Delphine Creek, BC • LLC Photo

CASE STUDY: Delphine Creek and Kindersley Creek Watersheds

COLUMBIA BASIN WATER MONITORING FRAMEWORK

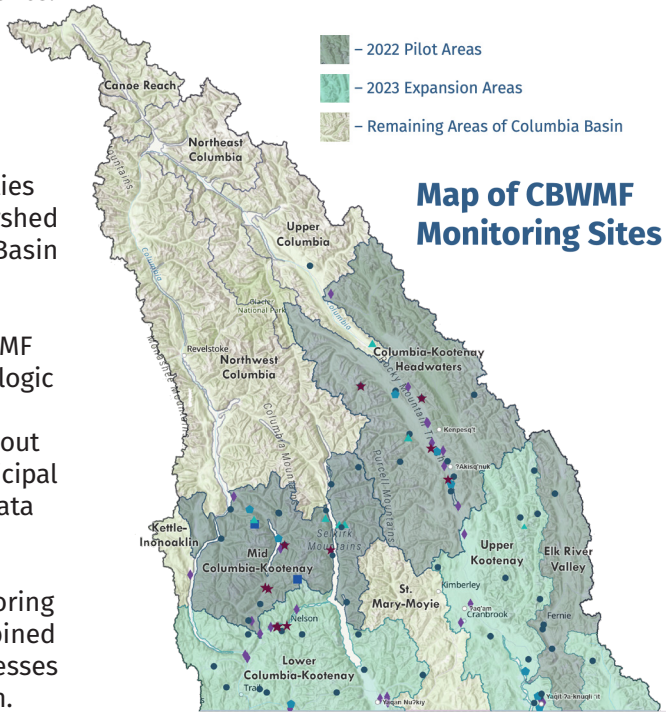
Living Lakes Canada acknowledges that this project is taking place in the unceded traditional territories of the Ktunaxa, Lheidli T'enneh, Secwepemc, Sinixt and Syilx Nations who have stewarded these lands for generations. Recognizing Indigenous People as the rightful caretakers of their unceded territories, we work to complement their intergenerational work and Indigenous-led water stewardship initiatives.

PROGRAM OVERVIEW

The Columbia Basin Water Monitoring Framework (CBWMF) is a coordinated monitoring network developed to track how climate change and other impacts are affecting water supply for communities and ecosystems. CBWMF data is available to inform adaptive watershed management and freshwater stewardship strategies for Columbia Basin communities.

Living Lakes Canada and partners are operating 123 monitoring CBWMF sites in small- to medium-sized watersheds across 4 of the 10 hydrologic regions in the Canadian Columbia Basin. This network is intended to complement the valuable monitoring and stewardship work carried out by local stewardship groups, First Nations, provincial agencies, municipal and regional governments, and the private sector to fill important data gaps across the region's complex landscapes.

Monitoring sites for the project are selected using a Priority Monitoring Matrix based on the results of a geospatial data gap analysis combined with community input. The result is a nested network, which addresses both scientific data gaps and local priorities for climate adaptation.



Map of CBWMF Monitoring Sites

AREAS OF INTEREST

In 2022, Living Lakes Canada piloted this approach in three areas of interest:

- Mid-Columbia Kootenay Hydrologic Region
- Columbia-Kootenay Headwaters Hydrologic Region
- Elk River Valley (in partnership with the Elk River Alliance) in the Upper Kootenay Hydrologic Region

In 2023, the Lower Columbia-Kootenay Hydrologic Region and remaining areas of the Upper Kootenay Hydrologic Region were added to the program (see map).

MONITORING IMPACT

The CBWMF network has led to an:

105% increase in tributary hydrometric monitoring

• BC Province/Water Survey of Canada sites	52
• CBWMF Hydrometric Network sites	55
• Combined Hydrometric monitoring sites	107

425% increase in combined groundwater monitoring

• BC Groundwater Observation Network wells	8
• CBWMF Groundwater Network wells	34
• Combined Groundwater monitoring wells	42

Case Study: Comparing Measured CBWMF Data with Two Modelling Tools

Current and locally-relevant hydrometric data is critical to inform an accurate understanding of local hydrology. Below, we provide an example of hydrological monitoring from two sites in the Columbia-Kootenay Headwaters pilot area. Observations are compared against available hydrologic regionalization tools, including the BC Water Tool and a process-developed hydrological model, to highlight the importance of local monitoring efforts in the Basin and beyond.

Results indicate that the hydrological model does a relatively good job representing the timing of streamflow, but may not fully and accurately capture flow magnitudes.

For instance, CBWMF flow data during the late summer of 2022 on Delphine Creek are consistent with the timing of modelled streamflow pulses, but the hydrological model underestimates volume. This is likely because glacier contributions are higher than simulated during this warm summer period. This suggests the model could be improved with these local observations. Similarly, Kindersley Creek shows the model under-represents streamflow for the summer in 2022.

The BC Water Tool was used at a monthly time step, and only the high and low estimates are shown in Figure 1. The results suggest the BC Water Tool does not represent local short-term streamflow conditions, which presents a challenge when using the tool to address water management questions.

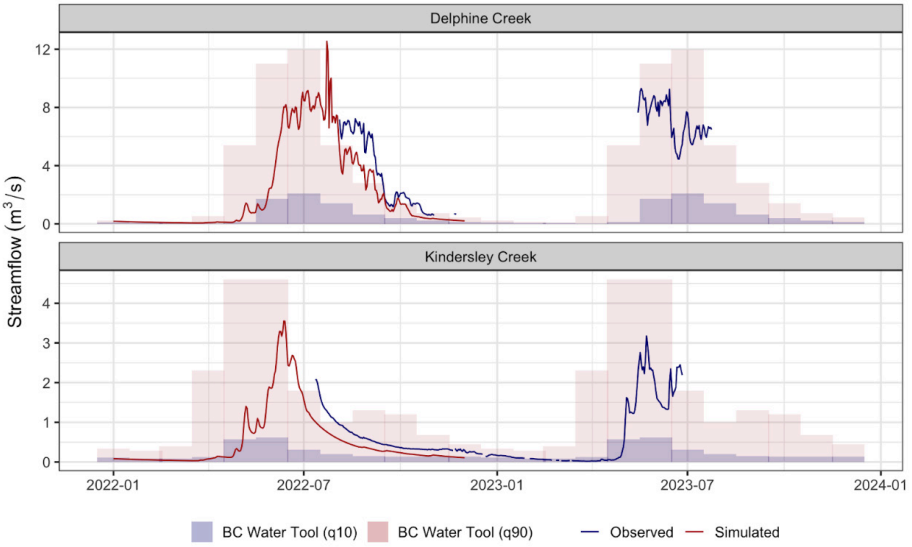


Figure 1. Comparisons between flows observed by CBWMF (blue line), simulated with hydrological model (red line), and simulated with BCWT 10th percentile (shaded blue) and BCWT 90th percentile (shaded red) streamflow values for Kindersley and Delphine creeks.

These comparisons highlight the need for continued monitoring efforts to calibrate hydrologic modelling tools and provide decision makers with better information about changing hydrologic conditions. A more extensive comparison of measured data to each of the modeling tools will be released later in 2024. *Acknowledgements to MacDonald Hydrology Consultants Ltd. for supporting this project.*

MODELLING METHODS

BC WATER TOOL — The BC Water Tool (BCWT) has been developed by the BC Ministry of Forests for the convenience of industry and the public. Monthly discharge estimates are generated from a hydrological model. The hydrological modelling study conducted in the Kootenay Boundary region employed a water balance approach to estimate runoff in ungauged basins. The model used 143 watersheds with hydrometric gauges, and included detailed information on watershed climate, evapotranspiration, topography, vegetation, and land cover. The model was calibrated using streamflow measurements from the Water Survey of Canada and validated using a leave-one-out cross validation. Predictions for small watersheds (generally smaller than 50 sq km) may be less accurate due to the lack of hydrometric data available for watersheds of this size.

HYDROLOGICAL MODEL — A process-developed hydrological model was applied to the Delphine Creek and Kindersley Creek watersheds to estimate streamflow timing and magnitude and to compare simulations with observations. The model has not been calibrated to data from these hydrometric sites and reflects calibration parameters derived from larger watersheds where long-term hydrometric monitoring is available; primarily in the Columbia River, Kicking Horse River, and Kootenay River. The semi-distributed hydrological model used in this study is an adapted version of the HBV-EC model, emulated within the Raven Hydrological Modelling Framework version 3.8 (Craig et al., 2023). The model simulates streamflow and other hydro-climatic variables (i.e. snowmelt, evaporation, etc.) at a daily time step. The model spatially distributes daily minimum and maximum air temperature, precipitation, and relative humidity from all weather stations across the study region. The model simulates major hydrological processes including canopy interception, snow accumulation and melt, evaporation, surface runoff, etc. A comprehensive discussion of model algorithms can be found in Bergström (1992), Jost et al. (2012), and Chernos et al. (2020).

Funders who have generously supported the CBWMF include:

RBC · British Columbia · StrongerBC for everyone · Watersheds BC · Real Estate Foundation of BC · Columbia Basin Trust

For a full list, visit livinglakescanada.ca/cbwmf.

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