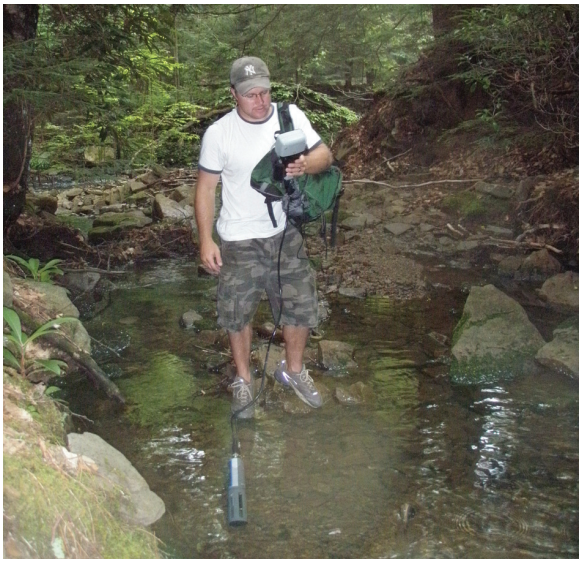
Methods

Sampling was conducted seasonally in both watersheds from spring 2010 through winter 2011. In addition to water quality sampling and flow measurements during all four sampling periods, macroinvertebrate sampling was completed during the spring and fish collection was done during the summer sampling period.

Water samples were collected while wading across the stream channel using a depth-integrated hand sampler. Field chemistry parameters (temperature, pH, conductivity, and dissolved oxygen) were measured instream using a YSI 6820 multi-parameter meter. Turbidity was measured using a Hach 2100P portable turbidometer. Flow measurements were taken using a FlowTracker and standard USGS methods when applicable. The bucket and stopwatch method was utilized for discharge points and high gradient, plunge pool tributaries where taking a traditional flow measurement was impossible. Macroinvertebrates were collected by compositing six D-frame kicks from riffles over the 100-meter sampling reach. Samples were preserved in 95-percent ethanol and taken back to the SRBC laboratory for subsampling and enumeration. Fish were collected using backpack electroshocking. All fish caught in the 100-meter reach were captured, identified to species, and returned to the stream. Game fish species were also weighed and measured.

Water quality data results were compared to water quality standards and levels of concern (Table 1). Sites were ranked for water quality as either severely, mildly, or non-impacted from AMD based on the water quality data analysis. Macroinvertebrate data analysis can be more complex in AMD-impacted communities because classically used metrics do not account for acidity or metal tolerances. For example, the Hilsenhoff Biotic Index (HBI) ranks macroinvertebrate taxa based on only their sensitivity to organic pollution. As a result, a sample taken in a heavily AMD-impacted



Field chemistry parameters (temperature, pH, conductivity, and dissolved oxygen) were measured instream using a YSI 6820 multi-parameter meter.

SRBC staff collecting fish in the headwaters of Drury Run using backpack electroshocking.

Table 1. Water Quality Standards and Levels of Concern for Aquatic Life

Parameter	Limit	Reference Code
Temperature	> 25 degrees	a,e
Dissolved Oxygen	< 4 mg/l	a,f
Conductivity	> 800 μmhos/cm	c
pH	< 6	a,b,e
Total Dissolved Solids	>500 mg/l	a,h
Total Aluminum	>0.75 mg/l	a
Total Iron	>1.5 mg/l	a
Total Manganese	>1.0 mg/l	a
Alkalinity	< 20 mg/l	a,f
Total Sulfate (drinking water)	> 250 mg/l	a
Hot Acidity	>0	d
Total Chloride	> 250 mg/l	a

Reference Code & References

a. http://www.pacode.com/secure/data/025/chapter93/s93.7.html
b. Gagen and Sharpe (1987) and Baker and Schofield (1982)
c. http://www.uky.edu/WaterResources/Watershed/KRB_AR/wq_standards.htm
d. Cravotta and Kirby (2004)
e. http://www.hach.com/h2ou/h2wtrqual.htm
f. http://sites.state.pa.us/PA_Exec/Fish_Boat/education/catalog/pondstream.pdf
g. http://www.epa.gov/waterscience/criteria/sediment/appendix3.pdf
h. http://water.usgs.gov/pubs/circ/circ1225/images/table.html
i. http://www.epa.gov/waterscience/criteria/wqcriteria.html

SRBC staff collects a water sample and takes a flow measurement in Drury Run during January 2010.

stream can be highly impaired and still have an excellent HBI score because the biological community is dominated by a couple of taxa that typically are intolerant to organic pollution yet acid tolerant. To better evaluate and account for impacts of AMD in the biological analysis, numerous other metrics were calculated in addition to the ones routinely used by SRBC. These included evenness, percent of taxa in each functional feeding group (i.e., scrapers, predators), similarity to reference, and community loss index (Table 2). Because the fish communities in both Drury Run and Birch Island Run were very simple and heavily dominated by brook trout, only richness and abundance measurements were used. Figures 2 and 3 depict a summary of water quality, macroinvertebrate, and fish conditions at each sampling location in Drury Run and Birch Island Run, respectively.

SRBC staff takes a flow measurement in Sandy Run.

Table 2. Explanation of Macroinvertebrate Analysis Tools

Taxonomic Richness: Total number of taxa in the sample. Number decreases with increasing stress.
Hilsenhoff Biotic Index: A measure of organic pollution tolerance. Index value increases with increasing stress.
EPT Index: Total number of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) taxa present in a sample. Number decreases with increasing stress.
Shannon-Wiener Diversity Index: A measure of the taxonomic diversity of the community. Index value decreases with increasing stress.
Percent Ephemeroptera: Percentage of number of Ephemeroptera (mayflies) in the sample divided by the total number of individuals in the sample. Percentage decreases with increasing stress.
Percent Chironomidae: Percentage of number of Chironomidae individuals out of the total number of macroinvertebrates in the sample. Percentage decreases with increasing stress.
Percent Contribution of Dominant Taxa: Percentage of the taxon with the largest number of individuals out of the total number of macroinvertebrates in the sample. Percentage increases with increasing stress.
Evenness: Measure of the relative abundance of the different species making up the richness of a population.
Percent Functional Feeding Groups: Percent of taxa that make up each functional feeding group, such as scrapers, grazers, shredders, and predators.
Jaccard Coefficient of Community Similarity: Estimates the degree of similarity between samples based on presence or absence of taxa.
Community Loss Index: Estimates the loss of taxa between comparison samples and reference samples.

All fish caught in the 100-meter reach were captured, identified to species, and returned to the stream. Game fish species were also weighed and measured.