

# Water Monitoring on the Goat River

**CABIN Report for 2025**



*Thank you to all the wonderful water volunteers, water advisors, and funders that made this project possible!*

Prepared by Melissa Flint, Wildsight Creston Valley Branch

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## **Project Objectives:**

Wildsight Creston Valley Branch (WCVB) is engaged in community-based monitoring on the Goat River. The community-based monitoring includes sampling for benthic invertebrates as an indicator for watershed health. These data should reveal if there are effects from agriculture, forestry, climate change and/or urban/rural development in the Creston Valley that have detrimental effects on water quality and river biota. In addition to the scientific data gathered, the program develops community awareness and involvement in watershed health in the Creston Valley.

The objectives of this report are:

1. Present benthic invertebrate data using CABIN (Canadian Aquatic Biomonitoring Network) protocols and analysis from 2025 at one site on the Goat River. Does the benthic community differ from the Reference Conditions Approach due to stress in the watershed?
2. Relate CABIN results from 2025 to CABIN results from 2022-2024
3. Provide recommendations for future stream data collection.

## **CABIN (Canadian Aquatic Biomonitoring Network)**

### **Methods:**

#### **CABIN Sampling**

One CABIN site was selected in riffle/run habitat on the Goat River (GOA01, Figure 1). The study site was chosen near the downstream limit of the river, with cumulative influences such as urbanization, agriculture and forestry. This site is 200m upstream of the highway 21 bridge. It was selected previously as a CABIN test site in 2008 for the BC MOE-Kootenay Region study. GOA01 was also sampled from 2022-2024 by Wildsight Creston. Benthic invertebrates were collected using CABIN protocol (Environment Canada 2012) in the fall of 2025 and the sample were sent to CABIN certified taxonomists Cordillera Consulting to be processed.

Figure 1 Sampling Location for the 2025 CABIN Benthic Invertebrate Sampling



**GOA01**

49.0807, -116.51907

200m upstream of highway 21 bridge,  
downstream view

CABIN protocol also includes habitat reach assessment, channel data, substrate data and water chemistry (Environment Canada 2012). Water chemistry variables included dissolved oxygen (Hach Dissolved Oxygen Winkler Method in 2024), water temperature (YSI Pro 30), specific conductivity (YSI Pro 30), pH (Oakton pHTestr 5), turbidity (LaMotte 2020i) and air temperature.

**Lab Tests**

Nutrients and metals were also tested during CABIN sampling. Water samples were collected in laboratory-supplied sample bottles, packed on ice and shipped to ALS Calgary to be analyzed.

Water samples analyzed in a laboratory were: alkalinity, hardness, total suspended solids, turbidity, Chloride, Ammonia, nitrogen (Nitrate, Nitrite, Nitrate+Nitrite, Total Nitrogen), Total phosphorus, Total dissolved phosphorus, Ortho- Phosphate and total metals.

**Data Analysis:**

**CABIN Analysis**

The data from the GOA1 test site sampled in 2025 were compared to reference conditions in the Columbia Basin 2020 model developed by Environment and Climate Change Canada (Strachan 2020). Invertebrate counts and habitat data collected in the field were uploaded to the online CABIN database. Several environmental variables required in the Columbia Basin 2020 model were also calculated by Living Lakes Canada GIS specialist and

uploaded to each site visit. Once complete datasets were uploaded, CABIN analytic tools were used to calculate the community composition and variation from the reference model.

CABIN analytic tools completed the BEAST (Benthic Assessment of Sediment) analysis, in which the test site (GOA01) was assigned to the appropriate reference group based on 12 habitat characteristics<sup>1</sup> (Strachan 2020). Then the benthic invertebrate composition of GOA01 was compared to those found in the assigned reference site group in an ordination analysis. The test site benthic communities were plotted with the reference communities on three different vectors (axes) based on taxonomic composition by the CABIN analytic tools. The overall assessment was determined from the vector plot with the most severe rating. Confidence ellipses were drawn around the plotted values to determine how similar the test site was to reference sites. The further the test site lies from the cloud of reference sites in the ordination group, the higher the environmental stress.

1. A site that falls within the 90% confidence ellipse is designated 'Similar to Reference'.
2. A test site that falls within the 90% and 99% confidence ellipses is designated 'Mildly Divergent'.
3. A test site that falls within the 99% and 99.9% confidence ellipses is designated 'Divergent'.
4. A site that falls outside of the 99.9% confidence ellipses is designated 'Highly Divergent'

CABIN analytic tools were also used to compare the data to:

- River Invertebrate Prediction and Classification System (RIVPACS) Analysis.
  - RIVPACS compares the test sites with benthic communities at reference sites based on habitat characteristics. It uses presence/absence data to compare what taxa were expected (E) to occur at the test site and which taxa were observed (O). These are based on the probability of a greater than 70% occurrence at reference sites.
- Bray-Curtis Dissimilarity analysis
  - Shows the dissimilarity between the test site invertebrate community to the median of the predicted reference sites.
- Metrics calculations:

Metric calculations can help describe the macroinvertebrate community in terms of species abundance, richness and composition.

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<sup>1</sup> The 12 habitat predictors include 4 variables measured on site (longitude, altitude, channel slope and canopy coverage) and 8 landscape GIS calculated variables (Bedrock Geology-Sedimentary%, Climate-Precipitation OCT and Temperature DEC Min; Hydrology- Drainage Area; Landcover- Grassland%, Shrub Low% and Water%; Topography- Max % Slope in the upstream watershed) (Strachan 2020)

- % Chironomidae- % of Chironomidae taxa.
- % EPT taxa - Is the percentage of individuals in the Ephemeroptera, Plecoptera and Trichoptera taxa (EPT) divided by the sum of all individuals in the sample.
- EPT taxa (no)- Measure of richness of Ephemeroptera, Plecoptera and Trichoptera taxa (EPT).
- Hilsenhoff Family index- Describes composition in terms of pollution tolerance. It estimates the overall tolerance of the community weighted by relative abundance and pollution/dissolved oxygen sensitivity. Each taxa is assigned a tolerance number from 0-10 for that group's sensitivity to organic pollutants.
- Number of EPT individuals/Chironomids+EPT Individuals- Is a ratio of the sensitive EPT taxa to the more tolerant Chironomidae taxa.
- Simpson's Diversity- Diversity index used to measure how many different taxa are present, and how evenly individuals are distributed among those taxa.
- Simpson's Evenness is an index of composition of how even the distribution of individuals is among all the taxa.
- Total abundance- Sum of all individuals.
- Functional Feeding Groups: Functional feeding group proportion changes with the availability of food in the creek and can reflect the health of the riparian vegetation, channel stability and impacts from land development

### **Lab Tests**

Lab tests and water quality data were compared to the British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture (BC Ministry of Water, Land and Resource Stewardship. 2026). Some of the aquatic guidelines require data over an extended period such as sampling daily for 30 days, to establish baseline information and acceptable ranges.

## Results

### CABIN Results

#### BEAST Analysis: Comparison to the Reference Model

The test site GOA01 was classified into a reference group using 12 predictor variables (Strachan 2020). GOA01 was classified into reference group 2 in 2025 with a probability of group membership 53.3% (Table 1).

Table 1 Probability of Assigning the GOA01 test site to the appropriate group

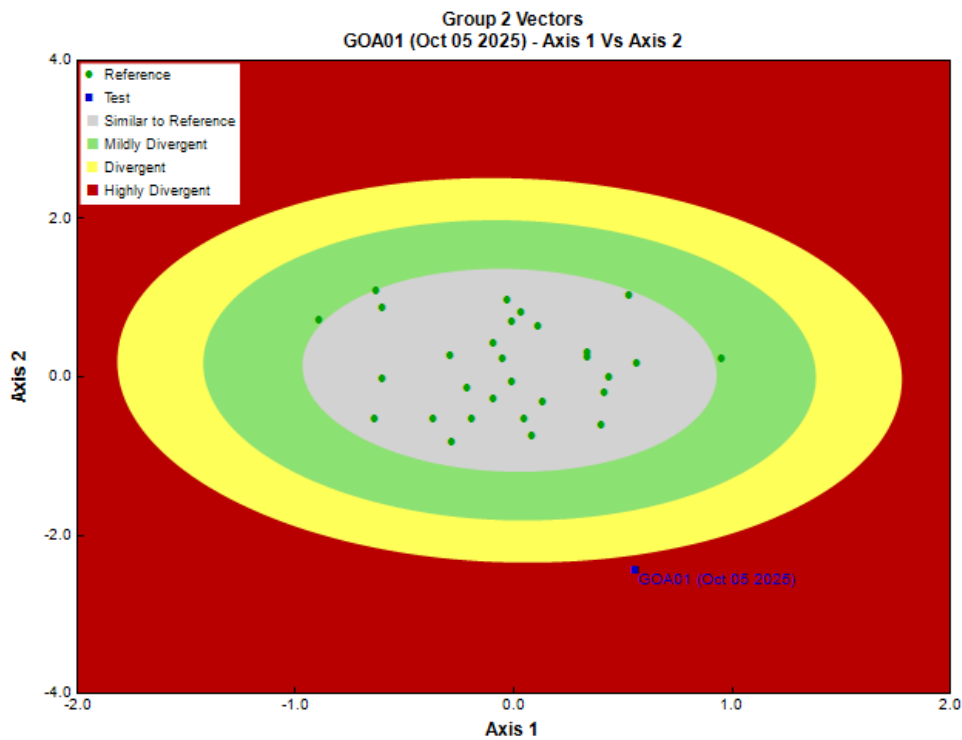
Site	Group Assignment	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
GOA01 (Oct 5 2025)	2	13.1%	53.3%	13.5%	12.5%	2.7%	4.9%

The benthic invertebrate composition of GOA01 was compared to those found in the reference sites for group 2 in an ordination analysis. Results from 2025 are summarized below in Table 2 and in Figure 2. GOA01 was highly divergent in 2025.

Table 2 BEAST Results of GOA01 2025

Site	Group	Prob.	Vector 1 vs 2	Vector 1 vs 3	Vector 2 vs 3	Overall
GOA01 (Oct 5 2025)	2	0.533	Highly Divergent	Divergent	Highly Divergent	Highly Divergent

Figure 2 Ordination Vector Graph for GOA01 Oct 5, 2025



### Additional Benthic Community Analysis

#### RIVPACS

GOA01 had a RIVPACS ratio of 0.8 in 2025 (Table 3). Samples with a RIVPACS ratio of Observed Taxa:Expected Taxa (O:E) that are less than 1 are considered impaired<sup>2</sup>. The missing families in the GOA01 samples (with a  $p > 0.7$ ) are taxa that are sensitive to resource development disturbances in BC (Strachan 2020).

Table 3 RIVPACS Results Goat River 2022-2024

Date Sampled	RIVPACS Observed:Expected Taxa Ratio with $p > 0.7$	Missing Taxa with $p > 0.7$
GOA01 Oct 5, 2025	0.8	Capniidae, Nemouridae, Rhyacophilidae

#### Bray-Curtis Dissimilarity

If the test site and the median reference site share all the same abundance of taxa the results of the Bray-Curtis Dissimilarity will be 0 and if the test sites do not share the same abundance of taxa the result will be 1. The Bray-Curtis dissimilarity distances indicate that

<sup>2</sup> O:E ratio =1 are healthy, O:E ratio <1 are impaired, O:E ratio > 1 are biodiversity hotspots/enriched

GOA01 does not share the same abundance of taxa to the median reference site. There was a high dissimilarity in 2025 (0.93) (Table 4).

Table 4 Bray-Curtis Dissimilarity for Goat River 2022-2024

Site	Bray-Curtis Distance
GOA01 (Oct 5, 2025)	0.93

### Community Metrics

The community metrics can give us a greater understanding of the macroinvertebrates and how they differ from the reference communities. Community metrics are summarized in Table 5.

Table 5 Community Metrics Results for the Goat River 2025

Metric	GOA01 (Oct 5, 2025)	RefMean	StdDev
% Chironomidae	9.1	6.0	5.6
% EPT Individuals	70.2	88.1	9.3
EPT taxa (no)	12.0	12.4	2.4
Hilsenhoff Family index (North-West)	2.86	3.15	0.31
No. EPT individuals/Chironomids+EPT Individuals	0.89	0.94	0.06
Simpson's Diversity	0.81	0.79	0.08
Simpson's Evenness	0.24	0.30	0.08
Total Abundance	<b>9820.0</b>	1083.1	932.4
Total No. of Taxa	22.0	18.2	4.7
% Filterers	0.0	0.6	0.31
% Gatherers	<b>88.8</b>	38.1	14.15
% Predatores	16.3	15.8	9.08
% Scrapers	<b>14.1</b>	60.8	14.62
% Shredder	18.3	23.9	11.07

\***bolded numbers** are >2 standard deviations away from the reference mean

- % Chironomidae- In 2025 Chironomidae were 9% which is within one standard deviation of the mean. Chironomidae taxa are generally more tolerant of habitat degradation.
- % EPT individuals - In 2025 the percentage of EPT individuals (70%) was lower than the reference mean (88%). EPT taxa are generally sensitive to habitat disturbance and therefore a lower percentage of EPT indicates a potential degradation of habitat.

- EPT taxa number- The number of EPT taxa (12) in 2025 was close to reference mean.
- Hilsenhoff Family index- A Hilsenhoff value was 2.9 (2025) which corresponds to an index value of 'Excellent'.
- No. EPT individuals/Chironomids+EPT Individuals- The closer to 1 the more EPT individuals you have compared to the Chironomids. The ratio in 2025 was 0.89 which is close to reference mean.
- Simpson's Diversity- Diverse and even communities can indicate good habitat quality. Values go from 0 to 1 with the greater diversity being higher values. Simpson's Diversity index of 0.8 for 2025 is excellent.
- Simpson's Evenness; The composition is relatively even in 2025 (0.24).
- Total abundance- Abundance can decrease due to habitat degradation, but can also increase if more nutrients are available. There was a very high abundance in 2025 (9820) compared to the reference mean (1083).
- Functional Feeding Groups: Gatherers were greater than 3 standard deviations above reference mean (38%) in 2025 (89%). Gatherers eat fine particulate organic matter in the water and are expected to increase in response to disturbance. Scrapers were greater than 3 standard deviations below reference mean (61%) in 2025 (14%). Scrapers are specialized to eat algae material and are expected to decrease at a site in response to disturbance

## Lab Results

In 2025, nutrients, metals, hardness, alkalinity and total suspended solids measurements were below the BC aquatic life guidelines, or below detection limit of the lab test. Full results can be found in the Lab Results Appendix.

## Discussion

The benthic invertebrate community was highly divergent in 2025. This indicates that the Goat River may have impaired habitat conditions. The benthic communities still show excellent species diversity and evenness, but EPT individuals are below reference mean. The most glaring difference was the abundance of the sample. The abundance of invertebrates was nine times the standard deviation of the reference mean. The high total abundance in 2025 could be caused by increased nutrients and organic material in the river, and/or other climatic factors like warmer conditions. The two most abundant families were Ephemerellidae and Leptophlebiidae in 2025. These two families are both more tolerant to habitat disturbance in BC based on 5500 sites in the CABIN database, even though they

are both Ephemeropterans (Mayflies) (Strachan 2020). Although nutrients levels were low during fall CABIN sampling, there may have been anthropogenic nutrient inputs earlier in the season.

In comparison to previous CABIN sampling on the Goat River, GOA01 was mildly divergent in 2022 and 2023, and highly divergent in 2024 (Wilsight Creston 2026). There was also a very high total abundance in 2024 (5333) and 2025 (9820) compared with the reference mean (1083). The percentage of gatherers, or invertebrates that collect fine particulate organic matter in the water, has been increasing since 2022 (43%), 2023 (79%), 2024 (83%), 2025 (89%) (Wildsight Creston 2026). This indicates that there is increasing organic matter being deposited in the Goat River. Gatherers eat fine particulate organic matter in the water and are expected to increase in response to disturbance (Environment and Climate Change Canada 2024).

It is likely that there are multiple stressors in the watershed that are causing this 'highly divergent' result. In a long term study of a temperate freshwater ecosystem, multiple anthropogenic stressors (climate change, invasive species and pollutants), were found to have significant effects on species composition and functional feeding groups in freshwater ecosystems (Worischka *et al.* 2023). This is a concern in the Goat River watershed with cumulative effects in the form of development, logging, increased water demand, climate change, and runoff.

Continued biomonitoring is recommended. In addition, activities to protect riparian habitat along the Goat River and to improve land management practices in this watershed would both improve the resiliency of this watershed and help restore ecological health and fish populations in this river.

## Recommendations

- Additional lab tests for nutrients would be recommended at GOA01 site in May/June after a rain event to attempt to capture the presence/absence of runoff from surrounding farms when there is more fertilizer application.
- CABIN sampling on the Goat River should continue to capture variation of the benthic community.
- With increasing anthropogenic pressures on the Goat River as well as impacts on flow and temperatures due to climate change, watershed management planning would be recommended.

## References

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## Appendices

Some of the data listed in the appendices are also available online:

- CABIN specific data available at <https://www.canada.ca/en/environment-climate-change/services/canadian-aquatic-biomonitoring-network/database.html>
- Water quality and lab data are available on the Columbia Basin Water hub: <https://data.cbwaterhub.ca/dataset/goat-river-cabin-water-quality>

## CABIN Appendix

2025 CABIN Report 5 pages

**Site Description**

<b>Study Name</b>	BC NGO-Goat River Ecological Monitoring
<b>Site</b>	GOA01
<b>Sampling Date</b>	Oct 05 2025
<b>Know Your Watershed Basin</b>	Lower Kootenay
<b>Province / Territory</b>	British Columbia
<b>Terrestrial Ecological Classification</b>	Montane Cordillera EcoZone Columbia Mountains and Highlands EcoRegion
<b>Coordinates (decimal degrees)</b>	49.08070 N, 116.51957 W
<b>Altitude</b>	547
<b>Local Basin Name</b>	Goat River
	Kootenay River
<b>Stream Order</b>	5



Up Stream

**Cabin Assessment Results**

<b>Reference Model Summary</b>	
<b>Model</b>	Columbia Basin 2020
<b>Analysis Date</b>	April 29, 2026
<b>Taxonomic Level</b>	Family
<b>Predictive Model Variables</b>	Altitude Drainage-Area Longitude Natl-Grassland Natl-ShrubLow Natl-Water Precip10_Oct Reach-%CanopyCoverage Sedimentary Slope SlopeMax Temp12_DECmin
<b>Reference Groups</b>	<b>1</b> <b>2</b> <b>3</b> <b>4</b> <b>5</b> <b>6</b>
<b>Number of Reference Sites</b>	13      24      28      35      32      15
<b>Group Error Rate</b>	53.8%      55.2%      34.1%      52.2%      23.1%      29.4%
<b>Overall Model Error Rate</b>	39.4%
<b>Probability of Group Membership</b>	13.1%      53.3%      13.5%      12.5%      2.7%      4.9%
<b>CABIN Assessment of GOA01 on Oct 05, 2025</b>	Highly Divergent

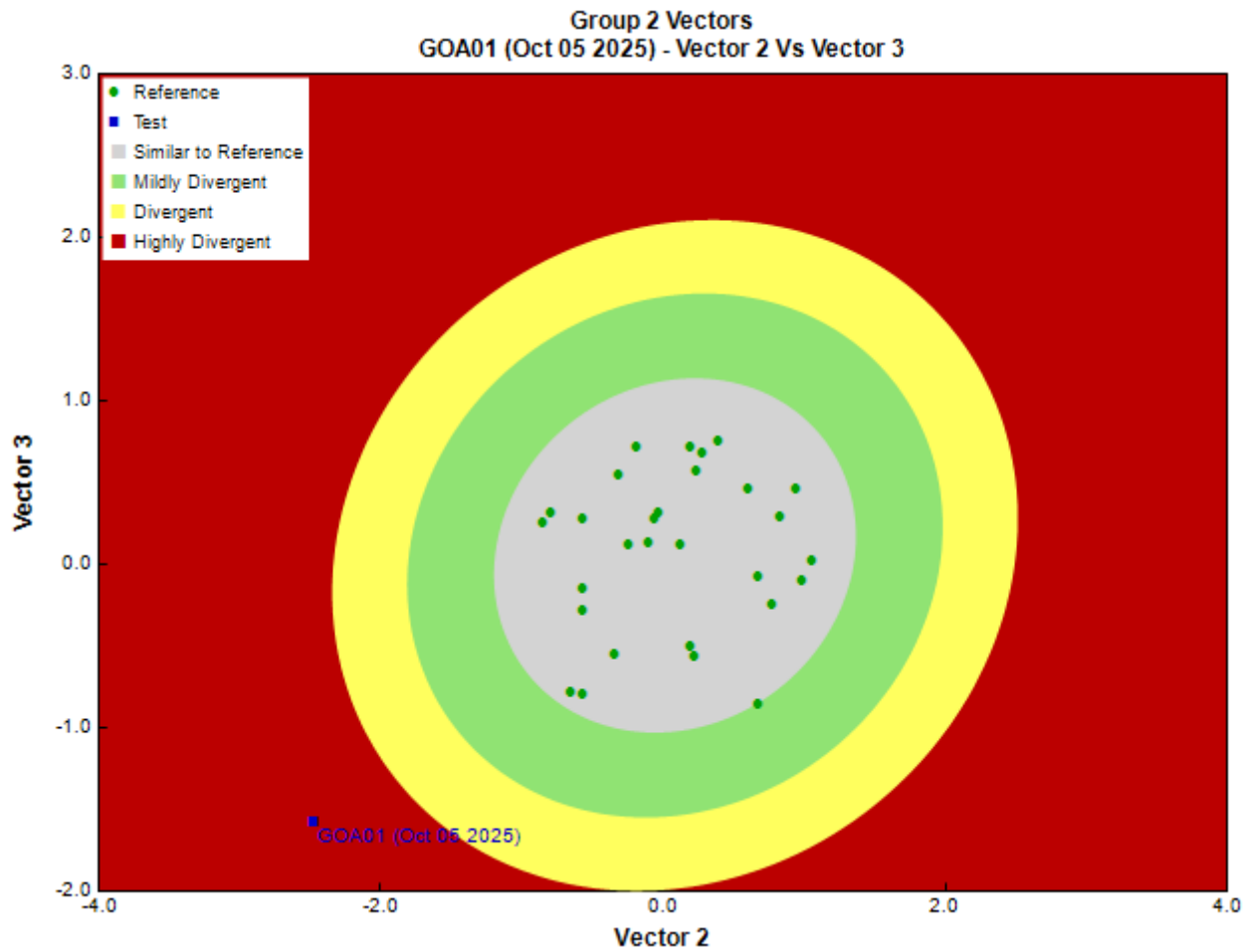


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

**Sample Information**

<b>Sampling Device</b>	Kick Net
<b>Mesh Size</b>	400
<b>Sampling Time</b>	3
<b>Taxonomist</b>	-
	-
<b>Sub-Sample Proportion</b>	5/100

**Community Structure**

Phylum	Class	Order	Family	Raw Count	Total Count			
Annelida	Clitellata	Tubificida	Naididae	15	300.0			
Arthropoda	Arachnida	Trombidiformes	Aturidae	1	20.0			
			Hygrobatidae	1	20.0			
			Lebertiidae	3	60.0			
			Sperchontidae	3	60.0			
			Torrenticolidae	9	180.0			
			Insecta	Coleoptera	Elmidae	18	360.0	
					Diptera	5	100.0	
						Chironomidae	44	880.0
						Empididae	1	20.0
						Tipulidae	49	980.0
				Ephemeroptera	Ameletidae	2	40.0	
					Baetidae	3	60.0	
					Ephemerellidae	98	1,960.0	
	Heptageniidae	25	500.0					
	Leptophlebiidae	171	3,420.0					

**Community Structure**

Phylum	Class	Order	Family	Raw Count	Total Count
		Plecoptera		2	40.0
			Chloroperlidae	1	20.0
			Perlidae	1	20.0
			Perlodidae	6	120.0
			Taeniopterygidae	13	260.0
		Trichoptera	Brachycentridae	1	20.0
			Hydropsychidae	10	200.0
			Lepidostomatidae	9	180.0
			Total	491	9,820.0

**Metrics**

Name	GOA01	Predicted Group Reference Mean $\pm$ SD
<b>Bray-Curtis Distance</b>	0.93	0.3 $\pm$ 0.1
<b>Biotic Indices</b>		
<b>Hilsenhoff Family index (North-West)</b>	2.9	3.2 $\pm$ 0.3
<b>Functional Measures</b>		
<b>% Filterers</b>	--	0.6 $\pm$ 0.3
<b>% Gatherers</b>	88.8	38.1 $\pm$ 14.1
<b>% Predatores</b>	16.3	15.8 $\pm$ 9.1
<b>% Scrapers</b>	14.1	60.8 $\pm$ 14.6
<b>% Shredder</b>	18.3	23.9 $\pm$ 11.1
<b>No. Clinger Taxa</b>	17.0	22.0 $\pm$ 5.6
<b>Number Of Individuals</b>		
<b>% Chironomidae</b>	9.1	6.0 $\pm$ 5.6
<b>% EPT Individuals</b>	70.2	88.1 $\pm$ 9.3
<b>% of 2 dominant taxa</b>	55.6	54.4 $\pm$ 11.4
<b>No. EPT individuals/Chironomids+EPT Individuals</b>	0.9	0.9 $\pm$ 0.1
<b>Total Abundance</b>	9820.0	1083.1 $\pm$ 932.3
<b>Richness</b>		
<b>EPT taxa (no)</b>	12.0	12.4 $\pm$ 2.4
<b>Shannon-Wiener Diversity</b>	2.1	2.0 $\pm$ 0.3
<b>Simpson's Diversity</b>	0.8	0.8 $\pm$ 0.1
<b>Simpson's Evenness</b>	0.2	0.3 $\pm$ 0.1
<b>Total No. of Taxa</b>	22.0	18.2 $\pm$ 4.7

**Frequency and Probability of Taxa Occurrence**

Reference Model Taxa	Frequency of Occurrence in Reference Sites						Probability Of Occurrence at GOA01
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
Baetidae	100%	100%	100%	100%	100%	100%	1.00
Capniidae	77%	79%	63%	74%	63%	76%	0.76
Chironomidae	100%	100%	100%	93%	100%	88%	0.99
Chloroperlidae	77%	93%	88%	93%	96%	82%	0.90
Ephemereillidae	85%	97%	98%	98%	98%	82%	0.95
Heptageniidae	92%	100%	100%	100%	100%	100%	0.99
Hydropsychidae	46%	72%	71%	91%	79%	53%	0.70
Nemouridae	85%	100%	98%	98%	98%	100%	0.97
Perlodidae	77%	97%	85%	83%	90%	82%	0.90
Rhyacophilidae	69%	100%	83%	91%	98%	82%	0.92
Taeniopterygidae	69%	97%	88%	100%	100%	88%	0.92

**RIVPACS Ratios**

<b>RIVPACS : Expected taxa P&gt;0.50</b>	12.33
<b>RIVPACS : Observed taxa P&gt;0.50</b>	12.00
<b>RIVPACS : O:E (p &gt; 0.5)</b>	0.97
<b>RIVPACS : Expected taxa P&gt;0.70</b>	9.99
<b>RIVPACS : Observed taxa P&gt;0.70</b>	8.00
<b>RIVPACS : O:E (p &gt; 0.7)</b>	0.80

## Habitat Description

Variable	GOA01	Predicted Group Reference Mean $\pm$ SD
<b>Bedrock Geology</b>		
Sedimentary (%)	90.91000	91.25558 $\pm$ 24.81348
<b>Channel</b>		
Depth-Avg (cm)	19.8	31.4 $\pm$ 15.4
Depth-BankfullMinusWetted (cm)	260.00	54.15 $\pm$ 36.59
Depth-Max (cm)	28.0	46.8 $\pm$ 23.7
Macrophyte (PercentRange)	0	0 $\pm$ 0
Reach-%CanopyCoverage (PercentRange)	0.00	1.00 $\pm$ 0.96
Reach-DomStreamsideVeg (Category(1-4))	3	3 $\pm$ 1
Reach-Pools (Binary)	0	1 $\pm$ 1
Reach-Rapids (Binary)	0	0 $\pm$ 0
Reach-Riffles (Binary)	1	1 $\pm$ 0
Reach-StraightRun (Binary)	1	1 $\pm$ 1
Slope (m/m)	0.0047500	0.0435622 $\pm$ 0.0544263
Veg-Coniferous (Binary)	1	1 $\pm$ 0
Veg-Deciduous (Binary)	1	1 $\pm$ 0
Veg-GrassesFerns (Binary)	1	1 $\pm$ 0
Veg-Shrubs (Binary)	1	1 $\pm$ 0
Velocity-Avg (m/s)	0.18	0.63 $\pm$ 0.23
Velocity-Max (m/s)	0.27	0.95 $\pm$ 0.33
Width-Bankfull (m)	88.9	23.6 $\pm$ 18.9
Width-Wetted (m)	44.0	14.0 $\pm$ 9.6
XSEC-VelInstrumentDirect (Category(1-3))	3	2 $\pm$ 0
XSEC-VelMethod (Category(1-3))	3	2 $\pm$ 1
<b>Climate</b>		
Precip10_OCT (mm)	65.43328	93.78954 $\pm$ 37.73803
Temp12_DECmin (Degrees Celsius)	-10.60250	-12.77499 $\pm$ 1.90440
<b>Hydrology</b>		
Drainage-Area (km^2)	1256.53600	267.49128 $\pm$ 347.95771
Perimeter (Km)	193.03860	107.09622 $\pm$ 85.97364
<b>Landcover</b>		
Natl-Grassland (%)	5.43000	4.84000 $\pm$ 3.39798
Natl-ShrubLow (%)	0.07000	4.94988 $\pm$ 4.53147
Natl-Water (%)	0.29000	0.22026 $\pm$ 0.32058
<b>Substrate Data</b>		
%Bedrock (%)	0	0 $\pm$ 1
%Boulder (%)	0	6 $\pm$ 7
%Cobble (%)	44	51 $\pm$ 23
%Gravel (%)	1	4 $\pm$ 6
%Pebble (%)	55	39 $\pm$ 23
%Sand (%)	0	0 $\pm$ 0
%Silt+Clay (%)	0	0 $\pm$ 0
D50 (cm)	5.75	8.79 $\pm$ 6.32
Dg (cm)	5.9	7.7 $\pm$ 3.1
Dominant-1st (Category(0-9))	5	6 $\pm$ 1
Dominant-2nd (Category(0-9))	6	6 $\pm$ 1
Embeddedness (Category(1-5))	5	4 $\pm$ 1
PeriphytonCoverage (Category(1-5))	2	2 $\pm$ 1
SurroundingMaterial (Category(0-9))	3	3 $\pm$ 1
<b>Topography</b>		
SlopeMax (%)	923.50000	475.68167 $\pm$ 413.51912
<b>Water Chemistry</b>		
Ag (mg/L)	0.0000050	0.0000038 $\pm$ 0.0000018
Al (mg/L)	0.0052000	0.0064450 $\pm$ 0.0021850
As (mg/L)	0.0003500	0.0002615 $\pm$ 0.0000120
B (mg/L)	0.0050000	0.0262500 $\pm$ 0.0335876
Ba (mg/L)	0.0132000	0.0683500 $\pm$ 0.0002121
Be (mg/L)	0.0000100	0.0000075 $\pm$ 0.0000035
Bi (mg/L)	0.0000250	0.0000038 $\pm$ 0.0000018
Ca (mg/L)	10.5000000	24.6363636 $\pm$ 20.0629852
Cd (mg/L)	0.0000050	0.0000038 $\pm$ 0.0000018
Chloride-Dissolved (mg/L)	0.9000000	0.3863636 $\pm$ 0.3806454

## Habitat Description

Variable	GOA01	Predicted Group Reference Mean $\pm$ SD
Co (mg/L)	0.0000500	0.0000114 $\pm$ 0.0000019
Cr (mg/L)	0.0002500	0.0000750 $\pm$ 0.0000354
Cu (mg/L)	0.0002500	0.0001155 $\pm$ 0.0000219
Fe (mg/L)	0.0340000	0.0105500 $\pm$ 0.0036062
General-Alkalinity (mg/L)	43.4000000	74.2125000 $\pm$ 53.9915558
General-Conductivity ( $\mu$ S/cm)	61.5000000	121.7600000 $\pm$ 104.0053005
General-DO (mg/L)	13.0000000	11.0129630 $\pm$ 0.8955266
General-Hardness (mg/L)	39.7000000	95.8956522 $\pm$ 77.3576081
General-pH (pH)	7.2	7.7 $\pm$ 0.8
General-SolidsTSS (mg/L)	1.5000000	5.9463636 $\pm$ 8.6422279
General-SpCond ( $\mu$ S/cm)	88.0000000	165.1777778 $\pm$ 128.4575336
General-TempAir (Degrees Celsius)	9.0	11.5 $\pm$ 5.9
General-TempWater (Degrees Celsius)	9.2000000	6.4451852 $\pm$ 2.2997548
General-Turbidity (NTU)	0.3200000	5.7154545 $\pm$ 6.9690564
K (mg/L)	0.4760000	0.4604091 $\pm$ 0.2737828
Li (mg/L)	0.0005000	0.0011000 $\pm$ 0.0000000
Mg (mg/L)	3.2800000	8.6045455 $\pm$ 7.5439965
Mn (mg/L)	0.0022600	0.0007470 $\pm$ 0.0001937
Mo (mg/L)	0.0004100	0.0006780 $\pm$ 0.0000170
Na (mg/L)	2.2600000	1.0881818 $\pm$ 0.7163042
Ni (mg/L)	0.0002500	0.0001625 $\pm$ 0.0001945
Nitrogen-NH3 (mg/L)	0.0025000	0.0014722 $\pm$ 0.0022127
Nitrogen-NO2 (mg/L)	0.0005000	0.0034091 $\pm$ 0.0048394
Nitrogen-NO2+NO3 (mg/L)	0.0025000	0.0789333 $\pm$ 0.0140433
Nitrogen-NO3 (mg/L)	0.0025000	0.0719000 $\pm$ 0.0408583
Nitrogen-TN (mg/L)	0.0450000	0.0929091 $\pm$ 0.0373336
Pb (mg/L)	0.0000250	0.0000337 $\pm$ 0.0000259
Phosphorus-OrthoP (mg/L)	0.0005000	0.0005167 $\pm$ 0.0006974
Phosphorus-TDP (mg/L)	0.0005000	0.0010200 $\pm$ 0.0007879
Phosphorus-TP (mg/L)	0.0026000	0.0049864 $\pm$ 0.0043795
S (mg/L)	0.9600000	5.0000000
Sb (mg/L)	0.0000500	0.0000635 $\pm$ 0.0000092
Se (mg/L)	0.0000250	0.0001105 $\pm$ 0.0000134
Si (mg/L)	4.3800000	2.5681818 $\pm$ 1.4562562
Sn (mg/L)	0.0000500	0.0000075 $\pm$ 0.0000035
Sr (mg/L)	0.0375000	0.0445000 $\pm$ 0.0002828
Te (mg/L)	0.0001000	0.0000000 $\pm$ 0.0000000
Th (mg/L)	0.0000500	0.0000000 $\pm$ 0.0000000
Ti (mg/L)	0.0001500	0.0005000
Tl (mg/L)	0.0000050	0.0000015 $\pm$ 0.0000007
U (mg/L)	0.0003700	0.0012050 $\pm$ 0.0000495
V (mg/L)	0.0002500	0.0001500 $\pm$ 0.0000707
Zn (mg/L)	0.0015000	0.0006400 $\pm$ 0.0005091
Zr (mg/L)	0.0001000	0.0000000 $\pm$ 0.0000000

## Lab Results Appendix

ALS Report 2025 5 pages

**CERTIFICATE OF ANALYSIS**

<b>Work Order</b>	: <b>CG2514525</b>	<b>Laboratory</b>	: ALS Environmental - Calgary
<b>Amendment</b>	: <b>1</b>	<b>Account Manager</b>	: Tolulope Ogundipe
<b>Client</b>	: <b>Cash Clients Canada</b>	<b>Address</b>	: 2559 29th Street NE Calgary AB Canada T1Y 7B5
<b>Contact</b>	: Melissa Flint	<b>E-mail</b>	: tolulope.ogundipe@alsglobal.com
<b>Address</b>	: 2559 29 Street NE Calgary Alberta Canada T1Y 7B5	<b>Telephone</b>	: +1 403 407 1800
<b>Telephone</b>	: ----	<b>Date Samples Received</b>	: 07-Oct-2025 09:00
<b>Project</b>	: ----	<b>Date Analysis Commenced</b>	: 07-Oct-2025
<b>PO</b>	: ----	<b>Issue Date</b>	: 05-Jan-2026 12:46
<b>C-O-C number</b>	: ----		
<b>Sampler</b>	: ----		
<b>Site</b>	: Wildsight Creston Valley Branch Surface Water Monitoring		
<b>Quote number</b>	: CG25-CASH100-048		
<b>No. of samples received</b>	: 1		
<b>No. of samples analysed</b>	: 1		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

**Signatories**

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Laboratory Department</i>
George Huang	Supervisor - Inorganic	Metals, Calgary, Alberta
Hannah Phung	Lab Assistant	Inorganics, Calgary, Alberta
Harpreet Chawla	Team Leader - Inorganics	Inorganics, Calgary, Alberta
Katarzyna Glinka	Analyst	Inorganics, Calgary, Alberta
Leon Yang	Analyst	Inorganics, Burnaby, British Columbia
Ping Yeung	Team Leader - Inorganics	Inorganics, Edmonton, Alberta
Shirley Li	Team Leader - Inorganics	Inorganics, Calgary, Alberta



### General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key: CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances.  
LOR: Limit of Reporting (detection limit).

<i>Unit</i>	<i>Description</i>
mg/L	milligrams per litre
NTU	nephelometric turbidity units

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.



## Analytical Results

Sub-Matrix: Water  
 (Matrix: Water)

					Client sample ID	COA01 (49.0807,- 116.051907)	----	----	----	----
					Client sampling date / time	06-Oct-2025 09:15	----	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit	CG2514525-001	----	----	----	----	----
						Result	----	----	----	----
<b>Physical Tests</b>										
Alkalinity, total (as CaCO3)	----	E290/CG	1.0	mg/L	43.4	----	----	----	----	----
Hardness (as CaCO3), from total Ca/Mg	----	EC100A/CG	0.50	mg/L	39.7	----	----	----	----	----
Solids, total suspended [TSS]	----	E160/CG	3.0	mg/L	<3.0	----	----	----	----	----
Turbidity	----	E121/CG	0.10	NTU	0.32	----	----	----	----	----
<b>Anions and Nutrients</b>										
Ammonia, total (as N)	7664-41-7	E298/CG	0.0050	mg/L	<0.0050	----	----	----	----	----
Chloride	16887-00-6	E235.Cl/CG	0.50	mg/L	0.90	----	----	----	----	----
Nitrate (as N)	14797-55-8	E235.NO3-L/CG	0.0050	mg/L	<0.0050	----	----	----	----	----
Nitrite (as N)	14797-65-0	E235.NO2-L/CG	0.0010	mg/L	<0.0010	----	----	----	----	----
Nitrogen, total	7727-37-9	E366/VA	0.030	mg/L	0.045	----	----	----	----	----
Phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U/CG	0.0010	mg/L	<0.0010	----	----	----	----	----
Phosphorus, total	7723-14-0	E372-U/CG	0.0020	mg/L	0.0026	----	----	----	----	----
Phosphorus, total dissolved	7723-14-0	E375-U/EO	0.0010	mg/L	<0.0010	----	----	----	----	----
Nitrate + Nitrite (as N)	----	EC235.N+N/CG	0.0050	mg/L	<0.0051	----	----	----	----	----
<b>Total Metals</b>										
Aluminum, total	7429-90-5	E420/CG	0.0030	mg/L	0.0052	----	----	----	----	----
Antimony, total	7440-36-0	E420/CG	0.00010	mg/L	<0.00010	----	----	----	----	----
Arsenic, total	7440-38-2	E420/CG	0.00010	mg/L	0.00035	----	----	----	----	----
Barium, total	7440-39-3	E420/CG	0.00010	mg/L	0.0132	----	----	----	----	----
Beryllium, total	7440-41-7	E420/CG	0.000020	mg/L	<0.000020	----	----	----	----	----
Bismuth, total	7440-69-9	E420/CG	0.000050	mg/L	<0.000050	----	----	----	----	----



### Analytical Results

Sub-Matrix: Water  
 (Matrix: Water)

					Client sample ID	COA01 (49.0807,- 116.051907)	----	----	----	----
					Client sampling date / time	06-Oct-2025 09:15	----	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit	CG2514525-001	----	----	----	----	----
						Result	----	----	----	----
<b>Total Metals</b>										
Boron, total	7440-42-8	E420/CG	0.010	mg/L	<0.010	----	----	----	----	----
Cadmium, total	7440-43-9	E420/CG	0.0000050	mg/L	<0.0000050	----	----	----	----	----
Calcium, total	7440-70-2	E420/CG	0.050	mg/L	10.5	----	----	----	----	----
Cesium, total	7440-46-2	E420/CG	0.000010	mg/L	0.000012	----	----	----	----	----
Chromium, total	7440-47-3	E420/CG	0.00050	mg/L	<0.00050	----	----	----	----	----
Cobalt, total	7440-48-4	E420/CG	0.00010	mg/L	<0.00010	----	----	----	----	----
Copper, total	7440-50-8	E420/CG	0.00050	mg/L	<0.00050	----	----	----	----	----
Iron, total	7439-89-6	E420/CG	0.010	mg/L	0.034	----	----	----	----	----
Lead, total	7439-92-1	E420/CG	0.000050	mg/L	<0.000050	----	----	----	----	----
Lithium, total	7439-93-2	E420/CG	0.0010	mg/L	<0.0010	----	----	----	----	----
Magnesium, total	7439-95-4	E420/CG	0.0050	mg/L	3.28	----	----	----	----	----
Manganese, total	7439-96-5	E420/CG	0.00010	mg/L	0.00226	----	----	----	----	----
Molybdenum, total	7439-98-7	E420/CG	0.000050	mg/L	0.000407	----	----	----	----	----
Nickel, total	7440-02-0	E420/CG	0.00050	mg/L	<0.00050	----	----	----	----	----
Phosphorus, total	7723-14-0	E420/CG	0.050	mg/L	<0.050	----	----	----	----	----
Potassium, total	7440-09-7	E420/CG	0.050	mg/L	0.476	----	----	----	----	----
Rubidium, total	7440-17-7	E420/CG	0.00020	mg/L	0.00059	----	----	----	----	----
Selenium, total	7782-49-2	E420/CG	0.000050	mg/L	<0.000050	----	----	----	----	----
Silicon, total	7440-21-3	E420/CG	0.10	mg/L	4.38	----	----	----	----	----
Silver, total	7440-22-4	E420/CG	0.000010	mg/L	<0.000010	----	----	----	----	----
Sodium, total	7440-23-5	E420/CG	0.050	mg/L	2.26	----	----	----	----	----



**Analytical Results**

**Sub-Matrix: Water**  
**(Matrix: Water)**

					Client sample ID	COA01 (49.0807,- 116.051907)	----	----	----	----
					Client sampling date / time	06-Oct-2025 09:15	----	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit	CG2514525-001	----	----	----	----	----
						Result	----	----	----	----
<b>Total Metals</b>										
Strontium, total	7440-24-6	E420/CG	0.00020	mg/L	0.0375	----	----	----	----	----
Sulfur, total	7704-34-9	E420/CG	0.50	mg/L	0.96	----	----	----	----	----
Tellurium, total	13494-80-9	E420/CG	0.00020	mg/L	<0.00020	----	----	----	----	----
Thallium, total	7440-28-0	E420/CG	0.000010	mg/L	<0.000010	----	----	----	----	----
Thorium, total	7440-29-1	E420/CG	0.00010	mg/L	<0.00010	----	----	----	----	----
Tin, total	7440-31-5	E420/CG	0.00010	mg/L	<0.00010	----	----	----	----	----
Titanium, total	7440-32-6	E420/CG	0.00030	mg/L	<0.00030	----	----	----	----	----
Tungsten, total	7440-33-7	E420/CG	0.00010	mg/L	<0.00010	----	----	----	----	----
Uranium, total	7440-61-1	E420/CG	0.000010	mg/L	0.000373	----	----	----	----	----
Vanadium, total	7440-62-2	E420/CG	0.00050	mg/L	<0.00050	----	----	----	----	----
Zinc, total	7440-66-6	E420/CG	0.0030	mg/L	<0.0030	----	----	----	----	----
Zirconium, total	7440-67-7	E420/CG	0.00020	mg/L	<0.00020	----	----	----	----	----

Please refer to the General Comments section for an explanation of any qualifiers detected.