

Horse Creek Stewardship Program Summary of Methods and Results

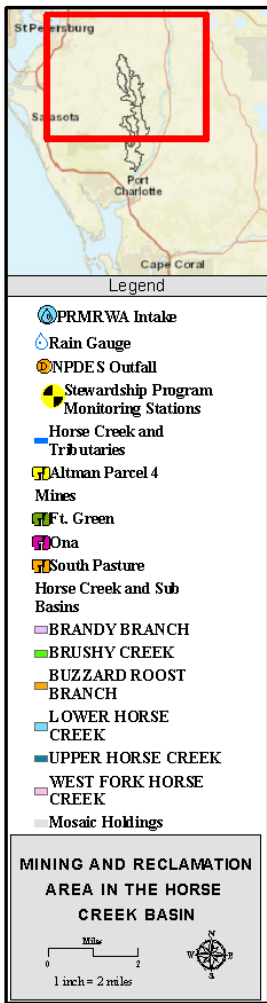
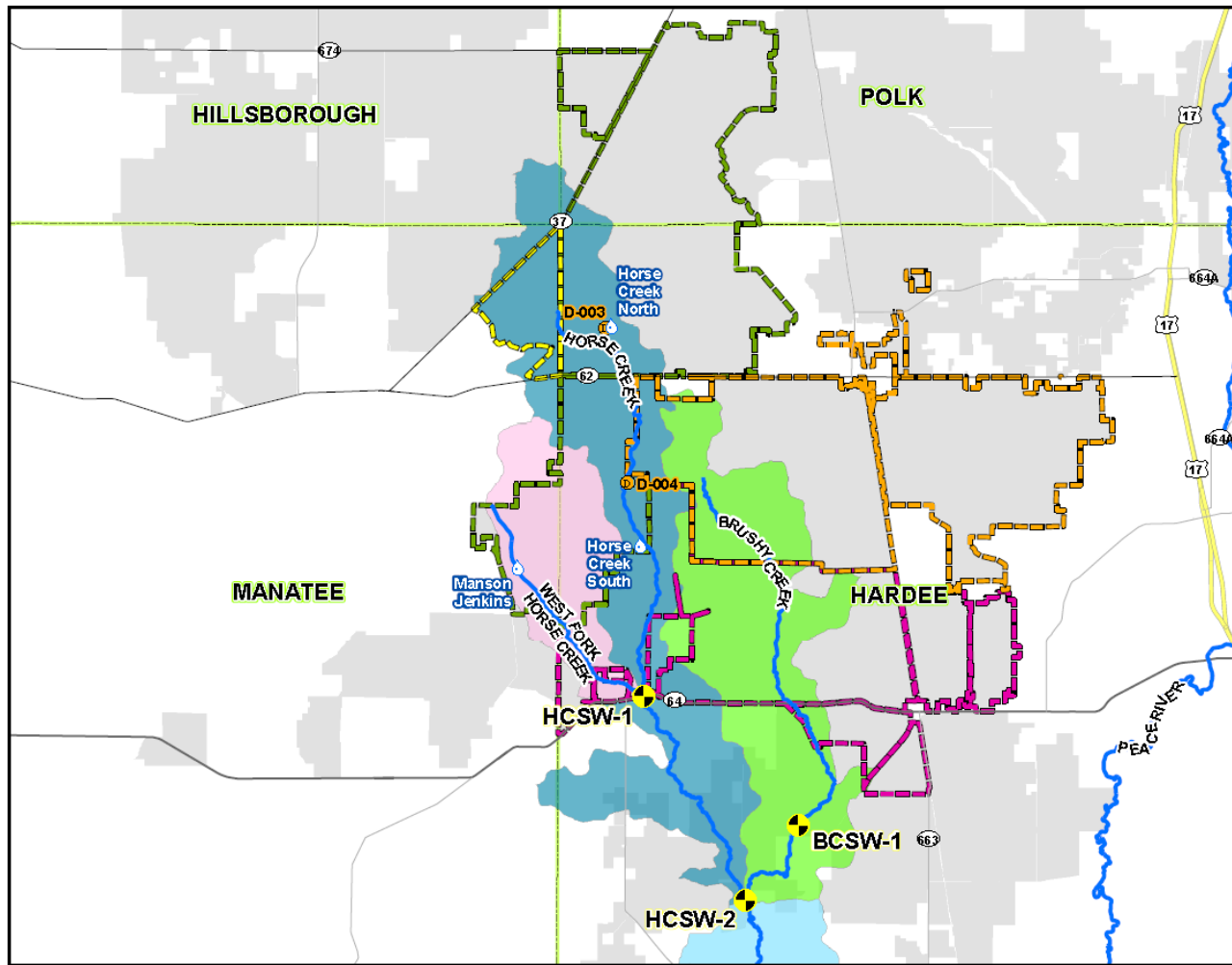


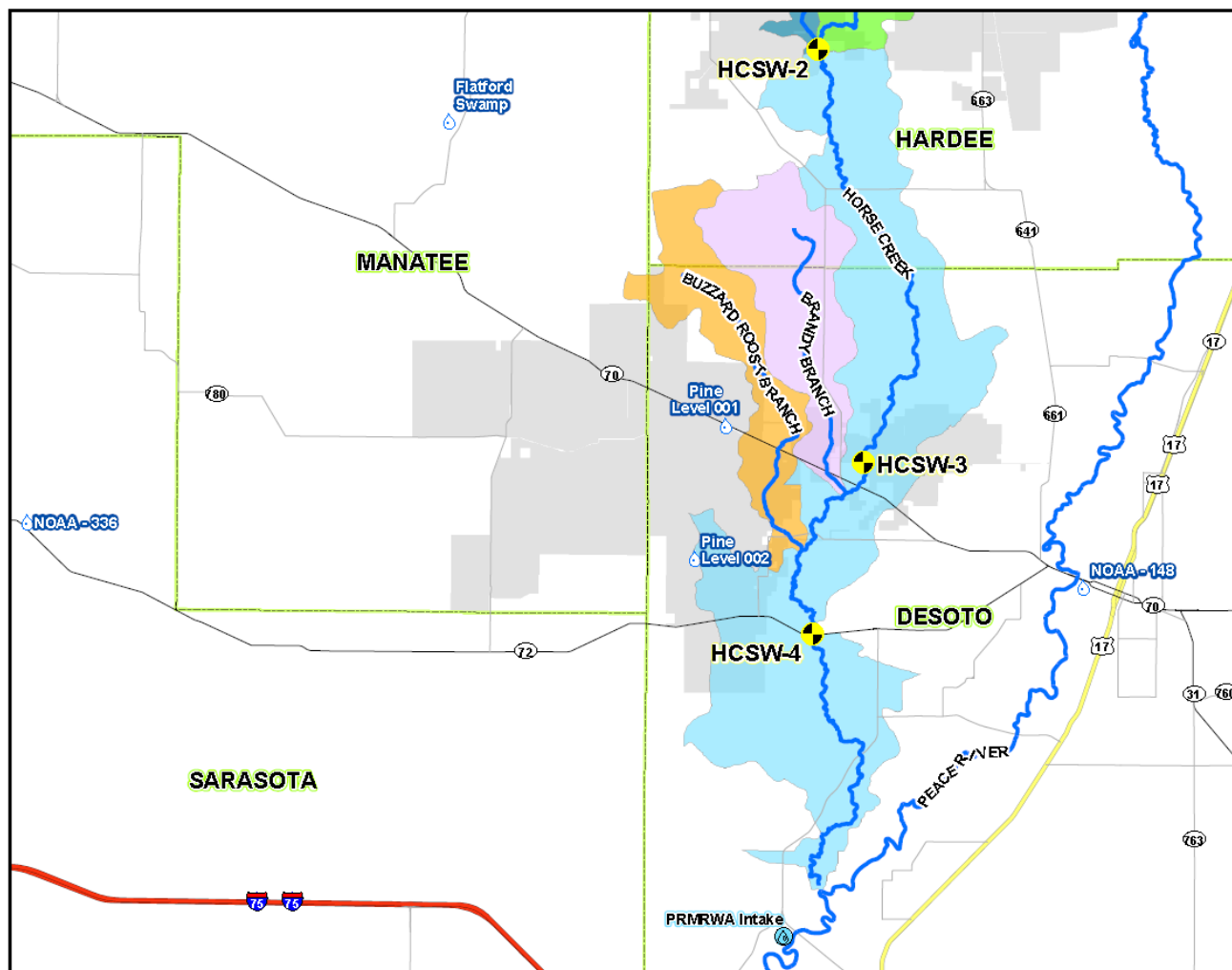
Overview

Created to ensure that Mosaic's mining activities do not adversely affect Horse Creek, Peace River, or Charlotte Harbor

The three components of the plan are:

- Monitoring and reporting on stream quality
- Investigating adverse conditions or significant trends
- Implementing corrective action for adverse changes to Horse Creek caused by Mosaic's mining activities, as necessary

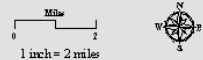




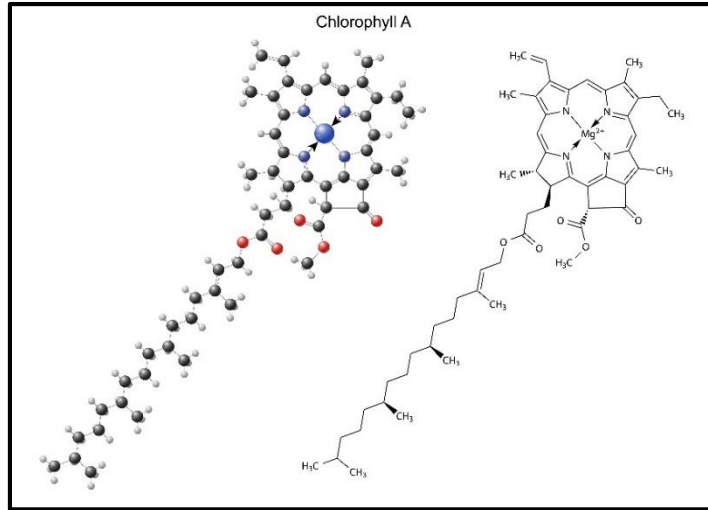
Legend

- PRMRWA Intake
- Rain Gauge
- NPDES Outfall
- Stewardship Program Monitoring Stations
- Horse Creek and Tributaries
- Altman Parcel 4
- Mines
- Ft. Green
- Ona
- South Pasture
- Horse Creek and Sub Basins
- BRANDY BRANCH
- BRUSHY CREEK
- BUZZARD ROOST BRANCH
- LOWER HORSE CREEK
- UPPER HORSE CREEK
- WEST FORK HORSE CREEK
- Mosaic Holdings

MINING AND RECLAMATION AREA IN THE HORSE CREEK BASIN



Methods



Water Quantity

Stream Level

- Monthly staff gauge readings at four Horse Creek stations

Discharge

- USGS daily streamflow at HCSW-1 and HCSW-4
- Continuous Mosaic NPDES discharge

Rainfall

- NOAA daily rainfall at Myakka River State Park and Arcadia
- SWFWMD Flatford Swamp daily rainfall
- Mosaic daily rainfall at three upper Horse Creek Basin gauges
- Horse Creek North
- Horse Creek South
- Manson Jenkins



Water Quality

Continuous (15-min intervals) sampling at HCSW-1

- pH, dissolved oxygen, specific conductivity, temperature, and turbidity

Monthly sampling at four stations

- Qualitative Stream Conditions
- Field Measurements: Water temperature, pH, dissolved oxygen, specific conductivity, and turbidity
- Samples split between Mosaic and independent third-party consultant
- Lab Analysis of 16 parameters including nutrients, minerals, and mining reagents

Additional sampling coincident with biological sampling

- Field parameters of temperature, pH, dissolved oxygen, specific conductivity, and turbidity

Trigger Levels

Pollutant Category	Analytical Parameters	Reporting Units	Trigger Level
<i>General Physio-chemical Indicators</i>	pH	Std. Units	<6.0->8.5
	Dissolved Oxygen Saturation	%	<38% daily average
	Turbidity	NTU	>29
	Color	PCU	<25
<i>Nutrients</i>	Total Nitrogen	mg/L	>3.0
	Total Ammonia	mg/L	>0.3
	Ortho Phosphate	mg/L	>2.5
	Chlorophyll- <i>a</i>	mg/L	>15
<i>Dissolved Minerals</i>	Specific Conductance	μS	>1,275
	Total Alkalinity	mg/L	>100
	Calcium	mg/L	>100
	Iron	mg/L	>0.3; >1.0
	Chloride	mg/L	>250
	Fluoride	mg/L	>1.5; >4
	Combined Radium (²²⁶ Ra + ²²⁸ Ra)	pCi/L	>5
	Sulfate	mg/L	>250
	Total Dissolved Solids	mg/L	>500
<i>Mining Reagents</i>	Petroleum Range Organics	mg/L	Discontinued
	Total Fatty Acids, Incl.Oleic, Linoleic, and Linolenic Acid	mg/L	
	Fatty Amido-Amines	mg/L	

Biology

Benthic Macroinvertebrates:

- Stream Habitat Assessment
- Florida Stream Condition Index (SCI)
- FDEP methodology (SCI-1000)
- Shannon-Wiener Diversity Index



Fish:

- Sampled with 4' x 8' seine and electrofishing
- Species richness
- Shannon-Wiener Diversity Index
- Morisita's Community Similarity Index
- Species Accumulation Curve



Reporting

- Immediate notification is provided to the PRMRWSA if continuous recorders detect high turbidity.
- Monthly reports of water quality data are submitted to the PRMRWSA and the TAG for review.
 - The TAG includes staff from Manatee, Sarasota, Charlotte, and Desoto counties, as well as an independent third-party consultant
 - Third-party review take place prior to data acceptance
 - Anomalous results are addressed immediately
- Annual reports are submitted to the PRMRWSA and the TAG for review.
 - Mosaic presents the results for water quantity, water quality, and biological data collected by the Program
 - The PRMRWSA and the TAG compile questions and comments that are incorporated into the final report draft
 - If any adverse long-term trends are identified in the report, Mosaic conducts an impact assessment
- Annual reports have been produced from 2003 to present, and a historical analysis was also prepared.
- Robust oversight and quality assurance is built in at every step
 - Field observations and split samples
 - Monthly water quality review
 - Annual report review
- The 2018 report is complete, and the 2019 report is prepared and currently in review process.

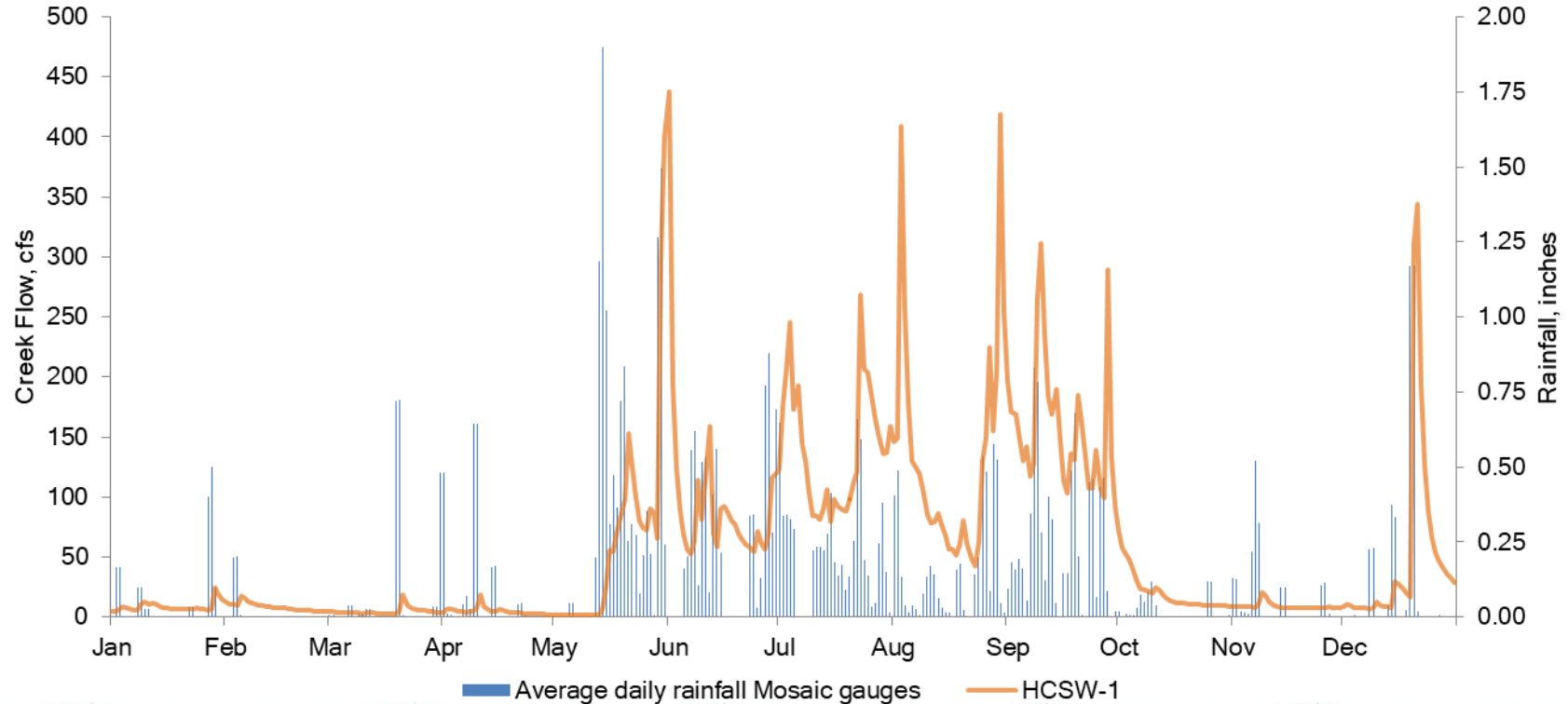
Summary of Results



Water Quantity Results



Rainfall and Streamflow, 2018 Daily Average



Streamflow, 2018

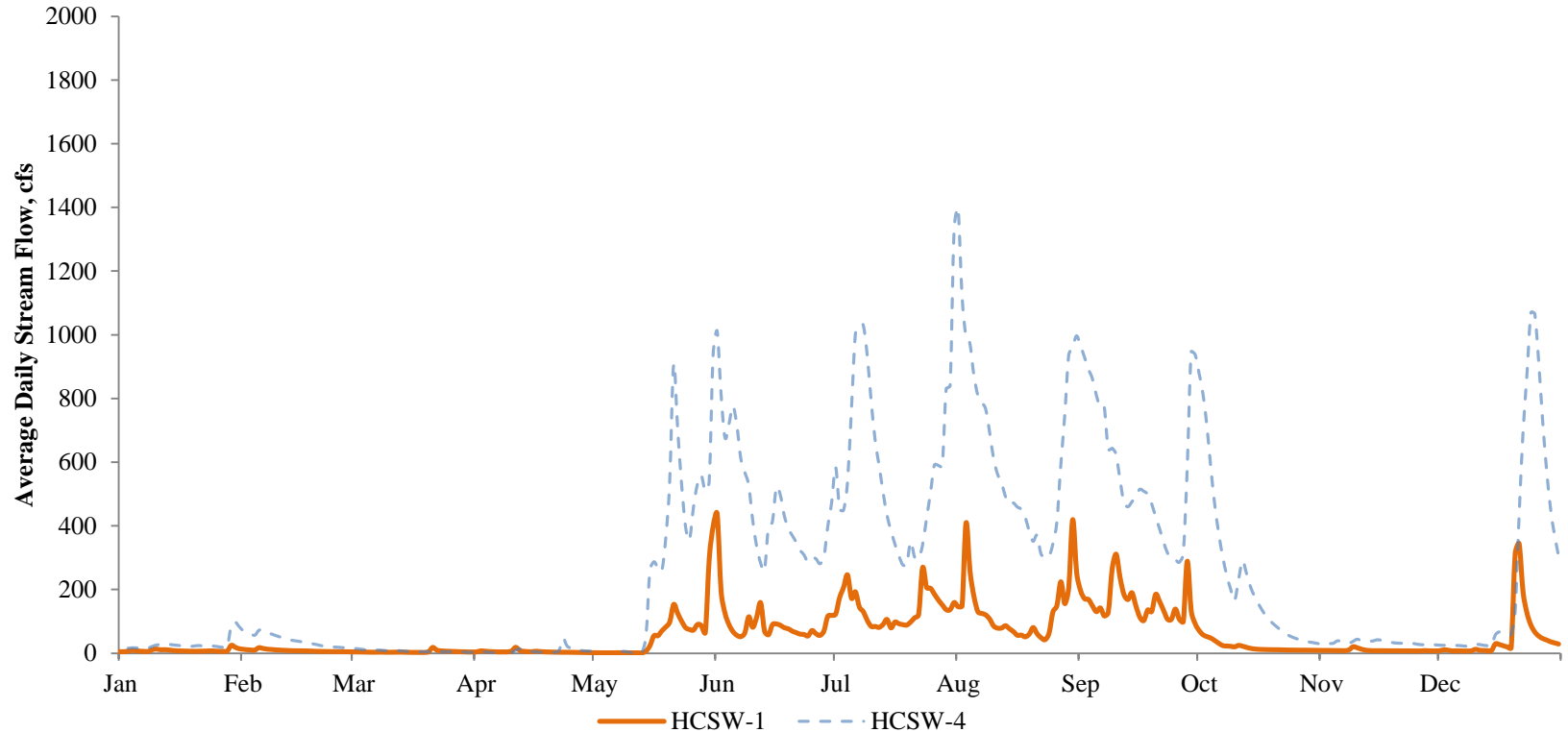
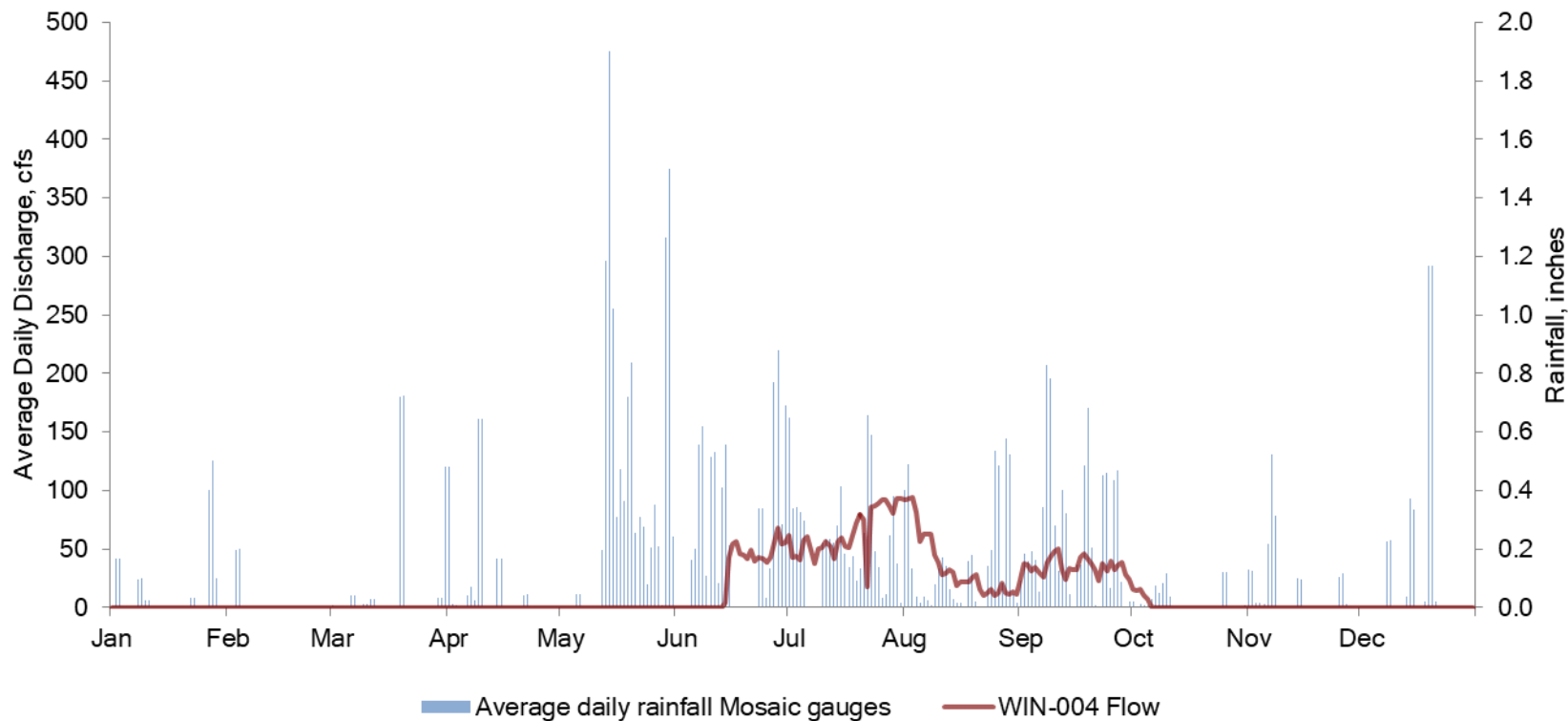
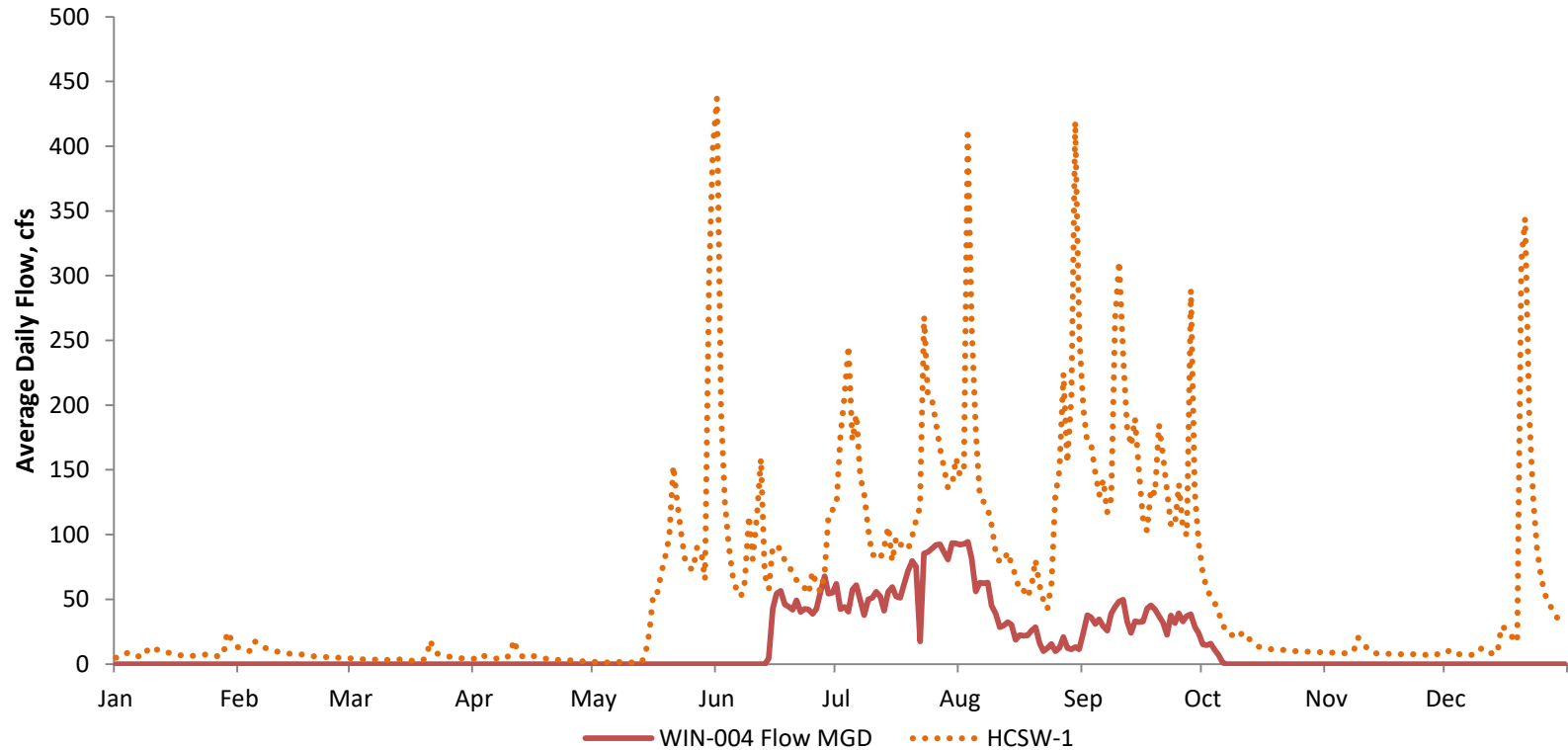


Figure 5-5

Rainfall and Streamflow – 2018 NPDES Discharge



Streamflow and NPDES Discharge, 2018



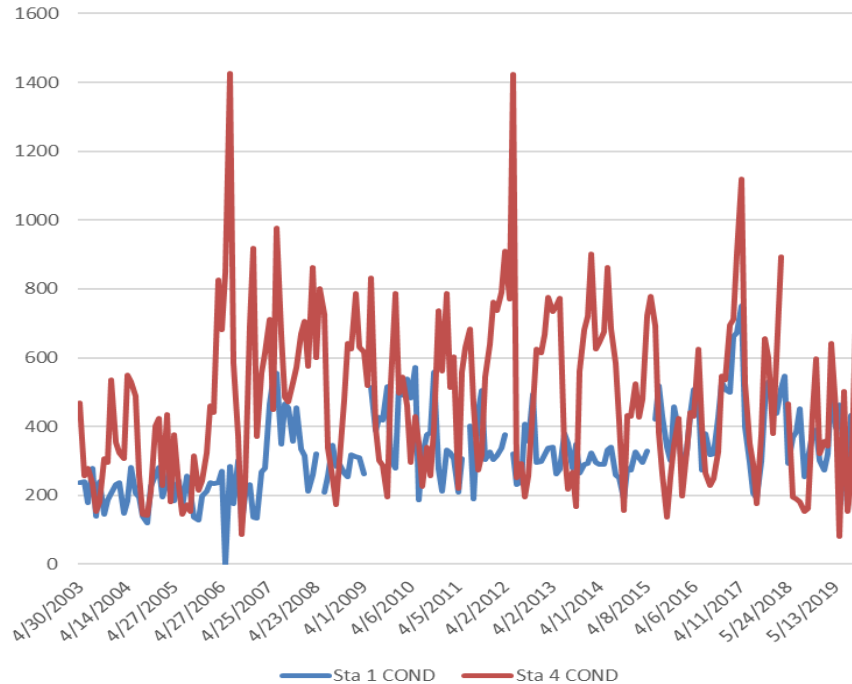
Combined NPDES Discharge to Horse Creek, POR

Year	Total annual flow, MG	Rank
2003	9253	1
2009	8767	2
2016	7047	3
2010	6712	4
2008	4613	5
2013	4597	6
2005	3411	7
2015	3224	8
2018	3201	9
2004	2222	10
2012	1947	11
2011	1766	12
2002	1338	13
2001	1239	14
2014	456	15
2007	210	16
2006	4	17
2017	0	18

Water Quality Results



Horse Creek Conductivity



- Station 1 in Blue Closest to Mining
- Station 4 in Red Farthest from Mining
- Station 4 Always Higher Conductivity
- Impacts from Irrigation

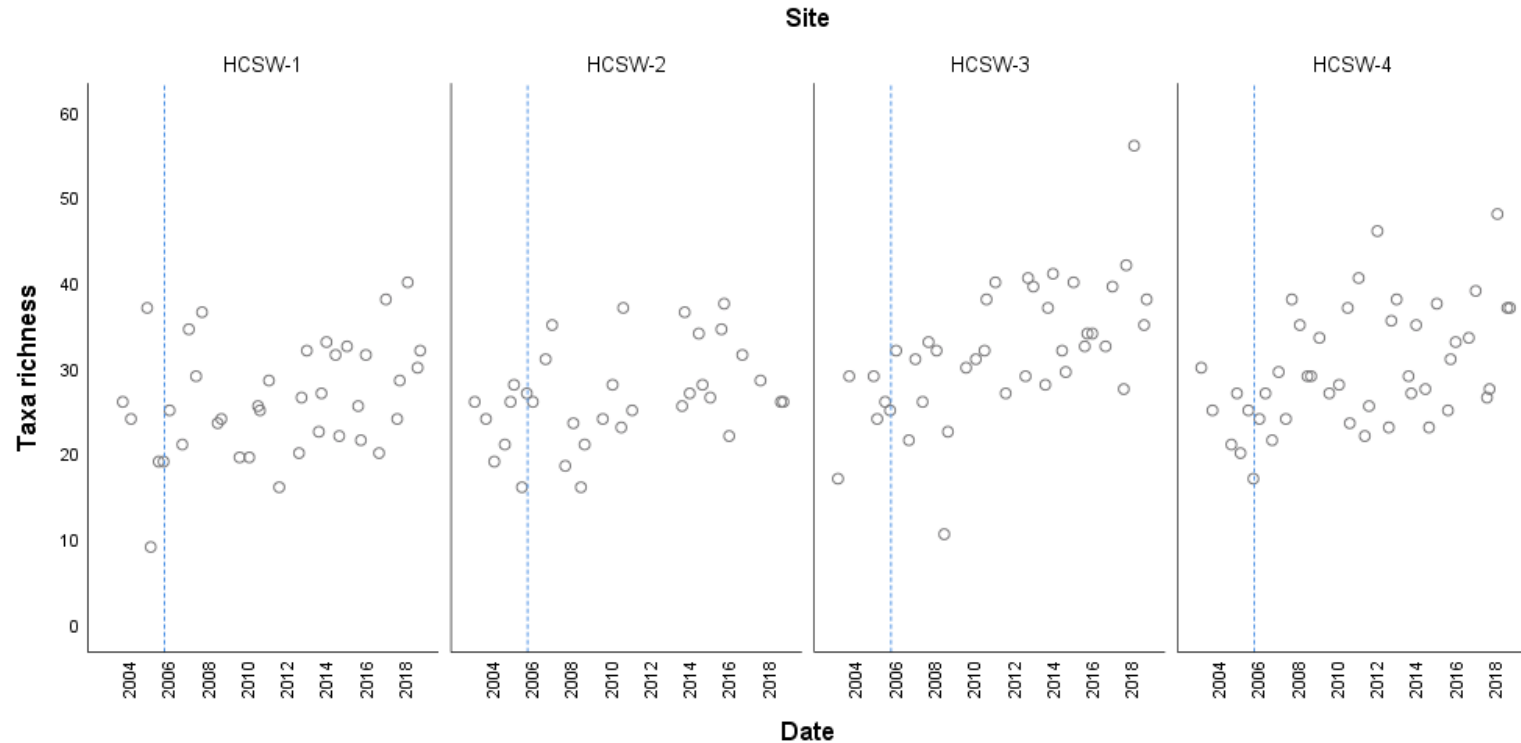
Water Quality Conclusion - 2018

- 24 water quality notifications in 2018 – all were deemed to be unrelated to mining discharges
- HCSW-1 (closest to outfalls) had only one notification - 495 days after the last discharge.
- HCSW-2 had notifications relating to Dissolved Oxygen and Ammonia
 - HCSW-2 is unlike other sites due to upstream impoundment and prairie.
 - Notifications were found to be related to longer residence time, periods of reduced or no water velocity and thick anaerobic organic benthic layer.
 - Ammonia notifications were G-qualified, Field blank > trigger value, and HCSW-1 < trigger value
- HCSW-3 had notifications relating to Dissolved Oxygen, Sulfate, TDS, and Ammonia
 - Notifications related to Dissolved Oxygen, Sulfate, and TDS occurred only at sites in lower basin
 - Ammonia notifications were G-qualified, Field blank > trigger value, and HCSW-1 < trigger value
- HCSW-4 had notifications relating to Iron, Sulfate, TDS, Ammonia, and Calcium
 - Iron levels were similar to HCSW-1, 2, and 3, but HCSW-4 has a lower trigger level for this analyte
 - Impact Assessments were conducted for Sulfate, TDS, and Calcium.
 - Ammonia notifications were G-qualified, Field blank > trigger value, and HCSW-1 < trigger value
 - Notifications were found to be related to low flow conditions coupled with non mining land use activities

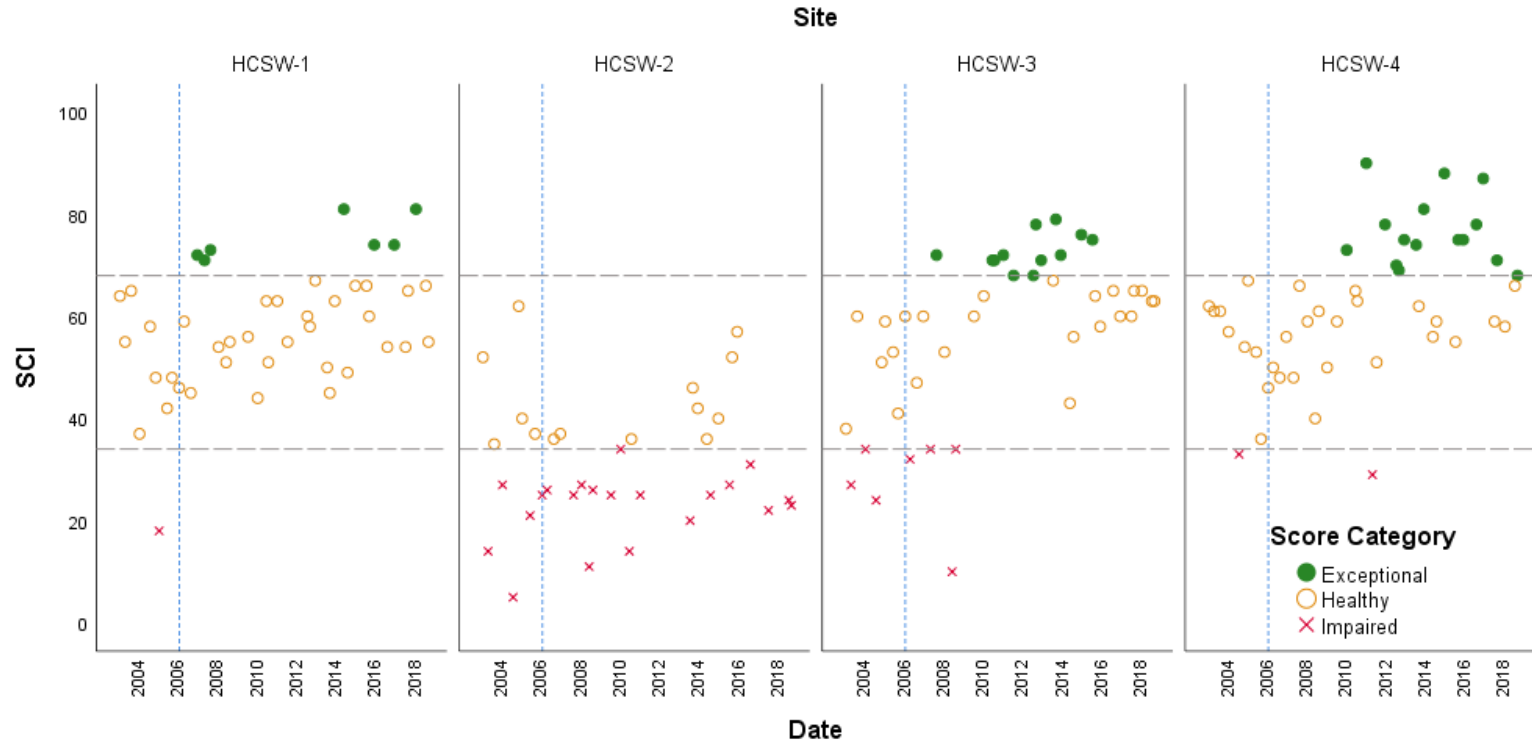
Biology Results



Macroinvertebrate Taxa Richness



SCI Scores



Macroinvertebrate Results POR

- **Biological Diversity**

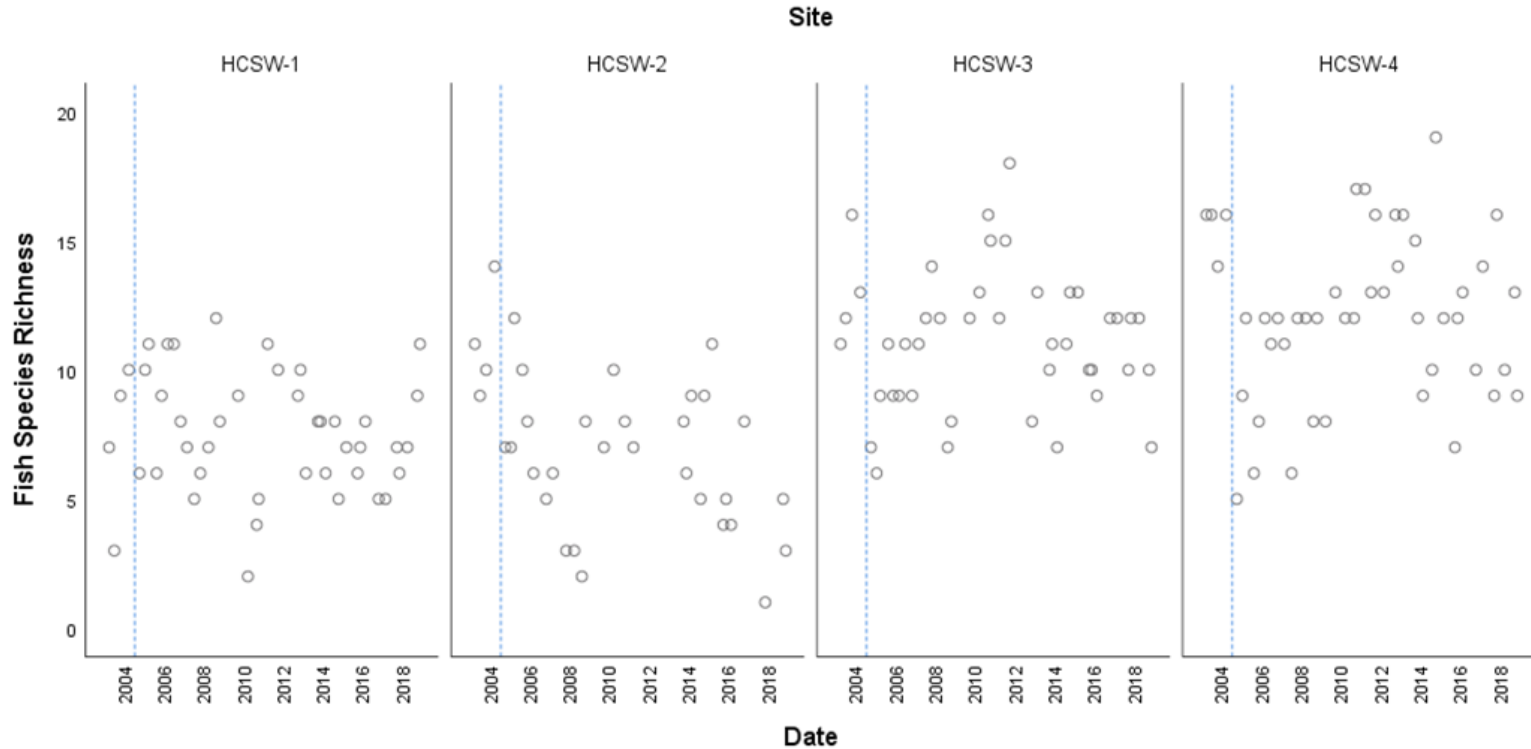
- Spring 2018 taxa richness was the highest recorded so far at HCSW-1, HCSW-3, & HCSW-4
- Spring 2018 Shannon-Wiener diversity was the highest on record so far at HCSW-1 & HCSW-3

- **Stream Condition Index**

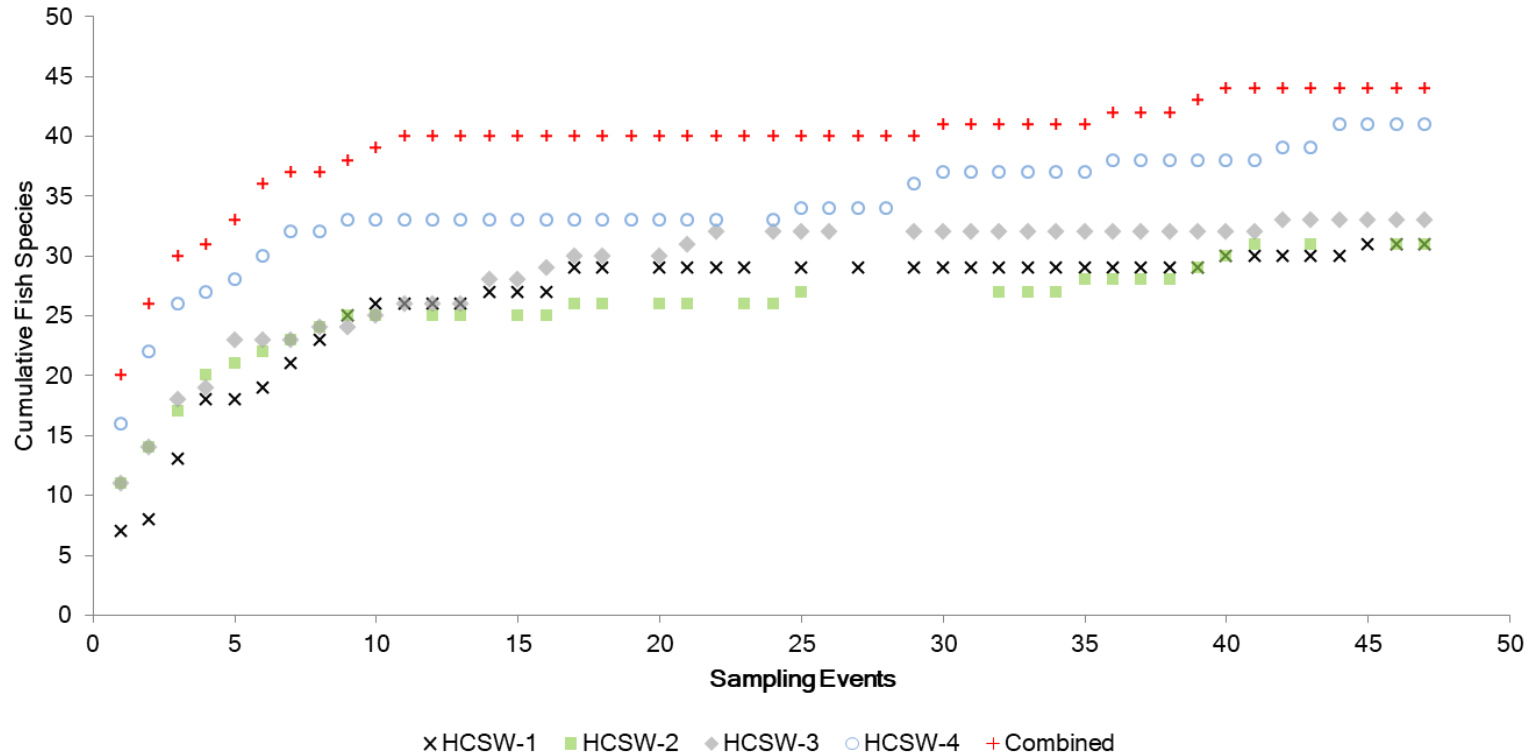
- HCSW-1 is the only station with a detected trend in SCI scores for the period 2007-2018 (+2.33/year, Annual Kendall tau = 0.55, $p < 0.05$)



Fish Species Richness



Species Accumulation Curve



2018 Fish Results & Conclusions

- Number of species caught: 21 (historical annual range 18-32)
- Cumulative total 2003-2018: 44
- Most commonly collected groups: livebearers, shiners, sunfishes, and silversides
- No increasing or decreasing trends when all stations were combined and analyzed annually or seasonally adjusted
- No increasing or decreasing trends for individual stations by annual median diversity; spring, summer, or winter diversity

Final Thoughts

- Sixteen years of data related to water quantity, water quality, and biology
- Robust quality assurance plan with input from many different stakeholders
- Baseline data for water quality and biological comparison as mining and reclamation progresses in the Horse Creek watershed
- No mining related impacts observed



Questions & Comments

