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Description of an anomalous discharge of containment pond water into Bings Creek on 10 May 2019

Somenos Rapid Science Communication 2019-01

Dave Preikshot, PhD, RPBio
Somenos Marsh Wildlife Society

About Somenos Rapid Science Communications

The Somenos Rapid Science Communication series is produced by science staff of the Somenos Marsh Wildlife Society. The purpose of this series is to provide objective assessments of topical and newly emergent concerns related to ecosystems in the Somenos basin and adjacent aquatic areas. Reports in this series will present analyses of data collected by science staff and volunteers working for the Somenos Marsh Wildlife Society. This series is intended to be informative to a broad audience including the public, the business community, scientists, government management staff, elected officials, and First Nations. These documents are made widely available to foster collaboration between stakeholders in the Somenos basin.

Description of an anomalous discharge of containment pond water into Bings Creek on 10 May 2019

Summary

This report describes the accidental discharge of water from a containment pond near Bings Creek on 10 May 2019. Discharge and temperature data from Environment Canada are used to describe the duration, magnitude and characteristics of the discharge event in Bings Creek. Observations are also provided based on Bings Creek site visits after the discharge event. Water quality data from sampling conducted in 2018 for the Cowichan Watershed Board is used to describe fish habitat conditions at present.

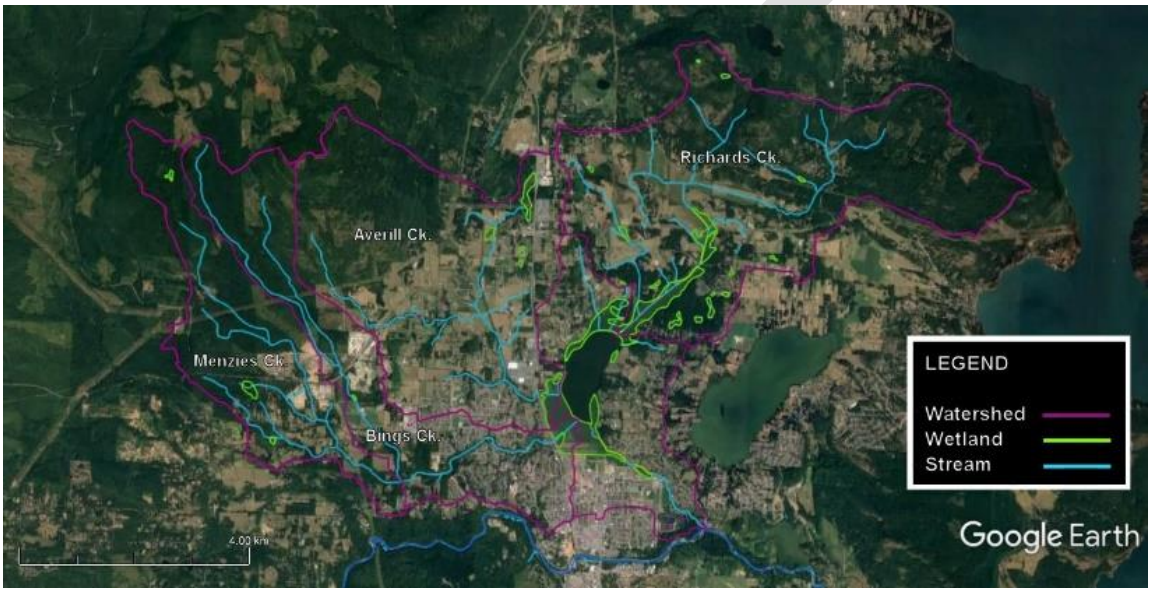

Figure1: The Somenos and tributary creeks watershed. The watersheds and sub-watersheds are outlined in purple. Data is from the Government of British Columbia freshwater atlas google earth add on available at: catalogue.data.gov.bc.ca/dataset/6164a2af-d3ac-4e92-8dbe-51a93bb5e24b.

Introduction

Bings Creek is one of three major tributary streams to Somenos Lake, the other two being Averill Creek and Richards Creek, Figure 1. Within the Bings Creek sub-watershed is Menzies Creek. Menzies Creek joins Bings Creek approximately 4 km upstream from Somenos Lake. Bings Creek provides spawning habitat for Rainbow Trout (*Oncorhynchus mykiss*), Cutthroat Trout (*O. clarkii*), Chum Salmon (*O. keta*) and Coho Salmon (*O. kisutch*) (Burns 1999). Bings Creek is also known to provide rearing habitat for juvenile Coho Salmon and many Rainbow and Cutthroat Trout complete their entire life history in the creek (Preikshot 2016).

Figure2: Bings Creek (blue line) near the Duncan Paving Property on the Cowichan Lake Highway. The containment pond can be seen just below the center of the photograph. The Bings Creek Transfer Station can be seen at the upper left.

On the afternoon of 10 May 2019 several members of the general public contacted the Somenos Marsh Wildlife Society about unusually high discharge combined with muddy water observed in Bings Creek. This report describes what happened in the Creek on May 10 and the potential effects of this event on fish and fish habitat in the creek.

The Discharge Event

This anomalous high discharge event has been identified as originating from an unplanned release of water from a containment pond on the Duncan Paving Property on Highway 18 (Barron 2019), Figure 2. Reporting indicates that the property owner took corrective action and reported the event to both the provincial Ministry of Energy, Mines and Petroleum Resources and Environment Canada. Because no one was available to take water samples during the event there is no way to draw any conclusions as to the presence of metals, nutrients or other pollutants in the discharged water. However, data from the Environment Canada water gauge near Agira Road can be used to make inferences on the total amount of water released, its physical characteristics and its potential effects on fish and fish habitat in Bings Creek.

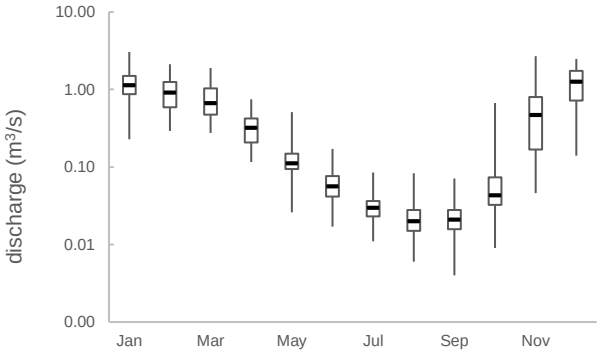

Figure 3: Monthly discharge observed in Bings Creek, 1961-2019. Horizontal black lines are medians, boxes are ±50% confidence intervals and vertical black lines show monthly maxima and minima. Data from: wateroffice.ec.gc.ca/mainmenu/historical_data_index_e.html

Historic data from Environment Canada (2019a) shows that during the observation period of 1961-2019 the median observed discharge for Bings Creek in May is ~0.1 m^3/s, with a 50% confidence interval ranging between 0.09 and 0.15 m^3/s, Figure 3. Real time observation data from 10 May 10 2019 (wateroffice.ec.gc.ca/mainmenu/real_time_data_index_e.html) shows that Bings Creek discharge was 0.076 m^3/s before the discharge event, Figure 4.

Data for 10 May 2019 shows that between 1310 hrs and 1315 hrs, Bings Creek experienced a sudden increase of discharge from 0.076 m^3/s to 2.15 m^3/s, i.e., 73 litres per second to 2,150 litres per second: an increase of almost 30 times. Although the magnitude of this pulse of water decreased relatively quickly, the flow augmentation remained more than double the base flow of 0.076 m^3/s until about 1600 hrs, Figure 4. Discharge in Bings Creek had returned to 0.076 m^3/s at 0040 hrs on May 11, meaning that the flow augmentation lasted 11.5 hours.

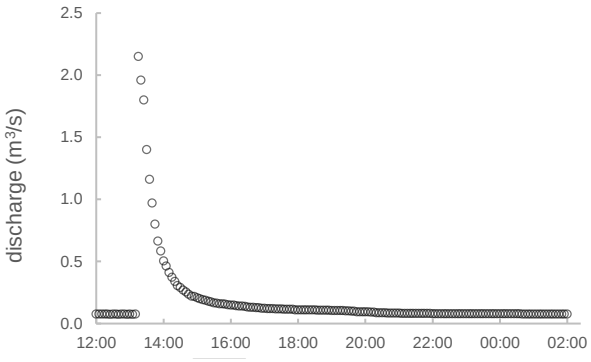

Figure 4: Discharge in Bings Creek 1200 hrs, 10 May 2019 to 0200 hrs, 11 May 2019. Data intervals are five minutes. Data from: wateroffice.ec.gc.ca/mainmenu/real_time_data_index_e.html

It is, therefore, possible to estimate the total amount of water discharged in this event by subtracting the total discharge expected (0.073 m^3/s for 11.5 hours) from the discharge observed over the time period of excess discharge (1310 hrs, 10 May 2109 to 0040 hrs, 11 May 2019). By summing up this excess discharge I estimate that ~ 5,140 m^3 of water was put into Bings Creek during this event, i.e., 5,140,000 litres of water. This amount of water could be stored in a square pond 2m deep and 50m per side. This estimate suggests a pond similar in size to that shown in the southwest of the Duncan paving property in Figure 2. We can further estimate that in the first hour of the event 3,673 m^3 of water moved through the system, approximately 70% of the total unanticipated discharge.

Bings Creek temperature data collected by Environment Canada (2019) suggests that the discharge event significantly altered physical stream characteristics, Figure 5. During the previous 6 days Bings Creek had been increasing in temperature during a period of warm spring weather. Daily increases and decreases in temperature associated with day / night cycles of sunlight warming the water are also visible within the overall warming trend.

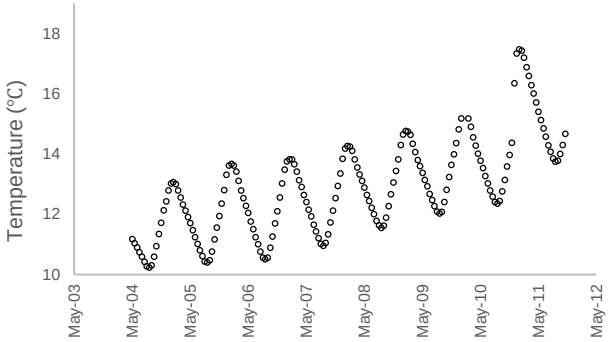

Figure 5: Bings Creek temperature measure by Environment Canada, between 0000hrs, May 4, 2019 and 1100 hrs, May 11, 2019. Data from: wateroffice.ec.gc.ca/mainmenu/real_time_data_index_e.html

The daily warming cycle on 10 May 2019 accelerated dramatically at 1400 hours, coincidental with the increased stream discharge. The temperature step between 1300 and 1400 hrs on 10 may is completely different from those observed on previous days, Figure 5. Note that the time step for temperature measurements is once per hour whereas discharge is measured once every 5 minutes. Given the increase in temperature that had been observed in Bings Creek over the previous 6 days we would have expected the peak daytime temperature on May 10 to be about 15.5 °C. Instead the peak temperature on 10 May 2019 was 17.5°C, ~2°C warmer. This accelerated increase in temperature is consistent with what one might expect given a sudden input of a large volume of water stored in a pond.

Due to a combination of shading from trees, contact with the substrate on the streambed, inputs of ground water and evaporative cooling, local creeks stay much cooler than local lakes and ponds during warm stretches of weather in the spring and summer. Due to this relatively cool condition, streams such

as Bings Creek provide summer habitat and refugia for trout and salmon in the Cowichan Valley. Heating the creek water can create a significant problem for fish because warmer water holds less oxygen which decreases their ability to endure stressful conditions, e.g., a high discharge event laden with silty water (Carter 2005). It is thus likely that the increase in temperature, turbidity and discharge would have imposed some stress on salmon and trout in Bings Creek on 10 May 2019.

Figure 6: Bings Creek at Phillip and Mary Streets looking West, photo taken at 1130 hrs 11 May 2019.

Site Visit

The author visited Bings Creek on Saturday, 11 May 2019 at two locations; the culvert at the intersection of Phillip and Mary Street (about 4,700 m downstream of the containment pond) the culver where Bings Creek crosses Cowichan lake Road (about 700 m downstream of the containment pond). Despite almost 12 hours having elapsed since the end of the timing of excess water input to Bings Creek, the water at Phillip and Mary Street was still very turbid, Figure 6. Juvenile trout and salmon were observed both upstream and downstream of the culvert at Phillip and Mary Street. Further upstream at Cowichan Lake Road, the water appeared to be much clearer, Figure 7. This change in turbidity suggests that excess sediment and fine particulate matter put into Bings Creek during the discharge event was moving along the creek bed and significant amounts had accumulated in stream reaches between the containment pond and Somenos Lake.

Figure 7: Bings Creek at Cowichan Lake Road looking South, photo taken at 1100 hrs 11 May 2019.

It does not appear that this discharge event caused any harm to fish. No dead fish were observed by the author on 11 May 2019. In subsequent days the author returned to various reaches of Bings Creek between the containment pond and Somenos Lake and on none of these occasions were dead salmon or trout observed.

Assessment

The effect of this event could have been far more dire had it occurred in the summer. Bings Creek temperature typically peaks at 18-19°C during the summer (Preikshot et al. 2015). This temperature is near the upper limit of the temperature range for growing juvenile salmon and trout. The observed spike in temperature that could have been associated with an unplanned discharge event at the peak of summer could have pushed temperatures to ranges lethal to salmon and trout. Summer surface temperature in Somenos Lake is often as high as 25-26°C. It is entirely likely that a containment pond in an open gravelly area would heat to similarly high temperatures. A pulse of such heated water through Bings Creek in August would be potentially catastrophic to juvenile trout and salmon. Such a risk is significant because most juvenile trout and salmon habitat in Bings Creek is downstream of the Duncan Paving property (Burns 1999).

A further concern of such unplanned discharge events are add-on effects to pre-existing poor water quality for both aquatic habitat and human health. Water quality samples for Bings Creek reported by Preikshot (2017) suggest that for much of the summer, E. coli levels exceed guidelines for primary and secondary human contact. For one of the measurements, at Phillip and Mary Street, E. coli was observed

to be 135 times the threshold for primary contact. Continued water quality sampling in 2018 found that E. coli had declined such that it was below the threshold for secondary contact but remained above that for primary contact (Preikshot 2019).

Water samples from three sites in the Bings Creek Watershed, in 2018 also suggest that the concentrations of several metallic elements exceed provincial standards for aquatic habitat (Ministry of Environment 2015). Samples taken from Bings Creek at Tansor Road, Bings Creek at Phillip and Mary Street and Menzies Creek at Curry Road exceeded the threshold for manganese. Bings Creek water samples were also observed to have concentrations of Iron and Aluminum in excess of aquatic habitat guidelines, Table 1. Reactive metals were consistently higher in Bings and Menzies Creeks than they were at nearby sites on the Cowichan River, Table 2

Table1: Concentrations of metals (mg/l) from sites on the Cowichan River and the Bings Creek, summer 2018. Provincial guidelines for fish habitat (WQ Std) are listed, where defined, in the second row. Cell colour indicates the concentration of each element at a given site: Red cells are the highest values, yellow middle and green are lowest. Sites at which measurements exceeded the fish habitat guideline a shown as **bold and outlined.**

	Al	Cr	Co	Cu	Fe	Pb	Mn	Ti	V
WQ Std	0.100		0.00400	0.00400	1.000	0.003	0.00100		
Cow R Weir	**0.110**	0.00023	~ 0	0.00077	0.142	0.000063	0.01090	0.00615	0.00068
Cow R Green Rd	0.015	~ 0	~ 0	0.00064	0.024	~ 0	0.00236	0.00042	~ 0
Cow R 7800 Cow Lk Rd	0.014	~ 0	~ 0	~ 0	0.025	~ 0	0.00302	0.00039	~ 0
CowR Stoltz Pool	0.027	0.00016	~ 0	0.00059	0.043	~ 0	0.00424	0.00092	0.00057
CowR Vimy Rd	0.015	0.00011	~ 0	0.00059	0.032	~ 0	0.00406	0.00058	0.00058
CowR Alllenby Rd	0.017	0.00012	~ 0	0.00056	0.036	~ 0	0.00391	0.00045	0.00058
CowR Isl Hwy	0.030	0.00014	~ 0	0.00061	0.048	~ 0	0.00424	~ 0	0.00063
CowR Hatchery Rd	0.024	0.00014	~ 0	0.00086	0.052	~ 0	0.00930	0.00059	0.00067
Bings Ck Phil+Mary	0.070	0.00023	0.00013	0.00081	0.572	~ 0	**0.05790**	0.00210	0.00091
Menzies Ck Curry Rd	**0.218**	0.00043	0.00031	0.00119	0.526	0.000075	**0.10400**	0.00810	0.00133
Bings Ck Tansor Rd	0.051	0.00029	0.00014	0.00139	**1.240**	0.000090	**0.02450**	0.00151	0.00099

Table2: Concentrations of reactive metals and metalloids (mg/l) from sites on the Cowichan River and the Bings Creek, summer 2018. Provincial guidelines for fish habitat (WQ Std) are listed, where defined, in the second row. Cell colour indicates the concentration of each element at a given site: Red cells are the highest values, yellow middle and green are lowest. Sites at which measurements exceeded the fish habitat guideline a shown as **bold and outlined.**

	As	Ba	Ca	Mg	K	Si	Na	Sr	S
WQ Std	0.00500								
Cow R Weir	0.00020	0.00521	7.48	0.661	0.163	1.58	1.38	0.020	~ 0
Cow R Green Rd	0.00015	0.00460	7.35	0.636	0.150	1.45	1.38	0.019	~ 0
Cow R 7800 Cow Lk Rd	0.00013	0.00460	7.41	0.647	0.185	1.49	1.47	0.019	~ 0
CowR Stoltz Pool	0.00018	0.00503	8.55	0.901	0.208	1.82	1.73	0.025	~ 0
CowR Vimy Rd	0.00018	0.00553	8.60	0.934	0.188	1.71	1.83	0.025	~ 0
CowR Alllenby Rd	0.00021	0.00561	8.77	1.000	0.206	1.71	1.95	0.026	~ 0
CowR Isl Hwy	0.00020	0.00548	8.61	0.926	0.183	1.70	1.85	0.025	~ 0
CowR Hatchery Rd	0.00025	0.00584	9.08	1.050	0.551	1.85	2.87	0.028	0.69
Bings Ck Phil+Mary	0.00048	0.01620	22.80	7.100	0.920	7.11	14.30	0.127	2.06
Menzies Ck Curry Rd	0.00048	0.02830	18.00	5.710	1.420	5.46	45.30	0.160	1.38
Bings Ck Tansor Rd	0.00153	0.01160	9.24	2.950	2.220	6.49	7.50	0.065	~ 0

Lastly, it should be noted that Bings Creek summer discharge has been steadily declining over the last 50 years during the summer. An analysis of monthly average discharge measured in Bings Creek between 1961 and 2019 (Environment Canada 2019a) shows that summer water quantity has declined for the months of May to September, Figure 8. This decline in available water is manifested during the season

that Bings Creek functions as refuge habitat for juvenile trout and salmon in the Somenos Watershed. One contributing factor to poor water *quality* is lower water *quantity*.

As an example of the effect that water quantity could have on water quality in Bings Creek, consider aluminum concentration. In 2018 sampling in August indicated an aluminum concentration of 0.218 mg/l in Menzies Creek, more than two times the provincial threshold. Data from Environment Canada shows that August discharge has declined from ~ 0.03 m3/s during the 1960s and 1970s to ~ 0.01 m3/s during the period after 2010. Therefore, assuming that Aluminium released into the stream remained constant, it's concentration would be within provincial guidelines if discharge in August were returned to levels seen in the h1960s and 1970s.

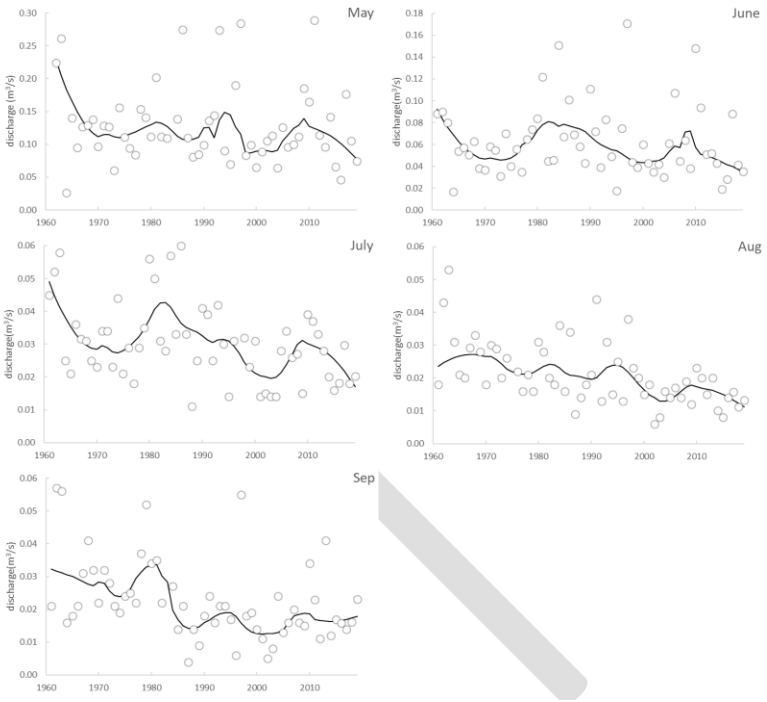

Figure 8: Bings Creek monthly mean discharge during Summer (1960-2019). Monthly mean data is shown as circles. Lines show decadal trends indicated by using a 2nd degree polynomial LOWESS smoothing function over a 20 year period.

Recommendations

Bings Creek water quality should be improved in order to safeguard local populations of trout and salmon. Events such as the unplanned release of settling pond water can lead to temporary declines in fish habitat quality. Management actions that would help address this situation include:

- Identify water quality parameters informative to assessing human health and aquatic habitat,
- Define target levels for problematic water quality parameters,
- Implement a water quality monitoring program for assessment parameters,
- Work within the Somenos Management Committee to identify stakeholders in a Bings Creek water quality project,
- Examine options to store and/or enhance summer water discharge in Bings Creek.

References

Barron, R. 2019. Paving company accidentally spills pond water into Cowichan's Bings Creek. Cowichan Valley Citizen, 17 May 2019. Available online at www.cowichanvalleycitizen.com/news/

Burns, T. 1999. The Somenos-Quamichan basin watershed atlas and fish production plan. Fisheries and Oceans Canada: 36 p.

Carter, K. 2005. The Effects of dissolved oxygen on Steelhead Trout, Coho Salmon, and Chinook Salmon biology and function by life stage. California Regional Water Quality Control Board, North Coast Region: 9 p.

Environment Canada. 2019a. Monthly Discharge Data for Bings Creek near the mouth (08HA016) [BC]. Available online at: wateroffice.ec.gc.ca/search/historical_e.html

Environment Canada. 2019b. Real-Time hydrometric data graph for Bings Creek near the mouth (08HA016) [BC]. Available online at: wateroffice.ec.gc.ca/search/real_time_e.html

Ministry of Environment. 2015. British Columbia Approved Water Quality Guidelines Summary Report. Water Protection & Sustainability Branch, Ministry of Environment, Victoria: 36 p. Available online at: www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines.

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

Preikshot, D. 2018. Cowichan/Koksilah Water Quality Sampling: Summer and Fall 2017. Cowichan Watershed Board, Duncan.

Preikshot, D. 2016. Somenos Basin Coho Salmon Summer Habitat Assessment (Year 2). Somenos Marsh Wildlife Society, Duncan, BC: 20 p.

Preikshot, D., T. Willmott, and J. Lange. 2015. Somenos basin Coho Salmon summer habitat assessment. Madrone Environmental Services, Duncan BC: 14 p.