Elk River Alliance

Community-Based Water Monitoring

2021 Monitoring Report

Prepared by:
The Elk River Alliance, Fernie BC

With Financial Support from:
The Province of British Columbia's BC Community Gaming Grant and The Healthy Watershed Initiative, Columbia Basin Trust, and the ERA community

Land Acknowledgment

ERA operates within the ʔamakʔis Ktunaxa, the Traditional Territory of the Ktunaxa Nation.

For more than 10,000 years, the Ktunaxa people have occupied their traditional territory, the ʔamakʔis Ktunaxa, which spans from southwestern Canada into parts of the United States. (Ktunaxa Nation Council 2022). The Elk River flows through part of this traditional territory, the Qukin ʔamakʔis, or the land of the raven. Prior to European settlement, the Ktunaxa people moved throughout this land, following vegetation and hunting cycles. The introduction of European settlers in the late 1800s and the creation of Indian reservations marked the beginning of large land-use changes and a long history of resource development.

Executive Summary

The Elk River Alliance's (ERA) Community-based Monitoring program (CBWM) was established in 2012 as a response to rising community concern over the health of the Elk River Watershed. The primary purpose of the program is to fill in gaps in currently available watershed data and to make these data accessible to the wider community. In 2020, ERA's CBWM program transitioned into a fully CABIN (Canadian Aquatic Biomonitoring Network) based program, adopting these nationally recognized protocols to assess 10 sites across 5 tributaries of the Elk River, all affected by different types of land-use and development.

The Elk Valley has a long history of resource development following European arrival more than 100 years ago. Currently, the valley is home to 4 active steelmaking coal mines, with two additional mines and a mine extension either currently submitted or pending submission for regulatory review. Following a long period of moderate timber extraction over the past century, the valley is experiencing a rapid increase in the rate and volume of clearcut timber harvesting by a private logging operation. Growing urban centers and linear development such as road, rail, power and natural gas also have their impacts on the Elk River and its tributaries. Since extensive government and industry water monitoring programs focus on the effects of mining operations, the Elk River Alliance's CBWM program to date has examined the impacts of other land uses on five tributaries which are not affected by current mining operations.

Analysis of 2021 sampling data indicates most sites were in relatively good condition, compared to reference sites which have little or no human disturbance. Exceptions to this were the lower Coal Creek and Morrissey Creek sites (COL001, MOR001), as well as both Lizard Creek locations (LIZ001, LIZ003), which contained benthic macroinvertebrate communities that differ from the "reference condition" modelled using undisturbed sites. All water chemistry parameters measured were below BC water quality guidelines. Morrissey and Coal Creek sites are downstream of moderate to high current and historical land use activities, particularly current logging, but did not show exceedances of water quality guidelines. These two streams are relatively new to the CBWM program, with Coal Creek added in 2019 and Morrissey in 2020. Other sites with a longer history in the CBWM program show fluctuating water quality and benthic macroinvertebrate conditions over time. Long-term data will allow for a greater understanding of the relative role of natural and human-influenced processes in these areas.

That being said, the confidence in the determination of differences between reference and test sites depends upon how well reference sites represent similar habitats to test sites. Reference site data are used to create "Reference Condition" models, which are then matched with test site data to determine the extent of differences. If Reference Condition models represent habitats which are not sufficiently representative of test sites, results can be misleading. In 2021, a newer, more region-specific reference Condition CABIN model (Columbia 2020) was used to assess CBWM monitoring locations. After this shift in the model, Lizard Creek site assessments went from a "mildly divergent" assessment to "highly divergent". Investigations are currently underway to examine the accuracy of these results, eliminate any possible errors that may have led to inaccurate assessments, and explore the next steps in monitoring this creek.

CBWM assessments continued in 2021 based on recommendations from the Elk River Watershed Monitoring Collaborative.

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Acknowledgements - 2021

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- Stella Swanson, ERA Board of Directors (Program Advisor)
- Ashlee Jollymore, ERA Board of Directors (Program Advisor)
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The **Healthy Watersheds Initiative** is a $27-million program, supported by the Province of BC, to stimulate British Columbia's economic recovery through investments in community-driven watershed conservation and restoration projects. Through this program, the Real Estate Foundation of BC, in partnership with Watersheds BC, is administering grants for more than 60 watershed security projects in communities across the province.

https://refbc.com/healthy-watersheds-initiative

The **Real Estate Foundation of BC** is a philanthropic organization that works to advance sustainable land use and real estate practices in British Columbia. Since 1988, the REFBC has granted more than $90 million for research, education, and policy projects that strengthen BC communities and protect our land and water.

https://refbc.com

Watersheds BC was launched in 2020 to support water leaders to improve decision-making for their home waters by equipping them with the knowledge, skills, and connections they need to engage effectively in their watershed. WBC supports water leaders across many organizations including First Nation communities and governments, local government staff, watershed boards and roundtables, provincial government staff, and other community champions.

https://www.watershedsbc.ca

The **Province of BC** has invested $37 million (including $27 million through the Healthy Watersheds Initiative) for projects that support healthy watersheds, species, and ecosystems, and create new jobs in areas that are critical to help communities adapt to the effects of climate change. This funding is part of the province's $10 billion COVID-19 response to help people in hard-hit industries.

https://strongerbc.gov.bc.ca

Introduction

The Elk River Alliance

Operating since 2010, the Elk River Alliance (ERA) is a community-based water charity that connects people to the Elk River using science, education and community collaboration to ensure sustainable stewardship of the Elk River watershed. ERA aims to improve and preserve watershed health through projects that raise watershed literacy, inform sustainable water decision-making, collect scientific data to prioritize restoration opportunities, and promote safe and sustainable river recreation. ERA is a registered charity that is governed by a volunteer board consisting of board members from various backgrounds.

ERA has four guiding principles: (1) Stimulate conversation, share information, and facilitate community input to encourage sustainable water decision-making in the Elk Valley; (2) Promote a new era in watershed thinking by coordinating a community voice to contribute to watershed planning and management activities, regulatory processes, and other regional water initiatives; (3) Bring together diverse points of view and offer a safe place to dialogue about the Elk River, and; (4) Unite not divide.

Advisor Credentials

Stella Swanson, Ph.D. Limnology (Director, Chair of the Program & Technical Working Group)

Stella is an aquatic biologist whose42 year-career has included management of the Aquatic Biology Group at the Saskatchewan Research Council and consulting with SENTAR Consultants and Golder Associates, Ltd. She has owned and operated Swanson Environmental Strategies since 2007, where she focuses on environmental risk management, Indigenous and community engagement, and sustainability. Stella has contributed to dozens of environmental impact assessments, ecological risk assessments and human health risk assessments. She provides strategic advice regarding the regulatory requirements for resource development projects and facilitates multidisciplinary teams working on a wide range of environmental issues. She led the development of a new generation of monitoring design approaches for Terrestrial Biological Monitoring, focused on monitoring for cumulative effects within the Oil Sands Monitoring Program and in 2020 was appointed to the Nuclear Waste Management Advisory Council to provide advice on siting a high-level nuclear waste facility in Canada. More locally, she led the original development of the Elk Valley Cumulative Effects Management Framework and was the chair of the Strategic Advisory Panel for Selenium Management.

Ashlee Jollymore, Ph.D. Resource Management Studies (Director, Vice Chair)

Ashlee is a hydrologist for the provincial government in the River Forecast Centre and has experience in forestry, land management and sustainable development.

Staff and Volunteer Credentials

Chad Hughes, Executive Director, B.Sc. Environmental Science

Kaileigh McCallum, Junior Ecologist, M.Sc. Biodiversity & Conservation

Chris Bush, ERA Volunteer

Alana Block, ERA Volunteer

Staff and Volunteers were trained and received CABIN Field technician (Chris Bush, Alana Block) and Project Manager level certification (Chad Hughes and Kaileigh McCallum), through the Canadian Rivers Institute and Living Lakes Canada (LLC). LLC also provided training on the new STREAM e-DNA program.

Community-based Water Monitoring (CBWM)

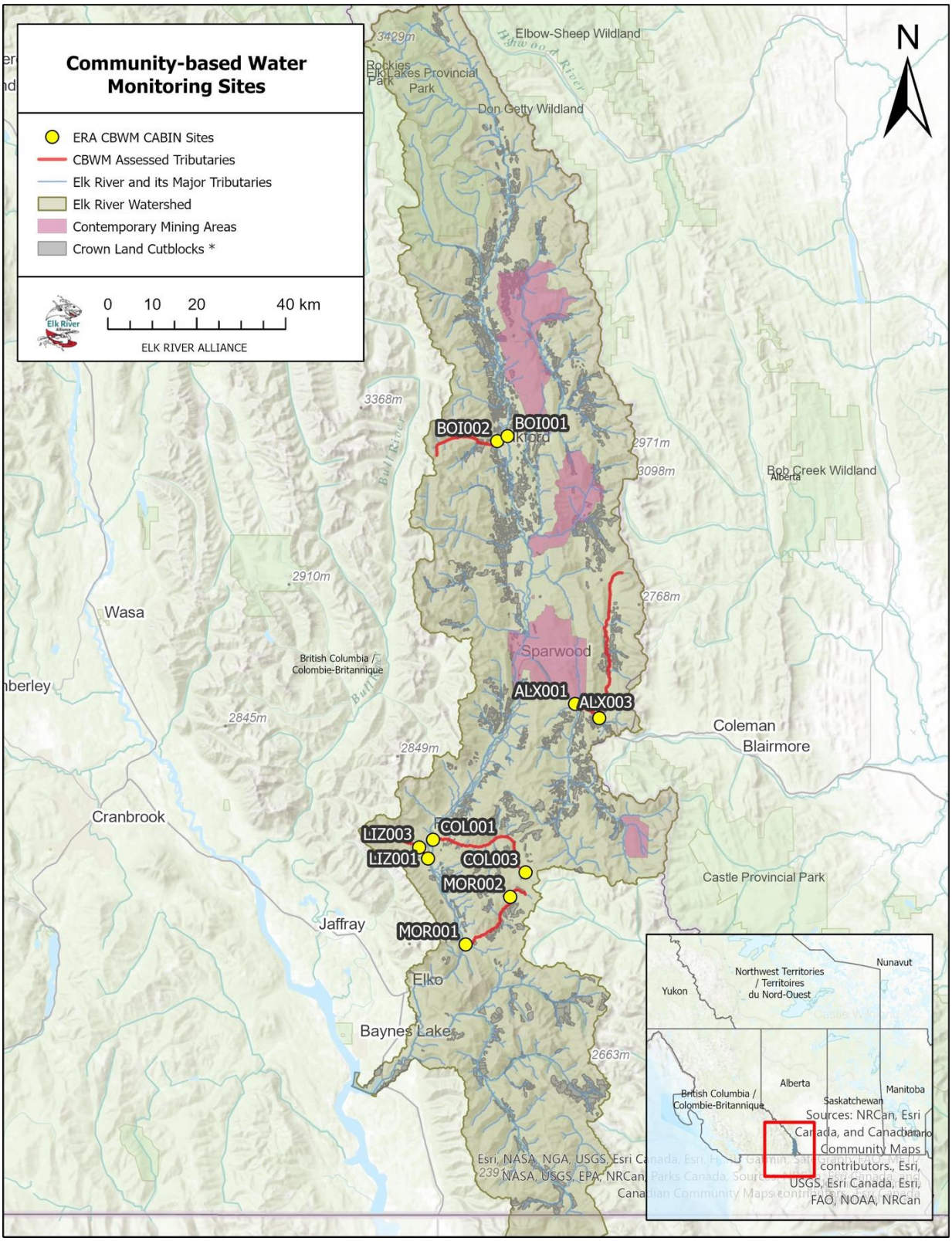
The Elk River Alliance's Community Based Water Monitoring (CBWM) program collects baseline data on aquatic habitat health and increases community water literacy in the Elk River Watershed, located in the East Kootenay Region of the Province. The program was created to fill gaps in watershed data, with findings creating an opportunity for community and industry discussion on watershed health and providing contextual information to decision makers. The program involves trained staff and volunteers conducting monitoring and research on targeted Elk River tributaries and sharing relevant findings with the community.

The valley's long-standing relationship with coal mining has resulted in the formation of extensive government and industry water monitoring programs covering a large extent of mine-affected areas. However, aquatic health of non-mine affected tributaries is not monitored despite impacts from other forms of land use. The Elk River alliance's Community Based Water Monitoring program began monitoring the effects of land use on non-mine affected Elk River tributaries to allow for a more well-rounded assessment of the state of the watershed. This program has expanded to now include five Elk River tributaries.

Study Area

ERA's CBWM program is located in the Elk River watershed, located within the East Kootenay region of British Columbia (Figure 1). This watershed begins at the Elk Lakes near the Continental Divide and extends to Lake Koocanusa, which extends across the Canada-US border. The communities of Elkford, Sparwood, Hosmer, Fernie and Elko are located along the river as well as rural properties in the Regional District of East Kootenay. .

In 2021, the CBWM program assessed ten sites across five major tributaries – Lizard Creek, Alexander Creek, Coal Creek, Boivin Creek and Morrissey Creek (Figure 1). All of these sites were chosen as they are areas of community interest and/or contain good aquatic habitat that ERA identified as important to monitor, preserve, or restore.



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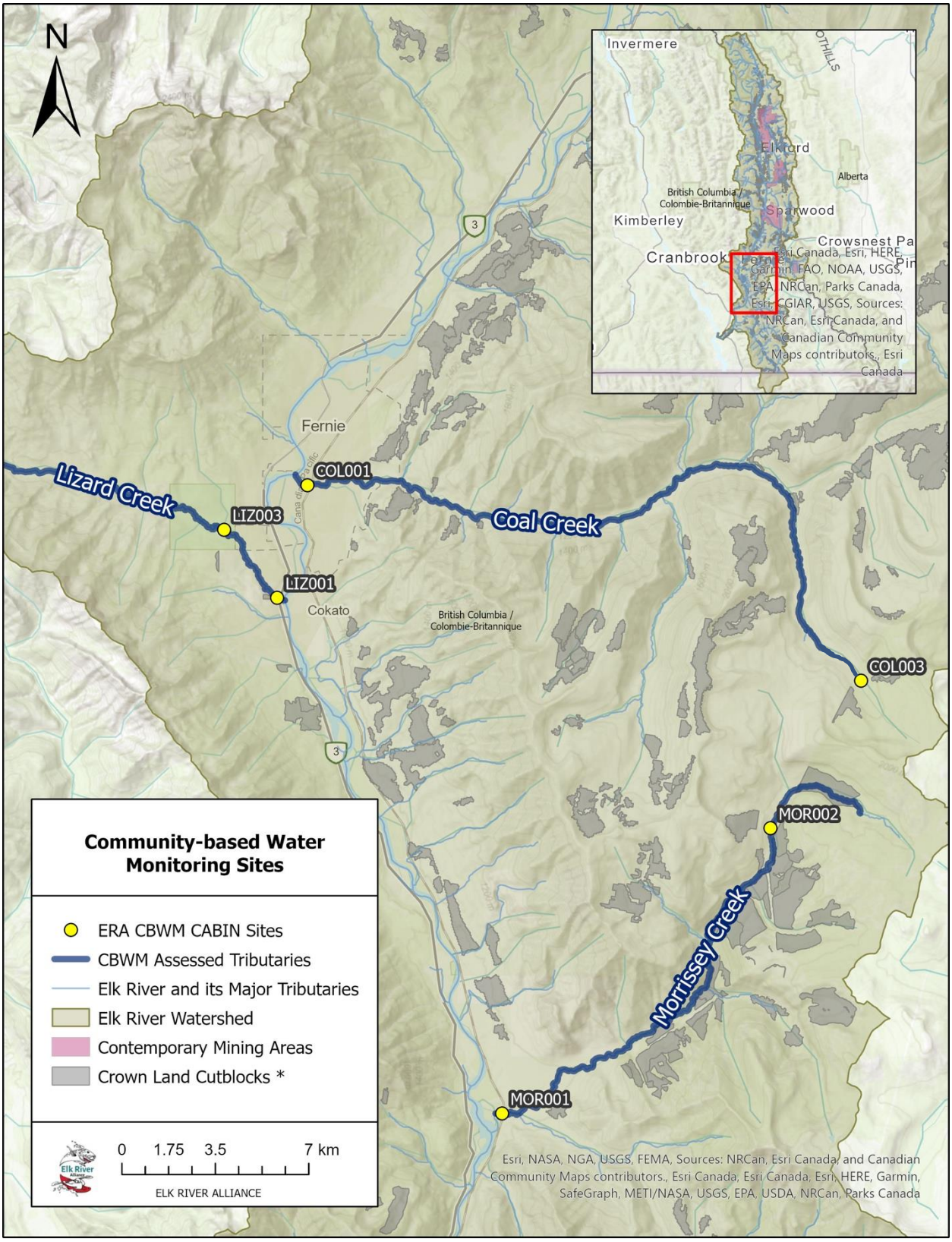

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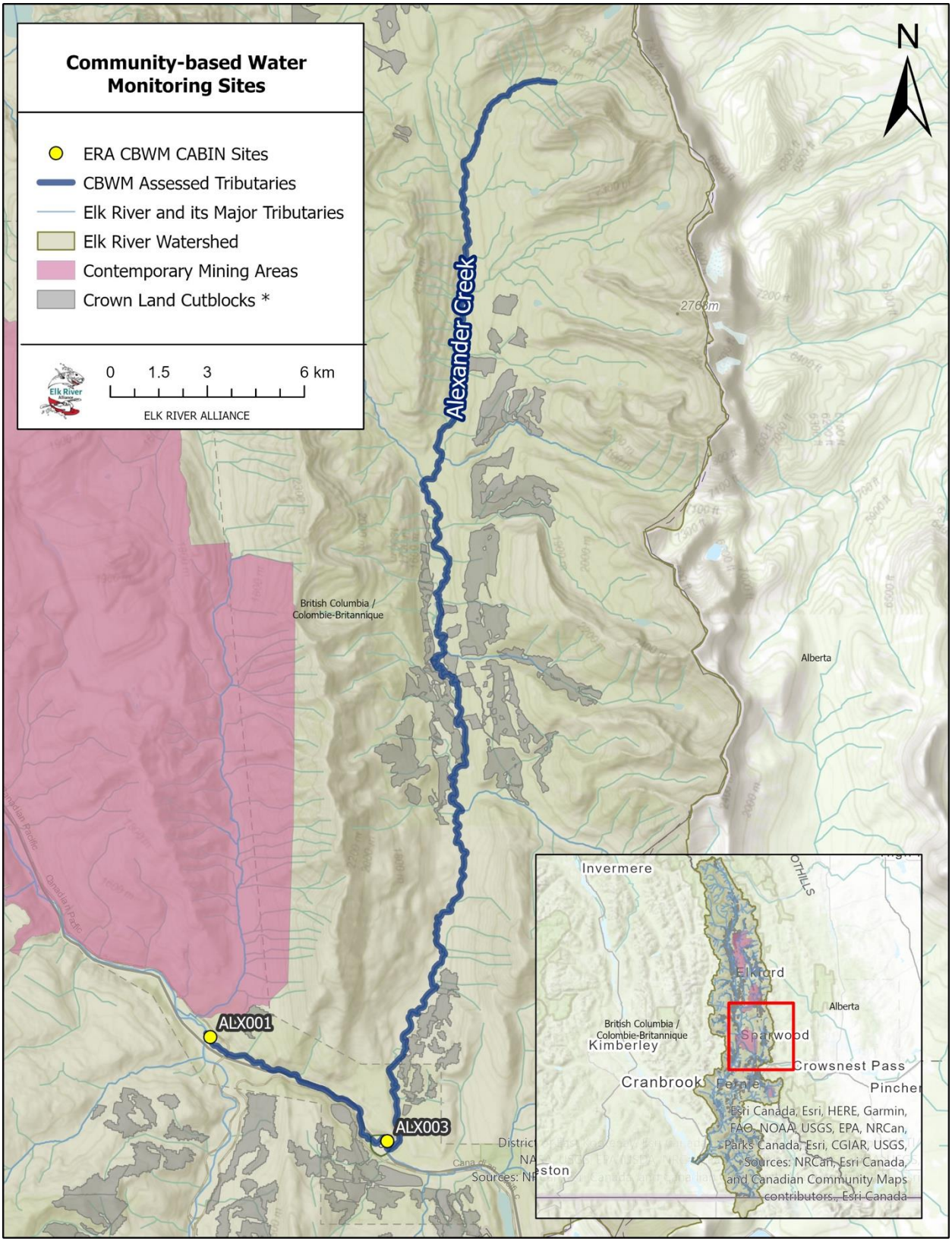

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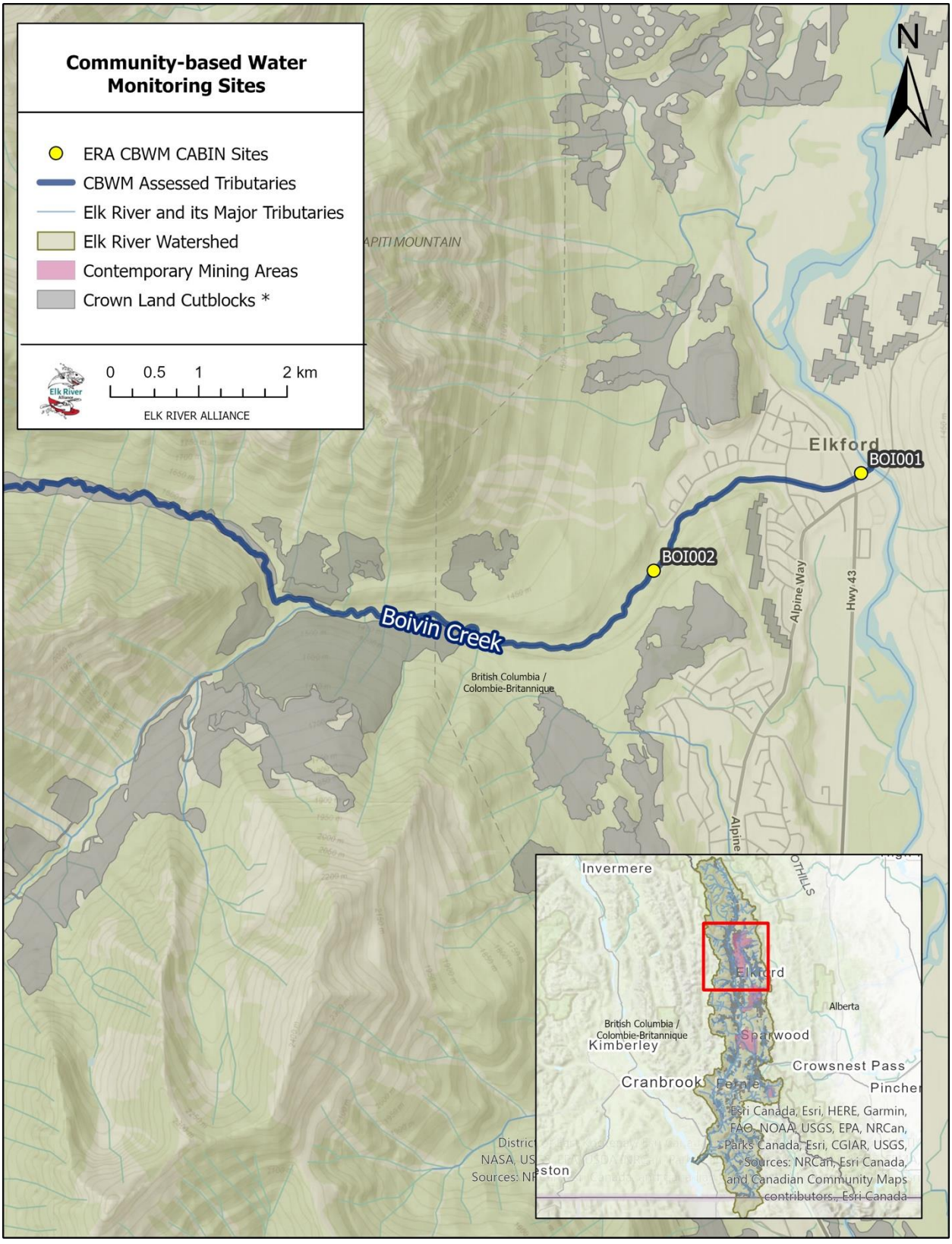

Figure 4. CBWM sites (BOI001, BOI002) on Boivin Creek in Elkford.

Lizard Creek

Lizard Creek, located approximately 5km south of Fernie, was the first Elk River tributary for ERA's CBWM program. It was initially assessed as a 'reference site' in 2011 since at the time, the creek and its catchment had relatively little residential development and no active industrial activity (although logging had occurred historically). A large amount of the lower portion of this creek falls within Mount Fernie Provincial Park and is protected. Upstream of the Provincial Park is Island Lake, a hotel and cat skiing area with access roads. Residential development in close proximity to the creek began in 2018. Lizard Creek has continued to be monitored as it contains important spawning grounds for Westslope Cutthroat Trout (Elk River Alliance 2020).

Since 2018, the Lizard Creek catchment downstream of the provincial park has seen increasing urban, road and trail development. ERA will continue to pay special attention to these sites as the surrounding land-use changes.

LIZ001

Figure 5. Images of LIZ001: upstream across the stream and downstream.

LIZ003

Figure 6. Images of LIZ003: upstream, across the stream and downstream.

Alexander Creek

In 2012, sites were established along Alexander Creek. This creek was identified as important due to its role as a significant tributary into Michel Creek, as well as the absence of effects from mining and urban development. The placement of sites along Alexander Creek allowed ERA to expand monitoring efforts into the Sparwood area. Sites along the creek were established to monitor effects related to stream proximity to the Crowsnest Highway, local logging and cattle grazing leases in the area.

The proposed Crown Mountain coal mine in the upper reaches of Alexander Creek poses an additional source of stressors, and continued monitoring here will provide baseline data for pre-mining conditions (NWP Coal Canada Ltd. 2014).

ALX001

Figure 7. Images of ALX001: upstream, across the stream and downstream.

ALX003

Figure 8. Images of ALX003: upstream, across the stream and downstream.

Boivin Creek

In 2018, Boivin Creek was selected in order to include Elkford in CBWM activities, and to contribute to a greater understanding of tributaries further upstream in the watershed. Boivin Creek was chosen for its undeveloped upstream catchment and to understand the effects of urban development and extensive riprap in its lower reaches.

BOI001

Figure 9. BOI001: upstream, across the stream and downstream.

BOI002

Figure 10. BOI002: upstream, across the stream and downstream.

Coal Creek

Coal Creek was added to the CBWM program in 2019. According to community discussions, this creek purportedly contained good quality habitat for Westslope Cutthroat Trout; however, few spawning sites were identified by ERA in a 2019 redd survey (Elk River Alliance 2020). Historical mining, logging, forestry, access roads, recreational trails/activities, and the old Fernie landfill are all likely stressors on this catchment. In recent years, increased clearcut logging activity and associated road development along Coal Creek continues to alter the waterways in this catchment area.

COL001

Figure 11. COL001: upstream, across the stream and downstream.

COL003

Figure 12. COL003: upstream, across the stream and downstream.

Morrissey Creek

The Morrissey Creek sites are the newest additions to ERA's CBWM monitoring locations, added in 2020 due to the presence of good quality trout spawning habitat coupled with logging, resource road use and cattle grazing activities in the catchment. Monitoring this creek is essential in understanding and potentially mitigating the effects of logging, linear development (forestry roads, gas lines), recreational use (vehicle and ATV access), agriculture, and natural erosion that may degrade Morrissey Creek.

MOR001

Figure 13. MOR001: upstream, across the stream and downstream.

MOR002

Figure 14. MOR002: upstream, across the stream and downstream.

Background Information

CABIN

2020 marked the completion of the CBWM program's transition from Streamkeepers-based stream assessment protocols to CABIN (Canadian Aquatic Biomonitoring Network) protocols for the assessment of aquatic health. CABIN is a nationally recognized program that uses a "reference system approach" to assess aquatic ecosystem condition and was designed with community-based water monitoring in mind. ERA staff and volunteers have been trained by certified CABIN trainers.

The reference system approach to assessment means study sites or "test sites" are compared to 'reference sites', or sites considered to be in pristine condition. CABIN uses a combination of physical, chemical and biological parameters, to statistically categorize a test site and analyze it in comparison to reference sites with similar hydrologic (amounts and quality of water), geomorphic (stream bed, channel features and bank forms) and geographic (topography, geology, climate, vegetation, and human setting) characteristics. The assumption is a test site in good condition will have similar assessed values to the associated reference sites, and the more polluted or poor quality the site is, the farther it will diverge from reference site conditions.

The use of CABIN protocols has greatly improved ERA's ability to produce data comparable to monitoring data collected by other organizations, government, and industry, increasing the validity of ERA's work and facilitating better data sharing.

In 2020, a new CABIN model for the Columbia Basin was released. In 2021, ERA's CBWM program upgraded from using the older Okanagan-Columbia 2020 model to the Columbia Basin 2020 model, which is tailored to a smaller, more specific region in BC, and includes the use of different criteria for site organization and assessment.

Habitat Variables

Geology, topography, stream morphology, climate and vegetation cover all play a critical role in stream health. The CABIN approach uses these characteristics to categorize and then assess test sites for similarities with reference sites. The physical characteristics of a test site are used to assign the site to a reference group for comparison.

These characteristics are important because the natural "pristine" state of a site is dependant upon these traits. For example, a creek with limestone as the primary underlying rock will naturally have a higher pH than a stream with sandstone as the base. If the CABIN test site was not compared to a suitable group of reference sites with similar physical variables results would not accurately assess the health of an area. For example, high pH could be interpreted as the result of a pollutant rather than a natural occurrence.

Physical Properties of Water

The physical properties of water – colour, temperature, turbidity, taste and odour - are useful indicators of what is occurring within a stream. The CBWM program assesses both temperature and turbidity to better understand the condition of studied sites.

The *temperature* of a stream needs to remain within certain limits for healthy aquatic life, and many species take their life stage cues from temperature changes in the water. For example, Westslope Cutthroat Trout (WCT) begin migration to spawning grounds when the temperature is between 7-10 degrees Celsius (Bear, McMahon, and Zale 2007). Figure 15 includes a visual representation of temperature limits for the survival of adult WCT. In green is the optimal temperature range for this species, with the orange-red showing the sub-optimal, or increased stress range. The bright red colour signifies the range at which the temperature increase becomes lethal for WCT. Outside of these temperatures, WCT do not survive.

Temperature is closely correlated with dissolved oxygen levels. Colder water contains higher oxygen levels, which are critical for the majority of stream life in the Rockies. Elevated water temperatures during WCT life stages such as embryo development (when oxygen requirements are particularly high) may result in embryo death or high mortality of alevins (a very young life stage, just after emergence from the egg). For example, if an early spring heat wave occurs and water temperature rises above 12°C, oxygen levels will fall below the guideline for protection of embryos and alevins (British Columbia Ministry of Environment and Climate Change Strategy 2021).

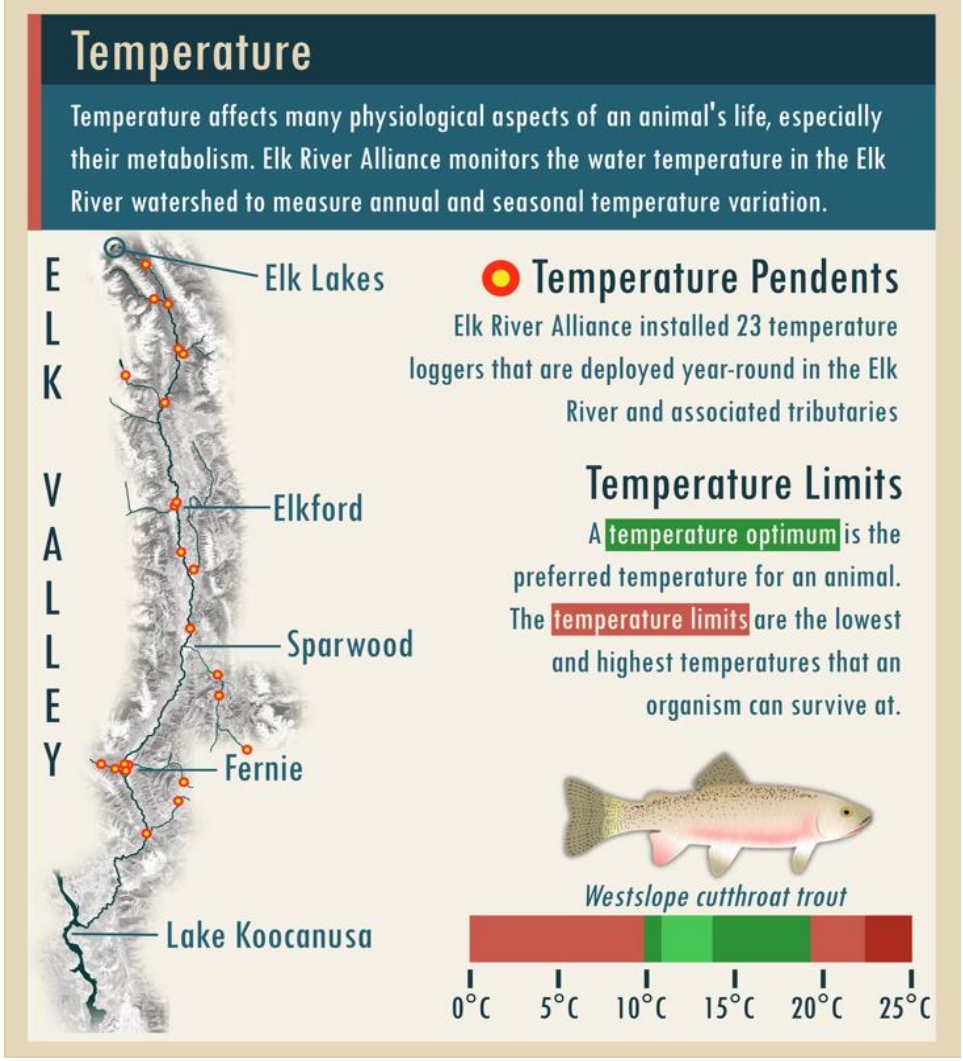

Figure 15. ERA Infographic outlining the importance of temperature to aquatic systems.

Turbidity is a measure of the ability of light to pass through water and is usually a reflection of the amount of sediment ((B.C. Ministry of Environment and Climate Change Strategy 2021b). Excess sediment can negatively affect aquatic life - reduces the amount of sunlight reaching aquatic plants and organisms, settles on the bottom of the stream reducing habitat for benthic invertebrates and smothering fish eggs (Figure 16)

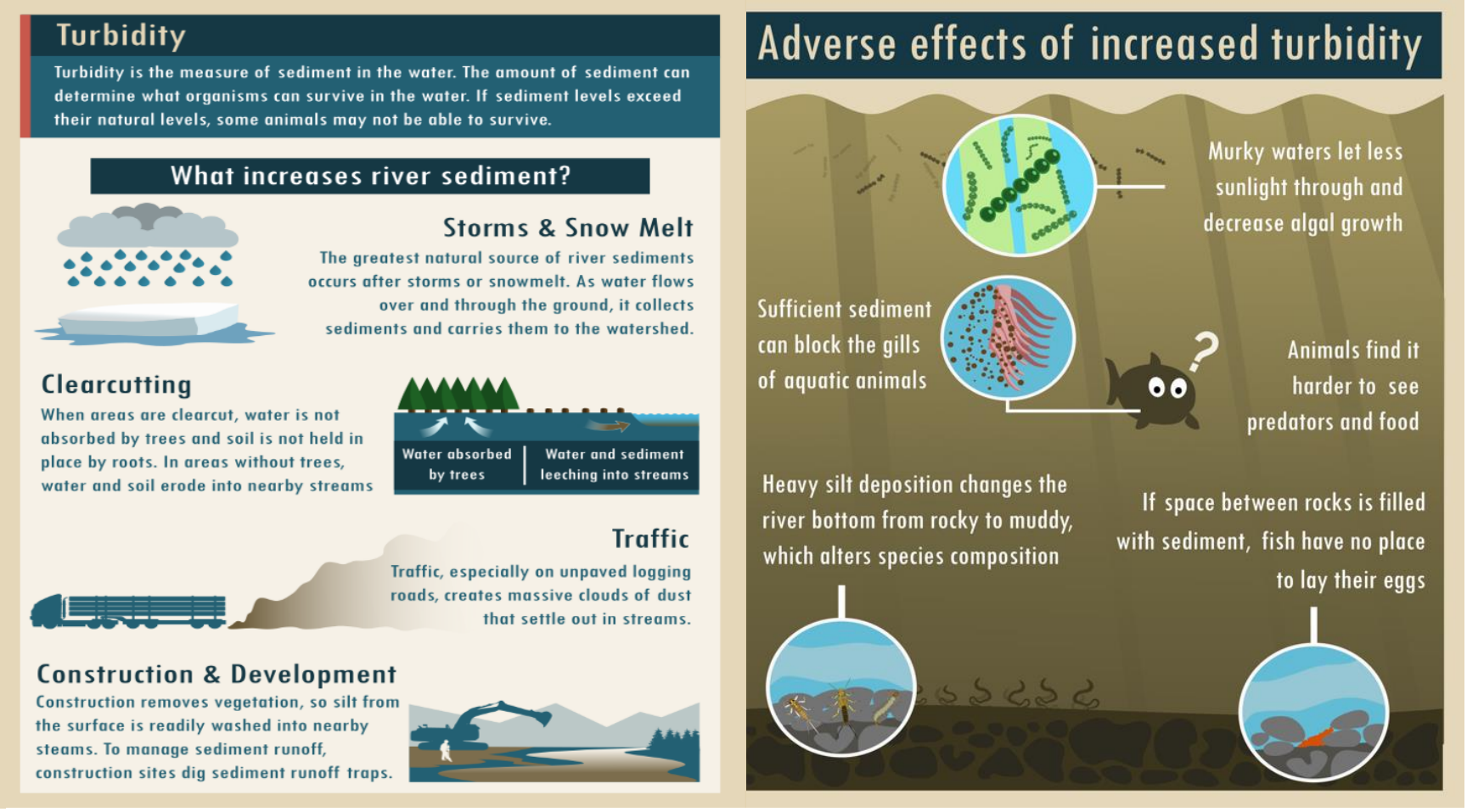

Figure 16. ERA CBWM infographic explaining turbidity and its importance.

Water Chemistry

Water chemistry parameters are important indicators of water quality. These parameters provide insight into the processes happening within a stream and the health of aquatic systems. Changes in water chemistry variables can signify landscape level changes or the introduction of new pollutants.

Dissolved oxygen, pH and conductivity are fundamental parameters measured as part of CABIN protocols. Aquatic life can only survive in water that falls within a specific range of water quality parameters. Unusually high or low measurements for any of these variables may suggest a problem in the stream.

Aquatic animals require enough dissolved oxygen for them to breathe easily. Oxygen levels depend on whether water is flowing or still, whether there are rocks or other obstacles for water to flow over, how many plants are growing in the water, and water temperature. Common causes of low dissolved oxygen are increases in temperature, decaying organic matter and weather (cloudy days reduce oxygen production from aquatic plants and algae). Excess nutrients added to the water via sewage or stormwater discharges, agricultural runoff or mine water discharges containing blasting residues can cause excessive algae growth which then decompose, using up oxygen. The amount of dissolved oxygen in water affects the types

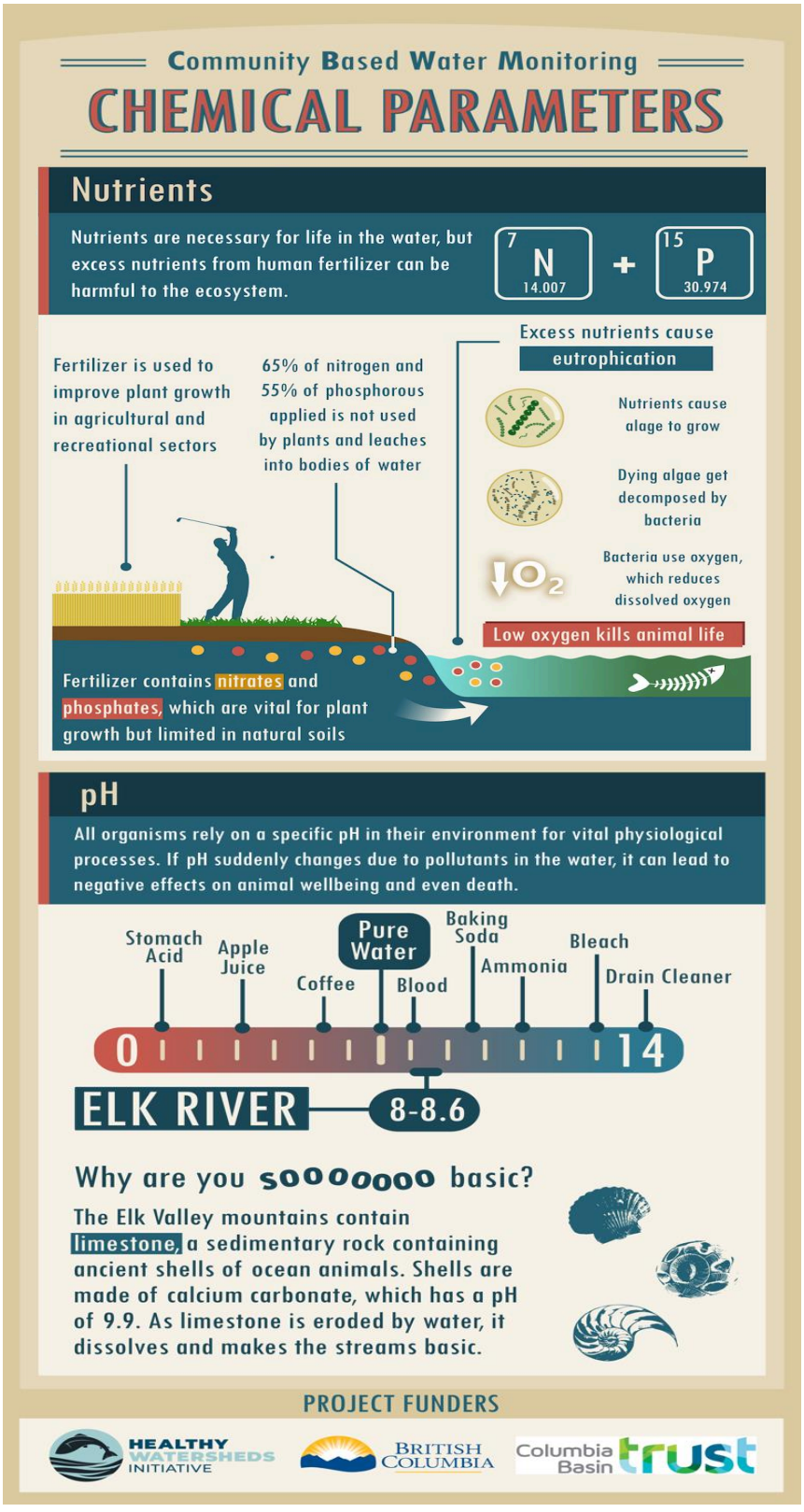

Figure 17. ERA infographic on chemical parameters associated with the CBWM program.

and health of aquatic life present. The lower the oxygen content, the less life that is able to persist in the water.

The pH range for freshwater aquatic life set by BC water quality guidelines is 6.5-9.0 Pure distilled water has neutral pH of 7. The local geology of an area can result in water that is alkaline or acidic. In the Elk River watershed, streams are more alkaline due to a limestone-based geology, and aquatic organisms have adapted to these conditions. When pH levels deviate from the original, natural ambient conditions, there may be direct or indirect effects on the health of aquatic organisms and partial or complete changes in species composition. The pH of water affects the solubility (amount that can be dissolved in water) and bioavailability (amount that can be used by aquatic life) of chemicals in water such as metals or nutrients (Government of British Columbia 2023). Low pH increases metal solubility. Thus, decreases in pH can damage fish gills via increases in dissolved metal concentrations which in, in turn, attach to the surface of fish gills, reducing oxygen uptake. Increases in pH can increase the concentration of the more toxic forms of ammonia in the water, killing fish quickly. (B.C. Ministry of Environment and Climate Change Strategy 2021a). Significant changes in pH can be caused by historic mine wastes, landfill leachate, runoff from cattle feedlots, recent draining of wetlands, asphalt production or disposal, and limestone gravel roads (US EPA 2003).

Conductivity is another measure that can indicate changes in aquatic health. It is a measure of the ability of water to pass an electrical current. Conductivity increases when there are more dissolved mineral salts such as sodium, potassium, magnesium, chloride and sulphate (Chapman 1996). Significant changes in conductivity can be indicative of increased or decreased mineral salts dissolved in the water. In the Elk Valley, high conductivity in stream water is often associated with groundwater influence (because groundwater naturally has higher concentrations of salts); however, an increase in conductivity may point to increased human disturbance. Mining commonly causes increased sulphate concentrations in surface waters. Sodium, calcium, or potassium chloride runoff due to road salting is another common source of increased conductivity.

In addition to measurement of dissolved oxygen, pH and conductivity, the CBWM program includes water samples collected for laboratory analysis of nutrients, total and dissolved metals, and major ions (salts).

Changes in physical and chemical parameters which fall outside of the range of natural variability can cause a cascade of effects on the diversity and productivity of aquatic life. If such changes are observed, further monitoring should be initiated to explore different local stressors as potential causes. From here, additional required mitigation and management measures can be identified. For example, if elevated water temperatures in areas known to be important for WCT spawning are shown to be connected to less vegetation along the streambanks providing shade, mitigation may include planting of fast-growing riparian species such as willow.

If CABIN analyses show a test site in poor condition, water chemistry results can provide vital insight into what is occurring in the system. Often, long term monitoring is needed to detect unusual changes in parameters such as conductivity, and then identify unnatural changes to stream chemistry.

Benthic Invertebrates

A “biological indicator” is an organism that can be used to monitor the health of an ecosystem. CABIN uses benthic macroinvertebrates (small aquatic insects and other species such as aquatic worms) as biological indicators of stream health. While water chemistry variables can provide a “snapshot” of what is happening at a distinct moment in time within an aquatic system, benthic organisms experience the cumulative effects of all the physical and chemical stressors interacting within this system over time. Benthic organisms tend to remain in one general location and can be an indicator of the effects of activities associated with land uses in that area. Changes in the health of an aquatic systems are reflected in the structure of the communities of these organisms within it.

In general, aquatic communities consist of groups (taxa) that are tolerant to pollution and those that are sensitive to it. By comparing the amount of tolerant versus intolerant groups in a community, assumptions can be made about the overall health of a system. For example, mayflies (*Ephemeroptera*), stoneflies (*Plectoptera*) and caddisflies (*Trichoptera*) are all, generally, considered to be sensitive to pollution, while groups like midges (*Chironomidae*), leeches (*Hirudin*ea) and worms (*Naididae*) are considered to be more tolerant to pollutants. A high number of midges, leeches and worms and little of anything else is a likely indication of a stream in poor condition (Figure 18).

CABIN assessments use the composition of the benthic macroinvertebrate community (at the taxonomic level of family) within the stream, and their sensitivities, to make assumptions about the health of the system.

STREAM e-DNA

In 2020, the CBWM program was further expanded to include participating in STREAM e-DNA sampling; a trial for a future phase of CABIN monitoring, where additional benthic invertebrate samples are collected and analyzed to a finer taxonomic resolution using DNA analysis (Wright, Robinson, and Hajibabaei 2020). This means benthic organisms can be identified to the species level. STREAM e-DNA is not currently part of the CABIN analysis process, and the aim of these trials is to potentially incorporate this feature in future monitoring efforts.

Although DNA analysis only produces data on presence versus absence of benthic species, it may prove helpful for the early identification of pathogenic species. For example, the *Tubifex tubifex* species of worm can host whirling disease (*Myxobolus cerebralis*), and the presence of *T. tubifex* may indicate a reach is vulnerable to whirling disease infection.

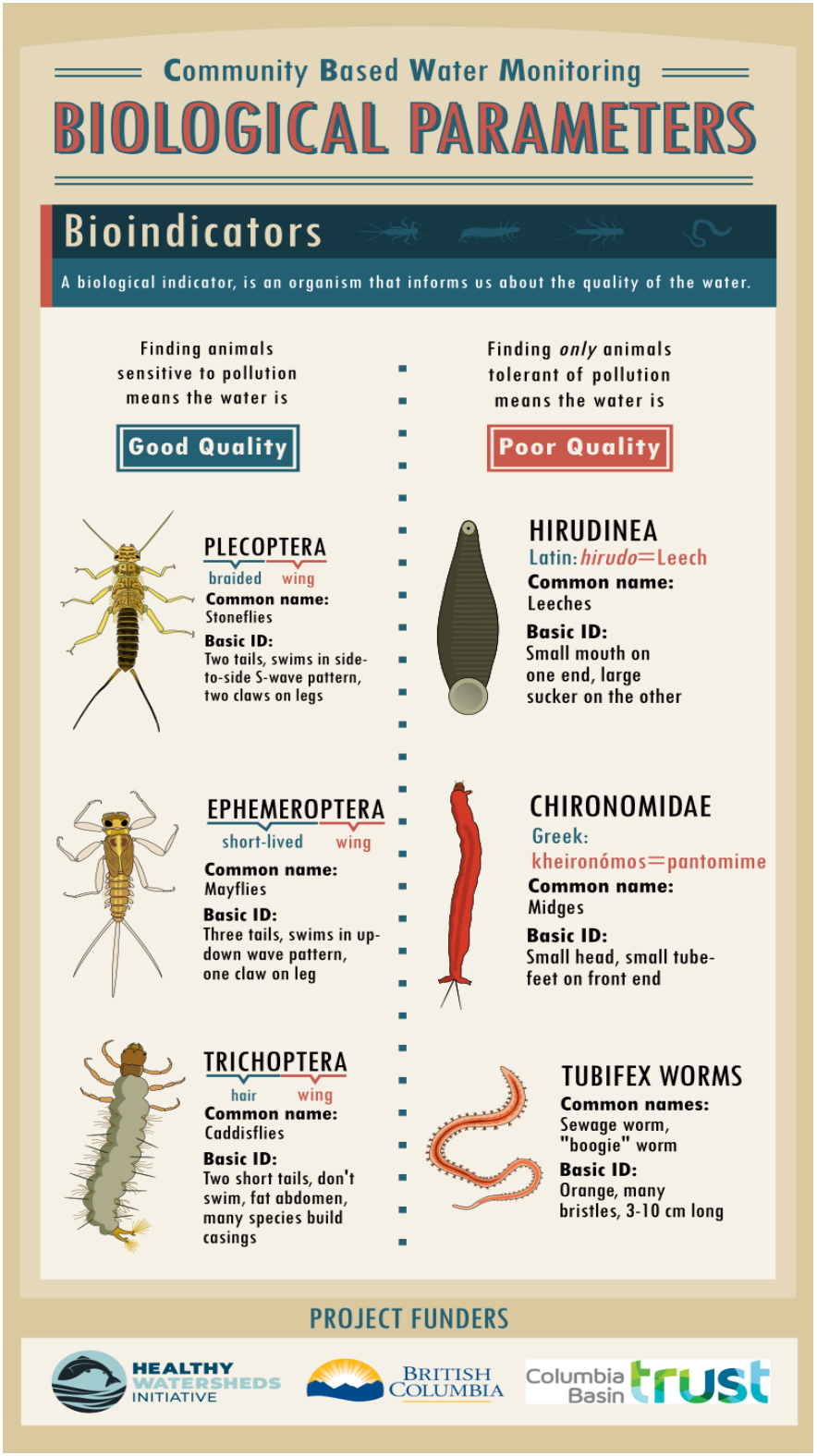

Figure 18. ERA infographic outlining the biological parameters associated with the CBWM program.

Methods

Site Selection

The Elk River Alliance's CBWM sites are chosen based on community input and/or the presence of important habitat that warrants monitoring. Areas of interest are identified using a combination of GIS (Geographic Information System) and in-person assessments. Representative sites along a creek are chosen to capture the effects of different types of land-use or disturbance. Typically, sites are placed upstream and downstream of suspected impacts or stressor source point. Sites may also be placed just above the confluence of tributaries to gain an overall idea of water quality and stream habitat health within a catchment.

Aquatic Habitat Assessment

Test sites were assessed using the techniques outlined in the Canadian Aquatic Biomonitoring Network (CABIN) Field Manual for Wadeable Streams (Carter 2012).

At each site, a detailed site description, including GPS location, surrounding land-use, site drawing, photographs, and reach[1] characteristics are recorded. This includes information on habitat types, canopy coverage, streamside vegetation and the amount of macrophyte (aquatic plants) and periphyton (organisms growing on submerged surfaces – i.e. algae, cyanobacteria, etc.) coverage.

Water chemistry measurements and water samples are taken at the lower end of the reach to avoid disturbing benthic macroinvertebrate communities. This includes the collection of on-site water quality parameters (temperature, dissolved oxygen, pH, conductivity, ORP, turbidity), and any samples that need to be taken for laboratory analysis of metals, nutrients, and major ions.

Next, the benthic macroinvertebrates are collected using the "kick-net" method, which includes 3 minutes of travelling backwards upstream, with a large net placed on the bottom of the stream, and aggressively kicking rocks to send any insects hanging on into the kick-net. Organisms and material collected in the net during these 3 minutes is moved into a sample jar and preserved with the appropriate chemicals.

When STREAM protocols are included, 3 additional 'kick-net' samples are collected, prior to the standard CABIN "kick-net" sampling, using the same protocol but with full decontaminations of the equipment and sampler before each round (Wright, Robinson, and Hajibabaei 2020). Since STREAM focuses on taxonomic identification through DNA, proper decontamination is necessary to avoid tainting the samples. Benthic invertebrate sampling is always performed beginning downstream and moving upstream. STREAM samples are collected in sampling jars and preserved according to STREAM protocols. Only the lower site on each creek (near the mouth) were included in the STREAM program (i.e., COL001, MOR001 etc.).

CABIN requires the sampler to collect information on substrate characteristics. This includes following the kick-net path while counting and measuring 100 pebbles from the bottom of the stream and assessing every 10th pebble for embeddedness. The surrounding substrate, or streambed, material is also assessed based on size and consistency.

Finally, the study site channel characteristics are measured. The width of the stream during high flow (estimated based on bank structure and changes in vegetation) and current flow is measured, as well as

[1] Reach is the length of the stream included in the test site – usually 6 times the stream width.

the slope, depth, velocity and overall discharge of the stream.

For more details on CABIN and STREAM protocols, please see the *Canadian Aquatic Biomonitoring Network (CABIN) Field Manual for Wadeable Streams*, and *STREAM: Procedure for collecting benthic macroinvertebrate DNA samples in wadeable streams* (Carter 2012; Wright, Robinson, and Hajibabaei 2020)

Laboratory Analysis

Basic water quality parameters – temperature, pH, conductivity, and dissolved oxygen – were tested on site by trained ERA staff and volunteers. Samples acquired during site assessments were preserved appropriately and shipped to independent laboratories for further analysis.

Water Chemistry

CARO Analytical Services in Kelowna, BC was responsible for 2020 water chemistry analyses. Typically, ERA CBWM sites are assessed for total and dissolved metals, nutrients, cations and anions (e.g. chloride, sulphate, carbonate) (Appendix C: CARO Reports).

Benthic Invertebrate Taxonomy

ERA contracted Surrey-based, CABIN-approved, aquatic invertebrate taxonomist, Pina Viola (B.Sc. Biology, SFS, SAFIT) to assess benthic macroinvertebrate samples for the CBWM program. She sorted, identified, and performed data entry for benthic invertebrate samples, following CABIN laboratory protocols (Environment and Climate Change Canada 2020).

Data Analysis

As per CABIN Wadable Streams Protocols, all data collected was entered into the Environment and Climate Change Canada (ECCC) national CABIN database, under “CBWQ – Elk study”.

In 2021, ERA shifted from using the older Okanagan-Columbia 2010 preliminary model to the new Columbia Basin 2020 model, to perform CABIN assessments. The new model includes 156 reference sites across the Columbia Basin, with 11 of these falling within the Elk River Watershed, an additional 4 in the neighbouring Flathead area, and 1 within the Bull River basin (Stephanie Strachan 2020).

To prepare site data for CABIN analysis, characteristics based on GIS data were assembled. Catchments for each site were delineated using GIS software and analysed for model requirements: drainage area (km2); % grassland; % low shrubland; % water; mean precipitation for October; minimum temperature for December; % sedimentary rock; and maximum slope.

From here the CABIN database sorts sites into smaller groups based on similarities in characteristics to designated groups of reference sites, then performs a BEAST (Benthic Assessment of Sediment) analysis to assess the health of a site, in comparison to similar reference sites, based on the benthic community structure, the functional responses of these invertebrates, and selected habitat variables. These analyses produce “community ellipses” for each site, which is an ordination plot that visually represents how similar reference sites are to each other and where a test site fits into the comparison among sites. The center ellipse represents reference condition. The further out from the center ellipse a test site appears,

the more it has diverged from the reference condition and the more likely it is to be in poor condition.

Where sites appeared to be diverging from reference condition, data were further explored to investigate pattens associated with these sites. Specific water chemistry results were assessed for any notable results. RIVPACS and Bray-Curtis dissimilarities were used to assess issues with benthic community structure.

RIVPACS (River Invertebrate Prediction and Classification System) is an aquatic biomonitoring system used to assess water quality. It measures taxa richness (presence/absence but not abundance), based on expected taxa according to reference sites versus what is observed at a test site. A value of 1, indicates the test site is similar to the reference sites, while values above 1 indicate increasing differences from the reference sites (and more taxa), and values below 1 indicate increasing differences but less taxa, and likely poorer conditions.

Bray-Curtis dissimilarity is a statistical assessment to measure the dissimilarity between sites based on numbers within groups at each site. In CABIN, the Bray-Curtis dissimilarity is used to measure both richness and abundance of test sites compared to the mean values of the reference sites. A value of 0 means that the sites are in good condition, similar to the mean values of the reference sites, while a value of 1 indicates complete dissimilarity.

Results & Discussion

In 2021, 10 sites were assessed across 5 tributaries – Lizard Creek, Alexander Creek, Boivin Creek, Coal Creek and Morrissey Creek. The use of the new Columbia 2020 CABIN model produced very different results from what was expected based on outcomes from the previous model (Okanagan-Columbia 2010 Preliminary model). This new model is specifically tailored to the Columbia Basin and is considered more sensitive that the previous model. While the Okanagan-Columbia covered 2 large basins using only 113 reference sites for the entire area, the new Columbia Basin model, along with focusing on a smaller, more specific area, includes twice as many reference sites as the previous model, as well as a validation dataset for testing the model. Reference groups in the previous model were largely determined by location – i.e. a majority of the sites in group 3 were in the East Kootenays, while Group 2 were primarily from the Okanagan basin - whereas groups within the new model appear to be more evenly spread across the entire region (Gaber 2012; Stephanie Strachan 2020).

The accuracy of some of these new results is uncertain, and ERA is currently investigating explanations for some of the unexpected assessment results – unknown stressors, the ability of the model to represent each site, field or data entry errors, etc. CABIN assessments indicate that most test sites have a similar benthic community structure to their associated reference sites, with the exception of the lower Coal Creek (COL001), lower Morrissey Creek (MOR001), and both Lizard Creek sites (LIZ001, LIZ003). According to the CABIN assessment model, all four of these sites diverge significantly from the designated ‘reference condition’.

Lizard Creek

Lizard Creek sites – LIZ001, LIZ003 – were "highly divergent" in 2021 (Figure 19). According to the old CABIN model (Okanagan-Columbia 2010 Preliminary model), LIZ001 (the site near the mouth) fluctuated between being in reference condition to mildly divergent between 2012 and 2021 (Figure 20). With the application of the new Columbia 2020 CABIN model, both Lizard Creek sites were "highly divergent "in 2020 and 2021 (Figure 19, Figure 21, Figure 22). Year to year changes using the new model indicate a steady shift at LIZ001 from reference condition to highly divergent from 2014 to 2017, then remaining at highly divergent from 2017-2021. The previous model did not generate this result and ERA is exploring potential reasons for this dramatic shift in assessment result between models.

Notably, the new Columbia 2020 CABIN model sorted the LIZ001 site for comparison with different reference groups for 2012, 2014 and 2015, meaning the reference sites that LIZ001 was compared to changed. Generally, sites are expected to be compared with the same reference group from year to year (based on the assumption that the fundamental geological, topographic, climate, stream morphological and vegetation cover characteristics remain the same). Capturing the full range of ecological variation of reference sites using an adequate number of sites sampled with sufficient frequency is critical for confident interpretation of CABIN data (S Strachan and Reynolds 2014). The changing assignment of the reference group for the LIZ001 site may indicate model or technician error rather than a truly changing site condition.

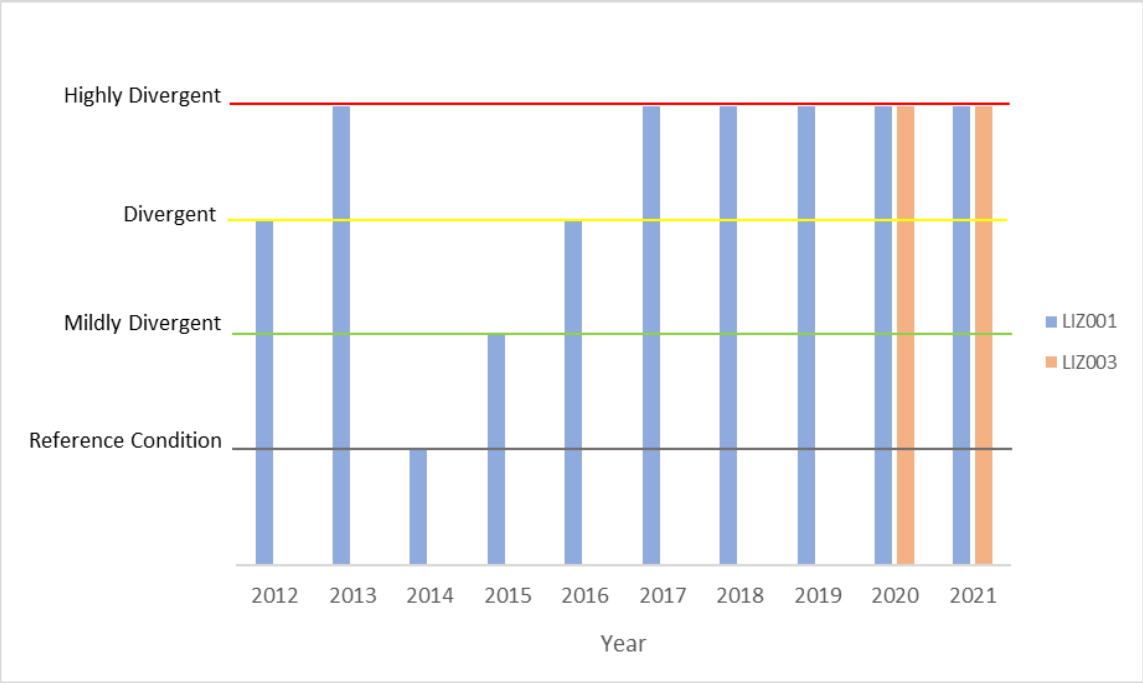

Figure 19. CABIN analysis results for Lizard Creek sites from 2012 – 2021 using the Columbia 2020 CABIN model.

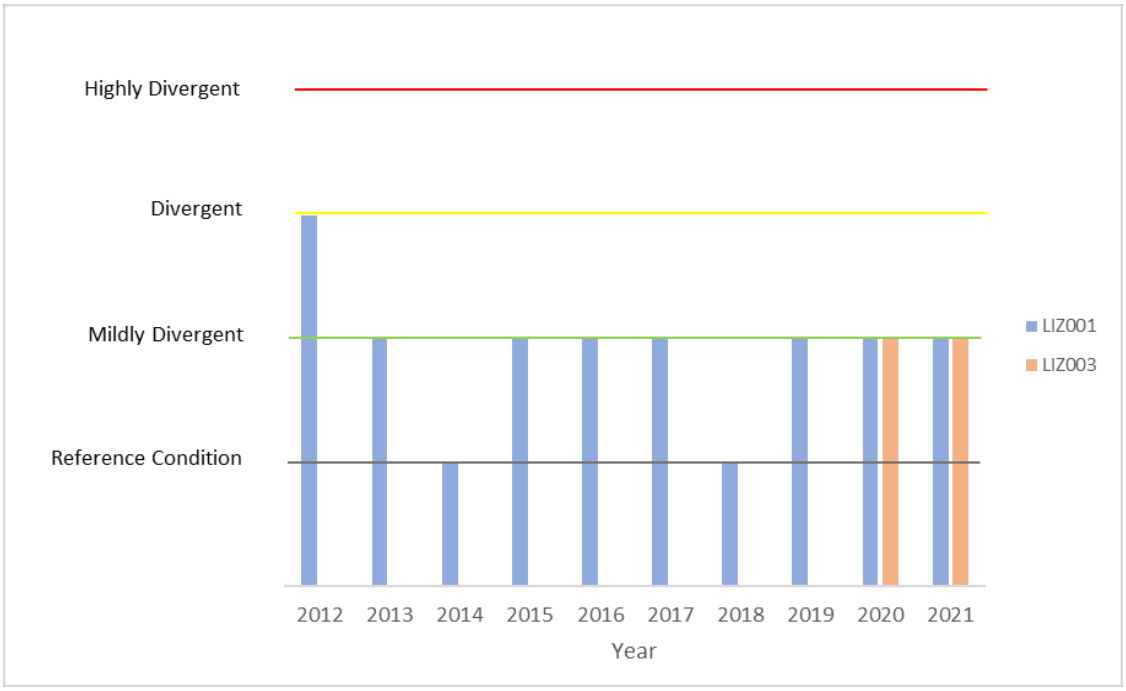

Figure 20. CABIN analysis results for Lizard Creek sites from 2012-2021 using the Okanagan-Columbia 2010 Preliminary model.

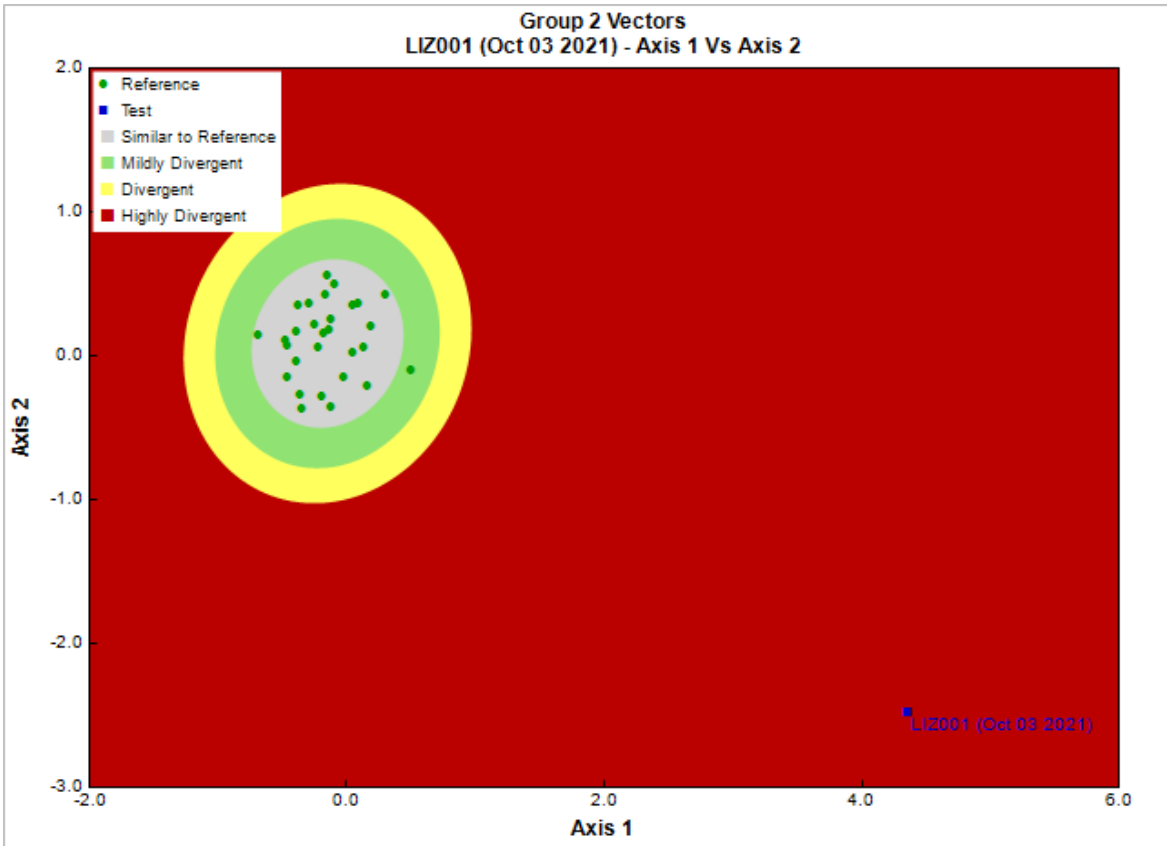

Figure 21. CABIN community ellipses for LIZ001 in 2021.

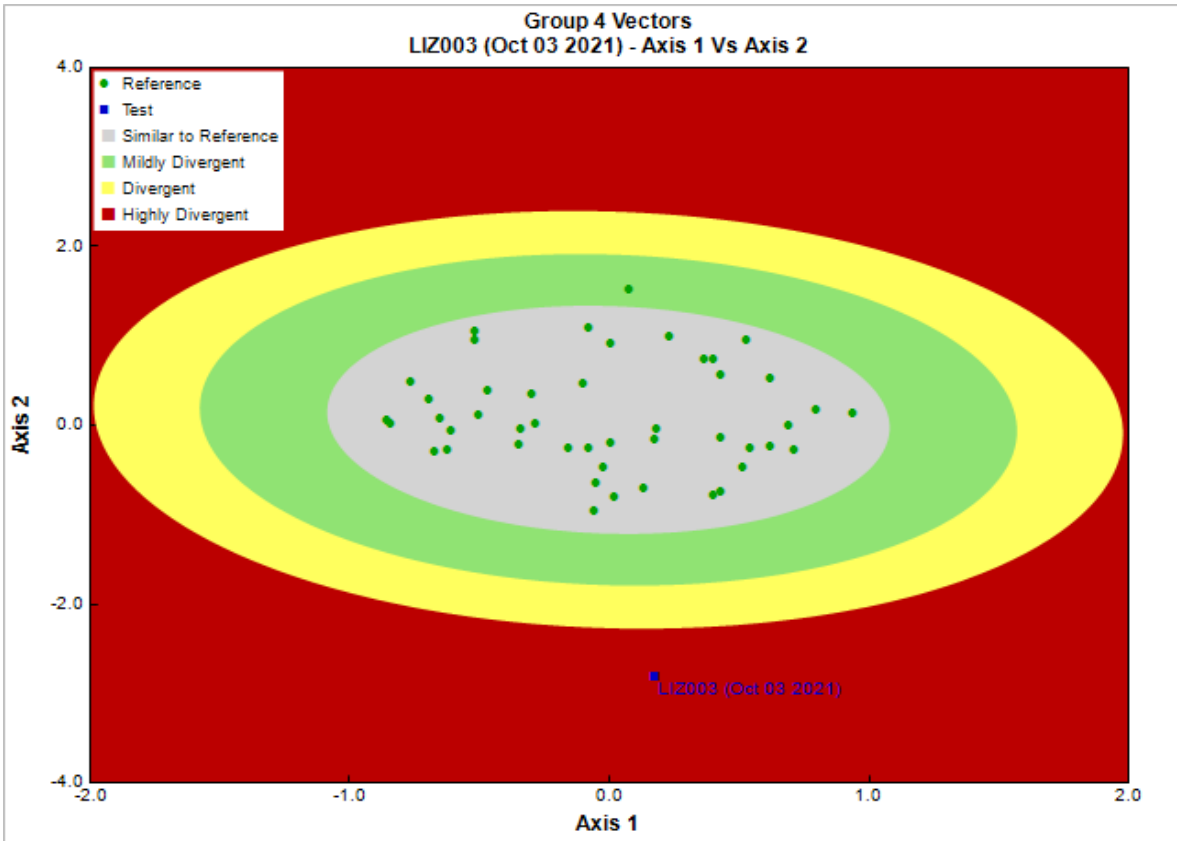

Figure 22. CABIN community ellipses for LIZ003 in 2021.

Both sites differ from reference sites according to the Bray-Curtis dissimilarity (LIZ001: 0.96, LIZ003: 0.93); however, RIVPACS assessment suggests that these sites still have good species richness. This difference may be in part due to a larger number of taxa present (Table 1). %EPT for both sites (37.45% and 60.09%, respectively) is far lower than what would be expected based on the reference site means (91.94% ±7.29; 88.13% ±9.26) but the total abundance of benthic macroinvertebrates was significantly higher than expected according to mean reference site values which may contribute to the unexpected significant divergence from reference condition (i.e. LIZ003, the upper Lizard Creek site, had 18 times abundance of associated reference sites' mean) (Table 1). The high abundance with lower diversity (and low EPT) within the populations at Lizard Creek may signify declining health of the Lizard system; however, without further investigation, it is difficult to eliminate the possibility of model/sampling issues. Comparison of differing methods of benthic invertebrate collection has shown that many metrics display greater differences between methods than between streams (Valois et al. 2009). Comparison of the CABIN method with a "live pick" method showed that streams sampled using the CABIN method may be more likely to be assessed as stressed as they are often lower in many metrics used as indicators of reference conditions, including taxa richness and %EPT (Valois et al. 2009).

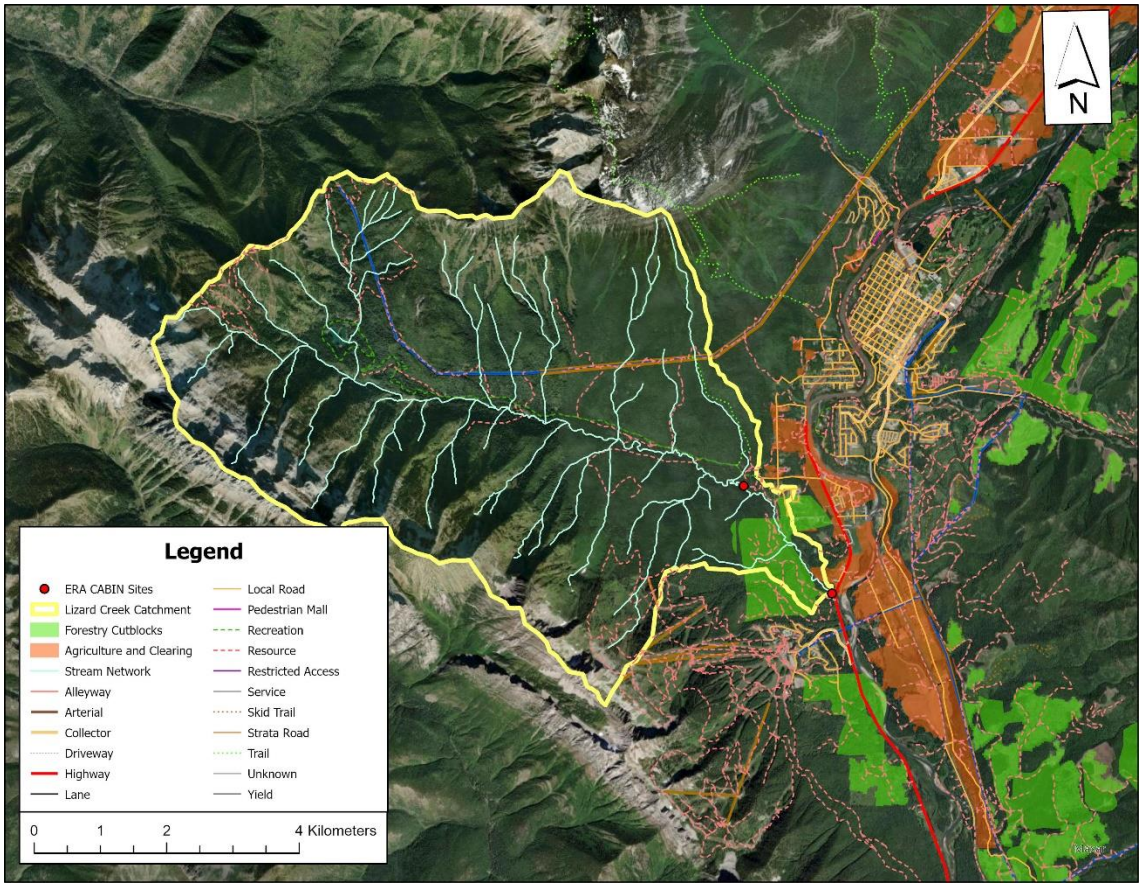

Figure 23. Land use in the Lizard Creek Catchment

Based on ERA's understanding of Lizard Creek, it would be unexpected for LIZ003 to be in very poor health. The LIZ003 site is within Mount Fernie provincial park and Island Lake Lodge is located near the headwaters of the creek (cat skiing, hotel and restaurant operations). There is a resource road that runs alongside Lizard Creek for approximately 9.5 kilometers from Highway 3 to Island Lake Lodge and comes within 300 meters of the creek at different points along the way (See

Figure 23 for more details on land use within the Lizard Creek catchment).

There are a number of tributaries that cross over this road and eventually feed into Lizard Creek. Recreational use is moderate-to-high depending on the time of year, with many formal and informal trails used for skiing, biking, hiking, and horseback riding. Anecdotal observations indicate the presence of fish in good condition in Lizard Creek as well as spawning redd and fry and fingerling rearing area. However, regular visitors to the creek have noted increasing algae growth (particularly filamentous algae). Increased algae growth may indicate increased nutrient inputs to the creek. Photos of Lizard Creek at the downstream site (LIZ001) taken during CABIN monitoring between 2012 and 2021 are not clear enough to confirm this (See Appendix F). Similarly, due to the qualitative nature of visual periphyton coverage categorization during CABIN monitoring, it is difficult to draw definitive conclusions regarding algal growth over time – these assessments seem to suggest a decrease in coverage for 2015 & 2016, but otherwise fluctuate between 1-5mm and 5-20mm coverage categories.

LIZ001 is closer to the Lizard Creek confluence into the Elk River (Figure 21). This site is downstream from the provincial park and has greater potential to be affected by human disturbance from residential development adjacent to the stream as well as recreational uses in the provincial park and adjacent private lands. Proposed future residential development adjacent to Lizard Creek, with associated access roads, water withdrawals from aquifers (which contribute to baseflow in the creek), and increased access for recreational uses may contribute additional impacts to those which may already be occurring. ERA is committed to continued monitoring of Lizard Creek as human activities in the catchment increase.

ERA is currently exploring possible causes for the large, unexpected shift in assessment results produced by the new model. Causes under investigation include technician or data collection errors, issues with the new model's method of grouping sites with similar reference sites, a possible lack of appropriate reference sites and potential unknown stressors affecting the creek.

Preliminary investigations into water quality parameters have not identified a clear cause - all measured water quality variables met BC guidelines for the protection of aquatic life and there have been no consistent worsening trends in dissolved oxygen, pH, conductivity, turbidity or temperature (see the water quality section below). However, trends cannot reliably be determined by "snapshot" sampling. ERA is currently implementing a network of real-time flow, temperature and turbidity monitoring in all CBWM streams. In the meantime, a closer look at the data has allowed ERA to begin flagging specific water quality parameters for more in-depth continued monitoring.

Anecdotal observations of algal growth, led to an exploration of nutrient levels within Lizard Creek – both phosphorus (Figure 24) and sulfate levels (Figure 25) within Lizard Creek are regularly higher than the other CABIN monitored creeks. Although there is currently there is no Water Quality Guideline for Phosphorus in streams in BC, the long-term chronic limit within lakes is 0.015mg/L – this may be a parameter to consider for future examinations. Sulfate measurements at Lizard Creek sites are all well below limits outlined in the BC Water Quality Guidelines (429 mg/L), but these limits are based on a maximum hardness ($CaCO_3$) of less than or equal to 250mg/L, which is at the lower limit of what is measured at Lizard Creek sites (~250-350mg/L Hardness, as $CaCO_3$) – there is no current guideline for above this level & documents suggest that a site-specific upper limit may need to be explored.

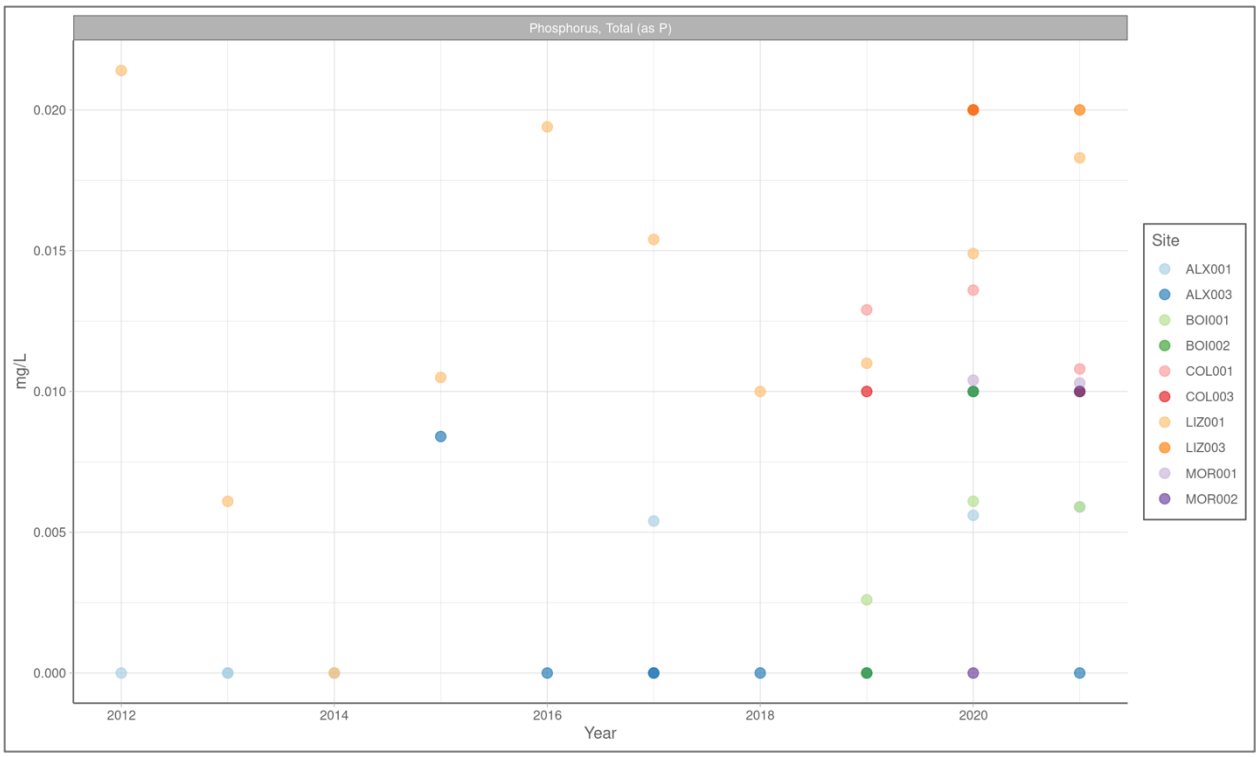

Figure 24. Amount of Phosphorus (mg/L) measured at monitoring sites during yearly CABIN sampling between 2012 and 2021.

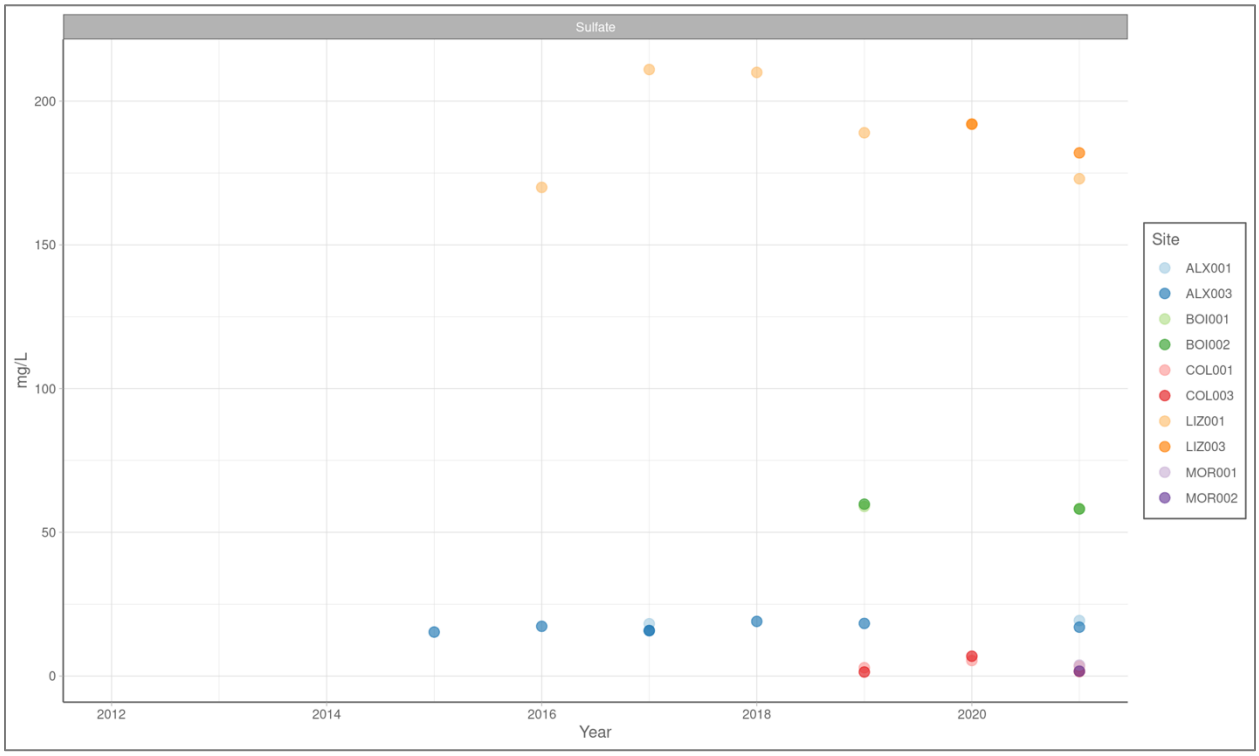

Figure 25. Amount of Sulfate (mg/L) measured at monitoring sites during yearly CABIN sampling between 2012 and 2021.

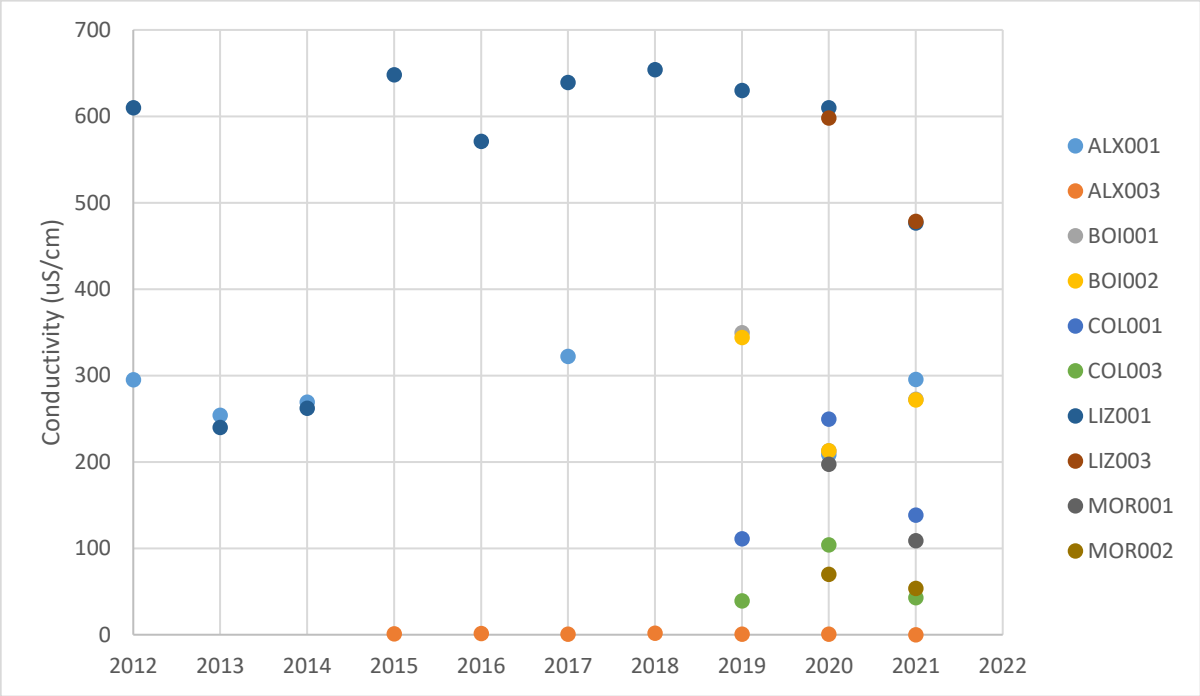

Figure 26. Conductivity at ERA CABIN sites between 2012 and 2021.

Other measured parameters, namely, hardness, conductivity, calcium and magnesium were also flagged, as their levels are higher in Lizard Creek than at other monitoring locations.

Hardness (CaCO3) levels are relatively high at most CABIN monitoring sites, primarily due to the limestone-based geology of the Elk Valley (Figure 27). Limestone is easily eroded and minerals like Calcium and Magnesium are released into streams with this erosion. High amounts of these minerals will also result in higher conductivity values for a stream. Lizard Creek sites see the highest levels of hardness (CaCO3), calcium (mg/L), magnesium (mg/L), and conductivity (uS/cm) of all monitoring locations (Figure 28; Figure 29; Figure 26). These elevated levels are likely related to increased groundwater influence (more interaction with limestone) at this site, but further investigation is needed to confirm this.

Although high amounts of these minerals, in the right conditions, can cause calcite to precipitate on rocks within a stream, naturally elevated levels are not a concern. These elevated levels instead act as evidence to call into question the ability of the CABIN 2020 Columbia Basin model to accurately represent Lizard Creek. Reference sites that are used in the current model to assess Lizard Creek have significantly lower levels of these same parameters – hardness (≅100 ± 77.36 mg/L), calcium (≅ 100 ± 20.063 mg/L), magnesium (≅9 ± 7.544 mg/L), and conductivity (≅120 ± 104.00 uS/cm). Additional investigations will be necessary to continue to explore the validity of this CABIN model for the assessment of Lizard Creek.

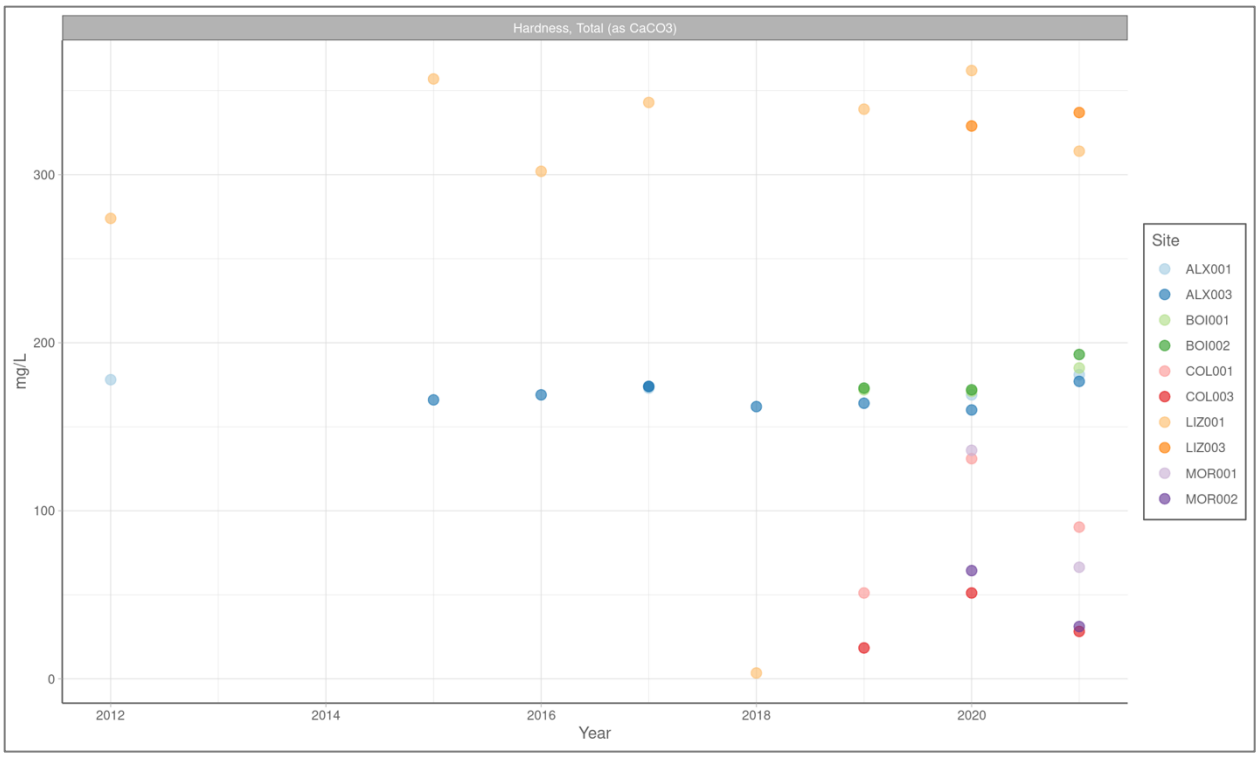

Figure 27. Hardness (CaCO3) levels (mg/L) measured at monitoring sites during yearly CABIN sampling between 2012 and 2021.

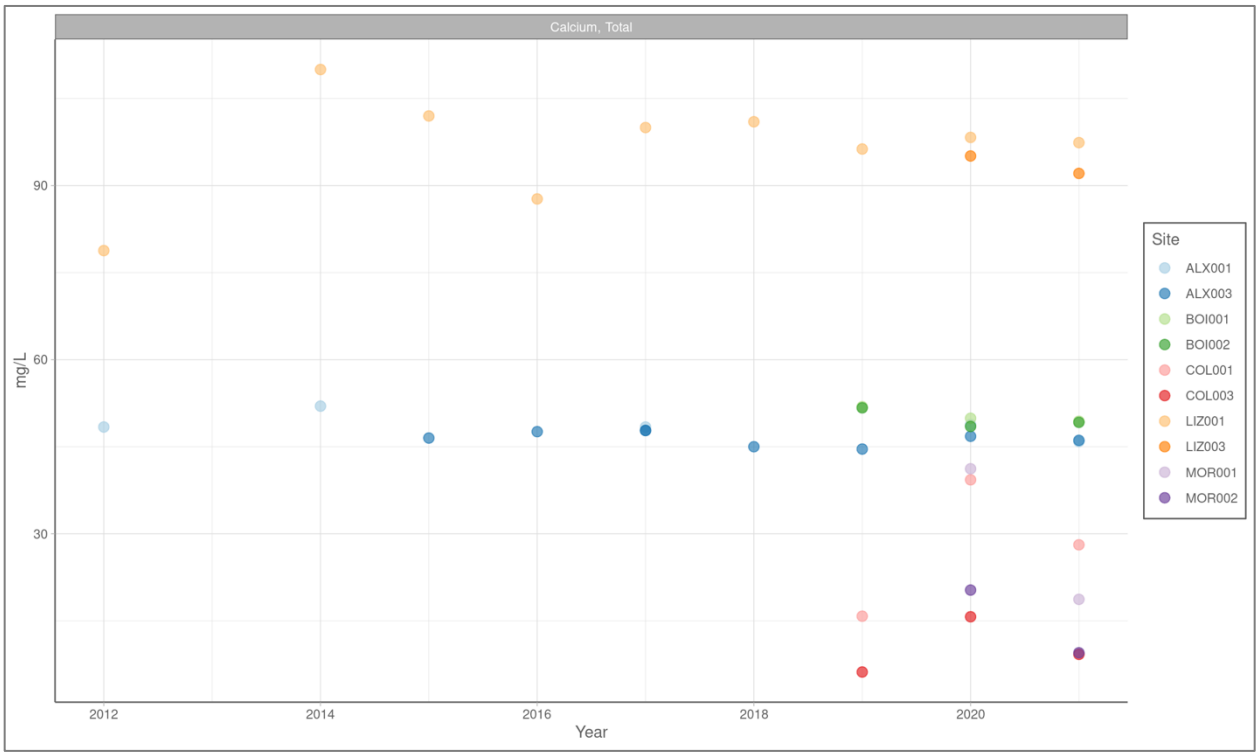

Figure 28. Amount of Calcium (mg/L) measured at monitoring sites during yearly CABIN sampling between 2012 and 2021.

Figure 29. Amount of Magnesium (mg/L) measured at monitoring sites during yearly CABIN sampling between 2012 and 2021.

Alexander Creek

In 2021, both the upstream (ALX003) and downstream (ALX001) sites were in good condition, according to CABIN analysis (Figure 30). Water chemistry variables were also consistent with good health, with all measurements for both sites meeting the BC guidelines for the protection of aquatic life. There have been no consistent trends in dissolved oxygen, pH, conductivity, turbidity or temperature (see the water quality section below). However, trends cannot reliably be determined by "snapshot" sampling. ERA is currently implementing a network of real-time flow, temperature and turbidity monitoring in all CBWM streams.

CABIN results from Alexander Creek sites have been relatively consistent over time, generally remaining in reference condition, however ALX001 was found to be highly divergent in 2012 and divergent in 2017. Further statistical testing (Bray-Curtis, RIVPACS) indicates that sites on Alexander Creek were similar to reference sites in taxa diversity and %EPT.

Alexander Creek runs alongside the Crowsnest highway for about 4 kilometers, is crossed by the CP Rail mainline, and passes a gun range and local logging roads. Fluctuations in divergence may result from intermittent disturbances caused by the use of these areas, combined with events such as runoff from heavy or prolonged rain causing erosion of disturbed areas. Proposed mining development in the upper catchment may increase stressors on Alexander Creek. If mining development goes forward, ongoing monitoring of Alexander Creek will become increasingly important to track changes in stream health.

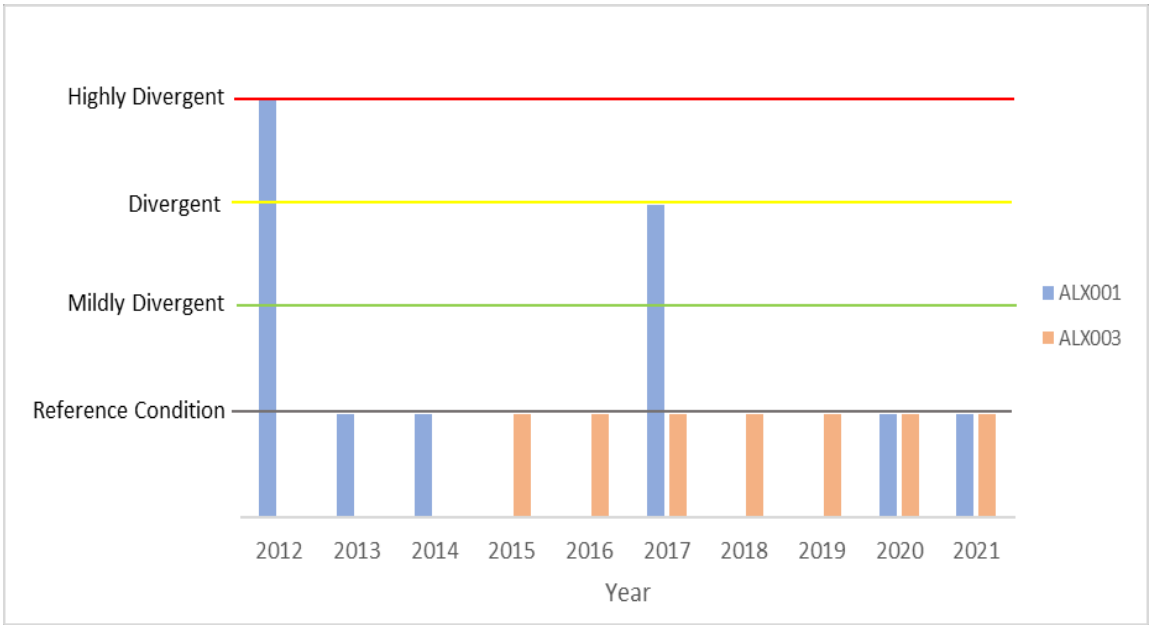

Figure 30. CABIN analysis results for Alexander Creek sites from 2012 - 2021.

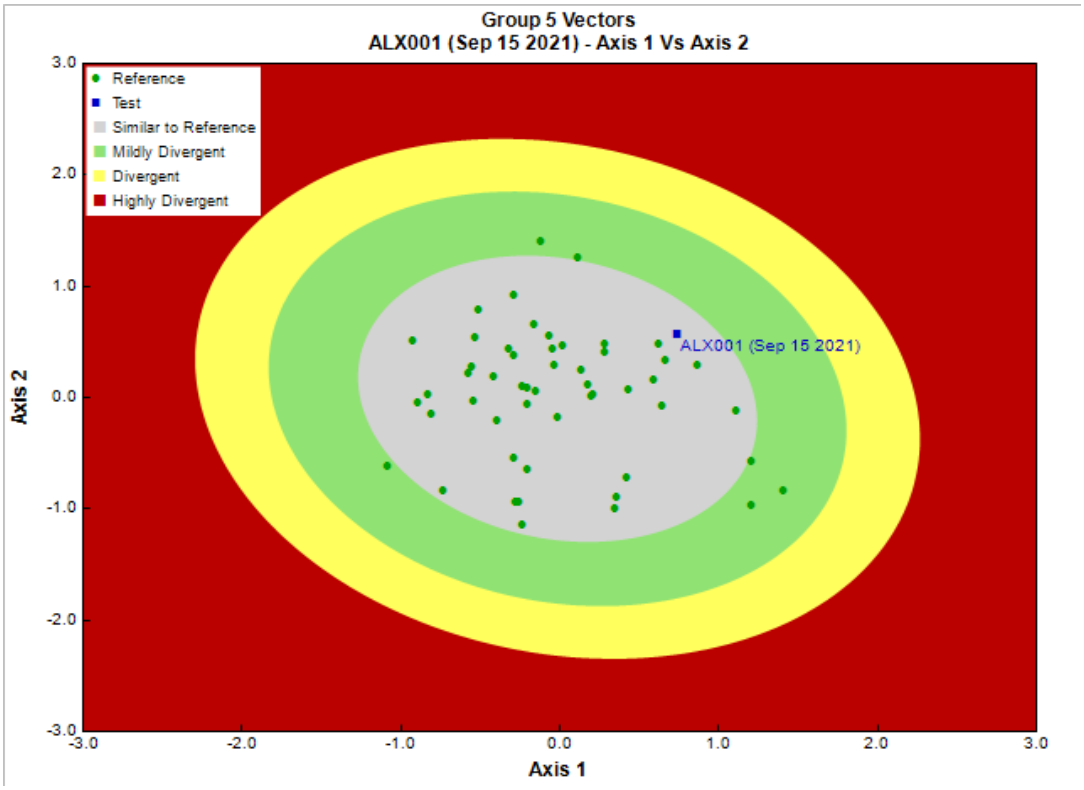

Figure 31. CABIN community ellipses for Alexander Creek's downstream site, ALX001 in 2021.

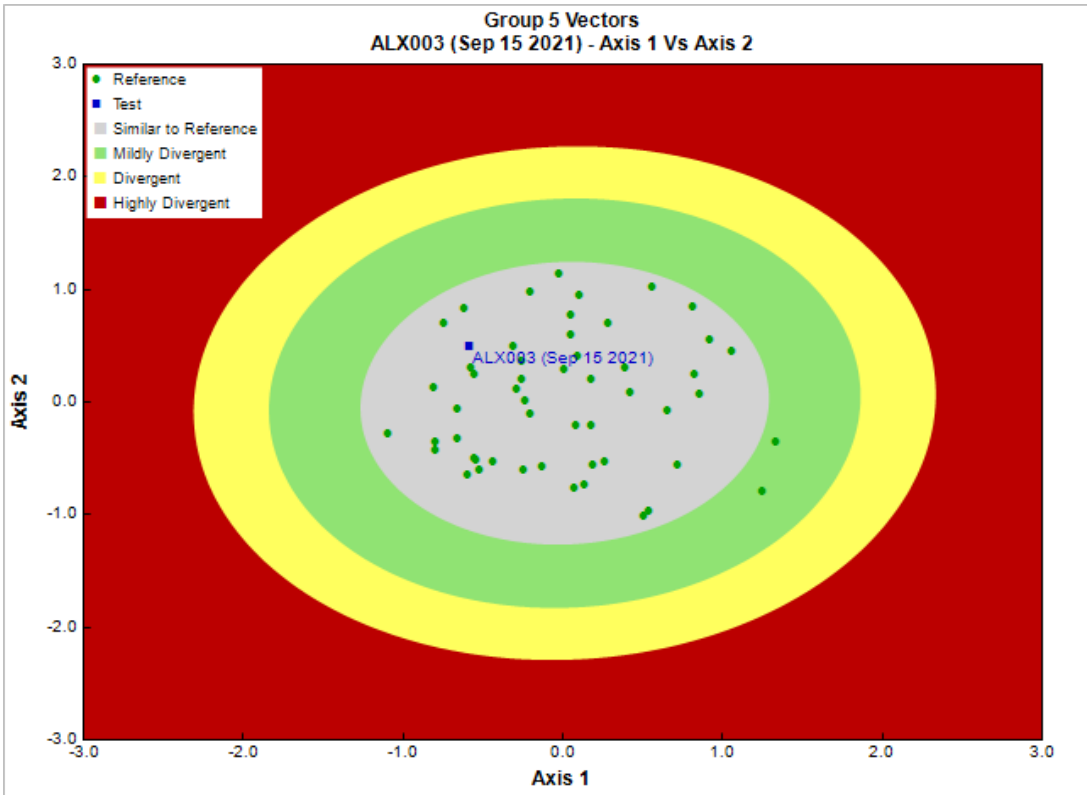

Figure 32. CABIN community ellipses for Alexander Creek's upstream site, ALX003 in 2021.

Boivin Creek

In the three years (2019 to 2021) of monitoring on Boivin Creek, sites have remained in relatively good, stable condition (Figure 33). 2021 CABIN analysis showed that the upper Boivin Creek site (BOI002) remained similar to reference condition, while the lower site (BOI001) shows mild divergence. Further statistical testing suggests that the BOI001 may be experiencing a slightly lower species richness (RIVPACS) which could be contributing to this assessment (Table 1). That said, the site's mild divergence from reference condition is similar to divergence of some individual reference sites which also fall within the mildly divergent ellipse. Therefore, results likely reflect natural variability of benthic invertebrate communities.

ERA began monitoring this site to assess the impacts of artificial riprap that stretches along large sections of the creek as it passes through Elkford. However, CABIN results to date show that the creek is similar to comparable reference sites. Continued monitoring efforts, including implementation of real-time monitoring of flow, temperature, and turbidity will allow for more long-term assessments of the creek and potential impacts of local urban developments. All measured water quality variables met BC guidelines for the protection of aquatic life.

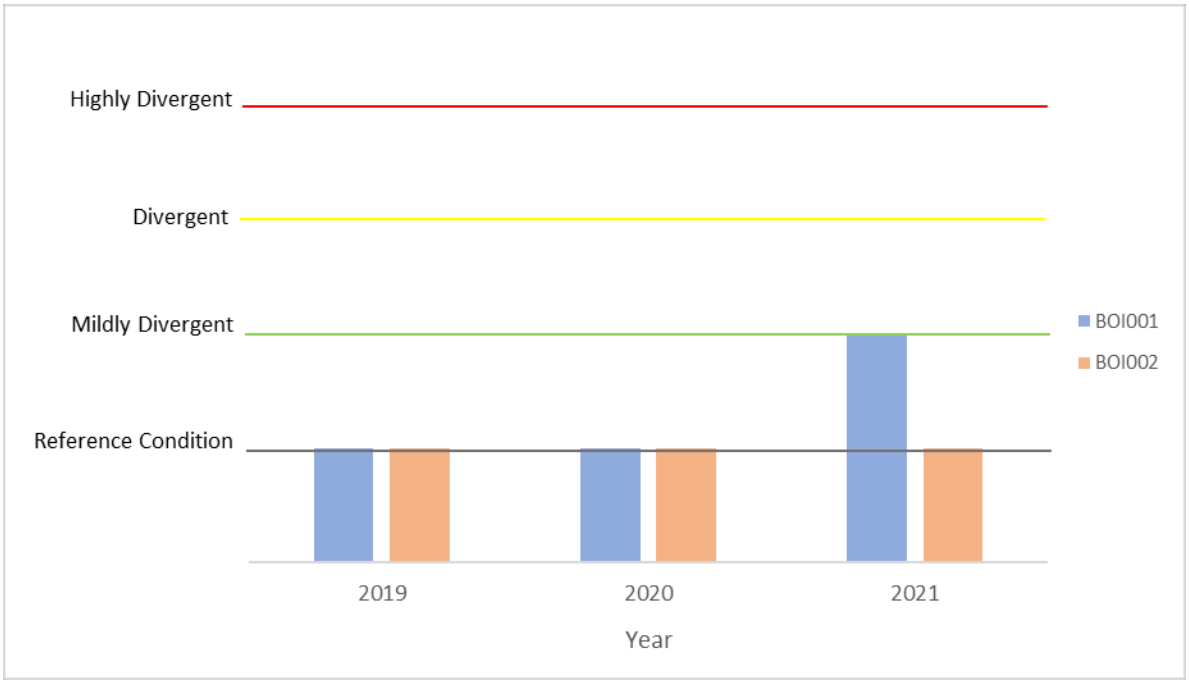

Figure 33. CABIN results for Boivin Creek sites in 2019 - 2021. The upstream (BOI002) site has remained in a similar state to reference condition, while the downstream site (BOI001) is beginning to diverge from this state. Future assessments will allow for ERA to monitor any developing patterns.

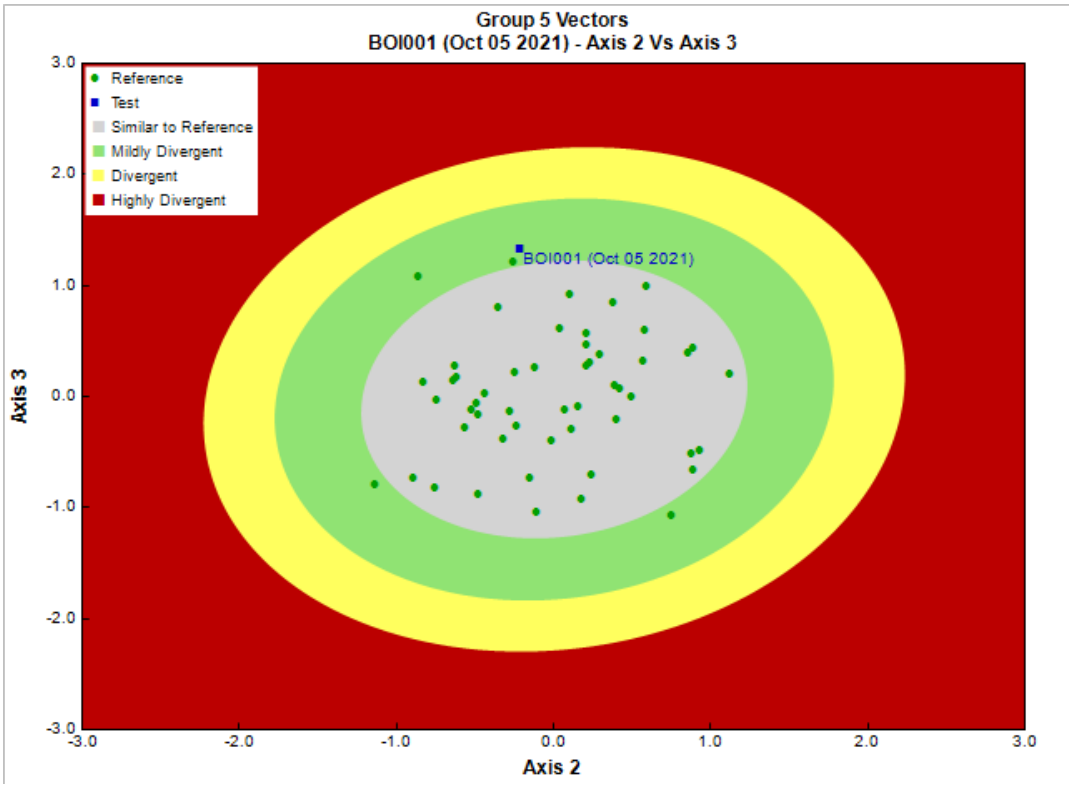

Figure 34. CABIN community ellipses for BOI001 (downstream) in 2021, showing the site to be "mildly divergent".

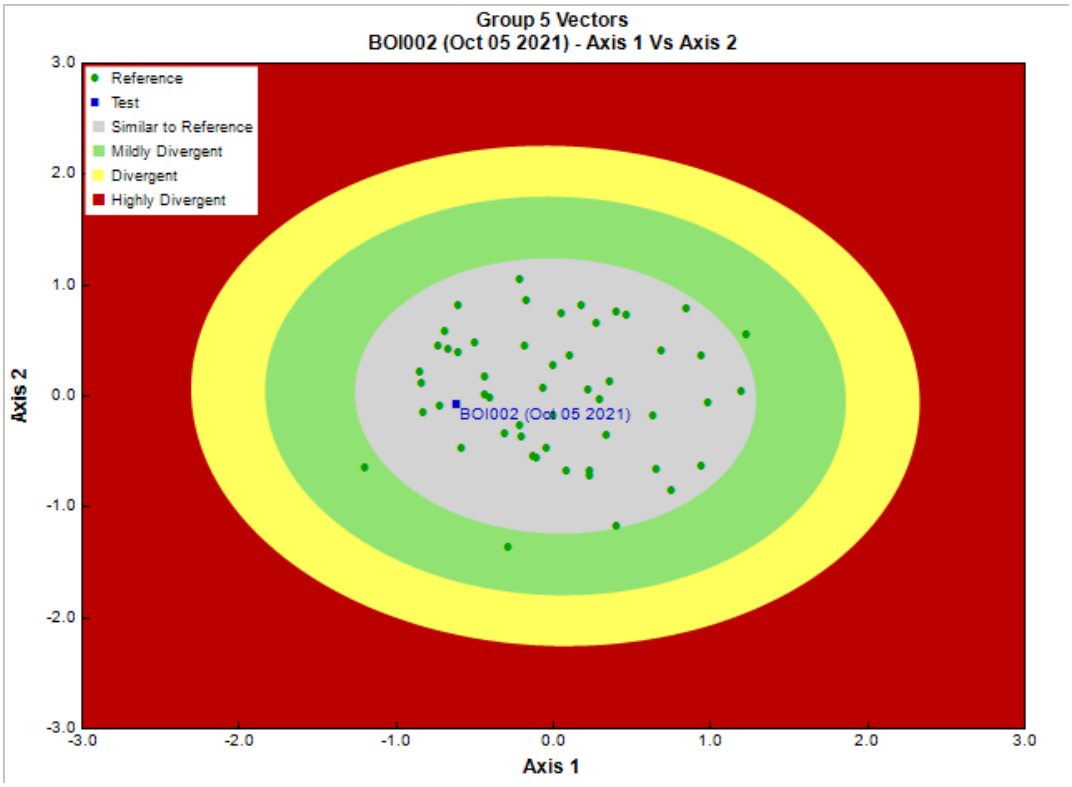

Figure 35. CABIN community ellipses for BOI002 (upstream) in 2021, showing the site to be "similar to reference".

Coal Creek

Coal Creek was added to the CBWM CABIN assessments in 2019. Results indicate the creek is divergent from reference condition, particularly at the site near the mouth (COL 001)(Figure 36). According to additional analyses, both sites along Coal Creek exhibited species diversity diverging from reference sites, with slightly lower taxa richness than reference sites, and significantly lower %EPT (Table 1). Total abundance of individuals was much higher than expected for the lower site (11,820 compared to an estimated reference site value of 1,449.38 ± 859.74) which may contribute to the highly divergent classification.

All measured water quality variables met BC guidelines for the protection of aquatic life. The Coal Creek sites were established too recently to enable comparison of water quality results over time. Furthermore, as noted for the other creeks in the CBWM program, one-time sampling for water quality is not sufficient for indicating trends.

The COL001 site is downstream of historic mining sites, a decommissioned landfill, cattle grazing, recreational ATV trails, and current clear-cut logging practices. The final kilometer stretch flows through a portion of Fernie before arriving at the sampling site. This urban portion of Coal Creek is confined by riprap and concrete armoring along the sides of the channel. Recreational use at the mouth of the creek in sometimes includes the construction of weirs in the streambed with large rocks and cobble to create swimming or wading areas.

The highly divergent results for the COL001 site are not unexpected, given the multiple historic and current stressors in the catchment. Benthic invertebrates integrate the effects of these multiple stressors, particularly flow, turbidity and temperature, but may also be responding to short and long-term changes in water quality parameters such as nutrients. The consistent categorization of COL001 as “highly divergent” from reference condition over the three years it has been monitored, along with the list of known stressors effecting this stream, give ERA confidence in these results.

ERA will continue to monitor COL001 and COL003 to confirm CABIN results and acquire sufficient data to evaluate trends. If the COL003 site continues to diverge from reference sites, ERA will seek to investigate further, as this site is within the headwaters, and poor conditions are not expected at this location.

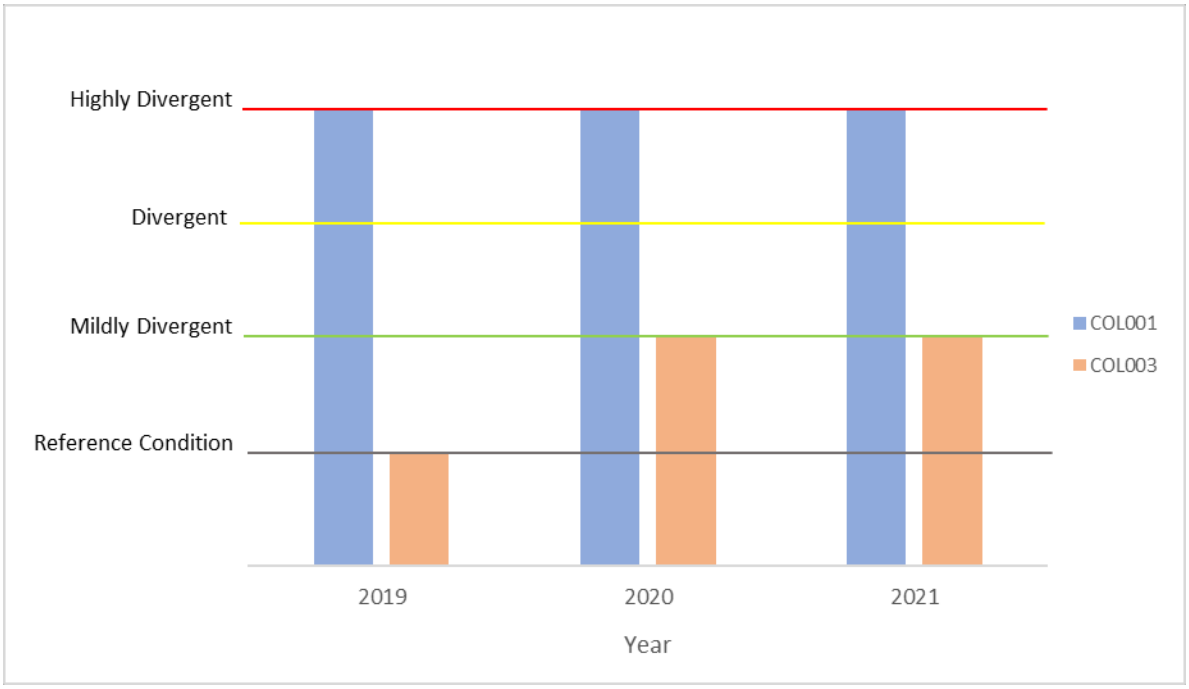

Figure 36. CABIN results for Coal Creek sites in 2019 – 2021.

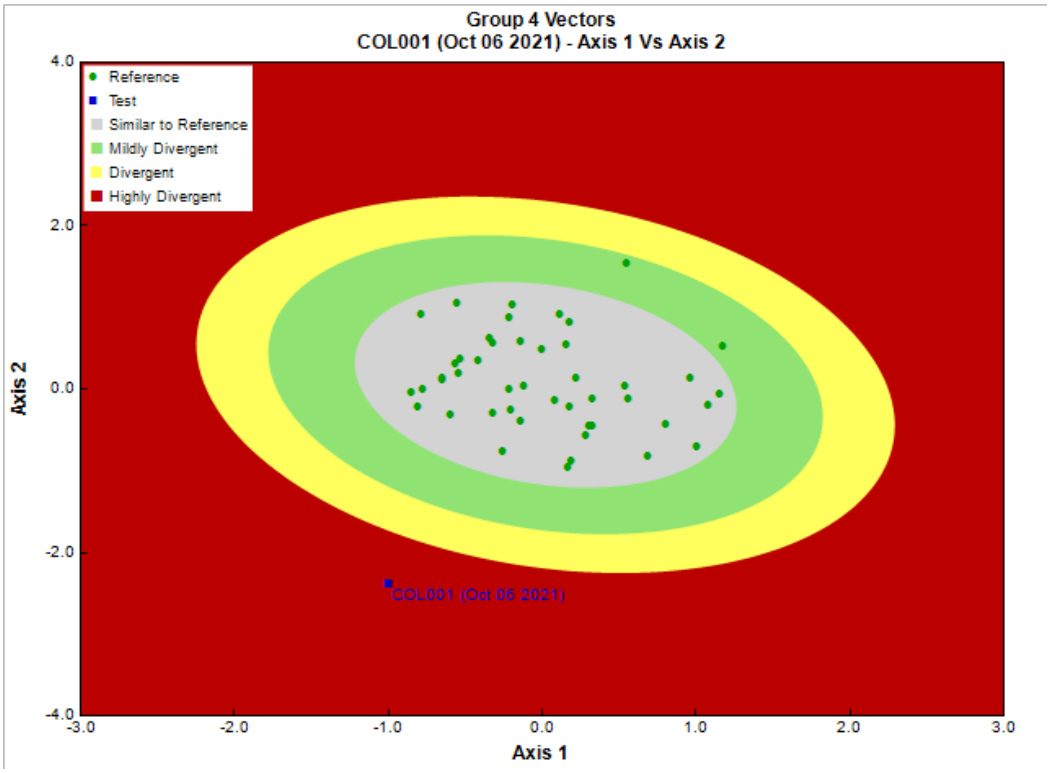

Figure 37. 2021 CABIN analysis community ellipses for the Coal Creek downstream site, COL001, showing the site has significantly diverged from reference condition.

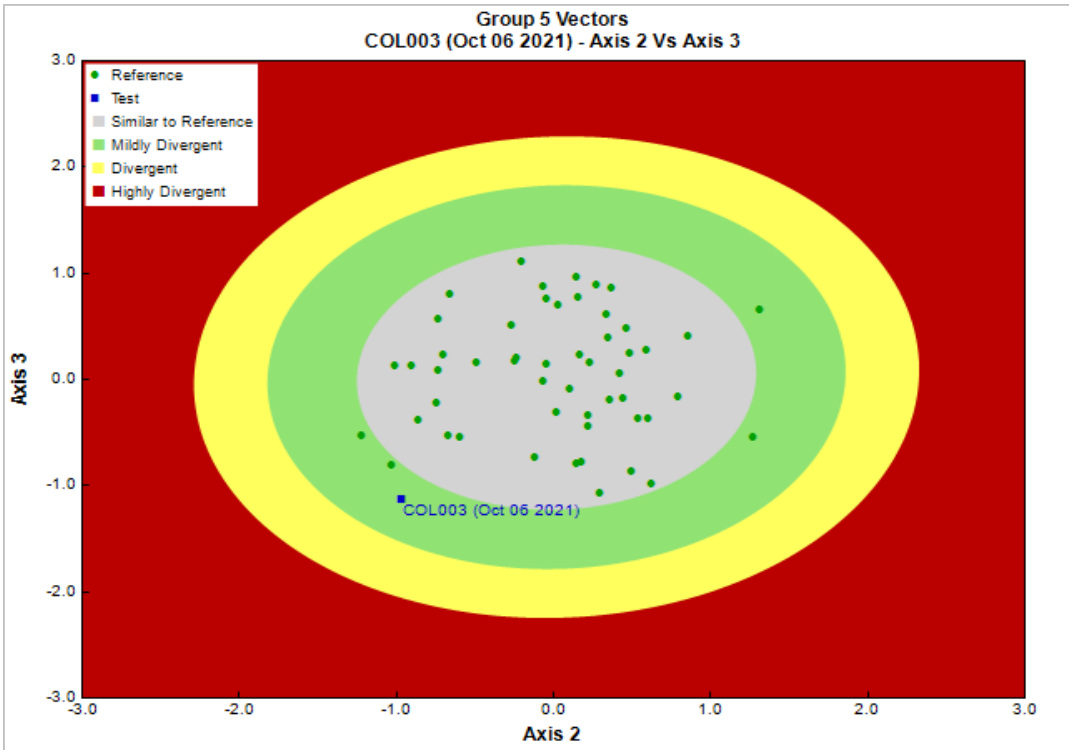

Figure 38. 2021 CABIN analysis community ellipses for the Coal Creek upstream site, COL003, showing the site is just at the edge of mild divergence from reference condition.

Morrissey Creek

2021 was the second year of CBWM assessments for Morrissey Creek. The upstream site, MOR002, was in a condition similar to that of the associated reference sites, while the downstream site, MOR001, was highly divergent (Figure 39). MOR001 was on the higher end of Bray-Curtis scores (0.81992), indicating the taxa diversity at the site was lower than expected. However, EPT values and the number of taxa present were similar to what would be expected from a site in good condition (Table 1). Like COL001, MOR001 also has very high total individual abundance numbers (7340, compared to a mean reference site abundance of 1449.37 ± 859.74).

There were no exceedances of BC Water Quality Guidelines. The Morrissey Creek sites were established too recently to enable comparison of water quality results over time. Furthermore, as noted for the other creeks in the CBWM program, one-time sampling for water quality is not sufficient for indicating trends. Morrissey Creek is part of ERA's real time flow, temperature and turbidity monitoring network, which is in the process of being implemented.

Morrissey Creek originates from a geographically similar location to Coal Creek, with similar historical logging in the upstream reaches. While MOR002 lies above most potential disturbance, MOR001 is downstream of active logging roads, ATV trails, cattle grazing, and an active farming area.

The downstream sites in both Coal and Morrissey Creeks have multiple land use-related stressors in their catchments. Therefore, divergence from reference condition is not unexpected in either. Continued monitoring over time should begin to reveal patterns in site characteristics that may help

identify the cause of these results. Further investigation, outside of CABIN monitoring, will be needed in future to fully understand the dynamics of this stream and the stressors effecting it.

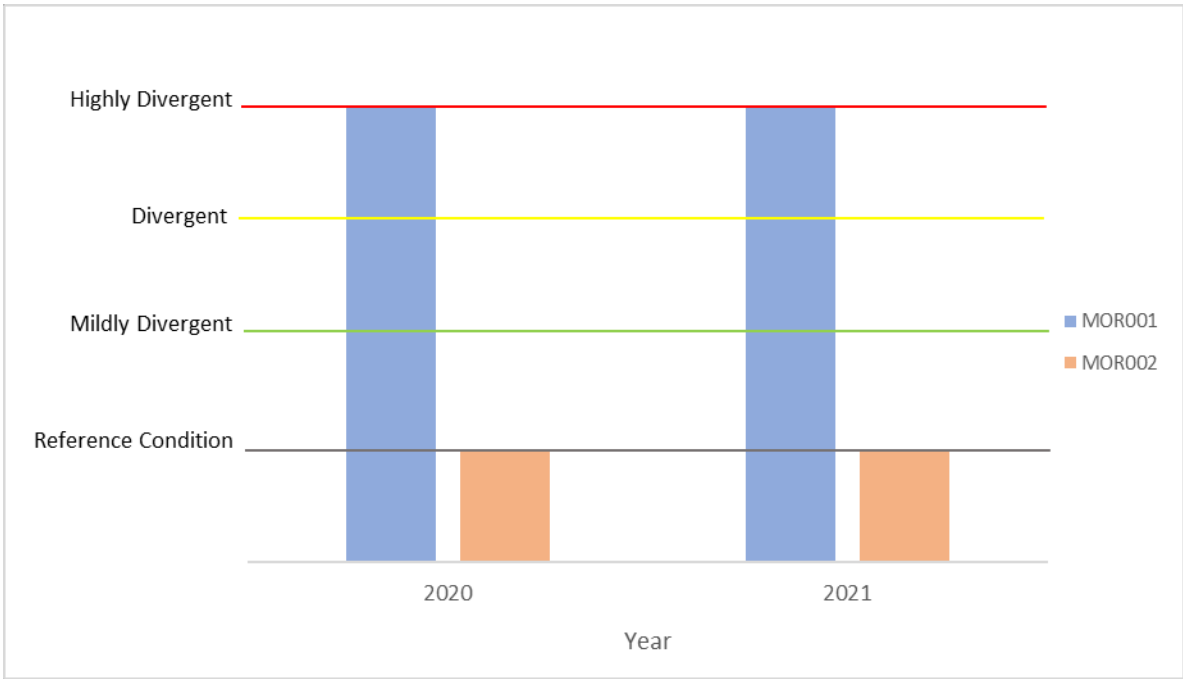

Figure 39. Results of CABIN assessment for Morrissey Creek sites in 2020 and 2021. MOR002 is in "reference condition" while MOR001 was classified as "highly divergent".

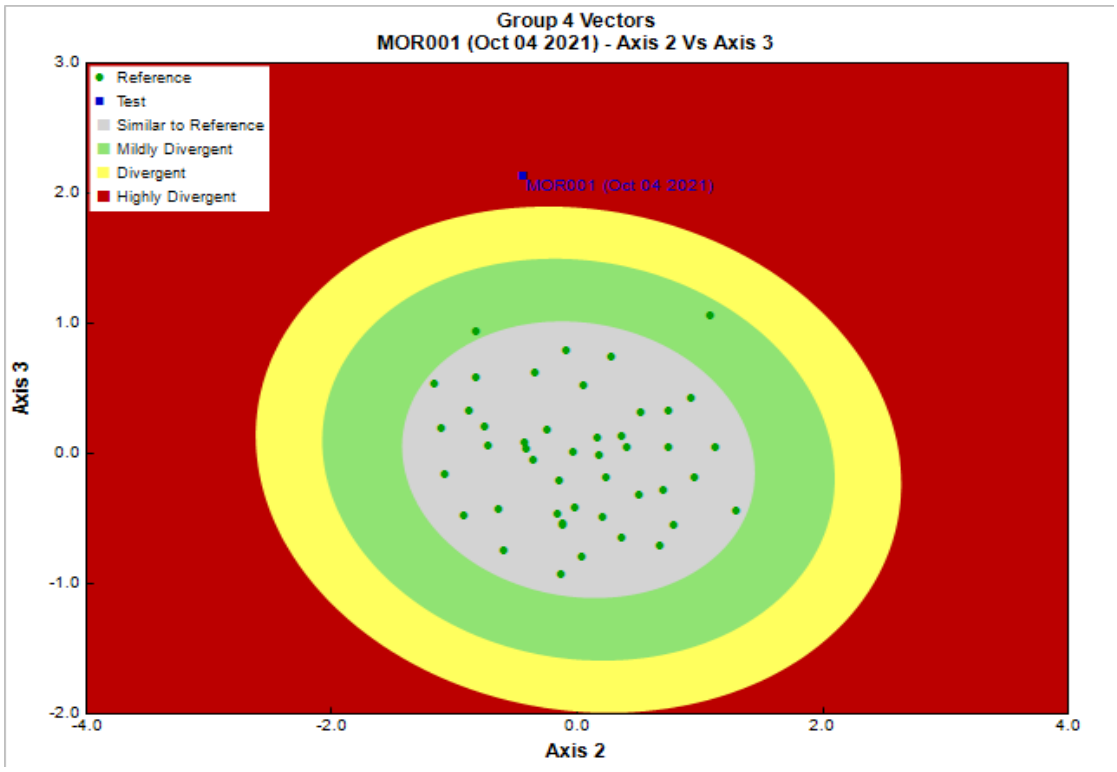

Figure 40. CABIN analysis community ellipses for the Morrissey Creek downstream site, MOR001, showing the site significantly diverging from reference condition.

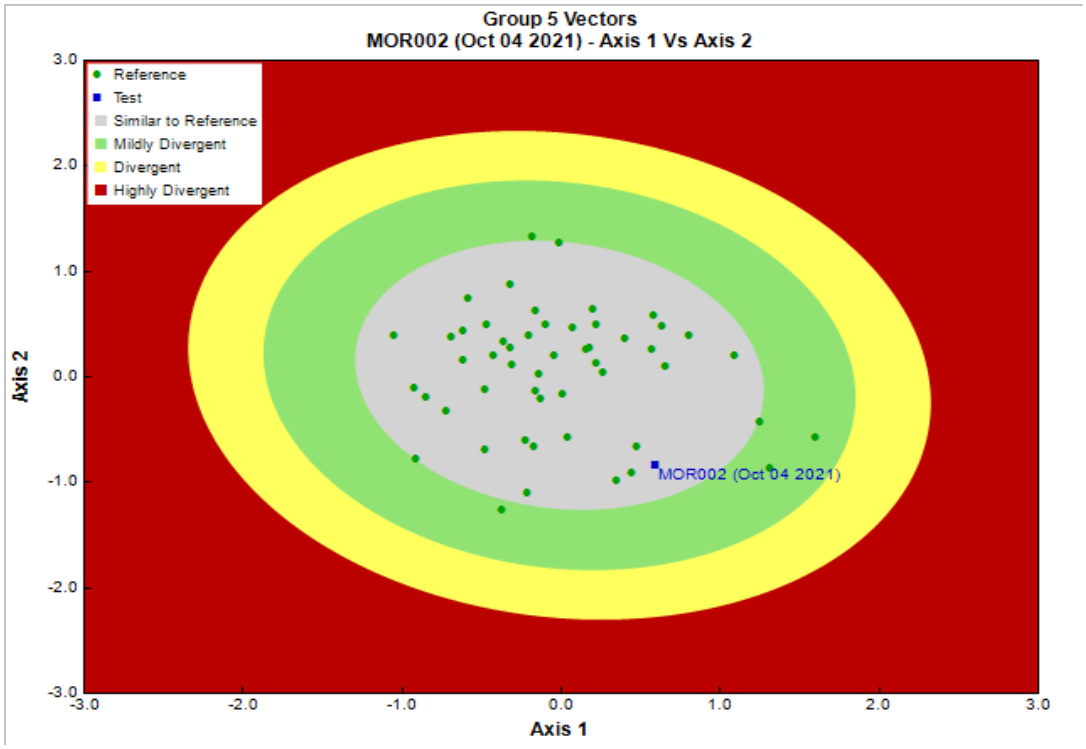

Figure 41. CABIN analysis community ellipses for the Morrissey Creek upstream site, MOR002, showing the site is similar to reference condition.

Benthic Macroinvertebrate Communities

CABIN assessments assign test sites a condition based on the structure of the benthic macroinvertebrate community.

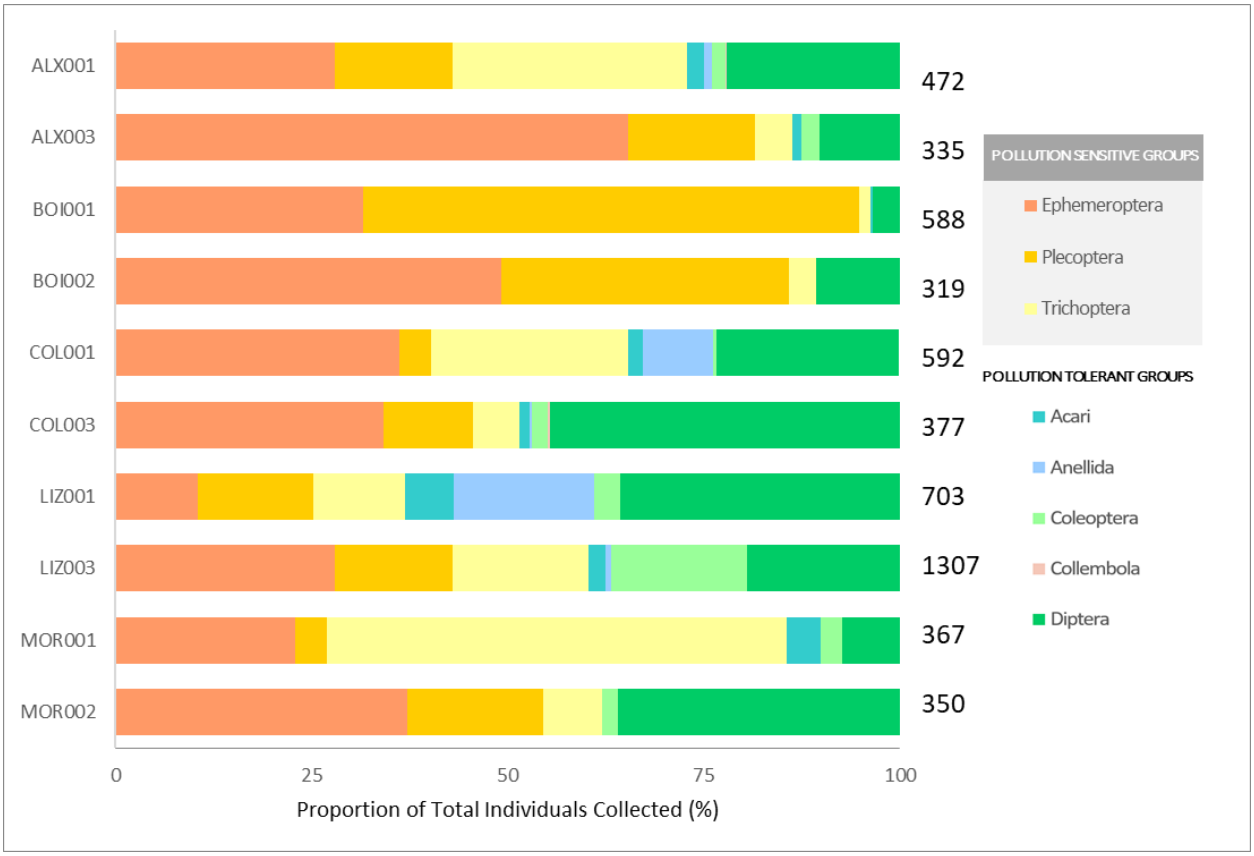

Figure 42. Graph representing the proportions of different benthic macroinvertebrates at each CBWM stream. The three left-most bars represent pollution-sensitive taxa (Ephemeroptera, Plecoptera, Trichoptera), while the taxa on the right are more pollution-tolerant. Higher % EPT is generally considered to equate to healthier streams. The numbers along the right-hand side of the graph are the raw individual counts of all benthic macroinvertebrates found at each site.

Figure 42 shows overall taxa diversity in each CBWM test stream, with the proportion of individuals belonging to each taxonomic order. Typically, pollutant-sensitive orders are on the left (EPT) and more tolerant orders are on the right. Streams with a higher proportion of EPT coincide with those deemed less divergent from reference condition through CABIN assessments. The exception to this is the lower Morrissey site (MOR001) which was assessed as "Divergent" yet over 80% of the taxa present belong are part of the typically pollution sensitive group (EPT). Nearly all of this 80% belongs to one order – *Trichoptera*. These results speak to the importance of biodiversity in a healthy stream.

A healthy ecosystem requires many different species with their own distinct roles to function properly. In areas where one particular taxon begins to take over, there is likely an issue that will eventually take a toll on the entire system. Further, although the EPT taxa are often associated with pollution sensitivity, these sensitivities may vary at finer taxonomic resolutions. *Trichoptera* (caddisflies) are regularly used as indicators of stream health and generally decreased numbers are associated with poor health, but there are certain species that exhibit a higher tolerance to pollution and have been found to thrive in these environments (Houghtona 2004).

Table 1 takes a closer look at these results within benthic communities at each CBWM site using RIVPACS, Bray-Curtis Dissimilarity, %EPT and total abundance. The highlighted cells indicate values that differ significantly (i.e. 2 x standard deviation from the mean) from what is expected from a site in "reference condition".

Table 1. A comparison of CBWM sites, their classification according to 2020 CABIN assessments, and additional statistical measures that address the classification – RIVPACS, Bray-Curtis dissimilarity, and the percent EPT (Ephemeroptera, Plecoptera, Trichoptera). Highlighted cells indicate values that differ from what is expected for a reference site in good condition.

Stream Name	Site ID	CABIN Analysis	RIVPACS O:E (p>0.7)	Bray-Curtis Dissimilarity*	% EPT	Total Abundance
Alexander Creek	ALX001	Reference	1.049	0.533[a]	72.9[a]	9,440[a]
	ALX003	Reference	0.943	0.329[a]	86.2[a]	5,583[a]
Boivin Creek	BOI001	Mildly Divergent	0.744	0.591[a]	96.4[a]	11,760[a]
	BOI002	Reference	0.951	0.254[a]	89.3[a]	4,557[a]
Coal Creek	COL001	Highly Divergent	0.692	0.895[b]	65.6[b]	11,820[b]
	COL003	Mildly Divergent	0.836	0.615[a]	51.2[a]	3,427[a]
Lizard Creek	LIZ001	Highly Divergent*	0.895	0.965[c]	37.4[c]	14,060[c]
	LIZ003	Highly Divergent*	1.09	0.930[b]	60.1[b]	26,140[b]
Morrissey Creek	MOR001	Highly Divergent	0.989	0.820[b]	85.6[b]	7,340[b]
	MOR002	Reference	0.841	0.561[a]	61.8[a]	3,181[a]
	Reference Mean			[(a)] 0.396 ±0.137 [(b)] 0.339 ±0.101 [(c)] 0.342 ±0.101	[(a)] 89.2 ±10.0 [(b)] 91.9 ±7.3 [(c)] 88.1 ±9.3	[(a)] 4,661 ±3,118.8 [(b)] 1449 ±859.7 [(c)] 1083 ±932.3

* The average dissimilarity value between individual reference sites and the "Reference Mean" that all test sites were measured against.

STREAM e-DNA

STREAM e-DNA analysis presents a list of species present at each sampled site, including general information on the species' ability to tolerate stressors and some general information regarding species richness at each site.

The report identifies the presence of *Tubifex tubifex,* one of the two host species necessary for the presence of whirling disease, caused by the *Myxobolus cerebralis* parasite. *Tubifex tubifex* was identified at MOR001 and LIZ001, as well as at BOI001 in previous years. There are no known cases of whirling

disease in British Columbia to date, but it is widespread in the neighbouring parts of Alberta, including the Oldman watershed bordering the Elk River watershed (Veillard and James 2020). If whirling disease were to enter BC, these creeks could be a high-risk area for an outbreak.

The initial discovery of this species at Boivin Creek has led to the development of the 'Elk Valley Whirling Disease Project', an ERA outreach and monitoring initiative within the Elk Valley to identify other potentially high-risk locations and educate to prevent the introduction of this disease.

The detailed STREAM report is available in (Appendix E: Stream Report).

Water Quality Trends

ERA's CBWM program monitors water quality parameters over time to assess long-term trends. Data on pH, temperature, turbidity, dissolved oxygen concentration, and discharge are available as far back as 2012.

pH

PH levels at all sites have been consistent over time (Figure 42). All areas assessed remained within the 6.5 to 9 pH BC Water Quality Guideline limits for freshwater aquatic life (British Columbia Ministry of Environment and Climate Change Strategy 2021). Stream pH is primarily a function of surrounding geology, so the Elk Valley's predominantly limestone formations result in high pH values. Aquatic life in these areas has adapted to high pH conditions. If values deviate outside of these limits, damage to current aquatic communities and a complete change to the species composition of the stream can occur (B.C. Ministry of Environment and Climate Change Strategy 2021a).

pH at sites with a longer sampling history (ALX001, ALX003 and LIZ001) appears to be decreasing from 2018 to 2021, however this may be a result of instrument error or other sampling issues. Should pH continue to decline at sampling sites, further investigation may be warranted.

Both upper Morrissey and Coal sites show lower pH than other sites. Both of these sites are located higher in the landscape than other sites and are from neighbouring catchments. It is likely these two sites have lower groundwater influence than other sites, resulting in lower pH.

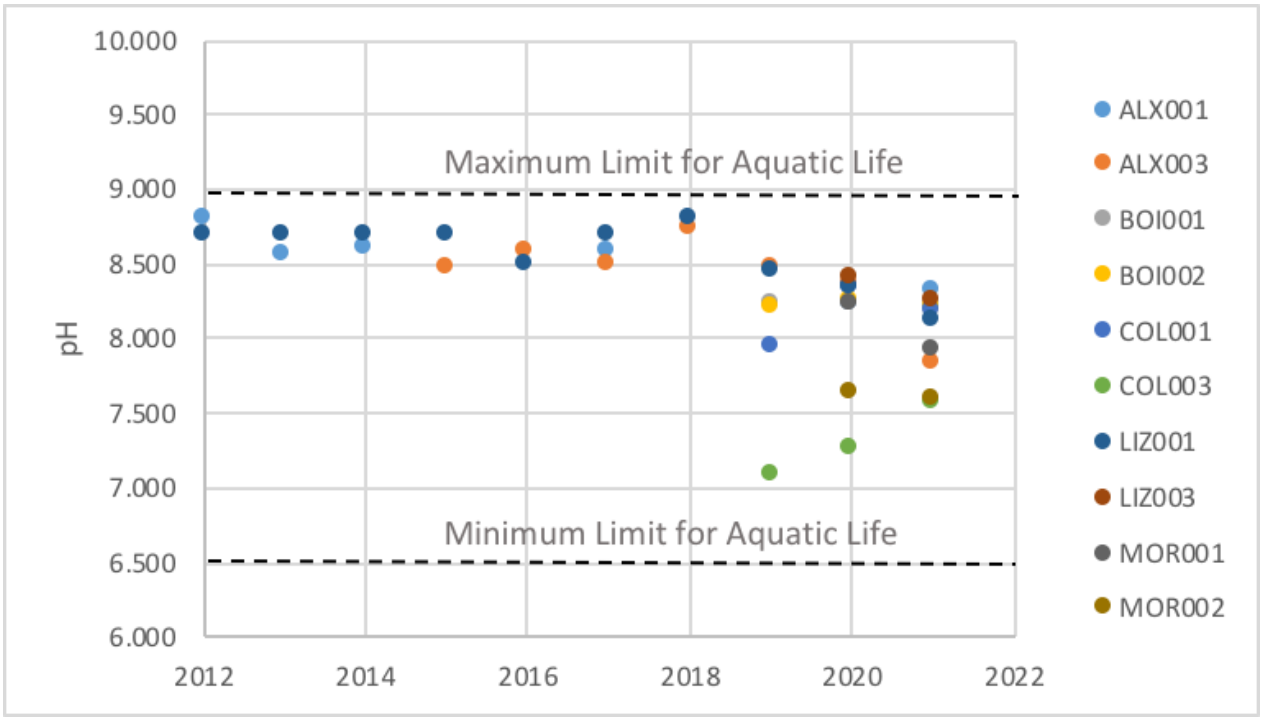

Figure 42. pH values for CBWM sites from 2012-2021. All sites remain within the range of limits outlined within the BC Water Quality Guidelines.

Temperature

In light of the potential effects of climate change on the Elk River system, understanding long-term temperature trends is a priority for ERA. Typically, aquatic life can only survive within specific ranges of temperatures. For example, WCT can only survive in waters between 0 – 25°C (Bear, McMahon, and Zale 2007).

Temperatures measured during CABIN monitoring varied considerably from sampling year to sampling year at all sites (Figure 43). However, this can be attributed to natural climatic variability and different sampling dates. Although all sites in CABIN are monitored during low flow conditions between the end of August and the beginning of November, relatively large fluctuations are expected during this period, and a single annual measurement is insufficient to understand long term trends. Overall, temperatures remained within the critical limit for important local species like the WCT and bull trout (DFO 2017).

Like other measured parameters, as temperate can fluctuate from day to day (and within the day). A single annual measurement is not sufficient to detect long term trends, and CBWM measurements are taken for CABIN analysis. In depth analysis of temperature is only possible with ongoing, frequent monitoring using instream logging equipment. To this end, as part of its broader monitoring program, ERA has developed a separate hydrometric monitoring program to examine stream temperature throughout the Elk Valley in more detail.

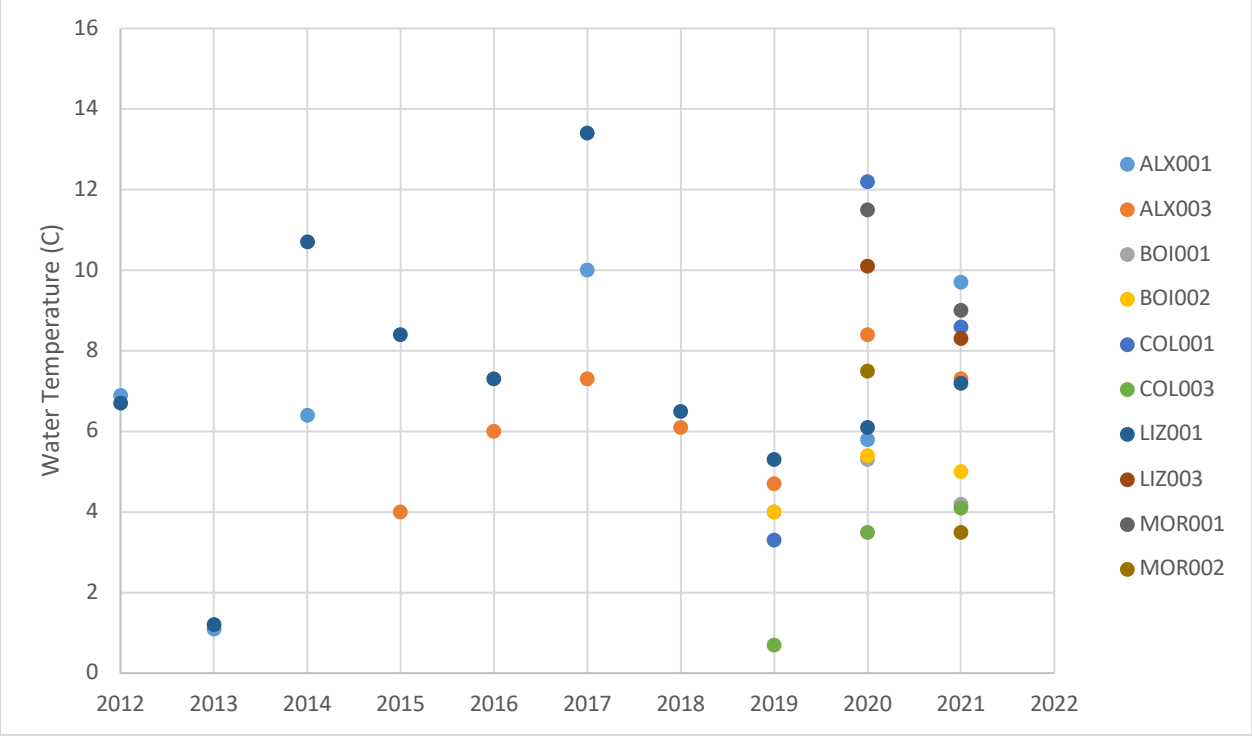

Figure 43. Temperature values for CBWM sites from 2012-2021.

Dissolved Oxygen

The concentration of dissolved oxygen (DO) at all CBWM sites has remained stable over time and is consistently above the BC Water Quality Guideline long-term minimum level of 8mg/L (Figure 44)(British Columbia Ministry of Environment and Climate Change Strategy 2021). Dissolved oxygen measurements are more consistent across sites in 2021, this is likely due to the use of new, more accurate equipment (YSI ProDSS). This consistency amongst these measurements is expected to be observed in future.

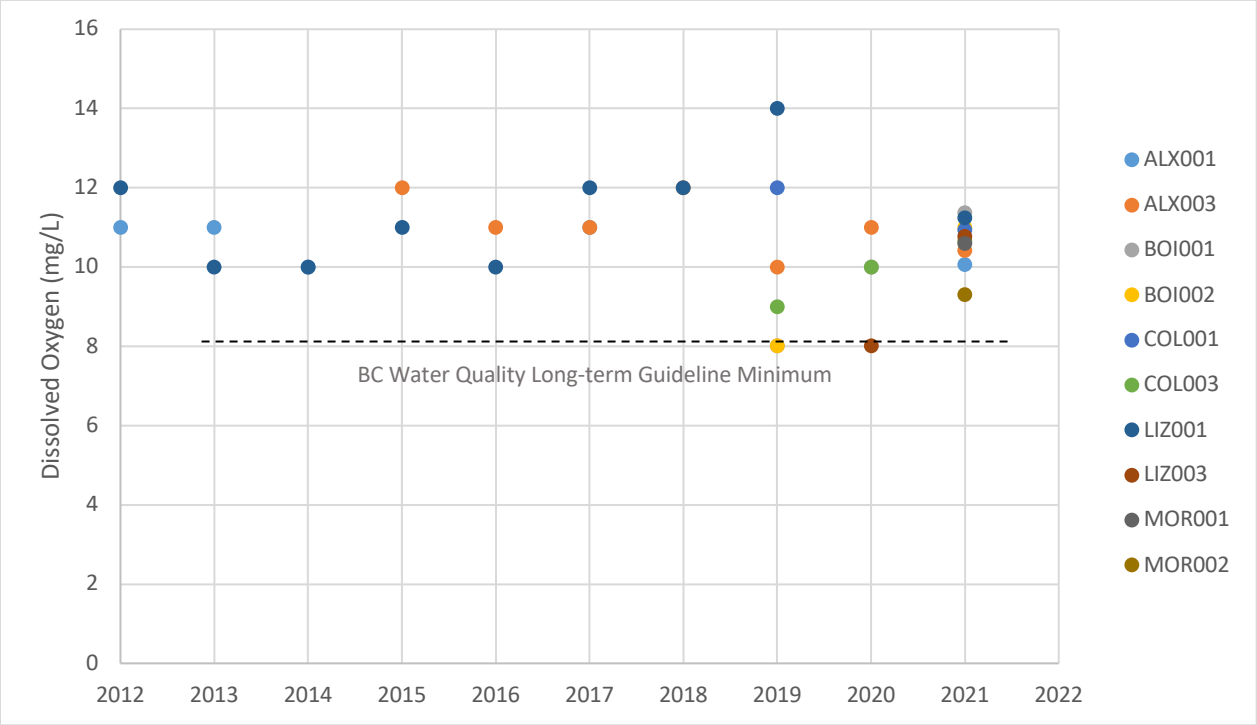

Figure 44. The amount of dissolved oxygen at CBWM sites in mg/L from 2012-2021. Site values do not fall below the BC water Quality Long-term Guideline minimum for Freshwater Aquatic Life (8mg/L).

Turbidity

Canadian Water Quality guidelines suggest that environmental samples vary within the normal range of 1 to 1000 NTU but that turbidity as low as 25 NTU can begin to have a negative effect on fish growth (Canadian Council of Ministers of the Environment 1999). Since 2012, CBWM site turbidity readings have remained below 4 NTU, with most readings below 2 NTU.

ERA staff and community observations indicate all tributaries in the Elk River watershed experience significant turbidity spikes during rainfall events and spring freshet. However, all monitored creeks tend to have low turbidity readings during low-flow conditions, with turbidity spikes generally being indicative of upstream disturbance coupled with high rainfall/snowmelt events, particularly during the May-July freshet.

According to the BC Water Quality Guidelines, turbidity is only a concern when the value changes by 8 or more NTU for 24 hours from the ambient turbidity level, or 2 NTU for 30 days (British Columbia Ministry of Environment and Climate Change Strategy 2021). Annual single occurrence sampling is not sufficient to detect these changes. ERA has been working with a PhD candidate from the university of Auckland to develop a program to test a low-cost sensor that hopes to enable continuous turbidity measurements throughout the year.

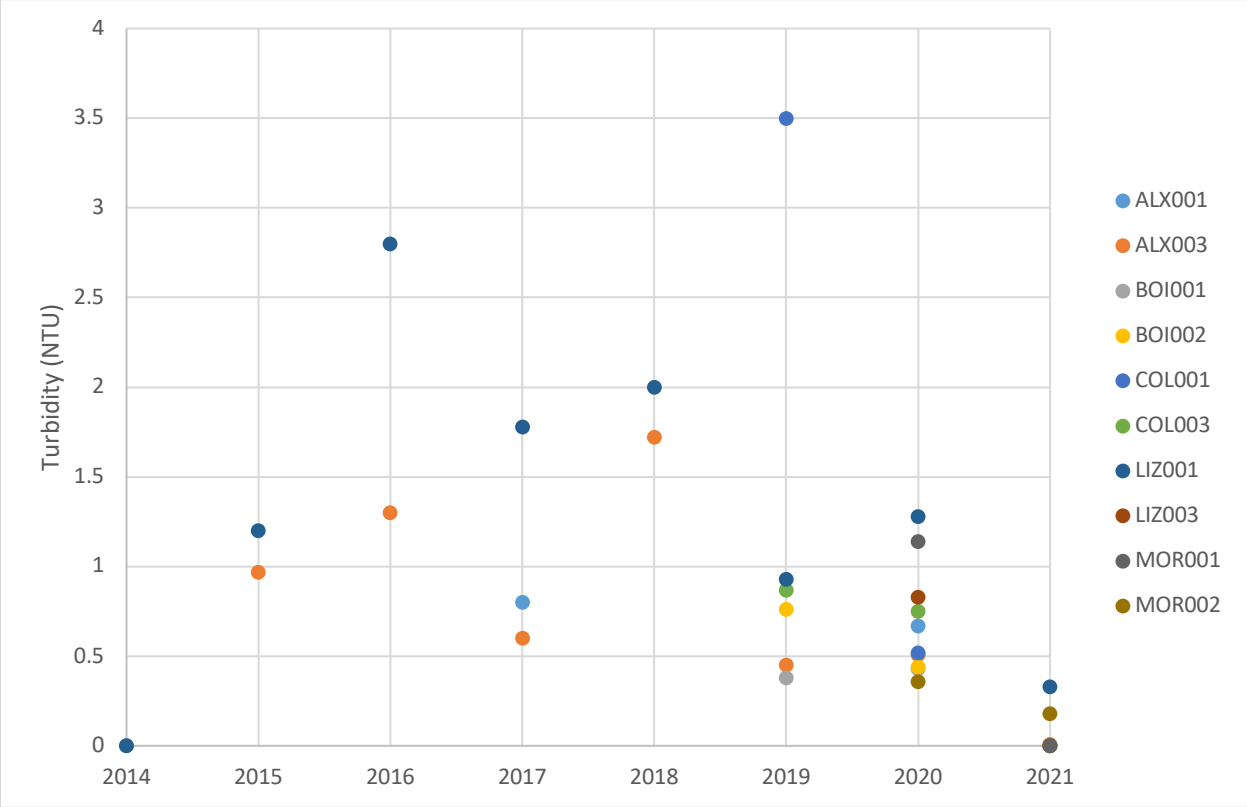

Figure 32. The turbidity (NTU) measured at CBWM sites from 2014-2021.

Conductivity

In general, conductivity levels for a freshwater river system range between 0 and 1000 uS/cm – conductivity levels above this are usually indicative of a saltwater system. Although all monitored sites fall within this range, the Lizard Creek sites have significantly higher conductivity levels than the other sites. This plot also shows a steep decrease in conductivity levels between 2012 and 2013, followed by levels more than doubling in 2015. Although conductivity levels can fluctuate, the large change may be a result of some added stressor. Further investigation into this trend is recommended.

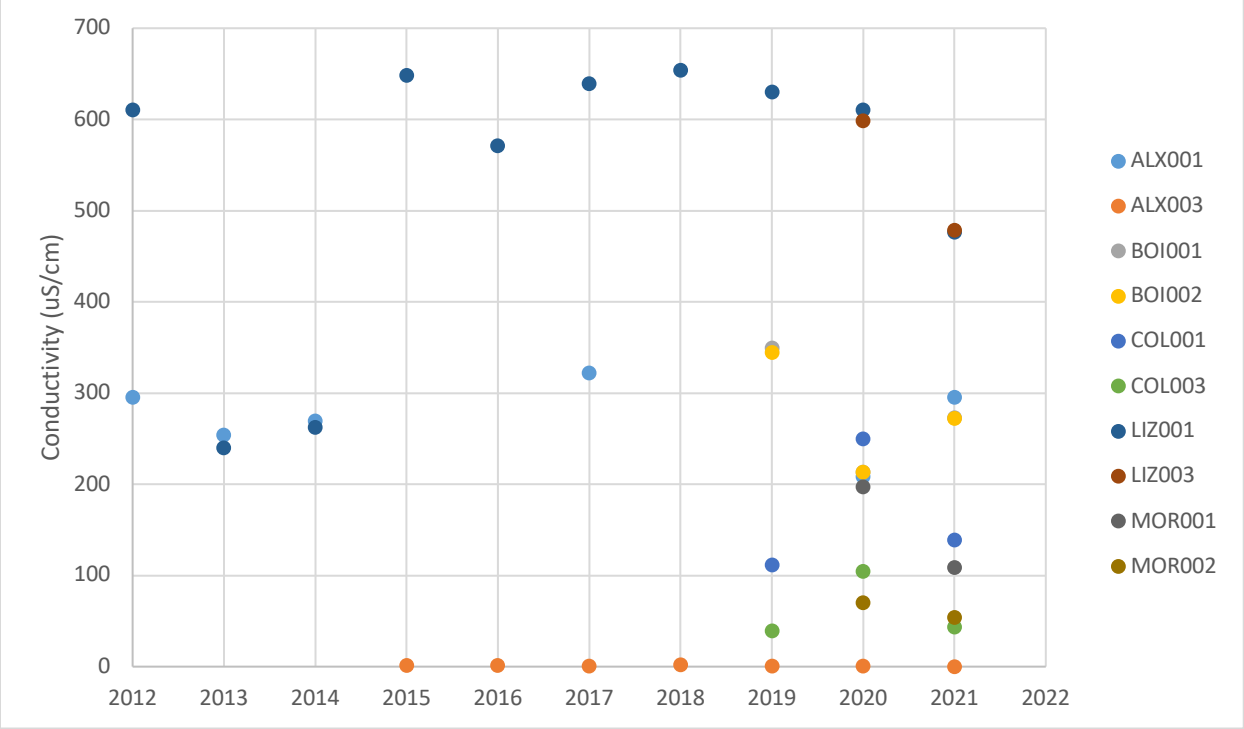

Figure 45. Conductivity levels measured at CBWM sites from 2012-2021.

Discharge

Discharge, referring to the volume of water flowing through a section of stream at a given time, was assessed during low flow conditions for each site over time (
Figure 46). Discharge measurements at all sites remained relatively stable between years, except COL001, which appeared to decrease by 1.76 m3/s between 2019 and 2020. This is not considered abnormal as Coal Creek has a high gradient and frequently experiences fluctuating flow and regular flood events.

Between the years of 2012 to 2020 discharge was measured using the CABIN recommended protocol, measuring depth and velocity at 5 panels across the stream and the average values were used to calculate an estimated discharge for the stream. In 2021, discharge measurements were calculated using the more accurate mid-section method (and a minimum of 20 panels across a stream). ERA is exploring the practicality of using methods that adhere to BC hydrometric RISC standards in CABIN monitoring.

Like other measured parameters, discharge can fluctuate from day to day (and within the day). A single annual measurement is not sufficient to detect long term trends, and CBWM measurements are taken for CABIN analysis. In depth analysis of discharge is only possible with ongoing, frequent monitoring (e.g. hourly logging). To address this, ERA has begun developing a hydrometric monitoring program to examine discharge in more detail.

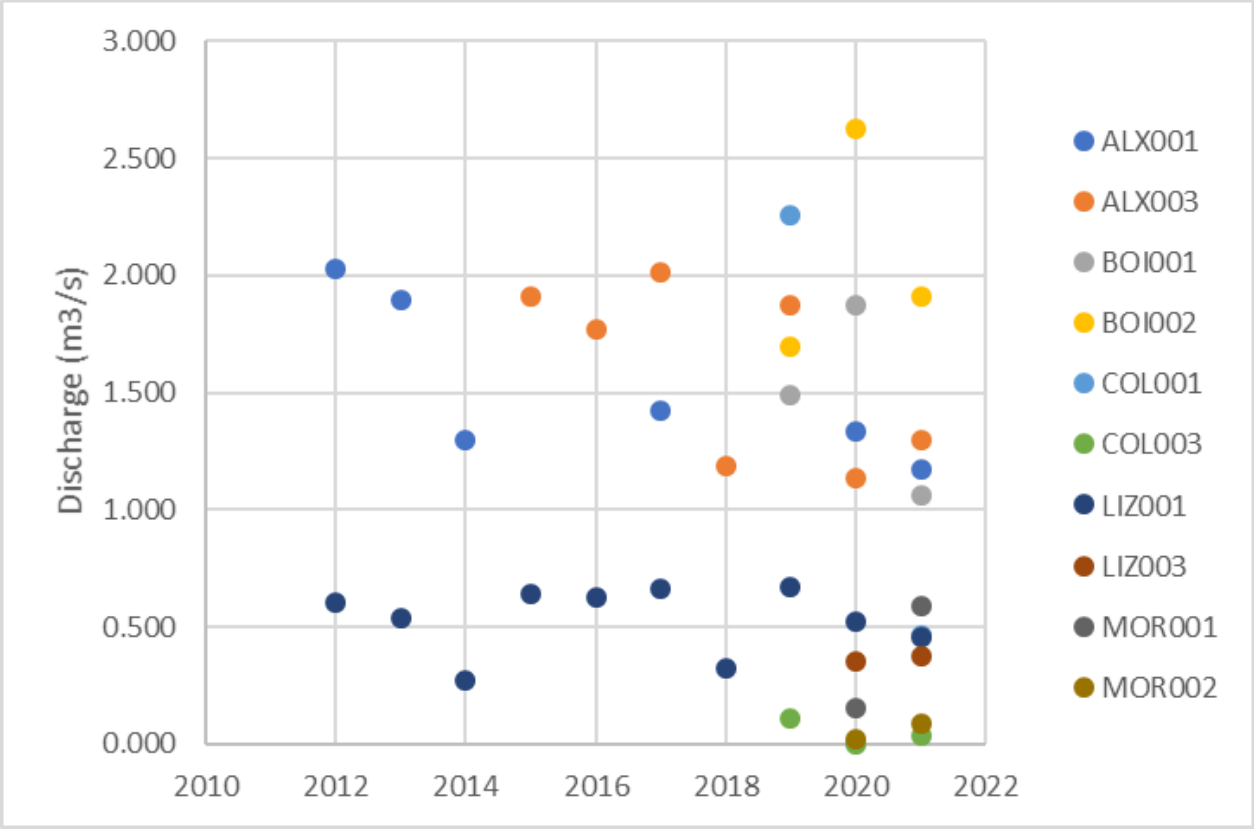

Figure 46. Discharge measurements calculated for CBWM sites from 2012- 2021.

Metals & Nutrients

Water chemistry data collected during the 2021 sampling period indicates there were no exceedances in metals or nutrients based on BC Water Quality Guidelines.

Selenium and Calcite

The Elk Valley has a long history of mining, and its residents are very aware of the associated environmental issues with this industry. Selenium and calcite are two constituents of serious concern in this region.

Selenium (Se) is a naturally occurring element and low levels are essential for the health of both humans and animals (Janz et al. 2010). Unfortunately, selenium actively bioaccumulates in tissues, and in higher concentrations, begins to become toxic, eventually causing reproductive issues and deformities (Teck Resources Ltd. 2015). Waste rock, resulting from coal mining operations, contains selenium. During the mining process, this rock is broken into smaller pieces, creating more opportunity for air and water to interact with the rock. This results in the conversion of selenium into its soluble form, which is then released in water seeping through these waste rock piles into local waterways (Teck Resources Ltd. 2015). The BC water quality guideline for the protection of aquatic life is 2 µg/L (micrograms/litre). The BC human drinking water consumption guideline is 10 µg/L (British Columbia Ministry of Environment and Climate Change Strategy 2021)

Calcite ($CaCO_3$) is also naturally occurring and is formed when calcium (Ca) and carbonate (CO_3) ions react under saturated conditions (Janz et al. 2010). Calcite concretion in streambeds, specifically downstream of local coal mining operations, has become an increasing concern in the Elk Valley. Although calcite precipitates occur naturally, the waste rock produced from mining has high concentrations of both calcium and carbonate which can solidify on large stretches of stream. Supersaturated conditions cause concretion of the streambed which can negatively affect aquatic life by actively eliminating benthic invertebrate habitat (Barrett, Weech, and Orr 2016). High amounts of calcite precipitate correlate with decreased %EPT and %*Ephemeroptera* (Golder Associates Ltd. 2014). There are no water quality guidelines associated with calcite in rivers, and as the Elk River watershed is primarily calcite-rich limestone, local rivers are naturally high in this substance (Golder Associates Ltd. 2014). Assessments of calcite usually measure the amount of solidified deposits within a stream through pebble counts (Barrett, Weech, and Orr 2016). CBWM monitoring includes a pebble count which should allow ERA to see any major deposits if present. To date, no major calcite deposits have been seen during monitoring. ERA may begin to explore options for more robust calcite monitoring, at the request of advisors on the Elk River Watershed Monitoring Collaborative.

Tributary catchments assessed with ERA's CBWM program are not affected by contemporary mining activities and are not expected to experience related contaminant issues. Selenium concentrations at the CBWM sites do not exceed reference levels and remain below the water quality guideline for freshwater aquatic life (Figure 47) (British Columbia Ministry of Environment and Climate Change Strategy 2021). For comparison, Figure 48 displays selenium concentrations in the Elk River mainstem near the outflow to Lake Koocanusa, (the Elk receives selenium loadings from upstream mines), and compares the levels found in ERA's CBWM assessed tributaries in 2020. The concentrations at these tributaries are well below what is now observed in the Elk River mainstem and are similar to those in the Elk River in the 1990s.

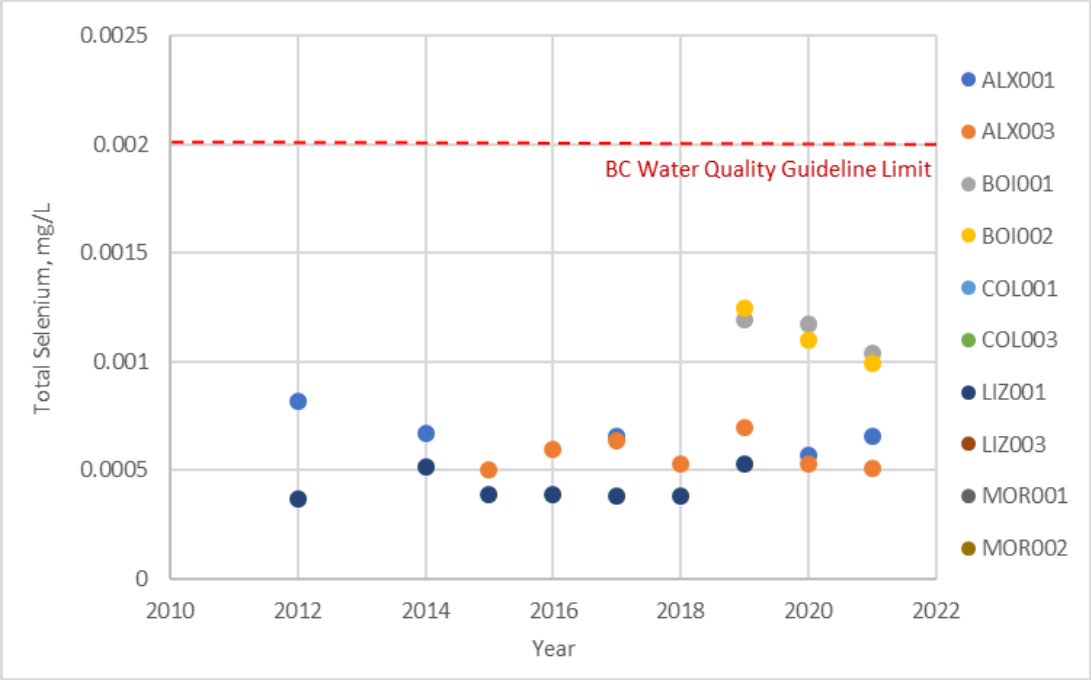

Figure 47. Total selenium concentrations at CBWM sites from 2012 to 2021. All concentrations are well below the BC water quality guideline of 0.002 mg/L (2µg/L).

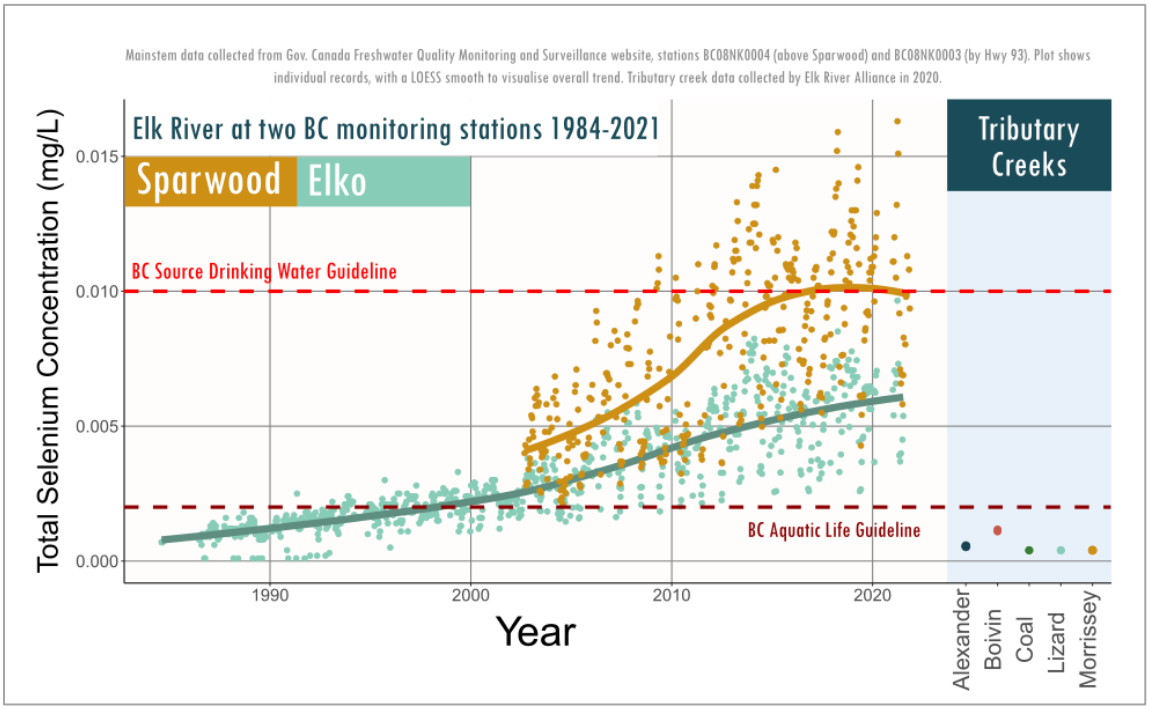

Figure 48. Total selenium in the Elk River mainstem at the outflow to Lake Koocanusa. Approximate concentrations at CBWM tributaries are included to the right and coincides with Elk River concentrations in the 1990s.

Study Limitations

A breakdown of some of the potential limitations for the 2021 CBWM sampling season.

Table 2. Outline of the potential limitations of ERA's Community-based Water Monitoring program

Aspect	Constraint	Comments on Limitations
Team competency/ experience	No	Teams performing site assessments are trained in CABIN protocols through either the Canadian Government or Living Lakes Canada, but many were inexperienced in applying them to new ERA sites. STREAM e-DNA sampling was new to the program in 2020, and although field teams received training, it is still a new component of ERA's CBWM program. As the team continues to use CABIN/STREAM and adjust to the new protocols, team members gain experience, improving confidence in data collection and assessment.
Timing / weather / seasonality	No	All monitoring is completed during low flow conditions, typically between August and November. This relatively large time window likely allows for fluctuations in some parameters, like temperature, may occur naturally rather than signify any important changes to the study site.
CABIN Model	Likely	In 2020 a new CABIN model was produced for the Columbia Basin. Prior to 2020, an Okanagan-Columbia Basin model was used. In 2021, ERA chose to assess sites using the new model. However, results are substantially different than with the previous model. ERA is currently investigating these issues to explore whether they are a result of unknown stressors on the aquatic systems, issues with the new model's ability to sort and assess ERA's sites, GIS, or field technician error.
Scope	No	The scope was clearly defined and realistically achievable within the designated timeframe.
Proportion of task achieved, and further work which might be needed	Maybe	All sites currently part of the program were successfully sampled and assessed, but there is room for improvement and expansion. The CBWM program aims to create a better understanding of watershed health. Increasing the number of sites across different watershed areas and incorporating a greater variety of habitats may be necessary to better understand overall ecosystem health.
Resources	No	Through the ERA board of directors and local partnerships, ERA staff have access to a diverse group of experts in various scientific fields. With the development of the Elk River Watershed Monitoring Collaborative, ERA's CBWM program focus will aim to align with the initiatives of this group and will gain further expertise in a number of different fields through its involvement in this program. Currently, ERA has limited access to industry-standard equipment. In 2021, ERA was able to upgrade equipment. Physical water quality parameters were assessed using the YSI ProDSS which increases the accuracy of measurements. Further, although CABIN data collection only requires a "head tube" for velocity measurements, ERA seeks to align data with BC RISC standards. In 2021,

Aspect	Constraint	Comments on Limitations
		discharge was calculated using velocity measurements taken by a Global Water Flow Probe. Although results are considered accurate and are comparable to more technical instruments (like Sontek's FlowTracker), velocity measurements are only available to the nearest 0.1 m/s and results do not adhere to BC RISC requirements.
Access	No	All sites were accessible. Initial CBWM site selection includes evaluating the accessibility of a site prior to inclusion in the program.

Conclusion & Recommended Actions

ERA's CBWM program is an ongoing program used to assess streams of concern identified through research and community input. 2021 methodology continued to center around CABIN-based assessments and marked the second year of STREAM e-DNA sampling.

Data assessment utilized the newly established 'Columbia 2020' CABIN model. The new model uses a new group of parameters to categorize sites and is better suited to the area than the previous model. Results produced from this new model significantly altered the assessment results for a number of monitoring sites, however, an adjustment period is expected to correctly apply and understand this new model. The new model has been applied to historical data and in some cases, this reassessment has result in altered historical results. Further investigation going forward will help determine the cause of these altered results and assess next steps.

Based on this new CABIN model, most study sites are in relatively healthy condition, with the exception of the Coal Creek site, COL001, the Morrisey Creek site, MOR001, and both Lizard Creek sites, LIZ001 and LIZ003. Both COL001 and MOR001 have large amounts of upstream development, and both are new sites. It will take additional sampling years to establish site norms and differentiate between stable fluctuations in their state and an ongoing trend in aquatic habitat. Analysis of water quality parameters associated with these sites does not indicate any obvious red flags due to exceedances of water quality guidelines that would point to causes for divergence, but the diversity of the benthic communities at these locations appears abnormal compared to reference condition sites. Continuing to monitor these sites and watching for patterns in water quality parameters over time, is a priority going forward.

The unexpected results for the Lizard Creek sites are a concern given the creek's importance in cutthroat trout population recruitment (Elk River Alliance 2020)**.** Although there are no specific exceedances of any water quality parameters based on BC guidelines, the benthic communities differ from what is expected from a typical healthy aquatic habitat. For each of these sites that have been assessed as "highly divergent", the total abundance of benthic invertebrates has been significantly higher than at associated reference sites. Furthermore, based on a number of measured water quality parameters, Lizard Creek may have unique conditions that are not captured by assigned reference sites (elevated alkalinity, hardness, calcium, magnesium, etc.). Due to the nature of CABIN models, which match a test site with a collection of specific reference sites and then compare the benthic communities, its possible that these high abundances have exaggerated how different the sites are, and produced these more extreme results, or that the differences in the natural state of this creek and reference creeks is too great to compare, yielding inaccurate results.

Understanding why these shifts in state have occurred, whether it is a data error, CABIN model issue, or a sign of a quickly degrading important aquatic habitat, is a high priority. Lizard Creek has been flagged as a high priority creek for more in-depth monitoring.

ERA has established and continues to engage with the Elk River Watershed Collaborative Monitoring Program. With the growth of new partnerships, the development of new research questions and access to previously inaccessible data, ERA hopes to continue to expand the CBWM program in the coming years and integrate ERA CABIN sites with the monitoring collaborative's recommendations to improve our understanding of watershed health. The primary focus will continue to be filling in current data gaps and finding answers to the local community's environmental concerns. ERA will seek to engage the ERWCMP

on the potential issues with Lizard Creek and hopes to enlist this group to take a leading role in new monitoring efforts on this Creek.

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Appendix A: CABIN Reports

Site Description

Study Name	CBWQ-Elk
Site	ALX001
Sampling Date	Sep 15 2021
Know Your Watershed Basin	Central Kootenay
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.67403 N, 114.77972 W
Altitude	1229
Local Basin Name	Alexander Creek
	Elk River
Stream Order	4

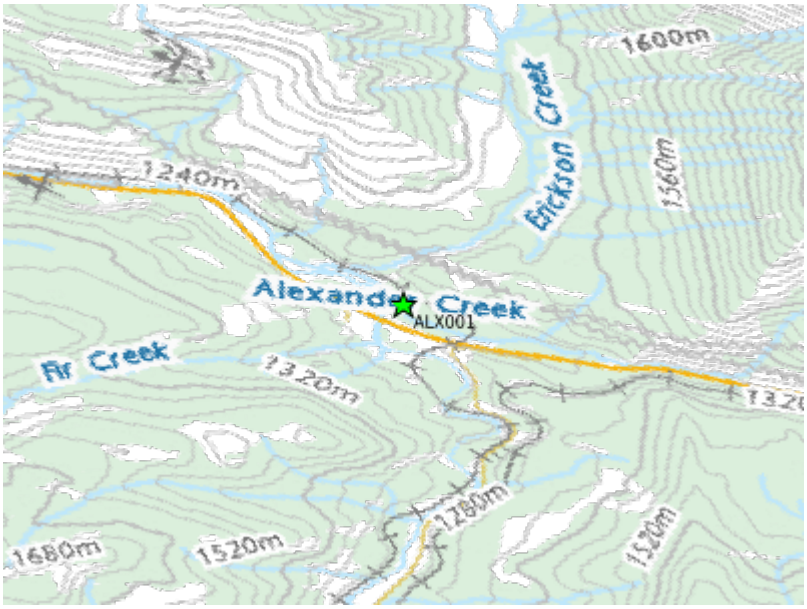
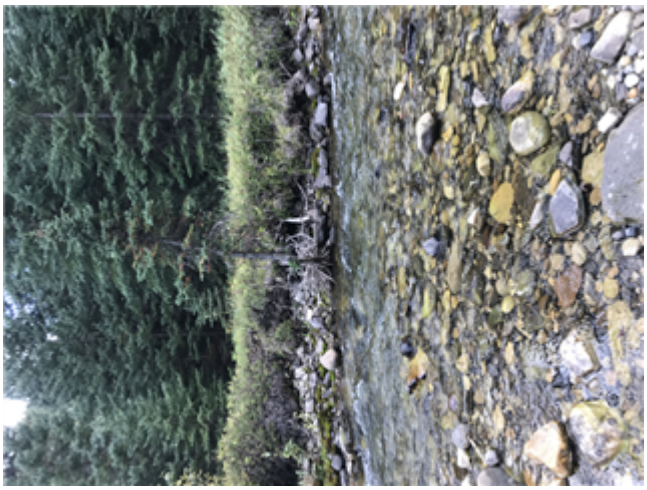


Figure 1. Location Map



Across Reach
Aerial (No image found)

Down Stream
Substrate (No image found)

Up Stream

Cabin Assessment Results

Reference Model Summary	
Model	Columbia Basin 2020
Analysis Date	December 06, 2023
Taxonomic Level	Family
Predictive Model Variables	Altitude Drainage-Area Longitude Natl-Grassland Natl-ShrubLow Natl-Water Precip10_Oct Reach-%CanopyCoverage Sedimentary Slope SlopeMax Temp12_DECmin

Reference Groups	1	2	3	4	5	6
Number of Reference Sites	13	24	28	35	32	15
Group Error Rate	53.8%	55.2%	34.1%	52.2%	23.1%	29.4%
Overall Model Error Rate	39.4%					
Probability of Group Membership	1.2%	3.0%	3.9%	7.9%	82.5%	1.5%
CABIN Assessment of ALX001 on Sep 15, 2021	Similar to Reference					

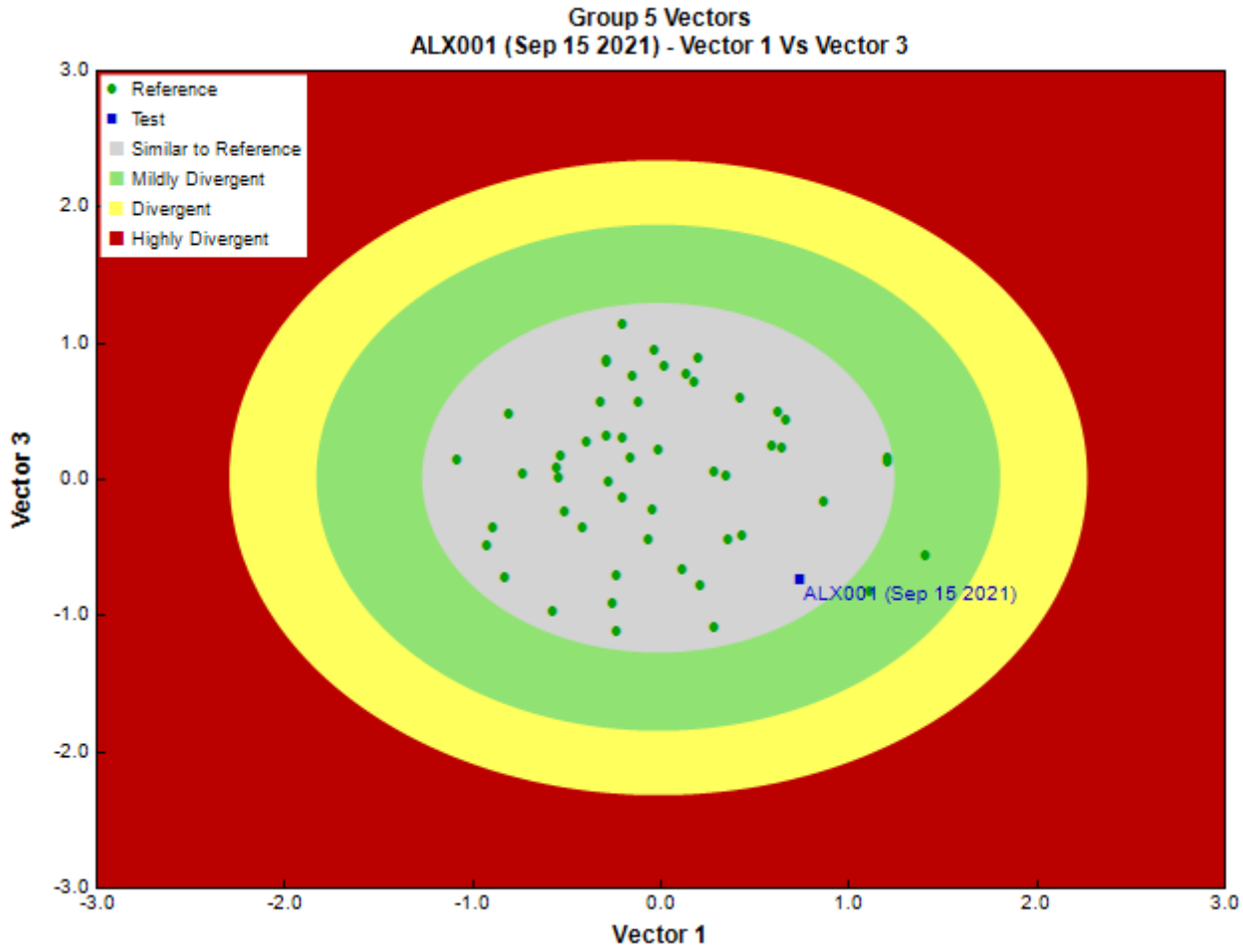


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Pina Viola, Consultant
	Marchant Box
Sub-Sample Proportion	5/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata		Enchytraeidae	2	40.0
		Lumbriculida	Lumbriculidae	3	60.0
Arthropoda	Arachnida	Trombidiformes	Lebertiidae	6	120.0
			Sperchontidae	2	40.0
			Torrenticolidae	2	40.0
	Collembola	Collembola		1	20.0
	Insecta	Coleoptera	Elmidae	8	160.0
		Diptera	Ceratopogonidae	1	20.0
			Chironomidae	18	360.0
			Empididae	2	40.0
			Psychodidae	78	1,560.0
			Simuliidae	4	80.0
			Tipulidae	1	20.0
		Ephemeroptera	Ameletidae	1	20.0
			Baetidae	33	660.0
			Ephemerellidae	48	960.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Heptageniidae	50	1,000.0
		Plecoptera		3	60.0
			Capniidae	2	40.0
			Chloroperlidae	4	80.0
			Nemouridae	36	720.0
			Perlidae	2	40.0
			Perlodidae	4	80.0
			Taeniopterygidae	20	400.0
		Trichoptera	Apataniidae	5	100.0
			Brachycentridae	2	40.0
			Glossosomatidae	103	2,060.0
			Hydropsychidae	7	140.0
			Rhyacophilidae	24	480.0
			Total	472	9,440.0

Metrics

Name	ALX001	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.53	0.4 ± 0.1
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	3.9	3.4 ± 0.4
Hilsenhoff Family index (North-West)	3.9	3.1 ± 0.5
Intolerant taxa	--	1.0 ± 0.0
Long-lived taxa	2.0	1.7 ± 1.2
Tolerant individuals (%)	--	0.3 ± 0.0
Functional Measures		
% Filterers	--	
% Gatherers	48.3	45.8 ± 14.9
% Predatores	15.5	14.8 ± 9.8
% Scrapers	48.7	59.4 ± 19.6
% Shredder	15.7	30.7 ± 17.4
No. Clinger Taxa	28.0	19.8 ± 4.0
Number Of Individuals		
% Chironomidae	3.8	7.5 ± 8.6
% Coleoptera	1.7	0.1 ± 0.3
% Diptera + Non-insects	25.0	10.7 ± 9.9
% Ephemeroptera	28.2	47.2 ± 15.8
% Ephemeroptera that are Baetidae	25.0	25.4 ± 20.8
% EPT Individuals	72.9	89.2 ± 10.0
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	38.7	58.3 ± 10.6
% of 5 dominant taxa	67.3	83.6 ± 6.3
% of dominant taxa	22.0	37.8 ± 11.1
% Plecoptera	14.5	36.3 ± 16.7
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	5.0	25.4 ± 24.6
% Tricoptera	30.1	5.7 ± 3.9
No. EPT individuals/Chironomids+EPT Individuals	0.9	0.9 ± 0.1
Total Abundance	9440.0	4661.0 ± 3119.0
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.1
Coleoptera taxa	1.0	0.1 ± 0.3
Diptera taxa	6.0	2.8 ± 1.0
Ephemeroptera taxa	4.0	3.7 ± 0.5
EPT Individuals (Sum)	6820.0	4035.4 ± 2618.4
EPT taxa (no)	15.0	12.3 ± 1.9
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.8	0.7 ± 0.1
Plecoptera taxa	6.0	5.5 ± 1.1
Shannon-Wiener Diversity	2.5	1.9 ± 0.3
Simpson's Diversity	0.9	0.8 ± 0.1
Simpson's Evenness	0.3	0.3 ± 0.1

Metrics

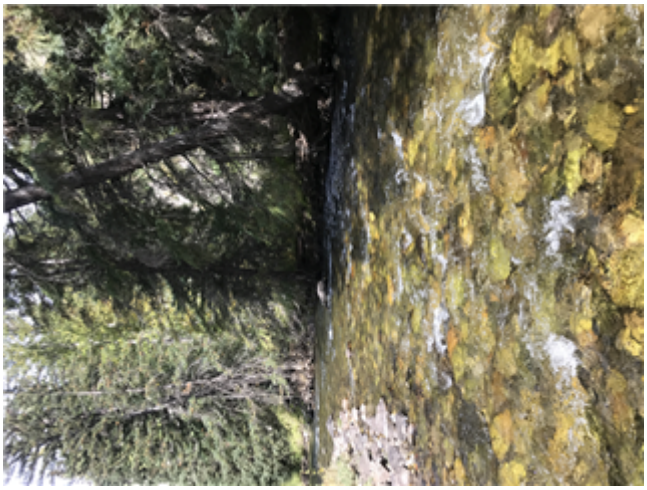
Name	ALX001	Predicted Group Reference Mean ±SD
Total No. of Taxa	27.0	17.0 ± 3.1
Trichoptera taxa	5.0	3.1 ± 1.2

Site Description

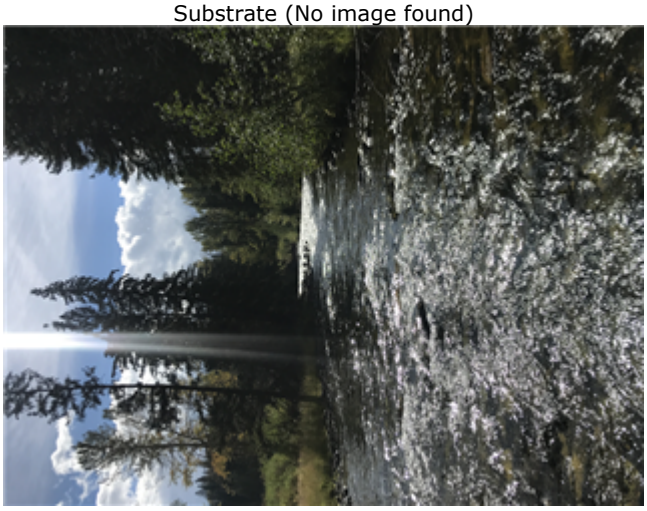
Study Name	CBWQ-Elk
Site	ALX003
Sampling Date	Sep 15 2021
Know Your Watershed Basin	Central Kootenay
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.65543 N, 114.73083 W
Altitude	1311
Local Basin Name	Alexander Creek
	Elk River Watershed
Stream Order	4

Figure 1. Location Map

Across Reach
Aerial (No image found)



Down Stream
Substrate (No image found)



Up Stream

Cabin Assessment Results

Reference Model Summary	
Model	Columbia Basin 2020
Analysis Date	December 06, 2023
Taxonomic Level	Family
Predictive Model Variables	Altitude Drainage-Area Longitude Natl-Grassland Natl-ShrubLow Natl-Water Precip10_Oct Reach-%CanopyCoverage Sedimentary Slope SlopeMax Temp12_DECmin

Reference Groups	1	2	3	4	5	6
Number of Reference Sites	13	24	28	35	32	15
Group Error Rate	53.8%	55.2%	34.1%	52.2%	23.1%	29.4%
Overall Model Error Rate	39.4%					
Probability of Group Membership	1.1%	2.0%	4.0%	7.5%	84.5%	0.9%
CABIN Assessment of ALX003 on Sep 15, 2021	Similar to Reference					

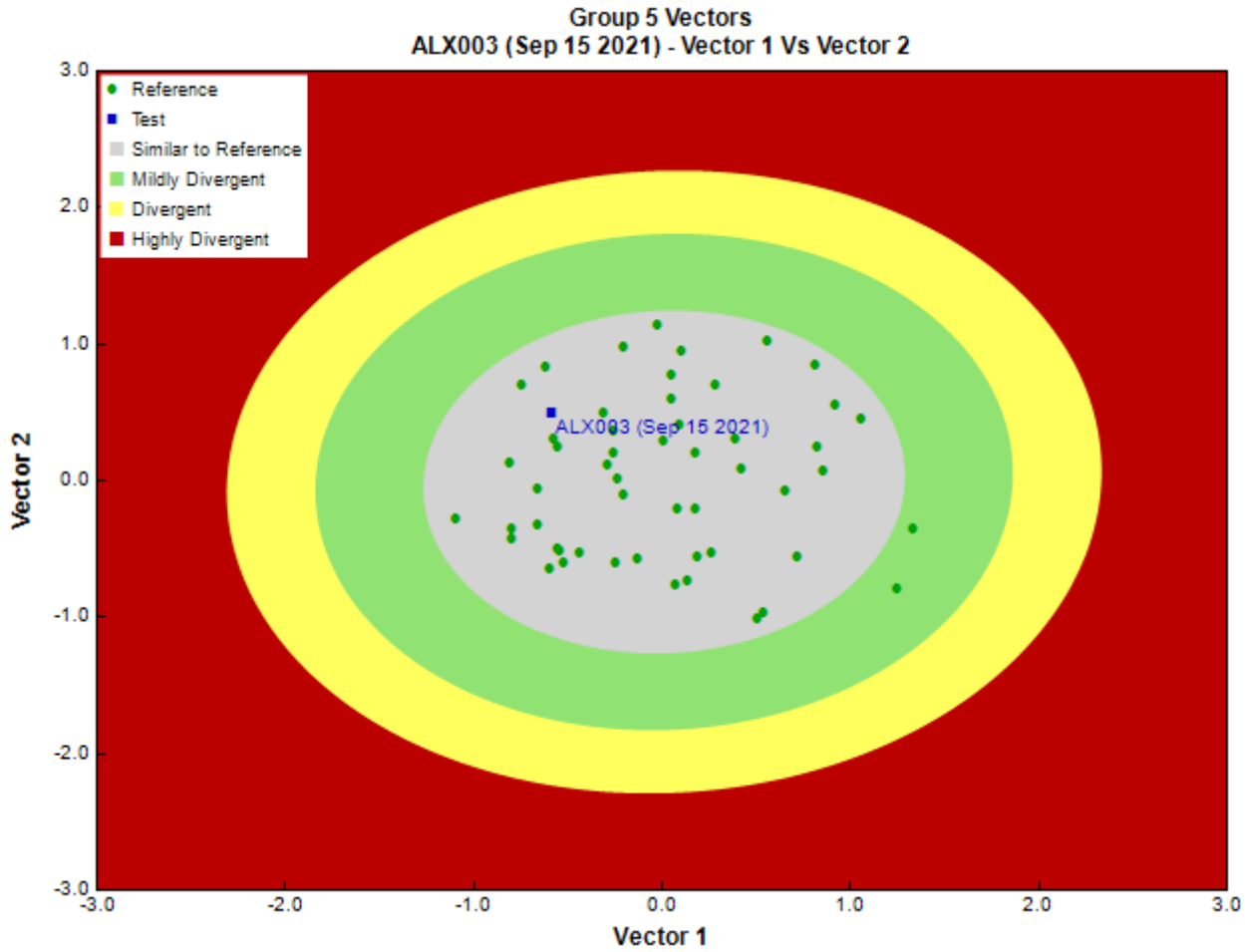


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Pina Viola, Consultant
	Marchant Box
Sub-Sample Proportion	6/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Arachnida	Trombidiformes	Lebertiidae	3	50.0
			Sperchontidae	1	16.7
	Insecta	Coleoptera	Elmidae	8	133.3
		Diptera	Chironomidae	9	150.0
			Empididae	7	116.7
			Psychodidae	18	300.0
		Ephemeroptera	Baetidae	40	666.7
			Ephemerellidae	93	1,550.1
			Heptageniidae	86	1,433.3
		Plecoptera		2	33.3
			Capniidae	1	16.7
			Chloroperlidae	4	66.7
			Nemouridae	21	350.0
			Taeniopterygidae	26	433.3
		Trichoptera	Glossosomatidae	2	33.3
			Hydropsychidae	3	50.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Rhyacophilidae	11	183.4
			Total	335	5,583.5

Metrics

Name	ALX003	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.33	0.4 ± 0.1
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	3.8	3.4 ± 0.4
Hilsenhoff Family index (North-West)	3.8	3.1 ± 0.5
Intolerant taxa	--	1.0 ± 0.0
Long-lived taxa	1.0	1.7 ± 1.2
Tolerant individuals (%)	--	0.3 ± 0.0
Functional Measures		
% Filterers	--	
% Gatherers	53.1	45.8 ± 14.9
% Predatores	10.1	14.8 ± 9.8
% Scrapers	49.3	59.4 ± 19.6
% Shredder	16.7	30.7 ± 17.4
No. Clinger Taxa	22.0	19.8 ± 4.0
Number Of Individuals		
% Chironomidae	2.7	7.5 ± 8.6
% Coleoptera	2.4	0.1 ± 0.3
% Diptera + Non-insects	11.4	10.7 ± 9.9
% Ephemeroptera	65.8	47.2 ± 15.8
% Ephemeroptera that are Baetidae	18.3	25.4 ± 20.8
% EPT Individuals	86.2	89.2 ± 10.0
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	53.8	58.3 ± 10.6
% of 5 dominant taxa	79.9	83.6 ± 6.3
% of dominant taxa	27.9	37.8 ± 11.1
% Plecoptera	15.6	36.3 ± 16.7
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	18.7	25.4 ± 24.6
% Tricoptera	4.8	5.7 ± 3.9
No. EPT individuals/Chironomids+EPT Individuals	1.0	0.9 ± 0.1
Total Abundance	5583.3	4661.0 ± 3119.0
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.1
Coleoptera taxa	1.0	0.1 ± 0.3
Diptera taxa	3.0	2.8 ± 1.0
Ephemeroptera taxa	3.0	3.7 ± 0.5
EPT Individuals (Sum)	4783.3	4035.4 ± 2618.4
EPT taxa (no)	10.0	12.3 ± 1.9
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.7	0.7 ± 0.1
Plecoptera taxa	4.0	5.5 ± 1.1
Shannon-Wiener Diversity	2.1	1.9 ± 0.3
Simpson's Diversity	0.8	0.8 ± 0.1
Simpson's Evenness	0.4	0.3 ± 0.1
Total No. of Taxa	16.0	17.0 ± 3.1
Trichoptera taxa	3.0	3.1 ± 1.2

Site Description

Study Name	CBWQ-Elk
Site	BOI001
Sampling Date	Oct 05 2021
Know Your Watershed Basin	Central Kootenay
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	50.02312 N, 114.91641 W
Altitude	1260
Local Basin Name	Elk River
	Boivin Creek
Stream Order	4

Figure 1. Location Map


Across Reach
Aerial (No image found)

Down Stream

Substrate

Up Stream

Cabin Assessment Results

Reference Model Summary	
Model	Columbia Basin 2020
Analysis Date	December 06, 2023
Taxonomic Level	Family

Cabin Assessment Results

Predictive Model Variables	Altitude Drainage-Area Longitude Natl-Grassland Natl-ShrubLow Natl-Water Precip10_Oct Reach-%CanopyCoverage Sedimentary Slope SlopeMax Temp12_DECmin

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**
Number of Reference Sites	13	24	28	35	32	15
Group Error Rate	53.8%	55.2%	34.1%	52.2%	23.1%	29.4%
Overall Model Error Rate	39.4%					
Probability of Group Membership	6.0%	9.3%	4.7%	18.2%	57.8%	4.0%
CABIN Assessment of BOI001 on Oct 05, 2021	Mildly Divergent					

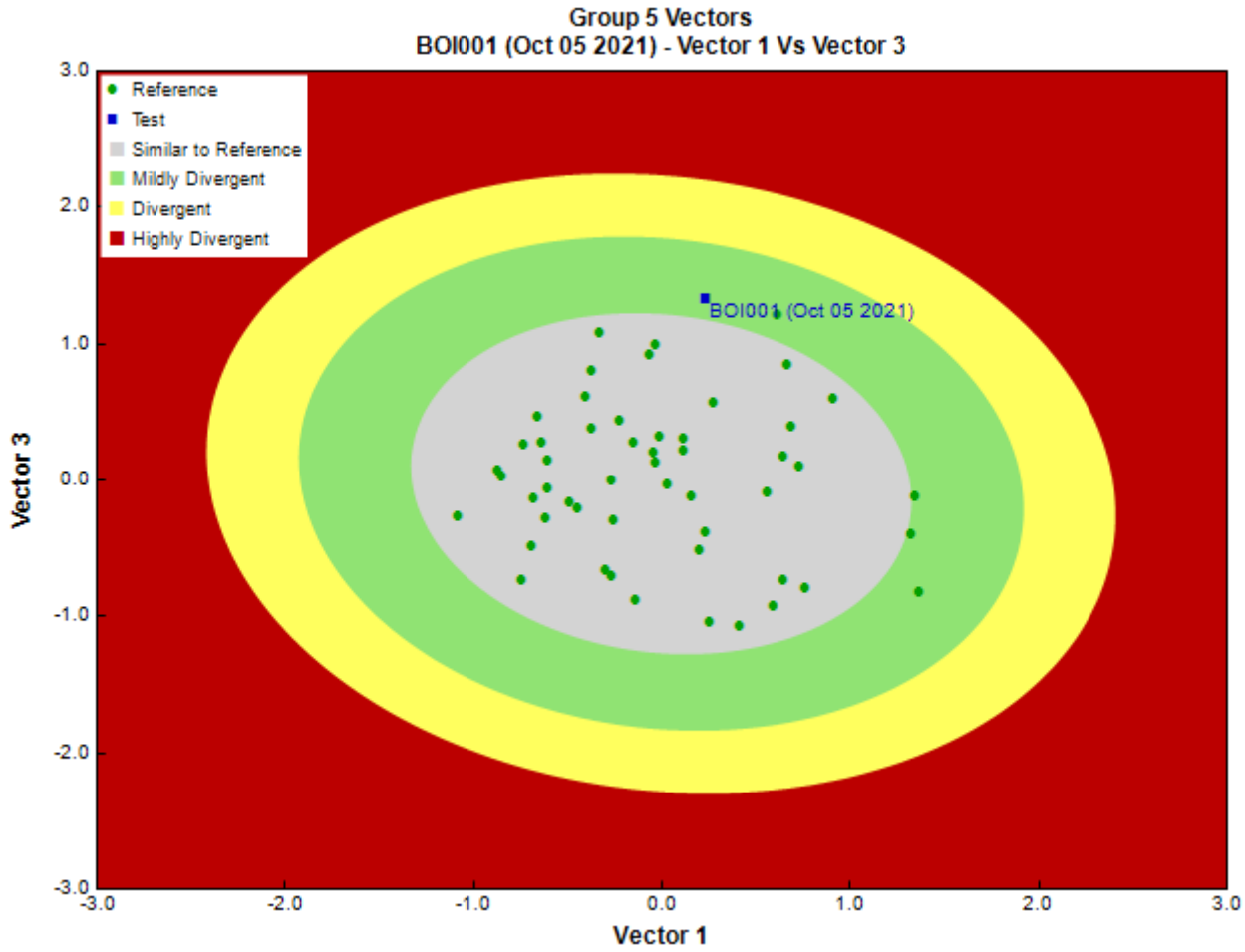


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3

Sample Information

Taxonomist	Pina Viola, Consultant
	Marchant Box
Sub-Sample Proportion	5/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Arachnida	Trombidiformes		1	20.0
			Sperchontidae	1	20.0
	Insecta	Diptera	Chironomidae	9	180.0
			Psychodidae	2	40.0
			Simuliidae	9	180.0
		Ephemeroptera	Baetidae	21	420.0
			Ephemerellidae	17	340.0
			Heptageniidae	148	2,960.0
		Plecoptera		1	20.0
			Capniidae	1	20.0
			Nemouridae	43	860.0
			Perlodidae	4	80.0
			Taeniopterygidae	323	6,460.0
		Trichoptera	Glossosomatidae	7	140.0
			Uenoidae	1	20.0
			Total	588	11,760.0

Metrics

Name	BOI001	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.59	0.4 ± 0.1
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	2.7	3.4 ± 0.4
Hilsenhoff Family index (North-West)	2.7	3.1 ± 0.5
Intolerant taxa	--	1.0 ± 0.0
Long-lived taxa	--	1.7 ± 1.2
Tolerant individuals (%)	--	0.3 ± 0.0
Functional Measures		
% Filterers	--	
% Gatherers	68.7	45.8 ± 14.9
% Predatores	3.9	14.8 ± 9.8
% Scrapers	86.6	59.4 ± 19.6
% Shredder	62.4	30.7 ± 17.4
No. Clinger Taxa	18.0	19.8 ± 4.0
Number Of Individuals		
% Chironomidae	1.5	7.5 ± 8.6
% Coleoptera	0.0	0.1 ± 0.3
% Diptera + Non-insects	3.6	10.7 ± 9.9
% Ephemeroptera	31.7	47.2 ± 15.8
% Ephemeroptera that are Baetidae	11.3	25.4 ± 20.8
% EPT Individuals	96.4	89.2 ± 10.0
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	80.4	58.3 ± 10.6
% of 5 dominant taxa	94.2	83.6 ± 6.3
% of dominant taxa	55.1	37.8 ± 11.1
% Plecoptera	63.3	36.3 ± 16.7
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	0.0	25.4 ± 24.6
% Tricoptera	1.4	5.7 ± 3.9
No. EPT individuals/Chironomids+EPT Individuals	1.0	0.9 ± 0.1
Total Abundance	11760.0	4661.0 ± 3119.0
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.1
Coleoptera taxa	0.0	0.1 ± 0.3
Diptera taxa	3.0	2.8 ± 1.0
Ephemeroptera taxa	3.0	3.7 ± 0.5

Metrics

Name	BOI001	Predicted Group Reference Mean ±SD
EPT Individuals (Sum)	11300.0	4035.4 ± 2618.4
EPT taxa (no)	9.0	12.3 ± 1.9
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.5	0.7 ± 0.1
Plecoptera taxa	4.0	5.5 ± 1.1
Shannon-Wiener Diversity	1.4	1.9 ± 0.3
Simpson's Diversity	0.6	0.8 ± 0.1
Simpson's Evenness	0.2	0.3 ± 0.1
Total No. of Taxa	13.0	17.0 ± 3.1
Trichoptera taxa	2.0	3.1 ± 1.2

Site Description

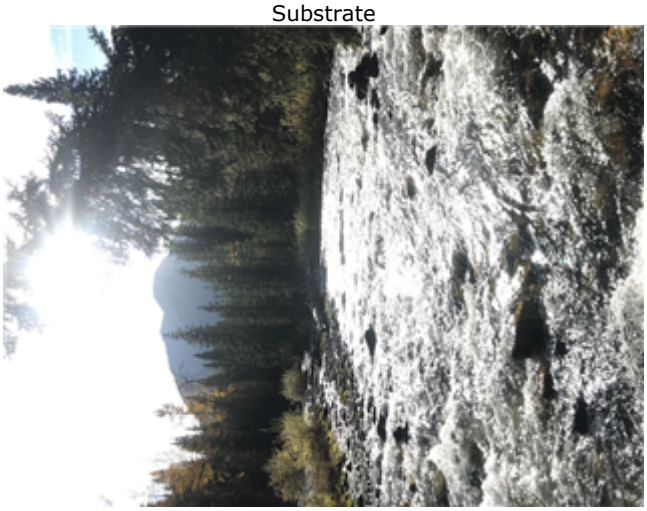
Study Name	CBWQ-Elk
Site	BOI002
Sampling Date	Oct 05 2021
Know Your Watershed Basin	Central Kootenay
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	50.01615 N, 114.93726 W
Altitude	1327
Local Basin Name	Elk River
	Boivin Creek
Stream Order	4

Figure 1. Location Map

Across Reach
Aerial (No image found)

Down Stream

Substrate



Up Stream

Cabin Assessment Results

Reference Model Summary	
Model	Columbia Basin 2020
Analysis Date	December 06, 2023
Taxonomic Level	Family

Cabin Assessment Results

Predictive Model Variables	Altitude Drainage-Area Longitude Natl-Grassland Natl-ShrubLow Natl-Water Precip10_Oct Reach-%CanopyCoverage Sedimentary Slope SlopeMax Temp12_DECmin

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**
Number of Reference Sites	13	24	28	35	32	15
Group Error Rate	53.8%	55.2%	34.1%	52.2%	23.1%	29.4%
Overall Model Error Rate	39.4%					
Probability of Group Membership	3.1%	4.4%	7.8%	14.4%	68.0%	2.3%
CABIN Assessment of BOI002 on Oct 05, 2021	Similar to Reference					

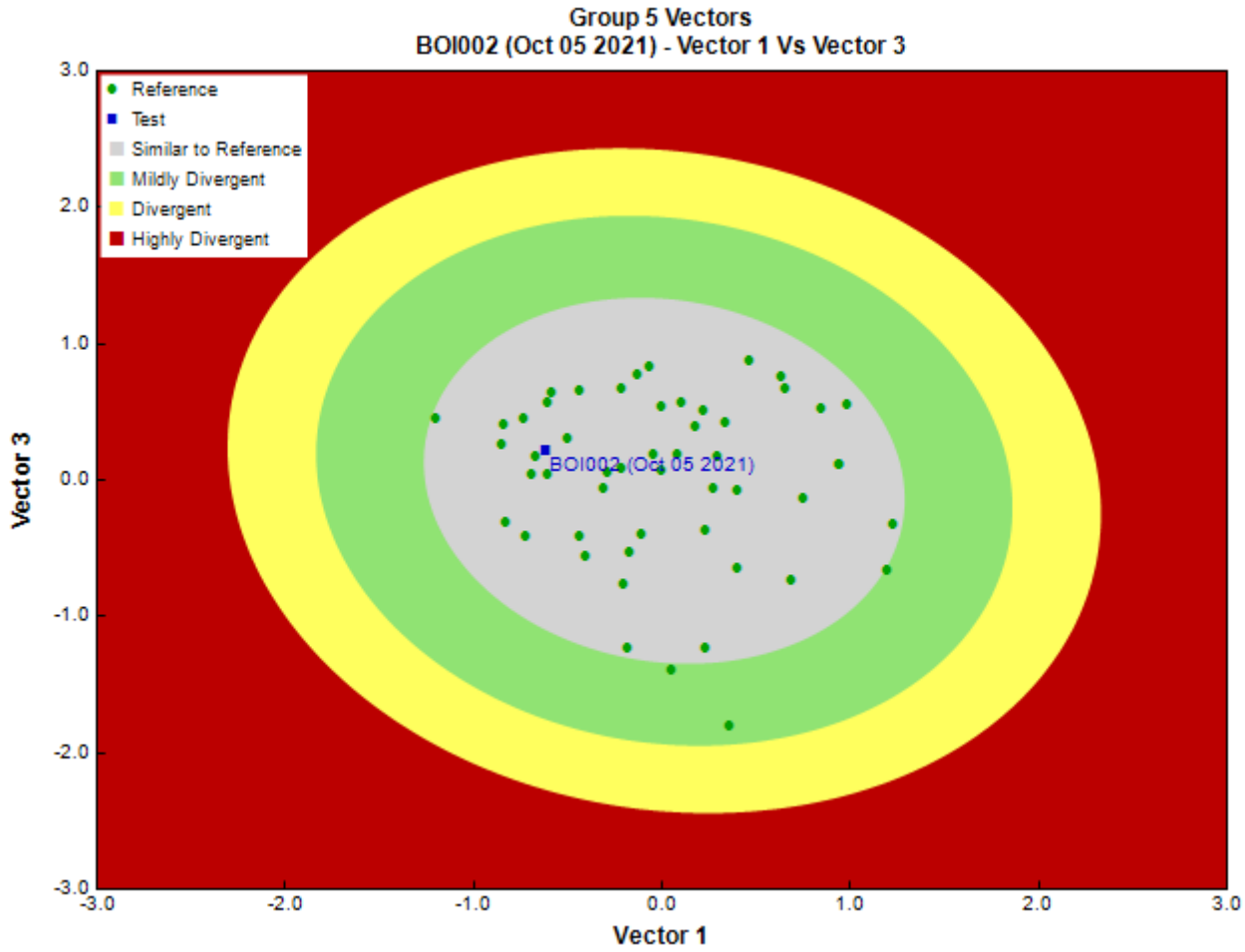


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3

Sample Information

Taxonomist	Pina Viola, Consultant
	Marchant Box
Sub-Sample Proportion	7/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Insecta	Diptera	Chironomidae	19	271.4
			Psychodidae	1	14.3
			Simuliidae	14	200.0
		Ephemeroptera	Baetidae	17	242.9
			Ephemerellidae	61	871.5
			Heptageniidae	79	1,128.6
		Plecoptera	Chloroperlidae	11	157.2
			Nemouridae	12	171.4
			Perlodidae	8	114.3
			Taeniopterygidae	86	1,228.6
		Trichoptera	Glossosomatidae	2	28.6
			Rhyacophilidae	9	128.6
			Total	319	4,557.4

Metrics

Name	BOI002	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.25	0.4 ± 0.1
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	3.2	3.4 ± 0.4
Hilsenhoff Family index (North-West)	3.2	3.1 ± 0.5
Intolerant taxa	--	1.0 ± 0.0
Long-lived taxa	--	1.7 ± 1.2
Tolerant individuals (%)	--	0.3 ± 0.0
Functional Measures		
% Filterers	--	
% Gatherers	60.5	45.8 ± 14.9
% Predatores	15.7	14.8 ± 9.8
% Scrapers	62.1	59.4 ± 19.6
% Shredder	30.7	30.7 ± 17.4
No. Clinger Taxa	15.0	19.8 ± 4.0
Number Of Individuals		
% Chironomidae	6.0	7.5 ± 8.6
% Coleoptera	0.0	0.1 ± 0.3
% Diptera + Non-insects	10.7	10.7 ± 9.9
% Ephemeroptera	49.2	47.2 ± 15.8
% Ephemeroptera that are Baetidae	10.8	25.4 ± 20.8
% EPT Individuals	89.3	89.2 ± 10.0
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	51.7	58.3 ± 10.6
% of 5 dominant taxa	82.1	83.6 ± 6.3
% of dominant taxa	27.0	37.8 ± 11.1
% Plecoptera	36.7	36.3 ± 16.7
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	0.0	25.4 ± 24.6
% Tricoptera	3.4	5.7 ± 3.9
No. EPT individuals/Chironomids+EPT Individuals	0.9	0.9 ± 0.1
Total Abundance	4557.1	4661.0 ± 3119.0
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.1
Coleoptera taxa	0.0	0.1 ± 0.3
Diptera taxa	3.0	2.8 ± 1.0
Ephemeroptera taxa	3.0	3.7 ± 0.5
EPT Individuals (Sum)	4071.4	4035.4 ± 2618.4
EPT taxa (no)	9.0	12.3 ± 1.9
Odonata taxa	--	0.0 ± 0.0

Metrics

Name	BOI002	Predicted Group Reference Mean ±SD
Pielou's Evenness	0.8	0.7 ± 0.1
Plecoptera taxa	4.0	5.5 ± 1.1
Shannon-Wiener Diversity	2.0	1.9 ± 0.3
Simpson's Diversity	0.8	0.8 ± 0.1
Simpson's Evenness	0.5	0.3 ± 0.1
Total No. of Taxa	12.0	17.0 ± 3.1
Trichoptera taxa	2.0	3.1 ± 1.2

Site Description

Study Name	CBWQ-Elk
Site	COL001
Sampling Date	Oct 06 2021
Know Your Watershed Basin	Central Kootenay
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.49548 N, 115.06645 W
Altitude	999
Local Basin Name	Elk River
	Coal Creek
Stream Order	3

Figure 1. Location Map

Across Reach (No image found)
Aerial (No image found)
Down Stream (No image found)
Substrate (No image found)
Up Stream (No image found)

Cabin Assessment Results

Reference Model Summary	
Model	Columbia Basin 2020
Analysis Date	December 06, 2023
Taxonomic Level	Family
Predictive Model Variables	Altitude Drainage-Area Longitude Natl-Grassland Natl-ShrubLow Natl-Water Precip10_Oct Reach-%CanopyCoverage Sedimentary Slope SlopeMax Temp12_DECmin

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**
Number of Reference Sites	13	24	28	35	32	15
Group Error Rate	53.8%	55.2%	34.1%	52.2%	23.1%	29.4%

Overall Model Error Rate	39.4%					
Probability of Group Membership	2.9%	14.0%	11.8%	46.7%	22.3%	2.2%
CABIN Assessment of COL001 on Oct 06, 2021	Highly Divergent					

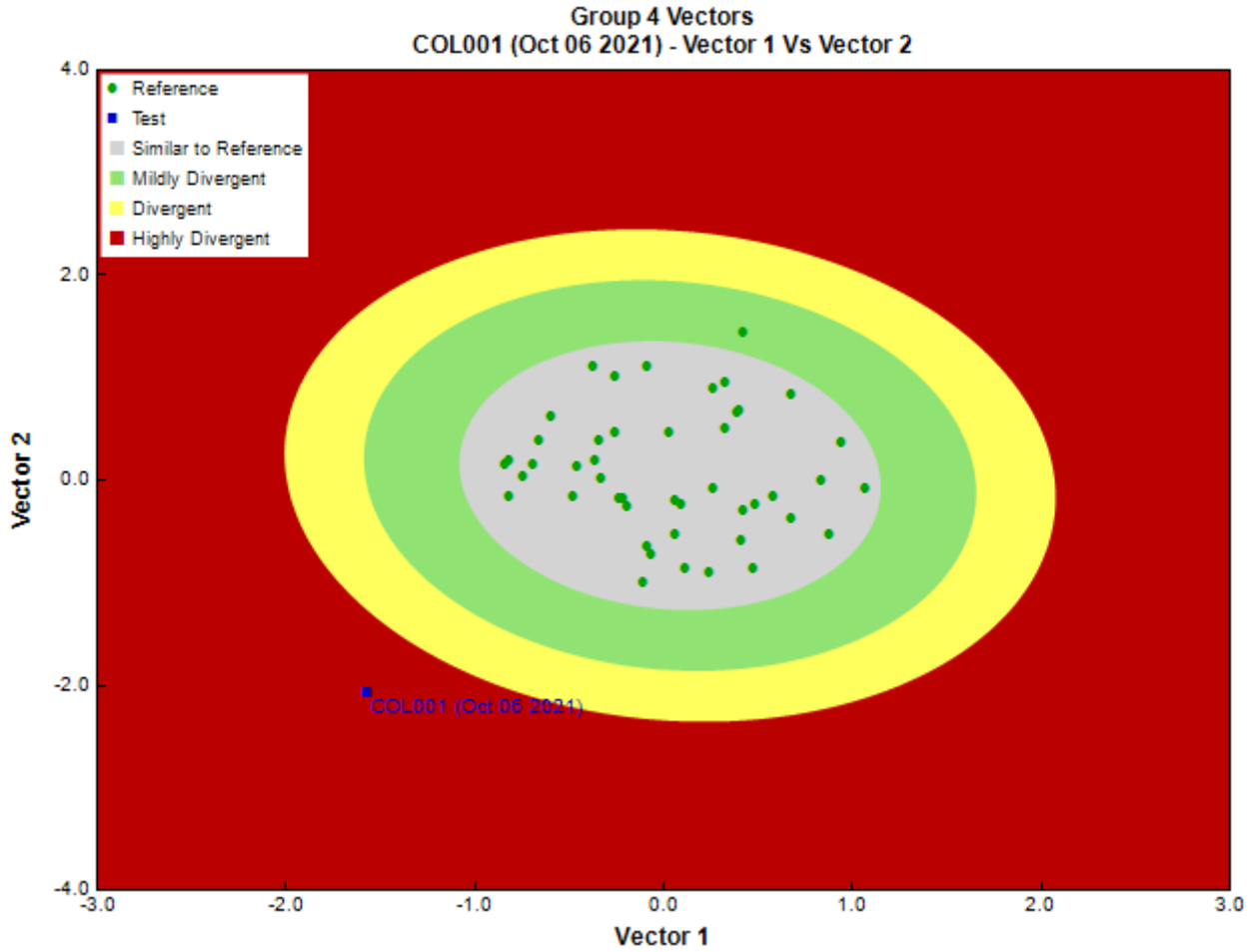


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	Pina Viola, Consultant
	Marchant Box
Sub-Sample Proportion	5/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata			1	20.0
		Tubificida	Naididae	52	1,040.0
Arthropoda	Arachnida	Trombidiformes		1	20.0
			Lebertiidae	4	80.0
			Sperchontidae	2	40.0
			Torrenticolidae	4	80.0
	Insecta	Coleoptera	Elmidae	3	60.0
		Diptera	Chironomidae	79	1,580.0
			Empididae	4	80.0
			Psychodidae	3	60.0
			Tipulidae	51	1,020.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
		Ephemeroptera	Ameletidae	2	40.0
			Baetidae	16	320.0
			Ephemerellidae	142	2,840.0
			Heptageniidae	49	980.0
			Leptophlebiidae	5	100.0
		Plecoptera		1	20.0
			Capniidae	18	360.0
			Perlodidae	5	100.0
		Trichoptera	Apataniidae	2	40.0
			Brachycentridae	1	20.0
			Hydropsychidae	9	180.0
			Lepidostomatidae	137	2,740.0
Cnidaria	Hydrozoa	Anthoathecatae	Hydridae	1	20.0
			Total	592	11,840.0

Metrics

Name	COL001	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.9	0.3 ± 0.1
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	4.4	3.2 ± 0.4
Hilsenhoff Family index (North-West)	4.4	2.9 ± 0.3
Intolerant taxa	--	1.0 ± 0.0
Long-lived taxa	2.0	1.9 ± 1.0
Tolerant individuals (%)	--	0.5 ± 0.4
Functional Measures		
% Filterers	--	0.3
% Gatherers	67.5	47.1 ± 15.4
% Predatores	18.4	12.9 ± 7.3
% Scrapers	13.4	68.3 ± 16.1
% Shredder	35.9	36.7 ± 14.6
No. Clinger Taxa	17.0	20.3 ± 4.6
Number Of Individuals		
% Chironomidae	13.4	5.2 ± 5.7
% Coleoptera	0.5	0.6 ± 2.2
% Diptera + Non-insects	33.8	7.4 ± 7.0
% Ephemeroptera	36.4	45.8 ± 15.1
% Ephemeroptera that are Baetidae	7.5	28.9 ± 20.8
% EPT Individuals	65.6	91.9 ± 7.3
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	47.4	59.5 ± 11.3
% of 5 dominant taxa	78.4	85.1 ± 6.5
% of dominant taxa	24.1	37.7 ± 10.4
% Plecoptera	3.9	40.5 ± 13.3
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	6.0	23.9 ± 23.6
% Tricoptera	25.3	5.6 ± 3.9
No. EPT individuals/Chironomids+EPT Individuals	0.8	0.9 ± 0.1
Total Abundance	11820.0	1449.6 ± 859.7
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.2
Coleoptera taxa	1.0	0.2 ± 0.5
Diptera taxa	4.0	2.6 ± 1.1
Ephemeroptera taxa	5.0	3.7 ± 0.6
EPT Individuals (Sum)	7720.0	1353.0 ± 804.6
EPT taxa (no)	11.0	12.3 ± 2.2
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.7	0.7 ± 0.1
Plecoptera taxa	2.0	5.4 ± 1.2
Shannon-Wiener Diversity	2.2	1.9 ± 0.3
Simpson's Diversity	0.8	0.8 ± 0.1
Simpson's Evenness	0.3	0.3 ± 0.1

Metrics

Name	COL001	Predicted Group Reference Mean ±SD
Total No. of Taxa	21.0	16.5 ± 3.6
Trichoptera taxa	4.0	3.2 ± 1.3

Site Description

Study Name	CBWQ-Elk
Site	COL003
Sampling Date	Oct 06 2021
Know Your Watershed Basin	Central Kootenay
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.45274 N, 114.88019 W
Altitude	1737
Local Basin Name	Elk River
	Coal Creek
Stream Order	1

Figure 1. Location Map

Across Reach
Aerial (No image found)

Down Stream

Substrate

Up Stream

Cabin Assessment Results

Reference Model Summary	
Model	Columbia Basin 2020
Analysis Date	December 06, 2023
Taxonomic Level	Family

Cabin Assessment Results

Predictive Model Variables	Altitude Drainage-Area Longitude Natl-Grassland Natl-ShrubLow Natl-Water Precip10_Oct Reach-%CanopyCoverage Sedimentary Slope SlopeMax Temp12_DECmin

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**
Number of Reference Sites	13	24	28	35	32	15
Group Error Rate	53.8%	55.2%	34.1%	52.2%	23.1%	29.4%
Overall Model Error Rate	39.4%					
Probability of Group Membership	1.0%	0.1%	0.9%	0.8%	97.2%	0.0%
CABIN Assessment of COL003 on Oct 06, 2021	Mildly Divergent					

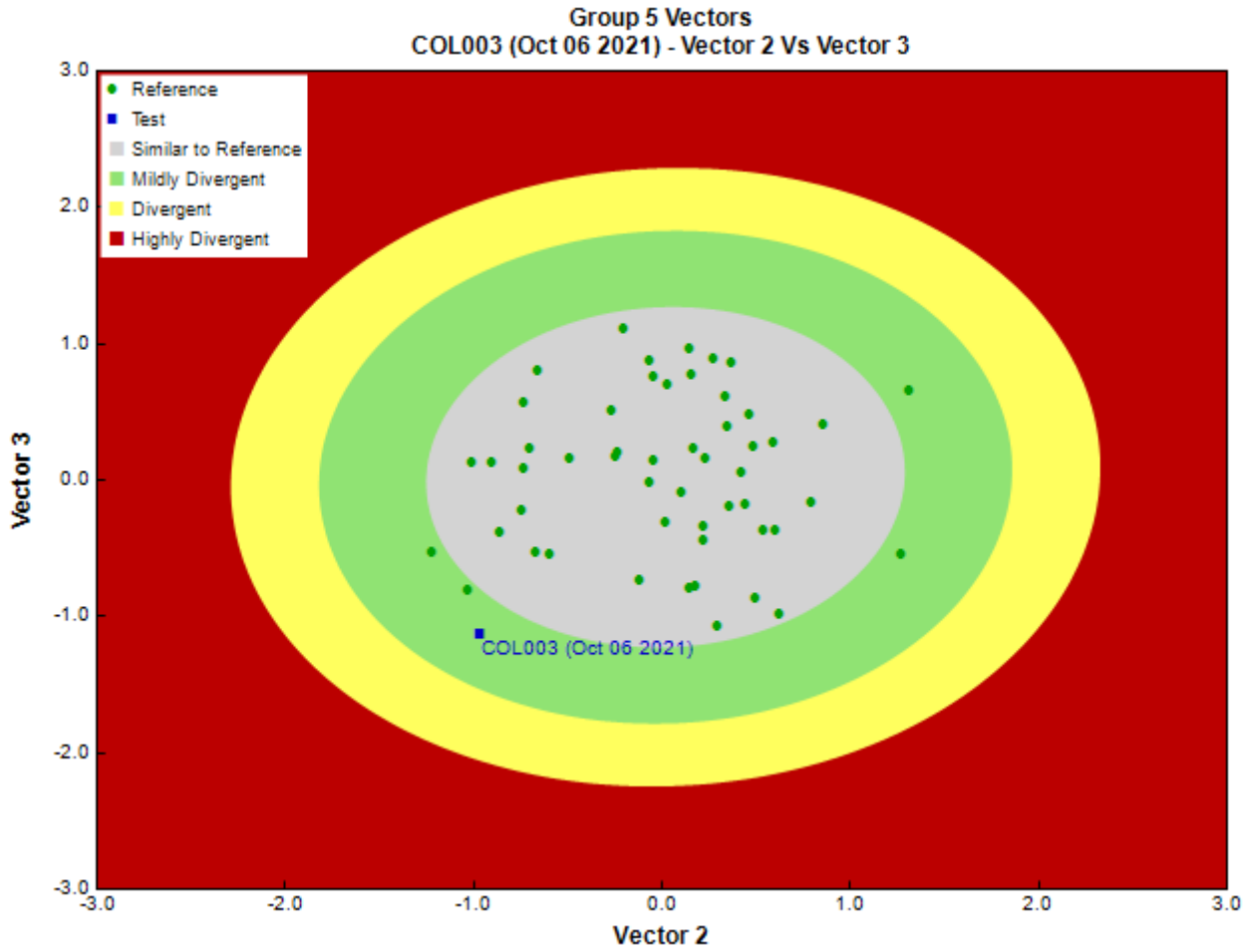


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3

Sample Information

Taxonomist	Pina Viola, Consultant
	Marchant Box
Sub-Sample Proportion	11/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata	Tubificida	Naididae	1	9.1
Arthropoda	Arachnida	Trombidiformes	Lebertiidae	3	27.3
			Sperchontidae	2	18.2
	Collembola	Collembola		1	9.1
	Insecta	Coleoptera	Elmidae	8	72.7
		Diptera	Chironomidae	166	1,509.1
			Empididae	1	9.1
			Psychodidae	1	9.1
		Ephemeroptera	Ameletidae	43	390.9
			Baetidae	52	472.7
			Ephemerellidae	13	118.2
			Heptageniidae	20	181.9
			Leptophlebiidae	1	9.1
		Plecoptera	Capniidae	6	54.5
			Chloroperlidae	8	72.8
			Leuctridae	1	9.1
			Nemouridae	17	154.6
			Peltoperlidae	4	36.4
			Perlidae	4	36.4
			Perlodidae	3	27.3
		Trichoptera		3	27.3
			Brachycentridae	15	136.4
			Rhyacophilidae	3	27.3
			Uenoidae	1	9.1
			Total	377	3,427.7

Metrics

Name	COL003	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.62	0.4 ± 0.1
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	3.4	3.4 ± 0.4
Hilsenhoff Family index (North-West)	3.4	3.1 ± 0.5
Intolerant taxa	--	1.0 ± 0.0
Long-lived taxa	3.0	1.7 ± 1.2
Tolerant individuals (%)	--	0.3 ± 0.0
Functional Measures		
% Filterers	--	
% Gatherers	70.8	45.8 ± 14.9
% Predatores	52.3	14.8 ± 9.8
% Scrapers	21.5	59.4 ± 19.6
% Shredder	13.5	30.7 ± 17.4
No. Clinger Taxa	24.0	19.8 ± 4.0
Number Of Individuals		
% Chironomidae	44.5	7.5 ± 8.6
% Coleoptera	2.1	0.1 ± 0.3
% Diptera + Non-insects	46.6	10.7 ± 9.9
% Ephemeroptera	34.6	47.2 ± 15.8
% Ephemeroptera that are Baetidae	40.3	25.4 ± 20.8
% EPT Individuals	51.2	89.2 ± 10.0
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	58.4	58.3 ± 10.6
% of 5 dominant taxa	79.9	83.6 ± 6.3
% of dominant taxa	44.5	37.8 ± 11.1
% Plecoptera	11.5	36.3 ± 16.7
% Tribe Tanyatarisini	--	

Metrics

Name	COL003	Predicted Group Reference Mean ±SD
% Trichoptera that are Hydropsychida	0.0	25.4 ± 24.6
% Tricoptera	5.1	5.7 ± 3.9
No. EPT individuals/Chironomids+EPT Individuals	0.5	0.9 ± 0.1
Total Abundance	3427.3	4661.0 ± 3119.0
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.1
Coleoptera taxa	1.0	0.1 ± 0.3
Diptera taxa	3.0	2.8 ± 1.0
Ephemeroptera taxa	5.0	3.7 ± 0.5
EPT Individuals (Sum)	1736.4	4035.4 ± 2618.4
EPT taxa (no)	15.0	12.3 ± 1.9
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.6	0.7 ± 0.1
Plecoptera taxa	7.0	5.5 ± 1.1
Shannon-Wiener Diversity	2.0	1.9 ± 0.3
Simpson's Diversity	0.8	0.8 ± 0.1
Simpson's Evenness	0.2	0.3 ± 0.1
Total No. of Taxa	22.0	17.0 ± 3.1
Trichoptera taxa	3.0	3.1 ± 1.2

Site Description

Study Name	CBWQ-Elk
Site	LIZ001
Sampling Date	Oct 03 2021
Know Your Watershed Basin	Central Kootenay
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.47094 N, 115.07678 W
Altitude	988
Local Basin Name	Lizard Creek
	Elk River
Stream Order	3

Figure 1. Location Map

Across Reach
Aerial (No image found)

Down Stream

Substrate

Up Stream

Cabin Assessment Results

Reference Model Summary	
Model	Columbia Basin 2020
Analysis Date	December 06, 2023
Taxonomic Level	Family

Cabin Assessment Results

Predictive Model Variables	Altitude Drainage-Area Longitude Natl-Grassland Natl-ShrubLow Natl-Water Precip10_Oct Reach-%CanopyCoverage Sedimentary Slope SlopeMax Temp12_DECmin

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**
Number of Reference Sites	13	24	28	35	32	15
Group Error Rate	53.8%	55.2%	34.1%	52.2%	23.1%	29.4%
Overall Model Error Rate	39.4%					
Probability of Group Membership	8.1%	44.9%	8.4%	25.1%	6.7%	6.8%
CABIN Assessment of LIZ001 on Oct 03, 2021	Highly Divergent					

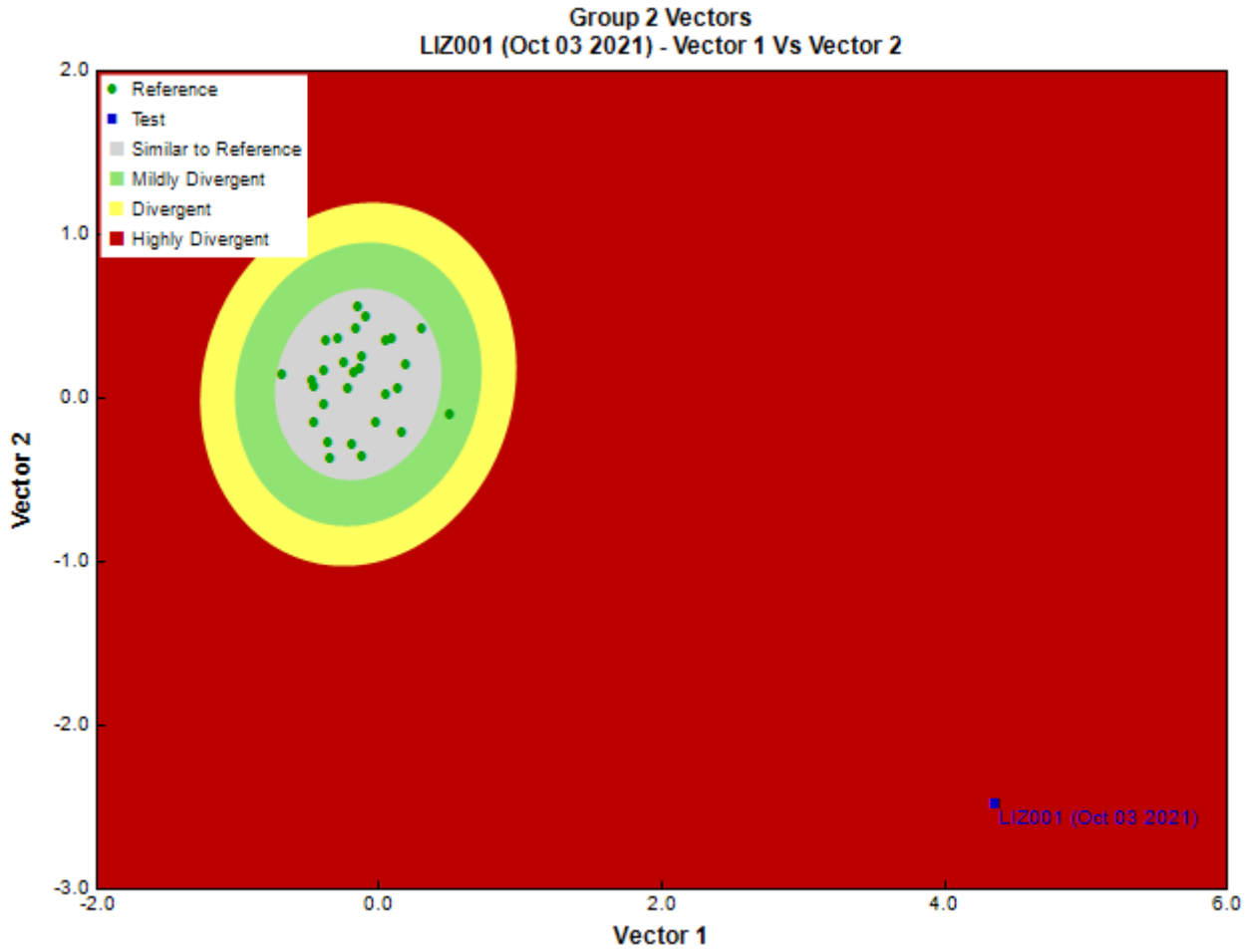


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3

Sample Information

Taxonomist	Pina Viola, Consultant
	Marchant Box
Sub-Sample Proportion	5/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata			12	240.0
		Tubificida	Naididae	114	2,280.0
Arthropoda	Arachnida	Trombidiformes		1	20.0
			Aturidae	1	20.0
			Lebertiidae	33	660.0
			Sperchontidae	2	40.0
			Torrenticolidae	7	140.0
	Insecta	Coleoptera	Elmidae	23	460.0
		Diptera	Ceratopogonidae	1	20.0
			Chironomidae	142	2,840.0
			Empididae	17	340.0
			Psychodidae	69	1,380.0
			Simuliidae	10	200.0
			Tipulidae	12	240.0
		Ephemeroptera	Baetidae	54	1,080.0
			Ephemerellidae	16	320.0
			Heptageniidae	4	80.0
		Plecoptera		1	20.0
			Capniidae	21	420.0
			Chloroperlidae	9	180.0
			Nemouridae	64	1,280.0
			Perlidae	8	160.0
		Trichoptera	Apataniidae	3	60.0
			Brachycentridae	17	340.0
			Glossosomatidae	11	220.0
			Hydropsychidae	33	660.0
			Hydroptilidae	2	40.0
			Lepidostomatidae	11	220.0
			Rhyacophilidae	4	80.0
			Uenoidae	1	20.0
			Total	703	14,060.0

Metrics

Name	LIZ001	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.96	0.3 ± 0.1
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	6.7	3.6 ± 0.4
Hilsenhoff Family index (North-West)	6.7	3.2 ± 0.3
Intolerant taxa	--	1.0 ± 0.0
Long-lived taxa	4.0	2.7 ± 1.5
Tolerant individuals (%)	--	0.9 ± 0.2
Functional Measures		
% Filterers	--	0.6 ± 0.3
% Gatherers	87.8	38.1 ± 14.1
% Predatores	39.0	15.8 ± 9.1
% Scrapers	20.1	60.8 ± 14.6
% Shredder	21.5	23.9 ± 11.1
No. Clinger Taxa	28.0	22.0 ± 5.6
Number Of Individuals		
% Chironomidae	20.6	6.0 ± 5.6
% Coleoptera	3.3	1.7 ± 4.1
% Diptera + Non-insects	59.2	10.1 ± 7.7
% Ephemeroptera	10.7	53.4 ± 13.8
% Ephemeroptera that are Baetidae	73.0	29.5 ± 17.8
% EPT Individuals	37.4	88.1 ± 9.3

Metrics

Name	LIZ001	Predicted Group Reference Mean ±SD
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	37.2	54.4 ± 11.4
% of 5 dominant taxa	64.3	81.6 ± 8.1
% of dominant taxa	20.6	35.2 ± 11.4
% Plecoptera	14.8	28.8 ± 11.6
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	40.2	28.7 ± 28.3
% Tricoptera	11.9	6.0 ± 5.0
No. EPT individuals/Chironomids+EPT Individuals	0.6	0.9 ± 0.1
Total Abundance	14060.0	1083.1 ± 932.3
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.1
Coleoptera taxa	1.0	0.3 ± 0.5
Diptera taxa	6.0	3.1 ± 1.3
Ephemeroptera taxa	3.0	3.8 ± 0.6
EPT Individuals (Sum)	5160.0	941.8 ± 766.3
EPT taxa (no)	15.0	12.4 ± 2.4
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.8	0.7 ± 0.1
Plecoptera taxa	4.0	5.3 ± 1.3
Shannon-Wiener Diversity	2.6	2.0 ± 0.3
Simpson's Diversity	0.9	0.8 ± 0.1
Simpson's Evenness	0.4	0.3 ± 0.1
Total No. of Taxa	27.0	18.2 ± 4.7
Trichoptera taxa	8.0	3.3 ± 1.5

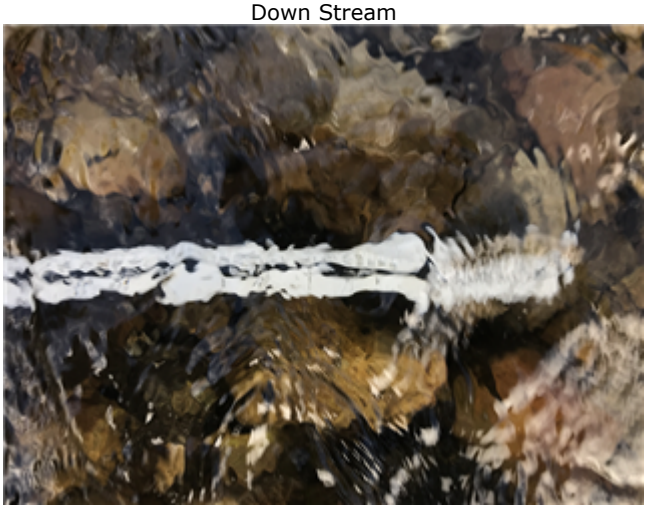
Site Description

Study Name	CBWQ-Elk
Site	LIZ003
Sampling Date	Oct 03 2021
Know Your Watershed Basin	Central Kootenay
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.48568 N, 115.09448 W
Altitude	1022
Local Basin Name	Lizard Creek
	Central Kootenay
Stream Order	3

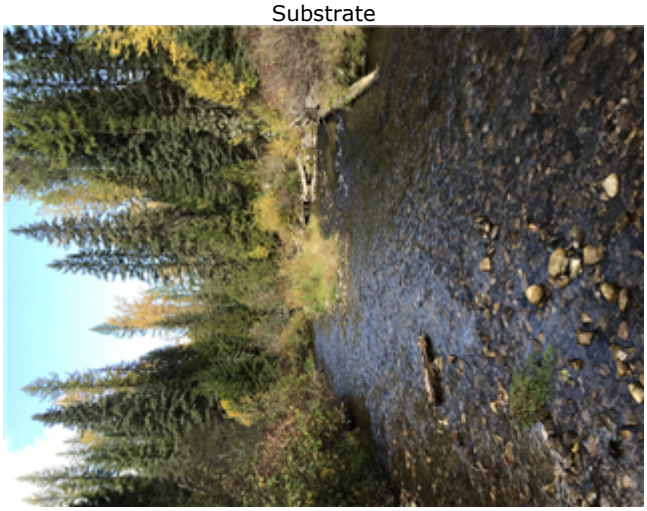
Figure 1. Location Map

Across Reach
Aerial (No image found)

Down Stream



Substrate



Up Stream

Cabin Assessment Results

Reference Model Summary	
Model	Columbia Basin 2020
Analysis Date	December 06, 2023
Taxonomic Level	Family

Cabin Assessment Results

Predictive Model Variables	Altitude Drainage-Area Longitude Natl-Grassland Natl-ShrubLow Natl-Water Precip10_Oct Reach-%CanopyCoverage Sedimentary Slope SlopeMax Temp12_DECmin

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**
Number of Reference Sites	13	24	28	35	32	15
Group Error Rate	53.8%	55.2%	34.1%	52.2%	23.1%	29.4%
Overall Model Error Rate	39.4%					
Probability of Group Membership	4.0%	28.0%	17.9%	33.0%	11.3%	5.7%
CABIN Assessment of LIZ003 on Oct 03, 2021	Highly Divergent					

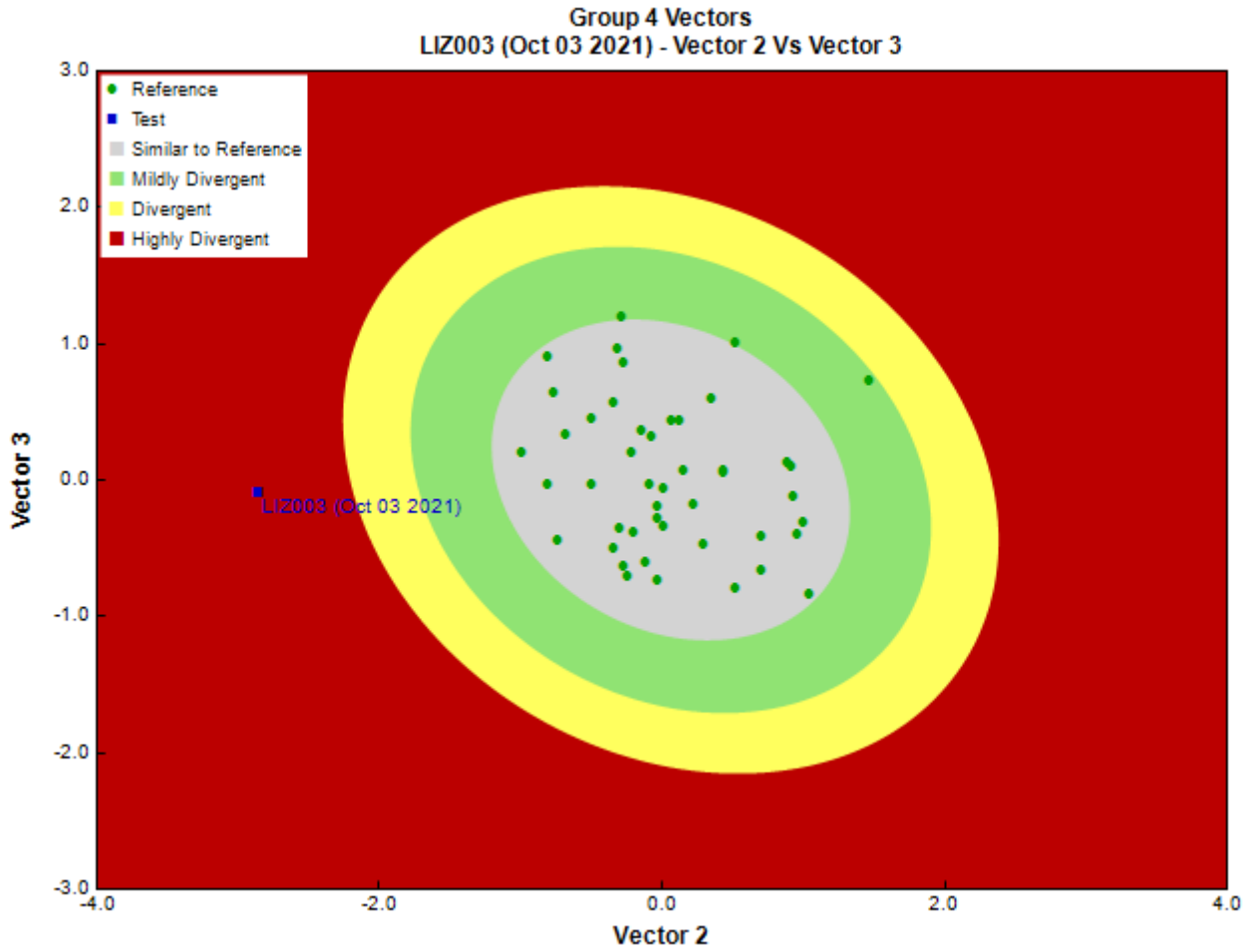


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3

Sample Information

Taxonomist	Pina Viola, Consultant
	Marchant Box
Sub-Sample Proportion	5/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Clitellata	Tubificida	Naididae	9	180.0
Arthropoda	Arachnida	Trombidiformes	Hygrobatidae	1	20.0
			Lebertiidae	10	200.0
			Torrenticolidae	17	340.0
	Insecta	Coleoptera	Dytiscidae	1	20.0
			Elmidae	225	4,500.0
		Diptera	Chironomidae	33	660.0
			Empididae	1	20.0
			Pelecorhynchidae	1	20.0
			Psychodidae	203	4,060.0
			Tipulidae	17	340.0
		Ephemeroptera	Baetidae	222	4,440.0
			Ephemerellidae	116	2,320.0
			Heptageniidae	27	540.0
		Plecoptera		9	180.0
			Capniidae	26	520.0
			Chloroperlidae	30	600.0
			Nemouridae	107	2,140.0
			Perlidae	10	200.0
			Perlodidae	6	120.0
			Taeniopterygidae	8	160.0
		Trichoptera	Apataniidae	32	640.0
			Brachycentridae	47	940.0
			Hydropsychidae	29	580.0
			Hydroptilidae	1	20.0
			Lepidostomatidae	1	20.0
			Rhyacophilidae	35	700.0
			Uenoidae	83	1,660.0
			Total	1,307	26,140.0

Metrics

Name	LIZ003	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.93	0.3 ± 0.1
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	3.8	3.2 ± 0.4
Hilsenhoff Family index (North-West)	3.8	2.9 ± 0.3
Intolerant taxa	--	1.0 ± 0.0
Long-lived taxa	5.0	1.9 ± 1.0
Tolerant individuals (%)	0.1	0.5 ± 0.4
Functional Measures		
% Filterers	--	0.3
% Gatherers	67.9	47.1 ± 15.4
% Predatores	14.6	12.9 ± 7.3
% Scrapers	48.0	68.3 ± 16.1
% Shredder	35.4	36.7 ± 14.6
No. Clinger Taxa	31.0	20.3 ± 4.6
Number Of Individuals		
% Chironomidae	2.5	5.2 ± 5.7
% Coleoptera	17.4	0.6 ± 2.2
% Diptera + Non-insects	22.5	7.4 ± 7.0
% Ephemeroptera	28.1	45.8 ± 15.1
% Ephemeroptera that are Baetidae	60.8	28.9 ± 20.8
% EPT Individuals	60.1	91.9 ± 7.3
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	34.4	59.5 ± 11.3

Metrics

Name	LIZ003	Predicted Group Reference Mean ±SD
% of 5 dominant taxa	67.3	85.1 ± 6.5
% of dominant taxa	17.3	37.7 ± 10.4
% Plecoptera	14.4	40.5 ± 13.3
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	12.7	23.9 ± 23.6
% Tricoptera	17.6	5.6 ± 3.9
No. EPT individuals/Chironomids+EPT Individuals	1.0	0.9 ± 0.1
Total Abundance	26140.0	1449.6 ± 859.7
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.2
Coleoptera taxa	2.0	0.2 ± 0.5
Diptera taxa	5.0	2.6 ± 1.1
Ephemeroptera taxa	3.0	3.7 ± 0.6
EPT Individuals (Sum)	15600.0	1353.0 ± 804.6
EPT taxa (no)	16.0	12.3 ± 2.2
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.8	0.7 ± 0.1
Plecoptera taxa	6.0	5.4 ± 1.2
Shannon-Wiener Diversity	2.5	1.9 ± 0.3
Simpson's Diversity	0.9	0.8 ± 0.1
Simpson's Evenness	0.3	0.3 ± 0.1
Total No. of Taxa	27.0	16.5 ± 3.6
Trichoptera taxa	7.0	3.2 ± 1.3

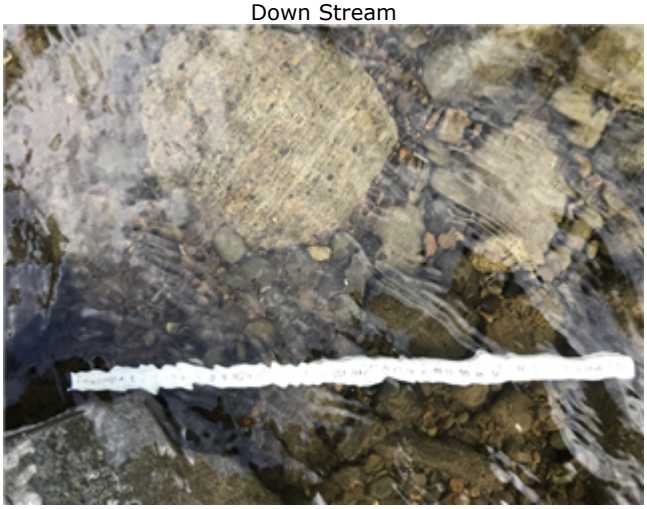
Site Description

Study Name	CBWQ-Elk
Site	MOR001
Sampling Date	Oct 04 2021
Know Your Watershed Basin	Central Kootenay
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.35806 N, 115.00080 W
Altitude	942
Local Basin Name	Morrissey Creek
	Central Kootenay
Stream Order	4

Figure 1. Location Map

Across Reach
Aerial (No image found)

Down Stream



Substrate

Up Stream

Cabin Assessment Results

Reference Model Summary	
Model	Columbia Basin 2020
Analysis Date	December 06, 2023
Taxonomic Level	Family

Cabin Assessment Results

Predictive Model Variables	Altitude Drainage-Area Longitude Natl-Grassland Natl-ShrubLow Natl-Water Precip10_Oct Reach-%CanopyCoverage Sedimentary Slope SlopeMax Temp12_DECmin

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**
Number of Reference Sites	13	24	28	35	32	15
Group Error Rate	53.8%	55.2%	34.1%	52.2%	23.1%	29.4%
Overall Model Error Rate	39.4%					
Probability of Group Membership	3.6%	25.0%	14.3%	44.8%	9.8%	2.5%
CABIN Assessment of MOR001 on Oct 04, 2021	Highly Divergent					

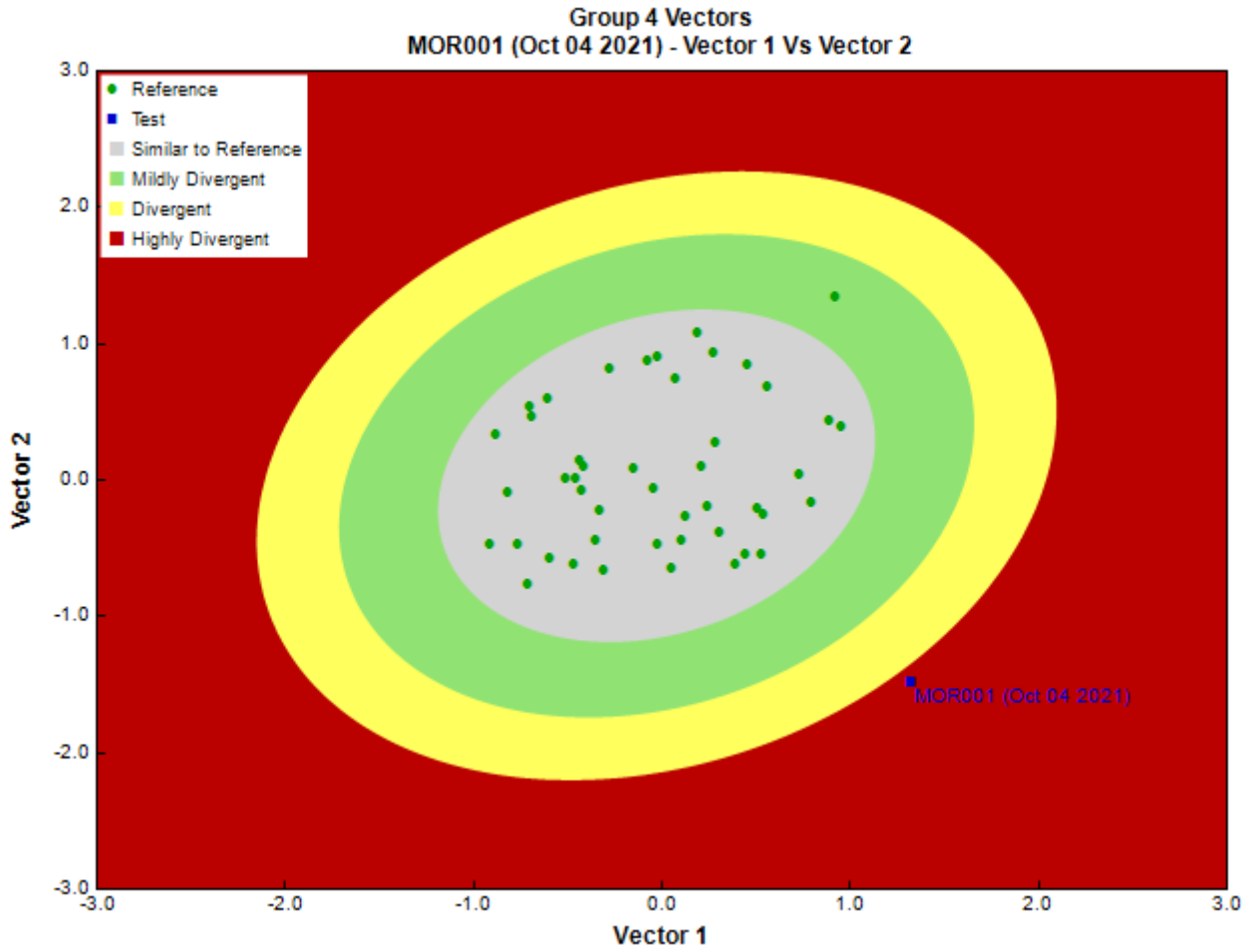


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3

Sample Information

Taxonomist	Pina Viola, Consultant
	Marchant Box
Sub-Sample Proportion	5/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Arachnida	Trombidiformes	Hydryphantidae	1	20.0
			Lebertiidae	8	160.0
			Sperchontidae	5	100.0
			Torrenticolidae	2	40.0
	Insecta	Coleoptera	Elmidae	10	200.0
		Diptera	Chironomidae	12	240.0
			Empididae	1	20.0
			Tipulidae	14	280.0
		Ephemeroptera	Baetidae	8	160.0
			Ephemerellidae	3	60.0
			Heptageniidae	67	1,340.0
			Leptophlebiidae	6	120.0
		Plecoptera	Capniidae	2	40.0
			Nemouridae	8	160.0
			Perlidae	2	40.0
			Perlodidae	2	40.0
			Taeniopterygidae	1	20.0
		Trichoptera	Brachycentridae	12	240.0
			Hydropsychidae	35	700.0
			Lepidostomatidae	167	3,340.0
			Rhyacophilidae	1	20.0
			Total	367	7,340.0

Metrics

Name	MOR001	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.82	0.3 ± 0.1
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	2.2	3.2 ± 0.4
Hilsenhoff Family index (North-West)	2.2	2.9 ± 0.3
Intolerant taxa	--	1.0 ± 0.0
Long-lived taxa	4.0	1.9 ± 1.0
Tolerant individuals (%)	--	0.5 ± 0.4
Functional Measures		
% Filterers	--	0.3
% Gatherers	27.5	47.1 ± 15.4
% Predatores	22.1	12.9 ± 7.3
% Scrapers	33.0	68.3 ± 16.1
% Shredder	58.3	36.7 ± 14.6
No. Clinger Taxa	21.0	20.3 ± 4.6
Number Of Individuals		
% Chironomidae	3.3	5.2 ± 5.7
% Coleoptera	2.7	0.6 ± 2.2
% Diptera + Non-insects	11.7	7.4 ± 7.0
% Ephemeroptera	22.9	45.8 ± 15.1
% Ephemeroptera that are Baetidae	9.5	28.9 ± 20.8
% EPT Individuals	85.6	91.9 ± 7.3
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	63.8	59.5 ± 11.3
% of 5 dominant taxa	80.4	85.1 ± 6.5
% of dominant taxa	45.5	37.7 ± 10.4
% Plecoptera	4.1	40.5 ± 13.3
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	16.3	23.9 ± 23.6
% Tricoptera	58.6	5.6 ± 3.9
No. EPT individuals/Chironomids+EPT Individuals	1.0	0.9 ± 0.1

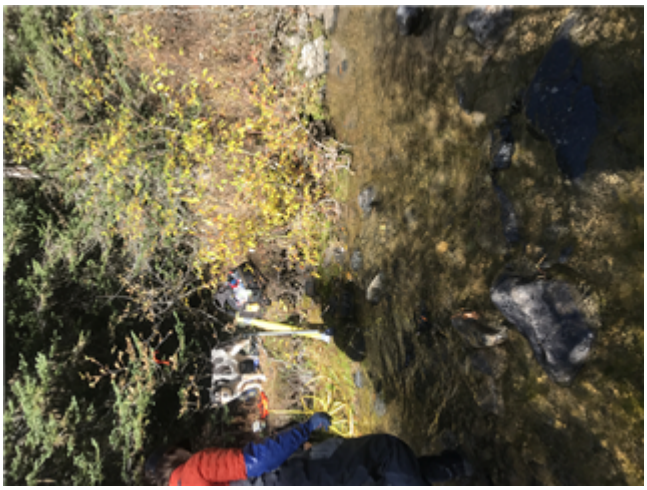
Metrics

Name	MOR001	Predicted Group Reference Mean ±SD
Total Abundance	7340.0	1449.6 ± 859.7
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.2
Coleoptera taxa	1.0	0.2 ± 0.5
Diptera taxa	3.0	2.6 ± 1.1
Ephemeroptera taxa	4.0	3.7 ± 0.6
EPT Individuals (Sum)	6280.0	1353.0 ± 804.6
EPT taxa (no)	13.0	12.3 ± 2.2
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.6	0.7 ± 0.1
Plecoptera taxa	5.0	5.4 ± 1.2
Shannon-Wiener Diversity	1.9	1.9 ± 0.3
Simpson's Diversity	0.7	0.8 ± 0.1
Simpson's Evenness	0.2	0.3 ± 0.1
Total No. of Taxa	21.0	16.5 ± 3.6
Trichoptera taxa	4.0	3.2 ± 1.3

Site Description

Study Name	CBWQ-Elk
Site	MOR002
Sampling Date	Oct 04 2021
Know Your Watershed Basin	Central Kootenay
Province / Territory	British Columbia
Terrestrial Ecological Classification	Montane Cordillera EcoZone Northern Continental Divide EcoRegion
Coordinates (decimal degrees)	49.42076 N, 114.91049 W
Altitude	1529
Local Basin Name	Morrissey Creek
	Central Kootenay
Stream Order	3

Figure 1. Location Map



Across Reach
Aerial (No image found)

Down Stream

Substrate

Up Stream

Cabin Assessment Results

Reference Model Summary	
Model	Columbia Basin 2020
Analysis Date	December 06, 2023
Taxonomic Level	Family

Cabin Assessment Results

Predictive Model Variables	Altitude Drainage-Area Longitude Natl-Grassland Natl-ShrubLow Natl-Water Precip10_Oct Reach-%CanopyCoverage Sedimentary Slope SlopeMax Temp12_DECmin

Reference Groups	**1**	**2**	**3**	**4**	**5**	**6**
Number of Reference Sites	13	24	28	35	32	15
Group Error Rate	53.8%	55.2%	34.1%	52.2%	23.1%	29.4%
Overall Model Error Rate	39.4%					
Probability of Group Membership	2.4%	0.9%	5.8%	7.7%	83.0%	0.2%
CABIN Assessment of MOR002 on Oct 04, 2021	Similar to Reference					

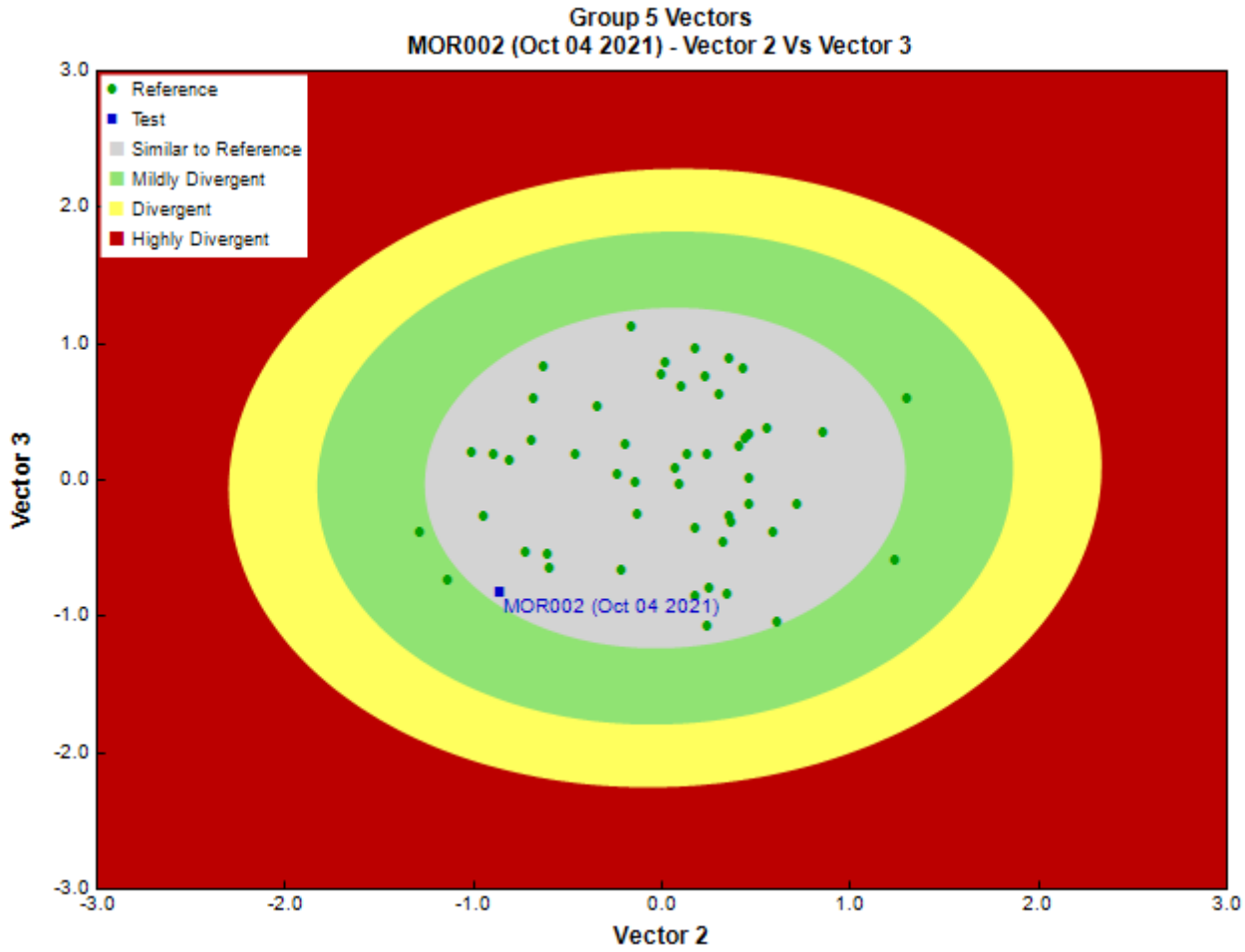


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3

Sample Information

Taxonomist	Pina Viola, Consultant
	Marchant Box
Sub-Sample Proportion	11/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Insecta	Coleoptera	Elmidae	7	63.6
		Diptera	Chironomidae	122	1,109.1
			Empididae	2	18.2
			Tipulidae	2	18.2
		Ephemeroptera	Ameletidae	4	36.4
			Baetidae	76	691.0
			Ephemerellidae	7	63.6
			Heptageniidae	41	372.8
			Leptophlebiidae	2	18.2
		Plecoptera	Capniidae	16	145.5
			Chloroperlidae	27	245.4
			Nemouridae	9	81.9
			Perlidae	3	27.3
			Perlodidae	6	54.6
		Trichoptera		2	18.2
			Brachycentridae	12	109.1
			Glossosomatidae	2	18.2
			Lepidostomatidae	2	18.2
			Rhyacophilidae	3	27.3
			Uenoidae	5	45.5
			Total	350	3,182.3

Metrics

Name	MOR002	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.56	0.4 ± 0.1
Biotic Indices		
Hilsenhoff Family index (Mid-Atlantic)	3.4	3.4 ± 0.4
Hilsenhoff Family index (North-West)	3.4	3.1 ± 0.5
Intolerant taxa	--	1.0 ± 0.0
Long-lived taxa	3.0	1.7 ± 1.2
Tolerant individuals (%)	--	0.3 ± 0.0
Functional Measures		
% Filterers	--	
% Gatherers	48.6	45.8 ± 14.9
% Predatores	42.3	14.8 ± 9.8
% Scrapers	37.4	59.4 ± 19.6
% Shredder	13.7	30.7 ± 17.4
No. Clinger Taxa	27.0	19.8 ± 4.0
Number Of Individuals		
% Chironomidae	35.1	7.5 ± 8.6
% Coleoptera	2.0	0.1 ± 0.3
% Diptera + Non-insects	36.2	10.7 ± 9.9
% Ephemeroptera	37.4	47.2 ± 15.8
% Ephemeroptera that are Baetidae	58.5	25.4 ± 20.8
% EPT Individuals	61.8	89.2 ± 10.0
% Odonata	--	0.0 ± 0.0
% of 2 dominant taxa	56.9	58.3 ± 10.6
% of 5 dominant taxa	81.0	83.6 ± 6.3
% of dominant taxa	35.1	37.8 ± 11.1
% Plecoptera	17.5	36.3 ± 16.7
% Tribe Tanyatarisini	--	
% Trichoptera that are Hydropsychida	0.0	25.4 ± 24.6
% Tricoptera	6.9	5.7 ± 3.9
No. EPT individuals/Chironomids+EPT Individuals	0.6	0.9 ± 0.1
Total Abundance	3181.8	4661.0 ± 3119.0

Metrics

Name	MOR002	Predicted Group Reference Mean ±SD
Richness		
Chironomidae taxa (genus level only)	1.0	1.0 ± 0.1
Coleoptera taxa	1.0	0.1 ± 0.3
Diptera taxa	3.0	2.8 ± 1.0
Ephemeroptera taxa	5.0	3.7 ± 0.5
EPT Individuals (Sum)	1954.5	4035.4 ± 2618.4
EPT taxa (no)	15.0	12.3 ± 1.9
Odonata taxa	--	0.0 ± 0.0
Pielou's Evenness	0.7	0.7 ± 0.1
Plecoptera taxa	5.0	5.5 ± 1.1
Shannon-Wiener Diversity	2.1	1.9 ± 0.3
Simpson's Diversity	0.8	0.8 ± 0.1
Simpson's Evenness	0.3	0.3 ± 0.1
Total No. of Taxa	19.0	17.0 ± 3.1
Trichoptera taxa	5.0	3.1 ± 1.2

Appendix B: Raw CABIN Datasheets

Field Crew: Chad Hughes, Kaileigh McCallum Site Code: ALX001

Sampling Date: (DD/MM/YYYY) ~~21/09~~ 15/09/2021

☒ **Occupational Health & Safety: Site Inspection Sheet completed**

PRIMARY SITE DATA

CABIN Study Name: CBWM-Elk Local Basin Name: Elk River

River/Stream Name: Alexander Creek Stream Order: (map scale 1:50,000) _____

Select one: ☒ Test Site ☐ Potential Reference Site

Geographical Description/Notes:
Take left turnoff from highway before Michel Cr. bridge (Spar→AB). Follow dirt road through forest - stay right. Park at river, walk up Michel to Alex. confluence. Site is ≈ 70 m u/s of confluence

Surrounding Land Use: (check those present) Information Source: visual, maps

☒ Forest ☐ Field/Pasture ☐ Agriculture ☐ Residential/Urban
☐ Logging ☒ Mining ☒ Commercial/Industrial ☒ Other train

Dominant Surrounding Land Use: (check one) Information Source: visual

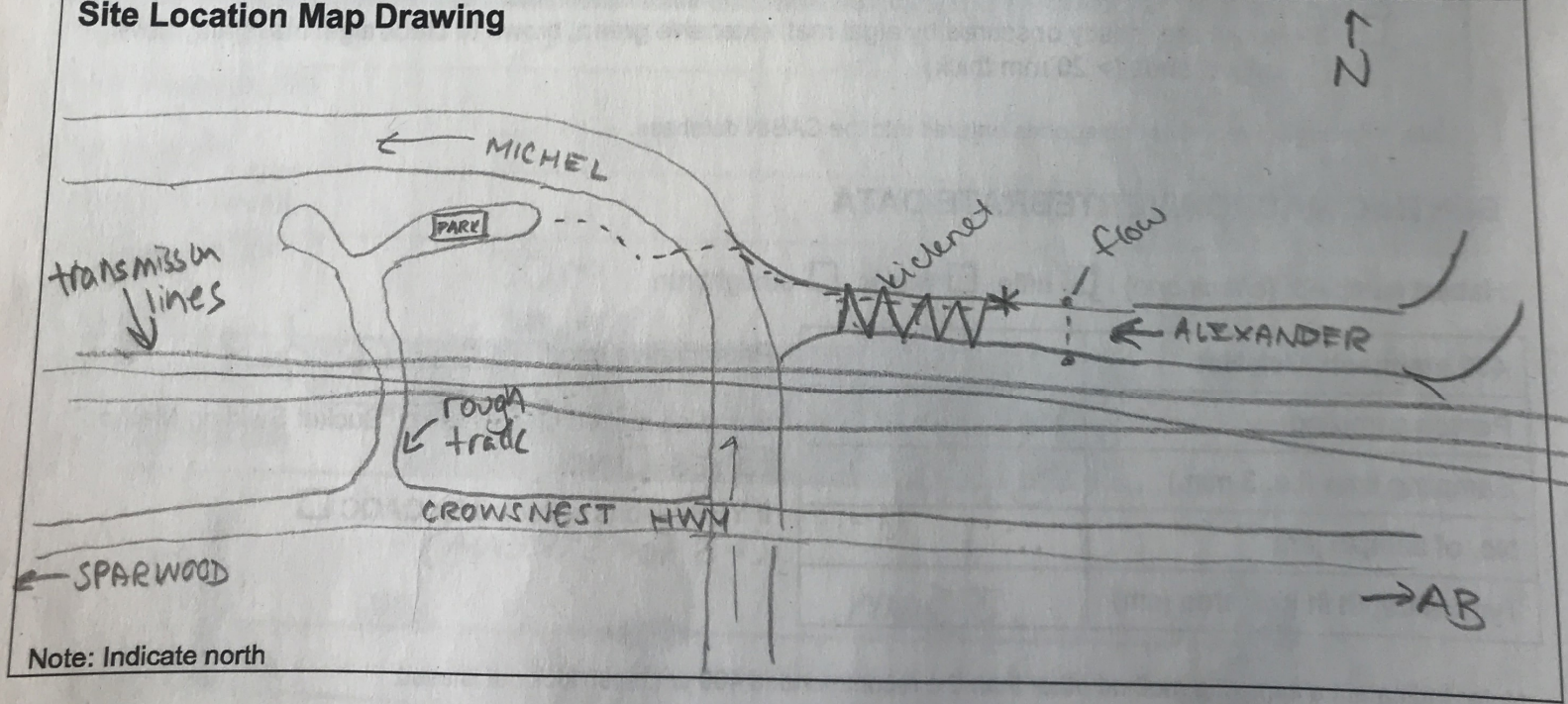
☒ Forest ☐ Field/Pasture ☐ Agriculture ☐ Residential/Urban
☐ Logging ☐ Mining ☐ Commercial/Industrial ☐ Other _____

Location Data

Latitude: 49.674031 N Longitude: - 114.7972 W (DMS or DD)

Elevation: 4031 (fasl or masl) GPS Datum: ☒ GRS80 (NAD83/WGS84) ☐ Other: _____

Site Location Map Drawing



Note: Indicate north

Field Crew: CH, KM

Site Code: ALX001

Sampling Date: (DD/MM/YYYY) 15/09/2021

Photos
☐ Field Sheet ☐ Upstream ☐ Downstream ☐ Across Site ☐ Aerial View
☐ Substrate (exposed) ☐ Substrate (aquatic) ☐ Other _____

REACH DATA *(represents 6 times bankfull width)*

1. Habitat Types: *(check those present)*
☒ Riffle ☐ Rapids ☒ Straight run ☐ Pool/Back Eddy

2. Canopy Coverage: *(stand in middle of stream and look up, check one)*
☐ 0 % ☒ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

3. Macrophyte Coverage: *(not algae or moss, check one)*
☒ 0 % ☐ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

4. Streamside Vegetation: *(check those present)*
☒ ferns/grasses ☒ shrubs ☒ deciduous trees ☒ coniferous trees

5. Dominant Streamside Vegetation: *(check one)*
☐ ferns/grasses ☒ shrubs ☐ deciduous trees ☐ coniferous trees

6. Periphyton Coverage on Substrate: *(benthic algae, not moss, check one)*

☐ **1** - Rocks are not slippery, no obvious colour (thin layer < 0.5 mm thick)
☒ **2** - Rocks are slightly slippery, yellow-brown to light green colour (0.5-1 mm thick)
☐ **3** - Rocks have a noticeable slippery feel (footing is slippery), with patches of thicker green to brown algae (1-5 mm thick)
☐ **4** - Rocks are very slippery (algae can be removed with thumbnail), numerous large clumps of green to dark brown algae (5 mm -20 mm thick)
☐ **5** - Rocks are mostly obscured by algal mat, extensive green, brown to black algal mass may have long strands (> 20 mm thick)

Note: 1 through 5 represent categories entered into the CABIN database.

BENTHIC MACROINVERTEBRATE DATA

Habitat sampled: *(check one)* ☒ riffle ☐ rapids ☐ straight run

400 µm mesh Kick Net	
Person sampling	Kaileigh McCallum
Sampling time (i.e. 3 min.)	3 min
No. of sample jars	1
Typical depth in kick area (cm)	35cm

Preservative used: Isopropyl alcohol

Sampled sieved on site using "Bucket Swirling Method":
☐ YES ☐ NO

If YES, debris collected for QAQC ☐
(+3 for STREAM)

Note: Indicate if a sampling method other than the recommended 400 µm mesh kick net is used.

Field Crew: CH, KM Site Code: ALX001

Sampling Date: (DD/MM/YYYY) 15/09/2021

WATER CHEMISTRY DATA **Time:** 13:30 (24 hr clock) **Time zone:** _____

Air Temp: 17.0 (°C) Water Temp: 9.7 (°C) pH: 8.31

Specific Conductance: 295.3 (209.1) (µs/cm) DO: 10.06 (mg/L) Turbidity: 10.05 (NTU)

Check if water samples were collected for the following analyses:

- ☑ TSS (Total Suspended Solids)
- ☑ Nitrogen (i.e. Total, Nitrate, Nitrite, Dissolved, and/or Ammonia)
- ☑ Phosphorus (Total, Ortho, and/or Dissolved)
- ☑ Major Ions (i.e. Alkalinity, Hardness, Chloride, and/or Sulphate)
- ☐ Other Metals (D+T) + others

Note: Determining alkalinity is recommended, as are other analyses, but not required for CABIN assessments.

CHANNEL DATA

Slope - Indicate how slope was measured: (check one)

☐ **Calculated from map**

Scale: _____ (Note: small scale map recommended if field measurement is not possible - i.e. 1:20,000).

contour interval (vertical distance) _____ (m),

distance between contour intervals (horizontal distance) _____ (m)

slope = vertical distance/horizontal distance = _____

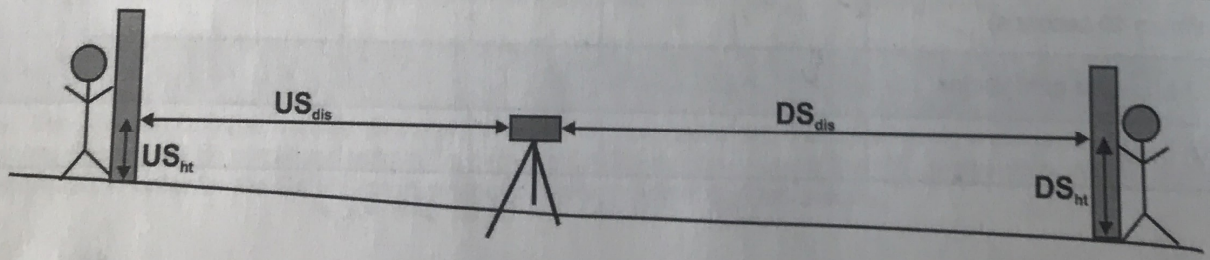
OR

☒ **Measured in field**

Circle device used and fill out table according to device:

a. Survey Equipment b. Hand Level & Measuring Tape

Measurements	Upstream (U/S)	Downstream(D/S)	Calculation
[a]Top Hairline (T)			
[a]Mid Hairline (ht) OR [b]Height of rod	0.72m	1.55m	
[a]Bottom Hairline (B)			
[b]Distance (dis) OR [a]T-B x 100	38m [a]US_{dis}=T-B	30m [a]DS_{dis}=T-B	$US_{dis}+DS_{dis}$=
Change in height (Δht)			$DS_{ht}-US_{ht}$=
Slope (Δht/total dis)			



Field Crew: CH, KM Site Code: ALX001

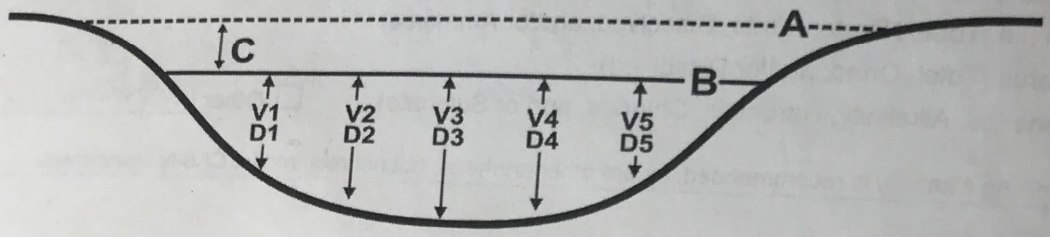
Sampling Date: (DD/MM/YYYY) 15/09/2021

Widths and Depth

Location at site: U/S of kick area (Indicate where in sample reach, ex. d/s of kick area)

A - Bankfull Width: 11 (m) B - Wetted Stream Width: 8.3 (m)

C - Bankfull–Wetted Depth (height from water surface to Bankfull): _____ (cm)



Note:
Wetted widths > 5 m, measure a minimum of 5-6 equidistant locations;
Wetted widths < 5 m, measure 3-4 equidistant locations.

Velocity and Depth

Check appropriate velocity measuring device and fill out the appropriate section in chart below. Distance from shore and depth are required regardless of method:

☐ **Velocity Head Rod (or ruler)**: Velocity Equation (m/s) = $\sqrt{[2(\Delta D/100) * 9.81]}$

☐ **Rotary meters**: Gurley/Price/Mini-Price/Propeller (Refer to specific meter conversion chart for calculation)

☒ **Direct velocity measurements:** ☐ Marsh-McBirney ☐ Sontek or ☒ Other Globo velocity meter

	1	2	3	4	5	6	AVG
Distance from Shore (m)							
Depth (**D**) (cm)							
Velocity Head Rod (ruler)							
Flowing water Depth (D_1) (cm)							
Depth of Stagnation (D_2) (cm)							
Change in depth ($\Delta D=D_2-D_1$) (cm)							
Rotary meter							
Revolutions							
Time (minimum 40 seconds)							
Direct Measurement or calculation							
Velocity (**V**) (m/s)							

See flow field sheet

Field Crew: CH, KM Site Code: ALX001

Sampling Date: (DD/MM/YYYY) 15/09/2021

SUBSTRATE DATA

Surrounding/Interstitial Material

Circle the substrate size category for the surrounding material.

Substrate Size Class	Category
Organic Cover	0
< 0.1 cm (fine sand, silt or clay)	1
0.1-0.2 cm (coarse sand)	2
0.2-1.6 cm (gravel)	3
1.6-3.2 cm (small pebble)	4
3.2-6.4 cm (large pebble)	5
6.4-12.8 cm (small cobble)	6
12.8-25.6 cm (cobble)	7
> 25.6 cm (boulder)	8
Bedrock	9

mix. slightly marbled gra

100 Pebble Count & Substrate Embeddedness

- Measure the intermediate axis (100 rocks) and embeddedness (10 rocks) of substrate in the stream bed.
- Indicate B for bedrock, S for sand/silt/clay (particles < 0.2 cm) and O for organic material.
- Embededness categories (E): Completely embedded = 1, 3/4 embedded, 1/2 embedded, 1/4 embedded, unembedded = 0

	Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E
1	8.9		26	9.8		51	1.0		76	18.5	
2	8.4		27	5.0		52	3.5		77	12.4	
3	0.16		28	6.4		53	4.4		78	15.4	
4	8.8		29	2.0		54	5.6		79	9.2	
5	4.2		30	10.6	1/2	55	2.9		80	34.8	1/2
6	19.1		31	3.3		56	10.5		81	7.9	
7	6.4		32	6.0		57	4.9		82	11.2	
8	11.3		33	9.5		58	16.0		83	18.8	
9	4.9		34	8.3		59	3.7		84	6.4	
10	13.6	1/4	35	3.4		60	13.2	1/2	85	1.1	
11	11.2		36	1.2		61	15.0		86	7.0	
12	5.9		37	8.8		62	10.2		87	19.2	
13	11.9		38	7.1		63	19.3		88	6.1	
14	12.4		39	3.9		64	15.4		89	2.8	
15	21.5		40	32.0	0	65	37.0		90	S	
16	5.1		41	2.5		66	10.0		91	2.9	0
17	6.8		42	1.8		67	5.6		92	18.2	
18	19.4		43	4.3		68	7.5		93	8.6	
19	15.5		44	4.4		69	10.3		94	18.0	
20	29.0	1/2	45	5.0		70	14.2	1/4	95	2.5	
21	0		46	3.6		71	24.8		96	5.5	
22	28.0		47	1.1		72	14.7		97	9.4	
23	33.0		48	11.0		73	24.3		98	18.3	
24	8.6		49	4.7		74	8.2		99	4.3	
25	14.2		50	29.0	1/4	75	22.6		100	34.2	1/2

Note: The Wolman D50 (i.e. median diameter), Wolman Dg (i.e. geometric mean diameter) and the % composition of the substrate classes will be calculated automatically in the CABIN database using the 100 pebble data. All 100 pebbles must be measured in order for the CABIN database tool to perform substrate calculations.

CABIN CANADIAN AQUATIC BIOMONITORING NETWORK

Site Code: ALX001

Field Crew: KM, CH

Sampling Date: (DD/MM/YYYY) 15/09/2021

SITE INSPECTION

Site Inspected by: K.M.

Communication Information

☒ Itinerary left with contact person (include contact numbers)

Contact Person: Evgeni Matveev Time checked-in: 9:00AM

Form of communication: ☐ radio ☒ cell ☐ satellite ☐ hotel/pay phone ☐ SPOT

Phone number: (709) 763-9678

Vehicle Safety

☑ Safety equipment (first aid, fire extinguisher, blanket, emergency kit in vehicle)

☐ Equipment and chemicals safely secured for transport

☐ Vehicle parked in safe location; pylons, hazard light, reflective vests if necessary

Notes:

Shore & Wading Safety

☑ Wading Task Hazard Analysis read by all field staff

☐ Wading Safe Work Procedures read by all field staff

☑ Instream hazards identified (i.e. log jams, deep pools, slippery rocks)

☐ PFD worn

☐ Appropriate footwear, waders, wading belt

☐ Belay used

Notes:

CABIN

Elk River Alliance

Velocimeter Measurement Field Sheet

Site: ALX001

Date: 21/09/15

Time: 15:00

Staff: CH, KM

Photos: ☐ 1. Completed Field Sheet ☐ 2. Upstream ☐ 3. Downstream ☐ 4. Across (from left bank if possible)

Staff Gauge: N/A

Wetted Width: 8.3

Bankful Width: 11

Instrument ID: GlobeFlow Probe

	Distance (m)	Depth (cm)	Velocity (m/s)	Notes
1	2.10	0	0	
2	2.40	12.5	0.2	
3	2.7	10.0	0.4	
4	3.0	36.2	0.2	
5	3.3	39.0	0.3	
6	3.6	36.0	0.3	
7	3.9	36.5	0.5	
8	4.2	26.0	0.5	
9	4.5	41.0	0.7	
10	4.8	29.0	0.6	
11	5.1	38.5	0.4	
12	5.4	38.5	0.8	
13	5.7	38.5	0.7	
14	6.0	41.2	0.6	
15	6.3	35.5	0.7	

Continued from other side

16	6.1	0.265	0.9	
17	6.45	0.282	1.1	
18	6.8	0.350	1.3	
* 19	7.15	0.298	0.5	
20	7.5	0.335	1.1	
21	7.85	0.320	1.2	
22	8.2	0.325	0.2	
* 23	8.55	0.314	0.9	
24	8.9	0.234	0.9	
25	9.25	0.176	0.5	
26	~~9.6~~			
27	~~9.95~~			
28	~~10.3~~			
29				
30	4.5	0.100	1.3	
31	6.6	0.362	1.3	
32				
33				
34				
35				

Comments: * rock directly u/s

shallow on left side w/ recent deposition

did two extras @ high flow locations

Field Crew: Charlie + Kaileigh M Site Code: ALX

Sampling Date: (DD/MM/YYYY) 15/09/2021

☐ **Occupational Health & Safety: Site Inspection Sheet completed**

PRIMARY SITE DATA

CABIN Study Name: CBWM Local Basin Name: ~~Alexander Creek~~ Elk River

River/Stream Name: Alexander Creek Stream Order: (map scale 1:50,000) _____ ★

Select one: ☒ Test Site ☐ Potential Reference Site

Geographical Description/Notes:
Alexander Creek near rifle range. High disturbance R, med. disturbance on left

Surrounding Land Use: (check those present) Information Source: visual

☒ Forest ☒ Field/Pasture ☐ Agriculture ☐ Residential/Urban
☐ Logging ☐ Mining ☐ Commercial/Industrial ☒ Other rifle range

Dominant Surrounding Land Use: (check one) Information Source: _____

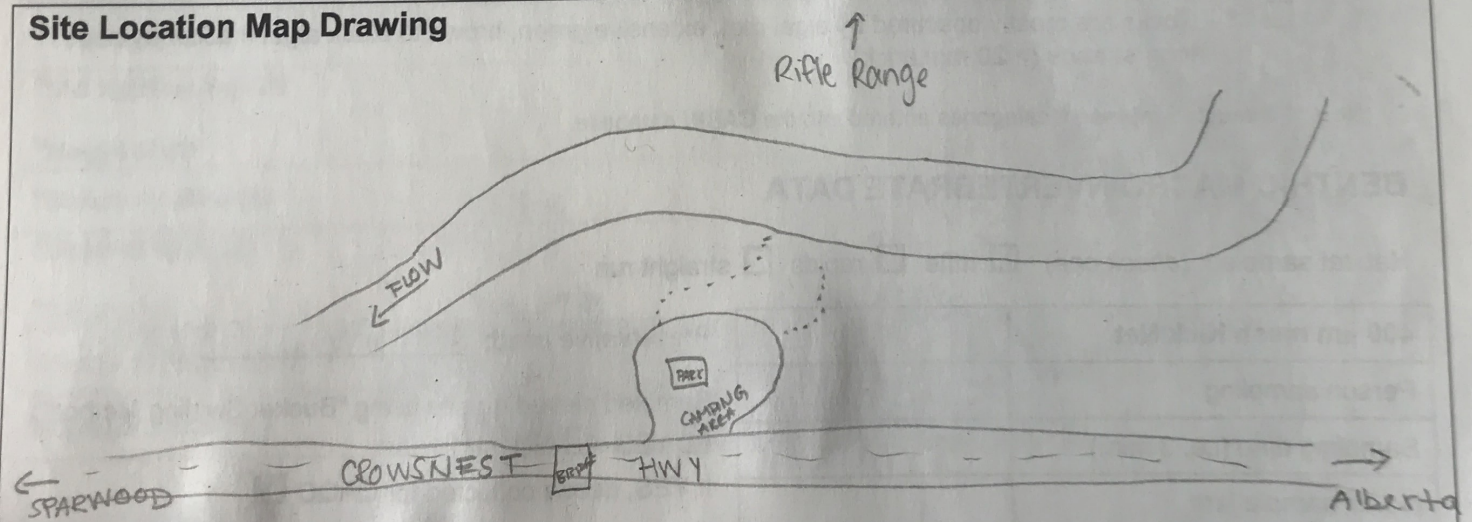
☐ Forest ☐ Field/Pasture ☐ Agriculture ☐ Residential/Urban
☐ Logging ☐ Mining ☐ Commercial/Industrial ☒ Other recreational

Location Data

Latitude: 49.65540 N Longitude: - 114.73088 W (DMS or DD)

★ Elevation: 1292? (fasl or masl) GPS Datum: ☒ GRS80 (NAD83/WGS84) ☐ Other: _____

Site Location Map Drawing



Note: Indicate north

Field Crew: CH, KM Site Code: ALX003

Sampling Date: (DD/MM/YYYY) 15/09/2021

Photos
☐ Field Sheet ☐ Upstream ☐ Downstream ☐ Across Site ☐ Aerial View
☐ Substrate (exposed) ☐ Substrate (aquatic) ☐ Other _____

REACH DATA *(represents 6 times bankfull width)*

1. Habitat Types: *(check those present)*
☒ Riffle ☐ Rapids ☒ Straight run ☐ Pool/Back Eddy

2. Canopy Coverage: *(stand in middle of stream and look up, check one)*
☐ 0 % ☒ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

3. Macrophyte Coverage: *(not algae or moss, check one)*
☒ 0 % ☐ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

4. Streamside Vegetation: (*check those present)*
☒ ferns/grasses ☒ shrubs ☒ deciduous trees ☒ coniferous trees

5. Dominant Streamside Vegetation: *(check one)*
☒ ferns/grasses ☒ shrubs ☐ deciduous trees ☐ coniferous trees

6. Periphyton Coverage on Substrate: *(benthic algae, not moss, check one)*

☐ **1** - Rocks are not slippery, no obvious colour (thin layer < 0.5 mm thick)
☒ **2** - Rocks are slightly slippery, yellow-brown to light green colour (0.5-1 mm thick)
☐ **3** - Rocks have a noticeable slippery feel (footing is slippery), with patches of thicker green to brown algae (1-5 mm thick)
☐ **4** - Rocks are very slippery (algae can be removed with thumbnail), numerous large clumps of green to dark brown algae (5 mm -20 mm thick)
☐ **5** - Rocks are mostly obscured by algal mat, extensive green, brown to black algal mass may have long strands (> 20 mm thick)

Note: 1 through 5 represent categories entered into the CABIN database.

BENTHIC MACROINVERTEBRATE DATA

Habitat sampled: (*check one*) ☒ riffle ☐ rapids ☐ straight run

400 µm mesh Kick Net	
Person sampling	K:McCallum
Sampling time (i.e. 3 min.)	3 min
No. of sample jars	1
Typical depth in kick area (cm)	35 cm

Preservative used: Isopropyl alcohol

Sampled sieved on site using "Bucket Swirling Method":
☒ YES ☐ NO
If YES, debris collected for QAQC ☒

Note: Indicate if a sampling method other than the recommended 400 µm mesh kick net is used.

Field Crew: CH, VM Site Code: ALX003

Sampling Date: (DD/MM/YYYY) 15/09/2021

WATER CHEMISTRY DATA Time: 10:00 (24 hr clock) Time zone: _____

Air Temp: 15.0°C (°C) Water Temp: 7.3 (°C) pH: 7.83

Specific Conductance: 292.9 (µs/cm) DO: 10.42 (mg/L) Turbidity: 0.01 (NTU)

C: 193.8 ORP: 288.5

Check if water samples were collected for the following analyses:

- ☒ TSS (Total Suspended Solids)
- ☒ Nitrogen (i.e. Total, Nitrate, Nitrite, Dissolved, and/or Ammonia)
- ☒ Phosphorus (Total, Ortho, and/or Dissolved)
- ☒ Major Ions (i.e. Alkalinity, Hardness, Chloride, and/or Sulphate) ☒ Other EPH

Note: Determining alkalinity is recommended, as are other analyses, but not required for CABIN assessments.

CHANNEL DATA

Slope - Indicate how slope was measured: (check one)

☐ **Calculated from map**

Scale: _____ (Note: small scale map recommended if field measurement is not possible - i.e. 1:20,000).

contour interval (vertical distance) _____ (m),

distance between contour intervals (horizontal distance) _____ (m)

slope = vertical distance/horizontal distance = _____

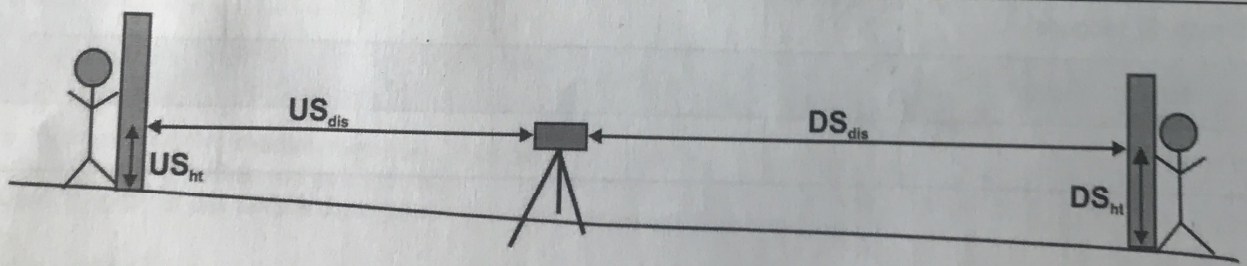
OR

☒ **Measured in field**

Circle device used and fill out table according to device:

a. Survey Equipment b. Hand Level & Measuring Tape

Measurements	Upstream (U/S)	Downstream(D/S)	Calculation
[a]Top Hairline (T)			
[a]Mid Hairline (ht) OR [b]Height of rod			
[a]Bottom Hairline (B)	1.510m	1.985 m	
[b]Distance (dis) OR [a]T-B x 100	30.0 m [a]US_{dis}=T-B	30.0m [a]DS_{dis}=T-B	$US_{dis}+DS_{dis}$=
Change in height (Δht)			$DS_{ht}-US_{ht}$=
Slope (Δht/total dis)			



CABIN CANADIAN AQUATIC BIOMONITORING NETWORK

Field Crew: CH, [illegible]

Sampling Date: (DD/MM/YYYY) 15/09/2021

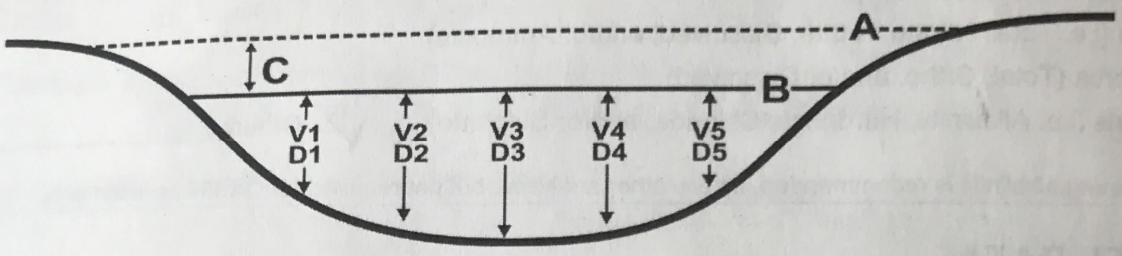
Widths and Depth

Location at site: US of kick area (Indicate where in sample reach, ex. d/s of kick area)

A - Bankfull Width: ~~10.~~ 10.0 (m)

B - Wetted Stream Width: ~~5.~~ 5.8 (m)

C - Bankfull–Wetted Depth (height from water surface to Bankfull): 5.5 cm (cm)



Note:
Wetted widths > 5 m, measure a minimum of 5-6 equidistant locations;
Wetted widths < 5 m, measure 3-4 equidistant locations.

0.8

Velocity and Depth

Check appropriate velocity measuring device and fill out the appropriate section in chart below. Distance from shore and depth are required regardless of method:

☐ **Velocity Head Rod (or ruler)**: Velocity Equation (m/s) = $\sqrt{[\ 2(\Delta D/100) * 9.81]}$

☐ **Rotary meters**: Gurley/Price/Mini-Price/Propeller (Refer to specific meter conversion chart for calculation)

☐ **Direct velocity measurements:** ☐ Marsh-McBirney ☐ Sontek or ☐ Other_____

	1	2	3	4	5	6	AVG
Distance from Shore (m)							
Depth (**D**) (cm)							
Velocity Head Rod (ruler)							
Flowing water Depth (D_1) (cm)							
Depth of Stagnation (D_2) (cm)							
Change in depth ($\Delta D=D_2-D_1$) (cm)							
Rotary meter							
Revolutions							
Time (minimum 40 seconds)							
Direct Measurement or calculation							
Velocity (**V**) (m/s)							

See Velocity sheet

Field Crew: CH, KM Site Code: ALX003

Sampling Date: (DD/MM/YYYY) 15/09/2021

SUBSTRATE DATA

Surrounding/Interstitial Material

Circle the substrate size category for the surrounding material.

Substrate Size Class	Category
Organic Cover	0
< 0.1 cm (fine sand, silt or clay)	1
0.1-0.2 cm (coarse sand)	2
0.2-1.6 cm (gravel)	3
1.6-3.2 cm (small pebble)	4
3.2-6.4 cm (large pebble)	5
6.4-12.8 cm (small cobble)	6
12.8-25.6 cm (cobble)	7
> 25.6 cm (boulder)	8
Bedrock	9

100 Pebble Count & Substrate Embeddedness

- Measure the intermediate axis (100 rocks) and embeddedness (10 rocks) of substrate in the stream bed.
- Indicate B for bedrock, S for sand/silt/clay (particles < 0.2 cm) and O for organic material.
- Embededness categories (E): Completely embedded = 1, 3/4 embedded, 1/2 embedded, 1/4 embedded, unembedded = 0

	Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E
1	9.4		26	9.8		51	12.0		76	6.8	
2	33.0		27	29.5		52	8.5		77	30.5	
3	7.2		28	9.8		53	8.0		78	9.4	
4	9.4		29	0.01		54	13.5		79	10.9	
5	15.8		30	35.0	3/4	55	5.0		80	14.6	1/4
6	0.5		31	16.0		56	6.8		81	14.4	
7	0.3		32	15.0		57	9.0		82	27.5	
8	10.3		33	17.2		58	10.0		83	16.3	
9	30.7		34	14.4		59	10.0		84	10.6	
10	6.9	O	35	16.2		60	3.6	O	85	7.7	
11	18.5		36	9.7		61	7.5		86	71.0	
12	14.4		37	23.0		62	9.2		87	23.0	
13	13.5		38	10.0		63	8.6		88	31.0	
14	7.7		39	3.1		64	23.1		89	7.6	
15	4.1		40	17.2	1/2	65	15.8		90	5	
16	2.0		41	15.1		66	3.0		91	25.2	.5
17	12.0		42	8.2		67	11.2		92	17.2	
18	11.1		43	11.0		68	21.0		93	7.6	
19	6.8		44	13.5		69	7.2		94	5.9	
20	12.5	1/4	45	18.5		70	13.1	1/4	95	5.8	
21	4.1		46	4.2		71	6.4		96	9.7	
22	13.5		47	5.1		72	18.0		97	13.4	
23	11.2		48	24.0		73	6.0		98	15.1	
24	50.2		49	16.5		74	15.6		99	12	
25	13.7		50	12.5	O	75	8.4		100	8.6	O

Note: The Wolman D50 (i.e. median diameter), Wolman Dg (i.e. geometric mean diameter) and the % composition of the substrate classes will be calculated automatically in the CABIN database using the 100 pebble data. All 100 pebbles must be measured in order for the CABIN database tool to perform substrate calculations.

Field Crew: CH, KM Site Code: AL2[illegible]

Sampling Date: (DD/MM/YYYY) 15/09/2021

SITE INSPECTION

Site Inspected by: _____

Communication Information

☒ Itinerary left with contact person (include contact numbers)

Contact Person: Evgeni Matveev Time checked-in: 9:00 AM

Form of communication: ☐ radio ☒ cell ☐ satellite ☐ hotel/pay phone ☐ SPOT

Phone number: (709) 763-9678

Vehicle Safety

☑ Safety equipment (first aid, fire extinguisher, blanket, emergency kit in vehicle)

☑ Equipment and chemicals safely secured for transport

☑ Vehicle parked in safe location; pylons, hazard light, reflective vests if necessary

Notes:

Shore & Wading Safety

☑ Wading Task Hazard Analysis read by all field staff

☑ Wading Safe Work Procedures read by all field staff

☑ Instream hazards identified (i.e. log jams, deep pools, slippery rocks)

☐ PFD worn

☑ Appropriate footwear, waders, wading belt

☐ Belay used

Notes:

CABIN

Elk River Alliance

Velocimeter Measurement Field Sheet

Site: ALX003

Date: ~~2021~~/9/15

Time: 10:00

Staff: KM/CH

Staff Gauge: —

Wetted Width: 8.8

Bankful Width: 10.10

Instrument ID: Global water

Photos: ☐ 1. Completed Field Sheet ☐ 2. Upstream ☐ 3. Downstream ☐ 4. Across (from left bank if possible)

	Distance (m)	Depth ~~(m)~~ CM	Velocity (m/s)	Notes
1 30	0	0	0	
2 60	.30	0	0	
3 90	.80	16.3	.1	
4 120		22.4	.1	
5 1,50		14.7	.3	
1 80		28.6	.2	
7 210		34.8	.3	
8 240		29.8	.2	
270		37.2	.5	
10 300		26.9	.4	
11 330		43.6	.5	
2 360		47.8	.5	
13 390		46.4	.4	
14 420		46.4	.5	
15 450		50.5	.6	

Continued from other side

16	6.0	0.250	1.5	
17	6.4	0.188	1.2	
18	6.8	0.138	0.8	
19	7.2	0.120	0.6	
20	7.6	0.140	0.3	
21	8.0	0.125	0.6	
22	8.4	0.164	0.2	
23	8.8	0.058	0.1	
24	9.2	0.044	0	
25	9.6	0.044	0	
26	10.0	0.024	0	
27				
28				
29				
30				
31				
32				
33				
34				
35				

Comments:

Field Crew: Kaileigh McCall - Chandra Buchanan Site Code: BovC01

Sampling Date: (DD/MM/YYYY) 05/10/2021

☒ **Occupational Health & Safety: Site Inspection Sheet completed**

PRIMARY SITE DATA

CABIN Study Name: CBWM Local Basin Name: Elk River

River/Stream Name: Boivin Creek Stream Order: (map scale 1:50,000) _____

Select one: ☒ Test Site ☐ Potential Reference Site

Geographical Description/Notes:
Park @ Race Trac Gas station, walk d/s on trail 20m, go down riprap. Site is at cobble bar across eroded bank u/s of undercut

Surrounding Land Use: (check those present) Information Source: Visual, local knowledge

☒ Forest ☐ Field/Pasture ☐ Agriculture ☒ Residential/Urban
☒ Logging ☒ Mining ☒ Commercial/Industrial ☐ Other _____

Dominant Surrounding Land Use: (check one) Information Source: Visual

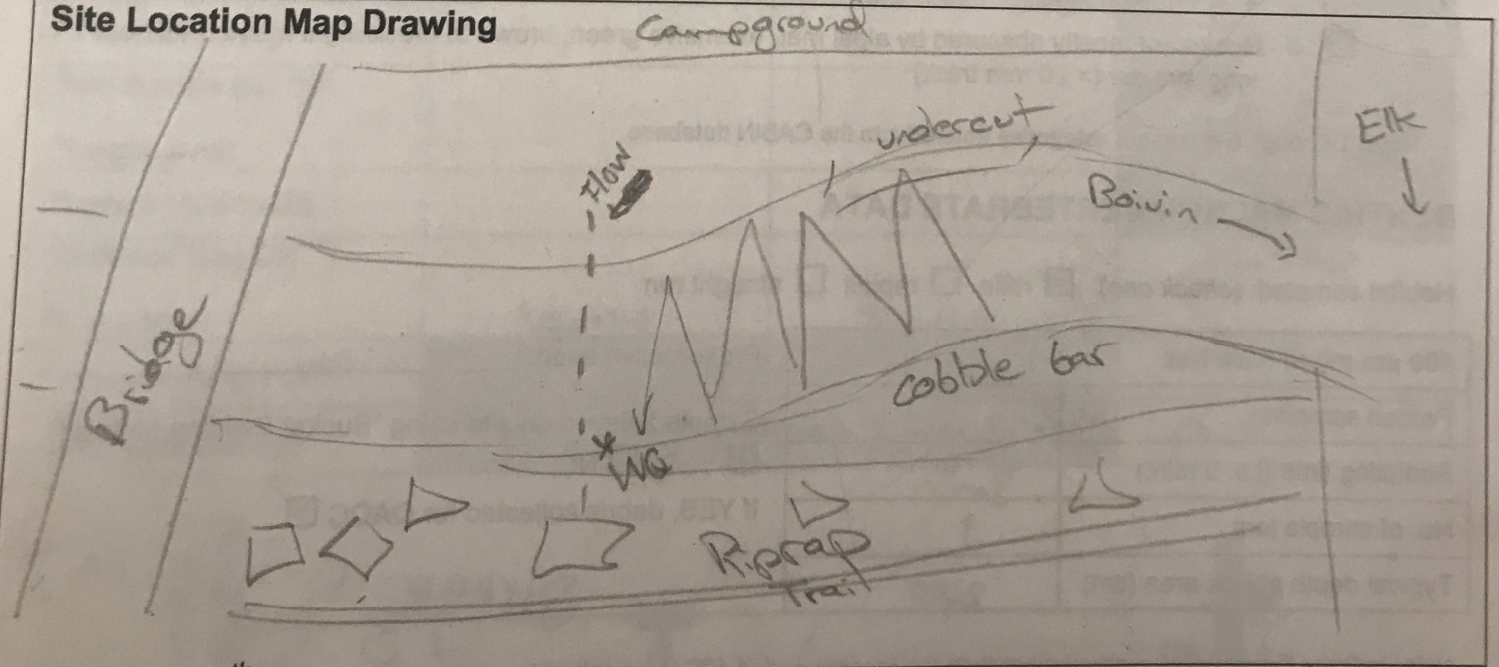
☐ Forest ☐ Field/Pasture ☐ Agriculture ☒ Residential/Urban
☐ Logging ☐ Mining ☐ Commercial/Industrial ☐ Other _____

Location Data

Latitude: [redacted]3.2 N Longitude: - 114.91641 W (DMS or DD)

Elevation: 1260 (fasl *or* masl) GPS Datum: ☐ GRS80 (NAD83/WGS84) ☐ Other: _____

Site Location Map Drawing



Note: Indicate north

* flow at beginning of gravel bar

Field Crew: Kaileigh McCall + Chandra Buchanan Site Code: BA10001

Sampling Date: (DD/MM/YYYY) 05/10/2021

Photos
☑ Field Sheet ☑ Upstream ☑ Downstream ☑ Across Site ☑ Aerial View
☑ Substrate (exposed) ☑ Substrate (aquatic) ☐ Other _____

REACH DATA *(represents 6 times bankfull width)*

1. Habitat Types: *(check those present)*
☑ Riffle ☐ Rapids ☐ Straight run ☐ Pool/Back Eddy

2. Canopy Coverage: *(stand in middle of stream and look up, check one)*
☑ 0 % ☐ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

3. Macrophyte Coverage: *(not algae or moss, check one)*
☑ 0 % ☐ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

4. Streamside Vegetation: (*check those present)*
☑ ferns/grasses ☐ shrubs ☑ deciduous trees ☑ coniferous trees

5. Dominant Streamside Vegetation: *(check one)*
☑ ferns/grasses ☐ shrubs ☐ deciduous trees ☐ coniferous trees

6. Periphyton Coverage on Substrate: *(benthic algae, not moss, check one)*

☑ **1** - Rocks are not slippery, no obvious colour (thin layer < 0.5 mm thick)
☐ **2** - Rocks are slightly slippery, yellow-brown to light green colour (0.5-1 mm thick)
☐ **3** - Rocks have a noticeable slippery feel (footing is slippery), with patches of thicker green to brown algae (1-5 mm thick)
☐ **4** - Rocks are very slippery (algae can be removed with thumbnail), numerous large clumps of green to dark brown algae (5 mm -20 mm thick)
☐ **5** - Rocks are mostly obscured by algal mat, extensive green, brown to black algal mass may have long strands (> 20 mm thick)

Note: 1 through 5 represent categories entered into the CABIN database.

BENTHIC MACROINVERTEBRATE DATA

Habitat sampled: (*check one*) ☑ riffle ☐ rapids ☐ straight run

400 µm mesh Kick Net	
Person sampling	Kaileigh McCall
Sampling time (i.e. 3 min.)	3min
No. of sample jars	1
Typical depth in kick area (cm)	20

Preservative used: 99% iso

Sampled sieved on site using "Bucket Swirling Method":
☑ YES ☐ NO
If YES, debris collected for QAQC ☑

Stream e-DNA x3 (antifreeze)

Note: Indicate if a sampling method other than the recommended 400 µm mesh kick net is used.

Field Crew: Kaileigh McCall, Chandra Buchanan Site Code: BOJ001

Sampling Date: (DD/MM/YYYY) 05/10/2021

WATER CHEMISTRY DATA

Time: 10:30 (24 hr clock) **Time zone:** MT

Air Temp: 8 (°C) Water Temp: 4.2 (°C) pH: 8.18

Specific Conductance: 276 (µs/cm) DO: 11.36 (mg/L) Turbidity: -1.10 (NTU) (0)

Check if water samples were collected for the following analyses:

ORP: 158.2 mV
Conductance: 164.0 µS/cm

- ☒ TSS (Total Suspended Solids)
- ☒ Nitrogen (i.e. Total, Nitrate, Nitrite, Dissolved, and/or Ammonia)
- ☒ Phosphorus (Total, Ortho, and/or Dissolved)
- ☐ Major Ions (i.e. Alkalinity, Hardness, Chloride, and/or Sulphate)
- ☒ Other EPH

Note: Determining alkalinity is recommended, as are other analyses, but not required for CABIN assessments.

CHANNEL DATA

Slope - Indicate how slope was measured: (check one)

☐ **Calculated from map**

Scale: _____ (Note: small scale map recommended if field measurement is not possible - i.e. 1:20,000).
contour interval (vertical distance) _____ (m),
distance between contour intervals (horizontal distance) _____ (m)
slope = vertical distance/horizontal distance = _____

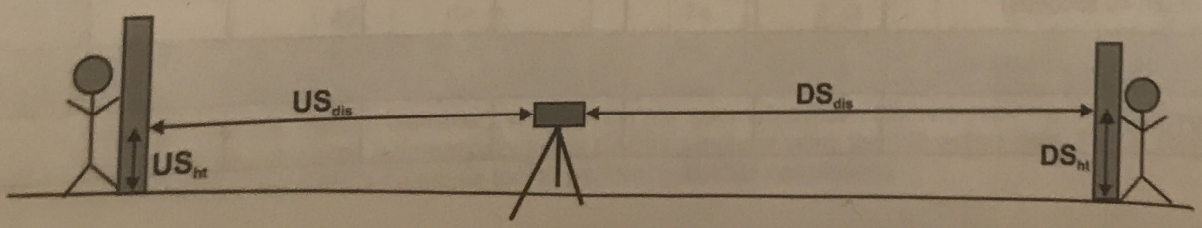
OR

☑ **Measured in field**

Circle device used and fill out table according to device:
a. Survey Equipment b. Hand Level & Measuring Tape

Less prev. years

Measurements	Upstream (U/S)	Downstream(D/S)	Calculation
[a]Top Hairline (T)			
[a]Mid Hairline (ht) OR [b]Height of rod			
[a]Bottom Hairline (B)			
[b]Distance (dis) OR [a]T-B x 100	[a]US_{dis}=T-B	[a]DS_{dis}=T-B	$US_{dis}+DS_{dis}$=
Change in height (Δht)			$DS_{ht}-US_{ht}$=
Slope (Δht/total dis)			0.026



Field Crew: Kaileigh McCall + Chandra Buchanan

Sampling Date: (DD/MM/YYYY) 04/10/2021

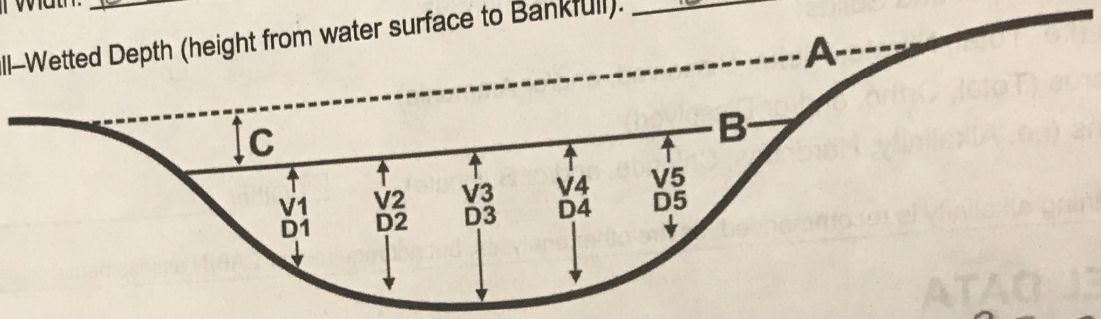
Widths and Depth

Location at site: U/S kicknet - directly before (U/S) of gravel bar on RWB (Indicate where in sample reach, ex. d/s of kick area)

A - Bankfull Width: 10.2 (m)

B - Wetted Stream Width: _____ (m)

C - Bankfull–Wetted Depth (height from water surface to Bankfull): 18 (cm)



Note:
Wetted widths > 5 m, measure a minimum of 5-6 equidistant locations;
Wetted widths < 5 m, measure 3-4 equidistant locations.

9.7 - 0.4 = 9.3

Velocity and Depth

*See attached discharge/flow sheet

Check appropriate velocity measuring device and fill out the appropriate section in chart below. Distance from shore and depth are required regardless of method:

☐ **Velocity Head Rod (or ruler)**: Velocity Equation (m/s) = √ [2(ΔD/100) * 9.81]

☐ **Rotary meters**: Gurley/Price/Mini-Price/Propeller (Refer to specific meter conversion chart for calculation)

☐ **Direct velocity measurements**: ☐ Marsh-McBirney ☐ Sontek or ☐ Other_____

	1	2	3	4	5	6	AVG
Distance from Shore (m)							
Depth (**D**) (cm)							
Velocity Head Rod (ruler)							
Flowing water Depth (D_1) (cm)							
Depth of Stagnation (D_2) (cm)							
Change in depth ($\Delta D=D_2-D_1$) (cm)							
Rotary meter							
Revolutions							
Time (minimum 40 seconds)							
Direct Measurement or calculation							
Velocity (**V**) (m/s)							

Field Crew: Raleigh McCall + Chandra Pachuau

Sampling Date: (DD/MM/YYYY) 05/10/2021 Site Code: BOW01

SUBSTRATE DATA

Surrounding/Interstitial Material

Circle the substrate size category for the surrounding material.

Substrate Size Class	Category
Organic Cover	0
< 0.1 cm (fine sand, silt or clay)	1
0.1-0.2 cm (coarse sand)	2
0.2-1.6 cm (gravel)	3
1.6-3.2 cm (small pebble)	4
3.2-6.4 cm (large pebble)	5
6.4-12.8 cm (small cobble)	6
12.8-25.6 cm (cobble)	7
> 25.6 cm (boulder)	8
Bedrock	9

100 Pebble Count & Substrate Embeddedness

- Measure the intermediate axis (100 rocks) and embeddedness (10 rocks) of substrate in the stream bed.
- Indicate B for bedrock, S for sand/silt/clay (particles < 0.2 cm) and O for organic material.
- Embededness categories (E): Completely embedded = 1, 3/4 embedded, 1/2 embedded, 1/4 embedded, unembedded = 0

	Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E
1	3.4		26	11.7		51	6.5		76	17.1	
2	4.7		27	9.5		52	5.3		77	17.9	
3	6.5		28	13.5		53	13.5		78	6.2	
4	8.0		29	6.8		54	19.5		79	1.5	
5	18.5		30	9.5	1/4	55	7.0		80	0.9	O
6	6.3		31	2.8		56	6.7		81	6.2	
7	9.5		32	5.0		57	4.0		82	18.0	
8	8.5		33	14.5		58	5.5		83	3.8	
9	2.7		34	6.3		59	11.6		84	6.1	
10	4.7		35	7.0		60	4.5	O	85	9.0	
11	3.0		36	16.5		61	11.8		86	2.9	
12	17.0	3/4	37	3.5		62	8.5		87	15.8	
13	14.5		38	4.8		63	3.0		88	7.0	
14	6.4		39	6.2		64	5.0		89	10.7	
15	9.5		40	7.7	O	65	12.1		90	7.3	3/4
16	8.7		41	7.0		66	9.0		91	7.4	
17	10.0		42	8.0		67	19.2		92	11.8	
18	11.0		43	16.4		68	6.6		93	11.4	
19	12.5		44	11.6		69	15.1		94	17.0	
20	3.5	O	45	15.7		70	7.4	1/4	95	8.3	
21	13.7		46	10.5		71	13.0		96	10.9	
22	1.8		47	7.3		72	4.2		97	12.8	
23	12.5		48	11.5		73	5.4		98	6.5	
24	4.7		49	3.8		74	2.9		99	10.0	
25	3.8		50	3.4	O	75	15.4		100	14.1	1/2

Note: The Wolman D50 (i.e. median diameter), Wolman Dg (i.e. geometric mean diameter) and the % composition of the substrate classes will be calculated automatically in the CABIN database using the 100 pebble data. All 100 pebbles must be measured in order for the CABIN database tool to perform substrate calculations.

Field Crew: Kaileigh McCall + Chandra Buchanan Site Code: BOND1

Sampling Date: (DD/MM/YYYY) 05/10/2021

SITE INSPECTION

Site Inspected by: Kaileigh McCall

Communication Information

☒ Itinerary left with contact person (include contact numbers)

Contact Person: Chad Hughes Time checked-in: 10:30

Form of communication: ☐ radio ☒ cell ☐ satellite ☐ hotel/pay phone ☐ SPOT

Phone number: (250) 423-0344

Vehicle Safety

☒ Safety equipment (first aid, fire extinguisher, blanket, emergency kit in vehicle)

☒ Equipment and chemicals safely secured for transport

☒ Vehicle parked in safe location; pylons, hazard light, reflective vests if necessary

Notes:

Shore & Wading Safety

☒ Wading Task Hazard Analysis read by all field staff

☒ Wading Safe Work Procedures read by all field staff

☒ Instream hazards identified (i.e. log jams, deep pools, slippery rocks)

☐ PFD worn

☒ Appropriate footwear, waders, wading belt

☐ Belay used

Notes:

Velocimeter Measure

Site: BOVO1

Date: 05/10/2021

Time: 11:30

Staff: Kaileigh McCall + Chandra Buchanan

Staff Gauge: _____

Wetted Width: _____

Bankful Width: _____

Instrument ID: Flowprobe

Photos:
- ☐ 1. Completed Field Sheet
- ☐ 2. Upstream
- ☐ 3. Downstream
- ☐ 4. Across (from left bank if possible)

	Distance (m)	Depth (m)	Velocity (m/s)	Notes
1	0.5	0.03	0	
2	0.85	0.035	0	
3	1.2	0.01	0	
4	1.55	0	0	
5	2.25	0.029	0	
6	2.6	0.036	0	
7	2.95	0.020	0	
8	3.3	0.037	0.4	
9	3.65	0.050	0.4	
10	4	0.155	0.6	
11	4.35	0.190	1.1	
12	4.7	0.138	1.0	
13	5.05	0.165	1.1	
14	5.4	0.240	0.8	
15	5.75	0.225	0.5	

Continued from other side

16	2.5	11.8	0.3	
17	2.9	12.1	0.1	
18	3.0	6.8	0.1	
19	3.1	9.0	0.2	
20	3.2	9.8	0.1	
21	3.3	7.4	0	
22	3.4	6.5	0	
23	3.5	9.0	0.1	
24	3.6	9.5	0.2	
25	3.7	9.4	0.2	
26	3.8	3.0	0	
27				
28				
29				
30				
31				
32				
33				
34				
35				

Comments:

☒ Occupational Health & Safety: Site Inspection Sheet completed

PRIMARY SITE DATA

CABIN Study Name: CBWQ-Elk Local Basin Name: Elk River Watershed

River/Stream Name: Boivin Creek Stream Order: (map scale 1:50,000) _____

Select one: ☒ Test Site ☐ Potential Reference Site

Geographical Description/Notes:

Park at cross-country ski-trails, follow path to bridge, ~~walk~~ walk U/S before bridge (LWB) until "nightmare before tree" (at temp. logger site)

Surrounding Land Use: (check those present) Information Source: visual, maps, local knowledge

- ☒ Forest
- ☒ Logging
- ☐ Field/Pasture
- ☐ Mining
- ☐ Agriculture
- ☒ Commercial/Industrial
- ☐ Residential/Urban
- ☒ Other recreation

Dominant Surrounding Land Use: (check one) Information Source: _____

- ☒ Forest
- ☐ Logging
- ☐ Field/Pasture
- ☐ Mining
- ☐ Agriculture
- ☐ Commercial/Industrial
- ☐ Residential/Urban
- ☐ Other _____

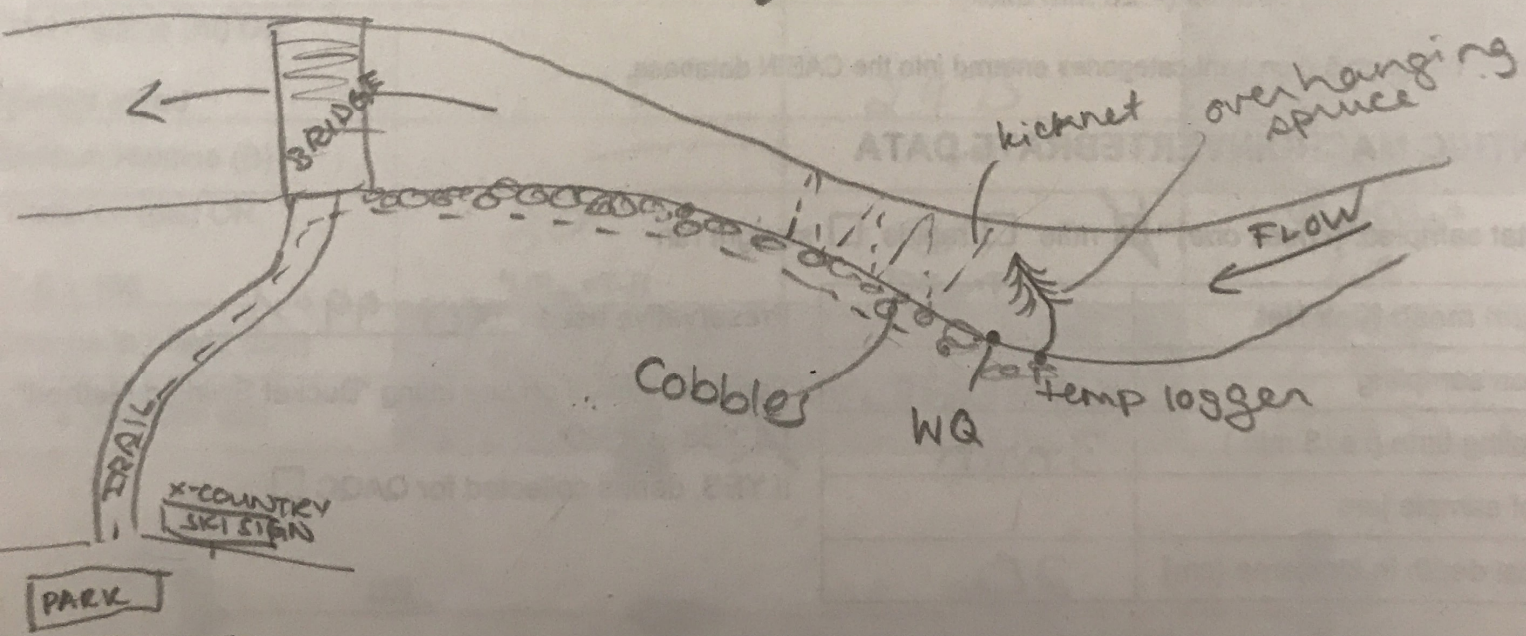
Location Data

Latitude: 50.016146 N Longitude: - 114.93726 W (DMS or DD)

Elevation: 4429 (fasl or masl) GPS Datum: ☒ GRS80 (NAD83/WGS84) ☐ Other: _____

1327 masl

Site Location Map Drawing



Note: Indicate north

Field Crew: KM, CB. Site Code: BO1002

Sampling Date: (DD/MM/YYYY) 05/10/2021

Photos
☐ Field Sheet ☐ Upstream ☐ Downstream ☐ Across Site ☐ Aerial View
☐ Substrate (exposed) ☐ Substrate (aquatic) ☐ Other _____

REACH DATA *(represents 6 times bankfull width)*

1. Habitat Types: *(check those present)*
☒ Riffle ☐ Rapids ☐ Straight run ☐ Pool/Back Eddy

2. Canopy Coverage: *(stand in middle of stream and look up, check one)*
☐ 0 % ☒ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

3. Macrophyte Coverage: *(not algae or moss, check one)*
☒ 0 % ☐ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

4. Streamside Vegetation: (*check those present)*
☒ ferns/grasses ☒ shrubs ☒ deciduous trees ☒ coniferous trees

5. Dominant Streamside Vegetation: *(check one)*
☐ ferns/grasses ☒ shrubs ☐ deciduous trees ☐ coniferous trees

6. Periphyton Coverage on Substrate: *(benthic algae, not moss, check one)*

☐ **1** - Rocks are not slippery, no obvious colour (thin layer < 0.5 mm thick)
☒ **2** - Rocks are slightly slippery, yellow-brown to light green colour (0.5-1 mm thick)
☐ **3** - Rocks have a noticeable slippery feel (footing is slippery), with patches of thicker green to brown algae (1-5 mm thick)
☐ **4** - Rocks are very slippery (algae can be removed with thumbnail), numerous large clumps of green to dark brown algae (5 mm -20 mm thick)
☐ **5** - Rocks are mostly obscured by algal mat, extensive green, brown to black algal mass may have long strands (> 20 mm thick)

Note: 1 through 5 represent categories entered into the CABIN database.

BENTHIC MACROINVERTEBRATE DATA

Habitat sampled: (*check one*) ☒ riffle ☐ rapids ☐ straight run

400 µm mesh Kick Net	
Person sampling	K. McCallum
Sampling time (i.e. 3 min.)	3 min
No. of sample jars	1
Typical depth in kick area (cm)	20

Preservative used: ISO 99%

Sampled sieved on site using "Bucket Swirling Method":
☒ YES ☐ NO
If YES, debris collected for QAQC ☐

Note: Indicate if a sampling method other than the recommended 400 µm mesh kick net is used.

Field Crew: KM, CB Site Code: BO1.0003

Sampling Date: (DD/MM/YYYY) 05/10/2021

WATER CHEMISTRY DATA Time: 14:50 (24 hr clock) Time zone: UTC MST

Air Temp: 18.5 (°C) Water Temp: 5.0 (°C) pH: 8.21

Specific Conductance: 294.8 (µs/cm) DO: 10.93 (mg/L) Turbidity: -1.2 (NTU) (0)

Check if water samples were collected for the following analyses: Press: 645.8 mm Hg ORP: 142.9 Cond: 168.1

- [x] TSS (Total Suspended Solids)
- [x] Nitrogen (i.e. Total, Nitrate, Nitrite, Dissolved, and/or Ammonia)
- [x] Phosphorus (Total, Ortho, and/or Dissolved)
- [x] Major Ions (i.e. Alkalinity, Hardness, Chloride, and/or Sulphate)
- [x] Other

Note: Determining alkalinity is recommended, as are other analyses, but not required for CABIN assessments.

FIELD BLANK HERE

CHANNEL DATA

Slope - Indicate how slope was measured: (check one)

☐ **Calculated from map**

Scale: _____ (Note: small scale map recommended if field measurement is not possible - i.e. 1:20,000).

contour interval (vertical distance) _____ (m),

distance between contour intervals (horizontal distance) _____ (m)

slope = vertical distance/horizontal distance = _____

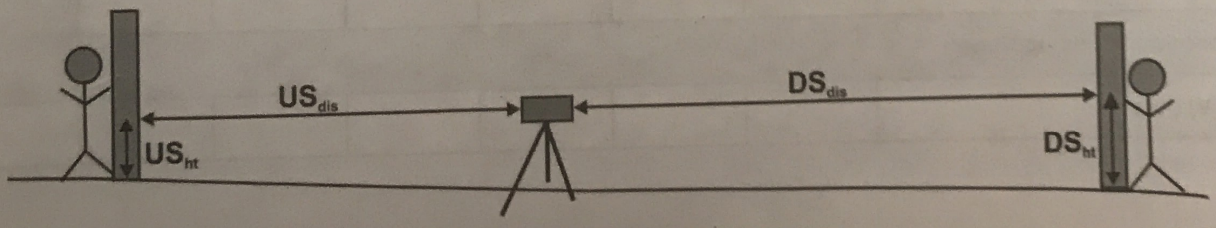
OR

☒ **Measured in field**

Circle device used and fill out table according to device:

a. Survey Equipment b. Hand Level & Measuring Tape

Measurements	Upstream (U/S)	Downstream(D/S)	Calculation
[a]Top Hairline (T)	—	—	
[a]Mid Hairline (ht) OR [b]Height of rod	1.208	2.975	
[a]Bottom Hairline (B)	—	—	
[b]Distance (dis) OR [a]T-B x 100	30 [a]US_{dis}=T-B	30 [a]DS_{dis}=T-B	$US_{dis}+DS_{dis}$= 60
Change in height (Δht)			$DS_{ht}-US_{ht}$= 1.767
Slope (Δht/total dis)			2.945



Field Crew: KM, CB Site Code: BG1002

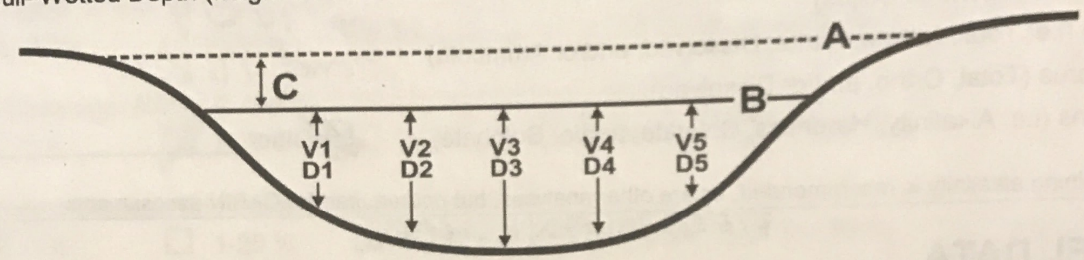
Sampling Date: (DD/MM/YYYY) 5/10/2021

Widths and Depth

Location at site: U/s kick area (Indicate where in sample reach, ex. d/s of kick area)

A - Bankfull Width: _____(m) B - Wetted Stream Width: _____(m)

C - Bankfull–Wetted Depth (height from water surface to Bankfull): 15.5 (cm)



Note:
Wetted widths > 5 m, measure a minimum of 5-6 equidistant locations;
Wetted widths < 5 m, measure 3-4 equidistant locations.

Velocity and Depth

* see flow field sheet

Check appropriate velocity measuring device and fill out the appropriate section in chart below. Distance from shore and depth are required regardless of method:

☐ **Velocity Head Rod (or ruler)**: Velocity Equation (m/s) = $\sqrt{[2(\Delta D/100) * 9.81]}$

☐ **Rotary meters**: Gurley/Price/Mini-Price/Propeller (Refer to specific meter conversion chart for calculation)

☒ **Direct velocity measurements**: ☐ Marsh-McBirney ☐ Sontek or ☐ Other globo flow probe

	1	2	3	4	5	6	AVG
Distance from Shore (m)							
Depth (**D**) (cm)							
Velocity Head Rod (ruler)							
Flowing water Depth (D_1) (cm)							
Depth of Stagnation (D_2) (cm)							
Change in depth ($\Delta D=D_2-D_1$) (cm)							
Rotary meter							
Revolutions							
Time (minimum 40 seconds)							
Direct Measurement or calculation							
Velocity (**V**) (m/s)							

Field Crew: KM, CB Site Code: BB1052

Sampling Date: (DD/MM/YYYY) 5/10/2021

SUBSTRATE DATA

Surrounding/Interstitial Material

Circle the substrate size category for the surrounding material.

Substrate Size Class	Category
Organic Cover	0
< 0.1 cm (fine sand, silt or clay)	1
0.1-0.2 cm (coarse sand)	2
0.2-1.6 cm (gravel)	3
1.6-3.2 cm (small pebble)	4
3.2-6.4 cm (large pebble)	5
6.4-12.8 cm (small cobble)	6
12.8-25.6 cm (cobble)	7
> 25.6 cm (boulder)	8
Bedrock	9

100 Pebble Count & Substrate Embeddedness

- Measure the intermediate axis (100 rocks) and embeddedness (10 rocks) of substrate in the stream bed.
- Indicate B for bedrock, S for sand/silt/clay (particles < 0.2 cm) and O for organic material.
- Embededness categories (E): Completely embedded = 1, 3/4 embedded, 1/2 embedded, 1/4 embedded, unembedded = 0

	Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E
1	19.0		26	10.8		51	11.1		76	18.7	
2	8.0		27	6.7		52	28.7		77	14.3	
3	20.2		28	4.1		53	5.1		78	8.8	
4	14.1		29	10.9		54	4.5		79	10.1	
5	5.9		30	6.0		55	5.9		80	20.1	1/2
6	13.7		31	17.9		56	9.7		81	8.8	
7	1.9		32	9.2		57	8.8		82	5.3	
8	14.6		33	29.1		58	6.5		83	15.1	
9	9.6		34	16.8		59	5.4		84	4.6	
10	2.5	O	35	13.4	1/4	60	14.1	3/4	85	17.6	
11	11.9		36	16.7		61	7.8		86	2.6	
12	5.2		37	6.6		62	7.5		87	1.8	
13	6.4		38	14.8		63	9.6		88	9.3	
14	3.1		39	13.4		64	2.7		89	1.5	
15	7.8		40	4.2	1/4	65	7.1		90	12.4	1/4
16	7.3		41	18.1		66	28.1		91	9.3	
17	6.0		42	25.8		67	8.9		92	13.1	
18	11.6		43	8.3		68	2.5		93	9.8	
19	6.0		44	5.4		69	13.6		94	4.6	
20	14.7	O	45	14.7		70	6.6	O	95	6.3	
21	10.6		46	8.6		71	2.2		96	10.9	
22	18.5		47	15.4		72	12.4		97	19.4	
23	2.4		48	12.1		73	10.5		98	2.8	
24	11.3		49	5.8		74	7.1		99	5.2	
25	17.9		50	4.6	1/4	75	11.1		100	4.3	1/4

Note: The Wolman D50 (i.e. median diameter), Wolman Dg (i.e. geometric mean diameter) and the % composition of the substrate classes will be calculated automatically in the CABIN database using the 100 pebble data. All 100 pebbles must be measured in order for the CABIN database tool to perform substrate calculations.

Field Crew: K.M.CB

Site Code: [illegible]

Sampling Date: (DD/MM/YYYY) 05/10/2021

SITE INSPECTION

Site Inspected by: K. McCallum

Communication Information

☒ Itinerary left with contact person (include contact numbers)

Contact Person: C. Hughes Time checked-in: 9,12

Form of communication: ☐ radio ☒ cell ☐ satellite ☐ hotel/pay phone ☐ SPOT

Phone number: (250) 423-0214

Vehicle Safety

☒ Safety equipment (first aid, fire extinguisher, blanket, emergency kit in vehicle)

☒ Equipment and chemicals safely secured for transport

☒ Vehicle parked in safe location; pylons, hazard light, reflective vests if necessary

Notes:

Shore & Wading Safety

☒ Wading Task Hazard Analysis read by all field staff

☒ Wading Safe Work Procedures read by all field staff

☒ Instream hazards identified (i.e. log jams, deep pools, slippery rocks)

☒ PFD worn

☒ Appropriate footwear, waders, wading belt

☐ Belay used

Notes:

Velocimeter Measurement Field Sheet

Site: B0102

Date: 2021/10

Time: 15:00

Staff: KM, EM

Staff Gauge: _____

Wetted Width: 10

Bankful Width: 18.6

Instrument ID: GlobalFlowProbe

Photos:
- ☐ 1. Completed Field Sheet
- ☑ 2. Upstream
- ☑ 3. Downstream
- ☐ 4. Across (from left bank if possible)

	Distance (m)	Depth (m)	Velocity (m/s)	Notes
1	0	0.045	0	
2	0.4	0.057	0	
3	0.8	0.257	0.4	
4	1.2	0.323	0.9	
5	1.6	0.365	0.8	
6	2.0	0.414	1.3	
7	2.4	0.405	1.1	
8	2.8	0.360	0.1	
9	3.2	0.315	0.0	
10	3.6	0.262	0.5	
11	4.0	0.406	0.8	
12	4.4	0.385	0.9	
13	4.8	0.430	1.1	
14	5.2	0.375	1.2	
15	5.6	0.264	1.8	

Continued from other side

16	7.30	0.154	0.3	
17	7.65	0.124	0.3	
18	8.00	0.116	0.4	
19	8.35	0.8	0.2	
20	8.70	0.125	0.1	
21	9.05	0.48	0.3	
22	9.40	0.58	0.1	
23	9.75	0.56	0.0	
24	10.10	0.4	0.0	BESIDE
25	10.45	0.3	0.0	BANK
26	10.80			
27				
28				
29				
30				
31				
32				
33				
34				
35				

Comments:

Field Crew: Kaileigh McCallum + Eugenia Matveeva Site Code: COLC01

Sampling Date: (DD/MM/YYYY) 06/10/2021

☐ **Occupational Health & Safety: Site Inspection Sheet completed**

PRIMARY SITE DATA

CABIN Study Name: CBWQ-Elk Local Basin Name: Elk River

River/Stream Name: Coal Creek Stream Order: (map scale 1:50,000) _____

Select one: ☒ Test Site ☐ Potential Reference Site

Geographical Description/Notes: Site between Park Ave + train bridge, d/s of giant greenhouse (Sombrowskia)

Surrounding Land Use: (check those present) Information Source: _____

☒ Forest ☐ Field/Pasture ☐ Agriculture ☒ Residential/Urban

☐ Logging ☐ Mining ☐ Commercial/Industrial ☒ Other trail, train

Dominant Surrounding Land Use: (check one) Information Source: _____

☐ Forest ☐ Field/Pasture ☐ Agriculture ☒ Residential/Urban

☐ Logging ☐ Mining ☐ Commercial/Industrial ☐ Other _____

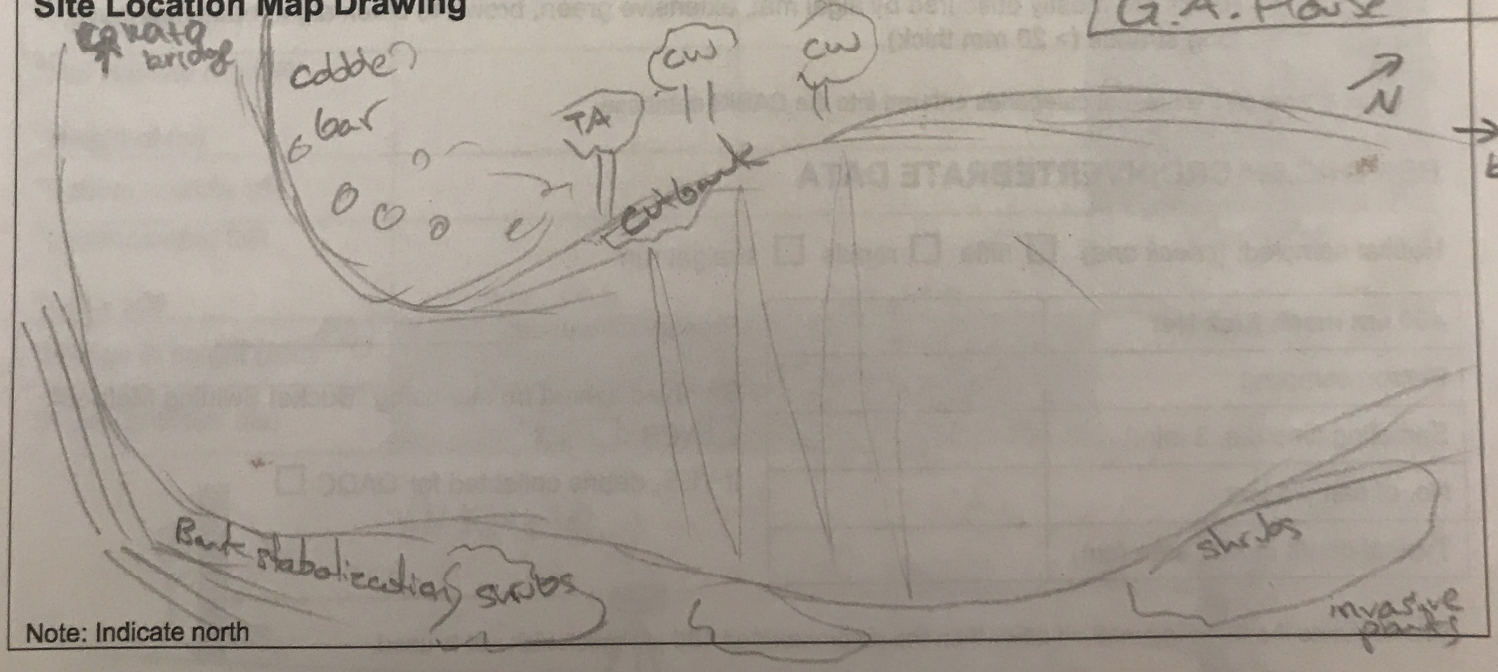
Location Data

Latitude: 49.405483 N Longitude: - 115.066488 W (DMS or DD)

Elevation: 999 (fasl *or* masl) GPS Datum: ☒ GRS80 (NAD83/WGS84) ☐ Other: _____

3286 ft

Site Location Map Drawing



Note: Indicate north

Sampling Date: (DD/MM/YYYY) 06/10/2021

Photos

☑ Field Sheet ☐ Upstream ☑ Downstream ☑ Across Site ☐ Aerial View
☑ Substrate (exposed) ☑ Substrate (aquatic) ☐ Other _____

REACH DATA *(represents 6 times bankfull width)*

1. Habitat Types: *(check those present)*
   ☑ Riffle ☐ Rapids ☑ Straight run ☑ Pool/Back Eddy

2. Canopy Coverage: *(stand in middle of stream and look up, check one)*
   ☐ 0 % ☑ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

3. Macrophyte Coverage: *(not algae or moss, check one)*
   ☑ 0 % ☐ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

4. Streamside Vegetation: (*check those present)*
   ☑ ferns/grasses ☑ shrubs ☑ deciduous trees ☐ coniferous trees

5. Dominant Streamside Vegetation: *(check one)*
   ☐ ferns/grasses ☑ shrubs ☐ deciduous trees ☐ coniferous trees

6. Periphyton Coverage on Substrate: *(benthic algae, not moss, check one)*

   ☐ **1** - Rocks are not slippery, no obvious colour (thin layer < 0.5 mm thick)
   ☐ **2** - Rocks are slightly slippery, yellow-brown to light green colour (0.5-1 mm thick)
   ☑ **3** - Rocks have a noticeable slippery feel (footing is slippery), with patches of thicker green to brown algae (1-5 mm thick)
   ☐ **4** - Rocks are very slippery (algae can be removed with thumbnail), numerous large clumps of green to dark brown algae (5 mm -20 mm thick)
   ☐ **5** - Rocks are mostly obscured by algal mat, extensive green, brown to black algal mass may have long strands (> 20 mm thick)

Note: 1 through 5 represent categories entered into the CABIN database.

BENTHIC MACROINVERTEBRATE DATA

Habitat sampled: (*check one*) ☑ riffle ☐ rapids ☐ straight run

400 µm mesh Kick Net	
Person sampling	EM
Sampling time (i.e. 3 min.)	3 min
No. of sample jars	3
Typical depth in kick area (cm)	

Preservative used: 99% iso

Sampled sieved on site using "Bucket Swirling Method":
☐ YES ☐ NO

If YES, debris collected for QAQC ☐
6 for e-DNA

Note: Indicate if a sampling method other than the recommended 400 µm mesh kick net is used.

Field Crew: RMFM Site Code: 2020

Sampling Date: (DD/MM/YYYY) 06/10/2021

WATER CHEMISTRY DATA **Time:** 11.00 (24 hr clock) **Time zone:** MT

Air Temp: 12 (°C) Water Temp: 8.6 (°C) pH: 8.18

Specific Conductance: 138.3 (µs/cm) DO: 10.68 (mg/L) Turbidity: -1.01 (NTU)

Check if water samples were collected for the following analyses:

ORP: 130.9 mV
Cond.: 94.9 µS/cm

- ☒ TSS (Total Suspended Solids)
- ☒ Nitrogen (i.e. Total, Nitrate, Nitrite, Dissolved, and/or Ammonia)
- ☒ Phosphorus (Total, Ortho, and/or Dissolved)
- ☒ Major Ions (i.e. Alkalinity, Hardness, Chloride, and/or Sulphate)
- ☒ Other BPH

Note: Determining alkalinity is recommended, as are other analyses, but not required for CABIN assessments.

CHANNEL DATA

Slope - Indicate how slope was measured: (check one)

☐ **Calculated from map**

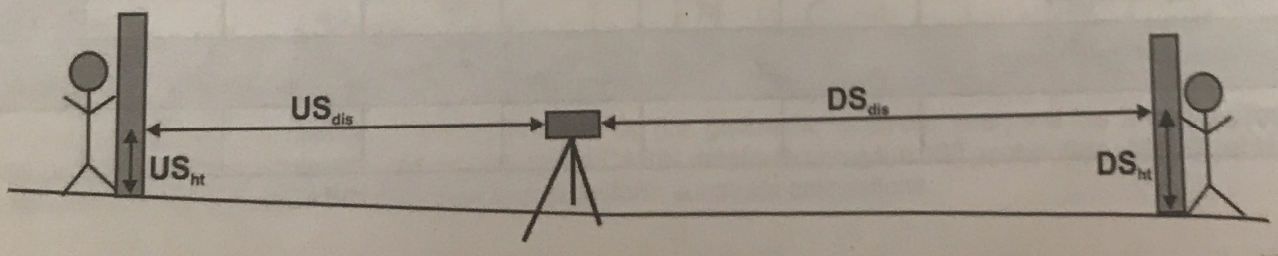
Scale: _____ (Note: small scale map recommended if field measurement is not possible - i.e. 1:20,000).
contour interval (vertical distance) _____ (m),
distance between contour intervals (horizontal distance) _____ (m)
slope = vertical distance/horizontal distance = _____

OR

☒ **Measured in field**

Circle device used and fill out table according to device:
a. Survey Equipment b. Hand Level & Measuring Tape (prev. year)

Measurements	Upstream (U/S)	Downstream(D/S)	Calculation
[a]Top Hairline (T)			
[a]Mid Hairline (ht) OR [b]Height of rod			
[a]Bottom Hairline (B)			
[b]Distance (dis) OR [a]T-B x 100	[a]US_{dis}=T-B	[a]DS_{dis}=T-B	$US_{dis}+DS_{dis}$=
Change in height (Δht)			$DS_{ht}-US_{ht}$=
Slope (Δht/total dis)			0.01



Field Crew: EM + RM

Sampling Date: (DD/MM/YYYY) 06/10/2021

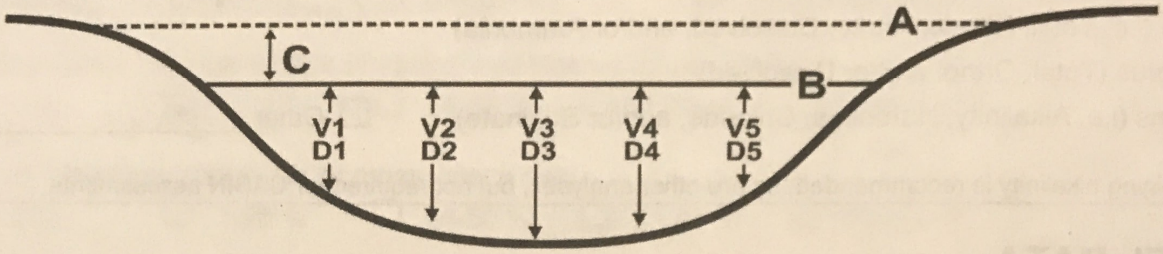
Widths and Depth

Location at site: U/S of kick site (Indicate where in sample reach, ex. d/s of kick area)

A - Bankfull Width: 17.7 (m)

B - Wetted Stream Width: 12.9 (m)

C - Bankfull–Wetted Depth (height from water surface to Bankfull): 25 (cm)



Note:
Wetted widths > 5 m, measure a minimum of 5-6 equidistant locations;
Wetted widths < 5 m, measure 3-4 equidistant locations.

Velocity and Depth

* see attatched flow sheet

Check appropriate velocity measuring device and fill out the appropriate section in chart below. Distance from shore and depth are required regardless of method:

☐ **Velocity Head Rod (or ruler):** Velocity Equation (m/s) = $\sqrt{[\ 2(\Delta D/100) * 9.81]}$

☐ **Rotary meters:** Gurley/Price/Mini-Price/Propeller (Refer to specific meter conversion chart for calculation)

☒ **Direct velocity measurements:** ☐ Marsh-McBirney ☐ Sontek or ☒ Other FlowProbe

	1	2	3	4	5	6	AVG
Distance from Shore (m)							
Depth (**D**) (cm)							
Velocity Head Rod (ruler)							
Flowing water Depth (D_1) (cm)							
Depth of Stagnation (D_2) (cm)							
Change in depth ($\Delta D=D_2-D_1$) (cm)							
Rotary meter							
Revolutions							
Time (minimum 40 seconds)							
Direct Measurement or calculation							
Velocity (**V**) (m/s)							

Site Code: COLOR01

Sampling Date: (DD/MM/YYYY) 06/10/2021

SUBSTRATE DATA

Surrounding/Interstitial Material

Circle the substrate size category for the surrounding material.

Substrate Size Class	Category
Organic Cover	0
< 0.1 cm (fine sand, silt or clay)	1
0.1-0.2 cm (coarse sand)	2
0.2-1.6 cm (gravel)	3
1.6-3.2 cm (small pebble)	4
3.2-6.4 cm (large pebble)	5
6.4-12.8 cm (small cobble)	6
12.8-25.6 cm (cobble)	7
> 25.6 cm (boulder)	8
Bedrock	9

100 Pebble Count & Substrate Embeddedness

- Measure the intermediate axis (100 rocks) and embeddedness (10 rocks) of substrate in the stream bed.
- Indicate B for bedrock, S for sand/silt/clay (particles < 0.2 cm) and O for organic material.
- Embededness categories (E): Completely embedded = 1, 3/4 embedded, 1/2 embedded, 1/4 embedded, unembedded = 0

	Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E
1	10.2	0	26	22.3		51	8.8		76	9.8	
2	6.2		27	5.5		52	23.7		77	0.9	
3	8.9		28	9.0		53	6.4		78	6.2	
4	7.1		29	6.4		54	14.8		79	33.4	
5	5.2		30	12.1	1/4	55	7.0		80	6.5	3/4
6	6.9		31	5.2		56	10.1		81	38.5	
7	23.1		32	11.4		57	0.3		82	9.7	
8	3.2		33	10.8		58	1.2		83	16.5	
9	10.2		34	17.3		59	13.4		84	15.7	
10	7.6	1/4	35	15.4		60	15.5	0	85	5.4	
11	21.4		36	17.6		61	8.5		86	32.4	
12	4.9		37	9.5		62	1.5		87	13.0	
13	4.1		38	8.7		63	21.0		88	13.5	
14	6.7		39	16.9		64	8.2		89	3.9	
15	8.0		40	16.7	1/4	65	5.9		90	12.2	0
16	7.5		41	4.2		66	0.9		91	16.5	
17	9.3		42	3.3		67	3.4		92	8.9	
18	30.5		43	8.0		68	8.1		93	8.2	
19	19.1		44	18.6		69	10.0	1/4	94	14.0	
20	12.1	1/4	45	18.8		70	3.3		95	3.7	
21	13.4		46	17.0		71	12.0		96	0.7	
22	5.6		47	27.9		72	4.5		97	3.6	
23	6.9		48	11.0		73	1.9		98	4.8	
24	24.5		49	2.4		74	10.4		99	7.9	
25	12.1		50	27.5	3/4	75	11.4		100	5.4	1/4

Note: The Wolman D50 (i.e. median diameter), Wolman Dg (i.e. geometric mean diameter) and the % composition of the substrate classes will be calculated automatically in the CABIN database using the 100 pebble data. All 100 pebbles must be measured in order for the CABIN database tool to perform substrate calculations.

Field Crew: KM + EM

Site Code: _____

Sampling Date: (DD/MM/YYYY) 06/10/2021

SITE INSPECTION

Site Inspected by: Kaileigh McCallum

Communication Information

☒ Itinerary left with contact person (include contact numbers)

Contact Person: Chad Hughes Time checked-in: 10:30

Form of communication: ☐ radio ☒ cell ☐ satellite ☐ hotel/pay phone ☐ SPOT

Phone number: (780) 423-0344

Vehicle Safety

☒ Safety equipment (first aid, fire extinguisher, blanket, emergency kit in vehicle)

☒ Equipment and chemicals safely secured for transport

☒ Vehicle parked in safe location; pylons, hazard light, reflective vests if necessary

Notes:

Shore & Wading Safety

☒ Wading Task Hazard Analysis read by all field staff

☒ Wading Safe Work Procedures read by all field staff

☒ Instream hazards identified (i.e. log jams, deep pools, slippery rocks)

☐ PFD worn

☒ Appropriate footwear, waders, wading belt

☐ Belay used

Notes:

Site: COL001

Date: 06/10/2021

Time: 12:00

Staff: KM + EM

Staff Gauge: N/A

Wetted Width: 12.9

Bankful Width: 17.7

Instrument ID: Flowprobe

Photos:
- ☑ 1. Completed Field Sheet
- ☑ 2. Upstream
- ☑ 3. Downstream
- ☑ 4. Across (from left bank if possible)

17

	Distance (m)	Depth (m)	Velocity (m/s)	Notes
1	4.10	0.19	0.1	
2	4.60	0.195	0.2	
3	5.10	0.160	0.2	
4	5.60	0.125	0.3	
5	6.10	0.194	0.1	large rock U/S
6	6.60	0.187	0.0	(edge)
7	7.10	0.227	0.0	"
8	7.6	0.260	0.2	
9	8.1	0.240	0.4	
10	8.6	0.184	0.4	
11	9.1	0.175	0.1	rock U/S
12	9.6	0.177	0.2	
13	10.1	0.20	0.3	
14	10.6	0.228	0.1	
15	11.1	0.130	0.2	

Continued from other side

16	6.6	31.0	0.8	
17	6.9	38.5	0.6	
18	7.2	32.5	0.5	
19	7.5	21.5	0.3	large room J/s
20	7.8	29.0	0.3	"
21	8.1	31.0	0.5	
22	8.4	33.5	0.5	
23	8.7	32.5	0.5	
24	9.0	25.0	0.4	
25	9.3	18.0	0.3	
26	9.6	14.5	0.3	
27	9.9	13.0	0.2	
28	10.2	15.5	0.2	
29	10.5	0	0	
30				
31				
32				
33				
34				
35				

Comments:

Field Crew: [illegible] Site Code: CBWQ-3

Sampling Date: (DD/MM/YYYY) 06/10/2021

☒ **Occupational Health & Safety: Site Inspection Sheet completed**

PRIMARY SITE DATA

CABIN Study Name: CBWQ-Elk Local Basin Name: ~~Coal Creek~~ Elk

River/Stream Name: Coal Creek Stream Order: (map scale 1:50,000) _____

Select one: ☒ Test Site ☐ Potential Reference Site

Geographical Description/Notes: Take Coal Cr. Rd to Paiges Draw, Park @ pullout on left before switchback. Follow flagging tape to site

Surrounding Land Use: (check those present) Information Source: visual

☒ Forest ☐ Field/Pasture ☐ Agriculture ☐ Residential/Urban

☐ Logging ☐ Mining ☐ Commercial/Industrial ☒ Other hunting

Dominant Surrounding Land Use: (check one) Information Source: visual

☐ Forest ☐ Field/Pasture ☐ Agriculture ☐ Residential/Urban

☒ Logging ☐ Mining ☐ Commercial/Industrial ☐ Other _____

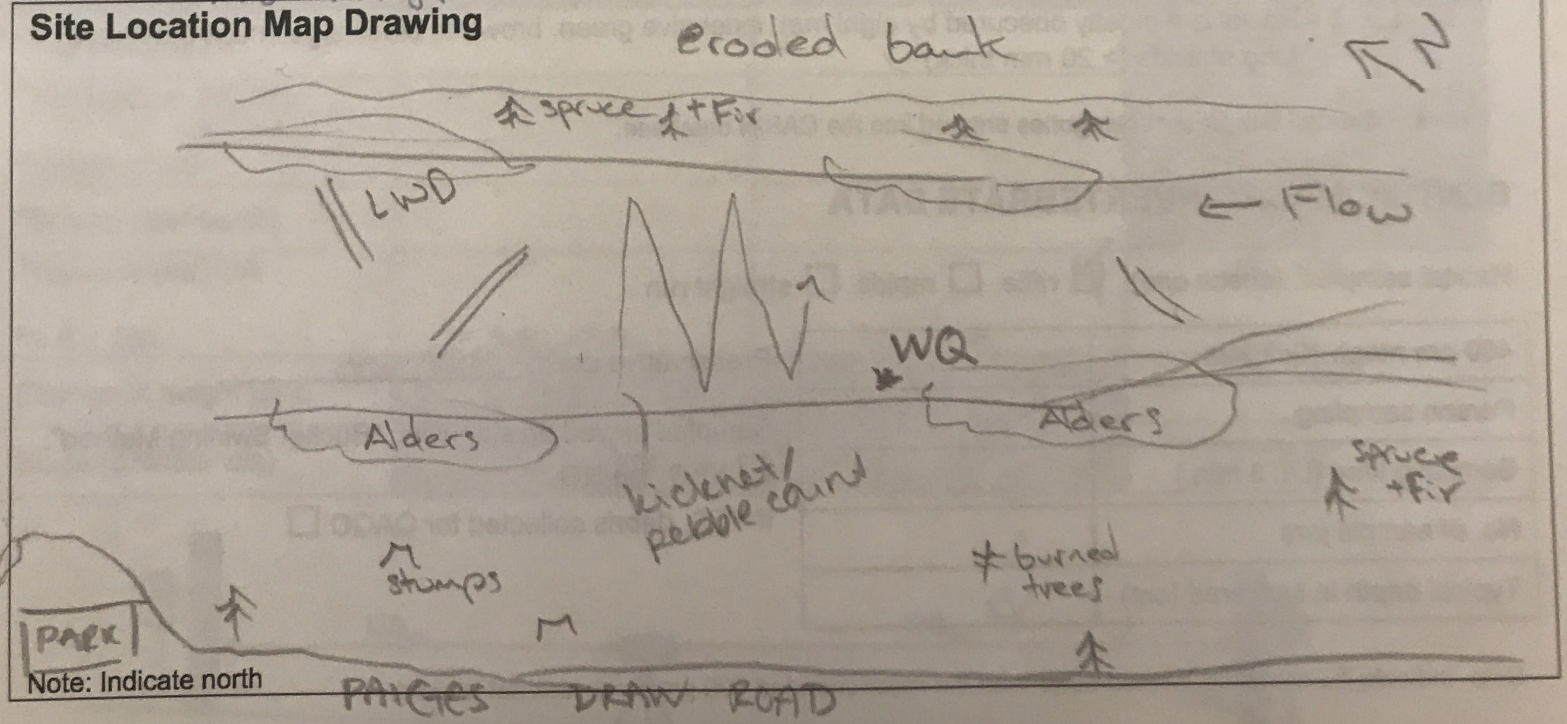
Location Data

Latitude: 49.457[illegible] N Longitude: - 114.88018[illegible] W (DMS or DD)

Elevation: 5702 (fasl or masl) GPS Datum: ☒ GRS80 (NAD83/WGS84) ☐ Other: _____

1737 masl

Site Location Map Drawing



Note: Indicate north

Field Crew: _____

Sampling Date: (DD/MM/YYYY) 06/10/2021

Photos

☒ Field Sheet ☒ Upstream ☒ Downstream ☐ Across Site ☒ Aerial View

☒ Substrate (exposed) ☐ Substrate (aquatic) ☐ Other _____

REACH DATA *(represents 6 times bankfull width)*

1. Habitat Types: *(check those present)*

☒ Riffle ☐ Rapids ☐ Straight run ☐ Pool/Back Eddy

2. Canopy Coverage: *(stand in middle of stream and look up, check one)*

☐ 0 % ☒ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

3. Macrophyte Coverage: *(not algae or moss, check one)*

☒ 0 % ☐ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

4. Streamside Vegetation: (*check those present)*

☒ ferns/grasses ☒ shrubs ☐ deciduous trees ☒ coniferous trees

5. Dominant Streamside Vegetation: *(check one)*

☐ ferns/grasses ☒ shrubs ☐ deciduous trees ☐ coniferous trees

6. Periphyton Coverage on Substrate: *(benthic algae, not moss, check one)*

☐ **1** - Rocks are not slippery, no obvious colour (thin layer < 0.5 mm thick)

☐ **2** - Rocks are slightly slippery, yellow-brown to light green colour (0.5-1 mm thick)

☒ **3** - Rocks have a noticeable slippery feel (footing is slippery), with patches of thicker green to brown algae (1-5 mm thick)

☐ **4** - Rocks are very slippery (algae can be removed with thumbnail), numerous large clumps of green to dark brown algae (5 mm -20 mm thick)

☐ **5** - Rocks are mostly obscured by algal mat, extensive green, brown to black algal mass may have long strands (> 20 mm thick)

Note: 1 through 5 represent categories entered into the CABIN database.

BENTHIC MACROINVERTEBRATE DATA

Habitat sampled: (*check one*) ☒ riffle ☐ rapids ☐ straight run

400 µm mesh Kick Net	
Person sampling	KM
Sampling time (i.e. 3 min.)	3min
No. of sample jars	1
Typical depth in kick area (cm)	10

Preservative used: 99% ISO

Sampled sieved on site using "Bucket Swirling Method":

☐ YES ☒ NO

If YES, debris collected for QAQC ☐

Note: Indicate if a sampling method other than the recommended 400 µm mesh kick net is used.

eld Crew: KM + EM Site Code: COL03

Sampling Date: (DD/MM/YYYY) 05/10/2021

WATER CHEMISTRY DATA Time: 09:00 (24 hr clock) Time zone: AT

Air Temp: 6 (°C) Water Temp: 4.1 (°C) pH: 7.57

Specific Conductance: 42.9 (µs/cm) DO: 10.65 (mg/L) Turbidity: -1.14 (NTU) (0)

ORP: 147.0 mV
Cond: 25.8 µS/cm

Check if water samples were collected for the following analyses:

- ☒ TSS (Total Suspended Solids)
- ☒ Nitrogen (i.e. Total, Nitrate, Nitrite, Dissolved, and/or Ammonia)
- ☒ Phosphorus (Total, Ortho, and/or Dissolved)
- ☒ Major Ions (i.e. Alkalinity, Hardness, Chloride, and/or Sulphate)
- ☒ Other EPH

Note: Determining alkalinity is recommended, as are other analyses, but not required for CABIN assessments.

CHANNEL DATA

Slope - Indicate how slope was measured: (check one)

☐ **Calculated from map**

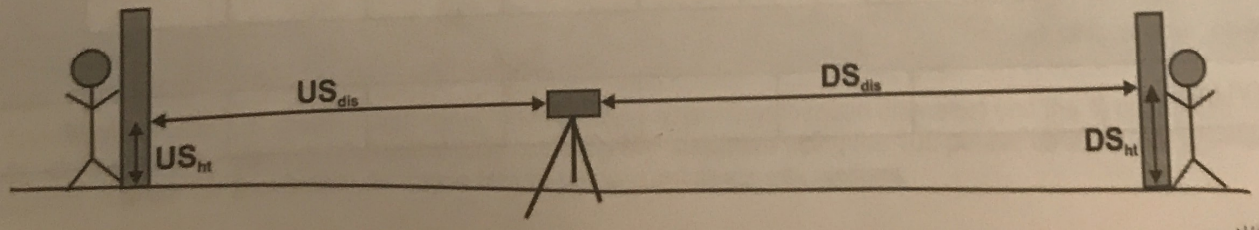
Scale: _____ (Note: small scale map recommended if field measurement is not possible - i.e. 1:20,000).
contour interval (vertical distance) _____ (m),
distance between contour intervals (horizontal distance) _____ (m)
slope = vertical distance/horizontal distance = _____

OR

☒ **Measured in field**

Circle device used and fill out table according to device:
a. Survey Equipment b. Hand Level & Measuring Tape (prev. year)

Measurements	Upstream (U/S)	Downstream(D/S)	Calculation
[a]Top Hairline (T)			
[a]Mid Hairline (ht) OR [b]Height of rod			
[a]Bottom Hairline (B)			
[b]Distance (dis) OR [a]T-B x 100	[a]US_{dis}=T-B	[a]DS_{dis}=T-B	$US_{dis}+DS_{dis}$=
Change in height (Δht)			$DS_{ht}-US_{ht}$=
Slope (Δht/total dis)			0.048



Field Crew: FM + KM

Sampling Date: (DD/MM/YYYY) 06/10/2021

Widths and Depth

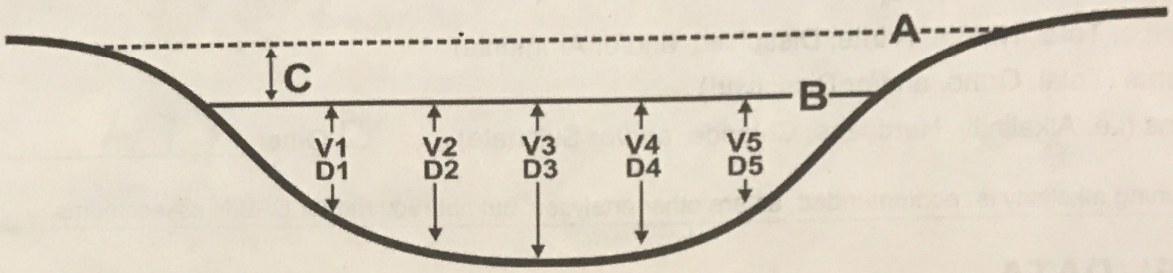
*look @ flow data

Location at site: _____ (Indicate where in sample reach, ex. d/s of kick area)

A - Bankfull Width: 4.6 (m)

B - Wetted Stream Width: 2.46 (m)

C - Bankfull–Wetted Depth (height from water surface to Bankfull): 15 (cm)



Note:
Wetted widths > 5 m, measure a minimum of 5-6 equidistant locations;
Wetted widths < 5 m, measure 3-4 equidistant locations.

Velocity and Depth

* see attached

Check appropriate velocity measuring device and fill out the appropriate section in chart below. Distance from shore and depth are required regardless of method:

☐ **Velocity Head Rod (or ruler)**: Velocity Equation (m/s) = √ [2(ΔD/100) * 9.81]

☐ **Rotary meters**: Gurley/Price/Mini-Price/Propeller (Refer to specific meter conversion chart for calculation)

☑ **Direct velocity measurements**: ☐ Marsh-McBirney ☐ Sontek or ☐ Other_____

	1	2	3	4	5	6	AVG
Distance from Shore (m)							
Depth (**D**) (cm)							
Velocity Head Rod (ruler)							
Flowing water Depth (D_1) (cm)							
Depth of Stagnation (D_2) (cm)							
Change in depth ($\Delta D=D_2-D_1$) (cm)							
Rotary meter							
Revolutions							
Time (minimum 40 seconds)							
Direct Measurement or calculation							
Velocity (**V**) (m/s)							

Field Crew: KM + EM Site Code: COL03

Sampling Date: (DD/MM/YYYY) 05/10/202

SUBSTRATE DATA

Surrounding/Interstitial Material

Circle the substrate size category for the surrounding material.

Substrate Size Class	Category
Organic Cover	0
< 0.1 cm (fine sand, silt or clay)	1
0.1-0.2 cm (coarse sand)	2
0.2-1.6 cm (gravel)	3
1.6-3.2 cm (small pebble)	4
3.2-6.4 cm (large pebble)	5
6.4-12.8 cm (small cobble)	6
12.8-25.6 cm (cobble)	7
> 25.6 cm (boulder)	8
Bedrock	9

100 Pebble Count & Substrate Embeddedness

- Measure the intermediate axis (100 rocks) and embeddedness (10 rocks) of substrate in the stream bed.
- Indicate B for bedrock, S for sand/silt/clay (particles < 0.2 cm) and O for organic material.
- Embeddedness categories (E): Completely embedded = 1, 3/4 embedded, 1/2 embedded, 1/4 embedded, unembedded = 0

	Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E
1	1.4		26	12.0		51	37.3		76	2.3	
2	14.2		27	5.2		52	3.6		77	5.2	
3	9.3		28	11.8		53	9.1		78	6.3	
4	19.3		29	28.0		54	11.2		79	7.4	
5	37.0		30	12.5	1/4	55	11.9		80	8.1	1/4
6	29.0		31	21.6		56	8.5		81	3.4	
7	36.9		32	7.9		57	3.4		82	1.6	
8	3.9		33	16.1		58	1.4		83	26.5	
9	7.3		34	26.5		59	4.9		84	21.0	
10	14.4	O	35	9.5		60	13.1		85	2.8	
11	7.6		36	7.5		61	3.2	1/2	86	2.7	
12	10.5		37	7.1		62	3.5		87	5.6	
13	3.4		38	7.4		63	20		88	5.0	
14	2.2		39	6.6		64	2.1		89	22.9	
15	130		40	9.8	O	65	2.6		90	50.0	3/4
16	11.0		41	1.7		66	3.9		91	3.9	
17	4.2		42	2.1		67	6.9		92	6.6	
18	7.6		43	19.8		68	18.6		93	9.1	
19	11.2		44	7.8		69	5.6		94	3.5	
20	2.8	O	45	9.4		70	1.4	O	95	11.2	
21	15.2		46	4.4		71	21.5		96	5.1	
22	12.8		47	2.2		72	14.2		97	8.6	
23	9.9		48	16.8		73	7.6		98	4.8	
24	8.6		49	29.2		74	3.4		99	4.4	
25	2.8		50	10.8	3/4	75	4.0		100	14.5	1/2

Note: The Wolman D50 (i.e. median diameter), Wolman Dg (i.e. geometric mean diameter) and the % composition of the substrate classes will be calculated automatically in the CABIN database using the 100 pebble data. All 100 pebbles must be measured in order for the CABIN database tool to perform substrate calculations.

Field Crew: KM + EM

Sampling Date: (DD/MM/YYYY) 06/10/2021

SITE INSPECTION

Site Inspected by: Kaileigh McCallum

Communication Information

☑ Itinerary left with contact person (include contact numbers)

Contact Person: Chad Hughes Time checked-in: 10:30

Form of communication: ☐ radio ☒ cell ☐ satellite ☐ hotel/pay phone ☐ SPOT

Phone number: (250) 423-0344

Vehicle Safety

☒ Safety equipment (first aid, fire extinguisher, blanket, emergency kit in vehicle)

☒ Equipment and chemicals safely secured for transport

☒ Vehicle parked in safe location; pylons, hazard light, reflective vests if necessary

Notes:

Shore & Wading Safety

☒ Wading Task Hazard Analysis read by all field staff

☒ Wading Safe Work Procedures read by all field staff

☒ Instream hazards identified (i.e. log jams, deep pools, slippery rocks)

☐ PFD worn

☒ Appropriate footwear, waders, wading belt

☐ Belay used

Notes:

Velocimeter Measurement Field Sheet

2.46

Site: COLOB

Date: 06/10/2021

Time: 09:30

Staff: KM + EM

Staff Gauge: _____

Wetted Width: 2.46

Bankful Width: 4.6

Instrument ID: Globo Flow Probe

Photos:
- ☑ 1. Completed Field Sheet
- ☑ 2. Upstream
- ☑ 3. Downstream
- ☑ 4. Across (from left bank if possible)

1.34

4 ✓

	Distance (m)	Depth (m)	Velocity (m/s)	Notes
1	1.3	6.8	0	
2	1.4	11.5	0	
3	1.5	12.5	0	
4	1.6	15.1	0	
5	1.7	2.5	0	
6	1.8	11.0	0	
7	1.9	7.0	0.1	
8	2.0	12.6	0.2	
9	2.1	17.3	0.2	
10	2.2	17.8	0.3	
11	2.3	14.8	0.3	
12	2.4	7.7	0.2	
13	2.5	12.6	0.1	
14	2.6	13.1	0.1	
15	2.7	6.4	0.2	

Continued from other side

16 480		50.4	0.7	
17 510		51.6	0.7	
18 540		52.1	0.7	
19 570		50.9	0.5	
20 600		41.1	0.4	
21 630		47.8	0.4	
22 660		43.0	0.5	
23 690		36.2	0.5	
24 720		30.1	0.6	
25 750		24.5	0.6	
26 780		29.0	0.3	
27 810		26.5	0.2	
28 840		16.4	0.1	
29 870		5.9	0.0	
30 900		1.5	0.0	
31 910		0	0.0	
32				
33				
34				
35				

Comments:

Sampling Date: (DD/MM/YYYY) 03/10/2021

☐ **Occupational Health & Safety: Site Inspection Sheet completed**

PRIMARY SITE DATA

CABIN Study Name: CBWQ - ELK Local Basin Name: LIZARD CREEK - ELK RIVER

River/Stream Name: LIZARD CREEK Stream Order: (map scale 1:50,000) * 3

Select one: ☑ Test Site ☐ Potential Reference Site

Geographical Description/Notes: LIZARD CRK SITE 1. ~100m UPSTREAM FROM HWY 3 LIZARD CRK BRIDGE, SET UP SITE IS RIGHT HAND SIDE OF STREAM

Surrounding Land Use: (check those present) Information Source: VISUAL - LOCAL KNOWLEDGE

☑ Forest ☑ Field/Pasture ☐ Agriculture ☑ Residential/Urban

☐ Logging ☐ Mining ☐ Commercial/Industrial ☑ Other RECREATION

Dominant Surrounding Land Use: (check one) Information Source: _____

☑ Forest ☐ Field/Pasture ☐ Agriculture ☐ Residential/Urban

☐ Logging ☐ Mining ☐ Commercial/Industrial ☐ Other _____

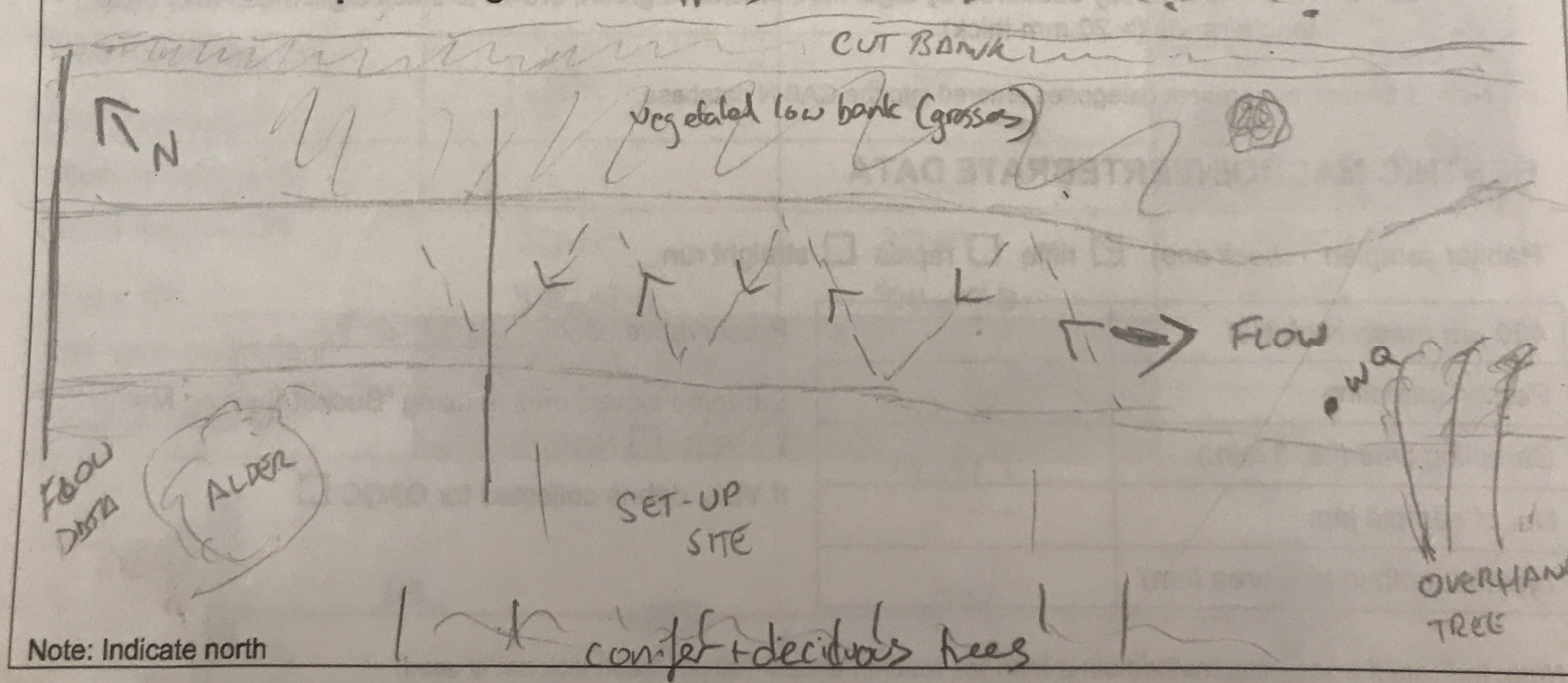
Location Data

Latitude: 49.490919 N Longitude: - 115.076780 W (DMS or DD)

Elevation: * 3259 (fasl or masl) GPS Datum: ☐ GRS80 (NAD83/WGS84) ☐ Other: _____

988 masl

Site Location Map Drawing



Note: Indicate north

Field Crew: Chad Hughes, Kaileigh McCallum, Evgeni Matveev, Chris Bush

Site Code: LR-001

Sampling Date: (DD/MM/YYYY) 03/10/2021

Photos
☐ Field Sheet ☐ Upstream ☐ Downstream ☐ Across Site ☐ Aerial View
☐ Substrate (exposed) ☐ Substrate (aquatic) ☐ Other _____

REACH DATA *(represents 6 times bankfull width)*

1. Habitat Types: *(check those present)*
☑ Riffle ☐ Rapids ☐ Straight run ☐ Pool/Back Eddy

2. Canopy Coverage: *(stand in middle of stream and look up, check one)*
☑ 0 % ☐ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

3. Macrophyte Coverage: *(not algae or moss, check one)*
☑ 0 % ☐ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

4. Streamside Vegetation: *(check those present)*
☑ ferns/grasses ☑ shrubs ☑ deciduous trees ☑ coniferous trees

5. Dominant Streamside Vegetation: *(check one)*
☑ ferns/grasses ☐ shrubs ☐ deciduous trees ☐ coniferous trees

6. Periphyton Coverage on Substrate: *(benthic algae, not moss, check one)*

☐ **1** - Rocks are not slippery, no obvious colour (thin layer < 0.5 mm thick)
☐ **2** - Rocks are slightly slippery, yellow-brown to light green colour (0.5-1 mm thick)
☑ **3** - Rocks have a noticeable slippery feel (footing is slippery), with patches of thicker green to brown algae (1-5 mm thick)
☐ **4** - Rocks are very slippery (algae can be removed with thumbnail), numerous large clumps of green to dark brown algae (5 mm -20 mm thick)
☐ **5** - Rocks are mostly obscured by algal mat, extensive green, brown to black algal mass may have long strands (> 20 mm thick)

Note: 1 through 5 represent categories entered into the CABIN database.

BENTHIC MACROINVERTEBRATE DATA

Habitat sampled: (*check one*) ☑ riffle ☐ rapids ☐ straight run

400 µm mesh Kick Net	
Person sampling	C. Bush
Sampling time (i.e. 3 min.)	3 min
No. of sample jars	←
Typical depth in kick area (cm)	40

Preservative used: ISOPROPYL

Sampled sieved on site using "Bucket Swirling Method":
☐ YES ☐ NO

If YES, debris collected for QAQC ☐

Note: Indicate if a sampling method other than the recommended 400 µm mesh kick net is used.

Site Code: [illegible]

ling Date: (DD/MM/YYYY) 03/10/2021

WATER CHEMISTRY DATA **Time:** 0930 (24 hr clock) **Time zone:** MST

Air Temp: 11.6 (°C) Water Temp: 7.2 (°C) pH: 8.12

Specific Conductance: 476.4 (µs/cm) DO: 11.24 (mg/L) Turbidity: 0.33 (NTU)

CONDUCTANCE -> (314.1)

ORP (207.2)

Check if water samples were collected for the following analyses:

- ☑ TSS (Total Suspended Solids)
- ☑ Nitrogen (i.e. Total, Nitrate, Nitrite, Dissolved, and/or Ammonia)
- ☑ Phosphorus (Total, Ortho, and/or Dissolved)
- ☑ Major Ions (i.e. Alkalinity, Hardness, Chloride, and/or Sulphate) ☑ Other E.P.H

Note: Determining alkalinity is recommended, as are other analyses, but not required for CABIN assessments.

CHANNEL DATA

Slope - Indicate how slope was measured: (check one)

☐ **Calculated from map**

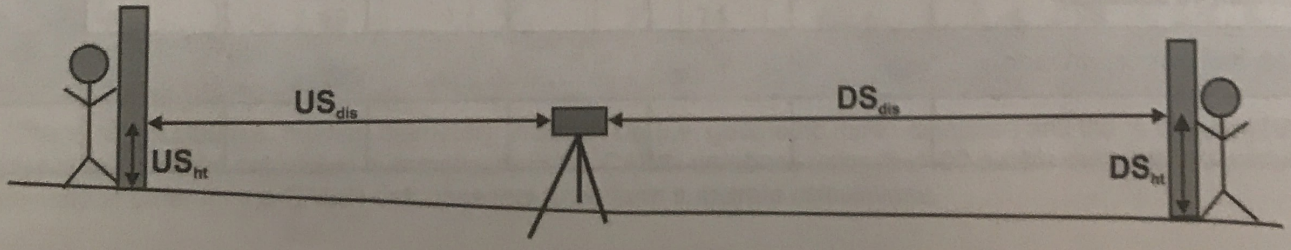
Scale: _____ (Note: small scale map recommended if field measurement is not possible - i.e. 1:20,000).
contour interval (vertical distance) _____ (m),
distance between contour intervals (horizontal distance) _____ (m)
slope = vertical distance/horizontal distance = _____

OR

☐ **Measured in field**

Circle device used and fill out table according to device:
a. Survey Equipment b. Hand Level & Measuring Tape

Measurements	Upstream (U/S)	Downstream(D/S)	Calculation
[a]Top Hairline (T)			
[a]Mid Hairline (ht) OR [b]Height of rod	1.12	2.23	
[a]Bottom Hairline (B)			
[b]Distance (dis) OR [a]T-B x 100	30m [a]US_{dis}=T-B	30m [a]DS_{dis}=T-B	$US_{dis}+DS_{dis}$= 60m
Change in height (Δht)			$DS_{ht}-US_{ht}$= 1.11
Slope (Δht/total dis)			.0185 (1.85%)



Field Crew: CH, KM, CB, EM Site Code: L2501

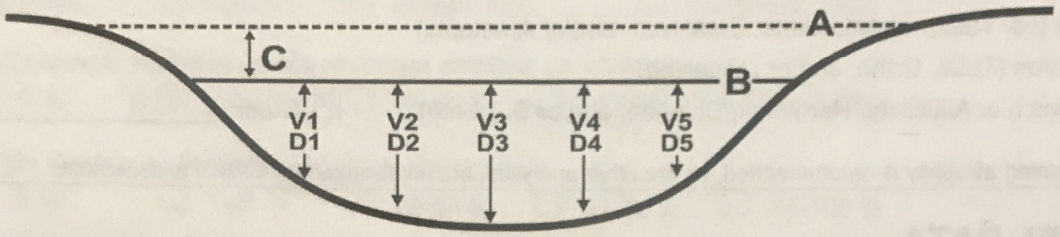
Sampling Date: (DD/MM/YYYY) 03/10/2021

Widths and Depth

Location at site: U/S of kick-net site (Indicate where in sample reach, ex. d/s of kick area)

A - Bankfull Width: 9.1 (m) B - Wetted Stream Width: 8.8 (m)

C - Bankfull–Wetted Depth (height from water surface to Bankfull): 15 (cm)



Note:
Wetted widths > 5 m, measure a minimum of 5-6 equidistant locations;
Wetted widths < 5 m, measure 3-4 equidistant locations.

Velocity and Depth

~~Ø~~ See attached flow sheet

Check appropriate velocity measuring device and fill out the appropriate section in chart below. Distance from shore and depth are required regardless of method:

☐ **Velocity Head Rod (or ruler)**: Velocity Equation (m/s) = $\sqrt{[2(\Delta D/100) * 9.81]}$

☐ **Rotary meters**: Gurley/Price/Mini-Price/Propeller (Refer to specific meter conversion chart for calculation)

☑ **Direct velocity measurements**: ☐ Marsh-McBirney ☐ Sontek or ☑ Other Global flow probe

	1	2	3	4	5	6	AVG
Distance from Shore (m)							
Depth (**D**) (cm)							
Velocity Head Rod (ruler)							
Flowing water Depth (D_1) (cm)							
Depth of Stagnation (D_2) (cm)							
Change in depth ($\Delta D=D_2-D_1$) (cm)							
Rotary meter							
Revolutions							
Time (minimum 40 seconds)							
Direct Measurement or calculation							
Velocity (**V**) (m/s)							

w: CH, ICM, CB, EM Site Code: UZ0091

ling Date: (DD/MM/YYYY) 03/10/2021

SUBSTRATE DATA

Surrounding/Interstitial Material

Circle the substrate size category for the surrounding material.

Substrate Size Class	Category
Organic Cover	0
< 0.1 cm (fine sand, silt or clay)	1
0.1-0.2 cm (coarse sand)	2
0.2-1.6 cm (gravel)	3
1.6-3.2 cm (small pebble)	4
3.2-6.4 cm (large pebble)	5
6.4-12.8 cm (small cobble)	6
12.8-25.6 cm (cobble)	7
> 25.6 cm (boulder)	8
Bedrock	9

100 Pebble Count & Substrate Embeddedness

- Measure the intermediate axis (100 rocks) and embeddedness (10 rocks) of substrate in the stream bed.
- Indicate B for bedrock, S for sand/silt/clay (particles < 0.2 cm) and O for organic material.
- Embededness categories (E): Completely embedded = 1, 3/4 embedded, 1/2 embedded, 1/4 embedded, unembedded = 0

	Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E
1	24.5	X	26	44.2	X	51	5.4	X	76	15.0	X
2	6.0	X	27	24.5	X	52	23.3	X	77	14.2	X
3	6.5	X	28	8.5	X	53	20.2	X	78	1.6	X
4	29.0	X	29	11.4	X	54	10.4	X	79	7.8	X
5	23.8	X	30	9.3	O	55	11.1	X	80	15.1	75%
6	24.0	X	31	19.0	X	56	10.2	X	81	8.0	X
7	9.5	X	32	9.8	X	57	3.3	X	82	12.4	X
8	3.8	X	33	12.6	X	58	5.0	X	83	12.6	X
9	6.5	X	34	7.5	X	59	19.6	X	84	4.9	X
10	13.5	25%	35	6.7	X	60	11.4	25%	85	11.3	X
11	6.8	X	36	7.7	X	61	6.5	X	86	6.3	X
12	10.5	X	37	9.3	X	62	9.5	X	87	11.0	X
13	11.5	X	38	13.5	X	63	28.2	X	88	10.0	X
14	9.5	X	39	16.5	X	64	2.8	X	89	8.8	X
15	13.0	X	40	9.5	.25	65	27.1	X	90	12.5	75%
16	12.2	X	41	7.0	X	66	19.8	X	91	12.9	X
17	8.5	X	42	7.5	X	67	S	X	92	5.6	X
18	12.0	X	43	7.4	X	68	69.1	X	93	13.2	X
19	14.3	X	44	4.4	X	69	26	X	94	38.4	X
20	7.7	O	45	45.3	X	70	1.1	O	95	12.5	X
21	5.0	X	46	10.7	X	71	36.3	X	96	19.9	X
22	8.3	X	47	8.4	X	72	5.4	X	97	8.7	X
23	12.4	X	48	14.0	X	73	30.0	X	98	2.5	X
24	8.4	X	49	11.8	X	74	12.2	X	99	25.6	X
25	8.9	X	50	18.5	50%	75	5.6	X	100	2.0	O

Note: The Wolman D50 (i.e. median diameter), Wolman Dg (i.e. geometric mean diameter) and the % composition of the substrate classes will be calculated automatically in the CABIN database using the 100 pebble data. All 100 pebbles must be measured in order for the CABIN database tool to perform substrate calculations.

Field Crew: CH, KM, CB, EM

Sampling Date: (DD/MM/YYYY) 03/10/2021

SITE INSPECTION

Site Inspected by: K. McCallum

Communication Information

☐ Itinerary left with contact person (include contact numbers) N/A. - 4 people on site + in town.

Contact Person: _____ Time checked-in: _____

Form of communication: ☑ radio ☑ cell ☐ satellite ☐ hotel/pay phone ☐ SPOT

Phone number: ( ) _____

Vehicle Safety

☑ Safety equipment (first aid, fire extinguisher, blanket, emergency kit in vehicle)

☑ Equipment and chemicals safely secured for transport

☑ Vehicle parked in safe location; pylons, hazard light, reflective vests if necessary

Notes:

Shore & Wading Safety

☑ Wading Task Hazard Analysis read by all field staff

☑ Wading Safe Work Procedures read by all field staff

☑ Instream hazards identified (i.e. log jams, deep pools, slippery rocks)

☑ PFD worn

☑ Appropriate footwear, waders, wading belt

☐ Belay used

Notes:

Site: LIZ-001

Date: 2021/10/3

Time: 1200

Staff: CHAD HUGHES, KAILEIGH MCCALLUM, EUGENI MARKEEV

Staff Gauge: ✓

Wetted Width: 9.1

Bankful Width: 8.80

Instrument ID: Global Flow probe

Photos:
- ☐ 1. Completed Field Sheet
- ☑ 2. Upstream
- ☐ 3. Downstream
- ☑ 4. Across (from left bank if possible)

	Distance (m)	Depth (m)	Velocity (m/s)	Notes
1	2.05 ~~2.30~~	0.15	0	@Bank
2	2.40	0.87	0.4	
3	2.75	0.193	0.1	
4	3.10	0.178	0.2	
5	3.45	0.224	0.2	
6	3.80	0.219	0.2	
7	4.15	0.257	0.2	
8	4.50	0.264	0.2	
9	4.85	0.171	0.3	
10	5.20	0.238	0.4	
11	5.55	0.225	0.4	
12	5.90	0.212	0.4	
13	6.25	0.231	0.4	
14	6.60	0.260	0.4	
15	6.95	0.235	0.3	

Continued from other side

16	11.6	0.119	0.1	
17	12.1	0.126	0.3	
18	12.6	0.172	0.1	
19	13.1	0.188	0.2	
20	13.6	0.191	0.1	
21	14.1	0.27	0.1	
22	14.6	0.223	0.3	
23	15.1	0.250	0.2	
24	15.6	0.140	0.4	
25	16.1	0.135	0.2	
26	16.6	0.150	0.4	
27	17.0	0	0.0	
28				
29				
30				
31				
32				
33				
34				
35				

Comments:

Field Crew: [illegible] Site Code: [illegible]

Sampling Date: (DD/MM/YYYY) 03/10/2021

☑ **Occupational Health & Safety: Site Inspection Sheet completed**

PRIMARY SITE DATA

CABIN Study Name: CBWQ-ELK Local Basin Name: LIZARD/ELK

River/Stream Name: LIZARD CREEK Stream Order: (map scale 1:50,000) ~3

Select one: ☑ Test Site ☐ Potential Reference Site

Geographical Description/Notes:

PARK @ EAST END IN VISITOR ~~CENTRE~~/DAY PARKING, WALK UP STREAM ALONG TRAIL SITE ON LEFT, DOWNSTREAM OF BANK RESTORATION. # ~~KOOT~~ BRIDGE

Surrounding Land Use: (check those present) Information Source: LOCAL / VISUAL

☑ Forest ☐ Field/Pasture ☐ Agriculture ☐ Residential/Urban

☐ Logging ☐ Mining ☐ Commercial/Industrial ☑ Other RECREATION

Dominant Surrounding Land Use: (check one) Information Source: _____

☑ Forest ☐ Field/Pasture ☐ Agriculture ☐ Residential/Urban

☐ Logging ☐ Mining ☐ Commercial/Industrial ☐ Other _____

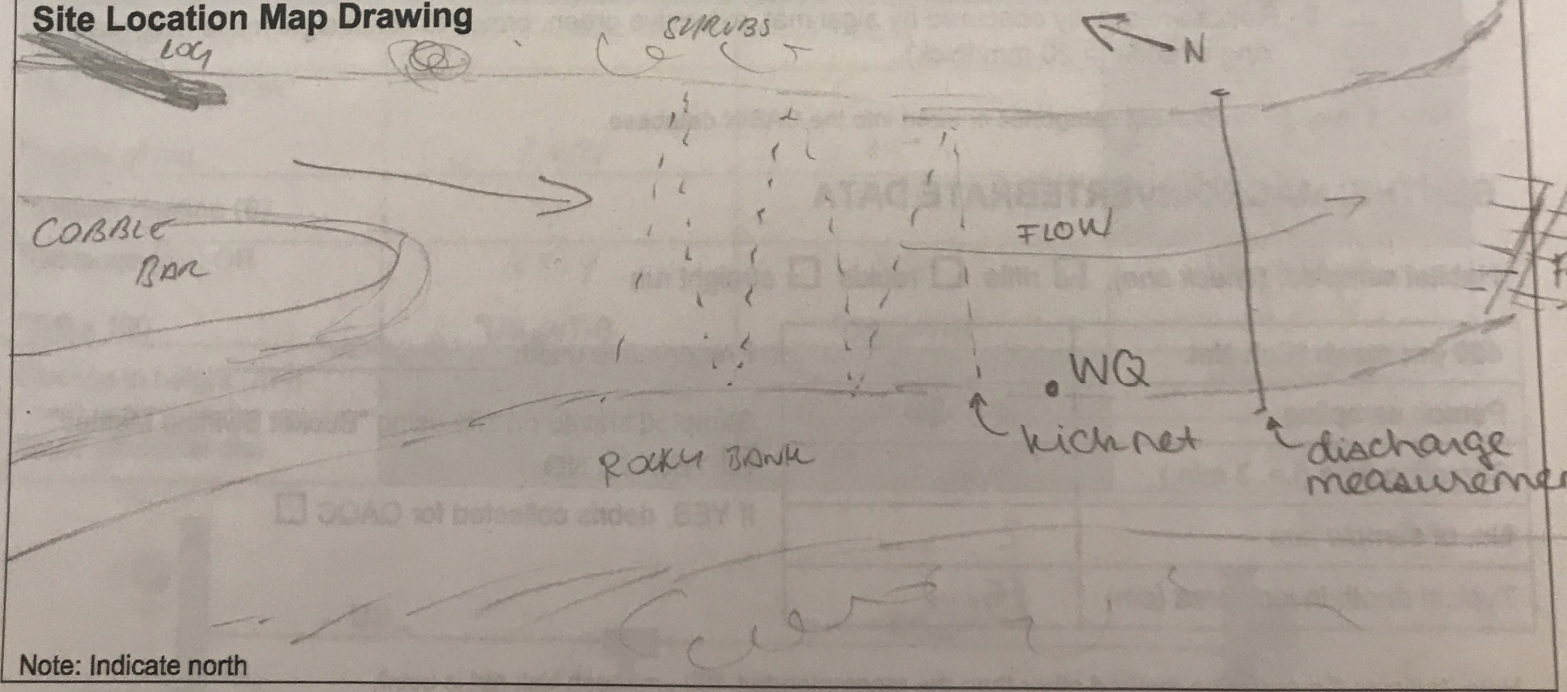
Location Data

Latitude: 49 48 56.76 N Longitude: - 115 09 44.81 W (DMS or DD)

Elevation: 3356 (fasl or masl) GPS Datum: ☐ GRS80 (NAD83/WGS84) ☐ Other: _____

1022 masl

Site Location Map Drawing



Note: Indicate north

Field Crew: C. [illegible], K. M'Callum, E. Matveev, C. Bush

Site Code: U2-003

Sampling Date: (DD/MM/YYYY) 03/10/2021

Photos

- ☐ Field Sheet ☐ Upstream ☐ Downstream ☐ Across Site ☐ Aerial View
- ☐ Substrate (exposed) ☐ Substrate (aquatic) ☐ Other ______

REACH DATA *(represents 6 times bankfull width)*

1. Habitat Types: *(check those present)*
   ☑ Riffle ☐ Rapids ☐ Straight run ☐ Pool/Back Eddy

2. Canopy Coverage: *(stand in middle of stream and look up, check one)*
   ☑ 0 % ☐ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

3. Macrophyte Coverage: *(not algae or moss, check one)*
   ☑ 0 % ☐ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

4. Streamside Vegetation: *(check those present)*
   ☑ ferns/grasses ☑ shrubs ☑ deciduous trees ☑ coniferous trees

5. Dominant Streamside Vegetation: *(check one)*
   ☐ ferns/grasses ☑ shrubs ☐ deciduous trees ☐ coniferous trees

6. Periphyton Coverage on Substrate: *(benthic algae, not moss, check one)*

   ☐ 1 - Rocks are not slippery, no obvious colour (thin layer < 0.5 mm thick)
   ☑ 2 - Rocks are slightly slippery, yellow-brown to light green colour (0.5-1 mm thick)
   ☐ 3 - Rocks have a noticeable slippery feel (footing is slippery), with patches of thicker green to brown algae (1-5 mm thick)
   ☐ 4 - Rocks are very slippery (algae can be removed with thumbnail), numerous large clumps of green to dark brown algae (5 mm -20 mm thick)
   ☐ 5 - Rocks are mostly obscured by algal mat, extensive green, brown to black algal mass may have long strands (> 20 mm thick)

Note: 1 through 5 represent categories entered into the CABIN database.

BENTHIC MACROINVERTEBRATE DATA

Habitat sampled: (*check one*) ☑ riffle ☐ rapids ☐ straight run

400 µm mesh Kick Net	
Person sampling	CHRIS BUSH
Sampling time (i.e. 3 min.)	3 mins
No. of sample jars	2
Typical depth in kick area (cm)	15cm

Preservative used: ISO-PROP

Sampled sieved on site using "Bucket Swirling Method":
☐ YES ☑ NO

If YES, debris collected for QAQC ☐

Note: Indicate if a sampling method other than the recommended 400 µm mesh kick net is used.

Field Crew: [illegible] Site Code: LL2-003

Sampling Date: (DD/MM/YYYY) 03/10/2021

WATER CHEMISTRY DATA

Time: 1330 (24 hr clock) Time zone: MST

Air Temp: 11 (°C) Water Temp: 8.3 (°C) pH: 8.25

Specific Conductance: 478.4 (µs/cm) 325.6 (ACTUAL) DO: 10.77 (mg/L) Turbidity: -0.69 (NTU) 187.4 (ORP)

Check if water samples were collected for the following analyses:

- ☐ TSS (Total Suspended Solids)
- ☐ Nitrogen (i.e. Total, Nitrate, Nitrite, Dissolved, and/or Ammonia)
- ☐ Phosphorus (Total, Ortho, and/or Dissolved)
- ☐ Major Ions (i.e. Alkalinity, Hardness, Chloride, and/or Sulphate)
- ☑ Other METALS, EPH

Note: Determining alkalinity is recommended, as are other analyses, but not required for CABIN assessments.

CHANNEL DATA

Slope - Indicate how slope was measured: (check one)

☐ **Calculated from map**

Scale: _____ (Note: small scale map recommended if field measurement is not possible - i.e. 1:20,000).

contour interval (vertical distance) _____ (m),

distance between contour intervals (horizontal distance) _____ (m)

slope = vertical distance/horizontal distance = _____

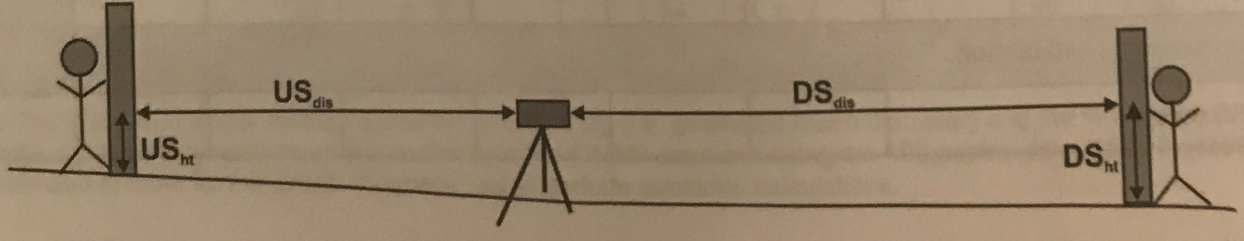
OR

☐ **Measured in field**

Circle device used and fill out table according to device:

a. Survey Equipment b. Hand Level & Measuring Tape

Measurements	Upstream (U/S)	Downstream(D/S)	Calculation
[a]Top Hairline (T)			
[a]Mid Hairline (ht) OR [b]Height of rod	1.40	1.85	0.45
[a]Bottom Hairline (B)			
[b]Distance (dis) OR [a]T-B x 100	28.4 [a]US_{dis}=T-B	30 [a]DS_{dis}=T-B	$US_{dis}+DS_{dis}$= 58.4
Change in height (Δht)			$DS_{ht}-US_{ht}$= 0.45
Slope (Δht/total dis)			0.0077 0.77%



Field Crew: CH, VM, CB, EV

Site Code: LIZ003

Sampling Date: (DD/MM/YYYY) 03/10/2021

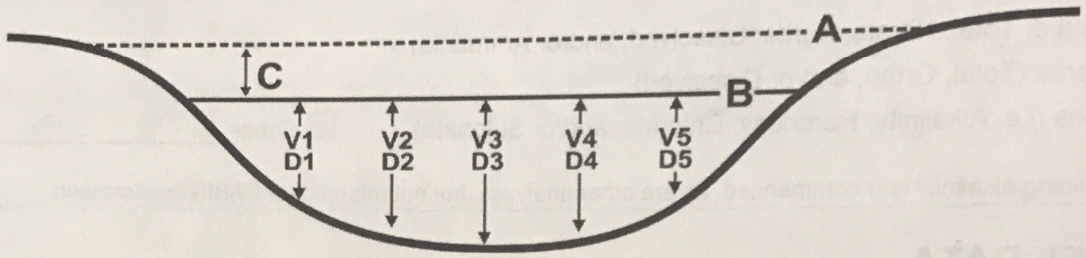
Widths and Depth

Location at site: 15m downstream of kicknet (Indicate where in sample reach, ex. d/s of kick area)

A - Bankfull Width: 7 (m)

B - Wetted Stream Width: 4.65 (m)

C - Bankfull–Wetted Depth (height from water surface to Bankfull): 9cm (cm)



Note:
Wetted widths > 5 m, measure a minimum of 5-6 equidistant locations;
Wetted widths < 5 m, measure 3-4 equidistant locations.

Velocity and Depth

Check appropriate velocity measuring device and fill out the appropriate section in chart below. Distance from shore and depth are required regardless of method:

☐ **Velocity Head Rod (or ruler)**: Velocity Equation (m/s) = $\sqrt{[\ 2(\Delta D/100) * 9.81]}$

☐ **Rotary meters**: Gurley/Price/Mini-Price/Propeller (Refer to specific meter conversion chart for calculation)

☐ **Direct velocity measurements:** ☐ Marsh-McBirney ☐ Sontek or ☒ Other Global Water

	1	2	3	4	5	6	AVG
Distance from Shore (m)							
Depth (**D**) (cm)							
Velocity Head Rod (ruler)							
Flowing water Depth (D_1) (cm)							
Depth of Stagnation (D_2) (cm)							
Change in depth ($\Delta D=D_2-D_1$) (cm)							
Rotary meter							
Revolutions							
Time (minimum 40 seconds)							
Direct Measurement or calculation							
Velocity (**V**) (m/s)							

SEE VOLUME SHEET

Crew: CH, KM, CB, EV

Site Code: LIZ003

Sampling Date: (DD/MM/YYYY) 03/10/2021

SUBSTRATE DATA

Surrounding/Interstitial Material

Circle the substrate size category for the surrounding material.

Substrate Size Class	Category
Organic Cover	0
< 0.1 cm (fine sand, silt or clay)	1
0.1-0.2 cm (coarse sand)	2
0.2-1.6 cm (gravel)	3
1.6-3.2 cm (small pebble)	4
3.2-6.4 cm (large pebble)	5
6.4-12.8 cm (small cobble)	6
12.8-25.6 cm (cobble)	7
> 25.6 cm (boulder)	8
Bedrock	9

30 m
1.89
28.9
1.40

100 Pebble Count & Substrate Embeddedness

- Measure the intermediate axis (100 rocks) and embeddedness (10 rocks) of substrate in the stream bed.
- Indicate B for bedrock, S for sand/silt/clay (particles < 0.2 cm) and O for organic material.
- Embededness categories (E): Completely embedded = 1, 3/4 embedded, 1/2 embedded, 1/4 embedded, unembedded = 0

	Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E
1	2.0	x	26	4.1	✓	51	1.6	✓	76	4.1	✓
2	3.1	x	27	1.4	✓	52	6.8	✓	77	7.5	✓
3	6.3	x	28	1.9	✓	53	4.2	✓	78	1.7	✓
4	7.4	x	29	4	✓	54	2.4	✓	79	5.7	✓
5	1.6	x	30	3.1	25%	55	2.8	✓	80	18.5	75%
6	5.2	x	31	6.8	✓	56	1.6	✓	81	2.4	✓
7	3.4	x	32	3.7	✓	57	1.4	✓	82	7.5	✓
8	1.6	x	33	4.5	✓	58	1.6	✓	83	5.3	✓
9	6.7	x	34	2.9	✓	59	5.9	✓	84	3.9	✓
10	9.5	O	35	5.4	✓	60	9.1	0.75	85	3.8	✓
11	4.2	x	36	11.3	✓	61	5.5	✓	86	10.4	✓
12	8.2	x	37	3.7	✓	62	5.1	✓	87	4.0	✓
13	7.1	x	38	8.8	✓	63	0.9	✓	88	5.0	✓
14	9.1	x	39	6.4	✓	64	2	✓	89	0.6	✓
15	1.5	x	40	6.8	25%	65	5.2	✓	90	4.1	O
16	1.4	x	41	4.7	✓	66	5.1	✓	91	3.7	✓
17	1.5	✓	42	7.9	✓	67	7.8	✓	92	4.2	✓
18	6.2	✓	43	5.4	✓	68	11.1	✓	93	3.4	✓
19	6.6	✓	44	3.7	✓	69	3.2	✓	94	5.5	✓
20	6	O	45	3.2	✓	70	19.6	25%	95	3.3	✓
21	5.6	✓	46	2.8	✓	71	6.1	✓	96	2.4	✓
22	4.8	✓	47	9.9	✓	72	3.7	✓	97	2.8	✓
23	4.3	✓	48	9.1	✓	73	5	✓	98	6.1	✓
24	3.5	✓	49	5.9	✓	74	3.4	✓	99	2.6	✓
25	5.1	✓	50	5.1	O	75	6.2	✓	100	5.6	O

Note: The Wolman D50 (i.e. median diameter), Wolman Dg (i.e. geometric mean diameter) and the % composition of the substrate classes will be calculated automatically in the CABIN database using the 100 pebble data. All 100 pebbles must be measured in order for the CABIN database tool to perform substrate calculations.

Field Crew: CH, KM, CB, EV Site Code: [illegible]

Sampling Date: (DD/MM/YYYY) 03/10/2021

SITE INSPECTION

Site Inspected by: KM, CH, CB, EV

Communication Information

☑ Itinerary left with contact person (include contact numbers)

Contact Person: _____ Time checked-in: _____

Form of communication: ☐ radio ☐ cell ☐ satellite ☐ hotel/pay phone ☐ SPOT

Phone number: ( ) _____

Vehicle Safety

☑ Safety equipment (first aid, fire extinguisher, blanket, emergency kit in vehicle)

☑ Equipment and chemicals safely secured for transport

☑ Vehicle parked in safe location; pylons, hazard light, reflective vests if necessary

Notes:

Shore & Wading Safety

☑ Wading Task Hazard Analysis read by all field staff

☑ Wading Safe Work Procedures read by all field staff

☑ Instream hazards identified (i.e. log jams, deep pools, slippery rocks)

☐ PFD worn

☑ Appropriate footwear, waders, wading belt

☐ Belay used

Notes:

neter Measurement Field Sheet

Site: LIZ-003

Date: 2021 10 03

Time: [redacted] 1330

Staff: Evgeni & Chad

Staff Gauge: ——

Wetted Width: ~~4~~ 4.65 m

Bankful Width: ~~90cm~~ 7 m

Instrument ID: Global water

Photos:
- ☐ 1. Completed Field Sheet
- ☐ 2. Upstream
- ☐ 3. Downstream
- ☐ 4. Across (from left bank if possible)

	Distance (m)	Depth (m)	Velocity (m/s)	Notes
1	1.15	0.15	0.04	0	
2	1.30	0.30	0,068	0	
3	1.45	0.45	0.065	0.2	
4	2.0	0.6	0.092	0,3	
5	2.5	0.75	0.129	0.3	
6		0.9	0.129	0.3	
7		1.05	0.133	0.3	
8		1.2	0.160	0.4	
9		1.35	0.196	0.4	
10		1.5	0.232	0.4	
11		1.65	0.18	0.4	
12		1.80	0.221	0.2	
13		1.95	0.232	0.5	
14		2.10	0.233	0.5	
15		2.25	0.235	0.5	

Continued from other side

16	2.40	0.317	0.5	
17	2.55	0.326	0.5	
18	2.7	0.362	0.5	
19	2.85	0.353	0.5	
20	3.0	0.320	0.6	
21	3.15	0.285	0.5	
22	3.30	0.215	0.5	
23	3.45	0.257	0.5	
24	3.60	0.233	0.5	
25	3.75	0.20	0.4	
26	3.90	0.144	0.4	
27	4.05	0.145	0.4	
28	4.20	0.11	0.3	
29	4.35	0.101	0.2	
30	4.5	0.090	0.2	
31	4.65	0.000	0	
32				
33				
34				
35				

Comments:

Field Crew: Raleigh McCall, Eugeni Matveev Site Code: MORO01

Sampling Date: (DD/MM/YYYY) 04/10/2021

☒ **Occupational Health & Safety: Site Inspection Sheet completed**

PRIMARY SITE DATA

CABIN Study Name: CBWM Local Basin Name: Elk River

River/Stream Name: Morrissey Stream Order: (map scale 1:50,000) _____

Select one: ☒ Test Site ☐ Potential Reference Site

Geographical Description/Notes: Take Morrissey Forest Service Rd to Lodgepole, turn right onto unnamed logging rd just before bridge over Morrissey cr. Drive to railway x, park, walk d/s 50 m to site

Surrounding Land Use: (check those present) Information Source: visual, maps

☒ Forest ☐ Field/Pasture ☐ Agriculture ☐ Residential/Urban
☒ Logging ☐ Mining ☐ Commercial/Industrial ☒ Other hunting

Dominant Surrounding Land Use: (check one) Information Source: visual

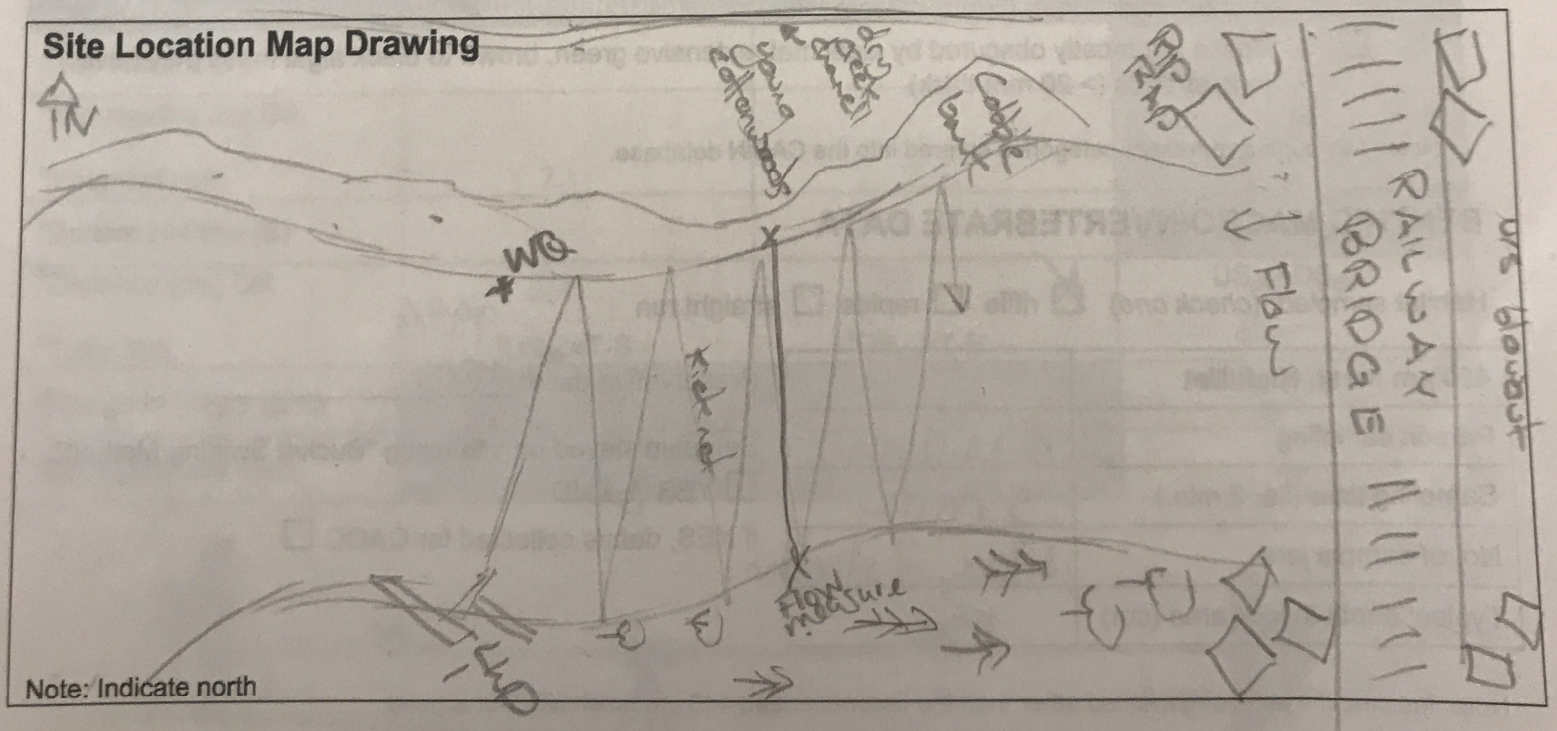
☒ Forest ☐ Field/Pasture ☐ Agriculture ☐ Residential/Urban
☐ Logging ☐ Mining ☐ Commercial/Industrial ☐ Other _____

Location Data

Latitude: 4935806 N Longitude: - 115.00088 W (DMS or DD)

Elevation: 941.63 (fasl *or* masl) GPS Datum: ☒ GRS80 (NAD83/WGS84) ☐ Other: _____

Site Location Map Drawing



Note: Indicate north

Field Crew: Kaileigh McCall, Evgeni Matveev Site Code: MoRot

Sampling Date: (DD/MM/YYYY) 04/10/2021

Photos
☑ Field Sheet ☑ Upstream ☑ Downstream ☑ Across Site ☐ Aerial View
☑ Substrate (exposed) ☐ Substrate (aquatic) ☐ Other _____

REACH DATA *(represents 6 times bankfull width)*

1. Habitat Types: *(check those present)*
☒ Riffle ☐ Rapids ☐ Straight run ☐ Pool/Back Eddy

2. Canopy Coverage: *(stand in middle of stream and look up, check one)*
☐ 0 % ☒ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

3. Macrophyte Coverage: *(not algae or moss, check one)*
☐ 0 % ☒ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

4. Streamside Vegetation: (*check those present)*
☒ ferns/grasses ☒ shrubs ☒ deciduous trees ☒ coniferous trees

5. Dominant Streamside Vegetation: *(check one)*
☐ ferns/grasses ☐ shrubs ☒ deciduous trees ☐ coniferous trees

6. Periphyton Coverage on Substrate: *(benthic algae, not moss, check one)*

☐ **1** - Rocks are not slippery, no obvious colour (thin layer < 0.5 mm thick)
☒ **2** - Rocks are slightly slippery, yellow-brown to light green colour (0.5-1 mm thick)
☐ **3** - Rocks have a noticeable slippery feel (footing is slippery), with patches of thicker green to brown algae (1-5 mm thick)
☐ **4** - Rocks are very slippery (algae can be removed with thumbnail), numerous large clumps of green to dark brown algae (5 mm -20 mm thick)
☐ **5** - Rocks are mostly obscured by algal mat, extensive green, brown to black algal mass may have long strands (> 20 mm thick)

Note: 1 through 5 represent categories entered into the CABIN database.

BENTHIC MACROINVERTEBRATE DATA

Habitat sampled: (*check one*) ☒ riffle ☐ rapids ☐ straight run 99%

400 µm mesh Kick Net	
Person sampling	B. Millions
Sampling time (i.e. 3 min.)	3 mins
No. of sample jars	1 tax, 3 stream
Typical depth in kick area (cm)	15

Preservative used: 150

Sampled sieved on site using "Bucket Swirling Method":
☐ YES ☒ NO
If YES, debris collected for QAQC ☐

Note: Indicate if a sampling method other than the recommended 400 µm mesh kick net is used.

Field Crew: Kaleigh McCall, Eugeni Matveev Site Code: MOR0001

Sampling Date: (DD/MM/YYYY) 04/10/2021

WATER CHEMISTRY DATA

Time: 12:30 (24 hr clock) **Time zone:** MT

Air Temp: 13 (°C) Water Temp: 9 (°C) pH: 7.93

Specific Conductance: 108.7 (µs/cm) DO: 10.59 (mg/L) Turbidity: -0.52 (NTU) o?

Conductance: 75.4

Check if water samples were collected for the following analyses:

ORP: 172.4

- ☒ TSS (Total Suspended Solids)
- ☒ Nitrogen (i.e. Total, Nitrate, Nitrite, Dissolved, and/or Ammonia)
- ☒ Phosphorus (Total, Ortho, and/or Dissolved)
- ☐ Major Ions (i.e. Alkalinity, Hardness, Chloride, and/or Sulphate)
- ☒ Other EP+1

Note: Determining alkalinity is recommended, as are other analyses, but not required for CABIN assessments.

CHANNEL DATA

Slope - Indicate how slope was measured: (check one)

☐ **Calculated from map**

Scale: _____ (Note: small scale map recommended if field measurement is not possible - i.e. 1:20,000).

contour interval (vertical distance) _____ (m),

distance between contour intervals (horizontal distance) _____ (m)

slope = vertical distance/horizontal distance = _____

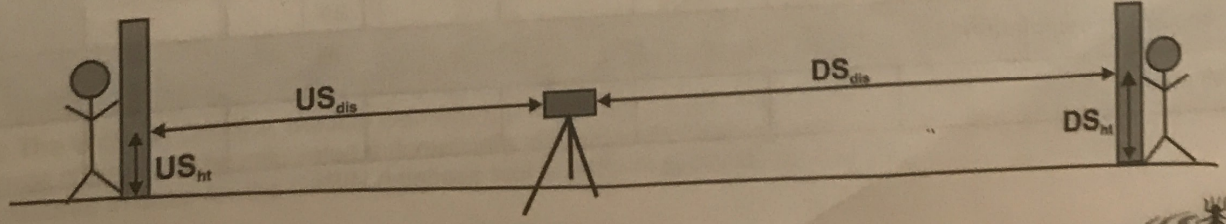
OR

☒ **Measured in field**

Circle device used and fill out table according to device:

a. Survey Equipment b. Hand Level & Measuring Tape

Measurements	Upstream (U/S)	Downstream(D/S)	Calculation
[a]Top Hairline (T)			
[a]Mid Hairline (ht) OR [b]Height of rod	1.21	2.26	
[a]Bottom Hairline (B)			
[b]Distance (dis) OR [a]T-B x 100	30 [a]US_{dis}=T-B	30 [a]DS_{dis}=T-B	$US_{dis}+DS_{dis}$= 60 m
Change in height (Δht)			$DS_{ht}-US_{ht}$= 1.05
Slope (Δht/total dis)			1.75%



Field Crew: Kaleigh McCall, Evgeni Matveev Site Code: MOR051

Sampling Date: (DD/MM/YYYY) 04/10/2021

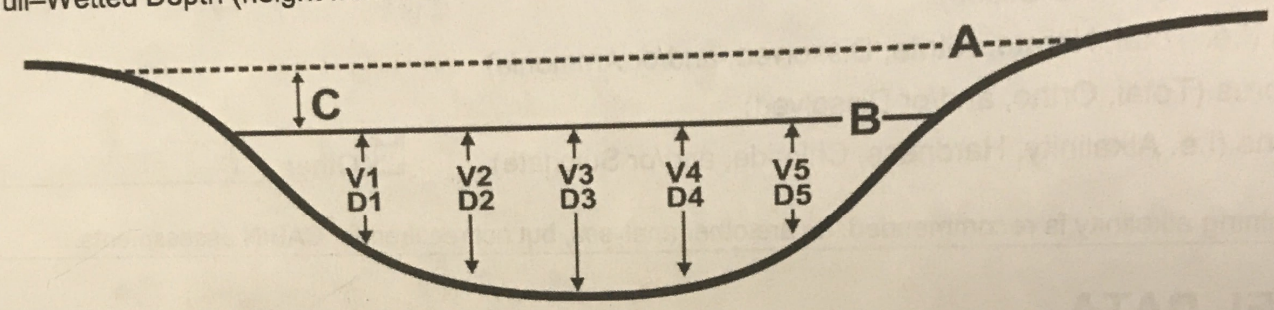
Widths and Depth

Location at site: d/s of ticknet area, flagging tape (Indicate where in sample reach, ex. d/s of kick area)

A - Bankfull Width: 13m (m)

B - Wetted Stream Width: 10.25 (m)

C - Bankfull–Wetted Depth (height from water surface to Bankfull): 42 (cm)



Note:
Wetted widths > 5 m, measure a minimum of 5-6 equidistant locations;
Wetted widths < 5 m, measure 3-4 equidistant locations.

Velocity and Depth

*See attached discharge measurement

Check appropriate velocity measuring device and fill out the appropriate section in chart below. Distance from shore and depth are required regardless of method:

☐ **Velocity Head Rod (or ruler)**: Velocity Equation (m/s) = $\sqrt{[2(\Delta D/100) * 9.81]}$

☐ **Rotary meters**: Gurley/Price/Mini-Price/Propeller (Refer to specific meter conversion chart for calculation)

☐ **Direct velocity measurements**: ☐ Marsh-McBirney ☐ Sontek or ☐ Other_____

	1	2	3	4	5	6	AVG
Distance from Shore (m)							
Depth (**D**) (cm)							
Velocity Head Rod (ruler)							
Flowing water Depth (D_1) (cm)							
Depth of Stagnation (D_2) (cm)							
Change in depth ($\Delta D=D_2-D_1$) (cm)							
Rotary meter							
Revolutions							
Time (minimum 40 seconds)							
Direct Measurement or calculation							
Velocity (**V**) (m/s)							

Sampling Date: (DD/MM/YYYY) 04/10/2021 Site Code: MOR0001

SUBSTRATE DATA

Surrounding/Interstitial Material

Circle the substrate size category for the surrounding material.

Substrate Size Class	Category
Organic Cover	0
< 0.1 cm (fine sand, silt or clay)	1
0.1-0.2 cm (coarse sand)	2
0.2-1.6 cm (gravel)	3
1.6-3.2 cm (small pebble)	4
3.2-6.4 cm (large pebble)	5
6.4-12.8 cm (small cobble)	6
12.8-25.6 cm (cobble)	7
> 25.6 cm (boulder)	8
Bedrock	9

100 Pebble Count & Substrate Embeddedness

- Measure the intermediate axis (100 rocks) and embeddedness (10 rocks) of substrate in the stream bed.
- Indicate B for bedrock, S for sand/silt/clay (particles < 0.2 cm) and O for organic material.
- Embededness categories (E): Completely embedded = 1, 3/4 embedded, 1/2 embedded, 1/4 embedded, unembedded = 0

	Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E
1	14.5		26	9.9		51	7.6		76	8.6	
2	29.0		27	23.0		52	24.0		77	3.4	
3	8.5		28	15.5		53	22.0		78	7.2	
4	20.3		29	3.3		54	3.3		79	17.9	
5	23.0		30	5.0	3/4	55	6.8		80	16.2	1/4
6	9.2		31	13.8		56	13.1		81	5.4	
7	4.4		32	31.5		57	9.4		82	2.9	
8	12.7		33	10.0		58	25.0		83	7.1	
9	16.4		34	7.5		59	11.8		84	3.4	
10	14.6	1/4	35	5.2		60	10.7	O	85	7.6	
11	17.5		36	11.9		61	14.5		86	4.5	
12	2.0		37	8.2		62	7.3		87	30.4	
13	7.8		38	32.8		63	4.2		88	10.9	
14	3.7		39	6.8		64	24.5		89	5.2	
15	4.4		40	6.5	O	65	10.7		90	16.5	O
16	13.8		41	9.0		66	6.2		91	21	
17	12.7		42	9.3		67	11.2		92	2.8	
18	28.0		43	7.5		68	12.5		93	1.3	
19	18.8		44	26.3		69	11.5		94	16.5	
20	21.0	1/4	45	26.5		70	8.4	O	95	12.9	
21	13.0		46	3.8		71	19.3		96	11.0	
22	10.3		47	21.0		72	5.9		97	15.4	
23	12.4		48	19.8		73	13.7		98	6.1	
24	7.9		49	13.5		74	15.4		99	4.7	
25	6.4		50	26.0	3/4	75	12.4		100	28.0	3/4

Note: The Wolman D50 (i.e. median diameter), Wolman Dg (i.e. geometric mean diameter) and the % composition of the substrate classes will be calculated automatically in the CABIN database using the 100 pebble data. All 100 pebbles must be measured in order for the CABIN database tool to perform substrate calculations.

Field Crew: Kaileigh McCall, Evgeni Site Code: McR01

Sampling Date: (DD/MM/YYYY) 04/10/2021

SITE INSPECTION

Site Inspected by: Kaileigh McCall

Communication Information

☒ Itinerary left with contact person (include contact numbers)

Contact Person: Chad Hughes Time checked-in: 13:00

Form of communication: ☐ radio ☒ cell ☐ satellite ☐ hotel/pay phone ☐ SPOT

Phone number: (250) 423-0344

Vehicle Safety

☒ Safety equipment (first aid, fire extinguisher, blanket, emergency kit in vehicle)

☒ Equipment and chemicals safely secured for transport

☒ Vehicle parked in safe location; pylons, hazard light, reflective vests if necessary

Notes:

Shore & Wading Safety

☒ Wading Task Hazard Analysis read by all field staff

☒ Wading Safe Work Procedures read by all field staff

☒ Instream hazards identified (i.e. log jams, deep pools, slippery rocks)

☐ PFD worn

☒ Appropriate footwear, waders, wading belt

☐ Belay used

Notes:

Elk River Alliance

Velocimeter Measurement Field Sheet

Site: MoRo01

Date: 04/10/2021

Time: 15:30

Staff: EM + KM

Staff Gauge: _____

Wetted Width: 10.25

Bankful Width: 12

Instrument ID: Flowprobe

Photos:
- ☑ 1. Completed Field Sheet
- ☑ 2. Upstream
- ☑ 3. Downstream
- ☑ 4. Across (from left bank if possible)

	Distance (m)	Depth (m)	Velocity (m/s)	Notes
1	0.4	0.400	0	
2	0.8	0.180	0.4	
3	1.2	0.142	0.4	
4	1.6	0.138	0.2	
5	2.0	0.130	0.6	
6	2.4	0.128	0.1	
7	2.8	0.198	0.4	
8	3.2	0.187	0.5	
9	3.6	0.255	0.6	
10	4.0	0.245	0.5	
11	4.4	0.220	0.6	
12	4.8	0.225	0.8	
13	5.2	0.185	0.3	
14	5.6	0.145	0.4	
15	6.0	0.210	0.4	

Continued from other side

16	6.4	0.265	0.4	
17	6.8	0.125	0.4	
18	7.2	0.135	0.3	
19	7.6	0.140	0.2	
20	8.0	0.100	0.2	
21	8.4	0.095	0	
22	8.8	0.048	0	
23	9.2	0.121	0.1	
24	9.6	0.063	0.2	
25	10	0098	0	
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				

Comments: large rocks forming eddies

Field Crew: Kaileigh McCall, Evgeni Matveev Site Code: MOR002

Sampling Date: (DD/MM/YYYY) 04/10/2021

☐ **Occupational Health & Safety: Site Inspection Sheet completed**

PRIMARY SITE DATA

CABIN Study Name: CBWM Local Basin Name: Elk River

River/Stream Name: Morrissey Stream Order: (map scale 1:50,000) _____

Select one: ☒ Test Site ☐ Potential Reference Site

Geographical Description/Notes: Drive Morrissey Forest Service Rd until 3rd bridge park @ bridge. Walk d/s ~50m to site. Flagging tape added at cross section + notes radio required; sig. logging traffic u/s of temp pendant

Surrounding Land Use: (check those present) Information Source: visual, maps

☒ Forest ☐ Field/Pasture ☐ Agriculture ☐ Residential/Urban
☒ Logging ☐ Mining ☐ Commercial/Industrial ☐ Other _____

Dominant Surrounding Land Use: (check one) Information Source: visual

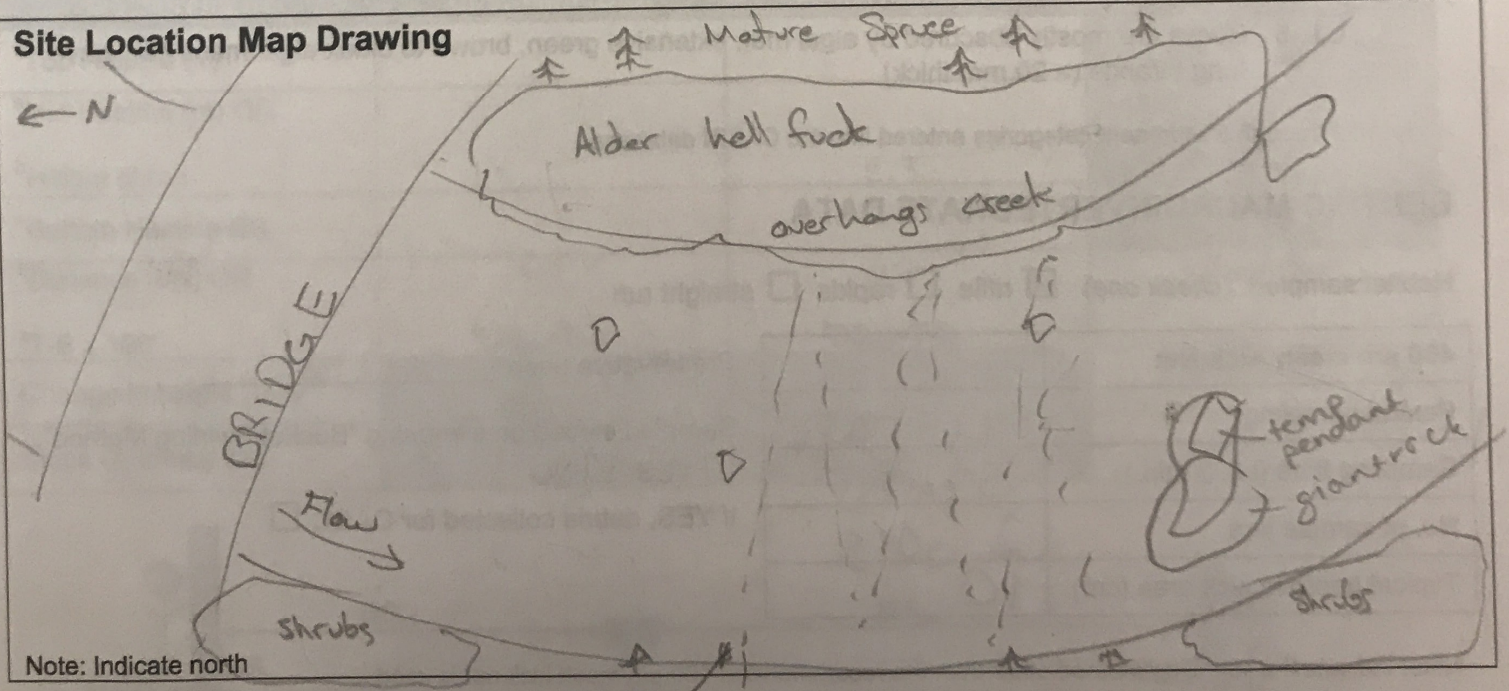
☒ Forest ☐ Field/Pasture ☐ Agriculture ☐ Residential/Urban
☐ Logging ☐ Mining ☐ Commercial/Industrial ☐ Other _____

Location Data

Latitude: 49.420776 N Longitude: - 114.91049 W (DMS or DD)

Elevation: 1529.35 (fasl or masl) GPS Datum: ☒ GRS80 (NAD83/WGS84) ☐ Other: _____

Site Location Map Drawing



Note: Indicate north

Field Crew: Kaileigh McCall, Evgeni Matveev Site Code: MR0002

Sampling Date: (DD/MM/YYYY) 04/10/2021

Photos

☐ Field Sheet ☐ Upstream ☐ Downstream ☐ Across Site ☐ Aerial View

☐ Substrate (exposed) ☐ Substrate (aquatic) ☐ Other _____

REACH DATA *(represents 6 times bankfull width)*

1. Habitat Types: *(check those present)*

☒ Riffle ☐ Rapids ☐ Straight run ☐ Pool/Back Eddy

2. Canopy Coverage: *(stand in middle of stream and look up, check one)*

☐ 0 % ☒ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

3. Macrophyte Coverage: *(not algae or moss, check one)*

☐ 0 % ☒ 1-25 % ☐ 26-50 % ☐ 51-75 % ☐ 76-100 %

4. Streamside Vegetation: (*check those present)*

☐ ferns/grasses ☒ shrubs ☐ deciduous trees ☒ coniferous trees

5. Dominant Streamside Vegetation: *(check one)*

☐ ferns/grasses ☒ shrubs ☐ deciduous trees ☐ coniferous trees

6. Periphyton Coverage on Substrate: *(benthic algae, not moss, check one)*

☐ **1** - Rocks are not slippery, no obvious colour (thin layer < 0.5 mm thick)

☐ **2** - Rocks are slightly slippery, yellow-brown to light green colour (0.5-1 mm thick)

☒ **3** - Rocks have a noticeable slippery feel (footing is slippery), with patches of thicker green to brown algae (1-5 mm thick)

☐ **4** - Rocks are very slippery (algae can be removed with thumbnail), numerous large clumps of green to dark brown algae (5 mm -20 mm thick)

☐ **5** - Rocks are mostly obscured by algal mat, extensive green, brown to black algal mass may have long strands (> 20 mm thick)

Note: 1 through 5 represent categories entered into the CABIN database.

BENTHIC MACROINVERTEBRATE DATA

Habitat sampled: (*check one*) ☒ riffle ☐ rapids ☐ straight run

400 µm mesh Kick Net	
Person sampling	B. Millions
Sampling time (i.e. 3 min.)	3 mins
No. of sample jars	2 jars
Typical depth in kick area (cm)	10

Preservative used: 99% ISO

Sampled sieved on site using "Bucket Swirling Method":

☐ YES ☒ NO

If YES, debris collected for QAQC ☐

Note: Indicate if a sampling method other than the recommended 400 µm mesh kick net is used.

Field Crew: Kaileigh McCall, Eugen Matveev, [redacted] Site Code: MOR002

Sampling Date: (DD/MM/YYYY) 04/10/2021

WATER CHEMISTRY DATA **Time:** 9:45 (24 hr clock) **Time zone:** MT

Air Temp: 4.0 (°C) Water Temp: 3.5 (°C) pH: 7.60

Specific Conductance: 53.7 (µs/cm) DO: 84.3% 9.3 (mg/L) Turbidity: 0.18 (NTU)

Cond: 31.6

ORP: 181.1

Press 634.3 mmHg

Check if water samples were collected for the following analyses:

- ☒ TSS (Total Suspended Solids)
- ☒ Nitrogen (i.e. Total, Nitrate, Nitrite, Dissolved, and/or Ammonia)
- ☒ Phosphorus (Total, Ortho, and/or Dissolved)
- ☒ Major Ions (i.e. Alkalinity, Hardness, Chloride, and/or Sulphate)
- ☒ Other EPH

Note: Determining alkalinity is recommended, as are other analyses, but not required for CABIN assessments.

CHANNEL DATA

Slope - Indicate how slope was measured: (check one)

☐ **Calculated from map**

Scale: _____ (Note: small scale map recommended if field measurement is not possible - i.e. 1:20,000).

contour interval (vertical distance) _____ (m),

distance between contour intervals (horizontal distance) _____ (m)

slope = vertical distance/horizontal distance = _____

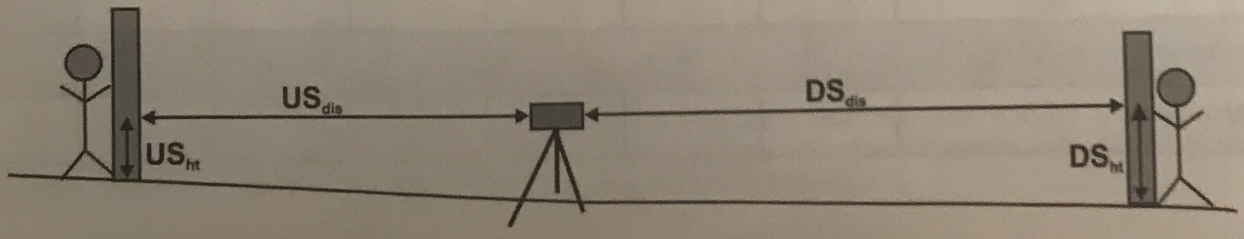
OR

☒ **Measured in field**

Circle device used and fill out table according to device:

a. Survey Equipment b. Hand Level & Measuring Tape

Measurements	Upstream (U/S)	Downstream(D/S)	Calculation
[a]Top Hairline (T)			
[a]Mid Hairline (ht) OR [b]Height of rod	1.3	2.3	
[a]Bottom Hairline (B)			
[b]Distance (dis) OR [a]T-B x 100	30 [a]US_{dis}=T-B	30 [a]DS_{dis}=T-B	$US_{dis}+DS_{dis}$= 60
Change in height (Δht)			$DS_{ht}-US_{ht}$= 1
Slope (Δht/total dis)			0.0167 1.67 %



Field Crew: Kaileigh McCall, Eugeni Matveev Site Code: MOR002

Sampling Date: (DD/MM/YYYY) 04/10/2021

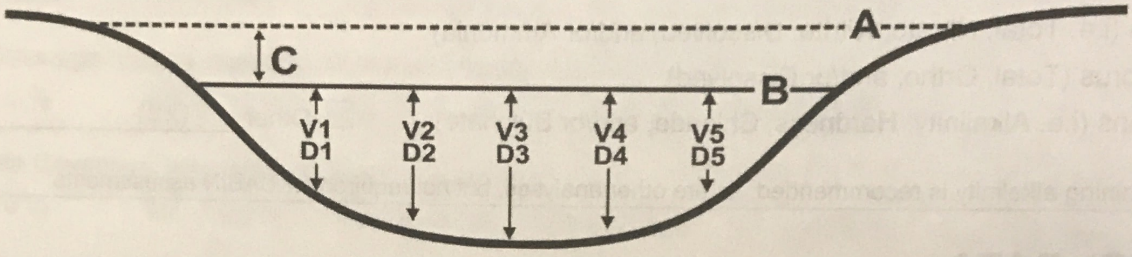
Widths and Depth

* See extra discharge sheet

Location at site: u/s of kicknet (Indicate where in sample reach, ex. d/s of kick area)

A - Bankfull Width: 7.25 (m) B - Wetted Stream Width: 5.3 (m)

C - Bankfull–Wetted Depth (height from water surface to Bankfull): 23.5 (cm)



Note:
Wetted widths > 5 m, measure a minimum of 5-6 equidistant locations;
Wetted widths < 5 m, measure 3-4 equidistant locations.

Velocity and Depth

* See attatched discharge sheet

Check appropriate velocity measuring device and fill out the appropriate section in chart below. Distance from shore and depth are required regardless of method:

☐ **Velocity Head Rod (or ruler)**: Velocity Equation (m/s) = $\sqrt{[2(\Delta D/100) * 9.81]}$

☐ **Rotary meters**: Gurley/Price/Mini-Price/Propeller (Refer to specific meter conversion chart for calculation)

☒ **Direct velocity measurements:** ☐ Marsh-McBirney ☐ Sontek or ☐ Other Flow Probe

	1	2	3	4	5	6	AVG
Distance from Shore (m)							
Depth (**D**) (cm)							
Velocity Head Rod (ruler)							
Flowing water Depth (D_1) (cm)							
Depth of Stagnation (D_2) (cm)							
Change in depth ($\Delta D=D_2-D_1$) (cm)							
Rotary meter							
Revolutions							
Time (minimum 40 seconds)							
Direct Measurement or calculation							
Velocity (**V**) (m/s)							

Field Crew: Kailegh McCall, Evgeni Matveev, Beth Millichs Site Code: MOR 07

Sampling Date: (DD/MM/YYYY) 04/10/2021

SUBSTRATE DATA

Surrounding/Interstitial Material

Circle the substrate size category for the surrounding material.

Substrate Size Class	Category
Organic Cover	0
< 0.1 cm (fine sand, silt or clay)	1
0.1-0.2 cm (coarse sand)	2
0.2-1.6 cm (gravel)	3
1.6-3.2 cm (small pebble)	4
3.2-6.4 cm (large pebble)	5
6.4-12.8 cm (small cobble)	6
12.8-25.6 cm (cobble)	7
> 25.6 cm (boulder)	8
Bedrock	9

100 Pebble Count & Substrate Embeddedness

- Measure the intermediate axis (100 rocks) and embeddedness (10 rocks) of substrate in the stream bed.
- Indicate B for bedrock, S for sand/silt/clay (particles < 0.2 cm) and O for organic material.
- Embededness categories (E): Completely embedded = 1, 3/4 embedded, 1/2 embedded, 1/4 embedded, unembedded = 0

	Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E
1	17.2		26	9.0		51	13.6		76	6.7	
2	6.4		27	11.7		52	4.3		77	8.6	
3	5.4		28	66.1		53	25.7		78	12.2	
4	32.1		29	9.8		54	3.0		79	18.2	
5	6.5		30	29.3	1/4	55	7.8		80	4.9	3/4
6	6.2		31	4.3		56	13.9		81	20.2	
7	6.3		32	17.2		57	3.2		82	7.8	
8	12.1		33	7.8		58	4.5		83	9.8	
9	19.0		34	1.2		59	18.1		84	1.0	
10	18.6	1/2	35	8.8		60	17.0	1	85	3.2	
11	6.7		36	0.4		61	20.0		86	11.5	
12	24.1		37	45.1		62	8.3		87	4.0	
13	5.7		38	26.5		63	16.5		88	21.6	
14	8.5		39	7.0		64	15.5		89	8.5	
15	29.2		40	10.5	3/4	65	89.0		90	1.8	1/2
16	6.9		41	18.2		66	36.0		91	0.6	
17	33.3		42	6.6		67	7.1		92	11.1	
18	11.6		43	19.5		68	8.5		93	4.2	
19	1.7		44	7.3		69	29.5		94	0.9	
20	7.5	O	45	220		70	10.8	1/2	95	15.5	
21	5.4		46	5.1		71	22.5		96	10.1	
22	18.8		47	1.9		72	1.3		97	25.2	
23	9.6		48	17.9		73	10.8		98	10.6	
24	100		49	4.3		74	8.5		99	11.0	
25	8.1		50	250	1	75	4.7		100	0.9	O

Note: The Wolman D50 (i.e. median diameter), Wolman Dg (i.e. geometric mean diameter) and the % composition of the substrate classes will be calculated automatically in the CABIN database using the 100 pebble data. All 100 pebbles must be measured in order for the CABIN database tool to perform substrate calculations.

Field Crew: Kaileigh McCallum Eugeni Matveev Site Code: MOR02

Sampling Date: (DD/MM/YYYY) 04/10/2021

SITE INSPECTION

Site Inspected by: Kaileigh McCallum

Communication Information

☒ Itinerary left with contact person (include contact numbers)

Contact Person: Chad Hughes Time checked-in: 9:00

Form of communication: ☐ radio ☒ cell ☐ satellite ☐ hotel/pay phone ☐ SPOT

Phone number: (250) 423-0344

Vehicle Safety

☒ Safety equipment (first aid, fire extinguisher, blanket, emergency kit in vehicle)

☒ Equipment and chemicals safely secured for transport

☒ Vehicle parked in safe location; pylons, hazard light, reflective vests if necessary

Notes:

Shore & Wading Safety

☒ Wading Task Hazard Analysis read by all field staff

☒ Wading Safe Work Procedures read by all field staff

☒ Instream hazards identified (i.e. log jams, deep pools, slippery rocks)

☐ PFD worn

☒ Appropriate footwear, waders, wading belt

☐ Belay used

Notes:

Site: MOR002

Date: 04/10/2021

Time: 10:00

Staff: KM + EM

Staff Gauge: /

Wetted Width: 5.3

Bankful Width: 7.25 m

Instrument ID: Global Flow Probe

Photos:
- ☑ 1. Completed Field Sheet
- ☑ 2. Upstream
- ☑ 3. Downstream
- ☑ 4. Across (from left bank if possible)

	Distance (m)	Depth (m)	Velocity (m/s)	Notes
1	2	0.219	0.1	
2	2.15	0.225	0	
3	2.3	0.247	0	
4	2.45	0.271	0	
5	2.6	0.206	0	
6	2.75	0.206	0.2	
7	2.9	0.132	0.2	
8	3.05	0.188	0.1	
9	3.20	0.137	0.3	
10	3.35	0.147	0.5	
11	3.50	0.153	0.5	
12	3.65	0.101	0.5	
13	3.90	0.165	0.3	
14	3.95	0.154	0	
15	4.10	0.160	0	

6.5
- 1.2
2
5.3 m

Continued from other side

16	4.25	0.114	0.1	
17	4.40	0.110	0.1	
18	4.55	0.138	0	
19	4.70	0.172	0	
20	4.85	0.164	0.1	
21	5	0.184	0.1	
22	5.15	0.197	0.2	
23	5.30	0.201	0.1	
24	5.45	0.155	0	
25	5.60	0.072	0.2	
26	5.75	0.158	0.1	
27	5.90	0.131	0	
28	6.05	0.172	0	
29	6.20	0.170	0	
30	6.35	0.176	0.1	
31	6.5	0.072	0	
32				
33				
34				
35				

Comments: large rocks w/s forming added

Appendix C: CARO Reports

CERTIFICATE OF ANALYSIS

REPORTED TO	Elk River Alliance PO Box 2095, 1111 2nd Ave Fernie, BC V0B1M0

ATTENTION	Kaileigh McCallum	**WORK ORDER**	21J0990
PO NUMBER		**RECEIVED / TEMP**	2021-10-06 09:50 / 7.4°C
PROJECT	ERA-CBWM	**REPORTED**	2021-10-14 16:07
PROJECT INFO	[info]	**COC NUMBER**	No Number

Introduction:

CARO Analytical Services is a testing laboratory full of smart, engaged scientists driven to make the world a safer and healthier place. Through our clients' projects we become an essential element for a better world. We employ methods conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts. CARO is accredited by the Canadian Association for Laboratories Accreditation (CALA) to ISO/IEC 17025:2017 for specific tests listed in the scope of accreditation approved by CALA.

Big Picture Sidekicks

You know that the sample you collected after snowshoeing to site, digging 5 meters, and racing to get it on a plane so you can submit it to the lab for time sensitive results needed to make important and expensive decisions (whew) is VERY important. We know that too.

We've Got Chemistry

It's simple. We figure the more you enjoy working with our fun and engaged team members; the more likely you are to give us continued opportunities to support you.

Ahead of the Curve

Through research, regulation knowledge, and instrumentation, we are your analytical centre for the technical knowledge you need, BEFORE you need it, so you can stay up to date and in the know.

If you have any questions or concerns, please contact me at teamcaro@caro.ca

Authorized By:

Team CARO
Client Service Representative

TEST RESULTS

REPORTED TO Elk River Alliance
PROJECT ERA-CBWM

WORK ORDER 21J0990
REPORTED 2021-10-14 16:07

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
LIZ001_20211003_0930 (21J0990-01) | Matrix: Water | Sampled: 2021-10-03 09:30						
Anions						
Chloride	**0.20**	AO ≤ 250	0.10	mg/L	2021-10-13	
Nitrate (as N)	< 0.010	MAC = 10	0.010	mg/L	2021-10-13	HT1
Nitrite (as N)	< 0.010	MAC = 1	0.010	mg/L	2021-10-13	HT1
Phosphate (as P)	< 0.0050	N/A	0.0050	mg/L	2021-10-13	HT1
Sulfate	**173**	AO ≤ 500	1.0	mg/L	2021-10-13	
BCMOE Aggregate Hydrocarbons						
EPHw10-19	< 250	N/A	250	µg/L	2021-10-13	
EPHw19-32	< 250	N/A	250	µg/L	2021-10-13	
Surrogate: 2-Methylnonane (EPH/F2-4)	*80*		*60-140*	%	*2021-10-13*	
Calculated Parameters						
Hardness, Total (as CaCO3)	**314**	None Required	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	< 0.0100	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	< 0.0500	N/A	0.0500	mg/L	N/A	
Dissolved Metals						
Aluminum, dissolved	< 0.0050	N/A	0.0050	mg/L	2021-10-10	
Antimony, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-10	
Arsenic, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-10	
Barium, dissolved	**0.0690**	N/A	0.0050	mg/L	2021-10-10	
Beryllium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-10	
Bismuth, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-10	
Boron, dissolved	< 0.0500	N/A	0.0500	mg/L	2021-10-10	
Cadmium, dissolved	< 0.000010	N/A	0.000010	mg/L	2021-10-10	
Calcium, dissolved	**88.0**	N/A	0.20	mg/L	2021-10-10	
Chromium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-10	
Cobalt, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-10	
Copper, dissolved	< 0.00040	N/A	0.00040	mg/L	2021-10-10	
Iron, dissolved	< 0.010	N/A	0.010	mg/L	2021-10-10	
Lead, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-10	
Lithium, dissolved	**0.00361**	N/A	0.00010	mg/L	2021-10-10	
Magnesium, dissolved	**22.8**	N/A	0.010	mg/L	2021-10-10	
Manganese, dissolved	**0.00221**	N/A	0.00020	mg/L	2021-10-10	
Mercury, dissolved	< 0.000010	N/A	0.000010	mg/L	2021-10-13	
Molybdenum, dissolved	**0.00167**	N/A	0.00010	mg/L	2021-10-10	
Nickel, dissolved	< 0.00040	N/A	0.00040	mg/L	2021-10-10	
Phosphorus, dissolved	< 0.050	N/A	0.050	mg/L	2021-10-10	
Potassium, dissolved	**0.43**	N/A	0.10	mg/L	2021-10-10	
Selenium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-10	
Silicon, dissolved	**3.1**	N/A	1.0	mg/L	2021-10-10	
Silver, dissolved	< 0.000050	N/A	0.000050	mg/L	2021-10-10	
Sodium, dissolved	**1.72**	N/A	0.10	mg/L	2021-10-10	
Strontium, dissolved	**1.44**	N/A	0.0010	mg/L	2021-10-10	

TEST RESULTS

REPORTED TO Elk River Alliance
PROJECT ERA-CBWM

WORK ORDER 21J0990
REPORTED 2021-10-14 16:07

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
LIZ001_20211003_0930 (21J0990-01) | Matrix: Water | Sampled: 2021-10-03 09:30, Continued						
Dissolved Metals, Continued						
Sulfur, dissolved	**63.4**	N/A	3.0	mg/L	2021-10-10	
Tellurium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-10	
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2021-10-10	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-10	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-10	
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2021-10-10	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2021-10-10	
Uranium, dissolved	**0.000357**	N/A	0.000020	mg/L	2021-10-10	
Vanadium, dissolved	< 0.0010	N/A	0.0010	mg/L	2021-10-10	
Zinc, dissolved	< 0.0040	N/A	0.0040	mg/L	2021-10-10	
Zirconium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-10	
General Parameters						
Alkalinity, Total (as CaCO3)	**157**	N/A	1.0	mg/L	2021-10-08	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-08	
Alkalinity, Bicarbonate (as CaCO3)	**157**	N/A	1.0	mg/L	2021-10-08	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-08	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-08	
Carbon, Total Organic	**1.06**	N/A	0.50	mg/L	2021-10-12	
Carbon, Dissolved Organic	**0.92**	N/A	0.50	mg/L	2021-10-12	
Nitrogen, Total Kjeldahl	< 0.050	N/A	0.050	mg/L	2021-10-13	
Phosphorus, Total (as P)	**0.0183**	N/A	0.0050	mg/L	2021-10-14	
Solids, Total Suspended	**2.4**	N/A	2.0	mg/L	2021-10-12	HT1
Total Metals						
Aluminum, total	**0.0517**	OG < 0.1	0.0050	mg/L	2021-10-14	
Antimony, total	< 0.00020	MAC = 0.006	0.00020	mg/L	2021-10-14	
Arsenic, total	< 0.00050	MAC = 0.01	0.00050	mg/L	2021-10-14	
Barium, total	**0.0673**	MAC = 2	0.0050	mg/L	2021-10-14	
Beryllium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-14	
Bismuth, total	< 0.00010	N/A	0.00010	mg/L	2021-10-14	
Boron, total	< 0.0500	MAC = 5	0.0500	mg/L	2021-10-14	
Cadmium, total	**0.000040**	MAC = 0.005	0.000010	mg/L	2021-10-14	
Calcium, total	**97.4**	None Required	0.20	mg/L	2021-10-14	
Chromium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2021-10-14	
Cobalt, total	< 0.00010	N/A	0.00010	mg/L	2021-10-14	
Copper, total	< 0.00040	MAC = 2	0.00040	mg/L	2021-10-14	
Iron, total	**0.061**	AO ≤ 0.3	0.010	mg/L	2021-10-14	
Lead, total	**0.00023**	MAC = 0.005	0.00020	mg/L	2021-10-14	
Lithium, total	**0.00392**	N/A	0.00010	mg/L	2021-10-14	
Magnesium, total	**25.4**	None Required	0.010	mg/L	2021-10-14	
Manganese, total	**0.00526**	MAC = 0.12	0.00020	mg/L	2021-10-14	
Mercury, total	< 0.000010	MAC = 0.001	0.000010	mg/L	2021-10-13	
Molybdenum, total	**0.00170**	N/A	0.00010	mg/L	2021-10-14	

TEST RESULTS

REPORTED TO Elk River Alliance
PROJECT ERA-CBWM

WORK ORDER 21J0990
REPORTED 2021-10-14 16:07

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
LIZ001_20211003_0930 (21J0990-01) | Matrix: Water | Sampled: 2021-10-03 09:30, Continued						
Total Metals, Continued						
Nickel, total	< 0.00040	N/A	0.00040	mg/L	2021-10-14	
Phosphorus, total	< 0.050	N/A	0.050	mg/L	2021-10-14	
Potassium, total	**0.49**	N/A	0.10	mg/L	2021-10-14	
Selenium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2021-10-14	
Silicon, total	**3.0**	N/A	1.0	mg/L	2021-10-14	
Silver, total	< 0.000050	None Required	0.000050	mg/L	2021-10-14	
Sodium, total	**1.92**	AO ≤ 200	0.10	mg/L	2021-10-14	
Strontium, total	**1.43**	7	0.0010	mg/L	2021-10-14	
Sulfur, total	**68.2**	N/A	3.0	mg/L	2021-10-14	
Tellurium, total	< 0.00050	N/A	0.00050	mg/L	2021-10-14	
Thallium, total	< 0.000020	N/A	0.000020	mg/L	2021-10-14	
Thorium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-14	
Tin, total	< 0.00020	N/A	0.00020	mg/L	2021-10-14	
Titanium, total	< 0.0050	N/A	0.0050	mg/L	2021-10-14	
Tungsten, total	< 0.0010	N/A	0.0010	mg/L	2021-10-14	
Uranium, total	**0.000373**	MAC = 0.02	0.000020	mg/L	2021-10-14	
Vanadium, total	< 0.0010	N/A	0.0010	mg/L	2021-10-14	
Zinc, total	< 0.0040	AO ≤ 5	0.0040	mg/L	2021-10-14	
Zirconium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-14	
LIZ003_20211003_1330 (21J0990-02) | Matrix: Water | Sampled: 2021-10-03 13:30						
Anions						
Chloride	**0.20**	AO ≤ 250	0.10	mg/L	2021-10-13	
Nitrate (as N)	< 0.010	MAC = 10	0.010	mg/L	2021-10-13	HT1
Nitrite (as N)	< 0.010	MAC = 1	0.010	mg/L	2021-10-13	HT1
Phosphate (as P)	< 0.0050	N/A	0.0050	mg/L	2021-10-13	HT1
Sulfate	**182**	AO ≤ 500	1.0	mg/L	2021-10-13	
BCMOE Aggregate Hydrocarbons						
EPHw10-19	< 250	N/A	250	µg/L	2021-10-13	
EPHw19-32	< 250	N/A	250	µg/L	2021-10-13	
Surrogate: 2-Methylnonane (EPH/F2-4)	*77*		*60-140*	%	*2021-10-13*	
Calculated Parameters						
Hardness, Total (as CaCO3)	**337**	None Required	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	< 0.0100	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	**0.112**	N/A	0.0500	mg/L	N/A	
Dissolved Metals						
Aluminum, dissolved	< 0.0050	N/A	0.0050	mg/L	2021-10-10	
Antimony, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-10	
Arsenic, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-10	
Barium, dissolved	**0.0644**	N/A	0.0050	mg/L	2021-10-10	

TEST RESULTS

REPORTED TO Elk River Alliance
PROJECT ERA-CBWM

WORK ORDER 21J0990
REPORTED 2021-10-14 16:07

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
LIZ003_20211003_1330 (21J0990-02) | Matrix: Water | Sampled: 2021-10-03 13:30, Continued						
Dissolved Metals, Continued						
Beryllium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-10	
Bismuth, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-10	
Boron, dissolved	< 0.0500	N/A	0.0500	mg/L	2021-10-10	
Cadmium, dissolved	**0.000012**	N/A	0.000010	mg/L	2021-10-10	
Calcium, dissolved	**93.7**	N/A	0.20	mg/L	2021-10-10	
Chromium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-10	
Cobalt, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-10	
Copper, dissolved	< 0.00040	N/A	0.00040	mg/L	2021-10-10	
Iron, dissolved	< 0.010	N/A	0.010	mg/L	2021-10-10	
Lead, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-10	
Lithium, dissolved	**0.00389**	N/A	0.00010	mg/L	2021-10-10	
Magnesium, dissolved	**25.1**	N/A	0.010	mg/L	2021-10-10	
Manganese, dissolved	**0.00441**	N/A	0.00020	mg/L	2021-10-10	
Mercury, dissolved	< 0.000010	N/A	0.000010	mg/L	2021-10-13	
Molybdenum, dissolved	**0.00195**	N/A	0.00010	mg/L	2021-10-10	
Nickel, dissolved	< 0.00040	N/A	0.00040	mg/L	2021-10-10	
Phosphorus, dissolved	< 0.050	N/A	0.050	mg/L	2021-10-10	
Potassium, dissolved	**0.48**	N/A	0.10	mg/L	2021-10-10	
Selenium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-10	
Silicon, dissolved	**3.5**	N/A	1.0	mg/L	2021-10-10	
Silver, dissolved	< 0.000050	N/A	0.000050	mg/L	2021-10-10	
Sodium, dissolved	**1.86**	N/A	0.10	mg/L	2021-10-10	
Strontium, dissolved	**1.56**	N/A	0.0010	mg/L	2021-10-10	
Sulfur, dissolved	**70.3**	N/A	3.0	mg/L	2021-10-10	
Tellurium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-10	
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2021-10-10	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-10	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-10	
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2021-10-10	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2021-10-10	
Uranium, dissolved	**0.000382**	N/A	0.000020	mg/L	2021-10-10	
Vanadium, dissolved	< 0.0010	N/A	0.0010	mg/L	2021-10-10	
Zinc, dissolved	< 0.0040	N/A	0.0040	mg/L	2021-10-10	
Zirconium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-10	
General Parameters						
Alkalinity, Total (as CaCO3)	**155**	N/A	1.0	mg/L	2021-10-08	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-08	
Alkalinity, Bicarbonate (as CaCO3)	**155**	N/A	1.0	mg/L	2021-10-08	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-08	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-08	
Carbon, Total Organic	**1.40**	N/A	0.50	mg/L	2021-10-12	
Carbon, Dissolved Organic	**1.03**	N/A	0.50	mg/L	2021-10-12	

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
LIZ003_20211003_1330 (21J0990-02) | Matrix: Water | Sampled: 2021-10-03 13:30, Continued						
General Parameters, Continued						
Nitrogen, Total Kjeldahl	**0.112**	N/A	0.050	mg/L	2021-10-13	
Phosphorus, Total (as P)	**0.0193**	N/A	0.0050	mg/L	2021-10-14	
Solids, Total Suspended	< 2.0	N/A	2.0	mg/L	2021-10-12	HT1
Total Metals						
Aluminum, total	**0.0206**	OG < 0.1	0.0050	mg/L	2021-10-14	
Antimony, total	< 0.00020	MAC = 0.006	0.00020	mg/L	2021-10-14	
Arsenic, total	< 0.00050	MAC = 0.01	0.00050	mg/L	2021-10-14	
Barium, total	**0.0640**	MAC = 2	0.0050	mg/L	2021-10-14	
Beryllium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-14	
Bismuth, total	< 0.00010	N/A	0.00010	mg/L	2021-10-14	
Boron, total	< 0.0500	MAC = 5	0.0500	mg/L	2021-10-14	
Cadmium, total	**0.000014**	MAC = 0.005	0.000010	mg/L	2021-10-14	
Calcium, total	**92.1**	None Required	0.20	mg/L	2021-10-14	
Chromium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2021-10-14	
Cobalt, total	< 0.00010	N/A	0.00010	mg/L	2021-10-14	
Copper, total	**0.00049**	MAC = 2	0.00040	mg/L	2021-10-14	
Iron, total	**0.022**	AO ≤ 0.3	0.010	mg/L	2021-10-14	
Lead, total	**0.00022**	MAC = 0.005	0.00020	mg/L	2021-10-14	
Lithium, total	**0.00376**	N/A	0.00010	mg/L	2021-10-14	
Magnesium, total	**24.3**	None Required	0.010	mg/L	2021-10-14	
Manganese, total	**0.00460**	MAC = 0.12	0.00020	mg/L	2021-10-14	
Mercury, total	< 0.000010	MAC = 0.001	0.000010	mg/L	2021-10-13	
Molybdenum, total	**0.00178**	N/A	0.00010	mg/L	2021-10-14	
Nickel, total	< 0.00040	N/A	0.00040	mg/L	2021-10-14	
Phosphorus, total	**0.054**	N/A	0.050	mg/L	2021-10-14	
Potassium, total	**0.47**	N/A	0.10	mg/L	2021-10-14	
Selenium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2021-10-14	
Silicon, total	**2.9**	N/A	1.0	mg/L	2021-10-14	
Silver, total	< 0.000050	None Required	0.000050	mg/L	2021-10-14	
Sodium, total	**1.83**	AO ≤ 200	0.10	mg/L	2021-10-14	
Strontium, total	**1.44**	7	0.0010	mg/L	2021-10-14	
Sulfur, total	**68.7**	N/A	3.0	mg/L	2021-10-14	
Tellurium, total	< 0.00050	N/A	0.00050	mg/L	2021-10-14	
Thallium, total	< 0.000020	N/A	0.000020	mg/L	2021-10-14	
Thorium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-14	
Tin, total	< 0.00020	N/A	0.00020	mg/L	2021-10-14	
Titanium, total	< 0.0050	N/A	0.0050	mg/L	2021-10-14	
Tungsten, total	< 0.0010	N/A	0.0010	mg/L	2021-10-14	
Uranium, total	**0.000381**	MAC = 0.02	0.000020	mg/L	2021-10-14	
Vanadium, total	< 0.0010	N/A	0.0010	mg/L	2021-10-14	
Zinc, total	< 0.0040	AO ≤ 5	0.0040	mg/L	2021-10-14	
Zirconium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-14	

TEST RESULTS

REPORTED TO Elk River Alliance
PROJECT ERA-CBWM

WORK ORDER 21J0990
REPORTED 2021-10-14 16:07

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
MOR001_20211004_1230 (21J0990-03) | Matrix: Water | Sampled: 2021-10-04 12:30						
Anions						
Chloride	**0.19**	AO ≤ 250	0.10	mg/L	2021-10-13	
Nitrate (as N)	< 0.010	MAC = 10	0.010	mg/L	2021-10-13	HT1
Nitrite (as N)	< 0.010	MAC = 1	0.010	mg/L	2021-10-13	HT1
Phosphate (as P)	< 0.0050	N/A	0.0050	mg/L	2021-10-13	HT1
Sulfate	**3.8**	AO ≤ 500	1.0	mg/L	2021-10-13	
BCMOE Aggregate Hydrocarbons						
EPHw10-19	< 250	N/A	250	µg/L	2021-10-13	
EPHw19-32	< 250	N/A	250	µg/L	2021-10-13	
Surrogate: 2-Methylnonane (EPH/F2-4)	*84*		*60-140*	%	*2021-10-13*	
Calculated Parameters						
Hardness, Total (as CaCO3)	**66.4**	None Required	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	< 0.0100	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	**0.104**	N/A	0.0500	mg/L	N/A	
Dissolved Metals						
Aluminum, dissolved	**0.0272**	N/A	0.0050	mg/L	2021-10-10	
Antimony, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-10	
Arsenic, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-10	
Barium, dissolved	**0.0914**	N/A	0.0050	mg/L	2021-10-10	
Beryllium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-10	
Bismuth, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-10	
Boron, dissolved	< 0.0500	N/A	0.0500	mg/L	2021-10-10	
Cadmium, dissolved	**0.000026**	N/A	0.000010	mg/L	2021-10-10	
Calcium, dissolved	**18.1**	N/A	0.20	mg/L	2021-10-10	
Chromium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-10	
Cobalt, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-10	
Copper, dissolved	**0.00061**	N/A	0.00040	mg/L	2021-10-10	
Iron, dissolved	< 0.010	N/A	0.010	mg/L	2021-10-10	
Lead, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-10	
Lithium, dissolved	**0.00223**	N/A	0.00010	mg/L	2021-10-10	
Magnesium, dissolved	**5.15**	N/A	0.010	mg/L	2021-10-10	
Manganese, dissolved	**0.00190**	N/A	0.00020	mg/L	2021-10-10	
Mercury, dissolved	< 0.000010	N/A	0.000010	mg/L	2021-10-13	
Molybdenum, dissolved	**0.00051**	N/A	0.00010	mg/L	2021-10-10	
Nickel, dissolved	< 0.00040	N/A	0.00040	mg/L	2021-10-10	
Phosphorus, dissolved	< 0.050	N/A	0.050	mg/L	2021-10-10	
Potassium, dissolved	**0.37**	N/A	0.10	mg/L	2021-10-10	
Selenium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-10	
Silicon, dissolved	**2.2**	N/A	1.0	mg/L	2021-10-10	
Silver, dissolved	< 0.000050	N/A	0.000050	mg/L	2021-10-10	
Sodium, dissolved	**1.35**	N/A	0.10	mg/L	2021-10-10	
Strontium, dissolved	**0.0775**	N/A	0.0010	mg/L	2021-10-10	

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
MOR001_20211004_1230 (21J0990-03) | Matrix: Water | Sampled: 2021-10-04 12:30, Continued						
Dissolved Metals, Continued						
Sulfur, dissolved	< 3.0	N/A	3.0	mg/L	2021-10-10	
Tellurium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-10	
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2021-10-10	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-10	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-10	
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2021-10-10	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2021-10-10	
Uranium, dissolved	**0.000090**	N/A	0.000020	mg/L	2021-10-10	
Vanadium, dissolved	< 0.0010	N/A	0.0010	mg/L	2021-10-10	
Zinc, dissolved	< 0.0040	N/A	0.0040	mg/L	2021-10-10	
Zirconium, dissolved	**0.00711**	N/A	0.00010	mg/L	2021-10-10	
General Parameters						
Alkalinity, Total (as CaCO3)	**73.8**	N/A	1.0	mg/L	2021-10-08	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-08	
Alkalinity, Bicarbonate (as CaCO3)	**73.8**	N/A	1.0	mg/L	2021-10-08	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-08	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-08	
Carbon, Total Organic	**2.54**	N/A	0.50	mg/L	2021-10-12	
Carbon, Dissolved Organic	**2.37**	N/A	0.50	mg/L	2021-10-12	
Nitrogen, Total Kjeldahl	**0.104**	N/A	0.050	mg/L	2021-10-13	
Phosphorus, Total (as P)	**0.0103**	N/A	0.0050	mg/L	2021-10-14	
Solids, Total Suspended	< 2.0	N/A	2.0	mg/L	2021-10-12	HT1
Total Metals						
Aluminum, total	**0.0253**	OG < 0.1	0.0050	mg/L	2021-10-14	
Antimony, total	< 0.00020	MAC = 0.006	0.00020	mg/L	2021-10-14	
Arsenic, total	< 0.00050	MAC = 0.01	0.00050	mg/L	2021-10-14	
Barium, total	**0.0905**	MAC = 2	0.0050	mg/L	2021-10-14	
Beryllium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-14	
Bismuth, total	< 0.00010	N/A	0.00010	mg/L	2021-10-14	
Boron, total	< 0.0500	MAC = 5	0.0500	mg/L	2021-10-14	
Cadmium, total	< 0.000010	MAC = 0.005	0.000010	mg/L	2021-10-14	
Calcium, total	**18.7**	None Required	0.20	mg/L	2021-10-14	
Chromium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2021-10-14	
Cobalt, total	< 0.00010	N/A	0.00010	mg/L	2021-10-14	
Copper, total	**0.00060**	MAC = 2	0.00040	mg/L	2021-10-14	
Iron, total	**0.025**	AO ≤ 0.3	0.010	mg/L	2021-10-14	
Lead, total	**0.00023**	MAC = 0.005	0.00020	mg/L	2021-10-14	
Lithium, total	**0.00231**	N/A	0.00010	mg/L	2021-10-14	
Magnesium, total	**5.09**	None Required	0.010	mg/L	2021-10-14	
Manganese, total	**0.00261**	MAC = 0.12	0.00020	mg/L	2021-10-14	
Mercury, total	< 0.000010	MAC = 0.001	0.000010	mg/L	2021-10-13	
Molybdenum, total	**0.00372**	N/A	0.00010	mg/L	2021-10-14	

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
MOR001_20211004_1230 (21J0990-03) | Matrix: Water | Sampled: 2021-10-04 12:30, Continued						
Total Metals, Continued						
Nickel, total	**0.00062**	N/A	0.00040	mg/L	2021-10-14	
Phosphorus, total	< 0.050	N/A	0.050	mg/L	2021-10-14	
Potassium, total	**0.34**	N/A	0.10	mg/L	2021-10-14	
Selenium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2021-10-14	
Silicon, total	**1.7**	N/A	1.0	mg/L	2021-10-14	
Silver, total	< 0.000050	None Required	0.000050	mg/L	2021-10-14	
Sodium, total	**1.36**	AO ≤ 200	0.10	mg/L	2021-10-14	
Strontium, total	**0.0728**	7	0.0010	mg/L	2021-10-14	
Sulfur, total	**4.4**	N/A	3.0	mg/L	2021-10-14	
Tellurium, total	< 0.00050	N/A	0.00050	mg/L	2021-10-14	
Thallium, total	< 0.000020	N/A	0.000020	mg/L	2021-10-14	
Thorium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-14	
Tin, total	< 0.00020	N/A	0.00020	mg/L	2021-10-14	
Titanium, total	< 0.0050	N/A	0.0050	mg/L	2021-10-14	
Tungsten, total	< 0.0010	N/A	0.0010	mg/L	2021-10-14	
Uranium, total	**0.000081**	MAC = 0.02	0.000020	mg/L	2021-10-14	
Vanadium, total	< 0.0010	N/A	0.0010	mg/L	2021-10-14	
Zinc, total	< 0.0040	AO ≤ 5	0.0040	mg/L	2021-10-14	
Zirconium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-14	
MOR002_20211004_0945 (21J0990-04) | Matrix: Water | Sampled: 2021-10-04 09:45						
Anions						
Chloride	**0.17**	AO ≤ 250	0.10	mg/L	2021-10-13	
Nitrate (as N)	< 0.010	MAC = 10	0.010	mg/L	2021-10-13	HT1
Nitrite (as N)	< 0.010	MAC = 1	0.010	mg/L	2021-10-13	HT1
Phosphate (as P)	< 0.0050	N/A	0.0050	mg/L	2021-10-13	HT1
Sulfate	**1.7**	AO ≤ 500	1.0	mg/L	2021-10-13	
BCMOE Aggregate Hydrocarbons						
EPHw10-19	< 250	N/A	250	µg/L	2021-10-13	
EPHw19-32	< 250	N/A	250	µg/L	2021-10-13	
Surrogate: 2-Methylnonane (EPH/F2-4)	*78*		*60-140*	%	*2021-10-13*	
Calculated Parameters						
Hardness, Total (as CaCO3)	**31.1**	None Required	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	< 0.0100	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	**0.0740**	N/A	0.0500	mg/L	N/A	
Dissolved Metals						
Aluminum, dissolved	**0.0217**	N/A	0.0050	mg/L	2021-10-10	
Antimony, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-10	
Arsenic, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-10	
Barium, dissolved	**0.0756**	N/A	0.0050	mg/L	2021-10-10	

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
MOR002_20211004_0945 (21J0990-04) | Matrix: Water | Sampled: 2021-10-04 09:45, Continued						
Dissolved Metals, Continued						
Beryllium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-10	
Bismuth, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-10	
Boron, dissolved	< 0.0500	N/A	0.0500	mg/L	2021-10-10	
Cadmium, dissolved	**0.000023**	N/A	0.000010	mg/L	2021-10-10	
Calcium, dissolved	**9.04**	N/A	0.20	mg/L	2021-10-10	
Chromium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-10	
Cobalt, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-10	
Copper, dissolved	**0.00057**	N/A	0.00040	mg/L	2021-10-10	
Iron, dissolved	**0.012**	N/A	0.010	mg/L	2021-10-10	
Lead, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-10	
Lithium, dissolved	**0.00054**	N/A	0.00010	mg/L	2021-10-10	
Magnesium, dissolved	**2.07**	N/A	0.010	mg/L	2021-10-10	
Manganese, dissolved	**0.00077**	N/A	0.00020	mg/L	2021-10-10	
Mercury, dissolved	< 0.000010	N/A	0.000010	mg/L	2021-10-13	
Molybdenum, dissolved	**0.00024**	N/A	0.00010	mg/L	2021-10-10	
Nickel, dissolved	< 0.00040	N/A	0.00040	mg/L	2021-10-10	
Phosphorus, dissolved	< 0.050	N/A	0.050	mg/L	2021-10-10	
Potassium, dissolved	**0.31**	N/A	0.10	mg/L	2021-10-10	
Selenium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-10	
Silicon, dissolved	**1.9**	N/A	1.0	mg/L	2021-10-10	
Silver, dissolved	< 0.000050	N/A	0.000050	mg/L	2021-10-10	
Sodium, dissolved	**0.72**	N/A	0.10	mg/L	2021-10-10	
Strontium, dissolved	**0.0469**	N/A	0.0010	mg/L	2021-10-10	
Sulfur, dissolved	< 3.0	N/A	3.0	mg/L	2021-10-10	
Tellurium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-10	
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2021-10-10	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-10	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-10	
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2021-10-10	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2021-10-10	
Uranium, dissolved	**0.000037**	N/A	0.000020	mg/L	2021-10-10	
Vanadium, dissolved	< 0.0010	N/A	0.0010	mg/L	2021-10-10	
Zinc, dissolved	< 0.0040	N/A	0.0040	mg/L	2021-10-10	
Zirconium, dissolved	**0.00011**	N/A	0.00010	mg/L	2021-10-10	
General Parameters						
Alkalinity, Total (as CaCO3)	**35.8**	N/A	1.0	mg/L	2021-10-08	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-08	
Alkalinity, Bicarbonate (as CaCO3)	**35.8**	N/A	1.0	mg/L	2021-10-08	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-08	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-08	
Carbon, Total Organic	**3.67**	N/A	0.50	mg/L	2021-10-12	
Carbon, Dissolved Organic	**3.43**	N/A	0.50	mg/L	2021-10-12	

TEST RESULTS

REPORTED TO Elk River Alliance
PROJECT ERA-CBWM

WORK ORDER 21J0990
REPORTED 2021-10-14 16:07

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
MOR002_20211004_0945 (21J0990-04) | Matrix: Water | Sampled: 2021-10-04 09:45, Continued						
General Parameters, Continued						
Nitrogen, Total Kjeldahl	**0.074**	N/A	0.050	mg/L	2021-10-14	
Phosphorus, Total (as P)	**0.0095**	N/A	0.0050	mg/L	2021-10-14	
Solids, Total Suspended	< 2.0	N/A	2.0	mg/L	2021-10-12	HT1
Total Metals						
Aluminum, total	**0.0834**	OG < 0.1	0.0050	mg/L	2021-10-14	
Antimony, total	< 0.00020	MAC = 0.006	0.00020	mg/L	2021-10-14	
Arsenic, total	< 0.00050	MAC = 0.01	0.00050	mg/L	2021-10-14	
Barium, total	**0.0819**	MAC = 2	0.0050	mg/L	2021-10-14	
Beryllium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-14	
Bismuth, total	< 0.00010	N/A	0.00010	mg/L	2021-10-14	
Boron, total	< 0.0500	MAC = 5	0.0500	mg/L	2021-10-14	
Cadmium, total	**0.000025**	MAC = 0.005	0.000010	mg/L	2021-10-14	
Calcium, total	**9.50**	None Required	0.20	mg/L	2021-10-14	
Chromium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2021-10-14	
Cobalt, total	< 0.00010	N/A	0.00010	mg/L	2021-10-14	
Copper, total	**0.00061**	MAC = 2	0.00040	mg/L	2021-10-14	
Iron, total	**0.058**	AO ≤ 0.3	0.010	mg/L	2021-10-14	
Lead, total	**0.00024**	MAC = 0.005	0.00020	mg/L	2021-10-14	
Lithium, total	**0.00066**	N/A	0.00010	mg/L	2021-10-14	
Magnesium, total	**2.24**	None Required	0.010	mg/L	2021-10-14	
Manganese, total	**0.00227**	MAC = 0.12	0.00020	mg/L	2021-10-14	
Mercury, total	< 0.000010	MAC = 0.001	0.000010	mg/L	2021-10-13	
Molybdenum, total	**0.00034**	N/A	0.00010	mg/L	2021-10-14	
Nickel, total	**0.00044**	N/A	0.00040	mg/L	2021-10-14	
Phosphorus, total	< 0.050	N/A	0.050	mg/L	2021-10-14	
Potassium, total	**0.32**	N/A	0.10	mg/L	2021-10-14	
Selenium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2021-10-14	
Silicon, total	**1.7**	N/A	1.0	mg/L	2021-10-14	
Silver, total	< 0.000050	None Required	0.000050	mg/L	2021-10-14	
Sodium, total	**0.82**	AO ≤ 200	0.10	mg/L	2021-10-14	
Strontium, total	**0.0486**	7	0.0010	mg/L	2021-10-14	
Sulfur, total	**3.9**	N/A	3.0	mg/L	2021-10-14	
Tellurium, total	< 0.00050	N/A	0.00050	mg/L	2021-10-14	
Thallium, total	< 0.000020	N/A	0.000020	mg/L	2021-10-14	
Thorium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-14	
Tin, total	< 0.00020	N/A	0.00020	mg/L	2021-10-14	
Titanium, total	< 0.0050	N/A	0.0050	mg/L	2021-10-14	
Tungsten, total	< 0.0010	N/A	0.0010	mg/L	2021-10-14	
Uranium, total	**0.000050**	MAC = 0.02	0.000020	mg/L	2021-10-14	
Vanadium, total	< 0.0010	N/A	0.0010	mg/L	2021-10-14	
Zinc, total	< 0.0040	AO ≤ 5	0.0040	mg/L	2021-10-14	
Zirconium, total	**0.00019**	N/A	0.00010	mg/L	2021-10-14	

TEST RESULTS

REPORTED TO Elk River Alliance
PROJECT ERA-CBWM

WORK ORDER 21J0990
REPORTED 2021-10-14 16:07

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
DUP1_20211004_0945 (21J0990-05) | Matrix: Water | Sampled: 2021-10-04 09:50						
Anions						
Chloride	**0.16**	AO ≤ 250	0.10	mg/L	2021-10-13	
Nitrate (as N)	< 0.010	MAC = 10	0.010	mg/L	2021-10-13	HT1
Nitrite (as N)	< 0.010	MAC = 1	0.010	mg/L	2021-10-13	HT1
Phosphate (as P)	< 0.0050	N/A	0.0050	mg/L	2021-10-13	HT1
Sulfate	**1.6**	AO ≤ 500	1.0	mg/L	2021-10-13	
Calculated Parameters						
Hardness, Total (as CaCO3)	**33.7**	None Required	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	< 0.0100	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	**0.0710**	N/A	0.0500	mg/L	N/A	
Dissolved Metals						
Aluminum, dissolved	**0.0255**	N/A	0.0050	mg/L	2021-10-10	
Antimony, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-10	
Arsenic, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-10	
Barium, dissolved	**0.0814**	N/A	0.0050	mg/L	2021-10-10	
Beryllium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-10	
Bismuth, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-10	
Boron, dissolved	< 0.0500	N/A	0.0500	mg/L	2021-10-10	
Cadmium, dissolved	**0.000029**	N/A	0.000010	mg/L	2021-10-10	
Calcium, dissolved	**9.84**	N/A	0.20	mg/L	2021-10-10	
Chromium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-10	
Cobalt, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-10	
Copper, dissolved	**0.00060**	N/A	0.00040	mg/L	2021-10-10	
Iron, dissolved	**0.014**	N/A	0.010	mg/L	2021-10-10	
Lead, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-10	
Lithium, dissolved	**0.00058**	N/A	0.00010	mg/L	2021-10-10	
Magnesium, dissolved	**2.21**	N/A	0.010	mg/L	2021-10-10	
Manganese, dissolved	**0.00086**	N/A	0.00020	mg/L	2021-10-10	
Mercury, dissolved	< 0.000010	N/A	0.000010	mg/L	2021-10-13	
Molybdenum, dissolved	**0.00031**	N/A	0.00010	mg/L	2021-10-10	
Nickel, dissolved	< 0.00040	N/A	0.00040	mg/L	2021-10-10	
Phosphorus, dissolved	< 0.050	N/A	0.050	mg/L	2021-10-10	
Potassium, dissolved	**0.32**	N/A	0.10	mg/L	2021-10-10	
Selenium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-10	
Silicon, dissolved	**2.0**	N/A	1.0	mg/L	2021-10-10	
Silver, dissolved	< 0.000050	N/A	0.000050	mg/L	2021-10-10	
Sodium, dissolved	**0.78**	N/A	0.10	mg/L	2021-10-10	
Strontium, dissolved	**0.0486**	N/A	0.0010	mg/L	2021-10-10	
Sulfur, dissolved	< 3.0	N/A	3.0	mg/L	2021-10-10	
Tellurium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-10	
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2021-10-10	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-10	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-10	

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
DUP1_20211004_0945 (21J0990-05) | Matrix: Water | Sampled: 2021-10-04 09:50, Continued						
Dissolved Metals, Continued						
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2021-10-10	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2021-10-10	
Uranium, dissolved	**0.000040**	N/A	0.000020	mg/L	2021-10-10	
Vanadium, dissolved	< 0.0010	N/A	0.0010	mg/L	2021-10-10	
Zinc, dissolved	< 0.0040	N/A	0.0040	mg/L	2021-10-10	
Zirconium, dissolved	**0.00013**	N/A	0.00010	mg/L	2021-10-10	
General Parameters						
Alkalinity, Total (as CaCO3)	**36.1**	N/A	1.0	mg/L	2021-10-08	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-08	
Alkalinity, Bicarbonate (as CaCO3)	**36.1**	N/A	1.0	mg/L	2021-10-08	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-08	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-08	
Carbon, Total Organic	**3.72**	N/A	0.50	mg/L	2021-10-12	
Carbon, Dissolved Organic	**3.52**	N/A	0.50	mg/L	2021-10-12	
Nitrogen, Total Kjeldahl	**0.071**	N/A	0.050	mg/L	2021-10-14	
Phosphorus, Total (as P)	**0.0079**	N/A	0.0050	mg/L	2021-10-14	
Solids, Total Suspended	< 2.0	N/A	2.0	mg/L	2021-10-12	HT1
Total Metals						
Aluminum, total	**0.0828**	OG < 0.1	0.0050	mg/L	2021-10-14	
Antimony, total	< 0.00020	MAC = 0.006	0.00020	mg/L	2021-10-14	
Arsenic, total	< 0.00050	MAC = 0.01	0.00050	mg/L	2021-10-14	
Barium, total	**0.0851**	MAC = 2	0.0050	mg/L	2021-10-14	
Beryllium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-14	
Bismuth, total	< 0.00010	N/A	0.00010	mg/L	2021-10-14	
Boron, total	< 0.0500	MAC = 5	0.0500	mg/L	2021-10-14	
Cadmium, total	**0.000025**	MAC = 0.005	0.000010	mg/L	2021-10-14	
Calcium, total	**9.78**	None Required	0.20	mg/L	2021-10-14	
Chromium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2021-10-14	
Cobalt, total	< 0.00010	N/A	0.00010	mg/L	2021-10-14	
Copper, total	**0.00087**	MAC = 2	0.00040	mg/L	2021-10-14	
Iron, total	**0.051**	AO ≤ 0.3	0.010	mg/L	2021-10-14	
Lead, total	**0.00023**	MAC = 0.005	0.00020	mg/L	2021-10-14	
Lithium, total	**0.00069**	N/A	0.00010	mg/L	2021-10-14	
Magnesium, total	**2.39**	None Required	0.010	mg/L	2021-10-14	
Manganese, total	**0.00162**	MAC = 0.12	0.00020	mg/L	2021-10-14	
Mercury, total	< 0.000010	MAC = 0.001	0.000010	mg/L	2021-10-13	
Molybdenum, total	**0.00035**	N/A	0.00010	mg/L	2021-10-14	
Nickel, total	**0.00043**	N/A	0.00040	mg/L	2021-10-14	
Phosphorus, total	< 0.050	N/A	0.050	mg/L	2021-10-14	
Potassium, total	**0.34**	N/A	0.10	mg/L	2021-10-14	
Selenium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2021-10-14	
Silicon, total	**1.8**	N/A	1.0	mg/L	2021-10-14	

TEST RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	21J0990
PROJECT	ERA-CBWM	**REPORTED**	2021-10-14 16:07

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
DUP1_20211004_0945 (21J0990-05) | Matrix: Water | Sampled: 2021-10-04 09:50, Continued						
Total Metals, Continued						
Silver, total	< 0.000050	None Required	0.000050	mg/L	2021-10-14	
Sodium, total	**0.85**	AO ≤ 200	0.10	mg/L	2021-10-14	
Strontium, total	**0.0491**	7	0.0010	mg/L	2021-10-14	
Sulfur, total	**3.8**	N/A	3.0	mg/L	2021-10-14	
Tellurium, total	< 0.00050	N/A	0.00050	mg/L	2021-10-14	
Thallium, total	< 0.000020	N/A	0.000020	mg/L	2021-10-14	
Thorium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-14	
Tin, total	< 0.00020	N/A	0.00020	mg/L	2021-10-14	
Titanium, total	< 0.0050	N/A	0.0050	mg/L	2021-10-14	
Tungsten, total	< 0.0010	N/A	0.0010	mg/L	2021-10-14	
Uranium, total	**0.000046**	MAC = 0.02	0.000020	mg/L	2021-10-14	
Vanadium, total	< 0.0010	N/A	0.0010	mg/L	2021-10-14	
Zinc, total	< 0.0040	AO ≤ 5	0.0040	mg/L	2021-10-14	
Zirconium, total	**0.00018**	N/A	0.00010	mg/L	2021-10-14	

Sample Qualifiers:

HT1 The sample was prepared and/or analyzed past the recommended holding time.

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Elk River Alliance	**WORK ORDER**	21J0990
PROJECT	ERA-CBWM	**REPORTED**	2021-10-14 16:07

Analysis Description	Method Ref.	Technique	Accredited	Location
Alkalinity in Water	SM 2320 B* (2017)	Titration with H2SO4	✓	Kelowna
Anions in Water	SM 4110 B (2017)	Ion Chromatography	✓	Kelowna
Carbon, Dissolved Organic in Water	SM 5310 B (2017)	Combustion, Infrared CO2 Detection	✓	Kelowna
Carbon, Total Organic in Water	SM 5310 B (2017)	Combustion, Infrared CO2 Detection	✓	Kelowna
Dissolved Metals in Water	EPA 200.8 / EPA 6020B	0.45 µm Filtration / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	✓	Richmond
EPH in Water	EPA 3511* / BCMOE EPHw	Hexane MicroExtraction (Base/Neutral) / Gas Chromatography (GC-FID)	✓	Richmond
Hardness in Water	SM 2340 B (2017)	Calculation: 2.497 [diss Ca] + 4.118 [diss Mg]	✓	N/A
Mercury, dissolved in Water	EPA 245.7*	BrCl2 Oxidation / Cold Vapor Atomic Fluorescence Spectrometry (CVAFS)	✓	Richmond
Mercury, total in Water	EPA 245.7*	BrCl2 Oxidation / Cold Vapor Atomic Fluorescence Spectrometry (CVAFS)	✓	Richmond
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2017)	Block Digestion and Flow Injection Analysis	✓	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2017)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Solids, Total Suspended in Water	SM 2540 D* (2017)	Gravimetry (Dried at 103-105C)	✓	Kelowna
Total Metals in Water	EPA 200.2 / EPA 6020B	HNO3+HCl Hot Block Digestion / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	✓	Richmond

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Glossary of Terms:

RL	Reporting Limit (default)
<	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
AO	Aesthetic Objective
MAC	Maximum Acceptable Concentration (health based)
mg/L	Milligrams per litre
OG	Operational Guideline (treated water)
µg/L	Micrograms per litre
EPA	United States Environmental Protection Agency Test Methods
SM	Standard Methods for the Examination of Water and Wastewater, American Public Health Association

Guidelines Referenced in this Report:

Guidelines for Canadian Drinking Water Quality (Health Canada, June 2019)

Note: In some cases, the values displayed on the report represent the lowest guideline and are to be verified by the end user

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Elk River Alliance	**WORK ORDER**	21J0990
PROJECT	ERA-CBWM	**REPORTED**	2021-10-14 16:07

General Comments:

The results in this report apply to the samples analyzed in accordance with the Chain of Custody document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Samples will be disposed of 30 days after the test report has been issued or once samples expire, whichever comes first. Longer hold is possible if agreed to in writing.

Results in **Bold** indicate values that are above CARO's method reporting limits. Any results that are above regulatory limits are highlighted **red**. Please note that results will only be highlighted red if the regulatory limits are included on the CARO report. Any Bold and/or highlighted results do not take into account method uncertainty. If you would like method uncertainty or regulatory limits to be included on your report, please contact your Account Manager:teamcaro@caro.ca

Please note any regulatory guidelines applied to this report are added as a convenience to the client, at their request, to help provide some initial context to analytical results obtained. Although CARO makes every effort to ensure accuracy of the associated regulatory guideline(s) applied, the guidelines applied cannot be assumed to be correct due to a variety of factors and as such CARO Analytical Services assumes no liability or responsibility for the use of those guidelines to make any decisions. The original source of the regulation should be verified and a review of the guideline (s) should be validated as correct in order to make any decisions arising from the comparison of the analytical data obtained to the relevant regulatory guideline for one's particular circumstances. Further, CARO Analytical Services assumes no liability or responsibility for any loss attributed from the use of these guidelines in any way.

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	21J0990
PROJECT	ERA-CBWM	**REPORTED**	2021-10-14 16:07

The following section displays the quality control (QC) data that is associated with your sample data. Groups of samples are prepared in "batches" and analyzed in conjunction with QC samples that ensure your data is of the highest quality. Common QC types include:

- **Method Blank (Blk)**: A blank sample that undergoes sample processing identical to that carried out for the test samples. Method blank results are used to assess contamination from the laboratory environment and reagents.
- **Duplicate (Dup)**: An additional or second portion of a randomly selected sample in the analytical run carried through the entire analytical process. Duplicates provide a measure of the analytical method's precision (reproducibility).
- **Blank Spike (BS)**: A sample of known concentration which undergoes processing identical to that carried out for test samples, also referred to as a laboratory control sample (LCS). Blank spikes provide a measure of the analytical method's accuracy.
- **Matrix Spike (MS)**: A second aliquot of sample is fortified with with a known concentration of target analytes and carried through the entire analytical process. Matrix spikes evaluate potential matrix effects that may affect the analyte recovery.
- **Reference Material (SRM)**: A homogenous material of similar matrix to the samples, certified for the parameter(s) listed. Reference Materials ensure that the analytical process is adequate to achieve acceptable recoveries of the parameter(s) tested.

Each QC type is analyzed at a 5-10% frequency, i.e. one blank/duplicate/spike for every 10-20 samples. For all types of QC, the specified recovery (% Rec) and relative percent difference (RPD) limits are derived from long-term method performance averages and/or prescribed by the reference method.

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Anions, Batch B1J0936										
Blank (B1J0936-BLK1)				Prepared: 2021-10-13, Analyzed: 2021-10-13						
Chloride	< 0.10	0.10	mg/L							
Nitrate (as N)	< 0.010	0.010	mg/L							
Nitrite (as N)	< 0.010	0.010	mg/L							
Phosphate (as P)	< 0.0050	0.0050	mg/L							
Sulfate	< 1.0	1.0	mg/L							
Blank (B1J0936-BLK2)				Prepared: 2021-10-13, Analyzed: 2021-10-13						
Chloride	< 0.10	0.10	mg/L							
Nitrate (as N)	< 0.010	0.010	mg/L							
Nitrite (as N)	< 0.010	0.010	mg/L							
Phosphate (as P)	< 0.0050	0.0050	mg/L							
Sulfate	< 1.0	1.0	mg/L							
LCS (B1J0936-BS1)				Prepared: 2021-10-13, Analyzed: 2021-10-13						
Chloride	15.9	0.10	mg/L	16.0		100	90-110			
Nitrate (as N)	4.08	0.010	mg/L	4.00		102	90-110			
Nitrite (as N)	2.04	0.010	mg/L	2.00		102	85-115			
Phosphate (as P)	0.994	0.0050	mg/L	1.00		99	80-120			
Sulfate	16.2	1.0	mg/L	16.0		101	90-110			
LCS (B1J0936-BS2)				Prepared: 2021-10-13, Analyzed: 2021-10-13						
Chloride	15.9	0.10	mg/L	16.0		99	90-110			
Nitrate (as N)	4.10	0.010	mg/L	4.00		102	90-110			
Nitrite (as N)	2.01	0.010	mg/L	2.00		100	85-115			
Phosphate (as P)	1.00	0.0050	mg/L	1.00		100	80-120			
Sulfate	16.2	1.0	mg/L	16.0		101	90-110			
BCMOE Aggregate Hydrocarbons, Batch B1J1307										
Blank (B1J1307-BLK1)				Prepared: 2021-10-13, Analyzed: 2021-10-13						
EPHw10-19	< 250	250	µg/L							
EPHw19-32	< 250	250	µg/L							
Surrogate: 2-Methylnonane (EPH/F2-4)	*1400*		*µg/L*	1620		*87*	*60-140*			
LCS (B1J1307-BS2)				Prepared: 2021-10-13, Analyzed: 2021-10-13						
EPHw10-19	15700	250	µg/L	15400		102	70-130			

APPENDIX 2: QUALITY CONTROL RESULTS

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Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
BCMOE Aggregate Hydrocarbons, Batch B1J1307, Continued										
LCS (B1J1307-BS2), Continued				Prepared: 2021-10-13, Analyzed: 2021-10-13						
EPHw19-32	22300	250	µg/L	22100		101	70-130			
Surrogate: 2-Methylnonane (EPH/F2-4)	*1040*		*µg/L*	1620		*64*	*60-140*			
LCS Dup (B1J1307-BSD2)				Prepared: 2021-10-13, Analyzed: 2021-10-13						
EPHw10-19	16700	250	µg/L	15400		108	70-130	6	20	
EPHw19-32	23600	250	µg/L	22100		107	70-130	6	20	
Surrogate: 2-Methylnonane (EPH/F2-4)	*1080*		*µg/L*	1620		*67*	*60-140*			
Dissolved Metals, Batch B1J1143										
Blank (B1J1143-BLK1)				Prepared: 2021-10-10, Analyzed: 2021-10-10						
Aluminum, dissolved	< 0.0050	0.0050	mg/L							
Antimony, dissolved	< 0.00020	0.00020	mg/L							
Arsenic, dissolved	< 0.00050	0.00050	mg/L							
Barium, dissolved	< 0.0050	0.0050	mg/L							
Beryllium, dissolved	< 0.00010	0.00010	mg/L							
Bismuth, dissolved	< 0.00010	0.00010	mg/L							
Boron, dissolved	< 0.0500	0.0500	mg/L							
Cadmium, dissolved	< 0.000010	0.000010	mg/L							
Calcium, dissolved, dissolved	< 0.20	0.20	mg/L							
Chromium, dissolved	< 0.00050	0.00050	mg/L							
Cobalt, dissolved	< 0.00010	0.00010	mg/L							
Copper, dissolved	< 0.00040	0.00040	mg/L							
Iron, dissolved	< 0.010	0.010	mg/L							
Lead, dissolved	< 0.00020	0.00020	mg/L							
Lithium, dissolved	< 0.00010	0.00010	mg/L							
Magnesium, dissolved, dissolved	< 0.010	0.010	mg/L							
Manganese, dissolved	< 0.00020	0.00020	mg/L							
Molybdenum, dissolved	< 0.00010	0.00010	mg/L							
Nickel, dissolved	< 0.00040	0.00040	mg/L							
Phosphorus, dissolved	< 0.050	0.050	mg/L							
Potassium, dissolved	< 0.10	0.10	mg/L							
Selenium, dissolved	< 0.00050	0.00050	mg/L							
Silicon, dissolved	< 1.0	1.0	mg/L							
Silver, dissolved	< 0.000050	0.000050	mg/L							
Sodium, dissolved	< 0.10	0.10	mg/L							
Strontium, dissolved	< 0.0010	0.0010	mg/L							
Sulfur, dissolved	< 3.0	3.0	mg/L							
Tellurium, dissolved	< 0.00050	0.00050	mg/L							
Thallium, dissolved	< 0.000020	0.000020	mg/L							
Thorium, dissolved	< 0.00010	0.00010	mg/L							
Tin, dissolved	< 0.00020	0.00020	mg/L							
Titanium, dissolved	< 0.0050	0.0050	mg/L							
Tungsten, dissolved	< 0.0010	0.0010	mg/L							
Uranium, dissolved	< 0.000020	0.000020	mg/L							
Vanadium, dissolved	< 0.0010	0.0010	mg/L							
Zinc, dissolved	< 0.0040	0.0040	mg/L							
Zirconium, dissolved	< 0.00010	0.00010	mg/L							
LCS (B1J1143-BS1)				Prepared: 2021-10-10, Analyzed: 2021-10-10						
Aluminum, dissolved	0.0225	0.0050	mg/L	0.0200		113	80-120			
Antimony, dissolved	0.0192	0.00020	mg/L	0.0200		96	80-120			
Arsenic, dissolved	0.0193	0.00050	mg/L	0.0200		97	80-120			
Barium, dissolved	0.0192	0.0050	mg/L	0.0200		96	80-120			
Beryllium, dissolved	0.0202	0.00010	mg/L	0.0200		101	80-120			
Bismuth, dissolved	0.0199	0.00010	mg/L	0.0200		99	80-120			

APPENDIX 2: QUALITY CONTROL RESULTS

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Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Dissolved Metals, Batch B1J1143, Continued										
LCS (B1J1143-BS1), Continued				Prepared: 2021-10-10, Analyzed: 2021-10-10						
Boron, dissolved	< 0.0500	0.0500	mg/L	0.0200		111	80-120			
Cadmium, dissolved	0.0190	0.000010	mg/L	0.0200		95	80-120			
Calcium, dissolved, dissolved	2.02	0.20	mg/L	2.00		101	80-120			
Chromium, dissolved	0.0192	0.00050	mg/L	0.0200		96	80-120			
Cobalt, dissolved	0.0193	0.00010	mg/L	0.0200		96	80-120			
Copper, dissolved	0.0186	0.00040	mg/L	0.0200		93	80-120			
Iron, dissolved	1.83	0.010	mg/L	2.00		92	80-120			
Lead, dissolved	0.0215	0.00020	mg/L	0.0200		108	80-120			
Lithium, dissolved	0.0205	0.00010	mg/L	0.0200		102	80-120			
Magnesium, dissolved, dissolved	2.12	0.010	mg/L	2.00		106	80-120			
Manganese, dissolved	0.0184	0.00020	mg/L	0.0200		92	80-120			
Molybdenum, dissolved	0.0196	0.00010	mg/L	0.0200		98	80-120			
Nickel, dissolved	0.0195	0.00040	mg/L	0.0200		97	80-120			
Phosphorus, dissolved	1.92	0.050	mg/L	2.00		96	80-120			
Potassium, dissolved	1.95	0.10	mg/L	2.00		98	80-120			
Selenium, dissolved	0.0218	0.00050	mg/L	0.0200		109	80-120			
Silicon, dissolved	2.3	1.0	mg/L	2.00		114	80-120			
Silver, dissolved	0.0189	0.000050	mg/L	0.0200		94	80-120			
Sodium, dissolved	2.03	0.10	mg/L	2.00		101	80-120			
Strontium, dissolved	0.0198	0.0010	mg/L	0.0200		99	80-120			
Sulfur, dissolved	5.1	3.0	mg/L	5.00		102	80-120			
Tellurium, dissolved	0.0211	0.00050	mg/L	0.0200		106	80-120			
Thallium, dissolved	0.0189	0.000020	mg/L	0.0200		95	80-120			
Thorium, dissolved	0.0182	0.00010	mg/L	0.0200		91	80-120			
Tin, dissolved	0.0206	0.00020	mg/L	0.0200		103	80-120			
Titanium, dissolved	0.0222	0.0050	mg/L	0.0200		111	80-120			
Tungsten, dissolved	0.0193	0.0010	mg/L	0.0200		96	80-120			
Uranium, dissolved	0.0188	0.000020	mg/L	0.0200		94	80-120			
Vanadium, dissolved	0.0178	0.0010	mg/L	0.0200		89	80-120			
Zinc, dissolved	0.0204	0.0040	mg/L	0.0200		102	80-120			
Zirconium, dissolved	0.0199	0.00010	mg/L	0.0200		100	80-120			
Reference (B1J1143-SRM1)				Prepared: 2021-10-10, Analyzed: 2021-10-10						
Aluminum, dissolved	0.207	0.0050	mg/L	0.235		88	70-130			
Antimony, dissolved	0.0434	0.00020	mg/L	0.0431		101	70-130			
Arsenic, dissolved	0.432	0.00050	mg/L	0.423		102	70-130			
Barium, dissolved	2.95	0.0050	mg/L	3.30		89	70-130			
Beryllium, dissolved	0.205	0.00010	mg/L	0.209		98	70-130			
Boron, dissolved	1.61	0.0500	mg/L	1.65		98	70-130			
Cadmium, dissolved	0.211	0.000010	mg/L	0.221		95	70-130			
Calcium, dissolved, dissolved	7.50	0.20	mg/L	7.72		97	70-130			
Chromium, dissolved	0.413	0.00050	mg/L	0.434		95	70-130			
Cobalt, dissolved	0.121	0.00010	mg/L	0.124		98	70-130			
Copper, dissolved	0.755	0.00040	mg/L	0.815		93	70-130			
Iron, dissolved	1.17	0.010	mg/L	1.27		92	70-130			
Lead, dissolved	0.116	0.00020	mg/L	0.110		105	70-130			
Lithium, dissolved	0.100	0.00010	mg/L	0.100		100	70-130			
Magnesium, dissolved, dissolved	6.90	0.010	mg/L	6.59		105	70-130			
Manganese, dissolved	0.310	0.00020	mg/L	0.342		91	70-130			
Molybdenum, dissolved	0.398	0.00010	mg/L	0.404		98	70-130			
Nickel, dissolved	0.815	0.00040	mg/L	0.835		98	70-130			
Phosphorus, dissolved	0.519	0.050	mg/L	0.499		104	70-130			
Potassium, dissolved	2.91	0.10	mg/L	2.88		101	70-130			
Selenium, dissolved	0.0311	0.00050	mg/L	0.0324		96	70-130			
Sodium, dissolved	17.1	0.10	mg/L	18.0		95	70-130			
Strontium, dissolved	0.861	0.0010	mg/L	0.935		92	70-130			

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Dissolved Metals, Batch B1J1143, Continued										
Reference (B1J1143-SRM1), Continued				Prepared: 2021-10-10, Analyzed: 2021-10-10						
Thallium, dissolved	0.0365	0.000020	mg/L	0.0385		95	70-130			
Uranium, dissolved	0.232	0.000020	mg/L	0.258		90	70-130			
Vanadium, dissolved	0.810	0.0010	mg/L	0.873		93	70-130			
Zinc, dissolved	0.900	0.0040	mg/L	0.848		106	70-130			
Dissolved Metals, Batch B1J1318										
Blank (B1J1318-BLK1)				Prepared: 2021-10-13, Analyzed: 2021-10-13						
Mercury, dissolved	< 0.000010	0.000010	mg/L							
Blank (B1J1318-BLK2)				Prepared: 2021-10-13, Analyzed: 2021-10-13						
Mercury, dissolved	< 0.000010	0.000010	mg/L							
Blank (B1J1318-BLK3)				Prepared: 2021-10-13, Analyzed: 2021-10-13						
Mercury, dissolved	< 0.000010	0.000010	mg/L							
Reference (B1J1318-SRM1)				Prepared: 2021-10-13, Analyzed: 2021-10-13						
Mercury, dissolved	0.00694	0.000010	mg/L	0.00581		120	70-130			
Reference (B1J1318-SRM2)				Prepared: 2021-10-13, Analyzed: 2021-10-13						
Mercury, dissolved	0.00587	0.000010	mg/L	0.00581		101	70-130			
Reference (B1J1318-SRM3)				Prepared: 2021-10-13, Analyzed: 2021-10-13						
Mercury, dissolved	0.00563	0.000010	mg/L	0.00581		97	70-130			
General Parameters, Batch B1J0918										
Blank (B1J0918-BLK1)				Prepared: 2021-10-12, Analyzed: 2021-10-12						
Carbon, Total Organic	< 0.50	0.50	mg/L							
Carbon, Dissolved Organic	< 0.50	0.50	mg/L							
Blank (B1J0918-BLK2)				Prepared: 2021-10-12, Analyzed: 2021-10-12						
Carbon, Total Organic	< 0.50	0.50	mg/L							
Carbon, Dissolved Organic	< 0.50	0.50	mg/L							
Blank (B1J0918-BLK3)				Prepared: 2021-10-12, Analyzed: 2021-10-12						
Carbon, Total Organic	< 0.50	0.50	mg/L							
Carbon, Dissolved Organic	< 0.50	0.50	mg/L							
LCS (B1J0918-BS1)				Prepared: 2021-10-12, Analyzed: 2021-10-12						
Carbon, Total Organic	9.60	0.50	mg/L	10.0		96	78-116			
Carbon, Dissolved Organic	9.84	0.50	mg/L	10.0		98	78-116			
LCS (B1J0918-BS2)				Prepared: 2021-10-12, Analyzed: 2021-10-12						
Carbon, Total Organic	9.32	0.50	mg/L	10.0		93	78-116			
Carbon, Dissolved Organic	9.32	0.50	mg/L	10.0		93	78-116			
LCS (B1J0918-BS3)				Prepared: 2021-10-12, Analyzed: 2021-10-12						
Carbon, Total Organic	9.42	0.50	mg/L	10.0		94	78-116			
Carbon, Dissolved Organic	9.34	0.50	mg/L	10.0		93	78-116			
Duplicate (B1J0918-DUP3)		**Source: 21J0990-05**		Prepared: 2021-10-12, Analyzed: 2021-10-12						
Carbon, Total Organic	3.79	0.50	mg/L		3.72			2	16	
Carbon, Dissolved Organic	3.60	0.50	mg/L		3.52			2	15	
Matrix Spike (B1J0918-MS3)		**Source: 21J0990-05**		Prepared: 2021-10-12, Analyzed: 2021-10-12						
Carbon, Total Organic	11.9	0.50	mg/L	10.0	3.72	81	70-130			

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Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
General Parameters, Batch B1J0918, Continued										
Matrix Spike (B1J0918-MS3), Continued	**Source: 21J0990-05**			Prepared: 2021-10-12, Analyzed: 2021-10-12						
Carbon, Dissolved Organic	11.8	0.50	mg/L	10.0	3.52	83	70-130			
General Parameters, Batch B1J0984										
Blank (B1J0984-BLK1)				Prepared: 2021-10-08, Analyzed: 2021-10-08						
Alkalinity, Total (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Bicarbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Carbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Hydroxide (as CaCO3)	< 1.0	1.0	mg/L							
Blank (B1J0984-BLK2)				Prepared: 2021-10-08, Analyzed: 2021-10-08						
Alkalinity, Total (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Bicarbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Carbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Hydroxide (as CaCO3)	< 1.0	1.0	mg/L							
Blank (B1J0984-BLK3)				Prepared: 2021-10-08, Analyzed: 2021-10-08						
Alkalinity, Total (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Bicarbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Carbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Hydroxide (as CaCO3)	< 1.0	1.0	mg/L							
LCS (B1J0984-BS1)				Prepared: 2021-10-08, Analyzed: 2021-10-08						
Alkalinity, Total (as CaCO3)	107	1.0	mg/L	100		107	80-120			
LCS (B1J0984-BS2)				Prepared: 2021-10-08, Analyzed: 2021-10-08						
Alkalinity, Total (as CaCO3)	107	1.0	mg/L	100		107	80-120			
LCS (B1J0984-BS3)				Prepared: 2021-10-08, Analyzed: 2021-10-08						
Alkalinity, Total (as CaCO3)	108	1.0	mg/L	100		108	80-120			
General Parameters, Batch B1J1173										
Blank (B1J1173-BLK1)				Prepared: 2021-10-11, Analyzed: 2021-10-13						
Nitrogen, Total Kjeldahl	< 0.050	0.050	mg/L							
Blank (B1J1173-BLK2)				Prepared: 2021-10-11, Analyzed: 2021-10-13						
Nitrogen, Total Kjeldahl	< 0.050	0.050	mg/L							
LCS (B1J1173-BS1)				Prepared: 2021-10-11, Analyzed: 2021-10-13						
Nitrogen, Total Kjeldahl	1.12	0.050	mg/L	1.00		112	85-115			
LCS (B1J1173-BS2)				Prepared: 2021-10-11, Analyzed: 2021-10-13						
Nitrogen, Total Kjeldahl	1.12	0.050	mg/L	1.00		112	85-115			
General Parameters, Batch B1J1220										
Blank (B1J1220-BLK1)				Prepared: 2021-10-12, Analyzed: 2021-10-12						
Solids, Total Suspended	< 2.0	2.0	mg/L							
LCS (B1J1220-BS1)				Prepared: 2021-10-12, Analyzed: 2021-10-12						
Solids, Total Suspended	91.5	5.0	mg/L	100		92	85-115			

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PROJECT	ERA-CBWM	**REPORTED**	2021-10-14 16:07

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
General Parameters, Batch B1J1260										
Blank (B1J1260-BLK1)				Prepared: 2021-10-12, Analyzed: 2021-10-14						
Nitrogen, Total Kjeldahl	< 0.050	0.050	mg/L							
Blank (B1J1260-BLK2)				Prepared: 2021-10-12, Analyzed: 2021-10-14						
Nitrogen, Total Kjeldahl	< 0.050	0.050	mg/L							
LCS (B1J1260-BS1)				Prepared: 2021-10-12, Analyzed: 2021-10-14						
Nitrogen, Total Kjeldahl	0.993	0.050	mg/L	1.00		99	85-115			
LCS (B1J1260-BS2)				Prepared: 2021-10-12, Analyzed: 2021-10-14						
Nitrogen, Total Kjeldahl	0.969	0.050	mg/L	1.00		97	85-115			
General Parameters, Batch B1J1435										
Blank (B1J1435-BLK1)				Prepared: 2021-10-14, Analyzed: 2021-10-14						
Phosphorus, Total (as P)	< 0.0050	0.0050	mg/L							
Blank (B1J1435-BLK2)				Prepared: 2021-10-14, Analyzed: 2021-10-14						
Phosphorus, Total (as P)	< 0.0050	0.0050	mg/L							
LCS (B1J1435-BS1)				Prepared: 2021-10-14, Analyzed: 2021-10-14						
Phosphorus, Total (as P)	0.0988	0.0050	mg/L	0.100		99	85-115			
LCS (B1J1435-BS2)				Prepared: 2021-10-14, Analyzed: 2021-10-14						
Phosphorus, Total (as P)	0.101	0.0050	mg/L	0.100		101	85-115			
Total Metals, Batch B1J1202										
Blank (B1J1202-BLK1)				Prepared: 2021-10-12, Analyzed: 2021-10-14						
Aluminum, total	< 0.0050	0.0050	mg/L							
Antimony, total	< 0.00020	0.00020	mg/L							
Arsenic, total	< 0.00050	0.00050	mg/L							
Barium, total	< 0.0050	0.0050	mg/L							
Beryllium, total	< 0.00010	0.00010	mg/L							
Bismuth, total	< 0.00010	0.00010	mg/L							
Boron, total	< 0.0500	0.0500	mg/L							
Cadmium, total	< 0.000010	0.000010	mg/L							
Calcium, total	< 0.20	0.20	mg/L							
Chromium, total	< 0.00050	0.00050	mg/L							
Cobalt, total	< 0.00010	0.00010	mg/L							
Copper, total	< 0.00040	0.00040	mg/L							
Iron, total	< 0.010	0.010	mg/L							
Lead, total	< 0.00020	0.00020	mg/L							
Lithium, total	< 0.00010	0.00010	mg/L							
Magnesium, total	< 0.010	0.010	mg/L							
Manganese, total	< 0.00020	0.00020	mg/L							
Molybdenum, total	< 0.00010	0.00010	mg/L							
Nickel, total	< 0.00040	0.00040	mg/L							
Phosphorus, total	< 0.050	0.050	mg/L							
Potassium, total	< 0.10	0.10	mg/L							
Selenium, total	< 0.00050	0.00050	mg/L							
Silicon, total	< 1.0	1.0	mg/L							
Silver, total	< 0.000050	0.000050	mg/L							
Sodium, total	< 0.10	0.10	mg/L							
Strontium, total	< 0.0010	0.0010	mg/L							
Sulfur, total	< 3.0	3.0	mg/L							
Tellurium, total	< 0.00050	0.00050	mg/L							

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Total Metals, Batch B1J1202, Continued										
Blank (B1J1202-BLK1), Continued				Prepared: 2021-10-12, Analyzed: 2021-10-14						
Thallium, total	< 0.000020	0.000020	mg/L							
Thorium, total	< 0.00010	0.00010	mg/L							
Tin, total	< 0.00020	0.00020	mg/L							
Titanium, total	< 0.0050	0.0050	mg/L							
Tungsten, total	< 0.0010	0.0010	mg/L							
Uranium, total	< 0.000020	0.000020	mg/L							
Vanadium, total	< 0.0010	0.0010	mg/L							
Zinc, total	< 0.0040	0.0040	mg/L							
Zirconium, total	< 0.00010	0.00010	mg/L							
Blank (B1J1202-BLK2)				Prepared: 2021-10-12, Analyzed: 2021-10-14						
Aluminum, total	< 0.0050	0.0050	mg/L							
Antimony, total	< 0.00020	0.00020	mg/L							
Arsenic, total	< 0.00050	0.00050	mg/L							
Barium, total	< 0.0050	0.0050	mg/L							
Beryllium, total	< 0.00010	0.00010	mg/L							
Bismuth, total	< 0.00010	0.00010	mg/L							
Boron, total	< 0.0500	0.0500	mg/L							
Cadmium, total	< 0.000010	0.000010	mg/L							
Calcium, total	< 0.20	0.20	mg/L							
Chromium, total	< 0.00050	0.00050	mg/L							
Cobalt, total	< 0.00010	0.00010	mg/L							
Copper, total	< 0.00040	0.00040	mg/L							
Iron, total	< 0.010	0.010	mg/L							
Lead, total	< 0.00020	0.00020	mg/L							
Lithium, total	< 0.00010	0.00010	mg/L							
Magnesium, total	< 0.010	0.010	mg/L							
Manganese, total	< 0.00020	0.00020	mg/L							
Molybdenum, total	< 0.00010	0.00010	mg/L							
Nickel, total	< 0.00040	0.00040	mg/L							
Phosphorus, total	< 0.050	0.050	mg/L							
Potassium, total	< 0.10	0.10	mg/L							
Selenium, total	< 0.00050	0.00050	mg/L							
Silicon, total	< 1.0	1.0	mg/L							
Silver, total	< 0.000050	0.000050	mg/L							
Sodium, total	< 0.10	0.10	mg/L							
Strontium, total	< 0.0010	0.0010	mg/L							
Sulfur, total	< 3.0	3.0	mg/L							
Tellurium, total	< 0.00050	0.00050	mg/L							
Thallium, total	< 0.000020	0.000020	mg/L							
Thorium, total	< 0.00010	0.00010	mg/L							
Tin, total	< 0.00020	0.00020	mg/L							
Titanium, total	< 0.0050	0.0050	mg/L							
Tungsten, total	< 0.0010	0.0010	mg/L							
Uranium, total	< 0.000020	0.000020	mg/L							
Vanadium, total	< 0.0010	0.0010	mg/L							
Zinc, total	< 0.0040	0.0040	mg/L							
Zirconium, total	< 0.00010	0.00010	mg/L							
LCS (B1J1202-BS1)				Prepared: 2021-10-12, Analyzed: 2021-10-14						
Aluminum, total	0.0239	0.0050	mg/L	0.0200		120	80-120			
Antimony, total	0.0219	0.00020	mg/L	0.0200		110	80-120			
Arsenic, total	0.0217	0.00050	mg/L	0.0200		108	80-120			
Barium, total	0.0204	0.0050	mg/L	0.0200		102	80-120			
Beryllium, total	0.0215	0.00010	mg/L	0.0200		108	80-120			
Bismuth, total	0.0225	0.00010	mg/L	0.0200		112	80-120			
Boron, total	< 0.0500	0.0500	mg/L	0.0200		116	80-120			

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO Elk River Alliance
PROJECT ERA-CBWM

WORK ORDER 21J0990
REPORTED 2021-10-14 16:07

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Total Metals, Batch B1J1202, Continued										
LCS (B1J1202-BS1), Continued				Prepared: 2021-10-12, Analyzed: 2021-10-14						
Cadmium, total	0.0208	0.000010	mg/L	0.0200		104	80-120			
Calcium, total	2.11	0.20	mg/L	2.00		105	80-120			
Chromium, total	0.0223	0.00050	mg/L	0.0200		112	80-120			
Cobalt, total	0.0223	0.00010	mg/L	0.0200		112	80-120			
Copper, total	0.0228	0.00040	mg/L	0.0200		114	80-120			
Iron, total	2.18	0.010	mg/L	2.00		109	80-120			
Lead, total	0.0228	0.00020	mg/L	0.0200		114	80-120			
Lithium, total	0.0211	0.00010	mg/L	0.0200		106	80-120			
Magnesium, total	2.30	0.010	mg/L	2.00		115	80-120			
Manganese, total	0.0217	0.00020	mg/L	0.0200		108	80-120			
Molybdenum, total	0.0208	0.00010	mg/L	0.0200		104	80-120			
Nickel, total	0.0227	0.00040	mg/L	0.0200		113	80-120			
Phosphorus, total	2.32	0.050	mg/L	2.00		116	80-120			
Potassium, total	2.16	0.10	mg/L	2.00		108	80-120			
Selenium, total	0.0222	0.00050	mg/L	0.0200		111	80-120			
Silicon, total	2.4	1.0	mg/L	2.00		118	80-120			
Silver, total	0.0214	0.000050	mg/L	0.0200		107	80-120			
Sodium, total	2.23	0.10	mg/L	2.00		112	80-120			
Strontium, total	0.0199	0.0010	mg/L	0.0200		99	80-120			
Sulfur, total	5.8	3.0	mg/L	5.00		115	80-120			
Tellurium, total	0.0209	0.00050	mg/L	0.0200		104	80-120			
Thallium, total	0.0220	0.000020	mg/L	0.0200		110	80-120			
Thorium, total	0.0210	0.00010	mg/L	0.0200		105	80-120			
Tin, total	0.0226	0.00020	mg/L	0.0200		113	80-120			
Titanium, total	0.0226	0.0050	mg/L	0.0200		113	80-120			
Tungsten, total	0.0216	0.0010	mg/L	0.0200		108	80-120			
Uranium, total	0.0213	0.000020	mg/L	0.0200		107	80-120			
Vanadium, total	0.0220	0.0010	mg/L	0.0200		110	80-120			
Zinc, total	0.0239	0.0040	mg/L	0.0200		120	80-120			
Zirconium, total	0.0220	0.00010	mg/L	0.0200		110	80-120			
LCS (B1J1202-BS2)				Prepared: 2021-10-12, Analyzed: 2021-10-14						
Aluminum, total	0.0237	0.0050	mg/L	0.0200		119	80-120			
Antimony, total	0.0206	0.00020	mg/L	0.0200		103	80-120			
Arsenic, total	0.0200	0.00050	mg/L	0.0200		100	80-120			
Barium, total	0.0194	0.0050	mg/L	0.0200		97	80-120			
Beryllium, total	0.0199	0.00010	mg/L	0.0200		99	80-120			
Bismuth, total	0.0205	0.00010	mg/L	0.0200		103	80-120			
Boron, total	< 0.0500	0.0500	mg/L	0.0200		113	80-120			
Cadmium, total	0.0196	0.000010	mg/L	0.0200		98	80-120			
Calcium, total	1.96	0.20	mg/L	2.00		98	80-120			
Chromium, total	0.0207	0.00050	mg/L	0.0200		104	80-120			
Cobalt, total	0.0210	0.00010	mg/L	0.0200		105	80-120			
Copper, total	0.0208	0.00040	mg/L	0.0200		104	80-120			
Iron, total	2.05	0.010	mg/L	2.00		102	80-120			
Lead, total	0.0209	0.00020	mg/L	0.0200		104	80-120			
Lithium, total	0.0194	0.00010	mg/L	0.0200		97	80-120			
Magnesium, total	2.16	0.010	mg/L	2.00		108	80-120			
Manganese, total	0.0213	0.00020	mg/L	0.0200		107	80-120			
Molybdenum, total	0.0198	0.00010	mg/L	0.0200		99	80-120			
Nickel, total	0.0211	0.00040	mg/L	0.0200		106	80-120			
Phosphorus, total	2.26	0.050	mg/L	2.00		113	80-120			
Potassium, total	2.06	0.10	mg/L	2.00		103	80-120			
Selenium, total	0.0213	0.00050	mg/L	0.0200		107	80-120			
Silicon, total	2.2	1.0	mg/L	2.00		111	80-120			
Silver, total	0.0198	0.000050	mg/L	0.0200		99	80-120			

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO Elk River Alliance
PROJECT ERA-CBWM

WORK ORDER 21J0990
REPORTED 2021-10-14 16:07

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Total Metals, Batch B1J1202, Continued										
LCS (B1J1202-BS2), Continued				Prepared: 2021-10-12, Analyzed: 2021-10-14						
Sodium, total	2.10	0.10	mg/L	2.00		105	80-120			
Strontium, total	0.0194	0.0010	mg/L	0.0200		97	80-120			
Sulfur, total	5.6	3.0	mg/L	5.00		111	80-120			
Tellurium, total	0.0192	0.00050	mg/L	0.0200		96	80-120			
Thallium, total	0.0202	0.000020	mg/L	0.0200		101	80-120			
Thorium, total	0.0190	0.00010	mg/L	0.0200		95	80-120			
Tin, total	0.0205	0.00020	mg/L	0.0200		102	80-120			
Titanium, total	0.0197	0.0050	mg/L	0.0200		99	80-120			
Tungsten, total	0.0195	0.0010	mg/L	0.0200		98	80-120			
Uranium, total	0.0197	0.000020	mg/L	0.0200		98	80-120			
Vanadium, total	0.0204	0.0010	mg/L	0.0200		102	80-120			
Zinc, total	0.0240	0.0040	mg/L	0.0200		120	80-120			
Zirconium, total	0.0207	0.00010	mg/L	0.0200		104	80-120			
Duplicate (B1J1202-DUP2)		**Source: 21J0990-05**		Prepared: 2021-10-12, Analyzed: 2021-10-14						
Aluminum, total	0.0797	0.0050	mg/L		0.0828			4	20	
Antimony, total	< 0.00020	0.00020	mg/L		< 0.00020				20	
Arsenic, total	< 0.00050	0.00050	mg/L		< 0.00050				20	
Barium, total	0.0873	0.0050	mg/L		0.0851			3	20	
Beryllium, total	< 0.00010	0.00010	mg/L		< 0.00010				20	
Bismuth, total	< 0.00010	0.00010	mg/L		< 0.00010				20	
Boron, total	< 0.0500	0.0500	mg/L		< 0.0500				20	
Cadmium, total	0.000036	0.000010	mg/L		0.000025				20	
Calcium, total	9.96	0.20	mg/L		9.78			2	20	
Chromium, total	< 0.00050	0.00050	mg/L		< 0.00050				20	
Cobalt, total	< 0.00010	0.00010	mg/L		< 0.00010				20	
Copper, total	0.00061	0.00040	mg/L		0.00087				20	
Iron, total	0.050	0.010	mg/L		0.051			1	20	
Lead, total	0.00022	0.00020	mg/L		0.00023				20	
Lithium, total	0.00072	0.00010	mg/L		0.00069			5	20	
Magnesium, total	2.35	0.010	mg/L		2.39			2	20	
Manganese, total	0.00163	0.00020	mg/L		0.00162			< 1	20	
Molybdenum, total	0.00029	0.00010	mg/L		0.00035				20	
Nickel, total	0.00050	0.00040	mg/L		0.00043				20	
Phosphorus, total	< 0.050	0.050	mg/L		< 0.050				20	
Potassium, total	0.33	0.10	mg/L		0.34				20	
Selenium, total	< 0.00050	0.00050	mg/L		< 0.00050				20	
Silicon, total	1.7	1.0	mg/L		1.8				20	
Silver, total	< 0.000050	0.000050	mg/L		< 0.000050				20	
Sodium, total	0.84	0.10	mg/L		0.85			2	20	
Strontium, total	0.0507	0.0010	mg/L		0.0491			3	20	
Sulfur, total	< 3.0	3.0	mg/L		3.8				20	
Tellurium, total	< 0.00050	0.00050	mg/L		< 0.00050				20	
Thallium, total	< 0.000020	0.000020	mg/L		< 0.000020				20	
Thorium, total	< 0.00010	0.00010	mg/L		< 0.00010				20	
Tin, total	< 0.00020	0.00020	mg/L		< 0.00020				20	
Titanium, total	< 0.0050	0.0050	mg/L		< 0.0050				20	
Tungsten, total	< 0.0010	0.0010	mg/L		< 0.0010				20	
Uranium, total	0.000050	0.000020	mg/L		0.000046				20	
Vanadium, total	< 0.0010	0.0010	mg/L		< 0.0010				20	
Zinc, total	< 0.0040	0.0040	mg/L		< 0.0040				20	
Zirconium, total	0.00017	0.00010	mg/L		0.00018				20	
Reference (B1J1202-SRM1)				Prepared: 2021-10-12, Analyzed: 2021-10-14						
Aluminum, total	0.301	0.0050	mg/L	0.299		101	70-130			
Antimony, total	0.0521	0.00020	mg/L	0.0517		101	70-130			
Arsenic, total	0.125	0.00050	mg/L	0.119		105	70-130			

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO Elk River Alliance
PROJECT ERA-CBWM

WORK ORDER 21J0990
REPORTED 2021-10-14 16:07

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Total Metals, Batch B1J1202, Continued										
Reference (B1J1202-SRM1), Continued				Prepared: 2021-10-12, Analyzed: 2021-10-14						
Barium, total	0.689	0.0050	mg/L	0.801		86	70-130			
Beryllium, total	0.0501	0.00010	mg/L	0.0501		100	70-130			
Boron, total	4.09	0.0500	mg/L	4.11		100	70-130			
Cadmium, total	0.0506	0.000010	mg/L	0.0503		101	70-130			
Calcium, total	10.5	0.20	mg/L	10.7		98	70-130			
Chromium, total	0.261	0.00050	mg/L	0.250		104	70-130			
Cobalt, total	0.0408	0.00010	mg/L	0.0384		106	70-130			
Copper, total	0.514	0.00040	mg/L	0.487		106	70-130			
Iron, total	0.518	0.010	mg/L	0.504		103	70-130			
Lead, total	0.299	0.00020	mg/L	0.278		107	70-130			
Lithium, total	0.400	0.00010	mg/L	0.398		100	70-130			
Magnesium, total	3.97	0.010	mg/L	3.59		111	70-130			
Manganese, total	0.112	0.00020	mg/L	0.111		101	70-130			
Molybdenum, total	0.204	0.00010	mg/L	0.196		104	70-130			
Nickel, total	0.265	0.00040	mg/L	0.248		107	70-130			
Phosphorus, total	0.208	0.050	mg/L	0.213		98	70-130			
Potassium, total	6.16	0.10	mg/L	5.89		105	70-130			
Selenium, total	0.128	0.00050	mg/L	0.120		107	70-130			
Sodium, total	9.45	0.10	mg/L	8.71		109	70-130			
Strontium, total	0.381	0.0010	mg/L	0.393		97	70-130			
Thallium, total	0.0836	0.000020	mg/L	0.0787		106	70-130			
Uranium, total	0.0346	0.000020	mg/L	0.0344		101	70-130			
Vanadium, total	0.396	0.0010	mg/L	0.391		101	70-130			
Zinc, total	2.81	0.0040	mg/L	2.50		112	70-130			
Reference (B1J1202-SRM2)				Prepared: 2021-10-12, Analyzed: 2021-10-14						
Aluminum, total	0.274	0.0050	mg/L	0.299		92	70-130			
Antimony, total	0.0484	0.00020	mg/L	0.0517		94	70-130			
Arsenic, total	0.114	0.00050	mg/L	0.119		96	70-130			
Barium, total	0.643	0.0050	mg/L	0.801		80	70-130			
Beryllium, total	0.0460	0.00010	mg/L	0.0501		92	70-130			
Boron, total	3.76	0.0500	mg/L	4.11		92	70-130			
Cadmium, total	0.0469	0.000010	mg/L	0.0503		93	70-130			
Calcium, total	9.52	0.20	mg/L	10.7		89	70-130			
Chromium, total	0.239	0.00050	mg/L	0.250		95	70-130			
Cobalt, total	0.0379	0.00010	mg/L	0.0384		99	70-130			
Copper, total	0.467	0.00040	mg/L	0.487		96	70-130			
Iron, total	0.482	0.010	mg/L	0.504		96	70-130			
Lead, total	0.279	0.00020	mg/L	0.278		100	70-130			
Lithium, total	0.367	0.00010	mg/L	0.398		92	70-130			
Magnesium, total	3.55	0.010	mg/L	3.59		99	70-130			
Manganese, total	0.104	0.00020	mg/L	0.111		94	70-130			
Molybdenum, total	0.189	0.00010	mg/L	0.196		96	70-130			
Nickel, total	0.239	0.00040	mg/L	0.248		96	70-130			
Phosphorus, total	0.191	0.050	mg/L	0.213		90	70-130			
Potassium, total	5.49	0.10	mg/L	5.89		93	70-130			
Selenium, total	0.118	0.00050	mg/L	0.120		99	70-130			
Sodium, total	8.30	0.10	mg/L	8.71		95	70-130			
Strontium, total	0.352	0.0010	mg/L	0.393		90	70-130			
Thallium, total	0.0775	0.000020	mg/L	0.0787		99	70-130			
Uranium, total	0.0320	0.000020	mg/L	0.0344		93	70-130			
Vanadium, total	0.358	0.0010	mg/L	0.391		92	70-130			
Zinc, total	2.54	0.0040	mg/L	2.50		102	70-130			
Total Metals, Batch B1J1319										

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	21J0990
PROJECT	ERA-CBWM	**REPORTED**	2021-10-14 16:07

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Total Metals, Batch B1J1319, Continued										
Blank (B1J1319-BLK1)				Prepared: 2021-10-13, Analyzed: 2021-10-13						
Mercury, total	< 0.000010	0.000010	mg/L							
Blank (B1J1319-BLK2)				Prepared: 2021-10-13, Analyzed: 2021-10-13						
Mercury, total	< 0.000010	0.000010	mg/L							
Blank (B1J1319-BLK3)				Prepared: 2021-10-13, Analyzed: 2021-10-13						
Mercury, total	< 0.000010	0.000010	mg/L							
Reference (B1J1319-SRM1)				Prepared: 2021-10-13, Analyzed: 2021-10-13						
Mercury, total	0.00511	0.000010	mg/L	0.00581		88	70-130			
Reference (B1J1319-SRM2)				Prepared: 2021-10-13, Analyzed: 2021-10-13						
Mercury, total	0.00581	0.000010	mg/L	0.00581		100	70-130			
Reference (B1J1319-SRM3)				Prepared: 2021-10-13, Analyzed: 2021-10-13						
Mercury, total	0.00590	0.000010	mg/L	0.00581		102	70-130			

CERTIFICATE OF ANALYSIS

REPORTED TO	Elk River Alliance PO Box 2095, 1111 2nd Ave Fernie, BC V0B1M0

ATTENTION	Kaileigh McCallum	**WORK ORDER**	21J1168
PO NUMBER		**RECEIVED / TEMP**	2021-10-08 09:40 / 4.7°C
PROJECT	ERA-CBWM	**REPORTED**	2021-11-05 16:36
PROJECT INFO	[info]	**COC NUMBER**	No Number

Introduction:

CARO Analytical Services is a testing laboratory full of smart, engaged scientists driven to make the world a safer and healthier place. Through our clients' projects we become an essential element for a better world. We employ methods conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts. CARO is accredited by the Canadian Association for Laboratories Accreditation (CALA) to ISO/IEC 17025:2017 for specific tests listed in the scope of accreditation approved by CALA.

Big Picture Sidekicks

You know that the sample you collected after snowshoeing to site, digging 5 meters, and racing to get it on a plane so you can submit it to the lab for time sensitive results needed to make important and expensive decisions (whew) is VERY important. We know that too.

We've Got Chemistry

It's simple. We figure the more you enjoy working with our fun and engaged team members; the more likely you are to give us continued opportunities to support you.

Ahead of the Curve

Through research, regulation knowledge, and instrumentation, we are your analytical centre for the technical knowledge you need, BEFORE you need it, so you can stay up to date and in the know.

If you have any questions or concerns, please contact me at teamcaro@caro.ca

Authorized By:

Team CARO
Client Service Representative

TEST RESULTS

REPORTED TO Elk River Alliance
PROJECT ERA-CBWM

WORK ORDER 21J1168
REPORTED 2021-11-05 16:36

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
B01001_20211005_1030 (21J1168-01) | Matrix: Water | Sampled: 2021-10-05 10:30						
Anions						
Chloride	< 0.10	AO ≤ 250	0.10	mg/L	2021-10-14	
Nitrate (as N)	**0.046**	MAC = 10	0.010	mg/L	2021-10-14	HT1
Nitrite (as N)	< 0.010	MAC = 1	0.010	mg/L	2021-10-14	HT1
Phosphate (as P)	< 0.0050	N/A	0.0050	mg/L	2021-10-14	HT1
Sulfate	**58.3**	AO ≤ 500	1.0	mg/L	2021-10-14	
BCMOE Aggregate Hydrocarbons						
EPHw10-19	< 250	N/A	250	µg/L	2021-10-17	
EPHw19-32	< 250	N/A	250	µg/L	2021-10-17	
Surrogate: 2-Methylnonane (EPH/F2-4)	*87*		*60-140*	%	*2021-10-17*	
Calculated Parameters						
Hardness, Total (as CaCO3)	**185**	None Required	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	**0.0459**	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	**0.168**	N/A	0.0500	mg/L	N/A	
Dissolved Metals						
Aluminum, dissolved	< 0.0050	N/A	0.0050	mg/L	2021-10-16	
Antimony, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-16	
Arsenic, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-16	
Barium, dissolved	**0.0263**	N/A	0.0050	mg/L	2021-10-16	
Beryllium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
Bismuth, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
Boron, dissolved	< 0.0500	N/A	0.0500	mg/L	2021-10-16	
Cadmium, dissolved	**0.000030**	N/A	0.000010	mg/L	2021-10-16	
Calcium, dissolved	**50.6**	N/A	0.20	mg/L	2021-10-16	
Chromium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-16	
Cobalt, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
Copper, dissolved	< 0.00040	N/A	0.00040	mg/L	2021-10-16	
Iron, dissolved	< 0.010	N/A	0.010	mg/L	2021-10-16	
Lead, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-16	
Lithium, dissolved	**0.00142**	N/A	0.00010	mg/L	2021-10-16	
Magnesium, dissolved	**14.2**	N/A	0.010	mg/L	2021-10-16	
Manganese, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-16	
Mercury, dissolved	< 0.000010	N/A	0.000010	mg/L	2021-10-15	
Molybdenum, dissolved	**0.00138**	N/A	0.00010	mg/L	2021-10-16	
Nickel, dissolved	< 0.00040	N/A	0.00040	mg/L	2021-10-16	
Phosphorus, dissolved	< 0.050	N/A	0.050	mg/L	2021-10-16	
Potassium, dissolved	**0.29**	N/A	0.10	mg/L	2021-10-16	
Selenium, dissolved	**0.00097**	N/A	0.00050	mg/L	2021-10-16	
Silicon, dissolved	**2.1**	N/A	1.0	mg/L	2021-10-16	
Silver, dissolved	< 0.000050	N/A	0.000050	mg/L	2021-10-16	
Sodium, dissolved	**0.68**	N/A	0.10	mg/L	2021-10-16	
Strontium, dissolved	**0.561**	N/A	0.0010	mg/L	2021-10-16	

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
B01001_20211005_1030 (21J1168-01) | Matrix: Water | Sampled: 2021-10-05 10:30, Continued						
Dissolved Metals, Continued						
Sulfur, dissolved	**16.9**	N/A	3.0	mg/L	2021-10-16	
Tellurium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-16	
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2021-10-16	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-16	
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2021-10-16	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2021-10-16	
Uranium, dissolved	**0.000948**	N/A	0.000020	mg/L	2021-10-16	
Vanadium, dissolved	< 0.0010	N/A	0.0010	mg/L	2021-10-16	
Zinc, dissolved	< 0.0040	N/A	0.0040	mg/L	2021-10-16	
Zirconium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
General Parameters						
Alkalinity, Total (as CaCO3)	**133**	N/A	1.0	mg/L	2021-10-12	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-12	
Alkalinity, Bicarbonate (as CaCO3)	**133**	N/A	1.0	mg/L	2021-10-12	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-12	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-12	
Carbon, Total Organic	**0.93**	N/A	0.50	mg/L	2021-10-12	
Carbon, Dissolved Organic	**0.64**	N/A	0.50	mg/L	2021-10-12	
Nitrogen, Total Kjeldahl	**0.122**	N/A	0.050	mg/L	2021-10-15	
Phosphorus, Total (as P)	**0.0059**	N/A	0.0050	mg/L	2021-10-18	
Solids, Total Suspended	< 2.0	N/A	2.0	mg/L	2021-10-13	HT1
Total Metals						
Aluminum, total	< 0.0050	OG < 0.1	0.0050	mg/L	2021-10-17	
Antimony, total	< 0.00020	MAC = 0.006	0.00020	mg/L	2021-10-17	
Arsenic, total	< 0.00050	MAC = 0.01	0.00050	mg/L	2021-10-17	
Barium, total	**0.0260**	MAC = 2	0.0050	mg/L	2021-10-17	
Beryllium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
Bismuth, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
Boron, total	< 0.0500	MAC = 5	0.0500	mg/L	2021-10-17	
Cadmium, total	**0.000026**	MAC = 0.005	0.000010	mg/L	2021-10-17	
Calcium, total	**49.4**	None Required	0.20	mg/L	2021-10-17	
Chromium, total	**0.00057**	MAC = 0.05	0.00050	mg/L	2021-10-17	
Cobalt, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
Copper, total	**0.00335**	MAC = 2	0.00040	mg/L	2021-10-17	
Iron, total	**0.032**	AO ≤ 0.3	0.010	mg/L	2021-10-17	
Lead, total	< 0.00020	MAC = 0.005	0.00020	mg/L	2021-10-17	
Lithium, total	**0.00151**	N/A	0.00010	mg/L	2021-10-17	
Magnesium, total	**14.5**	None Required	0.010	mg/L	2021-10-17	
Manganese, total	**0.00020**	MAC = 0.12	0.00020	mg/L	2021-10-17	
Mercury, total	< 0.000010	MAC = 0.001	0.000010	mg/L	2021-10-15	
Molybdenum, total	**0.00145**	N/A	0.00010	mg/L	2021-10-17	

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
B01001_20211005_1030 (21J1168-01) | Matrix: Water | Sampled: 2021-10-05 10:30, Continued						
Total Metals, Continued						
Nickel, total	**0.0112**	N/A	0.00040	mg/L	2021-10-17	
Phosphorus, total	< 0.050	N/A	0.050	mg/L	2021-10-17	
Potassium, total	**0.34**	N/A	0.10	mg/L	2021-10-17	
Selenium, total	**0.00104**	MAC = 0.05	0.00050	mg/L	2021-10-17	
Silicon, total	**2.0**	N/A	1.0	mg/L	2021-10-17	
Silver, total	< 0.000050	None Required	0.000050	mg/L	2021-10-17	
Sodium, total	**0.62**	AO ≤ 200	0.10	mg/L	2021-10-17	
Strontium, total	**0.552**	7	0.0010	mg/L	2021-10-17	
Sulfur, total	**21.4**	N/A	3.0	mg/L	2021-10-17	
Tellurium, total	< 0.00050	N/A	0.00050	mg/L	2021-10-17	
Thallium, total	< 0.000020	N/A	0.000020	mg/L	2021-10-17	
Thorium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
Tin, total	< 0.00020	N/A	0.00020	mg/L	2021-10-17	
Titanium, total	< 0.0050	N/A	0.0050	mg/L	2021-10-17	
Tungsten, total	< 0.0010	N/A	0.0010	mg/L	2021-10-17	
Uranium, total	**0.000919**	MAC = 0.02	0.000020	mg/L	2021-10-17	
Vanadium, total	< 0.0010	N/A	0.0010	mg/L	2021-10-17	
Zinc, total	**0.0044**	AO ≤ 5	0.0040	mg/L	2021-10-17	
Zirconium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
B01002_20211005_1450 (21J1168-02) | Matrix: Water | Sampled: 2021-10-05 14:50						
Anions						
Chloride	< 0.10	AO ≤ 250	0.10	mg/L	2021-10-14	
Nitrate (as N)	**0.040**	MAC = 10	0.010	mg/L	2021-10-14	HT1
Nitrite (as N)	< 0.010	MAC = 1	0.010	mg/L	2021-10-14	HT1
Phosphate (as P)	< 0.0050	N/A	0.0050	mg/L	2021-10-14	HT1
Sulfate	**58.1**	AO ≤ 500	1.0	mg/L	2021-10-14	
Calculated Parameters						
Hardness, Total (as CaCO3)	**193**	None Required	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	**0.0399**	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	< 0.0500	N/A	0.0500	mg/L	N/A	
Dissolved Metals						
Aluminum, dissolved	< 0.0050	N/A	0.0050	mg/L	2021-10-16	
Antimony, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-16	
Arsenic, dissolved	**0.00051**	N/A	0.00050	mg/L	2021-10-16	
Barium, dissolved	**0.0279**	N/A	0.0050	mg/L	2021-10-16	
Beryllium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
Bismuth, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
Boron, dissolved	< 0.0500	N/A	0.0500	mg/L	2021-10-16	
Cadmium, dissolved	**0.000027**	N/A	0.000010	mg/L	2021-10-16	

TEST RESULTS

REPORTED TO Elk River Alliance
PROJECT ERA-CBWM

WORK ORDER 21J1168
REPORTED 2021-11-05 16:36

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
B01002_20211005_1450 (21J1168-02) | Matrix: Water | Sampled: 2021-10-05 14:50, Continued						
Dissolved Metals, Continued						
Calcium, dissolved	**52.4**	N/A	0.20	mg/L	2021-10-16	
Chromium, dissolved	**0.00054**	N/A	0.00050	mg/L	2021-10-16	
Cobalt, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
Copper, dissolved	< 0.00040	N/A	0.00040	mg/L	2021-10-16	
Iron, dissolved	< 0.010	N/A	0.010	mg/L	2021-10-16	
Lead, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-16	
Lithium, dissolved	**0.00148**	N/A	0.00010	mg/L	2021-10-16	
Magnesium, dissolved	**14.9**	N/A	0.010	mg/L	2021-10-16	
Manganese, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-16	
Mercury, dissolved	< 0.000010	N/A	0.000010	mg/L	2021-10-15	
Molybdenum, dissolved	**0.00161**	N/A	0.00010	mg/L	2021-10-16	
Nickel, dissolved	< 0.00040	N/A	0.00040	mg/L	2021-10-16	
Phosphorus, dissolved	< 0.050	N/A	0.050	mg/L	2021-10-16	
Potassium, dissolved	**0.32**	N/A	0.10	mg/L	2021-10-16	
Selenium, dissolved	**0.00104**	N/A	0.00050	mg/L	2021-10-16	
Silicon, dissolved	**2.1**	N/A	1.0	mg/L	2021-10-16	
Silver, dissolved	< 0.000050	N/A	0.000050	mg/L	2021-10-16	
Sodium, dissolved	**0.68**	N/A	0.10	mg/L	2021-10-16	
Strontium, dissolved	**0.591**	N/A	0.0010	mg/L	2021-10-16	
Sulfur, dissolved	**19.7**	N/A	3.0	mg/L	2021-10-16	
Tellurium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-16	
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2021-10-16	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-16	
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2021-10-16	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2021-10-16	
Uranium, dissolved	**0.000979**	N/A	0.000020	mg/L	2021-10-16	
Vanadium, dissolved	< 0.0010	N/A	0.0010	mg/L	2021-10-16	
Zinc, dissolved	**0.0054**	N/A	0.0040	mg/L	2021-10-16	
Zirconium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
General Parameters						
Alkalinity, Total (as CaCO3)	**132**	N/A	1.0	mg/L	2021-10-12	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-12	
Alkalinity, Bicarbonate (as CaCO3)	**132**	N/A	1.0	mg/L	2021-10-12	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-12	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-12	
Carbon, Total Organic	**0.76**	N/A	0.50	mg/L	2021-10-12	
Carbon, Dissolved Organic	**0.52**	N/A	0.50	mg/L	2021-10-12	
Nitrogen, Total Kjeldahl	< 0.050	N/A	0.050	mg/L	2021-10-15	
Phosphorus, Total (as P)	**0.0050**	N/A	0.0050	mg/L	2021-10-18	
Solids, Total Suspended	< 2.0	N/A	2.0	mg/L	2021-10-14	HT1
Total Metals						

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
B01002_20211005_1450 (21J1168-02) | Matrix: Water | Sampled: 2021-10-05 14:50, Continued						
Total Metals, Continued						
Aluminum, total	**0.0068**	OG < 0.1	0.0050	mg/L	2021-10-17	
Antimony, total	< 0.00020	MAC = 0.006	0.00020	mg/L	2021-10-17	
Arsenic, total	< 0.00050	MAC = 0.01	0.00050	mg/L	2021-10-17	
Barium, total	**0.0247**	MAC = 2	0.0050	mg/L	2021-10-17	
Beryllium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
Bismuth, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
Boron, total	< 0.0500	MAC = 5	0.0500	mg/L	2021-10-17	
Cadmium, total	**0.000025**	MAC = 0.005	0.000010	mg/L	2021-10-17	
Calcium, total	**49.2**	None Required	0.20	mg/L	2021-10-17	
Chromium, total	**0.00052**	MAC = 0.05	0.00050	mg/L	2021-10-17	
Cobalt, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
Copper, total	< 0.00040	MAC = 2	0.00040	mg/L	2021-10-17	
Iron, total	< 0.010	AO ≤ 0.3	0.010	mg/L	2021-10-17	
Lead, total	< 0.00020	MAC = 0.005	0.00020	mg/L	2021-10-17	
Lithium, total	**0.00152**	N/A	0.00010	mg/L	2021-10-17	
Magnesium, total	**14.0**	None Required	0.010	mg/L	2021-10-17	
Manganese, total	**0.00042**	MAC = 0.12	0.00020	mg/L	2021-10-17	
Mercury, total	< 0.000010	MAC = 0.001	0.000010	mg/L	2021-10-15	
Molybdenum, total	**0.00138**	N/A	0.00010	mg/L	2021-10-17	
Nickel, total	< 0.00040	N/A	0.00040	mg/L	2021-10-17	
Phosphorus, total	< 0.050	N/A	0.050	mg/L	2021-10-17	
Potassium, total	**0.35**	N/A	0.10	mg/L	2021-10-17	
Selenium, total	**0.00099**	MAC = 0.05	0.00050	mg/L	2021-10-17	
Silicon, total	**1.9**	N/A	1.0	mg/L	2021-10-17	
Silver, total	< 0.000050	None Required	0.000050	mg/L	2021-10-17	
Sodium, total	**0.69**	AO ≤ 200	0.10	mg/L	2021-10-17	
Strontium, total	**0.538**	7	0.0010	mg/L	2021-10-17	
Sulfur, total	**20.4**	N/A	3.0	mg/L	2021-10-17	
Tellurium, total	< 0.00050	N/A	0.00050	mg/L	2021-10-17	
Thallium, total	< 0.000020	N/A	0.000020	mg/L	2021-10-17	
Thorium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
Tin, total	< 0.00020	N/A	0.00020	mg/L	2021-10-17	
Titanium, total	< 0.0050	N/A	0.0050	mg/L	2021-10-17	
Tungsten, total	< 0.0010	N/A	0.0010	mg/L	2021-10-17	
Uranium, total	**0.000889**	MAC = 0.02	0.000020	mg/L	2021-10-17	
Vanadium, total	< 0.0010	N/A	0.0010	mg/L	2021-10-17	
Zinc, total	< 0.0040	AO ≤ 5	0.0040	mg/L	2021-10-17	
Zirconium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
ALX001_20211006_1025 (21J1168-03) | Matrix: Water | Sampled: 2021-10-06 10:25						
Anions						
Chloride	**0.91**	AO ≤ 250	0.10	mg/L	2021-10-14	

TEST RESULTS

REPORTED TO Elk River Alliance
PROJECT ERA-CBWM

WORK ORDER 21J1168
REPORTED 2021-11-05 16:36

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
ALX001_20211006_1025 (21J1168-03) | Matrix: Water | Sampled: 2021-10-06 10:25, Continued						
Anions, Continued						
Nitrate (as N)	< 0.010	MAC = 10	0.010	mg/L	2021-10-14	HT1
Nitrite (as N)	< 0.010	MAC = 1	0.010	mg/L	2021-10-14	HT1
Phosphate (as P)	< 0.0050	N/A	0.0050	mg/L	2021-10-14	HT1
Sulfate	**19.3**	AO ≤ 500	1.0	mg/L	2021-10-14	
BCMOE Aggregate Hydrocarbons						
EPHw10-19	< 250	N/A	250	µg/L	2021-10-17	
EPHw19-32	< 250	N/A	250	µg/L	2021-10-17	
Surrogate: 2-Methylnonane (EPH/F2-4)	*102*		*60-140*	%	*2021-10-17*	
Calculated Parameters						
Hardness, Total (as CaCO3)	**181**	None Required	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	< 0.0100	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	**0.0700**	N/A	0.0500	mg/L	N/A	
Dissolved Metals						
Aluminum, dissolved	< 0.0050	N/A	0.0050	mg/L	2021-10-16	
Antimony, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-16	
Arsenic, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-16	
Barium, dissolved	**0.0700**	N/A	0.0050	mg/L	2021-10-16	
Beryllium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
Bismuth, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
Boron, dissolved	< 0.0500	N/A	0.0500	mg/L	2021-10-16	
Cadmium, dissolved	< 0.000010	N/A	0.000010	mg/L	2021-10-16	
Calcium, dissolved	**49.5**	N/A	0.20	mg/L	2021-10-16	
Chromium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-16	
Cobalt, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
Copper, dissolved	< 0.00040	N/A	0.00040	mg/L	2021-10-16	
Iron, dissolved	< 0.010	N/A	0.010	mg/L	2021-10-16	
Lead, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-16	
Lithium, dissolved	**0.00404**	N/A	0.00010	mg/L	2021-10-16	
Magnesium, dissolved	**14.0**	N/A	0.010	mg/L	2021-10-16	
Manganese, dissolved	**0.00046**	N/A	0.00020	mg/L	2021-10-16	
Mercury, dissolved	< 0.000010	N/A	0.000010	mg/L	2021-10-15	
Molybdenum, dissolved	**0.00069**	N/A	0.00010	mg/L	2021-10-16	
Nickel, dissolved	< 0.00040	N/A	0.00040	mg/L	2021-10-16	
Phosphorus, dissolved	< 0.050	N/A	0.050	mg/L	2021-10-16	
Potassium, dissolved	**0.41**	N/A	0.10	mg/L	2021-10-16	
Selenium, dissolved	**0.00067**	N/A	0.00050	mg/L	2021-10-16	
Silicon, dissolved	**2.1**	N/A	1.0	mg/L	2021-10-16	
Silver, dissolved	< 0.000050	N/A	0.000050	mg/L	2021-10-16	
Sodium, dissolved	**1.80**	N/A	0.10	mg/L	2021-10-16	
Strontium, dissolved	**0.119**	N/A	0.0010	mg/L	2021-10-16	
Sulfur, dissolved	**5.4**	N/A	3.0	mg/L	2021-10-16	

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
ALX001_20211006_1025 (21J1168-03) | Matrix: Water | Sampled: 2021-10-06 10:25, Continued						
Dissolved Metals, Continued						
Tellurium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-16	
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2021-10-16	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-16	
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2021-10-16	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2021-10-16	
Uranium, dissolved	**0.000621**	N/A	0.000020	mg/L	2021-10-16	
Vanadium, dissolved	< 0.0010	N/A	0.0010	mg/L	2021-10-16	
Zinc, dissolved	< 0.0040	N/A	0.0040	mg/L	2021-10-16	
Zirconium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
General Parameters						
Alkalinity, Total (as CaCO3)	**169**	N/A	1.0	mg/L	2021-10-12	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-12	
Alkalinity, Bicarbonate (as CaCO3)	**169**	N/A	1.0	mg/L	2021-10-12	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-12	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-12	
Carbon, Total Organic	**0.91**	N/A	0.50	mg/L	2021-10-12	
Carbon, Dissolved Organic	**0.90**	N/A	0.50	mg/L	2021-10-12	
Nitrogen, Total Kjeldahl	**0.070**	N/A	0.050	mg/L	2021-10-15	
Phosphorus, Total (as P)	**0.0059**	N/A	0.0050	mg/L	2021-10-18	
Solids, Total Suspended	< 2.0	N/A	2.0	mg/L	2021-10-14	HT1
Total Metals						
Aluminum, total	< 0.0050	OG < 0.1	0.0050	mg/L	2021-10-17	
Antimony, total	< 0.00020	MAC = 0.006	0.00020	mg/L	2021-10-17	
Arsenic, total	< 0.00050	MAC = 0.01	0.00050	mg/L	2021-10-17	
Barium, total	**0.0682**	MAC = 2	0.0050	mg/L	2021-10-17	
Beryllium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
Bismuth, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
Boron, total	< 0.0500	MAC = 5	0.0500	mg/L	2021-10-17	
Cadmium, total	< 0.000010	MAC = 0.005	0.000010	mg/L	2021-10-17	
Calcium, total	**45.9**	None Required	0.20	mg/L	2021-10-17	
Chromium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2021-10-17	
Cobalt, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
Copper, total	< 0.00040	MAC = 2	0.00040	mg/L	2021-10-17	
Iron, total	**0.014**	AO ≤ 0.3	0.010	mg/L	2021-10-17	
Lead, total	< 0.00020	MAC = 0.005	0.00020	mg/L	2021-10-17	
Lithium, total	**0.00390**	N/A	0.00010	mg/L	2021-10-17	
Magnesium, total	**13.6**	None Required	0.010	mg/L	2021-10-17	
Manganese, total	**0.00091**	MAC = 0.12	0.00020	mg/L	2021-10-17	
Mercury, total	< 0.000010	MAC = 0.001	0.000010	mg/L	2021-10-15	
Molybdenum, total	**0.00076**	N/A	0.00010	mg/L	2021-10-17	
Nickel, total	< 0.00040	N/A	0.00040	mg/L	2021-10-17	

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
ALX001_20211006_1025 (21J1168-03) | Matrix: Water | Sampled: 2021-10-06 10:25, Continued						
Total Metals, Continued						
Phosphorus, total	< 0.050	N/A	0.050	mg/L	2021-10-17	
Potassium, total	**0.47**	N/A	0.10	mg/L	2021-10-17	
Selenium, total	**0.00066**	MAC = 0.05	0.00050	mg/L	2021-10-17	
Silicon, total	**2.2**	N/A	1.0	mg/L	2021-10-17	
Silver, total	< 0.000050	None Required	0.000050	mg/L	2021-10-17	
Sodium, total	**1.78**	AO ≤ 200	0.10	mg/L	2021-10-17	
Strontium, total	**0.115**	7	0.0010	mg/L	2021-10-17	
Sulfur, total	**8.2**	N/A	3.0	mg/L	2021-10-17	
Tellurium, total	< 0.00050	N/A	0.00050	mg/L	2021-10-17	
Thallium, total	< 0.000020	N/A	0.000020	mg/L	2021-10-17	
Thorium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
Tin, total	< 0.00020	N/A	0.00020	mg/L	2021-10-17	
Titanium, total	< 0.0050	N/A	0.0050	mg/L	2021-10-17	
Tungsten, total	< 0.0010	N/A	0.0010	mg/L	2021-10-17	
Uranium, total	**0.000581**	MAC = 0.02	0.000020	mg/L	2021-10-17	
Vanadium, total	< 0.0010	N/A	0.0010	mg/L	2021-10-17	
Zinc, total	< 0.0040	AO ≤ 5	0.0040	mg/L	2021-10-17	
Zirconium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
ALX003_20211006_0935 (21J1168-04) | Matrix: Water | Sampled: 2021-10-06 09:35						
Anions						
Chloride	**0.64**	AO ≤ 250	0.10	mg/L	2021-10-14	
Nitrate (as N)	< 0.010	MAC = 10	0.010	mg/L	2021-10-14	HT1
Nitrite (as N)	< 0.010	MAC = 1	0.010	mg/L	2021-10-14	HT1
Phosphate (as P)	< 0.0050	N/A	0.0050	mg/L	2021-10-14	HT1
Sulfate	**17.0**	AO ≤ 500	1.0	mg/L	2021-10-14	
BCMOE Aggregate Hydrocarbons						
EPHw10-19	< 250	N/A	250	µg/L	2021-10-17	
EPHw19-32	< 250	N/A	250	µg/L	2021-10-17	
Surrogate: 2-Methylnonane (EPH/F2-4)	*101*		*60-140*	%	*2021-10-17*	
Calculated Parameters						
Hardness, Total (as CaCO3)	**177**	None Required	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	< 0.0100	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	**0.0690**	N/A	0.0500	mg/L	N/A	
Dissolved Metals						
Aluminum, dissolved	< 0.0050	N/A	0.0050	mg/L	2021-10-16	
Antimony, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-16	
Arsenic, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-16	
Barium, dissolved	**0.0686**	N/A	0.0050	mg/L	2021-10-16	
Beryllium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
ALX003_20211006_0935 (21J1168-04) | Matrix: Water | Sampled: 2021-10-06 09:35, Continued						
Dissolved Metals, Continued						
Bismuth, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
Boron, dissolved	< 0.0500	N/A	0.0500	mg/L	2021-10-16	
Cadmium, dissolved	< 0.000010	N/A	0.000010	mg/L	2021-10-16	
Calcium, dissolved	**48.3**	N/A	0.20	mg/L	2021-10-16	
Chromium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-16	
Cobalt, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
Copper, dissolved	< 0.00040	N/A	0.00040	mg/L	2021-10-16	
Iron, dissolved	< 0.010	N/A	0.010	mg/L	2021-10-16	
Lead, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-16	
Lithium, dissolved	**0.00362**	N/A	0.00010	mg/L	2021-10-16	
Magnesium, dissolved	**13.8**	N/A	0.010	mg/L	2021-10-16	
Manganese, dissolved	**0.00134**	N/A	0.00020	mg/L	2021-10-16	
Mercury, dissolved	< 0.000010	N/A	0.000010	mg/L	2021-10-15	
Molybdenum, dissolved	**0.00067**	N/A	0.00010	mg/L	2021-10-16	
Nickel, dissolved	< 0.00040	N/A	0.00040	mg/L	2021-10-16	
Phosphorus, dissolved	< 0.050	N/A	0.050	mg/L	2021-10-16	
Potassium, dissolved	**0.41**	N/A	0.10	mg/L	2021-10-16	
Selenium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-16	
Silicon, dissolved	**2.2**	N/A	1.0	mg/L	2021-10-16	
Silver, dissolved	< 0.000050	N/A	0.000050	mg/L	2021-10-16	
Sodium, dissolved	**1.61**	N/A	0.10	mg/L	2021-10-16	
Strontium, dissolved	**0.116**	N/A	0.0010	mg/L	2021-10-16	
Sulfur, dissolved	**4.0**	N/A	3.0	mg/L	2021-10-16	
Tellurium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-16	
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2021-10-16	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-16	
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2021-10-16	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2021-10-16	
Uranium, dissolved	**0.000539**	N/A	0.000020	mg/L	2021-10-16	
Vanadium, dissolved	< 0.0010	N/A	0.0010	mg/L	2021-10-16	
Zinc, dissolved	< 0.0040	N/A	0.0040	mg/L	2021-10-16	
Zirconium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
General Parameters						
Alkalinity, Total (as CaCO3)	**168**	N/A	1.0	mg/L	2021-10-12	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-12	
Alkalinity, Bicarbonate (as CaCO3)	**168**	N/A	1.0	mg/L	2021-10-12	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-12	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-12	
Carbon, Total Organic	**0.95**	N/A	0.50	mg/L	2021-10-12	
Carbon, Dissolved Organic	**0.84**	N/A	0.50	mg/L	2021-10-12	
Nitrogen, Total Kjeldahl	**0.069**	N/A	0.050	mg/L	2021-10-15	

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
ALX003_20211006_0935 (21J1168-04) | Matrix: Water | Sampled: 2021-10-06 09:35, Continued						
General Parameters, Continued						
Phosphorus, Total (as P)	< 0.0050	N/A	0.0050	mg/L	2021-10-18	
Solids, Total Suspended	< 2.0	N/A	2.0	mg/L	2021-10-14	HT1
Total Metals						
Aluminum, total	**0.0070**	OG < 0.1	0.0050	mg/L	2021-10-17	
Antimony, total	< 0.00020	MAC = 0.006	0.00020	mg/L	2021-10-17	
Arsenic, total	< 0.00050	MAC = 0.01	0.00050	mg/L	2021-10-17	
Barium, total	**0.0665**	MAC = 2	0.0050	mg/L	2021-10-17	
Beryllium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
Bismuth, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
Boron, total	< 0.0500	MAC = 5	0.0500	mg/L	2021-10-17	
Cadmium, total	**0.000015**	MAC = 0.005	0.000010	mg/L	2021-10-17	
Calcium, total	**46.1**	None Required	0.20	mg/L	2021-10-17	
Chromium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2021-10-17	
Cobalt, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
Copper, total	< 0.00040	MAC = 2	0.00040	mg/L	2021-10-17	
Iron, total	**0.018**	AO ≤ 0.3	0.010	mg/L	2021-10-17	
Lead, total	< 0.00020	MAC = 0.005	0.00020	mg/L	2021-10-17	
Lithium, total	**0.00365**	N/A	0.00010	mg/L	2021-10-17	
Magnesium, total	**13.9**	None Required	0.010	mg/L	2021-10-17	
Manganese, total	**0.00188**	MAC = 0.12	0.00020	mg/L	2021-10-17	
Mercury, total	< 0.000010	MAC = 0.001	0.000010	mg/L	2021-10-15	
Molybdenum, total	**0.00063**	N/A	0.00010	mg/L	2021-10-17	
Nickel, total	< 0.00040	N/A	0.00040	mg/L	2021-10-17	
Phosphorus, total	**0.053**	N/A	0.050	mg/L	2021-10-17	
Potassium, total	**0.48**	N/A	0.10	mg/L	2021-10-17	
Selenium, total	**0.00051**	MAC = 0.05	0.00050	mg/L	2021-10-17	
Silicon, total	**2.0**	N/A	1.0	mg/L	2021-10-17	
Silver, total	< 0.000050	None Required	0.000050	mg/L	2021-10-17	
Sodium, total	**1.59**	AO ≤ 200	0.10	mg/L	2021-10-17	
Strontium, total	**0.111**	7	0.0010	mg/L	2021-10-17	
Sulfur, total	**8.4**	N/A	3.0	mg/L	2021-10-17	
Tellurium, total	< 0.00050	N/A	0.00050	mg/L	2021-10-17	
Thallium, total	< 0.000020	N/A	0.000020	mg/L	2021-10-17	
Thorium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
Tin, total	< 0.00020	N/A	0.00020	mg/L	2021-10-17	
Titanium, total	< 0.0050	N/A	0.0050	mg/L	2021-10-17	
Tungsten, total	< 0.0010	N/A	0.0010	mg/L	2021-10-17	
Uranium, total	**0.000524**	MAC = 0.02	0.000020	mg/L	2021-10-17	
Vanadium, total	< 0.0010	N/A	0.0010	mg/L	2021-10-17	
Zinc, total	< 0.0040	AO ≤ 5	0.0040	mg/L	2021-10-17	
Zirconium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	

TEST RESULTS

REPORTED TO Elk River Alliance
PROJECT ERA-CBWM

WORK ORDER 21J1168
REPORTED 2021-11-05 16:36

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
C0L001_20211006_1100 (21J1168-05) | Matrix: Water | Sampled: 2021-10-06 11:00						
Anions						
Chloride	**0.35**	AO ≤ 250	0.10	mg/L	2021-10-14	
Nitrate (as N)	< 0.010	MAC = 10	0.010	mg/L	2021-10-14	HT1
Nitrite (as N)	< 0.010	MAC = 1	0.010	mg/L	2021-10-14	HT1
Phosphate (as P)	< 0.0050	N/A	0.0050	mg/L	2021-10-14	HT1
Sulfate	**3.4**	AO ≤ 500	1.0	mg/L	2021-10-14	
BCMOE Aggregate Hydrocarbons						
EPHw10-19	< 250	N/A	250	µg/L	2021-10-17	
EPHw19-32	< 250	N/A	250	µg/L	2021-10-17	
Surrogate: 2-Methylnonane (EPH/F2-4)	*102*		*60-140*	%	*2021-10-17*	
Calculated Parameters						
Hardness, Total (as CaCO3)	**90.3**	None Required	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	< 0.0100	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	**0.0960**	N/A	0.0500	mg/L	N/A	
Dissolved Metals						
Aluminum, dissolved	**0.0062**	N/A	0.0050	mg/L	2021-10-16	
Antimony, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-16	
Arsenic, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-16	
Barium, dissolved	**0.241**	N/A	0.0050	mg/L	2021-10-16	
Beryllium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
Bismuth, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
Boron, dissolved	< 0.0500	N/A	0.0500	mg/L	2021-10-16	
Cadmium, dissolved	**0.000037**	N/A	0.000010	mg/L	2021-10-16	
Calcium, dissolved	**25.9**	N/A	0.20	mg/L	2021-10-16	
Chromium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-16	
Cobalt, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
Copper, dissolved	**0.00057**	N/A	0.00040	mg/L	2021-10-16	
Iron, dissolved	**0.011**	N/A	0.010	mg/L	2021-10-16	
Lead, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-16	
Lithium, dissolved	**0.0106**	N/A	0.00010	mg/L	2021-10-16	
Magnesium, dissolved	**6.22**	N/A	0.010	mg/L	2021-10-16	
Manganese, dissolved	**0.00209**	N/A	0.00020	mg/L	2021-10-16	
Mercury, dissolved	< 0.000010	N/A	0.000010	mg/L	2021-10-15	
Molybdenum, dissolved	**0.00063**	N/A	0.00010	mg/L	2021-10-16	
Nickel, dissolved	< 0.00040	N/A	0.00040	mg/L	2021-10-16	
Phosphorus, dissolved	< 0.050	N/A	0.050	mg/L	2021-10-16	
Potassium, dissolved	**0.64**	N/A	0.10	mg/L	2021-10-16	
Selenium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-16	
Silicon, dissolved	**1.8**	N/A	1.0	mg/L	2021-10-16	
Silver, dissolved	< 0.000050	N/A	0.000050	mg/L	2021-10-16	
Sodium, dissolved	**2.59**	N/A	0.10	mg/L	2021-10-16	
Strontium, dissolved	**0.0959**	N/A	0.0010	mg/L	2021-10-16	

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
C0L001_20211006_1100 (21J1168-05) | Matrix: Water | Sampled: 2021-10-06 11:00, Continued						
Dissolved Metals, Continued						
Sulfur, dissolved	< 3.0	N/A	3.0	mg/L	2021-10-16	
Tellurium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-16	
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2021-10-16	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-16	
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2021-10-16	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2021-10-16	
Uranium, dissolved	**0.000150**	N/A	0.000020	mg/L	2021-10-16	
Vanadium, dissolved	< 0.0010	N/A	0.0010	mg/L	2021-10-16	
Zinc, dissolved	< 0.0040	N/A	0.0040	mg/L	2021-10-16	
Zirconium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
General Parameters						
Alkalinity, Total (as CaCO3)	**94.4**	N/A	1.0	mg/L	2021-10-12	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-12	
Alkalinity, Bicarbonate (as CaCO3)	**94.4**	N/A	1.0	mg/L	2021-10-12	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-12	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-12	
Carbon, Total Organic	**2.74**	N/A	0.50	mg/L	2021-10-12	
Carbon, Dissolved Organic	**2.68**	N/A	0.50	mg/L	2021-10-12	
Nitrogen, Total Kjeldahl	**0.096**	N/A	0.050	mg/L	2021-10-15	
Phosphorus, Total (as P)	**0.0108**	N/A	0.0050	mg/L	2021-10-18	
Solids, Total Suspended	< 2.0	N/A	2.0	mg/L	2021-10-14	HT1
Total Metals						
Aluminum, total	**0.0118**	OG < 0.1	0.0050	mg/L	2021-10-17	
Antimony, total	< 0.00020	MAC = 0.006	0.00020	mg/L	2021-10-17	
Arsenic, total	**0.00050**	MAC = 0.01	0.00050	mg/L	2021-10-17	
Barium, total	**0.261**	MAC = 2	0.0050	mg/L	2021-10-17	
Beryllium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
Bismuth, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
Boron, total	< 0.0500	MAC = 5	0.0500	mg/L	2021-10-17	
Cadmium, total	**0.000036**	MAC = 0.005	0.000010	mg/L	2021-10-17	
Calcium, total	**28.1**	None Required	0.20	mg/L	2021-10-17	
Chromium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2021-10-17	
Cobalt, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
Copper, total	**0.00075**	MAC = 2	0.00040	mg/L	2021-10-17	
Iron, total	**0.019**	AO ≤ 0.3	0.010	mg/L	2021-10-17	
Lead, total	< 0.00020	MAC = 0.005	0.00020	mg/L	2021-10-17	
Lithium, total	**0.0115**	N/A	0.00010	mg/L	2021-10-17	
Magnesium, total	**6.86**	None Required	0.010	mg/L	2021-10-17	
Manganese, total	**0.00314**	MAC = 0.12	0.00020	mg/L	2021-10-17	
Mercury, total	< 0.000010	MAC = 0.001	0.000010	mg/L	2021-10-15	
Molybdenum, total	**0.00116**	N/A	0.00010	mg/L	2021-10-17	

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
C0L001_20211006_1100 (21J1168-05) | Matrix: Water | Sampled: 2021-10-06 11:00, Continued						
Total Metals, Continued						
Nickel, total	**0.00050**	N/A	0.00040	mg/L	2021-10-17	
Phosphorus, total	< 0.050	N/A	0.050	mg/L	2021-10-17	
Potassium, total	**0.78**	N/A	0.10	mg/L	2021-10-17	
Selenium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2021-10-17	
Silicon, total	**1.8**	N/A	1.0	mg/L	2021-10-17	
Silver, total	< 0.000050	None Required	0.000050	mg/L	2021-10-17	
Sodium, total	**2.86**	AO ≤ 200	0.10	mg/L	2021-10-17	
Strontium, total	**0.105**	7	0.0010	mg/L	2021-10-17	
Sulfur, total	**3.3**	N/A	3.0	mg/L	2021-10-17	
Tellurium, total	< 0.00050	N/A	0.00050	mg/L	2021-10-17	
Thallium, total	< 0.000020	N/A	0.000020	mg/L	2021-10-17	
Thorium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
Tin, total	< 0.00020	N/A	0.00020	mg/L	2021-10-17	
Titanium, total	< 0.0050	N/A	0.0050	mg/L	2021-10-17	
Tungsten, total	< 0.0010	N/A	0.0010	mg/L	2021-10-17	
Uranium, total	**0.000164**	MAC = 0.02	0.000020	mg/L	2021-10-17	
Vanadium, total	< 0.0010	N/A	0.0010	mg/L	2021-10-17	
Zinc, total	< 0.0040	AO ≤ 5	0.0040	mg/L	2021-10-17	
Zirconium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
C0L003_20211006_0900 (21J1168-06) | Matrix: Water | Sampled: 2021-10-06 09:00						
Anions						
Chloride	**0.18**	AO ≤ 250	0.10	mg/L	2021-10-14	
Nitrate (as N)	< 0.010	MAC = 10	0.010	mg/L	2021-10-14	HT1
Nitrite (as N)	< 0.010	MAC = 1	0.010	mg/L	2021-10-14	HT1
Phosphate (as P)	< 0.0050	N/A	0.0050	mg/L	2021-10-14	HT1
Sulfate	**1.6**	AO ≤ 500	1.0	mg/L	2021-10-14	
BCMOE Aggregate Hydrocarbons						
EPHw10-19	< 250	N/A	250	µg/L	2021-10-17	
EPHw19-32	< 250	N/A	250	µg/L	2021-10-17	
Surrogate: 2-Methylnonane (EPH/F2-4)	*100*		*60-140*	%	*2021-10-17*	
Calculated Parameters						
Hardness, Total (as CaCO3)	**28.2**	None Required	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	< 0.0100	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	**0.213**	N/A	0.0500	mg/L	N/A	
Dissolved Metals						
Aluminum, dissolved	**0.0459**	N/A	0.0050	mg/L	2021-10-16	
Antimony, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-16	
Arsenic, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-16	
Barium, dissolved	**0.0542**	N/A	0.0050	mg/L	2021-10-16	

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
C0L003_20211006_0900 (21J1168-06) | Matrix: Water | Sampled: 2021-10-06 09:00, Continued						
Dissolved Metals, Continued						
Beryllium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
Bismuth, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
Boron, dissolved	< 0.0500	N/A	0.0500	mg/L	2021-10-16	
Cadmium, dissolved	**0.000054**	N/A	0.000010	mg/L	2021-10-16	
Calcium, dissolved	**8.53**	N/A	0.20	mg/L	2021-10-16	
Chromium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-16	
Cobalt, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
Copper, dissolved	**0.00055**	N/A	0.00040	mg/L	2021-10-16	
Iron, dissolved	**0.018**	N/A	0.010	mg/L	2021-10-16	
Lead, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-16	
Lithium, dissolved	**0.00021**	N/A	0.00010	mg/L	2021-10-16	
Magnesium, dissolved	**1.67**	N/A	0.010	mg/L	2021-10-16	
Manganese, dissolved	**0.00039**	N/A	0.00020	mg/L	2021-10-16	
Mercury, dissolved	< 0.000010	N/A	0.000010	mg/L	2021-10-15	
Molybdenum, dissolved	**0.00017**	N/A	0.00010	mg/L	2021-10-16	
Nickel, dissolved	**0.00064**	N/A	0.00040	mg/L	2021-10-16	
Phosphorus, dissolved	< 0.050	N/A	0.050	mg/L	2021-10-16	
Potassium, dissolved	**0.27**	N/A	0.10	mg/L	2021-10-16	
Selenium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-16	
Silicon, dissolved	**1.4**	N/A	1.0	mg/L	2021-10-16	
Silver, dissolved	< 0.000050	N/A	0.000050	mg/L	2021-10-16	
Sodium, dissolved	**0.19**	N/A	0.10	mg/L	2021-10-16	
Strontium, dissolved	**0.0127**	N/A	0.0010	mg/L	2021-10-16	
Sulfur, dissolved	< 3.0	N/A	3.0	mg/L	2021-10-16	
Tellurium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-16	
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2021-10-16	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-16	
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2021-10-16	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2021-10-16	
Uranium, dissolved	**0.000036**	N/A	0.000020	mg/L	2021-10-16	
Vanadium, dissolved	< 0.0010	N/A	0.0010	mg/L	2021-10-16	
Zinc, dissolved	< 0.0040	N/A	0.0040	mg/L	2021-10-16	
Zirconium, dissolved	**0.00019**	N/A	0.00010	mg/L	2021-10-16	
General Parameters						
Alkalinity, Total (as CaCO3)	**27.6**	N/A	1.0	mg/L	2021-10-12	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-12	
Alkalinity, Bicarbonate (as CaCO3)	**27.6**	N/A	1.0	mg/L	2021-10-12	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-12	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-12	
Carbon, Total Organic	**4.00**	N/A	0.50	mg/L	2021-10-12	
Carbon, Dissolved Organic	**3.96**	N/A	0.50	mg/L	2021-10-12	

TEST RESULTS

REPORTED TO Elk River Alliance
PROJECT ERA-CBWM

WORK ORDER 21J1168
REPORTED 2021-11-05 16:36

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
C0L003_20211006_0900 (21J1168-06) | Matrix: Water | Sampled: 2021-10-06 09:00, Continued						
General Parameters, Continued						
Nitrogen, Total Kjeldahl	**0.213**	N/A	0.050	mg/L	2021-10-15	
Phosphorus, Total (as P)	**0.0106**	N/A	0.0050	mg/L	2021-10-18	
Solids, Total Suspended	< 2.0	N/A	2.0	mg/L	2021-10-14	HT1
Total Metals						
Aluminum, total	**0.0605**	OG < 0.1	0.0050	mg/L	2021-10-17	
Antimony, total	< 0.00020	MAC = 0.006	0.00020	mg/L	2021-10-17	
Arsenic, total	< 0.00050	MAC = 0.01	0.00050	mg/L	2021-10-17	
Barium, total	**0.0577**	MAC = 2	0.0050	mg/L	2021-10-17	
Beryllium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
Bismuth, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
Boron, total	< 0.0500	MAC = 5	0.0500	mg/L	2021-10-17	
Cadmium, total	**0.000062**	MAC = 0.005	0.000010	mg/L	2021-10-17	
Calcium, total	**9.22**	None Required	0.20	mg/L	2021-10-17	
Chromium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2021-10-17	
Cobalt, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
Copper, total	**0.00072**	MAC = 2	0.00040	mg/L	2021-10-17	
Iron, total	**0.023**	AO ≤ 0.3	0.010	mg/L	2021-10-17	
Lead, total	< 0.00020	MAC = 0.005	0.00020	mg/L	2021-10-17	
Lithium, total	**0.00038**	N/A	0.00010	mg/L	2021-10-17	
Magnesium, total	**1.77**	None Required	0.010	mg/L	2021-10-17	
Manganese, total	**0.00070**	MAC = 0.12	0.00020	mg/L	2021-10-17	
Mercury, total	< 0.000010	MAC = 0.001	0.000010	mg/L	2021-10-15	
Molybdenum, total	**0.00026**	N/A	0.00010	mg/L	2021-10-17	
Nickel, total	**0.00081**	N/A	0.00040	mg/L	2021-10-17	
Phosphorus, total	**0.054**	N/A	0.050	mg/L	2021-10-17	
Potassium, total	**0.36**	N/A	0.10	mg/L	2021-10-17	
Selenium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2021-10-17	
Silicon, total	**1.6**	N/A	1.0	mg/L	2021-10-17	
Silver, total	< 0.000050	None Required	0.000050	mg/L	2021-10-17	
Sodium, total	**0.23**	AO ≤ 200	0.10	mg/L	2021-10-17	
Strontium, total	**0.0136**	7	0.0010	mg/L	2021-10-17	
Sulfur, total	< 3.0	N/A	3.0	mg/L	2021-10-17	
Tellurium, total	< 0.00050	N/A	0.00050	mg/L	2021-10-17	
Thallium, total	< 0.000020	N/A	0.000020	mg/L	2021-10-17	
Thorium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
Tin, total	< 0.00020	N/A	0.00020	mg/L	2021-10-17	
Titanium, total	< 0.0050	N/A	0.0050	mg/L	2021-10-17	
Tungsten, total	< 0.0010	N/A	0.0010	mg/L	2021-10-17	
Uranium, total	**0.000035**	MAC = 0.02	0.000020	mg/L	2021-10-17	
Vanadium, total	< 0.0010	N/A	0.0010	mg/L	2021-10-17	
Zinc, total	**0.0139**	AO ≤ 5	0.0040	mg/L	2021-10-17	
Zirconium, total	**0.00022**	N/A	0.00010	mg/L	2021-10-17	

TEST RESULTS

REPORTED TO Elk River Alliance
PROJECT ERA-CBWM

WORK ORDER 21J1168
REPORTED 2021-11-05 16:36

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
FLD001_20211005_1455 (21J1168-07) | Matrix: Water | Sampled: 2021-10-05 14:55						
Anions						
Chloride	< 0.10	AO ≤ 250	0.10	mg/L	2021-10-14	
Nitrate (as N)	< 0.010	MAC = 10	0.010	mg/L	2021-10-14	HT1
Nitrite (as N)	< 0.010	MAC = 1	0.010	mg/L	2021-10-14	HT1
Phosphate (as P)	< 0.0050	N/A	0.0050	mg/L	2021-10-14	HT1
Sulfate	< 1.0	AO ≤ 500	1.0	mg/L	2021-10-14	
Calculated Parameters						
Hardness, Total (as CaCO3)	< 0.500	None Required	0.500	mg/L	N/A	
Nitrate+Nitrite (as N)	< 0.0100	N/A	0.0100	mg/L	N/A	
Nitrogen, Total	< 0.0500	N/A	0.0500	mg/L	N/A	
Dissolved Metals						
Aluminum, dissolved	< 0.0050	N/A	0.0050	mg/L	2021-10-16	
Antimony, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-16	
Arsenic, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-16	
Barium, dissolved	< 0.0050	N/A	0.0050	mg/L	2021-10-16	
Beryllium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
Bismuth, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
Boron, dissolved	< 0.0500	N/A	0.0500	mg/L	2021-10-16	
Cadmium, dissolved	< 0.000010	N/A	0.000010	mg/L	2021-10-16	
Calcium, dissolved	< 0.20	N/A	0.20	mg/L	2021-10-16	
Chromium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-16	
Cobalt, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
Copper, dissolved	< 0.00040	N/A	0.00040	mg/L	2021-10-16	
Iron, dissolved	< 0.010	N/A	0.010	mg/L	2021-10-16	
Lead, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-16	
Lithium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
Magnesium, dissolved	< 0.010	N/A	0.010	mg/L	2021-10-16	
Manganese, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-16	
Mercury, dissolved	< 0.000010	N/A	0.000010	mg/L	2021-10-15	
Molybdenum, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
Nickel, dissolved	< 0.00040	N/A	0.00040	mg/L	2021-10-16	
Phosphorus, dissolved	< 0.050	N/A	0.050	mg/L	2021-10-16	
Potassium, dissolved	< 0.10	N/A	0.10	mg/L	2021-10-16	
Selenium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-16	
Silicon, dissolved	< 1.0	N/A	1.0	mg/L	2021-10-16	
Silver, dissolved	< 0.000050	N/A	0.000050	mg/L	2021-10-16	
Sodium, dissolved	< 0.10	N/A	0.10	mg/L	2021-10-16	
Strontium, dissolved	< 0.0010	N/A	0.0010	mg/L	2021-10-16	
Sulfur, dissolved	< 3.0	N/A	3.0	mg/L	2021-10-16	
Tellurium, dissolved	< 0.00050	N/A	0.00050	mg/L	2021-10-16	
Thallium, dissolved	< 0.000020	N/A	0.000020	mg/L	2021-10-16	
Thorium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
Tin, dissolved	< 0.00020	N/A	0.00020	mg/L	2021-10-16	

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
FLD001_20211005_1455 (21J1168-07) | Matrix: Water | Sampled: 2021-10-05 14:55, Continued						
Dissolved Metals, Continued						
Titanium, dissolved	< 0.0050	N/A	0.0050	mg/L	2021-10-16	
Tungsten, dissolved	< 0.0010	N/A	0.0010	mg/L	2021-10-16	
Uranium, dissolved	< 0.000020	N/A	0.000020	mg/L	2021-10-16	
Vanadium, dissolved	< 0.0010	N/A	0.0010	mg/L	2021-10-16	
Zinc, dissolved	< 0.0040	N/A	0.0040	mg/L	2021-10-16	
Zirconium, dissolved	< 0.00010	N/A	0.00010	mg/L	2021-10-16	
General Parameters						
Alkalinity, Total (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-12	
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-12	
Alkalinity, Bicarbonate (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-12	
Alkalinity, Carbonate (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-12	
Alkalinity, Hydroxide (as CaCO3)	< 1.0	N/A	1.0	mg/L	2021-10-12	
Carbon, Total Organic	< 0.50	N/A	0.50	mg/L	2021-10-12	
Carbon, Dissolved Organic	< 0.50	N/A	0.50	mg/L	2021-10-12	
Nitrogen, Total Kjeldahl	< 0.050	N/A	0.050	mg/L	2021-10-15	
Phosphorus, Total (as P)	< 0.0050	N/A	0.0050	mg/L	2021-10-18	
Solids, Total Suspended	< 2.0	N/A	2.0	mg/L	2021-10-14	HT1
Total Metals						
Aluminum, total	**0.0052**	OG < 0.1	0.0050	mg/L	2021-10-17	
Antimony, total	< 0.00020	MAC = 0.006	0.00020	mg/L	2021-10-17	
Arsenic, total	< 0.00050	MAC = 0.01	0.00050	mg/L	2021-10-17	
Barium, total	< 0.0050	MAC = 2	0.0050	mg/L	2021-10-17	
Beryllium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
Bismuth, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
Boron, total	< 0.0500	MAC = 5	0.0500	mg/L	2021-10-17	
Cadmium, total	< 0.000010	MAC = 0.005	0.000010	mg/L	2021-10-17	
Calcium, total	**0.38**	None Required	0.20	mg/L	2021-10-17	
Chromium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2021-10-17	
Cobalt, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
Copper, total	< 0.00040	MAC = 2	0.00040	mg/L	2021-10-17	
Iron, total	< 0.010	AO ≤ 0.3	0.010	mg/L	2021-10-17	
Lead, total	< 0.00020	MAC = 0.005	0.00020	mg/L	2021-10-17	
Lithium, total	**0.00021**	N/A	0.00010	mg/L	2021-10-17	
Magnesium, total	< 0.010	None Required	0.010	mg/L	2021-10-17	
Manganese, total	< 0.00020	MAC = 0.12	0.00020	mg/L	2021-10-17	
Mercury, total	< 0.000010	MAC = 0.001	0.000010	mg/L	2021-10-15	
Molybdenum, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
Nickel, total	< 0.00040	N/A	0.00040	mg/L	2021-10-17	
Phosphorus, total	< 0.050	N/A	0.050	mg/L	2021-10-17	
Potassium, total	< 0.10	N/A	0.10	mg/L	2021-10-17	
Selenium, total	< 0.00050	MAC = 0.05	0.00050	mg/L	2021-10-17	
Silicon, total	< 1.0	N/A	1.0	mg/L	2021-10-17	

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
FLD001_20211005_1455 (21J1168-07) | Matrix: Water | Sampled: 2021-10-05 14:55, Continued						
Total Metals, Continued						
Silver, total	< 0.000050	None Required	0.000050	mg/L	2021-10-17	
Sodium, total	< 0.10	AO ≤ 200	0.10	mg/L	2021-10-17	
Strontium, total	< 0.0010	7	0.0010	mg/L	2021-10-17	
Sulfur, total	< 3.0	N/A	3.0	mg/L	2021-10-17	
Tellurium, total	< 0.00050	N/A	0.00050	mg/L	2021-10-17	
Thallium, total	< 0.000020	N/A	0.000020	mg/L	2021-10-17	
Thorium, total	< 0.00010	N/A	0.00010	mg/L	2021-10-17	
Tin, total	< 0.00020	N/A	0.00020	mg/L	2021-10-17	
Titanium, total	< 0.0050	N/A	0.0050	mg/L	2021-10-17	
Tungsten, total	< 0.0010	N/A	0.0010	mg/L	2021-10-17	
Uranium, total	< 0.000020	MAC = 0.02	0.000020	mg/L	2021-10-17	
Vanadium, total	< 0.0010	N/A	0.0010	mg/L	2021-10-17	
Zinc, total	**0.0417**	AO ≤ 5	0.0040	mg/L	2021-10-17	
Zirconium, total	**0.00016**	N/A	0.00010	mg/L	2021-10-17	

Sample Qualifiers:

HT1 The sample was prepared and/or analyzed past the recommended holding time.

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO Elk River Alliance
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Analysis Description	Method Ref.	Technique	Accredited	Location
Alkalinity in Water	SM 2320 B* (2017)	Titration with H2SO4	✓	Kelowna
Anions in Water	SM 4110 B (2017)	Ion Chromatography	✓	Kelowna
Carbon, Dissolved Organic in Water	SM 5310 B (2017)	Combustion, Infrared CO2 Detection	✓	Kelowna
Carbon, Total Organic in Water	SM 5310 B (2017)	Combustion, Infrared CO2 Detection	✓	Kelowna
Dissolved Metals in Water	EPA 200.8 / EPA 6020B	0.45 µm Filtration / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	✓	Richmond
EPH in Water	EPA 3511* / BCMOE EPHw	Hexane MicroExtraction (Base/Neutral) / Gas Chromatography (GC-FID)	✓	Richmond
Hardness in Water	SM 2340 B (2017)	Calculation: 2.497 [diss Ca] + 4.118 [diss Mg]	✓	N/A
Mercury, dissolved in Water	EPA 245.7*	BrCl2 Oxidation / Cold Vapor Atomic Fluorescence Spectrometry (CVAFS)	✓	Richmond
Mercury, total in Water	EPA 245.7*	BrCl2 Oxidation / Cold Vapor Atomic Fluorescence Spectrometry (CVAFS)	✓	Richmond
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2017)	Block Digestion and Flow Injection Analysis	✓	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2017)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Solids, Total Suspended in Water	SM 2540 D* (2017)	Gravimetry (Dried at 103-105C)	✓	Kelowna
Total Metals in Water	EPA 200.2 / EPA 6020B	HNO3+HCl Hot Block Digestion / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	✓	Richmond

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Glossary of Terms:

RL	Reporting Limit (default)
<	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
AO	Aesthetic Objective
MAC	Maximum Acceptable Concentration (health based)
mg/L	Milligrams per litre
OG	Operational Guideline (treated water)
µg/L	Micrograms per litre
EPA	United States Environmental Protection Agency Test Methods
SM	Standard Methods for the Examination of Water and Wastewater, American Public Health Association

Guidelines Referenced in this Report:

Guidelines for Canadian Drinking Water Quality (Health Canada, June 2019)

Note: In some cases, the values displayed on the report represent the lowest guideline and are to be verified by the end user

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Elk River Alliance	**WORK ORDER**	21J1168
PROJECT	ERA-CBWM	**REPORTED**	2021-11-05 16:36

General Comments:

The results in this report apply to the samples analyzed in accordance with the Chain of Custody document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Samples will be disposed of 30 days after the test report has been issued or once samples expire, whichever comes first. Longer hold is possible if agreed to in writing.

Results in **Bold** indicate values that are above CARO's method reporting limits. Any results that are above regulatory limits are highlighted **red**. Please note that results will only be highlighted red if the regulatory limits are included on the CARO report. Any Bold and/or highlighted results do not take into account method uncertainty. If you would like method uncertainty or regulatory limits to be included on your report, please contact your Account Manager:teamcaro@caro.ca

Please note any regulatory guidelines applied to this report are added as a convenience to the client, at their request, to help provide some initial context to analytical results obtained. Although CARO makes every effort to ensure accuracy of the associated regulatory guideline(s) applied, the guidelines applied cannot be assumed to be correct due to a variety of factors and as such CARO Analytical Services assumes no liability or responsibility for the use of those guidelines to make any decisions. The original source of the regulation should be verified and a review of the guideline (s) should be validated as correct in order to make any decisions arising from the comparison of the analytical data obtained to the relevant regulatory guideline for one's particular circumstances. Further, CARO Analytical Services assumes no liability or responsibility for any loss attributed from the use of these guidelines in any way.

The following section displays the quality control (QC) data that is associated with your sample data. Groups of samples are prepared in "batches" and analyzed in conjunction with QC samples that ensure your data is of the highest quality. Common QC types include:

- **Method Blank (Blk)**: A blank sample that undergoes sample processing identical to that carried out for the test samples. Method blank results are used to assess contamination from the laboratory environment and reagents.
- **Duplicate (Dup)**: An additional or second portion of a randomly selected sample in the analytical run carried through the entire analytical process. Duplicates provide a measure of the analytical method's precision (reproducibility).
- **Blank Spike (BS)**: A sample of known concentration which undergoes processing identical to that carried out for test samples, also referred to as a laboratory control sample (LCS). Blank spikes provide a measure of the analytical method's accuracy.
- **Matrix Spike (MS)**: A second aliquot of sample is fortified with with a known concentration of target analytes and carried through the entire analytical process. Matrix spikes evaluate potential matrix effects that may affect the analyte recovery.
- **Reference Material (SRM)**: A homogenous material of similar matrix to the samples, certified for the parameter(s) listed. Reference Materials ensure that the analytical process is adequate to achieve acceptable recoveries of the parameter(s) tested.

Each QC type is analyzed at a 5-10% frequency, i.e. one blank/duplicate/spike for every 10-20 samples. For all types of QC, the specified recovery (% Rec) and relative percent difference (RPD) limits are derived from long-term method performance averages and/or prescribed by the reference method.

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Anions, Batch B1J1217										
Blank (B1J1217-BLK1)				Prepared: 2021-10-14, Analyzed: 2021-10-14						
Chloride	< 0.10	0.10	mg/L							
Nitrate (as N)	< 0.010	0.010	mg/L							
Nitrite (as N)	< 0.010	0.010	mg/L							
Phosphate (as P)	< 0.0050	0.0050	mg/L							
Sulfate	< 1.0	1.0	mg/L							
Blank (B1J1217-BLK2)				Prepared: 2021-10-14, Analyzed: 2021-10-14						
Chloride	< 0.10	0.10	mg/L							
Nitrate (as N)	< 0.010	0.010	mg/L							
Nitrite (as N)	< 0.010	0.010	mg/L							
Phosphate (as P)	< 0.0050	0.0050	mg/L							
Sulfate	< 1.0	1.0	mg/L							
Blank (B1J1217-BLK3)				Prepared: 2021-10-14, Analyzed: 2021-10-14						
Chloride	< 0.10	0.10	mg/L							
Nitrate (as N)	< 0.010	0.010	mg/L							
Nitrite (as N)	< 0.010	0.010	mg/L							
Phosphate (as P)	< 0.0050	0.0050	mg/L							
Sulfate	< 1.0	1.0	mg/L							
Blank (B1J1217-BLK4)				Prepared: 2021-10-14, Analyzed: 2021-10-14						
Chloride	< 0.10	0.10	mg/L							
Nitrate (as N)	< 0.010	0.010	mg/L							
Nitrite (as N)	< 0.010	0.010	mg/L							
Phosphate (as P)	< 0.0050	0.0050	mg/L							
Sulfate	< 1.0	1.0	mg/L							
Blank (B1J1217-BLK5)				Prepared: 2021-10-14, Analyzed: 2021-10-14						
Chloride	< 0.10	0.10	mg/L							
Nitrate (as N)	< 0.010	0.010	mg/L							
Nitrite (as N)	< 0.010	0.010	mg/L							
Phosphate (as P)	< 0.0050	0.0050	mg/L							
Sulfate	< 1.0	1.0	mg/L							
LCS (B1J1217-BS1)				Prepared: 2021-10-14, Analyzed: 2021-10-14						
Chloride	16.0	0.10	mg/L	16.0		100	90-110			
Nitrate (as N)	4.05	0.010	mg/L	4.00		101	90-110			

APPENDIX 2: QUALITY CONTROL RESULTS

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Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Anions, Batch B1J1217, Continued										
LCS (B1J1217-BS1), Continued				Prepared: 2021-10-14, Analyzed: 2021-10-14						
Nitrite (as N)	2.01	0.010	mg/L	2.00		100	85-115			
Phosphate (as P)	0.977	0.0050	mg/L	1.00		98	80-120			
Sulfate	16.1	1.0	mg/L	16.0		101	90-110			
LCS (B1J1217-BS2)				Prepared: 2021-10-14, Analyzed: 2021-10-14						
Chloride	16.0	0.10	mg/L	16.0		100	90-110			
Nitrate (as N)	4.04	0.010	mg/L	4.00		101	90-110			
Nitrite (as N)	2.00	0.010	mg/L	2.00		100	85-115			
Phosphate (as P)	0.980	0.0050	mg/L	1.00		98	80-120			
Sulfate	16.3	1.0	mg/L	16.0		102	90-110			
LCS (B1J1217-BS3)				Prepared: 2021-10-14, Analyzed: 2021-10-14						
Chloride	16.0	0.10	mg/L	16.0		100	90-110			
Nitrate (as N)	4.09	0.010	mg/L	4.00		102	90-110			
Nitrite (as N)	2.00	0.010	mg/L	2.00		100	85-115			
Phosphate (as P)	0.973	0.0050	mg/L	1.00		97	80-120			
Sulfate	16.1	1.0	mg/L	16.0		101	90-110			
LCS (B1J1217-BS4)				Prepared: 2021-10-14, Analyzed: 2021-10-14						
Chloride	16.0	0.10	mg/L	16.0		100	90-110			
Nitrate (as N)	4.10	0.010	mg/L	4.00		103	90-110			
Nitrite (as N)	2.01	0.010	mg/L	2.00		100	85-115			
Phosphate (as P)	1.07	0.0050	mg/L	1.00		107	80-120			
Sulfate	16.0	1.0	mg/L	16.0		100	90-110			
LCS (B1J1217-BS5)				Prepared: 2021-10-14, Analyzed: 2021-10-14						
Chloride	16.0	0.10	mg/L	16.0		100	90-110			
Nitrate (as N)	4.10	0.010	mg/L	4.00		102	90-110			
Nitrite (as N)	2.00	0.010	mg/L	2.00		100	85-115			
Phosphate (as P)	0.984	0.0050	mg/L	1.00		98	80-120			
Sulfate	16.1	1.0	mg/L	16.0		101	90-110			
BCMOE Aggregate Hydrocarbons, Batch B1J1594										
Blank (B1J1594-BLK1)				Prepared: 2021-10-15, Analyzed: 2021-10-16						
EPHw10-19	< 250	250	µg/L							
EPHw19-32	< 250	250	µg/L							
Surrogate: 2-Methylnonane (EPH/F2-4)	*1510*		*µg/L*	1620		*93*	*60-140*			
LCS (B1J1594-BS2)				Prepared: 2021-10-15, Analyzed: 2021-10-16						
EPHw10-19	16400	250	µg/L	15400		106	70-130			
EPHw19-32	25200	250	µg/L	22100		114	70-130			
Surrogate: 2-Methylnonane (EPH/F2-4)	*1250*		*µg/L*	1620		*77*	*60-140*			
LCS Dup (B1J1594-BSD2)				Prepared: 2021-10-15, Analyzed: 2021-10-16						
EPHw10-19	16300	250	µg/L	15400		105	70-130	< 1	20	
EPHw19-32	24700	250	µg/L	22100		112	70-130	2	20	
Surrogate: 2-Methylnonane (EPH/F2-4)	*1250*		*µg/L*	1620		*77*	*60-140*			
BCMOE Aggregate Hydrocarbons, Batch B1J1712										
Blank (B1J1712-BLK1)				Prepared: 2021-10-16, Analyzed: 2021-10-17						
EPHw10-19	< 250	250	µg/L							
EPHw19-32	< 250	250	µg/L							
Surrogate: 2-Methylnonane (EPH/F2-4)	*1340*		*µg/L*	1620		*83*	*60-140*			

APPENDIX 2: QUALITY CONTROL RESULTS

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Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
BCMOE Aggregate Hydrocarbons, Batch B1J1712, Continued										
LCS (B1J1712-BS2)				Prepared: 2021-10-16, Analyzed: 2021-10-17						
EPHw10-19	16400	250	µg/L	15400		106	70-130			
EPHw19-32	24600	250	µg/L	22100		111	70-130			
Surrogate: 2-Methylnonane (EPH/F2-4)	*1470*		*µg/L*	1620		*91*	*60-140*			
LCS Dup (B1J1712-BSD2)				Prepared: 2021-10-16, Analyzed: 2021-10-17						
EPHw10-19	16300	250	µg/L	15400		106	70-130	< 1	20	
EPHw19-32	24700	250	µg/L	22100		112	70-130	< 1	20	
Surrogate: 2-Methylnonane (EPH/F2-4)	*1510*		*µg/L*	1620		*93*	*60-140*			
Dissolved Metals, Batch B1J1470										
Blank (B1J1470-BLK1)				Prepared: 2021-10-16, Analyzed: 2021-10-16						
Aluminum, dissolved	< 0.0050	0.0050	mg/L							
Antimony, dissolved	< 0.00020	0.00020	mg/L							
Arsenic, dissolved	< 0.00050	0.00050	mg/L							
Barium, dissolved	< 0.0050	0.0050	mg/L							
Beryllium, dissolved	< 0.00010	0.00010	mg/L							
Bismuth, dissolved	< 0.00010	0.00010	mg/L							
Boron, dissolved	< 0.0500	0.0500	mg/L							
Cadmium, dissolved	< 0.000010	0.000010	mg/L							
Calcium, dissolved, dissolved	< 0.20	0.20	mg/L							
Chromium, dissolved	< 0.00050	0.00050	mg/L							
Cobalt, dissolved	< 0.00010	0.00010	mg/L							
Copper, dissolved	< 0.00040	0.00040	mg/L							
Iron, dissolved	< 0.010	0.010	mg/L							
Lead, dissolved	< 0.00020	0.00020	mg/L							
Lithium, dissolved	< 0.00010	0.00010	mg/L							
Magnesium, dissolved, dissolved	< 0.010	0.010	mg/L							
Manganese, dissolved	< 0.00020	0.00020	mg/L							
Molybdenum, dissolved	< 0.00010	0.00010	mg/L							
Nickel, dissolved	< 0.00040	0.00040	mg/L							
Phosphorus, dissolved	< 0.050	0.050	mg/L							
Potassium, dissolved	< 0.10	0.10	mg/L							
Selenium, dissolved	< 0.00050	0.00050	mg/L							
Silicon, dissolved	< 1.0	1.0	mg/L							
Silver, dissolved	< 0.000050	0.000050	mg/L							
Sodium, dissolved	< 0.10	0.10	mg/L							
Strontium, dissolved	< 0.0010	0.0010	mg/L							
Sulfur, dissolved	< 3.0	3.0	mg/L							
Tellurium, dissolved	< 0.00050	0.00050	mg/L							
Thallium, dissolved	< 0.000020	0.000020	mg/L							
Thorium, dissolved	< 0.00010	0.00010	mg/L							
Tin, dissolved	< 0.00020	0.00020	mg/L							
Titanium, dissolved	< 0.0050	0.0050	mg/L							
Tungsten, dissolved	< 0.0010	0.0010	mg/L							
Uranium, dissolved	< 0.000020	0.000020	mg/L							
Vanadium, dissolved	< 0.0010	0.0010	mg/L							
Zinc, dissolved	< 0.0040	0.0040	mg/L							
Zirconium, dissolved	< 0.00010	0.00010	mg/L							
Blank (B1J1470-BLK2)				Prepared: 2021-10-16, Analyzed: 2021-10-16						
Aluminum, dissolved	< 0.0050	0.0050	mg/L							
Antimony, dissolved	< 0.00020	0.00020	mg/L							
Arsenic, dissolved	< 0.00050	0.00050	mg/L							
Barium, dissolved	< 0.0050	0.0050	mg/L							
Beryllium, dissolved	< 0.00010	0.00010	mg/L							

APPENDIX 2: QUALITY CONTROL RESULTS

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Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Dissolved Metals, Batch B1J1470, Continued										
Blank (B1J1470-BLK2), Continued				Prepared: 2021-10-16, Analyzed: 2021-10-16						
Bismuth, dissolved	< 0.00010	0.00010	mg/L							
Boron, dissolved	< 0.0500	0.0500	mg/L							
Cadmium, dissolved	< 0.000010	0.000010	mg/L							
Calcium, dissolved, dissolved	< 0.20	0.20	mg/L							
Chromium, dissolved	< 0.00050	0.00050	mg/L							
Cobalt, dissolved	< 0.00010	0.00010	mg/L							
Copper, dissolved	< 0.00040	0.00040	mg/L							
Iron, dissolved	< 0.010	0.010	mg/L							
Lead, dissolved	< 0.00020	0.00020	mg/L							
Lithium, dissolved	< 0.00010	0.00010	mg/L							
Magnesium, dissolved, dissolved	< 0.010	0.010	mg/L							
Manganese, dissolved	< 0.00020	0.00020	mg/L							
Molybdenum, dissolved	< 0.00010	0.00010	mg/L							
Nickel, dissolved	< 0.00040	0.00040	mg/L							
Phosphorus, dissolved	< 0.050	0.050	mg/L							
Potassium, dissolved	< 0.10	0.10	mg/L							
Selenium, dissolved	< 0.00050	0.00050	mg/L							
Silicon, dissolved	< 1.0	1.0	mg/L							
Silver, dissolved	< 0.000050	0.000050	mg/L							
Sodium, dissolved	< 0.10	0.10	mg/L							
Strontium, dissolved	< 0.0010	0.0010	mg/L							
Sulfur, dissolved	< 3.0	3.0	mg/L							
Tellurium, dissolved	< 0.00050	0.00050	mg/L							
Thallium, dissolved	< 0.000020	0.000020	mg/L							
Thorium, dissolved	< 0.00010	0.00010	mg/L							
Tin, dissolved	< 0.00020	0.00020	mg/L							
Titanium, dissolved	< 0.0050	0.0050	mg/L							
Tungsten, dissolved	< 0.0010	0.0010	mg/L							
Uranium, dissolved	< 0.000020	0.000020	mg/L							
Vanadium, dissolved	< 0.0010	0.0010	mg/L							
Zinc, dissolved	< 0.0040	0.0040	mg/L							
Zirconium, dissolved	< 0.00010	0.00010	mg/L							
LCS (B1J1470-BS1)				Prepared: 2021-10-16, Analyzed: 2021-10-16						
Aluminum, dissolved	0.0232	0.0050	mg/L	0.0200		116	80-120			
Antimony, dissolved	0.0188	0.00020	mg/L	0.0200		94	80-120			
Arsenic, dissolved	0.0182	0.00050	mg/L	0.0200		91	80-120			
Barium, dissolved	0.0184	0.0050	mg/L	0.0200		92	80-120			
Beryllium, dissolved	0.0190	0.00010	mg/L	0.0200		95	80-120			
Bismuth, dissolved	0.0193	0.00010	mg/L	0.0200		97	80-120			
Boron, dissolved	< 0.0500	0.0500	mg/L	0.0200		106	80-120			
Cadmium, dissolved	0.0185	0.000010	mg/L	0.0200		93	80-120			
Calcium, dissolved, dissolved	2.11	0.20	mg/L	2.00		106	80-120			
Chromium, dissolved	0.0188	0.00050	mg/L	0.0200		94	80-120			
Cobalt, dissolved	0.0188	0.00010	mg/L	0.0200		94	80-120			
Copper, dissolved	0.0186	0.00040	mg/L	0.0200		93	80-120			
Iron, dissolved	1.83	0.010	mg/L	2.00		92	80-120			
Lead, dissolved	0.0187	0.00020	mg/L	0.0200		93	80-120			
Lithium, dissolved	0.0190	0.00010	mg/L	0.0200		95	80-120			
Magnesium, dissolved, dissolved	2.01	0.010	mg/L	2.00		100	80-120			
Manganese, dissolved	0.0189	0.00020	mg/L	0.0200		94	80-120			
Molybdenum, dissolved	0.0182	0.00010	mg/L	0.0200		91	80-120			
Nickel, dissolved	0.0190	0.00040	mg/L	0.0200		95	80-120			
Phosphorus, dissolved	1.89	0.050	mg/L	2.00		94	80-120			
Potassium, dissolved	1.90	0.10	mg/L	2.00		95	80-120			
Selenium, dissolved	0.0203	0.00050	mg/L	0.0200		101	80-120			

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO Elk River Alliance
PROJECT ERA-CBWM

WORK ORDER 21J1168
REPORTED 2021-11-05 16:36

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Dissolved Metals, Batch B1J1470, Continued										
LCS (B1J1470-BS1), Continued				Prepared: 2021-10-16, Analyzed: 2021-10-16						
Silicon, dissolved	1.8	1.0	mg/L	2.00		91	80-120			
Silver, dissolved	0.0183	0.000050	mg/L	0.0200		91	80-120			
Sodium, dissolved	1.95	0.10	mg/L	2.00		97	80-120			
Strontium, dissolved	0.0190	0.0010	mg/L	0.0200		95	80-120			
Sulfur, dissolved	4.7	3.0	mg/L	5.00		94	80-120			
Tellurium, dissolved	0.0190	0.00050	mg/L	0.0200		95	80-120			
Thallium, dissolved	0.0193	0.000020	mg/L	0.0200		97	80-120			
Thorium, dissolved	0.0187	0.00010	mg/L	0.0200		93	80-120			
Tin, dissolved	0.0196	0.00020	mg/L	0.0200		98	80-120			
Titanium, dissolved	0.0192	0.0050	mg/L	0.0200		96	80-120			
Tungsten, dissolved	0.0185	0.0010	mg/L	0.0200		92	80-120			
Uranium, dissolved	0.0187	0.000020	mg/L	0.0200		93	80-120			
Vanadium, dissolved	0.0191	0.0010	mg/L	0.0200		95	80-120			
Zinc, dissolved	0.0204	0.0040	mg/L	0.0200		102	80-120			
Zirconium, dissolved	0.0191	0.00010	mg/L	0.0200		95	80-120			
LCS (B1J1470-BS2)				Prepared: 2021-10-16, Analyzed: 2021-10-16						
Aluminum, dissolved	0.0227	0.0050	mg/L	0.0200		113	80-120			
Antimony, dissolved	0.0192	0.00020	mg/L	0.0200		96	80-120			
Arsenic, dissolved	0.0187	0.00050	mg/L	0.0200		93	80-120			
Barium, dissolved	0.0191	0.0050	mg/L	0.0200		96	80-120			
Beryllium, dissolved	0.0196	0.00010	mg/L	0.0200		98	80-120			
Bismuth, dissolved	0.0199	0.00010	mg/L	0.0200		100	80-120			
Boron, dissolved	< 0.0500	0.0500	mg/L	0.0200		107	80-120			
Cadmium, dissolved	0.0185	0.000010	mg/L	0.0200		92	80-120			
Calcium, dissolved, dissolved	2.17	0.20	mg/L	2.00		108	80-120			
Chromium, dissolved	0.0188	0.00050	mg/L	0.0200		94	80-120			
Cobalt, dissolved	0.0188	0.00010	mg/L	0.0200		94	80-120			
Copper, dissolved	0.0188	0.00040	mg/L	0.0200		94	80-120			
Iron, dissolved	1.85	0.010	mg/L	2.00		93	80-120			
Lead, dissolved	0.0191	0.00020	mg/L	0.0200		96	80-120			
Lithium, dissolved	0.0196	0.00010	mg/L	0.0200		98	80-120			
Magnesium, dissolved, dissolved	2.03	0.010	mg/L	2.00		101	80-120			
Manganese, dissolved	0.0193	0.00020	mg/L	0.0200		97	80-120			
Molybdenum, dissolved	0.0179	0.00010	mg/L	0.0200		89	80-120			
Nickel, dissolved	0.0194	0.00040	mg/L	0.0200		97	80-120			
Phosphorus, dissolved	1.90	0.050	mg/L	2.00		95	80-120			
Potassium, dissolved	1.91	0.10	mg/L	2.00		96	80-120			
Selenium, dissolved	0.0197	0.00050	mg/L	0.0200		98	80-120			
Silicon, dissolved	1.7	1.0	mg/L	2.00		87	80-120			
Silver, dissolved	0.0185	0.000050	mg/L	0.0200		92	80-120			
Sodium, dissolved	1.97	0.10	mg/L	2.00		99	80-120			
Strontium, dissolved	0.0266	0.0010	mg/L	0.0200		133	80-120			SPK1
Sulfur, dissolved	4.0	3.0	mg/L	5.00		80	80-120			
Tellurium, dissolved	0.0184	0.00050	mg/L	0.0200		92	80-120			
Thallium, dissolved	0.0197	0.000020	mg/L	0.0200		98	80-120			
Thorium, dissolved	0.0192	0.00010	mg/L	0.0200		96	80-120			
Tin, dissolved	0.0193	0.00020	mg/L	0.0200		96	80-120			
Titanium, dissolved	0.0193	0.0050	mg/L	0.0200		97	80-120			
Tungsten, dissolved	0.0182	0.0010	mg/L	0.0200		91	80-120			
Uranium, dissolved	0.0191	0.000020	mg/L	0.0200		96	80-120			
Vanadium, dissolved	0.0188	0.0010	mg/L	0.0200		94	80-120			
Zinc, dissolved	0.0218	0.0040	mg/L	0.0200		109	80-120			
Zirconium, dissolved	0.0191	0.00010	mg/L	0.0200		96	80-120			
Reference (B1J1470-SRM1)				Prepared: 2021-10-16, Analyzed: 2021-10-16						
Aluminum, dissolved	0.247	0.0050	mg/L	0.235		105	70-130			

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Dissolved Metals, Batch B1J1470, Continued										
Reference (B1J1470-SRM1), Continued				Prepared: 2021-10-16, Analyzed: 2021-10-16						
Antimony, dissolved	0.0434	0.00020	mg/L	0.0431		101	70-130			
Arsenic, dissolved	0.422	0.00050	mg/L	0.423		100	70-130			
Barium, dissolved	2.97	0.0050	mg/L	3.30		90	70-130			
Beryllium, dissolved	0.205	0.00010	mg/L	0.209		98	70-130			
Boron, dissolved	1.62	0.0500	mg/L	1.65		98	70-130			
Cadmium, dissolved	0.208	0.000010	mg/L	0.221		94	70-130			
Calcium, dissolved, dissolved	7.96	0.20	mg/L	7.72		103	70-130			
Chromium, dissolved	0.413	0.00050	mg/L	0.434		95	70-130			
Cobalt, dissolved	0.120	0.00010	mg/L	0.124		97	70-130			
Copper, dissolved	0.774	0.00040	mg/L	0.815		95	70-130			
Iron, dissolved	1.24	0.010	mg/L	1.27		98	70-130			
Lead, dissolved	0.107	0.00020	mg/L	0.110		97	70-130			
Lithium, dissolved	0.0976	0.00010	mg/L	0.100		98	70-130			
Magnesium, dissolved, dissolved	6.93	0.010	mg/L	6.59		105	70-130			
Manganese, dissolved	0.333	0.00020	mg/L	0.342		97	70-130			
Molybdenum, dissolved	0.388	0.00010	mg/L	0.404		96	70-130			
Nickel, dissolved	0.817	0.00040	mg/L	0.835		98	70-130			
Phosphorus, dissolved	0.511	0.050	mg/L	0.499		102	70-130			
Potassium, dissolved	2.98	0.10	mg/L	2.88		103	70-130			
Selenium, dissolved	0.0328	0.00050	mg/L	0.0324		101	70-130			
Sodium, dissolved	18.9	0.10	mg/L	18.0		105	70-130			
Strontium, dissolved	0.877	0.0010	mg/L	0.935		94	70-130			
Thallium, dissolved	0.0391	0.000020	mg/L	0.0385		102	70-130			
Uranium, dissolved	0.248	0.000020	mg/L	0.258		96	70-130			
Vanadium, dissolved	0.817	0.0010	mg/L	0.873		94	70-130			
Zinc, dissolved	0.880	0.0040	mg/L	0.848		104	70-130			
Reference (B1J1470-SRM2)				Prepared: 2021-10-16, Analyzed: 2021-10-16						
Aluminum, dissolved	0.235	0.0050	mg/L	0.235		100	70-130			
Antimony, dissolved	0.0441	0.00020	mg/L	0.0431		102	70-130			
Arsenic, dissolved	0.433	0.00050	mg/L	0.423		102	70-130			
Barium, dissolved	3.03	0.0050	mg/L	3.30		92	70-130			
Beryllium, dissolved	0.207	0.00010	mg/L	0.209		99	70-130			
Boron, dissolved	1.69	0.0500	mg/L	1.65		102	70-130			
Cadmium, dissolved	0.213	0.000010	mg/L	0.221		96	70-130			
Calcium, dissolved, dissolved	7.94	0.20	mg/L	7.72		103	70-130			
Chromium, dissolved	0.421	0.00050	mg/L	0.434		97	70-130			
Cobalt, dissolved	0.123	0.00010	mg/L	0.124		99	70-130			
Copper, dissolved	0.791	0.00040	mg/L	0.815		97	70-130			
Iron, dissolved	1.24	0.010	mg/L	1.27		98	70-130			
Lead, dissolved	0.108	0.00020	mg/L	0.110		98	70-130			
Lithium, dissolved	0.0992	0.00010	mg/L	0.100		99	70-130			
Magnesium, dissolved, dissolved	6.77	0.010	mg/L	6.59		103	70-130			
Manganese, dissolved	0.330	0.00020	mg/L	0.342		97	70-130			
Molybdenum, dissolved	0.396	0.00010	mg/L	0.404		98	70-130			
Nickel, dissolved	0.833	0.00040	mg/L	0.835		100	70-130			
Phosphorus, dissolved	0.470	0.050	mg/L	0.499		94	70-130			
Potassium, dissolved	2.90	0.10	mg/L	2.88		101	70-130			
Selenium, dissolved	0.0330	0.00050	mg/L	0.0324		102	70-130			
Sodium, dissolved	18.5	0.10	mg/L	18.0		103	70-130			
Strontium, dissolved	0.867	0.0010	mg/L	0.935		93	70-130			
Thallium, dissolved	0.0395	0.000020	mg/L	0.0385		103	70-130			
Uranium, dissolved	0.249	0.000020	mg/L	0.258		96	70-130			
Vanadium, dissolved	0.835	0.0010	mg/L	0.873		96	70-130			
Zinc, dissolved	0.905	0.0040	mg/L	0.848		107	70-130			

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	21J1168
PROJECT	ERA-CBWM	**REPORTED**	2021-11-05 16:36

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Dissolved Metals, Batch B1J1497										
Blank (B1J1497-BLK1)				Prepared: 2021-10-14, Analyzed: 2021-10-15						
Mercury, dissolved	< 0.000010	0.000010	mg/L							
Blank (B1J1497-BLK2)				Prepared: 2021-10-14, Analyzed: 2021-10-15						
Mercury, dissolved	< 0.000010	0.000010	mg/L							
Blank (B1J1497-BLK3)				Prepared: 2021-10-14, Analyzed: 2021-10-15						
Mercury, dissolved	< 0.000010	0.000010	mg/L							
Blank (B1J1497-BLK4)				Prepared: 2021-10-14, Analyzed: 2021-10-15						
Mercury, dissolved	< 0.000010	0.000010	mg/L							
Reference (B1J1497-SRM1)				Prepared: 2021-10-14, Analyzed: 2021-10-15						
Mercury, dissolved	0.00542	0.000010	mg/L	0.00581		93	70-130			
Reference (B1J1497-SRM2)				Prepared: 2021-10-14, Analyzed: 2021-10-15						
Mercury, dissolved	0.00555	0.000010	mg/L	0.00581		95	70-130			
Reference (B1J1497-SRM3)				Prepared: 2021-10-14, Analyzed: 2021-10-15						
Mercury, dissolved	0.00562	0.000010	mg/L	0.00581		97	70-130			
Reference (B1J1497-SRM4)				Prepared: 2021-10-14, Analyzed: 2021-10-15						
Mercury, dissolved	0.00573	0.000010	mg/L	0.00581		99	70-130			
General Parameters, Batch B1J1011										
Blank (B1J1011-BLK1)				Prepared: 2021-10-12, Analyzed: 2021-10-12						
Carbon, Total Organic	< 0.50	0.50	mg/L							
Carbon, Dissolved Organic	< 0.50	0.50	mg/L							
Blank (B1J1011-BLK2)				Prepared: 2021-10-12, Analyzed: 2021-10-12						
Carbon, Total Organic	< 0.50	0.50	mg/L							
Carbon, Dissolved Organic	< 0.50	0.50	mg/L							
LCS (B1J1011-BS1)				Prepared: 2021-10-12, Analyzed: 2021-10-12						
Carbon, Total Organic	9.60	0.50	mg/L	10.0		96	78-116			
Carbon, Dissolved Organic	9.63	0.50	mg/L	10.0		96	78-116			
LCS (B1J1011-BS2)				Prepared: 2021-10-12, Analyzed: 2021-10-12						
Carbon, Total Organic	9.60	0.50	mg/L	10.0		96	78-116			
Carbon, Dissolved Organic	9.84	0.50	mg/L	10.0		98	78-116			
General Parameters, Batch B1J1246										
Blank (B1J1246-BLK1)				Prepared: 2021-10-12, Analyzed: 2021-10-12						
Alkalinity, Total (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Bicarbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Carbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Hydroxide (as CaCO3)	< 1.0	1.0	mg/L							
Blank (B1J1246-BLK2)				Prepared: 2021-10-12, Analyzed: 2021-10-12						
Alkalinity, Total (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Bicarbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Carbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Hydroxide (as CaCO3)	< 1.0	1.0	mg/L							

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	21J1168
PROJECT	ERA-CBWM	**REPORTED**	2021-11-05 16:36

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
General Parameters, Batch B1J1246, Continued										
Blank (B1J1246-BLK3)				Prepared: 2021-10-12, Analyzed: 2021-10-12						
Alkalinity, Total (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Phenolphthalein (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Bicarbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Carbonate (as CaCO3)	< 1.0	1.0	mg/L							
Alkalinity, Hydroxide (as CaCO3)	< 1.0	1.0	mg/L							
LCS (B1J1246-BS1)				Prepared: 2021-10-12, Analyzed: 2021-10-12						
Alkalinity, Total (as CaCO3)	105	1.0	mg/L	100		105	80-120			
LCS (B1J1246-BS2)				Prepared: 2021-10-12, Analyzed: 2021-10-12						
Alkalinity, Total (as CaCO3)	104	1.0	mg/L	100		104	80-120			
LCS (B1J1246-BS3)				Prepared: 2021-10-12, Analyzed: 2021-10-12						
Alkalinity, Total (as CaCO3)	105	1.0	mg/L	100		105	80-120			
General Parameters, Batch B1J1302										
Blank (B1J1302-BLK1)				Prepared: 2021-10-13, Analyzed: 2021-10-13						
Solids, Total Suspended	< 2.0	2.0	mg/L							
Blank (B1J1302-BLK2)				Prepared: 2021-10-13, Analyzed: 2021-10-13						
Solids, Total Suspended	< 2.0	2.0	mg/L							
LCS (B1J1302-BS1)				Prepared: 2021-10-13, Analyzed: 2021-10-13						
Solids, Total Suspended	89.0	10.0	mg/L	100		89	85-115			
LCS (B1J1302-BS2)				Prepared: 2021-10-13, Analyzed: 2021-10-13						
Solids, Total Suspended	100	10.0	mg/L	100		100	85-115			
General Parameters, Batch B1J1380										
Blank (B1J1380-BLK1)				Prepared: 2021-10-13, Analyzed: 2021-10-15						
Nitrogen, Total Kjeldahl	< 0.050	0.050	mg/L							
Blank (B1J1380-BLK2)				Prepared: 2021-10-13, Analyzed: 2021-10-15						
Nitrogen, Total Kjeldahl	< 0.050	0.050	mg/L							
LCS (B1J1380-BS1)				Prepared: 2021-10-13, Analyzed: 2021-10-15						
Nitrogen, Total Kjeldahl	0.987	0.050	mg/L	1.00		99	85-115			
LCS (B1J1380-BS2)				Prepared: 2021-10-13, Analyzed: 2021-10-15						
Nitrogen, Total Kjeldahl	0.940	0.050	mg/L	1.00		94	85-115			
General Parameters, Batch B1J1421										
Blank (B1J1421-BLK1)				Prepared: 2021-10-14, Analyzed: 2021-10-14						
Solids, Total Suspended	< 2.0	2.0	mg/L							
Blank (B1J1421-BLK2)				Prepared: 2021-10-14, Analyzed: 2021-10-14						
Solids, Total Suspended	< 2.0	2.0	mg/L							
LCS (B1J1421-BS1)				Prepared: 2021-10-14, Analyzed: 2021-10-14						
Solids, Total Suspended	92.0	10.0	mg/L	100		92	85-115			
LCS (B1J1421-BS2)				Prepared: 2021-10-14, Analyzed: 2021-10-14						
Solids, Total Suspended	111	10.0	mg/L	100		111	85-115			

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO Elk River Alliance
PROJECT ERA-CBWM

WORK ORDER 21J1168
REPORTED 2021-11-05 16:36

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
General Parameters, Batch B1J1789										
Blank (B1J1789-BLK1)				Prepared: 2021-10-18, Analyzed: 2021-10-18						
Phosphorus, Total (as P)	< 0.0050	0.0050	mg/L							
Blank (B1J1789-BLK2)				Prepared: 2021-10-18, Analyzed: 2021-10-18						
Phosphorus, Total (as P)	< 0.0050	0.0050	mg/L							
LCS (B1J1789-BS1)				Prepared: 2021-10-18, Analyzed: 2021-10-18						
Phosphorus, Total (as P)	0.111	0.0050	mg/L	0.100		111	85-115			
LCS (B1J1789-BS2)				Prepared: 2021-10-18, Analyzed: 2021-10-18						
Phosphorus, Total (as P)	0.112	0.0050	mg/L	0.100		112	85-115			
Total Metals, Batch B1J1467										
Blank (B1J1467-BLK1)				Prepared: 2021-10-14, Analyzed: 2021-10-17						
Aluminum, total	< 0.0050	0.0050	mg/L							
Antimony, total	< 0.00020	0.00020	mg/L							
Arsenic, total	< 0.00050	0.00050	mg/L							
Barium, total	< 0.0050	0.0050	mg/L							
Beryllium, total	< 0.00010	0.00010	mg/L							
Bismuth, total	< 0.00010	0.00010	mg/L							
Boron, total	< 0.0500	0.0500	mg/L							
Cadmium, total	< 0.000010	0.000010	mg/L							
Calcium, total	< 0.20	0.20	mg/L							
Chromium, total	< 0.00050	0.00050	mg/L							
Cobalt, total	< 0.00010	0.00010	mg/L							
Copper, total	< 0.00040	0.00040	mg/L							
Iron, total	< 0.010	0.010	mg/L							
Lead, total	< 0.00020	0.00020	mg/L							
Lithium, total	< 0.00010	0.00010	mg/L							
Magnesium, total	< 0.010	0.010	mg/L							
Manganese, total	< 0.00020	0.00020	mg/L							
Molybdenum, total	< 0.00010	0.00010	mg/L							
Nickel, total	< 0.00040	0.00040	mg/L							
Phosphorus, total	< 0.050	0.050	mg/L							
Potassium, total	< 0.10	0.10	mg/L							
Selenium, total	< 0.00050	0.00050	mg/L							
Silicon, total	< 1.0	1.0	mg/L							
Silver, total	< 0.000050	0.000050	mg/L							
Sodium, total	< 0.10	0.10	mg/L							
Strontium, total	< 0.0010	0.0010	mg/L							
Sulfur, total	< 3.0	3.0	mg/L							
Tellurium, total	< 0.00050	0.00050	mg/L							
Thallium, total	< 0.000020	0.000020	mg/L							
Thorium, total	< 0.00010	0.00010	mg/L							
Tin, total	< 0.00020	0.00020	mg/L							
Titanium, total	< 0.0050	0.0050	mg/L							
Tungsten, total	< 0.0010	0.0010	mg/L							
Uranium, total	< 0.000020	0.000020	mg/L							
Vanadium, total	< 0.0010	0.0010	mg/L							
Zinc, total	< 0.0040	0.0040	mg/L							
Zirconium, total	< 0.00010	0.00010	mg/L							
Blank (B1J1467-BLK2)				Prepared: 2021-10-14, Analyzed: 2021-10-17						
Aluminum, total	< 0.0050	0.0050	mg/L							
Antimony, total	< 0.00020	0.00020	mg/L							
Arsenic, total	< 0.00050	0.00050	mg/L							

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Total Metals, Batch B1J1467, Continued										
Blank (B1J1467-BLK2), Continued				Prepared: 2021-10-14, Analyzed: 2021-10-17						
Barium, total	< 0.0050	0.0050	mg/L							
Beryllium, total	< 0.00010	0.00010	mg/L							
Bismuth, total	< 0.00010	0.00010	mg/L							
Boron, total	< 0.0500	0.0500	mg/L							
Cadmium, total	< 0.000010	0.000010	mg/L							
Calcium, total	< 0.20	0.20	mg/L							
Chromium, total	< 0.00050	0.00050	mg/L							
Cobalt, total	< 0.00010	0.00010	mg/L							
Copper, total	< 0.00040	0.00040	mg/L							
Iron, total	< 0.010	0.010	mg/L							
Lead, total	< 0.00020	0.00020	mg/L							
Lithium, total	< 0.00010	0.00010	mg/L							
Magnesium, total	< 0.010	0.010	mg/L							
Manganese, total	< 0.00020	0.00020	mg/L							
Molybdenum, total	< 0.00010	0.00010	mg/L							
Nickel, total	< 0.00040	0.00040	mg/L							
Phosphorus, total	< 0.050	0.050	mg/L							
Potassium, total	< 0.10	0.10	mg/L							
Selenium, total	< 0.00050	0.00050	mg/L							
Silicon, total	< 1.0	1.0	mg/L							
Silver, total	< 0.000050	0.000050	mg/L							
Sodium, total	< 0.10	0.10	mg/L							
Strontium, total	< 0.0010	0.0010	mg/L							
Sulfur, total	< 3.0	3.0	mg/L							
Tellurium, total	< 0.00050	0.00050	mg/L							
Thallium, total	< 0.000020	0.000020	mg/L							
Thorium, total	< 0.00010	0.00010	mg/L							
Tin, total	< 0.00020	0.00020	mg/L							
Titanium, total	< 0.0050	0.0050	mg/L							
Tungsten, total	< 0.0010	0.0010	mg/L							
Uranium, total	< 0.000020	0.000020	mg/L							
Vanadium, total	< 0.0010	0.0010	mg/L							
Zinc, total	< 0.0040	0.0040	mg/L							
Zirconium, total	< 0.00010	0.00010	mg/L							
LCS (B1J1467-BS1)				Prepared: 2021-10-14, Analyzed: 2021-10-17						
Aluminum, total	0.0231	0.0050	mg/L	0.0200		116	80-120			
Antimony, total	0.0201	0.00020	mg/L	0.0200		100	80-120			
Arsenic, total	0.0204	0.00050	mg/L	0.0200		102	80-120			
Barium, total	0.0189	0.0050	mg/L	0.0200		94	80-120			
Beryllium, total	0.0187	0.00010	mg/L	0.0200		94	80-120			
Bismuth, total	0.0198	0.00010	mg/L	0.0200		99	80-120			
Boron, total	< 0.0500	0.0500	mg/L	0.0200		107	80-120			
Cadmium, total	0.0193	0.000010	mg/L	0.0200		97	80-120			
Calcium, total	2.07	0.20	mg/L	2.00		103	80-120			
Chromium, total	0.0201	0.00050	mg/L	0.0200		100	80-120			
Cobalt, total	0.0200	0.00010	mg/L	0.0200		100	80-120			
Copper, total	0.0199	0.00040	mg/L	0.0200		100	80-120			
Iron, total	2.03	0.010	mg/L	2.00		101	80-120			
Lead, total	0.0192	0.00020	mg/L	0.0200		96	80-120			
Lithium, total	0.0192	0.00010	mg/L	0.0200		96	80-120			
Magnesium, total	2.04	0.010	mg/L	2.00		102	80-120			
Manganese, total	0.0198	0.00020	mg/L	0.0200		99	80-120			
Molybdenum, total	0.0186	0.00010	mg/L	0.0200		93	80-120			
Nickel, total	0.0203	0.00040	mg/L	0.0200		102	80-120			
Phosphorus, total	2.06	0.050	mg/L	2.00		103	80-120			

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	21J1168
PROJECT	ERA-CBWM	**REPORTED**	2021-11-05 16:36

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Total Metals, Batch B1J1467, Continued										
LCS (B1J1467-BS1), Continued				Prepared: 2021-10-14, Analyzed: 2021-10-17						
Potassium, total	1.99	0.10	mg/L	2.00		100	80-120			
Selenium, total	0.0207	0.00050	mg/L	0.0200		103	80-120			
Silicon, total	1.8	1.0	mg/L	2.00		91	80-120			
Silver, total	0.0188	0.000050	mg/L	0.0200		94	80-120			
Sodium, total	2.03	0.10	mg/L	2.00		101	80-120			
Strontium, total	0.0192	0.0010	mg/L	0.0200		96	80-120			
Sulfur, total	5.0	3.0	mg/L	5.00		101	80-120			
Tellurium, total	0.0208	0.00050	mg/L	0.0200		104	80-120			
Thallium, total	0.0199	0.000020	mg/L	0.0200		100	80-120			
Thorium, total	0.0184	0.00010	mg/L	0.0200		92	80-120			
Tin, total	0.0207	0.00020	mg/L	0.0200		103	80-120			
Titanium, total	0.0227	0.0050	mg/L	0.0200		114	80-120			
Tungsten, total	0.0190	0.0010	mg/L	0.0200		95	80-120			
Uranium, total	0.0190	0.000020	mg/L	0.0200		95	80-120			
Vanadium, total	0.0236	0.0010	mg/L	0.0200		118	80-120			
Zinc, total	0.0222	0.0040	mg/L	0.0200		111	80-120			
Zirconium, total	0.0198	0.00010	mg/L	0.0200		99	80-120			
LCS (B1J1467-BS2)				Prepared: 2021-10-18, Analyzed: 2021-10-18						
Aluminum, total	0.0230	0.0050	mg/L	0.0200		115	80-120			
Antimony, total	0.0185	0.00020	mg/L	0.0200		92	80-120			
Arsenic, total	0.0167	0.00050	mg/L	0.0200		83	80-120			
Barium, total	0.0180	0.0050	mg/L	0.0200		90	80-120			
Beryllium, total	0.0179	0.00010	mg/L	0.0200		89	80-120			
Bismuth, total	0.0180	0.00010	mg/L	0.0200		90	80-120			
Boron, total	< 0.0500	0.0500	mg/L	0.0200		86	80-120			
Cadmium, total	0.0167	0.000010	mg/L	0.0200		84	80-120			
Calcium, total	1.85	0.20	mg/L	2.00		93	80-120			
Chromium, total	0.0175	0.00050	mg/L	0.0200		87	80-120			
Cobalt, total	0.0169	0.00010	mg/L	0.0200		84	80-120			
Copper, total	0.0158	0.00040	mg/L	0.0200		79	80-120			
Iron, total	1.62	0.010	mg/L	2.00		81	80-120			
Lead, total	0.0189	0.00020	mg/L	0.0200		94	80-120			
Lithium, total	0.0173	0.00010	mg/L	0.0200		86	80-120			
Magnesium, total	1.83	0.010	mg/L	2.00		91	80-120			
Manganese, total	0.0170	0.00020	mg/L	0.0200		85	80-120			
Molybdenum, total	0.0177	0.00010	mg/L	0.0200		88	80-120			
Nickel, total	0.0171	0.00040	mg/L	0.0200		85	80-120			
Phosphorus, total	1.75	0.050	mg/L	2.00		88	80-120			
Potassium, total	1.79	0.10	mg/L	2.00		90	80-120			
Selenium, total	0.0178	0.00050	mg/L	0.0200		89	80-120			
Silicon, total	1.8	1.0	mg/L	2.00		88	80-120			
Silver, total	0.0163	0.000050	mg/L	0.0200		82	80-120			
Sodium, total	1.77	0.10	mg/L	2.00		89	80-120			
Strontium, total	0.0179	0.0010	mg/L	0.0200		90	80-120			
Sulfur, total	3.4	3.0	mg/L	5.00		68	80-120			
Tellurium, total	0.0189	0.00050	mg/L	0.0200		95	80-120			
Thallium, total	0.0172	0.000020	mg/L	0.0200		86	80-120			
Thorium, total	0.0177	0.00010	mg/L	0.0200		89	80-120			
Tin, total	0.0192	0.00020	mg/L	0.0200		96	80-120			
Titanium, total	0.0207	0.0050	mg/L	0.0200		103	80-120			
Tungsten, total	0.0197	0.0010	mg/L	0.0200		98	80-120			
Uranium, total	0.0179	0.000020	mg/L	0.0200		90	80-120			
Vanadium, total	0.0200	0.0010	mg/L	0.0200		100	80-120			
Zinc, total	0.0167	0.0040	mg/L	0.0200		83	80-120			
Zirconium, total	0.0189	0.00010	mg/L	0.0200		94	80-120			

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Total Metals, Batch B1J1467, Continued										
Reference (B1J1467-SRM1)				Prepared: 2021-10-14, Analyzed: 2021-10-17						
Aluminum, total	0.317	0.0050	mg/L	0.299		106	70-130			
Antimony, total	0.0500	0.00020	mg/L	0.0517		97	70-130			
Arsenic, total	0.125	0.00050	mg/L	0.119		105	70-130			
Barium, total	0.693	0.0050	mg/L	0.801		86	70-130			
Beryllium, total	0.0464	0.00010	mg/L	0.0501		93	70-130			
Boron, total	3.56	0.0500	mg/L	4.11		87	70-130			
Cadmium, total	0.0486	0.000010	mg/L	0.0503		97	70-130			
Calcium, total	10.2	0.20	mg/L	10.7		96	70-130			
Chromium, total	0.254	0.00050	mg/L	0.250		102	70-130			
Cobalt, total	0.0393	0.00010	mg/L	0.0384		102	70-130			
Copper, total	0.480	0.00040	mg/L	0.487		99	70-130			
Iron, total	0.512	0.010	mg/L	0.504		102	70-130			
Lead, total	0.269	0.00020	mg/L	0.278		97	70-130			
Lithium, total	0.387	0.00010	mg/L	0.398		97	70-130			
Magnesium, total	3.90	0.010	mg/L	3.59		109	70-130			
Manganese, total	0.109	0.00020	mg/L	0.111		99	70-130			
Molybdenum, total	0.194	0.00010	mg/L	0.196		99	70-130			
Nickel, total	0.252	0.00040	mg/L	0.248		101	70-130			
Phosphorus, total	0.255	0.050	mg/L	0.213		120	70-130			
Potassium, total	6.29	0.10	mg/L	5.89		107	70-130			
Selenium, total	0.127	0.00050	mg/L	0.120		105	70-130			
Sodium, total	9.68	0.10	mg/L	8.71		111	70-130			
Strontium, total	0.386	0.0010	mg/L	0.393		98	70-130			
Thallium, total	0.0784	0.000020	mg/L	0.0787		100	70-130			
Uranium, total	0.0324	0.000020	mg/L	0.0344		94	70-130			
Vanadium, total	0.411	0.0010	mg/L	0.391		105	70-130			
Zinc, total	2.67	0.0040	mg/L	2.50		107	70-130			
Reference (B1J1467-SRM2)				Prepared: 2021-10-14, Analyzed: 2021-10-17						
Aluminum, total	0.320	0.0050	mg/L	0.299		107	70-130			
Antimony, total	0.0508	0.00020	mg/L	0.0517		98	70-130			
Arsenic, total	0.125	0.00050	mg/L	0.119		105	70-130			
Barium, total	0.692	0.0050	mg/L	0.801		86	70-130			
Beryllium, total	0.0482	0.00010	mg/L	0.0501		96	70-130			
Boron, total	3.84	0.0500	mg/L	4.11		93	70-130			
Cadmium, total	0.0489	0.000010	mg/L	0.0503		97	70-130			
Calcium, total	10.6	0.20	mg/L	10.7		99	70-130			
Chromium, total	0.255	0.00050	mg/L	0.250		102	70-130			
Cobalt, total	0.0393	0.00010	mg/L	0.0384		102	70-130			
Copper, total	0.479	0.00040	mg/L	0.487		98	70-130			
Iron, total	0.511	0.010	mg/L	0.504		101	70-130			
Lead, total	0.277	0.00020	mg/L	0.278		100	70-130			
Lithium, total	0.408	0.00010	mg/L	0.398		102	70-130			
Magnesium, total	3.98	0.010	mg/L	3.59		111	70-130			
Manganese, total	0.113	0.00020	mg/L	0.111		102	70-130			
Molybdenum, total	0.195	0.00010	mg/L	0.196		99	70-130			
Nickel, total	0.253	0.00040	mg/L	0.248		102	70-130			
Phosphorus, total	0.251	0.050	mg/L	0.213		118	70-130			
Potassium, total	6.42	0.10	mg/L	5.89		109	70-130			
Selenium, total	0.126	0.00050	mg/L	0.120		105	70-130			
Sodium, total	9.89	0.10	mg/L	8.71		114	70-130			
Strontium, total	0.398	0.0010	mg/L	0.393		101	70-130			
Thallium, total	0.0809	0.000020	mg/L	0.0787		103	70-130			
Uranium, total	0.0333	0.000020	mg/L	0.0344		97	70-130			
Vanadium, total	0.410	0.0010	mg/L	0.391		105	70-130			
Zinc, total	2.66	0.0040	mg/L	2.50		106	70-130			

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Elk River Alliance	**WORK ORDER**	21J1168
PROJECT	ERA-CBWM	**REPORTED**	2021-11-05 16:36

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Total Metals, Batch B1J1498										
Blank (B1J1498-BLK1)				Prepared: 2021-10-14, Analyzed: 2021-10-15						
Mercury, total	< 0.000010	0.000010	mg/L							
Blank (B1J1498-BLK2)				Prepared: 2021-10-14, Analyzed: 2021-10-15						
Mercury, total	< 0.000010	0.000010	mg/L							
Reference (B1J1498-SRM1)				Prepared: 2021-10-14, Analyzed: 2021-10-15						
Mercury, total	0.00577	0.000010	mg/L	0.00581		99	70-130			
Reference (B1J1498-SRM2)				Prepared: 2021-10-14, Analyzed: 2021-10-15						
Mercury, total	0.00569	0.000010	mg/L	0.00581		98	70-130			

QC Qualifiers:

SPK1 The recovery of this analyte was outside of established control limits. The data was accepted based on performance of other batch QC.

Appendix D: Benthic Macroinvertebrate Taxonomy Report

ELK River Alliance			Site	ALX001	ALX003	BOI001	BOI002	COL001	COL003	LIZ001	LIZ003	MOR001	MOR002
2021 CABIN Benthos			Stream	Alexander Creek	Alexander Creek	Boivin Creek	Boivin Creek	Coal Creek	Coal Creek	Lizard Creek	Lizard Creek	Morrissey Creek	Morrissey Creek
Taxonomist: Pina Viola			CABIN study	CBWQ-Elk	CBWQ-Elk	CBWQ-Elk	CBWQ-Elk	CBWQ-Elk	CBWQ-Elk	CBWQ-Elk	CBWQ-Elk	CBWQ-Elk	CBWQ-Elk
Date: March 8, 2022			Sampling date	09/15/2021	09/15/2021	10/05/2021	10/05/2021	10/06/2021	10/06/2021	10/03/2021	10/03/2021	10/04/2021	10/04/2021
			Device	kicknet	kicknet	kicknet	kicknet	kicknet	kicknet	kicknet	kicknet	kicknet	kicknet
			Habitat	riffle	riffle	riffle	riffle	riffle	riffle	riffle	riffle	riffle	riffle
			% sorted	5/100	6/100	5/100	7/100	5/100	11/100	5/100	5/100	5/100	11/100
Order	**Family**	**Genus**	**Species**										
Anellida-Oligochaeta				0	0	0	0	1	0	12	0	0	0
	Enchytraeidae			2	0	0	0	0	0	0	0	0	0
	Lumbriculidae			3	0	0	0	0	0	0	0	0	0
	Naididae (Tubificidae)			0	0	0	0	52	1	114	9	0	0
Acari-Trombidiformes				0	0	1	0	1	0	1	0	0	0
	Aturidae	Aturus		0	0	0	0	0	0	1	0	0	0
	Hydryphantidae	Protzia		0	0	0	0	0	0	0	0	1	0
	Hygrobatidae	Hygrobates		0	0	0	0	0	0	0	1	0	0
	Lebertiidae	Lebertia		6	3	0	0	4	3	33	10	8	0
	Sperchontidae	Sperchon		2	1	1	0	2	2	2	0	3	0
		Sperchonopsis		0	0	0	0	0	0	0	0	2	0
	Torrenticolidae	Testudacarus		0	0	0	0	0	0	6	17	1	0
		Torrenticola		2	0	0	0	4	0	1	0	1	0
Collembola				1	0	0	0	0	1	0	0	0	0
Coleoptera	**Dytiscidae**			0	0	0	0	0	0	0	1	0	0
	Elmidae			0	0	0	0	2	0	4	43	3	1
		Heterlimnius		8	8	0	0	1	8	19	181	2	6
		Narpus		0	0	0	0	0	0	0	1	0	0
		Optioservus		0	0	0	0	0	0	0	0	5	0
Diptera	**Ceratopogonidae**			1	0	0	0	0	0	1	0	0	0
	Chironomidae			18	9	9	19	79	166	142	33	12	122
	Empididae			0	0	0	0	0	0	2	0	0	0
		Chelifera		2	7	0	0	1	0	0	0	1	1
		Wiedemannia		0	0	0	0	3	1	15	1	0	1
	Pelecorhynchidae	Glutops		0	0	0	0	0	0	0	1	0	0
	Psychodidae	Pericoma/Telmatoscopus		78	18	2	1	3	1	69	203	0	0
	Simuliidae			1	0	0	10	0	0	1	0	0	0
		Helodon		0	0	9	4	0	0	0	0	0	0
		Simulium		3	0	0	0	0	0	9	0	0	0
	Tipulidae			0	0	0	0	41	0	0	0	0	0
		Antocha		0	0	0	0	8	0	9	11	12	2
		Dicranota		1	0	0	0	0	0	2	5	0	0
		Hexatoma		0	0	0	0	2	0	0	0	0	0
		Limnophila		0	0	0	0	0	0	0	1	2	0
		Tipula (Arctotipula)		0	0	0	0	0	0	1	0	0	0
Ephemeroptera	**Ameletidae**	Ameletus		1	0	0	0	2	43	0	0	0	4
	Baetidae			0	0	1	0	2	0	5	3	0	0
		Baetis		33	40	20	17	13	23	49	218	8	71
		Diphetor		0	0	0	0	1	29	0	1	0	5
	Ephemerellidae			40	79	2	10	141	13	13	68	2	6
		Caudatella		3	7	0	0	0	0	0	0	0	0
			Drunella coloradensis	0	1	0	0	0	0	0	0	0	0
			Drunella doddsi	5	6	15	51	1	0	1	45	1	1
			Drunella grandis/spinifera	0	0	0	0	0	0	2	3	0	0
	Heptageniidae			13	26	41	29	8	3	3	10	9	3
		Cinygmula		28	33	48	15	36	13	0	15	47	26
		Epeorus		2	22	4	12	5	4	1	0	11	12
		Rhithrogena		7	5	55	23	0	0	0	2	0	0
	Leptophlebiidae			0	0	0	0	4	1	0	0	6	2
		Neoleptophlebia		0	0	0	0	1	0	0	0	0	0
Plecoptera				3	2	1	0	1	0	1	9	0	0
	Capniidae			2	1	1	0	18	6	21	26	2	16
	Chloroperlidae			1	1	0	10	0	4	4	19	0	9
		Sweltza		3	3	0	1	0	4	5	11	0	18
	Leuctridae			0	0	0	0	0	1	0	0	0	0
	Nemouridae			0	0	2	0	0	5	0	0	0	1
		Visoka		0	0	2	0	0	2	0	0	0	1
		Zapada		3	2	2	0	0	6	3	3	0	4
			Zapada cinctipes	25	12	0	0	0	0	56	100	7	1
			Zapada columbiana	0	0	37	12	0	3	5	3	1	1
			Zapada oregonensis/haisi	8	7	0	0	0	1	0	1	0	1
	Peltoperlidae	Yoraperla		0	0	0	0	0	4	0	0	0	0
	Perlidae			2	0	0	0	0	3	0	0	0	0
		Doroneuria		0	0	0	0	0	1	7	10	2	3
		Hesperoperla		0	0	0	0	0	0	1	0	0	0
	Perlodidae			2	0	0	0	0	3	0	5	0	2
		Megarcys		2	0	4	8	0	0	0	1	0	4
		Skwala		0	0	0	0	5	0	0	0	2	0
	Taeniopterygidae			20	26	323	86	0	0	0	8	1	0
Trichoptera				0	0	0	0	0	3	0	0	0	2
	Apatanidae	Apatania		4	0	0	0	2	0	3	32	0	0
		Pedomoecus		1	0	0	0	0	0	0	0	0	0
	Brachycentridae	Brachycentrus		2	0	0	0	1	0	0	0	0	0
		Micrasema		0	0	0	0	0	15	17	47	12	12
	Glossosomatidae	Glossosoma		103	2	7	2	0	0	11	0	0	2
	Hydropsychidae			2	1	0	0	1	0	5	3	2	0
		Artopsyche		2	0	0	0	0	0	1	0	0	0
		Hydropsyche		0	0	0	0	8	0	27	26	33	0
		Parapsyche		3	2	0	0	0	0	0	0	0	0
	Hydroptilidae	Hydroptila		0	0	0	0	0	0	2	1	0	0
	Lepidostomatidae	Lepidostoma		0	0	0	0	137	0	11	1	167	2
	Rhyacophilidae	Rhyacophila		11	3	0	2	0	2	1	3	1	2
			Rhyacophila betteni gr.A	0	1	0	0	0	0	1	6	0	0
			Rhyacophila narvae	2	1	0	0	0	0	0	0	0	0
			Rhyacophila sibirica gr., atrata complex	9	3	0	0	0	0	0	4	0	0
			Rhyacophila sibirica gr., vetina complex	0	0	0	1	0	0	0	0	0	0
			Rhyacophila vemna/brunnea	2	3	0	6	0	1	2	22	0	1
	Uenoidae	Neothremma		0	0	1	0	0	1	0	1	0	5
		Oligophlebodes		0	0	0	0	0	0	1	82	0	0
Cnidaria	**Hydridae**	Hydra		0	0	0	0	1	0	0	0	0	0
TOTAL				**472**	**335**	**588**	**319**	**592**	**377**	**703**	**1307**	**367**	**350**

Appendix E: Stream Report

Preliminary DNA Data

Elk River watershed, BC

Elk River Alliance – Community Based Water Monitoring

June 2022

Photo: Alexander Creek, Credit: Elk River Alliance

www.STREAM-DNA.com

Hajibabaei Lab, Centre for Biodiversity Genomics, University of Guelph

STREAM

WWF Canada

Environment and Climate Change Canada

Living Lakes Canada

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DISCLAIMER: This report is a preliminary report based on the samples and information provided by the corresponding organisation. Identifications of taxa are based on best available information at time of analysis and reporting.

1. INTRODUCTION

1.1. Benthic Macroinvertebrates

Freshwater benthic macroinvertebrates are typically insect orders, as well as crustaceans (e.g. crayfish), gastropods (e.g. snails), bivalves (e.g. freshwater mussels) and oligochaetes (e.g. worms), which are located on or within the benthic substrate of freshwater systems (i.e. streams, rivers, lakes; (Covich et al., 1999; Schmera et al., 2017). Benthic macroinvertebrates occupy important roles in the functioning of freshwater ecosystems, namely nutrient cycling within aquatic food webs and also influence numerous processes including microbial production and release of greenhouse gases (Covich et al., 1999; Schmera et al., 2017).

Biological monitoring (biomonitoring), referring to the collection and identification of particular aquatic species is an effective method for measuring the health status of freshwater systems. Currently, macroinvertebrates are routinely used for biomonitoring studies in freshwater habitats because they are relatively sedentary, have high species richness and a range of responses to different environmental stressors and contaminants, including temperature (Curry et al., 2018; Geest et al., 2010; Rosenberg and Resh, 1993; Sidney et al., 2016). Some groups of macroinvertebrates (mayflies, Ephemeroptera; stoneflies, Plecoptera and caddisflies, Trichoptera), commonly referred to as EPT groups, are more sensitive to change in the aquatic environment and are deemed important bioindicator taxa for assessing freshwater quality (Curry et al., 2018; Hajibabaei et al., 2012, 2011).

Traditionally, macroinvertebrates are identified to family level (**Figure 1**) through morphological identification using microscopy, however there has been a shift from this labour-intensive methodology to a DNA-based approach (Curry et al., 2018; Hajibabaei et al., 2012, 2011). 'Biomonitoring 2.0' combines bulk-tissue DNA collection (i.e. benthos) with next-generation sequencing (NGS), to produce high-quality data in large quantities and allows identification to a finer resolution than traditional methods (Baird and Hajibabaei, 2012; Hajibabaei et al., 2012).

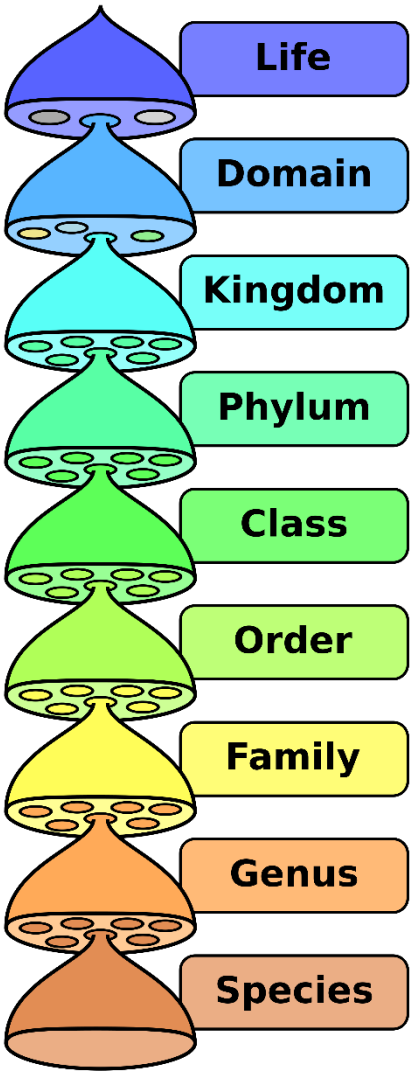

Figure 1. Graphical representation the classification of organisms.

1.2. Background of STREAM

STREAM (Sequencing The Rivers for Environmental Assessment and Monitoring), is a biomonitoring project, which involves the combination of community based monitoring and DNA metabarcoding technologies to assess the benthic macroinvertebrate communities in watersheds across Canada (**Figure 2**). STREAM is a collaboration between World Wildlife Fund (WWF) Canada, Living Lakes Canada

(LLC) and Environmental and Climate Change Canada (ECCC), led by the Hajibabaei Lab at Centre for Biodiversity Genomics (University of Guelph, Canada). STREAM is integrated with the Canadian Aquatic Biomonitoring Network (CABIN) programme, through the implementation of existing nationally standardized protocols for freshwater monitoring. The aquatic biodiversity data generated in STREAM will be added to the existing CABIN database, to improve our understanding of the health of Canadian watersheds.

The main objective of STREAM is to generate baseline benthic macroinvertebrate DNA data from across Canada. To understand the health status of freshwater systems, we first need to understand the natural fluctuations and trends of benthic macroinvertebrates, especially in locations which are data deficient. By building this baseline, in years to come we can investigate the longer-term trends and begin to understand the impact of issues, such as climate change, on freshwater systems. STREAM was established with the main premise of fast-tracking the generation of benthic macroinvertebrate data from 12-18 months to ~2 months, while increasing the taxonomic resolution of the data produced.

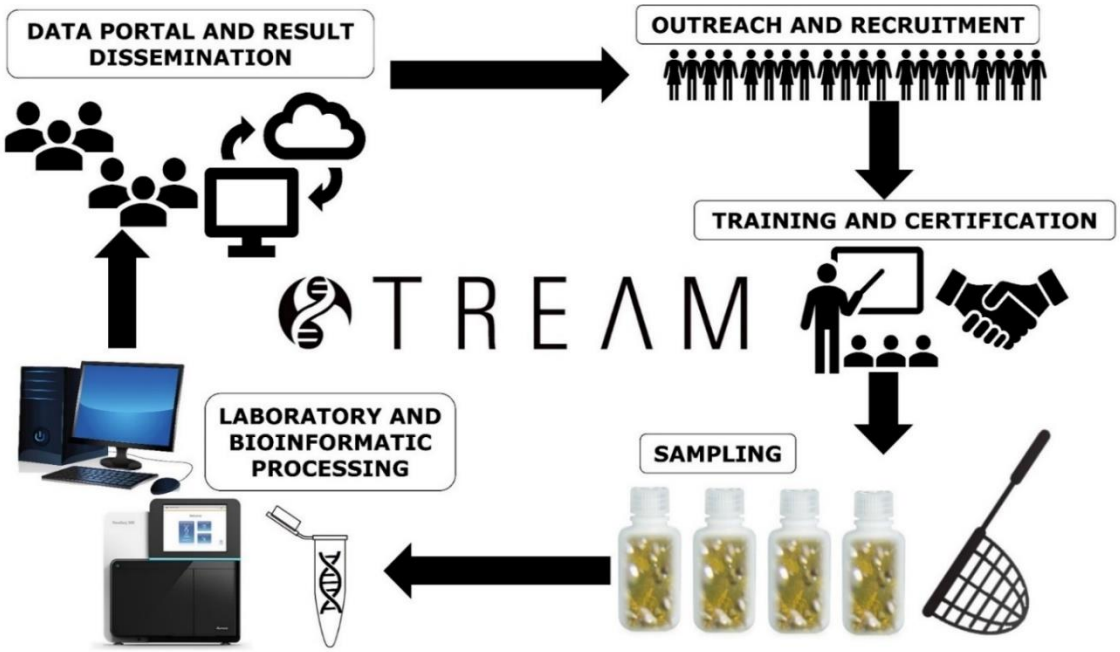

Figure 2. Graphical representation of the STREAM collaborative workflow for DNA biomonitoring of benthic invertebrates.

1.3. Objective of Report

Data and information included in this report is a preliminary examination of results from the Elk River watershed, within the Columbia Basin (BC), which consists of a list of the macroinvertebrate taxa detected within the samples submitted. This report aims to highlight the different macroinvertebrate EPT taxa and provide basic richness metrics as a useful contribution for community groups to assess river health. This report also includes data from 2020 sampling.

1.4. Study Objective

Community-based water monitoring (CBWM) groups collected baseline Elk River tributary habitat data to increase community water literacy and understanding of the Elk River Watershed. Monitoring and research is conducted by trained staff and volunteers and presented in easily understood terminology to the community, including updates on the current status of aquatic health and concerns regarding future trends. Community members are educated through the sharing of data to the public at annual workshops, summer markets, direct participation with the program, and mixed media reporting. This increases water literacy and opens a two-way dialogue with residents to discuss community concerns regarding watershed health.

2. METHODOLOGY

2.1. Study Area

From Sept-Oct 2021, this study was conducted at five sampling locations within the Elk River watershed (BC; Figure 3). Sampling was conducted by the Elk River Alliance for benthic macroinvertebrate monitoring with STREAM.

Additional site information, including coordinates is provided in Appendix A

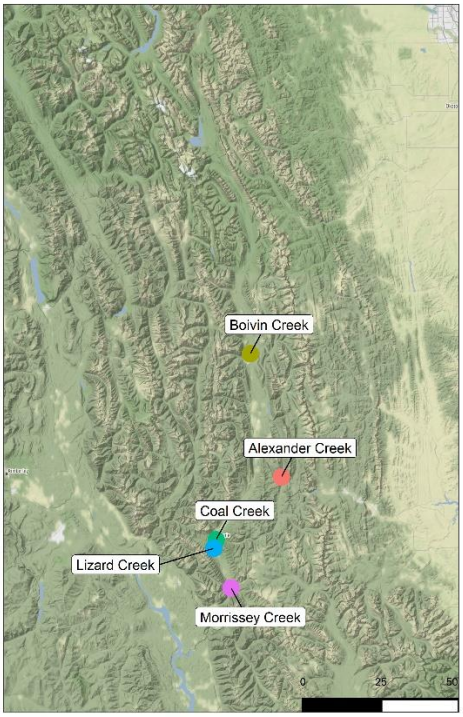

Figure 3. Map of sampling locations within the Elk River watershed (BC). Scale bar shown in kilometres.

2.2. DNA Sampling and Processing Methods

2.2.1. Measures to Avoid DNA Contamination

Prior to sampling, kick-nets were sanitized in bleach for 45 minutes and kept in clean garbage bags until they were used in the field. Gloves were used when handling all sampling materials to avoid contamination. During the kick-netting, the surveyor in the water wore two pairs of gloves while handling the kick-net. The outer pair of gloves was removed prior to transferring the contents into sampling containers so that the gloves used when contacting the sample were guaranteed to be clean. Each sampling container was individually sealed in a Ziploc bag prior to placing them in the cooler.

2.2.2. Benthic Macroinvertebrate Field Sampling Protocol

Benthic macroinvertebrate DNA samples were collected following the STREAM Procedure for collecting benthic macroinvertebrate DNA samples in wadeable streams (v1.0 June 2019) and the CABIN Field Manual for Wadeable Streams (2012). The STREAM procedure outlines steps to minimize DNA contamination and preserve DNA samples and was employed in conjunction with sampling steps outlined in the

CABIN manual. All samples collected were transported to the University of Guelph Centre for Biodiversity Genomics.

2.2.3. Laboratory Methods

Benthic samples were preserved in antifreeze and stored at -20°C until processing. Benthic samples were coarsely homogenized in a sterile blender and DNA was extracted using a DNeasy® PowerSoil® Pro kit (Qiagen, CA) kit. Extracted DNA was then processed following the standard Hajibabaei Lab protocol for Next-Generation Sequencing (NGS). Sequences were then processed through the MetaWorks (v1.6.4) pipeline: https://github.com/terrimporter/MetaWorks.

3. RESULTS

3.1. Overview

The raw data output from NGS produced sequences for a range of taxa. This taxa list was reduced to only sequences that identified macroinvertebrates associated with freshwater and riparian ecosystems, and that were of high enough quality to match reference sequences. These results consisted of **34 Orders, 87 Families, 152 Genera, and 160 Species of invertebrates**. After normalizing, species richness (number of species present) ranged from 13 in ALX-1C (2020) to 41 in ALX-1C (2021) (**Figure 4**). A full taxonomic list of macroinvertebrates identified to the raw genus and species level is included as a separate Excel spreadsheet (RP66_Taxonomy).

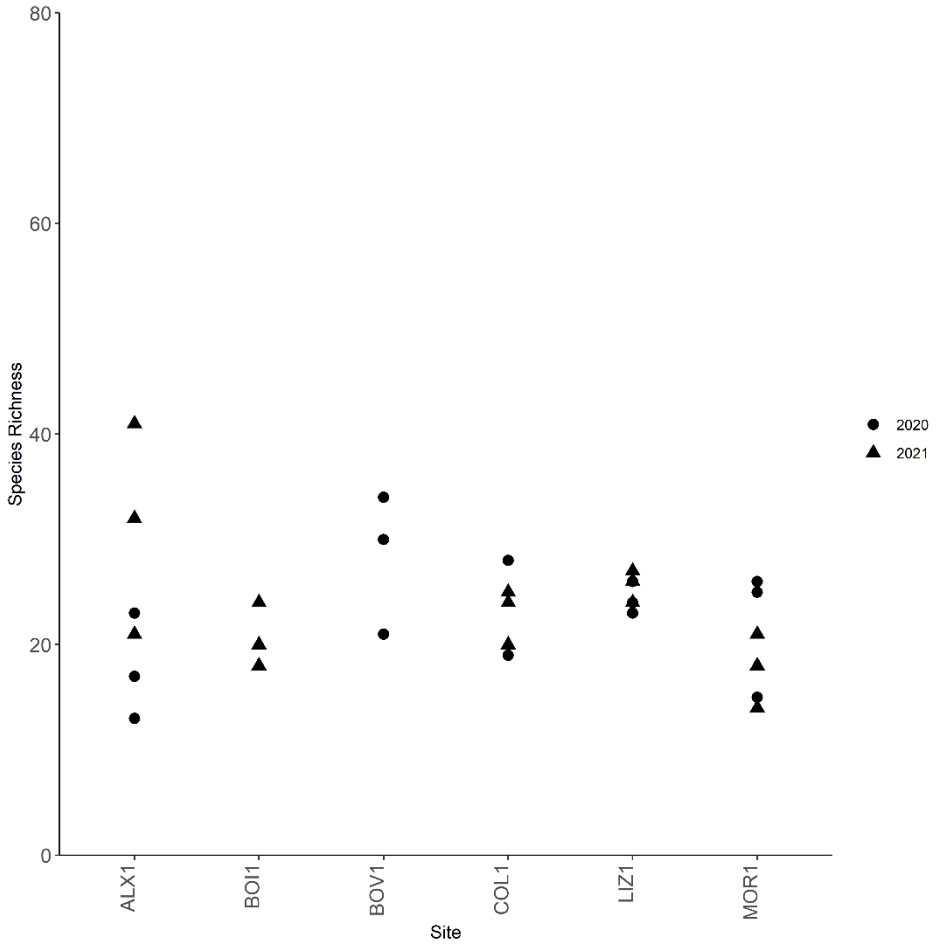

Figure 4. Species richness of each site sampled. Only species taxonomically assigned with high confidence (bootstrap support >= 0.70) are included. Based on normalized data.

3.2.Taxonomic Coverage

A range of macroinvertebrate species were detected. Traditional bioindicator EPT species were detected across the sampling sites, including 27 species of Ephemeroptera (mayflies), 31 species of Plecoptera (stoneflies) and 27 Trichoptera (caddisflies; **Table 2**). Some families of these EPT groups are typically sensitive to many pollutants in the stream environment and are therefore associated with clean water (Gresens et al., 2009; Laini et al., 2019; Loeb and Spacie, 1994).

Please refer to the '**Macroinvertebrate Bioindicator Families Guide v1.2**' attached with your data or visit the corresponding website here for more information on approximate tolerances for the species detected in your sites.

Note: The benthic macroinvertebrate kick-net sample procedure often results in collection of both aquatic and terrestrial taxa, however terrestrial taxa are not identified using the traditional taxonomic identification methods. Due to the nature of DNA metabarcoding, both terrestrial and aquatic macroinvertebrates are identified and described using the DNA approach in this report.

Table 1. List of Ephemeroptera, Plecoptera, Trichoptera (EPT) taxa identified to the species level. P = present. Grey cells indicate absence. Site names for each column refer to site code (see Appendix A). Only species taxonomically assigned with high confidence (bootstrap support >= 0.70) are included.

				2020					2021				
Order	Family	Common Name	Species	ALX-1	BOV-1	COL-1	LIZ-1	MOR-1	ALX-1	BOI-1	COL-1	LIZ-1	MOR-1
Ephemeroptera	Ameletidae	Comb-mouthed minnow mayflies	*Ameletus bellulus*						P				
Ephemeroptera	Ameletidae	Comb-mouthed minnow mayflies	*Ameletus celer*				P			P			
Ephemeroptera	Ameletidae	Comb-mouthed minnow mayflies	*Ameletus cooki*					P					
Ephemeroptera	Baetidae	Small minnow mayflies	*Acentrella turbida*				P	P		P			
Ephemeroptera	Baetidae	Small minnow mayflies	*Baetis bicaudatus*	P	P	P	P		P	P			
Ephemeroptera	Baetidae	Small minnow mayflies	*Baetis phoebus*		P	P		P	P				
Ephemeroptera	Baetidae	Small minnow mayflies	*Baetis tricaudatus*		P		P	P	P	P	P	P	P
Ephemeroptera	Baetidae	Small minnow mayflies	*Diphetor hageni*								P		P
Ephemeroptera	Ephemerellidae	Spiny crawler mayflies	*Drunella coloradensis*	P	P	P	P		P	P			
Ephemeroptera	Ephemerellidae	Spiny crawler mayflies	*Drunella doddsii*	P	P	P	P	P	P	P	P	P	
Ephemeroptera	Ephemerellidae	Spiny crawler mayflies	*Drunella flavilinea*		P	P		P	P				
Ephemeroptera	Ephemerellidae	Spiny crawler mayflies	*Drunella grandis*		P	P		P	P		P	P	P
Ephemeroptera	Ephemerellidae	Spiny crawler mayflies	*Drunella spinifera*		P								
Ephemeroptera	Ephemerellidae	Spiny crawler mayflies	*Ephemerella subvaria*				P						P
Ephemeroptera	Ephemerellidae	Spiny crawler mayflies	*Ephemerella tibialis*		P	P		P	P				
Ephemeroptera	Heptageniidae	Flat-headed mayflies	*Cinygmula spJMW3*	P	P	P	P		P	P	P		
Ephemeroptera	Heptageniidae	Flat-headed mayflies	*Cinygmula subaequalis*								P		
Ephemeroptera	Heptageniidae	Flat-headed mayflies	*Epeorus albertae*								P		P
Ephemeroptera	Heptageniidae	Flat-headed mayflies	*Epeorus deceptivus*	P	P	P	P		P	P			
Ephemeroptera	Heptageniidae	Flat-headed mayflies	*Epeorus grandis*	P	P		P	P	P	P			
Ephemeroptera	Heptageniidae	Flat-headed mayflies	*Epeorus longimanus*				P		P	P	P		
Ephemeroptera	Heptageniidae	Flat-headed mayflies	*Maccaffertium vicarium*		P								P
Ephemeroptera	Heptageniidae	Flat-headed mayflies	*Rhithrogena robusta*	P	P		P	P	P	P			
Ephemeroptera	Leptophlebiidae	Prong-gilled mayflies	*Habrophlebia vibrans*										P
Ephemeroptera	Leptophlebiidae	Prong-gilled mayflies	*Paraleptophlebia heteronea*		P	P		P			P		P
Ephemeroptera	Leptophlebiidae	Prong-gilled mayflies	*Paraleptophlebia memorialis*				P						P
Ephemeroptera	Siphlonuridae	Primitive minnow mayflies	*Siphlonurus occidentalis*				P						

Table 1 cont.

Order	Family	Common Name	Species	2020					2021				
				ALX-1	BOV-1	COL-1	LIZ-1	MOR-1	ALX-1	BOI-1	COL-1	LIZ-1	MOR-1
Plecoptera	Capniidae	Small winter stoneflies	*Capnia coloradensis*				P						
Plecoptera	Capniidae	Small winter stoneflies	*Capnia gracilaria*				P						
Plecoptera	Capniidae	Small winter stoneflies	*Eucapnopsis brevicauda*		P	P	P	P	P	P	P		P
Plecoptera	Capniidae	Small winter stoneflies	*Utacapnia columbiana*				P				P		
Plecoptera	Capniidae	Small winter stoneflies	*Utacapnia logana*					P			P		
Plecoptera	Chloroperlidae	Green stoneflies	*Alloperla serrata*	P									
Plecoptera	Chloroperlidae	Green stoneflies	*Paraperla frontalis*		P	P	P					P	
Plecoptera	Chloroperlidae	Green stoneflies	*Plumiperla diversa*				P						
Plecoptera	Chloroperlidae	Green stoneflies	*Sweltsa borealis*		P		P						
Plecoptera	Chloroperlidae	Green stoneflies	*Sweltsa coloradensis*					P	P		P		P
Plecoptera	Chloroperlidae	Green stoneflies	*Sweltsa urticae*	P						P			
Plecoptera	Leuctridae	Rolled-winged stoneflies	*Paraleuctra occidentalis*	P	P		P			P		P	
Plecoptera	Nemouridae	Spring stoneflies	*Prostoia besametsa*		P	P	P		P		P	P	
Plecoptera	Nemouridae	Spring stoneflies	*Visoka cataractae*				P			P		P	
Plecoptera	Nemouridae	Spring stoneflies	*Zapada cinctipes*	P	P	P	P	P	P	P	P	P	P
Plecoptera	Nemouridae	Spring stoneflies	*Zapada columbiana*	P	P	P	P	P	P	P		P	
Plecoptera	Nemouridae	Spring stoneflies	*Zapada haysi*	P	P	P	P		P	P		P	
Plecoptera	Nemouridae	Spring stoneflies	*Zapada oregonensis*	P	P	P			P	P		P	
Plecoptera	Peltoperlidae	Roach-like stoneflies	*Yoraperla brevis*							P			
Plecoptera	Perlidae	Common stoneflies	*Calineuria californica*	P									
Plecoptera	Perlidae	Common stoneflies	*Doroneuria theodora*	P	P	P	P	P	P		P	P	P
Plecoptera	Perlidae	Common stoneflies	*Hesperoperla pacifica*				P	P	P		P	P	
Plecoptera	Perlodidae	Springflies	*Isoperla fulva*								P		
Plecoptera	Perlodidae	Springflies	*Isoperla petersoni*		P		P					P	
Plecoptera	Perlodidae	Springflies	*Kogotus modestus*		P	P	P						
Plecoptera	Perlodidae	Springflies	*Megarcys signata*	P			P						
Plecoptera	Perlodidae	Springflies	*Megarcys watertoni*	P	P	P	P		P	P		P	
Plecoptera	Perlodidae	Springflies	*Setvena bradleyi*	P			P			P			
Plecoptera	Pteronarcyidae	Giant stoneflies	*Pteronarcys princeps*					P					
Plecoptera	Taeniopterygidae	Winter stoneflies	*Doddsia occidentalis*	P	P	P	P		P	P			
Plecoptera	Taeniopterygidae	Winter stoneflies	*Taenionema pallidum*				P						
Trichoptera	Apataniidae	Early smoky wing sedges	*Apatania comosa*		P	P		P	P		P	P	P
Trichoptera	Apataniidae	Early smoky wing sedges	*Apatania sorex*		P	P		P					
Trichoptera	Brachycentridae	Humpless casemaker caddisflies	*Brachycentrus americanus*					P	P				
Trichoptera	Brachycentridae	Humpless casemaker caddisflies	*Micrasema bactro*			P		P	P			P	P
Trichoptera	Glossosomatidae	Saddle casemaker caddisflies	*Glossosoma alascense*				P					P	
Trichoptera	Glossosomatidae	Saddle casemaker caddisflies	*Glossosoma pyroxum*		P	P			P			P	
Trichoptera	Glossosomatidae	Saddle casemaker caddisflies	*Glossosoma verdonum*	P					P	P			
Trichoptera	Hydropsychidae	Net-spinning caddisflies	*Arctopsyche grandis*		P	P	P	P	P		P	P	P
Trichoptera	Hydropsychidae	Net-spinning caddisflies	*Arctopsyche inermis*								P		
Trichoptera	Hydropsychidae	Net-spinning caddisflies	*Ceratopsyche oslari*		P	P		P			P	P	P
Trichoptera	Hydropsychidae	Net-spinning caddisflies	*Hydropsyche oslari*					P			P	P	P
Trichoptera	Hydropsychidae	Net-spinning caddisflies	*Parapsyche elsis*	P	P	P	P		P				
Trichoptera	Lepidostomatidae	Bizarre caddisflies	*Lepidostoma pluviale*			P		P			P		P
Trichoptera	Lepidostomatidae	Bizarre caddisflies	*Lepidostoma rayneri*			P		P			P		P
Trichoptera	Leptoceridae	Long-horned caddisflies	*Oecetis inconspicua*	P									
Trichoptera	Limnephilidae	Northern caddisflies	*Onocosmoecus unicolor*			P		P					
Trichoptera	Philopotamidae	Finger-net caddisflies	*Dolophilodes aequalis*				P						
Trichoptera	Rhyacophilidae	Free-living caddisflies	*Rhyacophila angelita*					P			P		P
Trichoptera	Rhyacophilidae	Free-living caddisflies	*Rhyacophila brunnea*		P			P	P		P	P	
Trichoptera	Rhyacophilidae	Free-living caddisflies	*Rhyacophila coloradensis*						P				
Trichoptera	Rhyacophilidae	Free-living caddisflies	*Rhyacophila hyalinata*						P				
Trichoptera	Rhyacophilidae	Free-living caddisflies	*Rhyacophila narvae*						P				
Trichoptera	Rhyacophilidae	Free-living caddisflies	*Rhyacophila pellisa*		P								
Trichoptera	Rhyacophilidae	Free-living caddisflies	*Rhyacophila vaccua*		P				P			P	
Trichoptera	Rhyacophilidae	Free-living caddisflies	*Rhyacophila vao*				P						
Trichoptera	Uenoidae	Stonecase caddisflies	*Neophylax rickeri*								P	P	
Trichoptera	Uenoidae	Stonecase caddisflies	*Oligophlebodes sierra*									P	

3.2. Whirling Disease Host Detection

Whirling Disease is a disease caused by *Myxobolus cerebralis*, a microscopic parasite that affects salmonid fish such as trout, salmon and whitefish (Gilbert and Granath, 2003). *M. cerebralis* requires a specific aquatic oligochaete (worm) intermediate

host, *Tubifex tubifex* (sludge worm). This species is most commonly associated with poor-quality, eutrophic conditions (Gilbert and Granath, 2003).

While there are still no documented cases of Whirling disease in BC, it has been confirmed in several locations in Alberta near the BC border. Across the five sites sampled, *T. tubifex* was detected in LIZ-01 and MOR-01 (Lizard and Morrisey Creek; 2021). If the whirling disease causal agent was to spread into BC, this would be a high-risk site for a whirling disease outbreak.

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5. APPENDICES

Appendix A. Summary table of sample sites, including site name, year of collection and site coordinates.

Site	River	Lat	Long	Year
ALX-01	Alexander Creek	49.67394	-114.78	2020 & 2021
BOI-01	Boivin Creek	50.02315	-114.916	2020 & 2021
COL-01	Coal Creek	49.49556	-115.066	2020 & 2021
LIZ-01	Lizard Creek	49.47094	-115.077	2020 & 2021
MOR-01	Morrissey Creek	49.35806	-115.001	2020 & 2021

6. GLOSSARY

Term	Meaning
Benthic/benthos	The ecological region at the lowest level of a body of water such as an ocean, lake, or stream, including the sediment surface and some sub-surface layers.
Biomonitoring	The science of inferring the ecological condition of an ecosystem (i.e. rivers, lakes, streams, and wetlands) by examining the organisms that live there.
Bootstrap support	Statistical methods used to evaluate and distinguish the confidence of results produced.
Bulk-tissue DNA sample	This refers to the collection and removal of a reasonable quantity of representative material (including organisms such as river bugs) from a location (i.e. river bed).
DNA extraction	Isolation of DNA from either the target organism (i.e. DNA from an insect leg) or from an environmental sample (i.e. DNA from a water or benthos sample).

DNA Metabarcoding	Amplification of DNA using universal barcode primers (e.g. universal for invertebrates) to allow sequencing of DNA from target organisms (e.g. invertebrates) from environmental samples (e.g. river water or benthos).
Environmental DNA (eDNA)	The DNA released into the environment through faeces, urine, gametes, mucus, etc. eDNA can result from the decomposition of dead organisms. eDNA is characterized by a complex mixture of nuclear, mitochondrial or chloroplast DNA, and can be intracellular (from living cells) or extracellular. Environmental DNA: DNA that can be extracted from environmental samples (such as soil, water, or air), without first isolating any target organisms.
EPT groups	The three orders of aquatic insects that are common in the benthic macroinvertebrate community: Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies).
Macroinvertebrate	Organisms that lack a spine and are large enough to be seen with the naked eye. Examples of macro-invertebrates include flatworms, crayfish, snails, clams and insects, such as dragonflies.
Metrics	The method of measuring something, or the results obtained from this.
Next-generation sequencing (NGS)	Use of next-generation sequencers (i.e. Illumina) to millions or billions of DNA strands in parallel.
Normalizing	The process of rarefying samples down to the smallest library size – a common practice in DNA metabarcoding methods.
Richness	The number of species represented in an ecological community, landscape or region. Species richness is simply a count of species, and it does not take into account the abundances of the species or their relative abundance distributions.
Riparian	Relating to or situated on the banks of a river.
Sample homogenization	The process of making an environmental sample (i.e. benthos) uniform. For liquid/benthos samples, this often involves mixing using a blender so that DNA is evenly distributed within the sample.
Taxa	Unit used in the science of biological classification, or taxonomy.

Appendix F: Lizard Creek Photos from 2012 to 2021

2012

2013

2014

2015

2016

2017

2018

2019

2020

2021