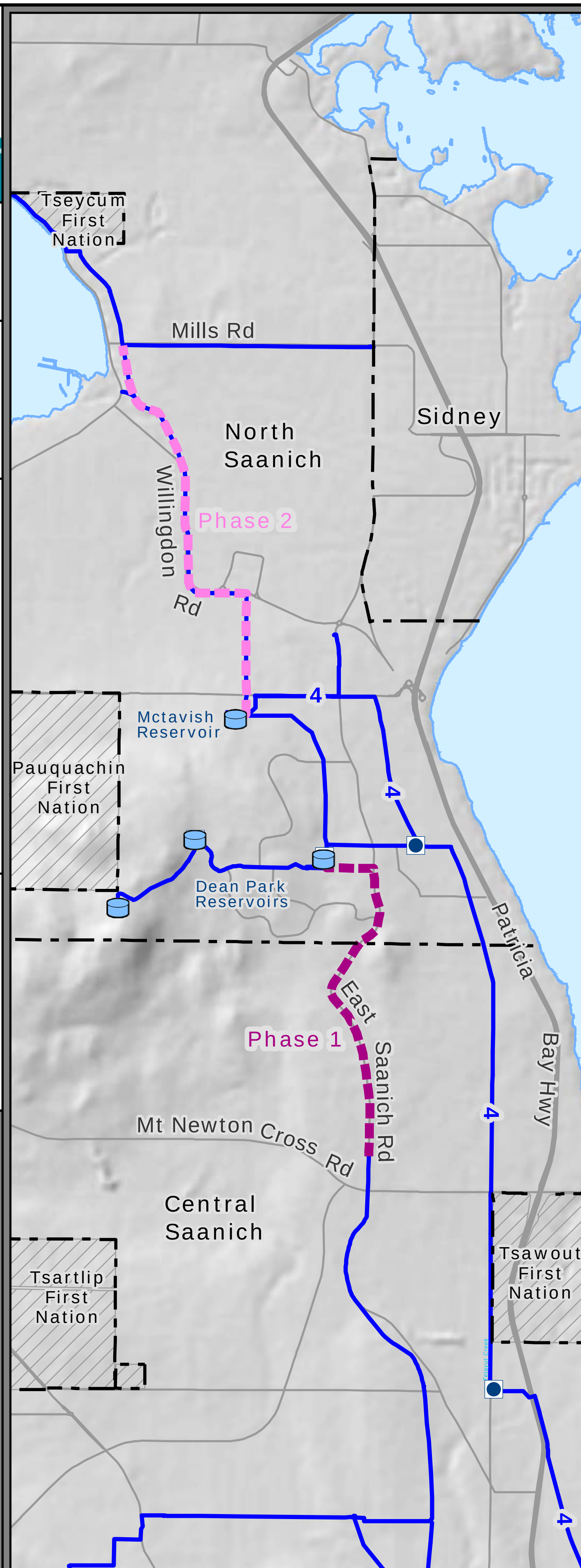
Phase 2 — SPW Water Main – Willingdon Road:
McTavish Reservoir to Mills Road
AC Replacement ⌀500mm 1980 ~3,500m

TP Treatment Plant

Reservoir

Pump Station





Seismically Resilient Hydrants
Appendix B

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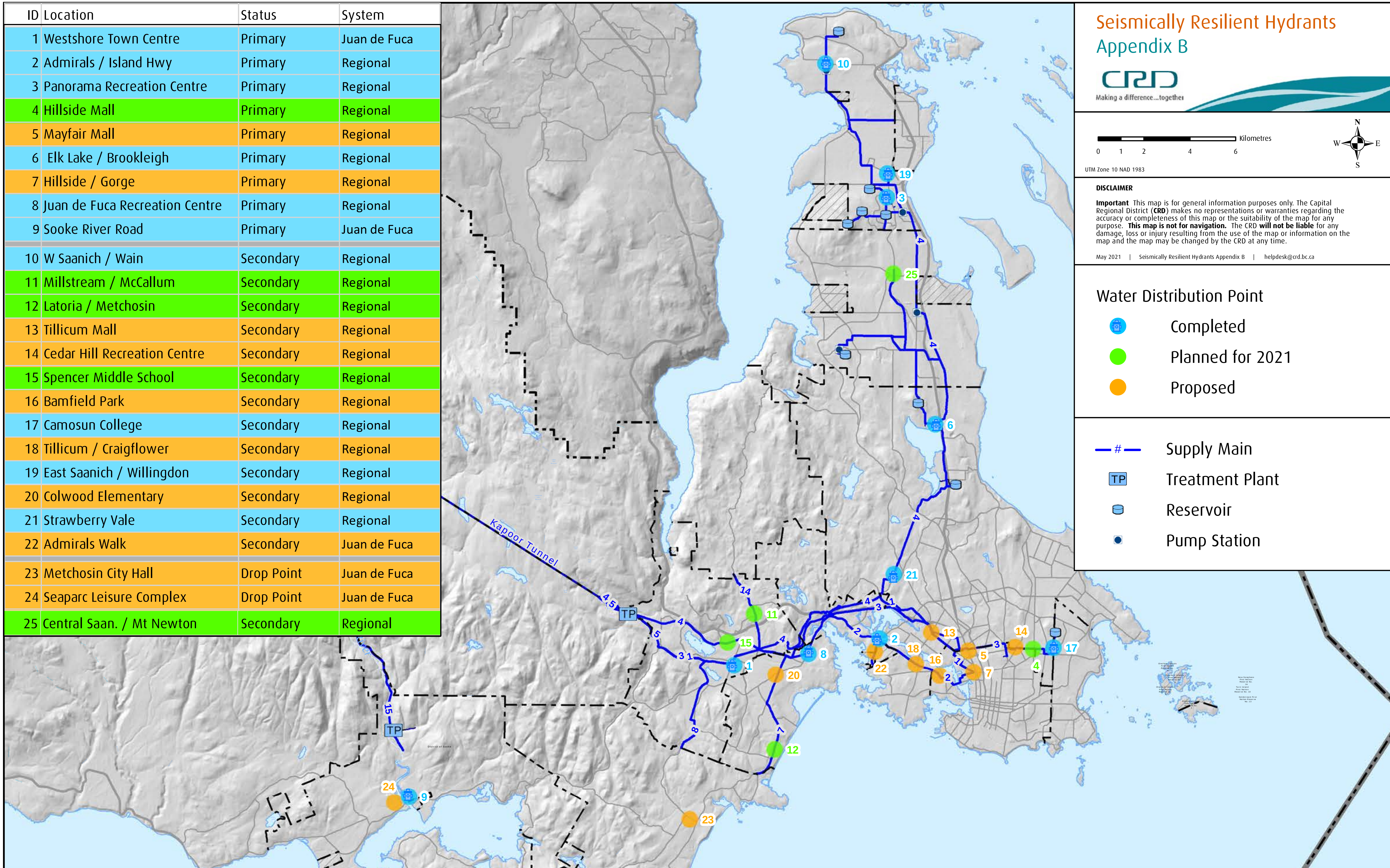
ID	Location	Status	System
1	Westshore Town Centre	Primary	Juan de Fuca
2	Admirals / Island Hwy	Primary	Regional
3	Panorama Recreation Centre	Primary	Regional
4	Hillside Mall	Primary	Regional
5	Mayfair Mall	Primary	Regional
6	Elk Lake / Brookleigh	Primary	Regional
7	Hillside / Gorge	Primary	Regional
8	Juan de Fuca Recreation Centre	Primary	Regional
9	Sooke River Road	Primary	Juan de Fuca
10	W Saanich / Wain	Secondary	Regional
11	Millstream / McCallum	Secondary	Regional
12	Latoria / Metchosin	Secondary	Regional
13	Tillicum Mall	Secondary	Regional
14	Cedar Hill Recreation Centre	Secondary	Regional
15	Spencer Middle School	Secondary	Regional
16	Bamfield Park	Secondary	Regional
17	Camosun College	Secondary	Regional
18	Tillicum / Craigflower	Secondary	Regional
19	East Saanich / Willingdon	Secondary	Regional
20	Colwood Elementary	Secondary	Regional
21	Strawberry Vale	Secondary	Regional
22	Admirals Walk	Secondary	Juan de Fuca
23	Metchosin City Hall	Drop Point	Juan de Fuca
24	Seaparc Leisure Complex	Drop Point	Juan de Fuca
25	Central Saan. / Mt Newton	Secondary	Regional



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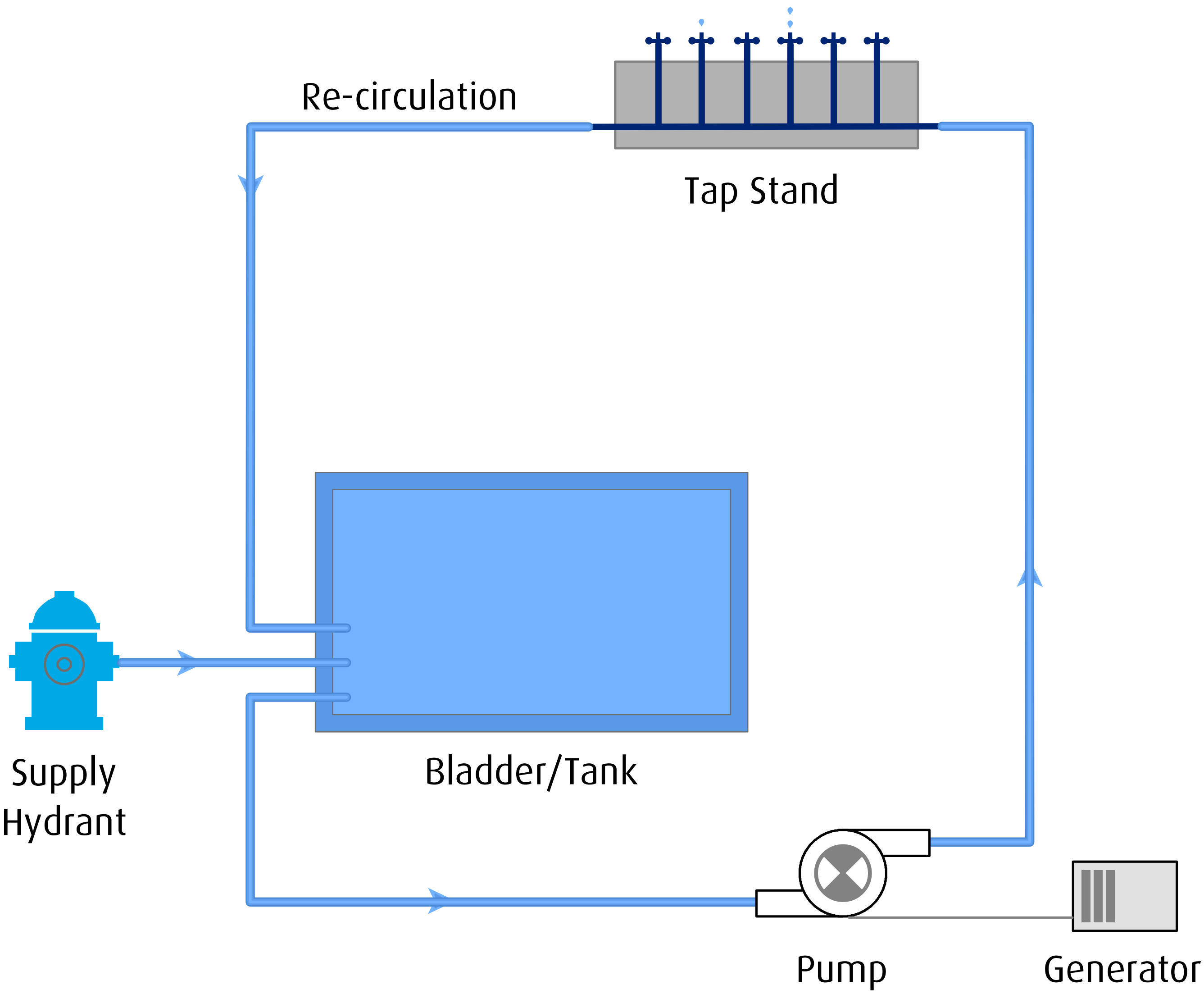
May 2021 | Seismically Resilient Hydrants Appendix B | helpdesk@crd.bc.ca



Water Distribution Module

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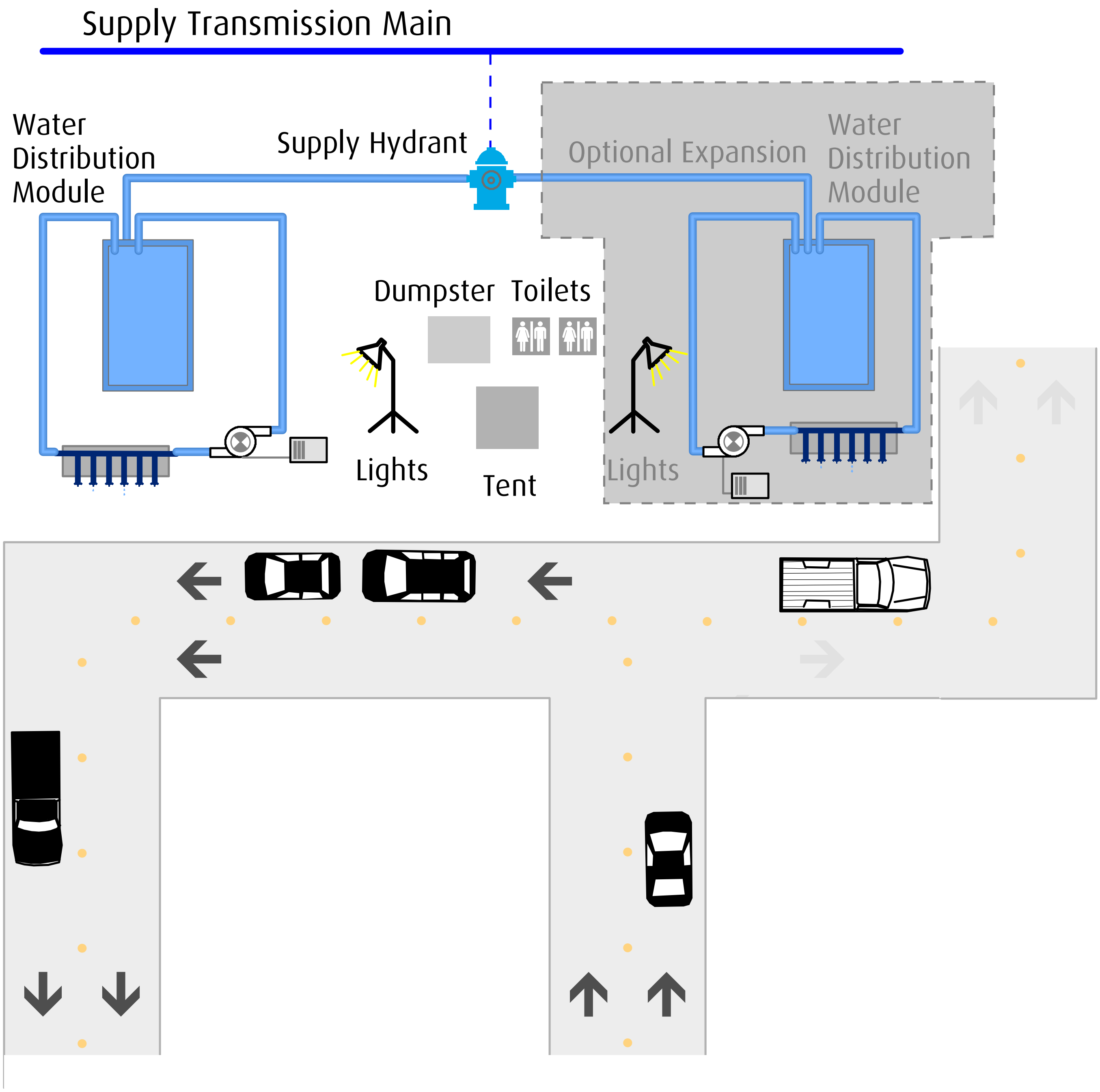

Water Distribution Point

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REPORT TO THE SAANICH PENINSULA WATER COMMISSION
MEETING OF THURSDAY, MAY 20, 2021

SUBJECT **Bylaw No. 4411: Saanich Peninsula Water Supply Water Works Facilities Loan Authorization Bylaw**

ISSUE SUMMARY

A Capital Regional District (CRD) Board resolution is required to approve loan authorization Bylaw No. 4411 for the purpose of financing the Saanich Peninsula Water Supply five year 2021-2025 capital plan.

BACKGROUND

The most recent loan authorization for the Saanich Peninsula Water Supply was approved in 1993 under Bylaw No. 2140 to finance capital spending. A loan authorization is typically prepared every five years, or as long-term debt is required. The Saanich Peninsula Water Supply capital plan (the "Capital Plan") includes planned system upgrades and expansion that will require borrowing of $12.9 million from the Municipal Finance Authority of British Columbia (MFABC). This borrowing will occur as required to meet cash flow needs for implementation of Commission approved capital projects. Under the *Local Government Act*, participating area approval is required.

The following bylaw is proposed:

Service Area	Action	Purpose	Bylaw
2.610	Loan Authorization Bylaw	To create a loan authorization bylaw to permit long-term borrowing related to the capital plan for this service.	4411 Saanich Peninsula Water Supply Water Works Facilities Loan Authorization Bylaw No. 1, 2021

ALTERNATIVES

Alternative 1
The Saanich Peninsula Water Commission recommends to the Capital Regional District Board:
1. That Bylaw No. 4411 cited as "Saanich Peninsula Water Supply Water Works Facilities Loan Authorization Bylaw No. 1, 2021" be introduced and read a first, second and third time; and
2. That Bylaw No. 4411 be referred to the Inspector of Municipalities for approval, and if received, to proceed with elector approval by way of the municipal consent process.

Alternative 2
That Bylaw No. 4411 be deferred to a future meeting pending further information.

IMPLICATIONS

Legislative & Financial Implications

Long-term borrowing (i.e. loans with a term of more than 5 years) cannot be undertaken without the loan authorization bylaw being approved by the Inspector of Municipalities after the bylaw is given three readings by the local government. In addition, in accordance with the *Local Government Act*, elector approval is required in order to approve the loan authorization bylaw. Electoral approval can be obtained through consent on behalf of two-thirds of municipal participants' councils or by alternative approval process. It is recommended that elector approval be obtained by the municipal consent process. In a service area of this size municipal council consent would require less administrative resources. This can be initiated when the loan authorization bylaw has received a third reading.

The loan authorization for the provisional Capital Plan is $12.9 million and will support the planned five year capital plan expenditures commencing in January 2022. The estimated debt servicing costs for the borrowing are included in the 2021–2025 five-year operating budget. Capital funds on hand will provide additional funds as required beginning in 2022.

This loan authorization covers planned spending contained within the next five years of the capital plan. Actual borrowings in each of these years will be based on the cash flow requirements for the year, subject to the availability of funds from consumption revenue (net of operating expenditures).

To ensure optimization of interest and timing of long term debt, issuance of a temporary borrowing will be proposed if municipal consent is received and Ministerial Approval is obtained. The timing of the debt issuance will be based on the timing of expenditures and will be dependent on prevailing interest rates at the time. Before long term debt issuance can be exercised, a security issuing bylaw will be brought forward for approval. The term of any debt issuances under such loan authorization will be 15 years.

CONCLUSION

Capital program work on the Saanich Peninsula Water Supply system is planned for 2021 and ongoing. The work will be funded through a combination of capital reserve funds on hand and borrowed funds. Timely access to the borrowed funds in 2022 is critical to meeting the capital program spending needs. To that end, a Capital Regional District (CRD) Board resolution is required to commence the loan authorization process for Bylaw No. 4411 for the purpose of financing the Saanich Peninsula Water Supply system five year 2021-2025 capital plan. An elector consent process will be undertaken to obtain elector approval and can be initiated once the loan authorization bylaw has received third reading.

RECOMMENDATION

The Saanich Peninsula Water Commission recommends to the Capital Regional District Board:

1. That Bylaw No. 4411, cited as "Saanich Peninsular Water Supply Water Works Facilities Loan Authorization Bylaw No. 1, 2021", be introduced and read a first, second and third time; and
2. That Bylaw No. 4411 be referred to the Inspector of Municipalities for approval, and if received, to proceed with elector approval by way of the municipal consent process.

Submitted by:	Rianna Lachance, BCom, CPA, CA, Senior Manager, Financial Services
Concurrence:	Nelson Chan, MBA, FCPA, FCMA, Chief Financial Officer
Concurrence:	Ted Robbins, B. Sc., C. Tech., General Manager, Integrated Water Services
Concurrence:	Kristen Morley, J.D., General Manager, Corporate Services & Corporate Officer
Concurrence:	Robert Lapham, MCIP, RPP, Chief Administrative Officer

ATTACHMENT(S)

Appendix A: Bylaw 4411, "Saanich Peninsula Water Supply Facilities Loan Authorization Bylaw No. 1, 2021"

CAPITAL REGIONAL DISTRICT

BYLAW NO. 4411

****
A BYLAW TO AUTHORIZE THE BORROWING OF TWELVE MILLION NINE HUNDRED THOUSAND DOLLARS ($12,900,000) FOR THE PURPOSE OF ACQUIRING, DESIGNING AND CONSTRUCTING WATER WORKS FACILITIES OF SAANICH PENINSULA WATER SUPPLY
****

WHEREAS:

A. Under Bylaw No. 376, "Bulk Water Rates Bylaw, 1977", the Board of the Regional District established a local service for the purpose of supplying water in the Regional District;

B. It is deemed desirable to fund works relating to the acquiring, designing and constructing water distribution facilities in the Saanich Peninsula Water Supply system, and the work shall include the planning, study, public consultation, site selection, design, land and material acquisition, construction, supply and installation of all material, equipment and components and all construction necessary for the preparation and works relating to the acquiring, designing and constructing water distribution facilities in the Saanich Peninsula Water Supply system;

C. The estimated cost of the works is the sum of twelve million nine hundred thousand dollars ($12,900,000) dollars;

D. Pursuant to sections 407 of the *Local Government Act*, participating area approval is required for this borrowing and shall be obtained by municipal council consent under s. 346 of the *Local Government Act*; and

E. Financing is proposed to be undertaken by the Municipal Finance Authority of British Columbia pursuant to agreements between it and the Capital Regional District;

NOW THEREFORE the Capital Regional District Board in open meeting assembled hereby enacts as follows:

1. The Board is hereby empowered and authorized to undertake and carry out or cause to be carried out the acquisition of land, planning, study, design and construction of buildings, plant, mains, dams, and other water works facilities and equipment herein before described and to do all things necessary in connection therewith and without limiting the generality of the foregoing:

    a) to borrow upon the credit of the Capital Regional District a sum not exceeding twelve million nine hundred thousand dollars ($12,900,000); and

b) to acquire all such real property, easements, rights-of-way, leases, licenses, rights or authorities as may be requisite or desirable for or in connection with the acquisition of land, planning, study, design and construction to add, replace, upgrade water works facilities and all related ancillary works, studies and equipment deemed necessary in connection with construction of said facilities.

2. The maximum term for which debentures may be issued to secure the debt intended to be created by this bylaw is 15 years.

3. This Bylaw may be cited as "Saanich Peninsula Water Supply Water Works Facilities Loan Authorization Bylaw No. 1, 2021".

READ A FIRST TIME THIS	th	day of	202_
READ A SECOND TIME THIS	th	day of	202_
READ A THIRD TIME THIS	th	day of	202_
APPROVED BY THE INSPECTOR OF MUNICIPALITIES THIS	th	day of	202_
APPROVED BY MUNICIPAL COUNCIL CONSENT PROCESS PER S.346 OF THE *LOCAL GOVERNMENT ACT* THIS	th	day of	202_
ADOPTED THIS	th	day of	202_

CHAIR CORPORATE OFFICER

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EEP 21-24

REPORT TO SAANICH PENINSULA WATER COMMISSION
MEETING OF THURSDAY, MAY 20, 2021

SUBJECT **Greater Victoria Drinking Water Quality – 2020 Annual Report**

ISSUE SUMMARY

To present the 2020 annual report to the Saanich Peninsula Water Commission.

BACKGROUND

The Capital Regional District (CRD) undertakes a comprehensive water quality monitoring program as part of its multi-barrier approach to provide a safe drinking water supply to the region. The Water Quality Monitoring program reports water trends on a regular basis to the Commission, along with a comprehensive annual report for each calendar year. The Greater Victoria Drinking Water Quality 2020 Annual Report is attached as Appendix A. Water suppliers in BC are responsible for monitoring and providing an annual report to the provincial regulator (i.e., Island Health Authority). To assist in meeting these responsibilities, the CRD has prepared this report, which will be distributed to Island Health and all municipal water purveyors, and posted on the CRD website.

IMPLICATIONS

Environmental & Climate Implications

The report indicates that our source water remains in good condition and there is excellent drinking water quality in all system components of the Greater Victoria Drinking Water System. The system is monitored for physical, chemical and biological water quality parameters. All trends are stable and indicate good conditions overall. Although operation of the new hypochlorite plant at the Goldstream Water Treatment Plant remained temporarily suspended throughout 2020 to complete work on some of the system's components, the existing treatment using ultraviolet radiation and a sequence of chlorination and chloramination remained effective in managing low risks associated with the unfiltered water supply.

Monitoring results indicate the CRD continues to meet guidelines for maintaining an unfiltered source water supply. Further monitoring within the distribution systems also indicates a good balance between managing bacterial growth and ensuring good water quality with low concentrations of disinfection byproducts.

The post-wildfire water quality assessment, in the wake of two wildfires in the Sooke Lake catchment (August 16 and 21, 2020), concluded that this event did not have any measurable short-term impact on the source water quality. While not expected to occur, ongoing regular water quality monitoring in the watershed will detect any potential long-term water quality impacts.

Financial and Regulatory Implications

The reporting function is included within the overall budget for the Water Quality Monitoring Program. This task is essential for ensuring there is adequate information to inform and work with

Island Health officials, meet provincial regulatory requirements and federal guidelines, and ensure CRD staff have sufficient information to maintain proper oversight of the water supply system.

The CRD continues to provide compliance monitoring of the municipal systems within the region to deliver effective and efficient oversight for both monitoring and reporting of water quality within the overall distribution system. Responsibility for any issues that may arise remains the responsibility of the municipalities.

Social Implications

The full disclosure of water quality monitoring data maintains public confidence that the CRD is effectively managing the regional drinking water supply. The data and reports are available online through the CRD public website. Staff respond to direct customer concerns and questions, and work with CRD operational staff, municipal staff, small system operators and Island Health officials to ensure good communication and support for the overall system.

CONCLUSION

The water quality monitoring program remains an essential component in the delivery of a safe drinking water supply to the region. Monitoring results summarized in the Greater Victoria Drinking Water Quality – 2020 Annual Report indicate good water quality overall with the low risks associated with the unfiltered source water being well managed by the CRD multi-barrier approach. Once the report is received and approved by the Board, it will be submitted to the Island Health Authority, as per requirement under the BC Drinking Water Protection Act.

RECOMMENDATION

That the Saanich Peninsula Water Commission receive this report for information.

Submitted by:	Glenn Harris, Ph.D., R.P.Bio., Senior Manager, Environmental Protection
Concurrence:	Larisa Hutcheson, P.Eng., General Manager, Parks & Environmental Services
Concurrence:	Robert Lapham, MCIP, RPP, Chief Administrative Officer

ATTACHMENT

Appendix A: Greater Victoria Drinking Water Quality – 2020 Annual Report

Greater Victoria Drinking Water Quality
2020 Annual Report

Parks & Environmental Services Department | Environmental Protection

Prepared By
Water Quality Program
Capital Regional District
479 Island Highway, Victoria, BC, V9B 1H7
T: 250.474.9680 F: 250.474.9691
www.crd.bc.ca
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Greater Victoria Drinking Water Quality
2020 Annual Report

EXECUTIVE SUMMARY

This report provides the annual overview of Capital Regional District (CRD) Water Quality Monitoring program and its results on water quality in 2020 within the Greater Victoria Drinking Water System (GVDWS) and its individual system components (Map 1). The results indicate that Greater Victoria's drinking water continues to be of good quality and is safe to drink.

The monitoring program is designed to meet the requirements of the provincial regulatory framework, which is defined by the *BC Drinking Water Protection Act* and *Drinking Water Protection Regulation*, and follow the federal guidelines for drinking water quality.

The approximately 11,000 hectares of the Sooke and Goldstream watersheds comprise the source of our regional drinking water supply area. Water flows from the reservoirs to the Sooke and Goldstream (formerly called Japan Gulch) water treatment plants and then through large-diameter transmission mains and a number of storage reservoirs into eight different distribution systems, which in turn deliver the drinking water to the consumers. The monitoring program covers the entire system to anticipate any issues (i.e., source water monitoring), ensure treatment is effective (i.e., monitoring at the treatment facilities), and confirm a safe conveyance of the treated water to customers (i.e., transmission and distribution system monitoring). It also enables CRD staff to address any concerns or questions by the general public. The program adopts a multiple-lines-of-evidence approach (biological, chemical and physical) to ensure all aspects of water quality are considered. The program is comprehensive, collecting approximately 10,000 samples and conducting approximately 75,000 individual analyses annually. The results are discussed with the Island Health Authority, which oversees compliance with drinking water standards, and with CRD operations and municipal staff, who rely on the information to properly operate and maintain the system components.

The five source water reservoirs, with established and intact ecosystems, provide raw water of excellent and stable water quality that can be utilized unfiltered for the preparation of potable water. Water quality monitoring in the watersheds serves several purposes: 1) to verify that the CRD continues to comply with the criteria for an unfiltered surface water source; 2) to understand the quality of the water flowing into the reservoirs; 3) to ensure that staff are aware of the presence and absence of water quality-relevant organisms, including specific pathogens in the lakes, prior to any treatment; 4) to confirm that the water quality parameters remain within the effectivity range of the disinfection treatment; and 5) to detect any taste and odour or other aesthetic concerns that could then pass through the system.

This annual water quality report separates the water system components that are the CRD's responsibility from system components that are the responsibility of the municipalities. The CRD provides water quality sampling and testing services for compliance purposes to all municipal water systems. Each water distribution system was assessed for compliance with the regulatory requirements. This annual report contains the compliance summary for CRD and municipal water distribution systems in the GVDWS.

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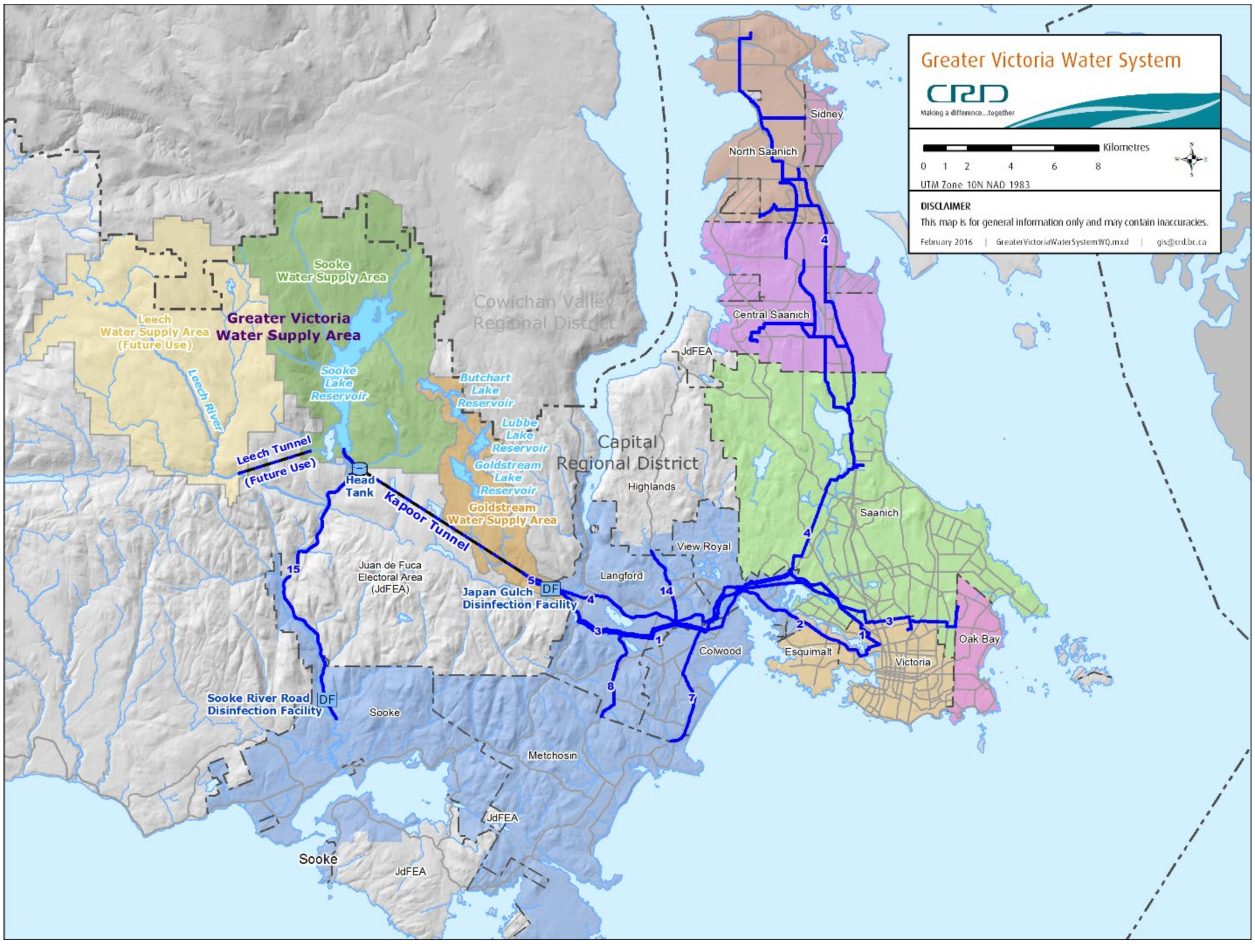
MAP 1. Greater Victoria Drinking Water System



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Greater Victoria Drinking Water Quality
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Greater Victoria Drinking Water Quality
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1.0 INTRODUCTION

This report is the annual overview of the results from water quality samples collected in 2020 from the Greater Victoria Drinking Water System (GVDWS) (Map 1). The report summarizes data from the Capital Regional District (CRD) owned and operated water infrastructure that includes the source reservoirs, the Regional Transmission System and the Juan De Fuca Water Distribution System, as well as data from the municipal distribution systems. Monthly and weekly summary reports on water quality data are posted on the CRD's website at: https://www.crd.bc.ca/about/data/drinking-water-quality-reports.

2.0 WATER SYSTEM DESCRIPTION

In 2020, the GVDWS supplied drinking water to approximately 392,000 people and is the third largest drinking water system operating in British Columbia. It comprises two separate service areas:

1. The **Goldstream (Japan Gulch) Service Area** that supplies water to approximately 376,500 people in Victoria, Saanich, Oak Bay, Esquimalt, Central Saanich, North Saanich, Sidney, Highlands, Colwood, Langford and Metchosin via the Goldstream Water Treatment Plant (formerly called Japan Gulch).

2. The **Sooke Service Area** that supplies water to approximately 15,500 people in Sooke and East Sooke via the Sooke River Road Water Treatment Plant.

2.1 Source Water Systems

Drinking water for the GVDWS comes from protected watersheds called the Greater Victoria Water Supply Area (see Map 1). This CRD-owned and managed area, which is approximately 20,500 hectares in size, is located about 30 km northwest of Victoria and encompasses about 98% of the Sooke Lake, 98% of the Goldstream Lake and 92% of the Leech River catchment areas. The Goldstream and Sooke watersheds, with 11,000 ha area, comprise the active water supply area, whereas 9,500 ha of the Leech watershed are currently inactive and designated for future water supply.

Goldstream (Japan Gulch) Service Area

The five reservoirs in the supply area have been used as a source of drinking water since the early 1900s. The Sooke Lake Reservoir, the largest of the reservoirs, is the primary water source for this system, supplying typically between 98% and 100% of Greater Victoria's drinking water. In 2020, Sooke Lake Reservoir supplied 100% of the source water. The four reservoirs in the Goldstream system (Butchart, Lubbe, Goldstream and Japan Gulch) are typically off-line and are used only as a backup water supply. Controlled releases from the Goldstream watershed provide water for salmon enhancement in the lower Goldstream River. The Leech River watershed does not yet contribute to the water supply for the GVDWS.

Water at the southern end of Sooke Lake Reservoir enters two of the variable depth gates in the intake tower and is screened through a stainless steel travelling screen (openings of 0.5 mm). From the intake tower, the water passes through two 1,200 mm-diameter pipelines to the head tank and then through the 8.8 km-long, 2.3 m-diameter Kapoor Tunnel and then into 1,525 mm- and 1,220 mm-diameter pipes connecting the Kapoor Tunnel to the Goldstream Water Treatment Plant, where it is disinfected.

During occasional brief periods of use (typically used only when the Kapoor Tunnel is out of service for inspection by CRD staff), water in the Goldstream Watershed is released from Goldstream Reservoir and flows down the upper reaches of Goldstream River into Japan Gulch Reservoir. Water from Japan Gulch Reservoir enters the Japan Gulch intake tower through a low-level and a high-level intake, passing through a 14-mesh, stainless steel screen and is then carried in a 1,320 mm-diameter pipe into the Goldstream Water Treatment Plant.

Sooke Service Area

Drinking water for the Sooke Service Area is only supplied from Sooke Lake Reservoir, but travels a different route. This water is passed through a 14.5 km-long (9 miles), 600 mm-diameter PVC and ductile iron pipe from a point just above the head tank to the Sooke River Road Water Treatment Plant. The Sooke Service Area has no backup water source.

2.2 Water Disinfection

The disinfection process in the GVDWS is both simple and effective and uses two water treatment plants to provide disinfected drinking water to the two service areas.

Both water treatment plants utilize the same disinfection concepts and process methods. The Goldstream Water Treatment Plant uses delivered liquid sodium hypochlorite and liquid ammonia for the disinfection process and still has the old chlorine gas injection plant as a backup system. In 2020, the new hypochlorite chlorination plant was out of service with the chlorine gas plant back in service. The Sooke River Road Water Treatment Plant generates sodium hypochlorite on site and injects delivered liquid ammonia to achieve the disinfection effect.

At both water treatment plants, the water passes through a three-part disinfection process in sequential order—two primary disinfection steps that provide disinfection of the water entering the system, followed by a secondary disinfection step that provides continuing disinfection throughout the transmission system and the distribution systems:

1. **UV Disinfection**. Ultraviolet (UV) disinfection provides the first step in the primary disinfection process (disinfection of the raw source water entering the plants) and inactivates parasites, such as *Giardia* and *Cryptosporidium* [3-log (99.9%) inactivation], as well as reducing the level of bacteria in the water.
2. **Free Chlorine Disinfection**. Free chlorine disinfection provides the second step in the primary disinfection process, using a free chlorine dosage of approximately 1.5-2.5 mg/L and a minimum of 10-minute (depending upon flow) contact time between the free chlorine and the water. The free chlorine disinfection step inactivates bacteria and provides a 4-log (99.99%) reduction of viruses.
3. **Ammonia Addition**. The secondary disinfection process consists of the addition of ammonia to form chloramines at a point downstream where the water has been in contact with the free chlorine for approximately 10 minutes or more. The ammonia is added at a ratio of approximately one part ammonia to four-five parts chlorine. In the water, these chemicals combine to produce a chloramine residual (measured as total chlorine). Monochloramine is the desired residual product, which typically represents 90% of the total chlorine when leaving the plants. This residual remains in the water and continues to protect the water from bacterial contamination (secondary disinfection), as it travels throughout the pipelines of the distribution system.

In East Sooke, at the Iron Mine Reservoir, CRD re-chloraminates the water to boost the chlorine residual provided to the extremities of that system. In Metchosin, at Rocky Point Reservoir, the CRD maintains another re-chloramination station, which has not been in service for approximately four years. It has been deemed unnecessary for maintaining adequate residuals. Currently, there are no provisions to re-chloraminate the water at the far reaches of the distribution system on the Saanich Peninsula; however, emergency re-chlorination stations are provided at the Upper Dawson Reservoir, Upper Dean Park Reservoir and Deep Cove pump station, supplying Cloake Hill Reservoir. These re-chlorination stations are able to add free chlorine to the system if the total chlorine residuals were to drop to inadequate levels or during water quality emergencies.

2.3 CRD Transmission System

The CRD Transmission System comprises a number of large-diameter transmission mains and several connected supply storage reservoirs. Almost all of the supply storage reservoirs are on the Saanich Peninsula, leaving the Core Area municipalities without any supply storage. Using a series of large-diameter transmission mains, the CRD supplies treated water to its downstream customers. These large-diameter transmission mains are sorted into three sections:

1. Regional Transmission System, that supplies the Core Area municipalities and up to the Saanich Peninsula boundary;

2. The Saanich Peninsula Trunk Water Distribution System that receives water at two points on the Saanich Peninsula from the Regional Transmission System and supplies it to the three municipalities and other customers on the Saanich Peninsula; and

3. The Sooke Supply Main.

2.3.1 Regional Transmission System

The CRD currently uses seven large-diameter transmission mains to supply drinking water to the municipal distribution systems in the Japan Gulch Service Area. These transmission mains range in diameter from 1,525 mm (60") down to 460 mm (18") and transfer water from the Goldstream Water Treatment Plant to the distribution systems listed in Section 2.4.

- Main #1 is a 1,067 mm-diameter (42"), cement mortar-lined, welded steel pipe that starts at the Humpback pressure regulating valve (PRV) below the Humpback Reservoir Dam and ends at the David Street vault. This transmission main provides water primarily to the City of Victoria, but also services portions of Saanich and the Westshore communities.
- Main #2 is a 780 mm-diameter (31") steel and ductile iron pipe, which starts at the Colwood overpass and runs primarily through View Royal, Esquimalt and Vic West along the Old Island Highway and Craigflower Road. Main #2 joins Main #1 at the David Street vault after crossing the Bay Street Bridge. This supply main is 7.6 km in length and provides water to View Royal, Victoria and Esquimalt.
- Main #3 is primarily a 990 mm-diameter (39") steel pipe that supplies water from the Humpback PRV and terminates at the CRD's Mt. Tolmie Reservoir. There are several sections in this line that include 1,220 mm-diameter (48") and 810 mm-diameter (32") pipes. The 810 mm-diameter pipe terminates at the Oak Bay meter vault. This supply main is 21.3 km in length and provides water to the Westshore communities, Saanich, Victoria and Oak Bay.
- Main #4, a high pressure transmission main, is primarily a 1,220 mm-diameter (48"), welded steel pipe that supplies water from the Goldstream Water Treatment Plant primarily to Saanich and the Saanich Peninsula. There are two small sections of 1,320 mm (52") and 1,372 mm (54") reinforced concrete pipe. This transmission main is 26.2 km in length and terminates near the Saanich-Central Saanich boundary, where it transfers water to the 762 mm (30") trunk main, which extends to McTavish Reservoir. It supplies the municipalities on the Saanich Peninsula and to Bear Hill Reservoir and Hamsterly pump station, near Elk Lake.
- Main #5 is a 1,524 mm-diameter (60") pipe that connects the Kapoor Tunnel via the Goldstream Water Treatment Plant to the Humpback PRV just below the old Humpback Reservoir dam. It is approximately 1.6 km in length and provides water to mains #1 and #3.
- Main #7 is a 610 mm-diameter (24") steel pipe that runs from Goldstream and Whitehead Road to Metchosin and Duke Road. It is 4 km in length and provides water to portions of Colwood, Langford and Metchosin.
- Main #8 is a 457 mm-diameter (18") steel and asbestos cement pipe that runs from Glen Lake School, primarily along Happy Valley Road to Happy Valley and Glenforest. It is 3.6 km in length and provides water to Langford, Colwood and Metchosin.

There are three active inter-connections between the high pressure Main #4 and the low pressure mains #1 and #3 where water can be transferred from Main #4 to the other two mains via PRV stations. These stations are located at Watkiss Way, Millstream at Atkins, at Goldstream/Veteran's Memorial Parkway, and Burnside at Wilkinson Road. There is also a series of inter-connections between mains #1 and #3 with the major inter-connections being at Price, Station, Tillicum and Dupplin roads.

2.3.2 Saanich Peninsula Trunk Water Distribution System

The Saanich Peninsula Trunk Water Distribution System receives water at two points on the Saanich Peninsula from the Regional Transmission System and supplies it to four customers on the Saanich Peninsula: the municipalities of Central Saanich, North Saanich, Sidney and the Agricultural Research Station.

The Saanich Peninsula Trunk Water Distribution System is comprised of 46 km of transmission mains, including the 750 mm (30") Bear Hill Main, the 400 mm (16") Keating Main, the 400 mm (16") Dean Park Main and the 250-500 mm (10-20") Saanich Peninsula mains.

At McTavish Reservoir (the terminus of the Regional Transmission System), the Saanich Peninsula Trunk Water Distribution System continues further along the peninsula via a 610 mm-diameter (24") concrete cylinder pipe. In the vicinity of the airport, this main reduces to a 406 mm-diameter (16") asbestos cement pipe that terminates at the Deep Cove pump house. A dedicated 250 mm-diameter (10") perm/PVC pipe connects Deep Cove pump station with Cloake Hill Reservoir. A 457 mm-diameter (18") pipe along Mills Road connects the trunk main to the northwest end of the Sidney Distribution System.

The CRD also operates six major pumping stations located at Hamsterly, Martindale, Lowe Road, Dean Park Lower, Dean Park Middle and Deep Cove, along with two minor pumping stations located at Mt. Newton and Dawson Upper Reservoir that are all considered part of the transmission system.

2.3.3 Sooke Supply Main

The Sooke Drinking Water Service Area is supplied by Main #15, a 600 mm pipe (upper section, PVC; lower high pressure section, ductile iron) that conveys raw water from Sooke Lake Reservoir to the Sooke River Road Water Treatment Plant. Main #15 feeds directly into the Sooke Distribution System downstream of the water treatment plant.

2.3.4 Supply Storage Reservoirs

A number of supply storage reservoirs are considered part of the transmission system, even though most of them technically operate as a distribution reservoir with all its typical functions: balancing, fire and emergency storage.

The only CRD-owned and operated transmission system storage reservoir in the Regional Transmission System is:

- Mt. Tolmie Reservoir, a two-cell concrete in-ground reservoir, 27,300 m^3 (6 M gallon), located on Mt. Tolmie, at the terminus of Main #3 near the Oak Bay-Saanich boundary.

Haliburton Reservoir, a one-cell concrete in-ground reservoir, 22,700 m^3 (5M gallon), located off Haliburton Road in Saanich has been disconnected from the system (off Main #4) and is empty. It is anticipated that this reservoir will not be used for drinking water purposes again.

The CRD-owned and operated transmission system storage reservoirs in the Saanich Peninsula Trunk Water Distribution System are:

- Bear Hill Reservoir, a two-cell concrete above-ground reservoir, 4,546 m^3 (1M gallon), located on Bear Hill in Saanich.
- Cloake Hill Reservoir, a one-cell, 4,546 m^3 (1M gallon) reservoir located on Cloake Hill in North Saanich.

- Dawson Upper Reservoir, a one-cell, 455 m^3 (100,000 gallon) reservoir located off Benvenuto Avenue in Central Saanich.
- Dean Park Lower Reservoir, a two-cell concrete above-ground reservoir, 4,546 m^3 (1M gallon), located beside Dean Park Road in North Saanich.
- Dean Park Middle Reservoir, two cylindrical concrete above-ground tanks, 2,730 m^3 (600,000 gallon), located near the bottom of Dean Park in North Saanich.
- Dean Park Upper Reservoir, a two-cell concrete partly in-ground reservoir, 4,546 m^3 (1M gallon), located near the top end of Dean Park in North Saanich.
- McTavish Reservoir, a two-cell concrete in-ground reservoir, 6,820 m^3 (1.5M gallon), located on the south side of McTavish Road in North Saanich.

2.4 Distribution Systems

The GVDWS contains eight individual distribution systems. Six distribution systems are separately owned and operated by the municipalities of Central Saanich, North Saanich, Oak Bay, Saanich, Sidney and Victoria. Victoria owns and operates the distribution system in Esquimalt. Two distribution systems are owned by the CRD and operated by the CRD Integrated Water Services Department. These latter two systems include the combined distribution system in the Westshore communities of Langford, Colwood, Metchosin, View Royal and a small portion of Highlands, and a separate system supplying water to Sooke and parts of East Sooke. Each distribution system owner/operator is defined as a water supplier and is responsible for providing safe water to their individual customers and meeting all the requirements under the *BC Drinking Water Protection Act* and *Drinking Water Protection Regulation*.

2.4.1 Juan de Fuca Water Distribution System – CRD

In 2020, water was supplied to the Juan de Fuca Water Distribution System (in this report, not including Sooke – see Sooke/East Sooke Distribution System below) primarily from mains #1 and #3. Parts of Langford and View Royal were supplied from Main #4. The development at Bear Mountain in Langford was supplied by Main #4. The Westhills development, serviced by its own privately-operated distribution system, was supplied via mains #1 and #3. In the Juan de Fuca Water Distribution System, water flowed generally in a northerly and southerly direction away from the supply mains. The federal William Head Institution and the Beecher Bay meter vault are located at the southern extremities of this system.

The Juan de Fuca Water Distribution System includes the following distribution reservoirs:

- Bear Mountain Reservoir #1, a two-cell, 1,250 m^3 (275,000 gallon) reservoir located on the lower slopes of the Bear Mountain development in Langford.
- Deer Park Reservoir, a one-cell, 182 m^3 (40,000 gallon) reservoir located downstream of Rocky Point Reservoir re-chloramination station near the extremity of the water system off of Deer Park Trail in Metchosin.
- Fulton Reservoir, a two-cell, 4,580 m^3 (1,007,459 gallon) reservoir located at the end of Fulton Road in Colwood.
- Peacock Reservoir, a two-cell, 583.8 m^3 (128,420 gallon) reservoir located north of the Trans-Canada Highway off of Peacock Place in Langford.
- Rocky Point Reservoir, a three-cell, 546 m^3 (120,000 gallon) reservoir located near the end of Rocky Point Road in Metchosin.
- Skirt Mountain Reservoir, a three-cell, 6,525 m^3 (1,435,300 gallon) reservoir located near the top of Skirt Mountain in the Bear Mountain development in Langford.
- Stirrup Place Reservoir, a two-cell, 242 m^3 (53,300 gallon) reservoir located off of Stirrup Place Road in Metchosin.

- Walfred Reservoir, a three-cell, 560 m^3 (123,180 gallon) reservoir located on Triangle Mountain in Colwood.

2.4.2 Sooke/East Sooke Distribution System – CRD

The Sooke/East Sooke Distribution System begins downstream of the Sooke River Road Water Treatment Plant, at the end of Main #15 on Sooke River Road, where the ammonia storage and metering building is located. The primary water supply main to the community follows Sooke River Road downstream and splits at Milne's Landing going east toward Sassenos and west toward the central area of Sooke. Two underwater pipelines across Sooke Basin supply East Sooke. Sunriver Estates came on-line in 2006 and is serviced by a 300 mm (12") pipeline on Phillips Road and the two-cell concrete Sunriver Reservoir. In 2020, the water main along West Coast Road was extended to connect the formerly self-sufficient Kemp Lake Waterworks District to the Sooke/East Sooke Distribution System. At this most western extremity of the Sooke/East Sooke Distribution system, the CRD now supplies bulk water to the Kemp Lake District. The CRD infrastructure ends with a meter station on West Coast Road before a Kemp Lake District-owned and operated pump station supplies their distribution system.

The Sooke/East Sooke Distribution System includes the following distribution reservoirs:

- Coppermine Reservoir, a one-cell concrete partly in-ground reservoir, 455 m^3 (100,000 gallon), located off of Coppermine Road in East Sooke.
- Helgesen Reservoir, a four-cell concrete partly in-ground reservoir, 6,973 m^3 (1,533,850 gallon), located at the west end of Helgesen Road in Sooke.
- Henlyn Reservoir, a one-cell steel tank tower, 224 m^3 (49,270 gallon), located off of Henlyn Drive in Sooke.
- Silver Spray Reservoir, a two-cell cylindrical concrete tank, 841 m^3 (185,000 gallon), located off of Silver Spray Drive in East Sooke.
- Sunriver Reservoir, a two-cell concrete above-ground reservoir, 1,800 m^3 (395,944 gallon), located off of Sunriver Way in Sooke.

2.4.3 Central Saanich Distribution System – District of Central Saanich

In 2020, drinking water was supplied to the Central Saanich Distribution System via 10 pressure zones (seven off the Bear Hill main and three off the Martindale Valley main). The Bear Hill main supplied the Tanner Ridge area by direct feed, the central area in one pressure zone through three PRVs, the Saanichton area in two pressure zones through two PRVs, the Brentwood Bay area, and the Tsartlip First Nation through a PRV. Five smaller pressure zones served the rest of Central Saanich. Dawson Upper Reservoir (CRD-owned and operated) supplied a small area of higher elevation residences in Brentwood Bay. Martindale pump station supplied an agricultural area in the southeast corner of the municipality. The Island View Road area was supplied by the Stelly's pump station. The Mount Newton pump station provided water to the northeast corner and to the Tsawout First Nation lands. A municipally-owned pump station on Oldfield Road serviced a small area in the southwest corner.

Bear Hill Reservoir (CRD-owned and operated) has the largest service population in Central Saanich, providing approximately 80% of the Central Saanich's water. It is the primary supply to most of Central Saanich (south of Haldon Road), including Brentwood Bay.

The Central Saanich Distribution System has technically no balancing, fire or emergency storage, but relies on CRD transmission system infrastructure to provide this. Several CRD-owned reservoirs in Central Saanich, that are considered part of the transmission system, function as distribution reservoirs for the Central Saanich Distribution System.

2.4.4 North Saanich Distribution System – District of North Saanich

In 2020, drinking water was supplied to the North Saanich Distribution System from a number of points along the Saanich Peninsula Trunk Water Distribution System. This included Dean Park via the Lowe Road pump station, Dean Park pump stations and Dean Park Reservoirs (all CRD-owned and operated), Deep Cove/Lands End area via connections upstream of the Deep Cove pump station, Cloake Hill Reservoir via Deep Cove pump station (all CRD-owned and operated), and Swartz Bay. In the North Saanich Distribution System, Cloake Hill Reservoir (CRD-owned and operated) was the largest pressure zone. Water flowed generally in an easterly direction through the Dean Park pressure zone, northwest into the Deep Cove/Lands End area and northeast to the Swartz Bay area. Dean Park Upper Reservoir (CRD-owned and operated) supplied a small portion of the Dean Park Estates.

The North Saanich Distribution System has technically no balancing, fire or emergency storage, but relies on CRD transmission system infrastructure to provide this. Several CRD-owned reservoirs in North Saanich, that are considered part of the transmission system, function as distribution reservoirs for the North Saanich Distribution System.

North Saanich provides water to the Greater Victoria Airport Authority via the water main on the south side and the east side of the airport. As water quality in the airport distribution system falls under federal jurisdiction, it was not monitored by the CRD in 2020 and is, therefore, not included in this report.

2.4.5 Oak Bay Distribution System – District of Oak Bay

In 2020, drinking water was supplied to the Oak Bay Distribution System at Lansdowne and Foul Bay roads from Main #3. The water flowed in a west to east direction across Lansdowne with north and south branches. Oak Bay conveys water via a 406 mm main, which crosses Oak Bay diagonally from northwest to southeast. Water was distributed from the north end to the south end via the 406 mm main. Oak Bay has an outer loop flow on Beach Drive to the Victoria boundary. The Oak Bay Distribution System has no balancing, fire or emergency storage and the CRD transmission system infrastructure has limited provisions for this.

Oak Bay used four local pressure zones supplied by booster pumps. Sylvan Lane pump station supplied the Barkley-Sylvan area; Plymouth supplied the north Henderson area; Foul Bay supplied the south Henderson area; and Uplands pump station (seasonal) supplied the Uplands area. There are two inter-connections with the Victoria/Esquimalt Distribution System, which are normally closed, but can be used in emergencies.

2.4.6 Saanich Distribution System – District of Saanich

In 2020, drinking water was supplied to the Saanich Distribution System at a number of points from the CRD's transmission mains. Water was supplied from Main #1 at Dupplin, Wilkinson and Marigold, Holland/Burnside, and Admirals/Burnside; from Main #3 at Douglas, Tillicum, Admirals, Shelbourne, Richmond, Foul Bay, Mt. Tolmie and Maplewood pump house; and from Main #4 at Burnside, Blue Ridge, Roy Road, Markham, Layritz, Cherry Tree Bend and Sayward. In the Saanich Distribution System, water flowed generally in a northerly direction from mains #1 and #3 and both east and west from Main #4.

There are four major pumping systems in the Saanich Distribution System. Maplewood pumps water north from Main #3, ending in the Gordon Head area. Cherry Tree Bend pumps from Main #4 to Wesley Reservoir and the west central high elevation area. The Mt. Tolmie/Plymouth pump station pumps water from Main #3 and the CRD Mt. Tolmie Reservoir to Saanich's Mt. Tolmie Reservoir and the Gordon Head area via a 610 mm-diameter (24") main.

Water from Sayward supplies the north end of the Saanich Distribution System via Main #4 with a southerly flow through Cordova Bay. Saanich also has a number of other small pressure zones controlled by pump stations.

The Saanich Distribution System includes some storage for balancing, fire and emergency purposes. The following distribution reservoirs are owned and operated by Saanich:

- Hartland Reservoir, a one-cell, 769 m^3 (170,000 gallon) reservoir located on Hartland Road in Saanich. This new one-cell steel tank reservoir was constructed in 2020 to replace the smaller old reservoir.
- Mt. Tolmie Reservoir (Saanich), a one-cell, 4,545 m^3 (1M gallon) reservoir located on the east side of the summit of Mt. Tolmie near Cromwell Reservoir in Saanich.
- Rithet Reservoir, a one-cell, 16,807 m^3 (3.7M gallon) reservoir located at the end of Perez Drive in Broadmead in Saanich.
- Wesley Reservoir, a two-cell, 3,182 m^3 (700,000 gallon) reservoir located at the end of Wesley Road on Haliburton Ridge in Saanich.

2.4.7 Sidney Distribution System – Township of Sidney

In 2020, drinking water was supplied to the northern portion of the Sidney Distribution System from the 300 mm-diameter water main on Mills Road via the 460 mm CRD transmission main on Mills Road from upstream of the Deep Cove pump station. The southern portion of the distribution system is supplied from a 300 mm main that is connected to the CRD transmission system and McTavish Reservoir. Within the Sidney Distribution System, water flowed generally from the west via Mills Road and from the south via McTavish Reservoir and met in the middle of the distribution system, with approximately 60% of the water coming from the Mills Road supply.

The Sidney Distribution System has no balancing, fire or emergency storage, but rather relies on the CRD transmission system infrastructure to provide this.

2.4.8 Victoria/Esquimalt Distribution System – City of Victoria/Township of Esquimalt

Note: The City of Victoria also owns and operates the Water Distribution System in the Township of Esquimalt.

In 2020, drinking water was supplied to the Victoria/Esquimalt Distribution System from mains #1 and #2 at David Street/Gorge Street and David Street/Rock Bay Avenue. From these supply points, the system divides into several smaller looped water mains within the distribution system. Water was also supplied to Victoria from Main #3 at Cook Street/Mallek Crescent, Sommerset Street/Tolmie Avenue, Douglas Street/Tolmie Avenue and Shelbourne/North Dairy. In general, water flows from a north to south direction.

Water was supplied at multiple locations to Vic West and Esquimalt from Main #2. These locations include Tyee Road/Bay Street, Burleith Crescent/Craigflower Road, Garthland Road/Craigflower Road and Admirals Road/Maple Bank Road.

The Victoria/Esquimalt Distribution System has no balancing, fire or emergency storage and the CRD transmission system infrastructure has limited provisions for this.

3.0 MULTIPLE BARRIER APPROACH TO WATER QUALITY

The CRD and the municipalities that operate their distribution systems use a multiple barrier approach to prevent the drinking water in the GVDWS from becoming contaminated. Multiple barriers can include procedures, operations, processes and physical components. In a drinking water system, any individual contamination barrier used in isolation has an inherent risk of failure and may result in contamination of the drinking water. However, if a number of individual barriers are used together in combination with each other and, especially if they are arranged so that they complement each other, these multiple barriers are a very powerful means of preventing drinking water contamination. All CRD-owned and operated, and most other large drinking water utilities, use the multiple barrier approach to prevent drinking water contamination. The exact types and applications of barriers are unique for each system, in order to address the system-specific risks.

The following barriers are used in the GVDWS to prevent the drinking water from becoming contaminated:

1. **Good Water System Design**. Good water system design is one of the preeminent barriers to drinking water contamination, as it allows all of the other components within the water system to operate in an optimal fashion and does not contribute to the deterioration of the quality of the drinking water contained within the system. Good water system design includes such aspects as: drinking water treatment plants that are easy to operate; piping appropriately sized to the number of users being supplied; and the use of appropriate pipe materials. All new designs are designed by qualified professionals registered in BC, reviewed and approved by qualified CRD or municipal staff, and approved and permitted by a Public Health Engineer from the Island Health Authority. This acts as a multiple check on good system design.
2. **Source Water Protection**. The CRD uses what is considered the ultimate source water protection: ownership of the catchment (watershed) lands surrounding the source reservoirs. This land area is called the Greater Victoria Drinking Water Supply Area. Within this area, no public access, commercial logging, farming, mining, or recreation is permitted and no use of herbicides, pesticides, or fertilizers is allowed. This source water protection barrier eliminates many of the organic and inorganic chemicals that can contaminate the source water and virtually eliminates the potential for human disease agents being present. Very few drinking water utilities in Canada and United States can claim this type of protection. In addition, the CRD Watershed Protection Division operates a complete and comprehensive watershed management program that provides additional protection to the quality of Greater Victoria’s source water.
3. **Water Disinfection**. The GVDWS is an unfiltered drinking water system that continues to meet the stringent United States Environmental Protection Agency (USEPA) criteria to remain an unfiltered surface water supply. The treatment process consists of primary disinfection (ultraviolet light and free chlorine) of the raw source water entering the treatment plant and secondary disinfection (chloramination) that provides a disinfectant residual throughout the transmission and distribution systems. Although the water treatment barrier used in Greater Victoria is not as rigorous as that provided by most drinking water utilities using a surface water supply, the microbiological quality of the source water is exceptionally good and the chief medical health officer for Island Health has approved this treatment process as providing safe drinking water for the public.
4. **Distribution System Maintenance**. All water suppliers in the GVDWS provide good distribution system maintenance, including activities such as annual water main flushing, hydrant maintenance, valve exercising, leak detection, and reservoir cleaning and disinfection. This barrier helps to promote good water quality within the distribution systems.
5. **Infrastructure Replacement**. The timely replacement of aging water system infrastructure is an important mechanism to prevent the deterioration of water quality in the pipes and provides a continual renewal of the water system.
6. **Well Trained and Experienced Staff**. All water system operators must receive regular training and be certified to operate water system components. In addition, the laboratory staff cannot analyze drinking water samples in accordance with the *BC Drinking Water Protection Regulation* unless the laboratory has been inspected by representatives of the BC Ministry of Health and issued an operating certificate. CRD and municipal staff meet these requirements.

7. **Cross Connection Control**. Cross connection control provides a barrier to contamination by assisting in the detection of conditions that have the potential to introduce contaminants into the drinking water from another type of system. Therefore, in cooperation with the other water suppliers, in 2005, the CRD implemented a regional Cross Connection Control Program throughout the GVDWS. 2008 saw the implementation of CRD Bylaw 3516, the Cross Connection Control Bylaw for the GVDWS. This bylaw was reviewed and updated last in 2019.
8. **Water Quality Monitoring**. Rigorous water quality monitoring can be considered a barrier not only because it verifies the satisfactory operation of other barriers and detects contaminations quickly, but comprehensive monitoring data may also allow water suppliers to see trends and react proactively, before a contamination occurs. The CRD has designed and executes a comprehensive water quality monitoring program for the GVDWS that collects daily bacteriological samples across the entire region for compliance purpose (on CRD water infrastructure and in the municipal water distribution systems). This CRD monitoring program tests for water quality parameters beyond the legislated requirements to verify good drinking water quality in the GVDWS.

4.0 WATER QUALITY REGULATIONS

The CRD and the municipal water suppliers in the GVDWS must comply with the BC *Drinking Water Protection Act* and *Drinking Water Protection Regulation*. The regulation stipulates the following water quality and sampling criteria for water supply systems:

- No detectable *Escherichia coli (E.coli)* per 100 mL
- At least 90% of samples have no detectable total coliform bacteria per 100 mL and no sample has more than 10 total coliform bacteria per 100 mL
- 5,000-90,000 population served: one sample per month per 1,000 population served
- >90,000 population served: 90 + 1 samples per month per 10,000 in excess of 90,000 population served

In addition to the aforementioned water quality monitoring criteria by the *Drinking Water Protection Regulation*, as due diligence to ensure public safety and maintain public trust, the CRD Water Quality Monitoring Program also uses the much larger group of water quality parameters listed in the current version of the *Guidelines for Canadian Drinking Water Quality* (the Canadian guidelines) for compliance purposes. These limits are provided in Appendix A, tables 1 to 5 under the column titled 'Canadian Guidelines'. The water quality limits in the Canadian guidelines[1] fall into one of the following five categories:

1. **Maximum Acceptable Concentration**. This is a health-related limit and lists the maximum acceptable concentration (MAC) of a substance that is known or suspected to cause adverse effects on health. Thus, an exceedance of an MAC can be quite serious and requires immediate action by the water supplier.
2. **Aesthetic Objectives.** These limits apply to certain substances or characteristics of drinking water that can affect its acceptance by consumers or interfere with treatment practices for supplying good quality drinking water. These limits are generally not health related, unless the substance is well above the aesthetic objectives (AO).
3. **Parameters without Guidelines**. Some chemical and physical substances have been identified as not requiring a numerical guideline because data currently available indicate that it poses no health risk or aesthetic problem at the levels currently found in drinking water in Canada. These substances are listed as 'No Guideline Required' in Appendix A, tables 1 to 5.
4. **Archived Parameters**. Guidelines are archived for parameters that are no longer found in Canadian drinking water supplies at levels that could pose a risk to human health, including pesticides that are no longer registered for use in Canada, and for mixtures of contaminants that are addressed individually. Some of these parameters are still being included in the current water quality monitoring program because the analytical laboratory includes them in their scans. These parameters are listed as 'Guideline Archived' in Appendix A, tables 1 to 5.
5. **Operational Guidance**. The limit was established based on operational considerations and listed as an operational guidance value. For example, the limit for aluminum is designed to apply only to drinking water treatment plants using aluminum-based coagulants.

It should be noted that not all of the water quality parameters analyzed by the CRD Water Quality Monitoring Program have the Canadian guidelines' limits, since some of these parameters are used for operational purposes. Where the Canadian guidelines are silent for a particular parameter, the limit for that parameter is left blank in Appendix A, tables 1 to 5.

In addition to the Canadian provincial regulations and federal guidelines, on a voluntary basis, the CRD also complies with most of the USEPA rules and regulations. Some of the limits in the USEPA rules are used as the basis for CRD's water treatment goals.

[1] (see: https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/water-quality/guidelines-canadian-drinking-water-quality-summary-table.html)

The GVDWS, as an unfiltered surface water system, must also meet the provincial Drinking Water Treatment Objectives for Surface Water Supplies in BC, which includes similar criteria as the conditions for filtration exemption in the Canadian guidelines, as well as the criteria for filtration exemption by the USEPA Surface Water Treatment Rules for Unfiltered Systems. In summary, the applicable criteria are:

- 4-log inactivation of viruses (met with chlorination)
- 3-log removal or inactivation of parasites (*Giardia* and *Cryptosporidium*) (met with UV disinfection)
- Two forms of disinfection (UV and chlorination)
- Water entering disinfection facilities has average daily turbidity <1 nephelometric turbidity unit (NTU) and not more than two days/year with an average daily turbidity of >5 NTU
- No *E. coli* or total coliform in treated water
- A watershed control program to minimize fecal, parasite and viral contamination of source water (in place)
- Detectable disinfectant residual in distribution system
- *E. coli* in source water $\leq$20 CFU/100 mL

5.0 OPERATIONAL CHANGES AND EVENTS – CRD SYSTEMS

5.1 Use of Goldstream Water

In 2020, the Goldstream Supply System was not used at all. A Kapoor Tunnel inspection project, necessitating a switch to the Goldstream Supply System, was scheduled for early December but had to be cancelled due to adverse weather conditions that could have resulted in increased turbidity in the raw water supply. It is anticipated that the Kapoor Tunnel inspection project will be delayed until the fall of 2021 and the Goldstream System will only be used for emergency purposes until then.

5.2 Sooke Lake Reservoir

Figure 1 shows the Sooke Lake Reservoir water levels in 2020 compared to previous years. In contrast to previous years, the reservoir did not fill completely until January 23. This was the first time since 2013 that the reservoir was not at 100% capacity by January 1. After filling, Sooke Lake Reservoir remained at 100% capacity until mid-April. In 2019, the reservoir remained full until the end of April. With drier and warmer weather beginning in May, the reservoir levels continuously receded throughout the summer and into the fall. Some productive rain events in mid-September slowed and temporarily halted the reservoir level decrease until the lowest level was finally reached on October 9 with 69.5% of full capacity. The typical rapid reservoir recharge began with the onset of heavy rainfalls at the beginning of November. By December 26, the reservoir reached the full service level, which has been typical in recent history.

A lightning storm passing over the CRD Water Supply Area on the night of Sunday August 16, 2020, ignited two wildfires within the watershed catchment of Sooke Lake Reservoir. The Mt Healey Fire grew to about 6 ha in size, but only a small portion burned inside the Sooke Lake catchment. Most of the area burned by this fire was within the neighbouring Deception Reservoir catchment. The Rithet Fire burned approximately 2 ha within the catchment of Sooke Lake Reservoir. The closest that any of the two fires came to the shore of Sooke Lake Reservoir was approximately 1 km. As a fire suppression response, approximately 11,000 L of 15% PHOS-CHECK LC95A retardant were dropped on the Mt. Healey Fire on August 17, 2020. For several days after August 17, CRD staff assumed that the retardant was also applied on the Rithet Fire but this misinformation was later corrected. The active chemical ingredient of this retardant consists mostly of ammonium phosphate, a potent fertilizer commonly used in agriculture. Its aerial application by the BC Wildfire Service was approved by CRD staff.

Both fires were fully contained and largely extinguished by August 21, 2020. This was partly a result of productive rainfall on August 20 and 21, 2020. This precipitation following the wildfire triggered a post-fire water quality assessment according to the Emergency Response Procedures (Water Quality Wildfire Action Plan). Water quality risks from wildfires in source water catchments generally include soil erosion with effects on turbidity, water chemistry and lake productivity due to nutrient and mineral input. In case of fire suppression chemical use, further risk comes with the direct input of chemicals into the source water. The first phase of the post-fire water quality assessment included sampling at various Sooke Lake sites (sampled by boat), as well as potentially fire-affected Sooke Lake tributary creeks. The parameter tested spanned a large spectrum of organic and inorganic parameters that could potentially be impacted by any soil erosion and chemical application. The results were compared to long-established baseline data from Sooke Lake and regularly sampled tributary creeks.

A second phase of post-fire water quality assessment was initiated following the next period of productive rainfall that occurred from September 23 to 26, 2020. With a total rainfall of 132 mm during this period, CRD staff concluded that if there was any measurable short-term water quality impact from the wildfires, it would certainly be triggered by this large rain event. The sampling sites included again several Sooke Lake sites (sampled by boat), as well an expanded number of tributary creeks. This phase also included two creeks in the Deception Reservoir catchment, of which one was impacted by the Mt Healey Fire (Deception Creek) and one that was not (Muckpile Creek). This was to compare results in an attempt to identify any potential water quality impacts from the fire.

All results were compared to historic baseline data for tributary creeks and the reservoir. None of the results indicated a measurable effect on water quality due to the wildfires from potential soil erosion or the use of fire retardant. It was therefore concluded that the 2020 wildfire event had no short-term impact on the source water quality. While not expected to occur, ongoing regular water quality monitoring in the watershed will detect any potential long-term water quality impacts.

5.3 Chlorine Dosage

In 2020, CRD Integrated Water Services Department did make some minor adjustments to the chlorine dosage rate at both plants, based on daily or weekly monitoring results. The objective for the chlorine dosage has been to dose sufficiently for adequate primary and secondary disinfection, while minimizing the amount of chemicals added. Critical for proper primary disinfection is achieving the required CT (Concentration x Contact Time), which was consistently achieved in 2020 at both plants. Critical for adequate secondary disinfection is achieving a high ratio of Total Chlorine/Monochloramine. While the new hypochlorite plant at the Goldstream Water Treatment Plant can achieve consistently ratios of 90%, the old chlorine gas plant that was utilized in 2020 achieved ratios of around 85%. The Sooke River Road Water Treatment Plant generally achieved ratios of 85-95%.

On December 26, 2020, the ammonia injection was discontinued at the Goldstream Water Treatment Plant for scheduled repairs on the ammonia system. To compensate for the higher chlorine demand associated with a free chlorine residual across the Goldstream Service Area, the chlorine dosage was increased from 2.3 mg/L to 2.6 mg/L at the Goldstream Water Treatment Plant. This event lasted until January 21, 2021 when the ammonia injection resumed and the chlorine dosage was lowered back to 2.3 mg/L.

5.4 CRD Reservoir Maintenance

CRD water system operators have followed the reservoir cleaning schedule developed through the reservoir review project led by the CRD Water Quality Operations Section. This schedule is based on a thorough water quality data review in each CRD-owned and operated transmission or distribution reservoir, and is regularly updated based on new data and information. Following this cleaning schedule has resulted in improved water quality conditions and operational efficiencies in a number of reservoirs.

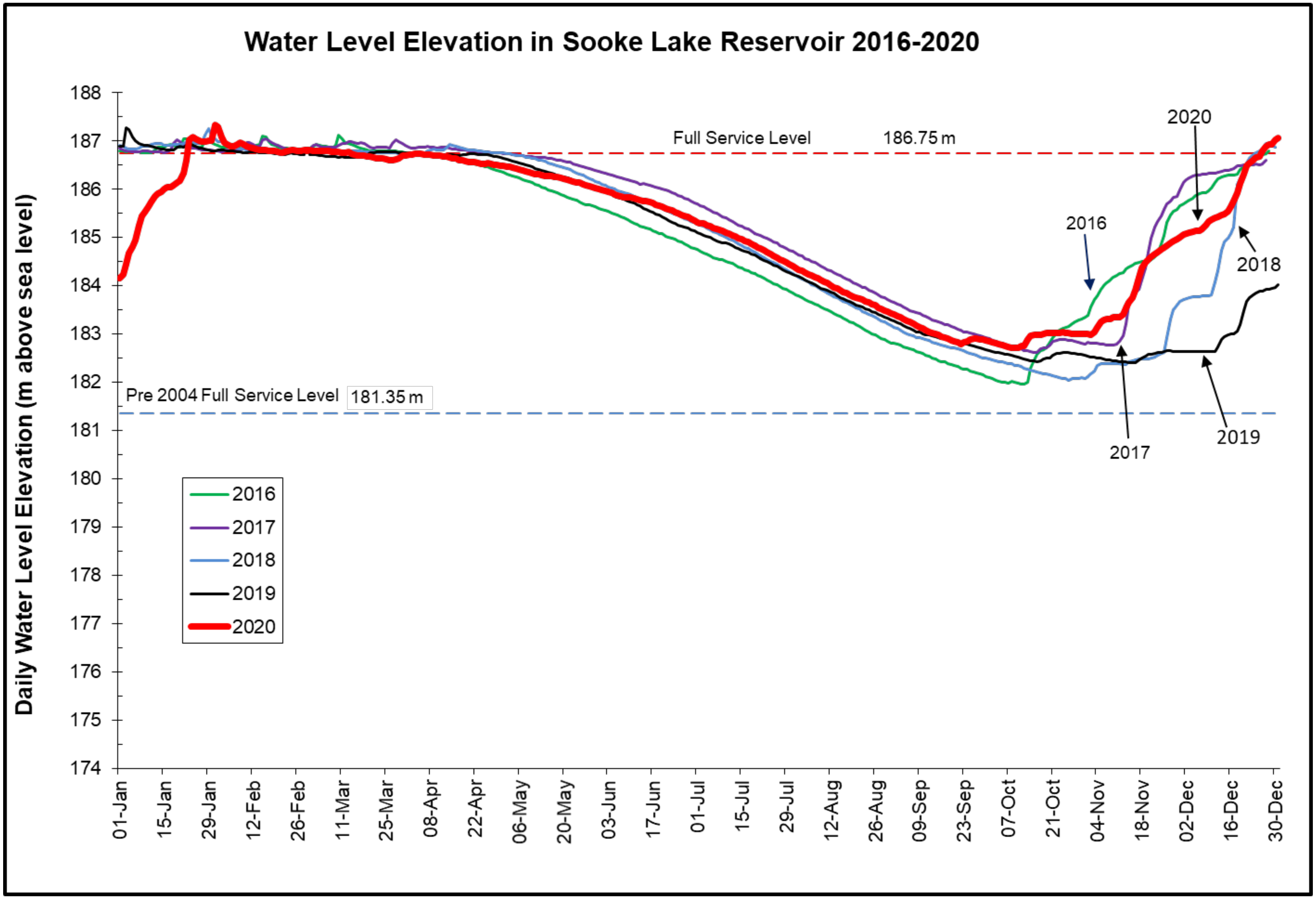

Figure 1 **Water Level Elevation in Sooke Lake Reservoir, 2016-2020**

6.0 WATER QUALITY MONITORING

The Water Quality Program, as delivered by the Water Quality Operations, the Cross Connection Control, and the Laboratory Services sections (all within the CRD Parks & Environmental Services Department), is responsible for the collection, analysis and reporting of water quality information in all CRD-owned and operated portions of the GVDWS from the source reservoirs to the point of delivery (typically the water meter) to each consumer. While the municipal water suppliers are responsible for water quality and any potential corrective measures within their particular distribution system, CRD staff provide water sampling and testing for regulatory compliance monitoring to these municipalities.

The CRD Water Quality Program has dedicated professional staff who are trained to collect water samples from source water and treated water sampling locations across the region, as well as technical staff trained to analyze and interpret water quality data in support of operational decisions. The CRD Water Quality Laboratory is certified for a number of water quality test methods and is staffed with highly-trained laboratory technicians. The CRD Aquatic Ecology Laboratory has professional staff specialized to analyze phyto- and zooplankton in lake water, periphyton communities in lakes and streams, to test for cyanotoxins and understand the source water limnology. The Cross Connection Control Section includes certified plumbing and cross connection control inspectors, as well as staff trained to process data in order to administer the requirements of the BC Building Code and the CRD Cross Connection Bylaw 3516.

6.1 CRD Water Quality Monitoring Program

The CRD Water Quality Monitoring Program consists of the following three components that provide direction for the collection and analysis of water quality samples from the water systems:

- **Compliance Monitoring:** The goal of the compliance monitoring is to ensure that water quality from source to consumer meets the relevant drinking water regulations and guidelines. The Island Health Authority, as the provincial regulator, has issued the CRD two operating permits [for CRD water infrastructure in the Goldstream (Japan Gulch) Service Area and in the Sooke Drinking Water Service Area]. These operating permits require, in addition to the water quality and sampling criteria, as per *Drinking Water Protection Regulation*, continuous monitoring of turbidity. The CRD Water Quality Operations Section, therefore, conducts bacteriological monitoring on the raw water entering the treatment plants, treated water after leaving the plants and at the first customer sampling locations, sampling locations on the large transmission mains and sampling locations in the CRD-owned distribution systems, including distribution reservoirs. Bacteriological samples are collected at a frequency that meets the regulatory requirements and provides a consistent and day-to-day system-wide water quality oversight. Continuous turbidity monitoring, as per operating permits, is accomplished by on-line turbidity meters (monitored via Supervisory Control and Data Acquisition) at each water treatment plant. Part of the compliance monitoring program are the services provided by the CRD to the municipal water suppliers where CRD staff collect and analyze bacteriological samples from inside the municipal water distribution systems, report monthly results on the CRD website and include the results and findings in this annual report.

  The Island Health Authority has granted the GVDWS an exemption from filtration treatment, the conventional water treatment requirement for surface water source users in BC, based on the evidence of year-round high source water quality. However, it expected that the CRD closely monitors a number of water quality parameters, in addition to the criteria listed in the regulations and in the operating permits. As a result, the CRD has included in its compliance monitoring program a number of water quality parameters that are regularly tested on the raw, as well as on the treated water to verify compliance with the Canadian guidelines and USEPA rules and regulations. Such parameters in the raw water include parasites, organic and inorganic compounds, including metals and various water chemistry and physical parameters. On the treated water, these include disinfection byproducts, metals and water chemistry and physical parameters that are used to verify good drinking water quality.

- **Aquatic Ecology Monitoring:** The goal of the aquatic ecology monitoring is to understand and document the components that affect or may affect the natural cycles of the source streams and reservoirs. The source reservoirs and streams in the Greater Victoria Water Supply Area (Map 1) are monitored according to the recommendations by the CRD Aquatic Ecology Section, as there are no legislated requirements for either sampling frequency or parameter selection for these water bodies. It is, however, important for the CRD, as the supplier of unfiltered surface water, to have a comprehensive understanding of the natural processes taking place in the source waters and potential implications for the drinking water quality in the GVDWS. Depending on the season, the source lakes and their tributaries are sampled at a frequency ranging from quarterly to weekly for parameters, such as algal species, distribution and concentrations, zooplankton species and concentrations, chlorophyll-a concentrations and nutrient concentrations. Additional samples may be collected based on risk management decisions, for instance, as a response to severe weather conditions or unusual observations.

- **Operational Water Quality Monitoring:** The CRD Water Quality Monitoring Program provides an audit function on all water quality-related aspects of the GVDWS, including performance monitoring of the treatment plants and distribution system. Specific sampling and testing occurs to support operational decisions by the CRD and municipal system operators. Daily field tests of chloramine residual concentrations are conducted to verify the efficiency of the secondary disinfection region-wide. A number of qualitative (taste and odour) and quantitative tests [e.g., heterotrophic plate count (HPC), turbidity] are regularly performed on samples across the region to verify the need for specific system maintenance. The customer inquiry program is also part of this monitoring program component, as a water quality complaint or observation by the public can give clues to ongoing system issues or identify water quality risks in the system. Water samples are collected from taps within individual houses or facilities, in response to inquiries from customers about the quality of water being received at their address.

- **Drinking Water Safety Plan:** In 2018, the CRD Water Quality Operations Section developed a Drinking Water Safety Plan, following the principle of a method developed by the Alberta Ministry of Environment for all drinking water systems in Alberta. This plan is a comprehensive water quality risk assessment and registry in the GVDWS. Identified risks have been documented and are being tracked as the CRD Integrated Water Services Department addresses them. At the end of 2020, the Drinking Water Safety Plan included 24 High Risks and 200 Moderate Risks to water quality.

6.2 Sampling Plans

The efforts to collect the required number of samples for the CRD Water Quality Monitoring Program are organized in three distinct sampling plans:

1. The **Watershed Sampling Plan** manages the sampling frequency, schedule and parameter list for the source water lakes and tributaries and is based on an up-to-date risk to water quality assessment. Sooke Lake Reservoir is sampled from a boat at three dedicated lake sampling stations from weekly in the summer to bi-weekly in the winter (see Figure 2). Goldstream Reservoir is sampled monthly from a boat at two dedicated lake sampling stations. Tributary creeks to Sooke Lake Reservoir are sampled monthly near their mouths. Significant tributary lakes in the Sooke Lake watershed, as well as Butchart Lake and Japan Gulch Reservoir in the Goldstream System, are sampled quarterly by boat. At the end of 2020, the CRD finished a two-year Leech River water quality monitoring project with weekly sampling/testing of multiple parameters in various parts of the Leech watershed. In 2021, this project is going to transform into an ongoing Leech River water quality monitoring program.
2. The **Treatment Plant Sampling Plan** includes the daily samples collected at the Goldstream Water Treatment Plant and the two first customer locations (for mains #4 and #5) and the weekly samples collected at the Sooke River Road Water Treatment Plant and the Sooke first customer location. This plan is designed to verify adequate treatment at both treatment plants and to detect unusual water quality conditions, before they spread across the systems.

3. The **Transmission and Distribution System Sampling Plan** is a designed sampling plan that manages sampling at approximately 220 permanent sampling stations across the GVDWS, including all municipal systems. These permanent sampling stations are installed on transmission mains, storage reservoirs, distribution mains, booster pump stations and meter or valve stations. The plan is designed to achieve an evenly-distributed two-week rotation for most sampling stations, while providing a representative snapshot of the entire Goldstream Service Area on each business day. The Sooke Drinking Water Service Area is sampled once per week. Samples collected on the daily runs, as part of this plan, are primarily used for compliance monitoring, but also for operational purposes.

   When total coliform-positive bacteriological results are found in a CRD-owned system, CRD sampling staff resample those locations and, depending upon the situation, may direct CRD operators to flush the affected mains and/or drain and clean affected storage reservoirs. When total coliform-positive bacteriological results are found in a municipal system, the CRD sampling staff resample those locations and notify the municipal operators of the results. If a sample tests positive for *E.coli*, the Island Health Authority is notified immediately and emergency response procedures are followed.

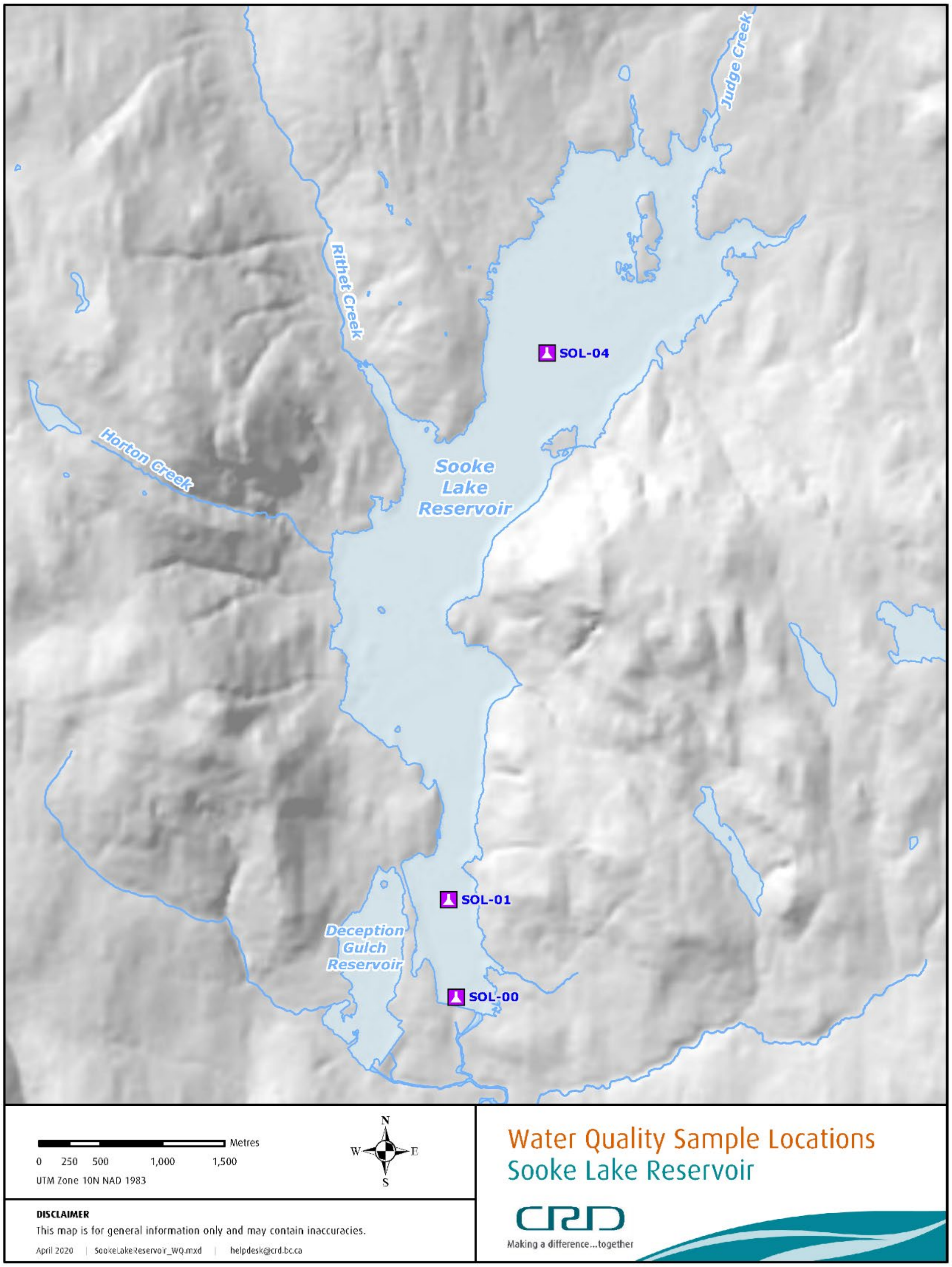

Figure 2 Sooke Lake Reservoir Water Sampling Stations

6.3 Bacteriological Analyses

A description of the bacteriological parameters used in the CRD Water Quality Monitoring Program, and the regulatory limits that were in place in 2020 for those parameters, are outlined below.

Total Coliform Bacteria

Total coliforms. Total coliforms are a group of bacteria found in high numbers in both human and animal intestinal (fecal) wastes and are found in water that has been contaminated with fecal material. Total coliform bacteria are also ubiquitous in the environment (water, soil, vegetation). Thus, in the absence of *E. coli*, the presence of total coliforms may indicate surface water infiltration or the presence of decaying organic matter. The total coliform bacteria group is used as an indicator for treatment adequacy and microbial conditions in drinking water systems because of its superior survival characteristics.

Test Method. In 2020, total coliform bacteria were analyzed at the CRD Water Quality Laboratory using the membrane filtration method and Chromocult Coliform Agar incubated at 36-38ºC for 21-24 hours. Test results were reported as colony-forming units (CFU) per 100 millilitres (mL) of water. Methods employing defined substrate technology rely on the fact that coliforms possess the enzyme β-galactosidase, which cleaves a chromogenic substrate, thus releasing a chromogen (coloured compound) that can be measured.

In compliance with regulations, the CRD Water Quality Monitoring Program tests for total coliforms to ensure treatment efficacy and to monitor intrusion of organisms into the system post-treatment.

Regulatory Limits. Based on the requirements in the *Drinking Water Protection Regulation* and the *Guidelines for Canadian Drinking Water Quality*, the maximum acceptable concentration for the GVDWS is summarized as follows:

- *No sample should contain more than 10 total coliform organisms per 100 mL.*
- *No consecutive sample from the same site should show the presence of coliform organisms.*
- *Not more than 10% of the samples based on a minimum of 10 samples should show the presence of coliform organisms.*

Escherichia coli

***Escherichia coli* (*E. coli*)**. *E. coli* is the only member of the total coliform group found exclusively in the feces of human beings and warm-blooded animals. Although most members of this species are considered harmless, some strains of *E. coli* can be pathogenic. The presence of *E. coli* in water indicates recent fecal contamination and the possible presence of intestinal disease-causing bacteria, viruses and protozoa. The absence of *E. coli* in drinking water generally indicates that the water is free of intestinal disease-causing bacteria.

Test Method. In 2020, *E. coli* were analyzed by the CRD Water Quality Laboratory using the membrane filtration method and Chromocult Coliform Agar incubated at 36-38ºC for 21-24 hours. Test results were reported as CFU per 100 mL of water The *E. coli* test measures bacteria possessing the enzymes β-galactosidase and β-glucuronidase.

Regulatory Limits. In disinfected drinking water, the maximum acceptable concentration of *E. coli* (both federal and provincial limits) is zero *E. coli* per 100 mL.

Heterotrophic Plate Count Bacteria

Heterotrophic Plate Count Bacteria. Heterotrophic plate count bacteria (HPC7D) are used as a general measure of the bacterial population present in a drinking water system and in the raw source water. Under increasing nutrient conditions and/or a reduction in the concentration of chlorine residual, the heterotrophic bacteria are usually the first group to increase and provide an early warning of the potential growth of coliforms. In the CRD Water Quality Monitoring Program, heterotrophic plate count bacteria are used to monitor the disinfection of the water at the disinfection plants and to track the decline in chlorine residuals in the distribution system and storage reservoirs.

Test Method. In 2020, heterotrophic plate count bacteria were analyzed by the CRD Water Quality Laboratory using membrane filtration (R2A media, 21-28ºC, seven-day incubation). As heterotrophic bacteria can be measured in several different ways, this method provides the quantity of heterotrophic bacteria capable of growing on R2A medium within seven days at room temperature. Raw water samples and water leaving the treatment plant were analyzed for HPC7D bacteria. In addition, samples with low chlorine residual levels (below 0.2 mg/L) were also analyzed for HPC7D.

Regulatory Limits. There is no federal or provincial regulatory limit on the quantity of heterotrophic bacteria allowed in drinking water. However, the US EPA Surface Water Treatment Rule considers a 500 CFU/mL HPC7D as an indicator for a “detectable chlorine residual”. Therefore, in the absence of a Canadian regulatory limit, the CRD Water Quality Monitoring Program uses the US EPA rule as a monitoring criteria to trigger site-specific operational measures for assessing and mitigating the drinking water quality.

6.4 Certification and Audits

To ensure that the analytical testing is performed to the highest possible standard, the Water Quality Laboratory participates in several types of external quality assurance and quality control (QA/QC) programs, in addition to rigorous internal QA/QC procedures that are included as part of the methodology and are a normal component of good laboratory practice.

6.4.1 Certification

The Province of BC requires that all laboratories analyzing drinking water samples be approved in writing by the provincial health officer. Laboratory approval requires both an approval certificate and a proficiency testing certificate, as noted below:

- **Water Bacteriology Testing Laboratory Approval Certificate**. This certificate is issued by the BC provincial health officer for bacteriological testing of drinking water in the Province of BC. This certificate is renewed every three years via an on-site inspection (audit) of the analytical laboratory.
- **Clinical Microbiology Proficiency Testing Program Certificate of Participation**. This certificate is issued by the Advisory Committee for Water Bacteriology Laboratories, which is operated by the Department of Pathology and Laboratory Medicine at the University of British Columbia. Satisfactory performance is required to maintain laboratory certification.

6.4.2 Accreditation

The CRD Water Quality Laboratory received in 2017 the accreditation to the International Standards Organization 17025 standard used by testing and calibration laboratories. The accreditation has management, quality and technical requirements. Accreditation is maintained by successful reassessment every two years by an accrediting body (The Canadian Association for Laboratory Accreditation) and satisfactory participation in an external proficiency testing program. The last reassessment of the CRD Water Quality Lab occurred in 2019.

7.0 WATER QUALITY RESULTS

The overview results of the 2020 CRD Water Quality Monitoring Program for the GVDWS are provided below. Water quality data are listed in Appendix A (tables 1, 2 and 3). Note that the median (middle value between the high and low) is used in these tables rather than the average value, as the median eliminates the effect of extreme values (very high or very low) on the average value and provides a more realistic representation of typical conditions.

7.1 Source Water Quality Results

Total Coliform Bacteria (TC). Similar to previous years, the raw (untreated) source water entering both plants exhibited generally very low concentration of total coliform bacteria with some increased concentrations between August and October when the Sooke Lake south basin was destratified and, therefore, fully mixed with warm water. There was one total coliform spike in mid-September that was likely caused by wind-induced internal seiche, as experienced in 2017, albeit on a much smaller scale.

With 245 samples analyzed in 2020, the total coliform concentration ranged from 0-470 CFU/100 mL, with a median value of 10 CFU/100 mL (Figure 3). The types of total coliforms present were not indicative of any particular type of contamination.

The United States Environmental Protection Agency (USEPA) *Surface Water Treatment Rule* for avoiding filtration has a non-critical total coliform criteria of maximum 100 CFU/100 mL at the 90th percentile of a six-month sample set. The 90th percentile of total coliform concentrations in the raw water between January and June 2020 was 11 CFU/100mL, and between July and December 2020 it was 88.6 CFU/100 mL. Therefore the source water was compliant with USEPA filtration exemption criteria in all of 2020.

***E. coli* Bacteria**. During more than two decades of monitoring bacteria within the GVDWS, it has been found that virtually 100% of the fecal coliform bacteria detected in the source water and the distribution system are *E. coli*. In 2020, as in previous years, the low detection of *E. coli* bacteria indicated that the raw water entering the Goldstream Water Treatment Plant from Sooke Lake Reservoir was good quality source water and complied with the primary criteria in the USEPA *Surface Water Treatment Rule* to remain an unfiltered drinking water supply (Figure 4).

In 2020, about 9.5% of the samples collected from the raw source water contained *E. coli* and those that were positive for *E. coli* had levels well below 20 CFU/100 mL. The low occurrence, as well as the low concentrations of *E.coli* bacteria in Sooke Lake, are in line with long-term historical bacteria concentrations. In 245 samples analyzed for *E. coli*, only some contained this bacteria and the concentration ranged from 0-2 CFU/100 mL, with a median value of 0 CFU/100 mL. These results do not indicate a particular source of *E.coli* bacteria, but rather point to low levels of naturally occurring fecal matter in a healthy and unproductive aquatic ecosystem. The few sporadic *E. coli* hits between fall and early spring were a typical result of the heavy rainfall and runoff into Sooke Lake, which transported organic matter accumulated in the watershed to the lake. In years with a Kapoor Tunnel Inspection Project, a slight *E. coli* concentration increase in mid-December can be attributed to the supply from the Goldstream System. In 2020, the Goldstream System was not used as a drinking water source.

***Giardia and Cryptosporidium* Parasites**. In 2020, parasite samples were collected eight times per year, as part of the CRD's routine monitoring program. This sampling frequency was set after an evaluation of long-term data showed extremely low detection of these organisms. The eight parasite samples were collected from the raw water sampling location at the Goldstream Water Treatment Plant and shipped for analysis to an external laboratory. It should be noted that the efficiency of the analysis for detecting *Giardia*, and especially *Cryptosporidium*, is quite low (typically in the 15-25% range).

In 2020, no *Giardia* cysts and no *Cryptosporidium* oocyst were detected in all samples on the raw water entering the Goldstream Water Treatment Plant. The 10-year median value for total *Giardia* cyst and total *Cryptosporidium* oocyst concentrations is 0/100L; however, historical data shows that occasionally very low concentrations of parasites can be found in the raw water from Sooke Lake. While these are extremely low values for a surface water supply, the addition of UV disinfection provides assurance that no infective parasites can enter the GVDWS.

The treatment target specified by the Canadian federal and provincial regulations, as well as the USEPA *Surface Water Treatment Rule*, require 3-log (99.9%) parasite inactivation to meet the filtration exemption criteria for surface water systems. Both CRD disinfection facilities provide UV treatment that, in conjunction with the CRD's drinking watershed management concept, is able to meet these targets and, therefore, adequately protects the public from waterborne parasitic illnesses.

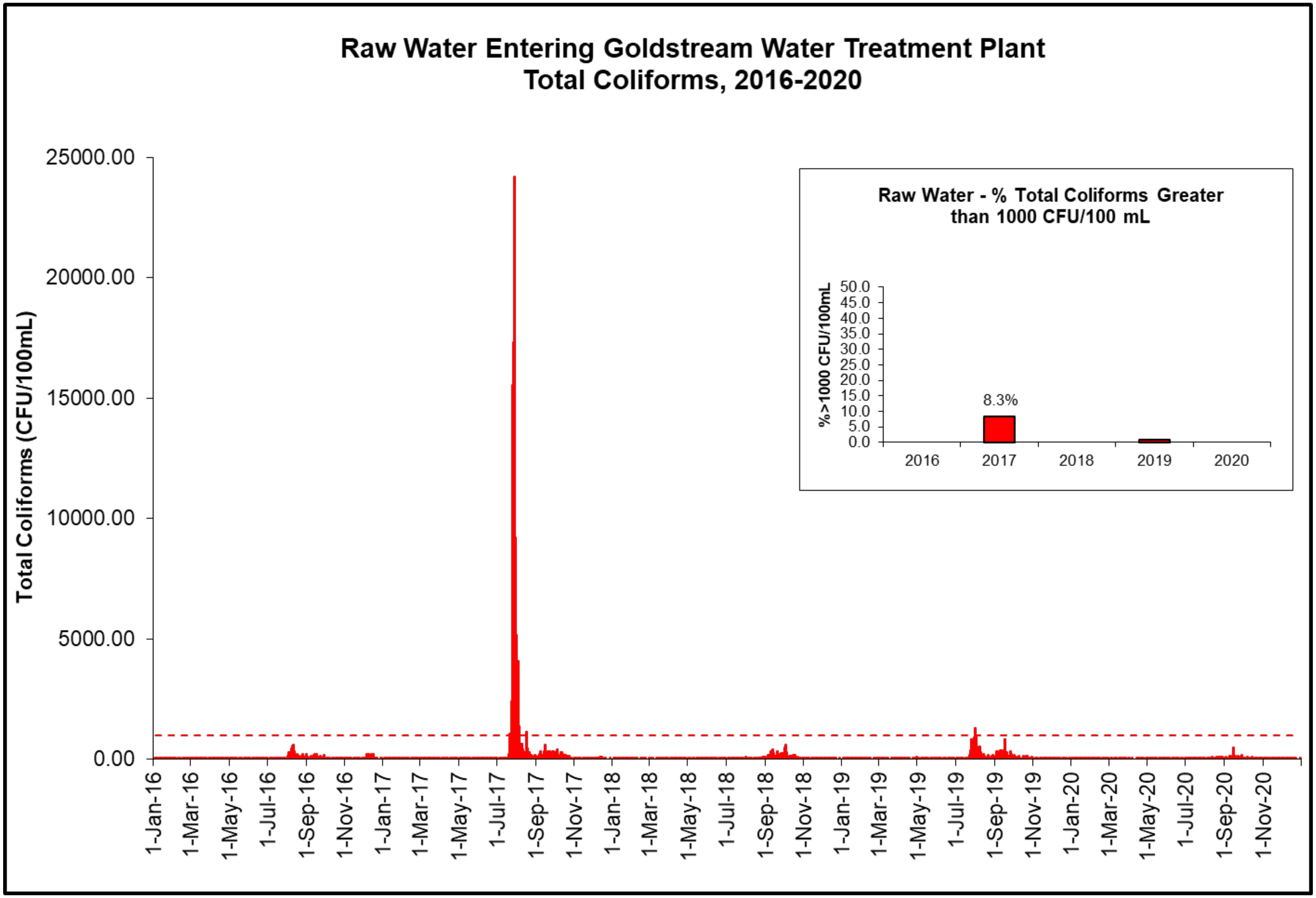

Figure 3 **Raw Water Entering Goldstream Water Treatment Plant Total Coliforms 2016-2020**

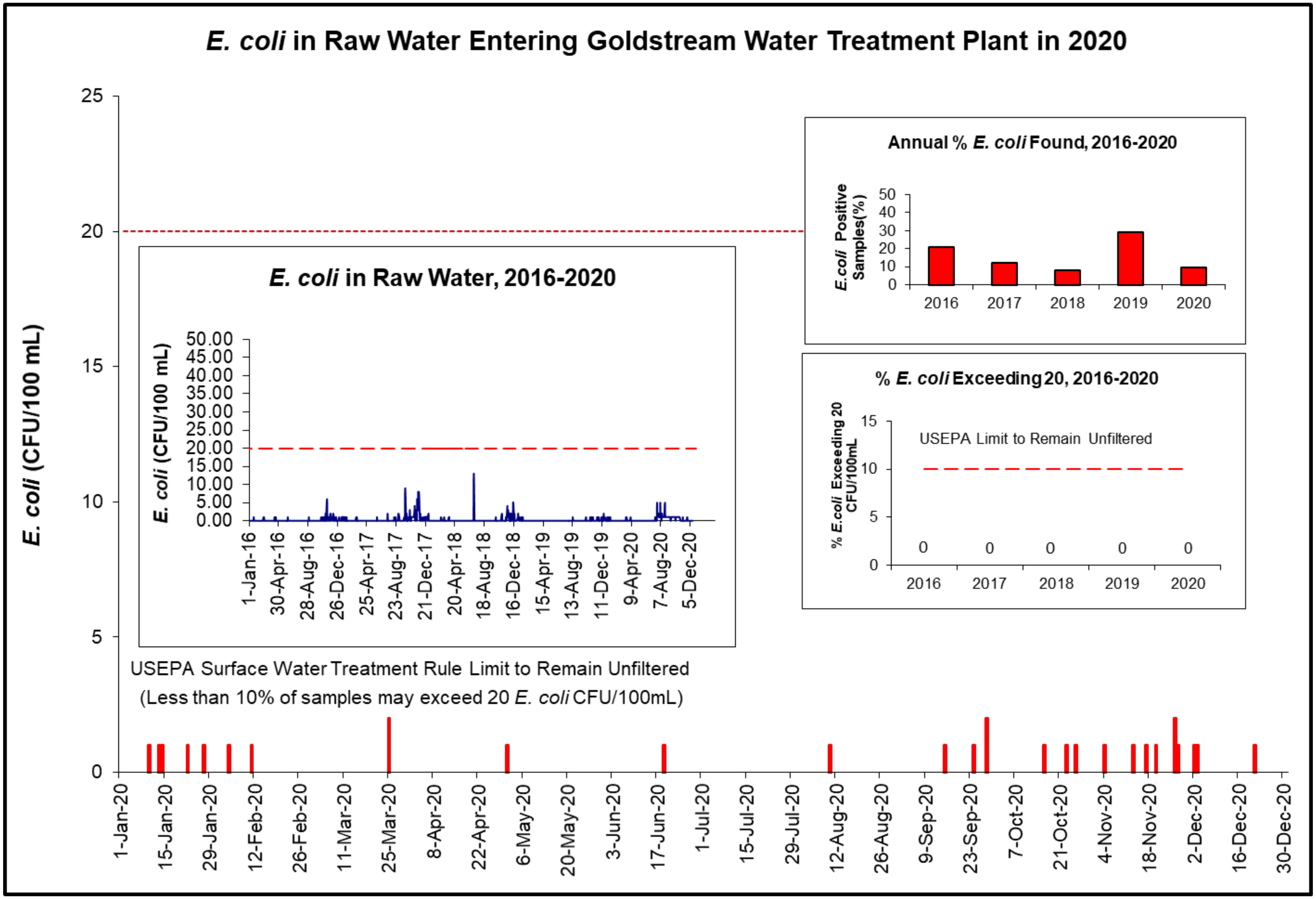

Figure 4 ***E.coli*** **in Raw Water Entering Goldstream Water Treatment Plant in 2020**

Algae – *Sooke Lake Reservoir (SOL).* In 2020, the algal dynamics were generally in line with the long-term trend. For example, diatoms increased from late winter and peaked in spring before decreasing in summer; golden algae had high density from the late winter to spring, declined in summer, but increased again in the fall. Nevertheless, the algal density was slightly higher than average from the late spring to the end of the year.

Algae are able to grow rapidly and become seasonally abundant under favourable weather conditions. The summer of 2020 featured above average seasonal temperatures with heat records broken in parts of BC, as well as strong and frequent rainfalls in late summer and fall. From early May to late June, a higher than usual abundance of the colonial golden alga, *Uroglena* sp occurred in Sooke Lake Reservoir. This was responsible for some taste and odour complaints from customers (approximately 20 complaints) during that period and a public advisory was issued between June 2 and 9, 2020. When in a bloom state, *Uroglena* sp. can cause a fishy smell or metallic-fishy taste. Taste and odour, however, are aesthetic issues and no health concern. Studies showed that phosphorus is the limiting factor for *Uroglena* sp. growth. However, as it is a mixotrophic alga (i.e., they carry out photosynthesis and/or feed on bacteria and micro-particles), it is able to bloom in water bodies with very low phosphorus concentration, such as Sooke Lake Reservoir. *Uroglena* blooms are not common in Sooke Lake Reservoir. Interestingly, a number of southern BC surface waters experienced *Uroglena* blooms during the summer of 2020, which indicates that favourable environmental conditions, such as frequent rainfalls, well into July were likely the cause for these events.

The source water quality monitoring program recorded small flagellates (~5 microns, possibly the green flagellates, *Pedinomonas* spp.), which were quite abundant from the end of summer until the end of fall in 2020, but these flagellates caused no water quality concerns. Due to their small size, these flagellates did not contribute significantly to the total algal biomass, therefore, they were excluded in the algal graphs to be consistent with previous years.

Overall, algal density fitted well with the long-term trend in Sooke Lake Reservoir, with natural unit counts a little higher compared to the multi-year average during the second half the year. Except for the short-term taste and odour issue, due to the *Uroglena* bloom, there were no other water quality concerns related to algae.

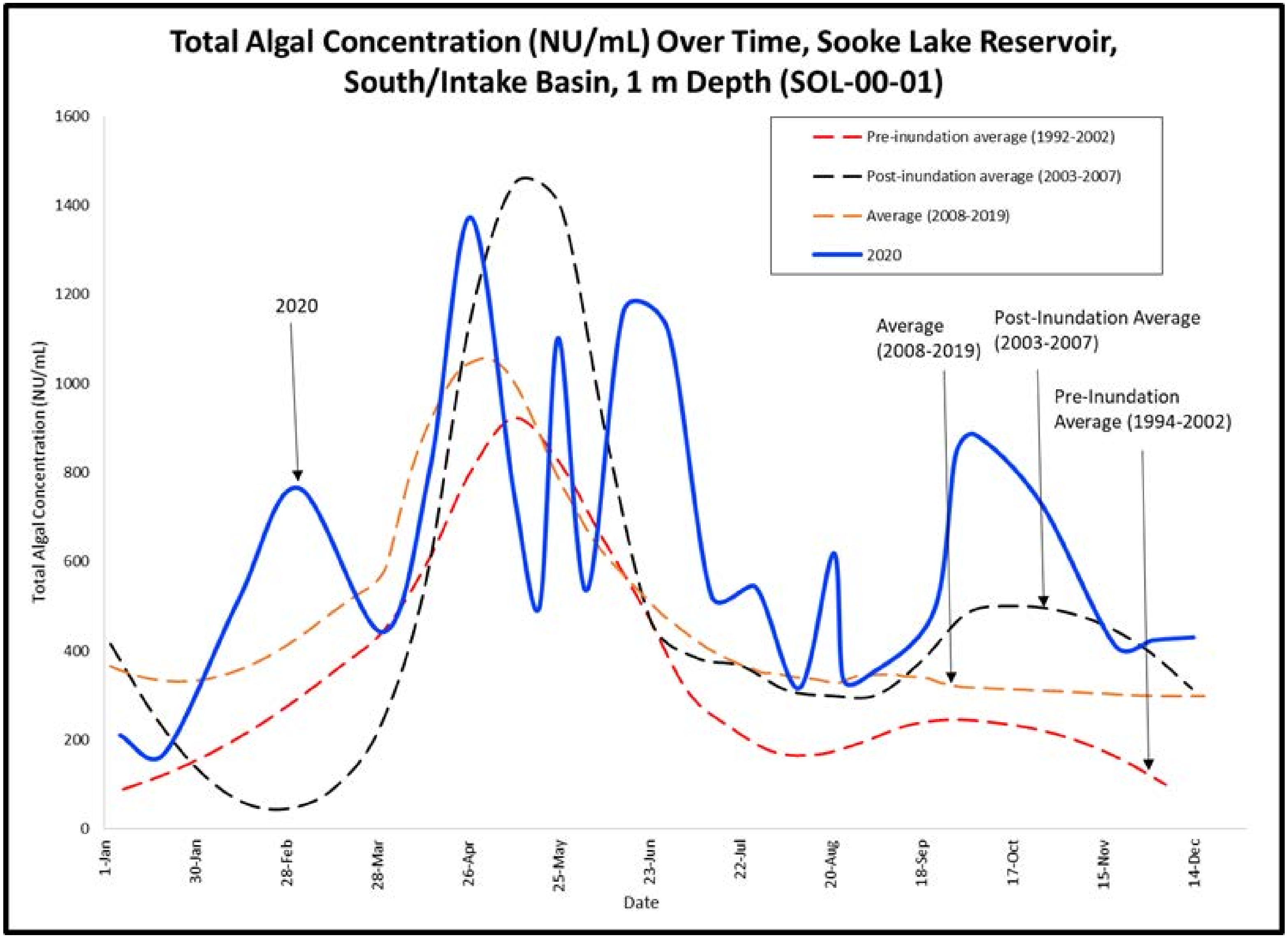

Figure 5 **Total Algal Concentration (natural units/mL) Over Time, Sooke Lake Reservoir, South/Intake Basin, 1 m depth (SOL-00-01)**

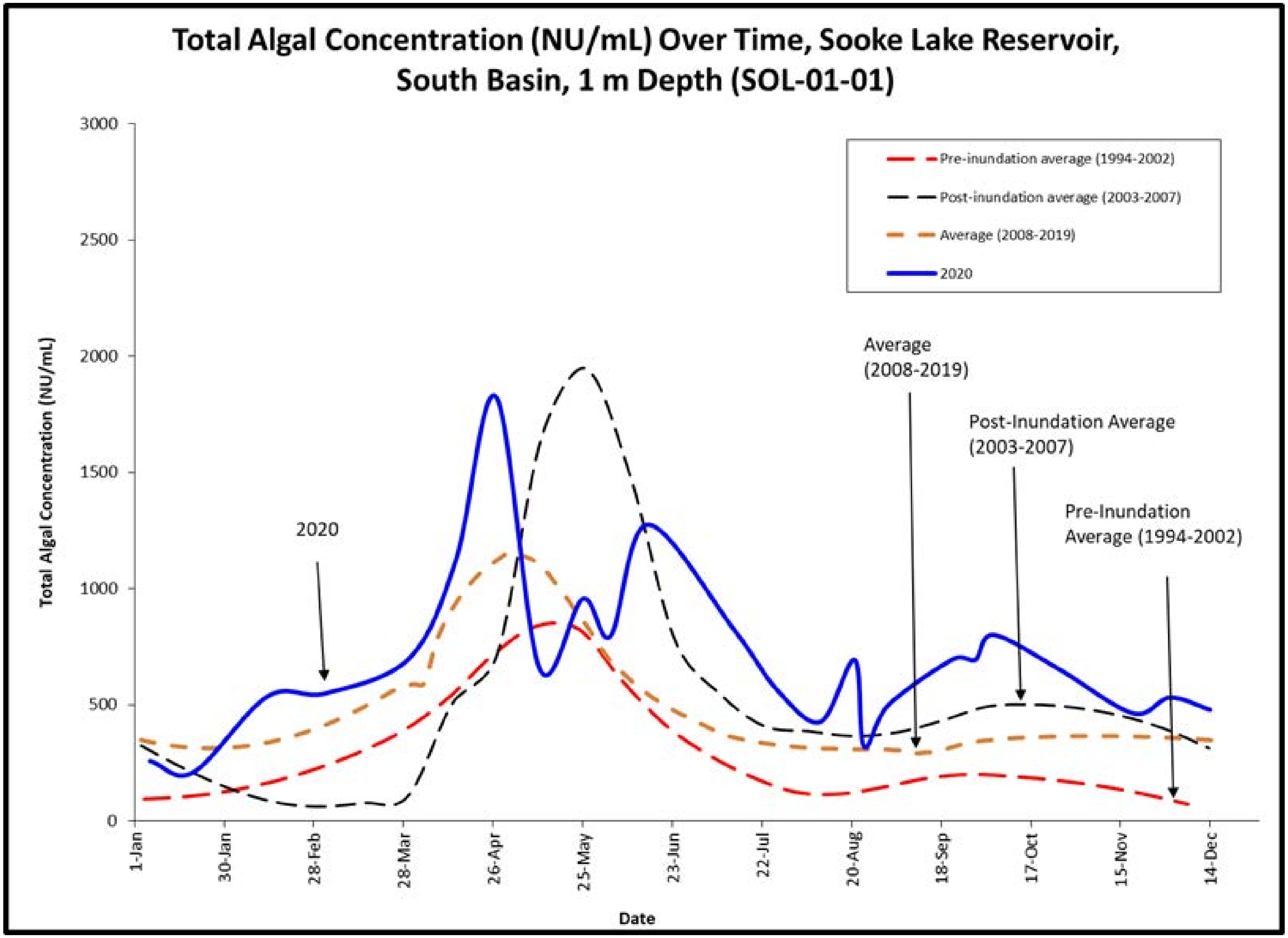

Figure 6 **Total Algal Concentration (natural units/mL) Over Time, Sooke Lake Reservoir, South Basin, 1 m depth (SOL-01-01)**

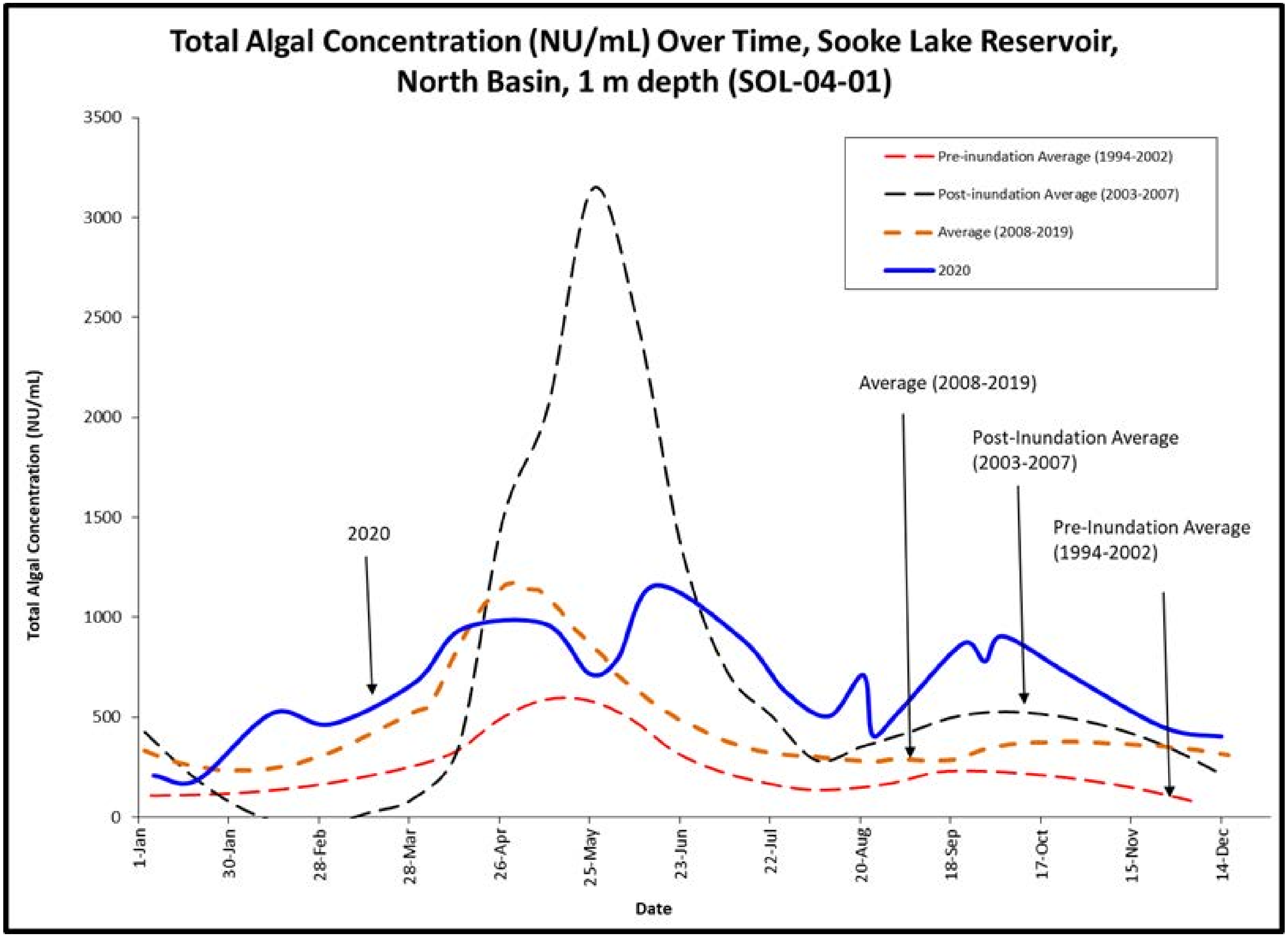

Figure 7 **Total Algal Concentration (natural units/mL) Over Time, Sooke Lake Reservoir, North Basin, 1 m depth (SOL-04-01)**

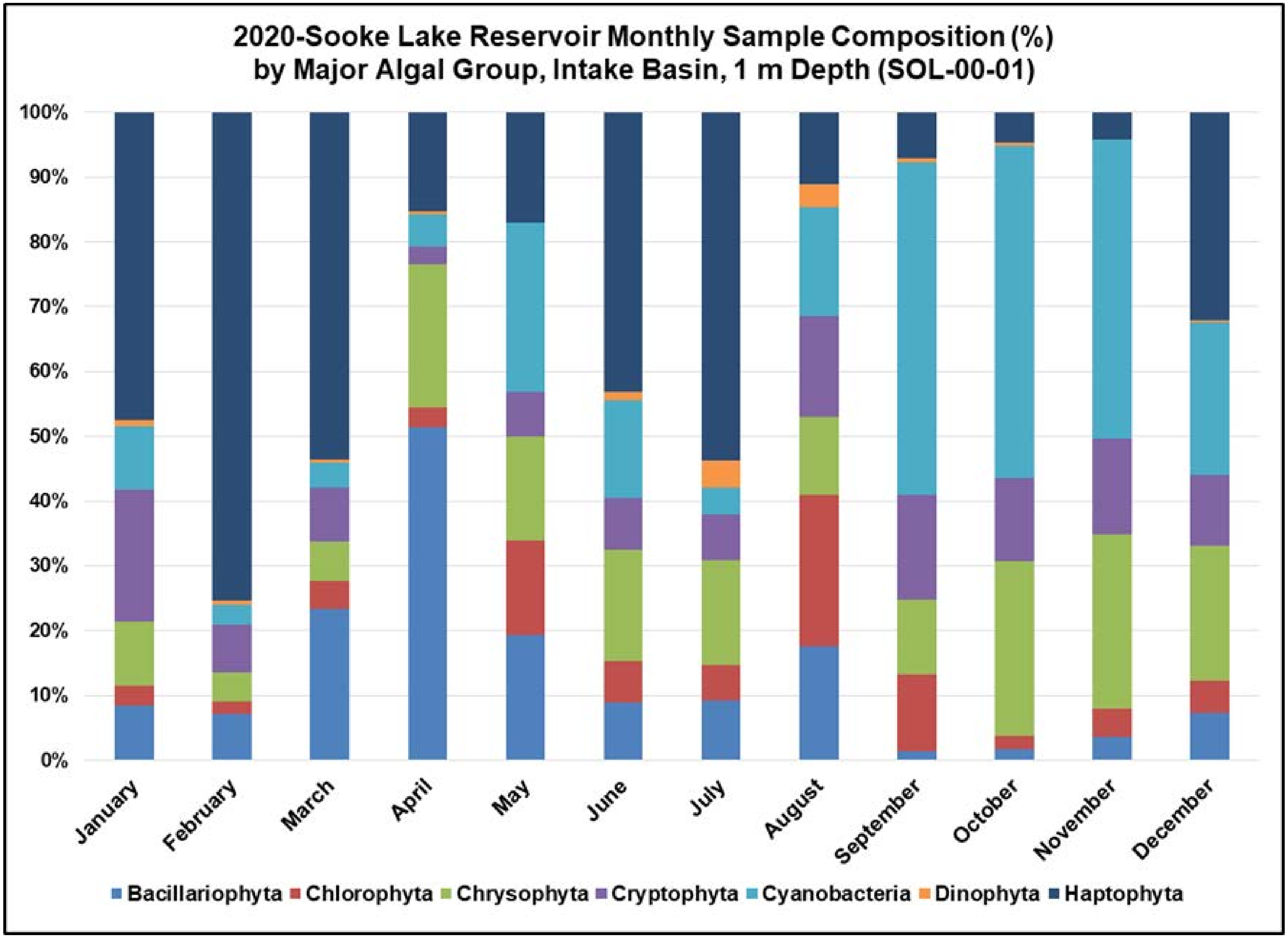

Figure 8 **Monthly Abundance Percent of Different Algal Groups, Intake Basin, 1 m depth, SOL-00-01, 2020**

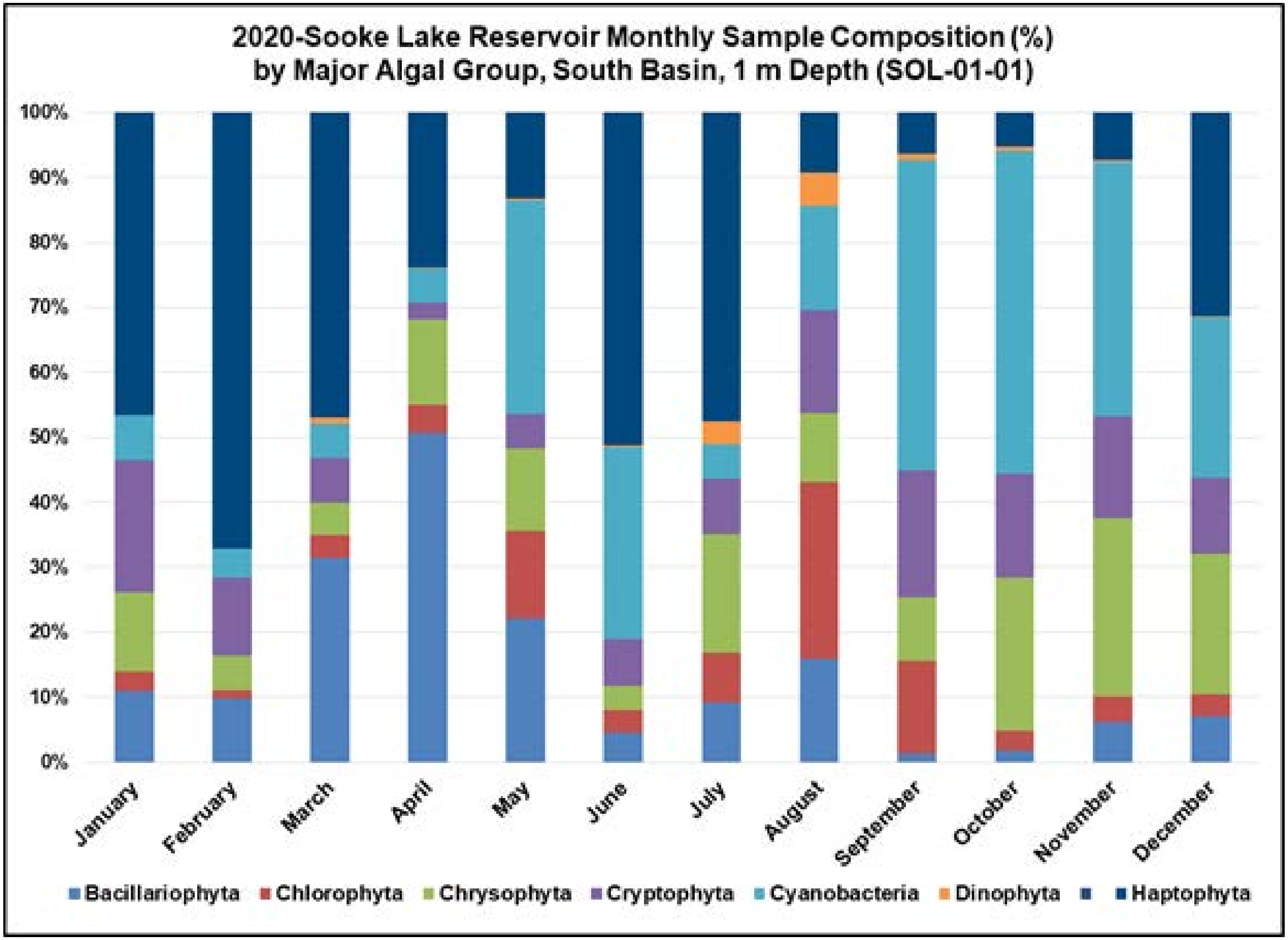

Figure 9 **Monthly Abundance Percent of Different Algal Groups, South Basin, 1 m depth, SOL-01-01, 2020**

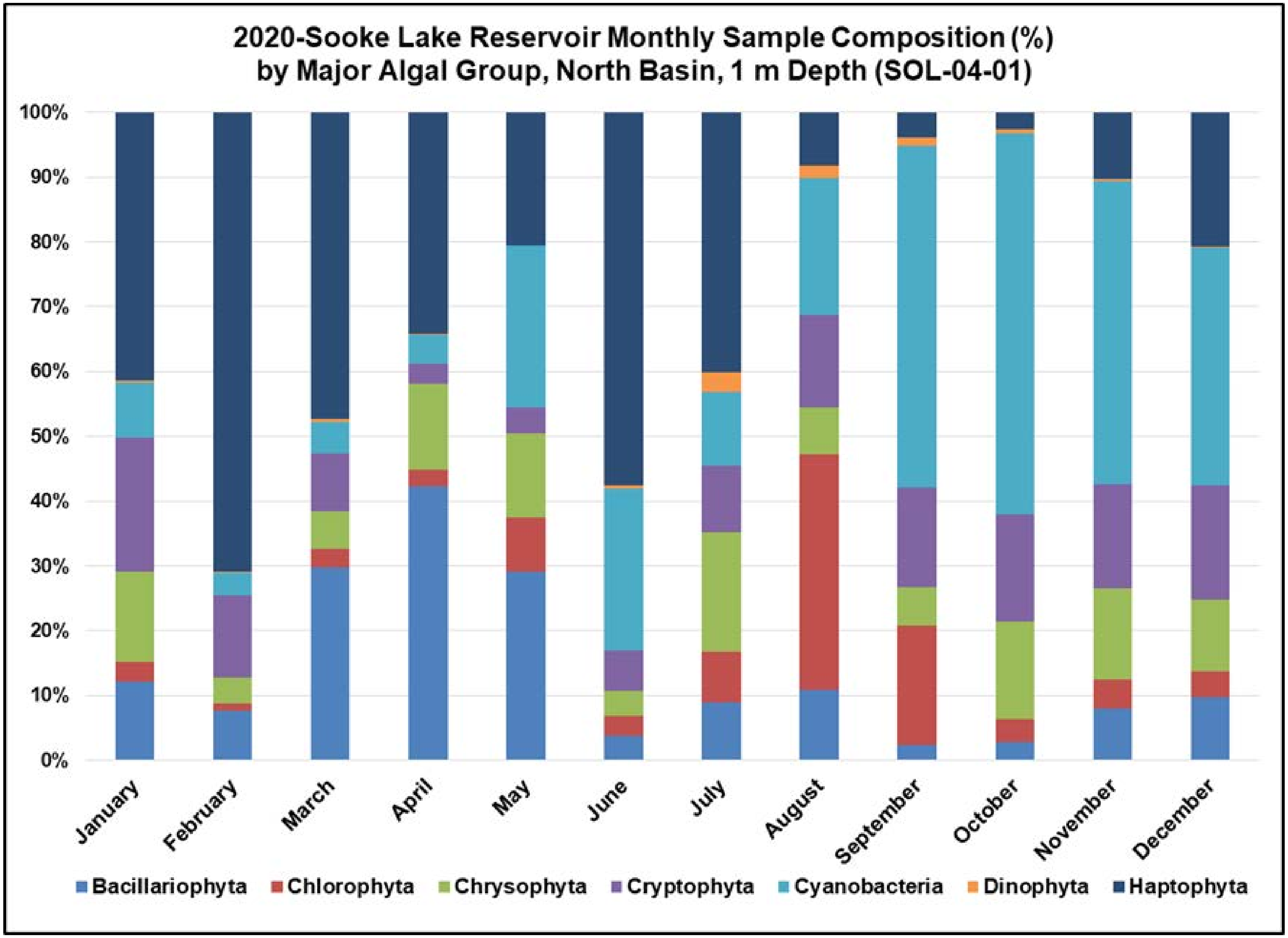

Figure 10 Monthly Abundance Percent of Different Algal Groups, North Basin, 1 m depth, SOL-04-01, 2020

Algae – *Leech River Watershed*. Most current water quality monitoring programs for streams use periphyton as bioindicators rather than potamoplankton (phytoplankton in streams). Periphyton are algae that are attached to the stream substrates and constitute the most dominant form of algae in flowing water. Phytoplankton, which are the most prevailing algal forms in standing water, play an insignificant role in streams. In August 2019, CRD staff started collecting and analyzing water samples from the Leech River watershed. The results revealed that most taxa were periphyton, possibly released from the benthic habitats, rather than typical phytoplankton. Further analyses showed that total chlorophyll concentrations were very low in Leech River water samples in 2019 and 2020. Consequently, CRD staff discontinued analysis for phytoplankton on Leech River samples. Quarterly chlorophyll-a tests have been included in the sampling plan.

Leech River watershed samples collected in 2020 were part of the multi-season baseline monitoring project that CRD staff conducted from August 2019 through December 2020. Within the scope of this project, algae samples were collected monthly from four sites in Leech Watershed (LWS): 1) LR-US, 2) LR-DS, 3) LR-TUN, and 4) LR-CRG (see Figure 11), whereas the LR-TUN is located at the entrance of the Leech River water diversion tunnel that was constructed in the 1980s, but only used very briefly in 1988.

Table 1 provides a habitat characterization of the four chosen sampling sites within the Leech River watershed. This information is important to consider when analyzing the water quality data collected over the period of the project. Figure 12 also showcases the drastic hydrological difference between stream conditions during wet and dry season. This also factors into the water quality data analysis and will play a major role in future evaluations for a potential use of the Leech River watershed for drinking water supply.

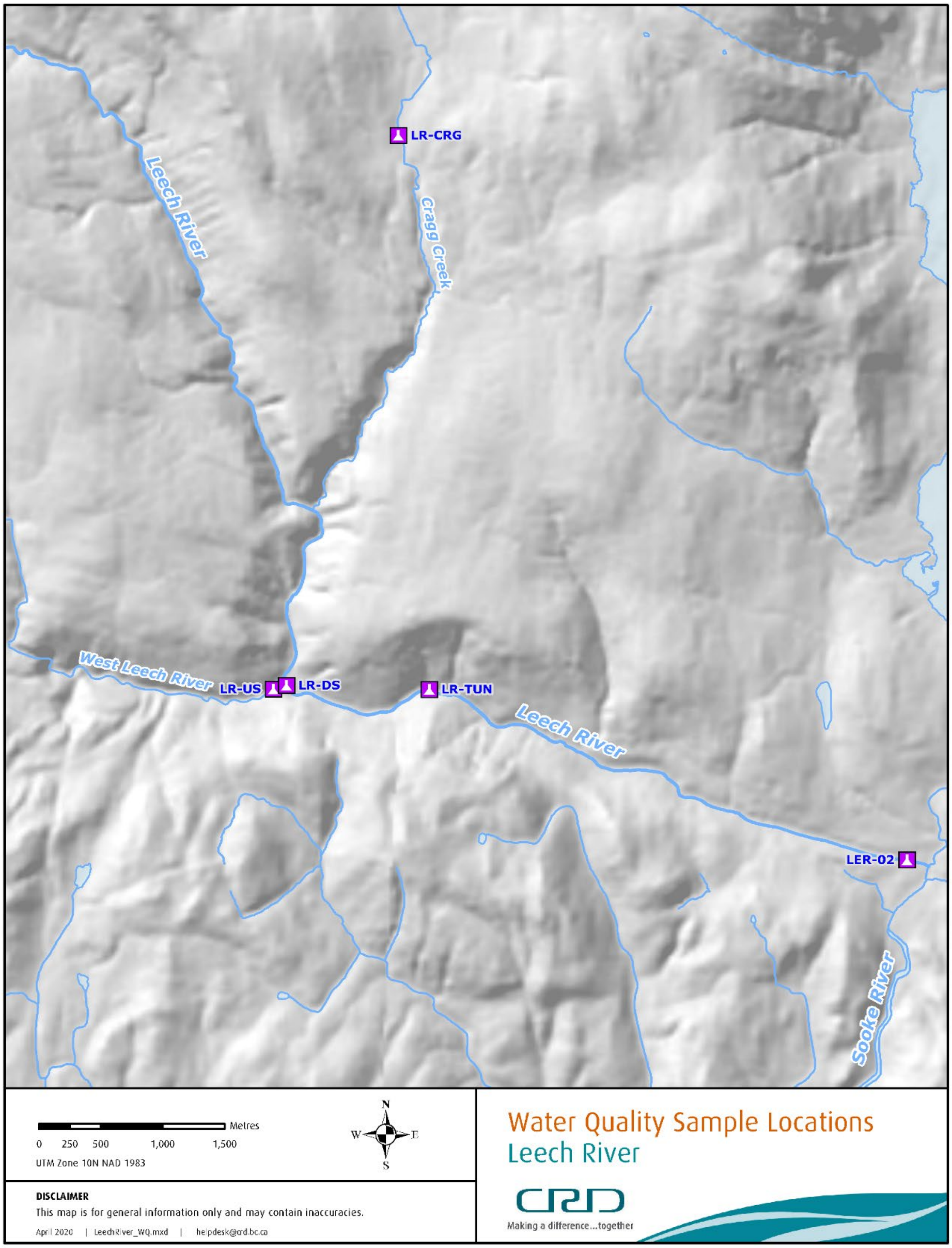

Figure 11 Leech River Water Sampling Stations

Table 1 Summaries of Habitat Characteristics at the Four Sampling Sites in Leech Watershed

Characteristics		Site 1			Site 2			Site 3			Site 4		
		Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.
Stream Anatomy	% Pool	5.0	30.0	15.3	5.0	20.0	10.3	5.0	30.0	19.0	0.0	30.0	10.0
	% Riffle	15.0	60.0	30.3	15.0	40.0	21.7	25.0	60.0	42.3	10.0	50.0	35.0
	% Run	10.0	70.0	54.3	50.0	80.0	68.0	25.0	60.0	38.7	30.0	75.0	55.0
Stream Characters	Bankfull width (m)	10.0	23.0	17.1	13.5	35.0	21.5	19.0	30.0	22.9	8.0	18.0	12.5
	Wetted width (m)	5.0	14.0	9.2	6.0	15.0	10.1	8.0	35.0	16.5	2.5	10.0	6.0
	Depth-Max (m)	0.6	1.8	1.3	0.5	1.8	1.4	1.0	1.8	1.5	0.2	0.9	0.6
Substrate Compositions	% mud/silt (< 0.06 mm)	0.0	3.3	0.7	0.0	1.7	0.2	0.0	1.7	0.3	0.0	1.7	0.1
	% sand (0.06-2 mm)	0.0	10.0	4.4	0.0	6.7	2.6	1.7	8.3	4.3	0.0	5.0	1.5
	% fine gravel (2-16mm)	1.7	16.7	9.1	3.3	16.7	7.2	3.3	15.0	8.7	0.0	13.3	2.2
	% coarse gravel (16-64mm)	10.0	35.0	20.3	8.3	25.0	14.8	6.7	25.0	13.1	0.0	18.3	6.4
	% cobbles (64-256mm)	21.7	46.7	33.7	33.3	76.7	51.1	33.3	53.3	40.7	0.0	73.3	47.0
	% Boulder (>256mm)	8.3	46.7	21.5	6.7	35.0	17.8	13.3	31.7	22.2	3.3	13.3	7.2
	% Bedrock	1.7	25.0	13.2	0.0	15.0	5.9	5.0	20.0	10.3	11.7	66.7	31.6
Riparian Vegetation	% Pasture	5.0	5.0	5.0	10.0	40.0	20.0	5.0	10.0	6.0	5.0	10.0	7.7
	% Scrub (< 2m)	5.0	20.0	11.7	5.0	20.0	6.0	5.0	20.0	12.3	10.0	25.0	12.7
	% trees (2-5m)	5.0	15.0	5.7	5.0	30.0	10.3	10.0	30.0	14.7	10.0	30.0	20.3
	% trees (>5m)	70.0	85.0	77.7	50.0	80.0	67.0	45.0	80.0	67.0	50.0	70.0	56.7
	Total Canopy cover (%)	40.0	95.0	70.3	10.0	30.0	20.3	20.0	70.0	35.3	5.0	40.0	18.3
	Dominant trees	Red Alder, Doug Fir			Red Alder, Maple			Red Alder			Pine, Alder, Cedar		

Notes: (Min.: Minimum, Max.: Maximum, Aver.: Average)

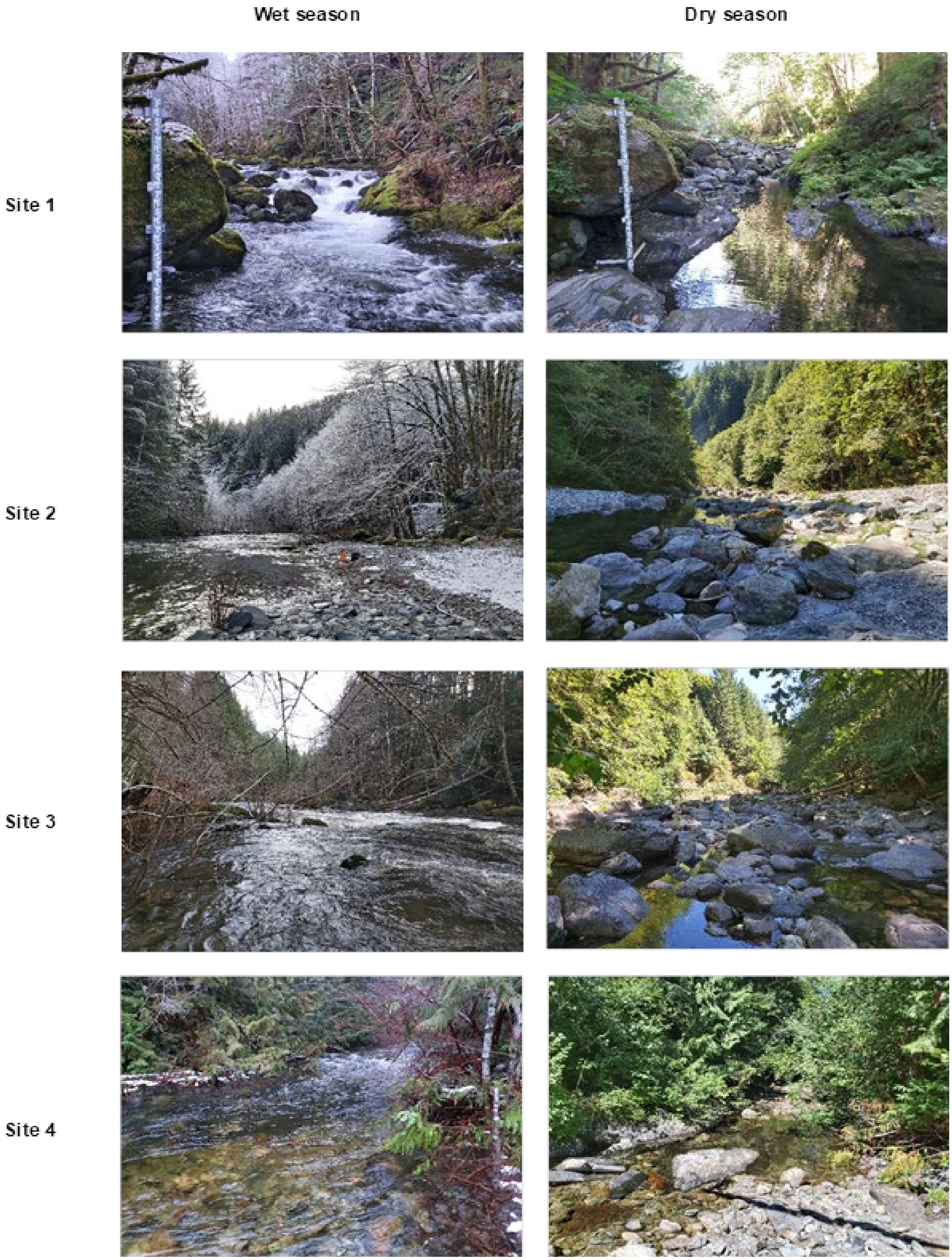

Figure 12 Pictures Illustrating the Difference between Wet and Dry Season at Each Leech Watershed Sampling Site

The analytical results revealed about 74 periphyton taxa, in which Chlorophyta (green algae), Cyanobacteria, and Bacillariophyta (diatoms) were the three main groups with 25, 23 and 21 taxa recorded, respectively; other groups had only 1 or 2 taxa (Figure 13).

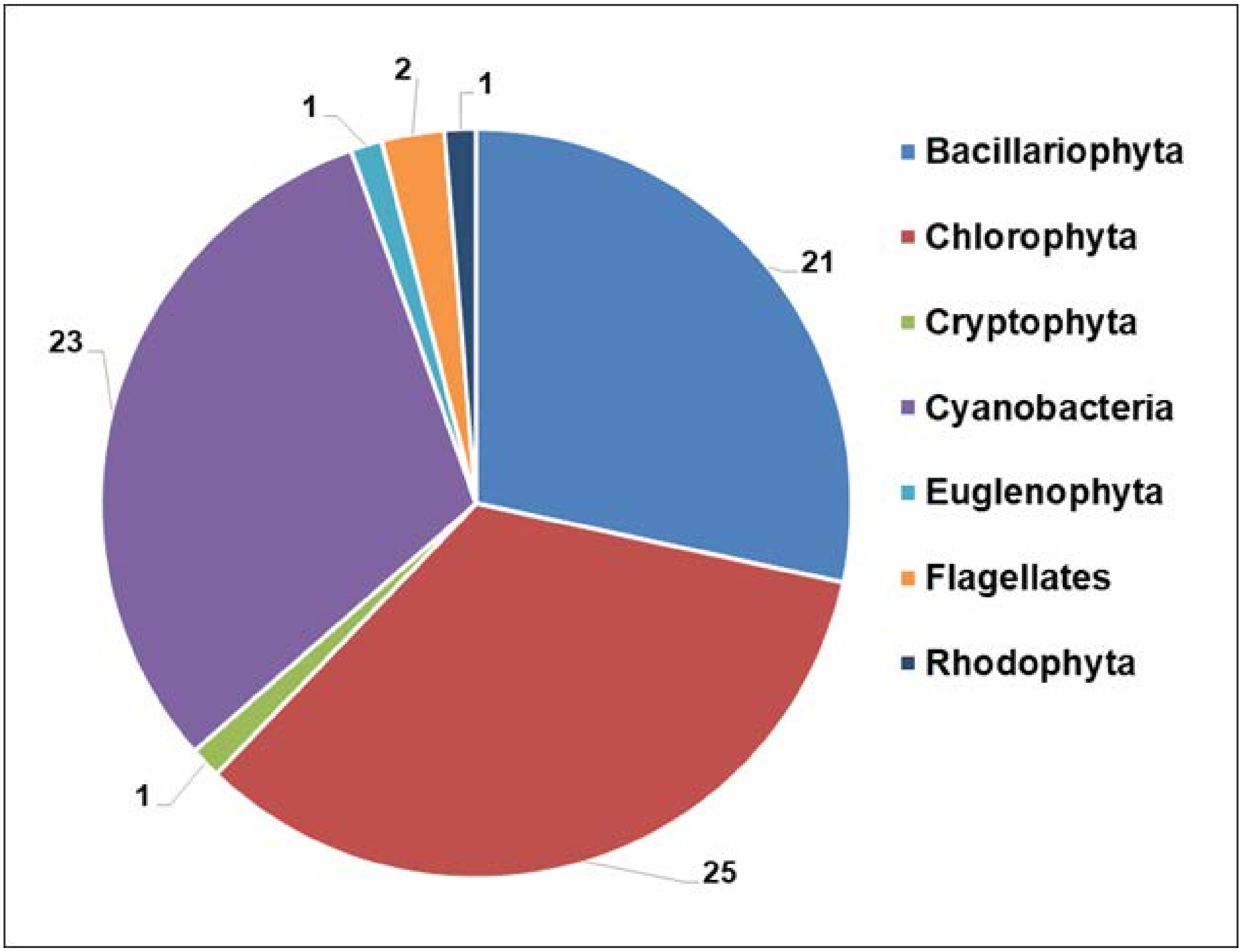

Figure 13 Taxon Composition of Periphyton in Leech Watershed from October 2019 to December 2020

Periphyton are algae that are attached to the stream substrates and unlike limnoplankton (phytoplankton in lakes), periphyton dynamics are mainly regulated by physical parameters. The data showed that the periphyton densities (NU/cm^2) in general decreased in late fall and started to increase in late winter, then peaked during the summer to early-fall period (Figure 14). While diatoms dominated at most sites, cyanobacteria and chlorophytes were the other main contributors to the total periphyton abundance (Figure 15 and Figure 16). In LWS, CRD staff observed a significant difference of periphyton density between winter and summer times, which was mainly attributable to the differing seasonal environmental conditions. For instance, in winter, the low photosynthetically active radiation (PAR), and heavy rains leading to habitat-damaging floods (e.g., strong water currents and erosion of substrates and streambeds), were likely the main factors limiting the periphyton communities. The streams of the LWS are known as very flashy (subject to fast rising levels/flooding), due to the topography and the lack of natural flow detention features. Periphyton densities at Site 4 were more consistent than at other sites, possibly because this site is located at a higher elevation and characterized by higher portions of bedrock, reducing the substrate erosion and periphyton abrasion effects of winter floods. Shallower water, or obtaining higher PAR at this site, can also support faster recovery of periphyton communities after floods.

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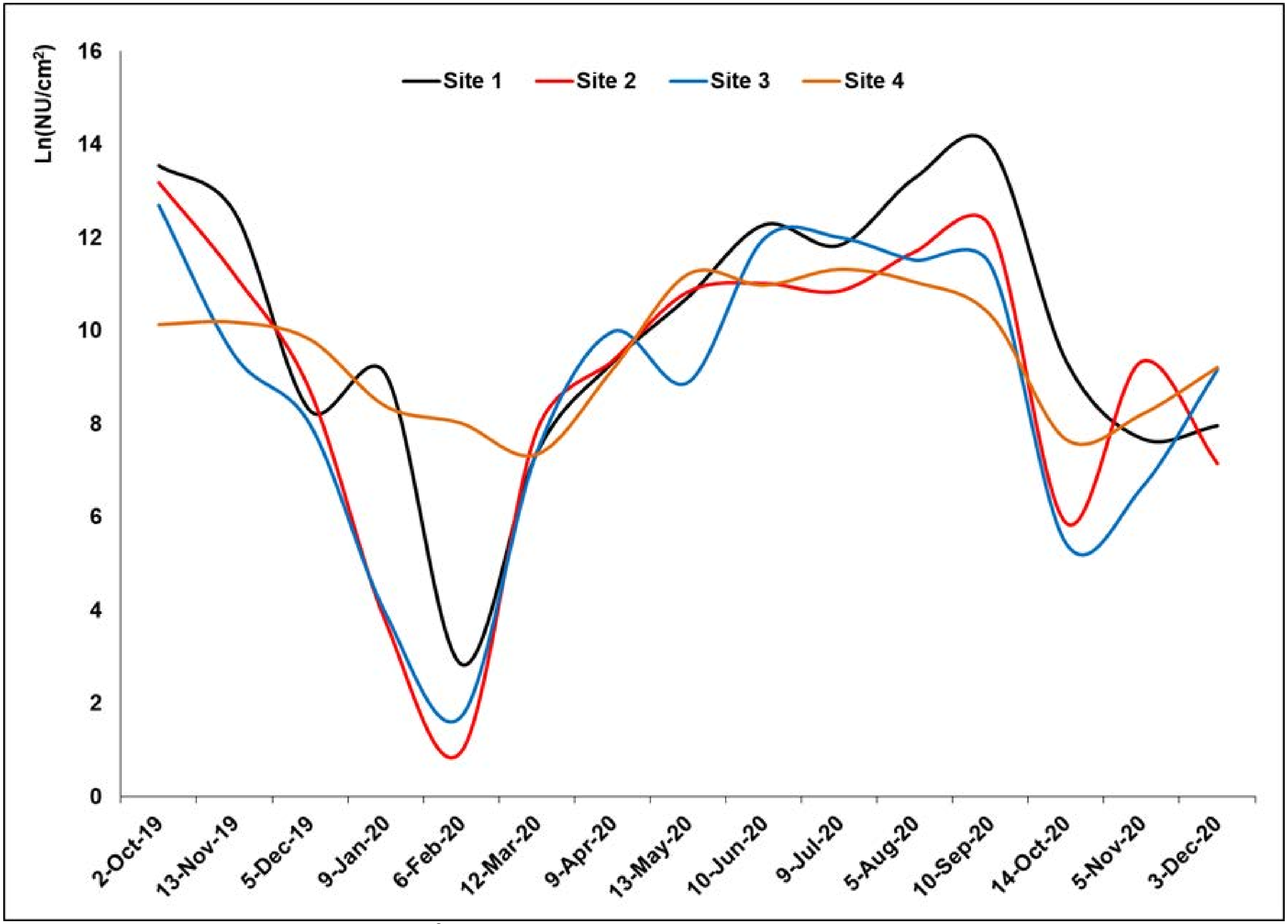

Figure 14 Periphyton Densities (NU/cm^2) in Leech Watershed Collected from October 2019 to December 2020

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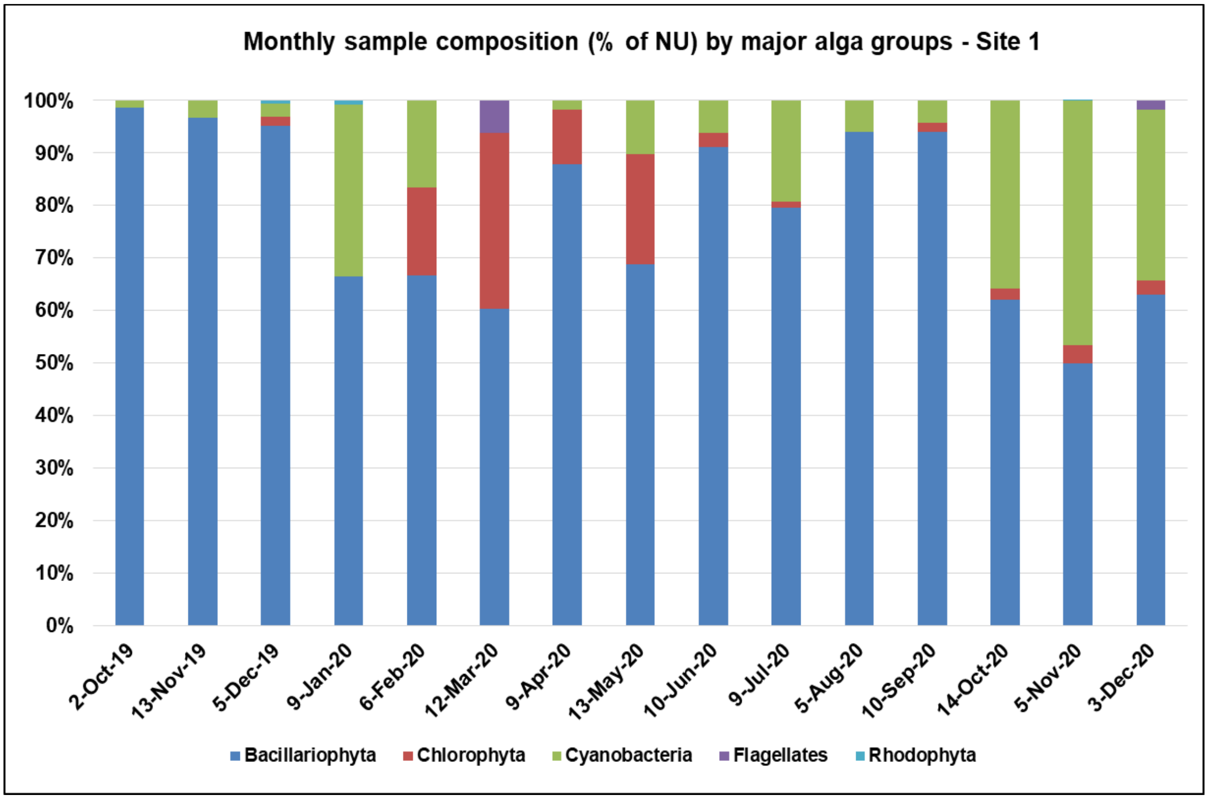


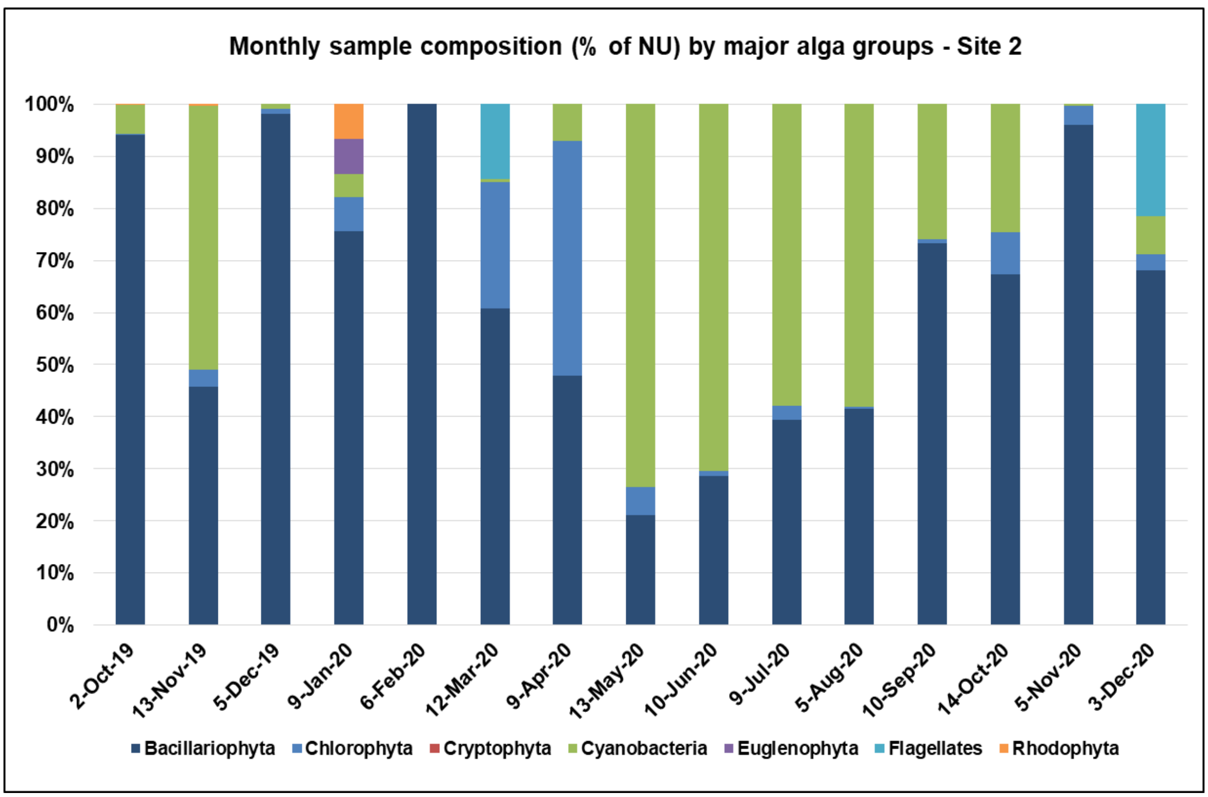
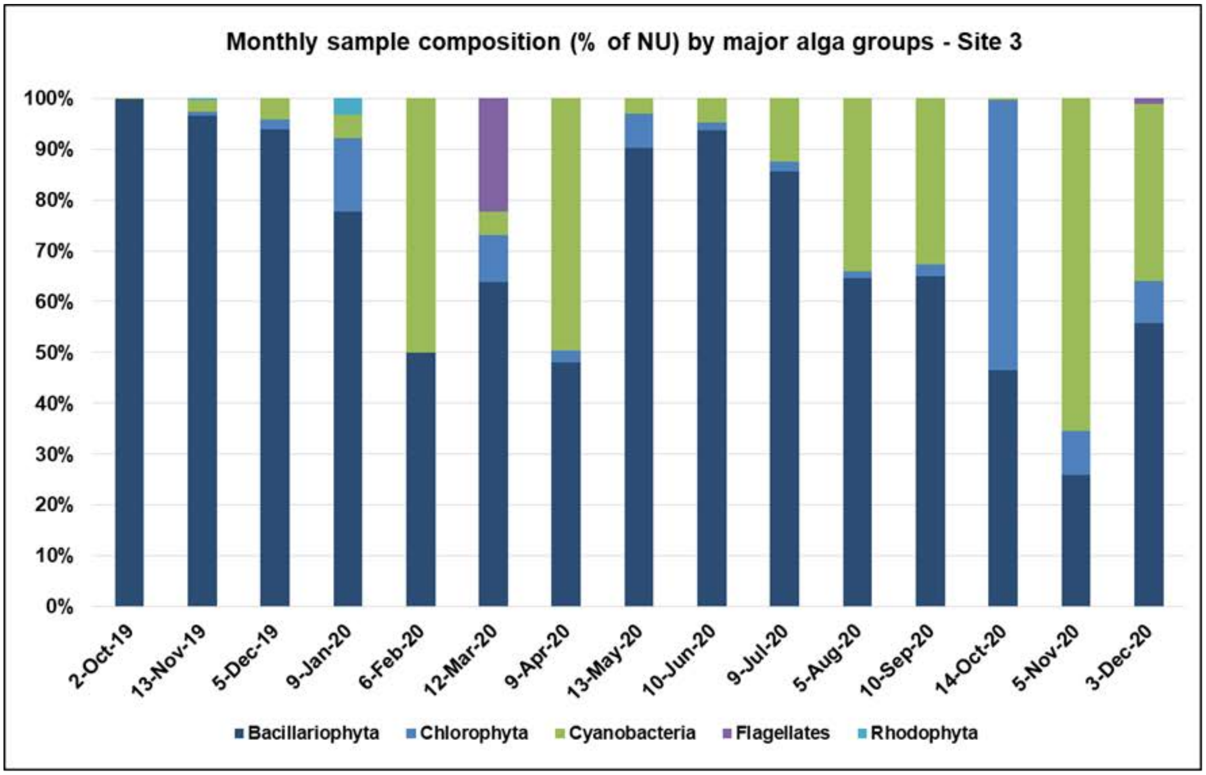


Figure 15 Monthly Sample Composition (% of Natural Unit counts - NU) by Major Alga Groups for LWS Site 1 (top) and 2 (bottom)



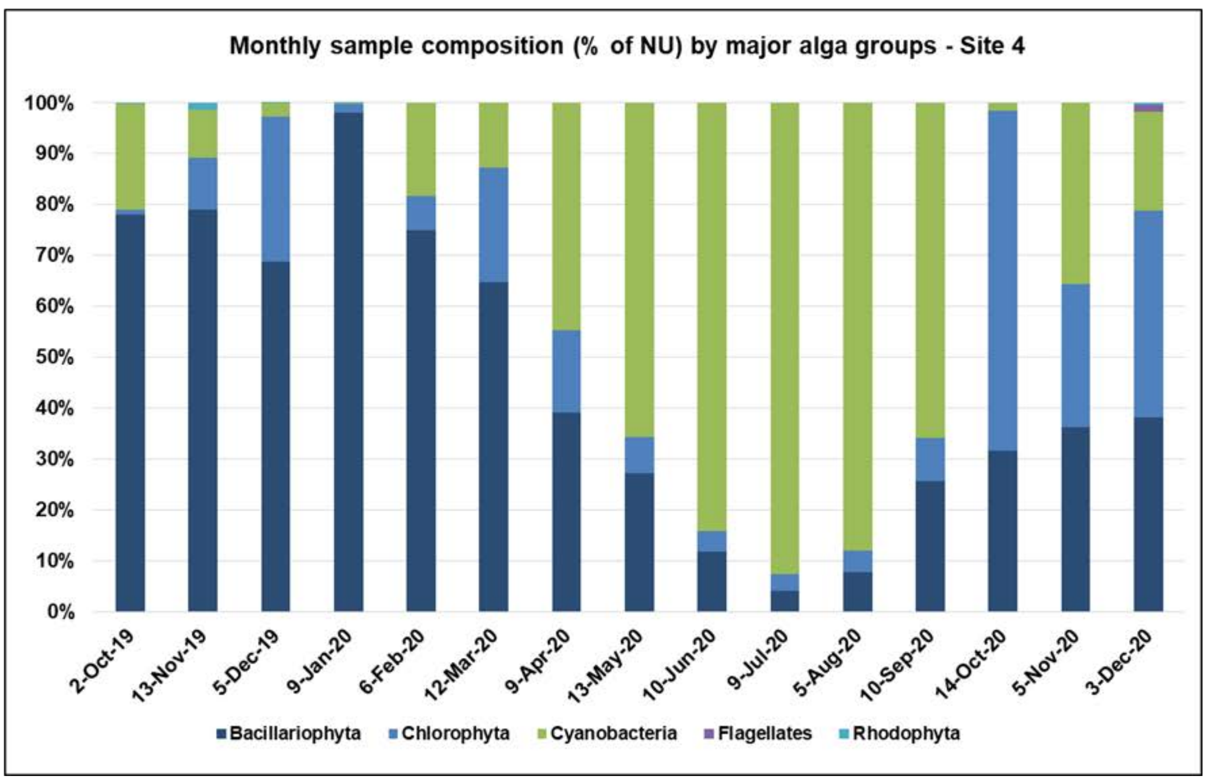


Figure 16 Monthly Sample Composition (% of Natural Unit counts - NU) by Major Alga Groups for Site 3 (top) and 4 (bottom)

In general, the percent of periphyton coverage with thickness of visible algal mats ≥1 mm was very low for most of the sites, except Site 4. The commonly observed algal mats at sites 2, 3 and 4 were mainly created by long-filamentous green algae, e.g., *Draparnaldia* sp., and/or *Klebsormidium* and/or *Zygnema* sp., mixed with cyanobacteria of *Phormidium/Lyngbya*, and diatoms of *Synedra, Cymbella,* and *Tabellaria*. Site 4 had shallow water and thin canopy coverage, which provided more favourable conditions for growth of these green algae than at the other sites. Diatoms, such as *Achnanthidium* spp., dominated over other algae at Site 1 during the year, due to the higher adaptability of diatoms to low light density and dense canopy coverage at this site. In stream systems, Nitrogen or Phosphorus or both can be limiting factors for periphyton growth. It is likely that low nutrients prevented periphyton from blooming in LWS. Other factors, such as heavy floods and grazing pressure of aquatic insects, e.g., chironomids, collectively keep periphyton at a low-growth rate.

The monitoring program also recorded some potentially toxin-producing cyanobacteria, e.g., *Anabaena, Nostoc, Limnothrix, Lyngbya, Phormidium, Oscillatoria* and *Pseudanabaena*, which grew mainly during the summer time. Their cell counts are shown in Figure 17. There was a higher density of these cyanobacteria at Site 3 than at the other sites. Algal mats of the cyanobacteria *Phormidium/Lyngbya* were observed from June to September 2020 at Site 3. A reason for this could be more favourable habitat characteristics at Site 3, such as wide wetted perimeter, moderately thin canopy coverage and more stagnant waters in small pools.

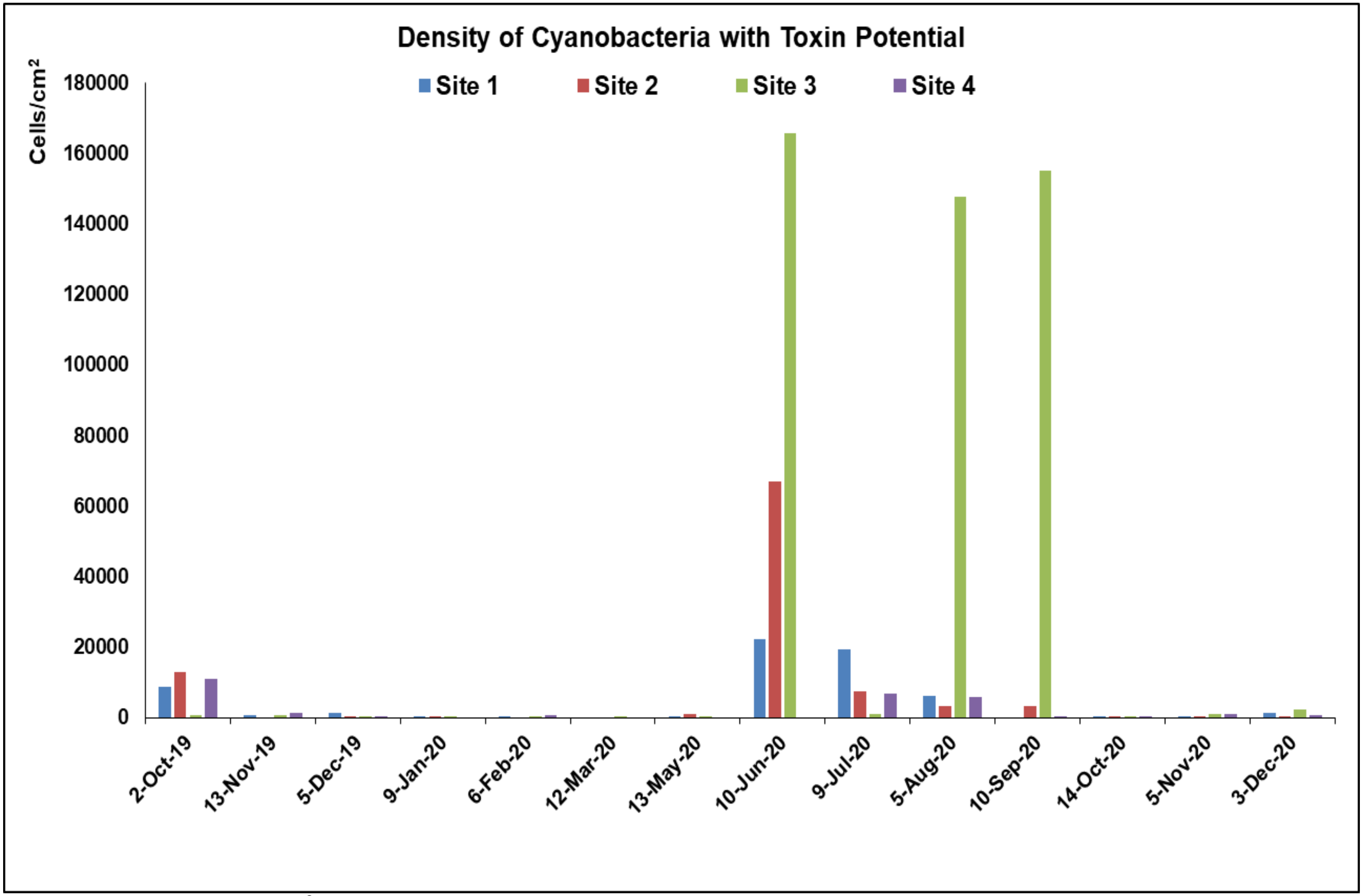


Figure 17 Density (cells/cm^2) of Cyanobacteria with Toxin Potential, at Four LWS Sites from October 2019 to December 2020

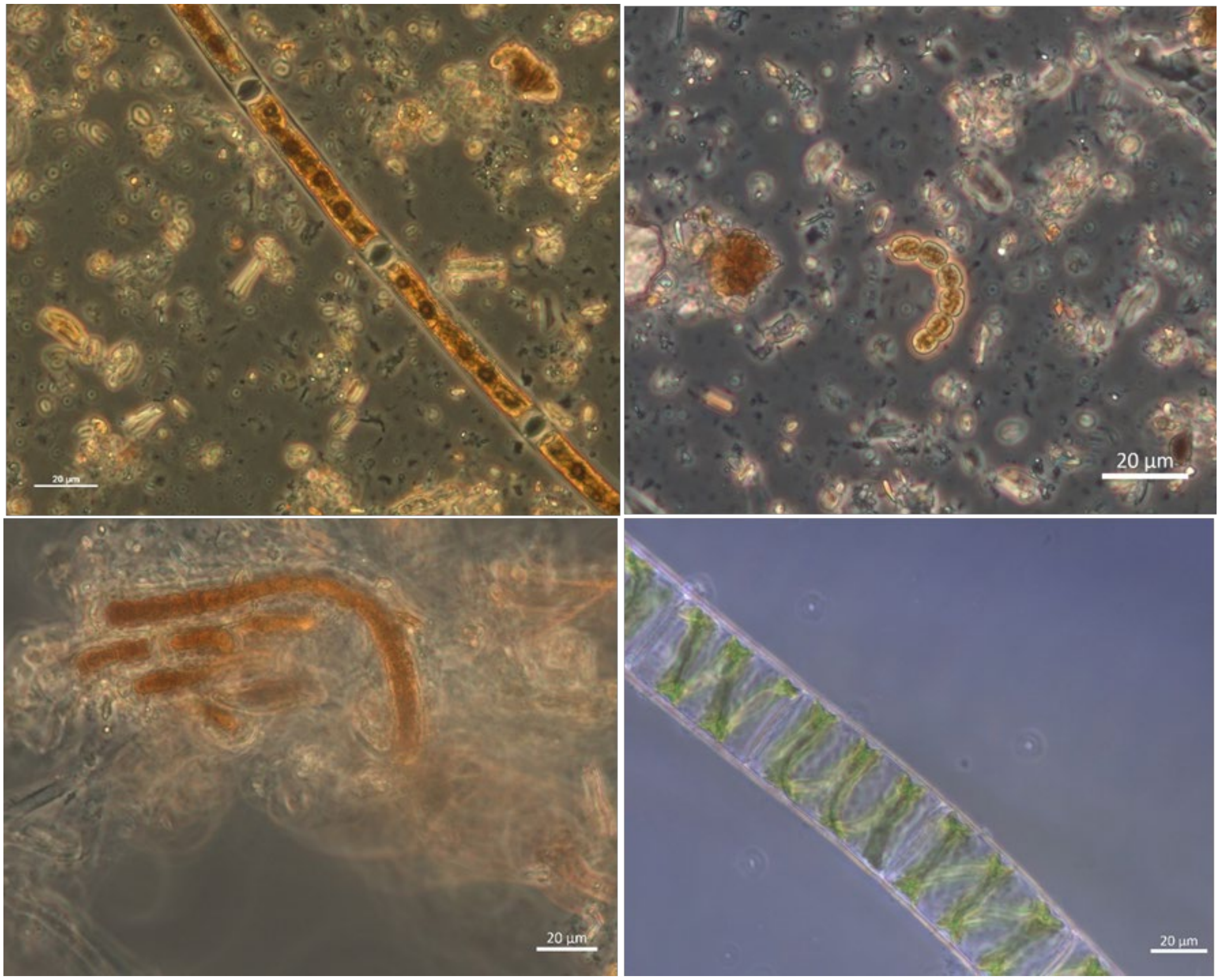


Figure 18 Some Periphyton Recorded in Leech Watershed

Notes: Green alga, *Mougeotia* sp. (top left), Cyanobacterium, *Anabaena* sp. (top right), Cyanobacterium, *Coleodesmium* sp. (bottom left), and green alga, *Spirogyra* sp. (bottom right)

Zooplankton – *Sooke Lake Reservoir (SOL)*. Zooplankton play an important role as an intermediate trophic stage, ensuring the energy flow from primary producers to higher trophic levels, e.g., macroinvertebrates, fish and other aquatic animals in aquatic ecosystems. Previous studies have shown that fish in SOL predominantly rely on zooplankton for forage. Because of this important biological role, the CRD has included a regular zooplankton analysis to its source water monitoring program. Zooplanktonic species themselves can be herbivores, carnivores or omnivores. Studies have shown that any change of zooplankton species composition or densities or both could influence not only the trophic structure, but also physiochemical parameters in the ecosystems. There are three main zooplankton groups, e.g., Protozoa, Rotifera and Crustacea (Copepoda and Cladocera). In the ecosystems, phytoplankton are considered as a main food source for zooplankton and, therefore, phytoplankton dynamics can significantly reflect the changes of zooplankton and *vice versa*. The peak of zooplankton abundance normally occurs after the peak of phytoplankton. In general, zooplankton tend to have higher density during the spring-to-fall period than in winter.

In SOL, zooplankton mainly consist of Rotifera and Copepoda, although Cladocera taxa, such as *Daphnia* spp. can be occasionally recorded. In 2020, these three main zooplankton groups were recorded in SOL. Rotifera was the most dominant group. Abundances of Rotifera and Copepoda were consistent with the long-term trends. Cladocera zooplankton, on the other hand, was less common and only observed in some discrete samples in May and September 2020.

As rotifers are considered as one of the main food sources for copepods, these two groups might show opposite abundance trends. Zooplankton dynamics in SOL are also regulated by other higher trophic organisms, such as macroinvertebrates and fish.

Zooplankton trends in Sooke Lake Reservoir are typical of ecological succession models. 2020 zooplankton activity was consistent with long-term trends (figures 19-24).

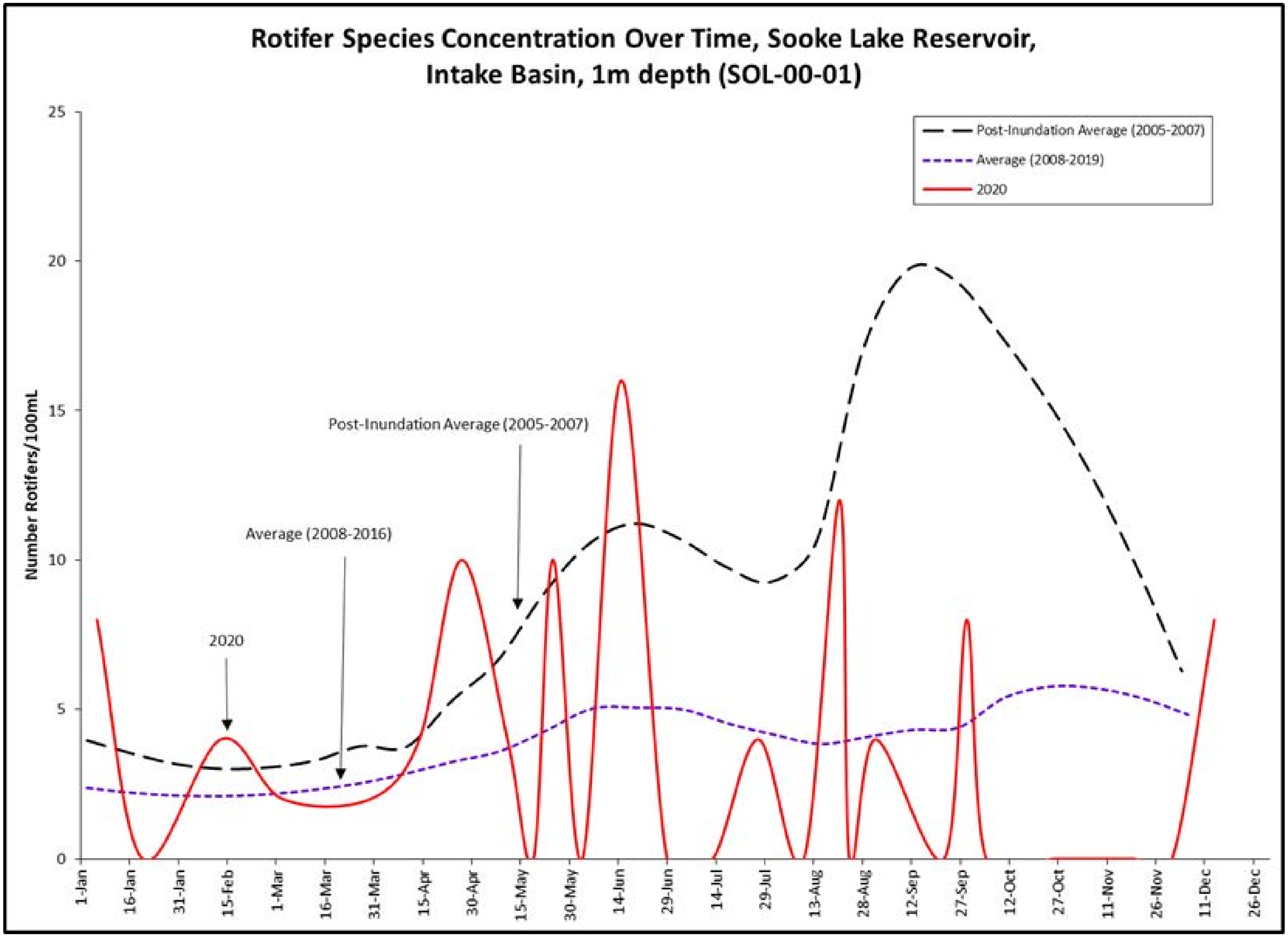


Figure 19 The Total Number of Rotifers over Time, Sooke Lake Reservoir, Intake Basin, 1 m depth (SOL-00-01)

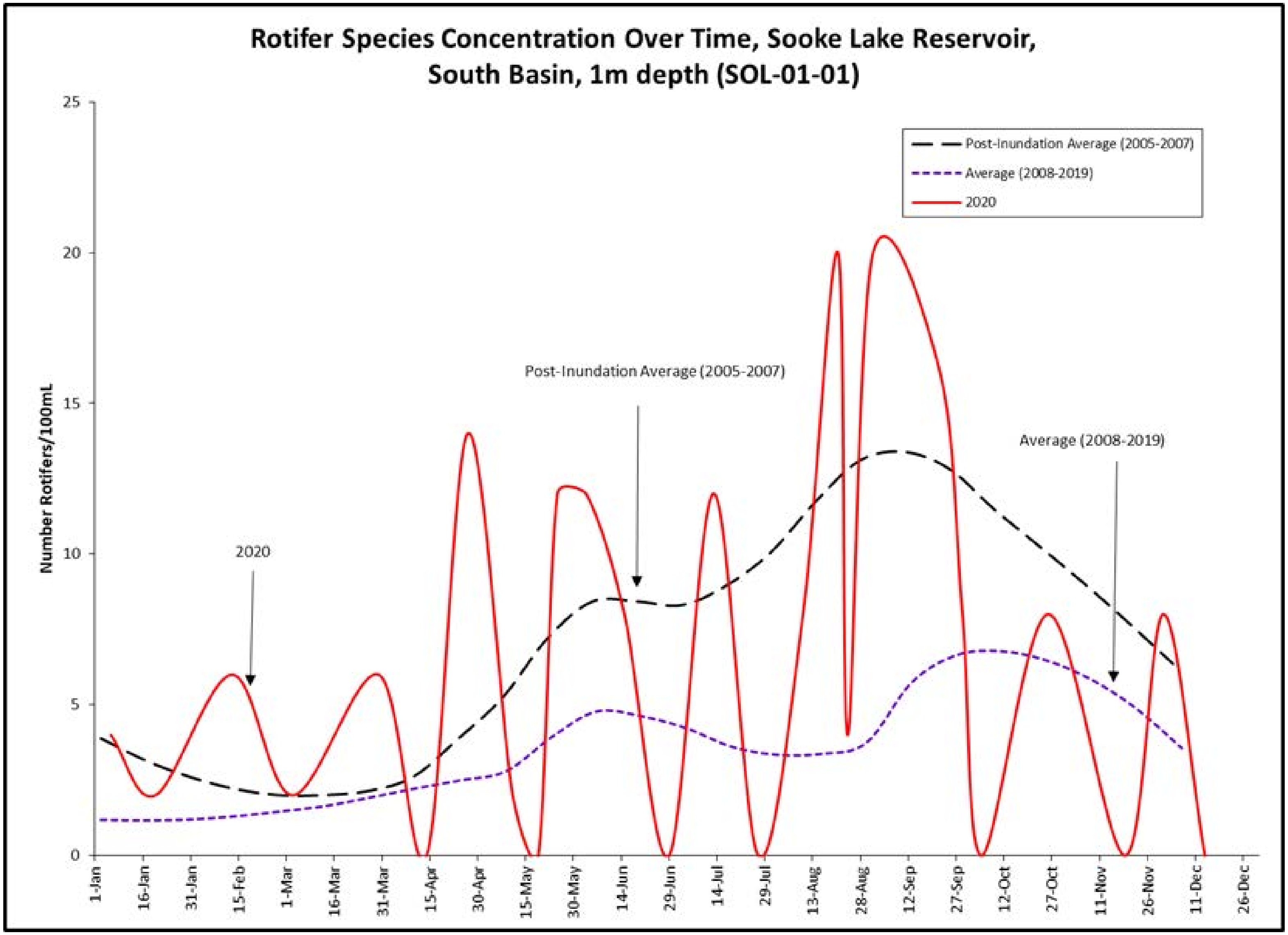


Figure 20 The Total Number of Rotifers over Time, Sooke Lake Reservoir, South Basin, 1 m depth (SOL-01-01)

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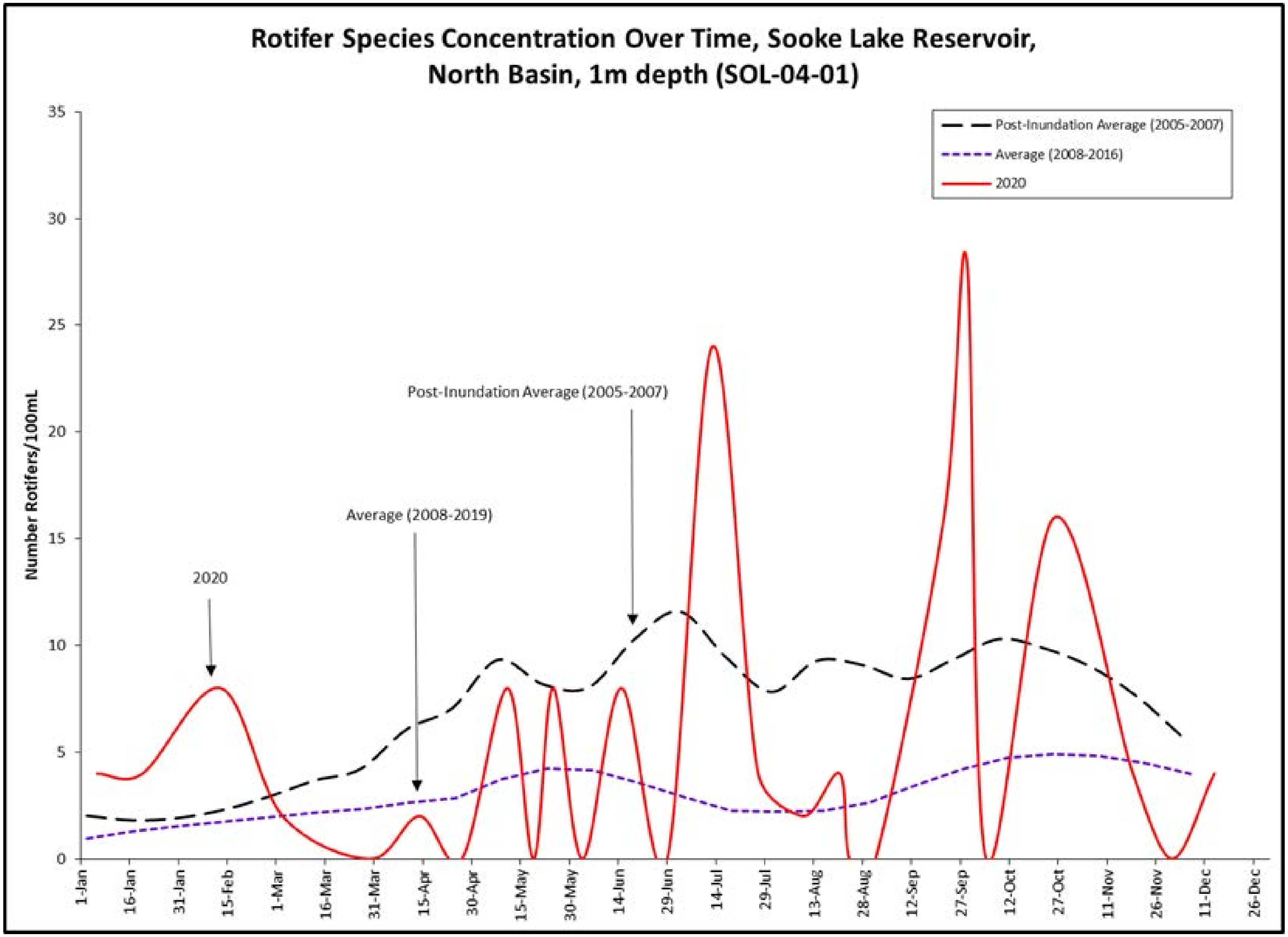

Figure 21 The Total Number of Rotifers over Time, Sooke Lake Reservoir, North Basin, 1 m depth (SOL-04-01)

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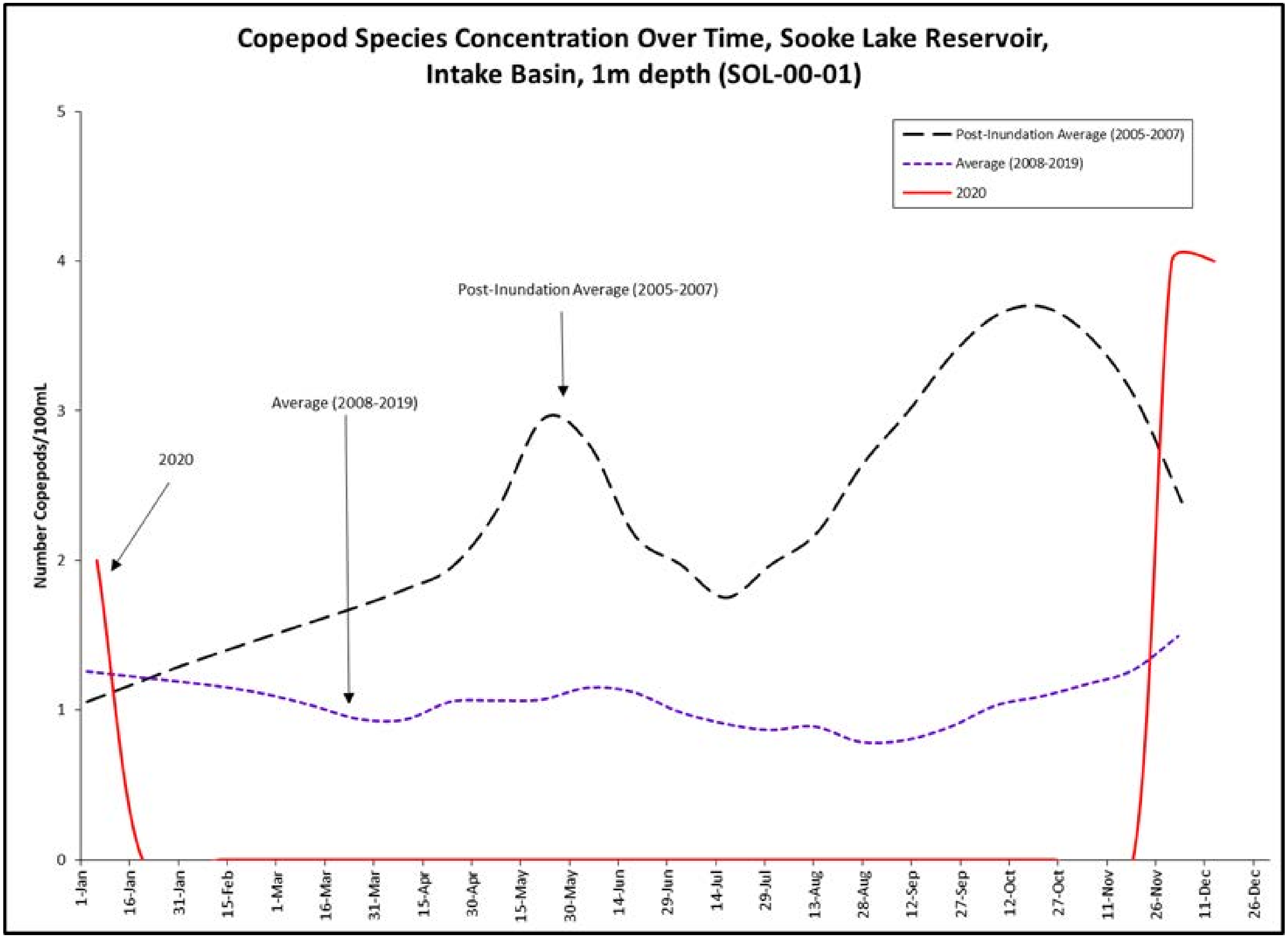

Figure 22 The Total Number of Copepods over Time, Sooke Lake Reservoir, Intake Basin, 1 m depth (SOL-00-01)

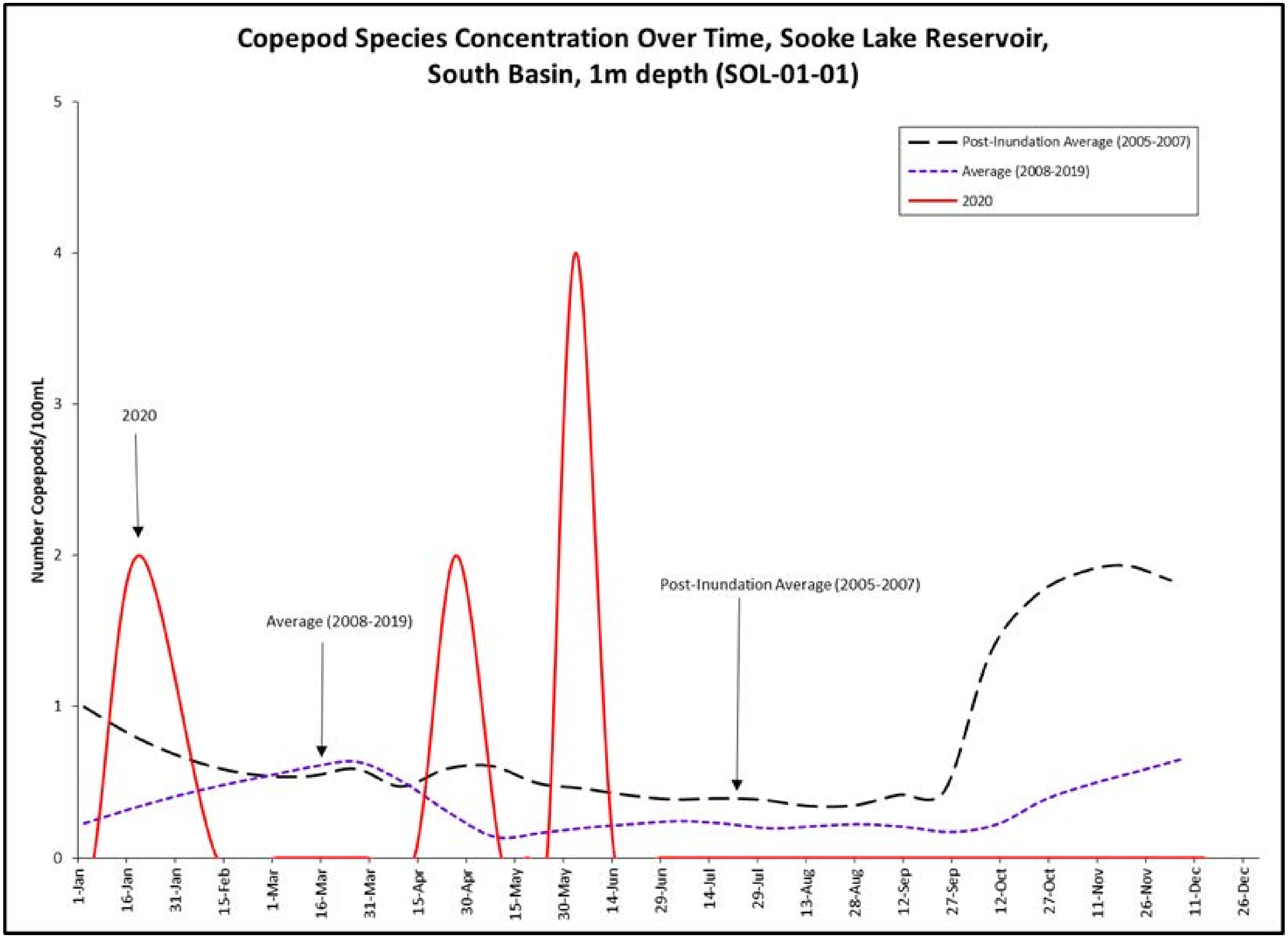

Figure 23 The Total Number of Copepods over Time, Sooke Lake Reservoir, South Basin, 1 m depth (SOL-01-01)

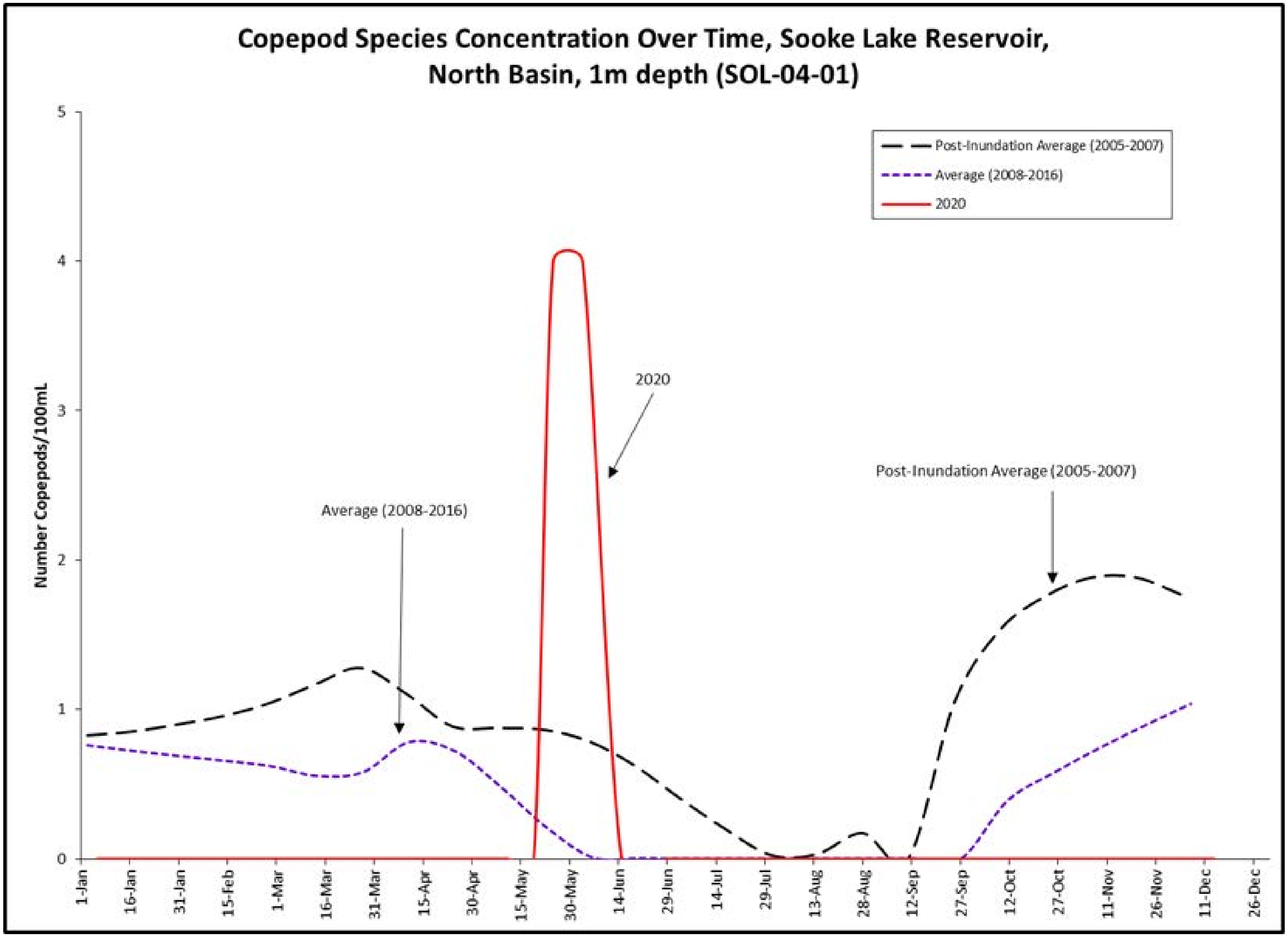

Figure 24 The Total Number of Copepods over Time, Sooke Lake Reservoir, North Basin, 1 m depth (SOL-04-01)

Stratification: The 2019 thermal stratification pattern in Sooke Lake Reservoir was consistent with historical trends, as stratification occurred during spring, summer and early fall months. This phenomenon happens when the water column is divided in three layers from top to bottom, including: *epilimnion* (atop, warm, circulating and fairly turbulent), *metalimnion* (characterized by a steep thermal gradient or rapid temperature change) and *hypolimnion* (bottom, denser and colder water with little temperature change). The stratification reflects the vertical heat distribution in the water column and, therefore, might have a significant association with the dynamics of plankton communities. In 2019, SOL started to stratify in early April. The South Basin remained stratified until early July when the hypolimnion was depleted due to the continuous deep water extraction. Compared to 2019, this hypolimnion depletion in the South Basin occurred about two weeks earlier in 2020, which could be a result of warmer summer temperatures and/or higher summer demand. The deeper parts of the reservoir destratified naturally in late November.

Turbidity. The turbidity is continuously measured at both water treatment plants and at the Sooke Lake intake tower, but also sampled and lab tested daily from the Goldstream Water Treatment Plant and weekly at the Sooke River Road Water Treatment Plant. Figure 25 shows that the source water turbidity was well under 1 NTU throughout 2020; however, on four days during the summer season, with peak demand and high flows due to outdoor water demand, sediments in the mains downstream of the Kapoor Tunnel were dislodged and caused short-period turbidity excursions to above 1 NTU (peak at 3.1 NTU). These events usually occurred on Wednesdays or Thursdays from 4AM to approximately 10AM or 11AM during the peak summer demand times, only at the Goldstream and not at the Sooke River Road Water Treatment Plant. Supervisory Control and Data Acquisition monitoring data shows that the average daily turbidity was still well below 1 NTU on these turbidity event days. Also, the UV transmittance, a measure of how much ultraviolet light can pass through the water, was always around 90% during those events and the UV dose at least 60 mJ/cm^2, ensuring effective UV treatment. The CRD has taken measures to mitigate these turbidity events at the Goldstream Water Treatment Plant (changed watering restrictions in the region, flushed raw water mains upstream of Goldstream plant in April) and these measures were successful in greatly reducing the number of turbidity exceedances, compared to summers before 2018. The CRD will look at further measures to reduce or eliminate these nuisance events. Overall, Sooke Lake water was very clear in 2020, and turbidity of the raw water was at no time a factor of concern to the drinking water quality in the GVDWS.

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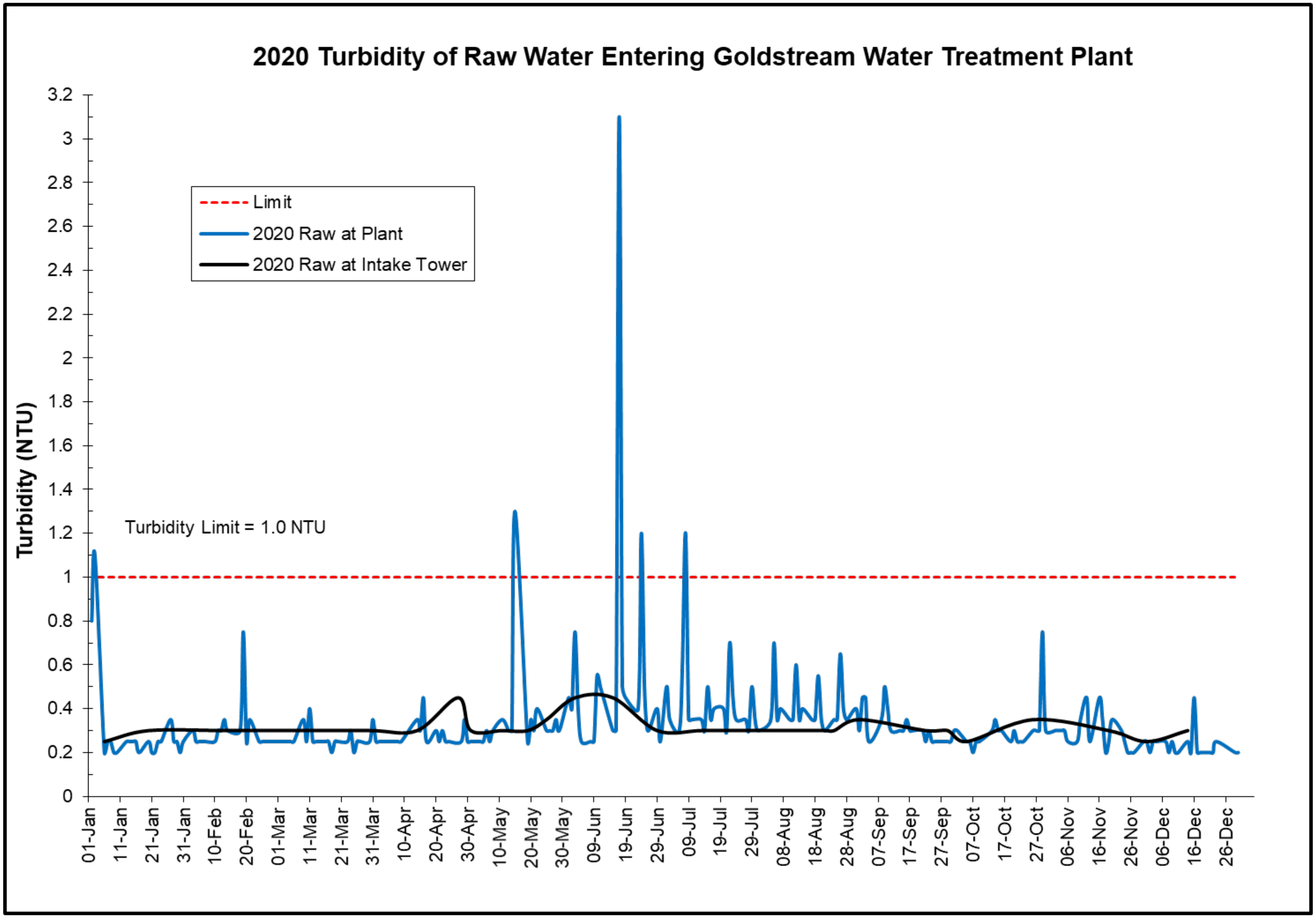

Figure 25 **2020 Turbidity of Raw Water Entering Goldstream Water Treatment Plant**

Raw Water Temperature. Cool water is beneficial in a distribution system because it reduces the potential for losses of chlorine residual and regrowth of bacteria. For that reason, the Canadian guidelines suggest a temperature limit of 15°C.

The temperature of the water entering the Goldstream Water Treatment Plant in 2020 was nearly following the long-term average trend line until the beginning of August. After that, for a period of two months, the temperature started to trend above the long-term average (Figure 26). The raw water entering both treatment plants exceeded the 15°C guideline limit between mid-July and mid-October. This has been the longest exceedance of the 15°C temperature threshold after 2019 already set the record for the last several years. 2020 also set a new temperature peak record since the dam raising in 2004. The weekly average raw water temperature exceeded 20.1°C for the first time in early September. Only 2017 saw the raw water temperature slightly exceed 20°C before. The usage of the lowest intake gates during the summer led to the depletion of the cool water stored in the hypolimnion water column of the reservoir's south basin. The cool water stored in the hypolimnion of the much deeper north basin is currently inaccessible for CRD with the existing infrastructure.

High raw water temperatures are not a new problem for the CRD. Before the expansion of Sooke Lake Reservoir in 2004, the water temperature entering the plant reached 15°C as early as mid-June. Warmer and longer summers, as a result of climate change, will likely exacerbate this problem in the future.

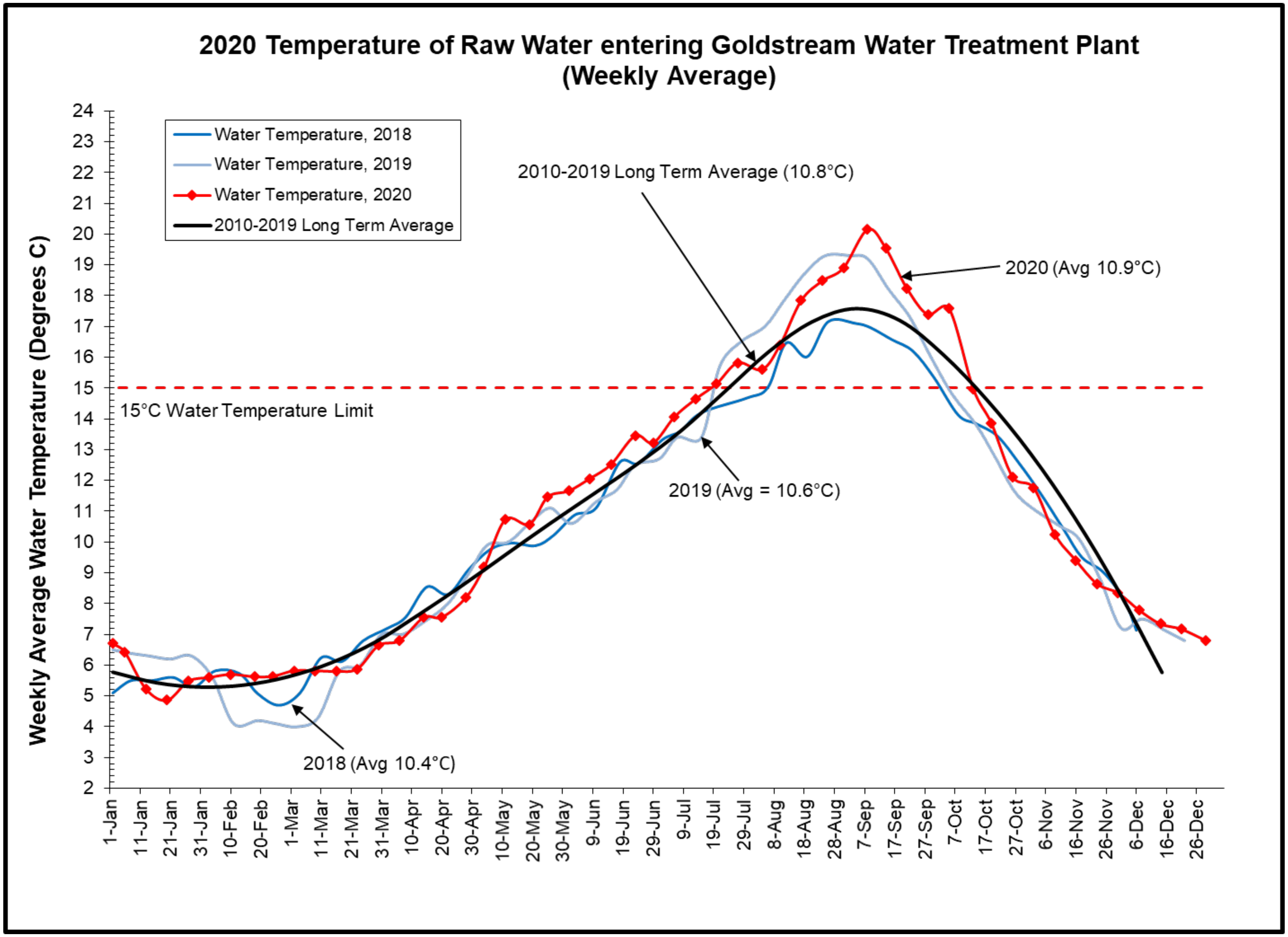

Figure 26 2020 Temperature of Raw Water Entering Goldstream Water Treatment Plant (Weekly Average)

Physical/Chemical Parameters. The raw water entering the Goldstream Water Treatment Plant had the following physical and chemical characteristics:

- Median pH: 7.2
- Median $CaCO_3$ Hardness: 16.70 mg/L
- Median Alkalinity: 14.90 mg/L
- Median Colour: 6.0 TCU
- Median Total Organic Carbon: 1.80 mg/L
- Median Conductivity (25ºC): 42.10 µS/cm

The values of the parameters above are consistent with those of previous years.

Inorganics/Metals. Table 1 in Appendix A lists all the inorganic and metal parameters tested in the source water in 2020. No unusual or concerning levels or trends have been detected.

Organics/Radionuclides. Table 1 in Appendix A lists all the organic radiological parameters tested in the source water in 2020. Most of them were not detected or were in insignificant concentrations. These results confirm the high level of protection from any anthropogenic impacts on the supply watershed.

Nutrients. Figures 27-30 show the total nitrogen and the total phosphorus concentrations in both the south and north basins at 1 m depths in Sooke Lake Reservoir. Total phosphorus concentrations at both stations trended below the long-term average. In the south basin, the total phosphorus concentration dropped at the end of April to levels below the detection limit of 1µg/L, which indicates that biological activity in the lake used up all available phosphorus nutrients in this part of the lake. The lack of phosphorus then severely limited the biological productivity in the lake after July, which resulted in a drastic decrease in algal activity. This crash in algal populations in July may have led to the spike in nitrogen at the end of July in the south basin when decomposing algal matter may have released nitrogen nutrients for further uptake. Spikes in nitrogen are usually attributable to significant rainfall and runoff events during that time; however, this spike was not induced by any rainfall event. Aside from this spike, the total nitrogen fluctuated only slightly above the long-term average trend line.

Additional water quality monitoring in the wake of the August 16-21 wildfires in the Sooke Lake watershed did not find any indication of increased nutrient input to the tributaries or lake.

In general, the nutrient concentrations confirm the ultra-oligotrophic status (extremely unproductive, phosphorus limited) of Sooke Lake Reservoir, which is positive for a drinking water supply source.

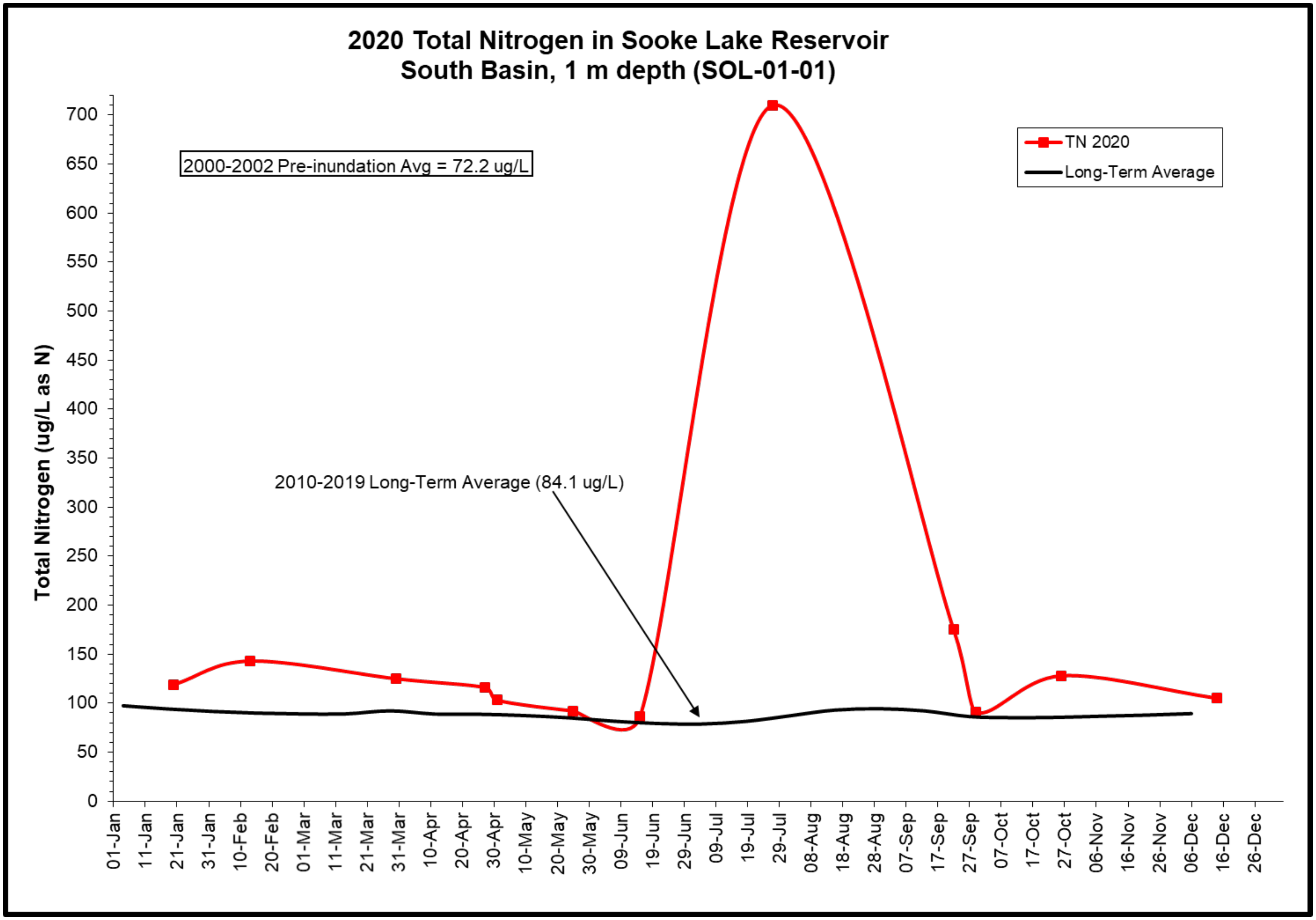

Figure 27 **Total Nitrogen in Sooke Lake Reservoir, South Basin, 1 m depth (SOL-01-01)**

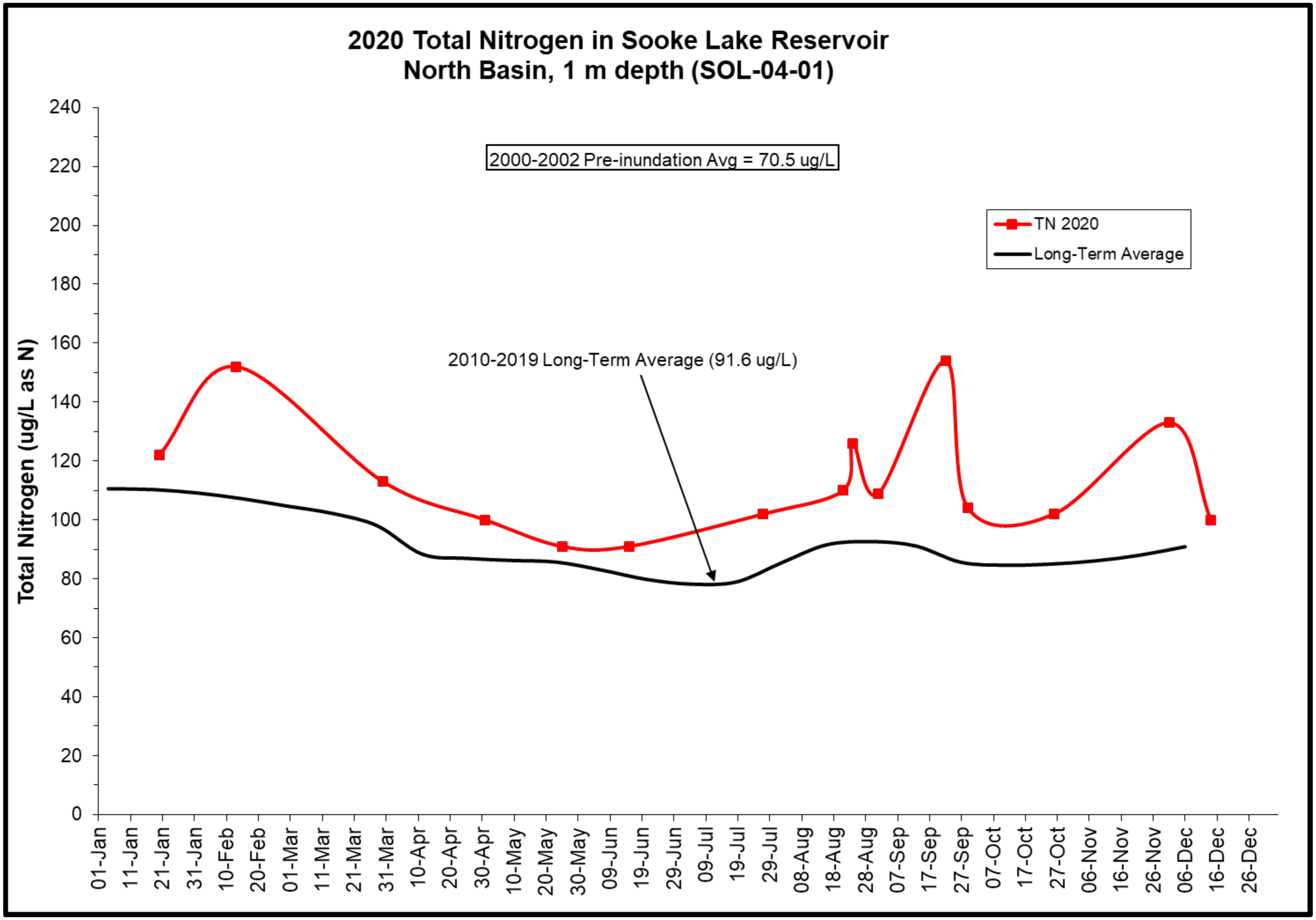

Figure 28 Total Nitrogen in Sooke Lake Reservoir, North Basin, 1 m depth (SOL-04-01)

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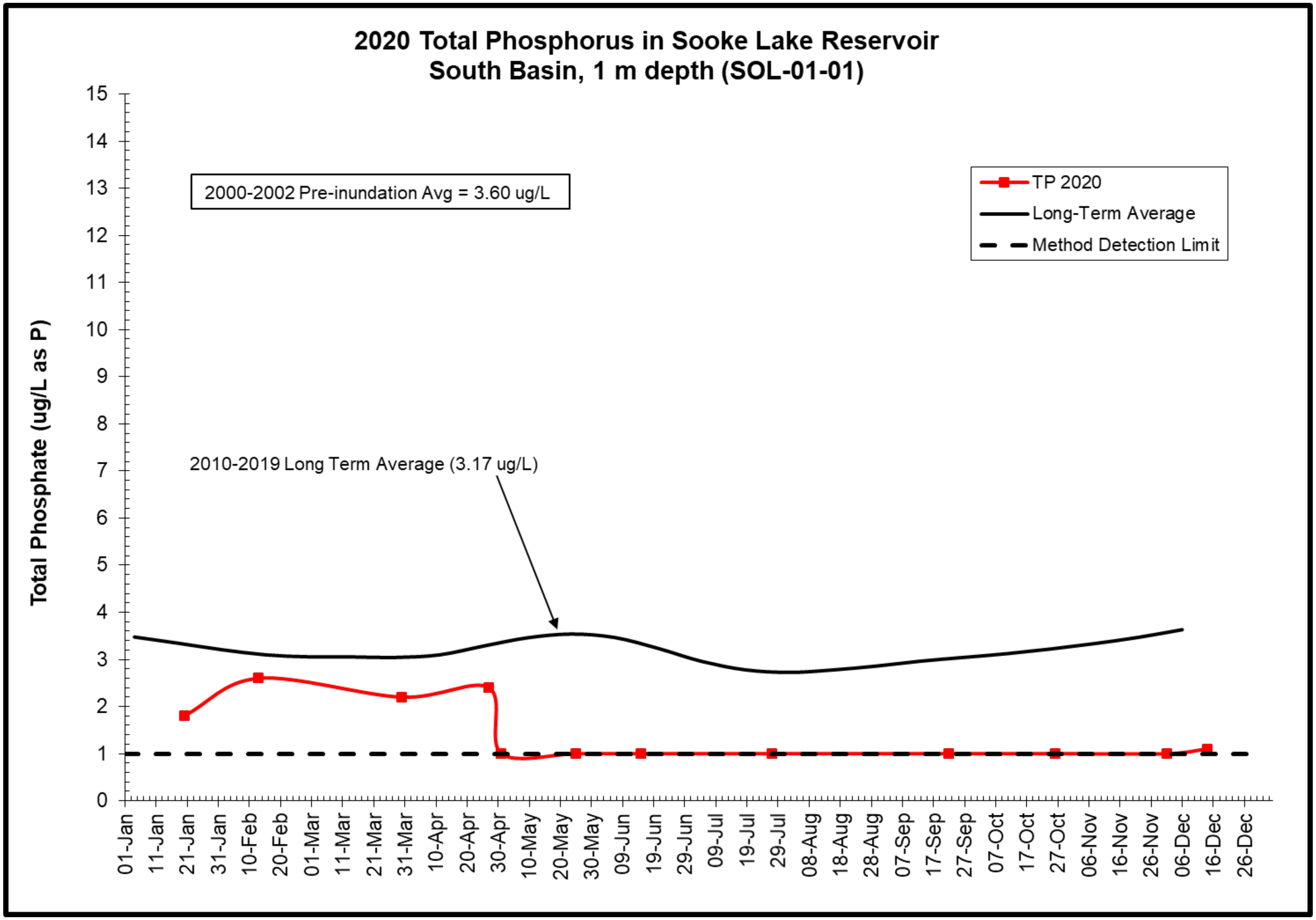

Figure 29 **Total Phosphorus in Sooke Lake Reservoir, South Basin, 1 m depth (SOL-01-01)**

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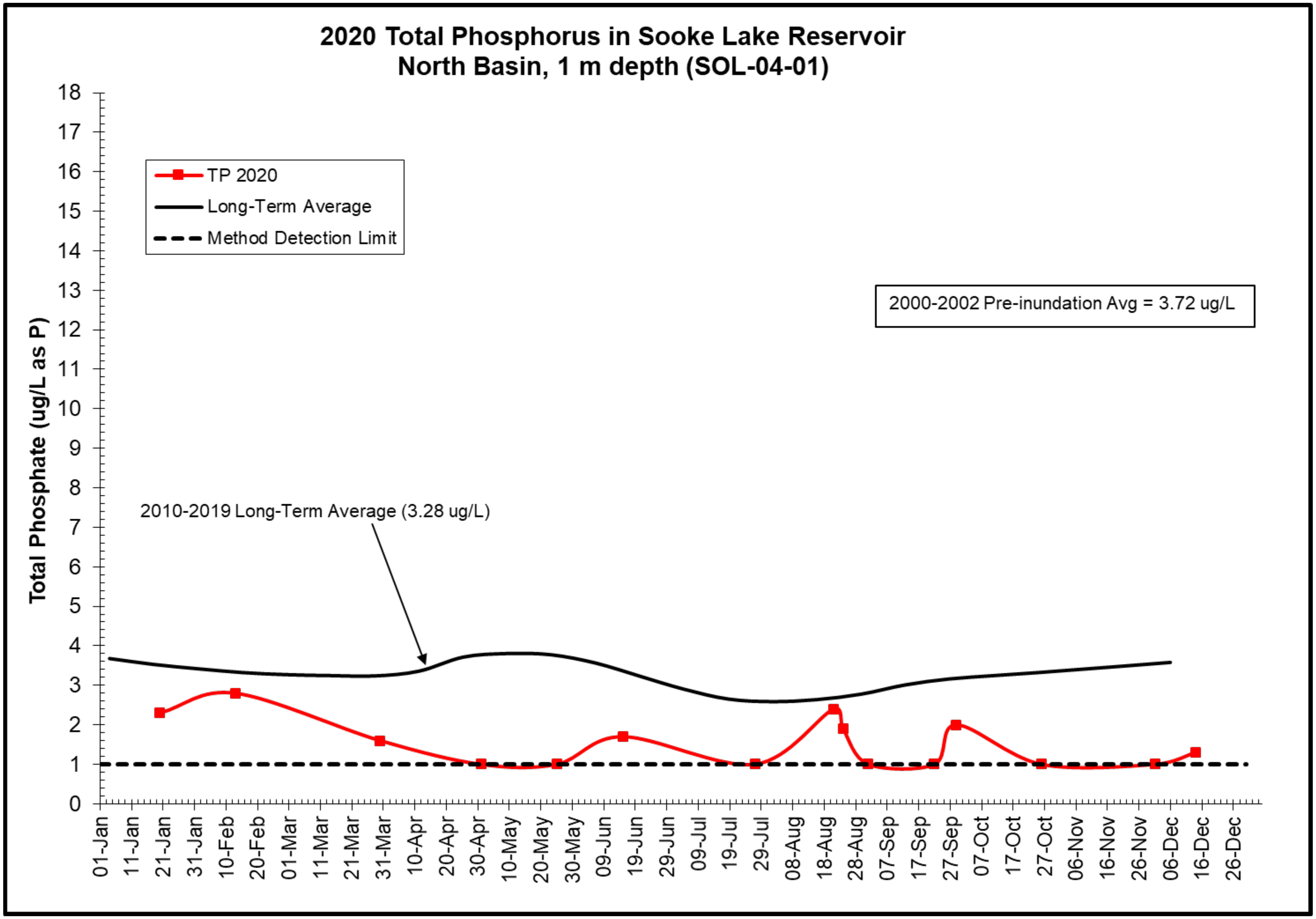

Figure 30 **Total Phosphorus in Sooke Lake Reservoir, North Basin, 1 m depth (SOL-04-01)**

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7.2 Treatment Monitoring Results

The following sections summarize the water quality data collected and analyzed to monitor and verify the effectiveness of the disinfection process at both CRD disinfection facilities in the GVDWS.

7.2.1 Goldstream Water Treatment Plant

Bacteriological Results after UV Treatment. Figure 31 shows the results from 245 samples collected and analyzed just downstream of the UV reactors. The results indicate that the UV treatment is capable of greatly reducing the *E. coli* and total coliform concentrations. On very few occasions, in all of 2020, and only in very low concentrations, have total coliform bacteria been found downstream of the UV treatment. Most of these low concentration hits were during May and June when the raw water total coliform concentrations started to increase.

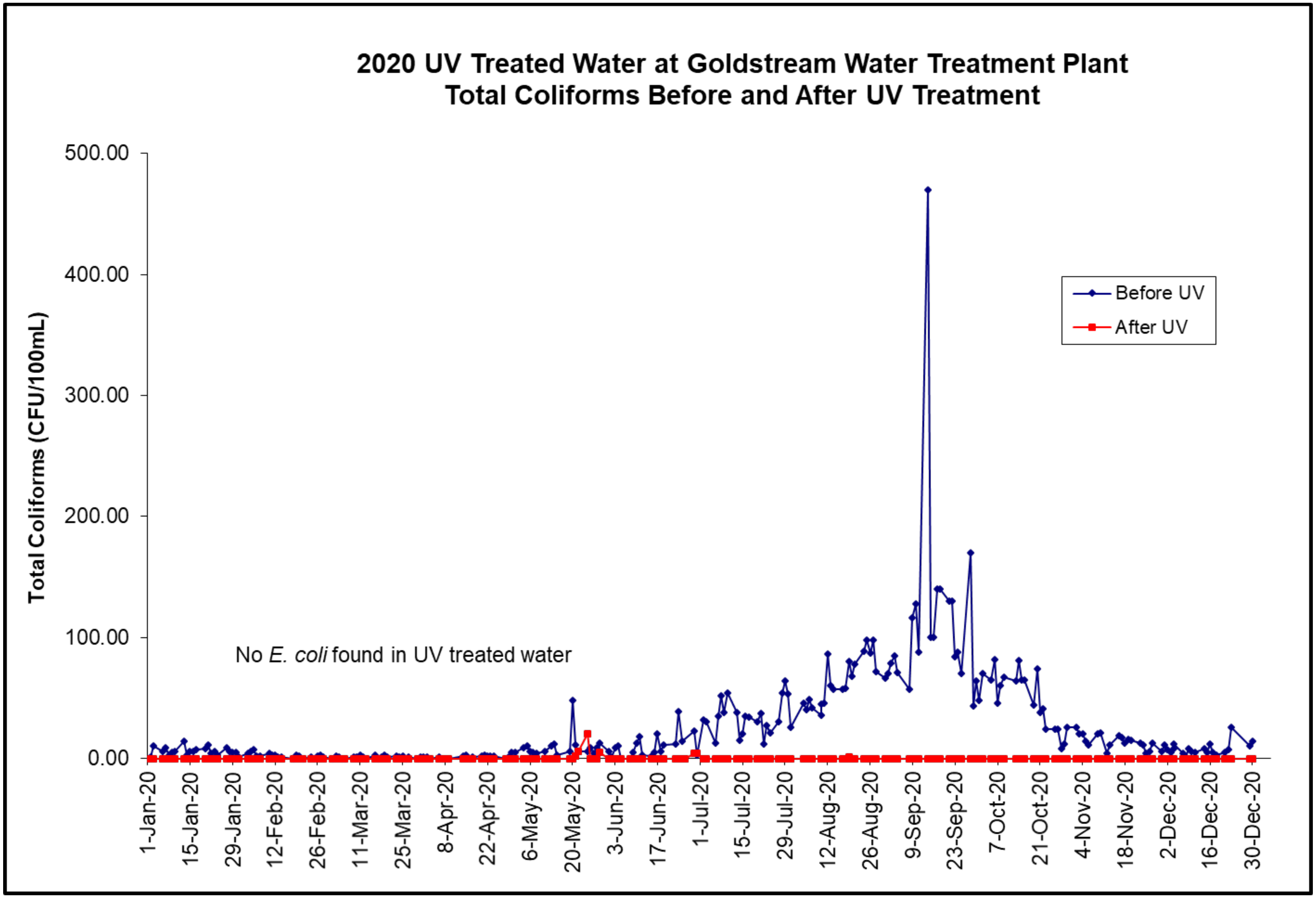

Figure 31 **2020 UV Treated Water at Goldstream Water Treatment Plant Total Coliforms Before and After UV Treatment**

Treated Water at Both First Customer Sampling Locations. The data collected from the two treated water sampling locations near the first customers below the Goldstream Water Treatment Plant (one at Main #4 and one at Main #5) indicated that the bacteriological quality of the disinfected water was good in all months of 2020 (Figure 32 and Appendix A, Table 2). In total, 246 samples were collected from the Main #4 first customer location and 211 samples from the Main #5 first customer location for a combined total of 457 samples.

There were a few total coliform-positive samples from each sampling station throughout the year. All eight positive samples registered at the Main #5 first customer sampling station. All but one were only very low total coliform concentrations. On May 21, 2020, a total coliform concentration of 32 CFU/100 mL was recorded. Because the parallel Main #4 first customer sampling station did not record any total coliform concentrations, a treatment breakthrough could be ruled out. The resample from May 22, 2020 was free of any total coliform bacteria. For all eight positive results, only one subsequent resample was positive for total coliform bacteria. The resample, following a positive total coliform hit of 3 CFU/100 mL on November 13, 2020, recorded 2 CFU/100mL. Follow-up investigations into this case found that debris had lodged in the sampling line near the sampling tap. The debris was removed, the sampling line thoroughly flushed and all subsequent results from this station (Main #5 first customer location) were negative for total coliform bacteria.

The few total coliform-positive results remained well under 10% of the monthly totals at both first customer locations. One of the positive results, the sample from May 21, 2020, was in exceedance of the 10 CFU/100 mL total coliform limit, as per *Drinking Water Protection Regulation*. But, the investigations and a negative resample ruled out a breach in the system and any real contamination of the treated water. While the regulations require 90% of all monthly samples in the entire system to be free of total coliform bacteria, the CRD monitors the first customer locations based on even more stringent criteria, where water quality is gauged on the bacteriological results of these two first customer locations only.

The total chlorine residual ranged from 1.23-2.1 mg/L (Appendix A, Table 2) with a median value of 1.79 mg/L (Figure 25).

The treated water leaving the Goldstream Water Treatment Plant had the following physical and chemical characteristics:

- Median pH: 7.1
- Median Alkalinity: 13.10 mg/L
- Median Colour: 4.0 TCU
- Median Total Organic Carbon: 1.65 mg/L
- Median Conductivity (25ºC): 45.15 µS/cm
- Median turbidity: 0.3 NTU

The values of the parameters above are consistent with those of previous years.

The median pH of 7.10 is consistent with historical data, with the gas chlorine plant in operation. This median pH is, however, lower compared to 2018 and 2019 when the new hypochlorite (liquid chlorine) plant operated.

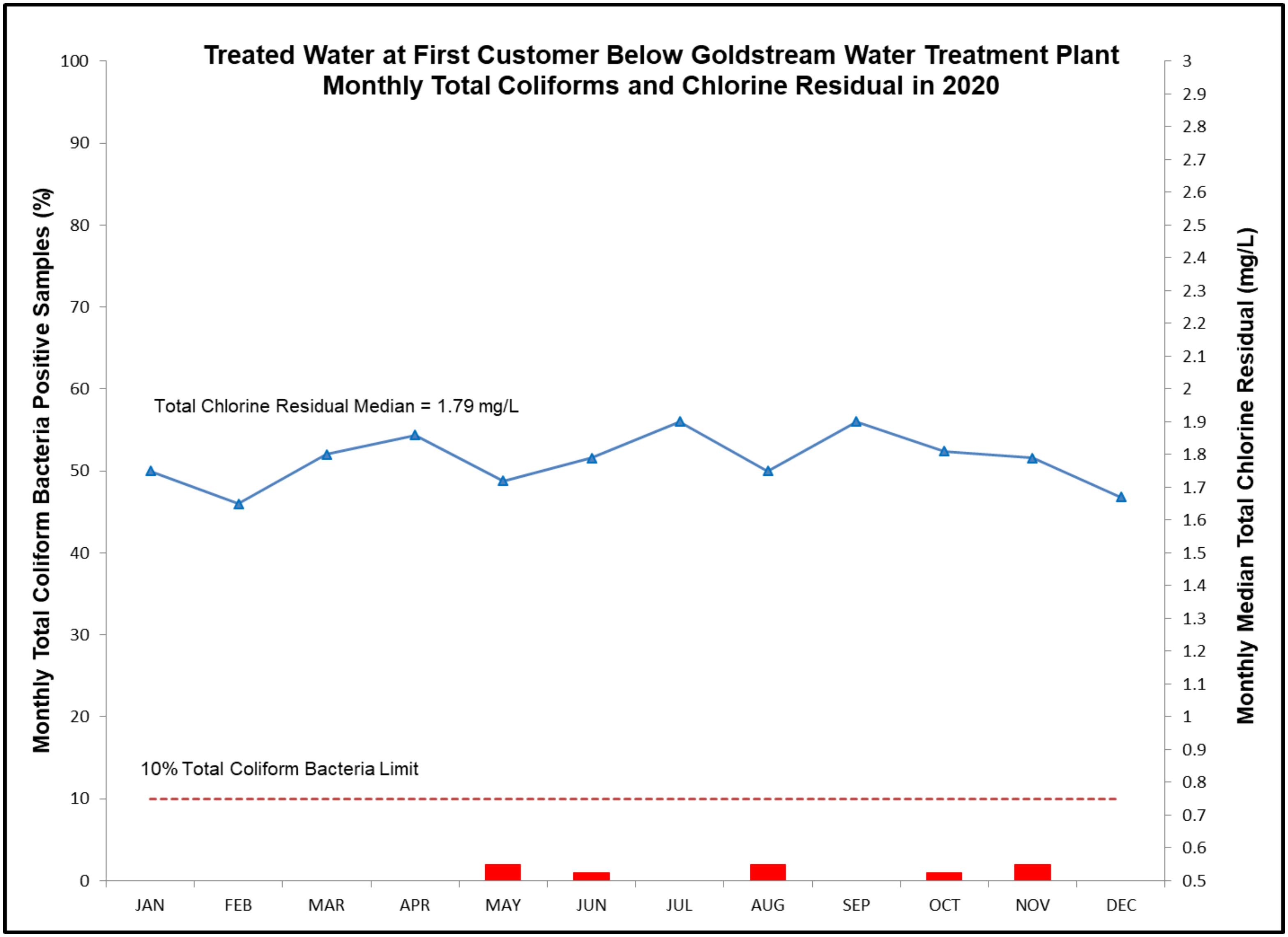

Figure 32 Treated Water at First Customer Location below Goldstream Water Treatment Plant; Monthly Total Coliforms and Chlorine Residual in 2020

7.2.2 Sooke River Road Water Treatment Plant

Bacteriological Results after UV Treatment. Figure 33 shows the results from 40 samples collected and analyzed just downstream of the UV reactors. The results indicate that the UV treatment is capable of greatly reducing the *E. coli* and total coliform concentrations. No total coliform bacteria were detected downstream of the UV treatment. This is evidence of a very effective UV disinfection stage at this plant.

Turbidity. The Sooke River Road Water Treatment Plant experienced four adverse turbidity events in 2020.

January 18-20, 2020: A major water main break caused very high flows in Main #15 supplying the plant. These extreme flows mobilized sediments in the raw water main and caused several turbidity excursions at the plant. Some of the excursions were very short and some lasted for several hours. At its peak, the turbidity reached 3.3 NTU, but in general the turbidity remained well under 3 NTU and usually just over 1 NTU with periods below 1 NTU for the course of two days. In response, the CRD increased UV dosage and chlorine dosage to compensate for any disinfection reduction, due to increased turbidity. Island Health was notified throughout this event.

March 12, 2020: A sudden turbidity spike at the plant that lasted about 70 minutes. The peak turbidity was not captured at the turbidity analyzer, as the instrument clogged up during this event. It is suspected that the turbidity was briefly much higher than 4 NTU. The cause of this event is unknown. It is assumed that large pieces of debris moved down Main #5 and caused this excursion. Island Health was notified of this event.

September 16, 2020: A sudden turbidity spike at the plant that lasted only about 7 minutes. The peak turbidity reached 7.5 NTU. The cause of this event is unknown. It is assumed that large pieces of debris moved down Main #5 and caused this excursion. In response to this event, secondary turbidity analyzers were installed at the Sooke River Road Water Treatment Plant and at the Goldstream Water Treatment Plant.

November 8, 2020: A sudden turbidity spike at the plant that lasted only about 75 minutes. The peak turbidity reached 6.2 NTU and the turbidity remained >3 NTU for a duration of 15 minutes. The cause of this event was determined to be high flows through the raw water Main #10 between the Sooke Lake intake and the Head Tank. Due to the decommissioned intake screen and the use of the old intake, only Main #10 conveyed the raw water to the Head Tank and Main #15 to Sooke. The parallel pipe to Main #10, Main #11, was out of service and this hydraulic bottle neck resulted in unusually high flow velocities in Main #15. This stirred up pipe sediments that travelled through Main #15 to the Sooke River Road Water Treatment Plant. The Goldstream Water Treatment Plant did not suffer the same turbidity excursion, because the stirred up sediments settled in the Head Tank and the Kapoor Tunnel before they could reach the Goldstream plant. CRD has since implemented procedures to limit the use of only one raw water main between intake and Head Tank and to thoroughly flush and clean these mains before any single use. Island Health was notified of this event.

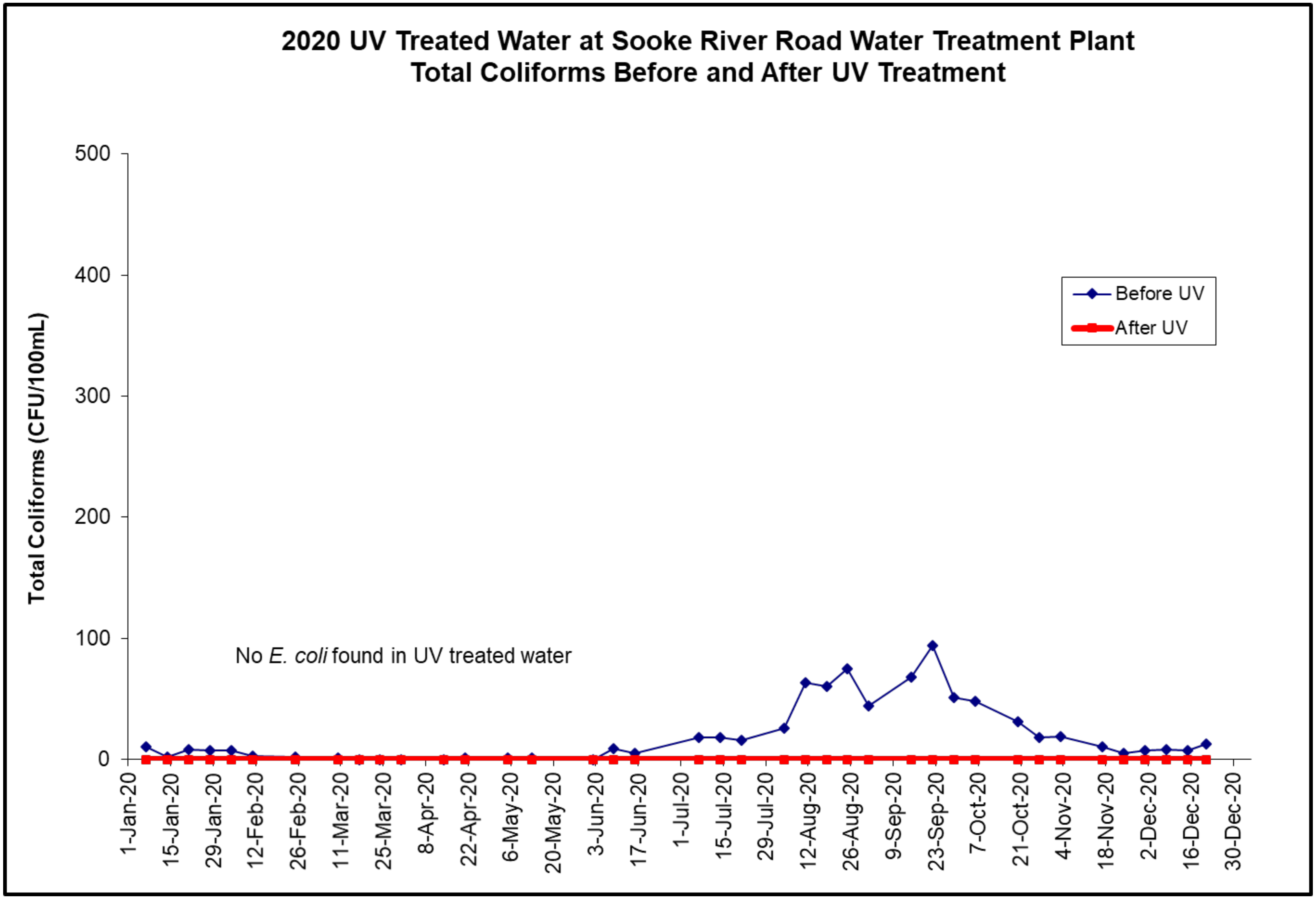

Figure 33 2020 UV Treated Water at Sooke River Road Water Treatment Plant Total Coliforms Before and After UV Treatment

Treated Water at First Customer. The data collected from the treated water sampling location near the first customer below the Sooke River Road Water Treatment Plant indicated that the bacteriological quality of the disinfected water was good in all months of 2020 (Figure 34). No total coliform bacteria were detected in all 40 samples from this sampling station in 2020.

The total chlorine residual ranged from 1.55-2.10 mg/L with a median value of 1.79 mg/L.

The treated water leaving the Sooke River Road Water Treatment Plant had the following physical and chemical characteristics:

- Median pH: 7.65
- Median Alkalinity: 16.50 mg/L
- Median Colour: 4.0 TCU
- Median Conductivity (25ºC): 57.00 µS/cm
- Median turbidity: 0.3 NTU

The values of the parameters above are consistent with those of previous years.

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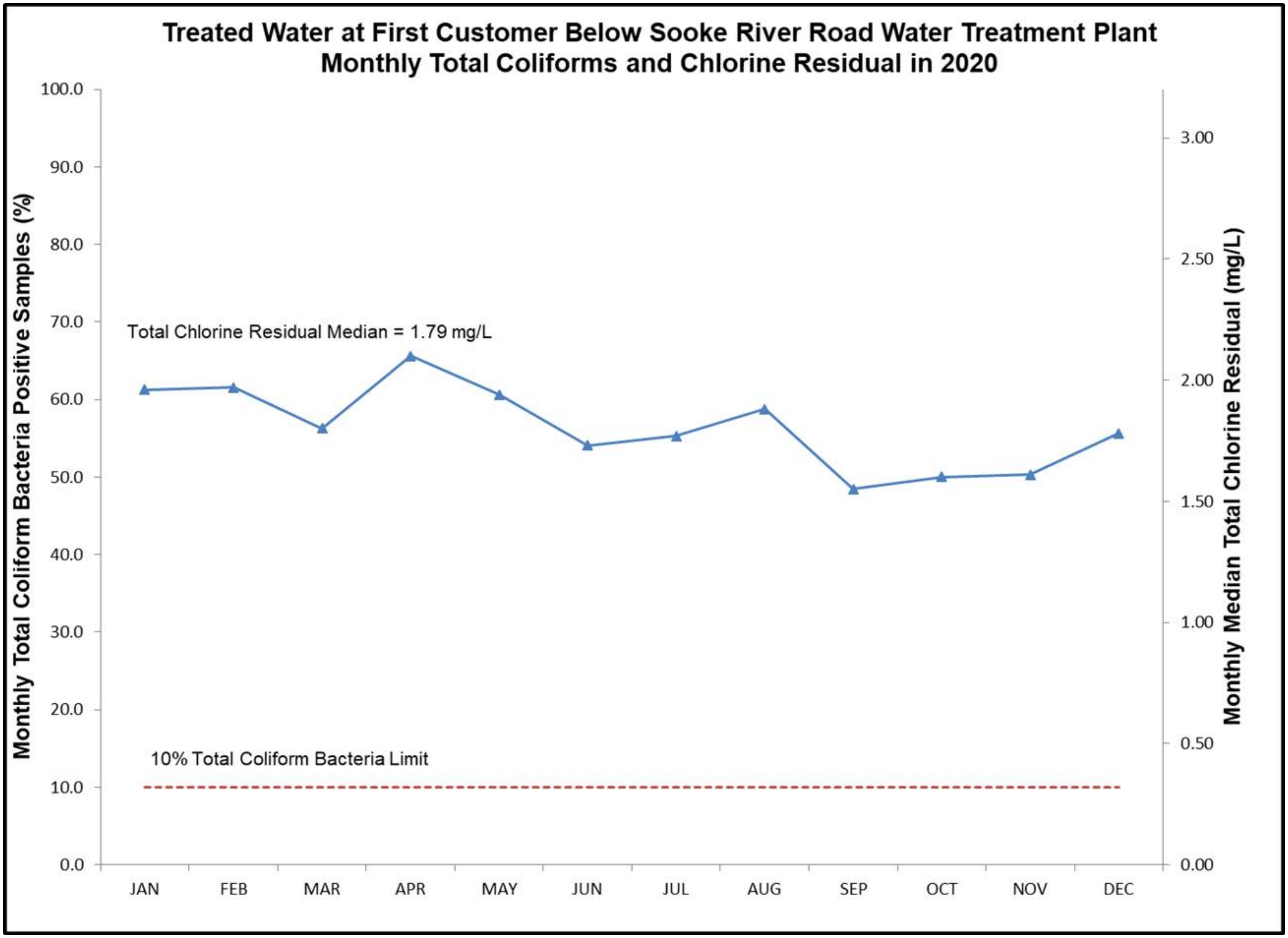

Figure 34 **Treated Water at First Customer below Sooke Rover Road Water Treatment Plant, Monthly Total Coliforms and Chlorine Residual in 2020**

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7.3 CRD Transmission System Results

The following sections summarize the water quality data collected and analyzed for monitoring and verifying the safety of the drinking water conveyed through the transmission system before it reaches the municipal distribution systems. Bacteriological results of the samples collected in the transmission system are considered for compliance purposes. There is no applicable requirement for monthly sample numbers for a transmission system. The number of samples collected monthly from the CRD Transmission System infrastructure was based on a water quality risk assessment, and based on professional judgement.

7.3.1 Transmission Mains

The CRD transmission mains were sampled in 20 different sampling locations. The sampling locations for CRD transmission mains also include the Main #4 and Main #5 first customer sampling stations. In 2020, a total of 913 bacteriological and 453 water chemistry samples were collected and analyzed.

Bacteriological Results. Figure 35 and Table 2 show the results from 913 CRD transmission main samples collected and analyzed in 2020. The results (no *E. coli* and few total coliform bacteria detected) indicate that the water delivered through the transmission mains was bacteriologically safe. This system complied with the 10% total coliform-positive limit for all months, except for August, when eight samples in total tested positive for total coliform bacteria (=10.1%). Three samples in May, July and August exceeded the 10 CFU/100 mL total coliform concentration threshold. Resamples for all three events were negative for total coliform bacteria. The only positive resample occurred in November at the Main #5 first customer sampling station (for details see Section 7.2.1).

Chlorine Residual. Table 2 and Figure 35 demonstrate that the annual median total chlorine concentration in the transmission mains was 1.67 mg/L and, therefore, provides for adequate secondary disinfection within the transmission system and within most areas of the downstream municipal distribution systems.

Water Temperature. The annual median water temperature in the transmission mains was 10.7°C, with monthly medians ranging between 5.9°C (February) and 19.2°C (September) (Table 2). Both the lowest and the highest monthly mean temperature was approximately 1°C warmer than in 2019, indicating both a warmer winter and summer in 2020.

Table 2 2020 Bacteriological Quality of the CRD Transmission Mains

Month	Samples Collected	Total Coliforms (CFU/100mL)				*E.coli* CFU/100mL)	Turbidity		Chlorine Residual	Water Temp.
		Samples TC > 0	Percent TC>0	Resamples TC > 0	Samples TC > 10	Samples >0	Samples Collected	Samples >1 NTU	Median mg/L as	Median ° C
JAN	82	0	0.0	0	0	0	21	0	1.67	6.3
FEB	68	0	0.0	0	0	0	19	0	1.73	5.9
MAR	83	0	0.0	0	0	0	21	0	1.70	6.3
APR	77	0	0.0	0	0	0	19	1	1.68	8.0
MAY	74	2	2.7	0	1	0	19	0	1.68	11.1
JUN	78	2	2.6	0	0	0	25	4	1.67	12.8
JUL	74	3	4.1	0	1	0	20	0	1.70	15.3
AUG	79	8	10.1	0	1	0	18	0	1.66	18.3
SEP	84	0	0.0	0	0	0	21	0	1.64	19.2
OCT	68	2	2.9	0	0	0	17	0	1.67	14.6
NOV	75	4	5.3	1	0	0	16	0	1.69	10.0
DEC	71	0	0.0	0	0	0	18	0	1.66	7.9
Total:	913	21	2.3	1	3	0	234	5	1.67	10.7

Notes:
TC = Total Coliforms, *E. coli* = *Escherichia coli,* Cl_2 = chlorine, NTU = Nephelometric turbidity unit.
> = Greater than, mg/L = milligrams per litre, °C = degrees Celsius

Disinfection Byproducts. The CRD collected six sets of samples for a disinfection byproduct analysis from a transmission main at Mills Road. The annual average total trihalomethane (TTHM) and annual average total haloacetic acid (HAA) concentrations were 18.3 and 19.5 µg/L, respectively, well below the MAC (TTHM = 100 and HAA = 80 µg/L) stipulated in the Canadian guidelines. This location was also sampled and tested for the disinfection byproduct Nitrosodimethylamine (NDMA), a newly-listed parameter that is classified as “probably carcinogenic” by Health Canada and associated with disinfection using chloramines. The Canadian guidelines MAC for NDMA is 40 ng/L. All NDMA results at this location were below the detection limit of 2.1 ng/L.

This was the only transmission main where disinfection byproduct samples were collected (bi-monthly). The CRD disinfection byproduct monitoring focuses on locations with higher potential for disinfection byproduct formation, such as system extremities with high water age or areas downstream of re-chlorination stations (free chlorine).

Metals. The CRD Water Quality Monitoring Program for the CRD Transmission System included regular metals tests in three strategic locations, where the water transitions from the CRD Transmission System to a downstream distribution system. In particular, the CRD pays attention to metals commonly found in drinking water, such as iron, manganese, copper and lead. All metal results were below the Canadian guideline limits. In one location (Lansdowne and Foul Bay roads), where water flows from Main #3 into the Oak Bay Distribution System, elevated lead concentrations have been found in each of the samples analyzed in 2020. In all samples, the concentrations were below the MAC, as per Canadian guidelines (5 µg/L), but an order of magnitude higher than in other samples across the GVDWS (1.95-4.28 µg/L). Investigations have concluded that the sampling line itself was the cause for the elevated lead concentrations at this site. In December 2020, CRD staff replaced the old sampling line and lead concentrations have since been reduced to normal background levels, well below the Canadian guideline limit.

In 2019, CRD, in concert with Saanich, Victoria/Esquimalt and Oak Bay, started the Greater Victoria pH & Corrosion Study to investigate water properties that may contribute to metal corrosion, and in particular, to lead leaching into the drinking water. The study examines the water inside the public and also the private drinking water piping systems. As part of this study, samples from a multitude of sampling locations were analyzed for lead and copper. The project was not completed by the end of 2020, due to Covid-19 impacts and the switch back to the old gas chlorination plant, which changed critical water chemistry parameters. The private side tap sampling project phase and the overall study completion were delayed into 2021. Preliminary study results were shared with stakeholders in November 2019. These results showed lead concentrations inside the sampled public systems that range from ‘below detection limit’ to low compared to the Canadian guideline MAC for lead in drinking water (5 µg/L). Elevated lead concentrations that were found in only a few locations in the CRD Transmission System (for instance at Lansdowne/Foul Bay and the Cook/Mallek sampling stations) were investigated in 2019 and 2020 and found to originate from old copper sampling lines. Upon replacement of these few old copper sampling lines, lead concentrations at these locations receded to background levels. Overall, the preliminary study results indicate that metal corrosion and lead leaching in the public piping systems is not an issue. The pending tap sampling project phase will determine the risk on the private side of the system.

Physical/Chemical Parameters. The drinking water in the regional transmission mains had the following physical and chemical characteristics:

- Median pH: 7.1
- Median $CaCO_3$ Hardness: 16.4 mg/L
- Median Alkalinity: 13.15 mg/L
- Median Colour: 4.00 TCU
- Median Turbidity: 0.30 NTU
- Median Conductivity (25ºC): 45.00 µS/cm

Compliance Status. The transmission mains of the CRD Transmission System were in compliance with the *BC Drinking Water Protection Act* and *Drinking Water Protection Regulation* for most months, except for May, July and August with samples that exceeded the 10 CFU/100 mL total coliform concentration, and in August with more than 10% of the samples testing positive for total coliform bacteria. Also, November had two consecutive total coliform-positive results at one sampling station, due to contamination of the sampling tap.

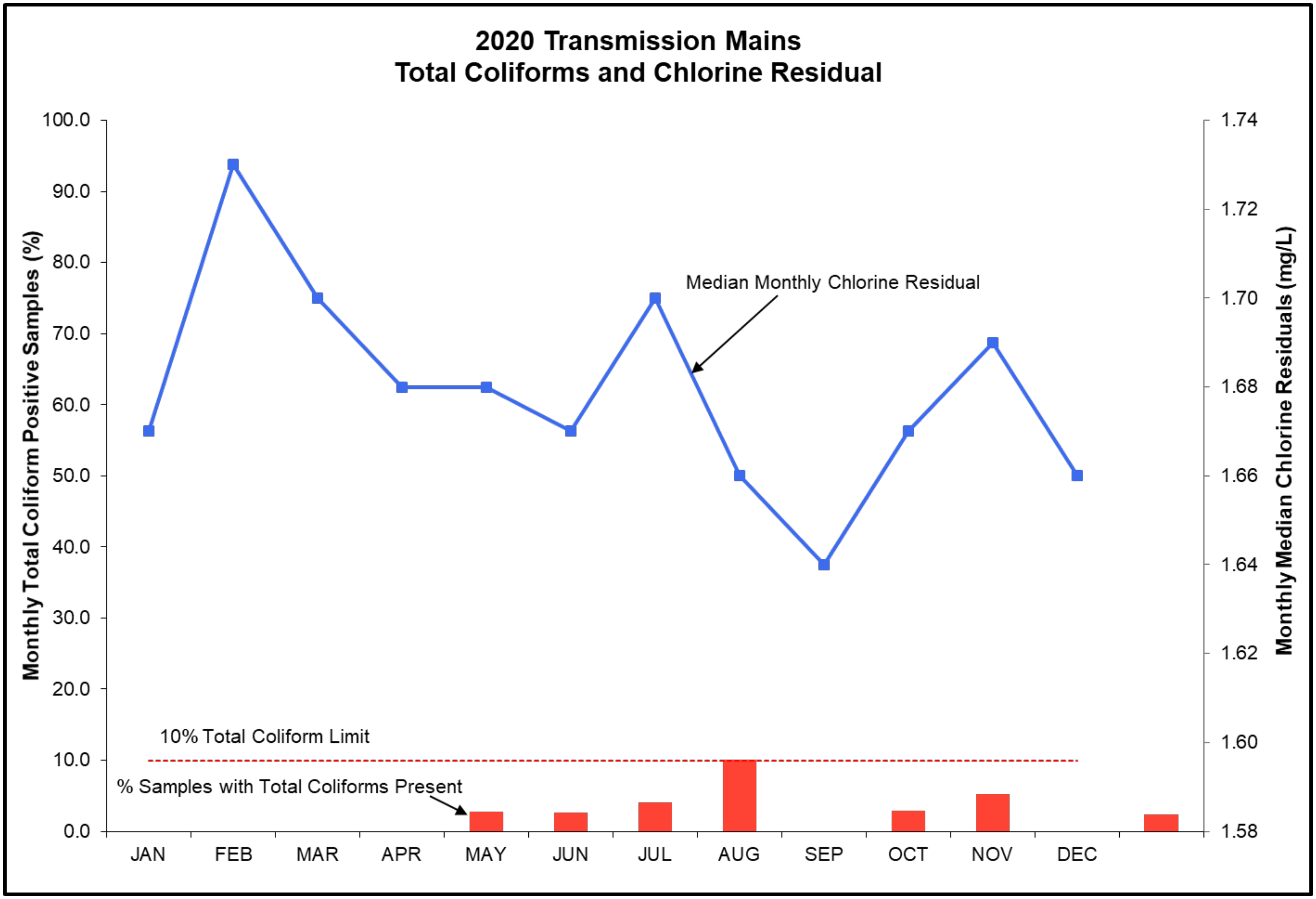

Figure 35 Transmission Mains Total Coliforms and Chlorine Residual in 2020

7.3.2 Supply Storage Reservoirs

The CRD supply storage reservoirs were sampled in 10 different sampling locations. In 2020, a total of 183 bacteriological and 61 water chemistry samples were collected and analyzed.

Bacteriological Results. Figure 36 and Table 3 show the 2020 results from the samples on CRD supply storage reservoirs that are considered part of the CRD Transmission System. The results indicate that the water in these storage reservoirs was bacteriologically safe. There were no total coliform-positive samples in 2020 (Table 3). Typically, storage reservoirs are vulnerable to bacteria regrowth and potential contamination, due to the long retention times and generally lower chlorine residual concentrations. Because of the higher risks to water quality in reservoirs compared to pipes, the CRD typically monitors the water quality closely in all of its storage reservoirs and follows a rigorous maintenance schedule at these facilities.

There were no *E coli*-positive samples in 2020.

Chlorine Residual. Table 3 and Figure 36 indicate that the median total chlorine concentration in the storage reservoirs ranged from 1.26-1.52 mg/L, with an annual median total chlorine concentration of 1.41 mg/L.

Water Temperature. The annual median water temperature in the storage reservoirs was 10.7°C, with monthly medians ranging between 7.0°C (February/March) and 18.8°C (September) (Table 3).

Table 3 2020 Bacteriological Quality of Storage Reservoirs

Month	Samples Collected	Total Coliforms (CFU/100mL)				*E.coli* CFU/100mL)	Turbidity		Chlorine Residual	Water Temp.
		Samples TC > 0	Percent TC>0	Resamples TC > 0	Samples TC > 10	Samples >0	Samples Collected	Samples >1 NTU	Median mg/L as CL2	Median ° C
JAN	19	0	0.0	0	0	0	1	0	1.47	7.5
FEB	14	0	0.0	0	0	0	1	0	1.52	7.0
MAR	14	0	0.0	0	0	0	1	0	1.46	7.0
APR	18	0	0.0	0	0	0	1	0	1.49	8.4
MAY	16	0	0.0	0	0	0	1	0	1.43	11.5
JUN	12	0	0.0	0	0	0	1	0	1.36	13.0
JUL	14	0	0.0	0	0	0	1	0	1.46	15.0
AUG	15	0	0.0	0	0	0	1	0	1.39	18.3
SEP	15	0	0.0	0	0	0	2	0	1.34	18.8
OCT	18	0	0.0	0	0	0	1	0	1.26	15.7
NOV	14	0	0.0	0	0	0	1	0	1.38	10.5
DEC	14	0	0.0	0	0	0	1	0	1.42	8.6
Total:	183	0	0.0	0	0	0	13	0	1.41	10.7

Notes:
TC = Total Coliforms, *E. coli* = *Escherichia coli;* Cl_2 = chlorine, NTU = Nephelometric turbidity unit.
> = Greater than, mg/L = milligrams per litre, °C = degrees Celsius

Disinfection Byproducts. The CRD collected a total of 36 samples for a disinfection byproduct analysis. The samples were collected at two storage reservoirs in the CRD Transmission System (Cloake Hill and Upper Dean Park reservoirs). At both locations, the CRD maintains a re-chlorination station that can boost free chlorine concentrations, if the residuals fall below 0.2 mg/L. While this procedure is rarely exercised, any free chlorine concentration can lead to an increase in disinfection byproduct formation. The annual average TTHM and HAA concentrations were 17.7 and 20.2 µg/L at Cloake Hill and 16.3 and 13.6 µg/L at Upper Dean, respectively, well below the MAC (TTHM = 100 and HAA = 80 µg/L) stipulated in the Canadian guidelines. In six samples each, the NDMA concentrations at both locations were below the detection limit (2.1 ng/L) and were, therefore, well below the Canadian guideline MAC of 40 ng/L.

Physical/Chemical Parameters. The drinking water in the regional supply storage reservoirs had the following physical and chemical characteristics in 2020:

- Median pH: 7.20
- Median Alkalinity: 13.8 mg/L
- Median Colour: 3.5 TCU
- Median Turbidity: 0.25 NTU
- Median Conductivity (25ºC): 46.4 µS/cm

Metals. No data for 2020.

Nitrification. Nitrification occurs in many chloraminated water systems. It is a complex bacteriological process in which ammonia is oxidized initially to nitrite and then to nitrate and is caused by two groups of bacteria that have low growth rates relative to other bacteria. Water temperature seems to be a critical factor for nitrification in distribution systems, as it has been almost exclusively associated with warm water temperatures. Nitrification is also associated with high water age (reservoirs, dead ends, low-flow pipes) and with sediment biofilms.

Monitoring for nitrifying bacteria directly is inefficient; however, the extent of nitrification in the distribution system can be monitored by measuring chlorine residuals and nitrite (also nitrate, free ammonia). When the chlorine residuals drop (in the absence of any pipe break or plant disinfection failure), accompanied by increases of nitrite, then nitrification is occurring. Since Greater Victoria's source water has no background nitrite, the presence of nitrite in the distribution system is the best indicator of nitrification.

The control of nitrification in a chloraminated distribution system involves limiting the excess free ammonia leaving the disinfection plant, maintaining an adequate chlorine residual throughout the distribution system, minimizing water age in storage facilities and in the low-flow areas of the distribution system, and maintaining annual flushing routines to limit the accumulation of sediment and biofilm in the distribution system piping. CRD Water Quality Operations staff, in conjunction with Integrated Water Services Department Operations and Engineering staff, are undertaking projects to optimize the reservoir and pipe-cleaning schedules to address nitrification and other water quality affecting processes throughout the distribution systems. The recommissioning of the new hypochlorite plant at the Goldstream Water Treatment Plant in 2021, temporarily out of service in 2020, will improve the chemical dosing system and further reduce the potential for free ammonia in the treated water.

Compliance Status. The CRD-owned and operated supply storage reservoirs in the CRD Transmission System were in full compliance with the *BC Drinking Water Protection Act* and *Drinking Water Protection Regulation*.

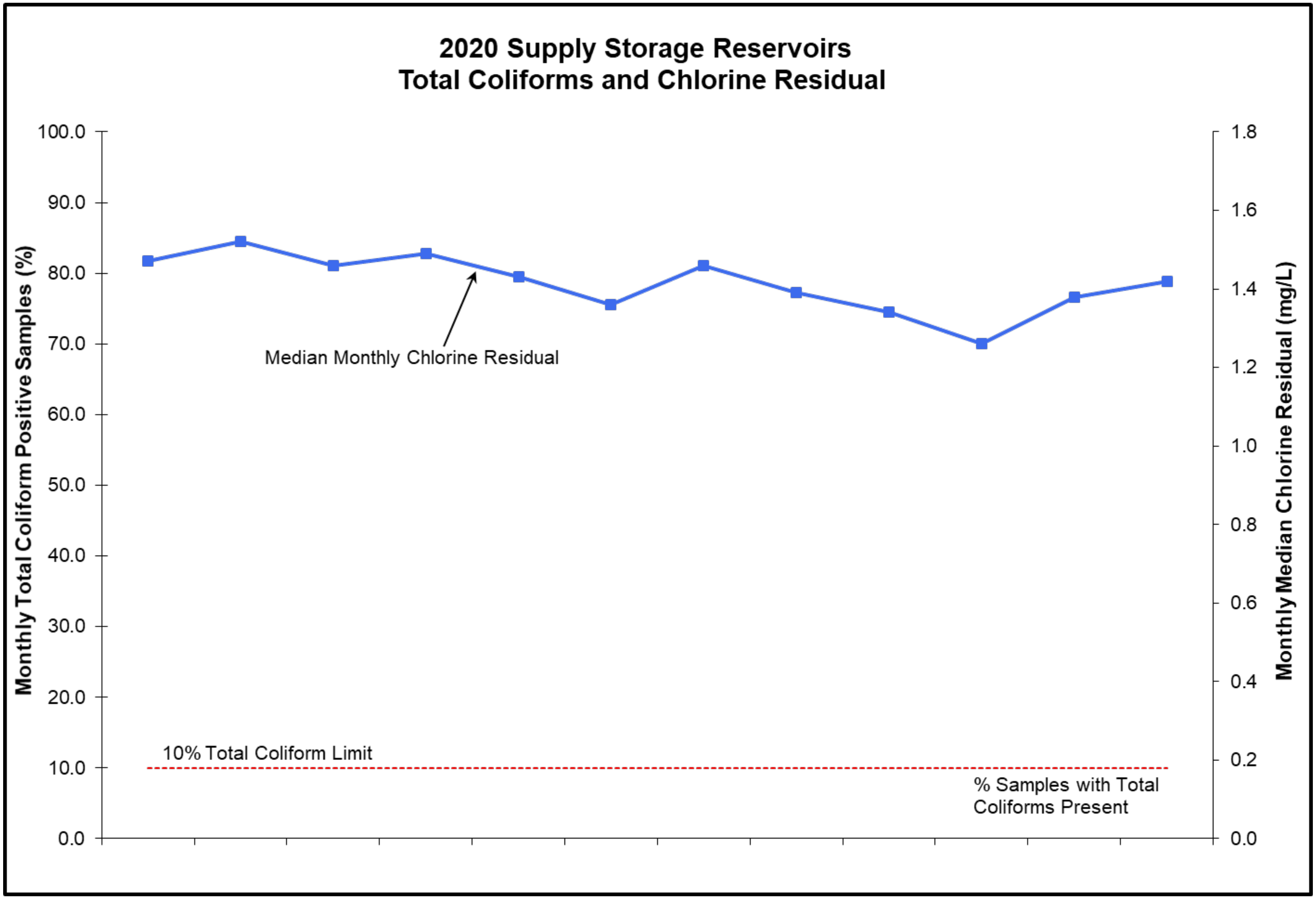

Figure 36 Supply Storage Reservoirs Total Coliforms and Chlorine Residual in 2020

7.4 Distribution System Results

The following sections summarize the water quality monitoring results within the various distribution systems and indicate the compliance status of each system.

7.4.1 Juan de Fuca Water Distribution System – Westshore Municipalities (CRD-owned and operated)

In 2020, 32 distribution system sampling locations were used by the CRD Water Quality Monitoring Program to monitor the bacteriological quality of the water in the Westshore system.

Sample Collection. In 2020, 904 bacteriological and 211 water chemistry samples were collected from the Juan de Fuca Water Distribution System (Table 4). Based on current population data for the Westshore municipalities, 66 samples are required for bacteria testing each month. Table 4 shows the number of monthly samples collected and analyzed for compliance.

Bacteriological Results. Total coliforms were found in a few samples between April and November. Two samples in May exceeded the 10 CFU/100 mL total coliform concentration threshold. There were no consecutive positive samples in 2020. This system complied with the 10% total coliform-positive limit for all months of the year during 2020. The annual total coliform percentage positive was well below the 10% limit at 1.0% (Table 4).

There were no *E coli*-positive samples in 2020.

Chlorine Residual. The annual median chlorine residual in the Westshore municipalities of the Juan de Fuca Water Distribution System was 1.33 mg/L (Table 3). The lowest monthly median was in December (1.10 mg/L) and the maximum monthly median was in February (1.44 mg/L) (Figure 37, Table 4).

Water Temperature. The annual median water temperature in the Juan de Fuca Water Distribution System was 11.7ºC, with monthly medians ranging between 6.8°C (February) and 18.4ºC (August, September) (Table 4).

Table 4 2020 Bacteriological Quality of the Juan de Fuca Distribution System – Westshore Municipalities (CRD)

Month	Samples Collected	Total Coliforms (CFU/100mL)				*E.coli* CFU/100mL)	Turbidity		Chlorine Residual	Water Temp.
		Samples TC > 0	Percent TC>0	Resamples TC > 0	Samples TC > 10	Samples >0	Samples Collected	Samples >1 NTU	Median mg/L as CL2	Median ° C
JAN	82	0	0.0	0	0	0	8	2	1.38	7.1
FEB	68	0	0.0	0	0	0	6	0	1.44	6.8
MAR	77	0	0.0	0	0	0	8	0	1.36	7.4
APR	77	1	1.3	0	0	0	5	0	1.39	9.2
MAY	75	6	8.0	0	2	0	4	0	1.41	12.5
JUN	79	0	0.0	0	0	0	2	0	1.38	14.0
JUL	69	0	0.0	0	0	0	5	0	1.32	16.5
AUG	74	0	0.0	0	0	0	6	1	1.29	18.4
SEP	75	1	1.3	0	0	0	4	0	1.23	18.4
OCT	68	0	0.0	0	0	0	8	0	1.17	15.1
NOV	79	1	1.3	0	0	0	11	1	1.33	10.4
DEC	81	0	0.0	0	0	0	9	1	1.10	8.5
Total:	904	9	1.0	0	2	0	76	5	1.33	11.7

Notes:
TC = Total Coliforms, E. coli = Escherichia coli, Cl2 = chlorine, NTU = Nephelometric turbidity unit.
> = Greater than, mg/L = milligrams per litre, °C = degrees Celsius

Disinfection Byproducts. One location in the Juan de Fuca Water Distribution System had 18 samples collected for disinfection byproducts. The annual average TTHM and haloacetic acid (HAA5) concentrations in six samples each were 15.2 and 9.5 µg/L, respectively, far below the Canadian guideline MAC (TTHM = 100; HAA5 = 80). In six samples, the NDMA concentrations were below the detection limit of 2.1ng/L, well below the Canadian guideline MAC of 40 ng/L.

Physical/Chemical Parameters. The drinking water in the Westshore municipalities of the Juan de Fuca Water Distribution System had the following physical and chemical characteristics in 2020:

- Median pH: 7.0
- Median CaCO3 Hardness: 16.85 mg/L
- Median Alkalinity: 14.0 mg/L
- Median Colour: 3.0 TCU
- Median Conductivity (25ºC): 46.85 µS/cm
- Median Turbidity: 0.30 NTU

Metals. One sampling station in this system was sampled for metals bi-monthly. All metals were below the Canadian guideline limits. Lead concentrations varied from ‘below detection limit’ to 0.43 µg/L.

In 2019, CRD, in concert with Saanich, Victoria/Esquimalt and Oak Bay, started the Greater Victoria pH & Corrosion Study to investigate water properties that may contribute to metal corrosion and in particular to lead leaching into the drinking water. The study examines the water inside the public and also the private drinking water piping systems. As part of this study, samples from a multitude of sampling locations were analyzed for lead and copper. The project was not completed by the end of 2020, due to Covid-19 impacts and the switch back to the old gas chlorination plant, which changed critical water chemistry parameters. The private side tap sampling project phase and the overall study completion was delayed into 2021. Preliminary study results were shared with stakeholders in November 2019. These results showed lead concentrations inside the sampled public systems that range from ‘below detection limit’ to low compared to the Canadian guideline MAC for lead in drinking water (5 µg/L). Elevated lead concentrations that were found in only a few locations in the CRD Transmission System (for instance at Lansdowne/Foul Bay and the Cook/Mallek sampling stations) were investigated in 2019 and 2020 and found to originate from old copper sampling lines. Upon replacement of these few old copper sampling lines, lead concentrations at these locations receded to background levels. Overall, the preliminary study results indicate that metal corrosion and lead leaching in the public piping systems is not an issue. The pending tap sampling project phase will determine the risk on the private side of the system.

Compliance Status. The Westshore municipalities of the Juan de Fuca Water Distribution System were in compliance with the *BC Drinking Water Protection Act* and *Drinking Water Protection Regulation*, except for May, with two total coliform-positive result in exceedance of 10 CFU/100 mL. Immediate resamples following this result were negative for total coliform bacteria and did not, therefore, confirm an actual drinking water contamination.

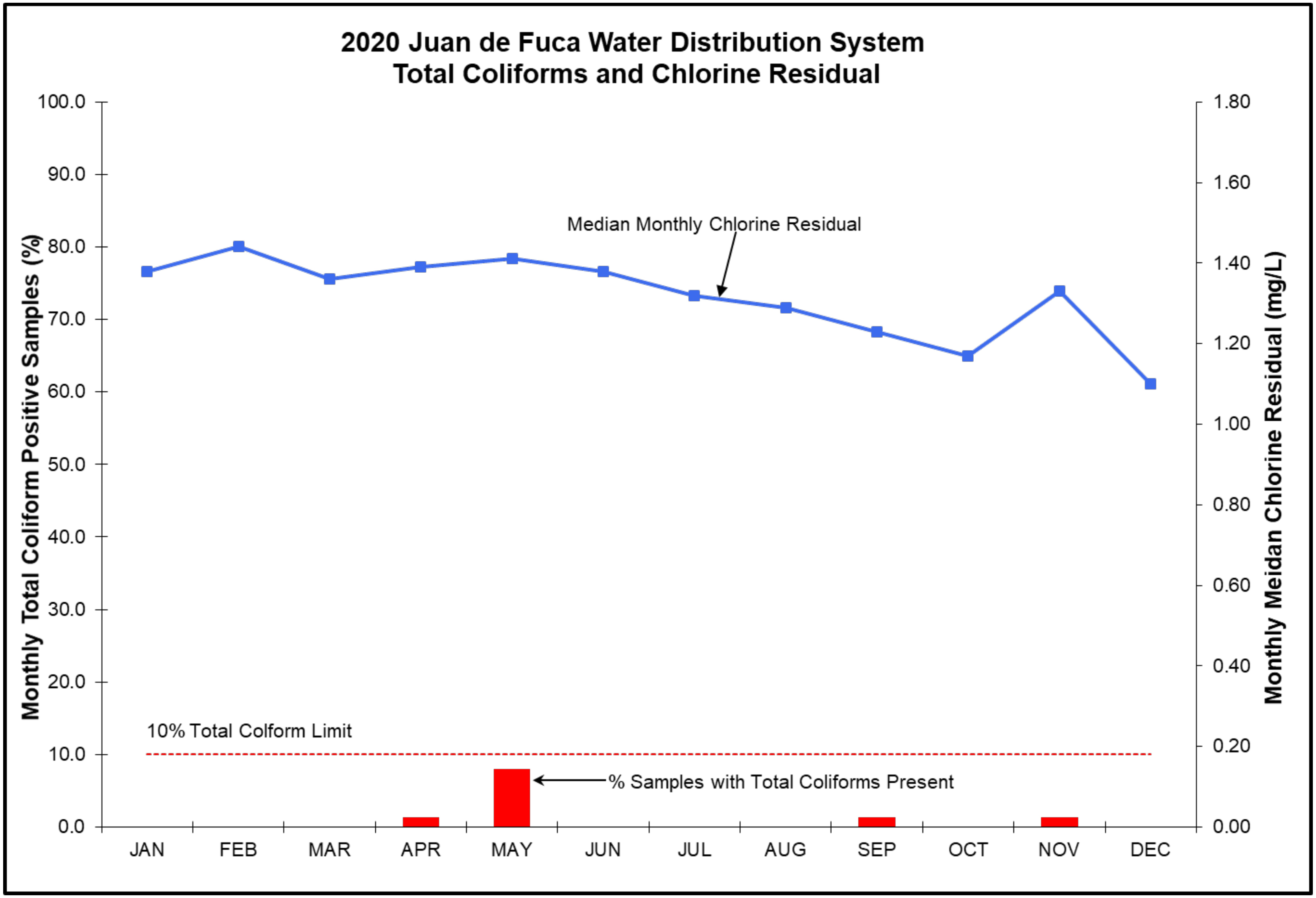

Figure 37 Juan de Fuca – Westshore Distribution System Total Coliforms and Chlorine Residual in 2020

7.4.2 Sooke/East Sooke Distribution System (CRD-Owned and Operated)

In 2020, 20 sampling locations were used by the CRD Water Quality Monitoring Program to monitor the bacteriological quality of the water in Sooke/East Sooke system. Half of all Sooke/East Sooke sampling stations were typically sampled once per week for a bi-weekly sampling frequency of all stations.

Sample Collection. In 2020, 391 bacteriological and 162 water chemistry samples were collected from the Sooke/East Sooke Distribution System (Table 5). Based on current population data for the District of Sooke, 13 samples are required for bacteria testing each month. Table 5 shows the number of monthly samples collected and analyzed for compliance.

Bacteriological Results. One sample in May tested positive for total coliform bacteria. The resample was negative. No sample exceeded the 10 CFU/100 mL total coliform concentration threshold. There were no consecutive positive samples in 2020. This system complied with the 10% total coliform-positive limit for all months of the year during 2020. The annual total coliform percentage positive was well below the 10% limit at 0.3% (Table 5).

No *E. coli* bacteria were found in any sample collected in 2020 (Table 5).

Chlorine Residual. The annual median chlorine residual in the Sooke/East Sooke Distribution System was 0.92 mg/L (Table 5, Figure 38). The lowest monthly median was in August and September (0.55 mg/L), and the maximum monthly median was in May (1.39 mg/L). The low chlorine residual in August and September is typical for the Sooke/East Sooke System, due to the increased chlorine demand in the warm water season.

Water Temperature. The annual median water temperature in the Sooke/East Sooke Distribution System was 12.0°C, with monthly medians ranging between 7.0ºC (February) and 18.2°C (August) (Table 5).

Table 5 2020 Bacteriological Quality of the Sooke/East Sooke Distribution System (CRD)

Month	Samples Collected	Total Coliforms (CFU/100mL)				*E.coli* CFU/100mL)	Turbidity		Chlorine Residual	Water Temp.
		Samples TC > 0	Percent TC>0	Resamples TC > 0	Samples TC > 10	Samples >0	Samples Collected	Samples >1 NTU	Median mg/L as CL2	Median ° C
JAN	39	0	0.0	0	0	0	5	0	1.08	7.5
FEB	30	0	0.0	0	0	0	4	0	1.18	7.0
MAR	40	0	0.0	0	0	0	5	0	1.12	7.6
APR	24	0	0.0	0	0	0	4	0	1.36	10.3
MAY	30	1	3.4	0	0	0	4	0	1.39	13.5
JUN	31	0	0.0	0	0	0	5	0	1.04	14.1
JUL	30	0	0.0	0	0	0	4	0	0.67	16.1
AUG	41	0	0.0	0	0	0	6	0	0.55	18.2
SEP	35	0	0.0	0	0	0	5	0	0.55	17.3
OCT	31	0	0.0	0	0	0	7	0	0.80	14.4
NOV	31	0	0.0	0	0	0	5	0	0.69	10.2
DEC	29	0	0.0	0	0	0	4	0	1.10	9.0
Total:	391	1	0.3	0	0	0	58	0	0.92	12.0

Notes:
TC = Total Coliforms, *E. coli* = *Escherichia coli,* Cl_2 = chlorine, NTU = Nephelometric turbidity unit.
> = Greater than, mg/L = milligrams per litre, °C = degrees Celsius

Disinfection Byproducts. One location in the Sooke distribution system had 18 samples collected for disinfection byproducts. The annual average TTHM and HAA5 concentrations from six samples each were 31.8 and 26.2 µg/L, respectively, far below the Canadian guideline MAC (TTHM = 100; HAA5 = 80). In six samples, the NDMA concentrations were below the detection limit of 2.1ng/L, well below the Canadian guideline MAC of 40 ng/L.

Physical/Chemical Parameters. The drinking water in the Sooke/East Sooke Distribution System had the following physical and chemical characteristics:

- Median pH: 7.2
- Median $CaCO_3$ Hardness: 17.0 mg/L
- Median Colour: 3.0 TCU
- Median Alkalinity: 16.6 mg/L
- Median Turbidity: 0.25 NTU
- Median Conductivity (25ºC): 57.6 µS/cm

Metals. The CRD Water Quality Monitoring Program for the Sooke/East Sooke system included bi-monthly metal tests in two strategic locations in 2020: first customer sampling station on Sooke River Road, and Whiffen Spit Road. All metallic parameters, including lead, were well below the Canadian guideline limits.

In 2019, the CRD, in concert with Saanich, Victoria/Esquimalt and Oak Bay, started the Greater Victoria pH & Corrosion Study to investigate water properties that may contribute to metal corrosion and, in particular, to lead leaching into the drinking water. The study examines the water inside the public and also the private drinking water piping systems. As part of this study, samples from a multitude of sampling locations were analyzed for lead and copper. The project was not completed by the end of 2020, due to Covid-19 impacts and the switch back to the old gas chlorination plant, which changed critical water chemistry parameters. The private side tap sampling project phase and the overall study completion was delayed into 2021. Preliminary study results were shared with stakeholders in November 2019. These results showed lead concentrations inside the sampled public systems that range from 'below detection limit' to low compared to the Canadian guideline MAC for lead in drinking water (5 µg/L). Elevated lead concentrations that were found in only a few locations in the CRD Transmission System (for instance at Lansdowne/Foul Bay and the Cook/Mallek sampling stations) were investigated in 2019 and 2020 and found to originate from old copper sampling lines. Upon replacement of these few old copper sampling lines, lead concentrations at these locations receded to background levels. Overall, the preliminary study results indicate that metal corrosion and lead leaching in the public piping systems is not an issue. The pending tap sampling project phase will determine the risk on the private side of the system.

Compliance Status. The Sooke/East Sooke Distribution System was in full compliance with the *BC Drinking Water Protection Act* and *Drinking Water Protection Regulation.*

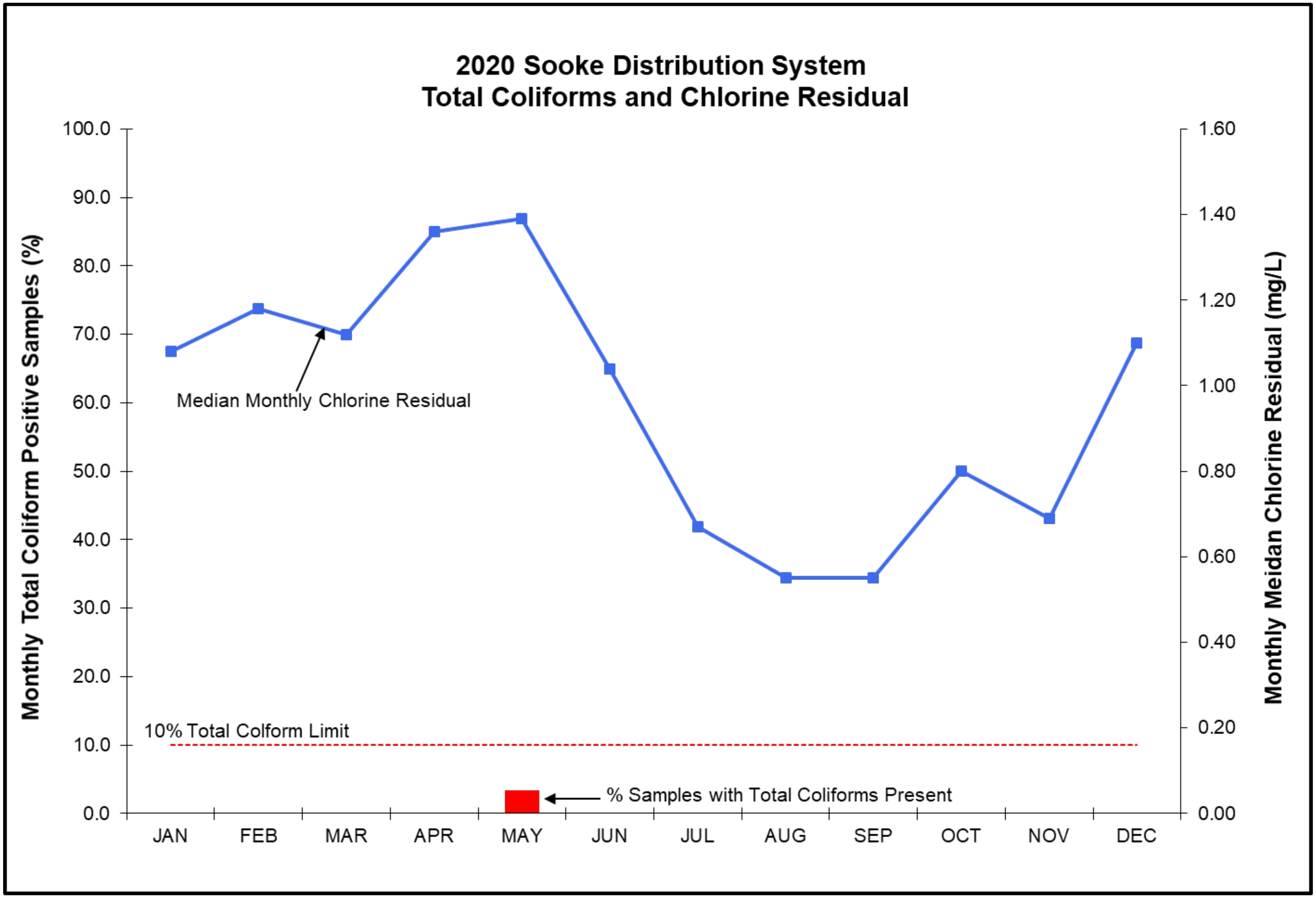

Figure 38 Sooke/East Sooke Distribution System Total Coliforms and Chlorine Residual in 2020

7.4.3 Central Saanich Distribution System – (District of Central Saanich-Owned and Operated)

In 2020, 11 sampling locations were used by the CRD Water Quality Monitoring Program to monitor the bacteriological quality of the water in the Central Saanich Distribution System. Central Saanich sampling stations are part of the daily distribution sampling runs by CRD staff.

Sample Collection. In 2020, 283 bacteriological and 208 water chemistry samples were collected from the Central Saanich Distribution System (Table 6). Based on current population data for the District of Central Saanich, 17 samples are required for bacteria testing each month. Table 6 shows the number of monthly samples collected and analyzed for compliance.

Bacteriological Results. Total coliforms were found in two samples collected in 2020, one in April and one in August. Resamples were both negative. This system complied with the 10% total coliform-positive limit for all of 2020. No samples exceeded the 10 CFU/100 mL total coliform concentration. There were also no consecutive positive samples in 2020 (Table 6).

None of the samples contained *E. coli* bacteria in 2020 (Table 6).

Chlorine Residual. The annual median chlorine residual in the Central Saanich Distribution System was 1.47 mg/L (Table 6). The lowest monthly median was in October (1.32 mg/L) and the maximum monthly median was in August (1.56 mg/L) (Figure 39).

Water Temperature. The annual median water temperature in the Central Saanich Distribution System was 11.8°C, with monthly medians ranging between 7.4°C (February) and 19.1°C (September) (Table 6).

Table 6 2020 Bacteriological Quality of the Central Saanich Distribution System

Month	Samples Collected	Total Coliforms (CFU/100mL)				*E.coli* CFU/100mL)	Turbidity		Chlorine Residual	Water Temp.
		Samples TC > 0	Percent TC>0	Resamples TC > 0	Samples TC > 10	Samples >0	Samples Collected	Samples >1 NTU	Median mg/L as CL2	Median ° C
JAN	26	0	0.0	0	0	0	9	0	1.48	7.8
FEB	22	0	0.0	0	0	0	8	1	1.54	7.4
MAR	24	0	0.0	0	0	0	8	0	1.46	7.8
APR	24	1	4.2	0	0	0	8	1	1.52	9.1
MAY	24	0	0.0	0	0	0	9	0	1.47	12.2
JUN	25	0	0.0	0	0	0	9	1	1.46	14.3
JUL	23	0	0.0	0	0	0	9	0	1.52	16.4
AUG	23	1	4.3	0	0	0	9	0	1.56	18.7
SEP	24	0	0.0	0	0	0	8	1	1.43	19.1
OCT	23	0	0.0	0	0	0	9	0	1.32	16.0
NOV	23	0	0.0	0	0	0	10	0	1.43	11.4
DEC	22	0	0.0	0	0	0	8	0	1.41	9.2
Total:	283	2	0.7	0	0	0	104	4	1.47	11.8

Notes:
TC = Total Coliforms, *E. coli* = *Escherichia coli,* Cl_2 = chlorine, NTU = Nephelometric turbidity unit.
> = Greater than, mg/L = milligrams per litre, °C = degrees Celsius

Disinfection Byproducts. No data for 2020.

Physical/Chemical Parameters. The drinking water in the Central Saanich Distribution System had the following physical and chemical characteristics in 2020:

- Median pH: 7.11
- Median Turbidity: 0.3 NTU
- Median Colour: 3.5 TCU
- Median Alkalinity: 13.6 mg/L
- Median Conductivity (25ºC): 46.2 µS/cm

Metals. No data for 2020.

Compliance Status. The Central Saanich Distribution System was in full compliance with the *BC Drinking Water Protection Act* and *Drinking Water Protection Regulation* in 2020.

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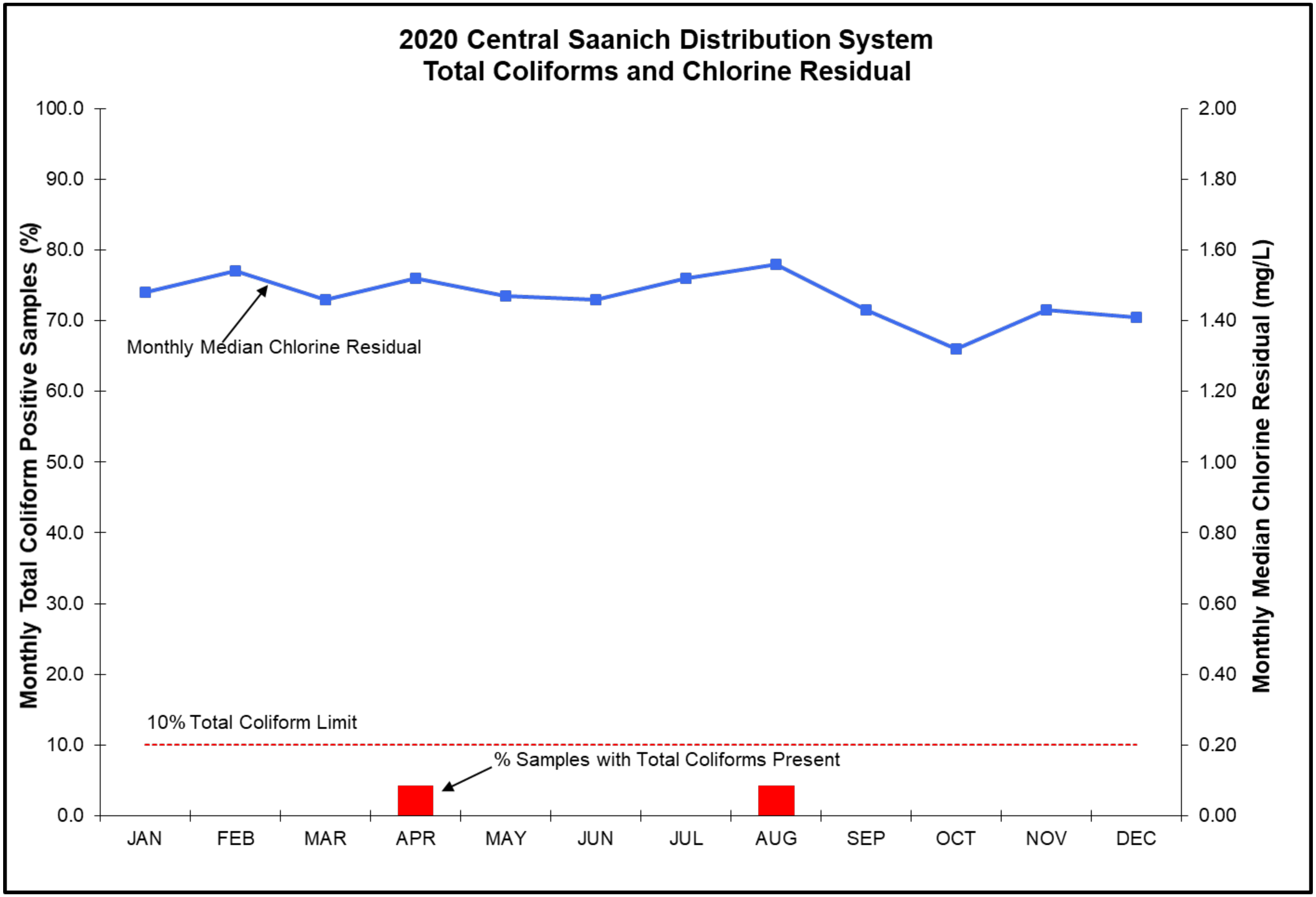

Figure 39 **Central Saanich Distribution System Total Coliforms and Chlorine Residual in 2020**

7.4.4 North Saanich Distribution System – (District of North Saanich-Owned and Operated)

In 2020, eight sampling locations were used by the CRD Water Quality Monitoring Program to monitor the bacteriological quality of the water in the North Saanich Distribution System. North Saanich sampling stations are part of the daily distribution sampling runs by CRD staff.

Sample Collection. In 2020, 206 bacteriological and 56 water chemistry samples were collected from the North Saanich Distribution System (Table 7). Based on current population data for the District of North Saanich, 12 samples are required for bacteria testing each month. Table 7 shows the number of monthly samples collected and analyzed for compliance.

Bacteriological Results. Total coliforms were found in one sample collected in April 2020. The resample was negative. This system complied with the 10% total coliform-positive limit for all of 2020. No sample exceeded the 10 CFU/100 mL total coliform concentration. There were also no consecutive positive samples in 2020 (Table 7).

None of the samples contained *E. coli* bacteria in 2020 (Table 7).

Chlorine Residual. The annual median chlorine residual in the North Saanich Distribution System was 1.15 mg/L (Table 7). The lowest monthly median was in October (0.69 mg/L) and the maximum monthly median was in November (1.84 mg/L) (Figure 40).

Water Temperature. The annual median water temperature in the North Saanich Distribution System was 11.8°C, with monthly medians ranging between 7.8°C (February) and 18.6°C (August) (Table 7).

Table 7 2020 Bacteriological Quality of North Saanich Distribution System

Month	Samples Collected	Total Coliforms (CFU/100mL)				*E.coli* CFU/100mL)	Turbidity		Chlorine Residual	Water Temp.
		Samples TC > 0	Percent TC>0	Resamples TC > 0	Samples TC > 10	Samples >0	Samples Collected	Samples >1 NTU	Median mg/L as CL2	Median ° C
JAN	18	0	0.0	0	0	0	1	0	1.29	8.4
FEB	16	0	0.0	0	0	0	0	0	1.06	7.8
MAR	18	0	0.0	0	0	0	1	0	1.20	8.0
APR	18	1	5.6	0	0	0	1	0	1.19	9.5
MAY	17	0	0.0	0	0	0	1	0	1.04	12.0
JUN	17	0	0.0	0	0	0	1	0	1.15	14.0
JUL	18	0	0.0	0	0	0	1	0	1.20	16.4
AUG	17	0	0.0	0	0	0	1	0	1.28	18.6
SEP	17	0	0.0	0	0	0	1	0	0.94	18.5
OCT	17	0	0.0	0	0	0	1	0	0.69	15.2
NOV	15	0	0.0	0	0	0	1	0	1.84	11.9
DEC	18	0	0.0	0	0	0	1	0	0.93	9.7
Total:	206	1	0.5	0	0	0	11	0	1.15	11.8

Notes:
TC = Total Coliforms, *E. coli* = *Escherichia coli,* Cl_2 = chlorine, NTU = Nephelometric turbidity unit.
> = Greater than, mg/L = milligrams per litre, °C = degrees Celsius

Disinfection Byproducts. No data in 2020.

Physical/Chemical Parameters. The drinking water in the North Saanich Distribution System had the following physical and chemical characteristics in 2020:

- Median pH: 7.29
- Median Colour: 3.5 TCU
- Median Turbidity: 0.25 NTU
- Median Alkalinity: 14.45 mg/L
- Median Conductivity (25ºC): 50.1 µS/cm

Metals. No data in 2020.

Compliance Status. The North Saanich Distribution System was in full compliance with the *BC Drinking Water Protection Act* and *Drinking Water Protection Regulation* in 2020.

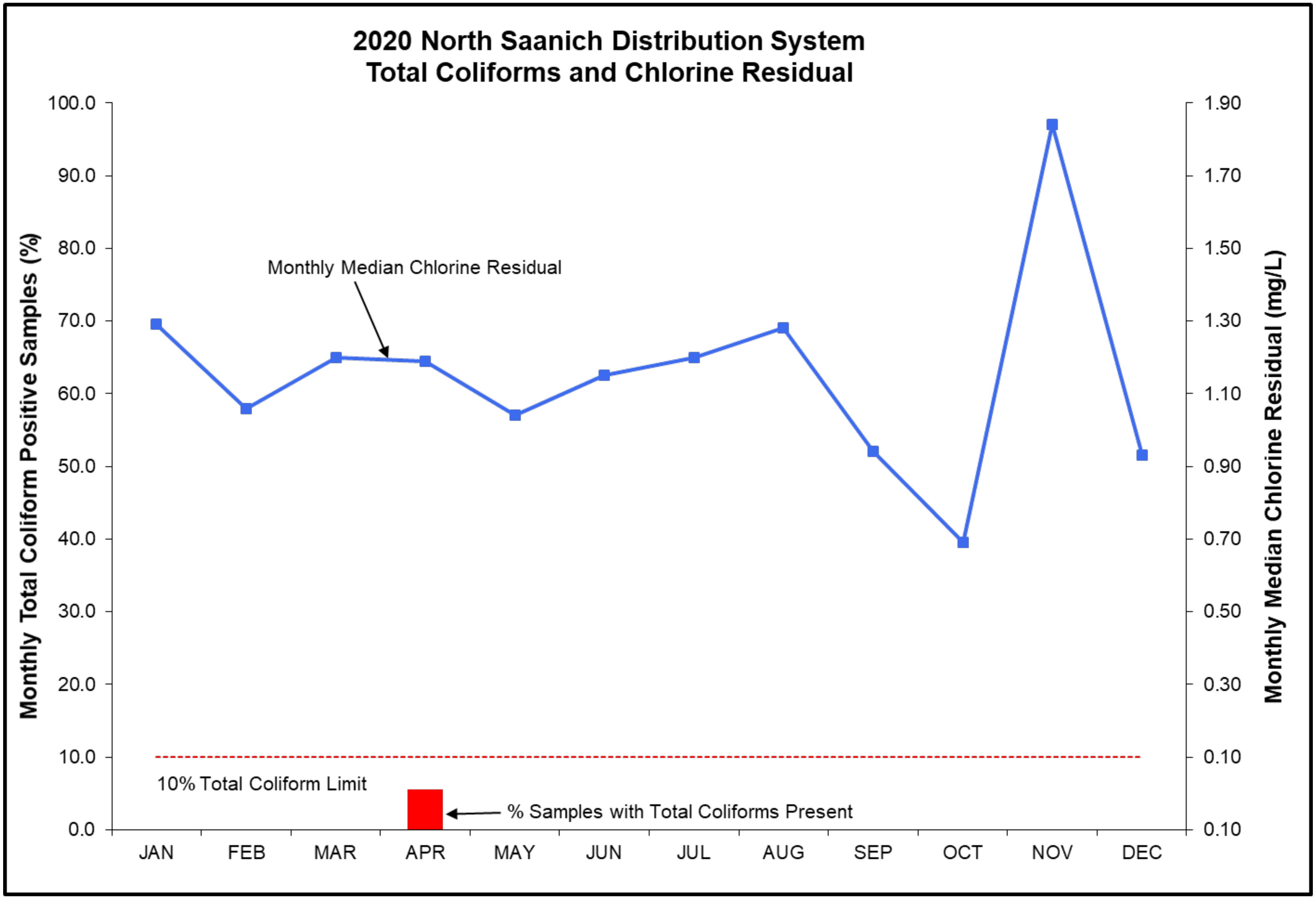

Figure 40 **North Saanich Distribution System Total Coliforms and Chlorine Residual in 2020**

7.4.5 Oak Bay Distribution System – (District of Oak Bay-Owned and Operated)

In 2020, eight sampling locations were used by the CRD Water Quality Monitoring Program to monitor the bacteriological quality of the water in the Oak Bay Distribution System. Oak Bay sampling stations are part of the daily distribution sampling runs by CRD staff.

Sample Collection. In 2020, 283 bacteriological and 121 water chemistry samples were collected from the Oak Bay Distribution System (Table 8). Based on current population data for the District of Oak Bay, 19 samples are required for bacteria testing each month. Table 8 shows the number of monthly samples collected and analyzed for compliance.

Bacteriological Results. No sample in 2020 tested positive for total coliform bacteria (Table 8).

None of the samples contained *E. coli* in 2020 (Table 8).

Chlorine Residual. The annual median chlorine residual in the Oak Bay Distribution System was 1.51 mg/L (Table 8). The lowest monthly median was in December (1.28 mg/L) and the maximum monthly median was in February and July (1.59 mg/L) (Figure 41).

Water Temperature. The annual median water temperature in the Oak Bay Distribution System was 12.5°C, with monthly medians ranging between 7.6°C (February) and 19.7°C (September) (Table 8).

Table 8 2020 Bacteriological Quality of Oak Bay Distribution System

Month	Samples Collected	Total Coliforms (CFU/100mL)				*E.coli* CFU/100mL)	Turbidity		Chlorine Residual	Water Temp.
		Samples TC > 0	Percent TC>0	Resamples TC > 0	Samples TC > 10	Samples >0	Samples Collected	Samples >1 NTU	Median mg/L as CL2	Median ° C
JAN	24	0	0.0	0	0	0	2	0	1.53	8.2
FEB	22	0	0.0	0	0	0	2	0	1.59	7.6
MAR	23	0	0.0	0	0	0	2	0	1.47	8.0
APR	26	0	0.0	0	0	0	2	0	1.56	10.1
MAY	22	0	0.0	0	0	0	2	0	1.54	13.1
JUN	26	0	0.0	0	0	0	2	0	1.58	14.6
JUL	24	0	0.0	0	0	0	3	0	1.59	17.2
AUG	23	0	0.0	0	0	0	2	0	1.47	19.4
SEP	23	0	0.0	0	0	0	3	0	1.50	19.7
OCT	22	0	0.0	0	0	0	2	0	1.50	16.0
NOV	26	0	0.0	0	0	0	6	0	1.44	11.7
DEC	22	0	0.0	0	0	0	2	0	1.28	9.2
Total:	283	0	0.0	0	0	0	30	0	1.51	12.5

Notes:
TC = Total Coliforms, *E. coli* = *Escherichia coli,* Cl_2 = chlorine, NTU = Nephelometric turbidity unit.
> = Greater than, mg/L = milligrams per litre, °C = degrees Celsius

Disinfection Byproducts. No data for 2020.

Physical/Chemical Parameters. The drinking water in the Oak Bay Distribution System had the following physical and chemical characteristics:

- Median pH: 7.2
- Median Alkalinity: 14.2 mg/L
- Median Turbidity: 0.3 NTU
- Median Conductivity (25ºC): 47.75 µS/cm
- Median Colour: 4.0 TCU

Metals. In 2019, Oak Bay participated with CRD, Saanich and Victoria/Esquimalt in the Greater Victoria pH & Corrosion Study to investigate water properties that may contribute to metal corrosion and, in particular, to lead leaching into the drinking water. The study examines the water inside the public and also the private drinking water piping systems. As part of this study, samples from a multitude of sampling locations were analyzed for lead and copper. The project was not completed by the end of 2020, due to Covid-19 impacts and the switch back to the old gas chlorination plant, which changed critical water chemistry parameters. The private side tap sampling project phase and the overall study completion was delayed into 2021. Preliminary study results were shared with stakeholders in November 2019. These results showed lead concentrations inside the sampled public systems that range from ‘below detection limit’ to low compared to the Canadian guideline MAC for lead in drinking water (5 µg/L). Elevated lead concentrations that were found in only a few locations in the CRD Transmission System (for instance at Lansdowne/Foul Bay and the Cook/Mallek sampling stations) were investigated in 2019 and 2020 and found to originate from old copper sampling lines. Upon replacement of these few old copper sampling lines, lead concentrations at these locations receded to background levels. Overall, the preliminary study results indicate that metal corrosion and lead leaching in the public piping systems is not an issue. The pending tap sampling project phase will determine the risk on the private side of the system.

Compliance Status. The Oak Bay Distribution System was in full compliance with the *BC Drinking Water Protection Act* and *Drinking Water Protection Regulation*.

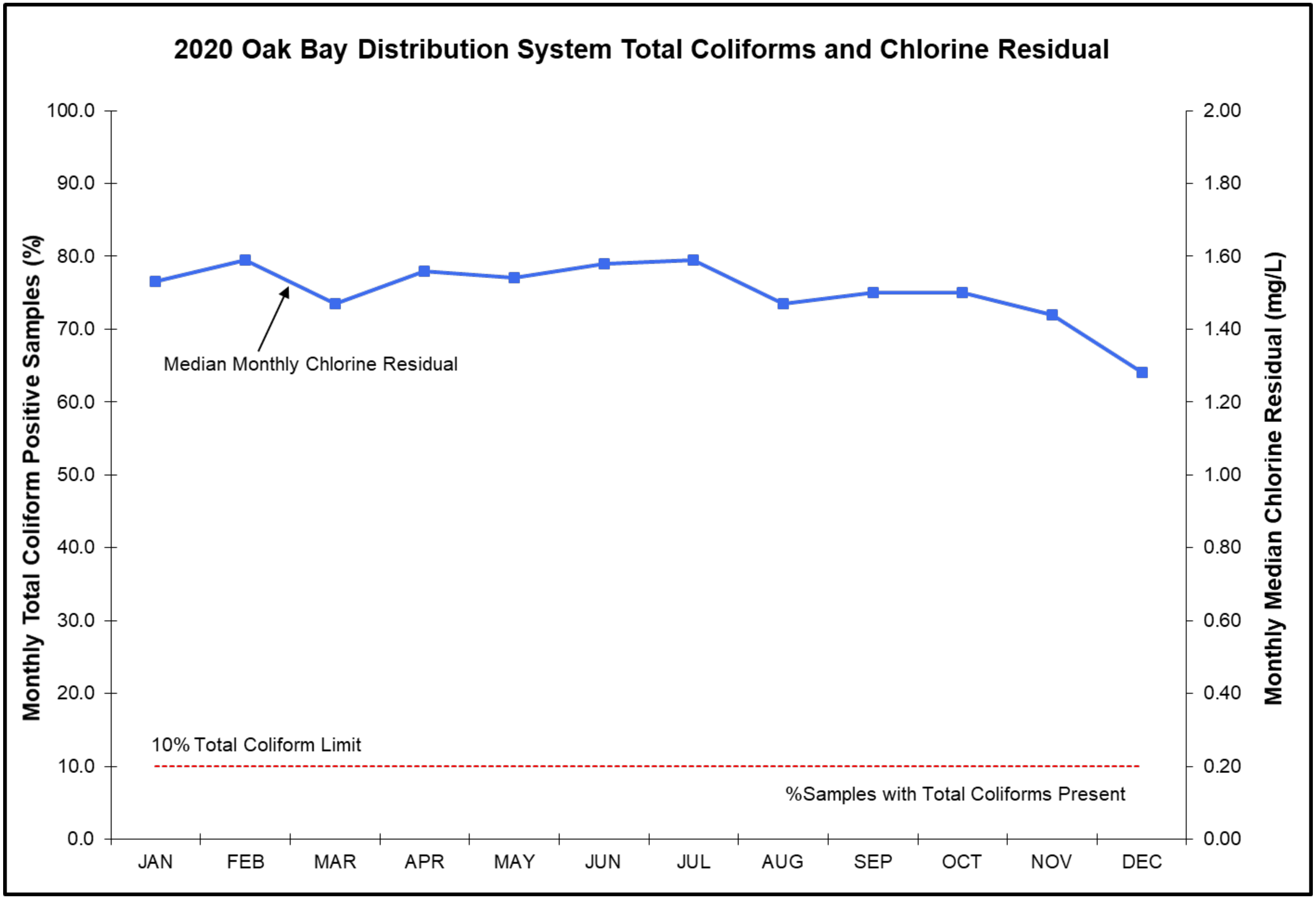

Figure 41 Oak Bay Distribution System Total Coliforms and Chlorine Residual in 2020

7.4.6 Saanich Distribution System – (District of Saanich-Owned and Operated)

In 2020, 64 sampling locations were used by the CRD Water Quality Monitoring Program to monitor the bacteriological quality of the water in the Saanich Distribution System. Saanich sampling stations were part of the daily distribution sampling runs by CRD staff and a weekly run by Saanich staff.

Sample Collection. In 2019, 1,161 bacteriological and 149 water chemistry samples were collected from the Saanich Distribution System (Table 9). Based on current population data for the District of Saanich, 93 samples are required for bacteria testing each month. Table 9 shows the number of monthly samples collected and analyzed for compliance.

Bacteriological Results. A small number of total coliform-positive results occurred in six months. There were no consecutive positive samples in 2020. One sample in February exceeded the 10 CFU/100 mL total coliform concentration limit, but the resample was negative. This system complied with the 10% total coliform-positive limit for all months. The annual total coliform percentage positive was well below the 10% limit at only 0.6% (Table 9).

One sample tested positive for *E. coli* in November of 2020 (Table 9). Island Health was notified and the District of Saanich initiated their emergency response protocol. The area was flushed thoroughly and multiple resamples from upstream and downstream of the site were taken. All resamples were negative for total coliform or *E. coli* bacteria, ruling out an actual drinking water contamination.

Chlorine Residual. The annual median chlorine residual in the Saanich Distribution System was 1.41 mg/L (Table 9). The lowest monthly median was in October (1.29 mg/L) and the maximum monthly median was in July (1.50 mg/L) (Figure 42).

Water Temperature. The annual median water temperature in the Saanich Distribution System was 12.1°C, with monthly medians ranging between 7.3°C (February) and 18.8°C (August) (Table 9).

Table 9 2020 Bacteriological Quality of Saanich Distribution System

Month	Samples Collected	Total Coliforms (CFU/100mL)				*E.coli* CFU/100mL)	Turbidity		Chlorine Residual	Water Temp.
		Samples TC > 0	Percent TC>0	Resamples TC > 0	Samples TC > 10	Samples >0	Samples Collected	Samples >1 NTU	Median mg/L as CL2	Median ° C
JAN	98	0	0.0	0	0	0	4	0	1.42	7.6
FEB	95	1	1.1	0	1	0	4	0	1.44	7.3
MAR	96	0	0.0	0	0	0	4	0	1.41	7.7
APR	98	0	0.0	0	0	0	3	0	1.39	9.9
MAY	96	1	1.0	0	0	0	4	0	1.44	12.5
JUN	105	1	1.0	0	0	0	5	0	1.43	14.4
JUL	95	0	0.0	0	0	0	4	0	1.50	16.8
AUG	93	0	0.0	0	0	0	4	0	1.45	18.7
SEP	96	1	1.0	0	0	0	4	0	1.34	18.8
OCT	95	1	1.1	0	0	0	4	0	1.29	15.8
NOV	99	2	2.0	0	0	1	6	0	1.30	11.2
DEC	95	0	0.0	0	0	0	4	0	1.34	9.2
Total:	1161	7	0.6	0	1	1	50	0	1.41	12.1

Notes:
TC = Total Coliforms, *E. coli* = *Escherichia coli,* Cl_2 = chlorine, NTU = Nephelometric turbidity unit.
> = Greater than, mg/L = milligrams per litre, °C = degrees Celsius

Disinfection Byproducts. No data for 2020.

Physical/Chemical Parameters. The drinking water in the Saanich Distribution System had the following physical and chemical characteristics in 2020:

- Median pH: 7.2
- Median Alkalinity: 13.8 mg/L
- Median Turbidity: 0.3 NTU
- Median Conductivity (25ºC): 47.0 µS/cm
- Median Colour: 4.0 TCU

Metals. In 2019, Saanich participated with CRD, Oak Bay and Victoria/Esquimalt in the Greater Victoria pH & Corrosion Study to investigate water properties that may contribute to metal corrosion and, in particular, to lead leaching into the drinking water. The study examines the water inside the public and also the private drinking water piping systems. As part of this study, samples from a multitude of sampling locations were analyzed for lead and copper. The project was not completed by the end of 2020, due to Covid-19 impacts and the switch back to the old gas chlorination plant, which changed critical water chemistry parameters. The private side tap sampling project phase and the overall study completion was delayed into 2021. Preliminary study results were shared with stakeholders in November 2019. These results showed lead concentrations inside the sampled public systems that range from 'below detection limit' to low compared to the Canadian guideline MAC for lead in drinking water (5 µg/L). Elevated lead concentrations that were found in only a few locations in the CRD Transmission System (for instance at Lansdowne/Foul Bay and the Cook/Mallek sampling stations) were investigated in 2019 and 2020 and found to originate from old copper sampling lines. Upon replacement of these few old copper sampling lines, lead concentrations at these locations receded to background levels. Overall, the preliminary study results indicate that metal corrosion and lead leaching in the public piping systems is not an issue. The pending tap sampling project phase will determine the risk on the private side of the system.

Compliance Status. The Saanich Distribution System was in compliance with the *BC Drinking Water Protection Act* and *Drinking Water Protection Regulation* in 2020, except for February with one sample that exceeded the 10 CFU/100 mL total coliform concentration, and November with one *E. coli*-positive test result. All resamples were negative and confirmed no actual drinking water contamination.

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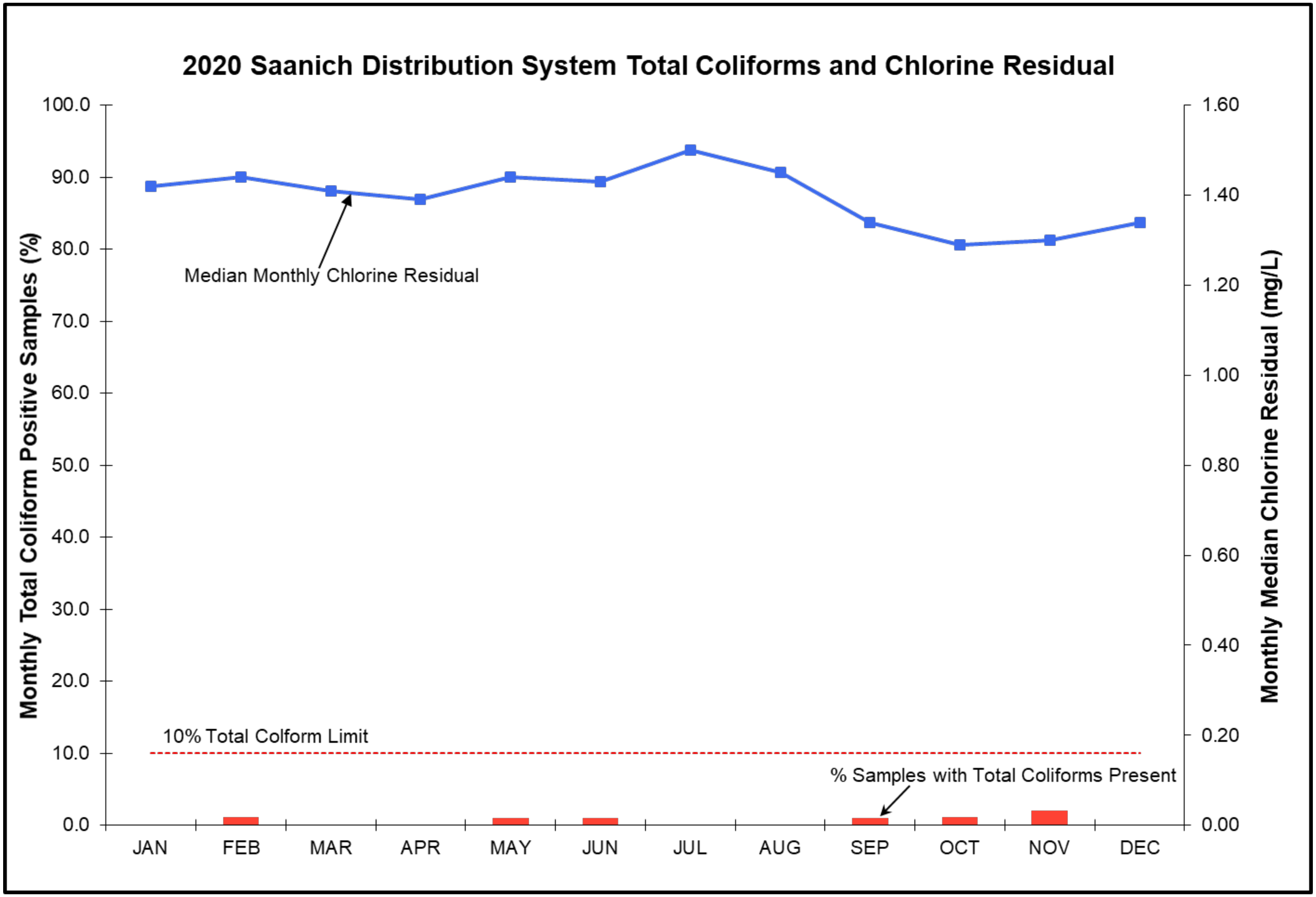

Figure 42 Saanich Distribution System Total Coliforms and Chlorine Residuals in 2020

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7.4.7 Sidney Distribution System – (Town of Sidney-Owned and Operated)

In 2020, six sampling locations were used by the CRD Water Quality Monitoring Program to monitor the bacteriological quality of the water in the Sidney Distribution System. Sidney sampling stations are part of the daily distribution sampling runs by CRD staff.

Sample Collection. In 2020, 183 bacteriological and 65 water chemistry samples were collected from the Sidney Distribution System (Table 10). Based on current population data for the Town of Sidney, 12 samples are required for bacteria testing each month. Table 10 shows the number of monthly samples collected and analyzed for compliance.

Bacteriological Results. Two samples, one in July and one in December, tested positive for total coliforms in 2020. Both resamples were negative. There were no consecutive positive samples in 2020. No sample exceeded the 10 CFU/100 mL total coliform concentration. This system complied with the 10% total coliform-positive limit for all months. The annual total coliform percentage positive was well below the 10% limit at only 1.1% (Table 10).

Also, no sample tested positive for *E. coli* in 2020 (Table 10).

Chlorine Residual. The annual median chlorine residual in the Sidney Distribution System was 1.32 mg/L (Table 10). The lowest monthly median was in October (1.10 mg/L) and the maximum monthly median was in February (1.48 mg/L) (Figure 43).

Water Temperature. The annual median water temperature in the Sidney Distribution System was 12.5°C, with monthly medians ranging between 8.0°C (February, March) and 19.3°C (September) (Table 10).

Table 10 2020 Bacteriological Quality of Sidney Distribution System

Month	Samples Collected	Total Coliforms (CFU/100mL)				*E.coli* CFU/100mL)	Turbidity		Chlorine Residual	Water Temp.
		Samples TC > 0	Percent TC>0	Resamples TC > 0	Samples TC > 10	Samples >0	Samples Collected	Samples >1 NTU	Median mg/L as CL2	Median ° C
JAN	15	0	0.0	0	0	0	2	0	1.43	8.1
FEB	14	0	0.0	0	0	0	1	0	1.48	8.0
MAR	15	0	0.0	0	0	0	1	0	1.41	8.0
APR	15	0	0.0	0	0	0	1	0	1.44	9.5
MAY	15	0	0.0	0	0	0	1	0	1.34	12.4
JUN	16	0	0.0	0	0	0	1	0	1.40	14.7
JUL	17	1	5.9	0	0	0	1	0	1.38	16.9
AUG	15	0	0.0	0	0	0	2	0	1.39	18.9
SEP	15	0	0.0	0	0	0	1	0	1.22	19.3
OCT	14	0	0.0	0	0	0	1	0	1.10	16.9
NOV	17	0	0.0	0	0	0	1	0	1.24	12.0
DEC	15	1	6.7	0	0	0	1	0	1.24	9.8
Total:	183	2	1.1	0	0	0	14	0	1.32	12.5

Notes:
TC = Total Coliforms, *E. coli* = *Escherichia coli,* Cl_2 = chlorine, NTU = Nephelometric turbidity unit.
> = Greater than, mg/L = milligrams per litre, °C = degrees Celsius

Disinfection Byproducts. No data for 2020.

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Physical/Chemical Parameters. The drinking water in the Sidney Distribution System had the following physical and chemical characteristics in 2019:

- Median pH: 7.1
- Median Alkalinity: 13.6 mg/L
- Median Turbidity: 0.3 NTU
- Median Conductivity (25ºC): 46.4 µS/cm
- Median Colour: 3.5 TCU

Metals. No data in 2020.

Compliance Status. The Sidney Distribution System was in full compliance with the *BC Drinking Water Protection Act* and *Drinking Water Protection Regulation* in 2020.

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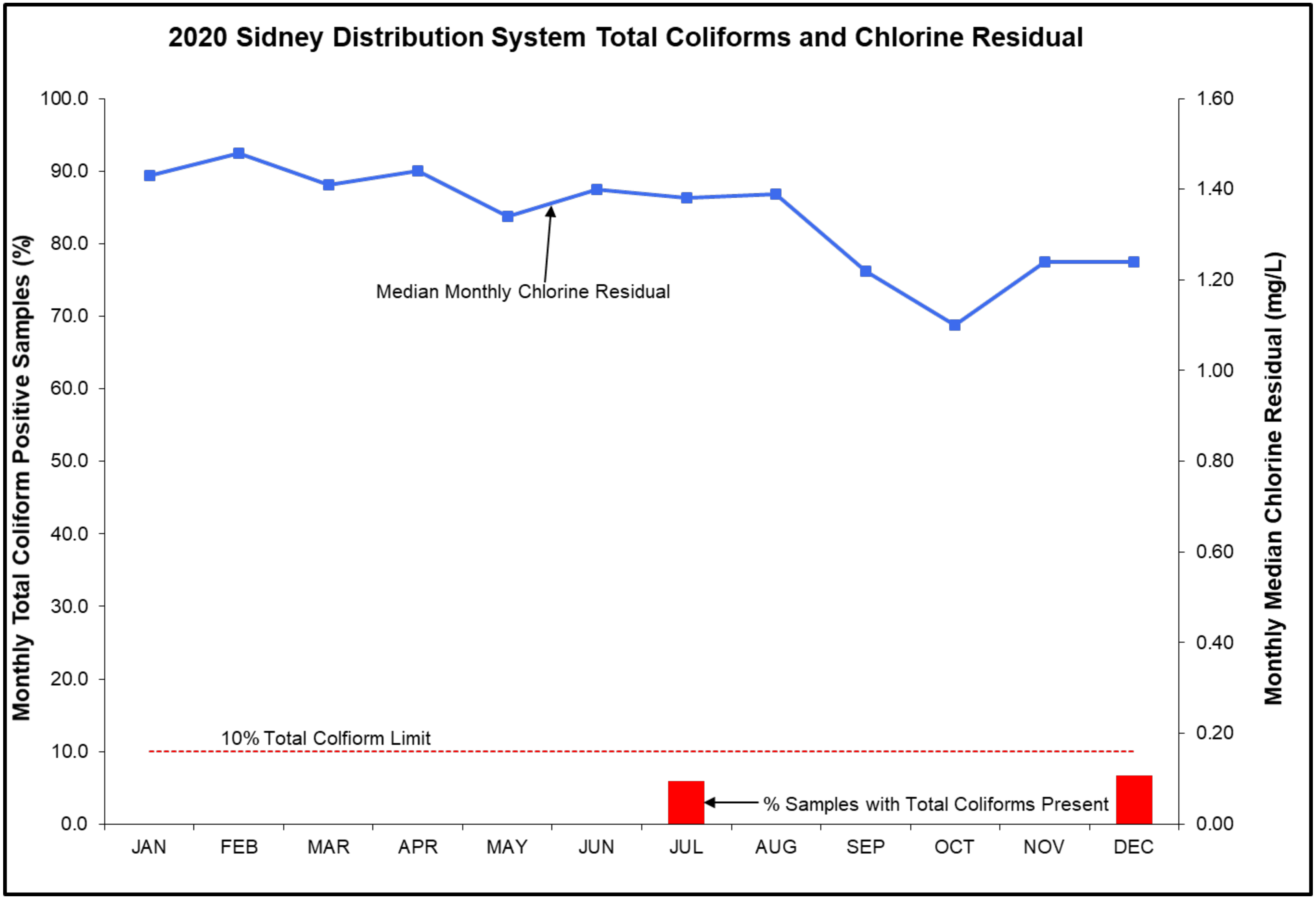

Figure 43 Sidney Distribution System Total Coliforms and Chlorine Residuals in 2020

7.4.8 Victoria/Esquimalt Distribution System – (City of Victoria-Owned and Operated)

In 2020, 16 sampling locations were used by the CRD Water Quality Monitoring Program to monitor the bacteriological quality of the water in the Victoria/Esquimalt Distribution System. Victoria/Esquimalt sampling stations are part of the daily distribution sampling runs by CRD staff.

Sample Collection. In 2020, 1,225 bacteriological and 191 water chemistry samples were collected from the Victoria/Esquimalt Distribution System (Table 11). Based on current population data for Victoria and Esquimalt, 92 samples are required for bacteria testing each month. Table 11 shows the number of monthly samples collected and analyzed for compliance.

Bacteriological Results. A small number of total coliform-positive results occurred in five months throughout the year. There were no consecutive positive samples in 2020. No sample exceeded the 10 CFU/100 mL total coliform concentration limit. This system complied with the 10% total coliform-positive limit for all months. The annual total coliform percentage positive was well below the 10% limit at only 0.6% (Table 11).

No *E. coli* was detected in any sample in 2020 (Table 11).

Chlorine Residual. The annual median chlorine residual in the Victoria/Esquimalt Distribution System was 1.45 mg/L (Table 11). The lowest monthly median was in September (1.32 mg/L) and the maximum monthly median was in February (1.57 mg/L) (Figure 44).

Water Temperature. The annual median water temperature in the Victoria/Esquimalt Distribution System was 13.0°C, with monthly medians ranging between 7.8°C (January/February) and 20.4°C (August) (Table 11).

Table 11 2020 Bacteriological Quality of Victoria Distribution System

Month	Samples Collected	Total Coliforms (CFU/100mL)				*E.coli* CFU/100mL)	Turbidity		Chlorine Residual	Water Temp.
		Samples TC > 0	Percent TC>0	Resamples TC > 0	Samples TC > 10	Samples >0	Samples Collected	Samples >1 NTU	Median mg/L as CL2	Median ° C
JAN	112	0	0.0	0	0	0	7	0	1.50	7.8
FEB	94	0	0.0	0	0	0	6	0	1.57	7.8
MAR	104	0	0.0	0	0	0	6	0	1.48	8.3
APR	105	0	0.0	0	0	0	9	1	1.47	11.0
MAY	98	2	2.0	0	0	0	7	0	1.51	14.2
JUN	115	0	0.0	0	0	0	9	1	1.51	16.2
JUL	96	0	0.0	0	0	0	6	0	1.48	18.4
AUG	96	0	0.0	0	0	0	7	0	1.38	20.4
SEP	103	1	1.0	0	0	0	6	0	1.32	20.0
OCT	98	1	1.0	0	0	0	5	0	1.33	16.2
NOV	108	1	0.9	0	0	0	9	0	1.43	11.4
DEC	96	2	2.1	0	0	0	6	0	1.41	9.5
Total:	1225	7	0.6	0	0	0	83	2	1.45	13.0

Notes:
TC = Total Coliforms, *E. coli* = *Escherichia coli,* Cl_2 = chlorine, NTU = Nephelometric turbidity unit.
> = Greater than, mg/L = milligrams per litre, °C = degrees Celsius

Disinfection Byproducts. No data for 2020.

Physical/Chemical Parameters. The drinking water in the Victoria/Esquimalt Distribution System had the following physical and chemical characteristics in 2020:

- Median pH: 7.2
- Median Alkalinity: 13.5 mg/L
- Median Turbidity: 0.3 NTU
- Median Conductivity (25ºC): 46.3 µS/cm
- Median Colour: 4.0 TCU

The system experienced occasional elevated turbidity in certain dead-end pipe sections, which were addressed with regular or ad hoc flushing at those locations.

Metals. In 2019, Victoria/Esquimalt participated with CRD, Oak Bay and Saanich in the Greater Victoria pH & Corrosion Study to investigate water properties that may contribute to metal corrosion and, in particular, to lead leaching into the drinking water. The study examines the water inside the public and also the private drinking water piping systems. As part of this study, samples from a multitude of sampling locations were analyzed for lead and copper. The project was not completed by the end of 2020, due to Covid-19 impacts and the switch back to the old gas chlorination plant which changed critical water chemistry parameters. The private side tap sampling project phase and the overall study completion was delayed into 2021. Preliminary study results were shared with stakeholders in November 2019. These results showed lead concentrations inside the sampled public systems that range from 'below detection limit' to low compared to the Canadian guideline MAC for lead in drinking water (5 µg/L). Elevated lead concentrations that were found in only a few locations in the CRD Transmission System (for instance at Lansdowne/Foul Bay and the Cook/Mallek sampling stations) were investigated in 2019 and 2020 and found to originate from old copper sampling lines. Upon replacement of these few old copper sampling lines, lead concentrations at these locations receded to background levels. Overall, the preliminary study results indicate that metal corrosion and lead leaching in the public piping systems is not an issue. The pending tap sampling project phase will determine the risk on the private side of the system.

Compliance Status. The Victoria/Esquimalt Distribution System was in full compliance with the *BC Drinking Water Protection Act* and *Drinking Water Protection Regulation* in 2020.

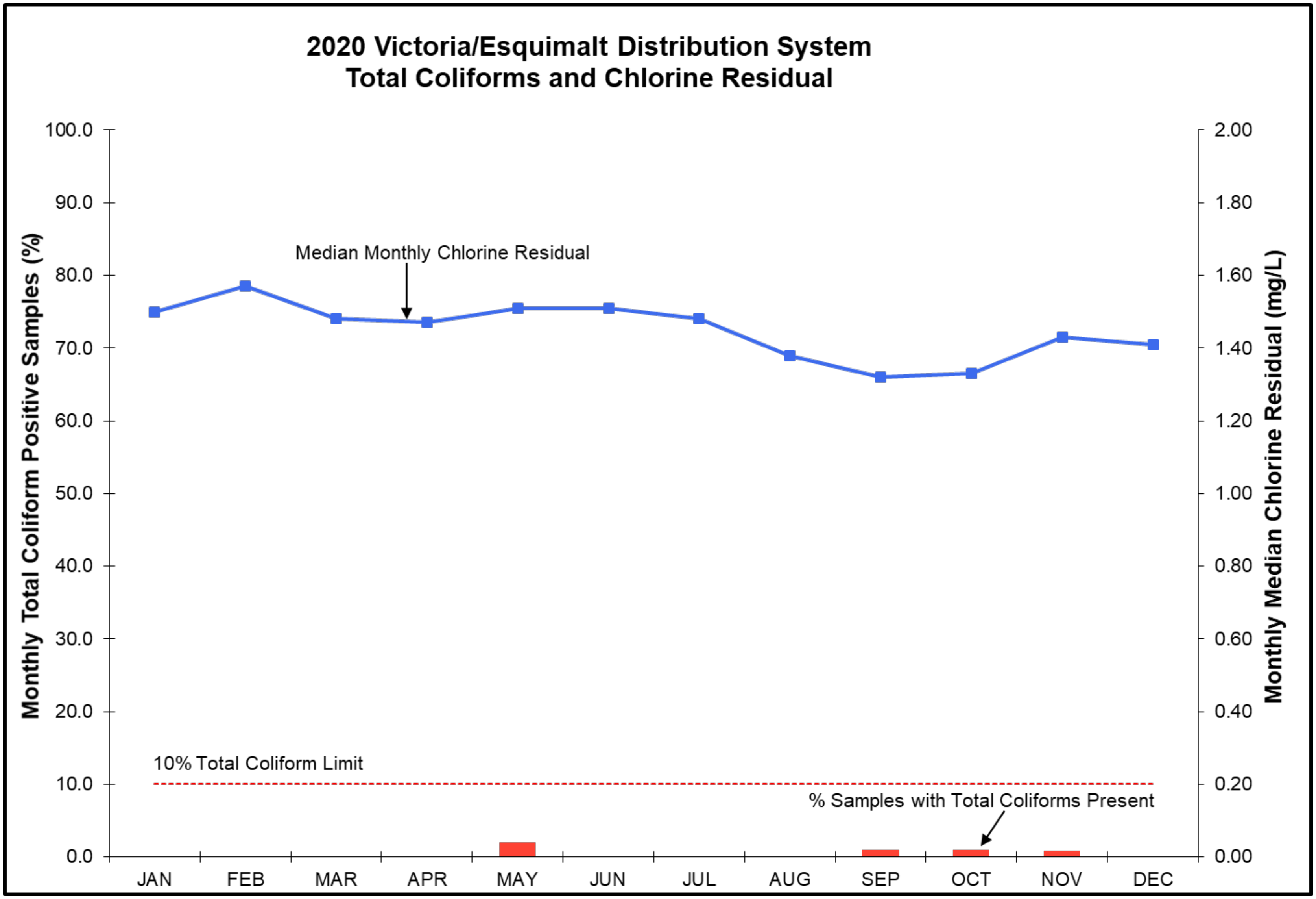

Figure 44 **Victoria/Esquimalt Distribution System Total Coliforms and Chlorine Residuals in 2020**

7.5 Water Quality Inquiry Program

Records of customer inquiries, including complaints about drinking water quality, have been maintained since 1992. In 2020, as was the case in recent years, there was no single category of water quality inquiry or complaint that stood out among the rest. During periods of water main flushing activities (January-May, September-December) in the distribution systems, complaints or concerns about water discolouration were more prevalent. A number of inquiries or complaints about chlorine taste and odour were received in 2020, but most of these were of a general nature where people object to the addition of any chemical to the drinking water.

Between June 2-9, 2020, the CRD issued a taste and odour public advisory, as a result of an *Uroglena* algae event in Sooke Lake Reservoir. During this time, CRD staff received a higher than normal volume of customer calls and complaints related to abnormal taste and/or odour associated with the drinking water. Over a period of two weeks in early June, CRD and municipal staff received in total about 20 customer complaints that could be attributed to this algal event in Sooke Lake Reservoir.

On the afternoon of June 17, 2020, the Victoria General Hospital noticed higher than usual turbidity in its water supply. This episode was linked to the typical early summer watering day turbidity excursions, due to high watering demands and thus high flows in the raw water mains upstream of the Goldstream Water Treatment Plant. Since this incident, CRD staff have communicated regularly with Island Health hospital facility management staff to provide useful water quality information to these facilities.

The absence of the intake screen for most of 2020 did not result in any increase of customer concerns or complaints.

In general, the number of water quality complaints or inquiries in 2020 was consistent with that of previous years.

In addition to complaints, CRD staff received a number of queries from people concerned about the general safety of their drinking water. These concerns were addressed individually and, in general, most customers are content to know that CRD staff are actively sampling both the source water and the treated drinking water being delivered to their homes. For those people wanting to know more about the composition of their drinking water, they were either provided with the annual tables or directed to the CRD website. The heightened public awareness around health risks associated with lead in drinking water that was noticed in public interactions in previous years was somewhat subdued in 2020, likely as a result of the dominant attention to the Covid-19 public health risks throughout most of the year.

7.6 Cross Connection Control Program

This program was created based on an Order by the Chief Medical Health Officer of the Island Health Authority in 2005. Since then, it has become exemplary for an effective and efficient cross connection control program in Canada and it forms an important component of the multi-barrier concept in the Greater Victoria Drinking Water System. Working with Island Health, the 13 municipalities and participating electoral areas, the objective of this program is to identify, eliminate and prevent cross connections within the Greater Victoria Drinking Water System that could lead to drinking water contaminations. The CRD was tasked to take over the responsibility for this program under a newly-created Cross Connection Control Bylaw (enacted in 2006). In 2019, this bylaw saw its most recent update to bring the technical and administrative requirements in line with new provincial legislation. The method by which the program meets its objectives is enforcement of the cross connection control requirements under the BC Building Code and as described by the Canadian Standard Association, and through public education. CRD staff work with municipal building officials, industry professionals and business and facility owners to achieve the goals of the Cross Connection Control Program.

In 2020, the Cross Connection Control Program conducted a total of 598 facility audits on high risk (100) and moderate risk (498) facilities. The focus was on facilities in malls and mixed-use residential buildings. The compliance rate, measured as facilities with outstanding deficiencies divided by the number of facilities audited, increased from 61% in 2019 to 74% by the end of 2020. This success is attributed to a shift to an outcome-oriented approach, coupled with effective outreach campaigns. It is expected that this compliance rate will further increase in future years.

In total, by the end of 2020, the Cross Connection Control Program had 27,147 cross connection control devices registered in its database (up from 24,134 in 2019). These devices were installed in 12,794 registered facilities across the region. On all testable devices, a total of 19,182 test reports (8,882 digital, 8,010 paper) were received and recorded by CRD staff in 2020. The compliance rate for getting testable devices tested in accordance with the bylaw was 71%.

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8.0 CONCLUSIONS

1. The water quality data collected in 2020 indicate that the drinking water in Greater Victoria is of good quality and safe to drink. The drinking water temperature exceeded the aesthetic objective of 15°C between mid-July and mid-October. This is the only parameter that system-wide did not meet water quality criteria listed in the G*uidelines for Canadian Drinking Water Quality*.

2. Greater Victoria continues to enjoy a water supply in which *Giardia* and *Cryptosporidium* parasites are well below the levels commonly considered by the health authorities to be responsible for disease outbreaks.

3. The bacteriological quality of the raw source water was excellent in 2020. Total coliform concentrations were very low for most of the year, with medium concentrations in late summer/early fall. This bacteriological pattern is typical for Sooke Lake Reservoir and does not cause any issues with the existing water treatment systems. *E. coli* bacterial levels in the raw source water were low for the entire year.

4. Consumers in the GVDWS receive drinking water that has very low disinfection byproducts. Overall levels of trihalomethanes and haloacetic acids remain well below the Canadian guidelines' limits and the USEPA limits. The newly-monitored disinfection byproduct, Nitrosodimethylamine, was, if detected at all, only in concentrations well below the current MAC in the Canadian guidelines.

5. The algal activity in 2020 was in line with the long-term average trend in Sooke Lake Reservoir. The species that were active, and relatively abundant in 2020, belonged to known and low-risk algal species. A higher than usual abundance of the golden-brown algae *Uroglena sp.* caused about 20 customer complaints about unpleasant taste and odour in the drinking water in early June. The CRD issued a public taste and odour advisory that was in place from June 2-9, 2020. Such higher abundance of *Uroglena* algae seemed a common phenomenon in southern BC in 2020 and likely the result of favourable environmental conditions for growth of this species. Cyanobacteria, with the potential to produce harmful cyanotoxins under bloom conditions, were present, as usual, throughout the year. However, a stable and nutrient-poor ecosystem, such as the Sooke Lake Watershed, does not provide conditions needed for cyanobacteria or other adverse algal blooms with serious implications for the drinking water quality. These natural nutrient-poor conditions limit the biological productivity in Sooke Lake Reservoir, which is very favourable for a drinking water source.

6. The number of water quality inquiries and complaints received by CRD staff in 2020 was low and similar to that in previous years. The subject of the majority of inquiries and concerns were, as usual, related to chlorine taste and odour or temporary water discolouration, due to operational activities. Lead has emerged as a priority topic for public concerns.

7. The CRD Transmission Mains, CRD Juan de Fuca, and Saanich distribution systems were not in full compliance with the *BC Drinking Water Protection Regulation*, due to samples containing total coliform concentrations higher than the limit of 10 CFU/100 mL, or due to the number of total coliform-positive samples exceeding 10% in a single month. Resamples did not confirm an actual drinking water contamination, therefore, there was no risk to the public, due to these results.

8. All systems did meet the monthly sampling requirements, as per *BC Drinking Water Protection Regulation.* This has been an issue in the past and has now been addressed with additional sampling/testing efforts by the CRD for the CRD and municipal water systems.

9. The analytical results in all CRD and municipal water systems show that the drinking water was of good quality and was safe for consumption at all times throughout 2020.

10. Covid-19 impacts, and issues with the new hypochlorite chlorination plant, prevented the multi-jurisdictional Greater Victoria pH & Corrosion Study from being completed in 2020. The tap sampling component of this project that was designed to assess the risk of lead exposure through drinking water at the residential tap was delayed into 2021. Staff anticipate completing this project in 2021.

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APPENDIX A
TABLE 1. UNTREATED (RAW) WATER QUALITY ENTERING GOLDSTREAM (JAPAN GULCH) WATER TREATMENT PLANT
(Guideline values provide reference only for untreated water)

PARAMETER		2020 ANALYTICAL RESULTS				CANADIAN GUIDELINES	TEN-YEAR RESULTS (2010-2019)			Target Sampling Frequency
Parameter Name	Units of Measure	Median Value	Samples Analyzed	Range		≤ = Less than or equal to	10-Year Median	Samples Analyzed	Range	
				Minimum	Maximum				Minimum - Maximum	
Physical Parameters (ND means less than instrument can detect)										
Alkalinity, Total	mg/L	14.9	18	13.0	15.7		15.3	135	8.84-19.1	12/yr
Carbon, Dissolved Organic	mg/L as C	1.6	14	1.4	4.0		1.72	116	ND-3.34	12/yr
Carbon, Total Organic	mg/L as C	1.8	13	1.3	3.9	Guideline Archived	1.9	118	0.82-3.29	12/yr
Colour, True	TCU	6.0	80	3.0	20.0	≤15 AO	6.4	541	ND-15.2	52/yr
Conductivity @ 25ºC	uS/cm	42.1	53	39.4	46.1		42.2	530	27.5-62.9	52/yr
Hardness as $CaCO_3$	mg/L	16.7	6	15.3	17.3	No Guideline Required	17.3	167	ND-20.9	6/yr
pH	pH units	7.2	41	6.5	7.9	7.0 - 10.5 AO	7.28	532	ND-7.6	52/yr
Tannins and Lignins	mg/L	0.1	2	ND	0.2	Guideline Archived	170	1	170-170	2/yr
Total Dissolved Solids	mg/L	27.0	12	ND	38.0	≤500 AO	27	102	ND-48	12/yr
Total Suspended Solids	mg/L	ND	12	ND	2.0		0.5	112	ND-4	12/yr
Total Solids	mg/L	27.0	14	ND	56.0		32	12	22-40	12/yr
Turbidity, Grab Samples	NTU	0.3	285	0.2	3.1	1.0 Operational Guideline	0.31	2451	0.17-2.7	250/yr
Ultraviolet Absorption, 5 cm	Abs.@254 nm	0.3	83	0.2	0.3		0.26	519	0.16-88.2	52/yr
Ultraviolet Transmittance	%	88.4	89	86.4	90.4		88.6	733	0.2-94.4	52/yr
Water Temp., Grab Samples	degrees C	10.4	243	4.6	20.4	≤15 AO	10.3	2493	2.7-21	250/yr
Non-Metallic Inorganic Chemicals (ND means less than instrument can detect)										
Bromide	ug/L as Br	ND	4	ND	0.00		ND	70	ND-22.79	4/yr
Chloride	mg/L as Cl	2.35	2	2.3	2.40	≤ 250 AO	2.4	25	ND-4.58	4/yr
Cyanide	mg/L as Cn	ND	2	ND	0.00	200 MAC	ND	17	ND-0	4/yr
Fluoride	mg/L as F	ND	4	ND	0.00	1.5 MAC	0.01	23	ND-0.07	4/yr
Iodide, dissolved	mg/L as I	ND	2	ND	0.00		ND	6	ND-0	4/yr
Nitrate, Dissolved	ug/L as N	ND	11	ND	41.00	10000 MAC	10	107	ND-222	12/yr
Nitrite, Dissolved	ug/L as N	ND	11	ND	0.00	1000 MAC	ND	106	ND-5	12/yr
Nitrate + Nitrite	ug/L as N	ND	11	ND	41.00		10	107	ND-55.1	12/yr
Nitrogen, Ammonia	ug/L as N	ND	11	ND	39.00	No Guideline Required	7.5	109	ND-130	12/yr
Nitrogen, Total Kjeldahl	ug/L as N	103	11	68	159.00		85	107	0-610	12/yr
Nitrogen, Total	ug/L as N	107	11	68	159.00		98.56	112	0-610	12/yr
Phosphate, Ortho, Dissolved	ug/L as P	ND	11	ND	1.80		1.5	107	ND-24.3	12/yr
Phosphate, Total, Dissolved	ug/L as P	ND	11	ND	3.40		2.5	111	ND-31	12/yr
Phosphate, Total	ug/L as P	2	11	ND	3.30		3.7	116	ND-12.6	12/yr
Silica	mg/L as SiO_2	4.3	11	3.9	4.90		3.88	97	0.09-5.6	12/yr
Silicon	ug/L as Si	1820	6	1650	2230.00		1860	89	681-2520	6/yr
Sulphate	mg/L as SO_4	1.4	11	ND	1.70	≤ 500 AO	1.74	108	ND-8.16	12/yr
Sulphide	mg/L as H_2S	ND	11	ND	0.01	≤ 0.05 AO	ND	43	ND-0.13	12/yr

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Appendix A, Table 1, continued

PARAMETER		2020 ANALYTICAL RESULTS				CANADIAN GUIDELINES	TEN-YEAR RESULTS (2010-2019)			Target Sampling Frequency
Parameter Name	Units of Measure	Median Value	Samples Analyzed	Range		≤ = Less than or equal to	10-Year Median	Samples Analyzed	Range	
				Minimum	Maximum				Minimum - Maximum	
Sulphur	mg/L as S	ND	6	ND	0.00		ND	87	ND-0	6/yr
Metallic Inorganic Chemicals (ND means less than instrument can detect)										
Aluminum	ug/L as Al	18.8	6	6	24.90	2900 MAC / 100 OG	13.8	89	ND-52.3	6/yr
Antimony	ug/L as Sb	ND	6	ND	0.00	6 MAC	ND	89	ND-0	6/yr
Arsenic	ug/L as	ND	6	ND	0.00	10 MAC	ND	89	ND-0.24	6/yr
Barium	ug/L as Ba	3.7	6	3.3	4.00	2000 MAC	3.9	89	ND-5	6/yr
Beryllium	ug/L as Be	ND	6	ND	0.00		ND	89	ND-0	6/yr
Bismuth	ug/L as Bi	ND	6	ND	0.00		ND	89	ND-0	6/yr
Boron	ug/L as B	ND	6	ND	0.00	5000 MAC	ND	89	ND-0	6/yr
Cadmium	ug/L as Cd	ND	6	ND	0.00	7 MAC	ND	89	ND-0.2	6/yr
Calcium	mg/L as Ca	4.79	6	4.44	4.98	No Guideline Required	5	88	ND-5.78	6/yr
Chromium	ug/L as Cr	ND	6	ND	0.00	50 MAC	ND	89	ND-0	6/yr
Cobalt	ug/L as Co	ND	6	ND	0.00		ND	89	ND-0	6/yr
Copper	ug/L as Cu	0.85	6	0.73	1.85	2000 MAC / ≤ 1000 AO	1.5	89	ND-30.5	6/yr
Iron	ug/L as Fe	25.2	6	13.9	63.30	≤ 300 AO	30	89	ND-217	6/yr
Lead	ug/L as Pb	ND	6	ND	0.00	5 MAC	ND	89	ND-0.4	6/yr
Lithium	ug/L as Li	Not tested in 2020					ND	77	ND-10.4	6/yr
Magnesium	mg/L as Mg	1.14	6	1.01	1.19	No Guideline Required	1.18	88	0.44-1.6	6/yr
Manganese	ug/L as Mn	4.8	6	1.4	22.80	120 MAC / ≤ 20 AO	5	89	ND-81.8	6/yr
Mercury, Total	ug/L as Hg	ND	6	ND	0.00	1.0 MAC	ND	87	ND-0.16	6/yr
Molybdenum	ug/L as Mo	ND	6	ND	0.00		ND	89	ND-0	6/yr
Nickel	ug/L as Ni	ND	6	ND	0.00		ND	89	ND-3	6/yr
Potassium	mg/L as K	0.13	6	0.13	0.14		0.14	88	ND-0.23	6/yr
Selenium	ug/L as Se	ND	6	ND	0.00	50 MAC	ND	89	ND-0	6/yr
Silver	ug/L as Ag	ND	6	ND	0.00	No Guideline Required	ND	89	ND-0.02	6/yr
Sodium	mg/L as Na	1.62	6	1.48	1.67	≤ 200 AO	1.7	88	ND-2.91	6/yr
Strontium	ug/L as Sr	14.6	6	13.5	15.50	7000 MAC	15.4	89	6.3-21.8	6/yr
Thallium	ug/L as Tl	ND	6	ND	0.00		ND	89	ND-0	6/yr
Tin	ug/L as Sn	ND	6	ND	0.00		ND	89	ND-0	6/yr
Titanium	mg/L as Ti	ND	6	ND	0.00		ND	89	ND-0	6/yr
Uranium	ug/L as U	ND	6	ND	0.00	20 MAC	ND	89	ND-0	6/yr
Vanadium	ug/L as V	ND	6	ND	0.00		ND	89	ND-0	6/yr
Zinc	ug/L as Zn	ND	6	ND	0.00	≤ 5000 AO	ND	89	ND-82.9	6/yr
Zirconium	ug/L as Zr	ND	6	ND	0.00		ND	89	ND-0	6/yr
Microbial Parameters										
Coliform Bacteria										
Coliforms, Total	Coliforms/100 mL	9	419	ND	470.00		11	2472	ND-24200	250/yr
E. coli	*E. coli*/100 mL	ND	419	ND	2.00		ND	2468	ND-15	250/yr

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Appendix A, Table 1, continued

PARAMETER		2020 ANALYTICAL RESULTS				CANADIAN GUIDELINES	TEN-YEAR RESULTS (2010-2019)			Target Sampling Frequency
Parameter Name	Units of Measure	Median Value	Samples Analyzed	Range Minimum	Range Maximum	≤ = Less than or equal to	10-Year Median	Samples Analyzed	Range Minimum - Maximum	
Heterotrophic / Other Bacteria										
Hetero. Plate Count, 28C (7 day)	CFU/1 mL	300.0	396.0	70.0	940.0		350	2417	ND-7200	250/yr
Cyanobacterial Toxins										
Anatoxin a	ug/L	Analyzed as required - last analyzed in 2005					ND	2	ND - ND	Special
Microcystin-LR	ug/L	Analyzed as required - last analyzed in 2011				1.5 MAC (Total Microcystins)	ND	11	ND - 0.34	Special
Parasites										
Cryptosporidium, Total oocysts	oocysts/100 L	ND	8	ND	0.00	Zero detection desirable	0	109	0 - 1	8/yr
Giardia, Total cysts	cysts/100 L	ND	8	ND	0.00	Zero detection desirable	0	108	0 - 2	8/yr
Radiological Parameters (ND means less than instrument can detect)										
Gross alpha radiation	Bq/L	ND	2	ND	0.00	0.5 (Screening)	ND	21	ND - 0.04	2/yr
Gross beta radiation	Bq/L	0.02	2	ND	0.02	1.0 (Screening)	ND	21	ND - 0.11	2/yr
Iodine-131	Bq/L	ND	2	ND	0.00	6 Bq/L	ND	17	ND - 0.0	Special
Cesium-134	Bq/L	Not tested in 2020					ND	14	ND - 0.20	Special
Cesium-137	Bq/L	ND	2	ND	0.00	10 Bq/L	ND	17	ND - 0.0	Special
Ruthenium-103	Bq/L	Not tested in 2020					ND	12	ND - 0.0	Special
Uranium	ug/L as U	ND	6	ND	0.00	20 MAC	ND	89	ND-0	6/yr
Organic Parameters (ND means less than instrument can detect)										
Pesticides/Herbicides										
1,4-DDD	ug/L	ND	2	ND	0.00	Guideline Archived	ND	17	ND-0	2/yr
1,4'-DDE	ug/L	ND	2	ND	0.00	Guideline Archived	ND	17	ND-0	2/yr
1,4'-DDT	ug/L	ND	2	ND	0.00	Guideline Archived	ND	17	ND-0	2/yr
2,4,5-T	ug/L	ND	2	ND	0.00	Guideline Archived	ND	18	ND-0	2/yr
2,4,5-TP (Silvex)	ug/L	ND	2	ND	0.00	Guideline Archived	ND	18	ND-0	2/yr
2,4-D (2,4-Dichlorophenoxy acetic acid)	ug/L	ND	2	ND	0.00	100 MAC	ND	1	ND-0	2/yr
2,4-D (BEE)	ug/L	ND	2	ND	0.00		ND	17	ND-0	2/yr
2,4-DP (Dichlorprop)	ug/L	ND	2	ND	0.00		ND	17	ND-0	2/yr
4,4'-DDD	ug/L	ND	2	ND	0.00	Guideline Archived	ND	15	ND-0	2/yr
4,4'-DDE	ug/L	ND	2	ND	0.00	Guideline Archived	ND	15	ND-0	2/yr
4,4'-DDT	ug/L	ND	2	ND	0.00	Guideline Archived	ND	15	ND-0	2/yr
Alachlor	ug/L	Not tested in 2020				Guideline Archived	ND	8	ND-ND	2/yr
Aldicarb	ug/L	ND	2	ND	0.00	Guideline Archived	ND	19	ND-0	2/yr
Aldrin	ug/L	ND	2	ND	0.00		ND	17	ND-0	2/yr
Aldrin + Dieldrin	ug/L	ND	2	ND	0.00	Guideline Archived	ND	6	ND-0	2/yr
Atrazine	ug/L	ND	2	ND	0.00	5 MAC	ND	18	ND-0	2/yr
Azinphos-methyl	ug/L	ND	2	ND	0.00	20 MAC	ND	18	ND-0	2/yr
BHC (alpha)	ug/L	ND	2	ND	0.00		ND	18	ND-0	2/yr
BHC (beta)	ug/L	ND	2	ND	0.00		ND	19	ND-0	2/yr
BHC (delta)	ug/L	ND	2	ND	0.00		ND	18	ND-0	2/yr
Bendiocarb	ug/L	ND	2	ND	0.00	Guideline Archived	ND	19	ND-0	Irregular

Appendix A, Table 1, continued

PARAMETER		2020 ANALYTICAL RESULTS				CANADIAN GUIDELINES	TEN-YEAR RESULTS (2010-2019)			Target Sampling Frequency
Parameter Name	Units of Measure	Median Value	Samples Analyzed	Range		< = Less than or equal to	10-Year Median	Samples Analyzed	Range	
				Minimum	Maximum				Minimum - Maximum	
Bromacil	ug/L	ND	2	ND	0.00		ND	10	ND-0	2/yr
Bromoxynil	ug/L	ND	2	ND	0.00	5.0 MAC	ND	15	ND-0	2/yr
Captan	ug/L	ND	2	ND	0.00		ND	8	ND-0	2/yr
Carbaryl	ug/L	ND	2	ND	0.00	90 MAC	ND	19	ND-0	2/yr
Carbofuran	ug/L	ND	2	ND	0.00	90 MAC	ND	19	ND-0	2/yr
Chlordane (alpha)	ug/L	ND	2	ND	0.00	Guideline Archived	ND	11	ND-0	2/yr
Chlordane (gamma)	ug/L	ND	2	ND	0.00	Guideline Archived	ND	17	ND-0	2/yr
Chlorpyrifos (Dursban)	ug/L	ND	2	ND	0.00	90 MAC	ND	1	ND-0	2/yr
Chlorothalonil	ug/L	ND	2	ND	0.00		ND	1	ND-0	2/yr
Cyanazine (Bladex)	ug/L	ND	2	ND	0.00	Guideline Archived	ND	16	ND-0	2/yr
Demeton	ug/L	ND	2	ND	0.00		ND	8	ND-0	2/yr
Desisopropylatrazine	ug/L	ND	2	ND	0.00		Not reported prior to 2020			2/yr
Diazinon	ug/L	ND	2	ND	0.00	20 MAC	ND	19	ND-0	2/yr
Dicamba	ug/L	ND	2	ND	0.00	120 MAC	ND	20	ND-0	2/yr
Diclofop-methyl	ug/L	ND	2	ND	0.0	9 MAC	ND	15	ND-ND	2/yr
Dichlorvos	ug/L	ND	2	ND	0.00		ND	17	ND-0	2/yr
Dieldrin	ug/L	ND	2	ND	0.00		ND	17	ND-0	2/yr
Dimethoate	ug/L	ND	2	ND	0.00	20 MAC	ND	19	ND-0	2/yr
Dinoseb (DNBP)	ug/L	ND	2	ND	0.00	Guideline Archived	ND	15	ND-0	2/yr
Diquat	ug/L	ND	2	ND	0.00	70 MAC	ND	18	ND-0	2/yr
Endosulfan I	ug/L	ND	2	ND	0.00		ND	17	ND-0	2/yr
Endosulfan II	ug/L	ND	2	ND	0.00		ND	17	ND-0	2/yr
Endosulfan Sulphate	ug/L	ND	2	ND	0.00		ND	18	ND-0	2/yr
Endosulfan (Total)	ug/L	ND	2	ND	0.00		ND	1	ND-0	2/yr
Endrin	ug/L	ND	2	ND	0.00	Guideline Archived	ND	17	ND-0	2/yr
Endrin Aldehyde	ug/L	ND	2	ND	0.00		ND	18	ND-0	2/yr
Endrin Ketone	ug/L	ND	2	ND	0.00		ND	18	ND-0	2/yr
Ethion	ug/L	ND	2	ND	0.00		ND	16	ND-0	2/yr
Ethyl Parathion	ug/L	ND	2	ND	0.00		ND	18	ND-0	2/yr
Fenchlorophos (Ronnel)	ug/L	ND	2	ND	0.00		ND	17	ND-0	2/yr
Fenthion	ug/L	ND	2	ND	0.00		ND	16	ND-0	2/yr
Fonofos	ug/L	ND	2	ND	0.00		ND	17	ND-0	2/yr
Glyphosate	ug/L	ND	2	ND	0.00	280 MAC	ND	18	ND-0	2/yr
Heptachlor	ug/L	ND	2	ND	0.00	Guideline Archived	ND	17	ND-0	2/yr
Heptachlor Epoxide	ug/L	ND	2	ND	0.00	Guideline Archived	ND	17	ND-0	2/yr
Imazapyr	ug/L	ND	2	ND	0.00		ND	8	ND-0	2/yr
Imidacloprid	ug/L	ND	2	ND	0.00		ND	8	ND-0	2/yr
IPBC	ug/L	ND	2	ND	0.00		ND	8	ND-0	2/yr
Lindane (BHC-gamma)	ug/L	ND	2	ND	0.00	Guideline Archived	ND	17	ND-0	2/yr

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Appendix A, Table 1, continued

PARAMETER		2020 ANALYTICAL RESULTS				CANADIAN GUIDELINES	TEN-YEAR RESULTS (2010-2019)			Target Sampling Frequency
Parameter Name	Units of Measure	Median Value	Samples Analyzed	Range Minimum	Range Maximum	≤ = Less than or equal to	10-Year Median	Samples Analyzed	Range Minimum - Maximum	
Malathion	ug/L	ND	2	ND	0.00	190 MAC	ND	19	ND-0	2/yr
MCPA	ug/L	ND	2	ND	0.00	100 MAC	ND	22	ND-0	2/yr
MCPP	ug/L	ND	2	ND	0.00		ND	17	ND-0	2/yr
Methoxychlor	ug/L	ND	2	ND	0.00	Guideline Archived	ND	17	ND-0	2/yr
Methyl Parathion	ug/L	ND	2	ND	0.00	Guideline Archived	ND	20	ND-0	2/yr
Metolachlor	ug/L	ND	2	ND	0.00	50 MAC	ND	18	ND-0	2/yr
Metribuzin (Sencor)	ug/L	ND	2	ND	0.00	80 MAC	ND	14	ND-0	2/yr
Mevinphos	ug/L	ND	2	ND	0.00		ND	17	ND-0	2/yr
Mirex	mg/L	ND	2	ND	0.00	Guideline Archived	ND	18	ND-0	2/yr
Nitrilotriacetic acid (NTA)	ug/L	ND	2	ND	0.00	400 MAC	ND	18	ND-0.1	Irregular
Oxychlordane	ug/L	ND	2	ND	0.00		ND	8	ND-0	2/yr
Parathion	ug/L	ND	2	ND	0.00	Guideline Archived	ND	10	ND-0	2/yr
Paraquat (ion)	ug/L	ND	2	ND	0.00	7 MAC	ND	18	ND-0	2/yr
Permethrin	ug/L	ND	2	ND	0.00		ND	1	ND-0	2/yr
Phorate (Thimet)	ug/L	ND	2	ND	0.00	2 MAC	ND	18	ND-0	2/yr
Phosmet	ug/L	ND	2	ND	0.00		ND	17	ND-0	2/yr
Picloram	ug/L	ND	2	ND	0.00	190 MAC	ND	19	ND-0	2/yr
Prometryn	ug/L	ND	2	ND	0.00		ND	13	ND-ND	Irregular
Simazine	ug/L	ND	2	ND	0.00	10 MAC	ND	17	ND-0	2/yr
Tebuthiuron	ug/L	ND	2	ND	0.00		ND	8	ND-0	2/yr
Temephos	ug/L	Not tested in 2020				Guideline Archived	ND	6	ND-ND	2/yr
Terbufos	ug/L	ND	2	ND	0.00	1 MAC	ND	18	ND-0	2/Yyr
Toxaphene	ug/L	Not tested in 2020				Guideline Archived	ND	13	ND-ND	2/Yyr
Trifluralin	ug/L	ND	2	ND	0.00	45 MAC	ND	19	ND-0	2/Yyr
Polycyclic Aromatic Hydrocarbons (PAHs)										
Acenaphthene	ug/L	0.01	2	ND	0.01	Guideline Archived	ND	19	ND-0	2/yr
Acenaphthylene	ug/L	0.01	2	ND	0.02	Guideline Archived	ND	19	ND-0	2/yr
Anthracene	ug/L	ND	2	ND	0.00	Guideline Archived	ND	19	ND-0	2/yr
Benzo(a)anthracene	ug/L	ND	2	ND	0.00	Guideline Archived	ND	18	ND-0.02	2/yr
Benzo(a)pyrene	ug/L	ND	2	ND	0.00	0.04 MAC	ND	16	ND-0.01	2/yr
Benzo(b)fluoranthene	ug/L	ND	2	ND	0.00	Guideline Archived	ND	17	ND-0	2/yr
Benzo(g,h,i)perylene	ug/L	ND	2	ND	0.00	Guideline Archived	ND	1	ND-0	2/yr
Benzo(b&j)fluoranthene	ug/L	ND	2	ND	0.00	Guideline Archived	Not reported prior to 2020			2/yr
Benzo(k)fluoranthene	ug/L	ND	2	ND	0.00	Guideline Archived	ND	1	ND-0	2/yr
Chrysene	ug/L	ND	2	ND	0.00	Guideline Archived	ND	19	ND-0.03	2/yr
Dibenz(a,h)anthracene	ug/L	ND	2	ND	0.00	Guideline Archived	ND	19	ND-0.04	2/yr
Fluoranthene	ug/L	0.02	2	ND	0.03	Guideline Archived	ND	19	ND-0.02	2/yr
Fluorene	ug/L	0.01	2	ND	0.01	Guideline Archived	ND	19	ND-0.03	2/yr
Indeno(1,2,3-c,d)pyrene	ug/L	ND	2	ND	0.00	Guideline Archived	ND	19	ND-0	2/yr

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Appendix A, Table 1, continued

PARAMETER		2020 ANALYTICAL RESULTS				CANADIAN GUIDELINES	TEN-YEAR RESULTS (2010-2019)			Target Sampling Frequency
Parameter Name	Units of Measure	Median Value	Samples Analyzed	Range		≤ = Less than or equal to	10-Year Median	Samples Analyzed	Range	
				Minimum	Maximum				Minimum - Maximum	
Naphthalene	ug/L	0.01	2	ND	0.02	Guideline Archived	ND	18	ND-0	2/yr
Phenanthrene	ug/L	0.01	2	ND	0.02	Guideline Archived	ND	19	ND-0.08	2/yr
Pyrene	ug/L	0.02	2	ND	0.03	Guideline Archived	ND	19	ND-0	2/yr
Volatile Hydrocarbons	ug/L	ND	4	ND	0.00	Guideline Archived	ND	22	ND-0	2/yr
Phenols										
2,3,4,5-Tetrachlorophenol	ug/L	ND	2	ND	0.00		ND	6	ND-ND	2/yr
2,3,4,6-Tetrachlorophenol	ug/L	ND	2	ND	0.00	100 MAC and ≤ 1.0 AO	ND	13	ND-ND	2/yr
2,3,5,6-Tetrachlorophenol	ug/L	ND	2	ND	0.00		ND	7	ND-0	2/yr
2,4,6-Trichlorophenol	ug/L	ND	2	ND	0.00	5.0 MAC and ≤ 2.0 AO	ND	17	ND-ND	2/yr
2,4-Dichlorophenol	ug/L	ND	2	ND	0.00	900 MAC and ≤ 0.3 AO	ND	1	ND-0	2/yr
2,4-Dimethylphenol	ug/L	ND	2	ND	0.00		ND	1	ND-0	2/yr
2,4-Dinitrophenol	ug/L	ND	2	ND	0.00		ND	19	ND-0	2/yr
2-Chlorophenol	ug/L	ND	2	ND	0.00		ND	1	ND-0	2/yr
2-Nitrophenol	ug/L	ND	2	ND	0.00		ND	18	ND-0	2/yr
4,6-Dinitro-2-Methylphenol	ug/L	ND	2	ND	0.00		ND	1	ND-0	2/yr
4-Chloro-3-Methylphenol	ug/L	ND	2	ND	0.00		ND	19	ND-0	2/yr
4-Nitrophenol	ug/L	ND	2	ND	0.00		ND	19	ND-0	2/yr
Alpha-Terpineol	ug/L	ND	2	ND	0.00		ND	1	ND-0	2/yr
Pentachlorophenol	ug/L	ND	2	ND	0.00	60 MAC and ≤ 30 AO	ND	17	ND-0	2/yr
Phenol	ug/L	ND	2	ND	0.00		ND	21	ND-6.2	2/yr
Total Phenolics	ug/L	ND	2	ND	0.00	Guideline Archived	1.3	10	ND-8.2	2/yr
Polychlorinated Biphenyls (PCBs)										
PCB-1016	ug/L	ND	2	ND	0.00	Guideline Archived	ND	15	ND-ND	Irregular
PCB-1221	ug/L	ND	2	ND	0.00	Guideline Archived	ND	15	ND-ND	Irregular
PCB-1232	ug/L	ND	2	ND	0.00	Guideline Archived	ND	15	ND-ND	Irregular
PCB-1242	ug/L	ND	2	ND	0.00	Guideline Archived	ND	15	ND-ND	Irregular
PCB-1248	ug/L	ND	2	ND	0.00	Guideline Archived	ND	15	ND-ND	Irregular
PCB-1254	ug/L	ND	2	ND	0.00	Guideline Archived	ND	15	ND-ND	Irregular
PCB-1260	ug/L	ND	2	ND	0.00	Guideline Archived	ND	16	ND-ND	Irregular
PCB-1262	ug/L	ND	2	ND	0.00	Guideline Archived	ND	4	ND-ND	Irregular
PCB-1268	ug/L	ND	2	ND	0.00	Guideline Archived	ND	4	ND-ND	Irregular
Total PCBs	ug/L	ND	2	ND	0.00	Guideline Archived	ND	15	ND-ND	Irregular
Other Synthetic Chemicals										
1,1,1-Trichloroethane	ug/L	ND	2	ND	0.00		ND	19	ND-0	
1,1,1,2-Tetrachloroethane	ug/L	ND	2	ND	0.0		ND	19	ND-ND	
1,1,2,2-Tetrachloroethane	ug/L	ND	2	ND	0.0		ND	17	ND-ND	
1,1,2-Trichloroethane	ug/L	ND	2	ND	0.00		ND	19	ND-0	
1,1-Dichloroethane	ug/L	ND	2	ND	0.00		ND	1	ND-0	
1,1-Dichloroethene (1,1-Dichloroethylene)	ug/L	ND	2	ND	0.00	14 MAC	ND	1	ND-0	

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Appendix A, Table 1, continued

PARAMETER		2020 ANALYTICAL RESULTS				CANADIAN GUIDELINES	TEN-YEAR RESULTS (2010-2019)			Target Sampling Frequency
Parameter Name	Units of Measure	Median Value	Samples Analyzed	Range Minimum	Range Maximum	≤ = Less than or equal to	10-Year Median	Samples Analyzed	Range Minimum - Maximum	
1,2,3-Trichlorobenzene	ug/L	ND	2	ND	0.00		ND	12	ND-0	
1,2,4-Trichlorobenzene	ug/L	ND	2	ND	0.00		ND	21	ND-0.2	
1,2-Dibromoethane	ug/L	ND	2	ND	0.00		ND	12	ND-0	
1,2-Dichlorobenzene	ug/L	ND	2	ND	0.00	200 MAC and ≤ 3.0 AO	ND	19	ND-0	
1,2-Dichloroethane	ug/L	ND	2	ND	0.00	5.0 MAC	ND	19	ND-0	
1,2-Dichloroethene (cis)	ug/L	ND	2	ND	0.00		ND	18	ND-ND	
1,2-dichloroethene (trans)	ug/L	ND	2	ND	0.00		ND	18	ND-ND	
1,2-Dichloropropane	ug/L	ND	2	ND	0.00		ND	1	ND-0	
1,2-Diphenylhydrazine	ug/L	ND	2	ND	0.00		ND	18	ND-ND	
1,3-Dichlorobenzene	ug/L	ND	2	ND	0.00		ND	18	ND-0	
1,3-Dichloropropene (cis)	ug/L	ND	2	ND	0.00		ND	18	ND-ND	
1,3-Dichloropropene (trans)	ug/L	ND	2	ND	0.00		ND	18	ND-ND	
1,4-Dichlorobenzene	ug/L	ND	2	ND	0.00	5.0 MAC and ≤ 1.0 AO	ND	19	ND-0	
2,4-Dinitrotoluene	ug/L	ND	2	ND	0.00		ND	19	ND-0	
2,6-Dinitrotoluene	ug/L	ND	2	ND	0.00		ND	19	ND-0	
2-Chloronaphthalene	ug/L	ND	2	ND	0.00		ND	19	ND-0	
1-Methylnaphthalene	ug/L	ND	2	ND	0.00		ND	3	ND-0	
2-Methylnaphthalene	ug/L	ND	2	ND	0.00		ND	19	ND-0	
3,3'-Dichlorobenzidene	ug/L	ND	2	ND	0.00		ND	19	ND-0	
4-Bromophenyl-phenylether	ug/L	ND	2	ND	0.00		ND	18	ND-ND	
4-Chlorophenyl-phenylether	ug/L	ND	2	ND	0.00		ND	18	ND-ND	
Atrazine	ug/L	ND	2	ND	0.00	5.0 MAC	ND	18	ND-0	
Atrazine + Desethyl Atrazine	ug/L	ND	2	ND	0.00		ND	8	ND-0	
Benzene	ug/L	ND	4	ND	0.00	5.0 MAC	ND	23	ND-0	
Benzidine	ug/L	Not tested in 2020					ND	15	ND-ND	
Bis(-2-chloroethoxy) methane	ug/L	ND	2	ND	0.00		ND	18	ND-ND	
Bis(-2-chloroethyl) ether	ug/L	ND	2	ND	0.00		ND	18	ND-ND	
Bis(2-chloroisopropyl) ether	ug/L	ND	2	ND	0.00		ND	18	ND-ND	
Bis(2-ethylhexyl) phthalate	ug/L	ND	2	ND	0.00		ND	18	ND-1.7	
Bromodichloromethane	ug/L	ND	2	ND	0.00		ND	18	ND-ND	
Bromobenzene	ug/L	ND	2	ND	0.00		ND	8	ND-ND	
Bromoform	ug/L	ND	2	ND	0.00		ND	19	ND-0	
Bromomethane	ug/L	ND	2	ND	0.00		ND	19	ND-0	
Butylbenzyl phthalate	ug/L	ND	2	ND	0.00		ND	17	ND-ND	
Carbon Tetrachloride (Tetrabromomethane)	ug/L	ND	2	ND	0.00	2.0 MAC	ND	1	ND-0	
Chloroform	ug/L	ND	2	ND	0.00		ND	19	ND-0	
Chloroethane	ug/L	ND	2	ND	0.00		ND	19	ND-0	
Chloromethane	ug/L	ND	2	ND	0.00		ND	19	ND-0	
Desethyl Atrazine	ug/L	ND	2	ND	0		ND	13	ND-ND	

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Appendix A, Table 1, continued

PARAMETER		2020 ANALYTICAL RESULTS				CANADIAN GUIDELINES	TEN-YEAR RESULTS (2010-2019)			Target Sampling Frequency
Parameter Name	Units of Measure	Median Value	Samples Analyzed	Range Minimum	Range Maximum	≤ = Less than or equal to	10-Year Median	Samples Analyzed	Range Minimum - Maximum	
Dibromochloromethane	ug/L	ND	2	ND	0		ND	1	ND-0	
Dibromomethane	ug/L	Not tested in 2020					ND	6	ND-ND	
Dichlorodifluoromethane	ug/L	ND	2	ND	0.00		ND	14	ND-0	
Dichloromethane	ug/L	ND	2	ND	0.00	50 MAC	ND	19	ND-0	
Diethyl phthalate	ug/L	ND	2	ND	0.00		ND	18	ND-0.6	
Dimethyl phthalate	ug/L	ND	2	ND	0.00		ND	18	ND-0	
Di-n-butyl phthalate	ug/L	ND	2	ND	0.00		ND	16	ND-4.9	
Di-n-ocyl phthalate	ug/L	ND	2	ND	0.00		ND	17	ND-ND	
Diuron	ug/L	ND	2	ND	0.00	150 MAC	ND	13	ND-0	
Ethylbenzene	ug/L	ND	4	ND	0.00	140 MAC and ≤ 1.6 AO	ND	19	ND-ND	
Formaldehyde	ug/L	ND	4	ND	0.00	No Guideline Required	ND	19	ND-18	
Hexachlorobenzene	ug/L	ND	2	ND	0.00		ND	19	ND-0	
Hexachlorobutadiene	ug/L	ND	2	ND	0.00		ND	25	ND-0	
Hexachlorocyclopentadiene	ug/L	ND	2	ND	0.00		ND	20	ND-0	
Hexachloroethane	ug/L	ND	2	ND	0.00		ND	21	ND-0	
Isophorone	ug/L	ND	2	ND	0.00	30 MAC	ND	19	ND-0	
Methyltertiarybutylether (MTBE)	ug/L	ND	4	ND	0.00	15 AO	ND	30	ND-0	
Monochlorobenzene	ug/L	ND	2	ND	0.00	80 MAC and ≤ 30 AO	ND	19	ND-0	
Nitrobenzene	ug/L	ND	1	ND	0	0.04 MAC	ND	11	ND-ND	
N-nitrosodimethylamine (NDMA)	ug/L	ND	2	ND	0.00	0.04 MAC	ND	19	ND-0	
N-nitroso-di-n-propylamine	ug/L	ND	2	ND	0.00		ND	19	ND-0	
N-nitrosodiphenylamine	ug/L	ND	2	ND	0		ND	19	ND-0	
Octachlorostyrene	ug/L	ND	2	ND	0.00		ND	17	ND-ND	
Styrene	ug/L	ND	4	ND	0.00		ND	19	ND-ND	
Tetrachloroethene	ug/L	ND	2	ND	0.00	10 MAC	ND	19	ND-0	
Toluene	ug/L	ND	4	ND	0.00	60 MAC and ≤ 24 AO	ND	23	ND-0	
Triallate	ug/L	ND	2	ND	0.00	Guideline Archived	ND	19	ND-0	
Trichloroethene	ug/L	ND	2	ND	0.00	5.0 MAC	ND	15	ND-ND	
Trichlorofluoromethane	ug/L	ND	2	ND	0.00		ND	18	ND-ND	
Trichlorotrifluoroethane	ug/L	ND	2	ND	0		ND	9	ND-ND	
Vinyl Chloride	ug/L	ND	2	ND	0.00	2.0 MAC	ND	19	ND-0	
o-Xylene	ug/L	ND	4	ND	0.00		ND	18	ND-ND	
m&p-Xylene	ug/L	ND	4	ND	0.00		ND	23	ND-0	
Xylenes (Total)	ug/L	ND	4	ND	0.00	90 MAC and ≤ 20 AO	ND	23	ND-0	
Miscellaneous										
Perfluorobutanioc Acid	ug/L	ND	1	ND	0.00		Not tested prior to 2020			2/yr
Perfluoropentanoic Acid (PFPeA)	ug/L	ND	1	ND	0.00		Not tested prior to 2020			2/yr
Perfluorohexanoic Acid (PFHxA)	ug/L	ND	1	ND	0.00		Not tested prior to 2020			2/yr
Perfluoroheptanoic Acid (PFHpA)	ug/L	ND	1	ND	0.00		Not tested prior to 2020			2/yr

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Appendix A, Table 1, continued

PARAMETER		2020 ANALYTICAL RESULTS				CANADIAN GUIDELINES	TEN-YEAR RESULTS (2010-2019)			Target Sampling Frequency
Parameter Name	Units of Measure	Median Value	Samples Analyzed	Range Minimum	Range Maximum	≤ = Less than or equal to	10-Year Median	Samples Analyzed	Range Minimum - Maximum	
Perfluorooctanoic Acid (PFOA)	ug/L	ND	1	ND	0.00	0.2 MAC	Not tested prior to 2020			2/yr
Perfluorononanoic Acid (PFNA)	ug/L	ND	1	ND	0.00		Not tested prior to 2020			2/yr
Perfluorodecanoic Acid (PFDA)	ug/L	ND	1	ND	0.00		Not tested prior to 2020			2/yr
Perfluoroundecanoic Acid (PFUnA)	ug/L	ND	1	ND	0.00		Not tested prior to 2020			2/yr
Perflurotridecanoic Acid	ug/L	ND	1	ND	0.00		Not tested prior to 2020			2/yr
Perfluorotetradecnoic Acid	ug/L	ND	1	ND	0.00		Not tested prior to 2020			2/yr
Perfluorobutanesulfonic Acid	ug/L	ND	1	ND	0.00		Not tested prior to 2020			2/yr
Perfluoropentanesulfonic Acid	ug/L	ND	1	ND	0.00		Not tested prior to 2020			2/yr
Perfluorohexanesulfonic Acid	ug/L	ND	1	ND	0.00		Not tested prior to 2020			2/yr
Perfluoroheptanesulfonic Acid	ug/L	ND	1	ND	0.00		Not tested prior to 2020			2/yr
Perfluorooctanesulfonic Acid	ug/L	ND	1	ND	0.00		Not tested prior to 2020			2/yr
Perfluorononane sulfonic Acid (PFOS)	ug/L	ND	1	ND	0.00	0.6 MAC	Not tested prior to 2020			2/yr
Perfluorodecanesulfonic Acid (PFDS)	ug/L	ND	1	ND	0.00		Not tested prior to 2020			2/yr
Perfluorooctane Sulfonamide (PFOSA)	ug/L	ND	1	ND	0.00		Not tested prior to 2020			2/yr
4:2 Flurotelomer Sulfonic Acid	ug/L	ND	1	ND	0.00		Not tested prior to 2020			2/yr
6:2 Flurotelomer Sulfonic Acid	ug/L	ND	1	ND	0.00		Not tested prior to 2020			2/yr
8:2 Flurotelomer Sulfonic Acid	ug/L	ND	1	ND	0.00		Not tested prior to 2020			2/yr

Notes: mg/L = milligrams per litre; ug/L = micrograms per litre; ND = Not Detected; CFU = Colony Forming Units; NTU = Nephelometric Units; TCU = True Colour Units; AO = Aesthetic Objective; MAC = Max. Acceptable Conc.; Median = middle point of all values

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APPENDIX A

TABLE 2. 2020 TREATED WATER QUALITY AFTER GOLDSTREAM (JAPAN GULCH) WATER TREATMENT PLANT

PARAMETER		2020 ANALYTICAL RESULTS				CANADIAN GUIDELINES	TEN-YEAR RESULTS (2010-2019)			Target Sampling Frequency
Parameter Name	Units of Measure	Median Value	Samples Analyzed	Range Minimum	Range Maximum	≤ = Less than or equal to	10-Year Median	Samples Analyzed	Range Minimum - Maximum	
Physical Parameters (ND means less than instrument can detect)										
Alkalinity, Total	mg/L	13.1	64	11.8	14		13.5	79	6.92-17.6	12/yr
Carbon, Dissolved Organic	mg/L	1.7	11	1.4	3.9		1.76	66	0.59-370	12/yr
Carbon, Total Organic	mg/L	1.65	12	1.4	4.6	Guideline Archived	1.84	66	0.93-4.99	12/yr
Colour, True	TCU	4	99	ND	10	≤ 15 AO	4	297	ND-10	52/yr
Conductivity @ 25ºC	uS/cm	45.15	90	40.7	60.6		45.4	299	31.1-98.6	52/yr
Hardness as $CaCO_3$	mg/L	16.5	11	15.1	17.6	No Guideline Required	17.45	98	12-22.1	12/yr
Odour	Odour Profile	1	400	1	1	Inoffensive	1	1179	1-1	250/yr
pH	pH units	7.1	88	6.6	7.51	7.0-10.5 AO	7	295	6.54-8.08	52/yr
Taste	Flavour Profile	1	398	1	1	Inoffensive	1	1172	1-1	250/yr
Total Dissolved Solids	mg/L	26	11	ND	42	≤500 AO	27	56	ND-78	12/yr
Total Suspended Solids	mg/L	ND	11	ND	6		ND	66	ND-10.9	12/yr
Total Solids	mg/L	32	19	18	52		33.5	6	17-38	12/yr
Turbidity, Grab Samples	NTU	0.3	449	0.2	2.8	1 Operational and ≤ 5 AO	0.31	1381	0.14-6.3	250/yr
Water Temperature, Grab Samples	degrees C	10.5	455	4.7	20.4	≤ 15 AO	10.8	1376	2.5-21.1	250/yr
Non-Metallic Inorganic Chemicals (ND means less than instrument can detect)										
Bromide	ug/L as Br	ND	4	ND	0		ND	26	ND-43	4/yr
Chloride	mg/L as Cl	4.4	2	4.3	4.50	≤ 250 AO	4	17	ND-5.3	4/yr
Cyanide	mg/L as Cn	ND	4	ND	0	0.2 MAC	ND	9	ND-0	4/yr
Fluoride	mg/L as F	ND	4	ND	0	1.5 MAC	ND	15	ND-0.03	4/yr
Nitrate, Dissolved	ug/L as N	ND	11	ND	45	10000 MAC	10	61	ND-47.5	12/yr
Nitrite, Dissolved	ug/L as N	ND	11	ND	5	1000 MAC	ND	60	ND-25	12/yr
Nitrate + Nitrite	ug/L as N	ND	11	ND	45		10	63	ND-47.5	12/yr
Nitrogen, Ammonia	ug/L as N	280	11	210	390		135	66	ND-500	12/yr
Nitrogen, Total Kjeldahl	ug/L as N	404	11	366	454		263	61	0-490	12/yr
Nitrogen, Total	ug/L as N	428	11	377	475		273	65	0-508	12/yr
Phosphate, Ortho, Dissolved	ug/L as P	ND	11	ND	0		ND	60	ND-6.2	12/yr
Phosphate, Total, Dissolved	ug/L as P	ND	11	ND	2.9		3.2	68	ND-18	12/yr
Phosphate, Total	ug/L as P	1.8	11	ND	4.5		3.25	66	ND-14	12/yr
Silica	mg/L as SiO2	4.2	11	3.7	4.9		3.93	57	2.91-4.3	12/yr
Silicon	ug/L as Si	1880	11	1650	2270		1,920.00	69	1400-2740	12/yr
Sulphate	mg/L as SO4	1.1	11	ND	1.9	≤ 500 AO	1.62	61	ND-5.31	12/yr

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Appendix A, Table 2, continued

PARAMETER		2020 ANALYTICAL RESULTS				CANADIAN GUIDELINES	TEN-YEAR RESULTS (2010-2019)			Target Sampling Frequency
Parameter Name	Units of Measure	Median Value	Samples Analyzed	Range Minimum	Range Maximum	≤ = Less than or equal to	10-Year Median	Samples Analyzed	Range Minimum - Maximum	
Sulphide	mg/L as H2S	ND	11	ND	0	≤ 0.05 AO	ND	33	ND-0.1	12/yr
Sulfur	mg/L as S	ND	11	ND	0		ND	68	ND-0	12/yr
Metallic Inorganic Chemicals (ND means less than instrument can detect)										
Aluminum	ug/L as Al	15.7	11	6.8	40.1	2900 MAC / 100 OG	16.5	69	4.5-67.7	12/yr
Antimony	ug/L as Sb	ND	11	ND	0.0	6 MAC	ND	69	ND-0	12/yr
Arsenic	ug/L as As	ND	11	ND	0	10 MAC	ND	69	ND-0.17	12/yr
Barium	ug/L as Ba	3.75	11	3.3	4.1	2000 MAC	3.8	69	3.3-4.8	12/yr
Beryllium	ug/L as Be	ND	11	ND	0		ND	68	ND-0	12/yr
Bismuth	ug/L as Bi	ND	11	ND	0		ND	69	ND-0.01	12/yr
Boron	ug/L as B	ND	11	ND	0	5000 MAC	ND	69	ND-0	12/yr
Cadmium	ug/L as Cd	ND	11	ND	0	7 MAC	ND	69	ND-0.06	12/yr
Calcium	mg/L as Ca	4.74	11	4.41	5.12	No Guideline Required	5.02	67	4.18-6.82	12/yr
Chromium	ug/L as Cr	ND	11	ND	0	50 MAC	ND	69	ND-1.2	12/yr
Cobalt	ug/L as Co	ND	11	ND	0		ND	69	ND-0.04	12/yr
Copper	ug/L as Cu	7.18	11	4.54	10.9	2000 MAC / ≤ 1000 AO	15.7	69	1.03-202	12/yr
Iron	ug/L as Fe	24.5	11	12.7	101	≤ 300 AO	26.7	69	12.2-198	12/yr
Lead	ug/L as Pb	ND	11	ND	0	5 MAC	ND	69	ND-0.92	12/yr
Lithium	ug/L as Li	ND	2	ND	0		ND	40	ND-13.5	12/yr
Magnesium	mg/L as Mg	1.14	11	1	1.19	No Guideline Required	1.16	67	0.15-1.41	12/yr
Manganese	ug/L as Mn	4.75	11	1.6	34	120 MAC / ≤ 20 AO	5	69	ND-51.1	12/yr
Mercury, Total	ug/L as Hg	ND	11	ND	0	1.0 MAC	ND	64	ND-0	12/yr
Molybdenum	Ug/L as Mo	ND	11	ND	0		ND	69	ND-0	12/yr
Nickel	mg/L as Ni	ND	11	ND	0		ND	69	ND-1.6	12/yr
Potassium	mg/L as K	0.13	11	0.13	0.15		0.14	67	0.11-0.22	12/yr
Selenium	ug/L as Se	ND	11	ND	0	50 MAC	ND	69	ND-0	12/yr
Silver	ug/L as Ag	ND	11	ND	0	No Guideline Required	ND	69	ND-0.06	12/yr
Sodium	mg/L as Na	1.6	11	1.5	1.66	≤ 200 AO	1.7	67	1.39-3.56	12/yr
Strontium	ug/L as Sr	14.7	11	13.8	15.8	7000 MAC	15.4	69	12.8-19.7	12/yr
Thallium	ug/L as Tl	ND	11	ND	0		ND	69	ND-0	12/yr
Tin	ug/L as Sn	ND	11	ND	0		ND	69	ND-0.22	12/yr
Titanium	ug/L as Ti	ND	11	ND	0		ND	69	ND-0	12/yr
Uranium	ug/L as U	ND	11	ND	0	20 MAC	ND	69	ND-0.02	12/yr
Vanadium	ug/L as V	ND	11	ND	0		ND	69	ND-0	12/yr
Zinc	ug/L as Zn	ND	11	ND	0	≤ 5000 AO	ND	69	ND-54.1	12/yr
Zirconium	ug/L as Zr	ND	11	ND	0		ND	69	ND-0	12/yr

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Appendix A, Table 2, continued

PARAMETER		2020 ANALYTICAL RESULTS				CANADIAN GUIDELINES	TEN-YEAR RESULTS (2010-2019)			Target Sampling Frequency
Parameter Name	Units of Measure	Median Value	Samples Analyzed	Range		≤ = Less than or equal to	10-Year Median	Samples Analyzed	Range	
				Minimum	Maximum				Minimum - Maximum	
Microbial Parameters (ND means less than method or instrument can detect)										
Coliform Bacteria										
Coliforms, Total	CFU/100 mL	ND	454	ND	32	0 MAC	0	1403	ND-200	250/yr
E. coli	CFU/100 mL	ND	454	ND	0	0 MAC	0	1403	ND-0	250/yr
Heterotrophic/Other Bacteria										
Hetero. Plate Count, 28C (7 day)	CFU/1 mL	ND	223	ND	230		ND	1310	ND-770	250/yr
Disinfectants (ND means less than instrument can detect)										
Disinfectants										
Chlorine, Total Residual	mg/L as Cl_2	1.87	459	1.23	2.1	No Guideline Required (chloramines)	1.90	199	0.83-2.33	250/yr
Monochloramine	mg/L as Cl_2	1.68	422	0	1.93		1.75	199	0.03-2.17	250/yr

Notes: mg/L = milligrams per litre; ug/L = micrograms per litre; ND = Not Detected; CFU = Colony Forming Units; NTU = Nephelometric Units; TCU = True Colour Units; AO = Aesthetic Objective; MAC = Max. Acceptable Conc.; Median = middle point of all values

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APPENDIX A
TABLE 3. 2020 TREATED WATER QUALITY AFTER SOOKE RIVER ROAD WATER TREATMENT PLANT

PARAMETER		2020 ANALYTICAL RESULTS				CANADIAN GUIDELINES	TEN-YEAR RESULTS (2010-2019)			Target Sampling Frequency
Parameter Name	Units of Measure	Median Value	Samples Analyzed	Range Minimum	Range Maximum	≤ = Less than or equal to	10-Year Median	Samples Analyzed	Range Minimum - Maximum	
Physical Parameters (ND means less than instrument can detect)										
Alkalinity, Total	mg/L	16.5	18	7.1	17.4		16.1	129	10.2-19.4	12/yr
Colour, True	TCU	4.0	39	ND	6.0	≤ 15 AO	3.2	484	ND-11.3	52/yr
Conductivity @ 25ºC	uS/cm	57.0	37	54.2	65.2		56.1	485	26.4-71.7	52/yr
Odour	Flavour Profile	1.0	33	1.0	1.0	Inoffensive	1	465	1-1	52/yr
pH	pH units	7.7	30	7.1	8.3	7.0-10.5 AO	7.4	484	6.32-8.32	52/yr
Taste	Flavour Profile	1.0	33	1.0	1.0	Inoffensive	1	463	1-1	52/yr
Turbidity, Grab Samples	NTU	0.3	40	0.2	0.6	1 MAC	0.3	505	0.15-1.7	52/yr
Water Temperature, Grab Samples	degrees C	9.7	39	5.3	18.9	≤ 15 AO	10.75	510	1.19-20	52/yr
Microbial Parameters (ND means less than instrument can detect)										
Coliform Bacteria										
Coliform, Total	CFU/100 mL	ND	40	ND	0	0 MAC	0	512	ND-12	52/yr
E. coli	CFU/100 mL	ND	40	ND	0	0 MAC	0	512	ND-0	52/yr
Heterotrophic Bacteria										
Hetero. Plate Count, 28C (7 day)	CFU/1 mL	ND	32	ND	40		ND	463	ND-1230	52/yr
Disinfectants (ND means less than instrument can detect)										
Disinfectants										
Chlorine, Total Residual	mg/L as Cl_2	1.77	37	1.27	2.31	3.0 MAC (chloramines)	1.81	36	1.29-2.12	52/yr
Monochloramine	mg/L as Cl_2	1.62	37	1.2	2.16		1.54	36	1.15-1.84	52/yr
Metallic Inorganic Chemicals (ND means less than instrument can detect)										
Aluminum	ug/L as Al	12.4	6	6.2	16.9	2900 MAC / 100 OG	13.9	23	5.3-22.7	6/yr
Antimony	ug/L as Sb	ND	6	ND	0	6 MAC	ND	23	ND-0	6/yr
Arsenic	ug/L as As	ND	6	ND	0	10 MAC	ND	23	ND-0	6/yr
Barium	ug/L as Ba	3.6	6	3.3	4	2000 MAC	3.8	23	3.5-4.2	6/yr
Beryllium	ug/L as Be	ND	6	ND	0		ND	23	ND-0	6/yr
Bismuth	ug/L as Bi	ND	6	ND	0		ND	23	ND-0	6/yr
Boron	ug/L as B	ND	6	ND	0	5000 MAC	ND	23	ND-0	6/yr
Cadmium	ug/L as Cd	ND	6	ND	0	7 MAC	ND	23	ND-0.02	6/yr
Calcium	mg/L as Ca	4.7	6	4.41	5.03	No Guideline Required	5140	1	5140-5140	6/yr
Chromium	ug/L as Cr	ND	6	ND	0	50 MAC	ND	23	ND-0	6/yr
Cobalt	ug/L as Co	ND	6	ND	0		ND	23	ND-0	6/yr
Copper	ug/L as Cu	26	6	14.2	41	2000 MAC / ≤ 1000 AO	31.5	23	10.9-80.4	6/yr

Appendix A, Table 3, continued

PARAMETER		2020 ANALYTICAL RESULTS				CANADIAN GUIDELINES	TEN-YEAR RESULTS (2010-2019)			Target Sampling Frequency
Parameter Name	Units of Measure	Median Value	Samples Analyzed	Range		≤ = Less than or equal to	10-Year Median	Samples Analyzed	Range	
				Minimum	Maximum				Minimum - Maximum	
Iron	ug/L as Fe	22.8	6	13.2	33	≤ 300 AO	24.4	23	12-53	6/yr
Lead	ug/L as Pb	ND	6	ND	0.22	5 MAC	0.29	24	ND-0.64	6/yr
Lithium	ug/L as Li	ND	2	ND	0		ND	9	ND-0	6/yr
Magnesium	mg/L as Mg	1.12	6	1.04	1.23	No Guideline Required	1.16	23	1-1.34	6/yr
Manganese	ug/L as Mn	3.4	6	1.6	5	120 MAC / ≤ 20 AO	3.6	23	1.3-10	6/yr
Mercury, Total	ug/L as Hg	ND	6	ND	0	1.0 MAC	ND	22	ND-0	6/yr
Molybdenum	ug/L as Mo	ND	6	ND	0		ND	23	ND-0	6/yr
Nickel	ug/L as Ni	ND	6	ND	0		ND	23	ND-0	6/yr
Potassium	mg/L as K	0.13	6	0.12	0.14		0.14	23	0.12-0.25	6/yr
Selenium	ug/L as Se	ND	6	ND	0	50 MAC	ND	23	ND-0.1	6/yr
Silver	ug/L as Ag	ND	6	ND	0	No Guideline Required	ND	23	ND-0	6/yr
Sodium	mg/L as Na	4.11	6	3.91	4.65	≤ 200 AO	4.51	23	3.74-7.02	6/yr
Strontium	ug/L as Sr	15.15	6	13.6	16.1	7000 MAC	14.7	23	13.2-16.2	6/yr
Thallium	ug/L as Tl	ND	6	ND	0		ND	23	ND-0.01	6/yr
Tin	ug/L as Sn	ND	6	ND	0		ND	23	ND-0	6/yr
Titanium	ug/L as Ti	ND	6	ND	0		ND	23	ND-0	6/yr
Uranium	ug/L as U	ND	6	ND	0	20 MAC	ND	23	ND-0	6/yr
Vanadium	ug/L as V	ND	6	ND	0		ND	23	ND-0	6/yr
Zinc	ug/L as Zn	ND	6	ND	9.6	≤ 5000 AO	ND	23	ND-7.8	6/yr
Zirconium	ug/L as Zr	ND	6	ND	0		ND	23	ND-0	6/yr

Notes: mg/L = milligrams per litre; ug/L = micrograms per litre; ND = Not Detected; CFU = Colony Forming Units; NTU = Nephelometric Units; TCU = True Colour Units; AO = Aesthetic Objective; MAC = Max. Acceptable Conc.; Median = middle point of all values

APPENDIX A
TABLE 4. 2020 TREATED WATER QUALITY TRANSMISSION / DISTRIBUTION SYSTEMS GOLDSTREAM SERVICE AREA

PARAMETER		2020 ANALYTICAL RESULTS				CANADIAN GUIDELINES	TEN-YEAR RESULTS (2010-2019)			Target Sampling Frequency
Parameter Name	Units of Measure	Median Value	Samples Analyzed	Range Minimum	Range Maximum	≤ = Less than or equal to	100Year Median	Samples Analyzed	Range Minimum - Maximum	
Metals (ND means less than instrument can detect)										
Mercury, Total	ug/L as Hg	ND	23	ND	0.00	1 MAC	ND	72	ND-0	24/yr
Aluminum	ug/L as Al	10.9	23	6.3	23.80	2900 MAC / 100 OG	14.2	91	6.9-61	24/yr
Antimony	ug/L as Sb	ND	23	ND	0.00	6 MAC	ND	91	ND-0	24/yr
Arsenic	ug/L as As	ND	23	ND	0.11	10 MAC	ND	91	ND-0.5	24/yr
Barium	ug/L as Ba	3.8	23	3.3	4.40	2000 MAC	3.9	91	2.8-4.4	24/yr
Boron	ug/L as B	ND	23	ND	0.00	5000 MAC	ND	91	ND-0	24/yr
Cadmium	ug/L as B	ND	23	ND	0.00	7 MAC	ND	91	ND-0.01	24/yr
Chromium	ug/L as Cr	ND	23	ND	0.00	50 MAC	ND	91	ND-0	24/yr
Copper	mg/L as Cu	30.8	23	10.2	234.00	2000 MAC / 1000 AO	26.6	91	6.27-387	24/yr
Iron	ug/L as Fe	25.15	23	13.7	85.00	300 AO	26.4	91	12.5-118	24/yr
Lead	ug/L as Pb	0.29	23	ND	4.28	5 MAC	0.43	99	ND-185	24/yr
Manganese	ug/L as Mn	5	23	1.5	11.70	120 MAC / 20 AO	4.4	91	1.7-35.1	24/yr
Selenium	ug/L as Se	ND	23	ND	0.00	50 MAC	ND	91	ND-0	24/yr
Strontrium	ug/L as Sr	15.3	23	13.1	18.80	7000 MAC	15.2	91	13.4-18.4	24/yr
Uranium	ug/L as U	ND	23	ND	0.00	20 MAC	ND	91	ND-0	24/yr
Zinc	ug/L as Zn	ND	23	ND	16.00	5000 MAC	ND	91	ND-41.5	24/yr
Sodium	mg/L as Na	1.59	23	1.47	1.71		1.73	89	1.46-3.46	24/yr
Disinfection Byproducts Parameters (ND means less than method or instrument can detect)										
Nitrosamines										
N-Nitrosodiethylamine	ng/L	ND	24	ND	0		ND	48	ND-3.8	24/yr
N-Nitrosodimethylamine	ng/L	ND	24	ND	0	40 MAC	0	12	ND-0	24/yr
N-Nitroso-di-n-butylamine	ng/L	ND	24	ND	0		ND	43	ND-42	24/yr
N-nitroso-di-n-propylamine	ng/L	ND	24	ND	0		ND	17	ND-ND	24/yr
N-Nitrosoethylmethylamine	ng/L	ND	24	ND	0		ND	42	ND-0	24/yr
N-Nitrosomorpholine	ng/L	ND	24	ND	0		ND	43	ND-4.6	24/yr
N-nitrosopiperidine	ng/L	ND	24	ND	0		ND	41	ND-0	24/yr
N-Nitrosopyrrolidine	ng/L	ND	24	ND	0		ND	42	ND-0.08	24/yr
Haloacetic Acids (HAAs)										
Total Haloacetic Acids	ug/L	18	24	ND	23	80 MAC	15	129	ND-104	24/yr
Monobromoacetic Acid (MBAA)	ug/L	ND	24	ND	0		ND	128	ND-15.04	24/yr
Dichloroacetic Acid (DCAA)	ug/L	11	24	ND	16		ND	128	ND-23	24/yr
Trichloroacetic Acid (TCAA)	ug/L	6.8	24	ND	8.7		6.85	130	ND-35	24/yr
Bromochloroacetic Acid (BCAA)	ug/L	ND	24	ND	0		ND	128	ND-11.63	24/yr

Appendix A, Table 4, continued

PARAMETER		2020 ANALYTICAL RESULTS				CANADIAN GUIDELINES	TEN-YEAR RESULTS (2010-2019)			Target Sampling Frequency
Parameter Name	Units of Measure	Median Value	Samples Analyzed	Range		≤ = Less than or equal to	100Year Median	Samples Analyzed	Range	
				Minimum	Maximum				Minimum - Maximum	
Dibromoacetic Acid (DBAA)	ug/L	ND	24	ND	0		ND	128	ND-0	24/yr
Monochloroacetic Acid (MCAA)	ug/L	ND	24	ND	0		ND	128	ND-26.73	24/yr
Trihalomethanes (TTHMs)										
Total Trihalomethanes	ug/L	17	24	12	21	100 MAC	19	130	3.3-77.9	24/yr
Bromodichloromethane	ug/L	2	24	1	2.7		2	130	ND-5.7	24/yr
Bromoform	ug/L	ND	24	ND	0		ND	132	ND-0	24/yr
Chlorodibromomethane	ug/L	ND	24	ND	0		ND	130	ND-1.3	24/yr
Chloroform	ug/L	15	24	10	19		17	130	3.3-77.9	24/yr

Notes: mg/L = milligrams per litre; ug/L = micrograms per litre; ND = Not Detected; CFU = Colony Forming Units; NTU = Nephelometric Units; TCU = True Colour Units; AO = Aesthetic Objective; MAC = Max. Acceptable Conc.; Median = middle point of all values

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APPENDIX A
TABLE 5. 2020 TREATED WATER QUALITY DISTRIBUTION SYSTEM SOOKE SERVICE AREA

PARAMETER		2020 ANALYTICAL RESULTS				CANADIAN GUIDELINES	TEN-YEAR RESULTS (2010-2019)			Target Sampling Frequency
Parameter Name	Units of Measure	Median Value	Samples Analyzed	Range		≤ = Less than or equal to	10-Year Median	Samples Analyzed	Range	
				Minimum	Maximum				Minimum - Maximum	
Metals (ND means less than instrument can detect)										
Mercury, Total	ug/L as Hg	ND	6	ND	0	1 MAC	ND	19	ND-0	6/yr
Aluminum	ug/L as Al	11.35	6	8.7	17.5	2900 MAC / 100 OG	14.45	24	9.5-242	6/yr
Antimony	ug/L as Sb	ND	6	ND	0	6 MAC	ND	24	ND-0	6/yr
Arsenic	ug/L as As	ND	6	ND	0	10 MAC	ND	24	ND-0	6/yr
Barium	ug/L as Ba	3.6	6	3.2	4.2	2000 MAC	3.75	24	3.2-4.6	6/yr
Boron	ug/L as B	ND	6	ND	0	5000 MAC	ND	24	ND-0	6/yr
Cadmium	ug/L as B	ND	6	ND	0	7 MAC	ND	24	ND-0.02	6/yr
Chromium	ug/L as Cr	ND	6	ND	0	50 MAC	ND	24	ND-0	6/yr
Copper	mg/L as Cu	4.64	6	3.54	6.38	2000 MAC / 1000 AO	7.22	24	2.93-16.6	6/yr
Iron	ug/L as Fe	29.4	6	20	44.6	300 AO	36.30	24	19.5-56	6/yr
Lead	ug/L as Pb	ND	6	ND	0	5 MAC	ND	60	ND-22.5	6/yr
Manganese	ug/L as Mn	2.9	6	1.7	4.8	120 MAC / 20 AO	3.00	31	ND-1760	6/yr
Selenium	ug/L as Se	ND	6	ND	0	50 MAC	ND	23	ND-0	6/yr
Strontrium	ug/L as Sr	18.45	6	16.9	19.5	7000 MAC	18.50	23	16.1-21.5	6/yr
Uranium	ug/L as U	ND	6	ND	0	20 MAC	ND	24	ND-0	6/yr
Zinc	ug/L as Zn	ND	6	ND	0	5000 MAC	ND	24	ND-10.9	6/yr
Sodium	mg/L as Na	4.17	6	3.72	4.49	200 MAC	4.59	23	3.47-6.08	6/yr
Disinfection Byproducts Parameters (ND means less than method or instrument can detect)										
Nitrosamines										
N-Nitrosodiethylamine	ng/L	ND	6	ND	0		ND	15	ND-3.22	6/yr
N-Nitrosodimethylamine	ng/L	ND	6	ND	0	40 MAC	0	3	ND-0	6/yr
N-Nitroso-di-n-butylamine	ng/L	ND	6	ND	0		ND	12	ND-0	6/yr
N-nitroso-di-n-propylamine	ng/L	ND	6	ND	0		ND	5	ND-ND	6/yr
N-Nitrosoethylmethylamine	ng/L	ND	6	ND	0		ND	12	ND-0	6/yr
N-Nitrosomorpholine	ng/L	ND	6	ND	0		ND	13	ND-0.42	6/yr
N-nitrosopiperidine	ng/L	ND	6	ND	0		ND	12	ND-0.31	6/yr
N-Nitrosopyrrolidine	ng/L	ND	6	ND	0		ND	12	ND-0	6/yr
Haloacetic Acids (HAAs)										
Total Haloacetic Acids	ug/L	27	6	22	29	80 MAC	27	16	21-34	6/yr
Monobromoacetic Acid (MBAA)	ug/L	ND	6	ND	0		ND	16	ND-0	6/yr
Dichloroacetic Acid (DCAA)	ug/L	13	6	11	15		14	16	11-19	6/yr
Trichloroacetic Acid (TCAA)	ug/L	13	6	11	14		13.5	16	9.1-18	6/yr
Bromochloroacetic Acid (BCAA)	ug/L	ND	6	ND	0		ND	16	ND-0	6/yr

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Appendix A, Table 5, continued

PARAMETER		2020 ANALYTICAL RESULTS				CANADIAN GUIDELINES	TEN-YEAR RESULTS (2010-2019)			Target Sampling Frequency
Parameter Name	Units of Measure	Median Value	Samples Analyzed	Range		≤ = Less than or equal to	10-Year Median	Samples Analyzed	Range	
				Minimum	Maximum				Minimum - Maximum	
Dibromoacetic Acid (DBAA)	ug/L	ND	6	ND	0		ND	16	ND-0	6/yr
Monochloroacetic Acid (MCAA)	ug/L	ND	6	ND	0		ND	16	ND-0	6/yr
Trihalomethanes (TTHMs)										
Total Trihalomethanes	ug/L	30	6	26	43	100 MAC	35	16	31-49	6/yr
Bromodichloromethane	ug/L	3	6	3	3.7		3	17	ND-4.4	6/yr
Bromoform	ug/L	ND	6	ND	0		ND	17	ND-0	6/yr
Chlorodibromomethane	ug/L	ND	6	ND	0		ND	16	ND-0	6/yr
Chloroform	ug/L	26	6	23	39		32.5	16	28-45	6/yr

Notes: mg/L = milligrams per litre; ug/L = micrograms per litre; ND = Not Detected; CFU = Colony Forming Units; NTU = Nephelometric Units; TCU = True Colour Units; AO = Aesthetic Objective; MAC = Max. Acceptable Conc.; Median = middle point of all values

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JUAN DE FUCA WATER DISTRIBUTION COMMISSION
Tuesday, May 4, 2021 at 12:00 PM

MEETING HOTSHEET (ACTION LIST)

The following is a quick snapshot of the FINAL **Juan de Fuca Water Distribution Commission** decisions made at the meeting. The minutes will represent the official record of the meeting.

3. ADOPTION OF MINUTES

That the minutes of the May 4, 2021 meeting be adopted.

CARRIED

5. PRESENTATIONS/DELEGATIONS

5.1. Delegations

5.1.1. Delegation – Bruce Cumming: Water Access, 2755 Sooke River Road

The Juan de Fuca Water Distribution Commission directs staff to prepare a report outlining the request for service and implications of the servicing proposal.

CARRIED

5.1.2. Delegation – Scott Douglas: Water Bill Appeal, 3491 Ambrosia Crescent

The Juan de Fuca Water Distribution Commission deny Mr. Douglas' request for a leak adjustment to his water bill.

CARRIED

6. COMMISSION BUSINESS

6.1. Water Watch Report

That the April 26, 2021 Water Watch report be received for information.

CARRIED

IWSS-297445977-7056

Making a difference...together

REGIONAL WATER SUPPLY COMMISSION
Wednesday, March 17, 2021 at 11:30 AM

MEETING HOTSHEET (ACTION LIST)

The following is a quick snapshot of the FINAL **Regional Water Supply Commission** decisions made at the meeting. The minutes will represent the official record of the meeting.

3. ADOPTION OF MINUTES

That the minutes of the February 17, 2021 meeting be adopted.

CARRIED

7. WATER ADVISORY COMMITTEE REPORT

7.2. Draft Minutes of the March 4, 2021 Water Advisory Committee Meeting

That the draft minutes of the March 4, 2021 Water Advisory Committee meeting be received for information.

CARRIED

8. COMMISSION BUSINESS

8.1. Potential Impacts of Climate Change on Integrated Water Services Operations

That the Regional Water Supply Commission receive this report for information.

CARRIED

Motion Arising:
That the Regional Water Supply Commission receive an updated climate impacts report every two years.

CARRIED

8.2. Mining Access Request – Leech Water Supply Area

That the Regional Water Supply Commission authorize Greater Victoria Water Supply Area access and special use to the mining tenure holders and their agents (where agency is confirmed) and workers (that hold valid free mining certificates) that meet Capital Regional District insurance requirements, as listed in Table 1 of Appendix A, subject to the conditions of their Access Agreement, for the valid mining tenures they hold.

CARRIED

IWSS-297445977-6929

8.3. Summary of Recommendations from Other Water Commissions

That the Summary of Recommendations from Other Water Commissions be received for information.

CARRIED

8.4. Water Watch Report

That the March 8, 2021 Water Watch report be received for information.

CARRIED

File No. 902-03

CAPITAL REGIONAL DISTRICT - INTEGRATED WATER SERVICES

Water Watch

Issued May 10, 2021

Water Supply System Summary:

1. Useable Volume in Storage:

Reservoir	May 31 5 Year Ave		May 31/20		May 9/21		% Existing Full Storage
	ML	MIG	ML	MIG	ML	MIG	
Sooke	87,476	19,245	87,340	19,215	89,960	19,791	97.0%
Goldstream	7,340	1,615	7,970	1,753	9,059	1,993	91.4%
Total	94,816	20,859	95,310	20,968	99,019	21,784	96.6%

2. Average Daily Demand:

For the month of May	141.2 MLD	31.06 MIGD
For week ending May 09, 2021	140.1 MLD	30.82 MIGD
Max. day May 2021, to date:	156.8 MLD	34.49 MIGD

3. Average 5 Year Daily Demand for May

Average (2016 - 2020)	151.6 MLD [1]	33.36 MIGD [2]

[1]MLD = Million Litres Per Day [2]MIGD = Million Imperial Gallons Per Day

4. Rainfall May:

Average (1914 - 2020):	47.7 mm
Actual Rainfall to Date	4.1 mm (9% of monthly average)

5. Rainfall: Sep 1- May 9

Average (1914 - 2020):	1,515.8 mm
2020/2021	1,555.8 mm (103% of average)

6. Water Conservation Action Required:

CRD's Stage 1 Water Conservation Bylaw is now in effect through to September 30, 2021.
Visit our website at www.crd.bc.ca/water for scheduling information.

If you require further information, please contact:

Ted Robbins, B.Sc., C.Tech
General Manager, CRD - Integrated Water Services
or
Glenn Harris, Ph D., RPBio
Senior Manager - Environmental Protection

Capital Regional District Integrated Water Services
479 Island Highway
Victoria, BC V9B 1H7
(250) 474-9600

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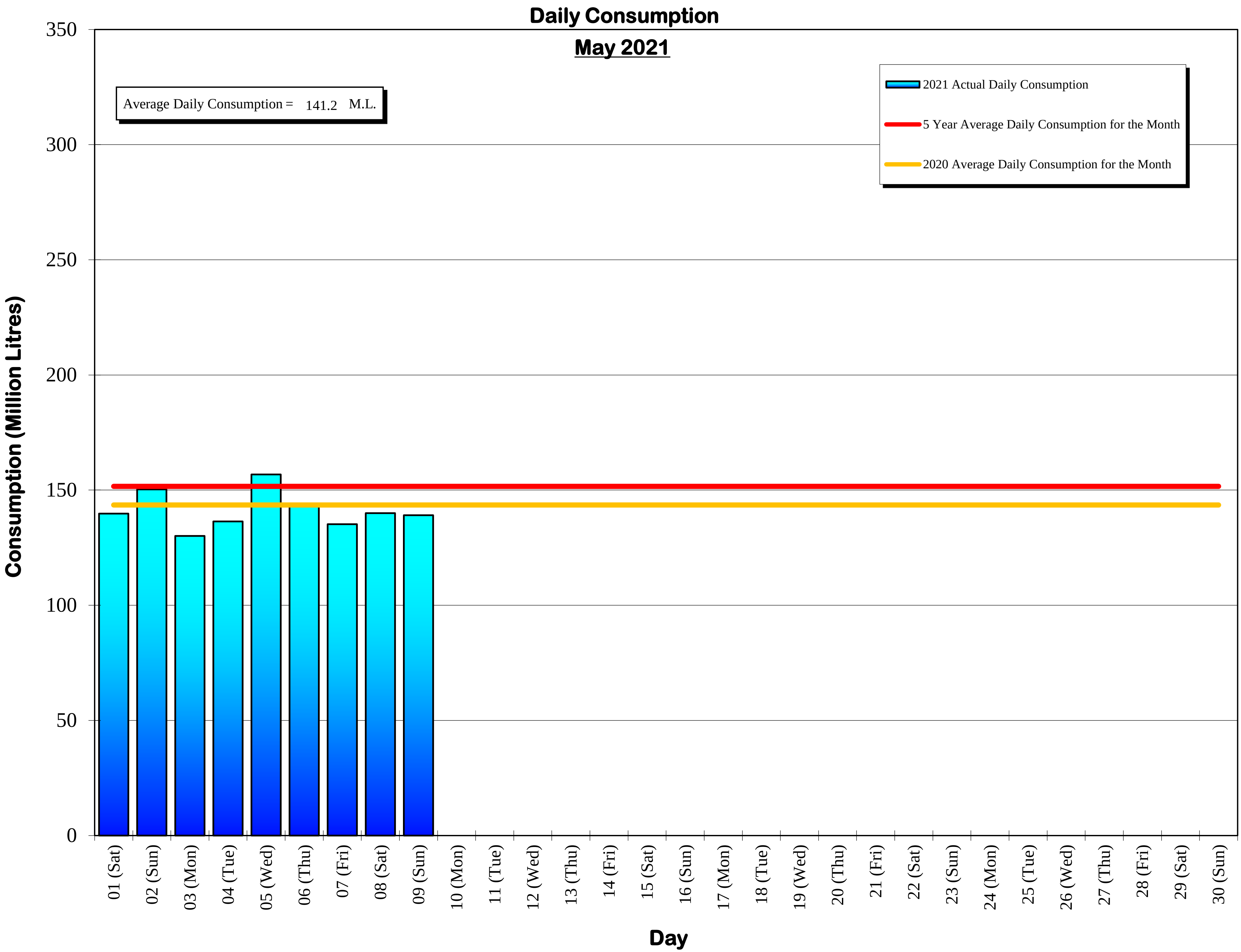
Daily Consumption
May 2021
Average Daily Consumption = 141.2 M.L.
2021 Actual Daily Consumption
5 Year Average Daily Consumption for the Month
2020 Average Daily Consumption for the Month
Consumption (Million Litres)
350
300
250
200
150
100
50
0
01 (Sat)
02 (Sun)
03 (Mon)
04 (Tue)
05 (Wed)
06 (Thu)
07 (Fri)
08 (Sat)
09 (Sun)
10 (Mon)
11 (Tue)
12 (Wed)
13 (Thu)
14 (Fri)
15 (Sat)
16 (Sun)
17 (Mon)
18 (Tue)
19 (Wed)
20 (Thu)
21 (Fri)
22 (Sat)
23 (Sun)
24 (Mon)
25 (Tue)
26 (Wed)
27 (Thu)
28 (Fri)
29 (Sat)
30 (Sun)
Day

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Daily Consumptions: - May 2021

Date	Total Consumption			Air Temperature @ Japan Gulch		Weather Conditions	Precipitation @ Sooke Res.: 12:00am to 12:00am		
	(ML) [1.]		(MIG) [2.]	High (°C)	Low (°C)		Rainfall (mm)	Snowfall [3.] (mm)	Total Precip.
01 (Sat)	139.8		30.8	15	6	Sunny / P. Cloudy	0.0	0.0	0.0
02 (Sun)	150.3		33.1	16	6	Sunny / P. Cloudy	0.0	0.0	0.0
03 (Mon)	130.1	<=Min	28.6	13	7	Sunny / P. Cloudy / Showers	2.3	0.0	2.3
04 (Tue)	136.4		30.0	16	6	Sunny / P. Cloudy	0.0	0.0	0.0
05 (Wed)	156.8	<=Max	34.5	18	5	Sunny / P. Cloudy	0.0	0.0	0.0
06 (Thu)	143.1		31.5	20	6	Sunny / P. Cloudy / Showers	0.5	0.0	0.5
07 (Fri)	135.2		29.7	13	5	Sunny / P. Cloudy / Showers	1.0	0.0	1.0
08 (Sat)	140.0		30.8	13	5	Cloudy / P. Sunny	0.0	0.0	0.0
09 (Sun)	139.1		30.6	15	7	Cloudy / Showers / P. Sunny	0.3	0.0	0.3
10 (Mon)									
11 (Tue)									
12 (Wed)									
13 (Thu)									
14 (Fri)									
15 (Sat)									
16 (Sun)									
17 (Mon)									
18 (Tue)									
19 (Wed)									
20 (Thu)									
21 (Fri)									
22 (Sat)									
23 (Sun)									
24 (Mon)									
25 (Tue)									
26 (Wed)									
27 (Thu)									
28 (Fri)									
29 (Sat)									
30 (Sun)									
31 (Mon)									
TOTAL	1270.8 ML		279.55 MIG				4.1	0	4.1
MAX	156.8		34.49	20	7		2.3	0	2.3
AVG	141.2		31.06	15.4	5.9		0.5	0	0.5
MIN	130.1		28.62	13	5		0.0	0	0.0

1. ML = Million Litres
2. MIG = Million Imperial Gallons
3. 10% of snow depth applied to rainfall figures for snow to water equivalent.

Average Rainfall for May (1914-2020)	47.7 mm
Actual Rainfall: May	4.1 mm
% of Average	9%
Average Rainfall (1914-2020): Sept 01 - May 09	1,515.8 mm
Actual Rainfall (2020/2021): Sept 01 - May 09	1,555.8 mm
% of Average	103%

Number days with precip. 0.2 or more
4

Water spilled at Sooke Reservoir to date (since Sept. 1) = 8.02 Billion Imperial Gallons
= 36.50 Billion Litres

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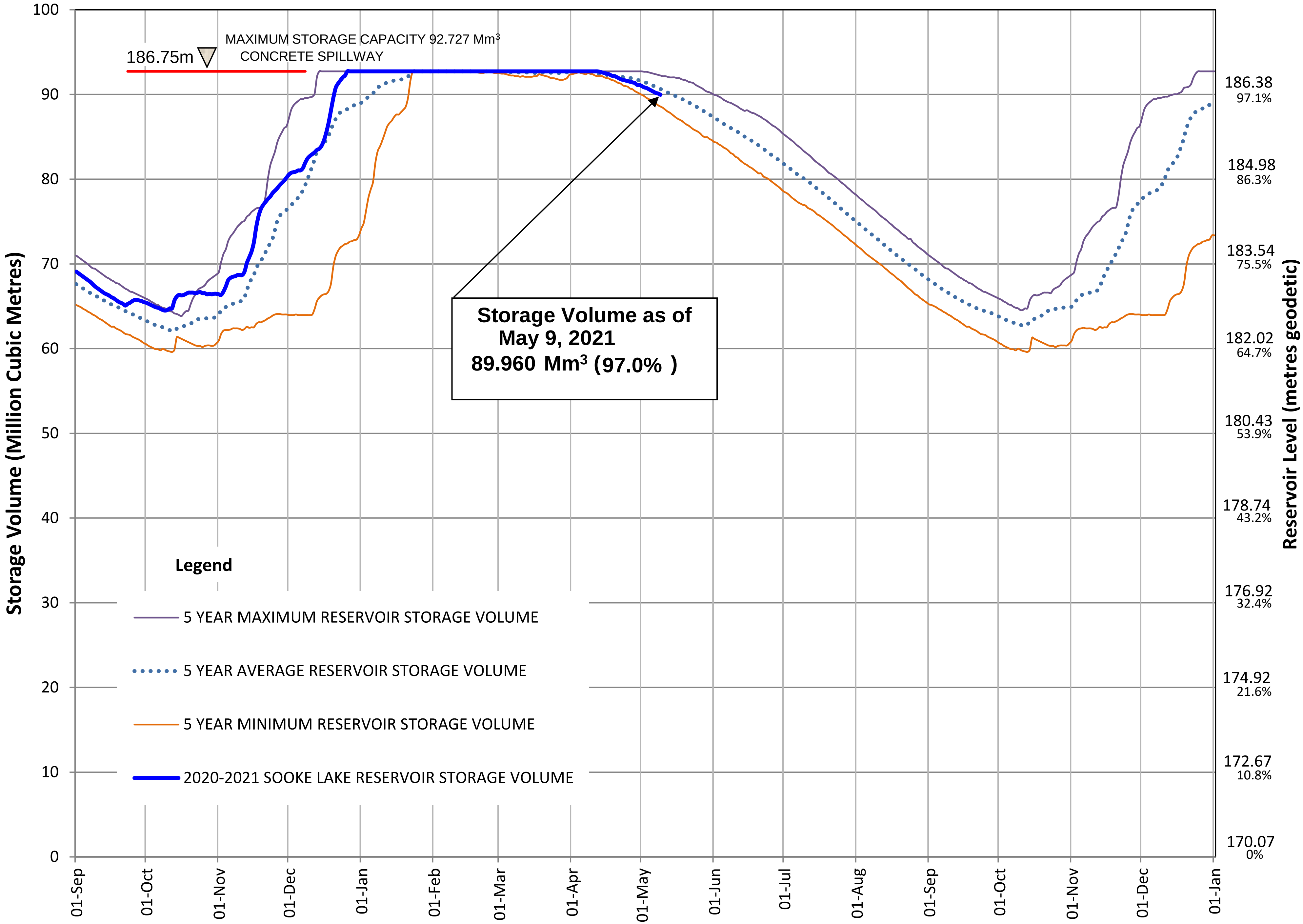
SOOKE LAKE RESERVOIR STORAGE SUMMARY
2020 / 2021



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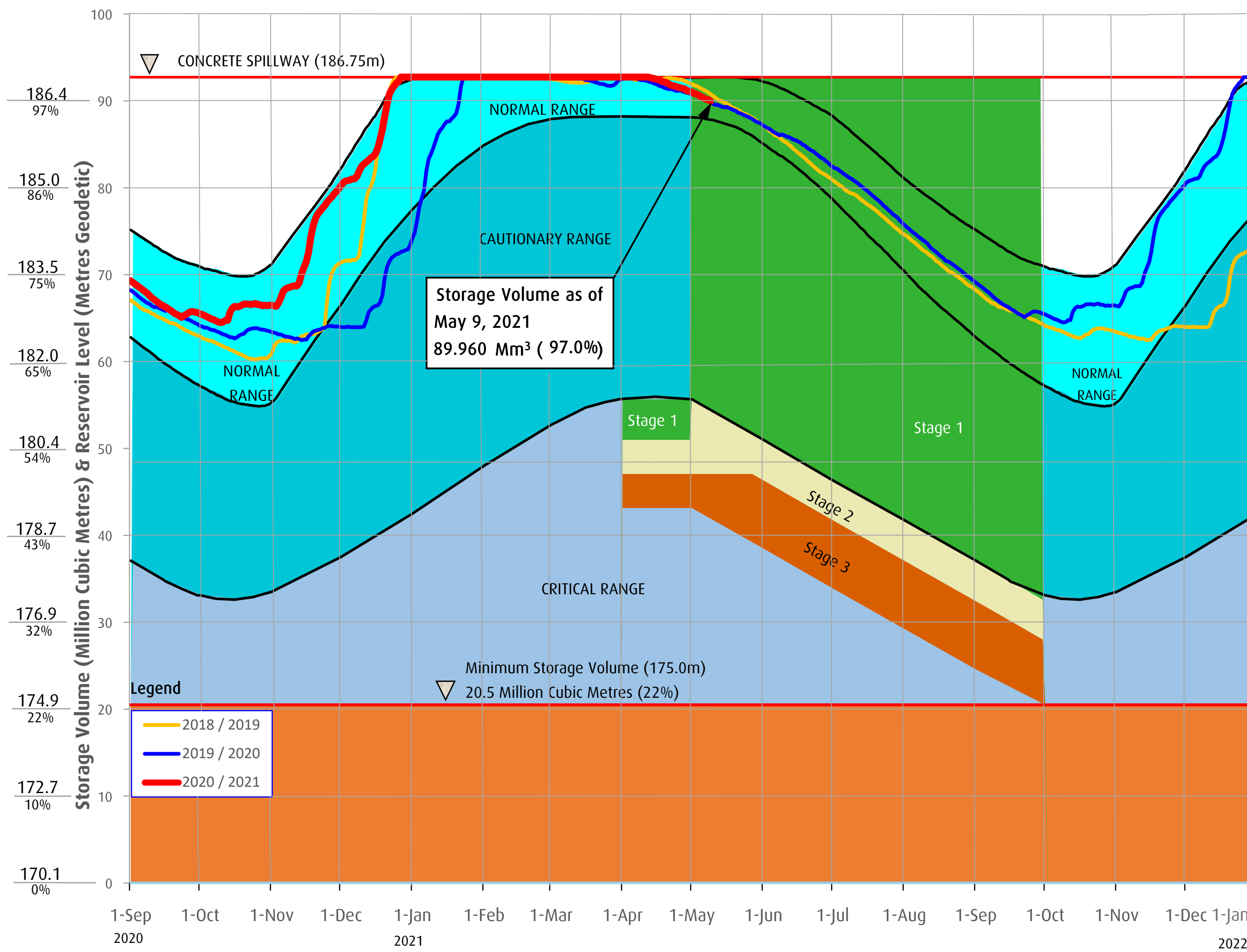
Sooke Lake Reservoir Storage Level

Water Supply Management Plan



FAQs

How are water restriction stages determined?

Several factors are considered when determining water use restriction stages, including,

1. Time of year and typical seasonal water demand trends;
2. Precipitation and temperature conditions and forecasts;
3. Storage levels and storage volumes of water reservoirs (Sooke Lake Reservoir and the Goldstream Reservoirs) and draw down rates;
4. Stream flows and inflows into Sooke Lake Reservoir;
5. Water usage, recent consumption and trends; and customer compliance with restriction;
6. Water supply system performance.

The Regional Water Supply Commission will consider the above factors in making a determination to implement stage 2 or 3 restrictions, under the Water Conservation Bylaw.

At any time of the year and regardless of the water use restriction storage, customers are encouraged to limit discretionary water use in order to maximize the amount of water in the Regional Water Supply System Reservoirs available for nondiscretionary potable water use.

Stage 1 is normally initiated every year from May 1 to September 30 to manage outdoor use during the summer months. During this time, lawn watering is permitted twice a week at different times for even and odd numbered addresses.

Stage 2 Is initiated when it is determined that there is an acute water supply shortage. During this time, lawn water is permitted once a week at different times for even and odd numbered addresses.

Stage 3 Is initiated when it is determined that there is a severe water supply shortage. During this time, lawn watering is not permitted. Other outdoor water use activities are restricted as well.

For more information, visit www.crd.bc.ca/drinkingwater

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Useable Reservoir Volumes in Storage for May 09, 2021