Harrop-Procter Watershed Protection Society

Harrop, Slater, Procter and Narrows Creeks 2024 Streamflow & Water Quality Monitoring Results

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Know Your Drainage

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Contents

Acronyms 2
Executive Summary 2
Background 3
Study Objectives and Scope 3
Results and Discussion 4
Streamflow Timing and Magnitude 4
Turbidity 7
Turbidity Results 7
Coliforms 9
Coliform Results 10
Specific Conductivity 13
Specific Conductivity Results 13
pH 16
pH Results 16
Station Performance 19
Solinst Levelogger 5 Diurnal Fluctuations 19
Ice and Leaf Litter Blockages at Slater Creek 20
Harrop MX2001 Failures and Resulting Data Gaps 21
Disclaimer 22
References 22

Acronyms

- CFU……..Colony Forming Units
- FEC……Filtration Exemption Criteria
- GCDWQ……Guidelines for Canadian Drinking Water Quality
- HPCC…… ….Harrop-Procter Community Cooperative
- HPWPS……Harrop-Procter Watershed Protection Society
- KEI……Kootenay-Columbia Environmental Innovations Ltd.
- MX2001……A model of sensor which measures water level
- NTU……..Nephelometric Turbidity Unit
- QHR……Qualified Hydrometric Reviewer
- RISC……..Resources Information Standards Committee
- SG……Staff Gauge
- SWTO…… Surface Water Treatment Objectives

Executive Summary

The Harrop-Procter Watershed Protection Society continued monitoring streamflow and water quality in Harrop, Slater, Narrows, and Procter Creeks through 2024 to support community watershed protection and inform forest management. Streamflows were significantly lower than in 2022–2023 and similar to 2021, resulting in fewer concerns related to flooding, sediment movement, or turbidity events. Turbidity values exceeded 1 NTU at all creeks at times, which is typical during freshet, though such occurrences were fewer than last year and rarely exceeded 2 NTU.

Coliform sampling showed no E. coli results above 20 CFU/100 mL, but low-level coliforms were consistently present. Notably, Harrop, Narrows, and Procter Creeks exhibited unusually elevated fecal coliform levels in both spring and fall, which is an unprecedented trend since KEI became involved in 2021. The cause is unknown and merits further investigation.

Specific conductivity and pH data generally remained within expected ranges, but late-season increases at all sites suggest issues with the meters rather than watershed changes. Quarterly lab verification is recommended.

Hydrometric stations performed well overall, though Slater Creek experienced ice and leaf litter blockages requiring substantial data correction, and equipment failures at Harrop led to data gaps and disrupted barometric compensation for all sites. Replacement sensors provided by Living Lakes Canada have since stabilized data collection. Solinst Levelogger 5 sensors also introduce significant diurnal fluctuation into the water level data, though these sensors have been replaced with sensors loaned to the project from KEI.

Overall, 2024 produced reliable hydrologic information and highlighted key water quality concerns, especially the rise in fecal coliforms. Improving equipment reliability, validating water quality instrumentation, and expanding low-flow discharge measurements will strengthen future monitoring and support long-term watershed stewardship.

Background

Kootenay-Columbia Environmental Innovations Ltd. (KEI) was retained by the Harrop-Procter Watershed Protection Society (HPWPS) to conduct streamflow (i.e., discharge) monitoring at Harrop Creek, Slater Creek, Narrows Creek and Procter Creek starting in the spring of 2020, and report on water quality metrics sampled by HPWPS's board members. Water quality samples were analyzed using desktop water quality instruments owned by HPWPS or by Passmore Laboratories.

The HPWPS is a sister organization of Harrop-Procter Community Cooperative (HPCC), which manages forests within the monitored watersheds and runs a sawmill utilizing the harvested timber. HPCC's mandate is to "practice socially and environmentally progressive forestry that protects local watersheds while creating sustainable jobs in our community." The HPWPS's mandate is to ensure "that the Community Forest's day-to-day operations are undertaken with water protection and other ecological values in mind." HPWPS provides oversight and input into community forest management. It also undertakes education, outreach and research.

Harrop and Narrows Creeks have been monitored for their water quality and discharge since 2002, while Procter and Slater Creeks began being monitored in the spring of 2021. The monitoring aligns with the HPWPS and HPCC's mandates and is intended to ensure that both organizations have the information they need to fulfill their mandates.

As of 2023, Living Lakes Canada (LLC), a water stewardship non-governmental organization, has offered additional assistance to ensure that the data collected at Harrop and Procter Creeks is of the best quality possible. To do this, Living Lakes Canada has offered to compensate KEI for any additional site visits and flow measurements over the contract between KEI and HPWPS to collect the best possible data at those two sites. In return, the data from those sites is made available through the Columbia Basin Water Hub, a free database created and managed by LLC.

Study Objectives and Scope

Based on KEI's roles and responsibilities, its objectives were to collect, analyze, and report on discharge data in line with the BC Hydrometric Resources Information Standards Committee (RISC) standards. The discharge data is presented in this report and is provided alongside a comprehensive spreadsheet containing each calculation used to calculate the discharge data.

KEI also presents the water quality data for the four creeks in the scope, including:

- specific conductivity,
- pH,
- turbidity,
- verified E. coli,
- fecal (thermotolerant) coliforms, and
- total coliforms.

Results and Discussion

The following sections will display the streamflow and water quality results of the 2024 monitoring season. The importance and purpose of each monitoring metric are outlined, and all trends observed in the data are discussed.

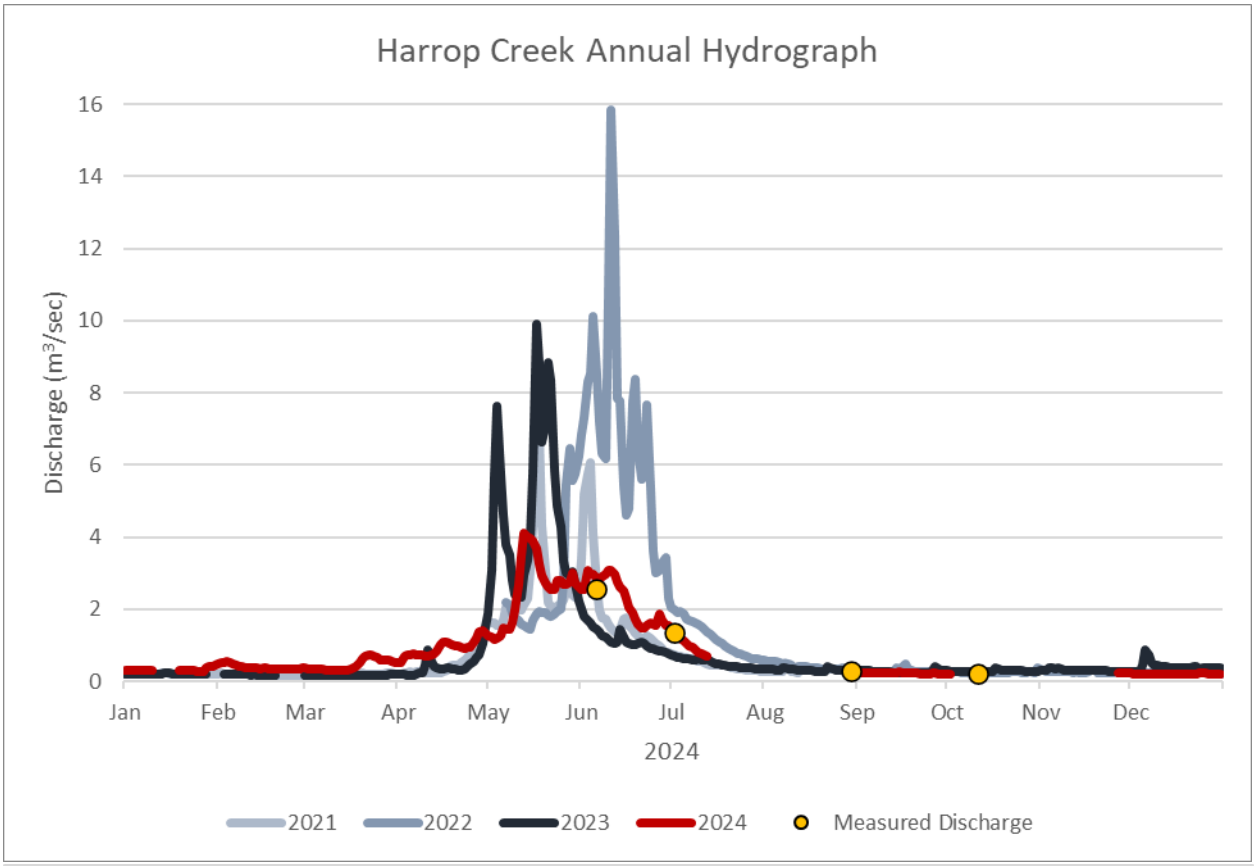
Since many of the residents of Harrop and Procter villages rely on surface water for their consumption, all aspects of the water quality will be discussed compared to the Drinking Water Treatment Objectives for Surface Water in BC (SWTO). The SWTO includes standards for untreated source water and treated water. The SWTO is limited to monitoring microbiological parameters such as bacteria (coliforms), protozoa and viruses in addition to turbidity. When comparison is needed outside the SWTO's scope, the Guidelines for Canadian Drinking Water Quality (GCDWQ) will be referenced.

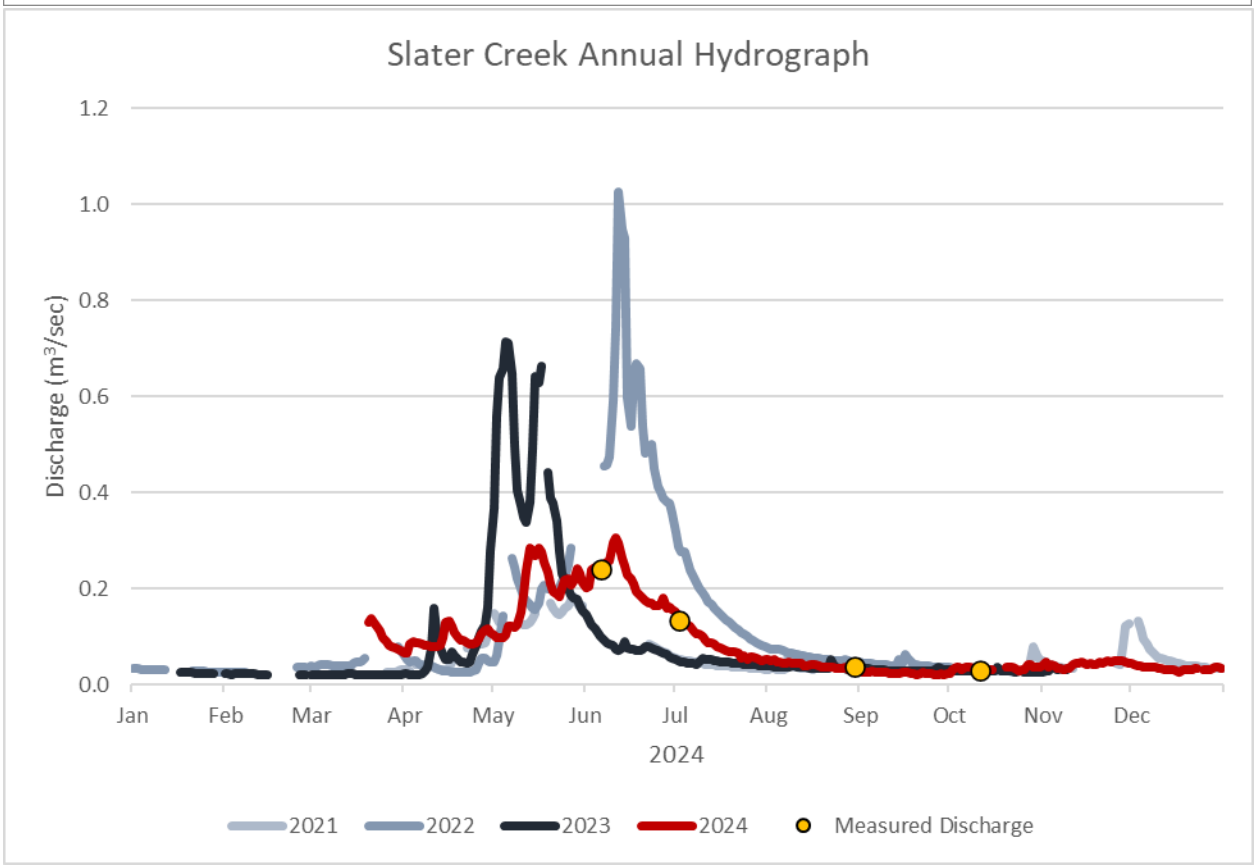
Referencing the water quality samples collected by the HPWPS board members and analyzed either by themselves or by an accredited lab is in no way meant to be used to make decisions on the potability of drinking water. To determine the potability of drinking water, the first step is to consult with Interior Health and follow their source-specific requirements for determining water potability. This analysis aims to observe general water quality and quantity trends over the long term only.

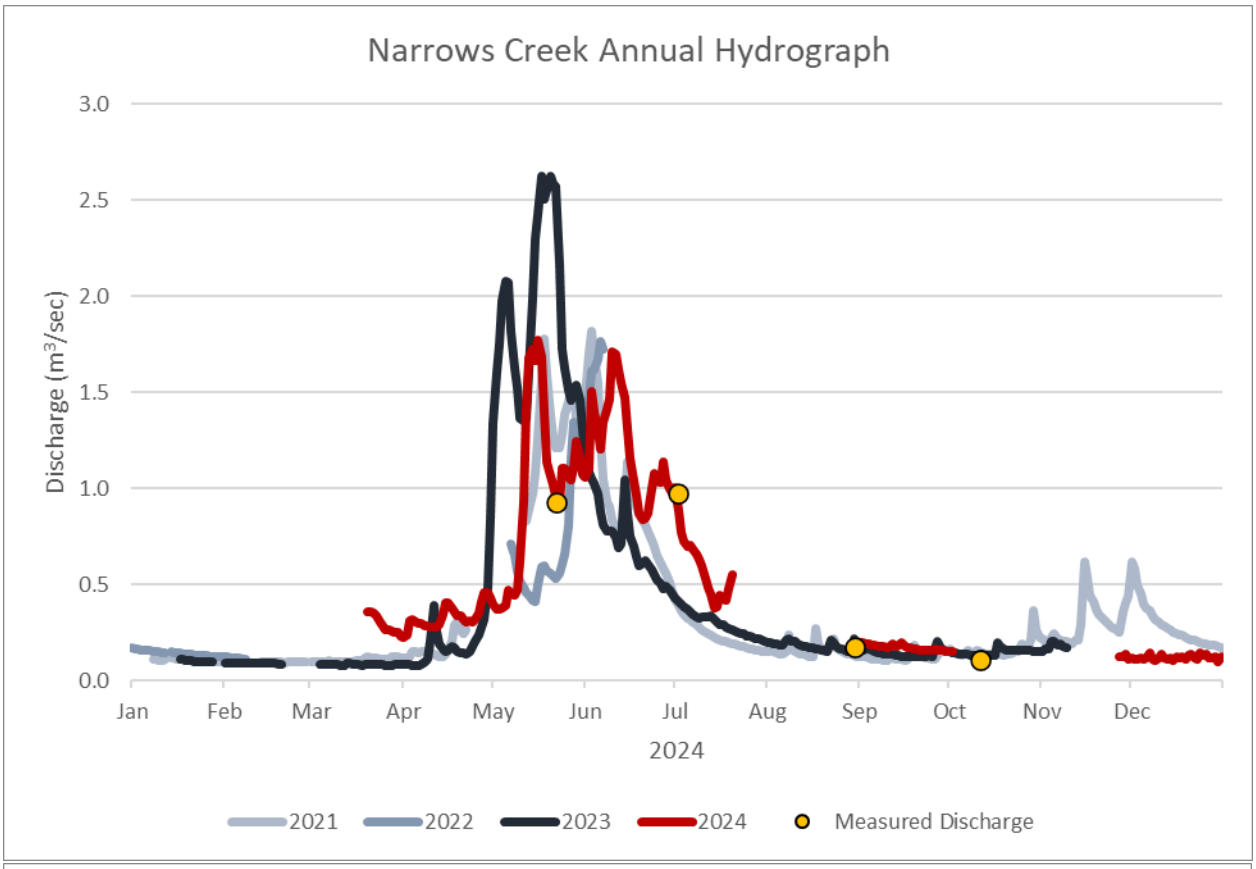
Streamflow Timing and Magnitude

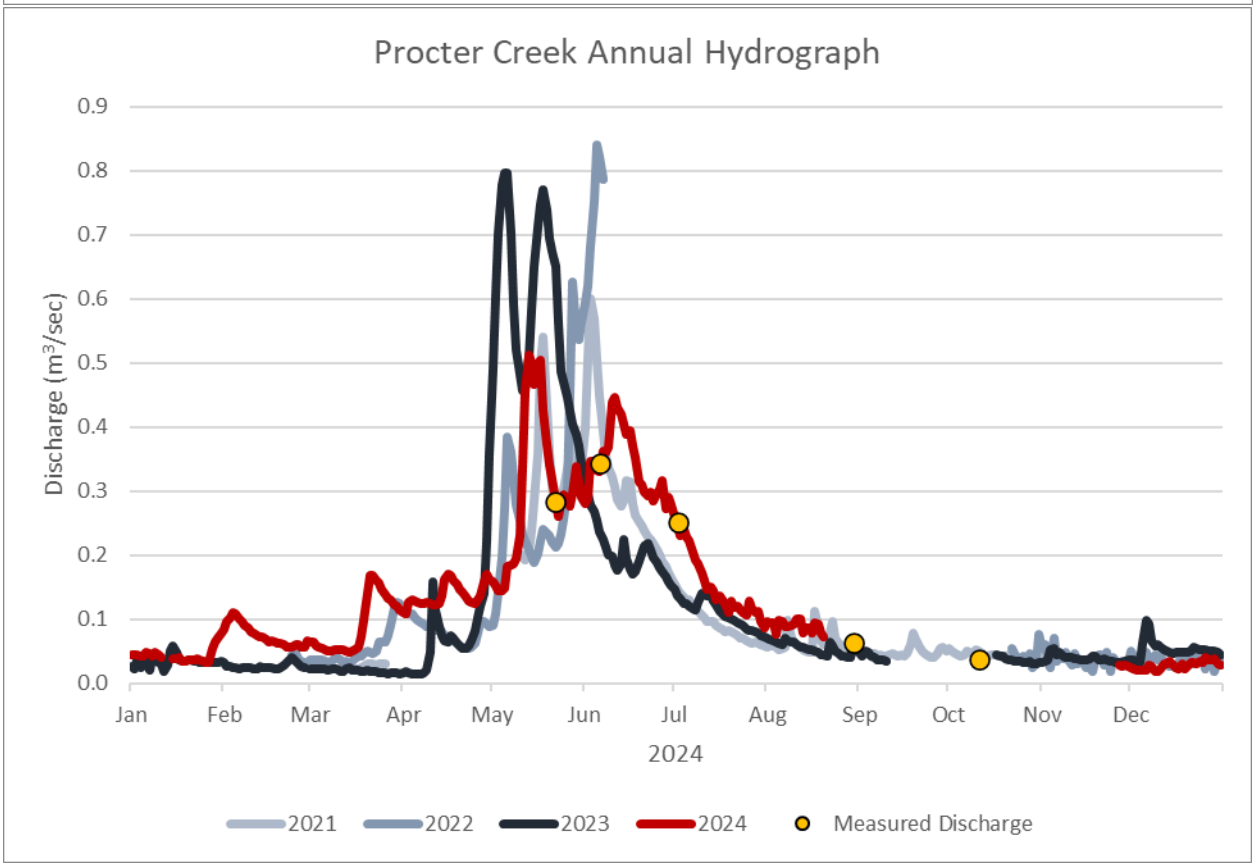
As seen in the hydrograph for each creek on the following pages, 2024 had significantly lower flows than in 2023 and 2022, though was comparable to 2021. This led to little concern due to flooding, damage to infrastructure, changes in bedload or turbidity events.

It is difficult to comment on low flows as the number of low flow measurements at the four sites does not allow for a precise calculation of the continuous low flow data. To be able to do an analysis on low flows, approximately 4 low flow measurements would need to be conducted each year, which would lead to a significant increase in the project budget.


Harrop Creek Annual Hydrograph
Discharge (m3/sec)
16
14
12
10
8
6
4
2
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2024
2021
2022
2023
2024
Measured Discharge


Slater Creek Annual Hydrograph
Discharge (m3/sec)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2024
2021
2022
2023
2024
Measured Discharge


Narrows Creek Annual Hydrograph
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Discharge (m3/sec)
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2024
2021
2022
2023
2024
Measured Discharge


Procter Creek Annual Hydrograph
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Discharge (m3/sec)
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2024
2021
2022
2023
2024
Measured Discharge

Turbidity

Turbidity is a commonly monitored water quality parameter as it indicates potential pathogens in the water, provides a surface area upon which bacteria can grow, and negatively impacts water treatment by decreasing the effectiveness of UV and chlorine disinfection and prematurely clogging filters (B.C. Ministry of Forests and Range, 2010) (BC Ministry of Health, 2012). Additionally, turbidity is cost-effective to monitor. Because of the value of turbidity data and ease of monitoring, the dataset collected by HPWPS's board members for the 2024 monitoring periods is of excellent value for analyzing water quality in all four creeks.

The SWTO sets the requirements for the treatment of surface water, including turbidity. While the villages of Harrop and Procter do not treat their water, the standards can be useful for comparison to the current untreated source water but cannot be extrapolated to determine potability. The SWTO notes that for treated water, turbidity "is generally acceptable [in source water] when less than 1 NTU [nephelometric turbidity unit]"(BC Ministry of Health, 2012). Turbidity becomes visible when greater than 5 NTU.

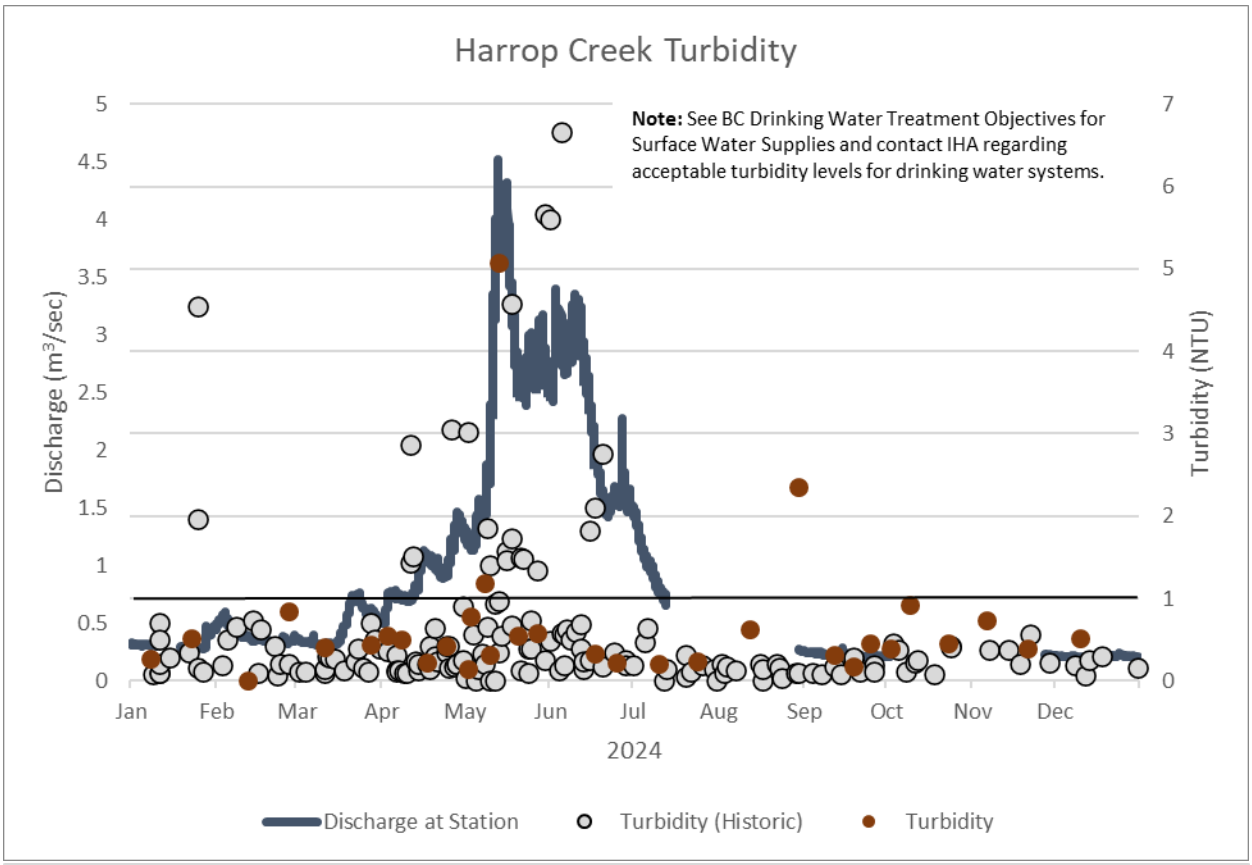
Turbidity Results

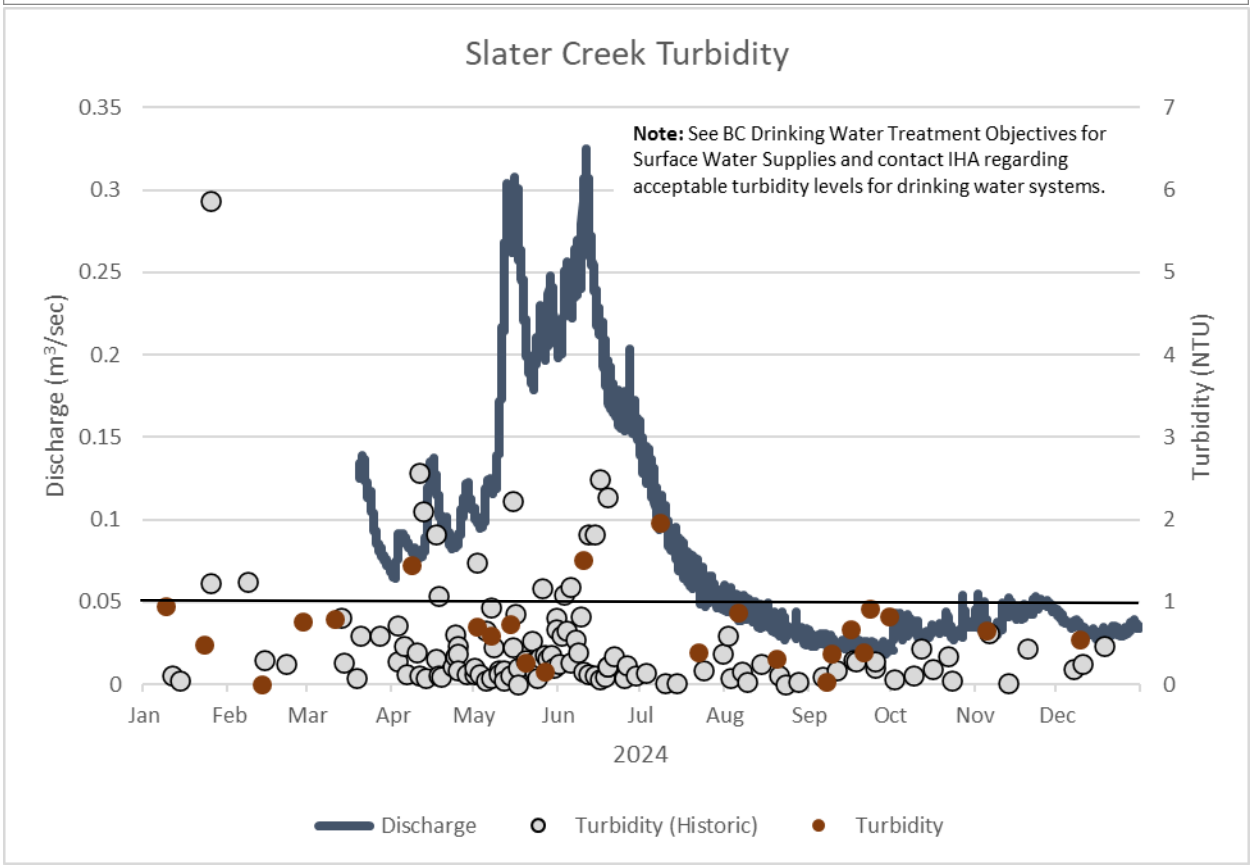
Reviewing the data in the graphs below shows that all four creeks have reported turbidity values above 1 NTU, though this is normal for all major creeks in the West Kootenays during times of high flows. It is somewhat difficult to compare each creek as turbidity samples were not necessarily collected on the same date or time. However, we can observe the number of turbidity samples above 1 NTU.

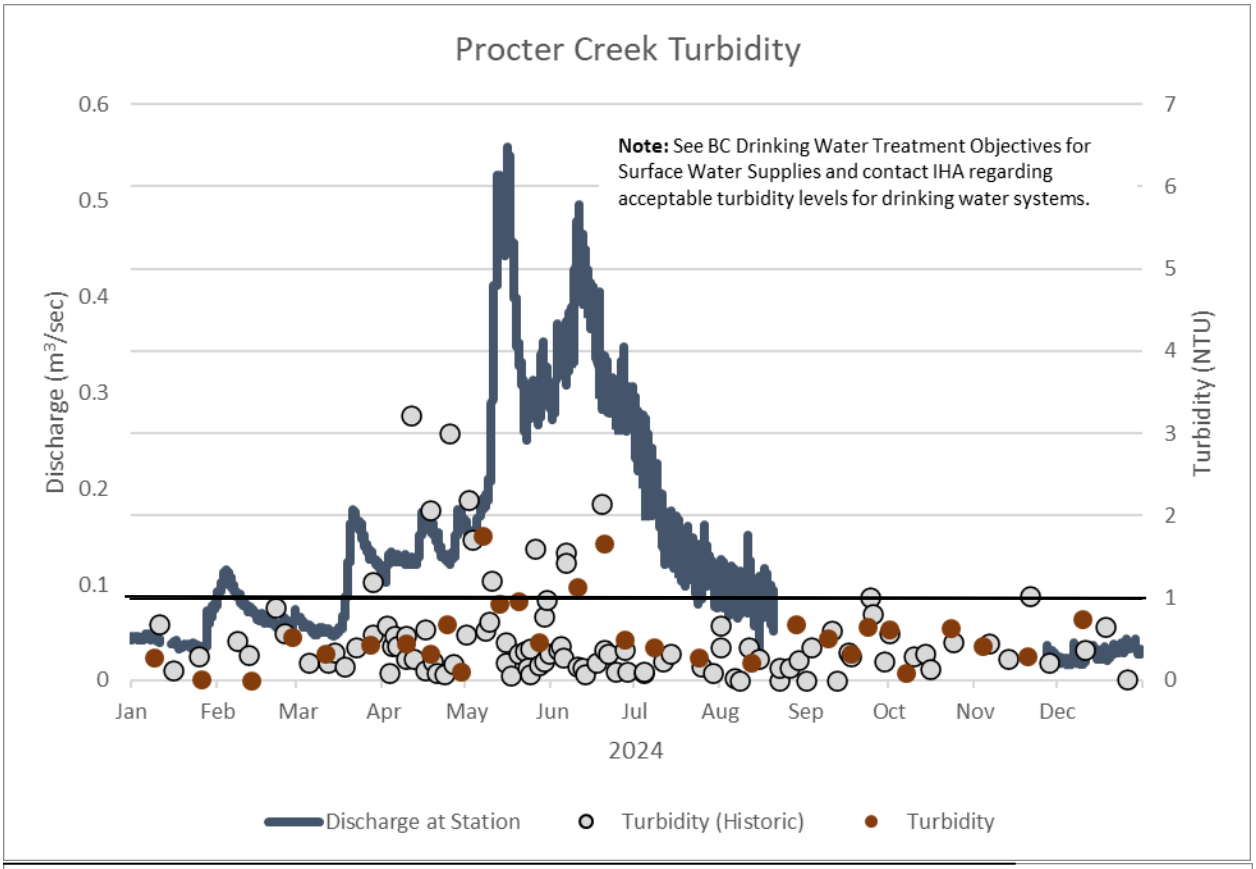
Turbidity Results Greater than 1NTU:

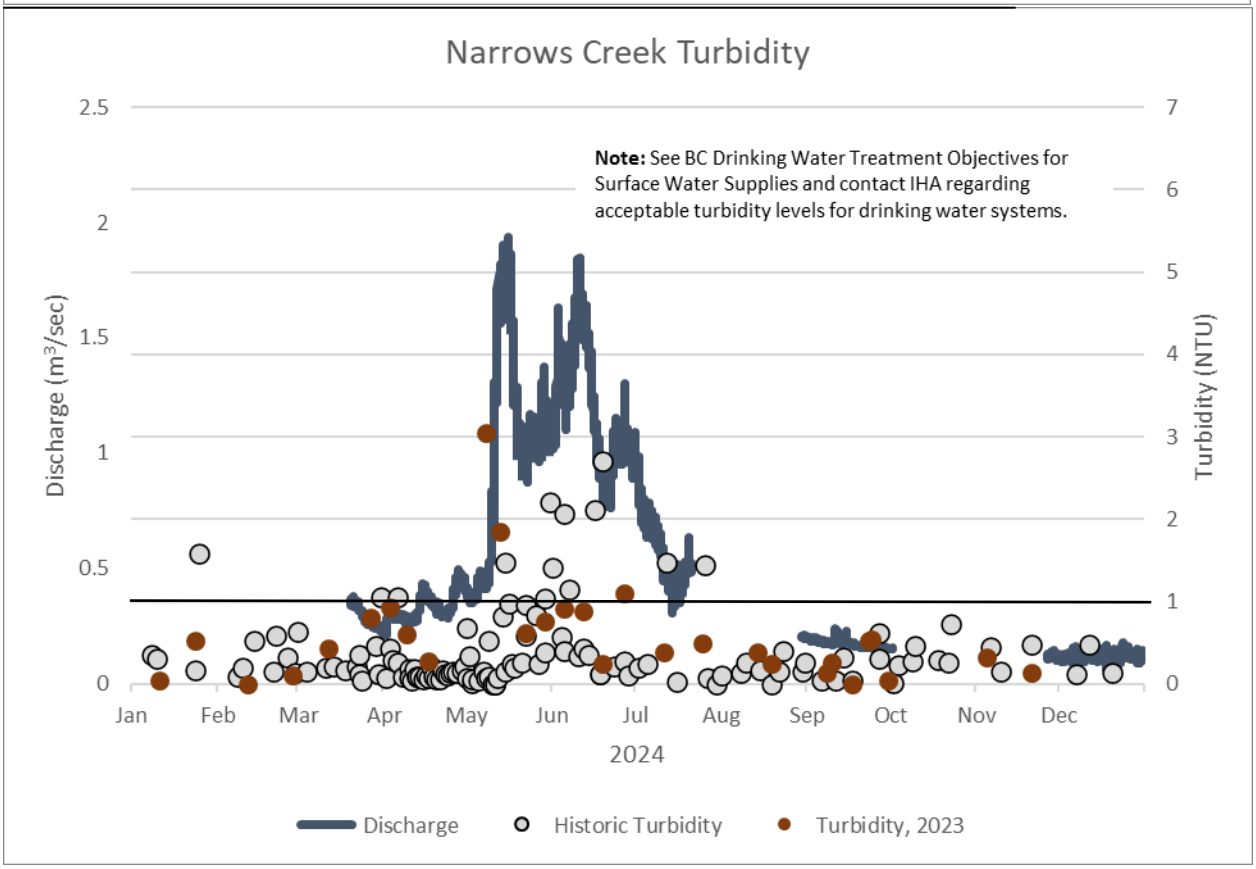
- Harrop Creek: 3
- Slater Creek: 3
- Narrows Creek: 3
- Procter Creek: 3

When observing the points above 1 NTU, we can see that only one result at Harrop Creek came back above 5 NTU, with most of the high turbidity results coming in below 2 NTU. The turbidity results showed many fewer results higher than 1 NTU than in the previous year (2023). This is likely due to in part the magnitude of the 2024 freshet being much lower than in other years.


Harrop Creek Turbidity
Note: See BC Drinking Water Treatment Objectives for Surface Water Supplies and contact IHA regarding acceptable turbidity levels for drinking water systems.
Discharge (m3/sec)
Turbidity (NTU)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
0
1
2
3
4
5
6
7
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2024
Discharge at Station
Turbidity (Historic)
Turbidity


Slater Creek Turbidity
Note: See BC Drinking Water Treatment Objectives for Surface Water Supplies and contact IHA regarding acceptable turbidity levels for drinking water systems.
Discharge (m3/sec)
Turbidity (NTU)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0
1
2
3
4
5
6
7
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2024
Discharge
Turbidity (Historic)
Turbidity


Procter Creek Turbidity
Note: See BC Drinking Water Treatment Objectives for Surface Water Supplies and contact IHA regarding acceptable turbidity levels for drinking water systems.
Discharge (m3/sec)
Turbidity (NTU)
0.6
0.5
0.4
0.3
0.2
0.1
0
7
6
5
4
3
2
1
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2024
Discharge at Station
Turbidity (Historic)
Turbidity


Narrows Creek Turbidity
Note: See BC Drinking Water Treatment Objectives for Surface Water Supplies and contact IHA regarding acceptable turbidity levels for drinking water systems.
Discharge (m3/sec)
Turbidity (NTU)
2.5
2
1.5
1
0.5
0
7
6
5
4
3
2
1
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2024
Discharge
Historic Turbidity
Turbidity, 2023

Coliforms

Coliforms may be the most critical water quality parameter commonly monitored as certain coliforms, such as E. coli, are known to be detrimental to human health. Unfortunately, compared to physical and chemical water quality parameters such as pH or turbidity, coliforms must be analyzed in an accredited laboratory, have moderately high analysis costs, and must be analyzed within a short period after sampling.

For treated water, the Surface Water Treatment Objectives (SWTO) limits E. coli, fecal coliforms and total coliforms to zero detectable colony-forming units per 100mL (CFU/100mL). The only guidance it gives on the presence of E. coli in untreated water is in the criteria for filtration exception (FEC). Water providers must meet this criterion, among others specified specifically by Interior Health, to be exempted from the requirement for filtration treatment. The limits state that "[t]he number of E. coli in raw water does not exceed 20 CFU/100 mL (or if E. coli data are not available less than 100 CFU/100 mL of total coliform) in at least 90% of the weekly samples from the previous six months."

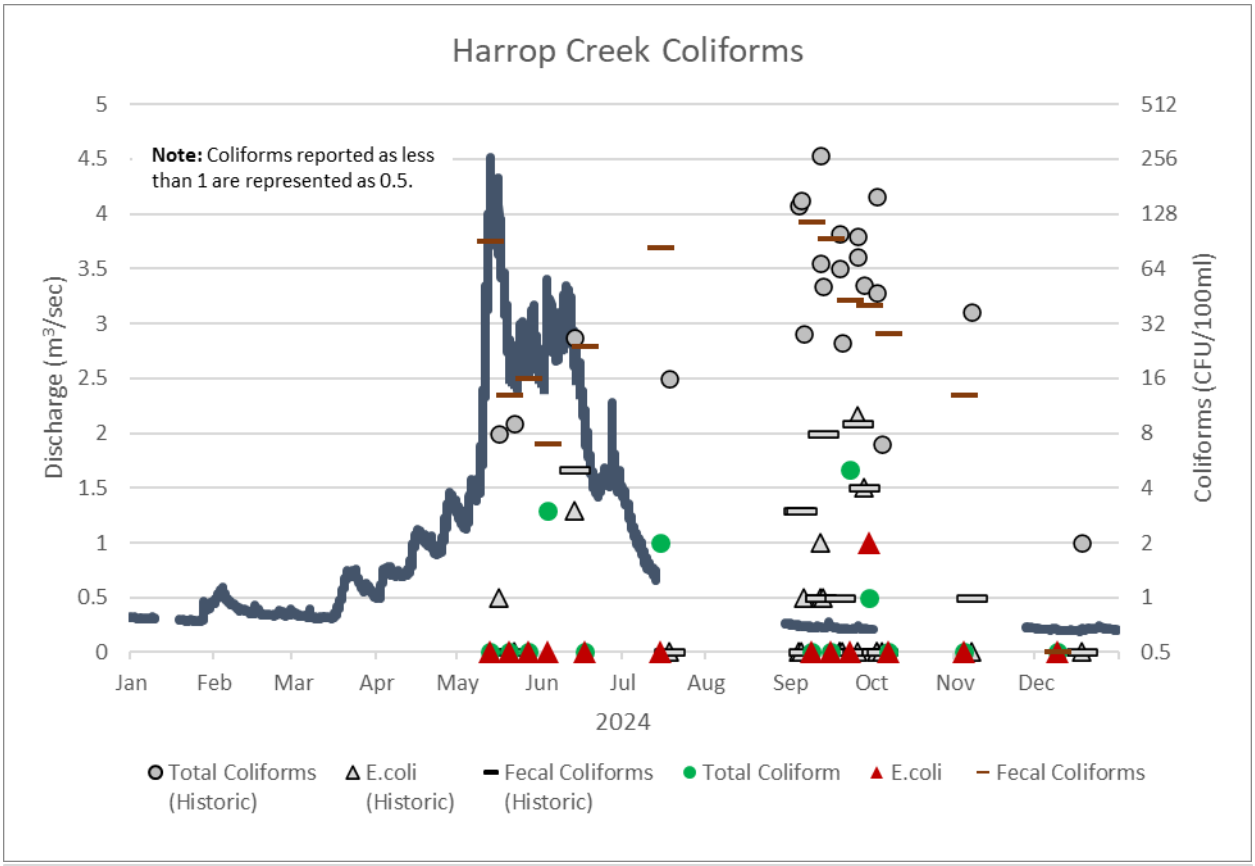
Coliform Results

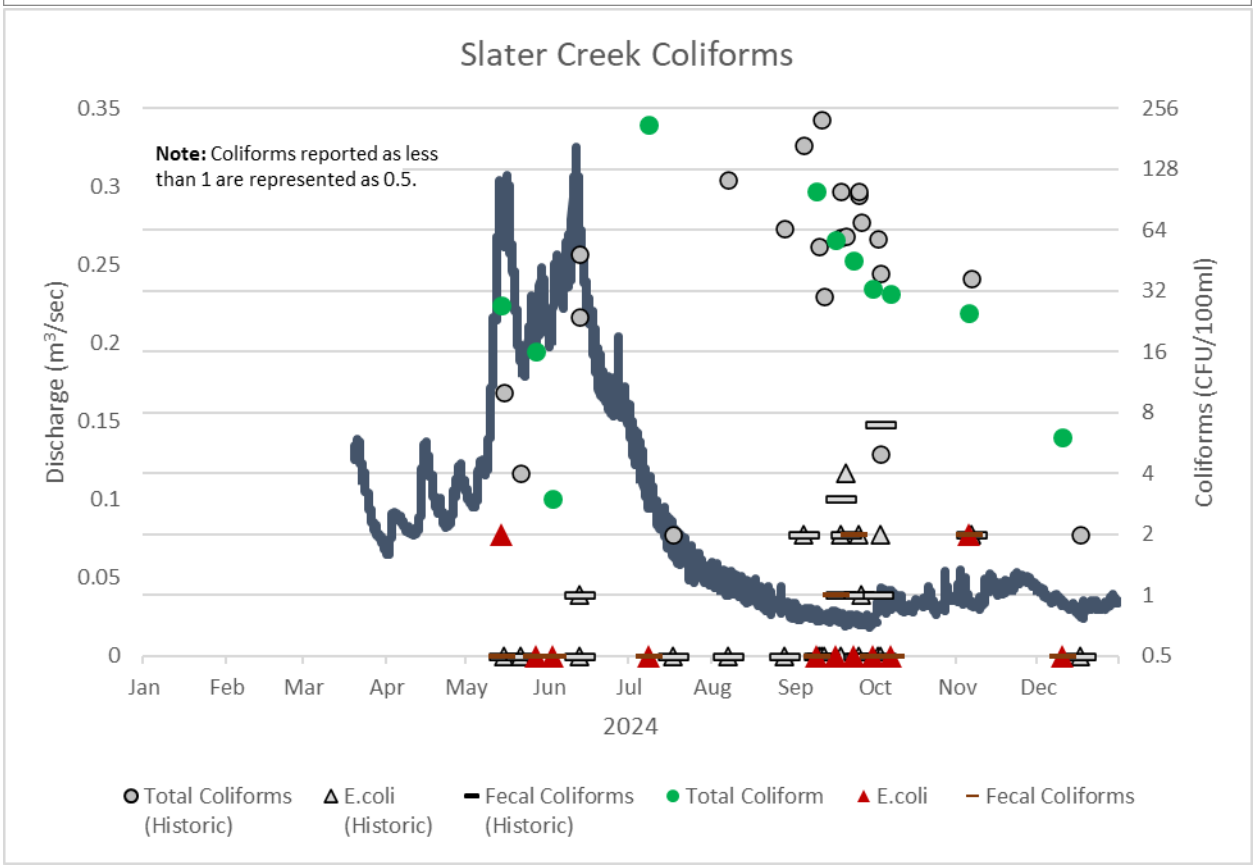
As the villages of Harrop and Procter do not provide water treatment nor weekly testing, the FEC requirements can only be used to provide context for the results and are not an indicator of potability. The 2024 HPWPS monitoring program only collected five coliform samples over 30 days each fall, supplemented by monthly samples throughout the summer.

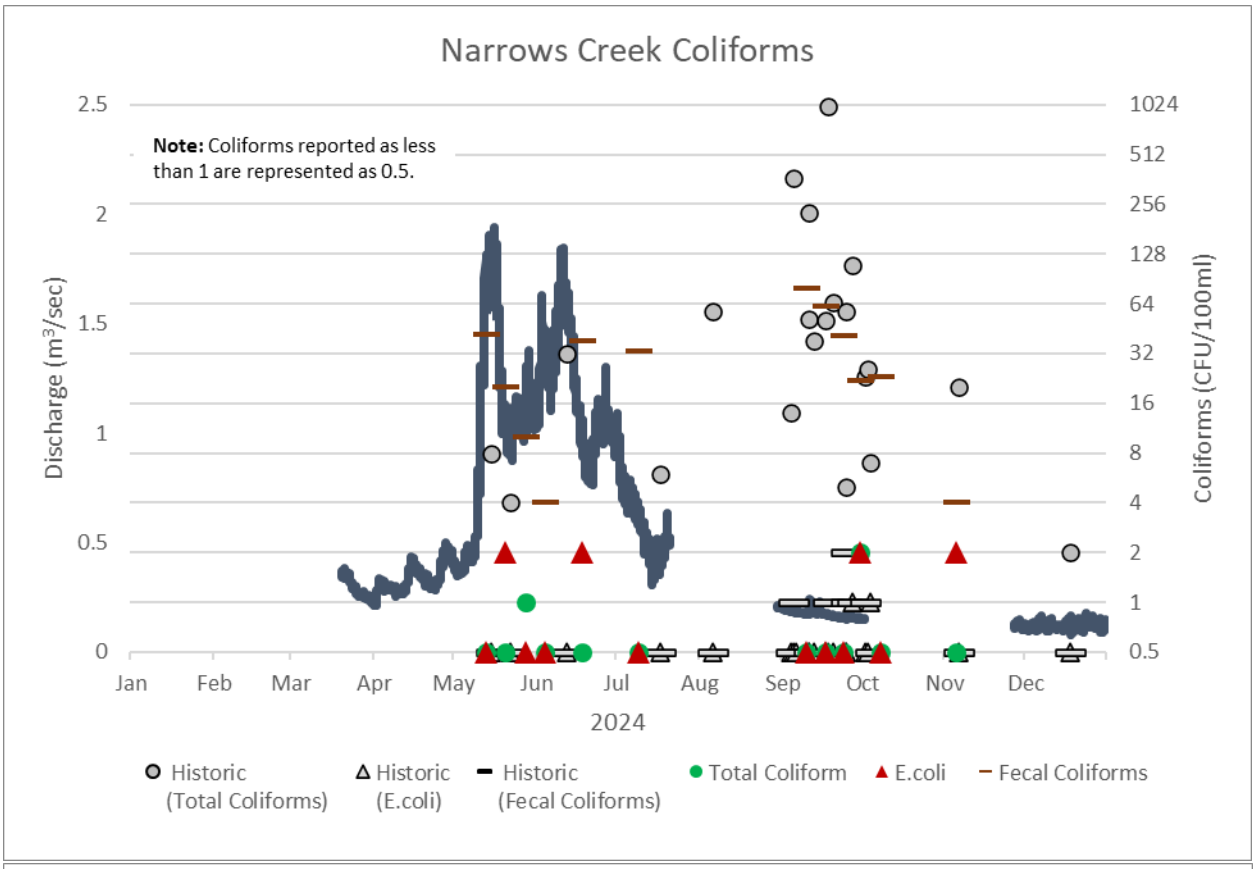
No results from the E. coli samples returned values greater than 20 CFU/100 mL. However, coliforms, including E. coli, were present in raw water at lower limits. Thus, if water is not adequately treated within individual households through boiling or filtration and UV disinfection, E. coli will be present in consumed water, which is above the limits set out in the SWTO of no detectable coliforms per 100ml.

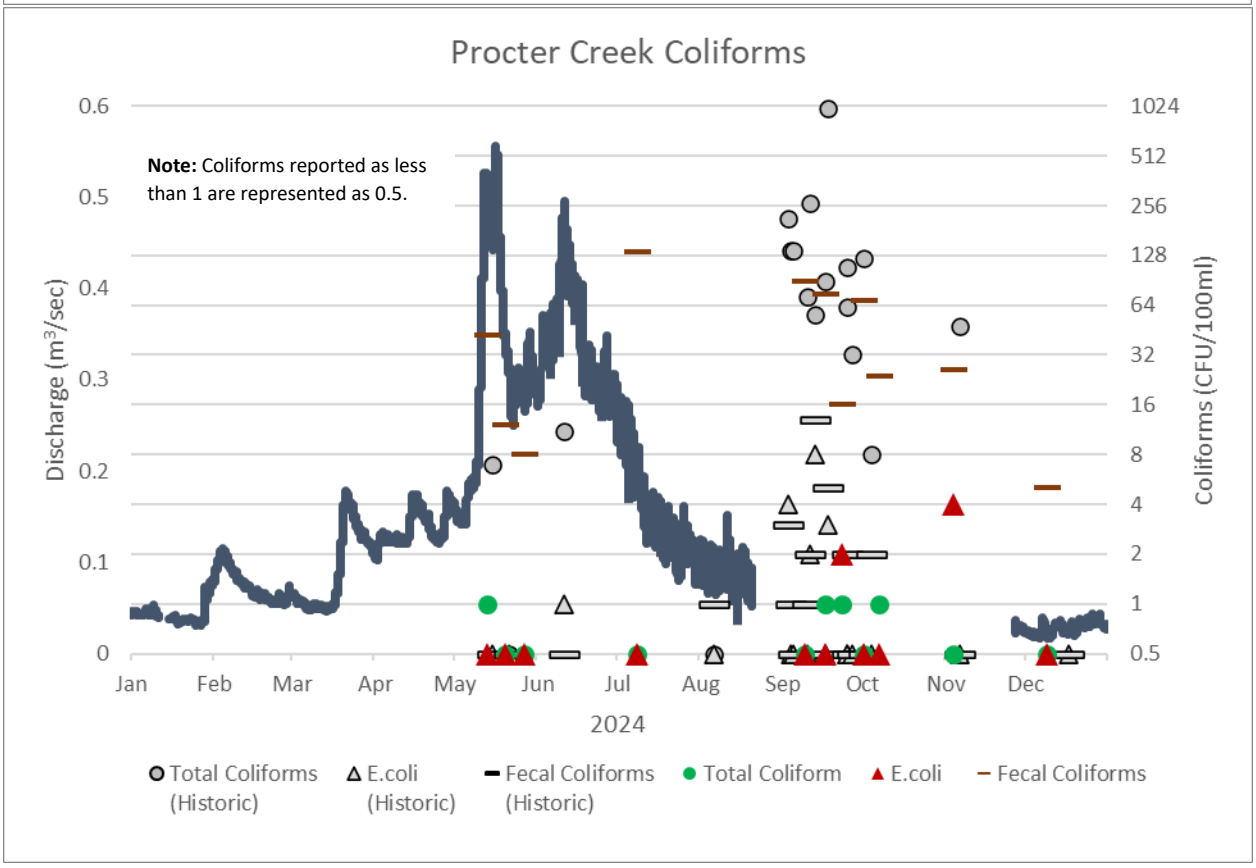
In 2024 Narrows Creek and Procter Creek showed higher results than in previous years for the presence of E.coli. More concerning were the significant and unprecedented (as of KEI's involvement in the project beginning in 2021) levels of fecal coliforms observed at Harrop, Narrows and Procter Creeks observed in both the spring and fall. Slater Creek did not see an increase in fecal coliforms.

It is unknown what the cause of the increase in fecal coliforms in the sample results indicates, though it does warrant further investigation and an increase in monitoring and QA/QC review going forward.


Harrop Creek Coliforms
Note: Coliforms reported as less than 1 are represented as 0.5.
Discharge (m3/sec)
Coliforms (CFU/100ml)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
512
256
128
64
32
16
8
4
2
1
0.5
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2024
Total Coliforms (Historic)
E.coli (Historic)
Fecal Coliforms (Historic)
Total Coliform
E.coli
Fecal Coliforms


Slater Creek Coliforms
Note: Coliforms reported as less than 1 are represented as 0.5.
Discharge (m3/sec)
Coliforms (CFU/100ml)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
256
128
64
32
16
8
4
2
1
0.5
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2024
Total Coliforms (Historic)
E.coli (Historic)
Fecal Coliforms (Historic)
Total Coliform
E.coli
Fecal Coliforms


Narrows Creek Coliforms
Note: Coliforms reported as less than 1 are represented as 0.5.
Discharge (m3/sec)
Coliforms (CFU/100ml)
2.5
2
1.5
1
0.5
0
1024
512
256
128
64
32
16
8
4
2
1
0.5
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2024
Historic (Total Coliforms)
Historic (E.coli)
Historic (Fecal Coliforms)
Total Coliform
E.coli
Fecal Coliforms


Procter Creek Coliforms
Note: Coliforms reported as less than 1 are represented as 0.5.
Discharge (m3/sec)
Coliforms (CFU/100ml)
0.6
0.5
0.4
0.3
0.2
0.1
0
1024
512
256
128
64
32
16
8
4
2
1
0.5
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2024
Total Coliforms (Historic)
E.coli (Historic)
Fecal Coliforms (Historic)
Total Coliform
E.coli
Fecal Coliforms

Specific Conductivity

Specific conductivity, sometimes referred to as specific conductance, is a measure of the ability of electricity to pass through water when corrected for temperature. Conductivity increases with increased dissolved ions (B.C. Ministry of Forests and Range, 2010) , which can be broken up into two sources: naturally occurring and artificially introduced. Naturally occurring ions are present in groundwater since the water in contact with rocks and minerals dissolves ions naturally over time, creating more conductive water. Surface water runoff is generally associated with low conductivity, so conductivity levels will drop when streamflow is mainly comprised of surface runoff, such as snow melt and rain. And the opposite is true as well: when water is sourced primarily from groundwater, conductivity levels will rise.

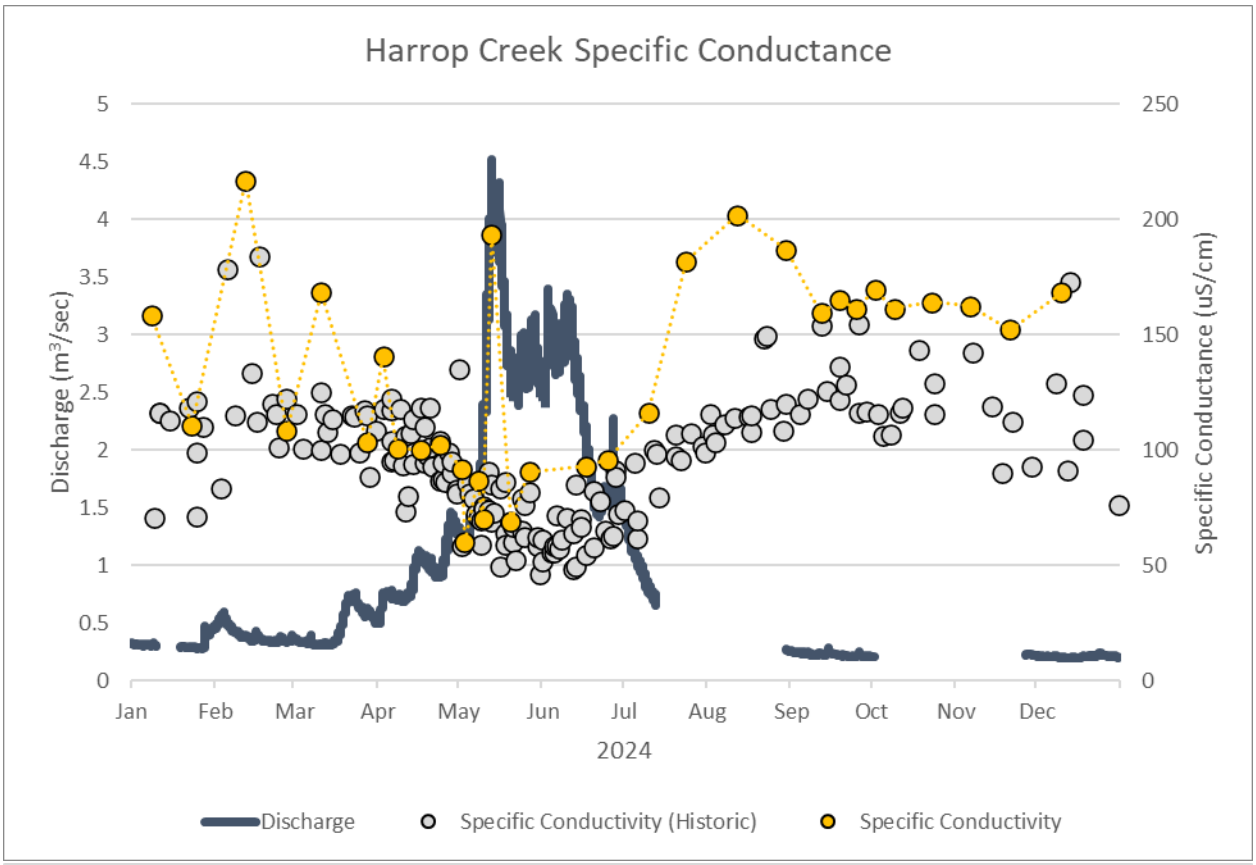
Conductivity monitoring can also identify non-natural sources of dissolved ions, such as pollutants, in a water body. Pollutants like salt applied to roads or landfill leachate often have high conductivity levels. If abnormal conductivity readings are recorded, this could indicate pollutants entering a stream.

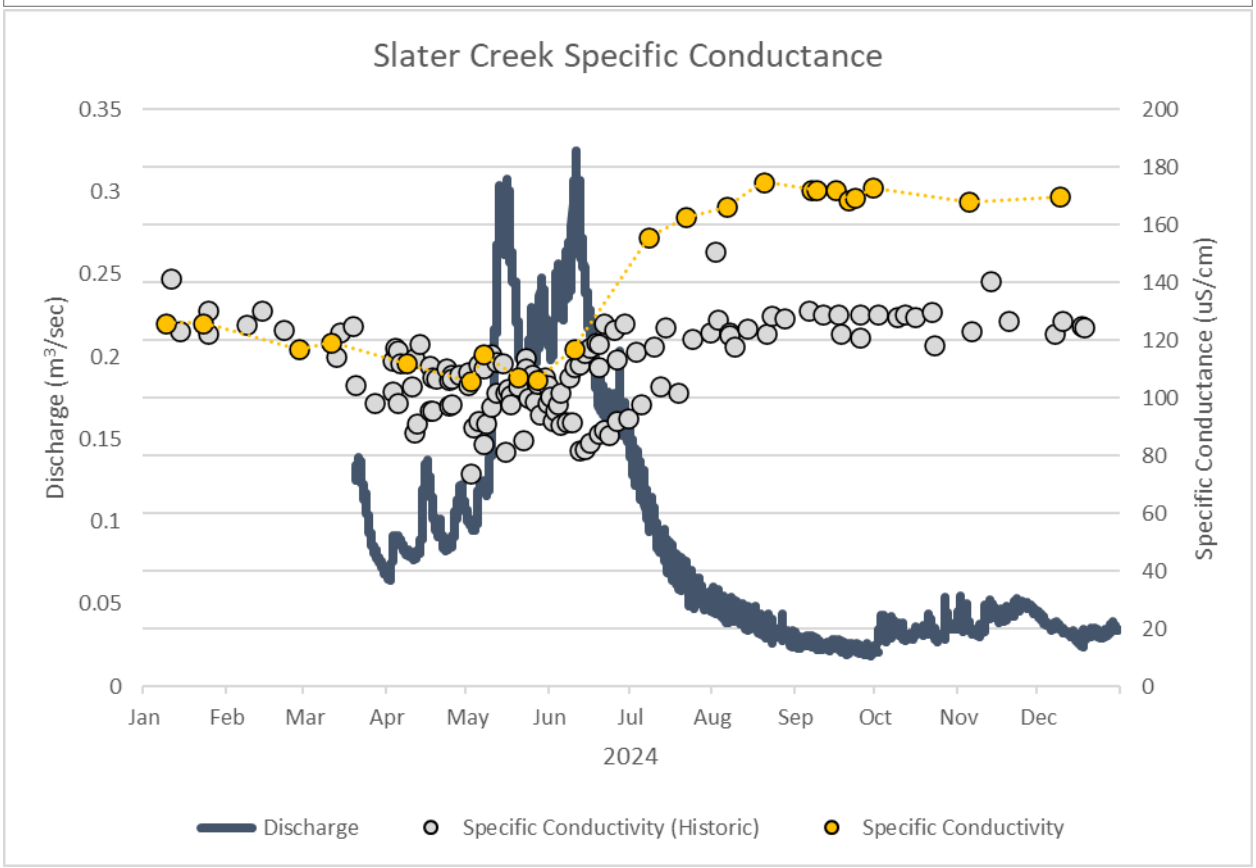
Specific Conductivity Results

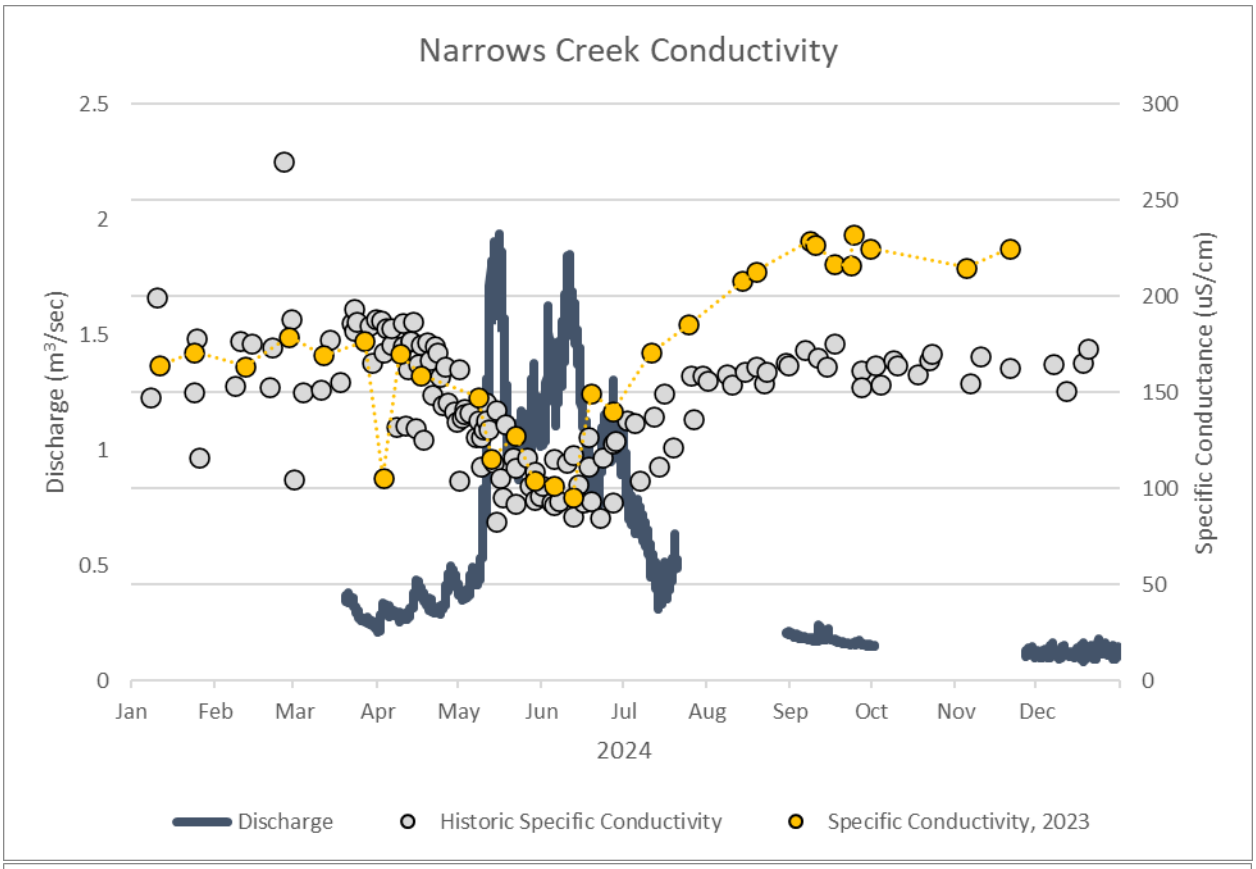
Trends for specific conductivity during low and high flow periods were established throughout the 2021-2023 monitoring years, with no significant shifts in background conductivity being observed. Individual spikes and dips did occur at each creek, though they have not been tied to any identified non-natural sources of dissolved ions. It is recommended that calibration, cleaning and record-keeping best practices be reviewed to validate the reading if data spikes are observed.

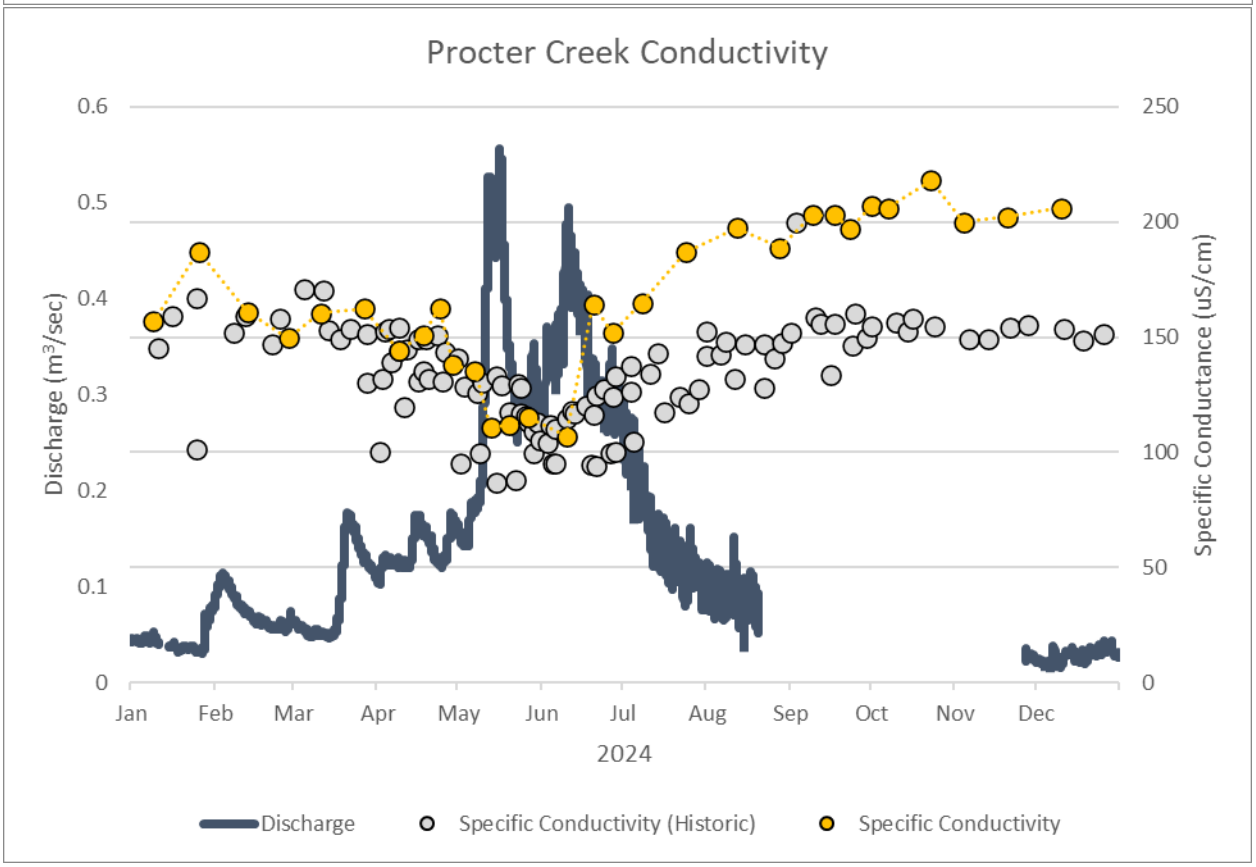
During the summer and fall of 2024 specific conductance results did appear to rise above background levels. Since this occurred at all four sites, it is thought that this was not necessarily due to changes in the watershed, but is more likely due to issues with the meter that is used to collect the results.

As a QA/QC measure, it would be recommended that 1 sample each quarter be sent to Passmore Labs to allow the HPWPS's volunteers to be able to compare the results of their sample to the results of a professional laboratory. If the results from Passmore Labs comes back as different than those recorded the by HPWPS volunteers, then the procedures and equipment used should be looked into.


Harrop Creek Specific Conductance
Discharge (m³/sec)
Specific Conductance (uS/cm)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
250
200
150
100
50
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2024
Discharge
Specific Conductivity (Historic)
Specific Conductivity


Slater Creek Specific Conductance
Discharge (m³/sec)
Specific Conductance (uS/cm)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
200
180
160
140
120
100
80
60
40
20
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2024
Discharge
Specific Conductivity (Historic)
Specific Conductivity


Narrows Creek Conductivity
Discharge (m³/sec)
Specific Conductance (uS/cm)
2.5
2
1.5
1
0.5
0
300
250
200
150
100
50
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2024
Discharge
Historic Specific Conductivity
Specific Conductivity, 2023


Procter Creek Conductivity
Discharge (m³/sec)
Specific Conductance (uS/cm)
0.6
0.5
0.4
0.3
0.2
0.1
0
250
200
150
100
50
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2024
Discharge
Specific Conductivity (Historic)
Specific Conductivity

pH

pH measures the activity of hydrogen ions within a liquid, which indicates whether the liquid is acidic, basic or neutral. The pH scale ranges from 0 to 14, with pH less than 7 being acidic, pH equal to 7 being neutral, and pH greater than 7 being basic. The scale is represented in log form, meaning a pH of 5 is ten times more acidic than a pH of 6.

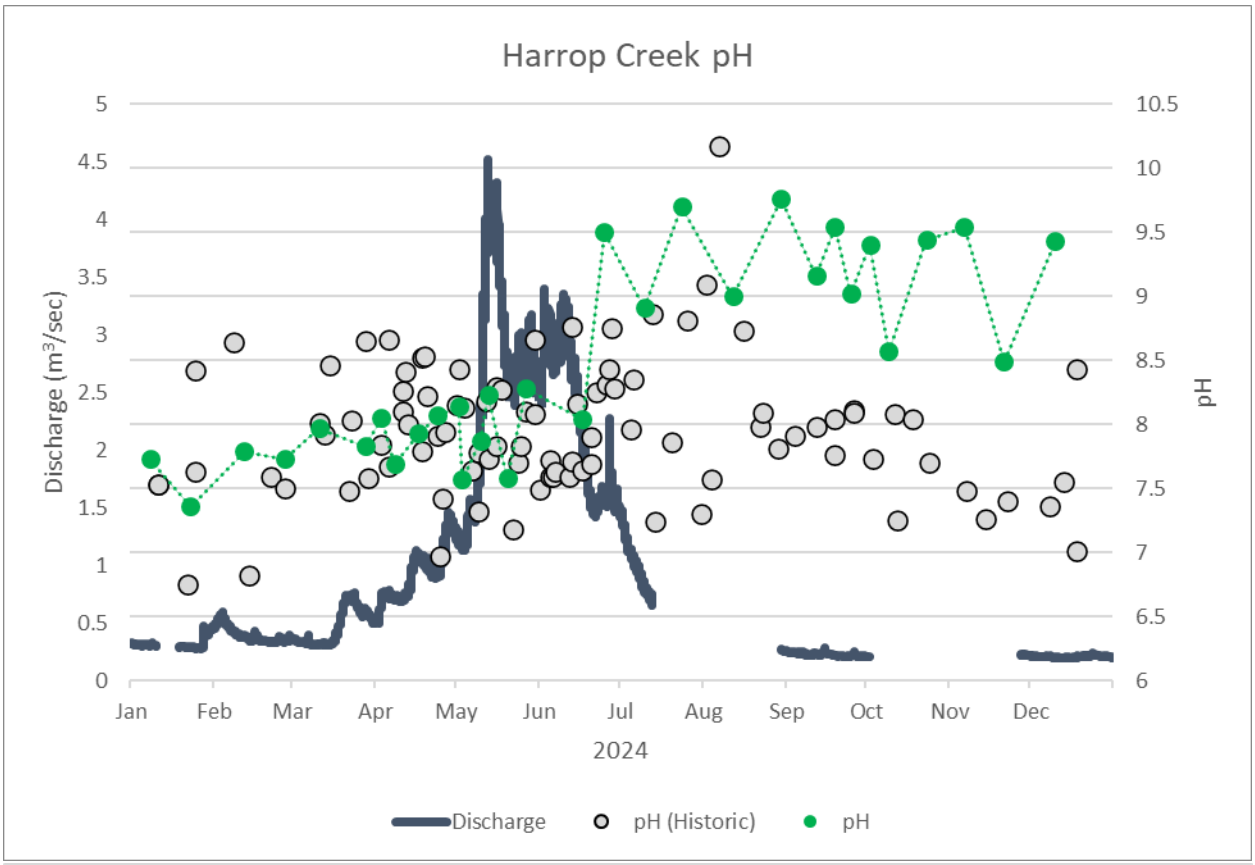
The importance of pH in drinking water is threefold: one is that water that is either too basic or too acidic would be harmful to human health. Another important aspect is optimizing the effectiveness of drinking water treatment. The most important in most scenarios is that acidic water is prone to leaching metals from plumbing components (Health Canada, 2023), the most concerning being lead.

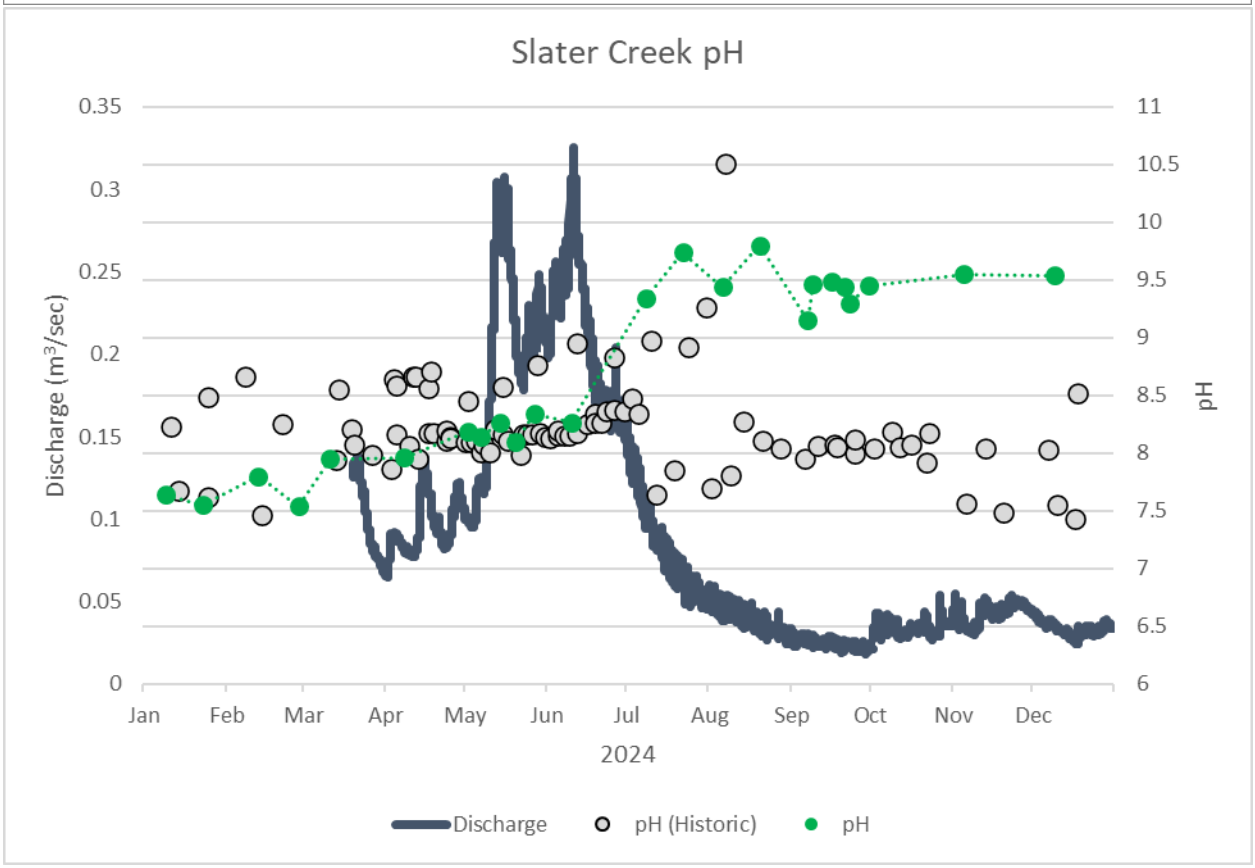
The SWTO does not set limits for pH, so the Guidelines for Canadian Drinking Water Quality (GCDWQ) is the best resource for referencing suitable pH levels in drinking water. The limits outlined in the GCDWQ for pH in drinking water are between 7.0 and 10.5.

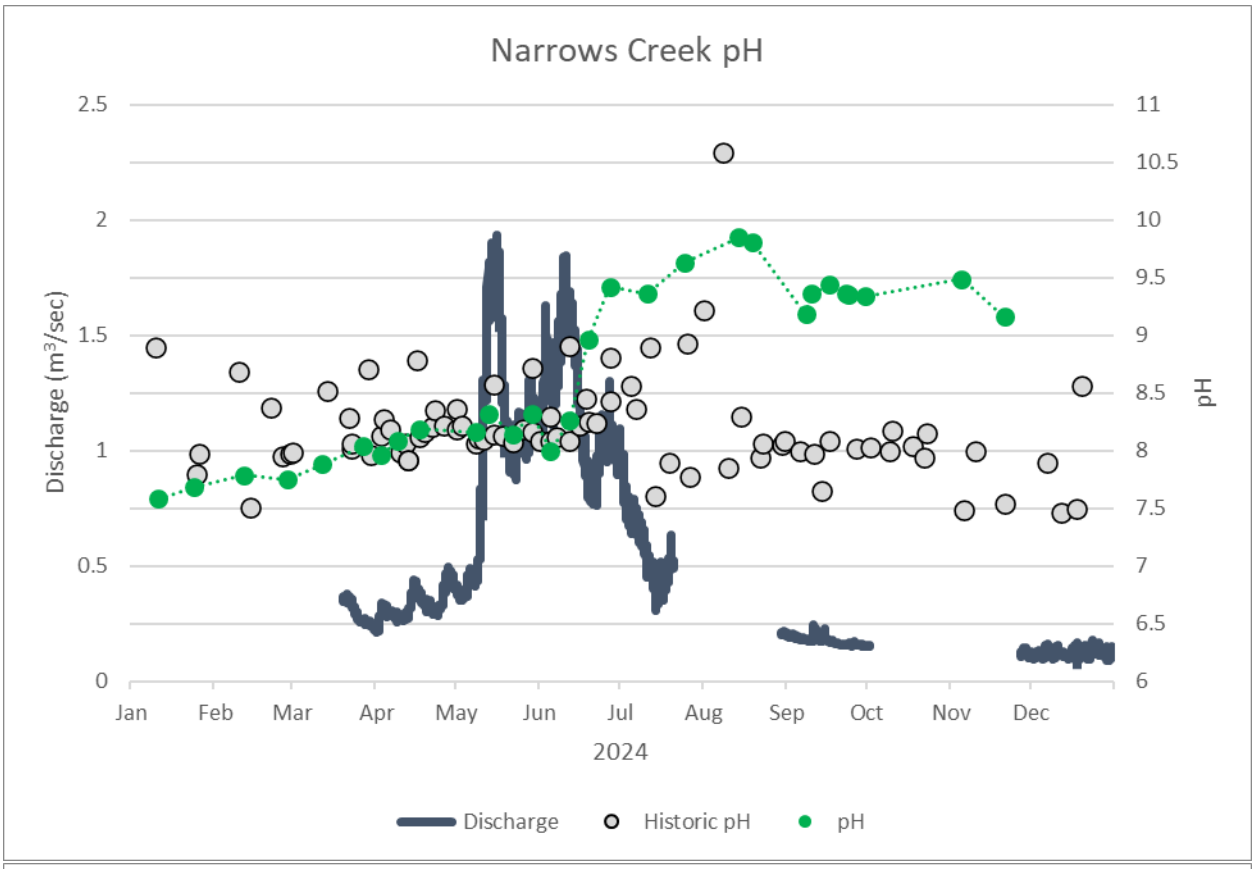
pH Results

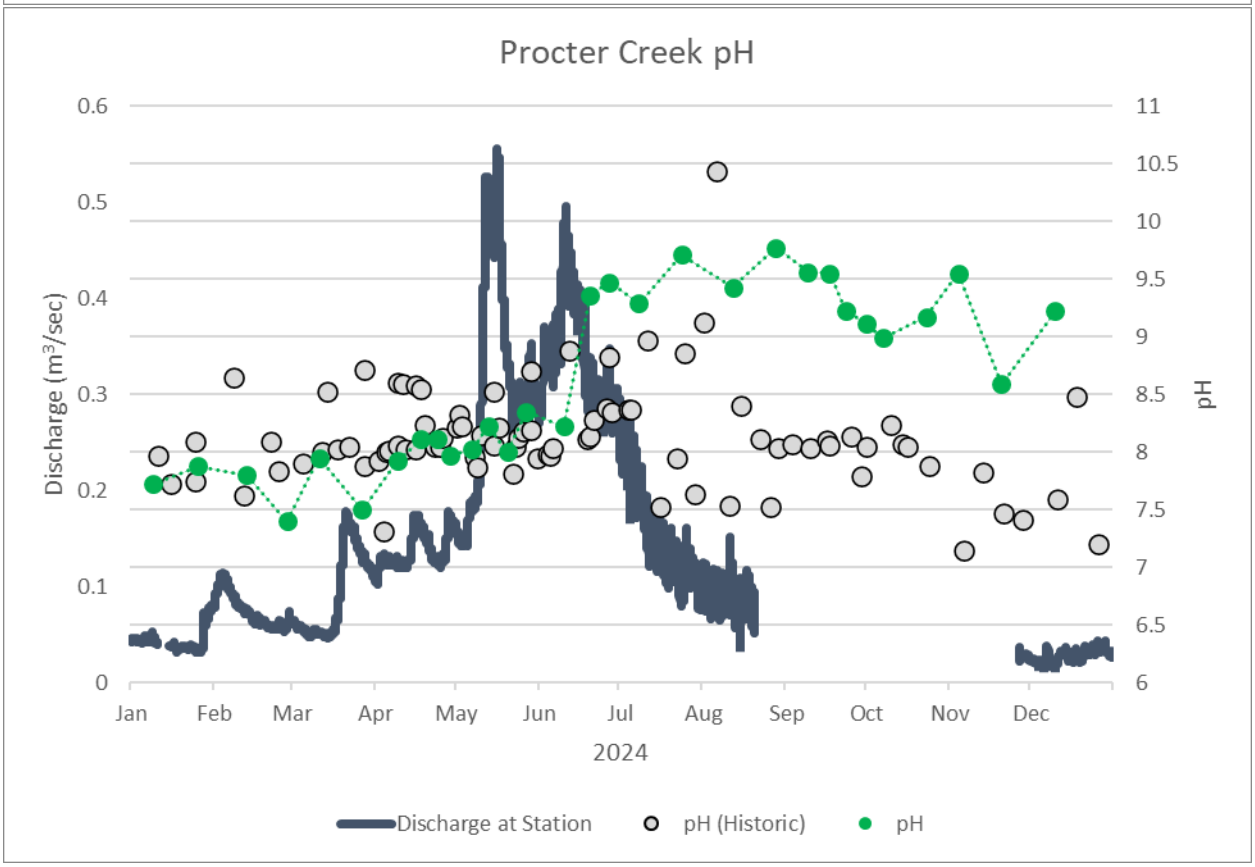
During 2024 all pH samples returned values within the GCDWQ. However, the pH results recorded after July 2024 showed a rising trend at all four sites. Similarly to what was mentioned in regards to the specific conductance results, since this is occurring at all four sites, it is thought that this was not necessarily due to changes in the watershed, but is more likely due to issues with the meter that is used to collect the results.

As a QA/QC measure, it would be recommended that one sample each quarter be sent to Passmore Labs to allow the HPWPS's volunteers to be able to compare the results of their sample to the results of a professional laboratory. If the results from Passmore Labs comes back as different than those recorded the by HPWPS volunteers, then the procedures and equipment used should be looked into.


Harrop Creek pH
Discharge (m³/sec)
pH
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
10.5
10
9.5
9
8.5
8
7.5
7
6.5
6
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2024
Discharge
pH (Historic)
pH


Slater Creek pH
Discharge (m³/sec)
pH
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
11
10.5
10
9.5
9
8.5
8
7.5
7
6.5
6
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2024
Discharge
pH (Historic)
pH


Narrows Creek pH
Discharge (m³/sec)
pH
2.5
2
1.5
1
0.5
0
11
10.5
10
9.5
9
8.5
8
7.5
7
6.5
6
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2024
Discharge
Historic pH
pH


Procter Creek pH
Discharge (m³/sec)
pH
0.6
0.5
0.4
0.3
0.2
0.1
0
11
10.5
10
9.5
9
8.5
8
7.5
7
6.5
6
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2024
Discharge at Station
pH (Historic)
pH

Station Performance

The four streamflow measurements that were conducted at each site matched the continuous discharge which is calculated from the stage-discharge relationship, indicating that they performed well. This indicates that the continuously calculated discharge which comprises each hydrograph is expected to be quite accurate for 2024.

In past years, Narrows Creek has seen significant control changes which lessened the accuracy of the hydrographs in past years. The control has stayed stable through 2024 and 2025.

Solinst Levelogger 5 Diurnal Fluctuations

After switching from MX2001s to Solinst Levelogger 5 sensors at Procter, Narrows and Slater it was observed that Levelogger 5s experience large diurnal fluctuations in the water level data that they produce. The Solinst Levelogger 5 series of water level sensors were recommended for the HPWPS's project by both colleagues and our distributors. Identifying this trend in the data coming from this model of sensors has been brought to the attention of the manufacturer who has since fixed the cause of the issue, though has taken no responsibility for the damage to data that their sensors have caused.

Figure 1: Diurnal Fluctuation Caused by Solinst Levelogger 5 SensorsFigure 1 shows the water level data collected in July of 2023 and 2024 at Procter Creek side by side. The data collected in 2023 was collected by an Onset MX2001, and the data collected in 2024 was collected by the Solinst Levelogger 5. The large, approximately 2cm, diurnal fluctuation coming from the Solinst sensor leads to noisy data, though the trend of the data is still expected to be accurate. This trend was present at Slater, Narrows and Procter Creeks. All Solinst Levelogger 5 sensors have been removed from the HPWPS sites as of December 2024 and Onset U20Ls have been loaned to the project while the issue of the Levelogger 5s was being investigated by KEI and Solinst.

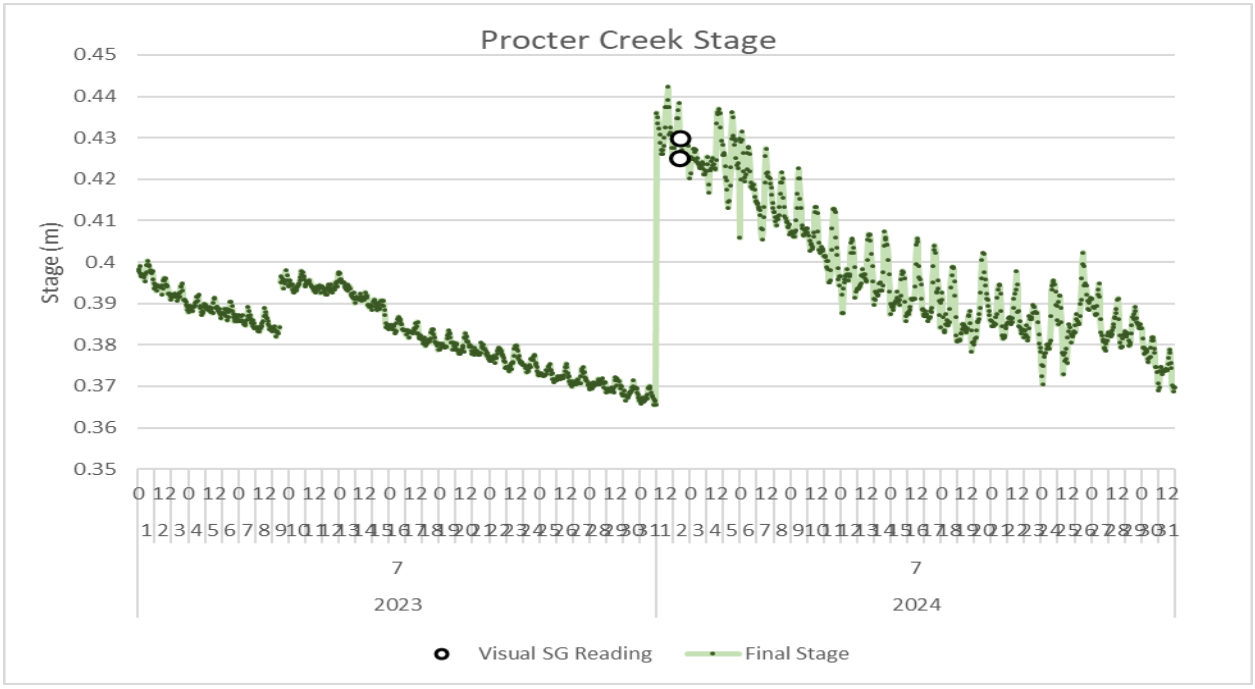


Figure 1: Diurnal Fluctuation Caused by Solinst Levelogger 5 Sensors

Ice and Leaf Litter Blockages at Slater Creek

As shown in Figure 2 and Figure 3, leaf and ice buildup at the grizzly grate at Slater Creek, immediately downstream of the water level sensor, led to inaccurate streamflow data while the blockages occurred. Consequently, the streamflow data collected at Slater is less accurate as the blockages occur incrementally, and no visual or written record is available to confirm when the blockages were present.



Figure 2: Leaf Litter Blockage at Slater Creek



Figure 3: Ice Blockage at Slater Creek

The results of the blockages lead to a need for significant manipulation in Excel to correct, which is both costly and leads to lower data quality. Figure 4 shows the manipulation that was required in 2024 alone at Slater Creek. The yellow data is the actual water level at the station, the white circles are the staff gauge readings taken during site visits, and the green line is the data that was corrected to match the staff gauge readings after the grizzly grate had been cleaned. In 2024 there were six separate offsets and drifts that had to be applied to the data to correct it. None of the three other sites in the project required a drift or offset.

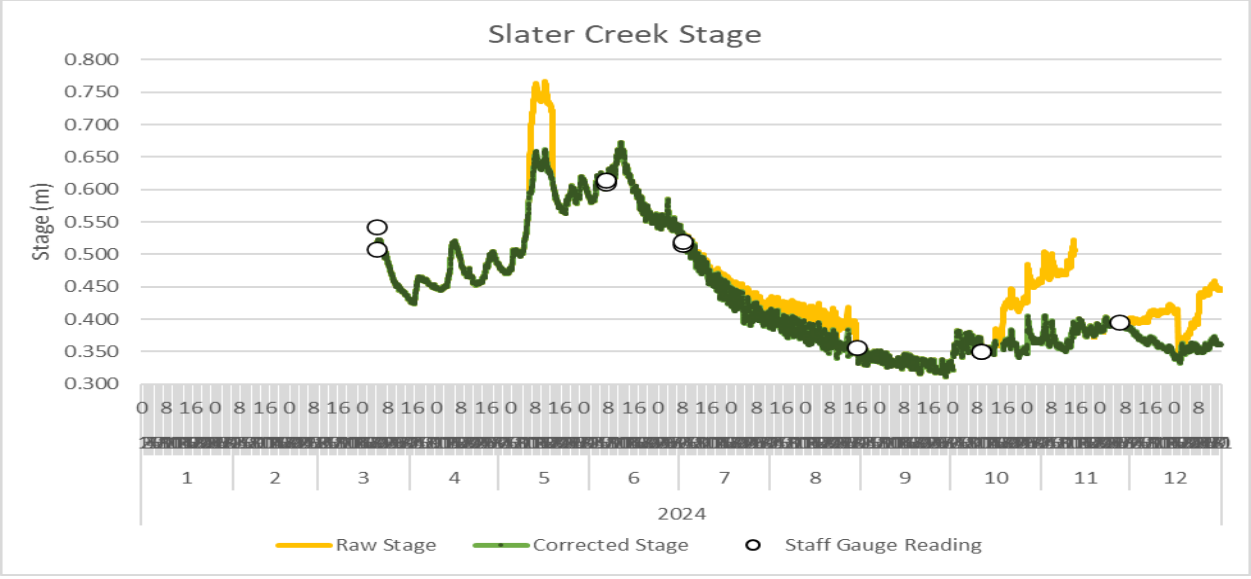


Figure 4: Slater Creek Stage 2024 Corrections

Harrop MX2001 Failures and Resulting Data Gaps

In 2022, MX2001 water level sensors were found to have systemic hardware failures which lead to the AA batteries that powered the unit to fail without warning and subsequently, delete all the data that the sensor had collected. Because of this, the HPWPS received refunds for all their recently purchased MX2001s. The MX2001 that was operating at Harrop was not available for a refund and was not thought to suffer from the battery failure issue.

However, in July of 2024 the MX2001 at Harrop failed for the first time. After seeing the MX2001 failed for a second time in October of 2024, it was then determined that the MX2001 at Harrop was also susceptible to the hardware failure observed in the other MX2001s which were refunded and removed. The resulting data gaps at Harrop can be viewed in Figure 5. Living Lakes Canada agreed to lend an MX2001 which has been running at the site without issue for over a year as of the writing of this report.

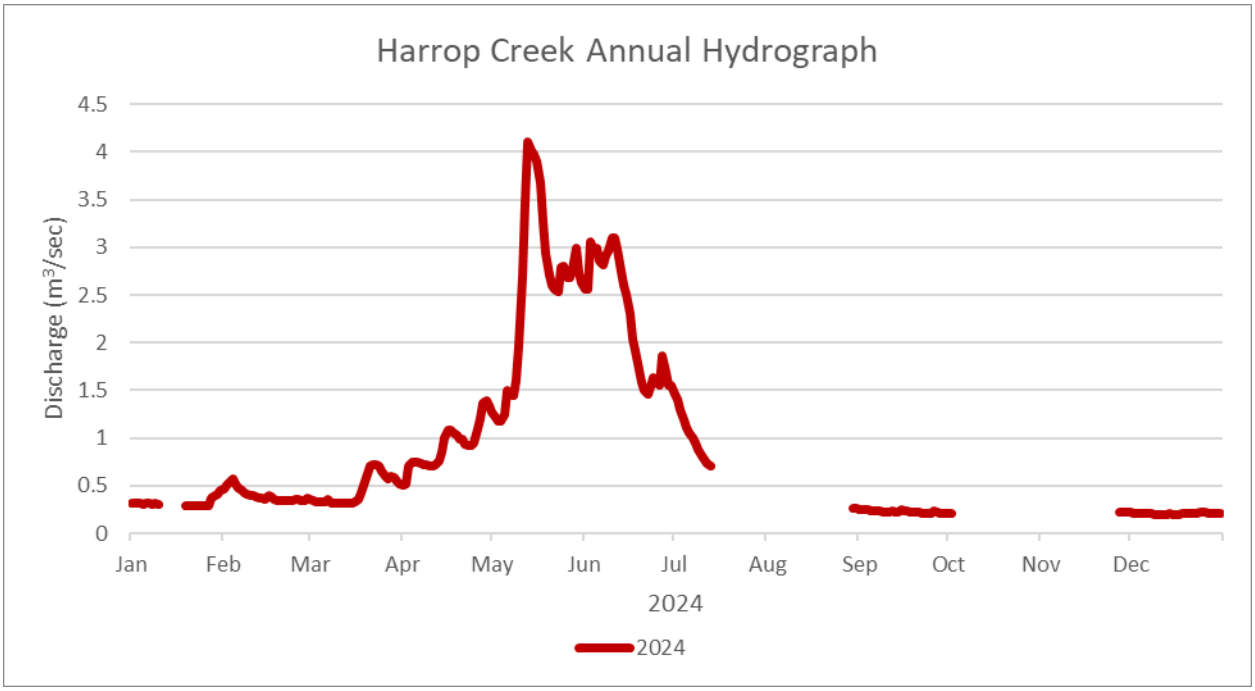


Figure 5: Harrop Creek Data Gaps Caused by Failed MX2001

Unfortunately, these data losses don't only impact Harrop Creek's data. Most in-water Leveloggers (water level data loggers) require barometric pressure to be subtracted from their data sets to calculate the weight of water above the sensor, which can then be converted to the level of water above the sensor. Since the goal is to run the HPWPS as cost effectively as possible, the MX2001 deployed at Harrop was the only source of barometric data for all four creeks, and therefore when the MX2001 at Harrop failed, there was no barometric data available to calculate the stage at the other three sites resulting in additional data losses.

At the same time that Living Lakes Canada loaned a new MX2001 to the Harrop site, they also loaned a Solinst Barologger 5 (a sensor that records only barometric pressure) to the HPWPS project which has been deployed at Slater. As of the deployment of Living Lakes Canada's MX2001 and Barologger 5, there have been no data losses due to lack of barometric pressure.

Disclaimer

The discharge data collected for Harrop-Procter Watershed Protection Society has been collected to meet the BC Hydrometric RISC Standards v.2 released in 2019. All data grades assigned to the discharge data have been assigned by Rory Gallaugher, AScT, Principal of Kootenay Environmental Innovations Ltd. (KEI). The data grades, if applied, are intended to assist users of the discharge data in understanding KEI's considerations on how the data was collected and analyzed and how the site conditions met the requirements presented in standards requirement criteria Table 1-1 of the RISC Standards.

Per the RISC Standards, grading hydrometric data is a subjective practice based on the Qualified Hydrometric Reviewer's (QHR's) interpretation of the RISC Standards and the data collected. In practice, each QHR may grade data differently based on their interpretation of the instrumentation, field procedures used, and data calculation and assessment. The RISC standards are intended to support data collection using calibrated equipment to provide standardization for review and audits and support the archiving of hydrometric data of known quality.

Further, data grades only apply for the period reported in the report. Changes to the creek morphology, watershed, or climate may change the water level and creek discharge in ways not reported by this data. Therefore, it is recommended that, should the data presented in this report be used for engineering purposes, or where there is any chance of damage or harm to personal property or health, KEI expects that the engineer using the data to apply their own data grade, based on their own interpretation of the data. KEI will not be held liable for any damages that occur due to the use of this data.

Water quality data is collected by third-party individuals most of the time and, depending on the metric, is analyzed at accredited third-party labs or by the third party collecting the data. Though water quality data are presented in the report with an emphasis on the Province of British Columbia's Drinking Water Treatment Objectives (Microbiological) for Surface Water Supplies in British Columbia, KEI makes no representation as to the potability of the water. For questions regarding the potability of drinking water, KEI recommends contacting the water supplier and Interior Health.

References

B.C. Ministry of Forests and Range. (2010). *Compendium of Forest Hydrology and Geomorphology in British Columbia.* Victoria: Province of British Columbia.

BC Ministry of Health. (2012). *Drinking Water Treatment Objectives (microbiological) for Surface Water Supplies in British Columbia v. 1.2.* Victoria: The Province of BC.

Health Canada. (2023, February 8). *Guidelines for Canadian Drinking Water Quality - Summary Tables*. Retrieved from Government of Canada: https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/water-quality/guidelines-canadian-drinking-water-quality-summary-table.html