Slocan Integral Forestry Cooperative

Trozzo Creek 2020-2022

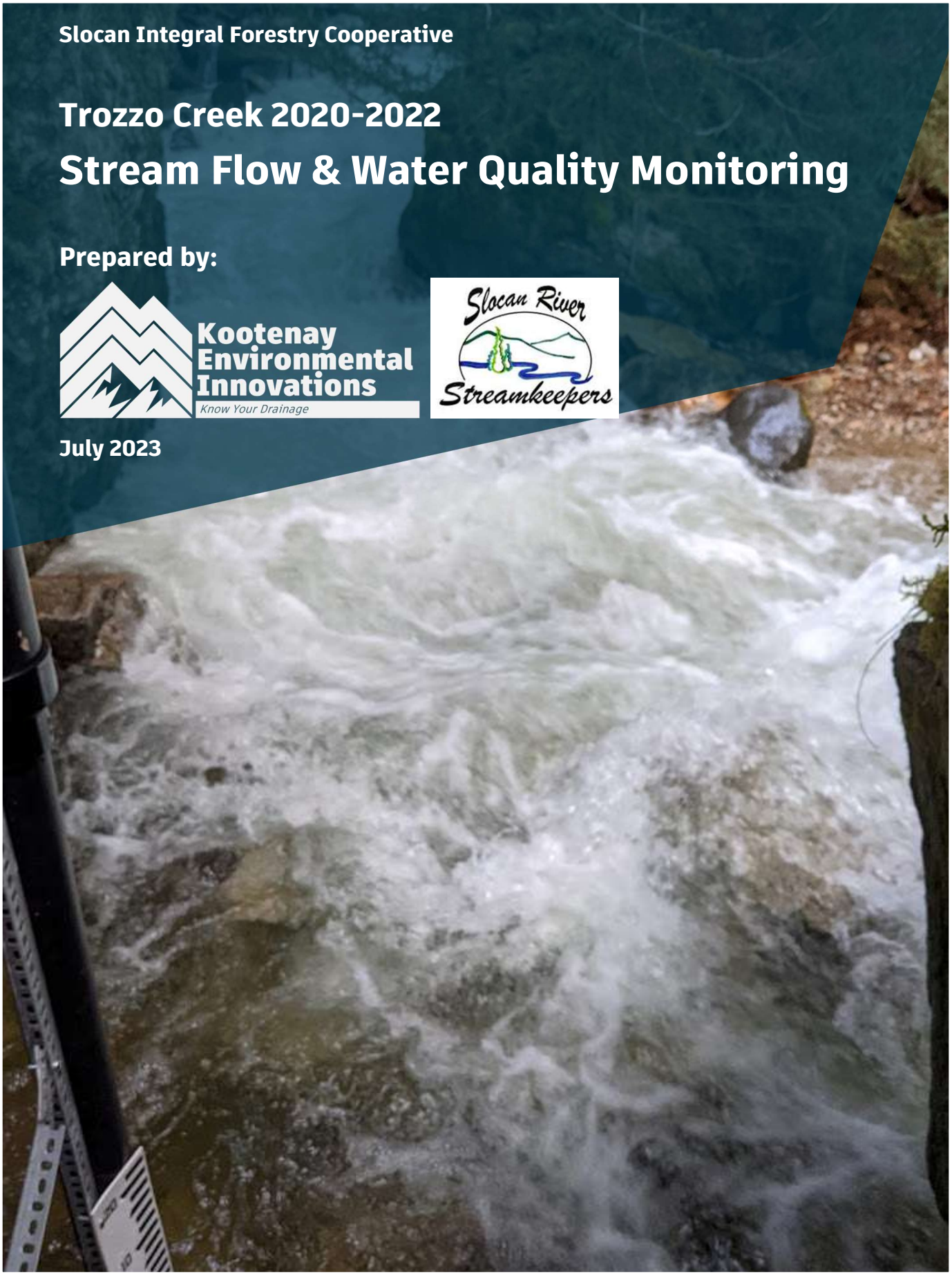
Stream Flow & Water Quality Monitoring

Prepared by:

Kootenay Environmental Innovations
Know Your Drainage

Slocan River Streamkeepers

July 2023



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Acronyms & Abbreviations

- A……Grade A Data
- B……Grade B Data
- BP……Grade 'Best Practices' Data
- C……Grade C Data
- CS……Citizen Scientist
- DI……Dilution
- D.O……Dissolved Oxygen
- E……Grade 'Estimated' Data
- FT……Flow Tracker
- GMT……Greenwich Mean Time
- KEI……Kootenay Environmental Innovations
- MM……Multi-Meter
- MX2001……A model of sensor which measures water level
- NTU……Nephelometric Turbidity Unit
- N/A……Not Applicable
- PT……Pressure Transducer
- Q……Discharge/Stream Flow
- QHR……Qualified Hydrometric Reviewer
- RISC……Resources Information Standards Committee
- SDR……Stage Discharge Relationship
- SG……Staff Gauge
- SIFCO……Slocan Integral Forestry Cooperative
- (S)FM……(Stream) Flow Measurement
- SRSKs……Slocan River Stream Keepers
- SW……Swoffer
- Temp……Temperature
- U…… Grade 'Unknown' Data
- WD……Wading (mid-section) Method

Disclaimer

The discharge data in this report has been collected per the BC Hydrometric RISC Standards v.2 (RISC Standards) released in 2019. All data grades assigned to the discharge data have been assigned by Rory Gallaugher, AScT, Principal of Kootenay Environmental Innovations (KEI). The data grades applied 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 grading 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, where there is any chance of damage or harm to personal property or health, KEI expects that the engineer using the data apply their own data grade, based on their own interpretation of the data, and KEI will not be held liable for any damages that occurred due to the use of this data.

Water quality data is collected by third-party individuals the majority of the time and analyzed at accredited third-party labs. 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.

Background

KEI was retained by the Slocan River Streamkeepers (SRSKs) to conduct the stream flow (i.e. discharge) monitoring at both Winlaw Creek and Trozzo Creek within the Slocan Valley for three years, starting in the spring of 2020.

The discharge monitoring at Winlaw and Trozzo Creeks was to be conducted as part of a more extensive study funded by the Slocan Integral Forestry Cooperative (SIFCo). The greater objective was to "collect data that can be compared to historical data collected by the Winlaw Watershed Committee to identify any long-term trends or changes to water quality, to monitor the impacts of controlled burns occurring in the watershed, and to monitor changes in the flow regime."

Study Objectives/Scope

Based on KEI's roles and responsibilities, KEI's objectives were to collect, analyze and report on discharge data per the BC Hydrometric RISC standards. The data is presented in a PDF report and in a comprehensive spreadsheet containing each calculation used to calculate the discharge data. This report presents the information for Trozzo Creek.

KEI also presented the water quality data associated with the drinking water indicators, turbidity and coliforms. Additional environmental data was also presented, which can be used to further understand the watershed's hydrological drivers, and physical and chemical data, which can be used to track the watershed's health as a drinking water source. These additional metrics include:

- specific conductance,
- water temperature,
- air temperature (Nelson CS weather station),
- precipitation (Nelson CS weather station),
- turbidity,
- verified E. coli,
- fecal (thermotolerant) coliforms, and
- total coliforms.
- nutrients and metals.

Methods

Discharge Data

The water level collected by a pressure transducer was corrected to a staff gauge using an offset to calculate continuous stage data (stage = water level data corrected to a staff gauge). When gaps in the stage data occurred due to sensor failures, a regional analysis was conducted using stage data from Anderson Creek, which is monitored by the Water Survey of Canada.

The stage data is then calculated into discharge by developing a stage-discharge relationship (SDR) for each site. The SDR is derived from a formula that draws a line between multiple discharge measurements conducted at varying stages throughout the monitoring period.

Discharge measurements were conducted using calibrated instruments, including a Swoffer, a Flow Tracker 2, and multi-metres which collect continuous conductivity. The

mid-section method was used where possible, but dilution measurements were conducted at high flows when the stream could not be waded.

Water Quality Data

The turbidity, specific conductance and coliform water quality samples were taken by SRSKs staff and processed at Passmore Laboratories. The water quality results are displayed alongside the discharge data to allow readers to identify correlations between the water quality and discharge data. Metal and nutrient sampling was also collected by SRSK and processed at CARO Analytical. Due to the large quantity of data, it has not been included in this report but is available in the accompanying spreadsheet.

Discussion

Water Level and Water Quality Sensor Challenges

The project suffered from two separate failures of water level sensors. The initial sensor consisted of a Hydros 21 water level and conductivity sensor, along with an experimental turbidity sensor. These sensors were connected to a Mayfly data logger, which can also be considered experimental. The data logger was programmed to work with the selected sensors.

This experimental route, which cost approximately $1,000 in equipment, was chosen to be used in place of industry-standard equipment (a multi-parameter sonde), which would have cost $7,000 to $8,000. The turbidity sensor was considered the most experimental and failed within the first months of deployment. The water level, conductivity sensors and Mayfly data logger proved much more robust, with the exception of one solder joint on a micro USB port.

The broken solder joint on the USB port proved challenging to troubleshoot as the solder would only fail when the circuit board flexed due to temperature fluctuations. The final data collected by the Mayfly data logger occurred in September 2020. However, multiple attempts were made to continue using the sensor over the winter of 2020/21.

In March 2021, a HOBO MX2001 water level sensor was purchased from ONSET to replace the Mayfly data logger. This sensor logged water levels continuously without issue through the summer of 2021. However, the MX2001 also suffered data losses in the winter of 2021/22. Though MX2001s have been reliable in the past, it appears that ONSET suffered quality control issues during the Covid-19 pandemic, leading to rapid battery consumption and unstable memory. The MX2001 was returned to ONSET under warranty, and no issues have occurred in the new MX2001.

Site Conditions and Data Accuracy

Two sites above the drinking water intakes were used during the course of this project. The site was requested to be above the intakes to mitigate the impacts of the water drawn from the intakes, primarily during low flow. However, the site conditions at the location requested were steep, which led to high energy stream flows. The high energy flows resulted in damage to the controls. Initially, one site was installed, but after it was damaged from high stream flows, a second was installed, and both were operated simultaneously.

In addition, the dam location was augmented multiple times by the owners of the drinking water intakes to back up water at their intakes. Each augmentation and site change due to stream flows altered the relationship between discharge and water level, which degraded the quality of the data. As a result, the discharge data collected at the two sites are graded as Unknown as per the BC Hydrometric RISC standards. Extreme caution should be used in future uses of the discharge data collected at these sites, and though the data is likely considered suitable for comparison to water quality data but is unsuitable for engineering purposes.

Recommendations

KEI recommends that the discharge monitoring locations above the drinking water intakes be abandoned due to the high energy flows and augmentation by water users. More favourable locations exist approximately two to four hundred metres downstream of the current sites. These recommended locations are less steep, leading to less energy in the water and fewer changes to the control. While they are located downstream of the drinking water intakes, the discharge above the intakes can be calculated if desired.

It is recommended that water quality samples be taken at the following intervals:

- Total Coliforms, Fecal Coliforms and E.Coli.
  - 1 sample taken monthly (if budget allows)
  - 5 samples taken over 30 days, twice a year:
    - during the freshet, and
    - starting with the fall rains.
- Turbidity
  - Weekly from April 1st to November 30th.
  - Every other week from December 1st to March 31st.
  - Event-based, e.g., if the water looks visibly turbid.

Though KEI recommends that the above samples be taken, KEI will not state whether or not water is potable. For questions regarding the potability of drinking water, KEI recommends that interested parties consult with their water provider and Interior Health.

The sample intervals are only recommendations to collect a robust dataset for annual analysis regarding the suitability of the creek to act as a source of drinking water (to be determined by a third party). In addition, the sampling results can be used to determine if changes in the watershed have affected the water quality, such as (but not limited to):

- fires,
- logging,
- changes in land use,
- landslides, or
- events associated with climate change.

Additional samples, such as specific conductance, metals, nutrients, and full raw water analysis, may be recommended based on study objectives outside of KEI's scope.

Discharge & Water Quality Data Presented in BC Hydrometric RISC Forms

The remainder of the report consists of the metadata used to calculate the discharge data in the forms supplied in the appendix of the RISC standards. The forms are intended to be completed so that the Province of British Columbia, consultants or any other industry professional can evaluate the methods used to calculate the discharge data. Datasets which are not included in this report, but which are captured in the spreadsheet, include:

- flow measurements metadata,
- benchmark surveys,
- nutrient and metals sampling results, and
- time series data needed to create the graphs.

In addition to the metadata, the discharge, water quality and meteorological data associated with the site are displayed in graphs.

Hydrometric Station History

A station's historical records are an essential component of the station's metadata. The station history provides information such as site location, the station's purpose, the types of data collected, records of installations, the types of equipment deployed at the station, benchmarks and levels, etc. (2019, RISC p.18)

Included in the Hydrometric station history are the following sections:

i Station Watershed Image
ii Station Location
1) Station Maintenance
2) Records Collected
3) Benchmarks/Elevations
4) Staff or Reference Gauge
5) Recording Gauge
6) Rated Structure
7) Level Checks
8) Station Controls and Channel Description
9) Kootenay Boundary Water Tool Data
10) Site Plan/Site Sketch

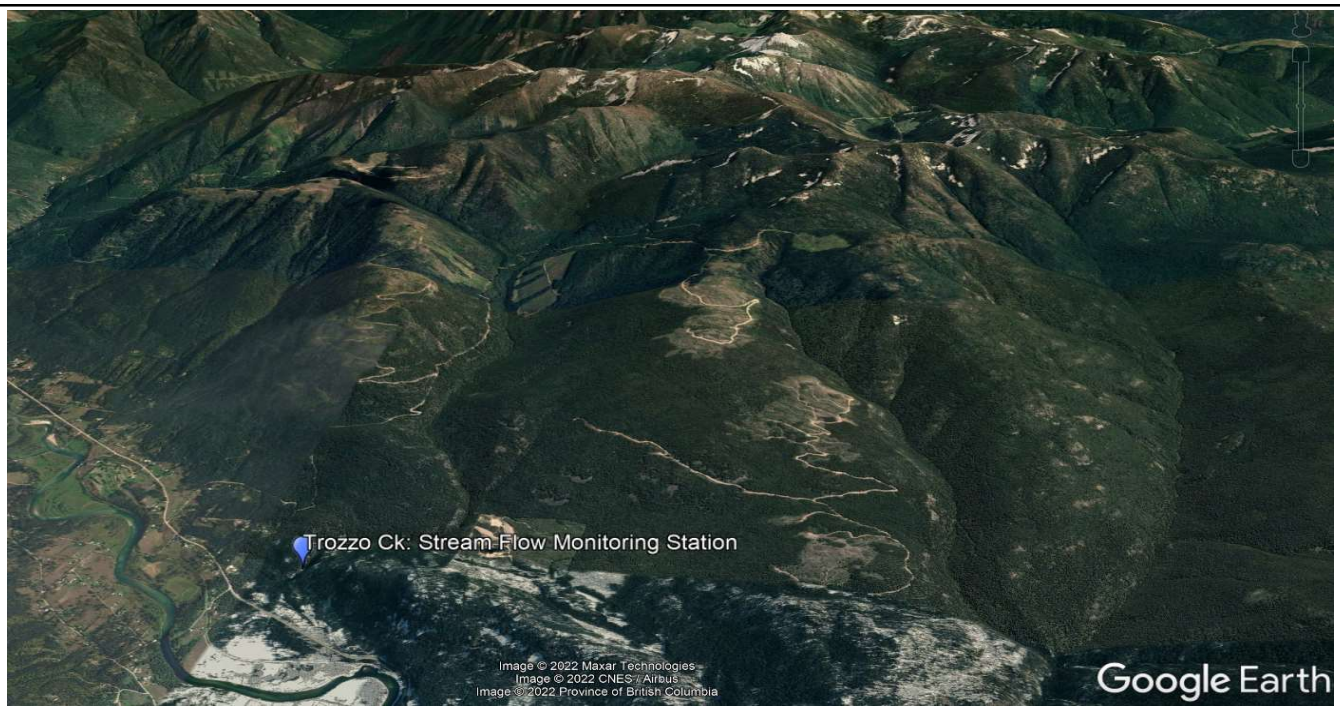
Hydrometric Station History

Station Identification Number: n/a

Station Name: Trozzo Creek at Dam & Upper Station at Rock

Gazetted Stream Name: Trozzo Creek

i) Station or Watershed Image



ii) Station Location

Latitude/Northing: 49.639290 **Longitude/Easting:** -117.528080

Georeferenced Source: NAD 83

Drainage Area Size[1]: 28.0 km^2 **Allocations Vol.[1]:** 0.006 m^3/sec **Allocations %[1]:** 0.9%

Watershed Elv.[1] **Min:** 678m **Mean:** 1,573m **Max:** 2,177m **Average Face Direction:** West

EMS ID. (if available): None **NESDIS ID (if available):** None

Description of Location: The station is located at the upper most drinking water intake where the stream has been dammed using logs, rocks and gravel. The "upper station at rock" is ~10m upstream of the at dam station.

Location Type: ☐ Lake ☐ River ☑ Stream ☐ Other:

Station Type: ☐ Water Level Only ☑ Flow Only ☐ Both ☐ Other:

Stream Flow: ☐ Regulated ☑ Natural ☐ Other:

Upstream Allocation: ☑ Yes ☐ No ☐ Other: One intake is above station

Other Parameters Collected: ☑ Water Temp ☐ Air Temp ☑ Barometric Pressure ☑ Other: Water quality parameters are collected via grab samples. The grab samples include turbidity, specific conductivity and coliforms.

Station Description and Purpose: The project is funded by the Slocan Integral Forestry Cooperative (SIFCo), with funding secured by the Columbia Basin Trust. Funding for the stream flow and water quality monitoring is intended to identify any affects on Trozzo Creek in regards to controlled burns in the area.

Station Operating Agency/Firm: Kootenay Environmental Innovations

Contact Details: Rory Gallaugher AScT, gallaugher.consulting@gmail.com

Section 1. Station Maintenance

Action (Station Established, Relocated, Modified, Closed)	Date	Remarks	Updated By	
			Initial	Date
Established	2020-05-01	The stilling well and staff gauge were installed in the pool created by the dam.	RJG	2022-02-18
Installed	2020-06-11	Hydros 21 Conductivity, Temperature, Depth (CTD) sensor was installed.	RJG	2022-02-18
Modified	2020-09-10	Stilling well and staff gauge were lowered due to the water level dropping below the sensor.	RJG	2022-02-18
Installed	2021-04-01	MX2001 water level sensor was installed to replace the Hydros CTD sensor.	RJG	2022-02-18
Closed	2021-13-31	The station was abandoned as the control is not stable. Residents dammed the stream.	RJG	2022-02-18

Section 2. Records Collected

Sensor/Sample Type	Start Date	End Date	Remarks
Hydros CTD 21 & Onset MX2001 (0-4m)	2020-06-11	2022-12-31	The CTD sensor records specific conductivity, water temperature and water level. The datalogger failed due to factory solder joints breaking during cold temperatures. The Hydros CTD sensor was replaced with a MX2001 unit on April 1, 2021.
Continuous Stream Flow	2020-06-11	2022-12-31	Stream flow data is calculated for the entire reporting period, though regional analysis were used when sensor failures occurred.
Turbidity, Specific Conductance, Coliforms, E-coli	Unknown	To Present	Multiple water quality samples are collected regularly by the Slocan River Stream Keepers.
Onset U20 (0-9m)	2021-06-08	2022-05-11	A U20 water level sensor was installed ~10m upstream of the MX2001 station. The U20 is not affected by the dam failures, though the control was damage when retriving the sensor.

Section 3. Benchmarks/Elevations

Benchmark (BM) No.	Date Established	Datum [Local datum always set at zero meter] (m)	GSC Datum Elevation [if any] (m)	Description
Staff Gauge	2020-05-01	0.000	none	SG length = 1.228m
BM1	2020-05-01	0.628	none	LB on rock, West
BM2	2020-05-01	0.170	none	RB on rock, close to end of path
BM3	2020-05-01	1.105	none	LB on rock, East

Benchmarks were installed at the upper station, but once it was known the data would be graded as Unknown due to the site conditions, the decision was made to cease surveying the benchmarks in order to reduce the cost of monitoring.

Modifications of Benchmarks

Benchmark (BM) No.	Date Modified	Original Datum (m)	New Datum (m)	Reasons & Remarks	Updated By	
					Initial	Date
None						

Section 4. Staff Gauge or Reference Gauge

Type	Date	Location Description	Zero Flow at Gauge Height (m)	Gauge reading Accuracy (mm)	Updated By	
					Initial	Date
Unknown staff gauge manufacture	2020-05-01	Within the pool created by the log dam.	Variable.	2mm	RJG	2022-02-18
Water Survey Canada	2021-06-28	~10 m Upstream of the dam. The new station is not affected by the failing dam.	Variable.	1mm	RJG	2022-02-18

Section 5. Recording Gauge

Type and Make	Date Installed	Date Removed	Zero Flow at Gauge Height (m)	Accuracy and Range	Remarks	Updated By	
						Initial	Date
Hydros 21 CTD	2020 May-1	2021 Mar-16	Variable	+- 0.05% FSO	Sensor was reliable, datalogger failed.	RJG	2022-02-18
MX2001	2021 Apr-1	2021 Dec-31	Variable	+- 0.05% FSO 6mm	Suffered a warranty issue.	RJG	2022-02-18
U20 (0-9m)	2021 Jun-28	2023 May-11	Variable	+- 0.05% FSO 8mm	Sensor was reliable.	RJG	2022-02-18

Section 6. Rated Structure

Type and Description	Date Installed	Date Removed	R.L. of Invert (m)	R.L. of Sensor Head [if any] (m)	Updated By	
					Initial	Date
None						

Section 7: Level Checks

Note: See Site Records for offset calculations

Section 8: Station Controls and Channel Description

Description of Control:

The control at the at dam location consists of a log, rock and soil dam which is constructed by the water users at the site. The control was backed up partway through 2021 by the water users in order to raise the water level at the pool behind the dam so that their drinking water intakes would remain submerged. Over time, the sand that the water users used to raise the dam had washed away, effectively lowering the control. The control at the upper station at rock consisted of naturally placed rocks, but the pool formed by the control filled with sediment which buried the sensor. The control was destroyed in trying to access the buried sensor.

The variability of the control is the reason why the data is graded as Unknown (U). It is also the reason why the at dam station was abandoned in favor of upper station at rock station installed approximately 10 m upstream, and why the upper station at rock was also abandoned.

Channel Description:

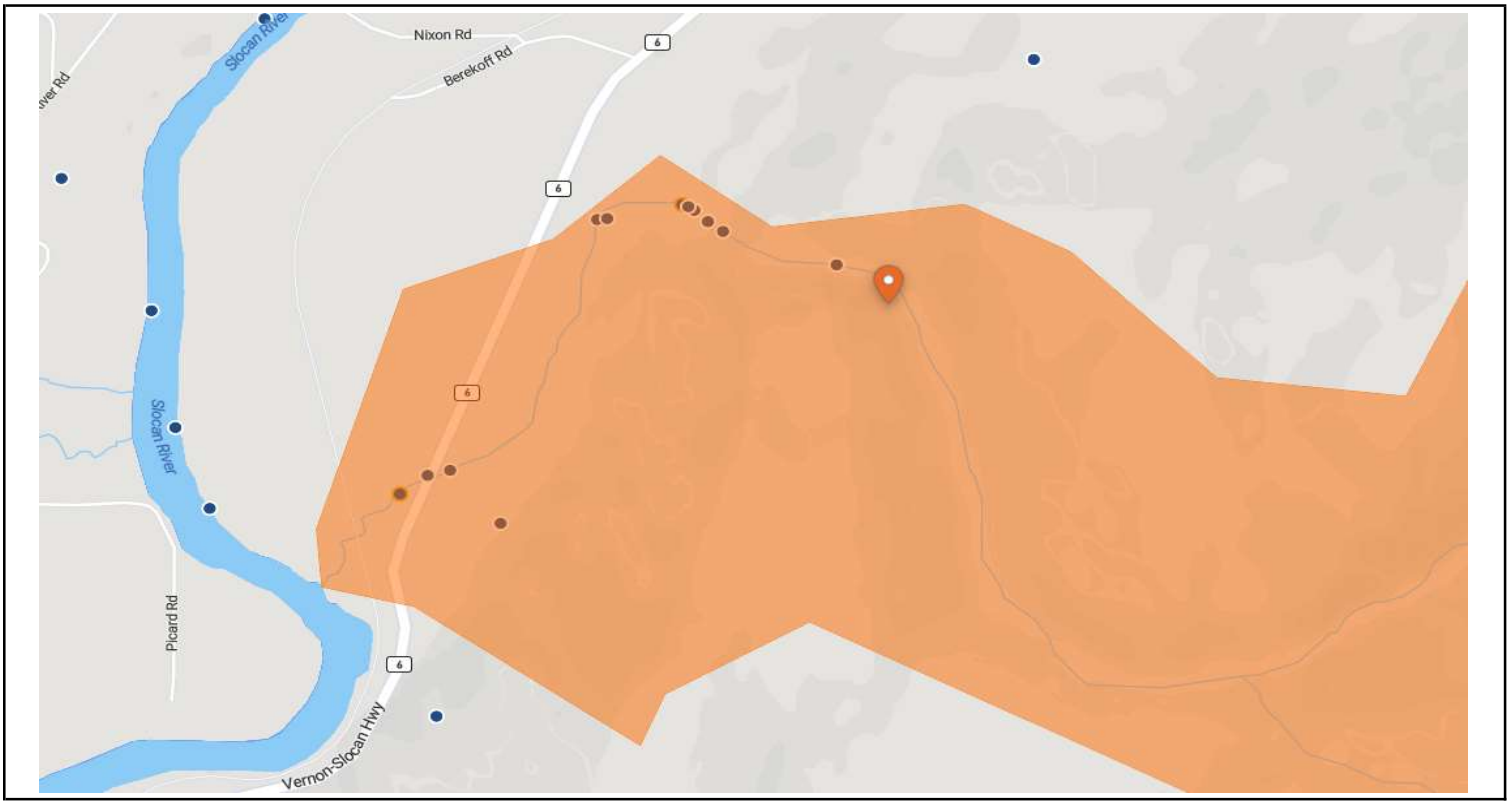
The channel is steep at the location and consists of gravel and large loose rocks. The channel width down stream of the station is relatively consistent at approximately three meters wide, though the stream does have locations where the width is smaller. Due to the steepness of the stream, the streambed is expected to shift during freshets. In addition, large wood debris is present in the stream.

Underground flow is present further downstream at the highway due to a porous streambed.

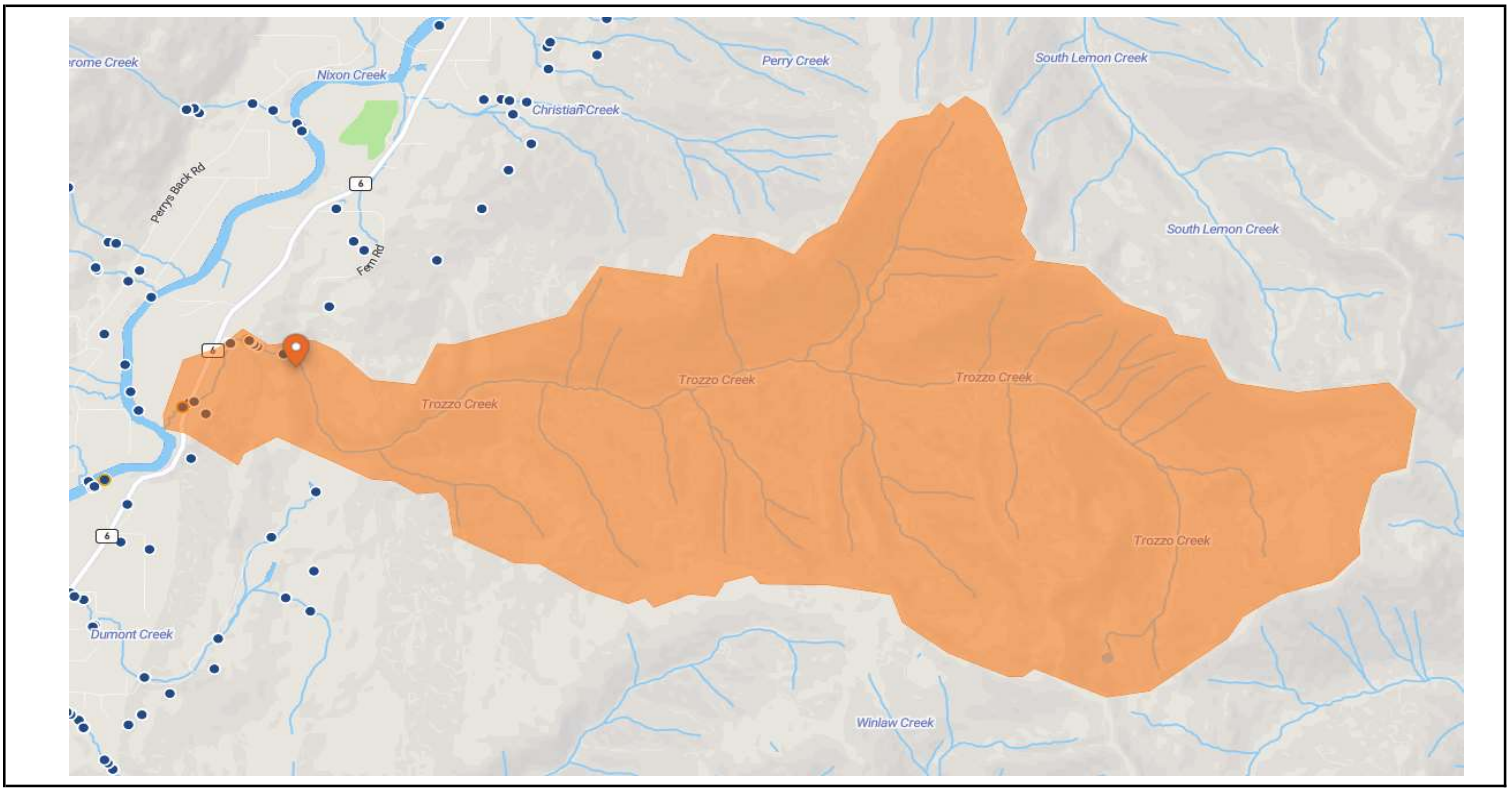
Section 9: Kootenay Boundary Water Tool Data[1]

Retrieval Date: 2022-02-19

1) Water Licences[1]



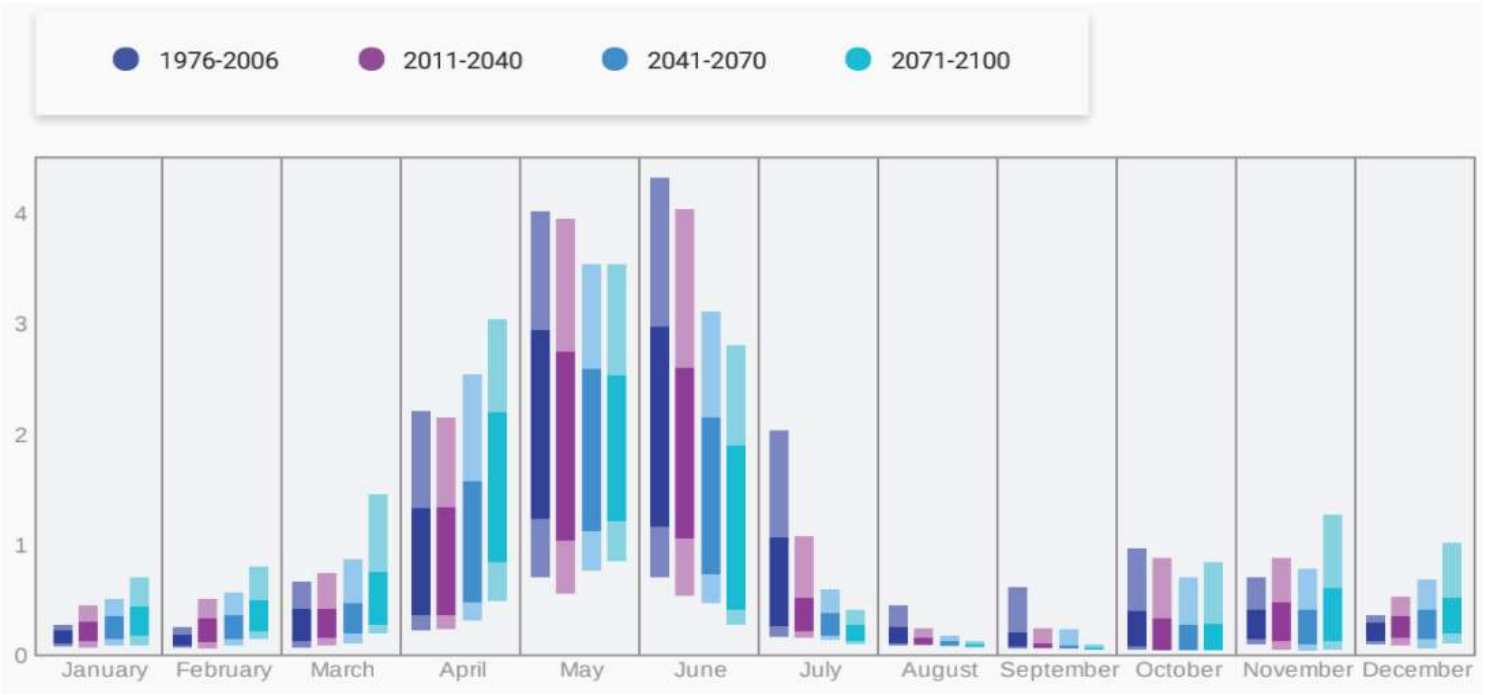
2) Watershed Delineation[1]



Section 9: Kootenay Boundary Water Tool Data[1]

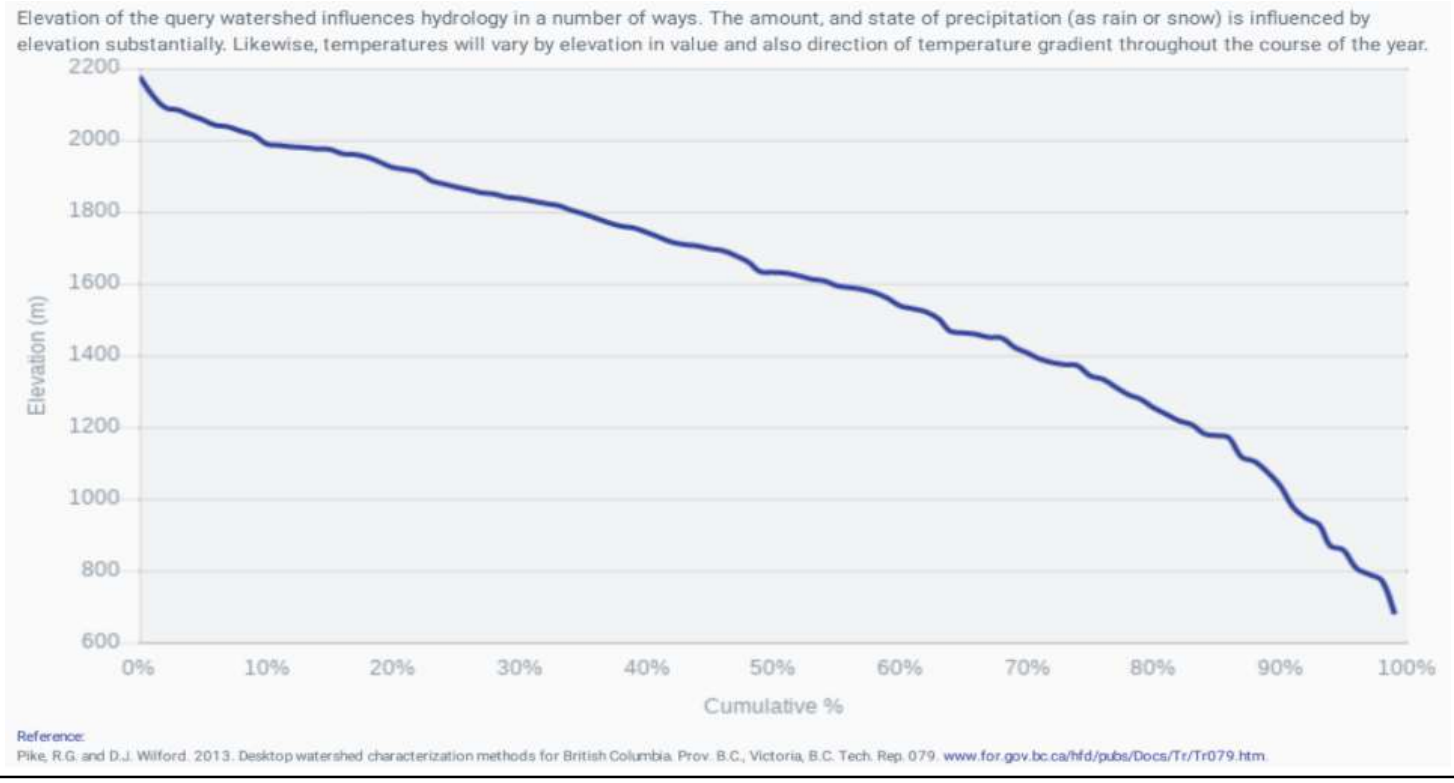
Retrieval Date: 2022-02-19

3) Current & Future Hydrologic Variability[1]



Monthly Flow Percentiles: 10th, 25th, 75th, 90th

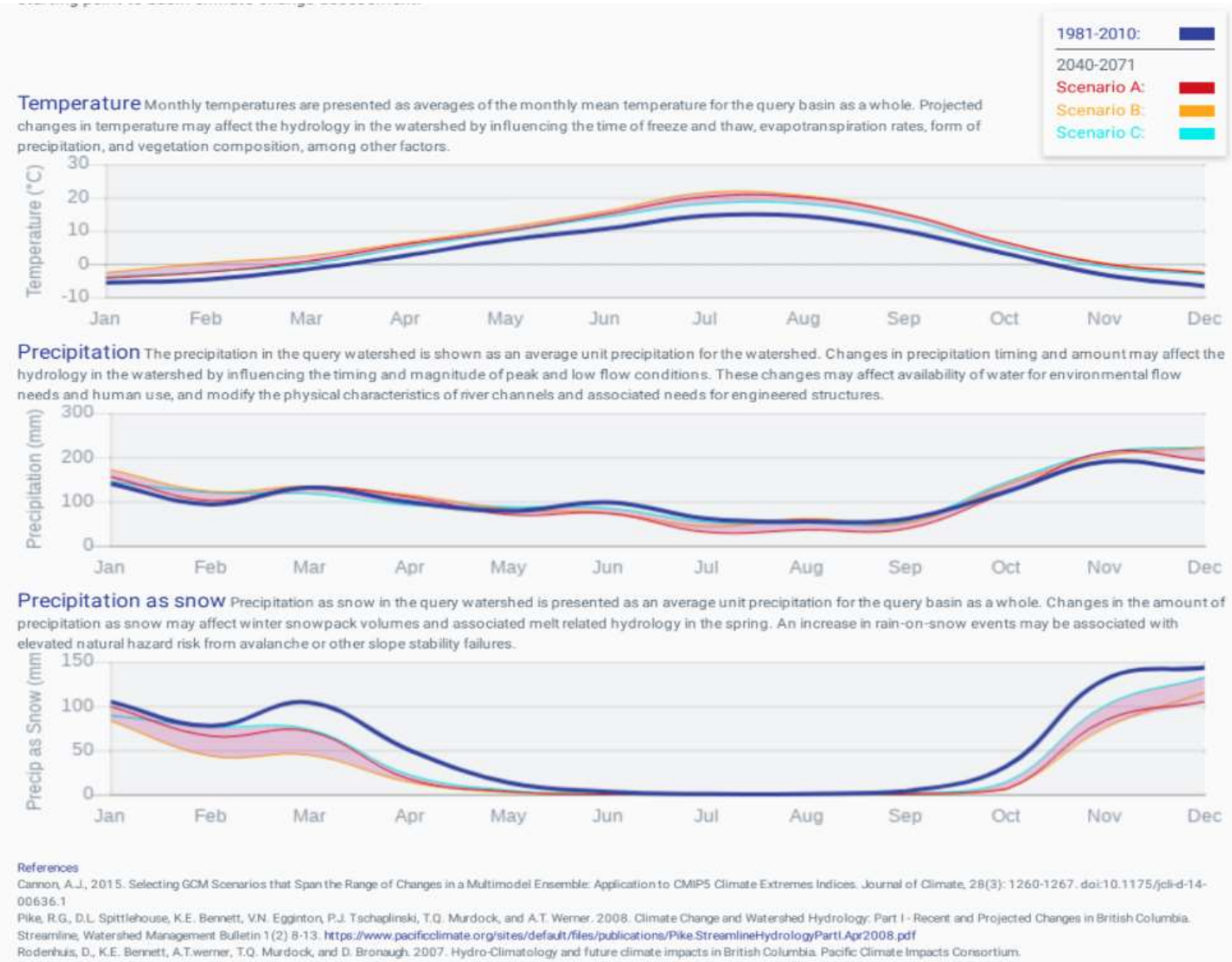
4) Topography[1]



Section 9: Kootenay Boundary Water Tool Data[1]

Retrieval Date: 2022-02-19

5) Current & Future Climate Variability[1]

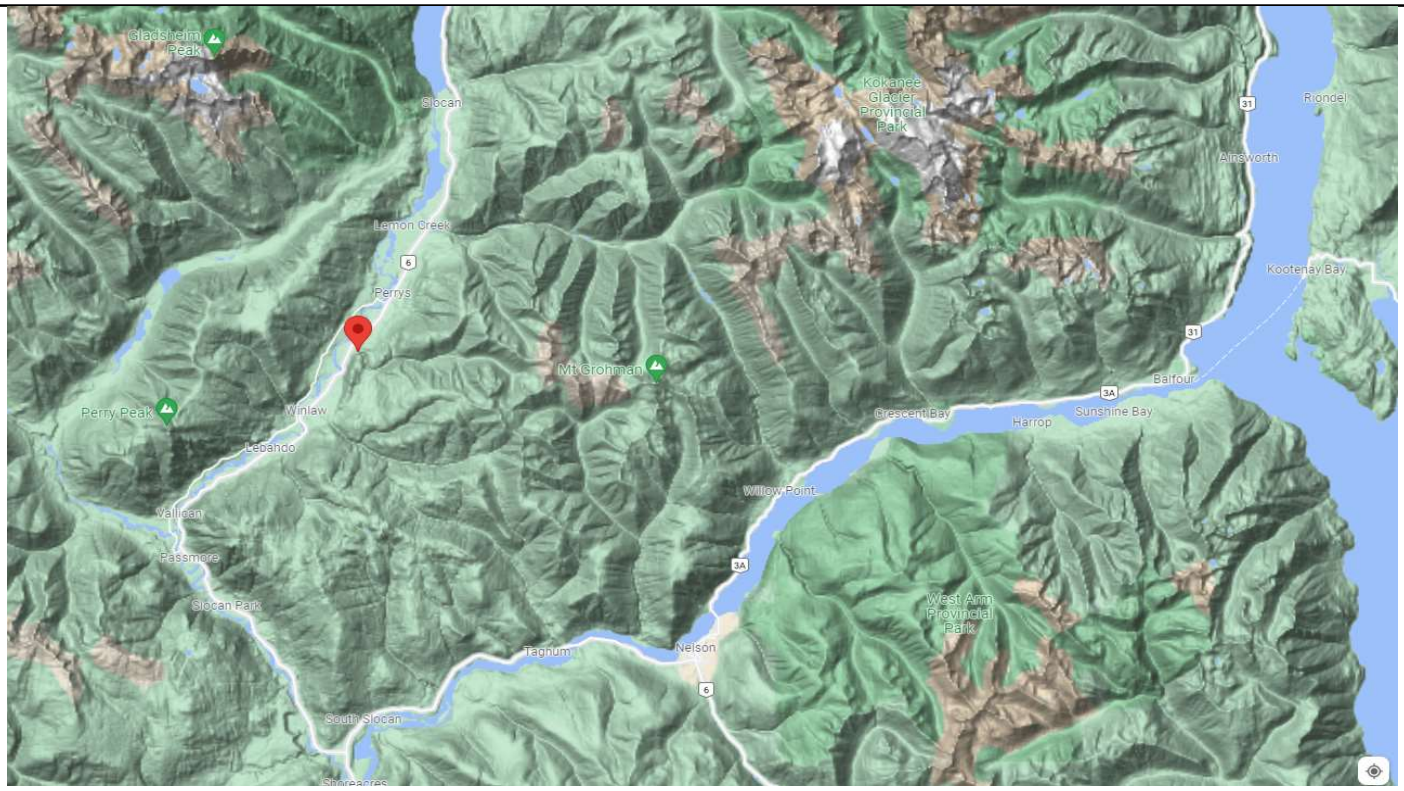


Section 10: Site Plan/Site Sketch

Site Plan 1 (original)

Drawn by: R. Gallaugher Date: 2022-02-18

1) General location on a standard base map.



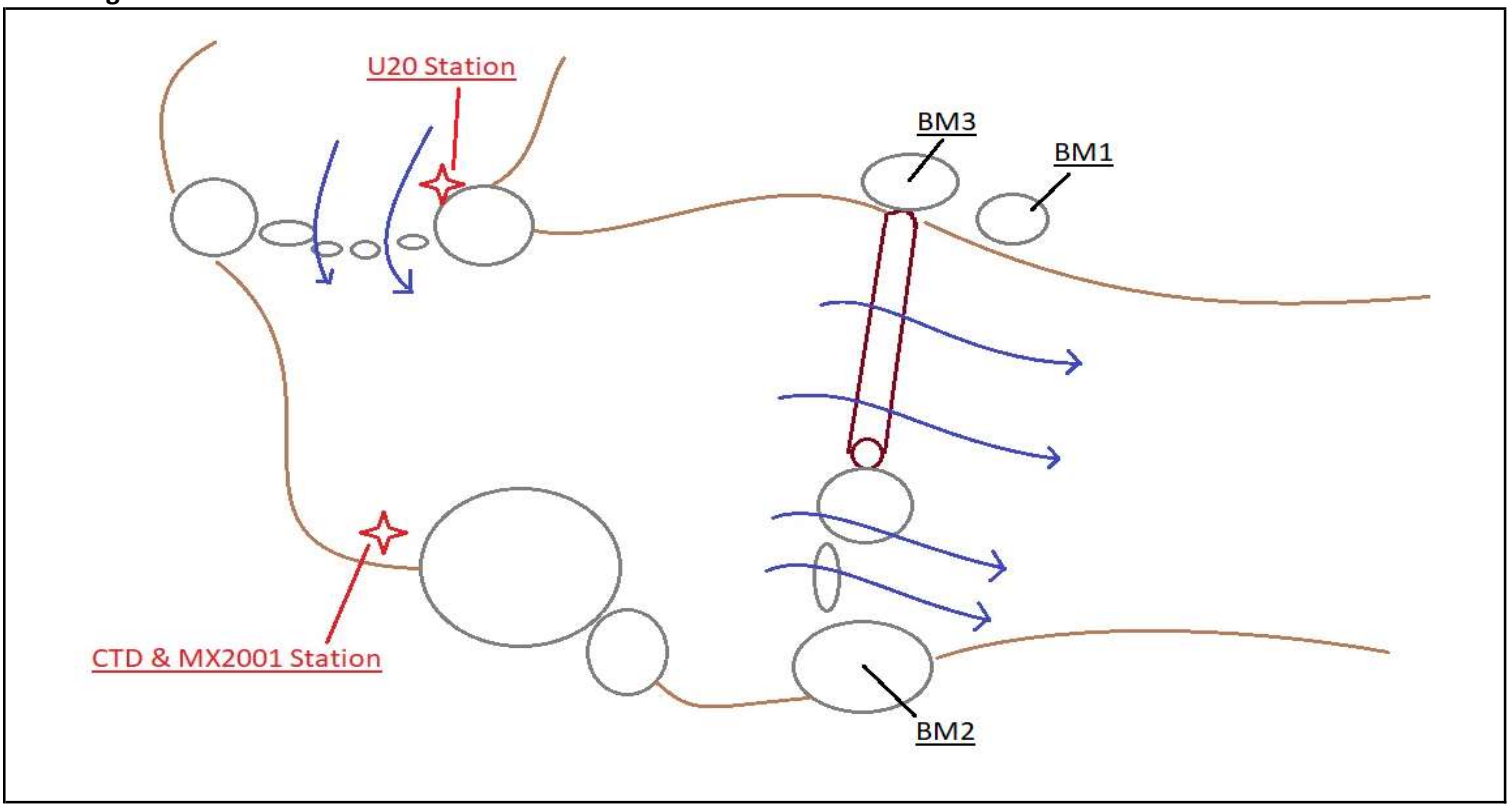
2) Sketch of station showing access and major landmarks.

The access and site are located on private property. Trespassing is not permitted.

Section 10: Site Plan/Site Sketch

Site Plan 1 (original)_Continued

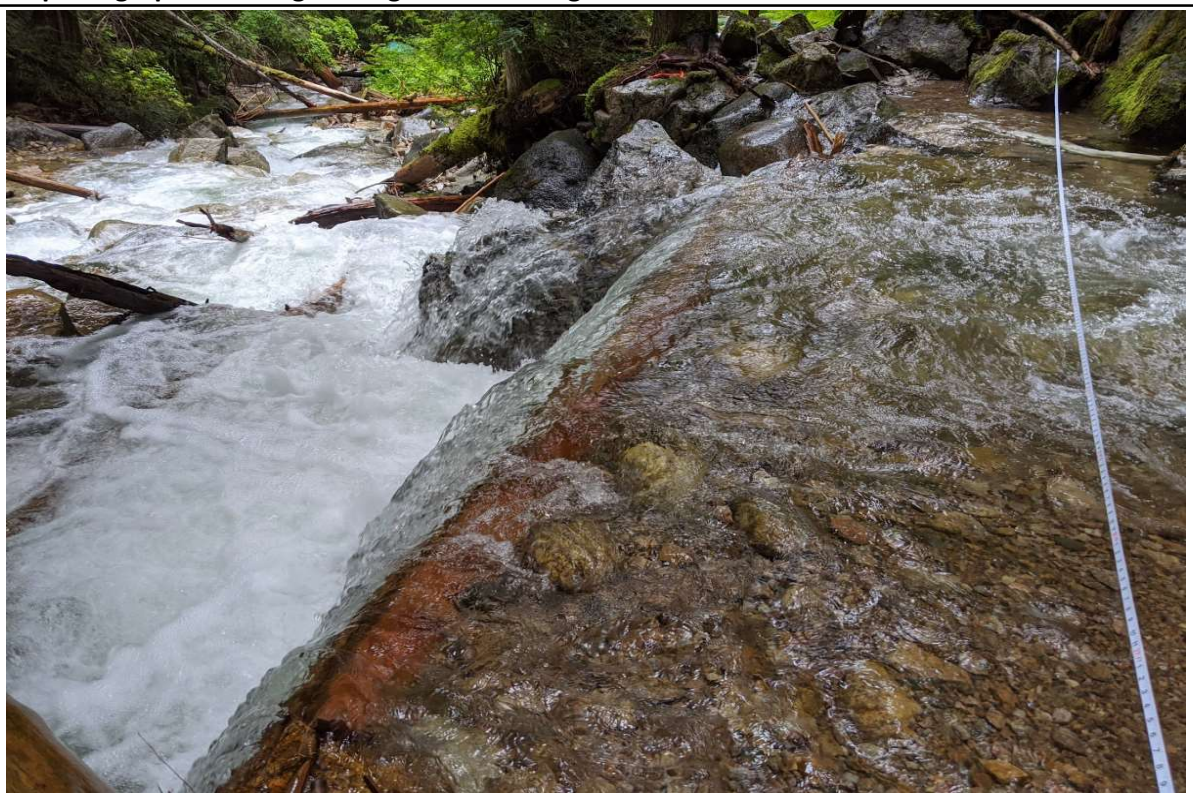
3) Sketch of site showing location of all equipment, benchmarks, channel morphology in the vicinity of the station including conditions.



4.1) Digital photographs showing station and control at high flow.

Section 10: Site Plan/Site Sketch
Site Plan 1 (original)_Continued

4.2) Digital photographs showing wading location at high flow.



4.3) Digital photographs showing sensor placement during dilution measurements.

Section 10: Site Plan/Site Sketch
Site Plan 1 (original)_Continued

4.4) Digital photographs showing dosing location during dilution measurement.

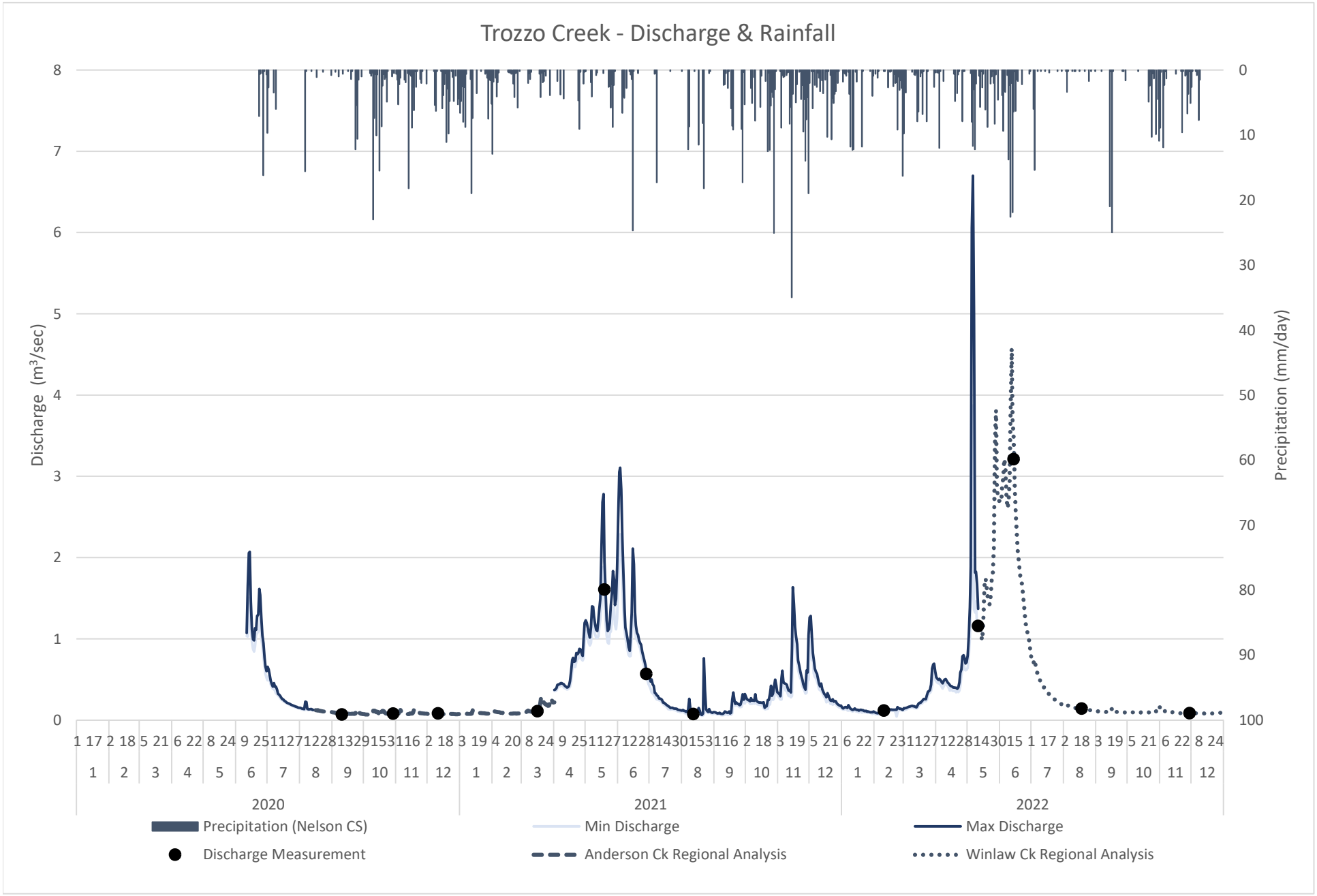
4.5) Digital photographs showing station and control at low flow.

Section 10: Site Plan/Site Sketch
Site Plan 1 (original)_Continued

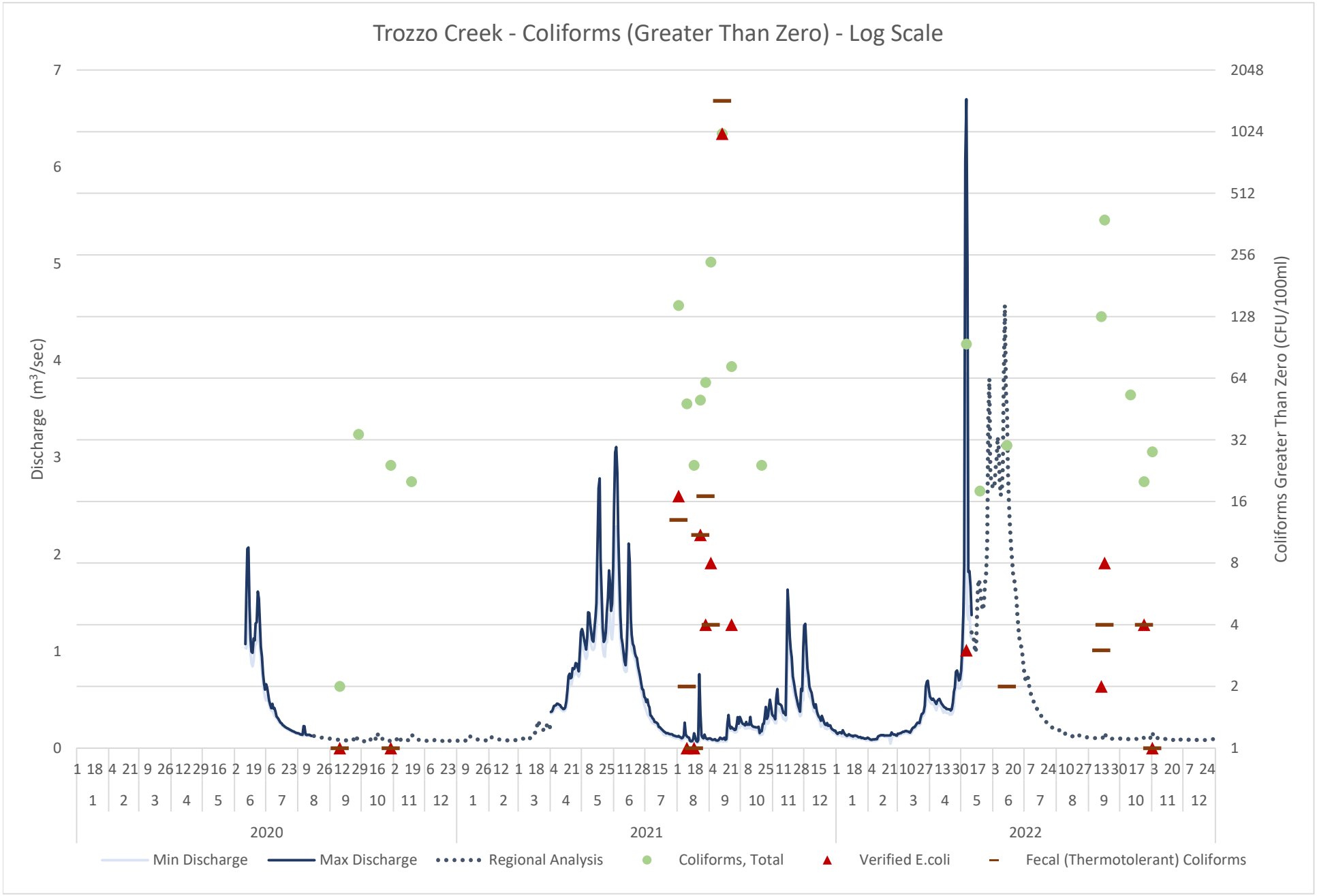
4.6) Digital Photographs showing wading location at low flow.

Hydrograph, Stage & Water Quality

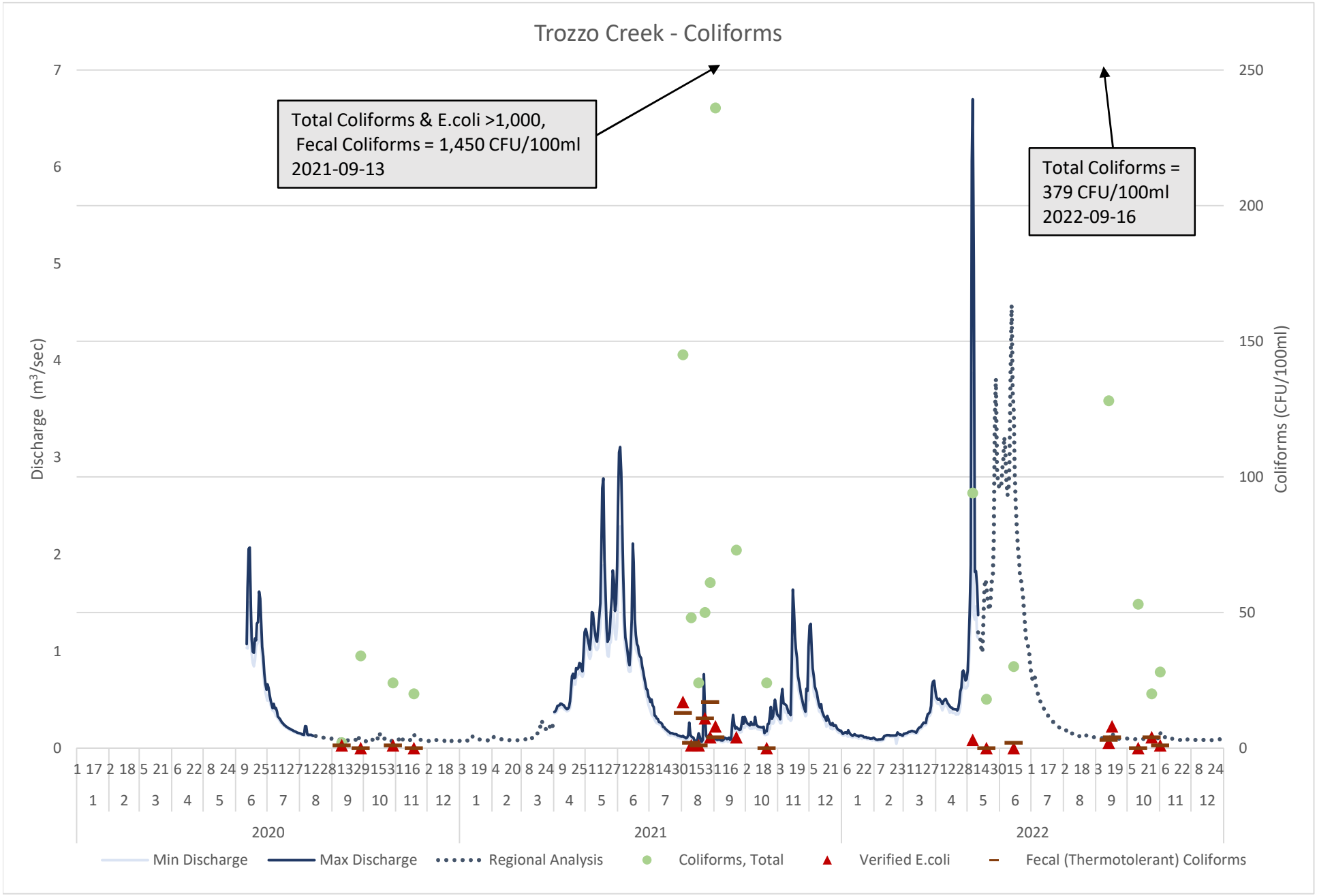
The following pages show the hydrograph, stage and water quality data over the current and past reporting periods.


Trozzo Creek - Discharge & Rainfall
Discharge (m³/sec)
Precipitation (mm/day)
0
1
2
3
4
5
6
7
8
0
10
20
30
40
50
60
70
80
90
100
1 17 2 18 5 21 6 22 8 24 9 25 11 27 12 28 13 29 15 3 16 2 18 3 19 4 20 8 24 9 25 11 27 12 28 14 30 15 3 16 2 18 3 19 5 21 6 22 7 23 11 27 12 28 14 30 15 1 17 2 18 3 19 5 21 6 22 8 24
1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12
2020
2021
2022
Precipitation (Nelson CS)
Min Discharge
Max Discharge
Discharge Measurement
Anderson Ck Regional Analysis
Winlaw Ck Regional Analysis

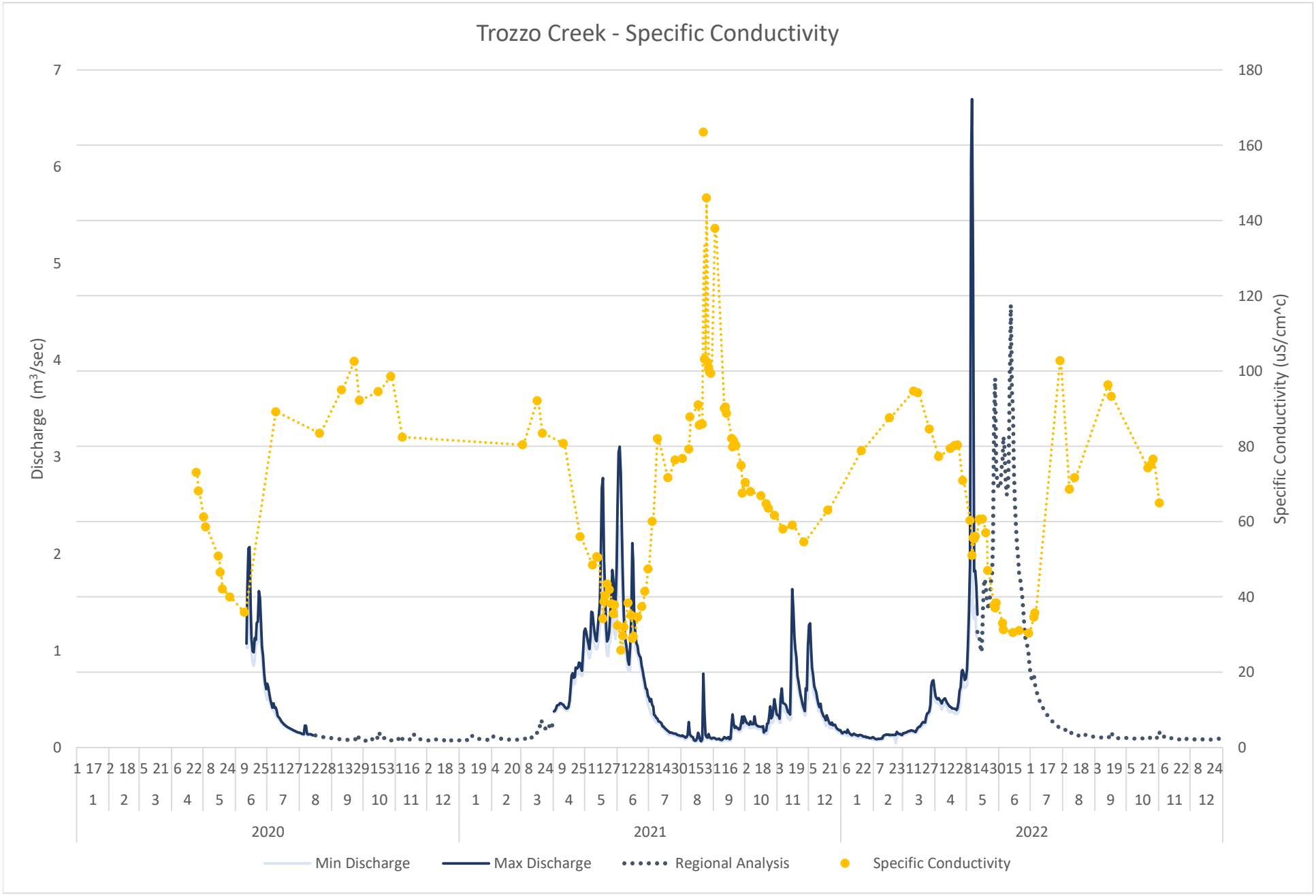
Nelson, BC
Gallaugher.Consulting@gmail.com

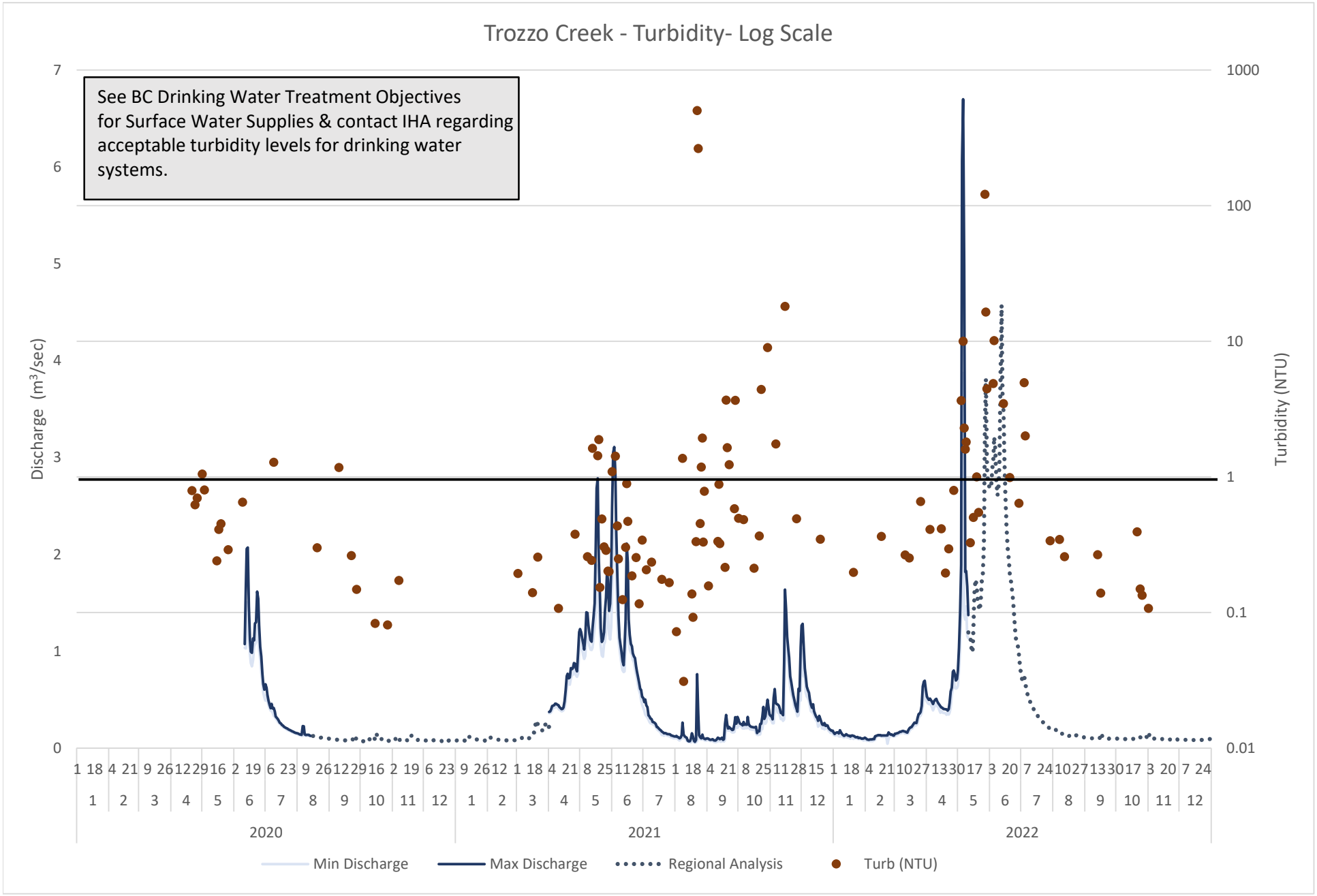


Nelson, BC
Gallaugher.Consulting@gmail.com

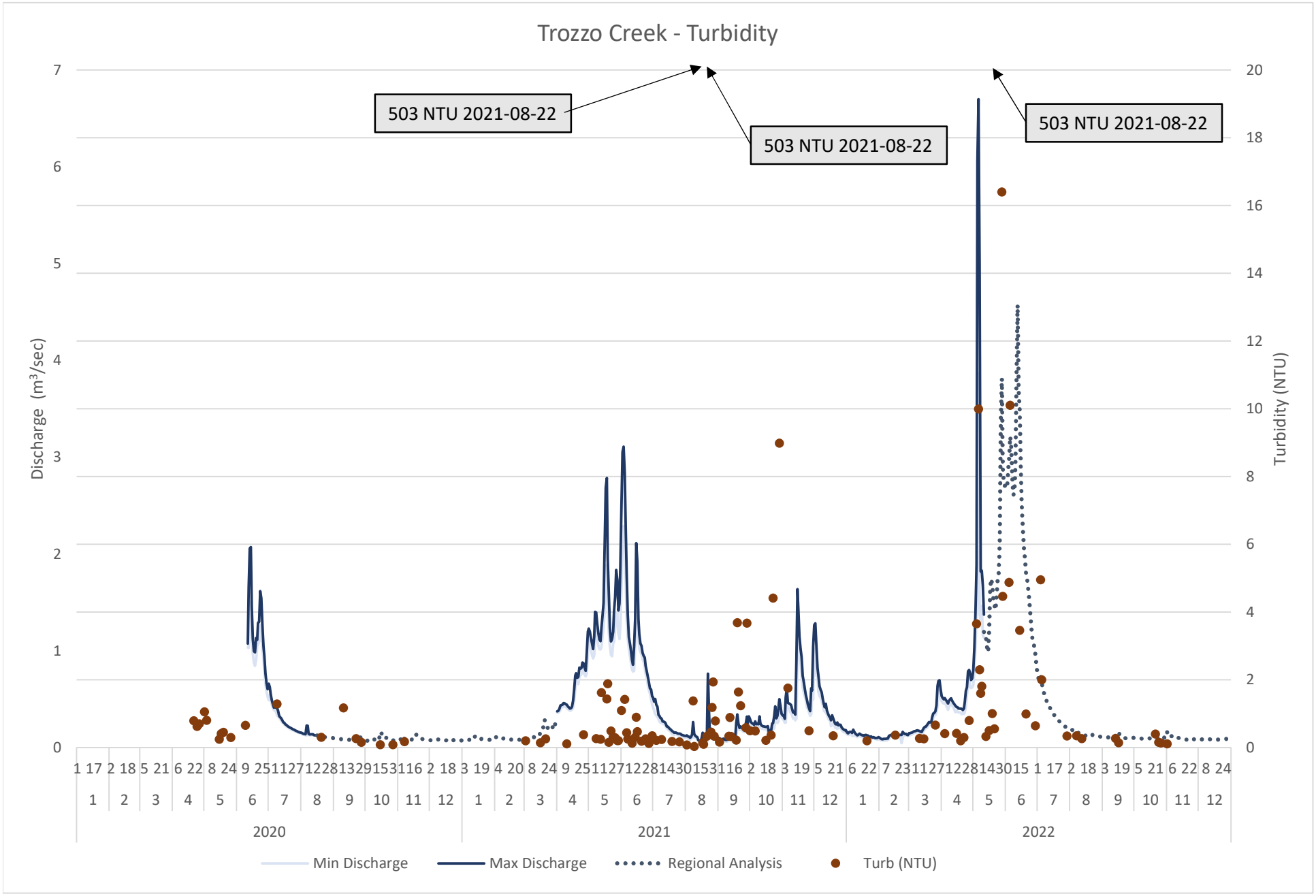


Nelson, BC
Gallaugher.Consulting@gmail.com




Trozzo Creek - Turbidity- Log Scale
See BC Drinking Water Treatment Objectives for Surface Water Supplies & contact IHA regarding acceptable turbidity levels for drinking water systems.
Discharge (m³/sec)
Turbidity (NTU)
7
6
5
4
3
2
1
0
1000
100
10
1
0.1
0.01
2020
2021
2022
Min Discharge
Max Discharge
Regional Analysis
Turb (NTU)

Nelson, BC
Gallaugher.Consulting@gmail.com



Nelson, BC
Gallaugher.Consulting@gmail.com

The stage data is not shown as the data is not comparable due to two stations being used at Trozzo Creek, and two regional analyses being used to construct the hydrograph.

Water Stage Log

The Water Stage Log, which is usually posted within the instrument shelter, may be used for systematically recording the gauge reading, time and date, and other information during a site visit. This information is particularly useful in support of data corrections (e.g., sensor drift). This form also provides a ready reference to the operating history of the station. (2019, RISC p.39)

Water Stage Log

Station ID # n/a **Station Name:** Trozzo Creek at Dam & Upper St **Gazetted Stream Name:** Trozzo Creek

Station Operation Agency/Firm: Kootenay Environmental Innovations

Contact Details: Rory Gallaugher AScT, gallaugher.consulting@gmail.com

Date	Arrival					Departure					Offset Drift (cm)	Stage Read Error (±cm)	Remarks
	Time -8GMT		Gauge Height/Stage			Time, PST		Gauge Height/Stage					
	Watch	Data	SG	Logger	Offset	Watch	Data	SG	Logger	Offset			
2020-06-11	17:50	17:50	0.425	0.267	15.8	18:00	18:00	0.425	0.264	16.1		0.5	0.175 added to the SG reading to correct for shift.
2020-07-12	12:45	12:48	0.240	0.086	15.4	12:48	14:30	0.240	0.092	14.8	-0.7	0.5	0.175 added to the SG reading to correct for shift.
2020-08-20	10:17		0.118			10:17		0.118				0.2	The sensor was not submerged due to low water.
2020-09-10	14:46	14:55	0.255	0.116	13.9	17:05	4:32	0.255	0.189	6.6		0.2	The SG and stilling well were lowered by 0.175m.
2020-10-29	14:00		0.250			14:00		0.250				0.2	The sensor failed prior to site visit.
2020-12-11	14:28		0.255			13:40		0.255				0.2	The sensor failed prior to site visit.
2021-03-16	13:20		0.265			14:22		0.255				0.2	The sensor failed prior to site visit.
2021-04-01	18:56					18:56	19:00	0.280	0.289	-0.9		0.2	MX2001 installed.
2021-05-19	15:34	15:30	0.555	0.578	-2.3	16:53	17:00	0.560	0.568	-0.8	-1.4	1.0	High flow conditions.
2021-06-28	11:30	11:30	0.345	0.362	-1.7	12:10	12:15	0.340	0.294	4.6	-0.9	0.5	
2021-08-12	17:41		0.155			17:41	18:00	0.155	0.111	4.4		0.5	The Logger's battery had died before the site visit.
													MX2001 no longer used for calculating flow.
2021-06-28						12:00	12:00	0.379	0.297	8.2		1.0	Beginning of U20 dataset at the Upper Station at Rock
2021-08-12	15:00	15:00	0.172	0.108	6.4	18:00	18:00	0.172	0.098	7.4	-1.8	0.5	
2021-10-18	11:00	11:00	0.227	0.174	5.3	14:00	14:00	0.227	0.208	1.9	-2.0	0.5	
2022-02-10	14:45	14:45	0.195	0.166	2.9	16:00	16:00	0.195	0.160	3.5	1.1	0.5	
2022-05-11	12:00	12:00	0.500	0.388	11.2						7.7	1.5	The control was damaged retrieving the logger.
													A scaled offset was applied to correct for the sensor drift which occurred on 2022-05-11.

Summary of Discharge Measurements and SDR

The stage-Discharge Relationship (SDR) page is where the SDR is created and has the ability to show multiple curves. This may be beneficial as curves that were under consideration or past curves can be shown.

Summary or Discharge Measurements

Station ID # n/a **Station Name:** Trozzo Creek at Dam & Upper Station at Rock **Gazetted Stream Name:** Trozzo Creek

Station Operation Agency/Firm: Kootenay Environmental Innovations

Contact Details: Rory Gallaugher AScT, gallaugher.consulting@gmail.com

Date	Time (-8 GMT)	Measured By	Codes				Profile				Stage/Discharge							Accur.		SDR 1 & 2 Max 28%			Remarks
			Meas. Type	Meas. Meth.	Meter Cal.	Meter Field Ver.	With (m)	No. of Verticals	Total Area (m^2)	Mean Vel. (m/sec)	Stage Accuracy (±m)	Mean Stage (m)	Q (m3/sec) At Dam Station	Q (m3/sec) Upper Station at Rock	Q (m3/sec) Blank	Q (m3/sec) Blank	Q (m3/sec) Abandoned	DI Q Diff. (%)	Data Grade	Calc'd. Q (m^3/sec)	Use in SDR (Y/N)	SDR Accuracy (%)	
2020-07-09	14:51	RG	SW	4	1	1	6.0	28	1.40	0.50		**0.270**					**0.693**		U	0.333			Location was poor.
2020-09-10	16:50	RG	SW	4	1	1	1.2	11	0.19	0.37		**0.148**	**0.070**						C	0.085	y	21%	SG = @ Dam Site
2020-10-29	14:21	RG	SW	4	1	1	1.4	24	0.23	0.35		**0.145**	**0.079**						B	0.081	y	2%	SG = @ Dam Site
2020-12-11	14:40	RG	SW	4	1	1	2.1	25	0.24	0.35		**0.141**	**0.084**						B	0.076	y	10%	SG = @ Dam Site
2021-03-16	14:05	RG	SW	4	1	1	1.6	28	0.31	0.35		**0.192**	**0.109**						B	0.155	n		SG = @ Dam Site
2021-05-19	17:13	RG	DI	14	1	1						**0.558**	**1.608**					4%	BP-A	1.600	Y	1%	SG = @ Dam Site
2021-06-28	11:50	RG	SW	4	1	1	4.1	31	1.55	0.49		**0.343**	**0.569**						B	0.560	y	2%	SG = @ Dam Site
2021-08-12	17:20	RG	SW	4	1	1	1.7	24	0.30	0.25		**0.155**	**0.074**						B	0.095	y	28%	SG = @ Dam Site
2021-06-28	11:50	RG	SW	4	1	1	4.1	31	1.55	0.49		**0.379**		**0.569**					B	0.574	y	1%	SG = @ Rock Site
2021-08-12	17:20	RG	SW	4	1	1	1.7	24	0.30	0.25		**0.172**		**0.074**				7%	BP-B	0.078	y	5%	SG = @ Rock Site
2022-02-10	15:15	RG	DI	14	1	1						**0.195**		**0.117**				3%	BP-A	0.107	y	9%	SG = @ Rock Site
2022-05-11	14:25	RG	DI	14	1	1						**0.500**		**1.159**				8%	BP-U	1.159	y	0%	CFT may be at issue
2022-06-14	18:42	RG	DI	14	1	1								**3.212**				12%	BP-B		y		Stage unavailable
2022-08-18	15:34	RG	DI	14	1	1								**0.141**				2%	BP-A		y		Stage unavailable
2022-11-29	13:07	RG	DI	14	1	1								**0.086**				2%	BP-A		y		Stage unavailable

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Stage-Discharge Relationship (SDR) Construction

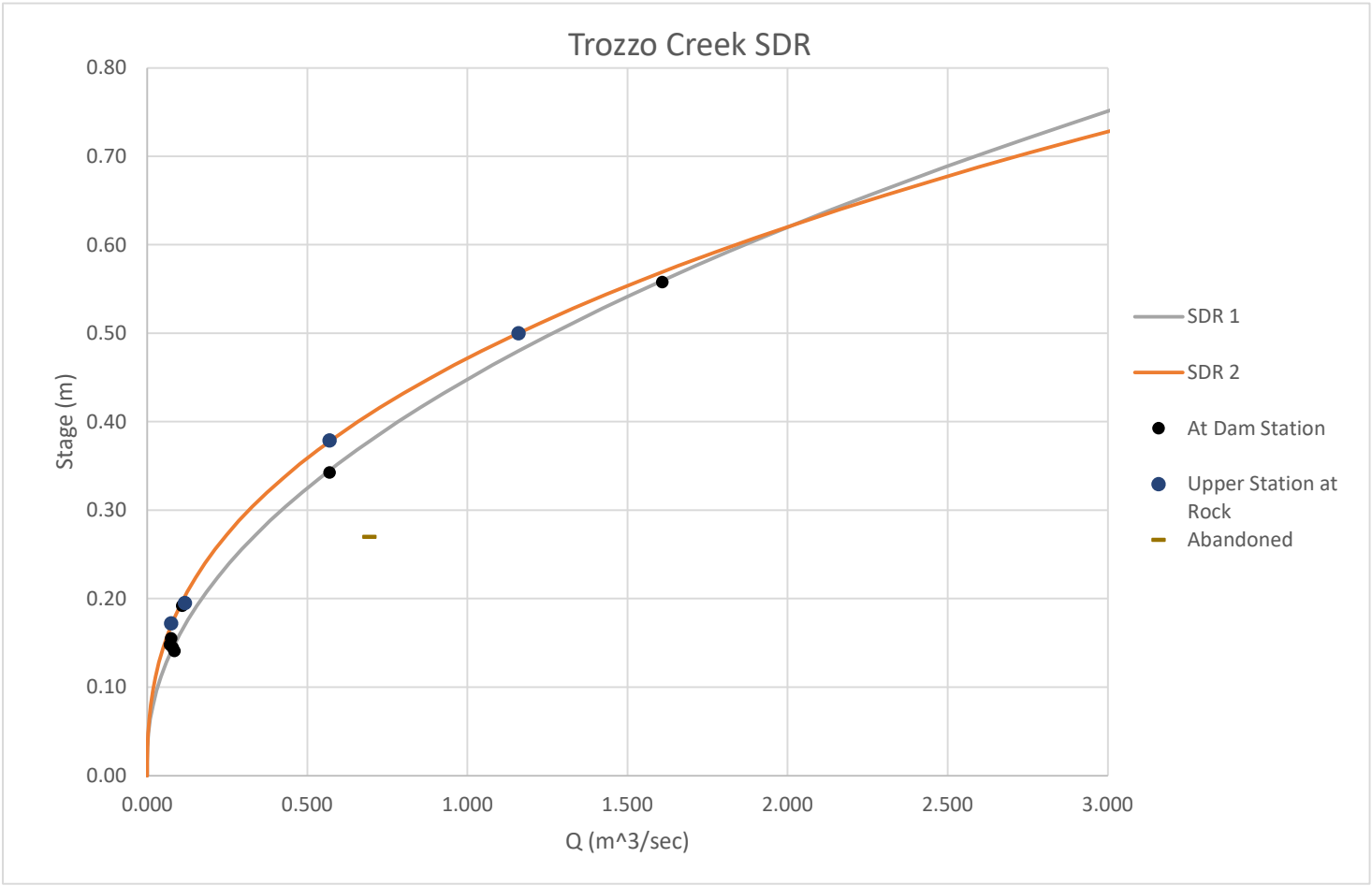
SDR Stage Start (m) **0.00**
SDR Stage End (m) **0.80**

SDR Formulas

SDR #	C	h_o	b	Disp. (Y/N)
1	5.69	0.02	2.06	Y
2	6.70	0.00	2.53	y
3				
4				
5				

SDR Descriptions

Both SDR #1, built for the station at the dam, and SDR #2, built for the upper station, are not considered unreliable as the controls regularly change. SDR #1 was build from stage data that was corrected due to changes in the control. All data is considered to be grade U (Unknown).



Stage-Discharge Relationship Sign-Off

Daily or continuous discharge data cannot practically be obtained directly. It is however possible to obtain daily or continuous water level/stage data and from those a continuous discharge record can be estimated based on this relationship of water level and flow. The result is a correlation called the stage-discharge relationship. A history of the relationship evolves over time, as each discharge measurement and corresponding stage is plotted, and a smooth curve is drawn that best represents these points (2019, RISC p.90).

Stage-Discharge Relationship Sign-Off

Station Identification Number: n/a **Gazetted Stream Name:** Trozzo Creek
Station Name: Trozzo Creek at Dam & Upper Station at Rock
Station Operation Agency/Firm: Kootenay Environmental Innovations
Contact Details: Rory Gallaugher AScT, gallaugher.consulting@gmail.com
SDR Curve No.: **Date Created:**
SDR Revised (Y/N): **Date of SDR Revision:**
Number of points used to generate the curve:
Curve Period: **From** **To**
Highest Measured Discharge (m3/sec): **At Stage (m):**
Lowest Measured Discharge (m3/sec): **At Stage (m):**
Stage at Zero Flow (m): **Approximate Bank Elevations (either bank overtopped) (m):**

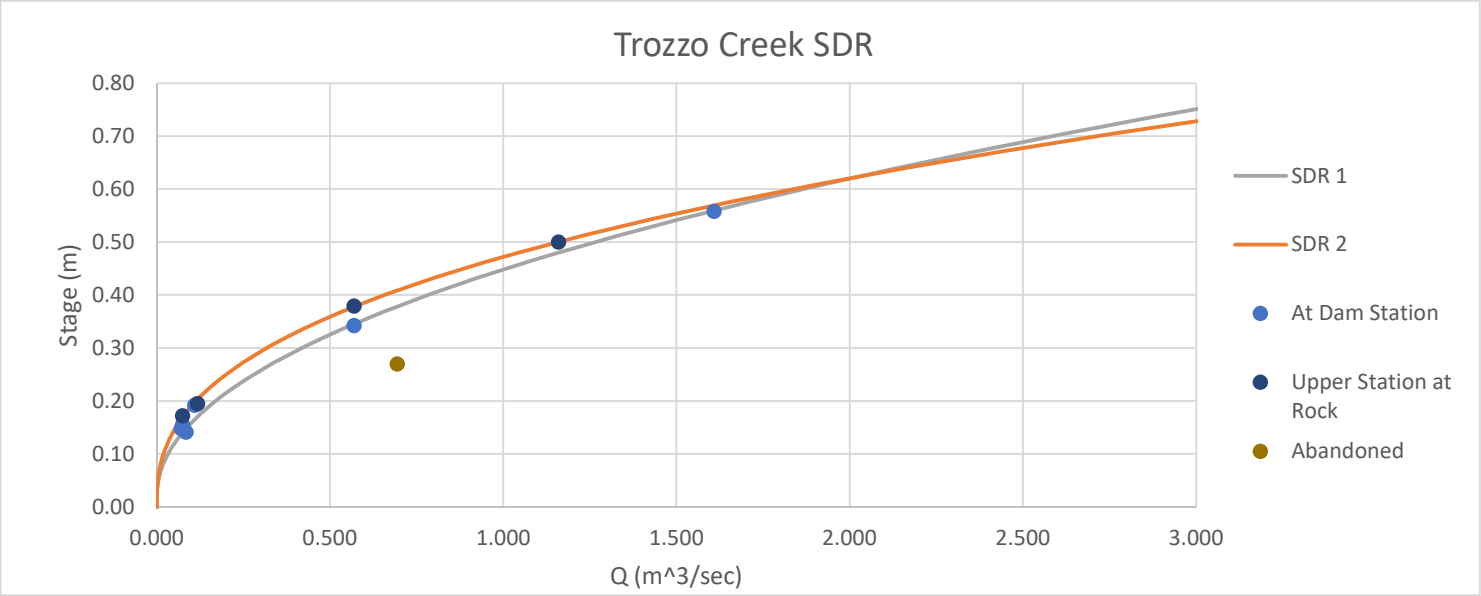
Date Grades

Data Grade	Unknown	Grade B	Best Practices	Estimated
Flow (m^3/sec)	All data			
Stage (m)				

SDR Formula:

$Q=C_o*(H-h_o)^b$ #1 $Q=5.69*(H-0.02)^{2.06}$ #2 $Q=6.70*(H-0.0)^{2.53}$

SDR Curve Image:



Remarks: SDR #1 was constructed with level data from the "at dam" location, and SDR #2 was constructed with level data from the "upper station at rock". The stage data used in SDR #1 was adjusted due to residents damming the location to pool water at their point of diversions. Both SDRs are no longer applicable as multiple control changes have occurred. All data is considered to be graded as Unknown.

Computed By: R. Gallaugher **Date:**
Checked By: R. Gallaugher **Date:**

Station Analysis

The Station Analysis form describes the complete analysis of data collected, procedures used in processing the data, and the logic upon which the computations are based (2019, RISC p.9).

Station Analysis for the Period:

From: 2020 Jun-11 **To:** 2022 Dec-31

[Note: This form must be signed by hydrometric data approver with appropriate professional seal and submitted both original and a PDF copy to the database administrator to capture in provincial water database]

Station Identification Number: n/a **Gazetted Stream Name:** Trozzo Creek
Station Name: Trozzo Creek at Dam & Upper Station at Rock
Station Operation Agency/Firm: Kootenay Environmental Innovations
Contact Details: Rory Gallaugher AScT, gallaugher.consulting@gmail.com

Number of Level Checks Made Per Year: ☑ **2 or more** ☐ **1 or more** ☐ **None/undefined**
☐ **Gauge Correction NOT Required**
☑ **Gauge Correction Requited (see table below):**

Date and Time (-8:00 GMT)	Correction (m)	Remarks
June 11, 2020 → Aug 13, 2020 @9:25	+0.030	Stage adjusted due to dam failure.
June 11, 2020 → Aug 13, 2020 @9:25	+0.175	Staff gauge was lowered.

Discharge Record (Instantaneous)

Disch. (m^3/sec)		% Diff.	Stage (m)	Stage Diff (m)	Date and Time (-8:00 GMT)
Max. Calculated Discharge					
Max. Measured Discharge					
Min. Calculated Discharge					
Min. Measured Discharge					

Number of Manual Flow Measurements Per Year:
☐ **5 or more** ☑ **3 or more** ☐ **2 or more** ☐ **Less than 2/ Undefined**

Missing Period of Discharge Record		Reason
From	To	
2020-08-16	2021-04-01	Mayfly datalogger suffered from a broken solder joint.
2022-05-11	2022-12-31	MX2001 suffered from a now-known warranty return issue. Batteries would drain completely in as few as two days, at which time the data would become corrupted.

Stage Discharge Relationship

	Curve No.	Start Date	End Date	Cause for the Shift
Previous Years	1	2020-06-11	2021-06-08	The control was first dammed, and then was subsequently wiped out by the freshet.
Present Year	2	2021-06-08	2022-05-11	The control was destroyed in retrieving the U20 sensor which was buried in sediment.

There is currently no applicable curve for the station due to the extreme flow conditions and bed movement directly above the points of diversions.

Remarks: Discharge estimates for missing periods derived by graphical comparison to: Stage and discharge
Climate Station(s): Nelson CS
Other Hydrometric Station(s): Anderson Creek's stage and Winlaw Creek's discharge.

Standard procedures followed for hydrometric operation:
☑ **RISC Standards (i.e., Manual of British Columbia Hydrometric Standards)**
☐ **None/Unknown** ☑ **Other, Specify:** Two regional analysis comprised a large part of the dataset.

Instruments & methods used for hydrometric operation were appropriate for field conditions (Y/N): ☐
All metadata, field notes and calculations were reviewed for anomalies (Y/N): ☐
Results were compared with other stations and/or other years for consistency (Y/N): ☑
Reviewed time series water level and discharge data with associated meta data were submitted to the Provincial Database (Y/N): ☐
Data can be made available to public (Y/N): ☐

DATA DECLARATION

I, Rory Gallaugher have reviewed all data and operating information for this hydrometric station. Data Grades have been assigned as per standards requirement criteria as defined by the Manual of British Columbia Hydrometric Standards.

Date	Professional Seal/Signature	Designation	Professional/Technological Association
2023-06-30		AScT.	Applied Science Technologists & Technicians of British Columbia