

Cowichan/Bings Watersheds Water Quality Sampling: Summer and Fall 2018



submitted to:

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The organisations listed above provided financial, technical, personnel and material support to this project.

This report may be cited as:

Preikshot, D. 2019. Cowichan/Bings Watersheds Water Quality Sampling: Summer and Fall 2018. Cowichan Watershed Board, Duncan.

Cover Image: A spawned out Chum Salmon observed while obtaining water quality samples from the Cowichan River on 13 November 2018 near the Allenby Road Bridge.

Introduction

In 2018 the author was contracted by the Cowichan Watershed Board to design, implement and report on water quality sampling in the Cowichan and Koksilah watersheds in a manner that would complement and continue extant sampling by the provincial Ministry of Environment (Smorong. 2015 and Obee 2011). Water quality sampling was carried out in three areas, see Figure 1;

- streams tributary to Cowichan Lake,
- stations in Cowichan Lake, and
- stations in the Cowichan River and Bings Creek.

A complete list of stations and their latitude / longitude coordinates can be seen in Table 1. This monitoring work continued a program begun in 2017 under the leadership of the Cowichan Watershed Board. The goal of this monitoring work is to provide local and provincial researchers, managers and the public with objective water quality data. This data will enable transparent discussions on the progress of management efforts and help identify new areas of research to inform the public and aid management decisions.

Sponsorship and Support

This monitoring work was possible in large part due to the generous financial support of the British Columbia Real Estate Foundation. This organisation was also the significant contributor to the monitoring work in 2017 and the author of this paper would like to thank the British Columbia Real Estate Foundation for their continued support.

Significant logistical support in the form of equipment, facilitating sample analysis, and database organisation was provided by Deb Epps and Michelle Meier at the Nanaimo Office of the Ministry of Environment and Climate Change Strategy.

The majority of labour to collect water quality data was conducted by a dedicated team of volunteers who provided 236 hours of work to the project, see Table 2 and 3. Volunteers were coordinated by three organisations; the Cowichan Watershed Board, The Cowichan Lake and River Stewardship Society, and the Somenos Marsh Wildlife Society.

Professional support for survey design and data collection and data analysis was provided by the author, representing the Somenos Marsh Wildlife Society.

Project Design

This sampling program adhered to the provincial '5 in 30' sampling standard, that is, at each site samples are taken once a week for five samples over a 30 day span (Epps and Phippen 2011). Sampling was conducted in the summer at the period of lowest flow and in the fall during the stage at which the first significant rain events begin to flush the land and stream levels start to rise to winter conditions, Figure 11 and 12. Sampling dates can be seen in Table 1.

Parameters measured at each station were not the same and reflected management concerns for each area. At the Cowichan Lake stations only *E. coli* samples were collected as there has

been no evidence from past sampling that phosphorus or turbidity poses a significant management concern.

Cowichan Lake Tributary Streams were sampled for turbidity and total dissolved solids due to concerns over runoff. Three Cowichan Lake tributaries (Shaw Creek, Cottonwood Creek, and MacKay Creek) were also sampled for phosphorus in the summer but values were consistently very low, or near, zero so this was not repeated in the fall for any of the lake tributaries. These same three creeks were the only tributary stream sites in summer sampling because the other creeks are dry during the summer. Samples for total suspended solids were not taken in summer.

The Cowichan River and Bings Creek sites were sampled for turbidity, total phosphorus and *E. coli*. For the Cowichan River sites there is some concern over *E. coli* in the river due to the significant presence of recreational activities such as fishing, paddling sports, swimming, and inner tubing. Additional sites were added in the Bings Creek watershed due to the observation of anomalously high levels of both *E. coli* and total phosphorus in Bings Creek and the Somenos watershed reported in Preikshot (2017). Additional sites added for the Bings Creek watershed were on Menzies Creek near its confluence with Bings Creek and Bings Creek at the Tansor Road culvert, about 1 km downstream of the Cowichan Valley Regional District transfer station. The third Bings watershed Station was Bings Creek at Phillip and Mary Street which was sampled in 2017 and in previous surveys by the Provincial Government.

Samples were analysed by the ALS Ltd. Environmental Laboratory in Burnaby BC. In both summer and fall sampling samples were placed on ice and shipped, via courier, within three hours of collection to be analysed in the Burnaby lab within 48 hours.

Results

Raw data from sampling will be made available with the publication of a technical document by the author through the Somenos Marsh Wildlife Society. In this report I present summaries of sampling for each station and parameter organised into sampling areas.

Phosphorus

Sampling in the summer showed that phosphorus levels in the lower Cowichan River and Bings Creek exceed provincial water quality standards for fish habitat (Nordin 1985): a maximum of 15 µ/l and the targets established by the Ministry of Environment (Obee 2011) for the Cowichan And Koksilah Rivers: a mean of 5 µg/l for 5 samples and maximum of 7 µg/l for 5 samples in the summer, Figure 2. Most sites in the lower Cowichan River and Bings Creek watershed were 4 to 8 times in excess of the target for the Cowichan and Koksilah Rivers. The Bings Creek site at Tansor Road had the highest observed mean phosphorus ~0.21 more than 40 times the target value.

Results from the fall sampling showed similar though more uniform and slightly lower mean concentrations of phosphorus, Figure 3. Note that no specific target has been established for fall or winter levels of phosphorus in the watershed. Variation in maximum and minimum values

over the sampling period was much greater reflective of the large variation in discharge seen during the fall.

E. coli

E. Coli sampling in Lake Cowichan showed that levels for most sites are well within targets established by the Ministry of environment (Epps 2011): that the 90th percentile of samples not exceed 10 coliform units per 100ml (CFU/100ml), Figure 4. Sites at Youbou had the highest mean and 90th percentile values with site 2 approaching the threshold and Youbou site 3 exceeding it. The reference target is set with a view that Cowichan Lake is a drinking water source.

Upper Cowichan River, i.e., the weir to Vimy Beach, *E. coli* targets are the same as those for Lake Cowichan, however, Lower Cowichan River, i.e., Allenby Road to the Estuary and Bings Creek, water quality targets are based on recommendations in Obee (2011) and follow Heath Canada Guidelines for that the geometric mean of samples not exceed 77 CFU/ 100ml for primary contact or 385 CFU/100ml for secondary contact. Primary contact includes activities like swimming and snorkeling, whereas secondary contact is incidental activities like canoeing and fishing. In the summer samples the Bings Creek geometric means from the Tansor Road site and the Phillip and Mary Street site exceeded the primary contact threshold but not that for secondary contact, Figure 5.

In the winter sampling at Cowichan Lake, two sites: Bear Lake and Youbou Site 3 exceeded the water quality target for *E. coli*, Figure 6. Youbou site 3, therefore, exceeded water quality guidelines in both summer and winter. In the upper Cowichan River sites, the geometric mean at the weir exceeded the primary contact threshold and would have also exceeded the drinking water threshold of the 90th percentile of samples being below 10 CFU/100ml. As with the phosphorus data most of the lower Cowichan and Bings Creek watershed sites had slightly lower *E. coli* mean results in the winter versus the summer. With the exception of the weir, all river and creek sites were within primary and secondary contact thresholds.

Turbidity and Total Suspended Solids

Analysis of turbidity data from summer sampling shows that two stations in the Bings Creek watershed: Menzies Creek at Curry Road and Bings Creek at Tansor Road exceeded the water quality target of a maximum value of 2 Nephelometric Turbidity Units (NTU), Figure 8. In winter sampling the maximum threshold target is higher, 5 NTU but this value was exceeded for most stations. Observed maxima were more likely to be below the target threshold at Upper Cowichan River station and the Cowichan Lake tributary streams. Figure 9.

The target thresholds for total dissolved solids for Cowichan Lake tributary streams was proposed to be a max 26 mg/L and an average of 6 mg/L in 5 weekly samples collected over a 30-day period (Epps 2011). Nixon, Robertson and Sutton Creek were observed to have exceeded both these thresholds while all other tributary streams met both targets, Figure 10.

References

Epps, D and B. Phippen. 2011. Water quality assessment and objectives for Cowichan Lake. British Columbia Ministry of Environment, Environmental Protection Division, Environmental Quality Section, Nanaimo: 67 p.

Nordin, R. 1985. Water Quality Criteria for Nutrients and Algae, Technical Appendix. Water Quality Unit, Resource Quality Section, Water Management Branch, Ministry of Environment, Victoria: 120 p.

Obee, N. 2011. Water quality assessment and objectives for the Cowichan and Koksilah rivers: first update. British Columbia Ministry of Environment, Environmental Protection Division, Environmental Sustainability & Strategic Policy Division, Nanaimo: 71 p.

Preikshot, D. 2017. Cowichan/Koksilah Water Quality Sampling: Summer and Fall 2017. Cowichan Watershed Board and Somenos Marsh Wildlife Society, Duncan: 29 p.

Smorong. 2015. Cowichan River and Koksilah River Water Quality Objectives Attainment Report 2012-14. British Columbia Ministry of Environment, Environmental Protection Division, Environmental Quality Section: 33 p.

Figures



Figure 1: Water quality sampling sites for the summer and fall 2018 sampling program. Sites are grouped into the three sample areas: Lake Cowichan tributary streams (red), Lake Cowichan stations (white), and Cowichan River/Bings Creek (blue).

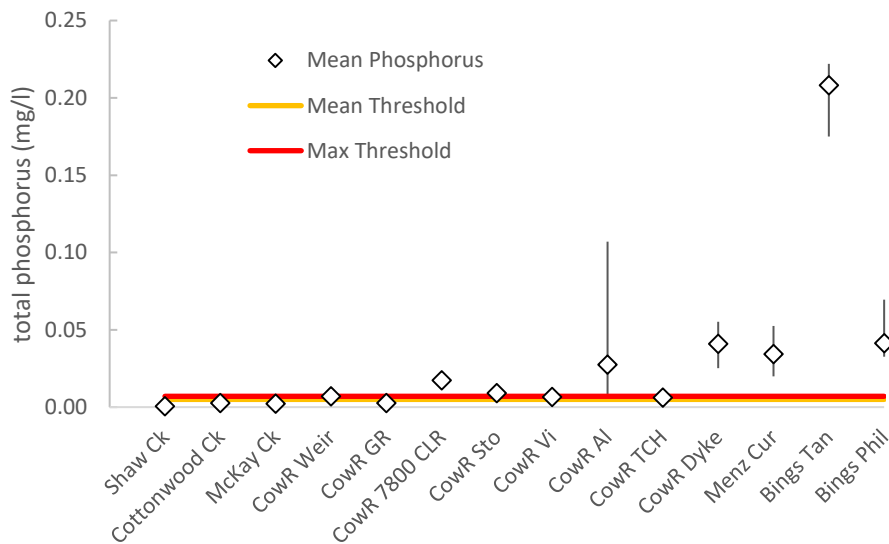


Figure 2: Mean (diamonds), maximum and minimum (bars) total phosphorus for summer 2018 samples.

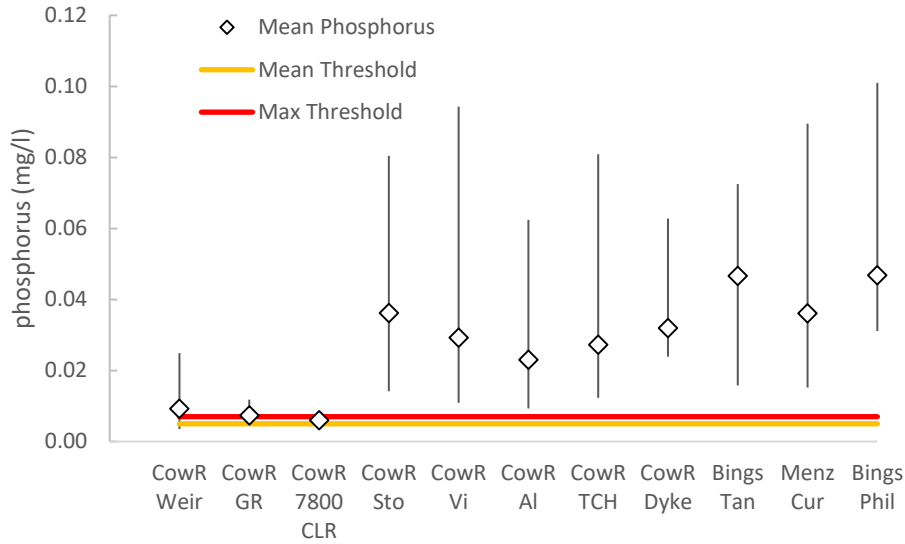


Figure 3: Mean (diamonds), maximum and minimum (bars) total phosphorus for fall 2018 samples.

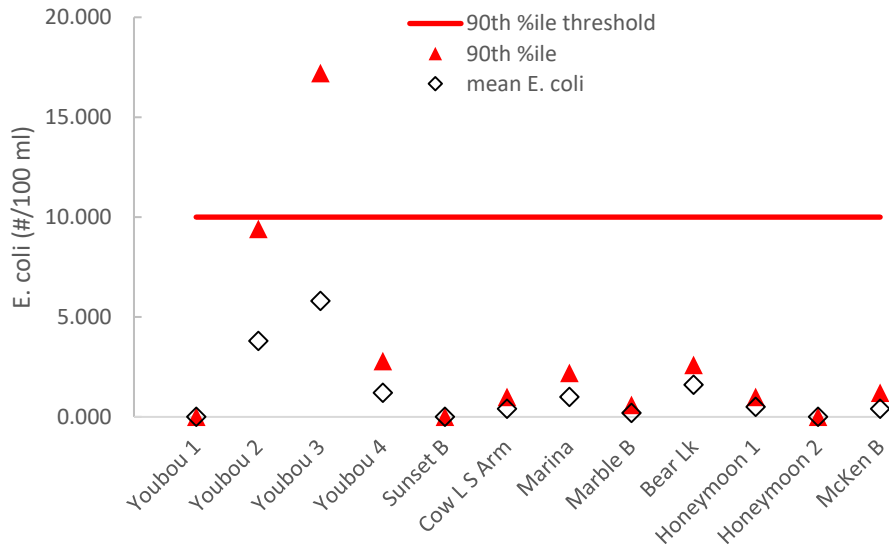


Figure 4: Mean (diamonds) and 90th percentile (red triangles) of 5 samples for E. coli measured at Cowichan Lake, summer 2018. The water quality target for the 90th percentile is shown as the red line.

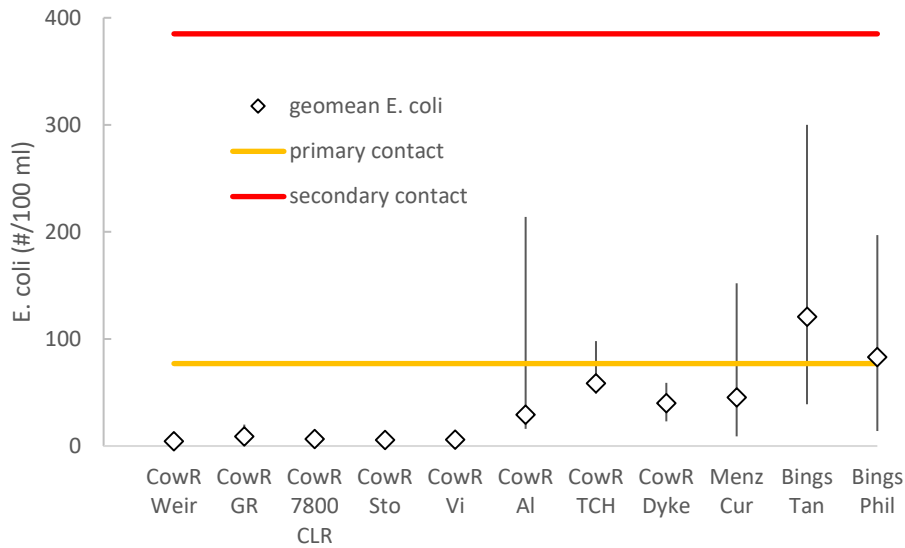


Figure 5: Geometric mean (diamonds) and maximum / minimum values over 5 sample periods for E. coli measured at Cowichan River and Bings Creek watershed, summer 2018. The water quality targets for primary and secondary contact are shown as the orange and red lines.

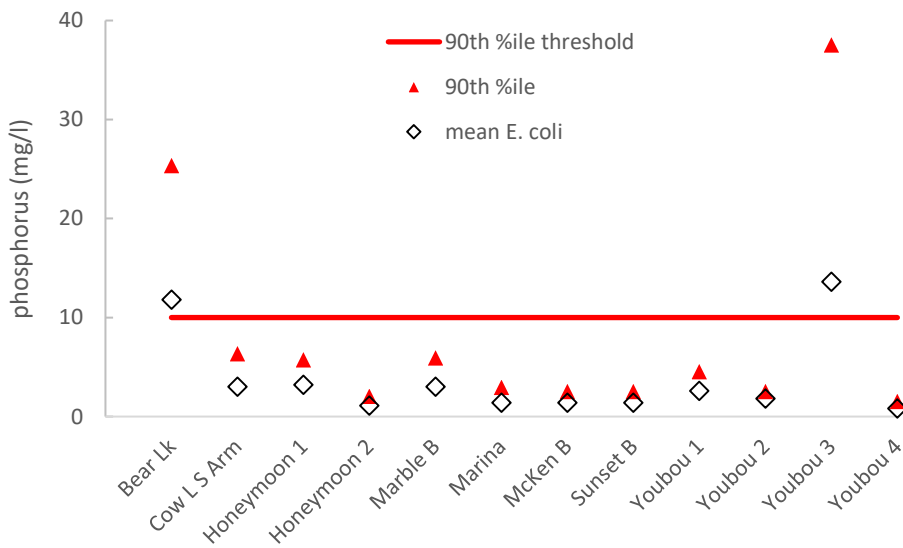


Figure 6: Mean (diamonds) and 90th percentile (red triangles) of 5 samples for E. coli measured at Cowichan Lake, fall 2018. The water quality target for the 90th percentile is shown as the red line.

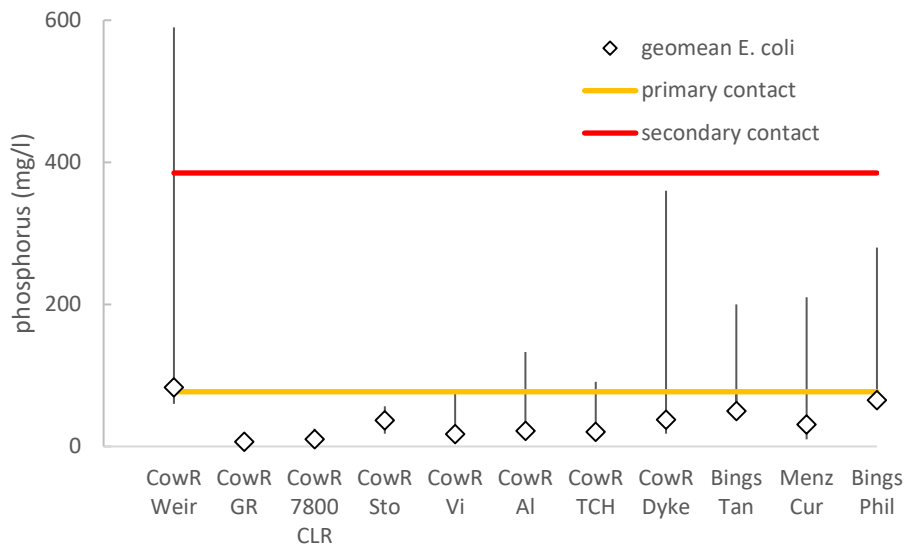


Figure 7: Geometric mean (diamonds) and maximum / minimum values (bars) over 5 sample periods for E. coli measured at Cowichan River and Bings Creek watershed, winter 2018. The water quality targets for primary and secondary contact are shown as the orange and red lines.

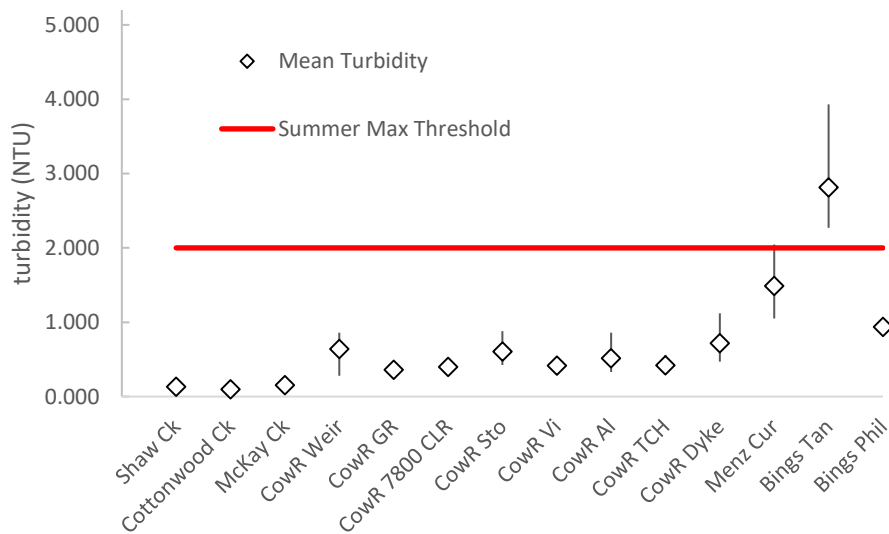


Figure 8: Mean turbidity (diamonds) and maximum/minimum values (bars) measured at Cowichan Lake tributary streams, the Cowichan River and the Bings Creek watershed, summer 2018. The target threshold for summer maximum turbidity is shown as the red line.

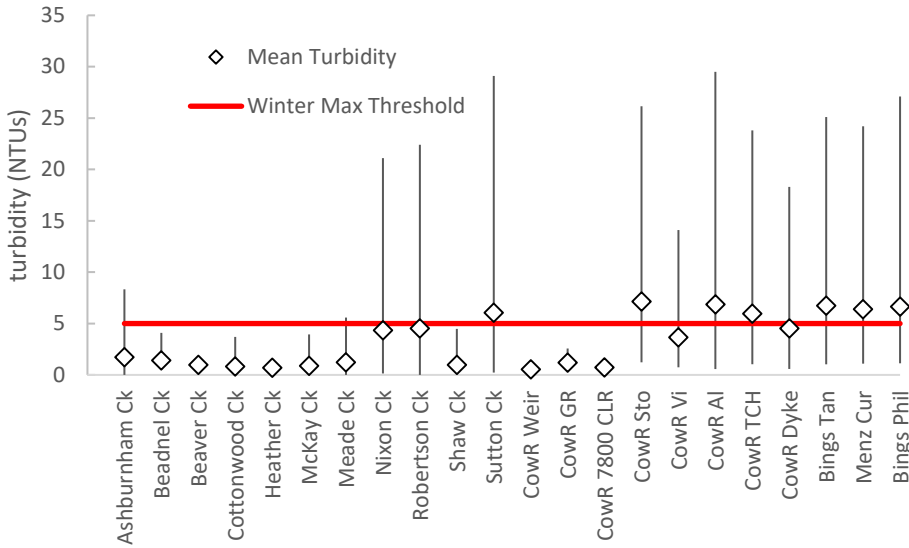


Figure 9: Mean turbidity (diamonds) and maximum/minimum values (bars) measured at Cowichan Lake tributary streams, the Cowichan River and the Bings Creek watershed, winter 2018. The target threshold for winter maximum turbidity is shown as the red line.

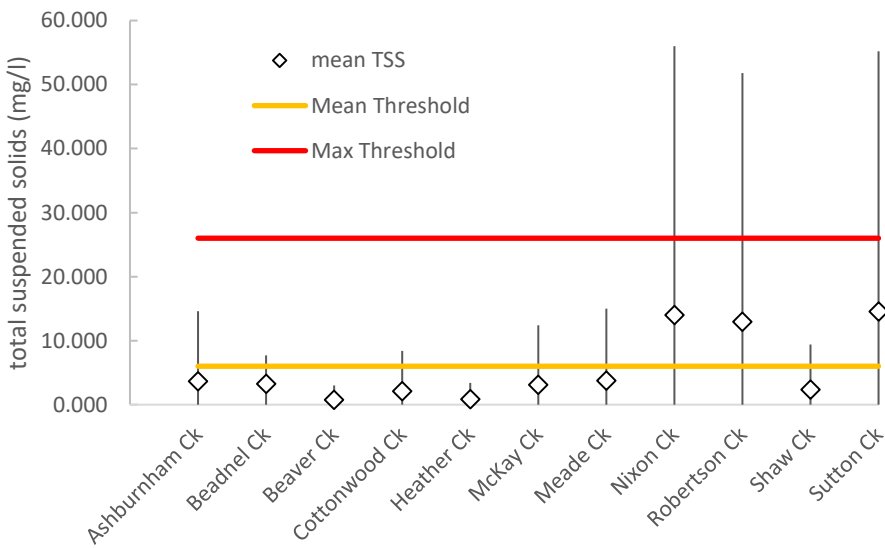


Figure 10: Mean total suspended solids (diamonds) and maximum/minimum recorded values (bars) for Cowichan Lake tributary stations, fall 2018. The target thresholds for mean and maximum values are shown as the orange and red lines, respectively.

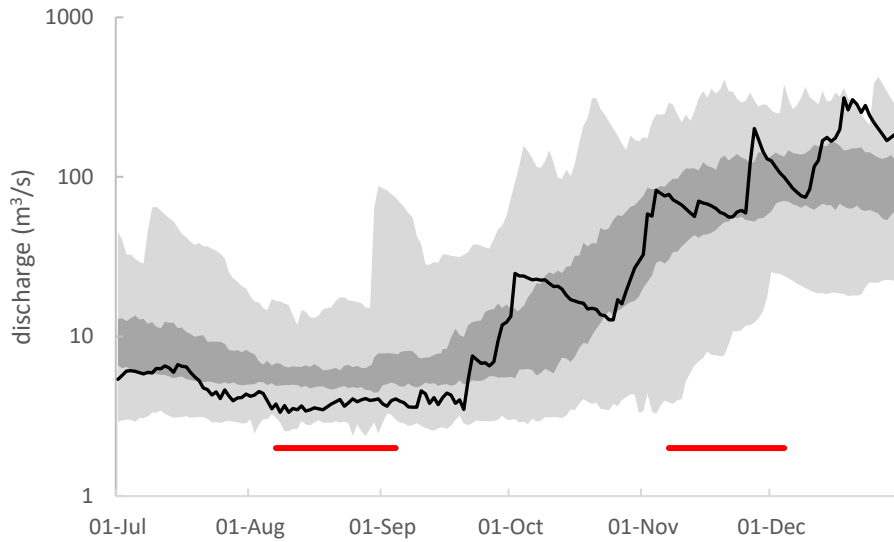


Figure 11: Mean daily discharge (dark line) in the Cowichan River, 01 July 2018 - 31 December 2018. Data from Environment Canada for the gauge station near Lake Cowichan (08HA002) The red lines indicate the sampling periods for summer minimum discharge (07 August 2018 – 04 September 2018) and first flush in the fall (07 November 2018 – 04 December 2018). The dark grey indicates the $\pm 50\%$ interval of historic (1913-2017) daily mean discharge data and the light grey indicates all time maximum and minimum daily mean discharge.

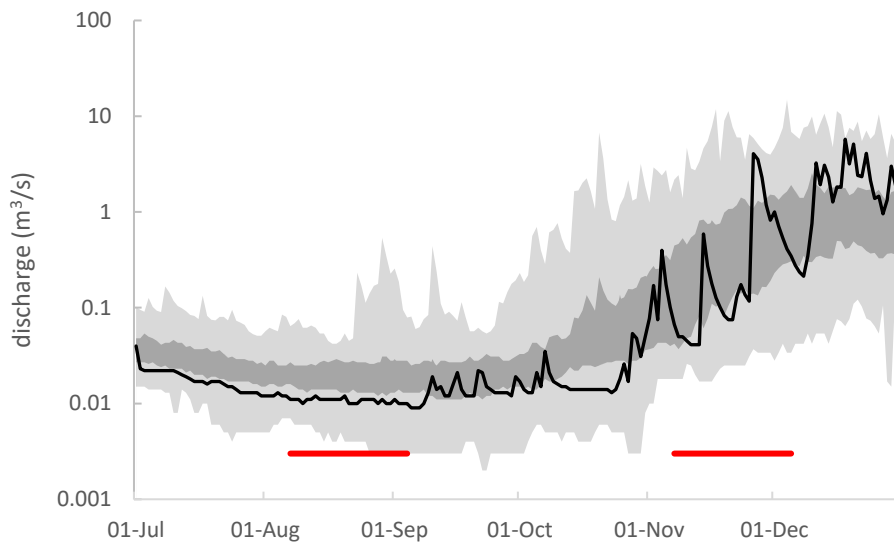


Figure 12: Mean daily discharge in Bings Creek, 01 July 2018 - 31 December 2018. Data from Environment Canada for the gauge station near the mouth of the creek (08HA016) The red lines indicate the sampling periods for summer minimum discharge (07 August 2018 – 04 September 2018) and first flush in the fall (07 November 2018 – 04 December 2018). The dark grey indicates the $\pm 50\%$ interval of historic (1961-2017) daily mean discharge data and the light grey indicates all time maximum and minimum daily mean discharge.

Tables

Table 1: Sampling sites and coordinates

Area	Site	Latitude	Longitude
Cowichan Lake	Youbou #1 – Cottonwood Estates	48.8803	-124.2194
Cowichan Lake	Youbou #2 - West	48.8750	-124.2050
Cowichan Lake	Youbou #3 - East	48.8697	-124.2039
Cowichan Lake	Youbou #4 – Billy Goat Islands	48.8669	-124.1858
Cowichan Lake	Cowichan Lake – Sunset Beach	48.8597	-124.1250
Cowichan Lake	Cowichan Lake – Marble Bay	48.8333	-124.1194
Cowichan Lake	Cowichan Lake at Head of South Arm	48.8292	-124.0706
Cowichan Lake	Cowichan Lake – Marina	48.8914	-124.0667
Cowichan Lake	Bear Lake – Lake Cowichan	48.8153	-124.1283
Cowichan Lake	McKenzie Bay – Lake Cowichan	48.8147	-124.1569
Cowichan Lake	Honeymoon Bay – Lake Cowichan	48.8219	-124.1811
Cowichan Lake	Honeymoon Bay #2	48.8292	-124.1894
Cowichan Lake Tributaries	Shaw Creek @ N. Shore Rd.	48.9233	-124.3934
Cowichan Lake Tributaries	McKay Creek @ N. Shore Rd.	48.9084	-124.3216
Cowichan Lake Tributaries	Cottonwood Creek @ N. Shore Rd.	48.8789	-124.2397
Cowichan Lake Tributaries	Robertson River @ S. Shore Rd.	48.8068	-124.1397
Cowichan Lake Tributaries	Ashburnham Creek @ S. Shore Rd.	48.8179	-124.1776
Cowichan Lake Tributaries	Sutton Creek @ S. Shore Rd.	48.8235	-124.1868
Cowichan Lake Tributaries	Nixon Creek @ S. Shore Rd.	48.8896	-124.3818
Cowichan Lake Tributaries	Heather Ck. @ Heather Campground	48.9177	-124.4599
Cowichan Lake Tributaries	Meade Creek @ N. Shore Rd.	48.8399	-124.0992
Cowichan Lake Tributaries	Beaver Creek @ S. Shore Rd.	48.8197	-124.0588
Cowichan Lake Tributaries	Beadnel Ck. @ Cowichan Lake Rd.	48.8281	-124.0491
Cowichan R./Bings Ck.	Cowichan River at weir	48.8228	-124.0607
Cowichan R./Bings Ck.	Cowichan River 300 m u/s PE247	48.8275	-124.0390
Cowichan R./Bings Ck.	Cowichan River 400 m d/s PE247	48.8252	-124.0250
Cowichan R./Bings Ck.	Cowichan River Stoltz	48.7720	-123.8932
Cowichan R./Bings Ck.	Cowichan River at Vimy Beach	48.7603	-123.7731
Cowichan R./Bings Ck.	Cowichan River at Allenby Rd bridge	48.7728	-123.7139
Cowichan R./Bings Ck.	Cowichan River at highway 1	48.7715	-123.6981
Cowichan R./Bings Ck.	Cowichan River 1km d/s PE1497	48.7730	-123.6646
Cowichan R./Bings Ck.	Bings Ck @ Phillip+Mary St	48.7890	-123.7180
Cowichan R./Bings Ck.	Menzies Ck @ Curry Rd	48.7830	-123.7460
Cowichan R./Bings Ck.	Bings Ck @ Cowichan L. Rd	48.7920	-123.7560

Table 2: Volunteer hours for Cowichan water quality sampling, Summer 2018

Date	Activity	George Anderson	Bruce Coates	Leroy VanWieren	Parker Jefferson	Ken Traynor	Joe Saysell	Paul Gowland	Jacklyn Kwiatkows	Date Total
03-Aug-18	planning			4	4	4	4			16
07-Aug-18	sampling			4		4	4			12
14-Aug-18	sampling	4		4		4	4			16
21-Aug-18	sampling	4		4		4	4			16
28-Aug-18	sampling			4		4	4	4	4	16
04-Sep-18	sampling		4	4		4	4			16
Volunteer Total		8	4	24	4	24	24	4	4	
Grand Total										92

Table 3: Volunteer hours for Cowichan water quality sampling, Fall 2018

Date	Activity	Erin Rowland	Ken Traynor	Leroy VanWieren	Bruce Coates	Barry Hetschko	Roger Hunter	Date Total
09-Oct-18	planning		4	4				8
24-Oct-18	labelling	4				4		8
31-Oct-18	labelling					4		4
07-Nov-18	sampling	4	4	4		6	6	24
13-Nov-18	sampling		4	4		6	6	20
20-Nov-18	sampling	4	4	4		6	6	24
27-Nov-18	sampling	4	4	4	4	6	6	28
04-Dec-18	sampling	4	4	4	4	6	6	28
Volunteer Total		20	24	24	8	38	30	
Grand Total								144

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