Mendocino • Humboldt
Redwood Companies

Hydrologic Monitoring Report 2022

North Fork Elk River Upstream of Station 532

Elk River

Freshwater Creek

Bear Creek

January 2023

PROJECT TITLE:

ELK RIVER WATERSHED WASTE DISCHARGE PERMIT R1-2019-0021

FRESHWATER CREEK WATERSHED WASTE DISCHARGE PERMIT R1-2006-0041

HY 2022 ANNUAL TURBIDITY TREND STATION DATA SUBMITTAL AND SUMMARY REPORT

ORGANIZATION IMPLEMENTING THE PROJECT:

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HUMBOLDT REDWOOD COMPANY LEAD HYDROLOGIST, FOREST SCIENCE

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HUMBOLDT REDWOOD COMPANY DIRECTOR, FOREST SCIENCE

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List of Acronyms

CI - Confidence Interval

DTS - Digital Turbidity Sensor

HCP - Habitat Conservation Plan

HRC - Humboldt Redwood Company

HTM - Hydrologic Trends Monitoring

HY - Hydrology Year

NCRWQCB - North Coast Regional Water Quality Control Board

NTU - Nephelometric Turbidity Unit

QAQC - Quality Assurance Quality Control

Q - Stream Discharge

SSC - Suspended Sediment Concentration

WDR - Waste Discharge Requirement

1.0 Introduction

Suspended sediment concentration (SSC) and streamflow are measured at seven hydrologic trends monitoring (HTM) stations in the Elk River watershed, eight locations in the Freshwater Creek watershed, and one location in the lower Eel River watershed (**Table 1**). This network is in place to monitor sediment-related water quality parameters.

The following data are collected at each monitoring station during the hydrology year (HY) which runs October 1st – May 15th:

1. 15-minute electronic recording of turbidity, water depth, and water temperature.

2. 100-500 mL water samples pumped by ISCO auto-samplers during storm events or collected manually by periodic depth-integrated sampling and grab sampling. These samples are analyzed for SSC, turbidity, and/or both.

3. Manual measurement of streamflow area and velocity using wading and non-wading techniques used to calculate discharge.

The above datasets are used to produce the following derived products:

- 15-minute SSC record
- 15-minute discharge record
- Annual suspended sediment load

Data collected and produced through this monitoring network support the following goals:

- Assess SSC and turbidity response to management techniques and natural disturbances on an annual and stormflow basis.

- Assess how management practices applied in each watershed through the North Coast Regional Water Quality Control Board (NCRWQCB) permits and Humboldt Redwood Company's (HRC) Habitat Conservation Plan (HCP) and Company policies affect trends in SSC and turbidity.

Each year, raw and processed data are submitted to the NCRWQCB per requirements of the Watershed Waste Discharge Permit for Elk River (R1-2019-0021) and Freshwater Creek (R1-2006-0041). This report supports the data submission for HY 2022 by reporting data collected from October 1, 2021 to May 15, 2022.

Table 1. HRC HTM station list for HY 2022.

Watershed	Station Number	Station Location	Basin Area (km^2)
Elk River	509	Mainstem Elk River	111.8
	510	South Fork Elk River	50.3
	511	Lower North Fork Elk River	56.9
	517	Bridge Creek	5.8
	522	Corrigan Creek	4.3
	532	Upper North Fork Elk River	35.1
	535	Little South Fork Elk River	9.4
Freshwater	500	Beck's Tributary	2.2
	504	Cloney Gulch	12.0
	505	Graham Gulch	6.2
	506	South Fork Freshwater Creek	8.2
	523	Lower Freshwater Creek	22.8
	526	Upper Freshwater Creek	5.1
	527	McCready Gulch	4.7
	528	Little Freshwater Creek	12.0
Lower Eel	530	Bear Creek	21.0

2.0 Methods

2.1 Site Operation and Instrumentation

All hydrology monitoring stations are equipped with the following instrumentation:

- Automatic pump sampler (ISCO by Teledyne Technologies, Inc.)
- Turbidimeter (DTS-12 by FTS)
- Pressure transducer (Druck by GE) or a gas bubbler system
- Datalogger (WaterLOG by YSI)

Table 2 through **Table 4** provide complete details regarding field and lab infrastructure.

Table 2. Standard operating protocols describing field and laboratory methods implemented by HRCs HTM program.

SOP	Title	Current Version	Description
SOP – 01 (HRC, 2020a)	Hydrologic Site Selection, Monumenting and Documentation	2.5	Establishing and documenting a permanent monitoring station.
SOP – 02 (HRC, 2020b)	Gaging Streams for Estimating Discharge	3.3	Installing a staff plate, measuring streamflow, constructing a stage-discharge rating curve.
SOP – 03 (HRC, 2020c)	Instrumentation Methodology	2.1	Turbidimeters, water samplers, pressure transducers, and rain gauge manuals.
SOP – 04 (HRC, 2020d)	Water Quality Grab Sampling and Field Turbidity Measurement	2.2	Depth-integrated sampling methods and portable turbidimeter manual.
SOP – 05 (HRC, 2020e)	Laboratory Analysis of Suspended Sediment Using Electronic Data Collection Methods	5.2	Turbidity and sediment concentration laboratory measurement.
SOP – 19 (HRC, 2020f)	Establishing and Maintaining the Physical Infrastructure of a Hydrologic Monitoring Station	1.5	Hydrologic monitoring station set-up.

Table 3. Equipment used in the field and laboratory for hydrologic monitoring and inspection.

Instrument	Model / Manufacturer	Instrument Range/Accuracy	Inspection Frequency	Inspection Type	Inspector
Datalogger	WaterLOG by YSI	NA	Weekly	Verify Data	Field Crew
Field Turbidimeter	DTS-12 by FTS	Range: 0 – 2000 NTU Zero, Offset ± 0.2 NTU Accuracy: ± 2% (0 – 500), ± 4% (501 – 1600) Temp: ± 0.20 °C	Weekly	Proper Operation	Field Crew
Water Sampler	ISCO 6100/6712 by Teledyne	NA	Weekly	Proper Operation	Field Crew
Pressure Transducer	Druck 1830/8388 by GE	Range: 75 mbar to 60 bar; Accuracy: ± 0.1%	Weekly	Proper Operation	Filed Crew
Flow Meter	Flo-Mate by Marsh-McBirney	Range: -0.15 – 6 m/s Stability: ± 0.15 m/s Accuracy: ± 2% Reading + Zero Stability	Each Use	Proper Operation	Field Crew
Lab Turbidimeter	HACH TL2300	Range: 0 – 4000 NTU ± 2% plus 0.01NTU from 0 – 1000 NTU, ± 5% from 1000 – 4000 NTU	Each Use	Calibration, Proper Operation.	Lab Leader
Analytical Balance	APX – 100 by Denver Instruments	Range: 0.0001 to 100.0 g Accuracy: ± 0.0001 g	Each Use	Standard Weight	Lab Leader
Top Loading Balance	XP-3000	Range: 0.1 to 1000.0 g Accuracy: ± 0.1 g	Each Use	Standard Weight	Lab Leader
Lab Oven	Quincy Lab	Accuracy: 1°C	Each Use	Proper Operation	Lab Leader
Vacuum Filtration	NA	NA	Each Use	Proper Operation	Lab Leader

Table 4. Instrumentation deployment at HRC hydrologic monitoring stations during HY 2022.

Station	Stream Name	Turbidimeter	Turbidimeter Range (NTU)	Water Level	Data Recorder	Peak flow Sampling Method
509	Mainstem Elk River	DTS-12	0 – 2,000	Gas Bubbler	WaterLOG	Bridge
510	Lower South Fork Elk River	DTS-12	0 – 2,000	Druck	WaterLOG	Cable System
511	Lower North Fork Elk River	DTS-12	0 – 2,000	Druck	WaterLOG	Cable System
517	Bridge Creek	DTS-12	0 – 1,400	Druck	WaterLOG	Platform
522	Corrigan Creek	DTS-12	0 – 1,400	Druck	WaterLOG	Platform
532	Upper North Fork Elk River	DTS-12	0 – 1,400	Druck	WaterLOG	Bridge
535	Little South Fork Elk River	DTS-13	0 – 1,400	Druck	WaterLOG	Cable System
500	Beck’s Tributary	DTS-12	0 – 1,400	Druck	WaterLOG	Platform
504	Cloney Gulch	DTS-12	0 – 1,400	Druck	WaterLOG	Cable System
505	Graham Gulch	DTS-12	0 – 1,400	Druck	WaterLOG	Cable System
506	South Fork Freshwater Creek	DTS-12	0 – 1,400	Druck	WaterLOG	Platform
523	Lower Freshwater Creek	DTS-12	0 – 1,400	Druck	WaterLOG	Cable System
526	Upper Freshwater Creek	DTS-12	0 – 1,400	Druck	WaterLOG	None
527	McCready Gulch	DTS-12	0 – 1,400	Druck	WaterLOG	Platform
528	Little Freshwater Creek	DTS-12	0 – 1,400	Druck	WaterLOG	Cable System
530	Bear Creek	DTS-12	0 – 1,400	Druck	WaterLOG	Bridge

2.2 Data Collection

2.2.1 Continuous Data

Turbidity, measured in nephelometric turbidity units (NTU), is recorded with a turbidimeter suspended in the stream at approximately 6/10 water depth. Measurement ranges are listed for each turbidimeter in **Table 4**. Instruments are secured to a boom arm that may be raised or lowered within the water column as depth changes.

Water depth is measured using a pressure transducer/gas bubbler mounted to the streambed. HRC has devised an apparatus at each site that firmly holds the instrument in place and allows the operator to return the device to the same position after servicing.

Water temperature (^{o}C) is measured within the water column at the same location as turbidity. All continuous data are collected at 15-minute intervals from October 1st - May 15th of each HY.

2.2.2 Water Quality Samples

Each datalogger contains a program that triggers an ISCO auto-sampler to begin sampling based on a specified sustained rise in stage. The program runs in two segments ('A' and 'B') that fill bottles to 100-500 mL based on a set time interval. The objective is to sample both the rising and falling limbs of storm hydrographs in sufficient detail to record SSC hysteresis. Hysteresis is defined here as the difference in sediment concentration at a given stage during the falling limb as compared to the same stage on the rising limb. Samples are collected within one week following sampling and submitted to the HRC laboratory. Samples are identified by the hydrologist and sent to the lab for turbidity and SSC analysis. During laboratory processing turbidity is measured with a HACH TL2300 bench turbidimeter (range of measurement = 0-4000 NTU) and SSC is determined through vacuum filtration.

Depth-integrated point samples are collected across the range of flows and submitted for lab analyses of turbidity and SSC. These samples are used to validate ISCO samples that are collected at a single point in the water column. Grab samples are also collected and submitted for lab analysis in order to compare with the turbidimeter data for calibration of the field and lab turbidity instruments.

2.2.3 Discharge Measurements

Discharge is calculated by the velocity-area technique for a range of flows. Low flow velocities are measured with a wading rod and high flow velocities are measured using a variety of cableway and platform techniques (**Table 4**). High flows that exceed bankfull stage are less common and are generally under-represented in the measured data at nearly all the sampling sites. High flows are estimated by extrapolating rating curves beyond the range of empirical data.

2.3 Data Processing

2.3.1 Stage-discharge Relationships

Stage-discharge relationships are essential in estimating discharge from field observed stage readings. In stable, well-defined channels, discharge can be predicted from stage measurements based on a power relationship. Stage-discharge relationships for our hydrology monitoring sites are updated on a yearly basis to reflect channel changes that often occur. Channel changes are tracked by yearly cross-section topographic surveys. It is common for some scour or aggradation to occur within the discharge cross-section at most sites since they are not controlled by weirs or flumes. Stations were originally selected to minimize change through the local reach. Most sites are sufficiently stable to allow the use of the same rating curve for multiple years.

Many monitoring sites require multiple rating equations for different flow ranges. An example stage-discharge relationship is shown in **Figure 1**. Rating equations are then used to calculate discharge on the 15-minute interval during which river stage is recorded.

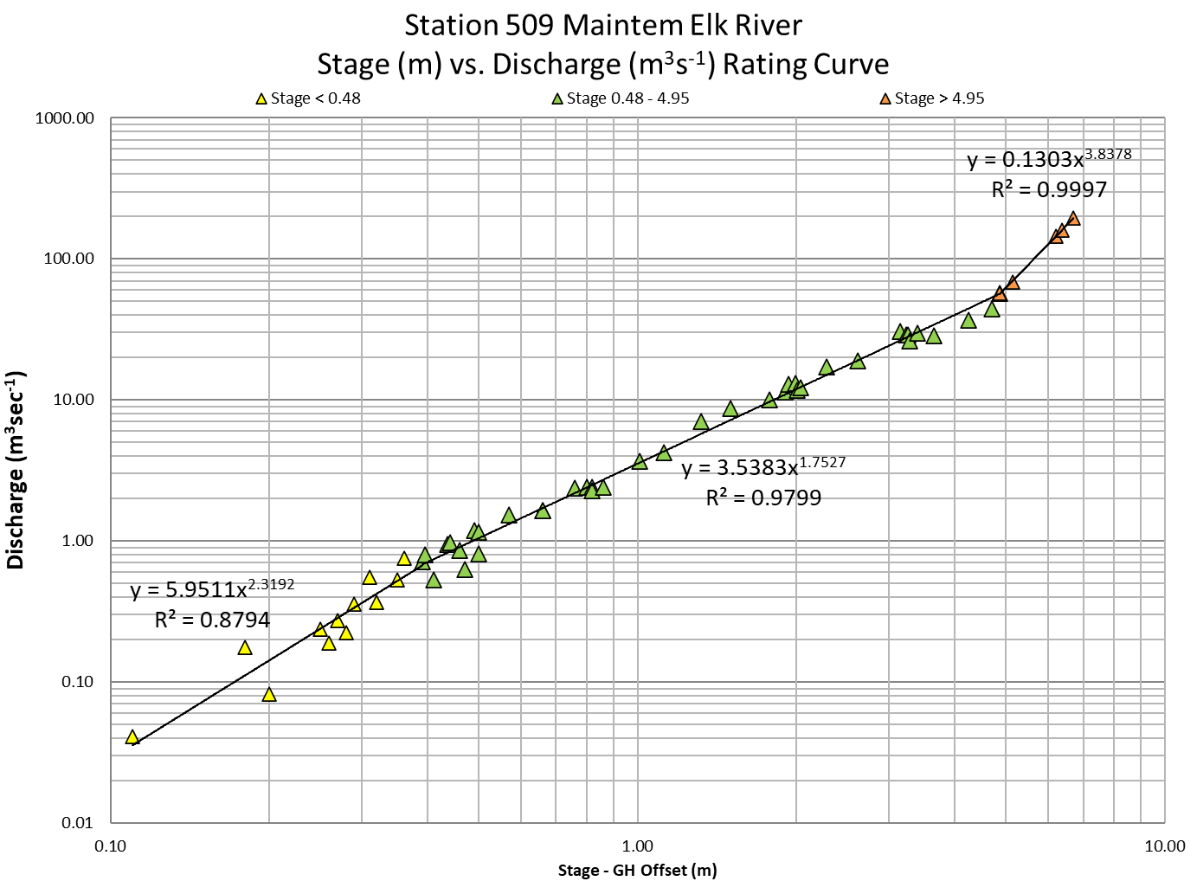

Figure 1. Stage-discharge relationship for the Mainstem Elk River gaging station 509. The gage height offset for zero flow is 0.09 meters (m).

2.3.2 Data Validation and Correction

Validation and correction of 15-minute measurement records are conducted using TTS Adjuster software to produce continuous, 15-minute, monitoring records for water year. The corrected data file contains codes for stage and turbidity data records to indicate which, if any, correction methods were applied in the TTS Adjuster program (**Table 5**). Quality Assurance Quality Control (QAQC) procedures remove outliers or spikes that appear to be anomalies of the data collection process. Missing data are filled using a variety of techniques at the discretion of the data processor. Data may be filled from physically measured data, interpolated between recorded data, or reconstructed from another best matched site.

Table 5. Stage and turbidity codes documenting edits made to hydrology datasets in TTS Adjuster.

Code	Definition
-1	Unedited, unapproved
0	Raw data, accepted as good
1	Raw data, accepted but questionable
2	Bad data, replaced with NA
3	Constant shift was applied
4	Variable (linear) shift was applied
5	Interpolated (linearly)
6	Reconstructed from another site
7	Free-hand reconstruction
8	Y-proportional shift was applied
9	Replaced with lab-measured value

Site specific correlations are developed between pairs of instrument recorded water depth and observed stage (recorded by observers at the staff plates). 15-minute water depths are then adjusted to water stage that correlates to staff plate readings prior to data correction in TTS adjuster (Lewis, 2009). An example correlation is shown for monitoring site 509 in **Figure 2a**.

Field turbidity is used to model continuous SSC at each monitoring site. Field turbidimeters are calibrated between 1,600 and 2,000 NTUs (**Table 3**). Turbidity peaks are replaced with lab turbidity values when field turbidity exceeds DTS calibration thresholds. Field and lab turbidity regressions are used to reconstruct turbidity peaks when stream turbidity exceeds the limit of field turbidimeters. An example field-lab turbidity relationship is shown in **Figure 2b**. Field turbidity is corrected and validated in TTS adjuster using QAQC codes that are listed in **Table 5**.

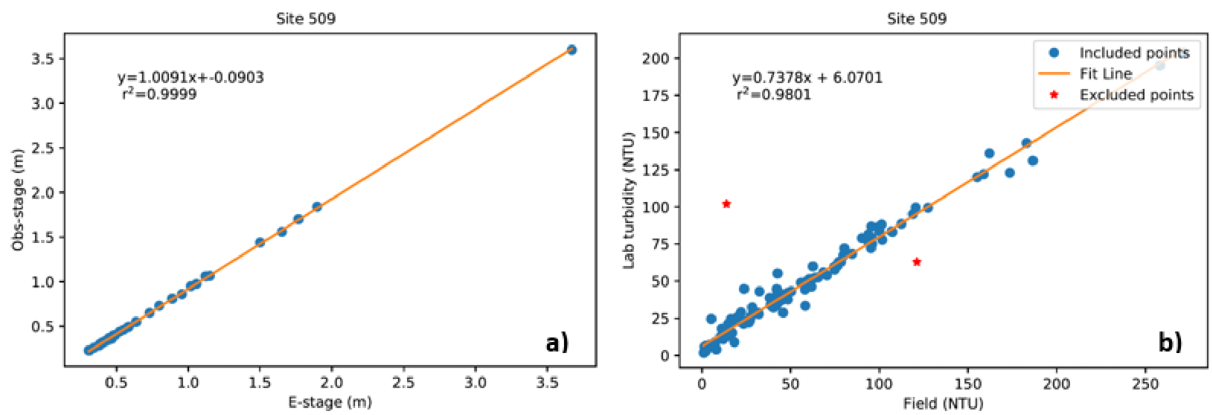

Figure 2. Instrument stage ("E-stage") vs. observer stage ("Obs-stage") for the Mainstem Elk River (**a**). Field turbidity (NTU) vs. laboratory turbidity (NTU) for the Mainstem Elk River (**b**).

Once all data correction and validation within TTS Adjuster is complete, discharge values are calculated for every 15-minute stage measurement (using the stage-discharge relationships described above) and the corrected data file is saved. A graphical example of the corrected data file is shown in **Figure 3**.

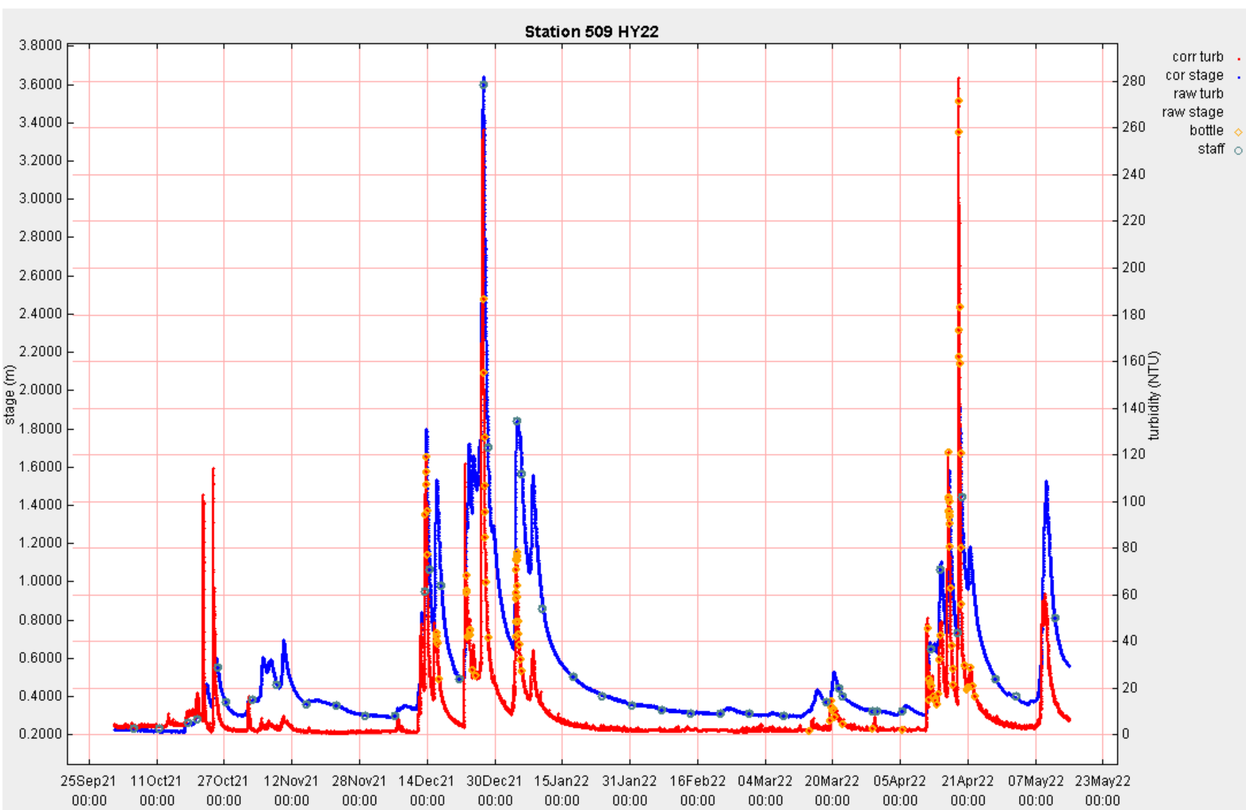

Figure 3. Corrected hydrologic data measured at Mainstem Elk River station 509, HY 2022.

2.3.3 Suspended Sediment Concentration

Continuous suspended sediment concentrations (SSC) are calculated from composited field turbidity/SSC relationships using R software packages developed by Jack Lewis (Lewis, 2009). All discrete SSC measurements (i.e., pumped samples, ISO samples, and grab samples) are combined for this analysis (**Figure 4**). SSC is then estimated using a linear or power fit model after combing all turbidity/SSC pairs throughout the water year. Sediment mass is calculated for each 15-minute interval using the appropriate 15-minute discharge. Total annual suspended sediment yield is then derived by accumulating the sediment mass throughout the measurement record.

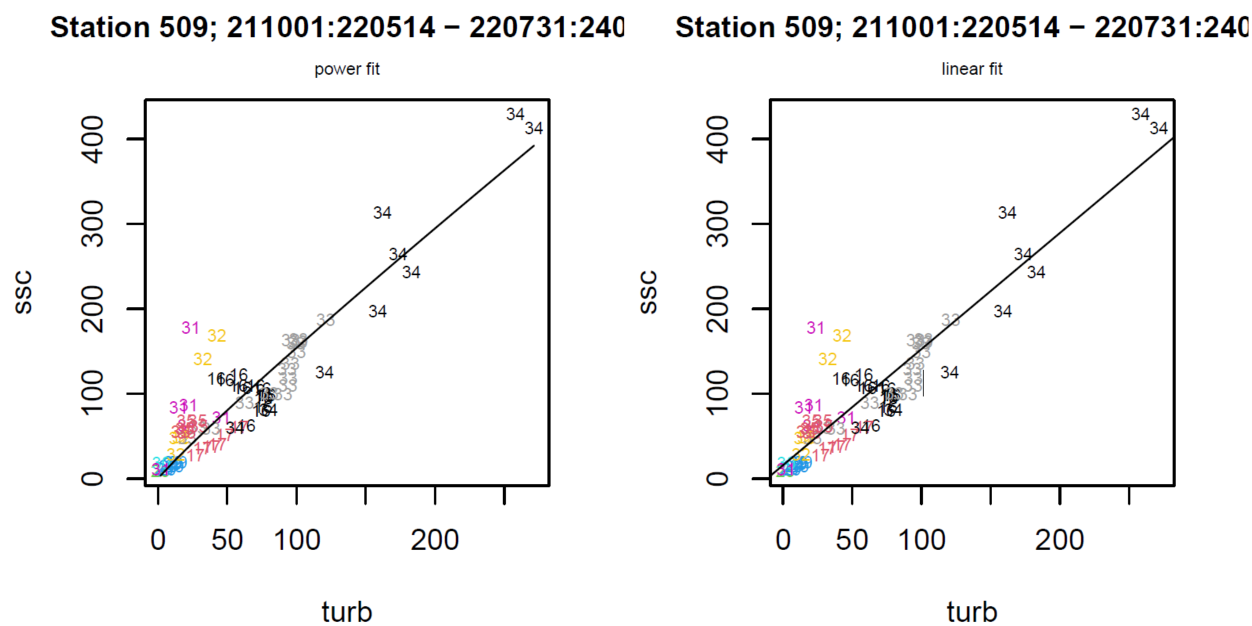

Figure 4. Power and linear fit data for field turbidity (NTU) vs. SSC (mg/L) at Mainstem Elk River station 509 for HY 2022. Numbers indicate groups of samples, or data dumps, collected during distinct storm events.

2.3.4 Uncertainties and Sources of Error

The combination of substrate characteristics, common rainfall intensities, and small size of many of our monitoring basins often produces streamflow responses that rise and fall quickly during and after a rainfall event. At times during certain storms, the ISCO sampling tube may end up close enough to the riverbed to collect bed load in addition to suspended sediment. Samples with obvious bedload or organic matter are flagged during lab analysis and excluded from predictive sediment models. When samples are less obvious and not flagged, suspended sediment concentrations may be biased high. Moreover, HRC sediment lab procedures do not burn off organic matter from filtered SSC samples which may further over-predict total sediment yields. Sediment values are reported to no more than two significant figures to account for these uncertainties.

High discharges, if estimated from rating curve extrapolation, included more uncertainty than lower discharges, and that error can be propagated through to sediment load estimates during the highest flows. Therefore, differences in high flow estimates due to rating curve creation could have large impacts on sediment yields, even in situations where small or no changes in actual sediment concentrations occurred. For flows that fall within the well constrained rating curves, the uncertainty in estimated discharge values is likely below ±5% (Whiting, 2016). For flows above the highest measured discharge, uncertainty may be greater. 95% confidence intervals (CI) are reported for peak flows but are based on the measured points used to construct the high end of the rating curve. Therefore, the actual 95% CI for peak flows may be greater.

3.0 Hydrology Year 2022 Data Summary

Suspended sediment yields and peak flows are summarized by site in **Table 6**. Data analysis conducted for HY 2022 shows relatively low sediment yields and instantaneous peak flows at each station when compared to previous HYs which is consistent with the drier than normal precipitation conditions received throughout the region during the monitoring period. HY 2022 data processing notes highlight minimal challenges due to data logger malfunctions for several short periods during the monitoring season. Relationships were created between appropriate stations to estimate turbidity and depth during these malfunction periods. Estimated data are stored within each of the aforementioned station's HY 2022 data folder. Additional data for each monitoring station have been stored on CD's that accompany this report. Please reference these data files for a complete summary of each monitoring station. Supporting data are filed by watershed and sites (**Appendix A**).

Table 6. Summary of annual sediment load and discharge at HRC HTM stations during HY 2022.

Station	Stream Name	Watershed	Upper Drainage Area (km^2)	Total Suspended Sediment Yield (Mg)	Total Suspended Sediment Yield (Mg/ km^2)	Instantaneous Ann. Peak Discharge (cms/ km^2)	Instantaneous Ann. Peak Discharge (cms) (95% CI)
509	Mainstem Elk River	Elk River	111.8	1400	13	0.29	32.6 (24.3-43.7)
510	Lower South Fork Elk River	Elk River	50.3	680	13	0.32	16.2 (10.1-26.0)
511	Lower North Fork Elk River	Elk River	56.9	570	10	0.4	22.7 (12.5-41.5)
517	Bridge Creek	Elk River	5.8	5.5	0.9	0.23	1.3 (0.5-3.4)
522	Corrigan Creek	Elk River	4.3	36	8.3	0.4	1.7 (1.1-2.7)
532	Upper North Fork Elk River	Elk River	35.1	350	10	0.33	11.6 (8.6-15.5)
535	Little South Fork Elk River	Elk River	9.4	54	5.8	0.29	2.7 (1.4-5.3)
500	Beck’s Tributary	Freshwater Creek	2.2	5.2	2.4	0.3	0.6 (0.5-0.9)
504	Cloney Gulch	Freshwater Creek	12.0	30	2.5	0.23	2.8 (1.3-6.0)
505	Graham Gulch	Freshwater Creek	6.2	26	4.2	0.29	1.8 (0.9-3.4)
506	South Fork Freshwater Creek	Freshwater Creek	8.2	41	5	0.33	2.7 (1.8-4.1)
523	Lower Freshwater Creek	Freshwater Creek	22.8	190	8.4	0.32	7.3 (5.7-9.3)
526	Upper Freshwater Creek	Freshwater Creek	5.1	100	20	0.84	4.3 (1.7-10.8)
527	McCready Gulch	Freshwater Creek	4.7	12	2.5	0.18	0.8 (0.6-1.2)
528	Little Freshwater	Freshwater Creek	12.0	55	4.6	0.32	3.9 (1.7-9.0)
530	Bear Creek	Lower Eel River	21.0	42	2	0.14	3 (1.8-4.9)

4.0 References

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5.0 Appendices

Appendix A. Data File Directory

1. "continuous_data_plots"

a. Full year (allTurb(X)) folder where (X) = regression model used in R software.

i. "allTurb(X).pdf" = SSC (estimated and samples), turbidity, and Q plots for the entire water year where (X) = regression model used in R software.

ii. "predData.csv" = 15-minute date, turbidity, and predicted SSC data.

iii. "q.csv" = 15-minute date, estimated discharge, and corrected stage data.

iv. "sed.csv" = date, dump, bottle #, SSC, turbidity, and estimated discharge used to model SSC for the full year, inter-storm, and individual storm events.

v. "total.csv" = summary with storm start and end date/time, type of model, SSC predictor ("surr"), total sediment load (kg), number of SSC samples used to model SSC ("n"), r2 for the model, and standard deviation.

b. Rproducts folder = allTurb(X), inter-storm (interstormWY2022(X)), and individual storm event folders named by storm (i.e. 2201(X), 2202(X), 2203(X), etc.) where (X) = regression model used in R software.

i. "predData.csv" = 15-minute date, turbidity, and predicted SSC data.

ii. "q.csv" = 15-minute date, estimated discharge, and corrected stage data.

iii. "sed.csv" = date, dump, bottle #, SSC, turbidity, and estimated discharge used to model SSC for the full year, inter-storm, and individual storm events.

iv. "total.csv" = summary with storm start and end date/time, type of model, SSC predictor ("surr"), total sediment load (kg), number of SSC samples used to model SSC ("n"), r2 for the model, and standard deviation.

v. "turbssc_fits.pdf" = plot of turb vs SSC correlation for full year and inter-storm events.

vi. "turbssc_(X)_fit.pdf" = plot of turb vs SSC correlation for the storm event where (X) = regression model used in R software.

c. "###_continuousData.csv"= 15-minute flow (discharge, m3sec-1), turbidity (NTU), and SSC (mg/L).

d. "###_dischargeRainPlot.pdf" = 15-minute discharge and precipitation over the entire measurement period.

e. "###_dischargeSSCPlot.pdf" = 15-minute discharge and SSC over the entire measurement period.

f. "###_StageTurbPlot.pdf" = 15-minute stage and turbidity data with observed stage readings and lab samples included. NOTE: not all lab NTU samples were also ran for SSC.

g. "peaks.csv" = peak discharge (m3sec-1/35.315) and associated date/time by storm.

h. "peakStage.csv" = peak stage (m) and associated date/time by storm.

2. "cross_section_data"

   a. "plots_allYears" = plot of cross sections at each monitoring site for all available years.

   b. "plots_change" = plot of change in area for all available years.

   c. "summaryTables" = summary table for all available years.

3. "field_lab_turbidity_relationship"

   a. "###_ntu.pdf" = field vs lab turbidity regression plot.

   b. "###22_NTU_Data.csv" = data used in field/lab NTU regression.

   c. "###22_NTU_DataExcluded.csv" = data excluded from field/lab NTU regression.

   d. "###22_NTU_Stats.csv" regression equation information.

4. "flow_ssc_turb_duration_data_plots"

   a. "###_(X).pdf" = exceedance probability plots for discharge ((X) = flow), NTU and SSC combined ((X) = ntu_ssc), field turbidity at index probabilities ((X) = NTUExceed), and stage ((X) = stage).

   b. "###_(X)Exceed.csv" = exceedance data files for discharge ((X) = flow), field turbidity at index probabilities ((X)= NTU), suspended sediment concentration ((X)= SSC), stage ((X)= stage), and field turbidity ((X) = turb).

      i. Counts number of 15-minute measurements in a given category (X). % of total time, total days, and total hours above each threshold are also included.

5. "instrument_observer_stage_relationship"

   a. "###_OR.pdf" = plot of E-stage (instrument stage) vs. Obs-Stage (observer stage) regression.

   b. "###22_orData.csv" = data used in instrument/observer stage regression.

   c. "###22_orDataExcluded.csv" = data excluded from instrument/observer stage regression.

   d. "###22_orStats.csv" = regression equation information.

6. "other_model_input_files"

   a. "###.sdr" = stage discharge relationship file used by TTS adjuster to calculate 15-minute discharge.

b. ###22.flo = data for entire monitoring period used in TTS adjuster, R software, and python scripts.

c. “###22.isc” = bottle dump, bottle number, and SSC (mg/L) value used by TTS adjuster.

d. “###22.or” = date, time, observed stage (m) used by TTS adjuster.

e. “###22_SSC.csv” = datetime and SSC (mg/L) values used by R software.

7. “peak_flow_estimate_data”

a. “Duan_bias_factors.csv” = nonparametric smearing estimator factor used to correct for retransformation (Duan, 1983).

b. “Qmax_###.csv” = estimate Q max with 95% CI (Clarke, 1999).

c. “Qmax_data.csv” = rating data used to predict max Q.

d. “Qmax_duan_cor_eq_###.txt” = Duan coefficient and associated Q equation.

Each Monitoring Site Contains the Following Files – Where ### = Station Number:

1. “###_Streamflow_Stats.csv” = relevant streamflow statistics.

2. “###_Summary_Info.csv” = relevant station metrics and summary information on sediment load, yield, turbidity, and discharge.

3. “###_totalAll.csv” = comprehensive list of totals, with additional information, including:

a. Storm sediment yields/watershed area, predicted peak Q by storm, and estimated water volume by storm.

4. “Station###_RatingData_WY2022.xlsx” = Excel workbook with stage discharge rating data. At a minimum, it includes tabs with all year’s rating data, rating data used for WY2022 discharge calculations, and notes on developing/updating the WY2022 rating curves.

5. “WY2022_###v###_Stage_NTU_Temp_Relationship” = for stations which experienced data logger malfunctions during the monitoring season, this workbook highlights the relationships established as well as the data used when estimating depth, turbidity, and temperature during the malfunction period.

Additional Data Included:

1. “FlowExceedance_above_measuredRatingQ” = max measured Q exceedance per site.

2. “OR_counts_site.csv” = counts of E-stage/Obs-stage pairs per monitoring site.

3. “rainfall_eureka.csv” = rainfall recorded at the Eureka NWS station between 10/01/2021 and 05/31/2022.

4. “storms22.csv”= storm event time periods used by R to calculate storm event sediment yields.

5. “WY22processingNotes.docx” – data processing notes from each station for the water year.