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LYALL HARBOUR BOOT COVE WATER LOCAL SERVICE COMMITTEE
Notice of Meeting on **Tuesday, November 22, 2022 at 2:00 p.m.**
Goldstream Conference Room, 479 Island Highway, Victoria, BC

For members of the **public who wish to listen to the meeting** via telephone please call **1-833-353-8610** 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.

J. Crerar (Chair)	P. Brent, Electoral Area Director	J. Money
A. Olsen	I. Rowe	J. Sabre-Makofka

AGENDA

1. APPROVAL OF AGENDA

2. ADOPTION OF MINUTES **3**

***Recommendation**: That the minutes of the June 21, 2022 meeting be adopted.*

3. CHAIR'S REMARKS

4. PRESENTATIONS/DELEGATIONS

The public are welcome to attend Committee meetings in-person.

Delegations will have the option to participate electronically. Please complete the online application for "Addressing the Board" on our website and staff will respond with details.

Alternatively, you may email your comments on an agenda item to the Lyall Harbour Boot Cove Water Local Service Committee at iwsadministration@crd.bc.ca.

Requests must be received no later than 4:30 p.m. two calendar days prior to the meeting.

5. SENIOR MANAGER'S REPORT

6. COMMITTEE BUSINESS

6.1. Lyall Harbour/Boot Cove 2023 Operating and Capital Budget **6**
***Recommendation:** That the Lyall Harbour/Boot Cove Water Local Service Committee:*

1. *Approve the 2023 operating and capital budget as presented and that the 2022 actual operating deficit be balanced on the 2022 Reserve Funds transfer (CRF and/or ORF); and*

2. *Recommends that the Electoral Areas Committee recommends that the CRD Board approve the 2023 Operating and Capital Budget and the five-year Financial Plan for the Lyall Harbour/Boot Cove Water Service as presented.*

6.2. Project and Operations Update **24**
There is no recommendation. This report is for information only.

*To ensure quorum, advise **Mikayla Risvold 250.474.9518** if you cannot attend.*

IWSS-297445977-9724

7. CORRESPONDENCE

8. NEW BUSINESS

9. ADJOURNMENT

Next Meeting: At the call of the Chair

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MINUTES OF A MEETING OF THE Lyall Harbour Boot Cove Water Local Service Committee, held Tuesday, June 21, 2022 at 2 p.m., In the Goldstream Conference Room, 479 Island Highway Victoria, BC

PRESENT: **Committee Members:** J. Crerar (Chair); J. Money; A. Olsen (EP); I. Rowe (EP); J. Sabre-Makofka (EP)

Staff: I. Jesney, Senior Manager, Infrastructure Engineering; M. McCrank, Senior Manager, Wastewater Infrastructure Operations; M. Risvold, Committee and Administrative Clerk (recorder)

REGRETS: P. Brent, Alternate Electoral Area Director

EP = Electronic Participation

The meeting was called to order at 2:02 pm.

1. APPROVAL OF AGENDA

MOVED by J. Money, **SECONDED** by A. Olsen,
That the agenda be approved.

CARRIED

2. ADOPTION OF MINUTES

MOVED by J. Sabre-Makofka, **SECONDED** by A. Olsen,
That the minutes of the February 24, 2022 meeting be adopted.

CARRIED

3. CHAIR'S REMARKS

The Chair thanked staff for their work to remove the boil water advisory (BWA).

4. PRESENTATIONS/DELEGATIONS

There were none.

5. SENIOR MANAGER'S REPORT

I. Jesney advised M. McCrank is leaving the Capital Regional District (CRD) effective September 2022.

- **Bylaw No. 4446 – A Bylaw to Amend Appointment for the Lyall Harbour/Boot Cove Water Local Service Committee (Bylaw No. 1875)**

I. Jesney provided an overview of Bylaw 4446. He noted advertisements for vacancies will be posted for 30 days, and nominations will be recommended to the Board by the Electoral Area Director.

- **Verbal discussion to introduce draft Local Service Area Water Conservation Bylaw**

  I. Jesney introduced the draft Local Service Area Water Conservation Bylaw, advising it will likely be enacted for Spring 2023. He added that current water conservation measures are voluntary. The new bylaw will bring standardization throughout the local services and the ability to enforce conservation. The draft bylaw will be shared with the committee for review and comment prior to adoption.

  Information was provided to the committee regarding the Alternate Approval Process (AAP). Staff advised the AAP process is more cost effective then a referendum. Only people within the service area can vote on the AAP.

6. COMMITTEE BUSINESS

6.1. Project and Operations Update

I. Jesney provided the capital projects update.

Staff responded to questions from the committee regarding the Dam Improvements and Regulatory Requirements project. Discussion ensued regarding the use of sandstone from the local rock quarry. Staff noted sandstone is not typically used but will review with geotechnical and possibly include an addendum.

M. McCrank provided the operational update.

Staff responded to a question from the committee regarding the University of Victoria (UVic) turbidity research findings. Staff advised a cross reference will take place through the summer, and samples have been collected. The next step is to speak with Island Health. If the turbidity reading is higher due to colour, it could result in shorter BWA's.

Discussion ensued regarding:

- Leak detection
- Turbidity analyzer

6.2. 2021 Annual Report

I. Jesney introduced the 2021 Annual Report.

Discussion ensued regarding:

- Increase in single family equivalents
- Total organic carbon guidelines
- Potential for high disinfection byproduct concentrations

7. CORRESPONDENCE

There was none.

8. NEW BUSINESS

8.1. Request for acquisition of well

The committee notified staff of an unused well that is located on private property.

Discussion ensued regarding:

- The distance from reservoir and well
- Quality of water produced from the well
- Depth of the well

MOVED by J. Money, **SECONDED** by A. Olsen,
That the Committee approach the Land Trust of British Columbia to acquire the use of a high velocity well on their property.

CARRIED

The committee will initiate discussion with the land owner, and staff will take direction from the committee on further action. Staff advised there will be cost implications.

8.2. Damage to Harris Road

Staff advised that the water system did not cause damage to Harris Road. MOTI asked to add asphalt grindings around the side of the lake, which was declined by CRD due to the risk of granular material and asphalt grindings being washed into the water source. CRD Operations Manager has been on site to meet the Ministry of Transportation and Infrastructure and has confidence they are aware of the location of the water line.

9. ADJOURNMENT

MOVED by J. Money, **SECONDED** by I. Rowe,
That the June 21, 2022 meeting be adjourned at 3:19.

CARRIED

_____
CHAIR

_____
SECRETARY

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REPORT TO LYALL HARBOUR/BOOT COVE WATER LOCAL SERVICE COMMITTEE MEETING OF TUESDAY, NOVEMBER 22, 2022

SUBJECT **Lyall Harbour/Boot Cove Water Service 2023 Operating and Capital Budget**

ISSUE SUMMARY

To present the 2023 Operating and Capital Budget for Committee approval, pursuant to Bylaw No. 1875, "Lyall Harbour/Boot Cove Water Local Services Committee Bylaw 1, 1990".

BACKGROUND

The Capital Regional District (CRD) is required by legislation under the *Local Government Act* (LGA) to prepare a five-year financial plan including Operating Budgets and Capital Expenditure Plans annually. CRD staff have prepared the financial plan shown in Appendix A for the Lyall Harbour/Boot Cove Water Local Service.

The Operating Budget includes the regular annual costs to operate the service. The Capital Expenditure Plan shows the anticipated expenditures for capital additions. These may include purchases of new assets or infrastructure, upgrades or improvements to existing assets or asset review and study work that could potentially lead to future capital improvements.

In preparing the Operating Budget, CRD staff considered:

- Actual expenditures incurred between 2020 and 2022
- Anticipated changes in level of service (if any)
- Maximum allowable tax requisition
- Annual cost per taxpayer and per single family equivalent (SFE)

Factors considered in the preparation of the Capital Expenditure Plan included:

- Available funds on hand
- Projects already in progress
- Condition of existing assets and infrastructure
- Regulatory, environmental, and health and safety factors

Adjustments for surpluses or deficits from 2022 will be made in January 2023. The CRD Board will give final approval to the budget and financial plan in March 2023.

The Financial Plan for 2024 to 2027 may be changed in future years.

BUDGET OVERVIEW

Operating Budget

It is projected that the 2022 operating expenses will be approximately $30,020 over budget. Factors contributing to the operating overage include emergency response and corrective maintenance primarily due to the following events:

- Unplanned work related to the water treatment plant filtering system carbon media augmentation to address treated water turbidity issues related to the boil water advisory issued in late 2021.
- Several leak investigations that resulted in identifying a significant leak on the reservoir supply line and several leaks identified on the private side of the system.
- Operational effort due to the boil water advisory issued on October 9, 2021 and rescinded on March 26, 2022.
- Replacement of the Money Lake recirculation feed pump due to freezing from the extreme cold weather event in early 2022.
- Damage to the upper treatment building and contents from flooding due to the November 2021 extreme weather event. A subsequent insurance claim was submitted and approved for costs related to the insurable loss.

These events resulted in additional labour, material and supply costs that go beyond operating budget contingencies. The 2022 budget included the inspection of the chlorine contact tank with a budget amount of $10,000 to be funded from the ORF. This work was initiated but will be deferred to 2023.

It is projected that the 2022 operating revenue will be over budget by approximately $3,791 primarily due to a reimbursement of costs (insurable loss) related to building and contents damage that occurred because of flooding.

This results in an overall estimated operating deficit of approximately $26,229. To balance the operating budget, it is proposed that the 2022 ORF transfer be reduced by $10,000 and the 2022 Capital Reserve Fund (CRF) transfer be reduced by $16,229. This reduced reserve funds transfer results in a deficiency within the reserve funding target levels, which will require replenishment in 2023 and future years' planning. Otherwise, the resulting deficiency in 2022 must immediately be included as an expenditure to be recovered from revenue in 2023 financial plan as required by *Local Government Act* (LGA) Section 374(11).

The 2023 over 2022 operating costs (excluding one-time cyclical program funded by ORF for chlorine contact tank and reservoir inspection) has been increased by $9,101 (5.6%). The increase is primarily to account for inflation and increased labour charges.

Increased labour charges are a result of the addition of a dedicated 'on-island' Manager of Operations who will be based on Salt Spring Island and have operational oversight of all CRD local services on Salt Spring Island (SSI) and Southern Gulf Islands (SGI). The total labour cost for this position will be cost-shared among 14 local utility services on SSI and SGI. The primary drivers for this role are to address regulatory requirements, workload management, capital project coordination and integration and to provide additional oversight and support to worker health and safety.

Municipal Finance Authority (MFA) Debt
Loan Authorization Bylaw 3587 (LA3857) to borrow $430,000 was approved and adopted in 2008 to construct a new treatment plant, storage tank and installation of meters.

Table 1 – Existing Debt Summary

MFA Issues	Term	Borrowing Year	Retirement Year	Refinance Year	Original Interest Rate	Current Interest Rate	Principal	Principal Payment	Interest Payment	Total Annual Debt Cost
LA3587-106	15	2009	2024	2019	4.13%	2.25%	$250,000	$12,485	$5,625	$18,110
LA3587-110	15	2010	2025	2020	4.50%	1.28%	$180,000	$9,663	$2,304	$11,967
Total							**$430,000**	**$22,148**	**$7,929**	**$30,077**

Operating Reserve Fund (ORF)

The Operating Reserve Fund is used to undertake maintenance activities that typically do not occur on an annual basis. Typical maintenance activities include hydrant/standpipe maintenance, reservoir cleaning and water treatment filter media servicing. The operating reserve also funds the procurement of equipment and supplies that are not purchased on an annual basis. Additionally, the operating reserve could be used for emergency unplanned repairs.

It is proposed that transfers to the operating reserve be set at $20,000 in 2023 to ensure future maintenance activities are fully funded and an optimal balance in the reserve fund is maintained. There is $45,000 of planned maintenance to be funded by the ORF over the next five years.

The ORF balance at the end of 2022 is projected to be approximately $10,825.

Capital Reserve Fund (CRF)

The Capital Reserve Fund is to be used to pay for capital expenditures that are not funded by other sources such as grants, operating budget, or debt.

It is proposed that the budgeted transfer to the CRF be set at $30,000 in 2023. The reserve fund transfer planning is influenced by the funding required to support the five-year capital expenditure plan, the emergency response to infrastructure failures and guided by *Capital Reserve Funding Guidelines* endorsed by the CRD Board in aiming to achieve the optimal reserve fund level to ensure long-term prudent and sustainable management of service delivery objectives through capital investments.

The capital reserve balance at the end of 2022 is projected to be $34,031.

Capital Expenditure Plan

The five-year plan includes $1,021,000 of expenditures for the period 2023 to 2027 to be funded by a combination of the services' CRF, grant funding, and new debt. The Pressure Release Valve (PRV) Bypass Assembly Replacement (19-02) is to be funded through the CRF for a total of $8,000 in 2023. A Community Works Fund Grant for the Dam Improvements & Regulatory Requirements (22-02) was approved for $390,000 and consulting review services are anticipated to be completed in 2022 with improvements suggested in the Dam Safety Review to be initiated in 2023 to the limit of available funding.

An Alternative Approval Process (AAP) (19-04) is to be funded through the CRF for a total of $15,000 in 2023 and is required to obtain elector input into borrowing strategies for multiple projects, including the larger future projects, such as the Water Treatment Plant Upgrades (23-01) necessary to meet Island Health requirements.

Table 2 below provides the future debt servicing cost simulation for analytical purpose with the indicative interest rate provided by MFA at the time of simulation. The AAP will be scheduled towards the end of the year and the actual borrowing requirement will be determined once the potential for well supplementation and possible treatment processes are reviewed.

Table 2 – Future New Debt Simulation

Future Borrowing(s) Estimation	*Term*	*Borrowing Year*	*Retirement Year*	*Estimated Interest Rate*	*Principal*	*Principal Payment*	*Interest Payment*	*Total Annual Debt Cost*
	15	2023	2038	4.20%	$58,000	$3,234	$2,436	$5,670
	15	2024	2039	4.50%	$340,000	$18,961	$15,300	$34,261
	15	2025	2040	4.50%	$350,000	$19,518	$15,750	$35,268
Total					**$748,000**	**$41,713**	**$33,486**	**$75,199**

At the commencement of each loan, 1% of the gross amount borrowed is withheld and retained by MFA as Debt Reserve Fund (DRF). To provide the full amount to fund the capital project, this 1% DRF amount is budgeted in the operating budget in the year of borrowing. However, there is no principal payment required in the year of borrowing. The estimated debt servicing cost of $75,199 equates to approximately $434.68 cost per parcel.

Capital Projects Fund

As specific capital projects are approved, the funding revenues for them are transferred into the Capital Projects Fund from multiple funding sources if applicable, including the CRF, grant funding, external contributions, and debt. Any funds remaining upon completion of a project are transferred back to the CRF for use on future capital projects or its original funding source(s).

User Charge and Parcel Tax

The service is funded by fixed user charge and parcel tax. Properties connected to the water system pay the annual user charge and all properties within the local service area are responsible for the parcel tax. Table 3 below summarizes the 2023 over 2022 changes for parcel tax and user charge.

Table 3 – Parcel Tax and User Charge Summary

Budget Year	*Parcel Tax*	*Taxable Folios Numbers*	*Parcel Tax per Folio**	*User Charge*	*SFE Numbers*	*User Charge per SFE*	*Parcel Tax & User Charge*
2022	$131,060	171	$806.67	$112,304	164	$684.78	**$1,491.45**
2023	$133,030	173	$809.33	$119,864	164	$730.88	**$1,540.21**
Change ($)	$1,970	2	$2.66	$7,560	0	$46.10	**$48.76**
Change (%)	1.50%	1.17%	0.33%	6.73%	0.00%	6.73%	**3.27%**

*Includes 5.25% collection fee charged by the Ministry of Finance (not CRD revenue)

RECOMMENDATIONS

That the Lyall Harbour/Boot Cove Water Local Service Committee:

1. Approve the 2023 operating and capital budget as presented and that the 2022 actual operating deficit be balanced on the 2022 Reserve Funds transfer (CRF and/or ORF); and

2. Recommends that the Electoral Areas Committee recommends that the CRD Board approve the 2023 Operating and Capital Budget and the five-year Financial Plan for the Lyall Harbour/Boot Cove Water Service as presented.

Submitted by	Jason Dales, BSc., WD IV, Senior Manager, Wastewater Infrastructure Operations
Submitted by	Rianna Lachance, BCom., CPA, CA, Senior Manager, Financial Services
Concurrence	Ian Jesney, PEng., Acting General Manager, Integrated Water Services
Concurrence	Ted Robbins, BSc., CTech., Chief Administrative Officer

ATTACHMENT:

Appendix A: 2023 Lyall Harbour/Boot Cove Budget

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CAPITAL REGIONAL DISTRICT

2023 Budget

Lyall Harbour Water

Commission Review

NOVEMBER 2022

APPENDIX A

Service: **2.640 Lyall Harbour Boot Cove Water (Saturna)** **Committee: Electoral Area**

DEFINITION:

To provide and operate and maintain a domestic water supply and distribution system for the Saturna Island Water Supply and Distribution System Specified Area in the Lyall Harbour/Boot Cove district on Saturna Island. Bylaw No. 513 (November 22, 1978).

PARTICIPATION:

Specified Area #14 - G(764)

MAXIMUM LEVY:

Greater of $150,000 or $6.90 / $1,000 on actual assessed value of land and improvements. To a maximum of $605,437.

MAXIMUM CAPITAL DEBT:

AUTHORIZED:	LA Bylaw No. 3587 (Jan 14, 2009)	$430,000
BORROWED:	SI Bylaw 3634 (Aug 12, 2009)	$250,000
BORROWED:	SI Bylaw 3677 (Feb 10, 2010)	$180,000
REMAINING:		$0

COMMITTEE:

Lyall Harbour/Boot Cove Water Committee established by Resolution - September 29, 1982
Lyall Harbour/Boot Cove Water Local Services Committee established by Bylaw No. 1875 (December 12, 1990)

FUNDING:

User Charge:	Annual charge per single family equivalency unit connected to the system.
Parcel Tax:	Annual charge levied only on properties capable of being connected to the system.
Connection Charges:	Actual Cost + 15% Admin Fee (Minimum Connection $400)

RESERVE FUND:

Bylaw No. 1785 (February 14, 1990)

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2.640 - Lyall Harbour Water	2022 BOARD BUDGET	2022 ESTIMATED ACTUAL	BUDGET REQUEST 2023 CORE BUDGET	BUDGET REQUEST 2023 ONGOING	BUDGET REQUEST 2023 ONE-TIME	BUDGET REQUEST 2023 TOTAL	FUTURE PROJECTIONS 2024	FUTURE PROJECTIONS 2025	FUTURE PROJECTIONS 2026	FUTURE PROJECTIONS 2027
OPERATING COSTS										
Repairs & Maintenance	15,310	15,000	5,470	-	25,000	30,470	25,580	5,822	5,950	6,080
Allocations	12,477	12,477	12,969	-	-	12,969	13,232	13,500	13,773	14,051
Water Testing	8,450	8,450	8,619	-	-	8,619	8,791	8,968	9,146	9,329
Electricity	3,550	4,800	3,660	-	-	3,660	3,730	3,800	3,880	3,960
Supplies	5,790	7,730	5,970	-	-	5,970	6,090	6,210	6,330	6,450
Labour Charges	112,420	135,000	112,420	7,520	-	119,940	126,170	128,690	131,260	133,890
Other Operating Expenses	15,400	9,960	15,870	-	-	15,870	16,230	16,600	16,980	17,370
TOTAL OPERATING COSTS	**173,397**	**193,417**	**164,978**	**7,520**	**25,000**	**197,498**	**199,823**	**183,590**	**187,319**	**191,130**
*Percentage Increase over prior year			-4.9%	4.3%	14.4%	13.9%	1.2%	-8.1%	2.0%	2.0%
DEBT / RESERVES										
Transfer to Operating Reserve Fund	20,000	10,000	20,000	-	-	20,000	20,600	21,200	20,500	20,000
Transfer to Capital Reserve Fund	26,000	9,771	30,000	-	-	30,000	24,800	20,500	16,640	20,770
MFA Debt Reserve Fund	120	120	680	-	-	680	3,500	3,600	100	100
MFA Debt Principal	22,148	22,148	22,148	-	-	22,148	25,382	31,858	41,713	41,713
MFA Debt Interest	7,929	7,929	8,538	-	-	8,538	14,190	22,826	33,486	33,486
TOTAL DEBT / RESERVES	**76,197**	**49,968**	**81,366**	**-**	**-**	**81,366**	**88,472**	**99,984**	**112,439**	**116,069**
TOTAL COSTS	**249,594**	**243,385**	**246,344**	**7,520**	**25,000**	**278,864**	**288,295**	**283,574**	**299,758**	**307,199**
FUNDING SOURCES (REVENUE)										
Balance c/fwd from 2021 to 2022	4,737	4,737	-	-	-	-	-	-	-	-
Transfer from Operating Reserve Fund	(10,000)	-	-	-	(25,000)	(25,000)	(20,000)	-	-	-
User Charges	(112,304)	(112,304)	(112,344)	(7,520)	-	(119,864)	(127,615)	(135,894)	(144,728)	(149,069)
Grants in Lieu of Taxes	(747)	(747)	(770)	-	-	(770)	(800)	(820)	(840)	(860)
Other Revenue	(220)	(4,011)	(200)	-	-	(200)	(200)	(200)	(200)	(200)
TOTAL REVENUE	**(118,534)**	**(112,325)**	**(113,314)**	**(7,520)**	**(25,000)**	**(145,834)**	**(148,615)**	**(136,914)**	**(145,768)**	**(150,129)**
REQUISITION - PARCEL TAX	**(131,060)**	**(131,060)**	**(133,030)**	**-**	**-**	**(133,030)**	**(139,680)**	**(146,660)**	**(153,990)**	**(157,070)**
*Percentage increase over prior year										
User Fees			0.0%	6.7%		6.7%	6.5%	6.5%	6.5%	3.0%
Requisition			1.5%			1.5%	5.0%	5.0%	5.0%	2.0%
Combined			**0.8%**	**3.1%**		**3.9%**	**5.7%**	**5.7%**	**5.7%**	**2.5%**

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Lyall Harbour Water
Reserve Summary Schedule
2023 - 2027 Financial Plan

Reserve/Fund Summary

	Estimated	Budget				
	2022	2023	2024	2025	2026	2027
Operating Reserve Fund	10,825	5,825	6,425	27,625	48,125	68,125
Capital Reserve Fund	34,031	41,031	65,831	86,331	102,971	123,741
Total	**44,856**	**46,856**	**72,256**	**113,956**	**151,096**	**191,866**

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Reserve Schedule

Reserve Fund: 2.640 Lyall Harbour Water System - Operating Reserve Fund - Bylaw 4144

Reserve fund used for: unforeseen operational repairs and maintenance; infrequent maintenance activities such as reservoir cleaning and inspection, filter media replacement etc.

Reserve Cash Flow

Fund: 1500 / Fund Centre: 105213	Estimated 2022	Budget 2023	2024	2025	2026	2027
Beginning Balance	815	10,825	5,825	6,425	27,625	48,125
Transfer from Ops Budget	10,000	20,000	20,600	21,200	20,500	20,000
Transfer to Ops Budget	-	(25,000)	(20,000)	-	-	-
Planned Maintenance Activity		Reservoir Cleaning & inspection and Chlorine Contact Tank and Inspection	Replace filtration Media			
Interest Income*	10					
Ending Balance $	**10,825**	**5,825**	**6,425**	**27,625**	**48,125**	**68,125**

Assumptions/Background:

Set level of transfers in order to avoid spikes in requisition resulting from unforeseen breakdowns in water infrastructure
* Interest is included in determining the estimated ending balance for the current year. Interest in planning years nets against inflation which is not included.

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Reserve Schedule

Reserve Fund: 2.640 Lyall Harbour Water System - Capital Reserve Fund - Bylaw 1785

Surplus money from the operation of the water system may be paid from time to time into the reserve fund.

Reserve Cash Flow

Fund: 1025 / Fund Centre: 101369	Estimated	Budget				
	2022	2023	2024	2025	2026	2027
Beginning Balance	23,956	34,031	41,031	65,831	86,331	102,971
Transfer from Ops Budget	9,771	30,000	24,800	20,500	16,640	20,770
Transfer from Cap Fund	-					
Transfer to Cap Fund	-	(23,000)	-	-	-	-
Interest Income*	304					
Ending Balance $	**34,031**	**41,031**	**65,831**	**86,331**	**102,971**	**123,741**

Assumptions/Background:

To fully fund capital expenditure plan

* Interest is included in determining the estimated ending balance for the current year. Interest in planning years nets against inflation which is not included.

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CAPITAL REGIONAL DISTRICT

FIVE YEAR CAPITAL EXPENDITURE PLAN SUMMARY - 2023 to 2027

Service No. 2.640 Lyall Harbour Boot Cove Water (Saturna)	Carry Forward from 2022	2023	2024	2025	2026	2027	TOTAL
EXPENDITURE							
Buildings	$0	$0	$0	$0	$0	$0	$0
Equipment	$0	$66,000	$0	$0	$0	$0	$66,000
Land	$0	$0	$0	$0	$0	$0	$0
Engineered Structures	$250,000	$265,000	$340,000	$350,000	$0	$0	$955,000
Vehicles	$0	$0	$0	$0	$0	$0	$0
	$250,000	**$331,000**	**$340,000**	**$350,000**	**$0**	**$0**	**$1,021,000**
SOURCE OF FUNDS							
Capital Funds on Hand	$0	$0	$0	$0	$0	$0	$0
Debenture Debt (New Debt Only)	$0	$58,000	$340,000	$350,000	$0	$0	$748,000
Equipment Replacement Fund	$0	$0	$0	$0	$0	$0	$0
Grants (Federal, Provincial)	$250,000	$250,000	$0	$0	$0	$0	$250,000
Donations / Third Party Funding	$0	$0	$0	$0	$0	$0	$0
Reserve Fund	$0	$23,000	$0	$0	$0	$0	$23,000
	$250,000	**$331,000**	**$340,000**	**$350,000**	**$0**	**$0**	**$1,021,000**

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CAPITAL REGIONAL DISTRICT
5 YEAR CAPITAL PLAN
2023 - 2027

Project Number
Project number format is "yy-##"
"yy" is the last two digits of the year the project is planned to start.
"##" is a numberical value. For example, 23-01 is a project planned to start in 2023.

For projects in previous capital plans, use the same project numbers previously assigned.

Capital Expenditure Type
Study - Expenditure for feasibility and business case report.
New - Expenditure for new asset only
Renewal - Expenditure upgrades an existing asset and extends the service ability or enhances technology in delivering that service
Replacement - Expenditure replaces an existing asset

Capital Project Title
Input title of project. For example "Asset Name - Roof Replacement", "Main Water Pipe Replacement".

Capital Project Description
Briefly describe project scope and service benefits.
For example: *"Full Roof Replacement of a 40 year old roof above the swimming pool area; The new roofing system is built current energy standards, designed to minimize maintenance and have an expected service life of 35 years".*

Total Project Budget
Provide the total project budget, even if it extends beyond the 5 years of this capital plan.

Asset Class
L - Land
S - Engineering Structure
B - Buildings
V - Vehicles

Funding Source Codes
Debt = Debenture Debt (new debt only)
ERF = Equipment Replacement Fund
Grant = Grants (Federal, Provincial)
Cap = Capital Funds on Hand
Other = Donations / Third Party Funding
Res = Reserve Fund
STLoan = Short Term Loans
WU - Water Utility
If there is more than one funding source, use additional rows for the project.

Carryforward from 2022
Input the carryforward amount from the 2022 capital plan that is remaining to be spent Forecast this spending in 2023 to 2027.

Project Drivers
Maintain Level of Service = Project maintains existing or improved level of service.
Advance Board or Corporate Priority = Project is a Board or Corporate priority.
Emergency = Project is required for health or safety reasons.
Cost Benefit = Economic benefit to the organization.

Long-term Planning
Master Plan / Servicing Plan = Plan that identifies new assets required to meet future needs.
Asset Management Plan / Sustainable Service Delivery Plan = Integrated plan that identifies asset replacements based on level of service, criticality, condition, risk, replacement costs as well as external impacts.
Replacement Plan = Plan that identifies asset replacements based primarily on asset age or asset material/type.
Condition Assessment = Assessment that identifies asset replacements based on asset condition.

Cost Estimate Class
Class A (±10-15%) = Estimate based on final drawings and specifications; used to evaluate tenders.
Class B (±15-25%) = Estimate based on investigations, studies or prelimminary design; used for budget planning.
Class C (±25-40%) = Estimate based on limited site information; used for program planning.
Class D (±50%) = Estimate based on little/no site information; used for long-term planning.

Service #: 2.640

Service Name: Lyall Harbour Boot Cove Water (Saturna)

Project List and Budget

Project Number	Capital Expenditure Type	Capital Project Title	Capital Project Description	Total Project Budget	Asset Class	Funding Source	Carryforward from 2022	2023	2024	2025	2026	2027	5 - Year Total
19-01	Replacement	Air Valve Replacement - Ph 2	Replace aging air valves that are a safety concern.	$20,000	E	Debt	$0	$20,000	$0	$0	$0	$0	$20,000
19-02	Replacement	PRV Bypass Assembly Replacement	Construct bypasses on the East Point, Narvaez and Boot Cove PRV stations to maintain system operation while the PRV's undergo maintenance.	$8,000	E	Res	$0	$8,000	$0	$0	$0	$0	$8,000
19-03	Replacement	Standpipe and Valve Replacement	Replace the standpipe valves at 119 and 155 East Point Road that are seized and inoperable	$8,000	E	Debt	$0	$8,000	$0	$0	$0	$0	$8,000
19-04	New	Alternative Approval Process	Conduct public consultation to inform strategies for a referendum (AAP) to borrow necessary future capital funds. If the grant is not successful.	$20,000	S	Res	$0	$15,000	$0	$0	$0	$0	$15,000
19-05	New	Autoflush Installation	Install 3 autoflushes within the water distribution system to maintain distribution water quality.	$20,000	E	Debt	$0	$20,000	$0	$0	$0	$0	$20,000
20-02	New	Raw Water Turbidity Meter	Supply and install a new turbidity meter in the raw water line to aid in operation of the WTP.	$10,000	E	Debt	$0	$10,000	$0	$0	$0	$0	$10,000
21-01	Replacement	Source Water Viability Study	Study to determine vulnerability of the source water and its viability.	$15,000	S	Debt	$0	$0	$15,000	$0	$0	$0	$15,000
22-01	New	Install Larger Supply Line to Tank	Construct a larger supply line to the tank to improve system reliability and operation.	$175,000	S	Debt	$0	$0	$175,000	$0	$0	$0	$175,000
22-02	Renewal	Dam Improvement and Regulatory Requirements	Seismic reinforcement of Money Lake Dam based upon the 2016 Dam Safety Review. Includes seepage pit construction and Dam Safety Review.	$390,000	S	Grant	$250,000	$250,000	$0	$0	$0	$0	$250,000
23-01	New	WTP Upgrades	Upgrades to the water treatment plant to meet IHA requirements including ozone upgrades and chlorination upgrades.	$500,000	S	Debt	$0	$0	$150,000	$350,000	$0	$0	$500,000
			GRAND TOTAL	**$1,166,000**			**$250,000**	**$331,000**	**$340,000**	**$350,000**	**$0**	**$0**	**$1,021,000**

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Service:	2.640	Lyall Harbour Boot Cove Water (Saturna)

Project Number	19-01	**Capital Project Title**	Air Valve Replacement - Ph 2	**Capital Project Description**	Replace aging air valves that are a safety concern.
Project Rationale	The air valves are 35 years old and are corroded, giving rise to safety concerns.				

Project Number	19-02	**Capital Project Title**	PRV Bypass Assembly Replacement	**Capital Project Description**	Construct bypasses on the East Point, Narvaez and Boot Cove PRV stations to maintain system operation while the PRV's undergo maintenance.
Project Rationale	The inlet and outlet piping at the East Point, Narvaez and Boot Cove PRV stations are very corroded and there is no way to isolate the stations to replace or maintain the pressure reducing valves. It is proposed that new inlet and outlet piping be installed with 100mm gate valves and bypass piping so that customers are not without water when PRV's are being serviced.				

Project Number	19-03	**Capital Project Title**	Standpipe and Valve Replacement	**Capital Project Description**	Replace the standpipe valves at 119 and 155 East Point Road that are seized and inoperable
Project Rationale	The standpipe valves at 119 and 155 East Point Road are seized and inoperable. Therefore, the operators cannot use them for flushing or draining of the mains. It is proposed the valves and corroded 50mm supply line to the standpipe be replaced. The scope of work and material pricing was re-evaluated in 2016. It was determined that the budget needed to be increased from $5,000 to $8,000 to accommodate the required works.				

Project Number	19-04	**Capital Project Title**	Alternative Approval Process	**Capital Project Description**	Conduct public consultation to inform strategies for a referendum (AAP) to borrow necessary future capital funds. If the grant is not successful.
Project Rationale	Future required projects to maintain public safety and level of service require funding in excess of current projected reserve balance. Future funding will be for improvements the Water Treatment Plant to increase reliability and optimize for improved operations, conducting a regulatory requirement for a dam safety review and construct a larger supply line to the storage tank.Funding is required to undertake public consultation to inform borrow strategies and conduct a referendum.				

Project Number	19-05	**Capital Project Title**	Autoflush Installation	**Capital Project Description**	Install 3 autoflushes within the water distribution system to maintain distribution water quality.
Project Rationale	Three watermains require frequent flushing to maintain disinfectant residuals and water quality. Flushing requires operator time which can be utilized conducting other maintenance tasks. Funds are required to construct 3 autoflushes.				

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Project Number	20-02	**Capital Project Title**	Raw Water Turbidity Meter	**Capital Project Description**	Supply and install a new turbidity meter in the raw water line to aid in operation of the WTP.
Project Rationale	Install a new turbidity meter in the raw water line to aid in operation of the WTP.				

Project Number	21-01	**Capital Project Title**	Source Water Viability Study	**Capital Project Description**	Study to determine vulnerability of the source water and its viability.
Project Rationale	Study to determine the medium to long term vulnerability of the source water (Money Lake) and its viability as a water source (quantity and quality) for the LHBC system in light of pressures such as projected demand changes and climate change.				

Project Number	22-01	**Capital Project Title**	Install Larger Supply Line to Tank	**Capital Project Description**	Construct a larger supply line to the tank to improve system reliability and operation.
Project Rationale	The supply line to the tank is undersized, installation of a larger supply line will improve operation. Funding is required to construct a larger supply line to the tank.				

Project Number	23-01	**Capital Project Title**	WTP Upgrades	**Capital Project Description**	Upgrades to the water treatment plant to meet IHA requirements including ozone upgrades and chlorination upgrades.
Project Rationale	Funds are required to upgrade the water treatment plant to meet IHA requirements including ozone upgrades and chorination works.				

Project Number	22-02	**Capital Project Title**	Dam Improvement and Regulatory Requirements	**Capital Project Description**	Seismic reinforcement of Money Lake Dam based upon the 2016 Dam Safety Review. Includes seepage pit construction and Dam Safety Review.
Project Rationale	This is a continuation of project 18-03, where seismic reinforcement of the Money Lake Dam will commence. Funds are required to retain a contractor to undertake the works and retain a consultant to conduct the dam safety review.				

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APPENDIX A

2.640 - Lyall Harbour

Capital Projects

Updated @ Oct 19, 2022

Year	Project#	Capital Plan#	Status	Capital Project Description	Total Project Budget	Spending		Total Funding in Place
						Expenditure Actuals	Remaining Spending	
2021	CE.781.4601	21-03	Open	Water System Upgrades - Access Platforms and Building	56,525	56,525	-	56,525
2022	CE.781.5501	22-02	Open	Money Lake Dam Improvements & Regulatory Requirements	390,000	-	390,000	390,000
				Totals	**446,525**	**56,525**	**390,000**	**446,525**

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APPENDIX A

Service:	2.640 Lyall Harbour Water	Committee: Electoral Area

Year	Taxable Folios	Parcel tax per Folio	Number SFE's	User Charge per SFE	Total Tax & Charges	Bylaw	Actual Assessments $(000's)
2011	170	$560.00	158	$325.00	$885.00	3799	$57,270.06
2012	171	$560.00	159	$375.00	$935.00	3823	$56,058.96
2013	171	$560.00	159	$390.31	$950.31	3892	$55,689.76
2014	171	$600.00	159	$461.14	$1,061.14	3924	$50,581.58
2015	171	$611.11	159	$472.48	$1,083.59	3987	$48,842.00
2016	174	$654.18	159	$528.24	$1,182.42	4074	$48,842.00
2017	174	$667.25	160	$535.34	$1,202.59	4170	$53,211.48
2018	174	$667.25	160	$585.06	$1,252.31	4233	$56,853.16
2019	174	$720.90	161	$624.84	$1,345.74	4274	$58,914.38
2020	171	$806.49	164	$638.74	$1,445.23	4337	$63,381.81
2021	171	$786.22	164	$667.45	$1,453.67	4389	$65,218.26
2022	171	$806.67	164	$684.78	$1,491.45	4471	$87,744.55
2023	173	$809.33	164	$730.88	$1,540.21		
Change from 2022 to 2023							
		$2.66		*$46.10*	*$48.76*		
		0.33%		*6.73%*	*3.27%*		

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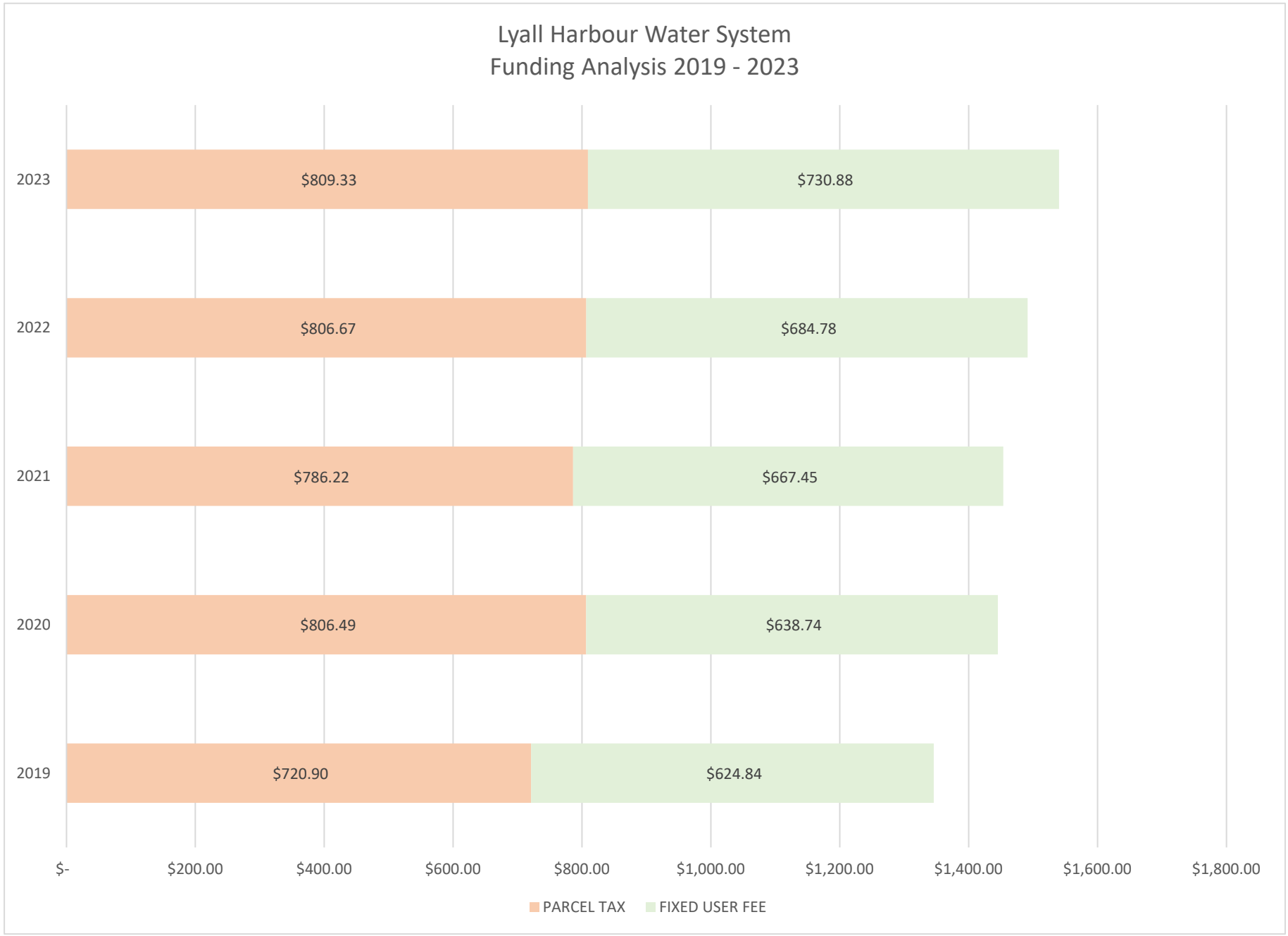
APPENDIX A



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Making a difference...together

REPORT TO LYALL HARBOUR/BOOT COVE WATER LOCAL SERVICE COMMITTEE MEETING OF TUESDAY, NOVEMBER 22, 2022

SUBJECT **Capital Project Status Reports and Operational Updates**

ISSUE SUMMARY

To provide the Lyall Harbour/Boot Cove Water Local Service Committee with capital project status reports and operational updates.

BACKGROUND

The Lyall Harbour/Boot Cove Water System is located on the west side of Saturna Island in the Southern Gulf Islands Electoral Area and provides drinking water to approximately 153 customers. Capital Regional District (CRD) Integrated Water Services is responsible for the overall operation of the water system with day-to-day operation and maintenance, design and construction of water system facilities provided by the CRD Infrastructure Engineering and Operations Divisions. The quality of drinking water provided to customers in the Lyall Harbour/ Boot Cove Water System is overseen by the CRD Water Quality Section.

CAPITAL PROJECT UPDATE

19-02 | Pressure Release Valve (PRV) Bypass Assembly Replacement

Project Description: Construct bypasses on the East Point, Narvaez and Boot Cove PRV stations to maintain system operation while the PRV's undergo maintenance.

Project Rationale: The inlet and outlet piping at the East Point, Narvaez and Boot Cove PRV stations are very corroded and there is no way to isolate the stations to replace or maintain the pressure reducing valves. It is proposed that new inlet and outlet piping be installed with 100 millimeter gate valves and bypass piping so that customers are not without water when PRV's are being serviced.

Project Update and Milestones:

- Operations to undertake the works.
- Scheduling with other maintenance work likely to occur, currently scheduled for fall 2022 unless an earlier opportunity is available.
- This project has now been deferred to 2023 due to resource constraints.

22-02 | Dam Improvements & Regulatory Requirements

Project Description: Seismic reinforcement of Money Lake Dam based upon the 2016 Dam Safety Review. Includes seepage pit construction and Dam Safety Review.

Project Rationale: This is a continuation of project 18-03, where seismic reinforcement of the Money Lake Dam will commence. Funds are required to retain a contractor to undertake the works and retain a consultant to conduct the dam safety review.

Project Update and Milestones:

- The Community Works Funds (CWF) were approved in 2021 for design work to start in 2022.
- Staff are currently engaging consultants to provide quotes for design and construction services.
- Geotechnical Engineer (Thurber) is conducting more detailed 3D analysis of the dam to better assess seismic risks and whether buttressing is going to be required. Dam Safety Review is still on schedule for end of year.

Milestone	Completion Date
CWF Approval	October 10, 2021
Contract Award	July 27, 2022
Consultant field investigation	August 31, 2022

OPERATIONAL UPDATE

This is an operational update reporting period from June 2022 through October 2022.

- System leak detection activities as a result of low reservoir alarms due to high water demands. As a result, several leaks were identified to be on the private side of the system. This also occurred during the last reporting period and continues to be a vulnerability for the service.
- Preventative maintenance completed on the raw water system which include cleaning of the surge tank and flushing of the raw waterlines from Money Lake to the water treatment plant.
- Operational involvement with issuing a boil water advisory on October 18, 2022 due to elevated treated water turbidity.
- Corrective maintenance completed on the sodium hypochlorite system including the chemical feed pump, piping and analyzer.
- Safety review of identified confined spaces that include pressure regulating stations within the water distribution system. Operations is working with CRD Corporate Safety reviewing these sites to determine what safety improvements might be necessary for operational staff to safely access these sites in order to perform preventative maintenance on the equipment within these spaces.

RECOMMENDATION

There is no recommendation. This report is for information only.

Submitted by:	Jared Kelly, P.Eng., Manager, Capital Projects
Submitted by:	Dan Robson, A.Sc.T., Manager, Saanich Peninsula and Gulf Islands Operations
Concurrence:	Joseph Marr, P.Eng., Acting Senior Manager, Infrastructure Engineering
Concurrence:	Jason Dales, B.Sc., WD IV., Acting Senior Manager, Wastewater Infrastructure Operations
Concurrence:	Ian Jesney, P.Eng., Acting General Manager, Integrated Water Services

Making a difference...together

EEP 22-24

REPORT TO LYALL HARBOUR/BOOT COVE WATER LOCAL SERVICE COMMITTEE MEETING OF TUESDAY, NOVEMBER 22, 2022

SUBJECT **Investigation of Turbidity Measurement at the Lyall Harbour/Boot Cove Water System**

ISSUE SUMMARY

Staff collaborated with University of Victoria on a research study to investigate the influence of colour on turbidity measurement in the Lyall Harbour/Boot Cove water system.

BACKGROUND

The Lyall Harbour/Boot Cove (LHBC) water system has been subject to frequent boil water advisories (BWA) as a result of elevated turbidity measured at the water treatment plant. Elevated turbidity indicates increased presence of suspended particles that can compromise water disinfection, in particular the ultra-violet (UV) disinfection. Turbidity levels less than 1.0 NTUs are required for effective treatment. There are several possible sources of the reoccurring elevated turbidity during the fall and winter seasons. Along with suspended particles of organic (e.g., algae) and/or mineral (e.g., soil particles) origin, colour may also be interfering with the actual turbidity measurements by the online turbidity analyzer at the treatment plant. Installation of 0.35 micron filters, which would remove all suspended particles, did not lower the measured turbidity. The study investigated the role of dissolved material in the system.

The CRD worked with Professor Caetano Dorea at the University of Victoria in the Environmental Engineering Faculty. Under Dr. Dorea's guidance, staff collected specific samples during and following a turbidity-related BWA in the winter and spring of 2022 and submitted these samples to UVic, as well as to a commercial lab and to the CRD Water Quality Lab for analysis. All lab results were then compiled and analyzed by UVic staff. Another round of sampling occurred in June 2022 to verify some of the initial findings. The final report titled *Technical Note: "Can background colour interfere with turbidity measurements?", Saturna Island Water Treatment Plant – Turbidity Study* was submitted to the CRD in September 2022 (see Appendix A).

The results indicate that dissolved organic matter (i.e., colour) and dissolved inorganics (i.e., metals) interfere with the turbidity measurements at the LHBC Treatment Plant when seepage water is the only source during the winter season. This interference causes the turbidity measurements to indicate an exceedance of the limit of 1.0 NTU and therefore trigger a BWA when in fact no suspended particles are present in treated water that could reduce the efficacy of the disinfection treatment.

DISCUSSION

The report recommends the installation of a colour interference-free turbidity sensor in addition to the existing turbidity analyzer. This short-term solution should correct for the colour interference and therefore reduce the number of required BWAs for the system. For the removal of the dissolved matter in the water (the cause of the interference), significant water treatment upgrades would be required.

Both the recommended short-term solution and the long-term treatment upgrade solution have financial implications for the LHBC water service. However, the short-term solution, if approved and accepted by Island Health, could reduce the frequency and duration of turbidity-related BWAs for the community.

CONCLUSION

Collaborative research with the University of Victoria indicated the presence of dissolved organic material (i.e., colour) and the interference it creates for turbidity measurements in the water treatment system. A final report released by UVic staff has highlighted short-term and long-term solutions to this water quality issue.

RECOMMENDATION

There is no recommendation. This report is for information only.

Submitted by:	Glenn Harris, Ph.D., R.P.Bio., Senior Manager, Environmental Protection
Concurrence:	Joseph Marr, Acting Senior Manager, Infrastructure Engineering
Concurrence:	Jason Dales, Acting Senior Manager, Wastewater Operations
Concurrence:	Larisa Hutcheson, P.Eng., General Manager, Parks & Environmental Services
Concurrence:	Ian Jesney, P. Eng., Acting General Manager, Integrated Water Services

ATTACHMENT

Appendix A: Technical Note: “Can background color interfere with turbidity Measurements?” Saturna Island Water Treatment Plant – Turbidity Study

University of Victoria | Faculty of Engineering | Department of Civil Engineering
Engineering Computer Science (ECS) 304A PO Box 1700 STN CSC Victoria BC V8W 2Y2

Technical Note: *"Can background color interfere with turbidity measurements?"* Saturna Island Water Treatment Plant – Turbidity Study

Corresponding Authors: Kelsey Shaw, MASc., & Caetano Dorea, PhD.
Contact Information: kelseyshaw@uvic.ca; caetanodorea@uvic.ca

Introduction:

Turbidity is an easy and common parameter monitored in most drinking water systems [1], [2]. Sources of turbidity can include naturally occurring particles both inorganic and organic in nature. These particles can harbour microorganisms, protecting them from disinfection. Elevated or fluctuating turbidity in treated water can also be used as an indicator of increased pathogen risk due to a potential problem with the existing water treatment process.

Health Canada recommends that small water systems (SWS) in British Columbia (BC) ensure drinking water meets the water quality criteria set out under the Guidelines for Canadian Drinking Water Quality (GCDWQ) [3]. The minimum level of treatment required to make drinking water microbiologically and chemically safe depends on the quality and type of the water source, as well as the size and type of the population served. However, at a minimum, the Province of BC states that SWS are required to meet the turbidity objective of less than 1 NTU, with a target of 0.1 NTU for systems that have full filtration capacity as a part of their treatment chain [4], [5]. B.C.'s regional health authorities administer the Drinking Water Protection Act and provide surveillance and monitoring of drinking water systems. In conjunction with the water supplier, they are also responsible for issuing notifications about drinking water quality. Commonly, a Boil Water Advisory (BWA) is issued when turbidity objectives are not met. Given that this parameter in itself does not constitute an increased human health risk these BWA are considered precautionary in nature. A BWA is used in situations where the authorities deem there is a public health threat, and the nature of the threat is one that can be effectively addressed by boiling the water. These BWA are onerous on SWS owners, operators, and users as they can remain on a BWA for an extended period of time until turbidity levels are maintained below the limit or there are costly and timely investments in treatment infrastructure. Additionally, long-term or recurring BWAs can result in consumer complacency and undermined confidence in the supplier [6].

It is important to note that public health concerns about elevated turbidity levels are primarily related to particulate (suspended) constituents. Understanding the source of elevated turbidity levels in a drinking water treatment chain and the potential for the interference of dissolved constituents is important for operational efficiency, especially in resource and operationally constrained SWSs. In conventional drinking water treatment, processes like coagulation are typically employed. These have the capacity to remove colour-causing natural organic matter (NOM). However, SWSs that rely on surface water and simplified treatment trains (e.g., simple filtration + disinfection) are not equipped with any means of colour removal, causing water quality monitoring implications.

A SWS operated by the Capital Regional District (CRD) is currently challenged with elevated turbidity levels coming through the filter system, often resulting in BWAs. Filter integrity and turbidity meter failure have been ruled out as causal factors. As such, the current suspicion is that the source water color (i.e., possibly from dissolved organics) may be interfering with the turbidity measurements. Although colour is a known interferant of turbidity measurements [7], an experimental approach and appropriate statistical analysis was devised to verify if source water color may be interfering with turbidity measurements.

Material & Methods:

The community of Lyall Harbour / Boot Cove is located on Saturna Island (Saturna WTP), one of the Southern Gulf Islands. The drinking water service for this rural residential community has been operated by the CRD since 1978 [8]. Since the installation of an online turbidity analyzer several years ago, the elevated turbidity level events that the Saturna WTP has been faced with intermittently were made evident. **Figure 1** summarizes the treatment chain and sampling points at the Saturna WTP.

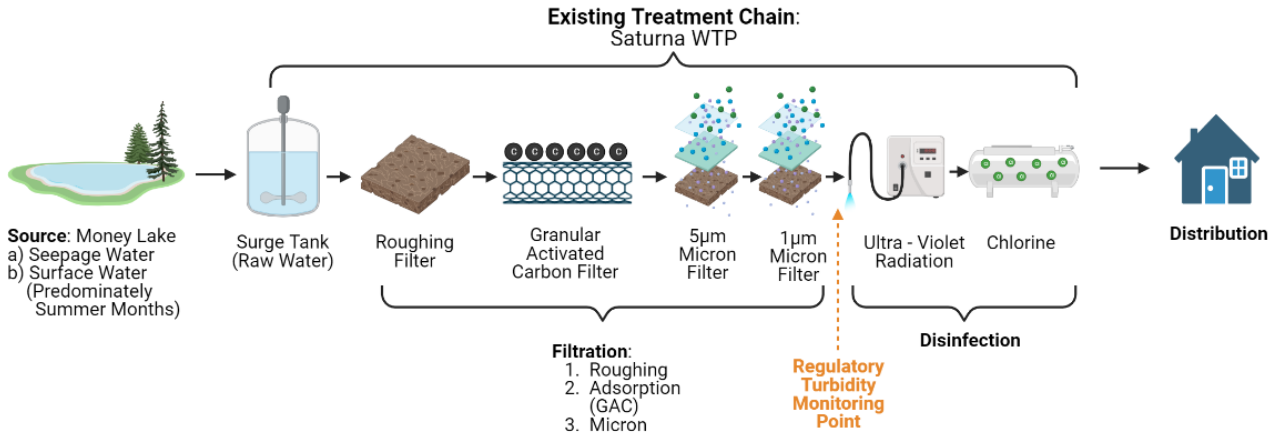

Figure 1. Saturna WTP existing treatment chain

The Saturna WTP uses predominantly seepage water collected from below the Money Lake dam as the primary raw water source. During the summer months this source is supplemented or completely replaced with flows from Money Lake. The treatment plant utilises a system comprised of two stages of simple (i.e., without coagulation) filtration (granular and adsorption) followed by cartridge polishing filters (i.e., micron filters) and disinfection (Ultraviolet light (UV) and chlorination). The system also comprises of a 136 cubic meter steel storage tank and 8360 meters of water main for the distribution system. Overall the system is monitored by a supervisory control and data acquisition (SCADA) system, with appropriate grab measurement samples at intervals and points where required and appropriate [8].

To achieve the objective set out for this study a testing framework (**Figure 2**) was developed with appropriate positive and negative controls. Samples were collected throughout the treatment system (starting at the source until treated water enters the distribution system). Samples were

sequentially filtered and analysed for parameters of interest (**Table 1**) before and after each filtration, 5 rounds of samples were collected during a BWA event (January – March 2022) and 2 rounds of samples during regular operation (May 2022).

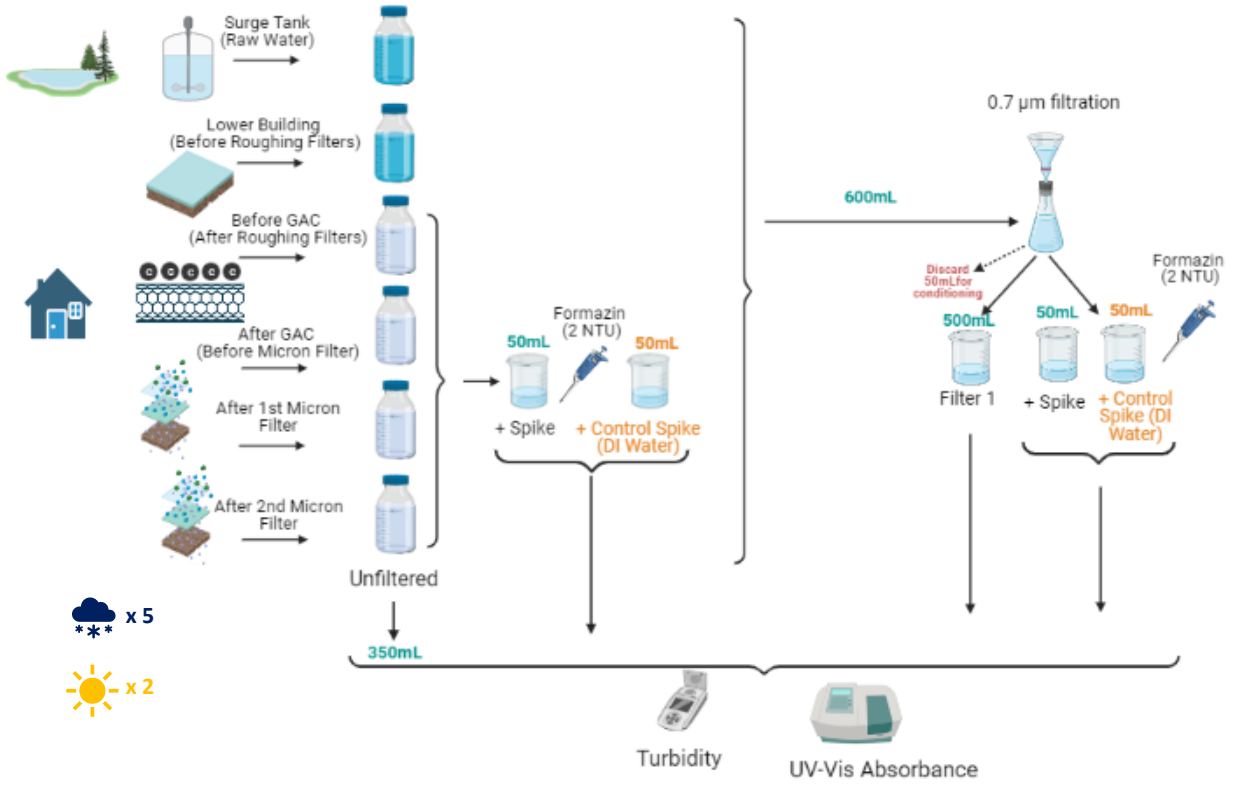

Figure 2. Graphical summary of sampling protocol and laboratory methodology employed

This method was developed to establish whether there are any turbidity-inducing particles passing through the system and serve as a negative control regarding particles. Additionally, the filtrate from the final filtration step was spiked with particles of known turbidity to serve as a positive control for particles and test any suspected interference of the sample matrix. Spiked turbidity was achieved using appropriate dilutions of a commercially-available certified formazin standard solution [7]. Such positive and negative paired control samples were then statistically analysed for significant differences to determine whether sample matrix interference on turbidity readings was occurring.

APPENDIX A

Table 1. Sampling location and parameter overview

Treatment Chain Location		CRD Laboratory Analysis		University of Victoria Analysis	
		Sample Volume	Parameter	Sample Volume	Parameter
1	Surge Tank (Raw Water)	120ml	DOC	1000ml	Turbidity
		120ml	Metals		UV-Vis
		120ml	Color		
2	Lower Building (Before roughing filter)	120ml	Color	1000ml	Turbidity
					UV-Vis
3	Before GAC (After Roughing Filter)	120ml	Color	1000ml	Turbidity
					UV-Vis
4	After GAC (Before Micron Filter)	120ml	DOC	1000ml	Turbidity
		120ml	Metals		UV-Vis
		120ml	DOC		
5	After 1st Micron Filter	120ml	Color	1000ml	Turbidity
					UV-Vis
6	After 2nd Micron Filter	120ml	DOC	1000ml	Turbidity
		120ml	Metals		UV-Vis
		120ml	Color		

Simple correlation analysis was performed in Python to determine if measured parameters demonstrated statistically significant interference with turbidity measurements. Further statistical evidence using calculated P-values were translated into relative ranges of evidence as discussed in Muff et al., 2022 [9].

Results:

Controlling for background turbidity using spiked samples with a formazin standard, results and experimental protocol were validated as they pertained to the operation of the Saturna WTP (**Figure 3**). There is very strong evidence there is no statistically significant difference between the samples with control spike added and those without, with P values of <0.01 for both unfiltered and filtered. This uniform but statistically insignificant difference indicates this is an acceptable experimentally induced variation and that measurements are in fact capturing interference.

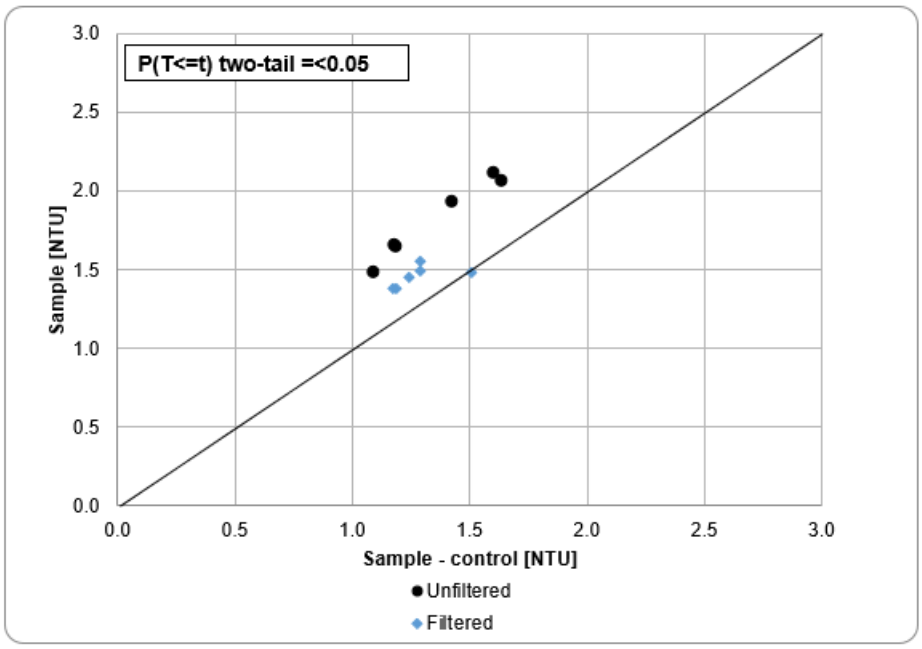

Figure 3. A comparison between average measured unfiltered and filtered samples across treatment chain locations and unfiltered and filtered samples with spike control (2 NTU) subtracted.

It was also demonstrated that the CRD field instrument is calibrated differently than lab instrument. Average measured filtered turbidity readings across treatment chain locations were 2.5NTU and 1.46NTU, for the CRD field meter and UVic lab meter, respectively. The laboratory results are considered valid for this system given the SCADA readings which were 1.78NTU. This highlights the need for regular calibration, operation and maintenance checks and validation of field and lab results.

When a BWA was issued the influent (i.e., untreated) water turbidity is approximately 2 to 3 NTU and leaves the plant at just over 1 NTU (the permissible maximum) (**Figure 4**). It has been speculated that with the onset of seasonal rainfall in the fall, the raw water conditions in Money Lake and in particular in the seepage water change to include dissolved and/or suspended solids fractions that the existing treatment plant is unable to remove in order to maintain a post-filtration water turbidity of < 1 NTU.

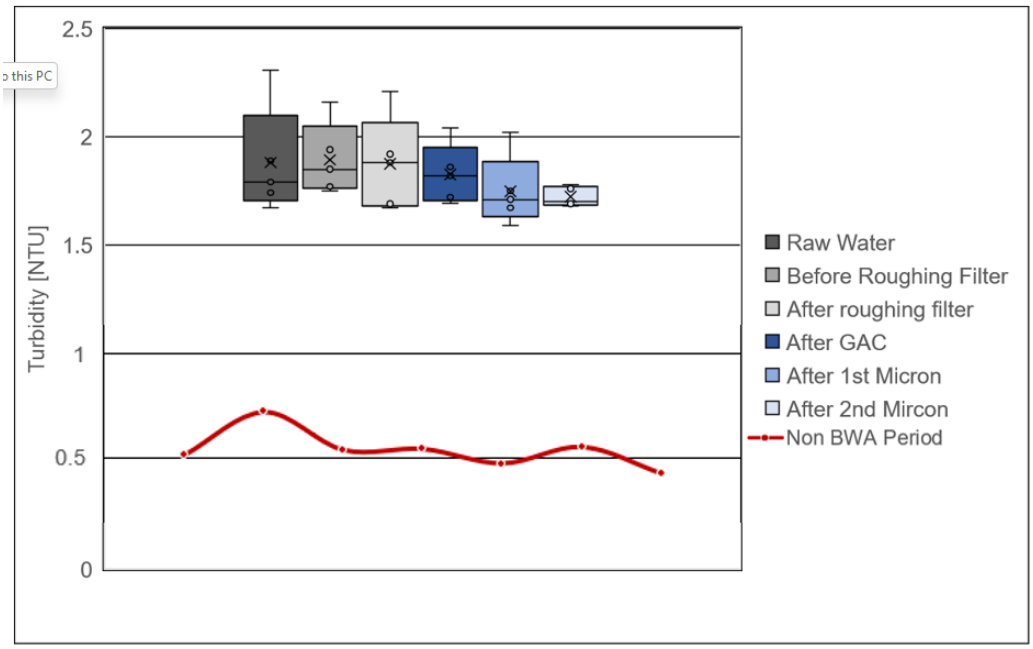

Figure 4. Box plot of turbidity readings from BWA advisory period across treatment chain locations: Red line indicates the average turbidity readings across treatment chain in non-BWA period for comparison.

These results indicate a clear downward linear tread as the water travels through the treatment chain, with the largest perceived drop in turbidity occurring after the GAC step, confirming filtration of particulate matter is indeed occurring. Filtering received samples along the treatment chain in the lab and comparing these results to the field filtered samples (i.e., after 2nd micron) it can be confirmed that filtration capacity for the current treatment systems is achieved, and the remaining particles should not be large enough to be responsible for the elevated turbidity levels that are being experienced during BWA periods. Additionally, the variability, as demonstrated by the boxplot, is relatively small after the second micron filter. This indicates that although there is still measured interference (approximately a 1.3 NTU difference between BWA and non-BWA periods) the particulate matter is being removed consistently.

In order to further investigate the interference from dissolved constituents, specifically those that are organic in nature, a humic acid standard was prepared. Turbidity and UVA254 values from both unfiltered and filtered samples in BWA periods were compared to this humic acid standard curve (**Figure 5**).

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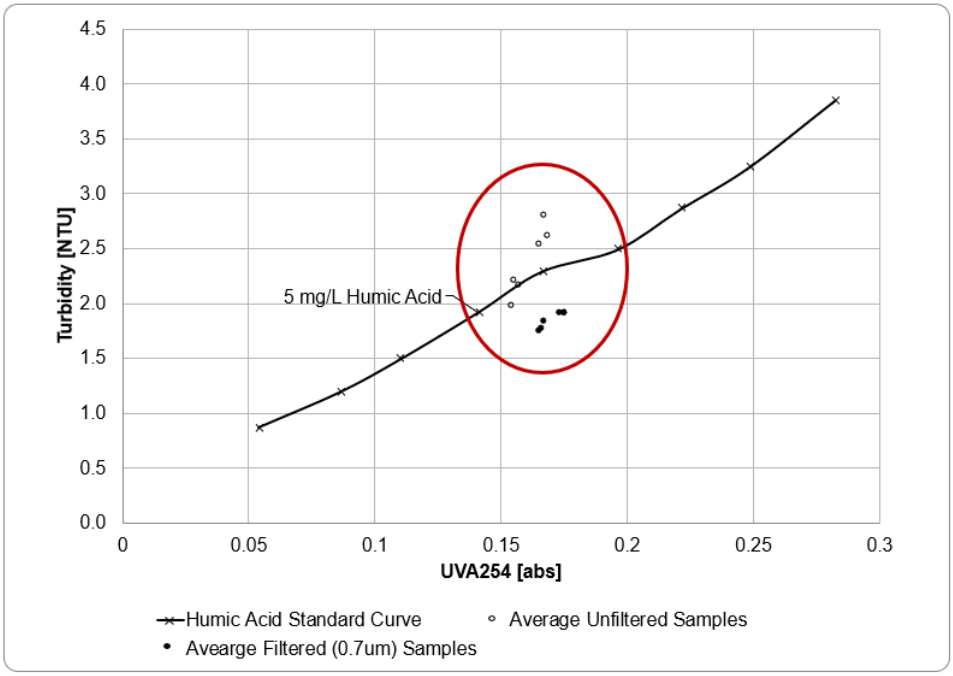

Figure 5. Plot of humic acid standard with BWA filtered and unfiltered events.

The average absorbance measured for both filtered and unfiltered samples was 0.165, which on the standard humic acid curve is approximately 2.3 NTU, a similar value to the recorded elevated turbidity levels during the BWA period (**Figure 4**). Additionally, the similar levels of interference (i.e., UVA254 absorbance values) for both unfiltered and filtered samples could indicate that it is organic in nature, as it appears that filtering the water through a 0.7µm filter does not significantly reduce the turbidity or UVA254 values.

Further investigation using the correlation of additional measured CRD parameters was conducted using Python to determine if there were other dissolved constituents that may be responsible for the elevated turbidity levels (**Table 2**).

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Table 2. Summary of calculated correlation coefficients for parameters of interest

	TOC	Colour	Field Turbidity	SCADA Turbidity	UVic Raw Turbidity	UVic Filtered Turbidity	UVic Raw UVA254	UVic Filtered UVA254
TOC	1	0.52	0.46	0.39	0.34	0.35	0.42	0.42
Colour	-	1	0.90	0.97	0.91	0.95	0.99	0.98
Field Turbidity	-	-	1	0.90	0.95	0.94	0.93	0.94
SCADA Turbidity	-	-	-	1	0.94	0.96	0.97	0.97
UVic Raw Turbidity	-	-	-	-	1	0.97	0.96	0.96
UVic Filtered Turbidity	-	-	-	-	-	1	0.97	0.98
UVic Raw UVA254	-	-	-	-	-	-	1	0.99
UVic Filtered UVA254	-	-	-	-	-	-	-	1

The results of this analysis indicate that color is correlated to turbidity and UV254, which are strongly corelated to each other, but not strongly correlated to total organic carbon (TOC). In fact, TOC is not strongly correlated to turbidity or UV254. Although TOC is sometimes responsible for elevated color readings, in this case there could be other dissolved constituents responsible for color (i.e., soluble metals) or given the small data set, measurement protocol issues (i.e., incorrect filters for TOC measurements) that are influencing these relationships.

It is also important to note that the Money Lake raw water has previously been documented to have naturally high concentrations of iron and manganese especially during the spring and fall season. Elevated iron and manganese concentrations are typically released during the fall turnover event in Money Lake and can be compounded by the ground passage of the seepage water. The natural total organic carbon in the source water is also relatively high (median 4.9 mg/L for 2020) [8]. Therefore, correlation relationships with these dissolved metals was also evaluated (**Table 3** and **Figure 6**).

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Table 3. Correlation coefficients of measured common soluble metals manganese and iron to other parameters of interest

Parameter	Manganese	Iron
CRD Field Turbidity	0.78	0.83
UVic Raw Turbidity	0.87	0.66
UVic Filtered Turbidity	0.59	0.68
UVic Raw UVA254	0.56	0.36
UVic Filtered UVA254	0.71	0.59

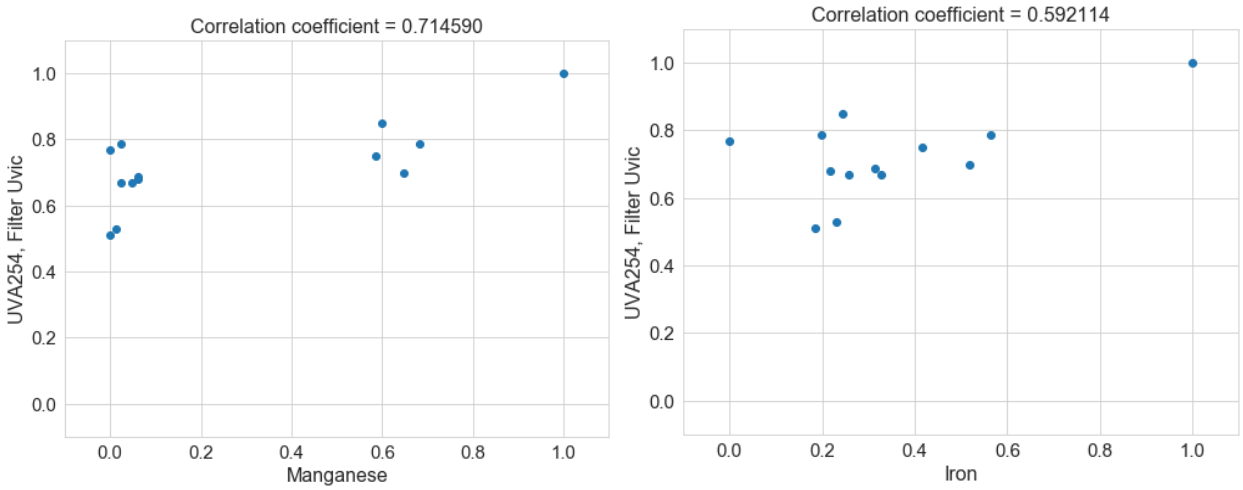

Figure 6. Correlation between CRD lab measured manganese (left) and iron (right) concentrations and UVic lab measured UVA254 for filtered samples for both BWA and non-BWA events.

This analysis shows that there is a moderate correlation between manganese values, turbidity and UV254, especially for filtered UV254 samples. Iron and manganese have previously been shown to be associated with color (soluble metals which cannot be removed with filtration) which can cause elevated turbidity levels [10]. This could explain the stronger correlation values observed with the filtered UV254 than the non-filtered values.

Implications:

Turbidity is not necessarily only attributed to suspended matter. Dissolved matter may also cause elevated turbidity readings, which does not necessarily indicate the water is unsafe to drink from a microbiological water quality perspective. Although disinfection by-products (DBPs) should still be considered as a potential hazard, this was outside the scope of this study. When it comes to safe drinking water it is the presence of the suspended matter that is the primary cause for concern as it impacts water disinfection.

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The results obtained in this study demonstrate the particulate removal capacity of the filtration steps is obtained at the end of the treatment chain. Although there may still be particulates in the water, they are smaller than the nominal retention in the filtration steps deployed. There was measurable, quantifiable, and consistent interference across the treatment chain from dissolved constituents which *could* be attributable to organic matter, based on results obtained with a humic acid standard. Additionally, elevated levels of soluble metals such as iron and manganese could also be contributing to these background turbidity levels.

Although outside the scope of this study, additional detailed engineering analysis could highlight potential solutions to address these elevated turbidity reading issues. One such solution could include upgrading the treatment process to remove dissolved organics and metals. This would result in lower readings due to a reduction in true turbidity from suspended particles and a reduction of dissolved constituents that are currently contributing to turbidity reading interferences. This would also improve the current system as it would reduce the risk of DBP formation. The cost of such an upgrade would need to be evaluated and could be significant but could also have other positive water quality implications. Another solution that could be tested could be the installation of a second interference-free online turbidity analyzer. Turbidity analyzers that use a different spectrum in order to avoid colour interference are commercially available and could provide the confirmation of safe treated water during periods of high dissolved matter interference.

This study showcased how collaboration between academia, municipalities and owner/operators of SWSs can lead to better, sustainable, and efficient operation of these systems. The sharing of insights and resources of common issues that plague SWSs not only reduces the cost on the end –user but also operators whilst protecting and promoting public and environmental health.

Sincerely,

Kelsey Shaw, MASc. Caetano Dorea, PhD

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References

[1] Health Canada, “Guidelines for Canadian Drinking Water Quality: Guideline Technical Document – Turbidity,” Jan. 13, 2005. https://www.canada.ca/en/health-canada/services/publications/healthy-living/guidelines-canadian-drinking-water-quality-turbidity.html (accessed Jul. 29, 2022).

[2] Health Canada, “Guidelines for Canadian Drinking Water Quality Summary Table.” 2017. [Online]. Available: https://www.canada.ca/content/dam/hc-sc/migration/hc-sc/ewh-semt/alt_formats/pdf/pubs/water-eau/sum_guide-res_recom/sum_guide-res_recom-eng.pdf

[3] Health Canada, “Guidance for Issuing and Rescinding Boil Water Advisories in Canadian Drinking Water Supplies,” Jun. 05, 2015. https://www.canada.ca/en/health-canada/services/publications/healthy-living/guidance-issuing-rescinding-boil-water-advisories-canadian-drinking-water-supplies.html (accessed Jul. 29, 2022).

[4] Province of British Columbia, “Drinking Water Protection Regulation - 200_2003,” p. 12, 2018.

[5] “Minimum Treatment Requirements for Small Water Systems,” *Online Help Centre for BC Small Water Systems*. https://smallwatersystemsbc.ca/minimum-treatment-requirements-small-water-systems (accessed Jul. 29, 2022).

[6] “Fit to Drink: Challenges in Providing Safe Drinking Water in British Columbia,” no. 32, p. 164, 2008.

[7] APHA, *Standard Methods for the Examination of Water and Wastewater*, 21st Edition. Washington DC: American Public Health Association / American Water works Association / Water Environment Federation, 2005.

[8] CRD, “Lyall Harbour/Boot Cove Water Service 2020 Annual Report,” CRD, Victoria BC, Annual 2020 Annual Report, 2020. [Online]. Available: https://www.crd.bc.ca/docs/default-source/crd-document-library/plans-reports/local-systems/2020-reports/lhbc2020annualreport.pdf?sfvrsn=7a7259cd_4

[9] S. Muff, E. B. Nilsen, R. B. O’Hara, and C. R. Nater, “Rewriting results sections in the language of evidence,” *Trends in Ecology & Evolution*, vol. 37, no. 3, pp. 203–210, 2022, doi: 10.1016/j.tree.2021.10.009.

[10] AWWA, *Water Quality and Treatment*, 3rd Edition. New York: McGraw Hill Book Company, 1971.