Chemical and Biological Assessment of Moshannon Creek
Clearfield and Centre Counties, PA

Technical Report Update Provided through the
Trout Unlimited AMD Technical Assistance Program

January 2023

Background

The Moshannon Creek Watershed Association requested technical assistance from Trout Unlimited's (TU) Pennsylvania Coldwater Habitat Restoration Program to complete benthic macroinvertebrate and fishery surveys on six different sites in Moshannon Creek (Table 1, Figure 1a and 1b). The Moshannon Creek watershed drains an area of approximately 275 square miles. It flows for approximately 57 miles and most of its length forms the line between Centre and Clearfield counties. Moshannon Creek meets the West Branch Susquehanna River upstream of Karthaus, PA.

The headwaters of Moshannon Creek and some of its tributaries are listed as unimpaired and are known to support trout, but about half of the watershed's stream miles are impacted by acid mine drainage (AMD) from abandoned coal and clay mines. These portions impacted by AMD are listed as impaired by the Pennsylvania Department of Environmental Protection (DEP). Mining for coal began in the early 1800s in the Moshannon Creek watershed and it continues today. The trend has gone from deep mining with underground tunnels to strip mining, which uses draglines to remove overburden and reach coal seams that are deep underground. Other issues within the watershed include dirt and gravel road crossings, the proximity of a couple of its tributaries to Interstate 80, logging activity, and the warming of streams and intolerance to drought conditions. The goal of this project was to collect baseline data on multiple sites in Moshannon Creek and its tributaries in order to better understand its current conditions and AMD impairment. The focus of this report is on the benthic macroinvertebrate and fishery surveys completed in the watershed in 2022.

Methods

Six sample sites were selected to be surveyed to assess the impact of AMD on biological communities in the watershed. Benthic macroinvertebrates were sampled at each of the six sites on 18-27 April 2022. Benthic macroinvertebrate collections were made according to DEP's Instream Comprehensive Evaluation (ICE) protocol (section C.1.b. Antidegradation Surveys). Benthic macroinvertebrate samples consisted of six D-frame efforts in a 100-meter stream section. These efforts were spread out to select the best riffle habitat areas at varying depths. Each effort consisted of an area of 1 meter to a depth of at least 4 inches as substrate allowed and was conducted with a 500-micron mesh 12-inch diameter D-frame kick net.

The six individual efforts were composited and preserved with ethanol for processing in the laboratory. Individuals were identified by taxonomists certified by the North American Benthological Society to genus or to the next highest possible taxonomic level. Samples containing 160 to 240 individuals were evaluated according to the six metrics comprising the DEP's Index of Biological Integrity (IBI) (Total Taxa Richness, EPT Taxa Richness, Beck's Index V.3, Shannon Diversity, Hilsenhoff Biotic Index, and Percent Sensitive Individuals). These metrics were standardized and used to determine if the stream met the Aquatic Life Use (ALU) threshold for coldwater fishes, warmwater fishes and stocked trout fishes (Figure 2). Appendix A contains a description of each metric.

Table 1: Sample sites for benthic macroinvertebrate and fishery surveys on Moshannon Creek.

Sample ID	Point Description	Latitude	Longitude	Macros	Fishery
MOSH UPS RR	Moshannon Creek Upstream of Roup Run	40.781362	-78.343978	X	X
RR at Camp	Roup Run at Camp	40.778965	-78.34198	X	X
MOSH DWS Hale	Moshannon Creek Downstream of Hale Road	40.788371	-78.342884	X	X
MOSH UPS WSR	Moshannon Creek Upstream of Whiteside Run	40.804547	-78.327901	X	
WSR at Birch	Whiteside Run at Birch Road (headwaters)	40.789834	-78.365257	X	X
WSR at KIRKST	Whiteside Run at Kirk Street	40.804166	-78.345728	X	

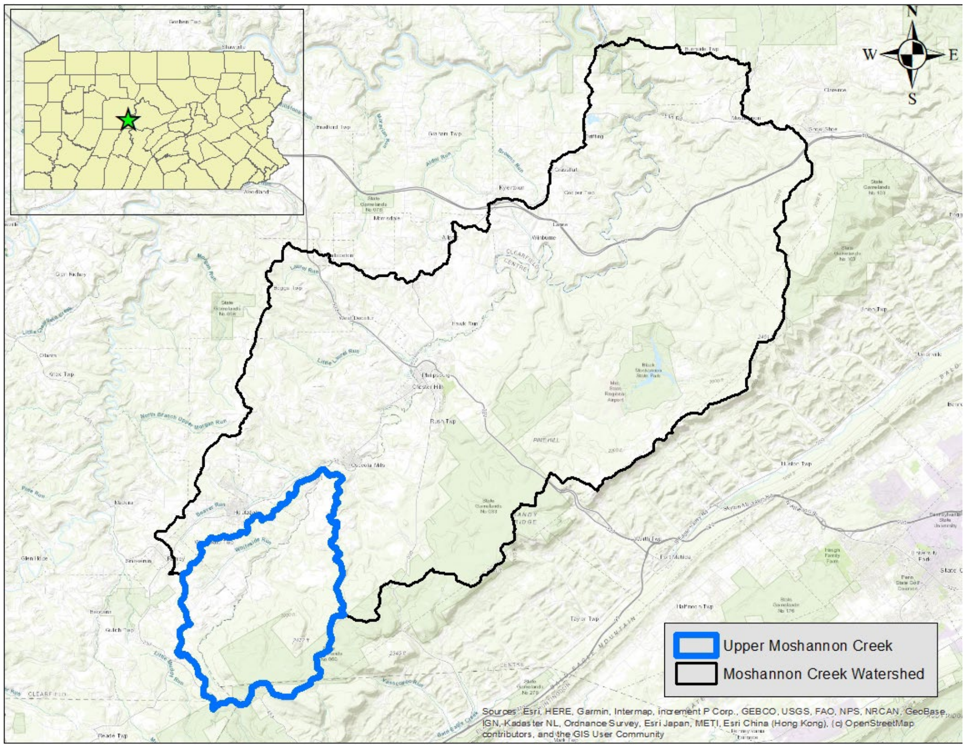

Figure 1a: Moshannon Creek watershed location and project location within waters.

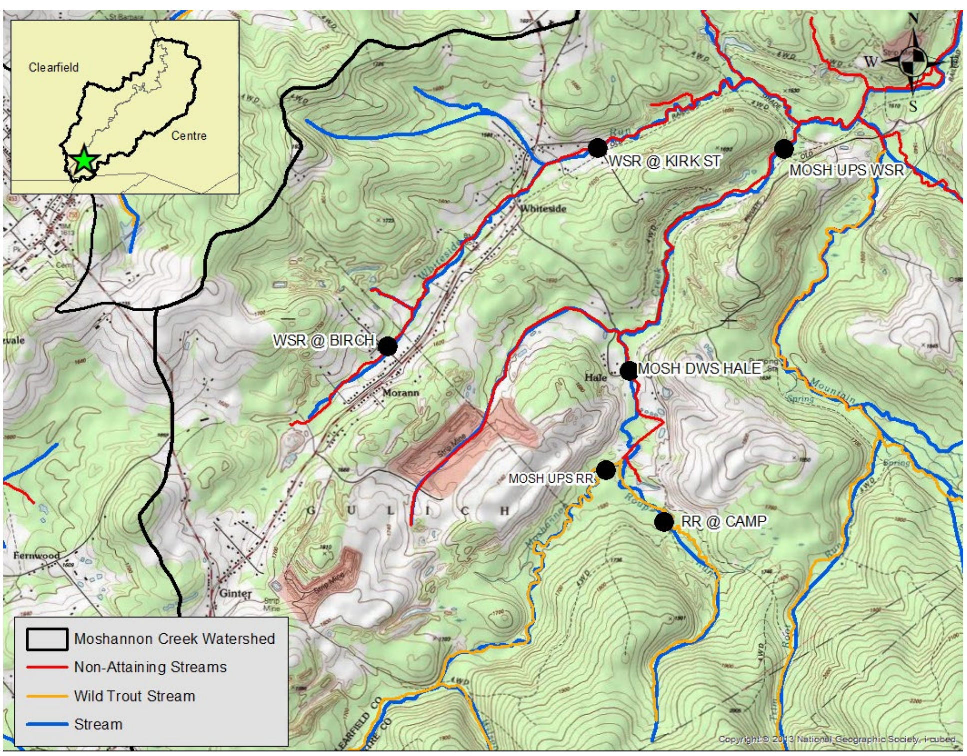

Figure 1b. Sampling locations in the Moshannon Creek watershed.

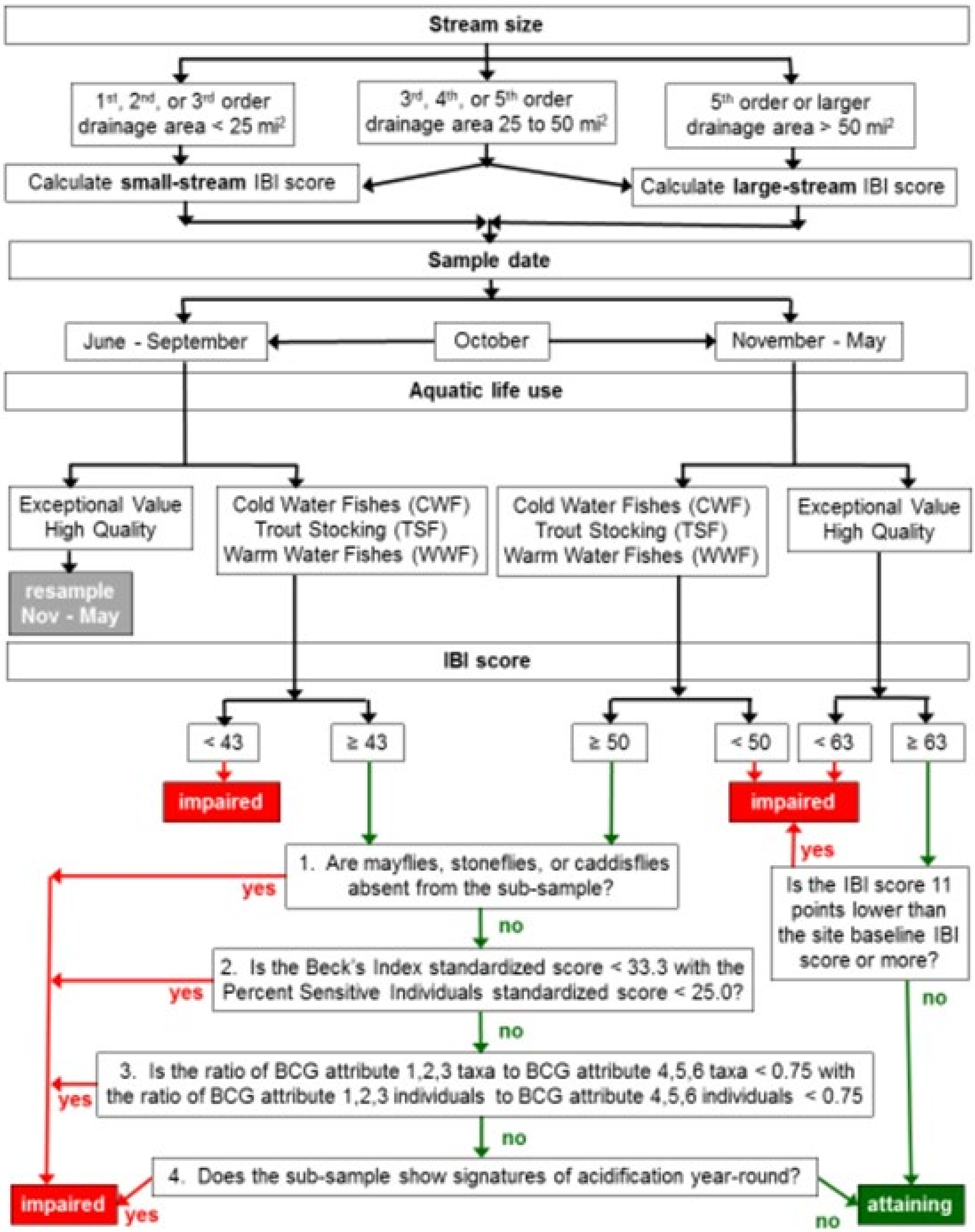

Figure 2: Aquatic life use determination chart for benthic macroinvertebrate sampling.

Five sites were selected for fishery surveys. WSR at KIRKST was only sampled for benthic macroinvertebrates. The fishery surveys were completed using a Smith-Root, LR-24 backpack electrofisher during September 2022. Pulsed DC was used at four of the sites. MOSH UPS WSR was not sampled due to poor water chemistry, including low pH, high conductivity, and a high temperature. Electrofishing proceeded in an upstream direction from the beginning of each sample site. This covered approximately 100 meters (where possible) in length ending at a natural break in the stream to prevent aquatic life from exiting the sample reach. The Pennsylvania Fish and Boat Commission's Unassessed Waters Protocol was followed for all fishery surveys. All salmonid species were held in buckets with stream water until the survey was completed and then weighed (nearest gram) and measured (total length, nearest millimeter) before being returned to the stream. All other species were assigned a relative abundance and also returned to the stream. Relative abundance values are assigned according to the PA Fish and Boat Commission's four relative abundance designations; Rare (1): <2 individuals, Present (2): 2-8 individuals, Common (3): 9-33 individuals, and Abundant (4): >33 individuals.

Results

Site Descriptions

RR at Camp is a forested, small stream relative to Moshannon Creek (average width of 1.76 m), that consisted of small riffles and good habitat. It should be noted that a couple of pipes were lying in the stream at the time of the fisheries survey and the purpose for them being there was unknown.

MOSH UPS RR is classified as a Class A trout stream. It is a forested area with adequate habitat.

Figure 3: Photo of MOSH UPS RR taken during the fisheries survey.

WSR at KIRKST has heavy iron precipitate on substrate, human impacts on the banks of the stream (mowing, etc.), and the site has no riparian cover.

WSR at Birch is near the headwaters of Whiteside Run. This site had some tree cover, but still had a high temperature (18.6 degrees Celsius) at the time of the fisheries survey in September. There is a significant drop on the downstream side of the culvert on Birch Road, which is creating a large pool and may be leading to reduced aquatic organism passage (AOP).

Figure 4: Photo taken of Whiteside Run just downstream of the culvert on Birch Road. There is a drop from the bottom of the culvert to the surface of the stream. This photo was taken in September. Whiteside Run was noted as dry when conducting culvert surveys in October.

MOSH UPS WSR runs through a ford crossing and contains a series of AMD discharges that flow directly into Moshannon Creek. The substrate is a thick layer of silt with an orange tint. A fisheries survey was not feasible at this site due to the thick layer of silt, poor water chemistry, and the deep water level created by beaver dams.

Figure 5: Photo taken of TU employee Allison Lutz kicking for macros at MOSH UPS WSR. Iron precipitate can be seen on the substrate, and there is a high concentration of silt suspended in the water.

MOSH DWS Hale comes directly into contact with a wetland complex affected by AMD. There is backed up water downstream of Hale Road and the substrate has an orange tint. There is no good habitat for fish and most of the area is open with no cover.

Figure 6: This is a zoomed out aerial photo taken from Google Earth of MOSH DWS Hale. The green star identifies the site location. This area is directly affected by AMD discharge and forms a wetland area that is backing up the water.

Macroinvertebrates

The biological metrics calculated for each sample site are shown in Table 2. A complete list of taxa and their abundances can be found in appendix B. MOSH UPS RR and RR at Camp were the only 2 sites found to be attaining ALU (highlighted in green in Table 2). The other 4 sites, including MOSH DWS Hale, MOSH UPS Whiteside, WSR at Birch, and WSR at KIRKST, would be considered impaired by the PA DEP. However, the IBI scores of MOSH UPS WSR and MOSH DWS Hale should be interpreted with caution due to the number of individuals being too low to calculate an accurate IBI.

MOSH DWS Hale had the lowest abundance of 7 individuals, with only 4 unique benthic macroinvertebrate taxa (Diptera, Plecoptera, Trichoptera, and Coleoptera). MOSH UPS WSR had zero EPT taxa richness and had the lowest IBI score of 7.1. MOSH DWS Hale and WSR at

KIRKST had low EPT taxa richness and % sensitive individuals, and therefore had low IBI scores. Figure 2 shows the total and EPT taxa richness for all six sites. MOSH UPS RR and RR at Camp were the only two sites attaining ALU. They had much higher total taxa richness and EPT taxa richness scores than the rest of the sites.

Functional feeding groups (FFG) were assigned to taxa found for this study and percent composition was calculated for each site (Table 3, Figure 4). Four sites, including MOSH UPS RR, MOSH DWS Hale, MOSH UPS WSR, and WSR at KIRKST, had a majority Collector-Gatherers (42.9 - 95.7%). The 2 remaining sites, WSR at Birch and RR at Camp, had a majority Shredders (37.6 - 44.8%).

Table 2: Biological metrics calculated for each of the six sample sites. Sites highlighted in green were attaining ALU.

Metric	MOSH UPS RR	RR at Camp	MOSH DWS Hale	MOSH UPS WSR	WSR at Birch	WSR at KIRKST
Total Abundance	161	229	7	69	201	205
Total Taxa Richness	27	22	4	5	13	12
EPT Taxa Richness	13	8	1	0	3	3
Beck's Index	22	16	3	0	3	3
Hilsenhoff Index	4.21	3.02	4.57	9.41	4.74	6.97
Shannon Diversity Index	1.93	2.46	1.28	0.52	1.66	1.73
% Sensitive Individuals	34.2	72.1	14.3	1.4	44.8	1.5
IBI Score	64.6	68	25.6	7.1	39.8	26.6

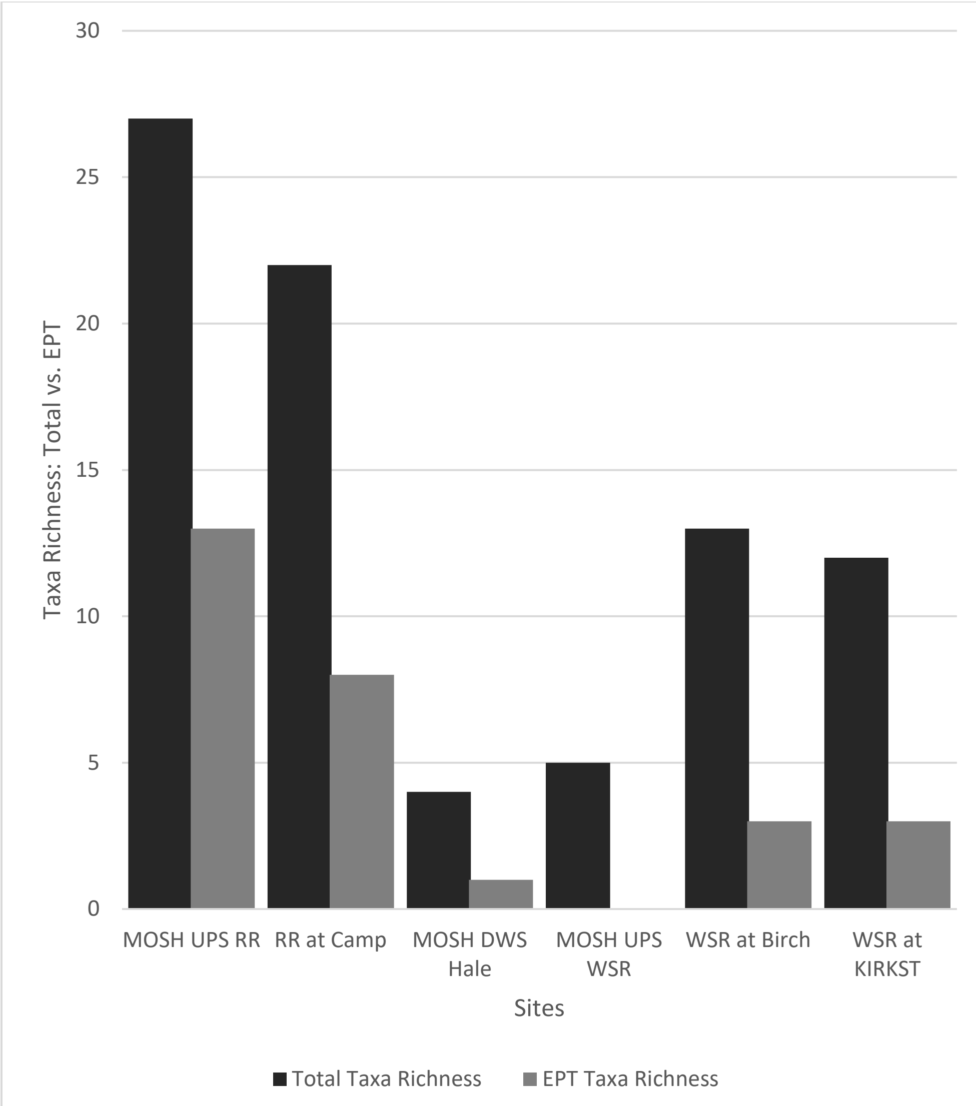

Figure 7. Total and EPT taxa richness at all six sites.

Table 3: Percentage of each functional feeding group (Collector Gatherer (CG), Collector Filterer (FC), Predator (PR), Scraper (SC), Shredder (SH), and Piercer (PI) by site.

Site	% CG	% FC	% SC	% SH	% PR	% PI
MC-UPS WSR	95.7	0.0	0.0	1.4	2.9	0
MC-UPS RR	60.9	5.0	4.3	4.3	23.6	1.2
MC at Hale	42.9	28.6	14.3	0.0	14.3	0
WSR at Birch	28.4	19.9	0.0	44.8	7.0	0
WSR at KIRKST	51.7	44.4	0.0	0.0	3.9	0
RR at Camp	23.1	20.9	1.7	37.6	15.7	0.9

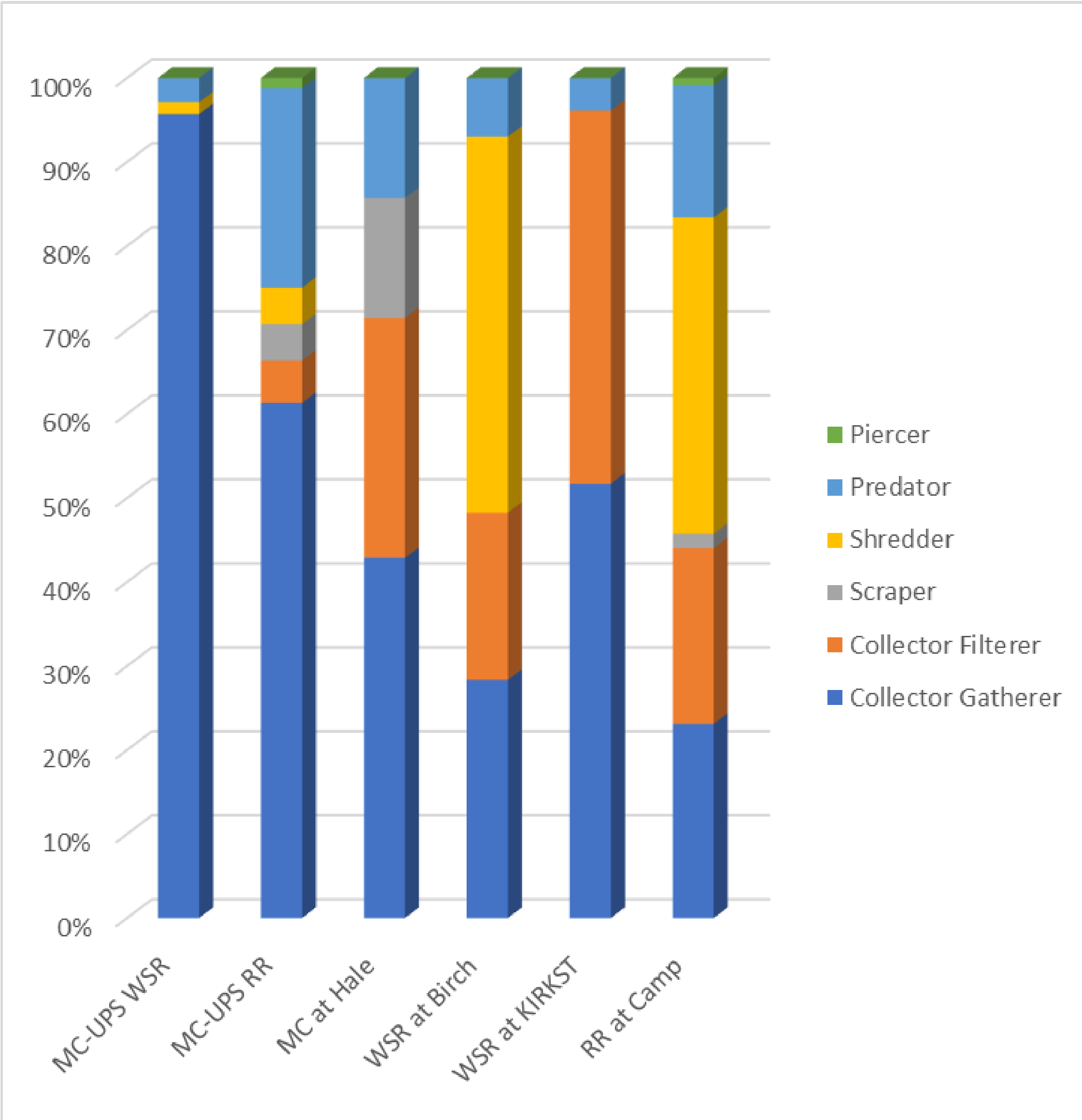

Figure 8: Percent composition of macroinvertebrate functional feeding groups by site.

Fishery Surveys

Fishery surveys were performed at 4 of the 5 fishery sampling locations. MOSH UPS WSR had a low pH, high conductivity, and a high temperature (pH= 4.08, 1158 micro siemens, 20.8 degrees Celsius). Due to the water chemistry and the water being very deep, a fisheries survey was not done on this site.

Three total species were found during fishery surveys, including Brook trout (*Salvelinus fontinalis*), creek chub (*Semotilus atromaculatuss*), and pumpkinseed (*Lepomis gibbosus*). The two sites with trout present were RR at Camp and MOSH UPS RR. Species were assigned a relative abundance at each site (Table 4). Size class information was recorded for all trout captured (Table 5). MOSH UPS RR had 8 distinct size classes and 69 total trout, whereas RR at Camp had 3 distinct size classes and 25 total trout. Individuals under 100 mm in length are considered young of year. MOSH UPS RR had 47 individuals under 100 mm in length and RR at Camp had 24, which indicates that both sites have naturally reproducing brook trout populations.

Table 4: Fish species captured at each site; numbers reported follow the PA Fish and Boat Commission's relative abundance scale: Rare (1): < 2 individuals, Present (2): 2-8 individuals, Common (3): 9-33 individuals, and Abundant (4): > 33 individuals

Fish Species	MOSH UPS RR	RR at Camp	MOSH DWS Hale	WSR at Birch
Brook trout	4	3		
Creek chub				1
Pumpkinseed	1		2	

Table 5: Numbers of individual trout captured by size class for sites MOSH UPS RR and RR at Camp. Size classes are based off the PA Fish and Boat Commission's list of size classes for trout.

Size class (mm)	**Species**	**MOSH UPS RR**	**RR at Camp**
25-49	Brook Trout	1	
50-74	Brook Trout	37	18
75-99	Brook Trout	9	6
100-124	Brook Trout	8	1
125-149	Brook Trout	7	
150-174	Brook Trout	4	
175-199	Brook Trout	2	
200-224	Brook Trout	1	

Conclusion

Overall, the benthic macroinvertebrate community was found to be impaired; only two sites were found to be attaining ALU out of the total six sites, and those were MOSH UPS RR and RR at Camp. Of the four sites found to be impaired, two of them (MOSH UPS WSR and MOSH DWS Hale) did not have enough individuals in order to calculate an accurate IBI score, and the sites should be considered impaired due to low abundance. The 4 impaired sites had very low EPT taxa richness (MOSH UPS WSR had none). This means that there were very little pollution sensitive taxa present at these sites.

The only two sites that attained ALU out of the six sites, MOSH UPS RR and RR at Camp, were also both found to have naturally reproducing brook trout populations. The remainder of the sites had no trout present. The only other species found during the fishery surveys were pumpkinseed at MOSH DWS Hale and creek chub at WSR at Birch. Both species can tolerate a wide range of environmental conditions, especially when compared to brook trout. This means that they are more likely to be found at sites with warmer water temperatures due to wetlands and beaver activity, as well as those sites affected by AMD.

Two sites were located on Whiteside Run, which is a tributary of Moshannon Creek that was flowing in the spring and summer but was found to be dry in October. According to the Coldwater Conservation Plan for the Moshannon Creek Watershed, this watershed is not resilient in drought conditions and this hinders its value as a refuge for coldwater fish. Whiteside Run also had an elevated temperature of 18.6 degrees Celsius in the summer as well as low IBI scores. Moshannon Creek upstream of Whiteside Run had the lowest pH, highest conductivity, and highest temperature out of all the sites. This area of Moshannon Creek is affected by a series of AMD discharges. There are also beaver dams that are likely contributing to the warm, deep water. Trout are not well-suited for conditions like these.

The results of these surveys should be used as baseline conditions for further monitoring and may be used as comparison pending future AMD restoration efforts in the watershed.

<u>Literature Cited</u>:

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APPENDIX A: Description of Instream Comprehensive Evaluation biological metrics that were used in this project.

Total Abundance
The total abundance is the total number of organisms collected in a sample or sub-sample.

Dominant Taxa Abundance
This metric is the total number of individual organisms collected in a sample or sub-subsample that belong to the taxa containing the greatest numbers of individuals.

Taxa Richness
This is a count of the total number of taxa in a sample or sub-sample. This metric is expected to decrease with increasing anthropogenic stress to a stream ecosystem, reflecting loss of taxa and increasing dominance of a few pollution-tolerant taxa.

% EPT Taxa
This metric is the percentage of the sample that is comprised of the number of taxa belonging to the orders Ephemeroptera, Plecoptera, and Trichoptera (EPT). Common names for these orders are mayflies, stoneflies, and caddisflies, respectively. The aquatic life stages of these three insect orders are generally considered sensitive to, or intolerant of, pollution (Lenat and Penrose 1996). This metric is expected to decrease in value with increasing anthropogenic stress to a stream ecosystem, reflecting the loss of taxa from these largely pollution-sensitive orders.

Shannon Diversity Index
The Shannon Diversity Index is a community composition metric that takes into account both taxonomic richness and evenness of individuals across taxa of a sample or sub-sample. In general, this metric is expected to decrease in value with increasing anthropogenic stress to a stream ecosystem, reflecting loss of pollution-sensitive taxa and increasing dominance of a few pollution-tolerant taxa.

Hilsenhoff Biotic Index
This community composition and tolerance metric is calculated as an average of the number of individuals in a sample or sub-sample, weighted by pollution tolerance values. The Hilsenhoff Biotic Index was developed by William Hilsenhoff (Hilsenhoff 1977, 1987; Klemm et al. 1990) and generally increases with increasing ecosystem stress, reflecting dominance of pollution-tolerant organisms. Pollution tolerance values used to calculate this metric are largely based on organic nutrient pollution. Therefore, care should be given when interpreting this metric for stream ecosystems that are largely impacted by acidic pollution from abandoned mine drainage or acid deposition.

Beck's Biotic Index
This metric combines taxonomic richness and pollution tolerance. It is a weighted count of taxa with PTVs of 0, 1, or 2. It is based on the work of William H. Beck in 1955. The metric is

expected to decrease in value with increasing anthropogenic stress to a stream ecosystem, reflecting the loss of pollution-sensitive taxa.

Percent (%) Sensitive Individuals
This community composition and tolerance metric is the percentage of individuals with PTVs of 0 to 3 in a sample or sub-sample and is expected to decrease in value with increasing anthropogenic stress to a stream ecosystem, reflecting the loss of pollution-sensitive organisms.

APPENDIX B: Taxa list and abundance for each of the six sample sites.

Order	**Family**	**PA Taxon**	MOSH UPS RR	Roup Run at Camp	MOSH DWS Hale	MOSH UPS Whiteside	WSR at Birch	WSR at KIRK ST
Ephemeroptera	Baetidae	Acerpenna	2				1	
	Baetidae	Baetis	1	3				
	Ephemerellidae	Ephemerella	5	2				
		Eurylophella	1					
	Heptageniidae	Maccaffertium	1					
	Leptophlebiidae	Leptophlebiidae						2
Plecoptera	Perlidae	Acroneuria	2					
	Chloroperlidae	Alloperla	1					
		Haploperla	22					
		Chloroperlidae		28	1			
	Nemouridae	Amphinemura	4	49			86	
		Nemouridae		9				
		Ostrocerca		9				
	Perlodidae	Isoperla	2					1
		Perlodidae	1					
		Clioperla						1
	Leuctridae	Leuctra	3	19			3	
	Capniidae	Allocapnia					1	
Diptera	Chironomidae	Chironomidae	88	34	3	6	47	61
	Tipulidae	Tipulidae				1		
	Ceratopogonidae	Ceratopogonidae	2	1			12	5
	Pediciidiidae	Dicranota	2	3				
	Limoniidae	Hexatoma	5					
		Pseudolimnophila	1	2				
	Simuliidae	Stegopterna	1	3			7	1
		Prosimulium		33				1
		Simulium		5			30	53
	Tabanidae	Tabanidae	2	2				
	Empididae	Neoplasta		1			1	1
Odonata	Cordulegastridae	Cordulegaster				1		
Megaloptera	Sialidae	Sialis				1		
Decapoda	Cambaridae	Cambaridae	1					
Trichoptera	Philopotamidae	Chimarra	1					
		Diplectrona	2	6				

	Hydropsychidae	Cheumatopsyche						15
		Hydropsyche	4	1	2			
	Thremmatidae	Neophylax	1					
	Polycentropodidae	Nyctiophylax	1					
	Psychomyiidae	Lype		5				
Coleoptera	Elmidae	Promoresia	3					
		Oulimnius	2	4				
		Optioservus			1			
Sphaeriida	Sphaeriidae	Sphaeriidae						21
Monostilifera	Prostomatidae	Prostoma					1	
		Oligochaeta		9		60	8	43
		Nematoda					1	
		Turbellaria		1				