ANNUAL REPORT FOR MONITORING OF SUSPENDED SEDIMENT CONCENTRATIONS AND TURBIDITY DURING THE 2023 WATER YEAR IN MCCLOUD CREEK, HUMBOLDT COUNTY, CALIFORNIA

Pursuant to:
Monitoring and Reporting Program (MRP)
Order No. R1-2020-0001

Submitted:
November 1, 2023

Prepared By:

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1.0 Introduction

Elk River is listed as an impaired water body under Section 303(d) of the Federal Clean Water Act (USEPA, 1999) due to high instream sediment loads and associated adverse impacts to the beneficial uses of water. In response to this, the North Coast Regional Water Quality Control Board (NCRWQCB) developed a Total Maximum Daily Load (TMDL) for sediment in Elk River. In May 2016 the NCRWQCB adopted the Action Plan for the Upper Elk River Sediment TMDL as an amendment to the Water Quality Control Plan for the North Coast. The TMDL Action Plan was approved by the State Water Resources Control Board in August 2017, the Office of Administrative Law in March 2018, and the US Environmental Protection Agency in April 2018.

To address the Elk River sediment impairment, the NCRWQCB has adopted and revised multiple Waste Discharge Requirements (WDRs) with Green Diamond Resource Company (GDRCo) over the years. These Orders have included Monitoring and Reporting Programs (MRPs), that includes the monitoring activities that GDRCo has been conducting in Elk River beginning in 2006. The current Order (R1-2020-0001) supersedes those portions of GDRCo's Forest Management WDR (Order R1-2012-0087) that apply to certain activities conducted by GDRCo on our timberlands in the Upper Elk River Watershed.

As part of the MRP in Order No. R1-2020-0001, GDRCo has agreed to continue to conduct water-quality trend monitoring in McCloud Creek, a tributary of SF Elk River. Using Turbidity Threshold Sampling (TTS), GDRCo measured stage, water velocity, turbidity and suspended sediment concentrations in McCloud Creek during the 2023 water year (WY). This annual report covers the period from October 1, 2022 through July 1, 2023, during which TTS monitoring occurred.

2.0 Data Collection and Analysis Activities

Data collection and analysis have been conducted as outlined in the MRP (Order No. R1-2020-0001), Standard Operating Procedures, and the Turbidity Threshold Sampling Quality Assurance Project Plan for McCloud Creek. See this document for further details on the monitoring parameters, protocols, and frequencies.

2.1 Station Installation and/or Adjustments

Equipment was installed on September 28, 2022 at the McCloud Creek TTS station for the 2023 WY. The station was turned online to monitor stage only as the monitoring unit was hydrologically disconnected at this time. Turbidity was monitored beginning on November 2, 2022, however continuous flow was not observed until November 7, 2022. The station remained powered on to monitor stage and turbidity for the remainder of the water year.

2.2 Continuous Measurement Station

The 2023 WY concluded the 17th year of monitoring at the McCloud Creek TTS station. The TTS station was established in McCloud Creek in 2007 on BLM property, approximately 400 feet upstream from the confluence with SF Elk River (Figure 1). The watershed area above the McCloud TTS monitoring site is approximately 1,482 acres (6.0 km^2). The specifications for the construction and operation of the TTS station are based on procedures developed by the United States Forest Service Redwood Science Laboratory (Lewis and Eads, 2008). The station automatically records stage height and turbidity at 10-minute intervals and collects and stores automated grab samples of creek water, which are later transported to the lab and analyzed to quantify turbidity and suspended sediment concentration. Table 1 displays all the parameters and frequency of measurements collected at the McCloud Creek TTS station.

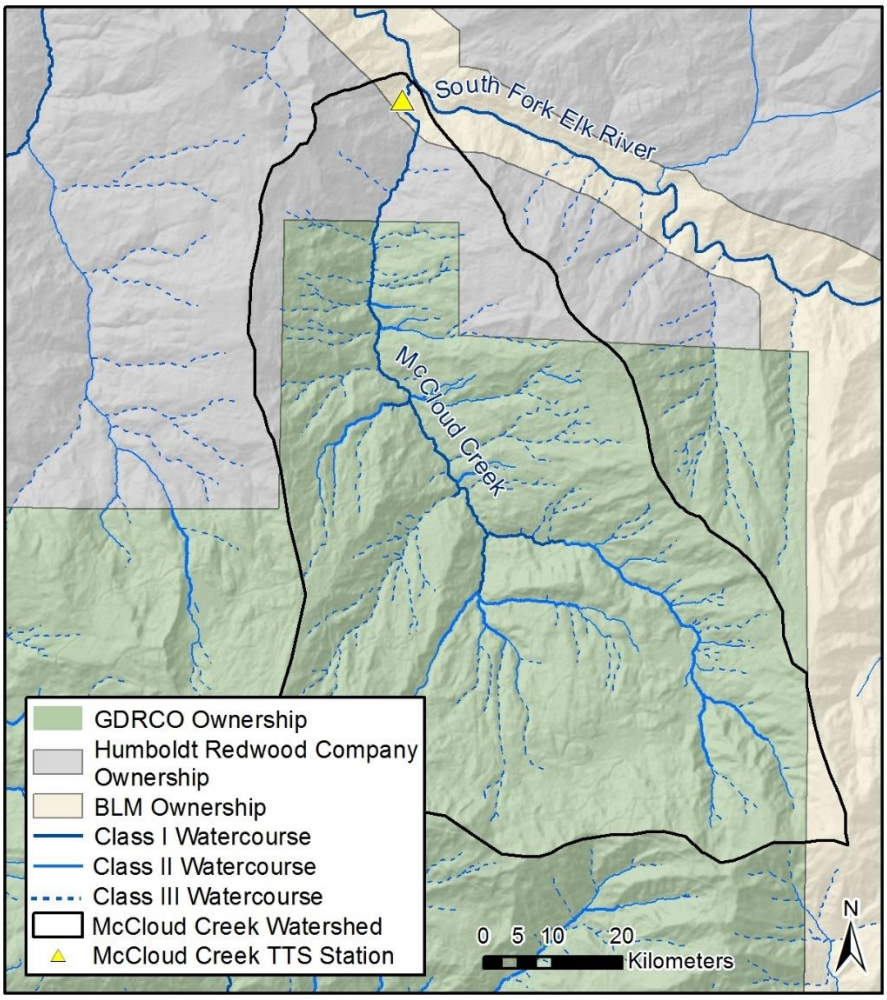

Figure 1. Location of the McCloud Creek TTS station and the extent of the watershed being monitored.

Table 1. McCloud Creek TTS station parameters and specifications.

Parameter	Units	Sampling Method	Sampling Frequency
Turbidity	FNU	DTS-12 (turbidimeter, *in situ* measurement)	Continuous (10-minute interval)
Turbidity	NTRU	Manual grab sample, ISCO water sampler	When FNU $\geq$ 30 during visit
Suspended sediment	mg/L	Manual grab sample, ISCO water sampler	When FNU $\geq$ 30 during visit
Suspended sediment	mg/L	Automated grab sample, ISCO water sampler	Event driven, based on turbidity thresholds
Discharge	CFS	Direct measurement	Weekly[1,2] and as needed for stage-discharge relationship
Stage	ft	Druck (pressure transducer, *in situ* measurement)	Continuous (10-minute interval)
Stage	ft	Stage plate	Weekly[2] and when present for stream flow measurements

[1] May vary due to low-flow conditions where velocity is below minimum required for current meters.

[2] May vary due to the inability to access MC2 during high flows.

2.2.1 Field Visits – Summary of Logs

A total of 45 field visits (about one or more times a week) were conducted during the 2023 WY. Visits were conducted to exchange bottles and batteries, download data, take flow measurements, or perform other storm-related maintenance activities. A summary of the activities conducted during the 2023 WY is provided in Table 2.

Table 2. Summary of field activities at the McCloud Creek TTS station during the 2023 WY. *Type: SI = Site installation, MO = Monitoring (flow measurements, and grab samples), MA = Maintenance (sensor cleanings and site adjustments), CO = Construction, G/C = grab and control sample collected.

Date	Type	Comments
9/28/2022	SI/CO	Monitoring equipment installed, station online for stage only
10/7/2022	MO/MA	Discharge not measured, station online for stage only
10/20/2022	MO	Discharge not measured, station online for stage only
10/26/2022	MO	Discharge not measured, station online for stage only
11/2/2022	SI/MO/MA	Discharge not measured, site is fully online for stage and turbidity
11/7/2022	MO/MA	Measured discharge, G/C, adjusted DTS
11/17/2022	MO/MA	Discharge not measured, adjusted DTS
11/22/2022	MO	Discharge not measured
12/1/2022	MO/MA	Measured discharge, adjusted DTS, G/C
12/5/2022	MO/MA	Discharge not measured, G/C, adjusted DTS
12/6/2022	MO/MA	Discharge not measured
12/9/2022	MO	Discharge not measured, adjusted DTS
12/12/2022	MO/MA	Measured discharge, adjusted DTS
12/19/2022	MO/MA	Measured discharge, adjusted DTS
12/22/2022	MO	Discharge not measured
12/27/2022	MO/MA	Measured discharge, adjusted DTS, G/C
12/29/2022	MO/MA	Measured discharge
12/31/2023	MO/MA	Measured discharge, adjusted DTS, G/C
1/10/2023	MO/MA	Discharge not measured, adjusted DTS, G/C
1/13/2023	MO/MA	Measured discharge, adjusted DTS
1/17/2023	MO/MA	Measured discharge, adjusted DTS, G/C, replaced DTS wiper blade
1/23/2023	MO/MA	Measured discharge, adjusted DTS
1/30/2023	MO	Measured discharge
2/6/2023	MO/MA	Measured discharge, adjusted DTS, G/C
2/15/2023	MO/MA	Measured discharge, adjusted DTS
2/22/2023	MO/MA	Measured discharge, adjusted DTS, G/C
3/1/2023	MO/MA	Measured discharge, adjusted DTS, G/C
3/6/2023	MO/MA	Measured discharge, adjusted DTS, G/C
3/16/2023	MO/MA	Measured discharge, adjusted DTS, G/C
3/20/2023	MO	Measured discharge, G/C
3/28/2023	MO/MA	Measured discharge, adjusted DTS, G/C
4/7/2023	MO/MA	Measured discharge, adjusted DTS
4/11/2023	MO/MA	Measured discharge, G/C, replaced DL desiccant
4/18/2023	MO/MA	Measured discharge, adjusted DTS
4/25/2023	MO/MA	Measured discharge, adjusted DTS
5/2/2023	MO/MA	Measured discharge, adjusted DTS
5/9/2023	MO	Measured discharge
5/16/2023	MO	Measured discharge
5/23/2023	MO/MA	Measured discharge, G/C
6/2/2023	MO/MA	Measured discharge, adjusted DTS
6/6/2023	MO	Measured discharge
6/12/2023	MO	Measured discharge
6/22/2023	MO/ MA	Discharge not measured, wiped DTS optics
6/26/2023	MA	Discharge not measured, Adjusted DTS
7/3/2023	MO/MA	Discharge not measured, Monitoring station taken offline and equipment removed

2.2.2 Site Observations

A summary of site observations was compiled for the 2023 WY (Table 3). These site visit observations included notable items relating to the station status and site conditions. Observations for this WY included station status, hydrologic conditions and discharge measurement quality.

Table 3. Summary of station observations collected at the McCloud Creek TTS station during the 2023 WY.

Start Date	End Date	Comment	Initials
09/28/22	11/02/22	Monitoring unit is an isolated pool and hydrologically disconnected. Station online for stage only.	MRR/SRB
11/02/22		Station is fully online for stage and turbidity	RCH
11/07/22		Reach is observed to be hydrologically connected at 0.69'	SRB
11/07/22		Discharge measurement had eight verticals <10% of total flow; graded as fair data in TTS.	SRB
12/05/22		Did not measure discharge, was recently measured at similar stage with no change in hydrograph	RCH
12/09/22		Discharge not measured as purpose of site visit was pre-storm maintenance.	MRR
12/29/22		Section control looks like it may have changed. Scour control change likely. Will review stage-discharge data to confirm.	MRR
01/17/23		Discharge measurement had one vertical >10% of total flow; graded as fair data in TTS.	SRB
01/23/23		Discharge measurement had four verticals >10% of total flow; graded as fair data in TTS.	RCH
01/30/23		Discharge measurement had four verticals >10% of total flow; graded as poor data in TTS.	SRB
01/30/23		Conducted stage plate survey of both plates, no adjustments needed.	SRB
02/06/23		Discharge measurement had one vertical >10% of total flow; graded as fair data in TTS.	SRB
04/25/23		Discharge measurement had one vertical >10% of total flow; graded as good data in TTS	RCH
05/02/23		Discharge measurement had three verticals >10% of total flow; graded as fair data in TTS	SRB
05/09/23		Discharge measurement had two verticals >10% of total flow; graded as fair data in TTS	RCH
05/16/23		Section control has light debris present, not cleaned	SRB
05/16/23		Discharge measurement had three verticals >10% of total flow; graded as fair data in TTS	SRB
05/23/23		Discharge measurement had four verticals >10% of total flow; graded as fair data in TTS	SRB
05/23/23		Even though DTS wiper is still working, cleaned some algae off DTS and DTS housing to avoid potential biofouling	SRB
06/02/23		Discharge measurement had five verticals >10% of total flow; graded as poor data in TTS	SRB
06/06/23		Discharge measurement had five verticals >10% of total flow; graded as poor data in TTS	RCH
06/12/23		Discharge measurement had two verticals >10% of total flow; graded as fair data in TTS	SRB
07/03/23		Monitoring equipment removed from station. Station offline.	RCH

2.2.3 Download Data Summary

The data logger at the TTS station was downloaded to a field tablet at least weekly when the station was online. The files were then transferred to the GDRCo server and compiled into a proprietary SQL database. Editing and analysis were performed using this database, Aquatic Informatics' AQUARIUS Time-Series©, and Microsoft Excel. The output data file for this report is labeled as "Appendix_A_MC2_All_Data_WY2023.xlsx" and was submitted with this annual report in accordance with the NCRWQCB 2014 electronic document submission guidelines (Appendix A).

2.2.3.1 Continuous Stage

A Druck pressure transducer (Druck Inc.) was used to measure continuous stage height (feet) at 10-minute intervals throughout the 2023 WY (Figure 2). Stage plate observation (accuracy +/- 0.02 feet) was used to validate the stage readings during each site visit. Where stage values were erroneous or missing due to stage drift, stage offset, or equipment failure, values were estimated using time-interpolated drift corrections, offset corrections, or interpolated using adjacent valid data in AQUARIUS. The type of estimates used for missing or erroneous data was noted and can be found in the 'Data Management' tab of the electronic data file (Appendix A).

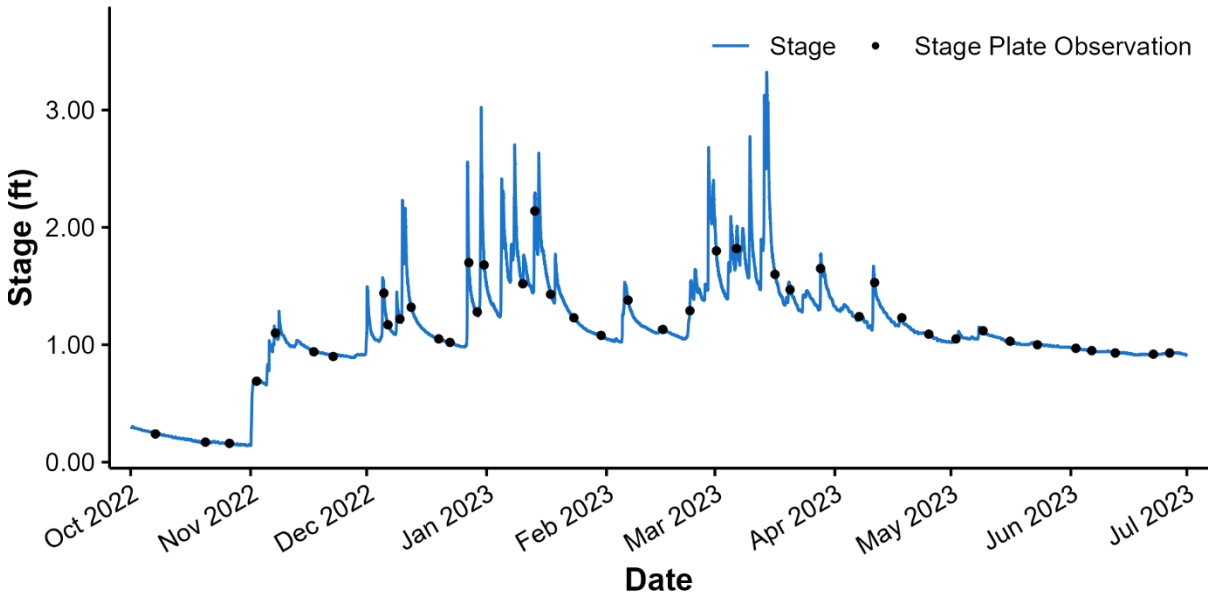

Figure 2. Continuous time-series of stage collected by the instream Druck pressure transducer sensor and stage plate observations at the McCloud Creek TTS station during the 2023 WY.

2.2.3.2 Stage-Discharge Relationship

During the 2023 WY, GDRCo personnel collected 30 water velocity measurements using the Price Pygmy flow meter. Using Aquatic Informatics' Rating Review Tool (Aquarius, 2022), coincidental stages were taken with discharge measurements and plotted to create a rating curve for the 2023 WY (Figure 3). Twenty-nine of the thirty measurements were used to verify the stage-discharge relationship used during this water year, as one measurement was poor quality due to low-streamflow conditions. The effective rating period begins on October 1, 2021 in which the same relationship was used between stage and discharge during this time since there were no major physical changes to the channel control of the monitoring unit.

Derived discharge values above the maximum measured stage of 2.12 ft for the rating period were extrapolated using the Flow Transference Method (FTM) with discharge data from the South Fork Elk River provided by Humboldt Redwood Company. Prior to water year 2022, measuring a high-water discharge above this stage has been limited by technician's ability to cross the SF Elk River which is unsafe at higher flows. Previous extrapolations of the rating curve simply extended the known curve to the maximum recorded stage value to produce a derived discharge. That extrapolation method yielded unusually high discharge values in excess of 1000 CFS which would begin to exceed discharge measurements from the Humboldt Redwood Company South Fork Elk River gaging station. The FTM yields a more realistic discharge value that is consistent with what would be expected of a watershed the size of McCloud Creek. These data should be used and viewed with caution without additional empirical support.

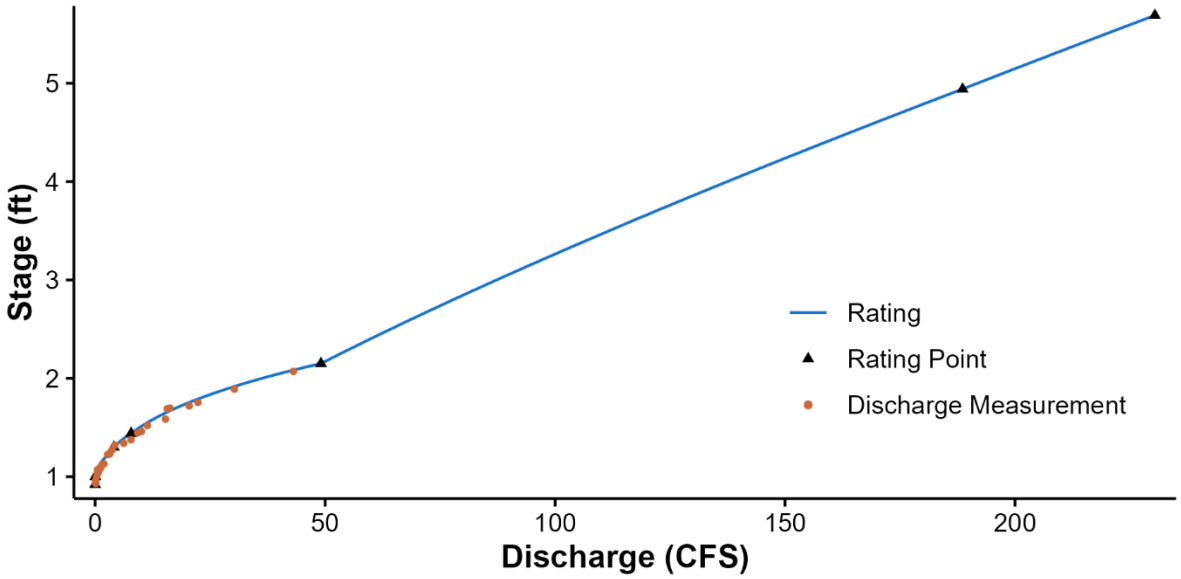

Figure 3. Discharge-stage rating including the associated rating points and measurements used for the 2023 WY.

2.2.3.3 Continuous Discharge

Continuous discharge for the 2023 WY (Figure 4) was derived using the discharge-stage rating curve and the continuous stage time series data in Aquarius. The estimated peak discharge for McCloud Creek during the 2023 WY occurred on March 14th and was about 103 CFS (stage = 3.32 ft). About 137 hours of stage measurements recorded during the 2023 WY (about 2.1%) were above the range of measured discharges in the rating period. Considering the strong relationship between stage and discharge, interpolated discharges below ≈ 50 CFS have high confidence. The extrapolated discharge values that exceed the range of empirical values have a high uncertainty given the lack of discharge measurements for stages greater than 2.12 ft. A general rule of thumb is to not estimate over two times the max measured discharge stage value as it becomes exceedingly difficult to account for when channel controls take effect. For this reason, the Flow Transference Method was used in an attempt to better predict high end discharges.

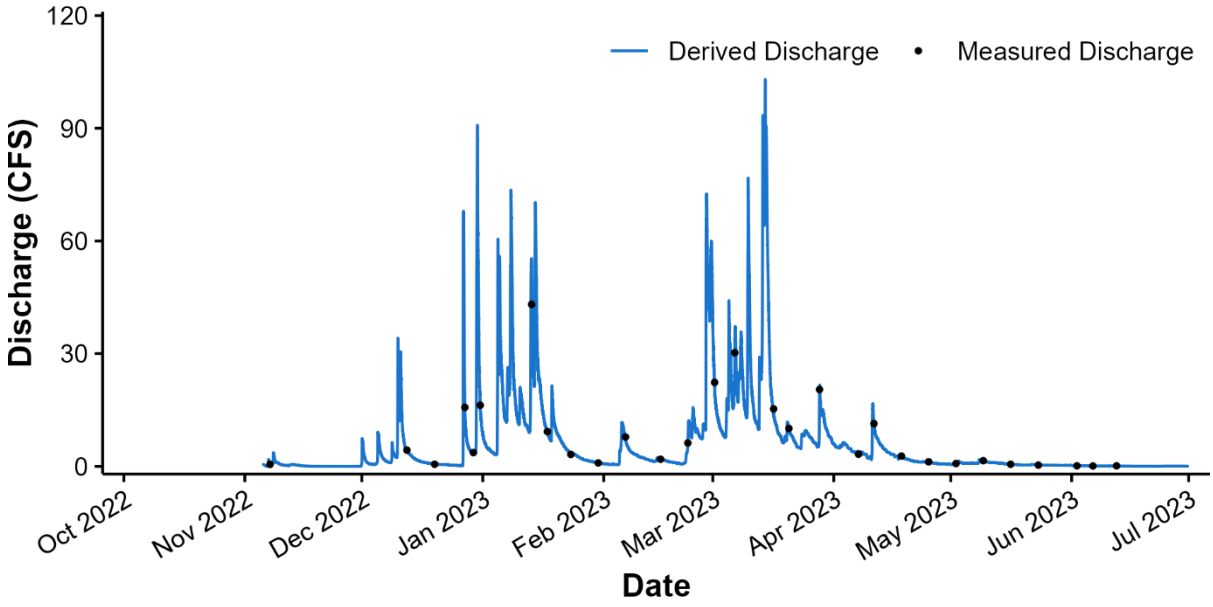

Figure 4. Continuous estimated discharge and measured discharge at the McCloud Creek TTS station during the 2023 WY.

2.2.3.4 Turbidity

Turbidity was measured simultaneously using two methodologies at the McCloud Creek TTS station during the 2023 WY. A DTS-12 turbidity sensor (Forest Technology Systems, LTD., Victoria, B.C., Canada) was used to measure water turbidity (Formazin Nephelometric Units [FNU]) in the field. Coincident water samples were collected using an ISCO 3700C water sampler (Teledyne ISCO, Lincoln, Nebraska) during each field visit and automatically based on established turbidity thresholds.

During the 2023 WY, 239 water samples were collected with the ISCO water sampler. Most of the water samples (87%) were collected by automated turbidity threshold sampling (n = 207) and the remainder were paired manual samples collected during site visits (n = 32 (16 pairs)). Low level turbidity samples (FNU <30) comprised a disproportionate amount of the total samples collected. Overprocessing of these samples can lead to bias in the low end of the FNU-NTRU relationship. To reduce this bias, a subsampling protocol was introduced, to process 50% of the samples in the lab with low turbidities (FNU <30). Water samples were brought to the laboratory and a Hach 2100N turbidimeter (Hach Company, Loveland, Colorado) was used to measure turbidity (Nephelometric Turbidity-Ratio Units [NTRU]). A total of 70 water samples collected via automated turbidity threshold sampling and 22 collected via manual collection were processed for turbidity in lab.

A relationship between the lab and field turbidity measurements was analyzed to develop a regression equation (Figure 5). This regression equation was then applied to lab sample

turbidities to assist in reconstructing missing field turbidity, smoothing erratic values, or verifying turbidity spikes.

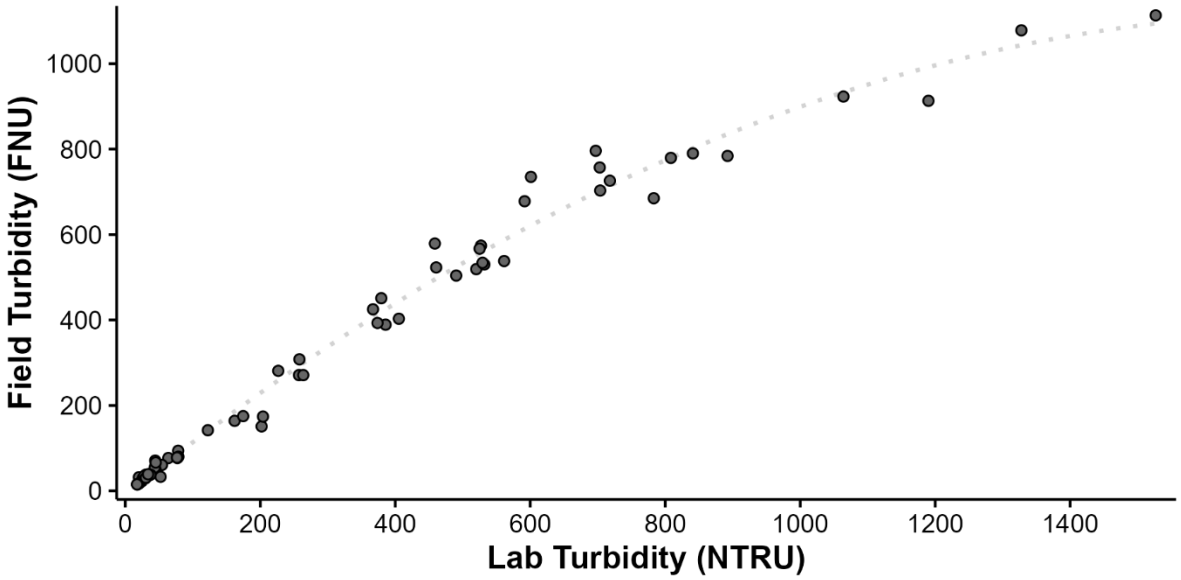

Figure 5. Relationship between coincident lab turbidity measurements (NTRU) and field turbidity measurements (FNU) collected at the McCloud Creek TTS station during the 2023 WY.

2.2.3.5 Continuous Turbidity

A DTS-12 sensor was used to measure continuous turbidity (FNU) at 10-minute intervals throughout the 2023 WY (Figure 6). Where turbidity values were missing or erroneous due to equipment failure or measurable range exceedance, values were estimated using stage-based regressions, values derived from grab samples (when possible), or interpolated using adjacent valid data. The type of estimates used for missing or erroneous data was noted and can be found in the 'Data Management' tab in the electronic data file (Appendix A).

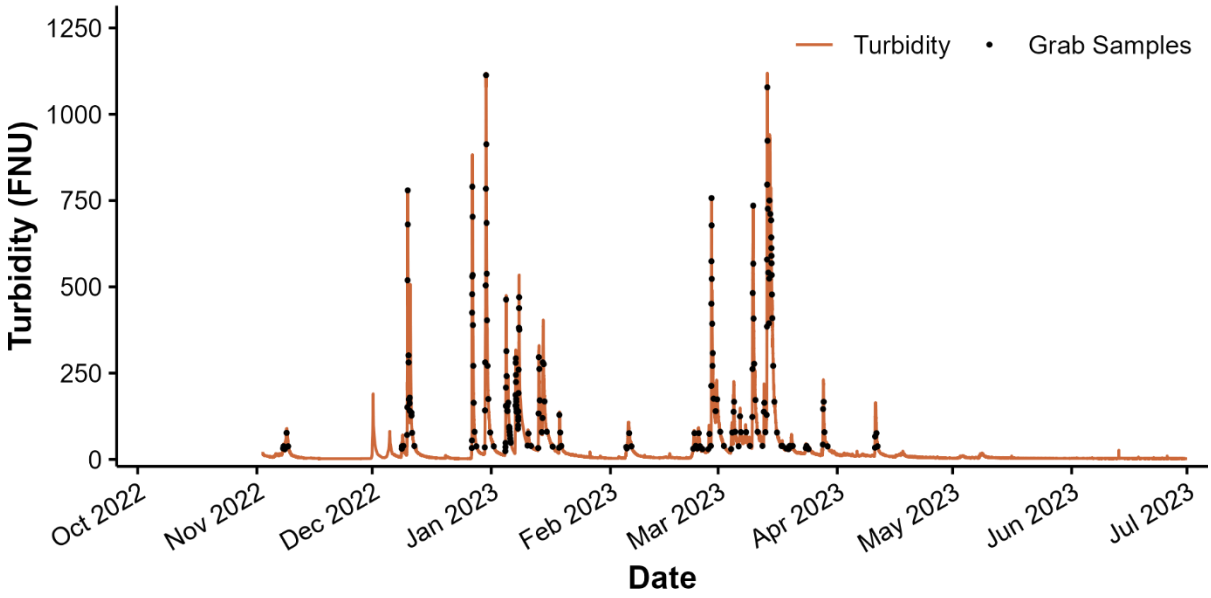

Figure 6. Continuous Time-Series of turbidity collected by the instream DTS-12 sensor and timing of turbidity threshold grab samples at the McCloud Creek TTS station during the 2023 WY.

2.2.3.6 Grab Sample Data Summary

A total of 239 water samples were collected (207 automated and 32 manual) during the 2023 WY. Paired manual grab samples were always taken if the station turbidity read >30 FNU and taken opportunistically when FNU was <30 during a site visit. These were collected using the ISCO sampler with a manual override and were primarily used as laboratory quality control samples. The collection times for manual and automated (i.e., turbidity threshold) grab samples were compiled and overlaid on the continuous turbidity time series for the 2023 WY (Figure 6).

2.2.3.7 Comparative Analysis of Continuous Stage and Turbidity

A visual assessment comparing continuous stage and turbidity data was made to determine if there were any increases in continuous turbidity that were not associated with an increase in continuous stage. This would indicate additional sediment input into the system though such sources as localized landslides, nearby upstream tributaries, or roads for example. As expected, all increases in turbidity coincided with an increase in stage at the McCloud Creek TTS monitoring site for the 2023 WY, indicating that turbidity was discharge driven (Figure 8). The two largest increases in turbidity coincided with the largest increases in stage and occurred on December 30th, 2022 and March 13th, 2023.

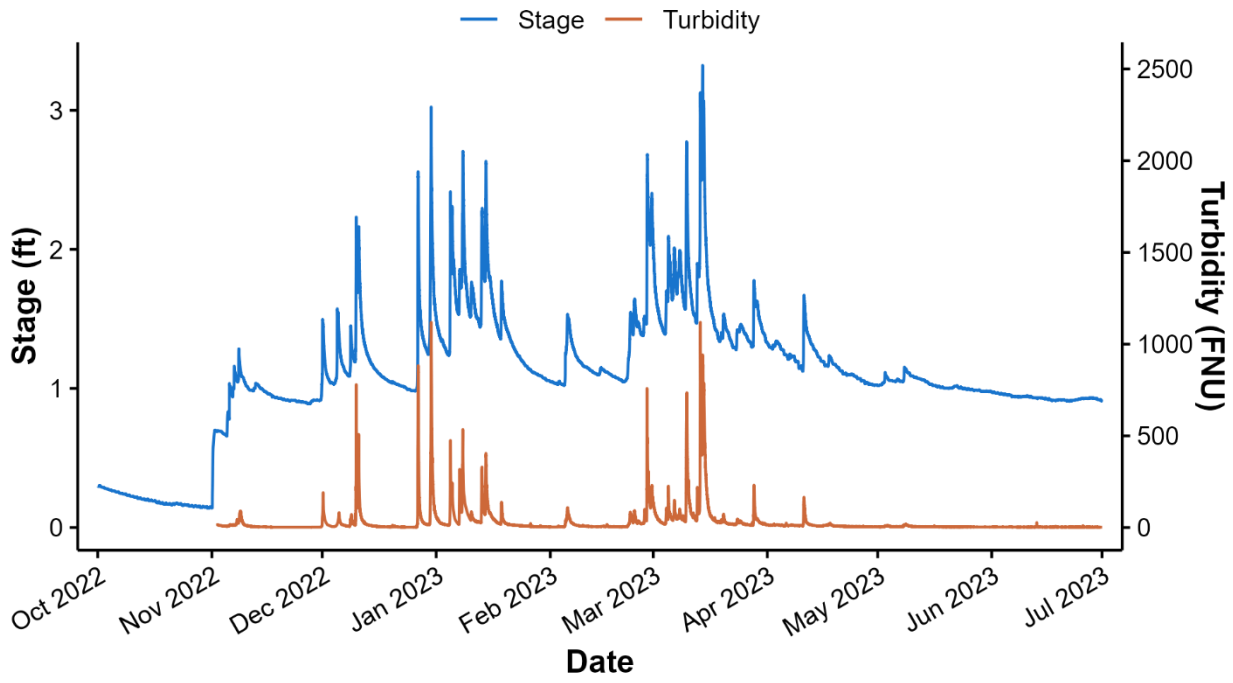

Figure 8. Continuous time-series of stage and turbidity at the McCloud Creek TTS station during the 2023 WY.

2.2.3.8 Suspended Sediment Concentration

The relationship between suspended sediment concentration (SSC, in mg/L) of the grab samples and the coincident field turbidity (FNU) for the entire 2023 WY is shown in Figure 9. There was a total of 136 automated samples processed for suspended sediment concentration during the 2023 WY. The initial assessment of this relationship is relatively simplistic, and a better fit of these data may be possible through an assessment of additional relationships and variables.

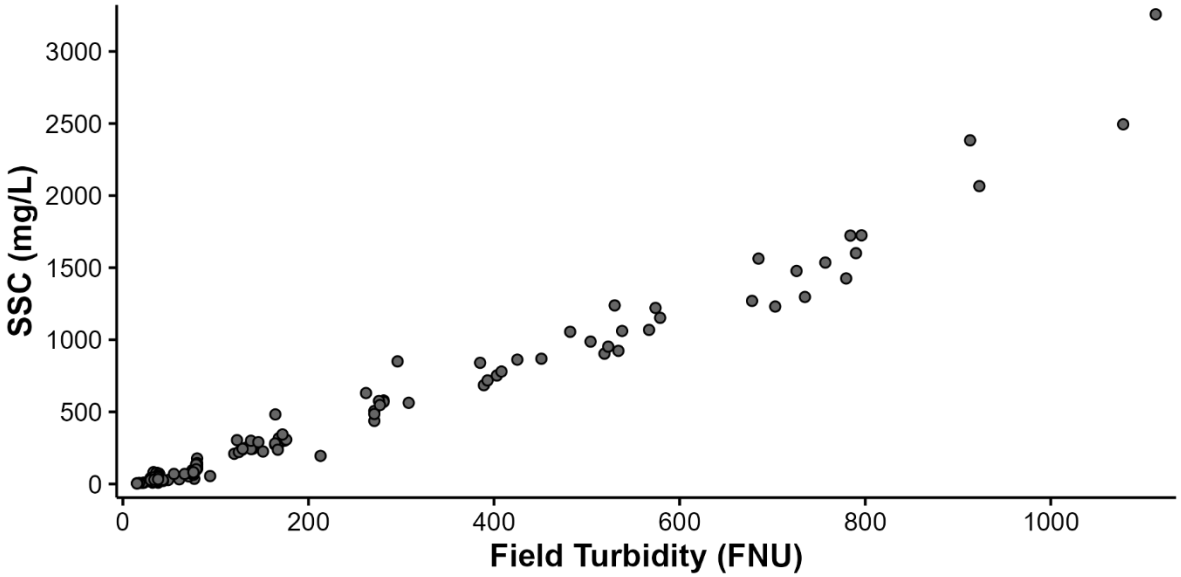

Figure 9. Relationship between turbidity and SSC for the McCloud Creek TTS station during the entire 2023 WY. This graph is an overview of the entire water year.

The relationship between SSC and turbidity can change over the course of the year either between or within storm events (Lewis 1996). We analyzed individual storm events to establish stronger relationships, and if possible, the relationships of individual rising and falling limbs of storms. SSC data was then paired with corresponding turbidity measurements using a set of procedures developed by Jack Lewis at Redwood Sciences Lab (Lewis 2007) for use within R, a free statistical software package (R Core Team 2018). This software allows for the construction of turbidity sediment rating curves where relationships between SSC and turbidity can be established on a storm-by-storm basis. Storm periods are defined for those rising and falling turbidities having at least four samples, sometimes separated further by rising and falling limbs if sample size allows. For those periods where the sample size was less than 4, they were combined with adjacent storm's samples. The best fit relationship for each storm period was determined after reviewing graphics, R-squared values and residual standard error. The best fit relationship is determined to be either linear, power or log transformed variables. Once relationships are

established, the software produces a derived SSC time-series data set using the turbidity time-series as the input (Figure 10). The derived SSC data set is then multiplied by the derived discharge data produced by a standard stage-discharge rating curve. The resulting data set gives instantaneous Suspended Sediment Load (iSSL) estimates for every 10-minute interval for the water year.

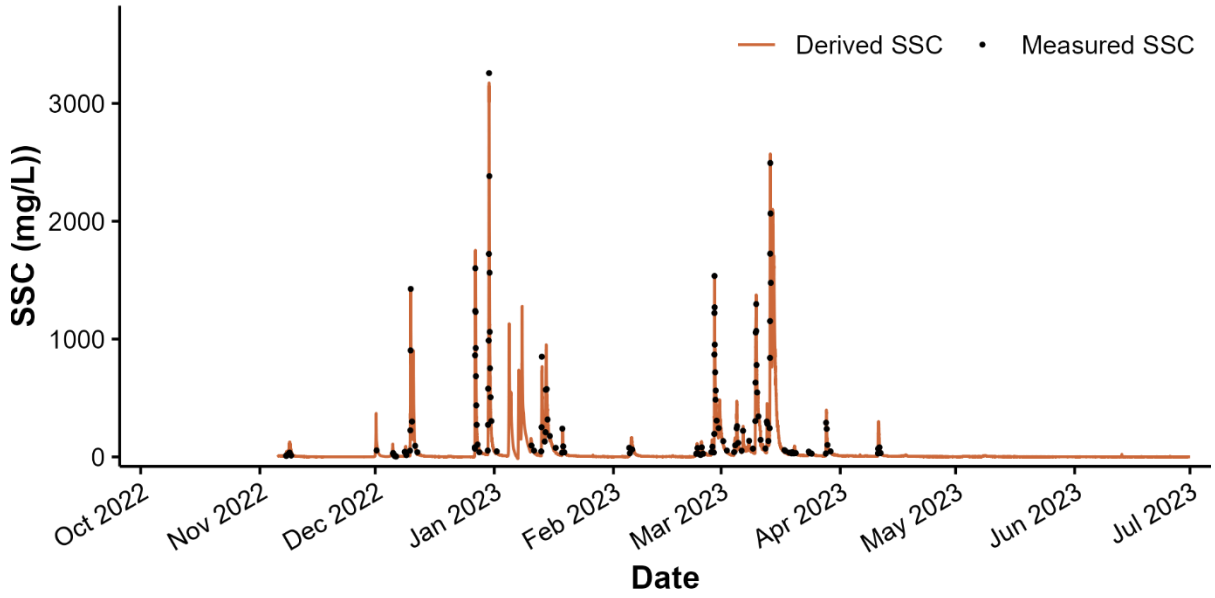

Figure 10. Derived Suspended Sediment Concentration (SSC) based on individual storm's best-fit relationships during the 2023 WY. Black points indicate the measured SSC of automated water samples.

2.2.3.9 Sediment Load and Yield

Sediment load was produced for the 2023 WY using a set of procedures developed by Jack Lewis at Redwood Sciences Lab (Lewis 2007) for use within R, a free statistical software package (R Core Team 2018). Sediment Load (kg) was estimated for the entire water year based on derived continuous sediment concentrations (mg/l). For the 2023 WY there was a total of 9 periods for which relationships were established between turbidity and SSC, including 8 storms and a base relationship (Table 4). This annual sediment load was adjusted by watershed area upstream of the TTS monitoring site (6.0 km^2) producing sediment yield in metric tons per km^2 per year (metric tons/km^2/year) and a coefficient of variation (CV). The estimated sediment load for the 2023 WY was 1,161,220 kg (1,161 metric tons). The sediment load for storm 7 comprised about 37% of the total annual sediment load. The annual sediment yield for the 2023 WY was 193.12 metric tons/km^2/year. The average annual sediment yield is 250.25 metric tons/km^2/year for the entire monitoring period since the 2007 WY (Table 5). Annual sediment and water yield for

monitoring years 2007 through 2023 are strongly and positively correlated (ρ = 0.84, Figure 11).

Table 4. Summary of time periods and relationships used to estimate continuous suspended sediment concentration (mg/l) and sediment Loads (kg) for the 2023 WY. (n = sample size, CV% = coefficient of variation).

Period	Start	End	Relationship	n	Sediment Load (kg)	CV%	Percent of Annual Sediment Load
Storm 1	12/10/2022 1:40	12/11/2022 23:30	linear	7	34763.817	1.752	3.0%
Storm 2	12/26/2022 22:10	12/30/2022 6:50	power	12	51301.102	3.599	4.4%
Storm 3	12/30/2022 7:00	1/1/2023 15:30	power	13	143351.579	2.389	12.3%
Storm 4	1/4/2023 16:50	1/16/2023 23:30	linear	12	228235.19	6.179	19.7%
Storm 5	2/27/2023 5:20	2/28/2023 4:40	power	10	66265.957	4.712	5.7%
Storm 6	3/9/2023 21:40	3/11/2023 6:40	linear	9	86050.445	3.703	7.4%
Storm 7	3/13/2023 15:20	3/16/2023 0:40	power	6	431471.852	2.358	37.2%
Storm 8	3/28/2023 5:50	3/29/2023 12:00	linear	5	6142.153	13.72	0.5%
Base	11/5/2022 18:30	12/10/2022 1:30	power	57	2703.374	5.537	9.8%
	12/11/2022 23:40	12/26/2022 22:00			367.88	13.947	
	1/1/2023 15:40	1/4/2023 16:40			478.868	12.879	
	1/16/2023 23:40	2/27/2023 5:10			13376.455	6.465	
	2/28/2023 4:50	3/9/2023 21:30			70151.324	3.057	
	3/11/2023 6:50	3/13/2023 15:10			12296.659	3.137	
	3/16/2023 0:50	3/28/2023 5:40			8427.232	7.8	
	3/29/2023 12:10	6/30/2023 23:50			5835.831	7.588	
			Total:	131	1161220		

Table 5. Annual sediment yield (metric tons/km^2/year) estimates for the McCloud TTS monitoring site for water years 2007 through 2023. Sediment yield was determined using the watershed area above the monitoring site (6.0 km^2).

WY	Sediment Yield (metric tons/km^2/year)
2007	298.53
2008	208.71
2009	43.71
2010	157.16
2011	429.96
2012	430.58
2013	209.46
2014	24.34
2015	611.87
2016	516.83
2017	499.79
2018	75.85
2019	468.75
2020	42.54
2021	25.56
2022	17.44
2023	193.12
Average:	250.25

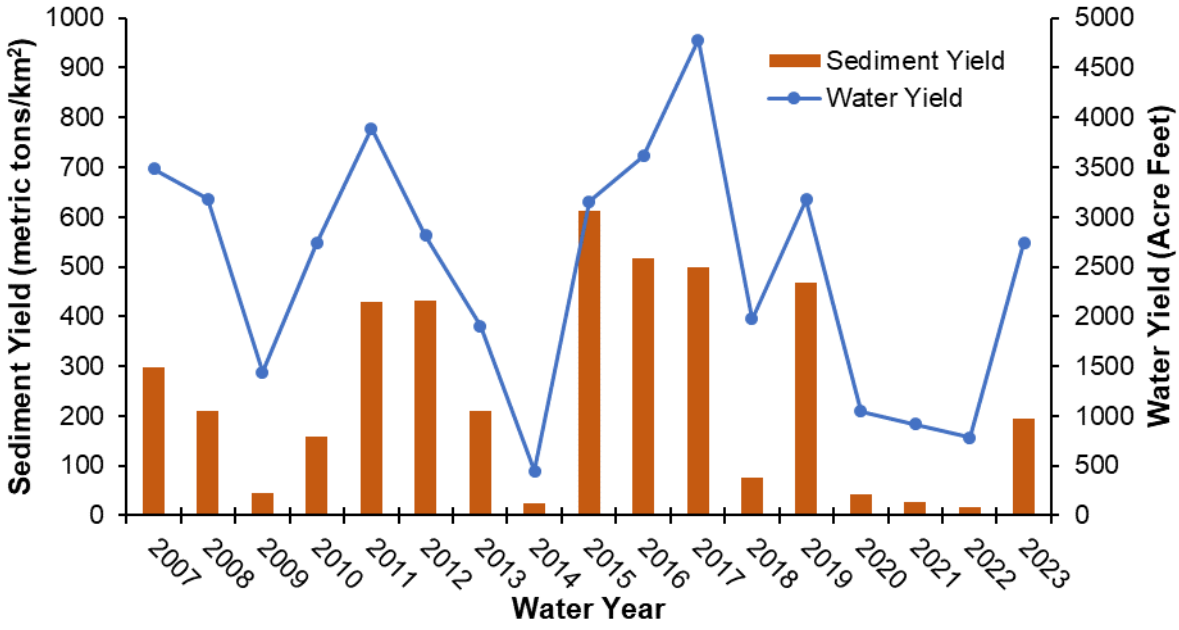

Figure 11. Annual sediment yield (metric tons/km^2) and water yield (Acre Feet) estimates for the McCloud TTS monitoring site for water years 2007 through 2023.

3.0 Summary of Field Problems Encountered and Resolutions

A summary of problems encountered and resolutions were compiled for the 2023 WY (Appendix B). Typical problems encountered included but were not limited to Druck offset adjustments, turbidimeter adjustments, stage plate observations, discharge measurement notes, and equipment maintenance.

4.0 Quality Assurance Summary

Special training is required for all GDRCo staff involved in the implementation of this project. During the 2023 WY, 5 individuals participated in some part of the implementation of field and lab standard operating procedures. All personnel were trained prior to performing assigned work tasks and responsibilities.

The Lead Watershed Technician was appointed by the Project Supervisor to perform the training and certification of the watershed staff during the 2023 WY (Table 7). Training was performed on all aspects of field work including cleaning and adjusting equipment, downloading of data, collecting grab samples, replacing ISCO bottles, and taking discharge measurements. Training in the laboratory included: preparing filters, taking turbidity measurements, filtering and weighing of suspended sediment, and recording data. Data management training included: data entry, QA/QC, and updating files. The chain-of-custody for all phases of project implementation was tracked.

Table 6. Summary of initial training dates for certifications completed by GDRCo staff involved in field and lab activities during the 2023 WY. Employees have annual refresher training before the beginning of each water year.

Personnel	Role	Field Methods Certification	Lab Certification	Data Management certification
Matt Nannizzi	Project Supervisor	10/1/2021	12/15/2011	10/21/2021
Melissa Reneski	Hydrology Coordinator / Lead Hydrology Technician	10/1/2015	10/1/2015	10/1/2015
Simon Boycott	Hydrology Techncian	11/15/2022	10/1/2022	10/1/2022
Reed Hamilton	Hydrology Technician	11/15/2022	10/1/2022	10/1/2022
Erin Philips	Aquatics Technician	12/14/2023	NA	NA

Among the turbidity samples collected and measured, no outliers were identified and excluded from the FNU-NTRU regression analysis. Potential outliers are identified empirically by graphing lab vs turbidity values. Generally, there is a tight relationship (R^2 > 95%) between the two measurements, so errors and outliers tend to stand out.

To evaluate the consistency of laboratory processing for turbidity and SSC, GDRCo performed a QA/QC test using paired grab and control water samples collected during site visits. Grabs are taken back to be immediately processed in the lab while controls are stored in a refrigerator until the end of the water year. Hydrochloric acid is added to each control sample that is placed in the refrigerator to help preserve it for later processing. At the end of the water year a random subsample of grabs and paired controls are processed for turbidity and SSC to assess lab repeatability. This subsample resulted in 6 of the 16 paired manual samples from McCloud to be selected. These samples were collected during routine site visits, using the ISCO pump sampler.
The relationships between the paired grab and control samples for turbidity and SSC were established (Figures 11 and 12, respectively) using data from 12 TTS sites that GDRCo operates including the McCloud Creek station. The relationship for lab turbidity was linear and strong (R^2= 0.984); and produced no outlier data, indicating that the turbidity laboratory process produced nearly identical values between paired water samples. The paired samples for SSC also produced a linear relationship (R^2= 0.762) and contained two outliers. One outlier pair, taken at McCloud Creek TTS station, indicated that there was sand on the grab sample filter while the control sample did not have sand and was slightly burned which would result in the observed discrepancy in SSC. Another outlier grab and control pair, taken at MSAP, had no clear reasoning for the discrepancy in SSC.

All equipment was maintained and calibrated within the frequency defined in Section B6 of the Turbidity Threshold Sampling QAPP submitted by GDRCo. The DTS-12 sensors were calibrated by FTS in August 2022 prior to deployment. The Hach 2100N was calibrated every 3 months with Formazin StableCal® standards and weekly during the monitoring season using Gelex Secondary standards and receives yearly calibration and maintenance from HACH. The Druck pressure transducer was calibrated by the GDRCo watershed staff on in mid-September, 2022 to ensure proper operation prior to deployment. Finally, current meters used during the monitoring season received calibrations at least weekly.

At times there can be complications regarding the DTS-12 turbidity sensor, resulting in missing, or “noisy”, data. When this happened, the “cleaning” of the data was applied conservatively. In the case of missing data, values were generated using the methods described in Section 2.2.3.5 and are noted in the ‘Data Management’ tab in the electronic data file (Appendix A).

Two different approaches were used to address “noisy” turbidity data where there was no association with fluctuations in stage. If the turbidity recordings prompted an automated grab sample that verified there was no increase in SSC, that turbidity value was interpolated from adjacent values. If there was no associated grab sample, which can happen when the turbidity increases didn’t cross set thresholds, the value was left and no “cleaning” took place.

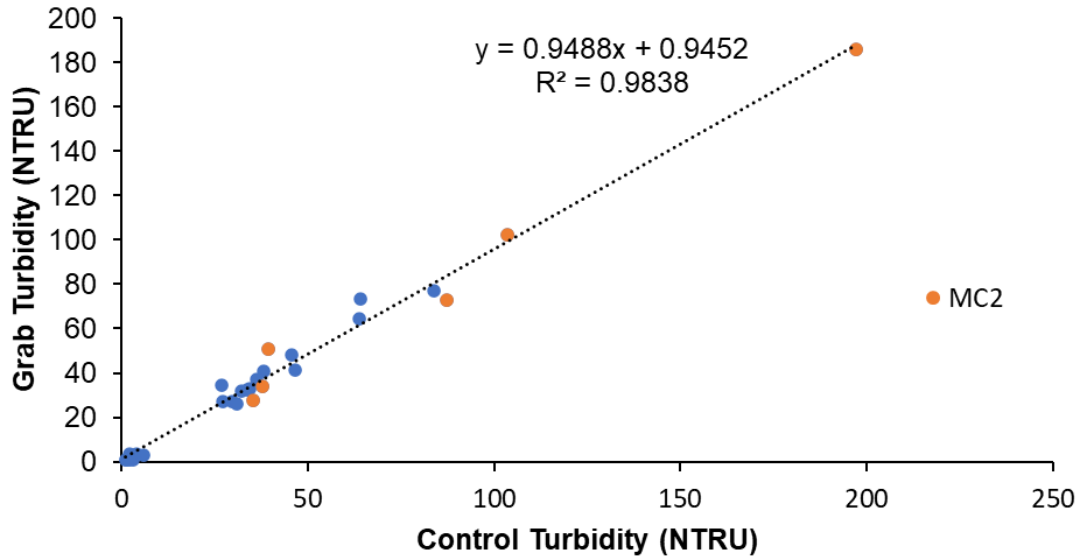

Figure 11. Relationship between lab turbidity (NTRU) of paired control and grab samples collected across 12 sites during the 2023 WY, with those samples collected at the McCloud Creek TTS station indicated by orange points.

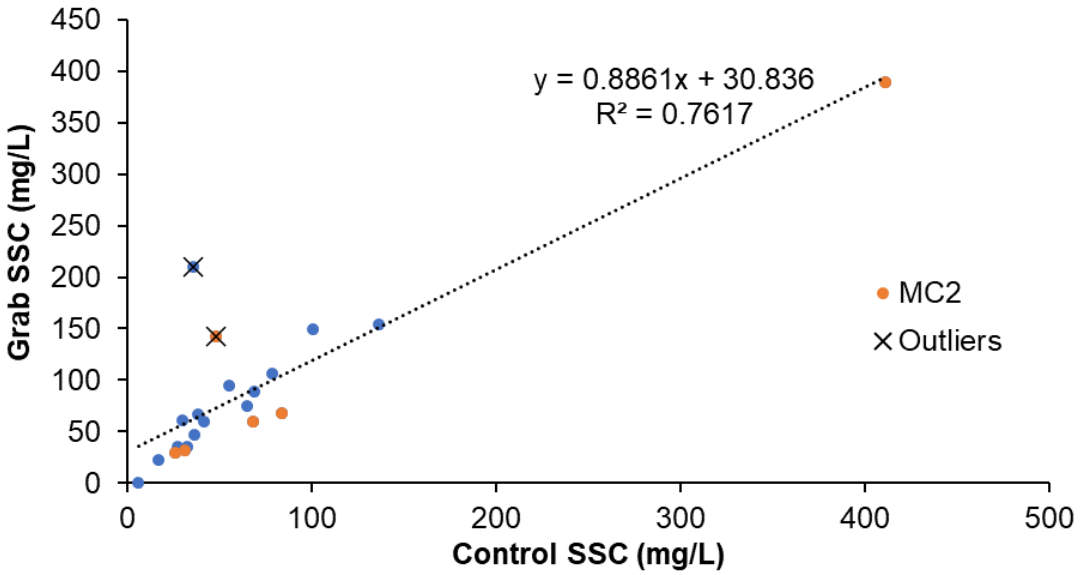

Figure 12. Relationship between suspended sediment concentration (SSC, mg/l) of paired control and grab samples collected across 12 sites during the 2023 WY, with those samples collected at the McCloud Creek TTS station indicated by orange points and outliers indicated by X.

5.0 Other Problems Encountered

Although access was available for monitoring the site at stages above 2.12 feet for the 2023 water year, most of the peak flows that exceeded this stage occurred in the evening or overnight when technicians are not working. Furthermore, the flashy nature of McCloud Creek makes it difficult to predict the timing of when flows will peak following a rain event. The inability to obtain discharge measurements at higher stages is a limitation when estimating discharges above the measured values. Given that the channel geometry at the monitoring site is substantially different above the range of empirical discharge measurements, we assume that the actual relationship is likely different than that predicted here for discharges above this range. Furthermore, large storm events are associated with higher sediment loads, and calculation of discharge and sediment load require extrapolation from relationships established at low to medium flow conditions, resulting in low confidence in the higher sediment load estimates. We will continue to prioritize obtaining discharge measurements for McCloud Creek at stages exceeding our current measurements to improve our discharge-stage rating and thus the accuracy of suspended sediment load estimates.

Literature Cited

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Appendix A

Electronic copy (file name = Appendix_A_MC2_All_Data_2023WY.xlsx) of data collected and data management notes for the McCloud TTS site during the 2023 WY. This file was submitted as an email attachment to the NCRQCB in accordance with the 2014 electronic document submission guidelines.

Appendix B

Summary of field problems encountered and resolutions at the McCloud Creek TTS station during the 2023 WY.

Start Date	End Date	Comment	Resolution	Resolution Date	Initials
10/07/22	11/02/22	Discharge not measured, monitoring unit is an isolated pool.		11/07/22	MRR/RCH
10/26/22	10/26/22	E-stage does not match observed stage measurement, is off by + 0.025'.	Recalculated stage offset so that e-stage matches observed stage measurement.	10/26/22	RCH
11/02/22	11/02/22	Station taken offline from 13:15-13:20 to wire DTS into datalogger	Station turned back online following the wiring of DTS into datalogger. Reset stage multiplier, stage offset, and dump count values in datalogger settings.	11/02/22	RCH
11/02/22	11/02/22	Datalogger pelican case desiccant requires replacement.	Replaced datalogger pelican case desiccant.	11/02/22	RCH
11/02/22	11/07/22	Station is hydrologically connected but streamflow is too low to obtain a discharge measurement.	Will monitor and measure discharge as streamflow increases.	11/07/22	RCH/SRB
11/07/22	11/17/22	ISCO was set to 0 rinse cycles	Reset ISCO to 2 rinse cycles	11/17/22	SRB
11/07/22	11/07/22	Low sample volume observed in manual Grab/Control samples of DD #1.	Calibrated sample volume in ISCO settings. Tested with additional manual sample and obtained OK sample volume.	11/07/22	SRB

11/07/22	11/07/22	Organic debris observed to be built up at monitoring unit tailcrest upon arrival to the site.	Removed debris that had built up around monitoring unit tailcrest. Stage was observed to decrease 0.03' .	11/07/22	SRB
11/17/22	12/01/22	Station is hydrologically connected but streamflow is too low to obtain a discharge measurement.	Will monitor and measure discharge as streamflow increases.	12/01/22	RCH
11/17/22	11/17/22	DTS is sitting too high in the water column.	Lowered DTS so that sensor is at standard 6/10 depth.	11/17/22	RCH
11/17/22	11/17/22	Organic debris observed to be built up at monitoring unit tailcrest upon arrival to the site.	Removed debris that had built up around monitoring unit tailcrest. Stage was observed to decrease 0.015'.	11/17/22	RCH
11/22/22	12/01/22	Station is hydrologically connected but streamflow is too low to obtain a discharge measurement.	Will monitor and measure discharge as streamflow increases.	12/01/22	SRB
11/22/22	11/30/22	Slight amount of water (approximately 5 mL) observed in ISCO base.	Made sure ISCO arm was in line with bottle 1 - will monitor and adjust ISCO settings if necessary next site visit.	11/30/22	SRB

11/30/22	12/06/22	DTS flatlined at 2 FNU and was discovered during a site visit on 12/1/2022 and during the storm event beginning on 11/30/2022. Cleaned DTS wires and disconnected/reconnected DTS from cable which appeared to resolve issue. Readings then flatlined again at 89 later in the evening of 12/1/2022.	ISCO was set to take timed water sample, every two hours beginning 12/5/2022 at 1600 until DTS functionality could be restored. Replaced faulty DTS quick connect cable and verified DTS was functioning on 12/6/2022.	12/06/22	RCH/MRR
12/01/22	12/01/22	DTS is sitting too low in the water column.	Raised DTS slightly so that sensor is at standard 6/10 depth.	12/01/22	MRR
12/05/22	12/22/22	E-stage does not match observed stage measurement, is off by +0.04'.	Recalculated stage offset so that e-stage matches observed stage measurement.	12/22/22	SRB
12/05/22	12/05/22	DTS is sitting too low in the water column.	Raised DTS slightly so that sensor is at standard 6/10 depth.	12/05/22	RCH
12/06/22	12/06/22	Station taken offline from 12:23-1429 while DTS cable is replaced and installed.	Station turned back online following the DTS cable switch.	12/06/22	RCH
12/09/22	12/09/22	DTS is sitting too low in the water column for anticipated flows.	Raised DTS so that sensor will be at standard 6/10 depth as stage rises.	12/09/22	MRR
12/12/22	12/12/22	Organic debris observed to be built up around DTS housing, stage plate, and druck	Removed debris that had been built up around DTS boom, stage plate, and druck.	12/12/22	SRB

12/12/22	12/12/22	To re-run ISCO tubing and DTS cable through conduit, powered off DL from 13:31-14:25	Reset stage multiplier, offset and DD at 15:10.	12/12/22	SRB
12/19/22	12/19/22	DTS is sitting too high in the water column.	Lowered DTS slightly so that sensor is at standard 6/10 depth.	12/19/22	SRB
12/27/22	12/27/22	DTS is sitting too low in the water column.	Raised DTS slightly so that sensor is at standard 6/10 depth.	12/27/22	MRR
12/27/22	12/27/22	Empty sample observed in ISCO slot 5 of DD #7.	DTS was likely out of the water due to accumulated debris on DTS boom. Issued generic BID# 9999 and changed data exception type to "NULL" in TTS.NET.	12/27/22	MRR
12/27/22	12/27/22	Slight amount of water (approximately 20 mL) observed in ISCO base.	OK sample volumes observed in ISCO slots 1-4 and 6-11 and in manual Grab and Controls samples of DD #7. Slot 5 was empty and DTS was likely in and out of the water contributing to water in ISCO base. Checked tube in ISCO distributor arm and length was appropriate. Will monitor and adjust ISCO settings if necessary.	12/27/22	MRR
12/29/22	12/29/22	Stage plate difficult to read in fast flows.	Observed stage plate measurement is an approximation (+/- 0.02'). Will monitor future stage plate	12/29/22	MRR

			measurements and edit if necessary.		
12/31/22	12/31/22	Stage plate unable to be accurately read in fast flows.	Used e-stage value as observed stage measurement due to difficulty reading stage plate.	12/31/2022	MRR
12/31/22	12/31/22	Organic debris observed to be built up around DTS housing upon arrival to the site. Did not appear to be obstructing DTS optics.	Removed debris that had been built up around DTS housing.	12/31/22	MRR
12/31/22	12/31/22	Organic debris observed to be built up around Druck sensor upon arrival to the site.	Removed debris that had built up around sensor.	12/31/22	MRR
01/04/23	01/10/23	DTS has been pulled out of the water by a downed tree.	Lowered DTS back into the water.	01/10/23	SRB
01/10/23	01/10/23	Stage plate difficult to read in fast flows.	Observed stage plate measurement is an approximation (+/- 0.02'). Will monitor future stage plate measurements and edit if necessary.	01/10/23	SRB
01/10/23	01/10/23	Empty samples observed in ISCO slots 3-13 and 15-24 of DD #10.	DTS was out of the water due to tree falling on DTS vales. Issued generic BID# 9999-9979 and changed data exception type to "NULL" in TTS.NET.	01/10/23	SRB

01/13/23	01/13/23	Organic debris observed to be built up around DTS housing upon arrival to the site, sensor optics were not obscured.	Organic debris observed to be built up around DTS housing upon arrival to the site, sensor optics were not obscured.	01/13/23	RCH
01/17/23	01/17/23	From 14:30-17:00, e-stage was off due to me cleaning out druck, losing the druck cap.	Hiked back to parking lot to get new one from MRR, and returned to finish job - reset offset at 17:10.	01/17/23	SRB
01/17/23	01/17/23	DTS is sitting too high in the water column.	Lowered DTS so that sensor is at standard 6/10 depth.	01/17/23	SRB
01/17/23	01/17/23	Wiper blade on DTS optics required replacement	Replaced wiper blade to DTS optics	01/17/23	SRB
01/23/23	01/23/23	DTS is sitting too high in the water column.	Lowered DTS so that sensor is at standard 6/10 depth.	01/23/23	RCH
01/23/23	01/23/23	Organic debris observed to be built up around DTS housing upon arrival to the site, sensor optics were not obscured.	Organic debris observed to be built up around DTS housing upon arrival to the site, sensor optics were not obscured.	01/23/23	RCH
02/06/23	02/06/23	DTS is sitting too high in the water column.	Lowered DTS so that sensor is at standard 6/10 depth.	02/06/23	SRB
02/06/23	02/06/23	Large amount of water (approximately 200 mL) observed in ISCO base.	OK sample volumes observed in ISCO slots 1-3 and in manual Grab and Controls samples of DD #14, empty number 4 bottle. Took kink out of tubing in the hope that fixes issue. Will monitor and adjust ISCO settings if necessary.	02/06/23	SRB
02/15/23	02/15/23	DTS is sitting too high in the water column.	Lowered DTS so that sensor is at standard 6/10 depth.	02/15/23	

02/22/23	02/22/23	DTS is sitting too low in the water column.	Raised DTS so that sensor is at standard 6/10 depth.	02/22/23	RCH
03/01/23	03/01/23	Moderate organic debris observed to be built up around DTS housing upon arrival to the site, sensor optics were not obscured.	Removed moderate debris that had been built up around DTS housing.	03/01/23	SRB
03/01/23	03/01/23	DTS is sitting too low in the water column for anticipated flows.	Raised DTS so that sensor will be at standard 6/10 depth as stage rises.	03/01/23	SRB
03/01/23	03/01/23	Stage plate difficult to read in fast flows.	Observed stage plate measurement is an approximation (+/- 0.04'). Will monitor future stage plate measurements and edit if necessary.	03/01/23	SRB
03/01/23	03/01/23	Large amount of water (approximately 200 mL) observed in ISCO base.	OK sample volumes observed in all other ISCO slots and in manual Grab and Control samples of DD #16 taken. Will monitor and adjust ISCO settings if necessary.	03/01/23	SRB
03/01/23	03/01/23	Empty sample observed in ISCO slot 21 of DD #16.	DTS was likely temporarily in and out of the water given that there was water in the ISO base. . Issued generic BID# 9999 and changed data exception type to "NULL" in TTS.NET.	03/01/23	SRB
03/06/23	03/06/23	DTS is sitting too low in the water column.	Raised DTS so that sensor is at standard 6/10 depth.	03/06/23	RCH

03/16/23	03/16/23	DTS is sitting too high in the water column.	Lowered DTS so that sensor is at standard 6/10 depth.	03/16/23	RCH
03/20/23	03/20/23	Stage plate difficult to read due to wake	Observed stage plate measurement is an approximation (+/- 0.04'). Will monitor future stage plate measurements and edit if necessary.	03/20/23	SRB
03/20/23	03/20/23	Large amount of water (approximately 125 mL) observed in ISCO base.	OK sample volumes observed in ISCO slots 1-8 and in manual Grab and Controls samples of DD #19. Will monitor and adjust ISCO settings if necessary.	03/20/23	SRB
03/28/23	03/28/23	DTS is sitting too low in the water column for rise in stage.	Raised DTS so that sensor is at standard 6/10 depth.	03/28/23	RCH
04/07/23	04/07/23	DTS is sitting too high in the water column for drop in stage.	Lowered DTS so that sensor is at standard 6/10 depth.	04/07/23	SRB
04/07/23	04/07/23	Between 7:20 and 7:30 the datalogger failed and re-set the DD#, stage multiplier and offset to defaults.	Reset DD# 21 and sensor-specific stage multiplier and offset	04/07/23	SRB
04/11/23	04/11/23	Datalogger pelican case desiccant requires replacement.	Replaced datalogger pelican case desiccant.	04/11/23	RCH
04/18/23	04/18/23	DTS is sitting too high in the water column for drop in stage.	Lowered DTS so that sensor is at standard 6/10 depth.	04/18/23	SRB
04/18/23	04/18/23	Light algal debris observed to be present on DTS optics and wiper is a little loose	Wiped off algal debris and tightened DTS wiper, and made sure wiper was still wiping.	04/18/23	SRB

04/25/23	04/25/23	DTS is sitting too high in the water column.	Lowered DTS so that sensor is at standard 6/10 depth.	04/25/23	RCH
05/02/23	05/02/23	DTS is sitting too high in the water column	Lowered DTS so that sensor is at standard 6/10 depth	05/02/23	SRB
05/16/23	06/02/23	E-stage is -0.02 -0.03 from stage plate	Will monitor and re-calculate stage offset if necessary.	06/02/23	SRB
05/23/23	05/23/23	Section control has moderate debris present	Cleaned section control of the moderate debris ahead of measuring discharge	05/23/23	SRB
05/23/23	05/23/23	Water (approximately 20 mL) observed in ISCO base after performing Grab and Control samples	OK sample volumes observed in ISCO slots 1 and 2. Emptied base and will monitor and adjust ISCO settings if necessary	05/23/23	SRB
06/02/23	06/02/23	DTS is sitting too high in the water column	Lowered DTS so that sensor is at standard 6/10 depth	06/02/23	SRB
06/02/23	06/02/23	Some light algae has collected on the DTS housing and around the edge of the DTS optics	Cleaned algae off the DTS housing and around the edge of the DTS optics with a brush	06/02/23	SRB
06/02/23	06/12/23	Section control has light debris present	Cleaned section control of the light debris ahead of measuring discharge	06/12/23	SRB
06/22/23		Station is hydrologically connected but streamflow is too low to obtain a discharge measurement.	Will monitor and measure discharge as streamflow increases.		RCH
06/26/23	06/26/23	DTS is sitting too high in the water column	Lowered DTS so that sensor is at standard 6/10 depth	06/26/23	SRB
06/26/23	06/26/23	Section control has light debris present	Did not clean section control of the light debris.	06/26/23	SRB

Start Date	End Date	Comment	Resolution	Resolution Date	Initials
10/07/22	11/02/22	Discharge not measured, monitoring unit is an isolated pool.		11/07/22	MRR/RCH
10/26/22	10/26/22	E-stage does not match observed stage measurement, is off by + 0.025'.	Recalculated stage offset so that e-stage matches observed stage measurement.	10/26/22	RCH
11/02/22	11/02/22	Station taken offline from 13:15-13:20 to wire DTS into datalogger	Station turned back online following the wiring of DTS into datalogger. Reset stage multiplier, stage offset, and dump count values in datalogger settings.	11/02/22	RCH
11/02/22	11/02/22	Datalogger pelican case desiccant requires replacement.	Replaced datalogger pelican case desiccant.	11/02/22	RCH
11/02/22	11/07/22	Station is hydrologically connected but streamflow is too low to obtain a discharge measurement.	Will monitor and measure discharge as streamflow increases.	11/07/22	RCH/SRB
11/07/22	11/17/22	ISCO was set to 0 rinse cycles	Reset ISCO to 2 rinse cycles	11/17/22	SRB
11/07/22	11/07/22	Low sample volume observed in manual Grab/Control samples of DD #1.	Calibrated sample volume in ISCO settings. Tested with additional manual sample and obtained OK sample volume.	11/07/22	SRB
11/07/22	11/07/22	Organic debris observed to be built up at monitoring unit tailcrest upon arrival to the site.	Removed debris that had built up around monitoring unit tailcrest. Stage was observed to decrease 0.03' .	11/07/22	SRB

Start Date	End Date	Comment	Resolution	Resolution Date	Initials
11/17/22	12/01/22	Station is hydrologically connected but streamflow is too low to obtain a discharge measurement.	Will monitor and measure discharge as streamflow increases.	12/01/22	RCH
11/17/22	11/17/22	DTS is sitting too high in the water column.	Lowered DTS so that sensor is at standard 6/10 depth.	11/17/22	RCH
11/17/22	11/17/22	Organic debris observed to be built up at monitoring unit tailcrest upon arrival to the site.	Removed debris that had built up around monitoring unit tailcrest. Stage was observed to decrease 0.015'.	11/17/22	RCH
11/22/22	12/01/22	Station is hydrologically connected but streamflow is too low to obtain a discharge measurement.	Will monitor and measure discharge as streamflow increases.	12/01/22	SRB
11/22/22	11/30/22	Slight amount of water (approximately 5 mL) observed in ISCO base.	Made sure ISCO arm was in line with bottle 1 - will monitor and adjust ISCO settings if necessary next site visit.	11/30/22	SRB
11/30/22	12/06/22	DTS flatlined at 2 FNU and was discovered during a site visit on 12/1/2022 and during the storm event beginning on 11/30/2022. Cleaned DTS wires and disconnected/reconnected DTS from cable which appeared to resolve issue. Readings then flatlined again at 89 later in the evening of 12/1/2022.	ISCO was set to take timed water sample, every two hours beginning 12/5/2022 at 1600 until DTS functionality could be restored. Replaced faulty DTS quick connect cable and verified DTS was functioning on 12/6/2022.	12/06/22	RCH/MRR

Start Date	End Date	Comment	Resolution	Resolution Date	Initials
12/01/22	12/01/22	DTS is sitting too low in the water column.	Raised DTS slightly so that sensor is at standard 6/10 depth.	12/01/22	MRR
12/05/22	12/22/22	E-stage does not match observed stage measurement, is off by +0.04'.	Recalculated stage offset so that e-stage matches observed stage measurement.	12/22/22	SRB
12/05/22	12/05/22	DTS is sitting too low in the water column.	Raised DTS slightly so that sensor is at standard 6/10 depth.	12/05/22	RCH
12/06/22	12/06/22	Station taken offline from 12:23-1429 while DTS cable is replaced and installed.	Station turned back online following the DTS cable switch.	12/06/22	RCH
12/09/22	12/09/22	DTS is sitting too low in the water column for anticipated flows.	Raised DTS so that sensor will be at standard 6/10 depth as stage rises.	12/09/22	MRR
12/12/22	12/12/22	Organic debris observed to be built up around DTS housing, stage plate, and druck	Removed debris that had been built up around DTS boom, stage plate, and druck.	12/12/22	SRB
12/12/22	12/12/22	To re-run ISCO tubing and DTS cable through conduit, powered off DL from 13:31-14:25	Reset stage multiplier, offset and DD at 15:10.	12/12/22	SRB
12/19/22	12/19/22	DTS is sitting too high in the water column.	Lowered DTS slightly so that sensor is at standard 6/10 depth.	12/19/22	SRB
12/27/22	12/27/22	DTS is sitting too low in the water column.	Raised DTS slightly so that sensor is at standard 6/10 depth.	12/27/22	MRR

Start Date	End Date	Comment	Resolution	Resolution Date	Initials
12/27/22	12/27/22	Empty sample observed in ISCO slot 5 of DD #7.	DTS was likely out of the water due to accumulated debris on DTS boom. Issued generic BID# 9999 and changed data exception type to "NULL" in TTS.NET.	12/27/22	MRR
12/27/22	12/27/22	Slight amount of water (approximately 20 mL) observed in ISCO base.	OK sample volumes observed in ISCO slots 1-4 and 6-11 and in manual Grab and Controls samples of DD #7. Slot 5 was empty and DTS was likely in and out of the water contributing to water in ISCO base. Checked tube in ISCO distributor arm and length was appropriate. Will monitor and adjust ISCO settings if necessary.	12/27/22	MRR
12/29/22	12/29/22	Stage plate difficult to read in fast flows.	Observed stage plate measurement is an approximation (+/- 0.02'). Will monitor future stage plate measurements and edit if necessary.	12/29/22	MRR
12/31/22	12/31/22	Stage plate unable to be accurately read in fast flows.	Used e-stage value as observed stage measurement due to difficulty reading stage plate.	12/31/2022	MRR
12/31/22	12/31/22	Organic debris was observed to be built up around DTS housing upon arrival at the site. Did not appear to be obstructing DTS optics.	Removed debris that had been built up around DTS housing.	12/31/22	MRR

Start Date	End Date	Comment	Resolution	Resolution Date	Initials
12/31/22	12/31/22	Organic debris observed to be built up around Druck sensor upon arrival to the site.	Removed debris that had built up around sensor.	12/31/22	MRR
01/04/23	01/10/23	DTS has been pulled out of the water by a downed tree.	Lowered DTS back into the water.	01/10/23	SRB
01/10/23	01/10/23	Stage plate difficult to read in fast flows.	Observed stage plate measurement is an approximation (+/- 0.02'). Will monitor future stage plate measurements and edit if necessary.	01/10/23	SRB
01/10/23	01/10/23	Empty samples observed in ISCO slots 3-13 and 15-24 of DD #10.	DTS was out of the water due to a tree falling on DTS vales. Issued generic BID# 9999-9979 and changed data exception type to "NULL" in TTS.NET.	01/10/23	SRB
01/13/23	01/13/23	Organic debris observed to be built up around DTS housing upon arrival to the site, sensor optics were not obscured.	Organic debris observed to be built up around DTS housing upon arrival to the site, sensor optics were not obscured.	01/13/23	RCH
01/17/23	01/17/23	From 14:30-17:00, e-stage was off due to me cleaning out druck, losing the druck cap.	Hiked back to parking lot to get new one from MRR and returned to finish job - reset offset at 17:10.	01/17/23	SRB
01/17/23	01/17/23	DTS is sitting too high in the water column.	Lowered DTS so that sensor is at standard 6/10 depth.	01/17/23	SRB
01/17/23	01/17/23	Wiper blade on DTS optics required replacement	Replaced wiper blade to DTS optics	01/17/23	SRB

Start Date	End Date	Comment	Resolution	Resolution Date	Initials
01/23/23	01/23/23	DTS is sitting too high in the water column.	Lowered DTS so that sensor is at standard 6/10 depth.	01/23/23	RCH
01/23/23	01/23/23	Organic debris observed to be built up around DTS housing upon arrival to the site, sensor optics were not obscured.	Organic debris observed to be built up around DTS housing upon arrival to the site, sensor optics were not obscured.	01/23/23	RCH
02/06/23	02/06/23	DTS is sitting too high in the water column.	Lowered DTS so that sensor is at standard 6/10 depth.	02/06/23	SRB
02/06/23	02/06/23	Large amount of water (approximately 200 mL) observed in ISCO base.	OK sample volumes observed in ISCO slots 1-3 and in manual Grab and Controls samples of DD #14, empty number 4 bottle. Took kink out of tubing in the hope that fixes issue. Will monitor and adjust ISCO settings if necessary.	02/06/23	SRB
02/15/23	02/15/23	DTS is sitting too high in the water column.	Lowered DTS so that sensor is at standard 6/10 depth.	02/15/23	
02/22/23	02/22/23	DTS is sitting too low in the water column.	Raised DTS so that sensor is at standard 6/10 depth.	02/22/23	RCH
03/01/23	03/01/23	Moderate organic debris observed to be built up around DTS housing upon arrival to the site, sensor optics were not obscured.	Removed moderate debris that had been built up around DTS housing.	03/01/23	SRB
03/01/23	03/01/23	DTS is sitting too low in the water column for anticipated flows.	Raised DTS so that sensor will be at standard 6/10 depth as stage rises.	03/01/23	SRB

Start Date	End Date	Comment	Resolution	Resolution Date	Initials
03/01/23	03/01/23	Stage plate difficult to read in fast flows.	Observed stage plate measurement is an approximation (+/- 0.04'). Will monitor future stage plate measurements and edit if necessary.	03/01/23	SRB
03/01/23	03/01/23	Large amount of water (approximately 200 mL) observed in ISCO base.	OK sample volumes observed in all other ISCO slots and in manual Grab and Control samples of DD #16 taken. Will monitor and adjust ISCO settings if necessary.	03/01/23	SRB
03/01/23	03/01/23	Empty sample observed in ISCO slot 21 of DD #16.	DTS was likely temporarily in and out of the water given that there was water in the ISO base. . Issued generic BID# 9999 and changed data exception type to "NULL" in TTS.NET.	03/01/23	SRB
03/06/23	03/06/23	DTS is sitting too low in the water column.	Raised DTS so that sensor is at standard 6/10 depth.	03/06/23	RCH
03/16/23	03/16/23	DTS is sitting too high in the water column.	Lowered DTS so that sensor is at standard 6/10 depth.	03/16/23	RCH
03/20/23	03/20/23	Stage plate difficult to read due to wake	Observed stage plate measurement is an approximation (+/- 0.04'). Will monitor future stage plate measurements and edit if necessary.	03/20/23	SRB

Start Date	End Date	Comment	Resolution	Resolution Date	Initials
03/20/23	03/20/23	Large amount of water (approximately 125 mL) observed in ISCO base.	OK sample volumes observed in ISCO slots 1-8 and in manual Grab and Controls samples of DD #19. Will monitor and adjust ISCO settings if necessary.	03/20/23	SRB
03/28/23	03/28/23	DTS is sitting too low in the water column for rise in stage.	Raised DTS so that sensor is at standard 6/10 depth.	03/28/23	RCH
04/07/23	04/07/23	DTS is sitting too high in the water column for drop in stage.	Lowered DTS so that sensor is at standard 6/10 depth.	04/07/23	SRB
04/07/23	04/07/23	Between 7:20 and 7:30 the datalogger failed and re-set the DD#, stage multiplier and offset to defaults.	Reset DD# 21 and sensor-specific stage multiplier and offset	04/07/23	SRB
04/11/23	04/11/23	Datalogger pelican case desiccant requires replacement.	Replaced datalogger pelican case desiccant.	04/11/23	RCH
04/18/23	04/18/23	DTS is sitting too high in the water column for drop in stage.	Lowered DTS so that sensor is at standard 6/10 depth.	04/18/23	SRB
04/18/23	04/18/23	Light algal debris observed to be present on DTS optics and wiper is a little loose	Wiped off algal debris and tightened DTS wiper, and made sure wiper was still wiping.	04/18/23	SRB
04/25/23	04/25/23	DTS is sitting too high in the water column.	Lowered DTS so that sensor is at standard 6/10 depth.	04/25/23	RCH
05/02/23	05/02/23	DTS is sitting too high in the water column	Lowered DTS so that sensor is at standard 6/10 depth	05/02/23	SRB
05/16/23	06/02/23	E-stage is -0.02 -0.03 from stage plate	Will monitor and re-calculate stage offset if necessary.	06/02/23	SRB

Start Date	End Date	Comment	Resolution	Resolution Date	Initials
05/23/23	05/23/23	Section control has moderate debris present	Cleaned section control of the moderate debris ahead of measuring discharge	05/23/23	SRB
05/23/23	05/23/23	Water (approximately 20 mL) observed in ISCO base after performing Grab and Control samples	OK sample volumes observed in ISCO slots 1 and 2. Emptied base and will monitor and adjust ISCO settings if necessary	05/23/23	SRB
06/02/23	06/02/23	DTS is sitting too high in the water column	Lowered DTS so that sensor is at standard 6/10 depth	06/02/23	SRB
06/02/23	06/02/23	Some light algae had collected on the DTS housing and around the edge of the DTS optics	Cleaned algae off the DTS housing and around the edge of the DTS optics with a brush	06/02/23	SRB
06/02/23	06/12/23	Section control has light debris present	Cleaned section control of the light debris ahead of measuring discharge	06/12/23	SRB
06/22/23		Station is hydrologically connected but streamflow is too low to obtain a discharge measurement.	Will monitor and measure discharge as streamflow increases.		RCH
06/26/23	06/26/23	DTS is sitting too high in the water column	Lowered DTS so that sensor is at standard 6/10 depth	06/26/23	SRB
06/26/23	06/26/23	Section control has light debris present	Did not clean section control of the light debris.	06/26/23	SRB