

**Trail Creek and Cambridge Creek (AreaA)**  
**Water Level and Flow Monitoring 2023/24**

Report prepared for Director Linda Worley of Area B RDKB

By Bill Coedy, Rossland Streamkeepers

October 2024

This report summarizes the hydrology activities, water level logger data and flow measurements collected at the stations Trail Creek at French Street in Warfield and Cambridge Creek over the 2023 - 2024 season.

**Trail Creek Hydrologic Station**

(GPS coordinates 49.09685, -117.7357)

Located in lower Warfield at the French Street bridge.



## Cambridge Creek Hydrology Station

(GPS coordinates 49.0827, -117.7553)

Located at City of Trail Cambridge weir ~500m upstream from Trail Creek confluence.



### Preamble

The 2023/24 deliverables for this project were to continue with the long term development of a Hydrological Cycle or Hydrograph and Discharge Rating Curve for Trail Creek and Cambridge Creek within the Area B region of RDKB. This hydrological information is important to water managers and planners, especially for the RDKB, the Village of Warfield and the City of Trail as the data can be used in the prediction of creek carrying capacity in terms of water abundance to water users and ecosystem health. Extreme fluctuation of water flows can cause floods during times of snowmelt combined with spring rains or lead to limitations or restrictions of water use during drought conditions throughout the summer and fall.

The Hydrologic Cycle of the creeks for the 2023 -24 season was developed from the continuous measurement of water levels at each station. A Solinst level5vent water level logger was set at 30 min intervals to record levels at the Trail Creek at French Street bridge culvert in lower Warfield. A HOBO MX2001 water level logger records water level every hour at the old City of

Trail Cambridge Reservoir weir on Cambridge Creek. The Cambridge weir is about 500m upstream from the Trail Creek confluence.

At least six independent flow measurements were taken near the hydrology station to determine discharge using salt dilution QQ instrumentation and methods. Flow measurements were taken directly downstream from the Trail Creek station between Turner St bridge and Silver St bridge. For Cambridge, flow measurements were taken directly upstream from the weir structure. The Rating Curve for discharge was verified with previous year flow measurements and further developed. This report compares the previous year (2022/23) hydrographs and discharge data with the 2023/24 season.

### Why monitor water level and flow?

A Hydrograph is useful to compare seasonal water level cycles. It tells us about the peak flows through water level changes throughout the year. Our mountain streams can be flashy during major snow melt times in the Spring and during extreme precipitation events from thunderstorms. With the added complication of climate warming, this can manifest in either flooding, or extended periods of summer drought well into October. This report compares the hydrographs or seasonal water level cycles for the years 2022/23 with 2023/24.

A Rating Curve, developed by measuring discharge (cubic meters per second) at that particular water level, is useful as one can estimate the discharge easily from an observation of the water level indicated by a Staff Gauge or measuring stick at the hydrology station. The level of discharge, or rate of flow, can overwhelm culverted streams and cause flooding. This has occurred several times in the past in Trail Creek where overburden debris has dammed culvert entrances. This report comments on the 2023/24 measurements added to the 2022/23 Rating Curve.

### Supportive Funds

Grant funding for the hydrology work was provided by Area B Director Linda Worley of RDKB.

### Results

Hydrologic data for Trail Creek and Cambridge Creek is currently stored in the publically assessable Columbia Basin Water HUB database under the Rossland Streamkeepers organization. <https://data.cbwaterhub.ca/organization/rossland-streamkeepers> (see <https://data.cbwaterhub.ca/>). The HUB is managed by Living Lakes Canada.

### **Trail Creek (at French St.) Hydrology Results**

#### Monitoring Visits

The following table documents the work visits to the Trail Creek Hydrological Station in 2023/24. Over 12 visits were made throughout the seasonal year for station maintenance, logger data upload and 7 salt dilution flow measurements were made for discharge

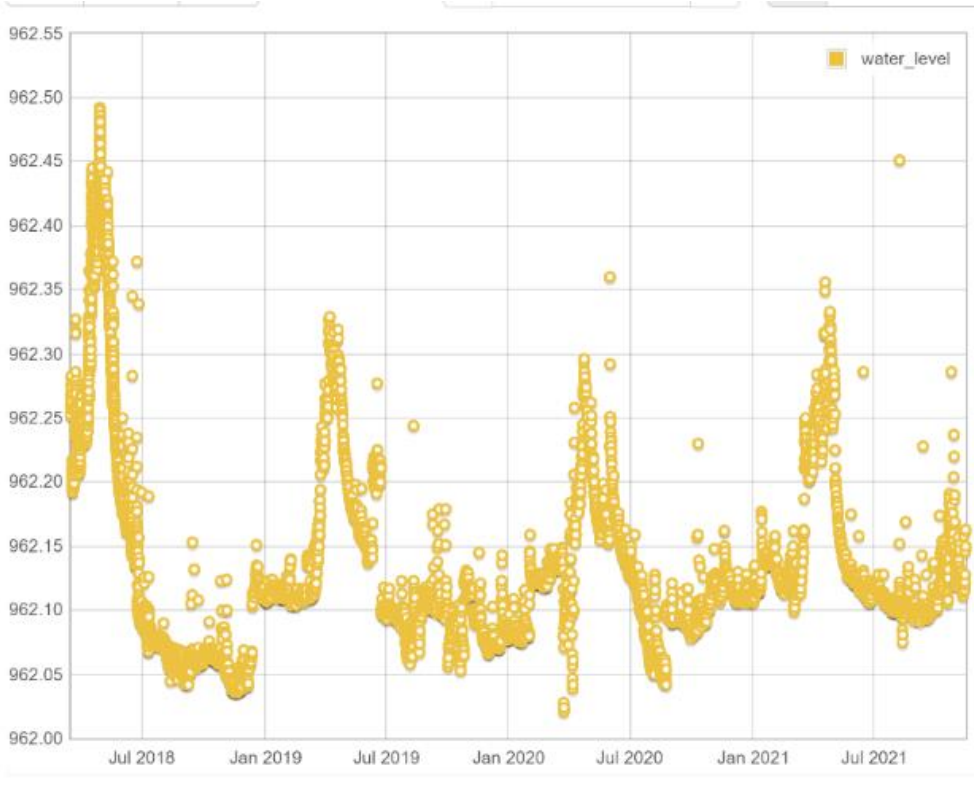
determinations. The Table indicates observed water level from the staff gauge and corresponding water level measurements from the logger and discharge data determined from flow measurements. The Table also contains temperature, pH and conductivity measurements obtained from a hand held Oakton probe. Conductivity in Trail Creek ranges from 157 to 327 uS/cm and is approximately 10 times higher than conductivity in the mountain stream Topping Creek.

Trail Creek at French St Water Level Logger						
location: 49.0827 Lat -117.7553 Long ; UTM 444862 E 5436920 N						
Solinst Level5 Vent SN2174515						
Solinst Installed 20 Sept 2023; intervals at 30min						
Date	Staff Gauge	WL logger	Q cms	Temp	pH	Cond
22-Sep-23	0.055	0.07				
28-Sep-23	0.095					
30-Oct-23	0.07	0.09	0.076	2.5	8.1	327
19-Dec-23	0.175	0.2		2.4		
23-Jan-24	0.22	0.23		0.5		
19-Mar-24	0.575	0.585		6.34		
09-Apr-24	0.5	0.504	0.92	6.73		163
15-Apr-24	0.475	0.474	0.749			158
16-Apr-24	0.475	0.46	1.01			162
30-Apr-24	0.38	0.391				
02-May-24	0.35	0.355	0.875			167
13-May-24	0.27	0.271	0.41	12		176
02-Jul-24	0.16	0.168	0.222	13		219
18-Aug-24	0.085	0.0996	0.0239	15.4	7.99	279

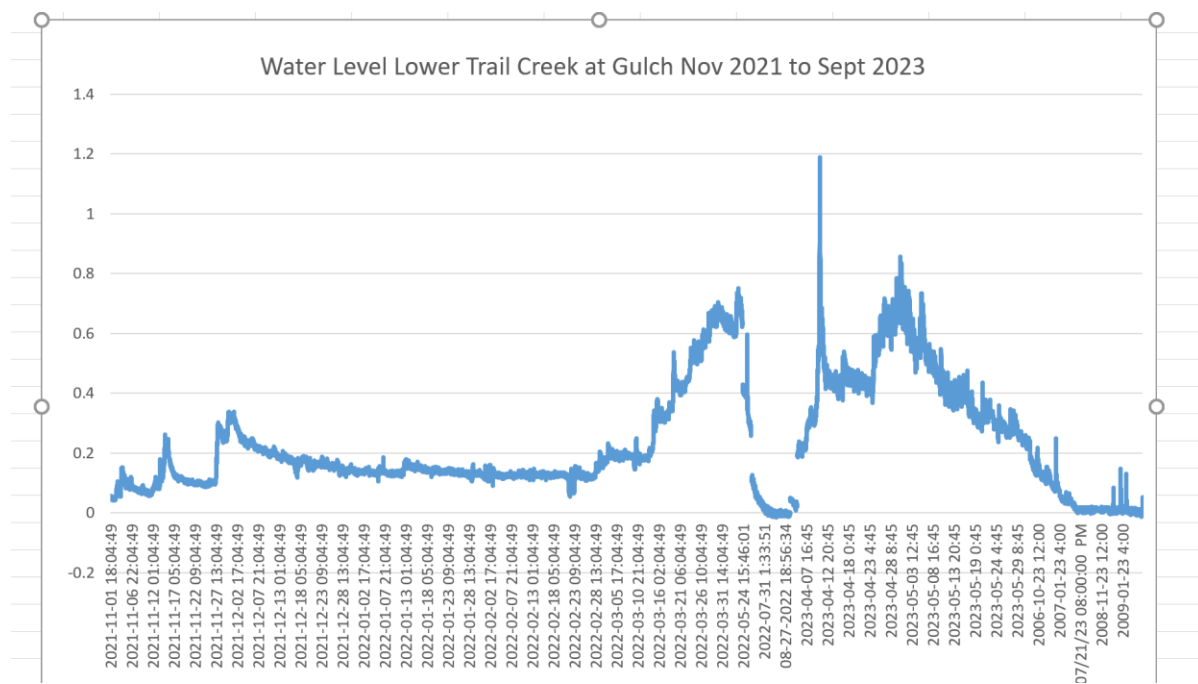
Hydrograph – Historic and Current

Water levels have been monitored by the Rossland Streamkeepers at different locations on Trail Creek since 2018. The following hydrograph illustrates the spring freshet peaks in upper Trail Creek at Rossland between 2018 and 2012. Peak freshet typically occurred mid April with highest levels recorded in 2018.



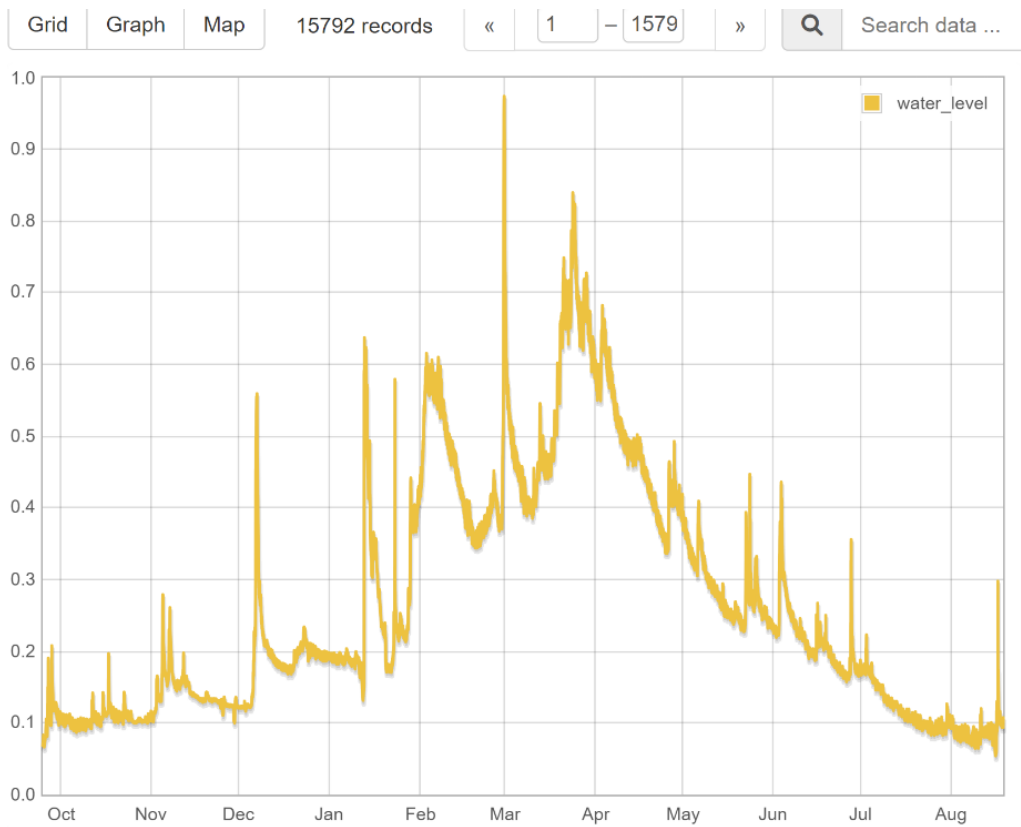


Because of excessive erosion in the creek at this upper location, the monitoring station was abandoned in 2021. In order to better capture all tributary inputs a station was established 8 km downstream at the Gulch flume entrance within the City of Trail. Unfortunately, logger malfunction at the Gulch site prevented the construction of a continuous annual hydrograph.



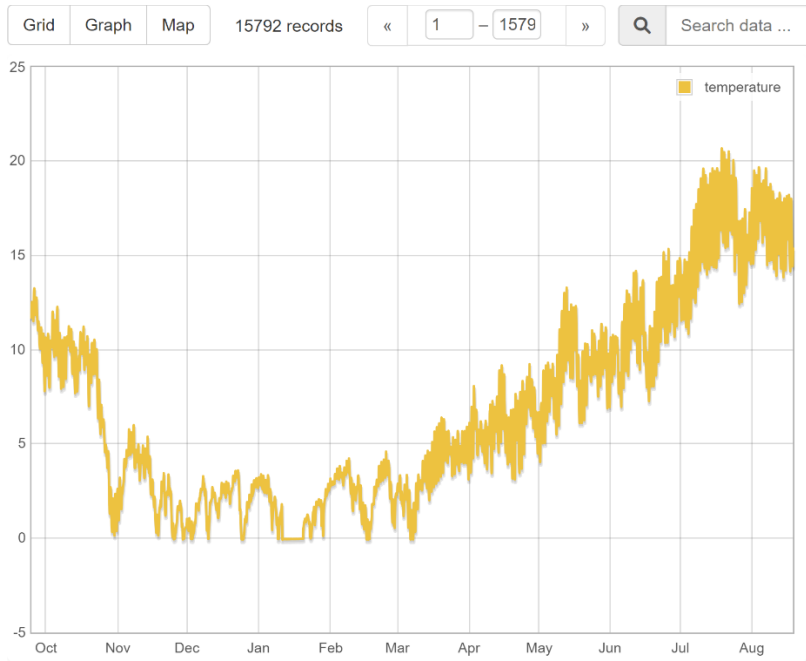
Data gaps occurred during peak freshet in April 2022 and weekly patches in May, July, August, and then January through to March 2023. The Onset MX2001 logger was replaced with a HOBO U20 logger just in time to capture the 2023 spring freshet. Logger readings were set to 30 min intervals. Peak water level for 2023 freshet was 1.2 m recorded on 11 April, which came close to the top of the flume, and a second peak of 0.84m on 30 April 2023. Water levels dropped to 0.01m below the datalogger sensor during fall and winter. This site did not allow for nearby seasonal flow measurements. Hence, the station was abandoned in Sept 2023 and moved ~400 m upstream to the French Street - Wellington bridge in Warfield.

A Solinst Levelvent5 logger was deployed at the new French Street location. This location had been used by Water Survey Canada (STN#08NE118) from 1975 to 1989. The hydrograph for 2023/2024 is illustrated below.



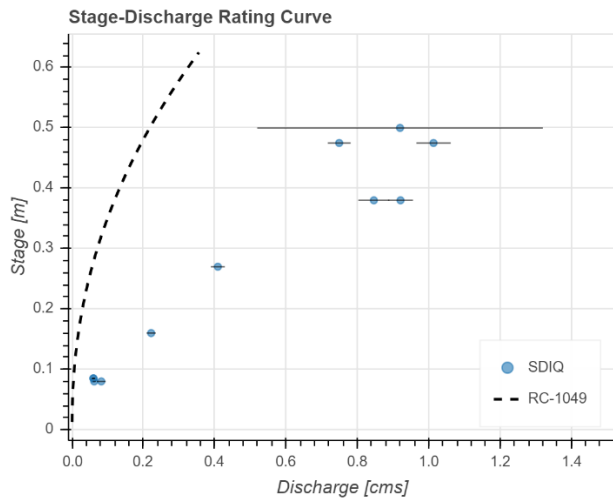
There are several “flashy” water level peaks which deserve mention. Heavy rainfall on Dec 6 & 7 caused flash creek swelling. Then in mid Jan there was a cold snap and the creek flooded due to ice jamming. This occurred again in early Feb. Extraordinary warm summer-like weather on the 1<sup>st</sup> of March caused another gush of snowmelt to new water level heights of almost 1 m. Spring freshet peaked at levels of 0.85 m on March 25 and steadily declined well into June.

Seasonal water temperature for Oct to August 2022/23 (see below graph) were typically between 0 and 3 C for winter months and a high of 20 C reached during low water and flow levels during the month of July.



### Stage - Rating Curve Trail Creek

Water flow measurements were taken ~ 200 m downstream between the bridges of Silver and Turner streets in Warfield to determine discharge. Measurements for 2023/24 were added to the Stage-Rating Curve created in 2022/23 to satisfy verification of the curve.



Discharge can be estimated from the curve by simply noting the water level from the Staff gauge on the weir. However, there was no discharge measurements made during peak freshet (above 0.5m on staff) so only an estimate can be made from the Rating Curve. From extrapolation on the curve, it is estimated that peak freshet reached a discharge of 1.5 cms. In contrast, the lowest discharge of <0.05 cms was observed at levels 0.08 m during August/September.

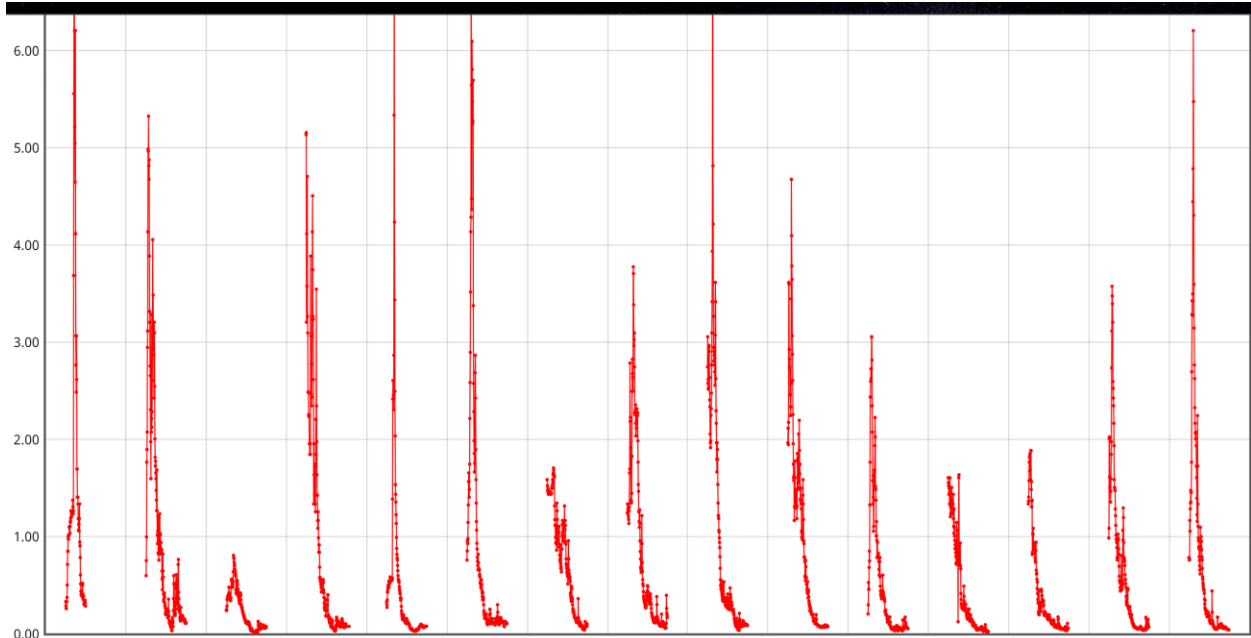
The Rating Curve requires annual verification. To ensure accuracy in using the curve, more flow measurements will need to be taken between a water level above 0.3 m in 2024/25.

### Historical Discharge Results 1975 - 1989

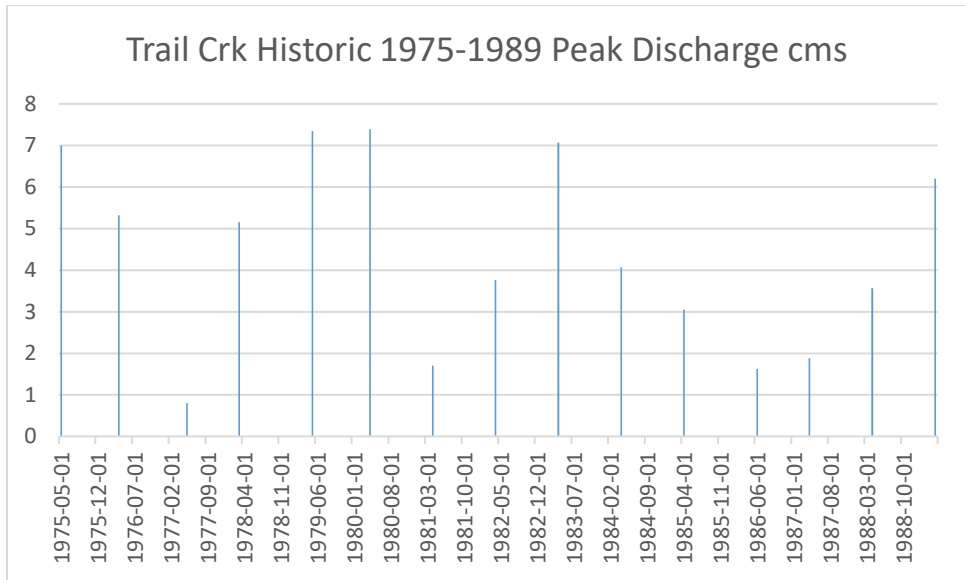
This location coincides with the discontinued Water Survey Canada Hydromet Station #08NE118 which monitored discharge from 1975-1989. Data discharge records are available from EC for the 15 year period.

Highest discharge (Q) recorded was 7.07 cms in 1983. This Q is about 3x higher compared to discharge in 2023-24. The lowest discharge was 0.014 cms in Sept 1986. Peak freshet generally occurred between early April to early May which appears to be more narrow of a timeframe compared to 2023-24.

Compiled peak Q from WSC for period 1975-1989.







**Cambridge Creek Hydrology Results**

**Monitoring Visits**

The following table documents the work visits to the Cambridge Creek Hydrology Station during the 2023/24 season. Seven visits (7) were made throughout the seasonal year for station maintenance, logger data upload and salt dilution flow measurements for discharge.

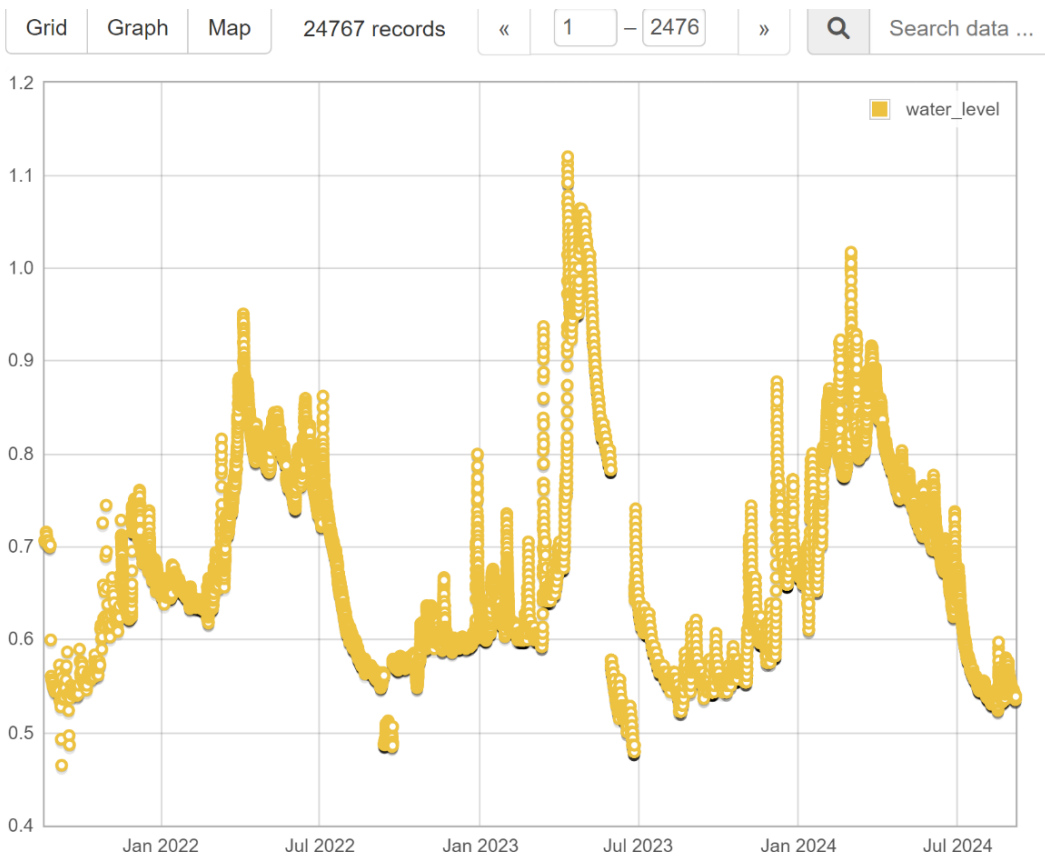
Cambridge Creek Water Level Logger						
location: 49.0827 Lat -117.7553 Long ; UTM 444862 E 5436920 N						
Installed August 16 2021; 12 hour intervals at 6am, 6pm						
Date	Staff Gauge	water Level (m)	Q discharge cms	Temp	pH	Cond uS/cm
11-Oct-22				6.7	8.23	134.7
14-Oct-22	0.578			6.48	8.23	134.7
10-Feb-23	0.6			0.35		
22-Sep-22	0.576	0.576	0.012			
30-May-23	0.75	0.75	0.138	14.4	8.22	123
03-Jun-23	0.72	0.72	0.092			
12-Jun-23	0.7	0.7	0.074			
26-Jun-23	0.665	0.665	0.048			129
21-Sep-23	0.555	0.555	0.057	8.99	8.29	156
30-Oct-23	0.57	0.57	0.013	0.2	8.15	159
16-Apr-24	0.8	0.8	0.267	5.46		101
27-Apr-24	0.8	0.8	0.279	8.1		103
13-May-24	0.755	0.755	0.149	11.5		109
05-Jul-24	0.64	0.64	0.054	12.7	8.07	129
05-Sep-24	0.54	0.537	0.0091	12.7	8.15	136

The Work Log Table indicates observed water level from the staff gauge and corresponding water level measurements from the logger and discharge data determined from flow measurements. The Table also contains temperature, pH and conductivity measurements obtained from a hand held Oakton probe. Compared to the conductivity in Trail Creek (range between 157 to 327 uS/cm) the conductivity of Cambridge is lower ranging between 101 and 136 uS/cm.

### Hydrograph 2022-24

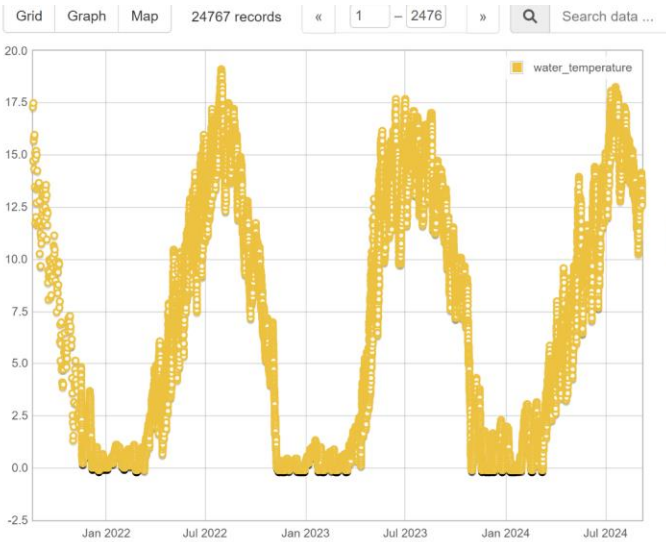
Water levels at the Cambridge Station have been monitored by the Rossland Streamkeepers since 2021. The following hydrograph illustrates the spring freshet peaks between 2022 and 2024. The Hydrologic Cycle of Cambridge Creek for the 2023 -24 season was developed from the continuous hourly measurement of water levels by a HOB0 MX2001 water level logger.

The Cambridge weir is about ~ 500m upstream from the Trail Creek confluence and ~ 1.5 km downstream from the restored Cambridge Reservoir. The dam decommissioning and wetland restoration project occurred in 2022. Unfortunately there is no historic hydrology data prior to the restoration project to make comparisons with post restoration.



Peak freshet typically occurs early April; highest levels were recorded in 2023. In 2022, high flows were sustained from early April through July. In 2023, peak flows occurred between 11 April and mid May. In 2024, peak flows began early 29<sup>th</sup> of February until mid April.

The following graph illustrates the water temperature at the station over the past 3 seasons.

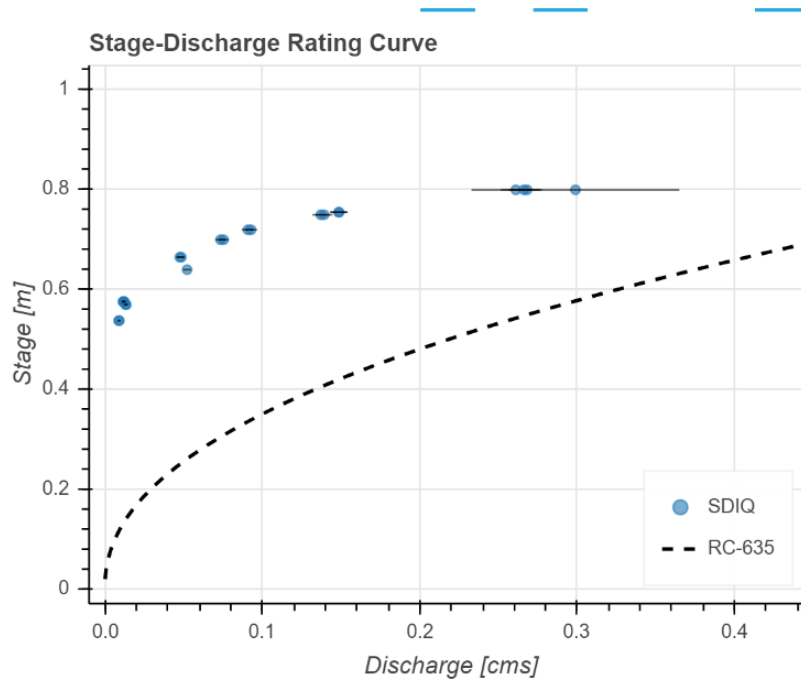


While water temperatures during winter months hover near 0 C, temperatures as high as 18 C are observed during shallow, lower flow conditions mid summer. Temperatures above 15 C are sustained from May through August. Bull Trout were seen upstream from the weir in September 2024.



## Stage - Rating Curve Cambridge Creek

Water flow measurements, using QQ salt dilution technique, were taken ~ 50 m upstream from the station to determine discharge. Measurements for the 2023/24 season were added to the Stage-Rating Curve created in 2022/23 to satisfy verification of the rating curve.



Since water level measurements of over 1m were recorded during peak freshet, it would be advantageous to obtain more flow measurements at high levels to complete the rating curve accuracy. Extrapolation of the curve indicates that discharge could be as high as 0.5 cms at water levels near 1m.

### **Workplan for 2024/25 Hydrology Monitoring**

1. Maintain the hydrometric station by changing logger batteries every 2 months and removing debris or rocks at the well and staff gauge.
2. Submit grant funding to purchase and replace the HOBO logger at the Cambridge Station with a Solinst logger.
3. Record water level on the staff gauge and off-load logger data; upload data to Living Lakes Canada water HUB database.
4. Perform water flow measurements using salt dilution QQ methods especially in the gap regions of the Rating Curve. Verify the Rating Curve.
5. Perform a station record survey to verify station well security. Inquire with land surveyors if there is a BM nearby to determine absolute water elevation.