

process of mining. The soil and rock layers, termed overburden, determine the characteristics of the AMD such as levels of acidity or alkalinity and levels of different metals and sulfates. The impacts to streams vary, but AMD often results in orange or gray colored metal precipitate that coats the streambed. These poor water quality and habitat conditions caused by AMD are detrimental to aquatic life.

Morgan Run Watershed, located in State Water Plan 08C, was impaired for AMD by SRBC biologists in 1999 and 2003 as part of the Pennsylvania Department of Environmental Protection (PADEP) Unassessed Waters Program. Approximately 10 miles of the mainstem of Morgan Run was listed on the 2002 and 2004 Pennsylvania Section 303(d) impairment lists for high metals and low pH. The tributaries, Crooked Sewer Run and Alberts Run, were assessed as attaining, and James Run was not assessed since it was determined to have intermittent flow.

On March 20, 2003, concerned citizens established the Morgan Run Watershed Group with a mission to:

- Restore Morgan Run by improving water quality and protecting the surrounding land through cooperation of the landowners;
- Restore aquatic life and a native fish population; and
- Educate the public and local communities on ecological benefits for future generations (Carnahan, 2005).

Prior to the formation of the Morgan Run Watershed Group, Clearfield County Conservation District (CCCD) conducted a study of the Morgan Run Watershed in 2002 and 2003 with water sampling and family-level macroinvertebrate investigations. Water sampling was conducted at 15 discharges, and inspections for macroinvertebrate life were conducted in springs, small tributaries, and sections of the mainstem to determine sources of recolonization for Morgan Run. CCCD concluded that Morgan Run was impacted by AMD; however, if this stream were reclaimed, it would have sources for recolonization and would

have excellent habitat for trout in beaver dam pools and in deep pools that exist in the lower two-thirds of the watershed.

Methods

DATA COLLECTION

During November 2003 to September 2004, SRBC collected water chemistry samples and measured flow quarterly at three tributary sites, nine instream sites, and 13 discharge sites. Macroinvertebrate collections and habitat assessments were completed at the nine instream sites and three tributary sites from May 24 - 27, 2004. Electrofishing surveys were completed at three instream sites and four tributary sites from June 28 - July 1, 2004. Appendix A contains a list of station names, sampling location descriptions, and latitude and longitude coordinates. Abandoned mine discharge sites are listed in red.

Water chemistry samples were collected quarterly in November 2003, March 2004, May 2004, and September 2004 for field and laboratory parameters (Table 1), according to the standard protocol for AMD TMDL analysis. Samples were split into a 250-ml bottle acidified with nitric acid for metals analysis, and a 500-ml bottle for all additional parameters. Hot acidity is measured in AMD streams since it takes into account metal oxidation and provides information on the excess alkalinity needed to neutralize the sample (Cravotta III and Kirby, 2004). Abandoned mine discharges were directed through a weir or pipe, and flow was measured according to the Clay Pipe Manual (National Clay Pipe Institute, 1974) at weirs, and as volume per time at pipes. The weirs were either 1-foot rectangular or 90° V-notch weirs where height of water was measured. The

smaller discharges were measured at a pipe with a container of known volume and a stopwatch. Flow at instream and tributary sites was measured using a Scientific Instruments pygmy meter according to the United States Geological Survey methods (Buchanan and Somers, 1969). If a weir was not functioning correctly at the time of sampling, flow was measured with the pygmy meter, where applicable.

Macroinvertebrate samples, fish surveys, and habitat assessments were completed according to a modified version of the United States Environmental Protection Agency's (USEPA's) Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers (RBP III) (Plafkin and others, 1989; Barbour and others, 1999). Electrofishing surveys included a one-time pass through 100-meter stretches of streams using a Coffelt electrofishing backpack unit that delivers a direct current. Fish captured were identified, measured for length, and released. A field sample of water chemistry was collected, and five measurements of stream width were gathered for an average width. An additional site was added in the headwaters of Alberts Run for the electrofishing survey due to anecdotal accounts of fish presence. All other water quality, macroinvertebrate collection, and habitat assessment methods follow the methods listed in LeFevre (2003).

Table 1. Water Quality Parameters Sampled in the Morgan Run Watershed

FIELD PARAMETERS	
Flow, instantaneous cfs ^a	Conductivity, $\mu\text{mhos}/\text{cm}^{\text{c}}$
Temperature, °C	Alkalinity, mg/l
pH	Acidity, mg/l
Dissolved Oxygen, mg/l ^b	
LABORATORY ANALYSIS	
pH-3.9	Sulfate, mg/l
Alkalinity-3.9, mg/l	Total Iron, $\mu\text{g}/\text{l}^{\text{d}}$
Total Suspended Solids, mg/l	Total Manganese, $\mu\text{g}/\text{l}$
Total Calcium, mg/l	Total Aluminum, $\mu\text{g}/\text{l}$
Total Magnesium, mg/l	Hot Acidity, mg/l

^a cfs = cubic feet per second ^c $\mu\text{mhos}/\text{cm}$ = micromhos per centimeter

^b mg/l = milligram per liter ^d $\mu\text{g}/\text{l}$ = micrograms per liter