ELK RIVER ALLIANCE

COMMUNITY-BASED WATER MONITORING

2025 HYDROMETRIC REPORT

PREPARED BY:

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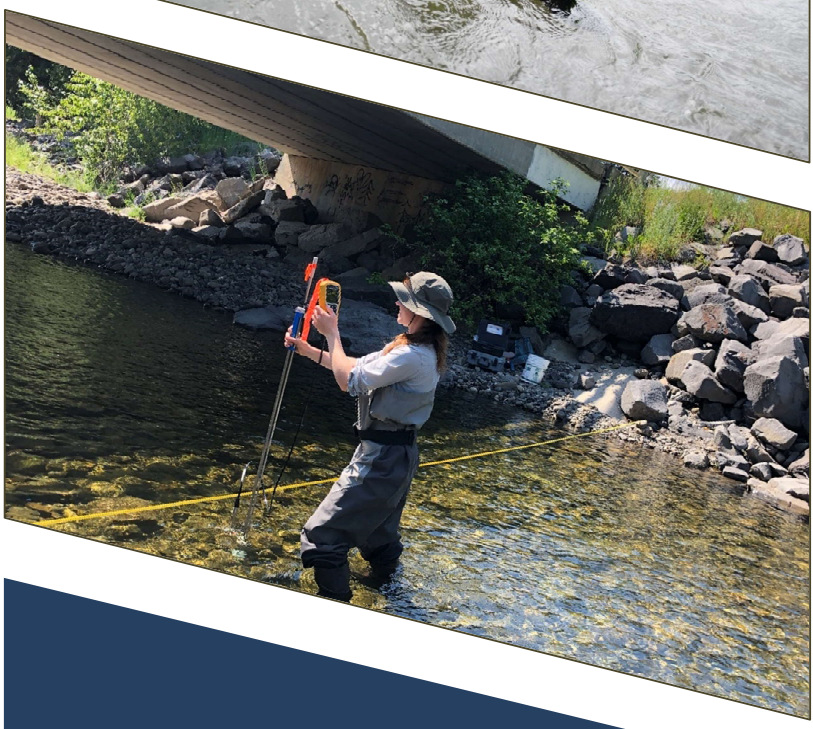
FERNIE, BC

WITH FINANCIAL SUPPORT FROM:

BC Provincial Gaming
TC Energy
Bass Pro Shops & Cabela's
Living Lakes Canada
Royal Bank of Canada
Real Estate Foundation of BC
Canadian Wildlife Federation
Columbia Basin Trust - Environmental Large & ReDi (Regional District of the East Kootenay)

The ERA Community



Program Overview

The Elk River Alliance's hydrometric program monitors temperature and flow variations over time, creating datasets to model the impacts of climate change and land use on the Elk River and its tributaries. Ongoing logging enables long-term assessment of changing conditions while accounting for daily, weekly, and monthly fluctuations. This information is critically important for monitoring the health of aquatic habitat for wildlife species, including SARA-listed Westslope Cutthroat Trout (WCT). This data also helps develop water budgets within the Elk Valley, giving decision makers and land managers the information needed for long-term planning for fisheries, climate change adaptation and flood mitigation.

The main stem of the Elk River and some mine-affected tributaries have several third-party hydrometric stations, as part of permit requirements. Smaller tributaries, including high-elevation streams, are not as well monitored (Carver et al., 2020). ERA works to fill these data gaps, identified by community partners, and through geospatial analysis commissioned by Living Lakes Canada (Lapp et al., 2022).

ERA's Hydrometric Program supports the Elk River Monitoring Collaborative (ERMC) objectives of monitoring processes, collaborative partnerships, and available and accessible data. The program is also tied into Living Lakes Canada's Columbia Basin Water Monitoring Collaborative (CBWMC) as a pilot project focused on the Elk Valley.

ERAs Hydrometric Program consists of five level logger stations and 17 temperature logger sites located on tributaries throughout the Elk River Watershed. Originally, 19 temperature loggers were installed, with two temperature logger stations being upgraded to level loggers in 2024, which also collect temperature data.

At the time of writing this report, ERA has collected between 2 and 3 years of temperature and hydrometric data. All data is publicly available and is uploaded to the Columbia Basin WaterHUB.

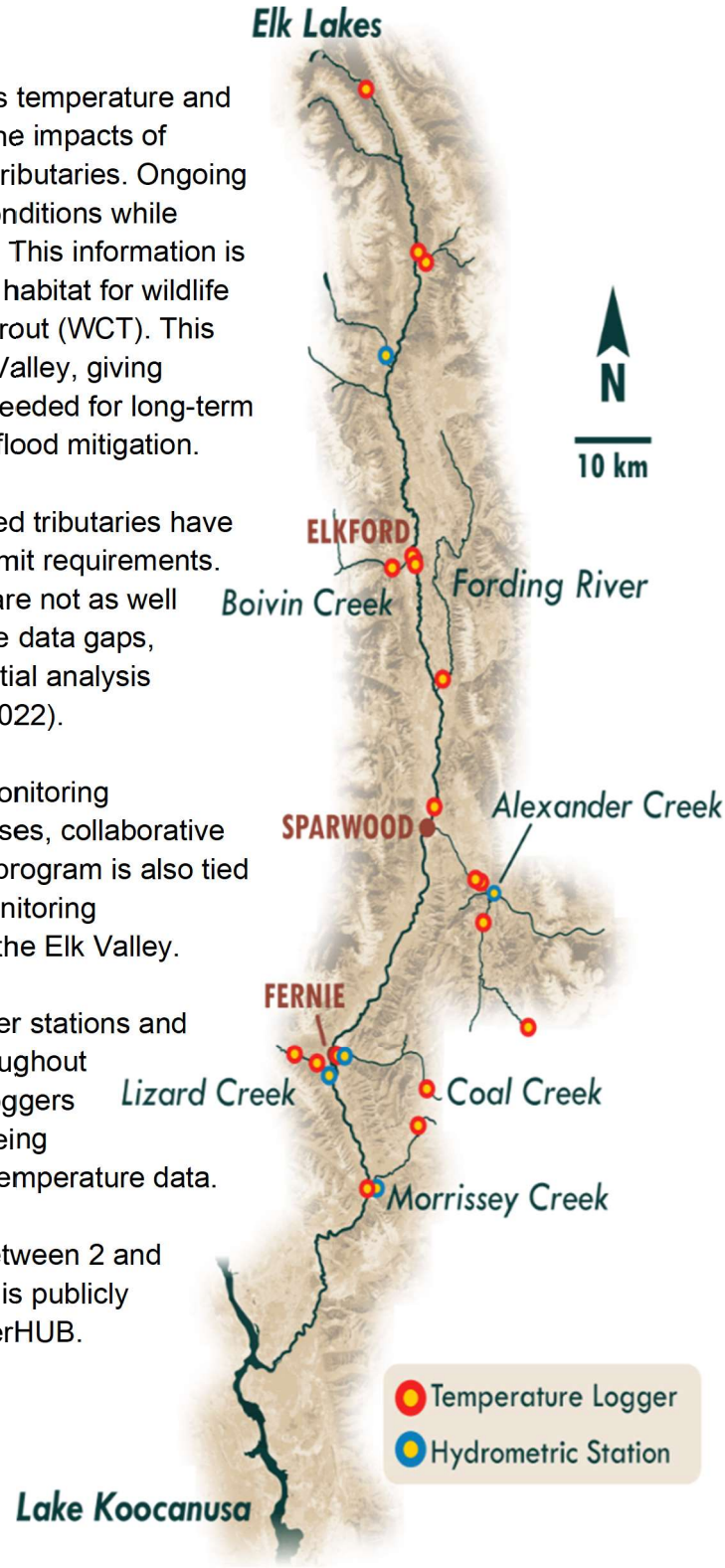


Figure 1: Hydrometric and temperature monitoring sites in the Elk River watershed.

Land Acknowledgement

The Elk River Alliance recognizes that our work takes place on the traditional land and waters of Yaq̓ɬ tʔa·k nuqɬi ‘it ‘ʔakanuxunik̓ ʔamakʔis the People from where the water comes out, within Qukin ʔamakʔis - the Land of the Raven in the Ktunaxa language.

Acknowledgements

The Hydrometric Program is managed and delivered by the Elk River Alliance (ERA) with financial assistance from Living Lakes Canada, BC Provincial Gaming, TC Energy, Bass Pro Shops & Cabela’s, Columbia Basin Trust’s Environmental Large & RDEK ReDi grants, Royal Bank of Canada, Real Estate Foundation of British Columbia and the Canadian Wildlife Federation. We’d also like to thank everyone who made in-kind contributions to the project, donated equipment, provided vehicles, or offered professional advice. A special thanks to Sontek, Xylem Inc. for their generous donation of an Acoustic Doppler Current Profiler (ADCP), and Mike Wrigglesworth and the Flathead Rivers Alliance for their assistance with this donation. ERA wishes to express its heartfelt thanks to all volunteers for their time and effort throughout this project.

Supporting Partners

Living Lakes Canada has contributed to the program development and ongoing monitoring through providing financial and technical support, including access to Aquarius.

The **British Columbia Provincial Hydrometric Team,** especially Jonathan Jeffrey (Hydrometric Supervisor) and Katy Fraser (Hydrometrics Specialist), has been instrumental for program development, training and capacity building.

MacHydro has played an essential role in assisting with site selection, program support and data review.

Financial Support

- BC Provincial Gaming
- TC Energy
- Bass Pro Shops & Cabela’s
- Living Lakes Canada
- Royal Bank of Canada
- Real Estate Foundation of BC
- Canadian Wildlife Federation
- Columbia Basin Trust - Environmental Large & ReDi (Regional District of the East Kootenay)

Staff

Fynley Kuijt – Community-Based Water Monitoring Coordinator

Kaileigh McCallum – Former Program Coordinator

Other past and current ERA staff have regularly supported the hydrometric program, including Larissa Kurtz (Field Technician), through a partnership with Living Lakes Canada.

Volunteers

Since installing the first water loggers, the Hydrometric and Temperature aspects of ERA's CBWM program have been supported by over 1,130 hours of volunteer time generously donated by 65 volunteers. Water monitoring volunteers are integral to the functioning of these projects, and ERA is eternally grateful for the time and effort these volunteers have given towards making them a reality.

Data disclaimer:

The data presented in this report are preliminary and should be interpreted accordingly. The data have undergone initial quality control, adjustment, and internal review in accordance with accepted best practices. The hydrometric data included in this report have also undergone an additional preliminary independent review by MacHydro.

Data gaps are present, and the review and interpretation of hydrometric data involve an element of professional judgment that may influence the resulting figures. Users are advised to exercise caution and to independently assess the accuracy, completeness, and suitability of the data for their intended use before making decisions or drawing conclusions based on it.
The ERA accepts no responsibility or liability for any use, interpretation, or reliance on the hydrometric data contained in this report. Please contact the Elk River Alliance for guidance on data use.

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Hydrometric Program

The Elk River Alliance's Hydrometric Program consists of 5 level logger sites stationed on tributaries of the Elk River throughout the Elk River Watershed. Sites are selected based on a combination of tributary importance due to WCT habitat, the Geospatial Analysis produced by MacHydro for Living Lakes Canada (Lapp et al., 2022) and a site's representativeness of the valley overall. As part of the analysis, sites aim to complement measurements already taken by Glencore (Teck at the time of installation), Water Survey Canada and the City of Fernie. Installation of ERA sites began in 2022 with the assistance of MacHydro and support from BC Provincial Hydrometrics team members, especially Jon Jeffrey.

Station equipment is industry-standard, and stage, discharge, and benchmark measurements are conducted in accordance with BC RISC standards (Ministry of Environment and Climate Change Strategy, 2018). ERA aims to complete two benchmark surveys and at least seven stage/discharge measurements at each hydrometric site per year.

Level logger data, stage and discharge data, field notes, and photos are uploaded to Aquarius. This software platform allows management, analysis, and export of water data. Initial data quality assurance and quality control (QA/QC) is conducted in-house by the Elk River Alliance. Further preliminary review of hydrometric data was conducted by MacHydro. Data is then uploaded to be publicly available through the Columbia Basin WaterHUB.

Before 2025, discharge measurements were taken using a FlowTracker 2, which requires being able to wade the stream safely for use. This restricted measurements to low-flow, wadable water levels, creating data gaps at high-flow, unwadable levels. Starting in 2025, ERA gained the capacity to conduct high-flow measurements through the donation of an Acoustic Doppler Current Profiler (ADCP) and will be working to fill in these high-flow data gaps in future years.

Because prior years only allowed for low-flow measurements, there is a limit to how far the stage-discharge relationship can be extrapolated beyond manual measurements. ERA has followed the Water Survey of Canada guidelines of not extending data beyond twice the highest and half the lowest valid measurements (Rainville et al., 2016). In datasets published on the Columbia WaterHUB and in Figures in this report, both high and low-flow gaps in discharge data are a result of these guidelines, with the exception of missing data caused by stage data gaps listed in Table *1*.

The hydrometric program focuses on long-term trends; with two to four years of data now collected for each site, it is too early to make any factual statements about trends. The current focus is instead on broadening the scope of flows measured at each site to better understand the stage-discharge relationship at the lowest and highest ends of the stage-discharge rating curve.

Table 1: Gaps in stage logger data from CBWM Hydrometric sites.

Site	Date Established	Data Gaps (>2h)	Reason
ALX004	2023-10-05	2024-06-28 to 2024-07-22 2024-06-26 to 2024-07-29	Logger storage issues
COL006	2023-07-06 (ERA)	2023-12-05_10:01 to 2023-12-05_19:33 2024-01-11 to 2024-10-31	Sensor issues during high flow event, Sensor offline (City of Fernie)
FOR001	2022-07-27	2024-05-23 to 2024-05-27	Logger battery died
LIZ001	2022-08-10	2023-04-10 to 2023-07-04 2024-09-24 to 2024-10-16	Logger hit during high flow event Data lost from corruption
MOR001	2023-07-10	N/A	N/A

ALEXANDER CREEK
Established October, 2023

LOCATION: Alexander Creek runs from alpine areas along the Continental Divide to down alongside Highway 3 (near the Alberta/BC border) and is a significant tributary of Michelle Creek. The catchment contains logging and cattle-grazing leases, as well as nearby mining and urban development. The proposed Crown Mountain coal mine in the upper reaches of Alexander Creek would have significant land use impacts on the catchment if approved.

Figure 2: Alexander Creek hydrometric site (ALX004), looking downstream.

BACKGROUND: Short-term data loss occurred during June and July 2024 due to issues with logger data storage capacity (Figure *3*). During the fall of 2024, wildlife fencing was installed along sections of Alexander Creek as it runs alongside Highway 3, affecting site access. As a result, new benchmarks were required in 2025.

This site is located between two old highway bridge walls, which constrain the creek and make for deeper, more channelized flow in this section (Figure *2*). Channelized, faster flows pose more of a safety concern during high-flow conditions, making high-flow measurements at this site historically challenging.

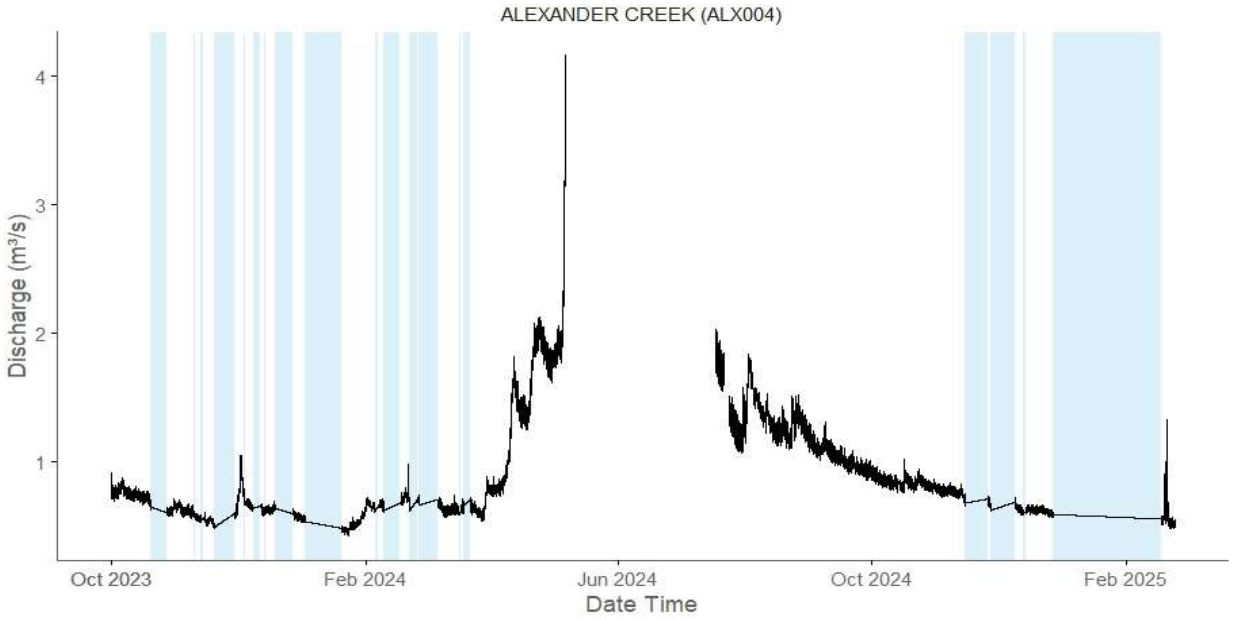

Figure 3: Discharge time-series for Alexander Creek (ALX004) hydrometric site from 2023-10-05 to 2025-03-01. Ice impacted periods are interpolated and indicated by shaded blue areas.

COAL CREEK
Established July 2023

Figure 4: Coal Creek hydrometric site (COL006), looking across stream from river

LOCATION: Coal Creek flows from its headwaters behind Morrissey Ridge, through the City of Fernie and into the Elk River. Historically, underground mining took place within the Coal Creek catchment. Other land uses have included logging, forestry activities, access roads, recreational trails, urban development, and the old Fernie landfill. Most recently, clear-cut logging and associated road development continue to alter waterways and the catchment area.

BACKGROUND: The Coal Creek level logger is owned and was installed by the City of Fernie in June 2022. ERA is not involved in the operation of this logger but has been collecting manual water level and discharge data at this site since July 2023. By combining manually collected data with data from the City's logger, ERA has created a complete hydrometric site. Unlike at ERA's other hydrometric sites, this logger is a non-contact water sensor and is not installed directly in the creek. The sensor has had some issues periodically since installation, causing some gaps in logger data (Figure *5*).

Coal Creek can experience very high, turbulent flows during freshets and large rain events, even washing out an upstream vehicle bridge during the 2021 atmospheric river. These events have been known to substantially change the course of the creek, especially at its mouth, where it deposits into the Elk River.

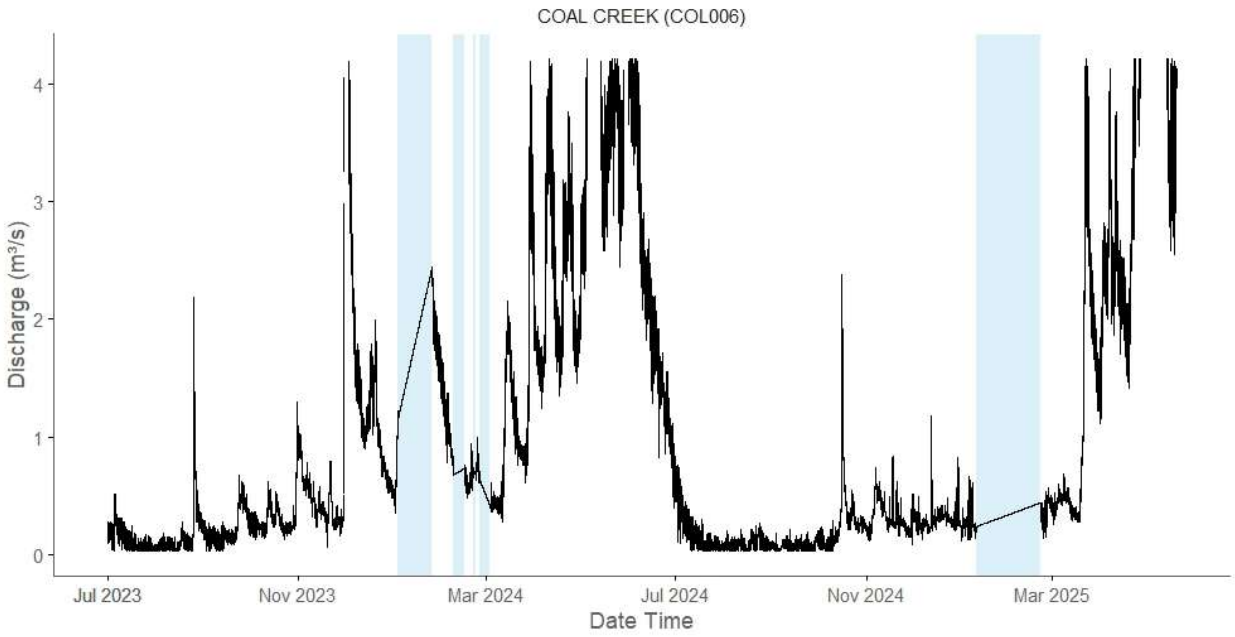

Figure 5: Coal Creek hydrometric site (COL006) discharge time series from 2023-07-06 to 2025-05-27. Ice impacted periods are interpolated and indicated by shaded blue areas.

FORSYTH CREEK
Established July, 2022

LOCATION: Forsyth Creek is 26km north of Elkford in the upper reaches of the Elk River Watershed. It flows from its headwaters in the southern-most part of Elk Lakes Provincial Park, between Mt. Ingram and Mt. Hornickel, across the Elk River FSR and into the Elk River. Notably, Forsyth Creek is not directly impacted by mining activities and is located upstream of most mining activity in the Elk River watershed.

Figure 6: Forsyth Creek hydrometric site (FOR001), looking across stream from river right.

BACKGROUND: Apart from one brief period due to a dead battery, the Forsyth hydrometric site has had no other logger data gaps. Freezing temperatures have led to unexplained decreases in water levels during winter (Figure 7). Due to challenges accessing the site in winter because of unplowed roads, the reason for these decreases is unknown, but it is thought to be due to flows being diverted or partially blocked by upstream ice. These winter decreases in water level create data gaps because they are lower flows than can be extrapolated from manually measured summer low flows.

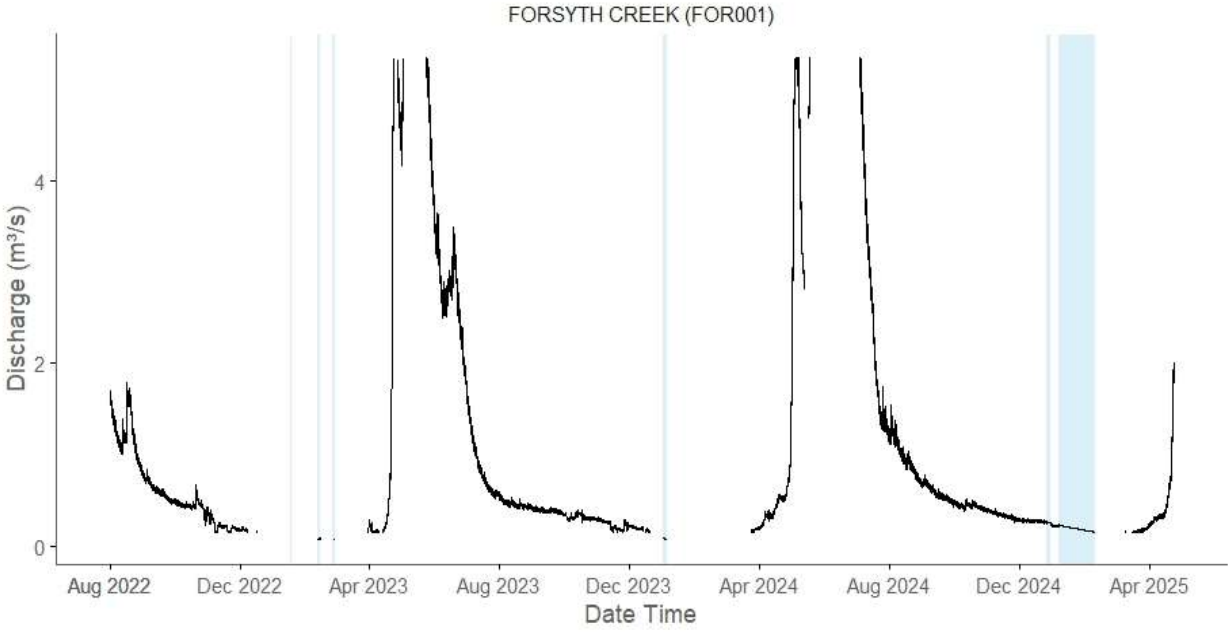

Figure 7: Discharge time series for Forsyth Creek hydrometric site (FOR001). Ice impacted data is interpolated and indicated by blue shaded areas.

LIZARD CREEK
Established August, 2022

Figure 8: Lizard Creek hydrometric site (LIZ001) before 2023 change to control, looking downstream.

Figure 10: Lizard Creek hydrometric site (LIZ001) after 2023 change to control.

LOCATION: Lizard Creek originates in the Lizard Range and flows from "Island Lake" into the Elk River approximately 15km south of Fernie. Although logging has occurred within the catchment 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/hiking area with gravel access roads. Residential development in the Lizard Creek Catchment downstream of the provincial park began in 2018. This creek has been identified as critical spawning habitat for WCT by ERA, fishery biologists and local guides.

BACKGROUND: During the freshet of 2023, this logger was hit, and its housing was damaged during high flows. The logger was removed and reinstalled once flows had subsided in July 2023. In December of 2023, a large rain-on-snow event appears to have significantly altered the kilometre stretch immediately upstream of the creek mouth, including the hydrometric site. As a result of this event, the creek has eroded down to a clay layer in some areas, and the substrate has become less rocky and the creek more channelized overall. This event also changed the downstream control (Figure 8 & Figure 10), leading to the development of a second rating curve for this site, with the new rating period beginning on 2023-12-05.

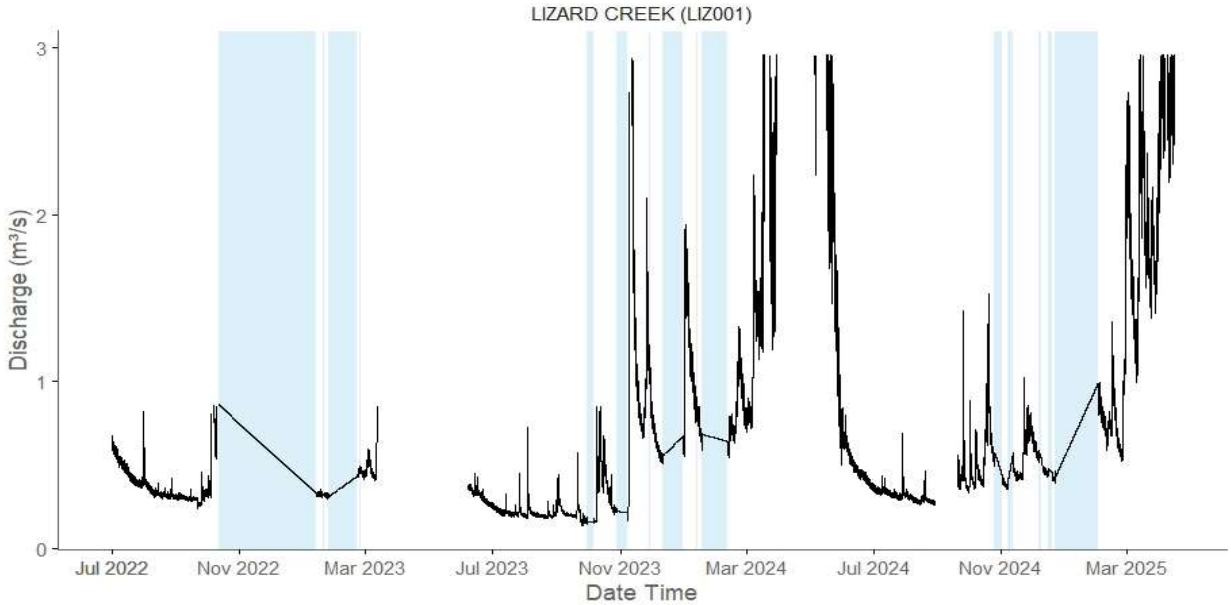

Figure 9: Lizard Creek hydrometric site (LIZ001) discharge time series from 2022-07-27 to 2025-05-13. A new rating period was started on 2023-12-05. Ice impacted data is interpolated and is indicated by shaded blue areas.

MORRISSEY CREEK
Established July 2023

LOCATION: Morrisey Creek runs from its headwaters behind Morrisey Ridge into the Elk River. Logging, linear development (forestry roads, gas lines, rail lines), recreational use (vehicle and ATV access) and agriculture occur throughout the Morrissey catchment. Additionally, TC Energy conducted pipeline work in the Morrissey area from 2022 to 2024, which included the expansion and increased use of roadways along Morrissey Creek.

Figure 11: Morrisey Creek hydrometric site (MOR001), across stream from river left.

BACKGROUND: To date, there are no gaps in the Morrisey level logger data since installation (Figure *12*).

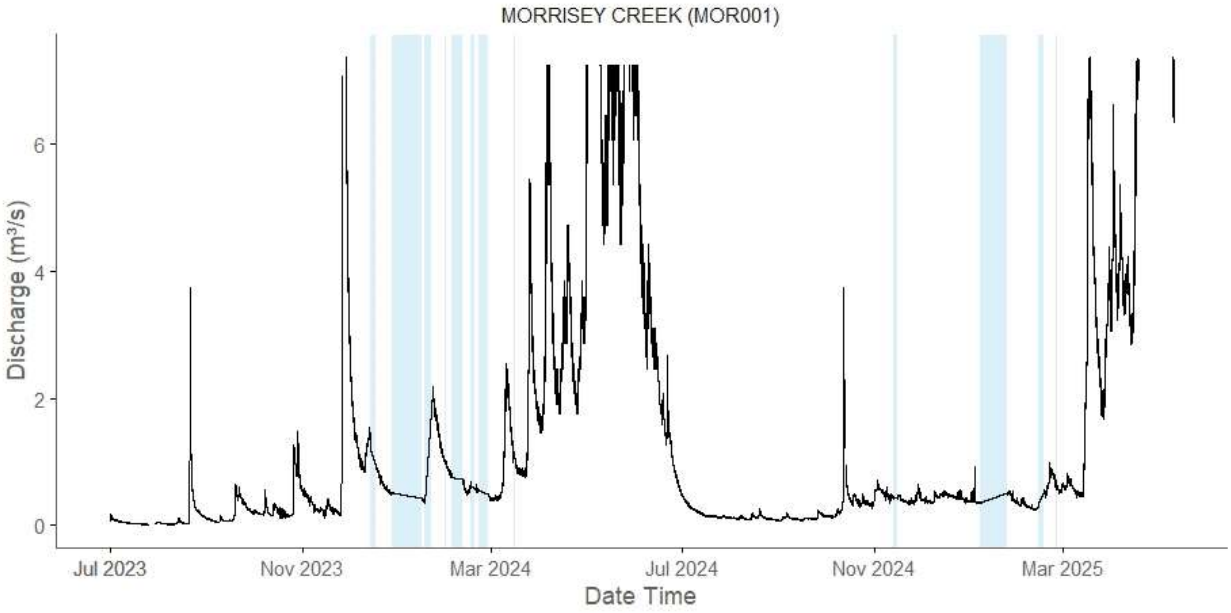

Figure 12: Morrisey Creek hydrometric site (MOR001) discharge time series from 2023-07-10 to 2025-05-21. Ice impacted data is interpolated and indicated by blue shaded areas.

Temperature Program

Considering the potential effects of climate change on the Elk River system and key species such as WCT, understanding long-term temperature trends is a priority for ERA. ERA has deployed long-term temperature loggers that record daily, seasonal, and annual changes in temperature. Nineteen temperature loggers were initially deployed throughout the Elk River Watershed, beginning in 2019. In 2024, two of these temperature loggers (MOR001 & LIZ001) were replaced by level loggers, which collect equivalent temperature data in Morrissey and Lizard Creeks.

Temperature logger sites were selected using the same Geospatial Analysis (Lapp et al., 2022). Focus was placed on installing two loggers in each monitored tributary, with one logger installed at an accessible location as near to the headwaters of the tributary as possible, and the other logger just above the tributary's end at the confluence. Temperature loggers are visited 1-2 times a year to download data and to complete any necessary maintenance. All initial review of temperature data is conducted in-house using HOBOware, Microsoft Excel and R. Data is then uploaded to the publicly available Columbia Basin WaterHUB.

For this report, temperature sites were divided into three areas based on their locations within the watershed. While there are not yet enough years of temperature data to observe trends, this data provides an early look at differences in water temperature between tributaries of the Elk River, and between sites located higher and lower within the tributaries themselves (Figure *13*, Figure 14 & Figure 15).

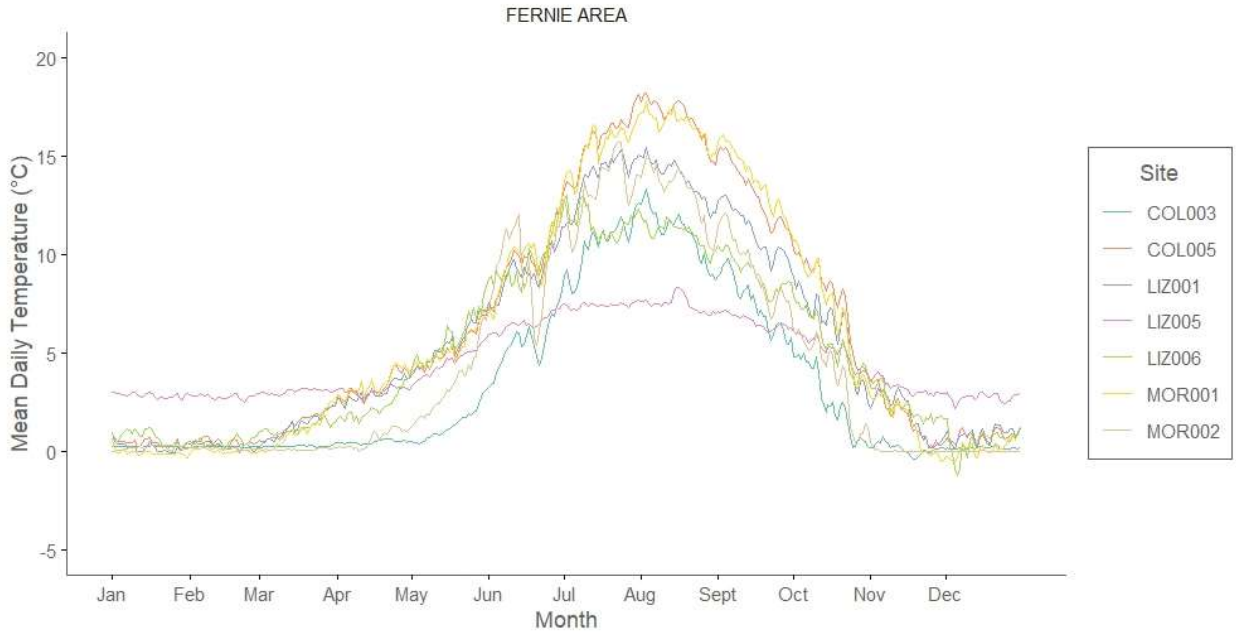

Figure 13: Mean daily temperature of tributaries of the Elk River located in the area surrounding Fernie, BC.

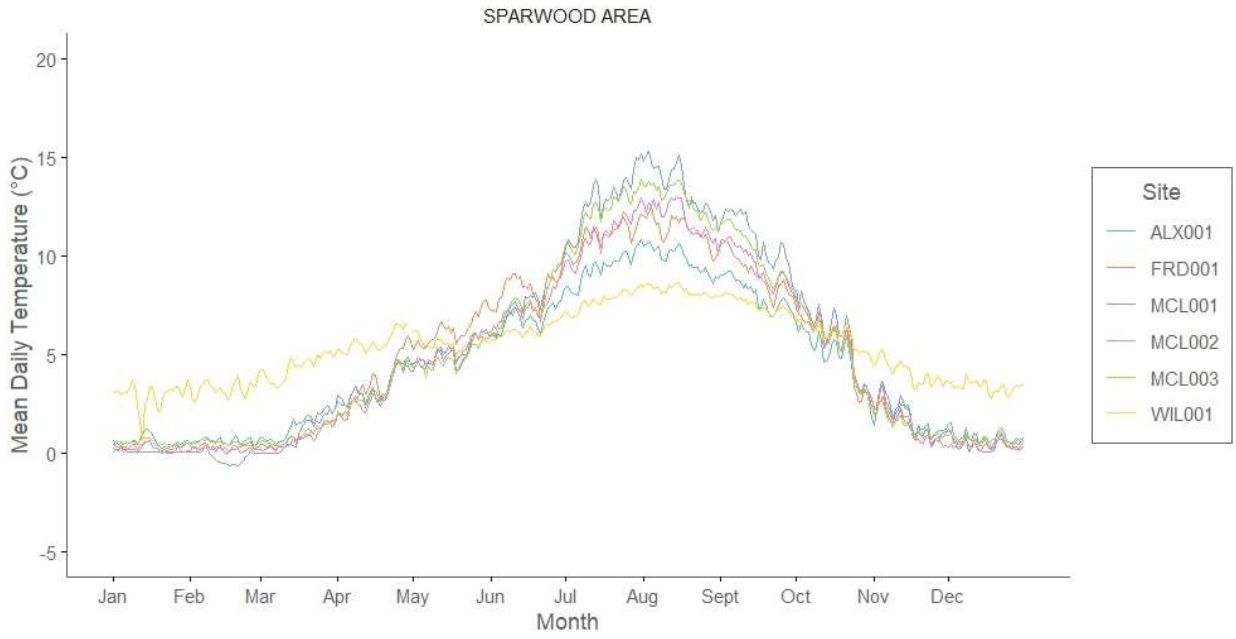

Figure 14: Mean daily temperature of tributaries of the Elk River located in the area surrounding the community of Sparwood, BC.

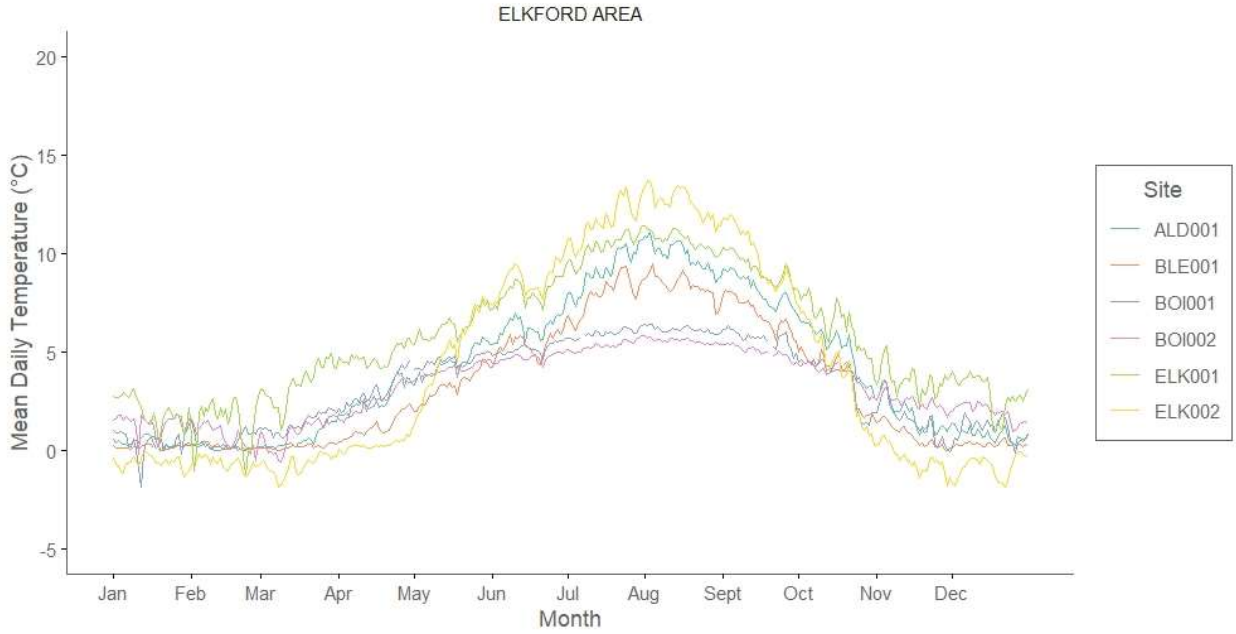

Figure 15: Mean daily temperature of tributaries of the Elk River located in the area surrounding the community of Elkford, BC.

Using daily mean temperature of all years of data as a general overview, none of the monitored tributaries surpassed the WCT thermal stress threshold of 20°C (Bear et al., 2007; Macnaughton et al., 2021), although Lower Coal and Morrisey Creeks came close with values around 17°C. These daily means do not account for temperature fluctuations within each day or between years; however, when looking at hourly data, some of the monitored tributaries were found to reach temperatures above the WCT stress threshold (Table 2).

When fish encounter temperatures that cause thermal stress, they can experience behavioural changes, reduced growth and metabolic strain, and will try to escape to cooler areas if possible (Enders & Durhack, 2022). Studies show that time spent at temperatures above thermal stress limits can ultimately be detrimental to fish health, even if temperatures remain below their lethal limit (Enders & Durhack, 2022). WCT begin to experience acute mortality in water temperatures above 25°C and cannot survive at these temperatures for long (Bear et al., 2007).

Temperature is also closely correlated with dissolved oxygen levels. Colder water contains higher oxygen levels, which are critical for most 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 (British Columbia Ministry of Environment and Climate Change Strategy, 2021).

For the most part, stream temperatures are generally higher at lower elevation sites, both within the Elk River Watershed overall and within individual tributaries. One exception to this is both Boivin Creek sites (BOI001, BOI002), which appear to have much lower temperatures despite the sites being lower in elevation than most other sites in the Elkford area (Figure 15, Figure 16).

Collection of temperature data involves many challenges, and some common causes of erroneous data include loggers becoming high and dry during low summer flows or loggers becoming encased in ice during winter months when air temperatures drop below freezing. Any data confirmed to be impacted by a dry logger, or by a site visit, were not used when creating the figures in this report; however, it is possible that loggers might have unverified dry periods between site visits. Efforts were made to choose sites that are wet year-round, but streams can change over time. It is likely that the extreme high temperatures observed in 2022 at LIZ006 in Lizard Creek are a result of this logger being dry, but this is unconfirmed (Figure 16). Data below or near zero degrees was not altered; however, caution should be used when interpreting this data since these values may not be an accurate reflection of the true water temperature below the ice.

Water level and flows can impact stream temperatures, as shallower, slower flowing water is often warmer than deeper, faster moving water. Seeing tributaries rise to temperatures within the thermal stress limits for WCT is concerning, as stream temperatures and water levels will likely continue to change with climate, snowpack levels and drought occurrences in the coming years. Because temperature and flows are intricately linked, ERA will continue to investigate these stream characteristics through the hydrometric and temperature components of the CBWM program to observe long-term trends.

Table 2: Hours recorded as above the thermal stress limit of Westslope cutthroat trout in temperature-monitored Elk River tributaries.

Site	Hours Above 20°C	Hours Above 25°C
ALD001	0	0
ALX001	0	0
BLE001	0	0
BOI001	0	0
BOI002	0	0
COL003	0	0
COL005	166	0
ELK001	18	0
ELK002	0	0
FRD001	0	0
LIZ001	166	0
LIZ005	0	0
LIZ006	166	70
MCL001	10	0
MCL002	0	0
MCL003	0	0
MOR001	166	0
MOR002	0	0
WIL001	0	0

Conclusion

This program is ongoing, with a focus on long-term trends caused by climate change, land-use impacts, and the reliability of these water systems. Continuous logging also allows ERA to capture the effects of natural events, such as atmospheric rivers, on water levels, discharge, and temperature.

With around three years of data collected for hydrometric and temperature sites, ERA has developed a good foundation of data that gives an early look at the hydrometric and temperature relationships within monitored creeks.

ERA plans to expand these datasets and build an understanding of high-flow stage-discharge relationships at hydrometric sites using ADCP equipment. Given the proximity of temperatures to the thermal stress limits of WCT, especially in lower Morrisey, Coal, and Lizard Creeks, ERA will closely monitor these creeks in the coming years. Continued community and funder support of these projects remains crucial for future monitoring efforts.

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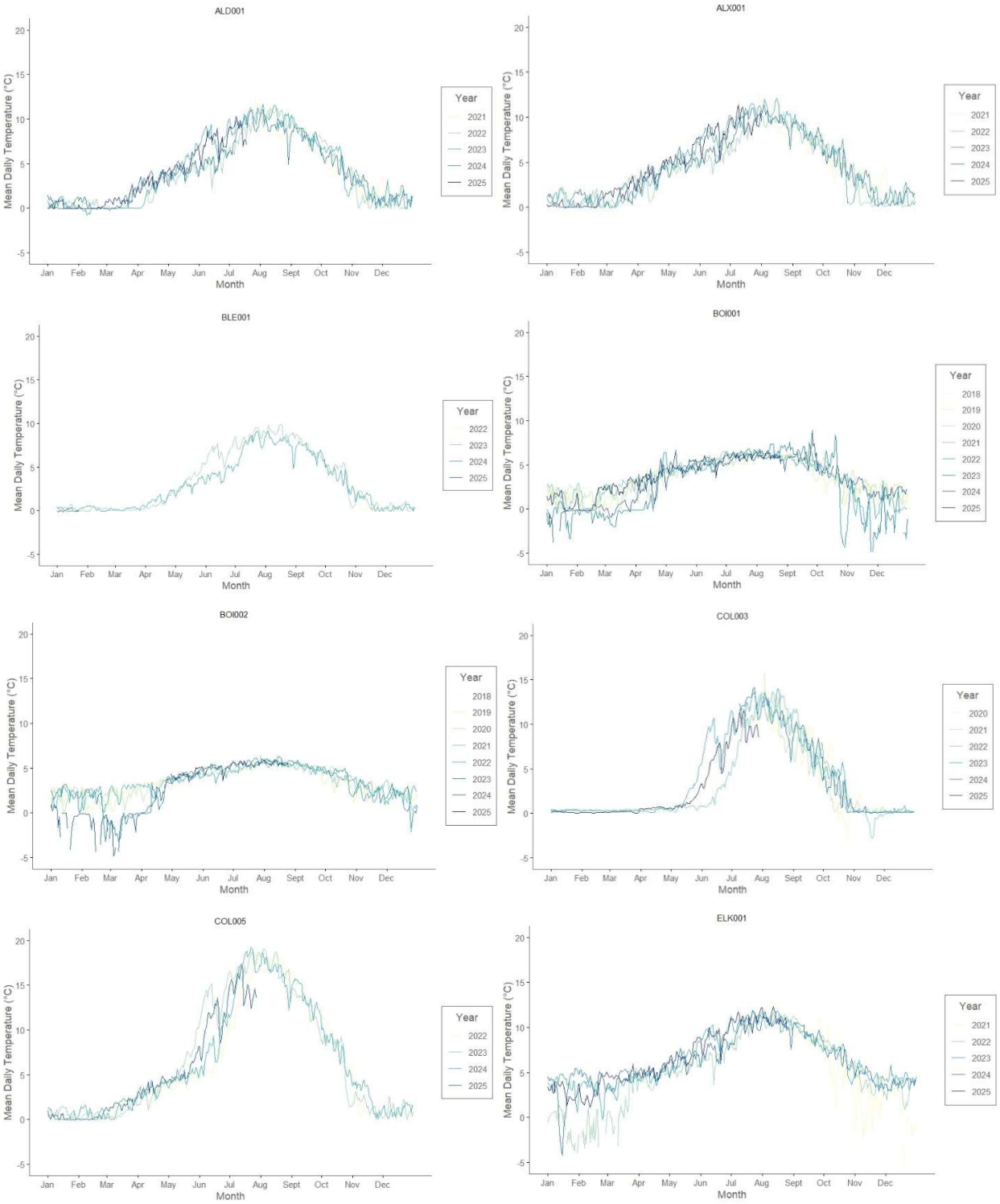
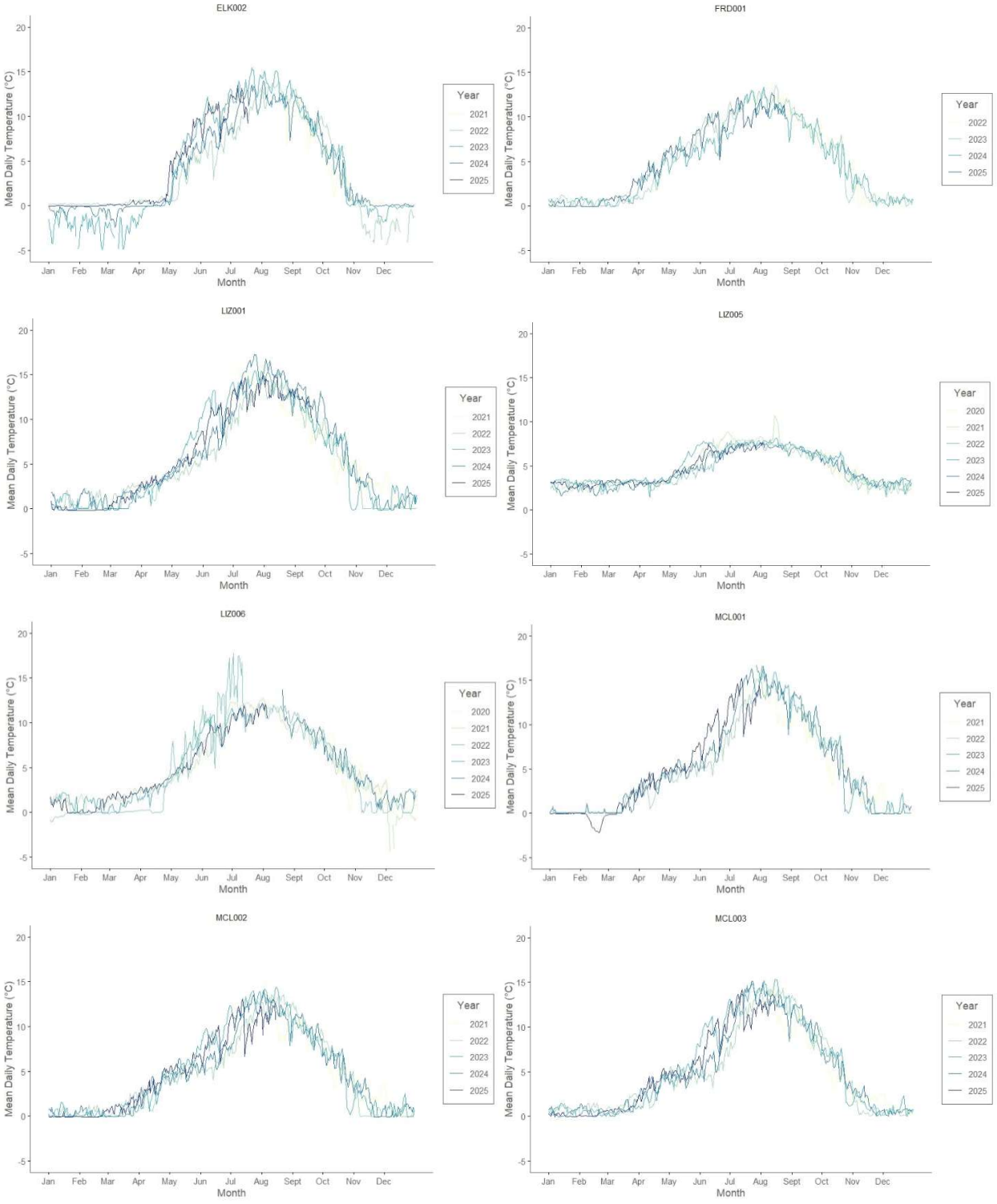
Appendix A: Water Temperature by Individual Site




ELK002
FRD001
LIZ001
LIZ005
LIZ006
MCL001
MCL002
MCL003
Mean Daily Temperature (°C)
Month
Jan Feb Mar Apr May Jun Jul Aug Sept Oct Nov Dec
Year
2020
2021
2022
2023
2024
2025

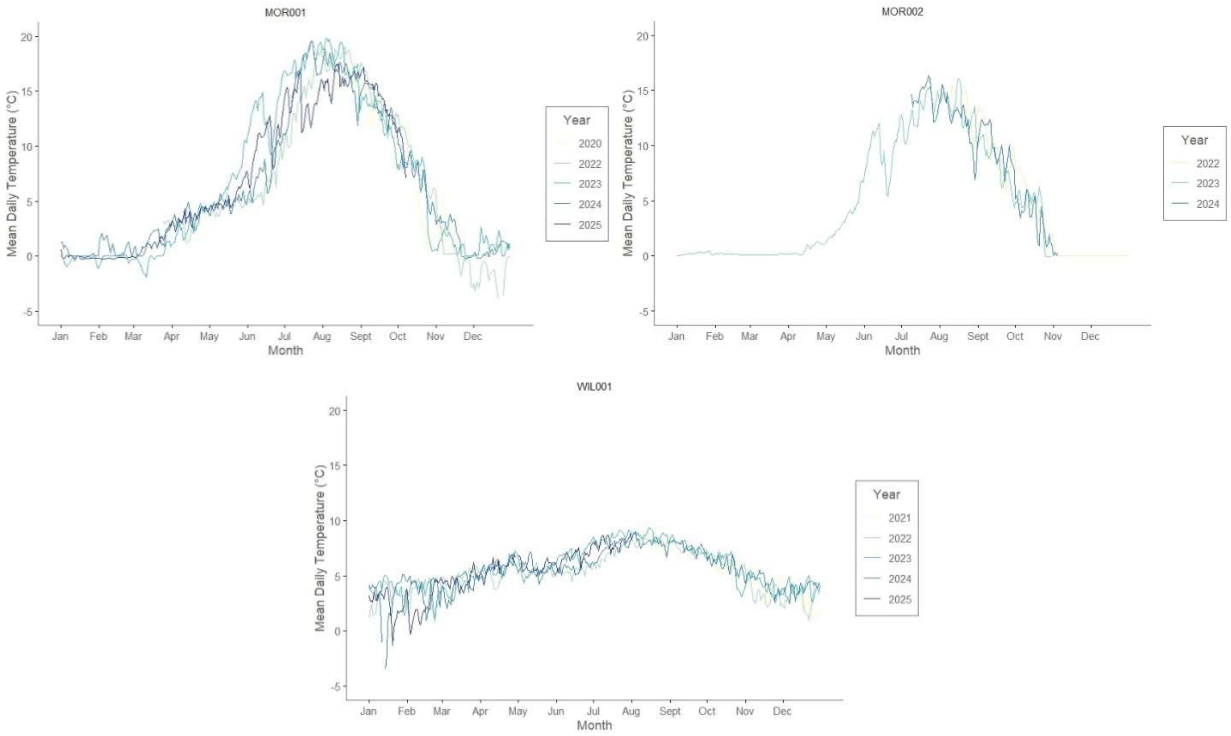


Figure 16: Annual water temperature of Elk River watershed tributaries by site, from installation to 2025.

Appendix B: Study Limitations

Table 3: Outline of the potential limitations of Hydrometric and Temperature projects within ERA's CBWM program.

Limitations	Description	Solution
Ice	Freezing temperatures during winter months forms ice around loggers installed in streams. This ice can impact stream stage data, causing it to rise as ice builds up. While it is a true reflection of what is occurring in streams, it does influence how data is reviewed and does not necessarily correlate to discharge in the same way. Winter conditions also restrict discharge measurements to ice-free months, limiting the range of stage over which measurements can be taken using current ERA equipment and training.	ERA actively consults BC Provincial hydrometric specialists on best practices to account for ice impacted data during review. Internal review processes are communicated to any professional reviewers. Effort is made to access sites through as many levels of stage as possible. 5 - 7 discharge measurements are completed per year at each site, with additional measurements completed as time and resources allow.
Funding	Available funding (i.e. grants) for hydrometric monitoring has a history of being variable and can be influenced by a myriad of factors. During years of lower funding, the program must be dialed back to just data collection, with analyzing and QA/QC occurring at a time of greater funding availability. Funding availability also impacts ERA's ability to have two staff members collect hydrometric field data.	To assist with data collection, ERA has a group of dedicated volunteers that support the hydrometric program.
Staff	Hydrometric data is difficult to collect in a repeatable way, and the level of accuracy can vary. Field measurement decisions also involve subjective elements, such as choosing a visit's discharge transect location. The experience level of staff may impact the quality and accuracy of field measurements.	Field teams always consist of at least one staff member trained in hydrometric data collection and either another staff member or a volunteer. Staff are trained through workshops with provincial hydrometric specialists and by other, more experienced staff members.
Sensor Sensitivity	Sensory type can have large ramifications for the quality of data produced, and sensors with lower accuracy can limit the RISC grading able to be achieved by the data.	All ERA hydrometric stations use industry-grade HOBO level loggers with a sensitivity of 0.005m. The ERA hydrometric program follows the BC provincial RISC Hydrometric Standards to ensure the quality and accuracy of data produced.
Equipment capabilities	Previously, the ERA was limited to taking only low flow discharge measurements due to the FlowTracker 2 requiring safe wading conditions to complete measurements. Wading at high flow is not possible for safety reasons.	As of 2024, an ADCP has been donated to the ERA by Xylem Analytics, which will allow for discharge measurements to be safely taken during higher flows.