RESULTS OF WATER QUALITY MONITORING PROGRAM 2020

Haslam Lang Community Watershed

Project Number: 21-102

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Client:
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SUMMARY

The Powell River Salmon Society (PRSS) has monitored water quality within the Haslam Lang Community Watershed since 1997. The watershed supplies drinking water to the City of Powell River and the community of Brew Bay. It also provides important habitat for salmon species and the PRSS operates a Hatchery on Lang Creek. Maintaining water quality is important for providing healthy drinking water and maintaining clean salmon habitat.

The PRSS retained Statlu Environmental Consulting Ltd. (Statlu) to analyze data collected during the 2020 water quality monitoring program and to compare the data with results from previous years. Stage, turbidity, pH, salinity, and water temperature were recorded bi-weekly at six locations within the watershed. The measurements were taken at Lang Creek near the Alex Dobler Salmon Centre, the outlet of Duck Lake, Anderson Creek, Blackwater Creek, Haslam Lake, and the weir at the outlet of Haslam Lake named Slough Station. The water quality monitoring program began at the six sites in 1997, providing a long history of data, which is a valuable tool for establishing baseline conditions within the watershed. This allows land managers to detect changes and implement solutions to maintain good water quality.

The stage and discharge measurements were higher in 2020 than in 2019 due to above average precipitation. Turbidity, pH, water temperature, and salinity generally varied within the normal and acceptable range for 2020. The pH measurements in November were slightly lower than the normal range over the last several years, but were at normal values for the rest of the year. Salinity values in 2020 remain slightly higher than the values recorded from 2009 to 2018, but were about 10% lower than in 2019. Furthermore, salinity values recorded in January are similar to values recorded in December, showing that the increasing salinity trend observed in 2018 and 2019 did not continue in 2020. The data suggests that forest management strategies intended to protect water quality are successful within the watershed.

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1.0 INTRODUCTION

The Powell River Salmon Society (PRSS) monitors water quality within the Haslam Lang Community Watershed with funding provided by British Columbia Timber Sales (BCTS) and the Powell River Community Forest (PRCF). The watershed provides drinking water to the City of Powell River and the community of Brew Bay. It also provides important fish habitat and the PRSS operates a hatchery on Lang Creek.

As part of an ongoing water quality monitoring program, PRSS retained Statlu Environmental Consulting Ltd. (Statlu) to analyze water quality data collected during 2020 and to compare the results with previous years of monitoring.

2.0 BACKGROUND

Land managers have prioritized sustainable development within the Haslam Lang Community Watershed for over two decades. A water quality monitoring program began within the watershed in 1997 and a watershed management plan was implemented in 1999. Both initiatives aimed to study and maintain water quality to protect communities and natural ecosystems.

The Haslam Lake and Lang Creek Integrated Watershed Management Plan (IWMP) and subsequent watershed assessments have guided sustainable development within the watershed by identifying resources at risk and effectively managing public interests. Management planning, watershed assessments, stakeholder involvement, and implementation of best management practices have provided sound scientific and practical guidance for sustainable development in the watershed.

The water quality monitoring program is a key component of the watershed management plan process. The water quality data provides a baseline used to identify short-term changes, long-term trends, and potential problems within the watershed. The monitoring program also ensures that license requirements are being met throughout the year. One requirement is to maintain a minimum flow greater than 15 ft^3/s (0.42 m^3/s) in Slough Creek downstream of the storage dam at all times of the year, and this minimum should be increased to 25 ft^3/s (0.71 m^3/s) during the months of October and November. Maintaining the minimum flow requirements and good water quality is key for sustainable development within the watershed. If potential problems are identified, the data can be used to guide management strategies that will reduce risks within the watershed and to downstream resources.

Four watershed assessments have been completed; the first in 1999 (Carson, 2000), the second in 2003 (Carson, 2003), and the third in 2015 (Carson Land Resource Management, 2015). Statlu completed the fourth and latest watershed assessment in 2020 (Statlu, 2020). Additionally, Carson (2010) assessed how PRCF operations affect water quality within the Powell River area, including areas within the PRCF but outside the community watershed.

3.0 METHODOLOGY

The water quality monitoring program involves measuring the stage, turbidity, pH, water temperature, and salinity on a bi-monthly basis at six locations within the watershed. The measurements were recorded at Lang Creek near the Alex Dobler Salmon Centre, the outlet of Duck Lake, Blackwater Creek, Anderson Creek, Haslam Lake near the community water intake, and Haslam Lake at Slough Station (Figure 1 in Appendix 1). Continuous stream flow data is collected on Lang Creek at the Alex Dobler Salmon Center. The PRSS bought a new sampling probe in 2020 to ensure accurate water quality measurements. The data, along with general observations and photographs, were sent to Statlu for analysis.

Statlu prepared two graphs for each water quality variable (stage, turbidity, pH, water temperature, and salinity) and the six measurement locations are plotted on each graph. The first graph shows how the variable for each location changed during 2020, which allows comparison between bi-weekly variations and events that occurred during the year. The second graph compares the 2020 data to previously recorded data from 1997 to present. The long-term graphs show how water quality variables have changed during the history of monitoring and allow anomalous trends to be identified.

The six water quality variables are also compared to the continuous hydrograph data recorded on Lang Creek. The daily maximum and minimum discharge were extracted from the continuous stream flow data and plotted against daily precipitation data collected at the same location. This precipitation data is compared to monthly precipitation and temperature data collected at the Powell River A climate station, located 130 m above mean sea level at the Powell River Airport, about 7 km southwest of Haslam Lake (Environment Canada, 2021). These datasets show how water quality in the watershed responds to weather events and yearly climate.

4.0 OBSERVATIONS

The PRSS made field observations and took photographs within the watershed to record conditions that could influence the data (Photos 1 to 4). Factors such as flood events, low summer flows, landslides, and road conditions can affect water quality measurements.

The observations provided by PRSS record road dust on the surface of Blackwater Creek in late July and early August, and on the surface Duck Creek in late July. The roads within the watershed were abnormally dusty this year. Tea coloured water was observed in Blackwater Creek during sampling on November 3, 2020, and during both samplings in January, which were completed after rainfall events. The area near Slough Station is a popular camping spot and sometimes garbage is left near the slough. An oily sheen on the water surface was observed in mid-August (Photo 3). The oily sheen was not observed during following measurements.

Several known and ongoing concerns to water quality persist through 2020. Muddy banks on Blackwater Creek continue to be a potential sediment source. An unstable and slumping bank on Lang Creek remains active upstream of the fish hatchery. A log jam in Haslam Lake near the sampling location disturbs lake sediment during windy conditions. These areas are known to reduce water quality measurements within the watershed.

Photo 1: Anderson Creek sampling, September 2020.

Photo 2: Haslam Lake driftwood, December 2020.

Photo 3: Sheen on the water surface at Slough Station, August, 2020.

Photo 4: Slough Creek at High water, December 2020

5.0 RESULTS

5.1 Precipitation and Air Temperature

Total monthly precipitation and mean monthly air temperature data for 2020 were collected at the Powell River A climate station, and compared to the 30-year average from 1981 to 2010, collected at the same location (Figure 2). Precipitation and temperature data are missing on January 12, February 10, and March 9 during 2020.

The total precipitation recorded during 2020 was 1294 mm, which is 52% more than the 849 mm recorded in 2019, and 7% more than the 30-year average from 1981 to 2010 of 1206 mm per year (Environment Canada, 2021). Less than normal precipitation fell from February to May and in July. Above normal precipitation fell in January, June, and was near or above normal from August to December. Mean air temperature was below average in February and March, and above average in May, September, and December.

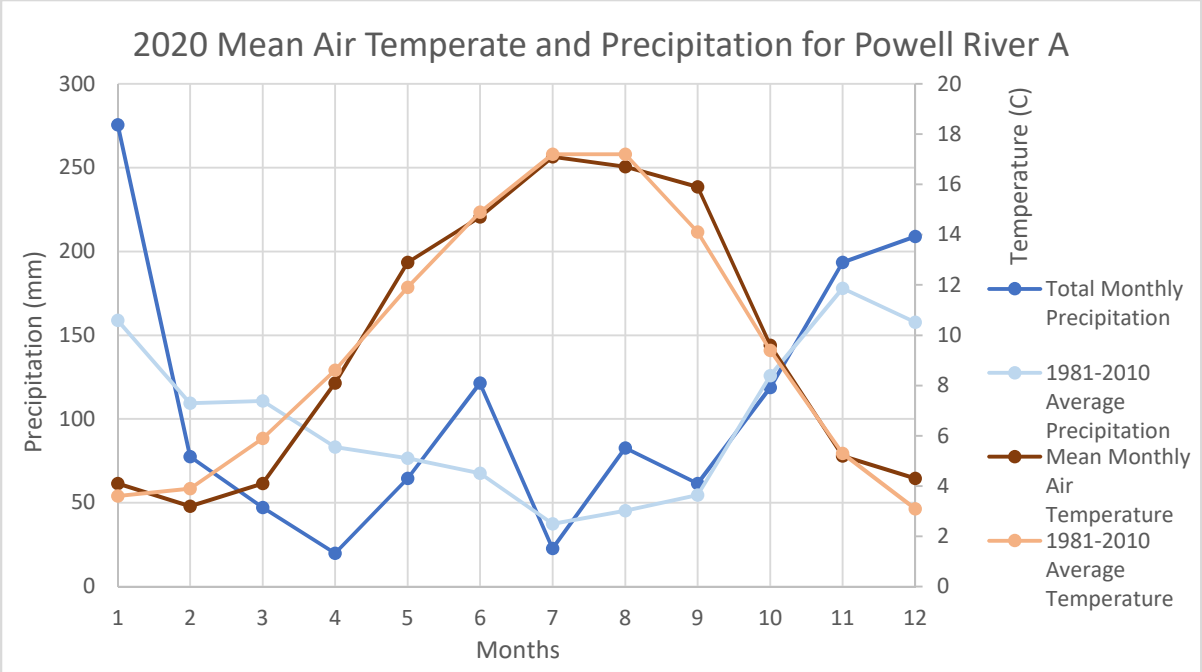

Figure 2: Mean air temperature (C°) and total monthly precipitation (mm) at the Powell River A climate station for 2020 compared to the 30-year average from 1981 to 2010.

5.2 Stage and Hydrograph

Stage measurements record the height of the water surface relative to a known reference elevation (Figure 3). The stage data for Haslam Lake and Slough Station are plotted on a secondary axis as their stage reference points are geodetic elevations, which differ from the other four sampling locations. Despite having two different reference points, the stage data for all six sites shows water level variations within the watershed during 2020.

The stage measurements show that all watercourses have similar flow patterns from January to July and from October to December, as water level changes in response to precipitation events and dry periods. From July to September, the weir at Haslam Lake and Slough Station moderate water levels downstream in Lang Creek, and their stages continue to fall while Lang Creek maintains minimal flow.

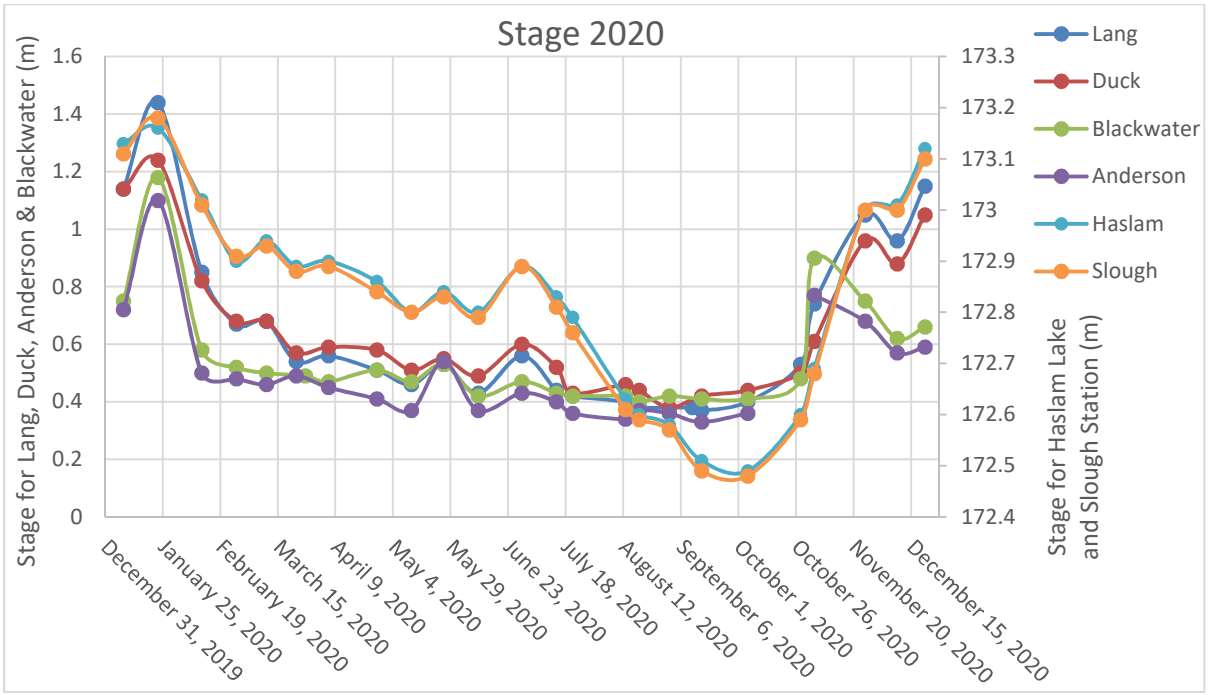

Figure 3: Stage discharge at six sites within the community watershed during 2020. Stage measurements for Haslam Lake and Slough Station are graphed on a secondary axis.

The stage measurements for 2020 are generally higher than the stage measurements in 2019. The average stage in all creeks is 0.04 m to 0.09 m (7% to 17%) higher and the maximum stage is 0.09 m to 0.48 m (8% to 66%) higher in 2020 than 2019. The minimum stage measurements at Lang, Anderson, Sloughs, and Haslam were 0.02 m to 0.14 m (6% to 40%) higher than they were in 2019. The minimum stage in Blackwater for 2020 was the same as the 2019 reading, and the minimum stage in Duck was about 0.01 m (3%) lower in 2020 than in 2019. The 2020 stage measurements are consistent with variations recorded since 1997 (Figure 4).

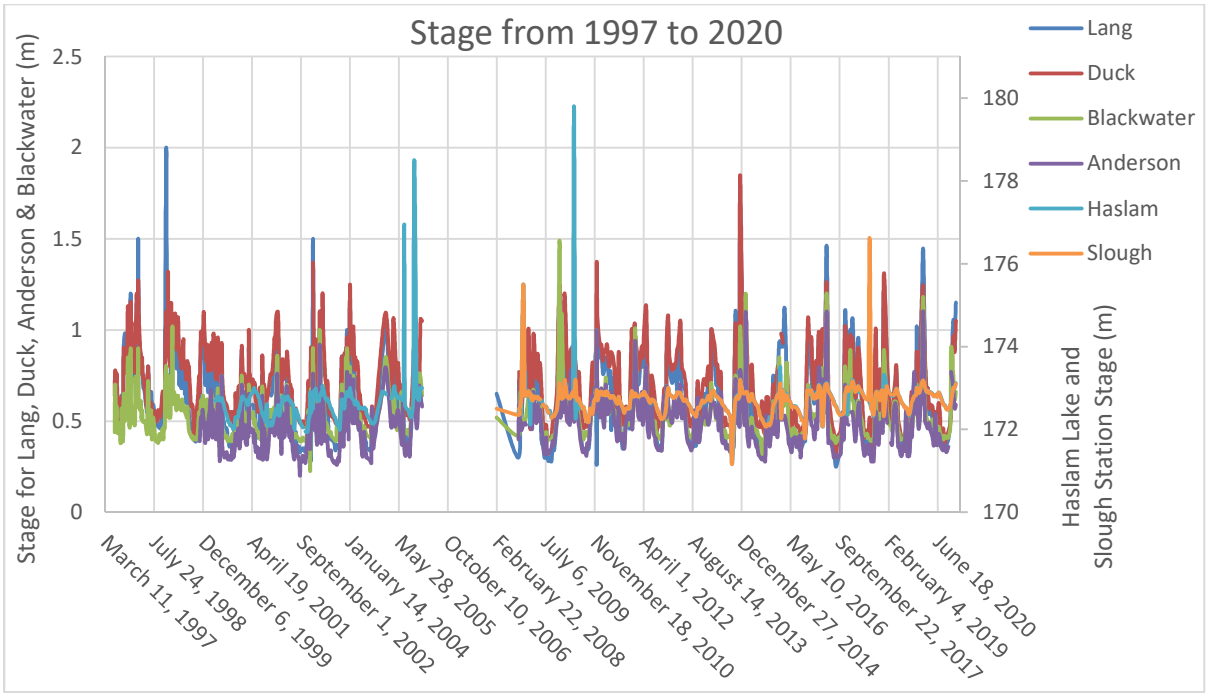

Figure 4: Stage discharge at six sites within the community watershed between 1997 and present. The stage for Haslam Lake and Slough Station are graphed on a secondary access.

Continuous data recording in Lang Creek during 2020 recorded discharge rates throughout the day (Figure 5). The maximum peak discharge in Lang Creek for 2020 was recorded on January 24 at 59.1 m^3/s. The lowest discharge was on September 13 at 0.472 m^3/s. The average discharge through 2020 was 6.07 m^3/s and the median discharge was 2.70 m^3/s.

The 2020 discharge values are greater than those recorded in 2019 (Table 1). The maximum discharge is 154% greater, the average discharge is 61% greater, the median discharge is 13% greater, and the minimum discharge is 53% greater than in 2019. Many of the discharge values are also greater than the discharge values recorded in 2018 (Table 1).

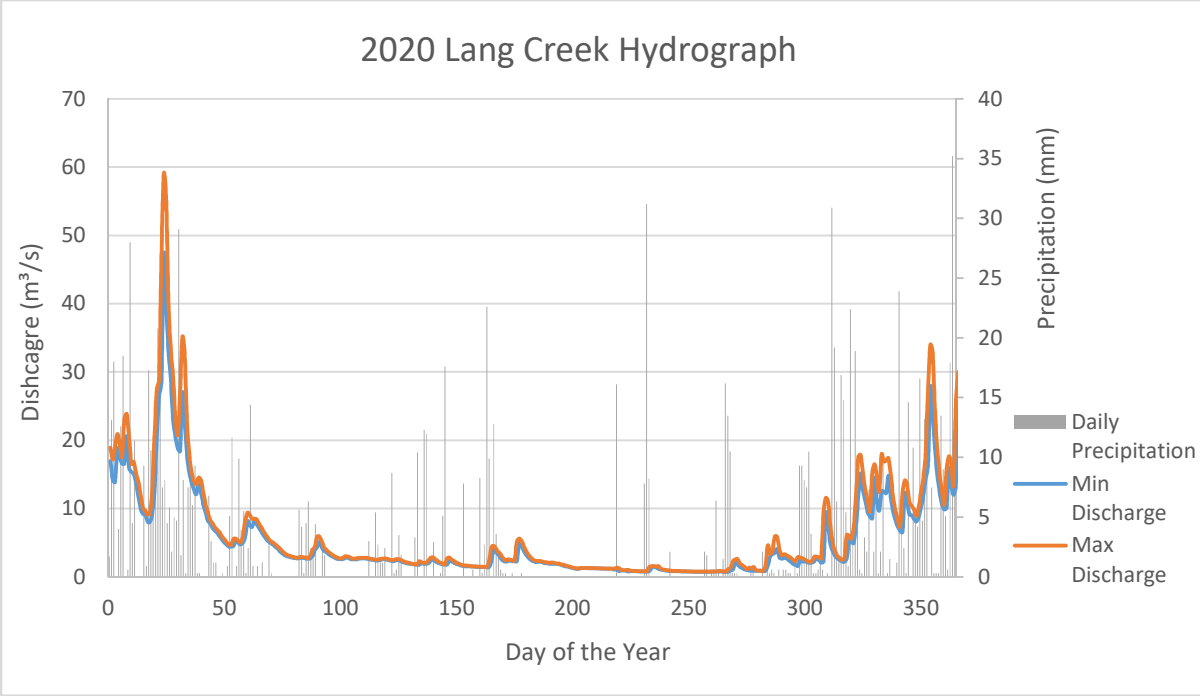

Figure 5: 2020 Hydrograph for Lang Creek. The minimum and maximum discharge (m³/s) is plotted against the total precipitation (mm) recorded at the same site.

Table 1: Yearly discharge rates of Lang Creek from 2018 to 2020.

Year	Maximum (m³/s)	Average (m³/s)	Median (m³/s)	Minimum (m³/s)
2018	49.9	6.02	3.99	0.382
2019	23.3	3.77	2.38	0.472
2020	59.1	6.07	2.70	0.722

5.3 Turbidity

Turbidity measurements in 2020 were between approximately 0.25 NTU and 3 NTU, with average readings between 0.7 NTU and 1.6 NTU (Figure 6). A rainfall event between January 21 and January 23 caused high turbidity at the Anderson, Blackwater, Lang, and Haslam observation points. Another turbidity spike occurred on November 3 in Blackwater and Lang Creeks. Turbidity remained higher than normal in Lang Creek following the November 3 event. Haslam Lake and Blackwater Creek have elevated turbidity levels during the summer from June to October. Duck and Slough show minimal turbidity changes through the year, despite road dust being observed on the surface of Duck Lake.

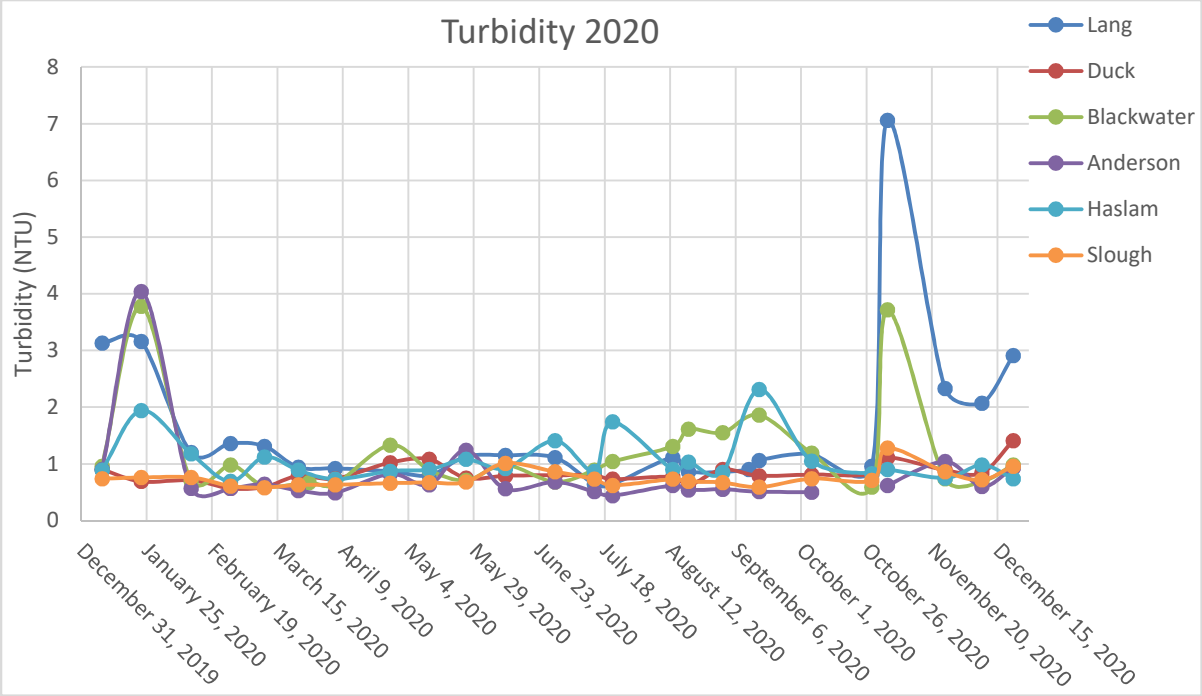

Figure 6: Turbidity through 2020 at six sites within the Haslam Lang Community Watershed.

Turbidity data from 1997 to present shows low average turbidity with episodic spikes in through the years (Figure 7). Turbidity levels in 2020 are similar to 2019 levels. Lang Creek had the maximum turbidity within the watershed in both 2020 and 2019, and the 2020 maximum of 7.06 NTU is 0.59 NTU (9%) higher than in 2019. The data shows that 2020 turbidity levels are well below previously recorded turbidity spikes in the watershed.

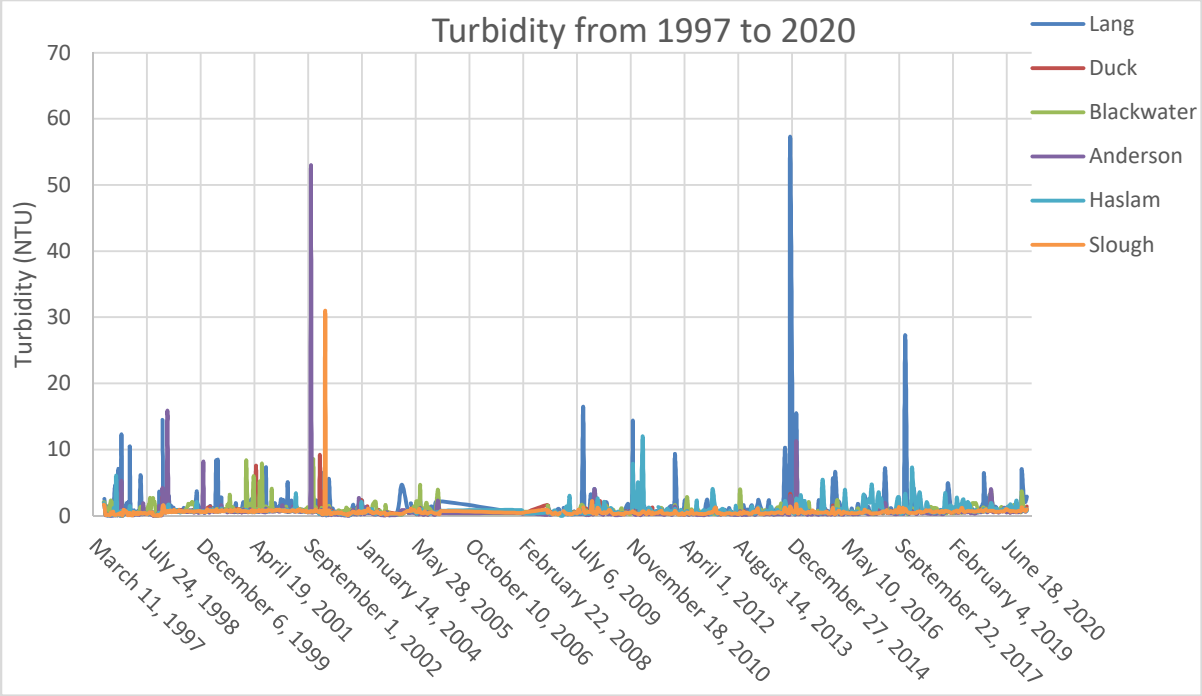

Figure 7: Turbidity at six sites within the Haslam Lang Community Watershed between 1997 and present.

5.4 pH

The pH ranged between 6.6 and 7.3 within the watershed during 2020, with average readings of 7.0 at all six sites for the year (Figure 8). The pH measurements were greatest between June and October and lowest during the end of October and beginning of November. Variations in pH for the recorded history of each creek are shown in Figure 9. The maximum 2020 value of 7.3 is the same as recorded in 2019. The minimum value of 6.6, recorded at the end of October in Anderson Creek, is about 2% lower than the 2019 minimum of 6.7. The minimum pH value is slightly lower than normal variations within the past 5 years, but remains near expected values. The pH range over the last 5 years generally varies between 6.7 and 7.3, which is less than the variability recorded from 1997 to 2013, which varied between 5 and 9.

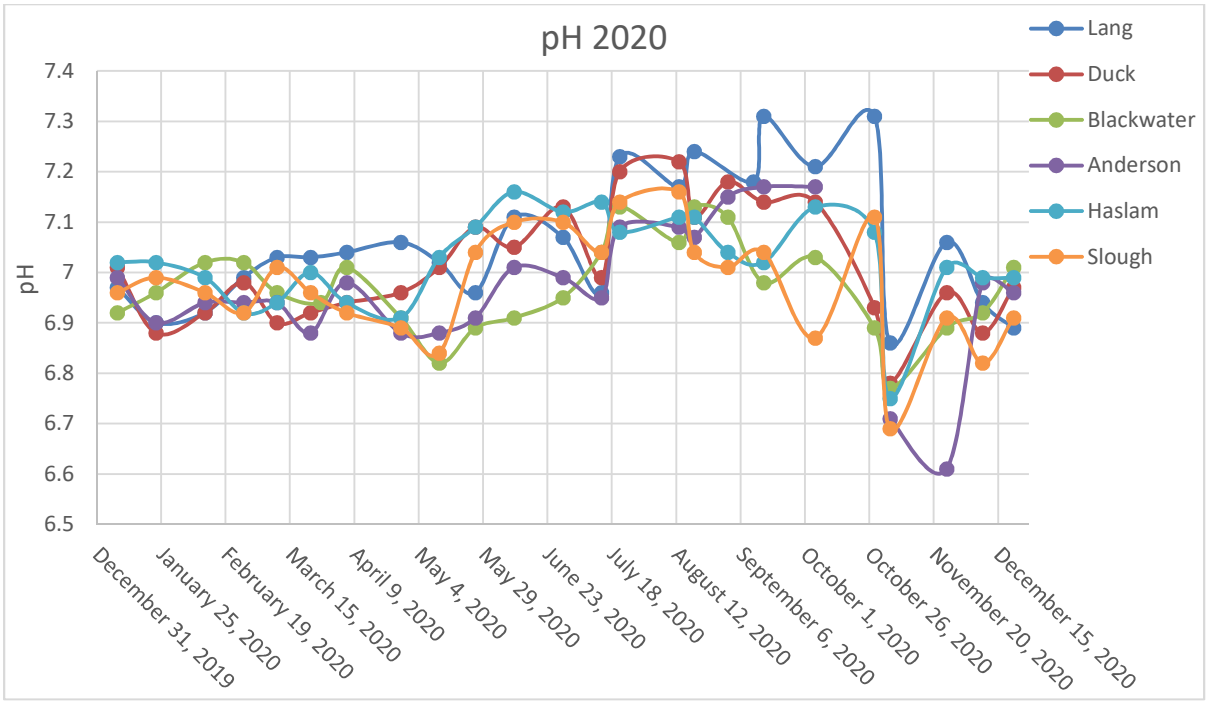

Figure 8: pH at six sites within the Haslam Lang Community Watershed.

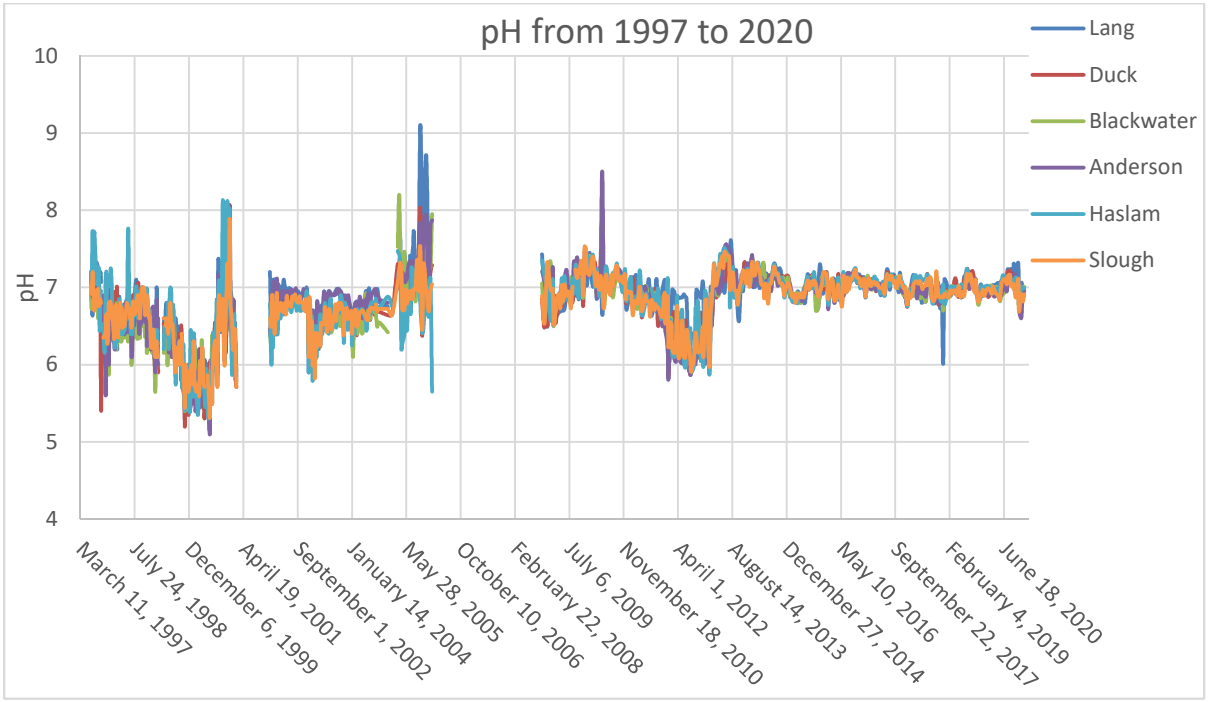

Figure 9: pH at six sites within the Haslam Lang Community Watershed between 1997 and present.

5.5 Salinity

Salinity varied from about 5 ppm to 19 ppm at the six recorded sites during 2020 (Figure 10). Blackwater, Anderson, and Lang Creeks show the greatest variability in salinity, with the greatest measurements in the watershed from July to November and the lowest measurements in the watershed from March to May. Lang Creek recorded a spike in salinity during the beginning of November. Haslam, Slough and Duck have the most consistent salinity levels within the watershed, varying between 8 ppm and 13 ppm. Average salinity ranged from 9 ppm to 11 ppm for all the six measurement sites, about 10% less than the 2019 averages, which ranged from 10 ppm to 12 ppm. Maximum salinity levels in Anderson Creek and at Slough Station were 4 ppm (20%) and 6 ppm (35%) lower than the 2019 maximums. Blackwater Creek had the highest salinity readings in 2020 and 2019, with the 2020 value of 19 ppm being 14% less than the 2019 value of 22 ppm.

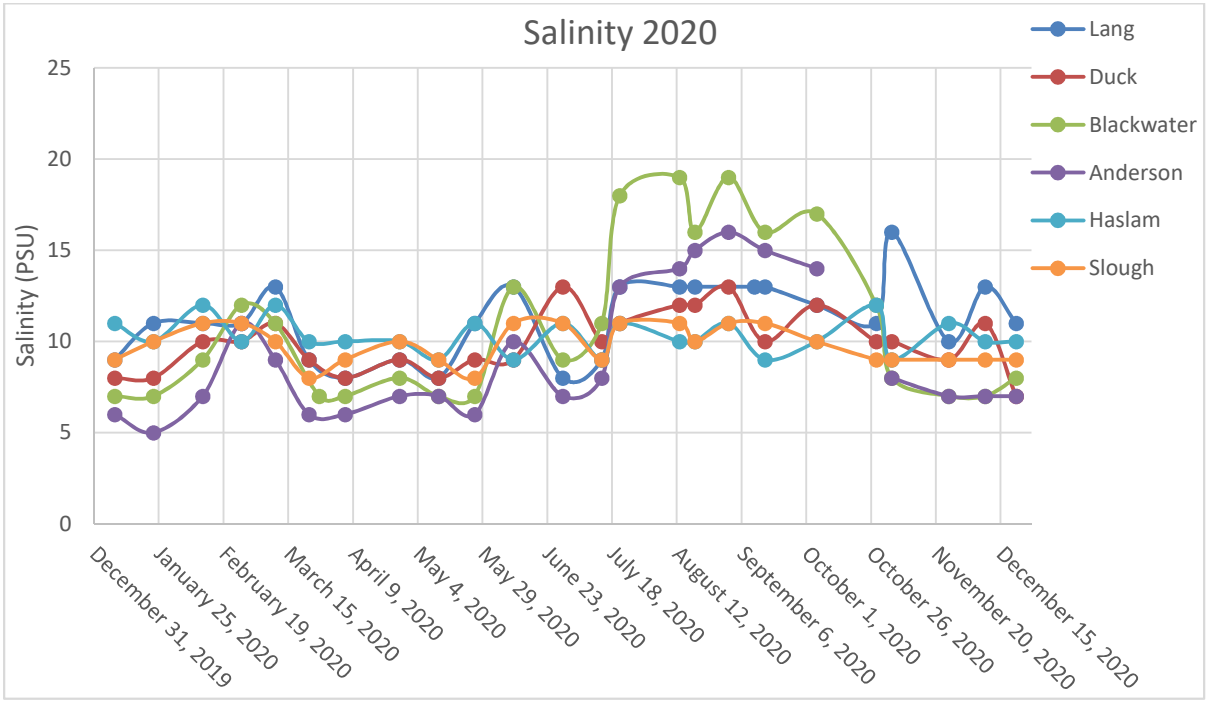

Figure 10: Salinity at six sites within the Haslam Lang Community Watershed.

Salinity data from 1997 to present are graphed on Figure 11, with a gap between 2006 and 2008 when no monitoring occurred. Salinity data recorded from 1997 to 2006 are greater than salinity data recorded from 2008 to 2019. The abrupt decrease in salinity could result from equipment or measuring differences between the two periods. From 2009 to 2018, the salinity data for all six creeks varies from 0 ppm to 16 ppm, and has average values between 4 ppm and 6 ppm. Salinity values started to increase at the end of 2018, and they continued to increase through 2019. The 2020 values are slightly less than the 2019 values but remain elevated above the 2008 to 2018 values.

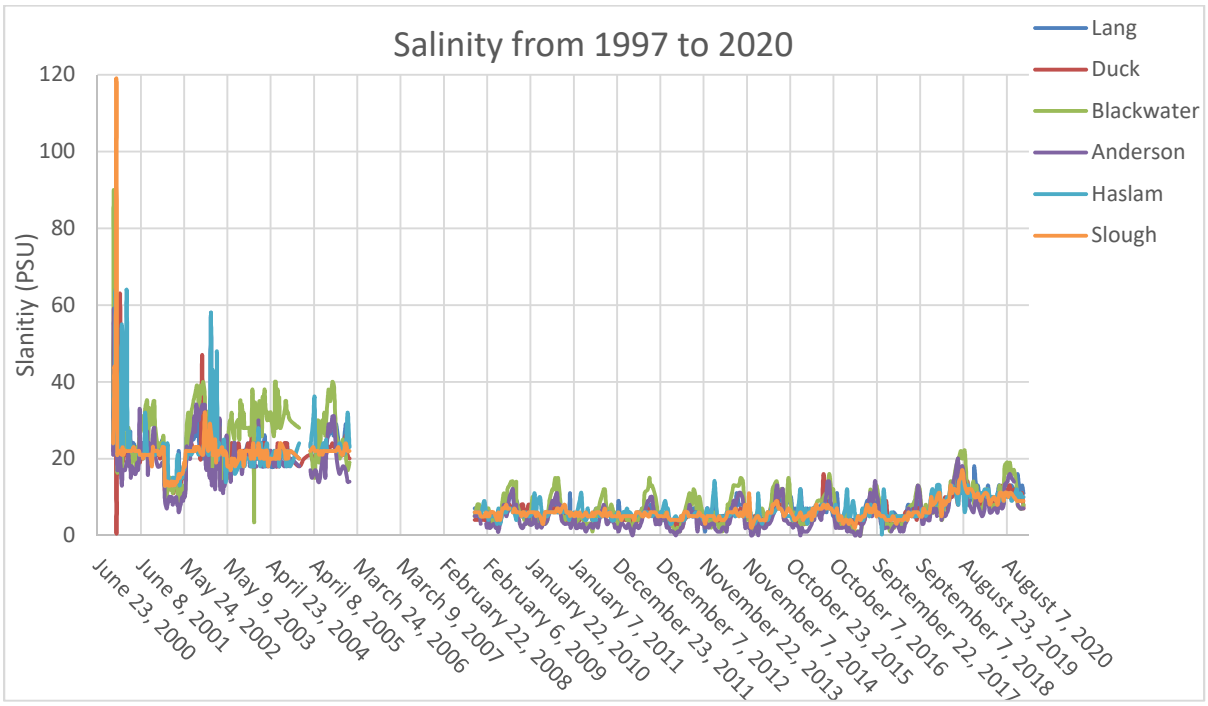

Figure 11: Salinity at six sites within the Haslam Lang Community Watershed between 2009 and present.

5.6 Water Temperature

Average water temperatures within the watershed ranged from 8.2 °C to 13.3 °C for all six sites. Lang, Duck, Blackwater, and Slough were 0.4 °C to 0.6 °C (4% to 6%) warmer than in 2019, while Anderson and Haslam were 0.2 °C to 0.4 °C (2% to 4%) cooler than 2019. The coldest temperatures occurred in February and March in Blackwater and Anderson Creek. The warmest water temperatures occurred in Duck Creek, Haslam Lake, and at Slough Station between May and October (Figure 12). Duck Creek historically has the highest maximum water temperatures, and the trend continues in 2020 (Figure 13). The highest water temperature was 24.7°C, about 6% warmer than in 2019 (23.2 °C), but about 2% cooler than the 2018 maximum of 25.2 °C. The maximum water temperatures in 2020 remain within the normal variability recorded at the six sites from 1997 to 2019. The water temperature data has a similar trend to the air temperature data in Figure 1.

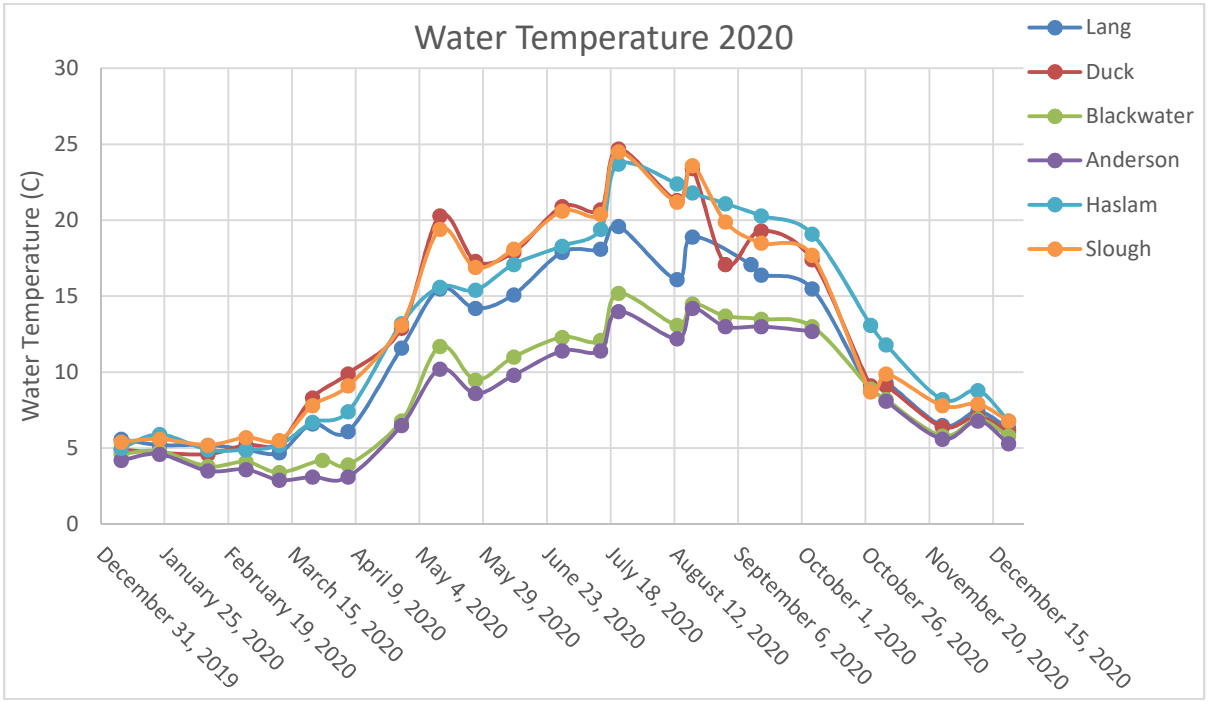

Figure 12: Water temperature measured at six sites within the Haslam Lang Community Watershed.

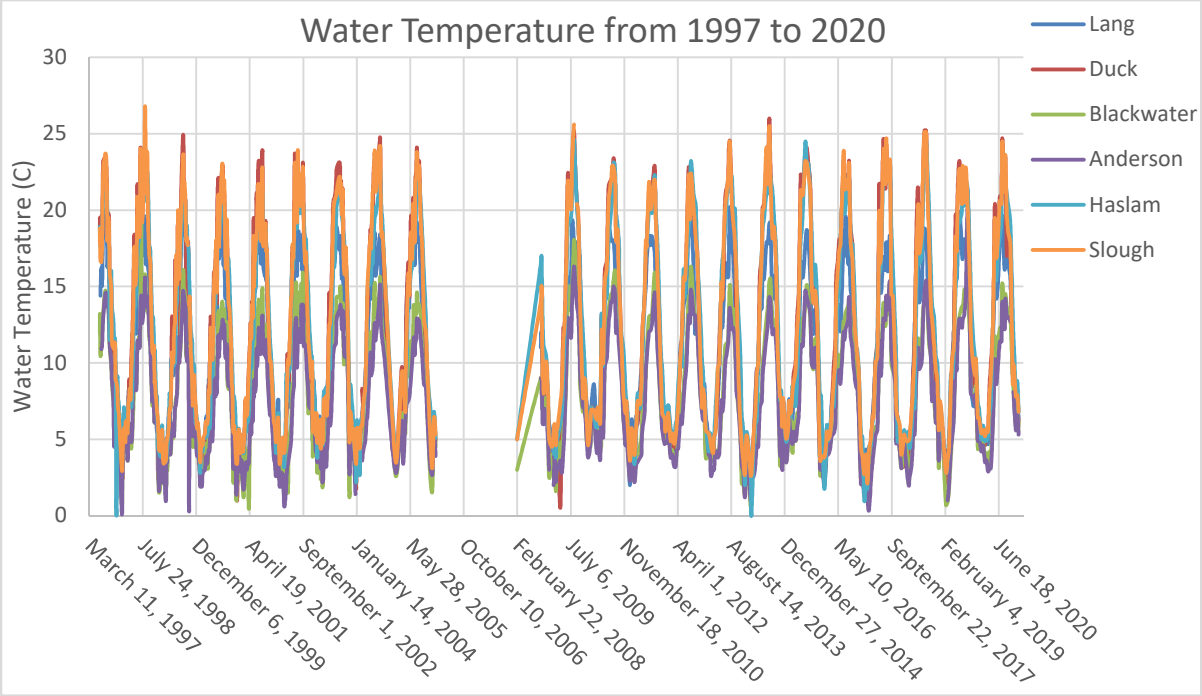

Figure 13: Water temperature at six sites within the Haslam Lang Community Watershed between 1997 and present.

6.0 DISCUSSION

The amount of water entering the watershed affects water quality. The Powell River A climate station recorded 52% more precipitation in 2020 than in 2019, and 7% more precipitation that the 30-year average from 1981 to 2010. The spring from February to April was drier than normal, while the summer from May to August was wetter than normal. Conditions remained wetter than normal through the second half of the year. This resulted in lower discharge levels in Lang Creek during the first part of the year, but higher flows through the summer than compared to 2019. September 2020 was drier than September 2019. This caused the minimum water discharge and stage, maximum pH, and maximum salinity values to occur later in the year than in 2019. Average temperatures were cooler than the 30-year normal through February and March, but were slightly warmer in May and September, extending the warmer weather longer than normal, potentially contributing to the lower discharge levels in September.

The stage of each creek shows similar variability throughout 2020, with peaks during the winter months and the lowest levels recorded during mid-September. The stage variability is similar to the precipitation data and continuous discharge data recorded in Lang Creek, with peaks occurring after precipitation events. The discharge data shows little variability between the beginning of July to mid-September (Days 190 to 267), suggesting that water levels in Haslam Lake fell below the elevation of the weir that controls water flow into Lang Creek. Small spikes in discharge on August 20 (Day 233) and September 23 (Day 267) coincide with precipitation events, and were likely caused by streams flowing into Lang Creek downstream of the weir. Water levels likely overtopped the weir after September 23 and all subsequent spikes represent the full drainage area of the watershed.

The average discharge in Lang Creek during 2020 was 6.07 m^3/s, 61% greater than 2019 and 1% greater than in 2018. The higher average discharge likely results from the greater precipitation that fell during 2020 compared to 2019, 2018, and the 30-year normal between 1981 and 2010. The minimum discharge in Lang Creek was 0.722 m^3/s which is 53% greater than 2019 and 89% greater than 2018. The maximum discharges in 2020 and 2019 both occurred in January, but the minimum discharge in 2020 occurred on September 13, almost two months after the minimum discharge in 2019. Dry weather and low flows persisted to September 23, three weeks later than 2019, due to September rainfall totals discussed above.

Turbidity levels generally change with discharge and stage levels. Peak turbidity readings on January 23 and November 3 coincide with heavy rainfall events and elevated bi-weekly stage measurements. The Lang Creek hydrograph station did not capture the November 3 rainfall, but the Powell River A climate station recorded 39 mm of rain from November 2 to November 3 (Environment Canada, 2021). Peak flows caused by heavy precipitation or rain on snow events can cause stream bank erosion and landslides, increasing water turbidity. Bank erosion on Lang Creek is an ongoing concern for the PRSS and may have contributed to the maximum reading of 7.06 NTU on November 3.

Peak turbidity in Blackwater Creek and Haslam Lake occurred in mid-September during low water levels. The 2020 turbidity trend in Blackwater Creek is similar to 2019, while peak turbidity in Haslam Lake occurred later in the year during the dry period. The turbidity in Haslam Lake could be caused by sediment inflow from summer storms or by wind events stirring up bank sediments near the measurement location. Road dust was observed on Blackwater Creek in July and August, and may have contributed to increased turbidity readings. Disturbances on the muddy banks from wildlife or human activity could also cause increased turbidity.

The maximum turbidity measurements in 2020 are similar to measurements recorded in 2019 and are well below maximum values recorded in previous years. The PRSS noted heavy dust on the roads within the watershed during the summer, but this did not cause an unusual increase in turbidity during the start of the wet season. This suggests that watershed management practices have been effective by limiting sediment production and reducing the volume of water that transports sediment from roads and ditches directly into streams.

The pH trend in 2020 is similar to the 2019 data, where pH was lowest during wet fall weather and highest during the summer when water levels are low. This is typical of creeks where summer flow is largely composed of groundwater and wet season flow is largely composed of precipitation and runoff. Ground water contains dissolved solids that increase pH while fall rainstorms can capture air pollution that decreases pH. Interestingly, the lowest pH value was recorded in Anderson Creek when the pH at all other sites increased. This suggests the low pH reading at Anderson Creek was caused by an isolated event or an anomalous reading. The low pH values recorded in October and November recovered to normal values in December. The pH recorded during 2020 is within the normal variability recorded from 1997 to present.

The 2019 water quality report by Statlu reported increasing salinity from 2018 to the end of 2019. We concluded the increasing trend was likely accurate, but there was some chance the increase was caused by equipment error. The PRSS replaced the sampling probe this year to ensure accurate water quality measurements.

Salinity values in 2020 were about 10% less than the salinity values recorded in 2019. The salinity is highest during the summer when water levels are low, suggesting that groundwater contributes to the increase. The stage, discharge, and total precipitation measurements were greater in 2020 than they were in 2019 for most streams, which could have resulted in lower salinity levels in 2020. As with pH, ground water has higher salinity than precipitation due to dissolved solids. This suggests the decrease in salinity levels from 2019 to 2020 is due to increased precipitation and runoff, and hence is a real effect and not a result of changing instruments. Following the summer maximum, salinity levels in December 2020 were almost identical to those recorded in January 2020. This shows the increasing salinity trend observed in 2018 and 2019 levelled off and did not continue in 2020.

The PRSS noted the sloughs are popular recreation areas and garbage can be left near the water. An oily sheen on the water at Slough Station was observed during one measurement in August (Photo 3). This was an isolated event and likely had minimal effect on water quality. Water sampling for general chemistry parameters such as fecal coliform, total metals, and $CaCO_3$ equivalent were last completed in 2010 (Carson, 2017). Additional data collection of these parameters could quantify how human activity affects water quality and would be useful to maintain a robust baseline monitoring program.

7.0 CONCLUSION

The Powell River Salmon Society (PRSS) has monitored water quality within the Haslam Lang Community Watershed since 1997. The watershed supplies drinking water to the City of Powell River and the community of Brew Bay. It also provides important habitat for salmon species and the PRSS operates a Hatchery on Lang Creek. Maintaining water quality is important for providing healthy drinking water and maintaining clean salmon habitat.

The PRSS retained Statlu Environmental Consulting Ltd. (Statlu) to analyze data collected during the 2020 water quality monitoring program and to compare the data with results from previous years. Stage, turbidity, pH, salinity, and water temperature were recorded bi-weekly at six locations within the watershed. The measurements were taken at Lang Creek near the Alex Dobler Salmon Centre, the outlet of Duck Lake, Anderson Creek, Blackwater Creek, Haslam Lake, and the weir at the outlet of Haslam Lake named Slough Station. The water quality monitoring program began at the six sites in 1997, providing a long history of data, which is a valuable tool for establishing baseline conditions within the watershed. This allows land managers to detect changes and implement solutions to maintain good water quality.

The stage and discharge measurements were higher in 2020 than in 2019 due to above average precipitation. Turbidity, pH, water temperature, and salinity generally varied within the normal and acceptable range for 2020. The pH measurements in November were slightly lower than the normal range over the last several years, but were at normal values for the rest of the year. Salinity values in 2020 remain slightly higher than the values recorded from 2009 to 2018, but were about 10% lower than in 2019. Furthermore, salinity values recorded in January are similar to values recorded in December, showing that the increasing salinity trend observed in 2018 and 2019 did not continue in 2020. The data suggests that forest management strategies intended to protect water quality are successful within the watershed.

8.0 LIMITATIONS

The recommendations provided in this report are based on observations made by Statlu and are supported by information Statlu gathered. Observations are inherently imprecise. Conditions other than those indicated above may exist on the site. If such conditions are observed or if additional information becomes available, Statlu should be contacted so that this report may be reviewed and amended accordingly.

This report was prepared considering circumstances applying specifically to Powell River Salmon Society and the forestry organizations which provide funding for the water quality sampling. It is intended only for internal use by the client for the purposes for which it was commissioned and for use by government agencies regulating the specific activities to which it pertains. It is not reasonable for other parties to rely on the observations or conclusions contained herein.

Statlu prepared the report in a manner consistent with current provincial standards and on par or better than the level of care normally exercised by Professional Geoscientists and Professional Agrologists currently practicing in the area under similar conditions and budgetary constraints. Statlu offers no other warranties, either expressed or implied.

9.0 CLOSURE

Please contact me should you have any questions or if you require further clarification.

Yours truly

Statlu Environmental Consulting Ltd.

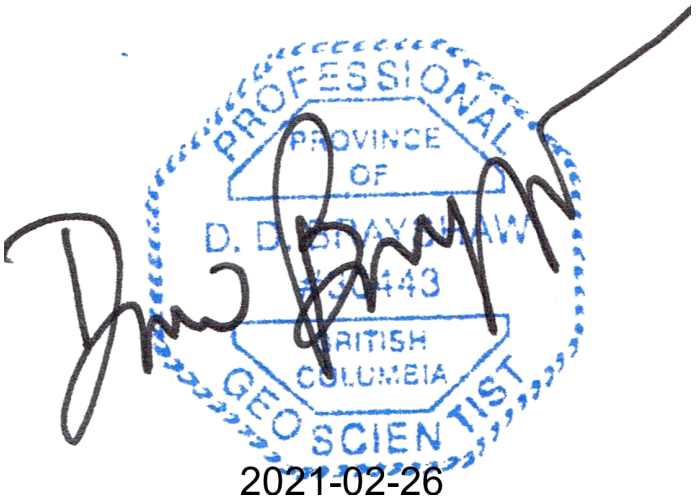

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Figure 1: Monitoring Stations within Haslam Lang Community Watershed

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