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Water Quality Assessment of the Ephemeral Streams and Overland Runoff into Tyhee Lake

Spring 2018 Data Summary



June 2021



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Author's Affiliation:

Natalie Fuller Co-op Student B.C. Ministry of Environment and Climate Change Strategy 3726 Alfred Avenue Smithers, B.C. Canada VOJ 2NO

Lisa Torunski, R.P.Bio Environmental Impact Assessment Biologist B.C. Ministry of Environment and Climate Change Strategy 3726 Alfred Avenue Smithers, B.C. Canada VOJ 2NO

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Cover Photographs: Lisa Torunski, East Creek looking south to Tyhee Lake.

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The final report was prepared by co-op student, Natalie Fuller and edited by Lisa Torunski Environmental Impact Assessment Biologist and Greg Tamblyn, Water Quality Section Head, with contributions from co-op student, Dylan Harvey.

EXECUTIVE SUMMARY

Overland runoff from roads, rural subdivisions, and agricultural operations, collects into ephemeral streams at the north end and east side of Tyhee Lake, British Columbia during the spring and presumably during high precipitation events. This document presents a summary of the ambient water quality for select ephemeral streams and overland runoff flowing into Tyhee Lake, during the spring snowmelt in 2018.

The Tyhee Lake catchment basin, of approximately 35 km², is located two kilometres off Highway 16 at Telkwa and twelve kilometres east of Smithers, in north-central B.C., within Wet'suwet'en territory. The lake is 318 hectares and has a maximum depth of 22.2 metres (Boyd et al., 1985). The water uses to be protected in Tyhee Lake include private domestic use, recreation, aquatic life, and wildlife.

The objective of the spring sampling project was to evaluate the potential risks to the aquatic environment of Tyhee Lake from agricultural inputs, entering the lake through ephemeral streams and overland runoff occurring during spring snowmelt.

The report describes the sampling program design in which five water samples were collected from nine sites from April 15 to May 13, 2018. The sample results are summarized and compared to the British Columbia (B.C.) Water Quality Guidelines (WQG) for physical, chemical, and microbial indicators.

Of the nine streams sampled, seven were downgradient of agricultural activities of various intensities (e.g., hayfields, dairy pastures, hobby horse farm); there were no agricultural activities upstream of the other two streams, one of which was used as a reference site owing to minimal upstream anthropogenic activity.

The data was collected with the help of the Tyhee Lake Protection Society.

The following conclusions were drawn from the water quality data collected.

The B.C. WQG for temperature, pH, chloride, nitrogen species (nitrate, nitrite, and ammonia) and *Escherichia coli* (*E. coli*) were met at all sites. Turbidity, total suspended sediments, total organic carbon, and total phosphorus concentrations were higher among those sites with upstream agricultural land use than those sites without. The results suggest that spring snowmelt ephemeral stream water quality is influenced by upstream agricultural land use, however, the sampling results indicate a low potential for impacts to aquatic life or recreational uses in Tyhee Lake based on measured concentrations and duration of inputs. Cumulative nutrient loading from all anthropogenetic sources including agriculture and residences may have the potential to affect the lake's future trophic status and water uses.

This report is intended to inform local land users, residents, and local governments about water quality in areas within the Tyhee Lake watershed and concludes with monitoring and management recommendations for the protection of existing water users.

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ACRONYMS

Abbreviation	Definition
B.C.	British Columbia
DOC	Dissolved Organic Carbon
E. coli	Escherichia coli
ENV	The Ministry of Environment and Climate Change Strategy
NTU	Nephelometric turbidity units
тос	Total Organic Carbon
TSS	Total Suspended Solids
WQG	Water Quality Guidelines
WQO	Water Quality Objective

1. INTRODUCTION

Tyhee Lake is located near Telkwa in north-west British Columbia, within Wet'suwet'en territory. The lake is 318 hectares and has a maximum depth of 22.2 metres (Boyd et al., 1985). The lake is fed primarily by overland runoff from perennial and ephemeral streams and drains into the Bulkley River via Tyhee Creek. The lake is highly productive and contains a variety of aquatic life, including a range of plant and fish species. Abundant non-rooted plant species that absorb nutrients from the water column include, northern water-milfoil (Myriophyllum sibiricum), Potamogeton spp., and duckweed spp. (Lemna minor and Spirodela polyhiza), Columbian watermeal (Wolffia coumbiana), and Ceratophyllum demersumm (Rysavy and Sharpe, 1995). Fish species in the lake include pygmy whitefish (Prosopium coulterii), burbot (Lota lota), rainbow (Oncorhynchus mykiss) and cutthroat trout (Oncorhynchus clarkii) and northern pikeminnow (Ptychocheilus oregonensis). The lake has been intermittently stocked with fish since 1955 (Boyd et al., 1985).

Land use around the lake is varied. Residential lakefront properties are distributed around most of the lake, including some rural housing on the eastern hillside. Tyhee Lake Provincial Park is located on the west side of the lake and covers approximately 1.5 kilometres of shoreline. A public beach and boat launch, accessed from within the Provincial Park, are used for recreational activities such as swimming, boating, and fishing. On the north end of the lake, there is a bible camp and a hobby horse farm. There is a small floatplane base at the northwest end of the lake. Agricultural land use, which consists of several hay fields and a dairy farm, is concentrated on the northeast and southeast upland areas around the lake.

Members of the Tyhee Lake Protection Society approached the B.C. Ministry of Environment and Climate Change Strategy (ENV) for information regarding the water quality of some perennial and ephemeral streams entering the lake from the north end and east side of the lake during spring melt. Overland runoff during spring snow melt is of particular concern. Spring melts can cause overland runoff to pick-up contaminants from upslope anthropogenic land activities and carry them into a watershed. Runoff from agricultural land has been shown to carry excessive nutrients originating from land applications of manures and fertilizers (Nordin, 1985). The runoff is a potential source of fecal pathogens from livestock and animal manures (Bicudo and Goyal, 2003). The potential effects of agricultural land use practises on lake water quality have been a source of concern in the past (Rysavy and Sharpe, 1995).

To address these concerns, physical, chemical, and microbial indicators were used to evaluate the water quality of the select streams entering Tyhee Lake.

1.1 Project Objectives

The study was a collaborative project between ENV and the Tyhee Lake Protection Society to support stewardship and water protection in the Tyhee Lake watershed. The water quality of ephemeral streams and overland runoff entering the lake during spring melt were assessed. The objectives of the project were to evaluate the potential risks agricultural land use may pose to the aquatic environment of Tyhee Lake and to make monitoring and management recommendations for the protection of existing water uses. Additionally, by reviewing the existing lake water quality data the study aimed to estimate the trophic status of the lake over time.

2. <u>METHODOLOGY</u>

2.1 Study Design

ENV staff trained volunteers to collect water samples based on approved methods (ENV, 2013). Nine sites representing ephemeral streams and an overland runoff that flow into Tyhee Lake in the spring along its north end and east side were selected for water quality sampling (Figure 1). One was a reference site and eight had upstream agricultural land uses, hobby farm activity or minimal domestic influences. Members of the Tyhee Lake Protection Society collected weekly surface water grab samples for five consecutive weeks from April 15 to May 13, 2018 (Table 1), during spring melt. The flows are ephemeral (only existing for a short period following precipitation or snowmelt) and it was noted that by the beginning of July, surface water flows had ceased at all sample sites. Table 2 is a list of the sampling sites including the Environmental Monitoring System (EMS) reference numbers, latitude and longitude and site descriptions and Appendix B contains photos of each sampling location.

Field parameters including temperature, conductivity and pH were measured using a YSI63 handheld meter and recorded on field sheets. Other observations including water clarity, odour and weather conditions were also noted. Copies of the field sheets can be found in Appendix A. Each week a site was randomly selected from which to collect a replicate sample for quality control purposes. All water samples were shipped to ALS Environmental in Burnaby for lab analysis. The parameters selected for analyses were pH, total organic carbon, turbidity, conductivity, total suspended solids, nitrogen and phosphorus species, chloride, and *Escherichia coli (E. coli.)*.

Summary statistics were calculated from the water chemistry data. Replicate data used for quality assurance and control purposes was not included in these calculations. For results below the detection limit, a value of half the detection limit was substituted. Where available, historic stream and lake data were also used in the assessment. The results of the analysis were compared to current B.C. WQGs for recreational use and the protection of aquatic life¹. Site conditions and water quality were compared between sites. This was done to provide a water quality assessment at the site level and identify any sites of potential concern.

Week	1	2	3	4	5
Date	April 15	April 22	April 29	May 06	May 13

Table 1. Tyhee Lake 2018 spring melt ephemeral stream sample collection dates.

3. <u>RESULTS</u>

Table 3 shows summary statistics for the parameters of interest for each sample site. The B.C. WQGs are provided for comparison. Appendix C contains the raw data.

¹ The streams were not considered domestic water sources due to their ephemeral nature and upstream land uses, therefore comparison of the water quality results to drinking water quality guidelines was not the focus of the assessment but is mentioned where appropriate.

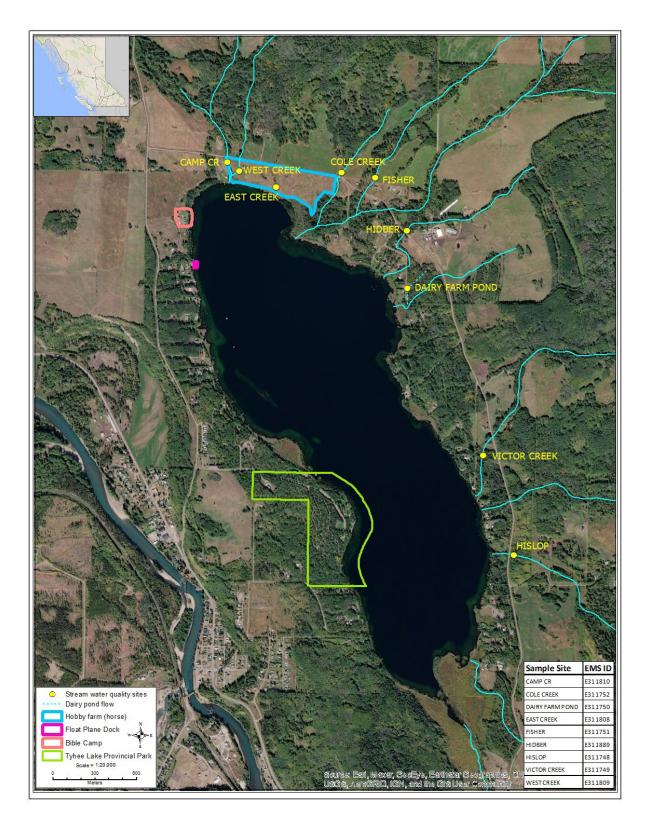


Figure 1. Project location near Telkwa, B.C. and individual sampling sites on the east side of Tyhee Lake.

Table 2. Description and site locations.

Site Name ¹	EMS ID	Lat. Long.	Description
CAMP CR DOWNSTREAM OF TYHEE LK RD	E311810	54.72988 N 127.05076 W	The flow is through the Tyhee David property between a private residence and the horse hobby farmland. The sample site is downstream of the Tyhee Lake road culvert and upstream of the confluence with West Creek through Tyhee David Property (E311809) to the east.
WEST CREEK THROUGH TYHEE DAVID PROPERTY	E311809	54.72873 N 127.04935 W	The drainage crosses Tyhee Lake Road through a culvert west of Fisher Road and flows past the horse barn on the Tyhee David property. The sample site is downstream of the culvert, and upstream of the confluence with Camp Creek (E311810).
EAST CREEK THROUGH TYHEE DAVID PROPERTY	E311808	54.72759 N 127.04311 W	The drainage crosses Tyhee Lake Road through a culvert west of Fisher Rd, through the Tyhee David property. The sample site is downstream of the culvert. The upstream land use is hay and horse fields.
COLE CR AT TYHEE LK RD	E311752	54.72873 N 127.03741 W	The drainage crosses Tyhee Lake Road through a culvert west of Fisher Rd. The sample site is upstream of the culvert crossing. The upstream land use is hay fields.
CREEK CROSSING <u>FISHER RD</u> NEAR OCTAGON HOUSE	E311751	54.72847 N 127.03347 W	The drainage crosses Fisher Road through a culvert 200m east of the Tyhee Lake Road and Fisher Road junction. The upstream land use is hay fields.
CREEK EAST OF HIDBER RD	E311889	54.72570 N 127.03052 W	The drainage crosses Tyhee Lake Road through a culvert east of Hidber Road. The upstream land use is a dairy farm and hay fields.
DAIRY FARM SETTLING POND OUTFLOW NEAR LAKE RD	E311750	54.72223 N 127.02962 W	The drainage is on the east side of Lake Road. The upstream land use is a dairy farm and an associated settling pond.
<u>VICTOR CR</u> NEAR PENNER RD	E311749	54.71085 N 127.02158 W	The drainage of Victor Cr is east of Penner Road and downstream of Tyhee Lake Road. The upstream land use is hay fields.
CREEK NEAR <u>HISLOP</u> <u>RD</u>	E311748	54.70292 N 127.01767 W	The ephemeral creek is to the north of Hislop Road at Tyhee Lake Road. The sample location is on the upstream end of a culvert crossing Tyhee Lake Road. The upstream land use is rural residential land ² with but no agriculture.

¹The **bolded**, <u>underlined</u> portion of the site name indicates the short names the sites are referred to throughout the report.

² The residential land use presents the potential for domestic septic systems or drainage pipes discharge that if exist would be confounding factors at the Hislop Road site reference.

Variable					Site					B.C	. WQG
	Camp Cr	West Cr	East Cr	Cole Cr	Fisher Rd	Hidber Rd	Dairy Farm Settling Pond Outflow	Victor Cr	Hislop Rd (Ref)	Recreation	Freshwater Aquatic Life
Temp. – field (<i>°C</i>)	6.0 ± 4.6	7.2 ± 4.7	7.6 ± 5.2	8.8 ± 3.8	4.8 ± 2.9	5.4 ± 4.2	11.2 ± 5.7	4.1 ± 3.8	7.4 ± 5.1	No appreciable change to swimmers	19 (max daily temp.)
Conductivity (<i>uS/cm</i>)	190 ± 34	210 ± 15	164 ± 84	169 ± 108	232 ± 20	186 ± 47	385 ± 74	161 ± 25	294 ± 112	-	-
рН (<i>рН</i>)	8.06 ± 0.21	8.13 ± 0.13	7.78 ± 0.23	7.83 ± 0.30	8.03 ± 0.22	7.98 ±0.15	8.45 ± 0.14	7.99 ± 0.17	8.22 ± 0.27	5 - 9	6.5 - 9
Total Organic Carbon (mg/L)	18.4 ± 1.5	14.2 ± 0.79	23.9 ± 6.0	23.0 ± 5.3	17.0 ± 0.4	20.7 ± 2.5	13.1 ± 1.3	18.6 ± 2.3	16.4 ± 4.9		Within 20% of
TOC (median – mg/L))	18.5	14.1	25.5	24.9	16.8	22.0	12.7	17.7	14.5	-	- background median
*Total Suspended Solids (<i>mg/L</i>)	2.5 ± 1.4	11.72 ± 14.92	3.9 ± 4.1	4.0 ± 4.4	2.5 ± 1.5	30.9 ± 33.3	26.0 ± 48.2	22.8 ± 13.6	3.7 ± 3.0	-	Change from background of 10 mg/L at any time during high flows
**Turbidity (<i>NTU</i>)	4.67 ± 4.08	11.58 ± 12.55	9.58 ± 9.72	29.5 ± 13.7	2.48 ± 0.85	18.34 ± 16.92	12.34 ± 20.92	19.64 ± 12.46	11.66 ± 10.59		Change from background of 5 NTU at any time during high flows
Phosphorous, Total (<i>mg/L</i>)	0.0211 ± 0.0141	0.0351 ± 0.0335	0.0429 ± 0.0174	0.0566 ± 0.0086	0.0219 ± 0.0132	0.0657 ± 0.0580	0.1995 ± 0.1528	0.0407 ± 0.0229	0.0303 ± 0.0325	0.01 (for lakes)	0.005-0.015 (for lakes)
Orthophosphate (<i>mg/L</i>)	0.0068 ± 0.0069	0.0065 ± 0.0050	0.0061 ± 0.0013	0.0120 ± 0.0035	0.0062 ± 0.0047	0.0139 ± 0.0151	0.1498 ± 0.0975	0.0021 ± 0.0008	0.0081 ± 0.0113	-	-

Table 3. Mean values ± standard deviations from five weekly samples(n=5) collected at each site.

Variable					Site					В.С	C. WQG
	Camp Cr	West Cr	East Cr	Cole Cr	Fisher Rd	Hidber Rd	Dairy Farm Settling Pond Outflow	Victor Cr	Hislop Rd (Ref)	Recreation	Freshwater Aquatic Life
***Ammonia, Total (<i>mg/L</i>)	0.0106 ± 0.0019	0.0188 ± 0.0144	0.0131 ± 0.0035	0.0154 ± 0.0037	0.0128 ± 0.0040	0.0117 ± 0.0062	0.0233 ± 0.0249	0.0096 ± 0.0021	0.0114 ± 0.0051	-	Table 26C & 26D in Appendix D
Nitrate (<i>mg/L</i>)	0.0264 ± 0.0358	0.0772 ± 0.1390	0.0041 ± 0.0057	0.0442 ± 0.0955	0.0056 ± 0.0050	0.2726 ± 0.1862	0.2602 ± 0.5483	0.2579 ± 0.2257	0.0680 ± 0.1084	10	Max: 32.8 Average: 3
****Nitrite (<i>mg/L</i>)	0.0009 ± 0.0009	0.0011 ± 0.0013	0.0007 ± 0.0005	0.0007 ± 0.0004	0.0006 ± 0.0003	0.0008 ± 0.0005	0.0019 ± 0.0028	0.0008 ± 0.0006	0.0005 ± 0	1	Table 26B in Appendix D
Chloride (<i>mg/L</i>)	5.44 ± 2.24	9.69 ± 4.18	11.23 ± 9.29	5.3 ± 8.0	13.3 ± 4.4	7.11 ± 3.98	5.43 ± 4.81	2.55 ± 1.80	10.53 ± 5.33	Max:600	30-d average: 150
E.Coli (<i>CFU/100ml</i>)¹	66 ± 116	55 ± 74	16 ± 15	2 ± 3	9 ± 14	80 ± 75	4 ± 3	57 ± 103	7 ± 9	200	-

Bolded values indicate results outside of their respective B.C. WQG thresholds.

* Bolded values where sample variability is greater than 10mg/L; ** Bolded values where sample variability is greater than 5 NTU; *** and **** B.C. WQG for ammonia is pH and temperature dependent and for nitrite is chloride dependent

¹ Maximum drinking water quality guideline for *E. coli* is 10 CFU/100mL

3.1 Tyhee Lake Water Quality 1950s to 2015– Phosphorus, Turbidity and Bacteriology

Lake sediments reveal that Tyhee Lake is naturally eutrophic based on diatom assemblages and diatom- inferred spring total phosphorus ranging from 0.035mg/L to 0.043 mg/L² prior to European settlement (Reavie, and Smol, 1997). These sediments also reveal that significant eutrophication has occurred post 1950s due to anthropogenic influences. Since the mid 1980s, Tyhee Lake has been considered phosphorous limited, with a nitrogen to phosphorous ratio greater than 15:1 (Boyd, 1985). Average total phosphorous concentrations measured at spring overturn from 1986 to 1999 ranged from 0.005 mg/L to 0.040 mg/L. More recent spring phosphorous concentrations measured at the lake's deep station, from 2016 to 2018 (B.C. Lake Monitoring Network³, 2018) show an average of 0.022 mg/L, which remains within the historic ranges observed, and supports a proposed summer average phosphorus water quality objective (WQO) of 0.04mg/L for Tyhee Lake (Zirnhelt, 2015).

The average turbidity WQO set for the lake is 1 NTU from five samples collected weekly in 30 days (Boyd *et al.*, 1985). Between 2002 and 2003 this objective was surpassed in three of seven sample sets. The maximum WQO of 5 NTU was never exceeded (Downie and Kokelj, 2004). The historic data shows both objectives were attained from 2004 to 2011 (Zirnhelt, 2015) but the parameter has not been measured again in the lake since 2011.

The most recent microbial sampling for Tyhee Lake was conducted in 2013 at four sample locations: near the public beach on the west side, near Lock Road at the south end, between Hidber and Penner Roads on the east side and near the bible camp at the north end. The beach site had a geometric mean of 4.8 CFU/100mL which was below the water quality objective of 77 CFU/100mL. The results (90th percentile) from each of the other three sites were below the drinking water quality objective of 10 CFU/100mL at lake intakes (Zirnhelt, 2015).

Table 4 is a list of the water quality objectives for Tyhee Lake. However, the stream data was not directly compared to these objectives as they pertain to the lake.

Parameter	Water Quality Objective
Colour (near water intakes) ^{1, *}	Long-term objective: 15 TCU (maximum)
<i>Escherichia coli</i> bacteria ²	Drinking water intakes: <10 CFU/100 mL (90th percentile) with a minimum of 5 weekly samples collected over a 30-day period Recreational beaches: geometric mean ≤ 77 CFU/100mL
Turbidity ¹	< 1 NTU (average); < 5 NTU (maximum)
Total Phosphorus ³	Summer average of 40 μg/L (0.04 mg/L).
,	and Kokelj in the 2004 objectives attainment report for the Smithers lakes, but not formally established. n 2015 draft attainment report for the Smithers lakes, but not formally established

Table 4. Water Quality Objectives for Tyhee Lake (established and proposed between 1996 and 2015).

³ Interim WQO as proposed by Zirnhelt in 2015 draft attainment report for the Smithers lakes, but not formally established.

*Not assessed in this study

² These concentrations result from modeling that takes into consideration the relationships between water chemistry variables and diatom distributions in the surface sediments of B.C. lakes.

³ B.C. Lake Monitoring Network internet link: <u>https://www2.gov.bc.ca/gov/content/environment/research-monitoring-reporting/monitoring/lake-monitoring/bc-lake-monitoring-network</u>

3.2 Spring 2018 Water Quality

3.2.1 pH

pH is a measure of the concentration of hydrogen ions (H+) in water measured on a logarithmic scale between zero and fourteen. A pH between zero and seven is acidic (the lower the number, the more acidic the water) and a pH greater than seven is alkaline (the higher the number, the more basic the water). A pH of seven is neutral. The B.C. WQG for the protection of aquatic life is between 6.5 to 9.0 pH units (McKean and Nagpal, 1991).

The two largest factors that determine pH in freshwater in B.C. are precipitation and weathering of sediments (McKean and Nagpal, 1991). Increases or decreases of pH can affect aquatic communities in terms of both composition and abundance for all taxonomic levels.

The average pH values across the study area ranged from 7.78 at East Creek to 8.45 at the Dairy Farm settling pond outflow, with average pH of 8.22 at the Hislop road reference site. pH at all sample sites were within the WQG range of 6.5 to 9 pH.

3.2.2 Temperature

Temperature has a substantial influence on how species respond to physical or chemical stressors. Many anthropogenic activities can affect surface water temperature. This includes the use of settling ponds upstream of receiving water bodies. For example, during certain seasons, and related to depth of flow and capacity, the water in the settling pond may be warmer than the receiving water (Oliver and Fidler, 2001). The WQG is set to protect aquatic life at every life stage from adverse effects caused by extreme temperatures (Oliver and Fidler, 2001). As optimal temperatures are species specific the temperature guidelines are set for specific fish species and life stages when the community composition is known. Volunteers noted fish in the outflow from the Dairy Farm settling pond on May 13, 2018; however, the species and life stage were not noted. Therefore, the general guideline of 19°C for the protection of all aquatic life was used for comparison with the water quality results from all sample sites. Over the five-week sampling period, the average temperatures across the study area ranged from between 4.1°C and 4.8°C at Victor and Fisher creeks to 11.2°C at the Dairy Farm settling pond outflow, with average temperatures of 7.4°C at the Hislop Road reference site. The spring temperature readings at all sites were below the general WQG of 19°C for the protection of aquatic life.

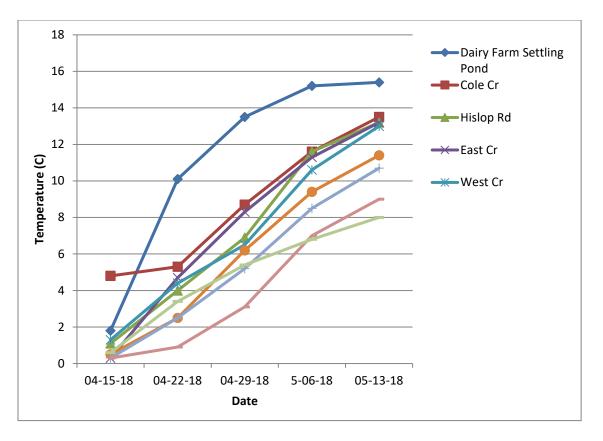


Figure 2. Water temperature at each site over five weeks as measured in the field with a YSI63 handheld meter showing the temperature trajectory over the sampling period.

3.2.3 Total Organic Carbon

Total organic carbon (TOC) is comprised of dissolved (DOC) and particulate organic carbon in water. Humic substances found in partially degraded terrestrial and aquatic plant materials, make up much of the organic carbon in water (Moore, 1998). Knowing the amount of carbon in a freshwater stream is an indicator of the organic character of the stream.

Organic contaminants (natural organic substances, insecticides, herbicides, and other agricultural chemicals and waste products) enter waterways in rainfall runoff and influence TOC concentrations in the receiving waters. TOC as an indicator of environmental effects arising from anthropogenic activities, provides a speedy and convenient way of determining the degree of organic contamination. The larger the carbon or organic content, the more oxygen is consumed in the water as the organics decompose. A high organic content means an increase in the growth of microorganisms which contribute to the depletion of oxygen and can create unfavorable conditions for aquatic life (Moore, 1998).

The TOC WQG concentration for the protection of aquatic life is based on background levels or an appropriate reference site. The WQG suggests that a 30-day median of TOC should be within ± 20% of a seasonally adjusted median background level.

The study design did not include sample sites upstream of potential "contaminant" sources and therefore the sample location on the creek near Hislop Road was used as a reference site⁴ since the upstream land use was rural domestic with no notable agricultural influence. The 30-day median from the Hislop Road site was 14.5 mg/L (Table 3); this would provide a threshold range of 11.6 mg/L to 17.4.mg/L. Five sites exceeded the upper threshold. Listed in order of highest exceedance (25.5 mg/L) to lowest exceedance (17.7 mg/L), the sites were East Creek through the Tyhee David Property, Cole Creek, Hidber Road, Camp Creek and Victor Creek.

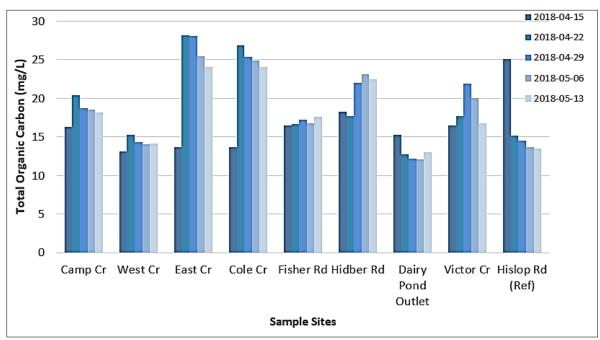


Figure 3. Total organic carbon concentrations in water samples collected at each site over five consecutive weeks between April and May 2018.

3.2.4 Turbidity and Total Suspended Solids

Turbidity is a measurement of the amount of light scattering caused by suspended particles in the water and is highly correlated to TOC and total suspended solids (TSS) concentrations. TSS include all the undissolved particulate matter in a sample. High quantities of suspended sediments may inhibit primary production and smother benthic invertebrate communities (Singleton, 1985; as cited Caux *et al.*, 1997). For the protection of aquatic life, the water quality guidelines for turbidity and suspended sediment are based on changes from background levels. The guidelines suggest that during high flows or turbid water events, such as spring runoff, when background is between 8 and 50 NTU, the turbidity guideline is a change of no more than 5 NTU. The change from background for TSS should be no more than 10 mg/L at any time when background is 25 to 100 mg/L during high flows or in turbid waters.

The guidelines are site-specific to assess the influence of anthropogenic causes on the water quality. Factors, including sediment compositions, are site-specific and because of site differences it is not appropriate to use Hislop Creek as a reference when reviewing and interpreting the turbidity data.

⁴ Potential confounding factors at the Hislop road site related to its use as a reference site is the possibility of leaking septic systems or drainage pipes from rural domestic discharge

In the absence of a suitable reference site or upstream background data for each site, the water quality guidelines for these parameters could not be precisely determined or assessed against the water quality sampling results. Instead, the variability in the concentrations within a site and between sites was described and assessed. Figure 4 shows the turbidity results for all sites for each date sampled.

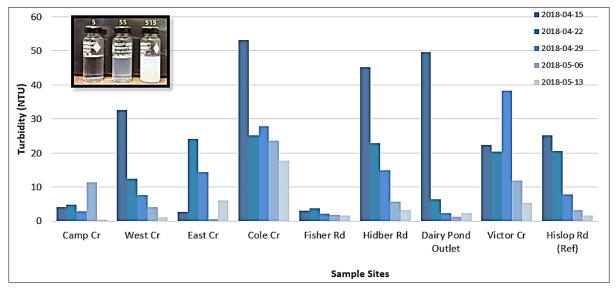


Figure 4. Turbidity measures from water samples collected at each site over five consecutive weeks between April and May 2018. The inset in the top left demonstrates turbidity of 5 NTU, 55 NTU and 515 NTU.

Turbidity values at the Fisher Rd creek showed the least variability over the five-week sampling period with values ranging from 1.63 to 3.67 NTU. All other sites show a much larger range of turbidity values over the sampling period, especially Hidber Road (3.2 to 45.2 NTU) and the outflow from the Dairy Farm settling pond (1.2 to 49.6 NTU). The highest turbidity values for West, Cole, and Hislop Creeks, the Dairy Farm settling pond outflow and Hidber Road occurred on the first week of sampling, at the start of the spring melt. The highest values observed at Camp, East and Victor Creeks occurred somewhere within the second to fourth week of sampling. Turbidity values at all sites except Cole Creek were less than 7 NTU in the last week of sampling. At Cole Creek, turbidity values started higher in the first week of sampling relative to the other sites at 53.2 NTU and remained higher than all the other sites in the final week of sampling at 17.8 NTU. Similar patterns of declining concentrations over the sampling period were observed for TSS (Figure 5). Over the five-week period average turbidity and TSS were highest at Cole Creek and Hidber Road respectively compared to all other sites, but the results show the highest initial concentrations of both were from the Dairy Pond outlet.

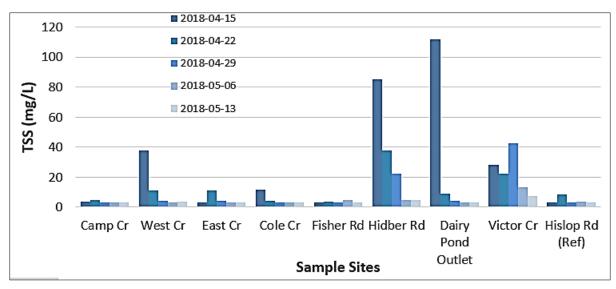


Figure 5. Total suspended solids (TSS) concentrations in water samples collected at each sample site over five consecutive weeks between April and May 2018.

3.2.5 Total Phosphorous and Ortho-phosphorous

Total phosphorous is a combination of both organic (found in plant or animal tissues and other organic materials) and inorganic compounds. Phosphorous is an important nutrient in lakes for primary productivity and is shown to be the major limiting nutrient in Tyhee Lake (Boyd *et al.*, 1985). Currently there are no drinking water, recreation, or aquatic life protection guidelines for total phosphorous in streams. This is due to other conditions that limit algal growth before nutrients do, such as water velocity, substrate, light, temperature, and grazing pressure (Nordin, 1985). However, nutrient concentrations can indicate effects of agricultural land use on the water quality. Fertilizers and manures used in agricultural practices often contain high concentrations of phosphorous.

Prior to the 2018 sampling program, ephemeral streams surrounding Tyhee Lake were sampled in the spring of 1995 and 2001 by ENV (Table C1). The data is publicly available and stored in the EMS database. This data suggests these streams experienced a short flush of total phosphorus at the onset of spring melt followed by a quick decline in total phosphorus concentrations. Concentrations were higher in March than April in both years. Of the sites sampled historically, five are included in the current study (Fisher, Hislop, West Creek (aka Horse Farm historically), Victor and Yakisda Bik'a Camp creek. Among these sites, the highest total phosphorous concentration was 1.28 mg/L found at Yakisda Bik'a Camp creek in 1995, which was a site located further downstream from the 2018 Camp Creek sample site. Total phosphorus concentrations in 2001 were lower than those measured in 1995.

In 2018, total phosphorous concentrations were below 0.1 mg/L in most samples (Figure 6). The exceptions were at Hidber Road where total phosphorus on the first week of sampling (April 15) was 0.162 mg/L; West Creek where the concentration on the last week of sampling was 0.140 mg/L; and all samples collected at the settling pond outflow. Over the entire sampling period, the settling pond outflow concentrations were consistently above 0.1 mg/L with the five samples in 30-day average of 0.199 \pm 0.153mg/L (SD). Table 3 shows that the average total phosphorus concentrations at East, Cole and Victor Creeks, Hidber Road and the Dairy Farm settling pond outflow in the spring were above the recommended summer average total phosphorus concentration of 0.04mg/L for Tyhee Lake (Zirnhelt, 2015).

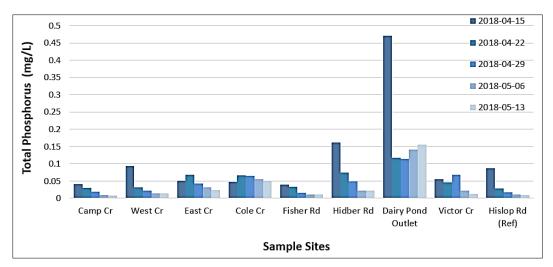


Figure 6. Total phosphorous concentrations from five water samples collected at each site over five consecutive weeks between April and May 2018.

Orthophosphate is an inorganic and readily available form of phosphorous and is naturally produced through the phosphorous cycle. It is found in low concentrations in waters not contaminated by anthropogenic activities (Oram, 2009). Manures and fertilizers used on agricultural lands often contain high concentrations of orthophosphates, which can then make their way into a waterbody through overland runoff. Because the compounds are readily available for uptake they are more directly related to algal concentration in streams. There are no guidelines for orthophosphate.

Orthophosphate levels followed a similar pattern to total phosphate. However, the difference between the outflow from the Dairy Farm settling pond and the other sample sites was even more noticeable. The outflow from the Dairy Farm settling pond had an average orthophosphate concentration of 0.15 ± 0.097 mg/L, which was over tenfold greater than the next highest site. Average orthophosphate concentrations at the remaining sites were all between 0.002 mg/L to 0.0139 mg/L, with Victor Creek and Hidber Road being the lowest and highest respectively.

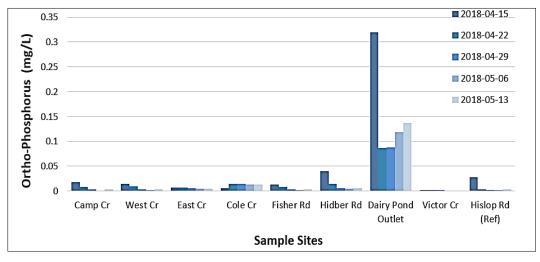


Figure 7. Orthophosphate concentrations from five water samples collected at each site over five consecutive weeks between April and May 2018.

3.2.6 Nitrogen – Nitrate, Nitrite and Ammonia

Nitrogen compounds are essential nutrients for life and move through the nitrogen cycle in numerous forms. The most common forms of nitrogen in aquatic environments are nitrate, nitrite, and ammonia. If concentrations of nitrogen are too high, they can be harmful to aquatic ecosystems by allowing excessive algal growth, direct toxicity to aquatic organisms and decreasing dissolved oxygen through nitrification (Nordin and Pommen, 1986). Although nitrogen compounds can be naturally sourced, industrial activities including agricultural practices can elevate concentrations. To protect the most sensitive freshwater species and life stages, ENV has water quality guidelines for three forms of inorganic nitrogen (nitrate, nitrite, and ammonia). The nitrate guideline consists of a short-term limit of 32.8 mg/L and a long-term average (calculated using five samples collected over 30 days) of 3.0 mg/L for the protection of aquatic life. The aquatic life guidelines for nitrite and ammonia are site-specific. The nitrite guideline is based on chloride concentration. As chloride concentrations increase the maximum allowable nitrite concentration increases. The ammonia guideline is based on site pH and temperature. As pH and temperature increase ammonia becomes more toxic and therefore the ammonia guideline value decreases. Recreational guidelines have been set for nitrate and nitrite as thresholds of less than 10.0 mg/L and 3.0 mg/L respectively, to account for the potential of accidental ingestion of water during recreational activities (Nordin and Pommen, 1986). The WQG tables for ammonia and nitrite are in Appendix D.

Hidber Road had the highest average nitrate concentration (0.2726 \pm 0.1862 mg/L). The outflow from the Dairy Farm settling pond and Victor Creek had concentrations that were very close to Hidber Road, with averages of 0.2602 \pm 0.5483 mg/L and 0.2579 \pm 0.2257 mg/L respectively. The remaining sites had substantially lower nitrate concentrations with averages between 0.004 mg/L and 0.068 mg/L. Most nitrite concentrations were below the laboratory's detection limit of \leq 0.0001 mg/L, which is two to three orders of magnitude lower than the guideline limits, based on chloride concentrations between two and 10 mg/L. A one-time maximum nitrite concentration of 0.007 mg/L was reported at the outflow of the Dairy Farm settling pond. This value is an order of magnitude below guideline limits. The site with the highest average ammonia concentrations (0.0233 \pm 0.0249 mg/L) was the Dairy Farm settling pond outflow. This site also had the lowest guideline limit of 3.64 mg/L (May 13, 2108) due to the higher pH and temperature recorded here, compared to the other sites. The lowest average ammonia concentration (0.0096 \pm 0.0021 mg/L) was reported in Victor Creek. Concentrations at all sites were below the short-term and long-term aquatic life WQG set for each of the three forms of nitrogen (*i.e.* nitrate, nitrite, and ammonia) and the recreational WQG for nitrate and nitrite.

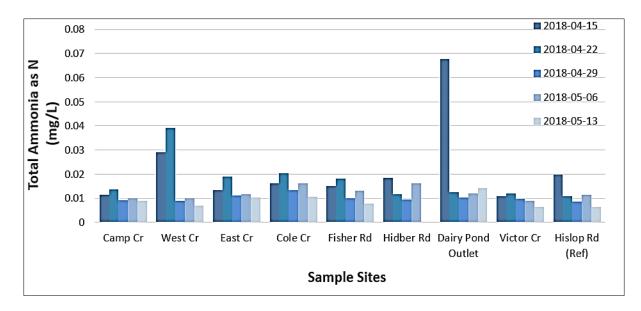


Figure 8. Ammonia concentrations in water samples collected at each site over five consecutive weeks between April and May 2018. WQGs are temperature and pH dependent and are not shown on the figure.

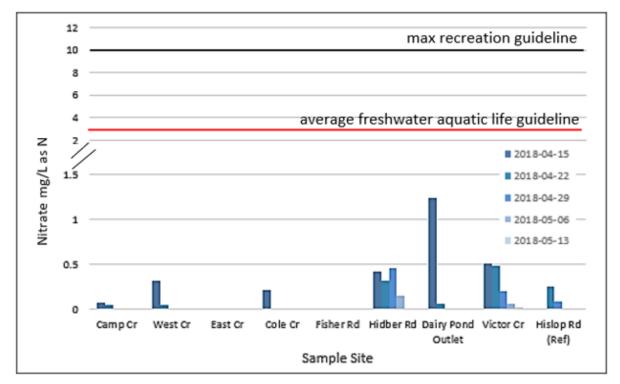


Figure 9. Nitrate concentrations in water samples collected at each site over five consecutive weeks between April and May 2018. Note the y-axis discontinuity after 1.5 mg/L. The chronic and acute recreational WQG are indicated as solid lines.

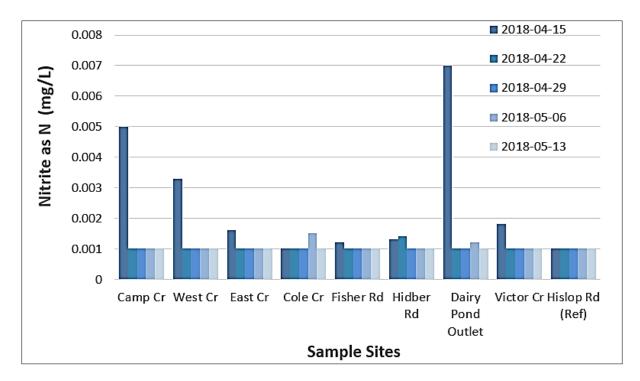


Figure 10. Nitrite concentrations in water samples collected at each site over five consecutive weeks between April and May 2018. WQGs are chloride dependent and not shown on the figure.

3.2.7 Chloride

Low concentrations of sodium chloride are found naturally in freshwater sources. Elevated chloride concentrations can lead to impaired growth and reproduction of freshwater organisms or can be lethal due to the disruption of their osmoregulation processes (Nagpal, 2003). The main anthropogenic source of chloride to the environment in B.C. is the application of road salts, which leach into the surrounding environment (Nagpal, 2003). Streams and rivers are highly affected by this practice because of their proximity to roads. Chloride may also be sourced in some fertilizers, which contain potassium chloride, and from other anthropogenic influences such as sewage, irrigation drainage, and refuse leachates (Nagpal, 2003). For the protection of freshwater aquatic life, short-term chloride concentrations should not exceed a maximum of 600 mg/L at any time. To protect against long-term effects, the average concentration should not exceed 150 mg/L (minimum of five samples in 30 days).

Chloride concentrations did not exceed either the short-term or long-term thresholds at any site. The chloride data did not follow the same pattern as the other measured nutrients, probably due to differences in their primary anthropogenic sources. The site with the highest average chloride concentration was the creek crossing at Fisher Road ($13.3 \pm 4.41 \text{ mg/L}$) and the site with the lowest average concentration was Victor Creek ($2.55 \pm 1.80 \text{ mg/L}$). The highest one-time maximum was 27.6mg/L at East Creek on April 15, week one of five.

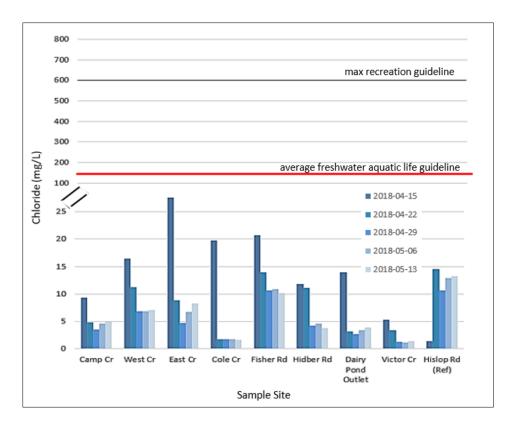


Figure 11. Chloride concentrations from five water samples collected at each site over five consecutive weeks between April and May 2018. Note the y-axis discontinuity at 30 mg/L.

3.2.8 Microbiology

Microbial indicators are used to assess the potential of fecal contamination. Bacterial indicators are not typically disease-causing, but are used to indicate the potential of water-borne pathogens that may cause diseases (Meays, 2005). Many different microbes can be used to assess fecal contamination. *E. coli* is considered the better indicator of fecal contamination compared to either total coliforms or fecal coliforms (Health Canada, 2012). The 2018 spring sampling program focused on *E. coli*, an organism that inhabits a mammal's intestinal tract. Many factors, such as rainfall, wildlife use, temperature and light exposure can all affect the amount of *E. coli* in a water body, causing concentrations to be sporadic (Meays, 2005). The microbial water quality guideline recommended for both general livestock use (ENV, 2001) and primary contact recreation (e.g. swimming, wading, and diving) (ENV, 2017), is a geometric mean of less than or equal to 200 *E. coli*/100 ml. The geometric mean is calculated for a minimum of five samples within a 30-day period to accurately assess the quantity of *E. coli* present because of their irregular and uneven distribution. This guideline has been set to minimize the risk of potential gastrointestinal diseases to water users.

All sites had geometric means below the WQG of 200 *E. coli*/100 ml (Table C-1). Hidber Road had the highest geometric mean of 54.19 CFU/100 ml. Cole Creek had the lowest with 1.32 CFU/100 ml. The highest one time maximum (270 CFU/100 ml) was from Camp Creek (Figure 12). This however does not indicate a long-term trend, as the rest of the samples from the site were much lower. The highest *E. coli* concentrations were on April 15 (the first sample week) at all sites. The exception was East Creek, where the highest concentration was on April 22 (the second sample week).

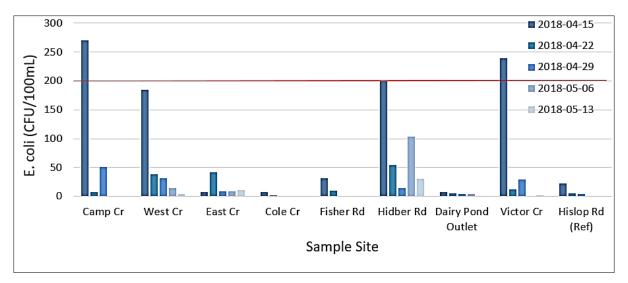


Figure 12. Escherichia coli concentrations in water samples collected at each site over five consecutive weeks between April and May 2018. The red line represents the BC livestock and recreational WQG.

3.3 Discussion

3.3.1 Total Organic Carbon

Most types of organic carbon found in surface waters are naturally occurring, and non-toxic to aquatic life and to humans. TOC in natural surface waters can range from 1 mg/L to over 30 mg/L, with the highest values typically emanating from sphagnum bogs or other types of wetlands. In high concentrations (>15 mg/L), organic carbon can impart a brownish or tea-colour to water, but these levels are still not toxic to aquatic life.

Spring runoff TOC concentrations in the ephemeral streams entering Tyhee Lake were within the range of the natural surface waters but five sites exceeded the derived upper water quality guideline for the protection of aquatic life. The three highest concentrations measured were from sites with upstream hobby farm and agricultural activity suggesting these activities may be influencing TOC concentrations. For example, Schepers and Francis (1982) found that grazing livestock increased total organic carbon by 11% in runoff waters on account of increased soil erosion and production of animal wastes.

3.3.2 Nutrients

Nitrogen has not historically been a limiting nutrient in Tyhee Lake. Concentrations of nitrogen species in the streams did not exceed water quality guidelines designed to protect the environment from negative impacts; however, concentrations during spring melt were higher at sites located downstream of the dairy farm, suggesting nutrients could be entering the lake from the dairy farm.

Phosphorous is the limiting nutrient for primary productivity in Tyhee Lake (Boyd et al., 1985). Reavie and Smol (1997) found that Tyhee Lake was most likely naturally mesotrophic before anthropogenic influences, based on the diatom community composition in a sediment core from the lake. Increased human activity since the 1950s has increased primary productivity in the lake resulting in algae blooms and increase plant growth (Reavie and Smol, 1997). Table 5 is an estimation of the trophic status of the lake between 2015 and 2018 based on deep station (EMS E216924) chlorophyll *a* and total phosphorus concentrations. The data shows that with annual average chlorophyll *a* concentrations ranging from 6.82 ug/L to 10.80 ug/L and average total phosphorous concentrations ranging from 23 ug/L to 31 ug/L the lake is mostly in a eutrophic state (B.C. Lake Monitoring Network, 2018).

Trophic state	Chl a uglL	TP ug/L	Year	Chlorophyll a ug/L	Total Phosphorus ug/L	Trophic Status
			2015	8.18	22.76	low-eutrophic
Oligotrophic	0-2	1-10	2016	10.80	30.43	eutrophic
Mesotrophic	2-7	10-30	2017	7.47	30.83	eutrophic
Eutrophic	>7	>30	2018	6.82	25.00	mesotrophic

Table 5. Tyhee Lake trophic status estimations based on deep station average chlorophyll a and average total phosphorus concentration, 2015 – 2018.

Increases in nitrogen and phosphorous from anthropogenic sources can lead to eutrophication. Eutrophication can have negative impacts on aquatic life and reactional activities because the process can result in harmful algal blooms, decreased oxygen levels, fish kills and poor water quality.

The highest total phosphorus concentrations are in the bottom waters of the lake in late summer. These observations suggest that phosphorus is likely being lost from the water column to the sediments. Problems often arise when phosphorus is released from the sediments of eutrophic lakes as it is regularly associated with the proliferation of nuisance algal blooms, and excess aquatic plant growth. Anecdotally, there have been reports of large increases in algae growth in areas around the lake over the past thirty years. So much so that some areas are no longer accessible for fishing and recreation due to extreme algae and macrophyte growth.

The stream results showed that concentrations of orthophosphate, a readily available form of phosphorous, were considerably higher in the outflow from the Dairy Farm settling pond compared to the other sites (Figure 7) and may indicate elevated nutrients coming from a higher intensity anthropogenic activity source. To a lesser extent, this may also be the case related to land use above Cole Creek and Hidber Road.

3.3.3 Microbial Indicators of Water-Borne Pathogens

Diseases caused by water-borne pathogens have become an increasing health concern around the world. While this concern is mostly related to drinking water contamination, some pathogens can cause diseases or infections in people involved in aquatic recreational activities (Warrington, 1988). Microbial indicators, such as *E. coli*, signal when fecal contamination is entering a waterbody, and are an indirect measurement for pathogen abundance, as the pathogens themselves are often found in lower numbers with uneven distribution (Meays, 2005). However, indicator organisms do not specify the source of contamination because the same organisms can be found in the feces of all warm-blooded mammals.

E. coli results showed that all sampled tributaries are a source of microbial inputs to the lake. At the onset of the spring melt, concentrations of E. coli were considerably higher in Camp, West and

Victor Creeks as well Hidber Road, although there was no discernable pattern between *E. coil* concentrations and upstream land uses. All results were below the livestock and recreational use guidelines. However, the water in these streams are unsuitable as raw drinking water sources, partly due to *E. coli* concentrations that exceeded the drinking water guideline.

Differences in environmental conditions, such as light exposure, temperature and nutrients are important in determining *E. coli* survival (Meays, 2005). Temperatures across the sites were similar but nutrient concentrations were not and light exposure was not accounted for. Light exposure may have varied between samples sites as some were located on fields and some were in more forested areas.

In the past, research concerning the influence of livestock farms on fecal contamination in runoff has been inconclusive because the sources of microbes cannot be definitively discerned between livestock, wildlife, and humans (Bicudo and Goyal, 2003). However, bacteria source tracking is a growing field where the sample microorganisms are compared with those found in a known fecal source (Health Canada, 2012). This type of analysis would be needed to scientifically confirm the sources of *E. coli*.

4. CONCLUSION AND RECOMMENDATIONS

For two or three months each year, the ephemeral streams around Tyhee Lake flow from the onset of spring melt in April until they dry up, usually by the month of July. Overland runoff from roads, rural subdivisions, and agricultural operations collects into these streams during the spring and presumably during high precipitation events. This report looked at the water quality of these streams during spring melt in 2018.

The water quality results were compared to the B.C. Ministry of Environment and Climate Change Strategy water quality guidelines (WQG). The parameters of interest were assessed for the protection of aquatic life and recreational use where appropriate. The assessment considered the potential for agricultural land use impacts on the streams and the lake.

The study demonstrates that ephemeral stream water quality during spring melt is influenced by the intensity and concentration of upstream agricultural land use.

The main findings of this study were:

- B.C. WQGs were met for temperature, pH, chloride, nitrogen compounds and *E. coli* at all sites.
- Over the five weeks, similar patterns were observed for nutrient concentrations and water clarity; sample weeks with higher nutrient concentrations also had higher turbidity and total suspended solids.
- In general, higher turbidity, TSS, TOC and phosphorous concentrations, were measured coming
 from the Dairy Farm settling pond outflow, Hidber Road and Cole Creek. Lower concentrations
 were measured from East Creek and Victor Creek and were lower still from the remaining four
 sites. The main differences between the sites were the extent or intensity of upstream land use.
 The former sites generally have more agricultural (livestock and hayfields) and animal husbandry
 (horse hobby farm) use and disturbance relative to the latter sites.
- Concentrations of orthophosphate were indicative of elevated nutrients levels from anthropogenic sources rather than the conversion of natural organic phosphate compounds.

• Recent deep station lake monitoring for chlorophyll a and total phosphorus concentrations estimate the lake's overall trophic status to be eutrophic.

Historic data and the results of the spring melt sampling program indicate a low potential for shortterm impacts to aquatic life or other uses in the downstream receiving environment, based on the concentration levels measured and the duration of input. However, cumulative nutrient (primarily phosphorus) loading from all anthropogenetic sources including agriculture, may have the potential to shift the lake's trophic status and acceptable water uses into the future.

To preserve lake water quality and protect the aquatic resources and lake water uses, the following are recommended:

4.1 Recommendations for Future Monitoring and Assessment

Water quality:

- Tyhee Lake water quality monitoring programs should include turbidity. Special attention should be given to any changes in chlorophyll *a* and phosphorous concentrations.
- Future monitoring of the streams should include sites upstream and downstream of land use on each stream for comparison purposes.

Lake Productivity

- To assess temporal changes in lake productivity, a time series of air photos or satellite images of Tyhee Lake could be used to determine if vegetation levels in the lake have changed over time.
- To identify point and non-point sources of phosphorus and their relative contributions to lake phosphorous levels, an update of the watershed phosphorous budget could be undertaken.

4.2 Best Management Practices

- A review and assessment of the Code of Practice for Agricultural Environmental Management (<u>https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/8_2019</u>) under the *Environmental Management Act* by landowners or a qualified professional retained by them, is recommended to minimize the potential for aquatic effects from agricultural land use activities.
- It is recommended that agricultural landowners identify and implement strategies to reduce known nutrient (primarily phosphorous) inputs and agricultural waste runoff to the lake from upstream agricultural lands. For example, phosphorus loss and TOC loading via surface runoff and erosion may be reduced by conservation tillage and crop residue management, buffer strips, riparian zones, terracing, contour tillage, cover crops, and impoundments (e.g., settling basins).

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APPENDIX A: FIELD SHEETS

Kup this record until end

Trevelberg

Tyhee Lake Stream Sampling Program Spring 2018

Week	1	2	3	4	5
Sample day	Sun	Mon	Tues	Wed	Thurs
To Lab	Mon	Tues	Wed	Thurs	Fri

EMS Site #: E3118	0	Sit	e Name:	Camp C	rook		
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Label Bottles with perm		clude the fol	lowing		·····		
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Project: Tyhee Stre							
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Collect Water Samples				water water			
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Collect your sample fro	m stagnant water	•	•				
Disturb bottom sedimer							
Hold the sample for mo	ore than the recon	nmended ho	Iding tim	e			
DO							
 Sample in the main 							
 To minimize potenti 	al for cross-conta	imination, st	and facir	ng upstream a	nd reach as far		
upstream as possib	le to collect the s	ample		A			
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Has it rained in the past		, ,	Yes		No		
Water		-		Sp Conducti			
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Site photos View upstream View Downstream							
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1	- ·						

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Samples collected	•						
General			Bacteria 🖌		□ QA/QC		
500mL	(preserve with H2SO			200mL	sample		
Field data:					·		
Stream level (normal, h	igh, low)						
Current weather conditi	ons - rainy, clear,	, cloudy					
Has it rained in the past	24 hours?		Yes		No		
Water			Sp Conducti		•		
Temperature (°C):	.5	рН: 🐔 о	(uS/cm):		312		
Site photos		View upst	ream	View Downs	stream		
Comments:							
	*						
		. 4					
WEEK 3				1 # 5 0 2 3 5	867		
DATE: yyyy/mm/dd 2019, 04 29		Ti	Time:24 hh/mm				

			1				
DATE: yyyy/mm/dd 2013 04 29 Ti			me:24 hh/mm				
Samples collected							
General	Amber glass120mL		B	Bacteria	□ QA/QC		
500mL	(preserve with I	12SO4)		200mL	sample		
Field data:							
Stream level (normal, h	igh, low)		h	lich			
Current weather conditi	ons – rainy, clear, cl	loudy		cea-			
Has it rained in the past 24 hours?			Yes		No 🖌		
Water			Sp Conductivity				
Temperature (°C):	2 p	н: 7.6	3	(uS/cm):	146.5		
Site photos View upst							
Comments:				-			
Clea	1						

WEEK 2	quisition # S023586				
DATE: yyyy/mm/dd 2	018/04/22	Tin	ne:24 hh	/mm 14.0	×2,
Samples collected	• •				
General	Amber g	lass120mL	Bacteria		□ QA/QC
500mL	(preserve wit	h H2SO4)		200mL	sample
Field data:					
Stream level (normal, h	igh, low)				
Current weather conditi	ons – rainy, clear	, cloudy			
Has it rained in the past	24 hours?		Yes		No
Water				Sp Conducti	vity
Temperature (°C):	Temperature (°C): 3.5 pH: 4		8	(uS/cm): 4	3.2
Site photos		View upst	ream	View Downs	stream
Comments:					
WEEK 3		- Po	anisition	1# 5023 59	
			ne:24 hh		361
DATE: yyyy/mm/dd 2 Samples collected	019 04 24	111	ne.24 mi	/	
General	Amber g	lass120mL		Bacteria	□ QA/QC
500mL	(preserve wit		200mL		sample
Field data:	(preserve wit	1112004)		2001111	Junpie
Stream level (normal, h	igh low)		1	inte	
	cloudy	1	high Cear		
Current weather conditions – rainy, clear, cloudy Has it rained in the past 24 hours?			Yes		No /
Water				Sp Conducti	
Temperature (°C): 6	2	pH: 7,6	3		
Site photos		View upst			
Comments:		· · · · · · · · · · · · · · · · · · ·		• · · · · · · · · · · · · · · · · · · ·	
<u> </u>					

Clear.

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Genelale

		2		3	4	5
Sample day	(Sun)	Mon		Tues	Wed	Thurs
To Lab	Mon	Tues		Wed	Thurs	Fri
<u></u>	50					
EMS Site #:			Site	Name:	Narse Bo	m Creeke
DO NOT RINS				(band's u	sant Creek)
Label Bottles w	vith permanent n	narker, include	e the follo	wing		,
	istry of Environi	<u>ment;</u>				
 Project: <u>Tyl</u> Sample Id: 		11				
	Is the <u>Site EMS</u> yyyy/mm/dd, 24					
Collect Water S		+1111/111111				
DO NOT	ampies					
	e of the bottle o	r the can with	vour fina	are or wit	hony other	uinmant
Collect your sar	nple from stagn	ant water	your ing		n any other ec	upment
Disturb bottom	sediment (as m	uch as feasibl	e)			
Hold the sample	e for more than	the recommer	nded hold	ing time		
DO						· · · · · · · · · · · · · · · · · · ·
	ne main current					
To minimize	potential for cre	oss-contamina	ation, star	nd facing	upstream and	reach as far
upstream as	s possible to col	lect the samp	le		• · · · · · · · · · · · · · · · · · · ·	
A visual assessr	nent of the mon	itoring site car	n provide	invaluab	le information	and make
interpretation of WEEK 1	other data easie	er and more m			2000	- not a
DATE: yyyy/m	m/dd 2018/1	54/15		usition #		
Samples col			111111	:24 hh/m	m 19:0	2
General	Icelicu P	A	00 T			
	1 7					□ QA/QC
500mL	1 7	serve with H2			Bacteria 200mL	□ QA/QC sample
500mL Field data:	(pre	serve with H2				
500mL Field data: Stream level (no	(pre	serve with H2	2804)	2 Hegl		
500mL Field data: Stream level (no Current weather	(pre prmal(high) low conditions – ra	serve with H2) iny, clear, clou	2SO4) udy	2 High Clear	200mL	sample
500mL Field data: Stream level (no Current weather Has it rained in	(pre prmal(high) low conditions – ra	serve with H2) iny, clear, clou	2SO4) udy	High Clear Tes	200mL	sample
500mL Field data: Stream level (no Current weather Has it rained in Water	ormal(high) low conditions – ra the past 24 hour	serve with H2) iny, clear, clou s?	2SO4) udy	High Clear Tes	200mL (N p Conductivity	sample
500mL Field data: Stream level (no Current weather Has it rained in Water Temperature (°C	ormal(high) low conditions – ra the past 24 hour	serve with H2) iny, clear, clou s? pH:	2SO4) udy 7,7)	High Olean Tes	p Conductivity	sample
500mL Field data: Stream level (no Current weather Has it rained in Water Temperature (°C Site photos	ormal(high) low conditions – ra the past 24 hour	serve with H2) iny, clear, clou s? pH:	2SO4) udy	High Olean Tes	200mL (N p Conductivity	sample
500mL Field data: Stream level (no Current weather Has it rained in Water Temperature (°C Site photos Comments:	(pre ormal(high) low conditions – ra the past 24 hour): 1,3	serve with H2) iny, clear, clou s? pH:	2SO4) udy 7,7)	High Olean Tes	200mL (N p Conductivity uS/cm):	sample
	(pre ormal(high) low conditions – ra the past 24 hour): 1,3	serve with H2) iny, clear, clou s? pH:	2SO4) udy 7,7)	High Olean Tes	200mL (N p Conductivity uS/cm):	sample
500mL Field data: Stream level (no Current weather Has it rained in Water Temperature (°C Site photos Comments:	(pre ormal(high) low conditions – ra the past 24 hour): 1,3	serve with H2) iny, clear, clou s? pH:	2SO4) udy 7,7)	High Olean Tes	200mL (N p Conductivity uS/cm):	sample
500mL Field data: Stream level (no Current weather Has it rained in Water Temperature (°C Site photos Comments:	(pre ormal(high) low conditions – ra the past 24 hour): 1,3	serve with H2) iny, clear, clou s? pH:	2SO4) udy 7,7)	High Olean Tes	200mL (N p Conductivity uS/cm):	sample

Gene Cole Horse Barn Creek

WEEK 2	•	R	quisition	1# 50523	5860		
DATE: yyyy/mm/dd 20	18/04/22		Time:24 hh/mm 13:45				
Samples collected					¥		
🗹 General	Amber g	lass120mL	Ø	Bacteria	□ QA/QC		
500mL	(preserve wit	h H2SO4)		200mL	sample		
Field data:							
Stream level (normal, h	igh, low)		14	igh			
Current weather condition		, cloudy	Clear/				
Has it rained in the past	24 hours?		Yes	(No)			
Water		~		Sp Conductivit	Y		
Temperature (°C):	4.4	pH: 8, 1	William-	(uS/cm):	118.7		
Site photos		View upst	ream	View Downstre	am		
Comments: Wader	clear but	green	ting	ч ч			
			ran sh				

×

WEEK 3	1 1	Re	quisition	n# 504	5235860
DATE: yyyy/mm/dd 2	018/04/29	Ti	me:24 hh	1	6.00
Samples collected	1 6				¥
🖻 General	Amber glass120r		mL 🗗 Bacteria		□ QA/QC
500mL	(preserve with H2SO4)			200mL	sample
Field data:					
Stream level (normal, h			high		
Current weather conditi	ons – rainy, clear	, cloudy		Clean-	
Has it rained in the past	24 hours?		Yes		No 🗸
Water				Sp Conduc	
Temperature (°C):	1.5	рН: Ъ	12		188.5
Site photos		View upst		View Dow	
Comments:					······································
Clea	r was				
,					
s hor	ses on sit	(



Tyhee Lake Stream S	Sampling Program Sp	oring 2018		Horse burn
WEEK 4				
DATE: yyyy/mm/dd	2018/05/05	Tir	ne:24 hh/r	nm 17132
General 500n	iL ZA	mber glass reserve wit	120mL &	
Field data:	<u> </u>			
Stream level (normal	, high, low)		Nor	mal-midlevel
Current weather conc		cloudy		ea.
Has it rained in the pa			Yes	NO
Water Temperature (°C)	10.6	pH: 7.8	4	Sp Conductivity (uS/cm): 119,4
Site photos		View	upstream	View Downstream
Comments: Char wear	these coorder	Alexan.	·	View Downstream I have in adjusant profit (E of barh)
2 horses in	pasture aff	àbing (læek.	I have in adjacent paste
Duplicates	clone	,		(

WEEK 5				
DATE: yyyy/mm/dd	Tin	ne:24 hh/mm	16:30	
F General 500mL	Amber glass preserve wit			ia 200mL
Field data:		L_		·····
Stream level (normal, high, low)	-1	Low)	
Current weather conditions - rain	y, clear, cloudy	Clear	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	
Has it rained in the past 24 hours?		Yes	No	5
Water Temperature (°C) 13.0 C	pH: 7.5	} Sp (uS	Conductivity /cm):	129,0
Site photos	Viewu	ipstream		wnstream
Comments: Two horses in page	store after	ding 3 dr		

Gen Cole

Week	1	2	3	4	5
Sample day	Sun	Mon	Tues	Wed	Thu
To Lab	Mon	Tues	Wed	Thurs	Fri
EMS Site #:	••••		Site Name:	Howard (1. he
DO NOT RINS	E BOTTLES			MONSTAC	<u>L'C. den J & </u>
		marker, include t	he following		
Client: Min	istry of Enviro	nment;			·
Project: <u>Tyl</u>	hee Streams;	/			
• Sample Id:	Is the Site EM	IS <u>#:</u>			
 Date/Time: 	yyyy/mm/dd.	24hh/mm			
Collect Water S					
DO NOT					
Touch the insid	le of the bottle	or the cap with yo	our fingers or wi	th any other equi	pment
Collect your sa	mple from stag	gnant water			
Disturb bottom	sediment (as	much as feasible)			
Hold the sampl	e lor more ma	in the recommende	ed noiding time		
DO			ea noiaing time		
DOSample in t	he main curre	nt of streams			
DOSample in tTo minimize	he main curre e potential for	nt of streams cross-contaminatio			each as far
DOSample in tTo minimize	he main curre e potential for				each as far
 DO Sample in t To minimize upstream a 	he main curre e potential for s possible to c	nt of streams cross-contaminatio collect the sample	on, stand facing	upstream and re	
 DO Sample in t To minimize upstream a A visual assess 	he main current potential for s possible to c ment of the mo	nt of streams cross-contaminatio collect the sample ponitoring site can p	on, stand facing	upstream and re	
 DO Sample in t To minimize upstream a A visual assess interpretation o 	he main current potential for s possible to c ment of the mo	nt of streams cross-contaminatio collect the sample	on, stand facing provide invaluab ningful	upstream and re	nd make
 DO Sample in t To minimize upstream a A visual assess interpretation o WEEK 1 	he main current potential for s possible to c ment of the mo f other data ea	nt of streams cross-contamination collect the sample ponitoring site can p sier and more mea	on, stand facing provide invaluab ningful Requisition #	upstream and reprint the probability of the probab	nd make
 DO Sample in t To minimize upstream a A visual assess interpretation o WEEK 1 DATE: yyyy/m 	he main current potential for s possible to comment of the mo f other data ea m/dd 201	nt of streams cross-contaminatio collect the sample ponitoring site can p	on, stand facing provide invaluab ningful	upstream and reprint the second seco	nd make
 DO Sample in t To minimize upstream a A visual assess interpretation o WEEK 1 DATE: yyyy/m Samples co	he main current potential for s possible to c ment of the mo f other data ea m/dd 201 llected	nt of streams cross-contamination collect the sample ponitoring site can p sier and more mea	on, stand facing provide invaluab ningful Requisition #	upstream and reprint the second seco	nd make
DO Sample in t To minimize upstream a A visual assess interpretation o WEEK 1 DATE: yyyy/m Samples co General	he main current potential for s possible to c ment of the mo f other data ea m/dd 201 llected	nt of streams cross-contamination collect the sample ponitoring site can p sier and more mea	on, stand facing provide invalual ningful Requisition # Time:24 hh/n	upstream and reprint the second seco	nd make 1955
 DO Sample in t To minimize upstream a A visual assess interpretation o WEEK 1 DATE: yyyy/m Samples co	he main curren potential for s possible to c ment of the mo f other data ea m/dd 201 llected	nt of streams cross-contamination collect the sample ponitoring site can particular the siter and more mean $\frac{\sqrt{04}}{\sqrt{5}}$	on, stand facing provide invaluat ningful Requisition # Time:24 hh/n OmL	upstream and reprint the pole of $30, 235, 200, 35, 200, 35, 200, 35, 200, 35, 200, 35, 200, 35, 200, 200, 200, 200, 200, 200, 200, 20$	nd make 255
 DO Sample in t To minimize upstream a A visual assess interpretation o WEEK 1 DATE: yyyy/m Samples co Samples co	he main current potential for a s possible to comment of the main f other data ea m/dd 201 llected	nt of streams cross-contamination collect the sample onitoring site can p sier and more mean $\frac{c}{c} 0^{cf} 15$ Amber glass120	on, stand facing provide invaluat ningful Requisition # Time:24 hh/n OmL	upstream and re ble information at 4 502359 nm 18:32 Bacteria	nd make 255 E QA/QC
 DO… Sample in t To minimize upstream a A visual assess interpretation o WEEK 1 DATE: yyyy/m Samples co. ⊠ General 500mL 	he main current potential for s possible to c ment of the mo f other data ea m/dd 201 llected	nt of streams cross-contamination collect the sample onitoring site can p sier and more mean with 15 Amber glass120 preserve with H2S0	on, stand facing provide invaluat ningful Requisition # Time:24 hh/n OmL OML	upstream and re ble information ar 50235 g nm 18:32 Bacteria 200mL	nd make 255 E QA/QC
DO ■ Sample in t ■ To minimize upstream a A visual assess interpretation o WEEK 1 DATE: yyyy/m Samples co © General 500mL Field data: Stream level (m Current weather	he main current potential for s possible to c ment of the mo f other data ea m/dd 201 llected (r ormal, high; lo	nt of streams cross-contamination collect the sample onitoring site can p sier and more mean $\frac{1}{\sqrt{ 0 ^2}}$ /15 Amber glass120 preserve with H2S0 pw) rainy, clear, cloud	on, stand facing provide invaluat ningful Requisition # Time:24 hh/n OmL OML	upstream and re ble information and 50235 g nm 18:32 Bacteria 200mL	nd make 255 E QA/QC
DO ■ Sample in t ■ To minimize upstream a A visual assess interpretation o WEEK 1 DATE: yyyy/m Samples co © General 500mL Field data: Stream level (m	he main current potential for s possible to c ment of the mo f other data ea m/dd 201 llected (r ormal, high; lo	nt of streams cross-contamination collect the sample onitoring site can p sier and more mean $\frac{1}{\sqrt{ 0 ^2}}$ /15 Amber glass120 preserve with H2S0 pw) rainy, clear, cloud	on, stand facing provide invaluat ningful Requisition # Time:24 hh/n OmL OML OML OML OML OML OML OML OML OML OM	y upstream and re ole information ar # 50235 g nm 18:32 Bacteria 200mL	nd make 255
DO ■ Sample in t ■ To minimize upstream a A visual assess interpretation o WEEK 1 DATE: yyyy/m Samples co © General 500mL Field data: Stream level (m Current weather	he main current potential for s possible to c ment of the mo f other data ea m/dd 201 llected (r ormal, high; lo	nt of streams cross-contamination collect the sample onitoring site can p sier and more mean $\frac{1}{\sqrt{ 0 ^2}}$ /15 Amber glass120 preserve with H2S0 pw) rainy, clear, cloud	on, stand facing provide invaluat ningful Requisition # Time:24 hh/n OmL OML OML OML OML OML OML OML OML Ves	y upstream and re ole information ar # 50235 g nm 18:32 Bacteria 200mL	nd make 255
DO Sample in t To minimize upstream a A visual assess interpretation o WEEK 1 DATE: yyyy/m Samples co General 500mL Field data: Stream level (n. Current weather Has it rained in Water	he main current potential for s possible to c ment of the mo f other data ea m/dd 201 llected cormal, high; lo r conditions – the past 24 ho	nt of streams cross-contamination collect the sample onitoring site can p sier and more mean $\frac{1}{8} 0 + 1 \le 1$ Amber glass120 preserve with H2S0 pow) rainy, clear, cloud purs?	on, stand facing provide invaluat ningful Requisition # Time:24 hh/n OmL D4) Y Y Yes	y upstream and re ole information ar 4 50235 g nm 18:32 Bacteria 200mL A (No Sp Conductivity	nd make
DO • Sample in t • To minimize upstream a A visual assess interpretation o WEEK 1 DATE: yyyy/m Samples co ⊠ General 500mL Field data: Stream level (m Current weather Has it rained in Water Temperature (%	he main current potential for s possible to c ment of the mo f other data ea m/dd 201 llected cormal, high; lo r conditions – the past 24 ho	nt of streams cross-contamination collect the sample onitoring site can p sier and more mean $\frac{\sqrt{ 0 ^2}}{15}$ Amber glass120 preserve with H2S0 pw) rainy, clear, cloud pH:	on, stand facing provide invalual ningful Requisition f Time:24 hh/n OmL OML OML OML OML V Yes Z, 4/1	upstream and re ole information ar 4 50235 9 nm 18:32 Bacteria 200mL A Sp Conductivity (uS/cm): 154	nd make 255 D QA/QC sample 5, 3
DO Sample in t To minimize upstream a A visual assess interpretation o WEEK 1 DATE: yyyy/m Samples co General 500mL Field data: Stream level (n. Current weathed Has it rained in Water	he main current potential for s possible to c ment of the mo f other data ea m/dd 201 llected cormal, high; lo r conditions – the past 24 ho	nt of streams cross-contamination collect the sample onitoring site can p sier and more mean $\frac{\sqrt{ 0 ^2}}{15}$ Amber glass120 preserve with H2S0 pw) rainy, clear, cloud pH:	on, stand facing provide invalual ningful Requisition f Time:24 hh/n OmL OML OML OML OML V Yes Z, 4/1	y upstream and re ole information ar 4 50235 g nm 18:32 Bacteria 200mL A (No Sp Conductivity	nd make 255 D QA/QC sample 5, 3

Gene Cole Howard Creek

				Gei	ne tole
Tyhee Lake Stream Sa	mpling Program S	Spring 2018		Howar	ne Cole rd Creek
WEEK 2		Re	quisition #	5023	<i>5855</i>
DATE: yyyy/mm/dd 2	017/04/22		ne:24 hh/m		38
Samples collected	1				<u> </u>
D General	Amber s	glass120mL	1	Bacteria	□ QA/QC
500mL	(preserve wi		1	200mL	sample
Field data:					Junipie
Stream level (normal, l			His	k.	
Current weather condit	ions - rainy, clear	, cloudy	Clea	~	
Has it rained in the pas	t 24 hours?	<u> </u>	Yes	1	No
Water	·	have	S	p Conductiv	
Temperature (°C):	(.7	pH: 7,8		uS/cm):	1ty 69.2
Site photos		View upstr	With the second s	iew Downs	fream
WEEK 3					
		Rec	misition #	502 0	r cif a
DATE: VVVV/mm/dd 🕰	018/04/29		uisition #	5023	585 7
DATE: yyyy/mm/dd 2 Samples collected	018/04/29		uisition # ne:24 hh/m	5023 m 161	585 9 15
Samples collected	77.	Tim	ne:24 hh/m	<u>m 161</u>	.15
Samples collected General 500mL	Amber g	Tin lass120mL	ne:24 hh/m	m 16: Bacteria	
Samples collected General	77.	Tin lass120mL	ne:24 hh/m	<u>m 161</u>	.15
Samples collected General 500mL Field data:	Amber g (preserve wit	Tin lass120mL	ne:24 hh/m	m 16. Bacteria 00mL	
Samples collected General 500mL Field data: Stream level (normal, h	Amber g (preserve win igh, low)	Tim lass120mL th H2SO4)	he:24 hh/m E 2 hve	m 16. Bacteria 00mL	
Samples collected General 500mL Field data: Stream level (normal, h Current weather conditi	Amber g (preserve win igh, low) ions – rainy, clear	Tim lass120mL th H2SO4)	he:24 hh/m 2 E 2 huk CI	m 16: Bacteria 00mL ch.	□ QA/QC sample
Samples collected General 500mL Field data: Stream level (normal, h	Amber g (preserve win igh, low) ions – rainy, clear	Tim lass120mL th H2SO4)	le:24 hh/m E E 2 huiz CL Yes	m 161 Bacteria 00mL h eowr	IS □ QA/QC sample No
Samples collected General 500mL Field data: Stream level (normal, h Current weather conditi Has it rained in the past Water	Amber g (preserve win igh, low) ions – rainy, clear 24 hours?	Tim lass120mL th H2SO4)	le:24 hh/m E E 2 hole Yes S	m 161 Bacteria 00mL	IS QA/QC sample No ity
Samples collected General 500mL Field data: Stream level (normal, h Current weather conditi Has it rained in the past	Amber g (preserve win igh, low) ions – rainy, clear 24 hours?	Tim lass120mL th H2SO4)	$\begin{array}{c c} e:24 \text{ hh/m} \\ \hline & e \\ 2 \\ \hline & 2 2 \\ \hline \hline & 2 \\ \hline \\ \hline \hline & 2 \\ \hline \hline & 2 \\ \hline \hline & 2 \\ \hline \hline \hline & 2 \\ \hline \hline &$	m 161 Bacteria 00mL	IS QA/QC sample

Murky water.

- 3 horse's on site

Gene Colo Howard Creek

WEEK 4			
DATE: yyyy/mm/dd 2018 05/06	/ Tin	ne:24 hh/	mm 18:40
pres	iber glass serve wit		Bacteria 200mL
Field data:			a
Stream level (normal, high, low)		NA	rmal
Current weather conditions - rainy, clear, c	oudy	Cl	epr
Has it rained in the past 24 hours?		Yes	(No)
Water //. 3 pH Temperature (°C)	H: 7.5	6	Sp Conductivity (uS/cm):
Site photos	Viewu	ipstream	
Comments: Clear water 3 Horses in Reld	' ₂	-	

WEEK 5			
DATE: yyyy/mm/dd 2018-05.	-13 Tin	ne:24 hh/mm	17:2-5
& General 500mL	Amber glass	s120mL &	E Bacteria 200mL
Field data:		1	······································
Stream level (normal, high, low)			
Current weather conditions - rainy,	, clear, cloudy		~
Has it rained in the past 24 hours?		Yes	Nà
Water Temperature (°C) 13.2	pH: 7.1	/t/ Sp	Conductivity 96.0
Site photos	View	upstream	View Downstream
Comments:		1M	
Water clear,	n		
Wafer Clear O horses in field)		
U NOTSES I			

5				8		ا	
٨	COLE	CIC ダ eam Sampling P		1.5.1		2ª	A A
S	Typee Lake Str	eam Samtling P	rouram Sw	0018	J	att a mile	Xank Jack
) X3 ``	a jinee Bune Bu	Con Contracting 1		Lan Louis	STREET	NO MOSTOF	>) JOHNON
^v	Week	1	2		3		5
	Sample day	Sun	Mon		Tues	Wed	Thurs
	To Lab	Mon	Tues		Wed	Thurs	Fri
	EMS Site #:	7		Sit	e Name:	COLE CIK	
	DO NOT RINS	E BOTTLES		I			
	Label Bottles w	ith permanent m	arker, inclu	ide the fo	lowing	······	
	Client: Mini	stry of Environn	<u>nent;</u>				
	 Project: <u>Tyl</u> 						
	 Sample Id: I 	s the <u>Site EMS</u>	<u>#;</u>				
		yyyy/mm/dd, 24	<u>hh/mm</u>	201	8/0	4/15 👾	
	Collect Water S	amples	····			· • • •	
	DO NOT						
	Collect your cor	e of the bottle of nple from stagna	the cap wi	th your fir	gers or v	with any other equ	lipment
		sediment (as mu		ihla)			
	Hold the sample	e for more than t	he recomm	ended ho	ldina tim	0	
	DO				ianig an	0	
	Sample in the second seco	ne main current	of streams				
				ination. st	and facir	ng upstream and r	each as far
	upstream as	possible to coll	ect the san	nple		g sponoulli unu i	
			5	/ ·	Tel ala		
	A visual assess	nent of the moni	toring site	can provid	le invalu	able information a	ind make
-	interpretation of	other data easie	r and more				
	WEEK 1	(11			quisition		50
-	DATE: yyyy/mi		04/15	Tir	ne:24 hh	mm 17:14	<u> </u>
ŀ	Samples col						
	General		Amber glas		Gr Gr	Bacteria	□ QA/QC
-	500mL	(pre	serve with	H2SO4)			sample
	Field data:					<u> </u>	
ŀ	Stream level (no Current weather			1 . 1		mal	
ŀ	Has it rained in			loudy	Sun		
ŀ	Water	the past 24 hours	<u>s:</u>		Yes	No	-
	Temperature (°C	9. 4.8		H: 6.1	0	Sp Conductivity	96.5
ŀ	Site photos		P	iew upsti		(uS/cm): View Downstrea	
ŀ	Comments:			new upsu	ean	view Downstrea	m
	4	ea cole	SUNC	alle	the states		c
	,						
	2						
	· ·						
Jer -						- 16/210	
1-10-10-10-10-10-10-10-10-10-10-10-10-10	odour		× c	sulu i	-HO.	1	ſ
1	,			. 5	JUNG	has prese	rvature
	Colour						
	clarity		* R	EP on	neolis	ate bottle	
	8					for manual dispersion	

WEEK 2			Requisition # 502 358 51				
DATE: yyyy/mm/dd	2018 104/22		Time:24 hh/mm 16:15				
Samples collected							
General	Amber g	lass120	mL	l l	Bacteria		A/QC
500mL	(preserve wit	h H2SC	04)		200mL	sa	mple
Field data:							
Stream level (normal,	high, low)			101	ف		
Current weather condi	tions – rainy, clear	, cloudy	1	ذا	eur		
Has it rained in the pa	st 24 hours?			Yes		No 🛩	
Water Temperature (°C):	5.3	pH:	7.(oZ.	Sp Conducti (uS/cm):	^{ivity} 54.7	7
Site photos		View	upsti	eam	View Down	stream	
Comments:							
clea	vring						

WEEK 3		R	equisition	1# 5023	5852
DATE: yyyy/mm/dd	2018/04/24	γ Ti	me:24 hh	/mm / 4. • 5	50
Samples collected					
B General	Amber g	lass120mL		Bacteria	🗆 QA/QC
500mL	(preserve wit	h H2SO4)		200mL	sample
Field data:					
Stream level (normal, h		<u>۲</u>	1	ł	
Current weather condit	ions – rainy, elear,	, cloudy	10.6	air	
Has it rained in the past	t 24 hours?	,	Yes	1	No
Water	0,00	- may	- Au	Sp Conductiv	ity 170
Temperature (°C):	8.7°C		14	(uS/cm):	113.9
Site photos		View ups	tream	View Downst	tream
Shallow a	over long	deco	l gvæ	ssnot	much flow

COLE CREEK . CULVERT (TOP)

COLE CR.

WEEK 4				Requisition #			
DATE: yyyy/mm/dd	2018		Time:24 hh/mm				
Samples collected							
General General	Amber g	lass1201	nL	G	Bacteria	□ QA/QC	
500mL	(preserve wit	h H2SO	4)		200mL	sample	
Field data:							
Stream level (normal, h	igh, low)		ā.	٦	ພ		
Current weather condition	ions – rainy, clear	, cloudy		C	ear		
Has it rained in the past	24 hours?			Yes		No 🗸	
Water				-	Sp Conducti		
Temperature (°C):	1.6	pH:	6.0	{	(uS/cm):	77.9	
Site photos		View ı	ipstre	eam	View Down	stream	
Comments: Very small	flow						
1 3	•						
h.							

WEEK 5				Requisition #			
DATE: yyyy/mm/dd			Time:24 hh/mm 15:33				
Samples collected					/		
🖻 General	Amber g	lass120n	nĽ	Ē	Bacteria	□ QA/QC	
500mL	(preserve wit	h H2SO	4)		200mL	sample	
Field data:							
Stream level (normal, h	igh, low)				ω		
Current weather condition	ons-rainy, clear	, cloudy		اے	ear, s	unny	
Has it rained in the past	24 hours?			Yes		No 5	
Water	~ ~				Sp Conduct	ivity	
Temperature (°C):	3.5	pH:	1.	00	(uS/cm):	86.7	
Site photos		View u	pstre	am	View Down	stream	
Comments: (100000 NO Water	of veru rin ditel) SW	\al	11 Pl	ow do	wn hell,	

x 2 1g

Field form Dunb.

-							unbars	
	Week	1	2		3	4	5]
	Sample day	Sun	Mon		Tues	Wed	Thurs]
Ĺ	To Lab	Mon	Tues		Wed	Thurs	Fri]
The care		461				tAST Q	F OCTAGO	N 8
EMS Site		171	Sit	e Name:	OCT	IGON F	ISHER R	20
	RINSE BOTT							
		anent marker, in	clude the fo	llowing				
	:: <u>Ministry of E</u> ct: <u>Tyhee</u> Streau			0.0	a 110	4.72841		
	ole ld: Is the <u>Site</u>			GP.				
	Time: <u>yyyy/mr</u>				~ W 12	17,03345		
	ater Samples	<u>add, 2-4110 mm</u>						
DO NOT								
		ottle or the cap	with your fir	naers or v	with any other	equipment		
Collect y	our sample from	n stagnant wate	r	.g	,	-4		
		(as much as fe						
	sample for mor	e than the recor	nmended ho	olding tim	e			
DO								
		current of stream						
• Iomi	nimize potentia	tor cross-conta to collect the s	amination, st	and facil	ng upstream a	and reach as far		
upsure	sam as possible	e to collect the s	ample					
A visual :	assessment of th	ne monitoring si	te can provid	de invalu	able informat	ion and make		
interpreta	tion of other da	ta easier and mo	ore meaning	ful	aoie informat	ion and make		
WEEK 1		1		quisition	ı#			
DATE: y	yyy/mm/dd Zo/	18/04/15		ne:24 hh		2 16:13		
Samp	les collected	7.9				/		
g G	eneral	Amber g	lass120mL	B	Bacteria	QA/Q	C	
	0mL	(preserve with	th H2SO4)		200mL	sampl		
Field dat						· · · · · · · · · ·		
	vel (normal, hig							
		ns – rainy, clear	, cloudy					
181 al 1910 a sub a barra de la composition de	ned in the past 2	24 hours?		Yes		No		
Water		01-	1.0	26	Sp Conducti	ivity		
Temperat		0.6	pri.	<u> </u>	(uS/cm):	ivity 127,0		
Site photo		~~~~	View upst	ream	View Down	stream		
Comment								
(Odour, c	olour, clarity)							

WEEK 2			Requisition #				
DATE: yyyy/mm/dd 🤉	018/04/22	Ti	Time:24 hh/mm 18:00				
Samples collected							
General	General 🛛 Amber glass120m			nL 🖸 Bacteria 🛛 🗘			
500mL	(preserve wit	h H2SO4)		200mL	sample		
Field data:					1		
Stream level (normal(h		and the second sec		1.4.944.1899			
Current weather condition	ions – rainy, clear.	, cloudy					
Has it rained in the past	24 hours?	1-MUR. 9-1-1-1-1	Yes				
Water 7	i.		Ð	Sp Conducti			
Temperature (°C): 3	4	pH: 7.	8	(uS/cm):	109		
Site photos		View ups	tream	View Downs	stream		
Comments:							
(Odour, colour, clarity)							
	i. Trop						
	Contraction of the second seco						

WEEK 3			equisition		
DATE: yyyy/mm/dd 2	2018 04 2	<i>⁰</i> T	me:24 hh	1mm 16:2	5
Samples collected				£.	
General		lass120mL		Bacteria	□ QA/QC
500mL	(preserve wit	<u>h H2SO4)</u>		200mL	sample
Field data:		prmal	-to le	<u>Lx</u>	
Stream level (normal)h					
Current weather condition		Cloudy			<u> </u>
Has it rained in the past	t 24 hours?	n	Yes	V	No)
Water	1		2	Sp Conductiv	
Temperature (°C):	3.4	pH: 1	,3	(uS/cm):	
Site photos		View ups	tream	View Downs	tream
Comments:					
(Odour, colour, clarity)					
1	dear				
	dear Anny	or WC	am	6	

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East of Octogen an Tishe

WEEK 4	()	R	equisitio	n #	
DATE: yyyy/mm/dd	2018/05/06	Ti	me:24 hl	1/mm 14.2	0
Samples collected				,	
General	Amber g	lass120mL	0	Bacteria	□ QA/QC
500mL	(preserve wit	h H2SO4)		200mL	sample
Field data:					
Stream level (normal, h	igh, low)				
Current weather condit	ions – rainy, clear	, cloudy	Elea	r Sumy 7	Dy 15°C
Has it rained in the pas	t 24 hours?		Yes) (NØ
Water (2-9	10		Sp Conductiv	ity 131 5
Temperature (°C):	<i>5-V</i>	_{pH:} 7.9		(uS/cm):	171.5
Site photos		View ups	tream	View Downst	ream
Comments:					
(Odour, colour, clarity)	<u> </u>		ጉ		
	\mathbf{C}	150			
Blue bird Day	Juna	· ~~~			
July and the second second	•				

WEEK 5		Req	uisition	#	
DATE: yyyy/mm/dd 🤉	018/05/13	Time	e:24 hh/	mm 8:0	0
Samples collected	/				
General	🛛 🗹 🛛 Amber g	lass120mL	9	Bacteria	□ QA/QC
500mL	(preserve wit	th H2SO4)		200mL	sample
Field data:				~	
Stream level (normal, h	igh, low)		Norm		
Current weather conditi	ons - rainy, clear) cloudy	higho	verant 23	S°C
Has it rained in the past	24 hours?	-	Yes		No)
Water				Sp Conductiv	ity
Temperature (°C):		pH: 7.4		(uS/cm):	151.4
Site photos		View upstre	am	View Downst	ream
Comments:			i	. 1 .	1
(Odour, colour, clarity)	Clearing	up in	colon	- V Clari	ty
	J	ł			0

Field form

I ynee Lake Su	eam Sampling Pi	ogram Spi	ring 2018			Dunbars
Week	1	2		3	4	5
Sample day	Sun	Mon		Tues	Wed	Thurs
To Lab	Mon	Tues		Wed	Thurs	Fri
EMS Site #: DO NOT RINS Label Bottles w • Client: Mini • Project: Tyl • Sample Id: • Date/Time: Collect Water S DO NOT Touch the insid Collect your sat Disturb bottom Hold the sample DO	<u>E 3/1 887</u> E BOTTLES ith permanent m stry of Environm tee Streams; ls the <u>Site EMS</u> i yyyy/mm/dd, 24	arker, inclu arker, inclu ent; <u><u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u></u></u>	ith your fir	e Name: lowing gers or v	UR & & & & & & & & & & & & & & & & & & &	MIDBLR FS
Upstream as A visual assessinterpretation of WEEK 1	e potential for cro s possible to coll nent of the moni f other data easie	ect the sar toring site r and more	nple can provie meaning Re	le invalu ful quisition	able informatic	
	m/dd 2013/04	15	Tir	ne:24 hh	/mm 16:3	5
Samples col						
🗹 General		Amber gla			Bacteria	□ QA/QC
500mL	(pre:	serve with	H2SO4)		200mL	sample
Field data:				1		
	ormal, high, low)		1			
	r conditions – rai		cloudy	V		ÁT.)
Water	the past 24 hours			Yes		No
Temperature (°	c): 0, .	3°0	ы: 7	29	Sp Conductiv (uS/cm):	137.1
Site photos			View upst	ream	View Downst	
Comments:						

ODOUR

COLOUR

CLARITY

WEEK 2			Req	uisition	#	
DATE: yyyy/mm/dd 7	018/04/22	-	Time	:24 hh/	mm 🔏: 12_	
Samples collected	, ,				•••	
☐ General	Amber g	lass120	mL		Bacteria	□ QA/QC
500mL	(preserve wit	h H2SC)4).		200mL	sample
Field data:						
Stream level (normal	igh, low)	e				
Current weather condit	ions – rainy clear	, cloudy				
Has it rained in the past	t 24 hours?	\sim	,	Yes	(No)
Water					Sp Conductiv	ity
Temperature (°C):	2.5	pH:	7.0		(uS/cm):	104
Site photos		View	upstre	am	View Downst	ream
Comments:	ł	A .	1.	,	6 C	
Jun	's day.	AV -	fl un	$\rho = 1$	or C	
Lots of mn - a	H. Wat		olo	is u	bit br	wn.
-	Ŋ	-				· •

WEEK 3			Req	uisition	ı#	
DATE: yyyy/mm/dd	2018042	29.	Tim	e:24 hh/	/mm	16:15
Samples collected	3,					
☐ General	Amber g	lass120	mL	D	Bacteria	□ QA/QC
500mL	(preserve wit				200mL	sample
Field data:	わ					
Stream level (normal, h	igh,\low)					
Current weather condition	ions – rainy,(clear	cloudy	7			A
Has it rained in the past	24 hours?			Yes		(No)
Water					Sp Conducti	vity
Temperature (°C):	5.a	pH:	7.2	-	(uS/cm):	77.6.
Site photos		View	upstre	am	View Down	
Comments:						
Sum	ng + white	m t v	fal	Row		

4.

*,*27

WEEK 4					
DATE; yyyy/mm/dd Zofg 05 06	Tir	ne:24 hh/	mm	114.40	
General 500mL	Amber glass preserve wit			Bacteria 20	0mL
Field data:			- 0		
Stream level (normal, high, low)			High		
Current weather conditions - rainy, clear,	, cloudy		Clea	Sanny	+15°C
Has it rained in the past 24 hours?		Yes		No /	
Water	pH: 🥎	<u> </u>	Sp Con	ductivity 00	L
Temperature (°C)	-	55	(uS/cm)	<u>):</u> 00.	1
Site photos	View	upstream		View Downs	tream
Comments:					

(Hidber Rd)

WEEK 5					
DATE: yyyy/mm/dd 2010/05,	/13	Tin	ne:24 hh/1	mm 18	:33
☑ General 500mL		iber glass			Bacteria 200mL
	pres	serve wit	h H2SO4		
Field data:					
Stream level (normal, high, low))				
Current weather conditions - rai	ny, clear, cle	oudy	high or	<i>ie</i> -cast	- 23°C
Has it rained in the past 24 hour	s?		Yĕs		No
Water	pl و م	H: 76	4	Sp Con	ductivity
Temperature (°C) $/ 0 / 1$	6	1, 6	Y	(uS/cm)): 107
Site photos		View	upstream		View Downstream
Comments:					

Tyhee Lake Stream Sam	pling Program Sj			Field form	Dunbars
Week	1	2	3	4	5
Sample day	Sun	Mon	Tues	Wed	Thurs
To Lab	Mon	Tues	Wed	Thurs	Fri
EMS Site #: E31 DO NOT RINSE BOTT Label Bottles with perm		Site Na		G Parid C. G Parid C. UAKE ROAD	P
Client: <u>Ministry of E</u> Project: <u>Tyhee Strea</u> Sample Id: Is the <u>Sit</u> Date/Time: <u>yyyy/mn</u> Collect Water Samples	nvironment; <u>ms;</u> e EMS #;		154,722 1127,0296	20	
 DO NOT Touch the inside of the I Collect your sample fror Disturb bottom sedimen Hold the sample for mor DO Sample in the main To minimize potentia upstream as possible 	n stagnant water t (as much as fea e than the recom current of streams Il for cross-contar	sible) mended holding s nination, stand	g time		
A visual assessment of t interpretation of other da		e meaningful		on and make	
WEEK 1	11	Requis			
DATE: yyyy/mm/dd 2	213/09/15	Time:2	4 hh/mm /5 : :	21	
Samples collected General 500mL	Amber gl (preserve with	ass120mL 1 H2SO4)	Bacteria 200mL	QA/QC sample	
Field data:					
Stream level (normal, hi	Contraction and Contraction of Contr				
Current weather condition			oken Clavi		
Has it rained in the past	24 hours?	Ye	s	/No/	
remperature (C).	1.3 C	pH: 7,54	Sp Conducti (uS/cm):	vity 199,0	
Site photos		View upstream			
Comments: (Odour, colour, clarity)	Som't S	-	BEING		
REALIC	ATE TAKY		Hardbard 115 SITE		

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WEEK 2		Re	quisitior	n #	
DATE: yyyy/mm/dd Ə	018/04/22	Tin	ne:24 hh	/mm 18:33	
Samples collected	u ^{ri}				
General	Amber g	lass120mL		Bacteria	□ QA/QC
500mL	(preserve wit			200mL	sample
Field data:					
Stream level (normal, k		(Charment,			
Current weather condition		, cloudy			
Has it rained in the past	24 hours?		Yes		No)
Water	j.	2	0	Sp Conductiv	ity
Temperature (°C): /O	<u> </u>	рн: 8,	3	(uS/cm):	172
Site photos		View upstr	eam	View Downst	ream
Comments: (Odour, colour, clarity) Mah aň Creek wa	crepk, 1	aug 1	han	1 prein-a	AD
(Odour, colour, clarity)	Creed 1	U war I	100010	i waa a	0
man	ly Sunni	1			
1	1 temps 1	10%			
ar	, , , , , , , , , , , , , , , , , , , ,		<i>,</i>	<i>i</i> - Λ	- Horas 1
Creek Wa	ter warmer	than oth	hers - h	lanned up 1	n setting pond,
WEEK 3	,	Re	quisitior	1 #-	
DATE: yyyy/mm/dd	2018 04/2	9 Tin	ne:24 hh	/mm 160	0
Samples collected				1	
☑ General		lass120mL	Q.	Bacteria	🗆 QA/QC
500mL	(preserve wit	h H2SO4)		200mL	sample
Field data:					
Stream level (normal) h					
Current weather conditi		, cloudy	Suni		
Has it rained in the past	24 hours?		Yes		No
Water	0-	0		Sp Conductiv	
Temperature (°C):	13.5	рн: 8		(uS/cm):	
Site photos		View upstr	eam	View Downst	ream
Comments:				~	
(Odour, colour, clarity)					
Sunny é,	Warm.				

Davig form settling pord

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WEEK 4		R	equisitior	n #		
DATE: yyyy/mm/dd 2	018/05/06	T	ime:24 hh	/mm /3	5:00	
Samples collected				/	······································	
General	🗹 Amber g	lass120mI	. 6	Bacteria	0	QA/QC
500mL	(preserve wit	h H2SO4)		200mL		sample
Field data:					~	
Stream level (normal, h			ja	W - Norn	nel	·····
Current weather conditi	ons – rainy, clear	, cloudy	c	ear San	+15	°C
Has it rained in the past	24 hours?		Yes		No	
Water			,	Sp Conduc	tivity	
Temperature (°C):	1S.Z	pH: 👻	15	(uS/cm):	115.5	
Site photos		View ups	tream	View Dow	nstream	
Comments:						
(Odour, colour, clarity)						

WEEK 5		Rec	uisition	ı #	
DATE: yyyy/mm/dd 2	018/05/13	Tim	e:24 hh	/mm /8'46	
Samples collected	/				
🗹 General	Amber g	lass120mL	B	Bacteria	□ QA/QC
500mL	(preserve wit	h H2SO4)		200mL	sample
Field data:					
Stream level (normal, hi	igh, low) med	Turn to los	J		
Current weather condition	ons – rainy, clear	, cloudy	nigh o	vercust 23°C	,
Has it rained in the past	24 hours?		Yes		No)
Water Temperature (°C): /	5.4 °C	рн: 8.2	2	Sp Conductiv (uS/cm):	ity 307.0
Site photos		View upstro	eam	View Downst	ream
Comments: (Odour, colour, clarity)	Fish in	creek	energy (a	

Veek	1	2	3	4	5
ample day	(Sun)	Mon Sun	TuesSue	Wed_Sy	_
`o Lab	Mon	Tues	Wed	Thurs	Fri
888.8					
MS Site #: E	2311744	S	ite Name: V	ctor C.	m
	SE BOTTLES'	-	·····	<u>, , , , , , , , , , , , , , , , , , , </u>	,,,,
abel Bottles v	with permanent m	arker, include the f	ollowing		
	istry of Environn	nent;			
Project: <u>Ty</u>	hee Streams;				
	Is the Site EMS				
	yyyy/mm/dd, 24	<u>hh/mm</u>			
ollect Water S	Samples				
0 NOT					
		the cap with your f	ingers or with	any other equip	ment
	mple from stagna sediment (as mu				
isturo pottorri	seument as mu	icii as leasible)			
old the samp		he recommended h	holding time		
		he recommended h	nolding time		
D	e for more than t		nolding time	10 VAA E	
O Sample in t	e for more than t he main current o	of streams		ostream and rea	ach as far
O Sample in t To minimize	e for more than t he main current o e potential for cro	of streams oss-contamination,		ostream and rea	ach as far
00 Sample in t To minimize	e for more than t he main current o	of streams oss-contamination,		ostream and rea	ach as far
O… Sample in t To minimize upstream a	e for more than t he main current o e potential for cro s possible to coll	of streams oss-contamination,	stand facing up		
00 Sample in t To minimize upstream a	te for more than t he main current of potential for cro s possible to collo ment of the moni	of streams oss-contamination, ect the sample	stand facing up		
O… Sample in t To minimize upstream a visual assess terpretation o	te for more than t he main current of potential for cro s possible to collo ment of the moni	of streams oss-contamination, ect the sample toring site can prov r and more meanin	stand facing up		
O Sample in t To minimize upstream a visual assess nterpretation o VEEK 1	the main current of the main current of the potential for cro s possible to collo ment of the moni f other data easie	of streams oss-contamination, ect the sample toring site can prov or and more meanin	stand facing up ride invaluable gful	information an	
OO… Sample in t To minimize upstream a	the main current of e potential for cross possible to colle ment of the moni f other data easier	of streams oss-contamination, ect the sample toring site can prov r and more meanin R	stand facing up ride invaluable gful Requisition #	information an	
O Sample in t To minimize upstream a visual assess terpretation o / EEK 1 ATE: yyyy/m	the main current of e potential for cro s possible to colle ment of the moni f other data easie m/dd 2018	of streams oss-contamination, ect the sample toring site can prov r and more meanin R	stand facing up ride invaluable gful Requisition # Time:24 hh/mm	information an 50235 78735	
) Sample in t To minimize upstream a visual assess erpretation o EEK 1 ATE: yyyy/m Samples co	the main current of e potential for cross possible to colle ment of the moni f other data easier m/dd 2.018 llected	of streams oss-contamination, ect the sample toring site can prover and more meanin R	stand facing up ride invaluable gful Requisition # Time:24 hh/mm	information an 50235 78735	d make 8-3/
O Sample in t To minimize upstream a visual assess terpretation o VEEK 1 ATE: yyyy/m Samples co General 500mL ield data:	the main current of e potential for cross possible to colle ment of the moni f other data easien m/dd 2018 Ilected	of streams oss-contamination, ect the sample toring site can prov r and more meanin R //04/15 T Amber glass120mI serve with H2SO4)	stand facing up ride invaluable gful Requisition # Time:24 hh/mm	information an 50235 78735 cteria	d make 8-3/ D_QA/QC
O Sample in t To minimize upstream a visual assess terpretation o /EEK 1 ATE: yyyy/m Samples co SomL ield data: tream level (fn	the main current of e potential for cross possible to colle ment of the moni f other data easie m/dd 2018 llected (pression)	of streams oss-contamination, ect the sample toring site can prover and more meanin R //04/15 T Amber glass120mI serve with H2SO4)	stand facing up vide invaluable gful Requisition # ime:24 hh/mm	information an 50235 78735 cteria	d make 8-3/ D_QA/QC
O Sample in t To minimize upstream a visual assess terpretation o /EEK 1 ATE: yyyy/m Samples co SolomL General 500mL teld data: ream level (fn urrent weathe	the main current of e potential for cross possible to collect ment of the moning f other data easier m/dd 2.018 llected ormal, high, low) r conditions - (rai	of streams oss-contamination, ect the sample toring site can prover and more meanin <i>R</i> <i>104/15</i> T Amber glass120mI serve with H2SO4)	stand facing up vide invaluable gful Requisition # ime:24 hh/mm	information an 50235 78735 cteria 0mL 5 i cc in i	d make 8-3/ D_QA/QC
O Sample in t To minimize upstream a visual assess terpretation o /EEK 1 ATE: yyyy/m Samples co SolomL General 500mL teld data: ream level (fn urrent weathe	the main current of e potential for cross possible to colle ment of the moni f other data easie m/dd 2018 llected (pression)	of streams oss-contamination, ect the sample toring site can prover and more meanin <i>R</i> <i>104/15</i> T Amber glass120mI serve with H2SO4)	stand facing up vide invaluable gful Requisition # ime:24 hh/mm Ba 200 still ba very lig	information an 50235 78735 cteria 0mL 5 i cc in i	d make 7 3/
O Sample in t To minimize upstream a visual assess terpretation o /EEK 1 ATE: yyyy/m Samples co ⊠ General 500mL ield data: tream level (in urrent weathe as it rained in /ater	the main current of e potential for cross s possible to colle ment of the moni f other data easier m/dd 2.0) & llected Ilected ormal, high, low) r conditions - (rai the past 24 hours	of streams oss-contamination, ect the sample toring site can prover and more meanin <i>R</i> <i>104/15</i> T Amber glass120mI serve with H2SO4) nyl clear, cloudy s?	stand facing up ride invaluable gful Requisition # Time:24 hh/mm Ba 200 Shill ha vecy lig Yes) Sor	information an 50235 78735 cteria OmL s ice in i ht	d make R 3/ QA/QC sample
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500mL	(preserve wit	h H2SO4)		200mL	sample	
Field data:						
Stream level (normal), h]
Current weather conditi	ons - rainy clear,	, cloudy	ontai	de temp 2	30	1
Has it rained in the past	24 hours?		Yes	(No	one with
Water	. 90	-76	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	Sp Conductiv	ity	one w/o.
Temperature (°C): 7	0.0	pH: /,	>7	(uS/cm):	Hod. P	sink tope
Site photos		View upstr	eam	View Downs	tream	nlo
Comments: TWD J9.43 May B	7.9°C	6.8.	Ś.		84. 9 WP	10
WEEK 5] T
			uisition			
DATE: yyyy/mm/dd	<u>1018/05/13</u>	1 im	ie:24 nn	/mm /4 42		
Samples collected	,	100 T	T	(D		
General		lass120mL	P	Bacteria	□ QA/QC	
500mL	(preserve wit	n H2804)		200mL	sample	
Field data:						1

WEEKS	I	Kee	quisitior	1#	
DATE: yyyy/mm/dd 🔮	2018/195/13	Tin	ne:24 hh	/mm /4, 427	
Samples collected	/- /.				
🛛 General	Amber g	lass120mL	ß	Bacteria	🗆 QA/QC
500mL	(preserve wit	h H2SO4)		200mL	sample
Field data:	\sim				
Stream level (normal, h	igh, low)				
Current weather condition	ions – rainy clear	, cloudy			
Has it rained in the past	24 hours?		Yes	(No
Water	- PA			Sp Conducti	vity
Temperature (°C):	$\mathcal{O}(z)$	pH: /	58	(uS/cm):	10107
Site photos		View upstr	eam	View Downs	stream
Comments:					
			-		
				v.	

HISLOP HILL CK

Typee Lake Stream Sampling Program Spring 2018 Week 2 3 4 5 1 Sample day Wed Mon Thurs Sun Tues To Lab Mon Tues Thurs Wed Fri EMS Site #: Site Name: DO NOT RINSE BOTTLES Label Bottles with permanent marker, include the following Client: Ministry of Environment; ٠ Project: Tyhee Streams; • Sample Id: Is the Site EMS #; . Date/Time: yyyy/mm/dd, 24hh/mm **Collect Water Samples** DO NOT... Touch the inside of the bottle or the cap with your fingers or with any other equipment Collect your sample from stagnant water Disturb bottom sediment (as much as feasible) Hold the sample for more than the recommended holding time DO... Sample in the main current of streams • . To minimize potential for cross-contamination, stand facing upstream and reach as far upstream as possible to collect the sample A visual assessment of the monitoring site can provide invaluable information and make interpretation of other data easier and more meaningful WEEK 1 **Requisition #** 50235826 DATE: yyyy/mm/dd Time:24 hh/mm 2018 104/15 17:40 Samples collected □ General Amber glass120mL **D**-Bacteria □ QA/QC 500mL (preserve with H2SO4) 200mL sample Field data: Stream level (normal, high, low) Normal Current weather conditions - rainy, clear, cloudy cl-eav Has it rained in the past 24 hours? Yes No Water 192.8 1 uls Sp Conductivity 7.90 $\widehat{}$ pH: Temperature (°C): LERR (uS/cm): Site photos View upstream View Downstream Comments: clear, us adour, light brown

ODOUR

COLOUR

CLARITY

WEEK 2			Requisitio	n# 302 3	5827
DATE: yyyy/mm/dd	2018/04/2	Z (Гime:24 h	h/mm d	6:25
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500mL	(preserve wit	h H2SO4)	200mL	sample
Field data:					
Stream level (normal, h	igh, low)		hi	gh	
Current weather condit	ions – rainy, clear	, cloudy	CL	ean	
Has it rained in the past	t 24 hours?		Yes		No
Water ,	10	0	2-1	Sp Conduc	
Temperature (°C):	1.0	pH: S	\$1	(uS/cm):-	171.2
Site photos		View up	ostream	View Dow	nstream
Comments:					

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		3104,129,	Requisition # 50235 828				
	DATE: yyyy/mm/dd	018/04/29	Ti	ime:24 hh/	/mm 14,"	3.5	
	Samples collected				, .		
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	500mL	(preserve wit	h H2SO4)		200mL	sample	
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	Stream level (normal, h						
	Current weather conditi		dloudy	10	Cair		
	Has it rained in the past	24 hours?		Yes	(No	
	Water Temperature (°C): 6	.9°C	pH: 7	:93	Sp Conductivi (uS/cm):	ty 282.3	
	Site photos		View ups	tream	View Downst	ream	
	Comments:						
. · · ·	HUSCOP HI	LRD CU	WERT	(BOT.)			

HISLOP CK

WEEK 4			Req	uisition	#				
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□ General	□ Amber g	lass1201	mL	0	Bacte	ria		Q	A/QC
500mL	(preserve wit	h H2SO	94)		200m	L		sa	mple
Field data:									
Stream level (normal, hi	igh, low)								
Current weather conditi	ons – rainy, clear,	, cloudy							
Has it rained in the past	24 hours?			Yes			No		
Water	1.1			176	Sp Co	nducti	vity	7	A14 5
Temperature (°C):	26 11.6	pH: É	ZΫ	1,10	(uS/cr	n):		AD	214.5
Site photos		View 1	upstre	am	View	Down	strea	m	
Comments: wækv	clear, m	roct. (flo	س					

WEEK 5		R	equisitior	n #	
DATE: yyyy/mm/dd		T	ime:24 hh	/mm f	5:45
Samples collected	/	×		.'	
General	Amber g	lass120mI	. 0	Bacteria	QA/QC
500mL	(preserve wit	h H2SO4)		200mL	(3) sample ^s
Field data:					
Stream level (normal, h	igh, low)		n	red.	
Current weather conditi	ons – rainy, clear	, cloudy	C	ear	
Has it rained in the past	24 hours?		Yes		No
Water		. 7	1.1	Sp Conduct	ivity and 7
Temperature (°C):	13.2	_{рН:} 7.	66	(uS/cm):	1Vity 5 246.7
Site photos		View ups	stream	View Dowr	stream
Comments:	•	,			
modero	te flow,	decre	asing	1. cls	ear
	. 7		•	, .	
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APPENDIX B: STREAM PHOTOS

Pictures were taken and supplied by local volunteer and Tyhee Lake residents, Gene Cole and Mike Dunbar.



Figure B-1. Camp Creek looking south and downstream (above) and looking north and upstream (below).



Figure B-2. West Creek through Tyhee David Property looking south (above) and looking north (below).



Figure B-3. East Creek through Tyhee David Property looking south (above) and looking north (below).



Figure B-4. Cole Creek looking southwest (above) and looking north (below).



Figure B-5. Creek crossing Fisher Road near the octagon house looking southwest (above) and looking northeast (below).



Figure B-6.The creek east of Hidber Road (aka Hidbert Road) and looking upstream east of the creek. Taken by Jim Dunbar



Figure B-7. Outflow from the Dairy Farm settling pond, looking northeast (above) and the Dairy Farm settling pond looking west (below).



Figure B-8. Victor Creek near Penner Road.



Figure B-9. Creek near Hislop Road looking southwest (above) and the ditch that feeds the creek, looking north (below)

APPENDIX C: WATER QUALITY DATA

Table C-1. List of Tyhee lake stream sites in historic data assessment, 1995 and 2001. The site data can be found in EMS.

Site Name	EMS ID
FISHER RD JUNCTION CREEK - NE SIDE TYHEE LAKE ¹	E219765
FOX RD CREEK - TYHEE LAKE, NW	E219761
HISLOP RD CREEK - TYHEE LAKE, SE ¹	E219771
HOEK`S CREEK - TYHEE LAKE, N	E219766
HORSE FARM CREEK - N TYHEE LAKE ^{1, 2}	E219763
HOWARD`S CREEK - TYHEE LAKE, N	E219764
KOOPMAN`S NORTH CREEK - TYHEE LAKE, N	E219768
KOOPMAN`S SOUTH CREEK - TYHEE LAKE, N	E219769
TYHEE CREEK - OUTLET TO TYHEE LAKE	E243521
VICTOR CREEK - TYHEE LAKE, E ¹	E219770
YAKISDA BIK`A CAMP CREEK - TYHEE LAKE, N ¹	E219762

¹Creeks sampled in 2018

² Horse Farm Creek (1995-2001) and West Creek (2018) are the same creek.

Parameter	Date	Camp Cr	West Cr	East Cr	Cole Cr	Fisher Rd	Hidber Rd	Dairy Farm Settling Pond	Victor Cr	Hislop Rd
Conductivity –	04-15-18	226.9	130	155.3	96.5	127	137.1	199	106.7	192.2
Field	04-22-18	83.2	118.7	63.2	54.7	109	104	172	86.4	171.2
(uS/cm)	04-29-18	146.5	188.5	102.2	113.9	122.3	77.6	210	123.7	282.3
	05-06-18	113.8	119.4	81.1	77.9	137.5	88.4	275.5	142.7	214.5
	05-13-18	134.9	129	96	86.7	151.4	107	307	101.7	246.7
pH – Field	04-15-18	7.67	7.71	7.41	6.6	7.56	7.28	7.54	7.88	7.9
(pH	04-22-18	8.08	8.12	7.87	7.62	7.8	7.8	8.3	7.94	8.37
	04-29-18	7.63	7.72	7.47	7.04	7.3	7.4	8.15	7.58	7.93
	05-06-18	7.41	7.84	7.56	6.9	7.9	7.55	8.15	7.59	7.76
	05-13-18	7.22	7.53	7.44	7	7.47	7.64	8.22	7.38	7.66
Temperature –	04-15-18	0.5	1.3	0.3	4.8	0.6	0.3	1.8	0.3	1.1
Field	04-22-18	2.5	4.4	4.7	5.3	3.4	2.5	10.1	0.9	4
(°C)	04-29-18	6.2	6.5	8.3	8.7	5.4	5.2	13.5	3.1	6.9
	05-06-18	9.4	10.6	11.3	11.6	6.8	8.5	15.2	7	11.6
	05-13-18	11.4	13	13.2	13.5	8	10.7	15.4	9	13.2
Conductivity	04-15-18	222	232	311	360	234	262	365/353	196	111
(uS/cm)	04-22-18	157	216	115	97.7	201	195	288	163	308
	04-29-18	152	193	102	119	228	144	361	129/129	290
	05-06-18	196	201/214	140	129	243	152	432	146	349
	05-13-18	221	207	154	138	255	176	481	172	410/407

Table C-2. Raw data of results from water samples collected from nine ephemeral streams and overland runoff locations surrounding Tyhee Lake, B.C., for the 2018 Spring Melt Bacteriological Sampling Program. Where two results for a site on a single date the data represents regular/replicate samples.

Parameter	Date	Camp Cr	West Cr	East Cr	Cole Cr	Fisher Rd	Hidber Rd	Dairy Farm Settling Pond	Victor Cr	Hislop Rd
рН (<i>рН</i>)	04-15-18	8.14	8.16	7.88	8.13	8.00	7.94	8.40/8.41	8.20	7.80
	04-22-18	7.79	8.03	7.47	7.44	7.75	7.76	8.31	7.79	8.26
	04-29-18	7.88	7.96	7.61	7.57	7.90	7.93	8.36	7.85/7.86	8.14
	05-06-18	8.27	8.27/8.18	8.03	8.03	8.25	8.10	8.64	8.12	8.50
	05-13-18	8.23	8.23	7.90	7.96	8.24	8.15	8.56	8.01	
Total Suspended	04-15-18	3.4	37.6	<3.0	11.6	<3.0	85.0	112/118	28,4	<3.0
Solids	04-22-18	4.5	11.3	10.9	4.1	3.67	37.9	9.1	22.5	8.7
(mg/L)	04-29-18	<3.0	4.3	4.1	<3.0	2.20	22.5	4.1	42.4/52.2	3.3
	05-06-18	<3.0	<3.0/<3.0	<3.0	<3.0	1.87	4.7	3.3	13.4	3.7
	05-13-18	<3.0	3.9	<3.0	<3.0	1.63	4.5	<3.0	7.3	<3.0/6.5
Turbidity	04-15-18	4.05	32.70	2.59	53.20	3.01	45.20	49.60/50.80	22.30	25.20
(NTU)	04-22-18	4.88	12.50	24.20	25.20	3.67	22.80	6.38	20.40	20.50
	04-29-18	2.77	7.60	14.40	27.90	2.20	14.90	2.25	38.30/38.30	7.78
	05-06-18	11.30	4.02/3.67	0.63	23.60	1.87	5.60	1.21	11.90	3.18
	05-13-18	0.37	1.08	6.07	17.80	1.63	3.20	2.26	5.30	1.66/1.73
Ammonia, Total	04-15-18	0.0114	0.0290	0.0134	0.0163	0.0150	0.0184	0.0678/0.0644	0.0109	0.0199
(mg/L)	04-22-18	0.0136	0.0392	0.0190	0.0204	0.0181	0.0116	0.0124	0.0120	0.0108
	04-29-18	0.0093	0.0088	0.0112	0.0135	0.0099	0.0095	0.0102	0.0097/0.0103	0.0086
	05-06-18	0.0099	0.0101/0.0088	0.0116	0.0163	0.0130	0.0163	0.0119	0.0090	0.0115
	05-13-18	0.0089	0.0070	0.103	0.0105	0.0079	<0.0050	0.0142	0.0065	0.0064/0.0054

Parameter	Date	Camp Cr	West Cr	East Cr	Cole Cr	Fisher Rd	Hidber Rd	Dairy Farm Settling Pond	Victor Cr	Hislop Rd
Chloride	04-15-18	9.30	16.40	27.60	19.70	20.70	11.80	14.00/12.80	5.33	1.35
(<i>mg/L</i>)	04-22-18	4.78	11.20	8.87	1.81	13.90	11.10	3.13	3.43	14.60
	04-29-18	3.50	6.89	4.68	1.76	10.60	4.29	2.67	1.33/1.33	10.6
	05-06-18	4.59	6.82/6.74	6.71	1.72	10.90	4.61	3.42	1.21	12.90
	05-13-18	5.02	7.14	8.28	1.59	10.20	3.75	3.92	1.45	13.20/13.20
Nitrate and	04-15-18	0.079	0.326	0.0159	0.215	0.0132	0.424	1.24/1.14	0.511	<0.0032
Nitrite	04-22-18	0.0456	0.0518	<0.0032	<0.0032	0.01	0.323	0.0564	0.479	0.251
(mg/L)	04-29-18	0.0045	0.0084	<0.0032	<0.0032	<0.0032	0.454	<0.0032	0.207/0.208	0.0846
	05-06-18	<0.0032	<0.0032/<0.0032	<0.0032	<0.0032	0.0032	0.155	<0.0032	0.065	<0.0032
	05-13-18	<0.0032	<0.003	<0.0032	<0.0032	<0.0032	0.0141	<0.0032	0.0297	<0.0032/<0.0032
Nitrate	04-15-18	0.79	0.323	0.0143	0.215	0.012	0.423	1.24/1.13	0.509	<0.0030
(mg/L)	04-22-18	0.0456	0.0518	<0.0030	<0.0030	0.0100	0.322	0.0564	0.479	0.251
	04-29-18	0.0045	0.0084	<0.0030	<0.0030	<0.0030	0.454	<0.0030	0.207/0.208	0.0846
	05-06-18	<0.0030	<0.0030/<0.0030	<0.0030	<0.0030	0.0032	0.155	<0.0030	0.065	<0.0030
	05-13-18	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0141	<0.0030	0.0297	<0.0030/<0.0030
Nitrite	04-15-18	<0.0050	0.0033	0.0016	<0.0010	0.0012	0.0013	0.0070/0.0060	0.0018	<0.0010
(mg/L)	04-22-18	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0014	<0.0010	<0.0010	<0.0010
	04-29-18	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010/<0.0010	<0.0010
	05-06-18	<0.0010	<0.0010/<00010	<0.0010	0.0015	<0.0010	<0.0010	0.0012	<0.0010	<0.0010
	05-13-18	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010/<0.0010
Total Nitrogen	04-15-18	0.771	1.07	1.10	0.740	0.926	1.67	2.44/2.72	1.28	1.23
(mg/L)	04-22-18	0.808	0.693	2,22	2.40	0.892	2.33	0.682	1.18	0.819
	04-29-18	0.735	0.611	1.08	1.20	0.801	1.09	0.595	0.882/0.870	0.676
	05-06-18	0.686	0.598/0.575	1.01	1.480	0.765	1.02	0.651	0.766	0.565
	05-13-18	0.657	0.562	0.96	0.720	0.792	1.05	0.734	0.634	0.495/0.518

Parameter	Date	Camp Cr	West Cr	East Cr	Cole Cr	Fisher Rd	Hidber Rd	Dairy Farm Settling Pond	Victor Cr	Hislop Rd
Total Organic	04-15-18	0.68	0.718	1.07	0.509	0.888	1.23	1.13/1.51	0.76	1.21
Nitrogen	04-22-18	0.748	0.602	2.2	2.38	0.864	1.99	0.613	0.69	0.558
(mg/L)	04-29-18	0.721	0.593	1.06	1.19	0.791	0.63	0.585	0.666/0.652	0.583
	05-06-18	0.676	0.588/0.567	1.00	1.47	0.749	0.85	0.638	0.691	0.553
	05-13-18	0.648	0.555	0.95	0.71	0.784	1.03	0.719	0.598	0.488/0.512
Orthophosphate	04-15-18	0.0184	0.0138	0.0072	0.058	0.0137	0.04000	0.320/0.303	0.0027	0.0283
-Dissolved (mg/L)	04-22-18	0.0078	0.0097	0.0075	0.0138	0.0079	0.0141	0.0868	0.0025	0.0039
	04-29-18	0.0033	0.0030	0.0061	0.0145	0.0033	0.0059	0.0874	0.0027/0.0025	0.0023
	05-06-18	0.0015	0.0024/0.0023	0.0046	0.0131	0.0026	0.0044	0.1180	0.0014	0.0025
	05-13-18	0.0028	0.0036	0.0049	0.0130	0.0033	0.0052	0.1370	0.0011	0.0034/0.0034
Phosphorous –	04-15-18	0.0406	0.0936	0.0500	0.0467	0.0394	0.162	0.471/0.609	0.0555	0.0869
Total	04-22-18	0.0298	0.0320	0.0676	0.0667	0.0327	0.0736	0.117	0.0456	0.0282
(mg/L)	04-29-18	0.0184	0.0217	0.0432	0.0639	0.0155	0.0488	0.113	0.0675/0.0667	0.0172
	05-06-18	0.0087	0.0141/0.0151	0.0312	0.0558	0.0110	0.022	0.141	0.0224	0.0105
	05-13-18	0.0079	0.140	0.0226	0.0501	0.0110	0.022	0.1550	0.0124	0.0087/0.0095
Total Organic	04-15-18	16.3	13.1	13.7	13.7	16.5	18.3	15.3/20.5	16.5	25.1
Carbon	04-22-18	20.4	15.3	28.2	26.9	16.7	17.7	12.7	17.7	15.2
(mg/L)	04-29-18	18.7	14.3	28.1	25.4	17.2	22.0	12.2	21.9/21.9	14.5
	05-06-18	18.5	14.0/14.2	25.5	24.9	16.8	23.1	12.1	20.0	13.7
	05-13-18	18.2	14.1	24.1	24.1	17.6	22.5	13	16.8	13.5/13.3
E. coli	04-15-18	270	185	8	8	32	200	8/8	240	23
(CFU/100mL)	04-22-18	8	39	42	2	10	54	5	12	5
	04-29-18	51	32	9	<1	<1	14	4	29/40	4
	05-06-18	1	14/7	9	1	1	103	4	1	<1
	05-13-18	1	4	11	<1	<1	30	1	2	<1/<1

Site	90 th percentile	Geometric Mean
East Creek	29.6	12.45
West Creek	126.6	26.44
Camp Creek	182.4	10.20
Victor Creek	155.6	11.08
Hislop Road	15.8	2.58
Cole Creek	5.6	1.32
Hidber Road	161.2	54.19
Fishers Road	23.2	2.40
Dairy Farm Settling Pond	6.8	3.64

Table C-3. Escherichia coli 90th percentile and geometric concentration (CFU/mL) from five consecutive samples between April and May 2018.

APPENDIX D WATER QUALITY GUIDELINES

Table 26A. Water quality guidelines for nitrogen (N).

Water Use	Nitrate WQG (mg/L N)	Nitrite WQG (mg/L N)	Total Ammonia WQG (mg/L N) See Table 26C	
Freshwater Aquatic Life - Long-term Average	3.0	0.02 when Cl [°] ≤ 2 - also see Table 26B		
Freshwater Aquatic Life - Short-term Maximum	32.8	0.06 when Cl [°] ≤ 2 - also see Table 26B	See Table 26D	
Marine Aquatic Life - Long-term Average	3.7	None proposed	See Table 26E	
Marine Aquatic Life - Short-term Maximum			See Table 26F	
Wildlife – Short-term Maximum	100 *	10		
Livestock – Short-term Maximum	100 *	10		

• * When nitrate and nitrite are present, total nitrate- plus nitrite-nitrogen should not exceed the nitrate WQG.

 Source: Water Quality Guidelines for Nitrogen (Nitrate, Nitrite, and Ammonia): Overview Report Update (2009).

Table 26B. Water quality guidelines for nitrite (NO²⁻).

Chloride (mg/L Cl ⁻)	Freshwater Long-term Average NO ²⁻ WQG (mg/L as N)	Freshwater Short-term Maximum NO ²⁻ WQG (mg/L as N)	
< 2	0.02	0.06	
2 to 4	0.04	0.12	
4 to 6	0.06	0.18	
6 to 8	0.08	0.24	
8 to 10	0.10	0.30	
> 10	0.20	0.60	

 The long-term average CI concentration should be used to find the appropriate long-term average NO²⁻ WQG.

 Source: Water Quality Guidelines for Nitrogen (Nitrate, Nitrite, and Ammonia): Overview Report Update (2009).

	Temperature (°C)								
pН	0.0	1.0	2.0	3.0	4.0	5.0	6.0		
6.5	2.08	2.05	2.02	1.99	1.97	1.94	1.92		
6.6	2.08	2.05	2.02	1.99	1.97	1.94	1.92		
6.7	2.08	2.05	2.02	1.99	1.97	1.94	1.92		
6.8	2.08	2.05	2.02	1.99	1.97	1.94	1.92		
6.9	2.08	2.05	2.02	1.99	1.97	1.94	1.92		
7.0	2.08	2.05	2.02	1.99	1.97	1.94	1.92		
7.1	2.08	2.05	2.02	1.99	1.97	1.94	1.92		
7.2	2.08	2.05	2.02	1.99	1.97	1.94	1.92		
7.3	2.08	2.05	2.02	1.99	1.97	1.94	1.92		
7.4	2.08	2.05	2.02	2.00	1.97	1.95	1.92		
7.5	2.08	2.05	2.02	2.00	1.97	1.95	1.92		
7.6	2.09	2.05	2.03	2.00	1.97	1.95	1.93		
7.7	2.09	2.05	2.03	2.00	1.98	1.95	1.93		
7.8	1.78	1.75	1.73	1.71	1.69	1.67	1.65		
7.9	1.50	1.48	1.46	1.44	1.43	1.41	1.39		
8.0	1.26	1.24	1.23	1.21	1.20	1.18	1.17		
8.1	1.00	0.989	0.976	0.963	0.952	0.942	0.932		
8.2	0.799	0.788	0.777	0.768	0.759	0.751	0.743		
8.3	0.636	0.628	0.620	0.613	0.606	0.599	0.594		
8.4	0.508	0.501	0.495	0.489	0.484	0.479	0.475		
8.5	0.405	0.400	0.396	0.381	0.387	0.384	0.380		
8.6	0.324	0.320	0.317	0.313	0.310	0.308	0.305		
8.7	0.260	0.257	0.254	0.251	0.249	0.247	0.246		
8.8	0.208	0.206	0.204	0.202	0.201	0.200	0.198		
8.9	0.168	0.166	0.165	0.163	0.162	0.161	0.161		
9.0	0.135	0.134	0.133	0.132	0.132	0.131	0.131		

Table 26C. Long-term average water quality guidelines for ammonia nitrogen (NH $_3$ as mg/L N) to protect freshwater aquatic life.

Table 26C continued

	Temperature (°C)								
pН	7.0	8.0	9.0	10.0	11.0	12.0	13.0		
6.5	1.90	1.88	1.86	1.84	1.82	1.81	1.80		
6.6	1.90	1.88	1.86	1.84	1.82	1.81	1.80		
6.7	1.90	1.88	1.86	1.84	1.83	1.81	1.80		
6.8	1.90	1.88	1.86	1.84	1.83	1.81	1.80		
6.9	1.90	1.88	1.86	1.84	1.83	1.81	1.80		
7.0	1.90	1.88	1.86	1.84	1.83	1.81	1.80		
7.1	1.90	1.88	1.86	1.84	1.83	1.81	1.80		
7.2	1.90	1.88	1.86	1.85	1.83	1.81	1.80		
7.3	1.90	1.88	1.86	1.85	1.83	1.82	1.80		
7.4	1.90	1.88	1.87	1.85	1.83	1.82	1.80		
7.5	1.91	1.88	1.87	1.85	1.83	1.82	1.81		
7.6	1.91	1.89	1.87	1.85	1.84	1.82	1.81		
7.7	1.91	1.89	1.87	1.86	1.84	1.83	1.81		
7.8	1.63	1.62	1.60	1.59	1.57	1.56	1.55		
7.9	1.38	1.36	1.35	1.34	1.33	1.32	1.31		
8.0	1.16	1.15	1.14	1.13	1.12	1.11	1.10		
8.1	0.922	0.914	0.906	0.899	0.893	0.887	0.882		
8.2	0.736	0.730	0.724	0.718	0.714	0.709	0.706		
8.3	0.588	0.583	0.579	0.575	0.571	0.568	0.566		
8.4	0.471	0.467	0.464	0.461	0.458	0.456	0.45		
8.5	0.377	0.375	0.372	0.370	0.369	0.367	0.366		
8.6	0.303	0.301	0.300	0.298	0.297	0.297	0.29		
8.7	0.244	0.243	0.242	0.241	0.241	0.240	0.240		
8.8	0.197	0.197	0.196	0.196	0.196	0.196	0.19		
8.9	0.160	0.160	0.160	0.160	0.160	0.161	0.16		
9.0	0.131	0.131	0.131	0.131	0.132	0.132	0.133		

The average of the 5 measured NH₃ values must be less than the average of the 5 corresponding tabled NH₃ values (WQGs) obtained by finding the measured pH and temperature values in the table.

- No more than 1 of 5 of the measured values can exceed 1.5 times the corresponding WQG.
- Source: Water Quality Guidelines for Nitrogen (Nitrate, Nitrite, and Ammonia): Overview Report Update (2009).

	Temperature (°C)								
pН	0.0	1.0	2.0	3.0	4.0	5.0	6.0		
6.5	28.7	28.3	27.9	27.5	27.2	26.8	26.5		
6.6	27.9	27.5	27.2	26.8	26.4	26.1	25.8		
6.7	26.9	26.5	26.2	25.9	25.5	25.2	24.9		
6.8	25.8	25.5	25.1	24.8	24.5	24.2	23.9		
6.9	24.6	24.2	23.9	23.6	23.3	23.0	22.7		
7.0	23.2	22.8	22.5	22.2	21.9	21.6	21.4		
7.1	21.6	21.3	20.9	20.7	20.4	20.2	19.9		
7.2	19.9	19.6	19.3	19.0	18.8	18.6	18.3		
7.3	18.1	17.8	17.5	17.3	17.1	16.9	16.7		
7.4	16.2	16.0	15.7	15.5	15.3	15.2	15.0		
7.5	14.4	14.1	14.0	13.8	13.6	13.4	13.3		
7.6	12.6	12.4	12.0	11.9	11.9	11.7	11.6		
7.7	10.8	10.7	10.5	10.4	10.3	10.1	10.0		
7.8	9.26	9.12	8.98	8.88	8.77	8.67	8.57		
7.9	7.82	7.71	7.60	7.51	7.42	7.33	7.25		
8.0	6.55	6.46	6.37	6.29	6.22	6.14	6.08		
8.1	5.21	5.14	5.07	5.01	4.95	4.90	4.84		
8.2	4.15	4.09	4.04	3.99	3.95	3.90	3.86		
8.3	3.31	3.27	3.22	3.19	3.15	3.12	3.09		
8.4	2.64	2.61	2.57	2.54	2.52	2.49	2.47		
8.5	2.11	2.08	2.06	2.03	2.01	1.99	1.98		
8.6	1.69	1.67	1.65	1.63	1.61	1.60	1.59		
8.7	1.35	1.33	1.32	1.31	1.30	1.29	1.28		
8.8	1.08	1.07	1.06	1.05	1.04	1.04	1.03		
8.9	0.871	0.863	0.856	0.849	0.844	0.839	0.836		
9.0	0.703	0.697	0.692	0.688	0.685	0.682	0.681		

Table 26D. Short-term maximum water quality guidelines for ammonia nitrogen (NH $_3$ as mg/L N) to protect freshwater aquatic life.

Table 26D continued

	Temperature (°C)							
pH	7.0	8.0	9.0	10.0	11.0	12.0	13.0	
6.5	26.2	26.0	25.7	25.5	25.2	25.0	24.8	
6.6	25.5	25.2	25.0	24.7	24.5	24.3	24.1	
6.7	24.6	24.4	24.1	23.9	23.7	23.5	23.3	
6.8	23.6	23.4	23.1	22.9	22.7	22.5	22.3	
6.9	22.5	22.2	22.0	21.8	21.6	21.4	21.3	
7.0	21.1	20.9	20.7	20.5	20.3	20.2	20.0	
7.1	19.7	19.5	19.3	19.1	18.9	18.8	18.7	
7.2	18.1	17.9	17.8	17.6	17.4	17.3	17.2	
7.3	16.5	16.3	16.2	16.0	15.9	15.7	15.6	
7.4	14.8	14.7	14.5	14.4	14.2	14.1	14.0	
7.5	13.1	13.0	12.9	12.7	12.6	12.5	12.4	
7.6	11.5	11.4	11.3	11.2	11.1	11.0	10.9	
7.7	9.92	9.83	9.73	9.65	9.57	9.50	9.43	
7.8	8.48	8.40	8.32	8.25	8.18	8.12	8.07	
7.9	7.17	7.10	7.04	6.98	6.92	6.88	6.83	
8.0	6.02	5.96	5.91	5.86	5.81	5.78	5.74	
8.1	4.80	4.75	4.71	4.67	4.64	4.61	4.59	
8.2	3.83	3.80	3.76	3.74	3.71	3.69	3.67	
8.3	3.06	3.03	3.01	2.99	2.97	2.96	2.94	
8.4	2.45	2.43	2.41	2.40	2.38	2.37	2.36	
8.5	1.96	1.95	1.94	1.93	1.92	1.91	1.91	
8.6	1.58	1.57	1.56	1.55	1.55	1.54	1.54	
8.7	1.27	1.26	1.26	1.25	1.25	1.25	1.25	
8.8	1.03	1.02	1.02	1.02	1.02	1.02	1.02	
8.9	0.833	0.832	0.831	0.831	0.832	0.834	0.838	
9.0	0.681	0.681	0.681	0.682	0.684	0.688	0.692	

	Temperature (°C)							
pН	14.0	15.0	16.0	17.0	18.0	19.0	20.0	
6.5	24.6	24.5	24.3	24.2	24.0	23.9	23.8	
6.6	23.9	23.8	23.6	23.5	23.3	23.3	23.2	
6.7	23.1	23.0	22.8	22.7	22.6	22.5	22.4	
6.8	22.2	22.0	21.9	21.8	21.7	21.6	21.5	
6.9	21.1	21.0	20.8	20.7	20.6	20.5	20.4	
7.0	19.9	19.7	19.6	19.5	19.4	19.3	19.2	
7.1	18.5	18.4	18.3	18.2	18.1	18.0	17.9	
7.2	17.1	16.9	16.8	16.8	16.7	16.6	16.5	
7.3	15.5	15.4	15.3	15.2	15.2	15.1	15.1	
7.4	13.9	13.9	13.8	13.7	13.6	13.6	13.5	
7.5	12.4	12.3	12.2	12.2	12.1	12.1	12.0	
7.6	10.8	10.8	10.7	10.7	10.6	10.6	10.5	
7.7	9.37	9.31	9.26	9.22	9.18	9.15	9.12	
7.8	8.02	7.97	7.93	7.90	7.87	7.84	7.82	
7.9	6.79	6.75	6.72	6.69	6.67	6.65	6.64	
8.0	5.71	5.68	5.66	5.62	5.61	5.60	5.74	
8.1	4.56	4.54	4.53	4.51	4.50	4.49	4.49	
8.2	3.65	3.64	3.63	3.62	3.61	3.61	3.61	
8.3	2.93	2.92	2.92	2.91	2.91	2.91	2.91	
8.4	2.36	2.35	2.35	2.35	2.35	2.35	2.36	
8.5	1.90	1.90	1.90	1.90	1.90	1.91	1.92	
8.6	1.54	1.54	1.54	1.55	1.56	1.56	1.57	
8.7	1.25	1.25	1.26	1.26	1.27	1.28	1.29	
8.8	1.02	1.03	1.03	1.04	1.05	1.06	1.07	
8.9	0.842	0.847	0.853	0.861	0.870	0.880	0.89	
9.0	0.698	0.704	0.711	0.720	0.729	0.740	0.75	

Table 26D continued

• Source: Water Quality Guidelines for Nitrogen (Nitrate, Nitrite, and Ammonia): Overview Report Update (2009).