GETTING STARTED

Monitoring the effectiveness of a passive treatment system
(Photo courtesy of Alan J. King)

Determining which passive treatment method is best suited for a specific drainage problem can be a tricky task. Several variables exist which make each individual contaminated discharge unique. These variables require every system to be custom designed to fit the parameters associated with the affected site. This individual attention allows each damaged site to teach us something new about fixing an old problem.

Homework First

Just as assignments in school provide the hands-on experience necessary to build a solid educational foundation, a great deal of research and studying is required before a polluted discharge can be remedied.

A great deal of homework is required before a type of system is chosen or developed. This homework uncovers valuable information critical to the successful treatment of the degraded water. Using this information, important steps should be methodically taken to ensure that the correct passive technology is applied and properly constructed.

Identify the source of the drainage

Similar to a research assignment, this step helps determine where the mine drainage is coming from. Obtaining mine, soil, and topographic maps of the area provides an understanding of what type of mining occurred and how it may have affected the landscape. These valuable resources may reveal tunnels, shafts, or waste piles that could be a source of contaminated drainage. Many important decisions, such as drainage characteristics and erosion control methods, are based on this information.

Determine water quantity

This information is the cornerstone to determining the type and size of system or systems to be installed. An accurate measurement of AMD discharge rates will prevent the under-sizing of a system, which may result in the unsuccessful treatment of AMD. Nothing technical needed here, a bucket, stopwatch, and simple calculator work well. Gallons per minute can be easily calculated by timing how

Typical "V notch" weir used to measure the flow of a small stream
(Photo courtesy of Jennings Environmental Education Center)

long it takes to fill a bucket of known volume. For example, if it takes 5 seconds to fill a 1 gallon bucket, divide 60 seconds by 5 to determine that the flow is 12 gallons per minute. Weirs are another method used to determine flow rates. Often weirs are constructed at the discharge point. These simple devices resemble a miniature dam. Water flows through a notch cut into this dam.

By measuring the height of the water in this notch and using a simple equation, flow rates can be determined.
Often mine drainage has a diffuse flow over a large area making it impossible to measure accurately. Collection ditches are often necessary to collect the water and channel it to a localized discharge point.

It is important for the water flow to be measured several times throughout the year. Flow can change drastically depending on the season or due to storm events. For a passive system to successfully treat AMD throughout the year, it must be able to handle fluctuations in flow.

Determine water quality

Chemical analysis in the field is done to gain a general understanding of what is dissolved in the water. Careful chemical monitoring of the discharge is done in the laboratory for complete and accurate analysis. Water samples are collected at the source of the drainage and taken to a lab to be analyzed for pH, acidity, alkalinity, iron, manganese, aluminum, and sulfates. It is also helpful to take water samples above and below where the discharge is entering the receiving tributary. This will identify what impact the discharge is having on the tributary. It will also provide information to refer back to once the passive system is operating.

Determining the chemical parameters is crucial to what passive system will be installed. An anoxic limestone drain will not be effective if chemical analysis reveals that aluminum or dissolved oxygen is present.

Iron precipitating out of severely degraded mine drainage formed this eight foot "wall of iron" in Indiana County, PA
(Photo courtesy of Stream Restoration Inc.)

Members of the Slippery Rock Watershed Coalition at the Jennings Research and Demonstration Site
(Photo courtesy of Alan J. King)

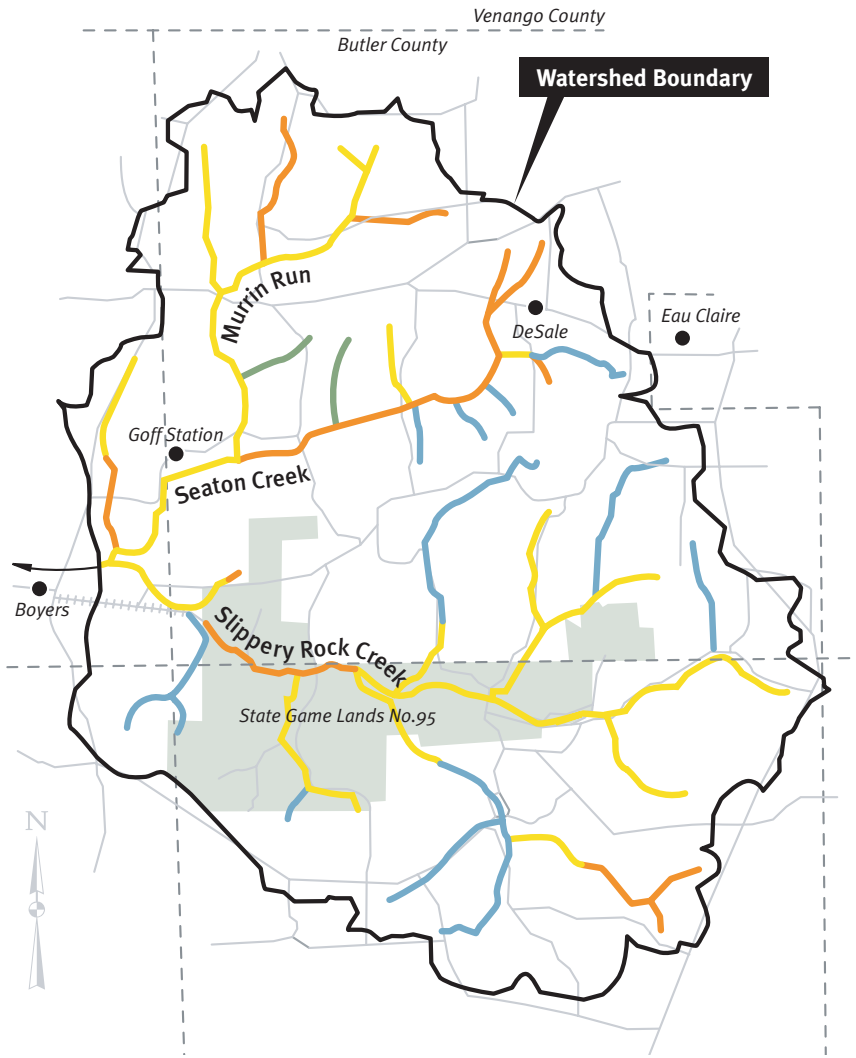
Accepting the Challenge

Pennsylvania has the largest inventory of abandoned mine land problems in the entire United States. No one government agency, business, or concerned group of individuals can hope to restore the entire state. Only through cooperative partnerships, statewide concern, and the innovation of improved treatment techniques will this unfortunate legacy be resolved.

Throughout Pennsylvania the effort is underway to improve freshwater streams impacted by acid mine drainage. Hundreds of passive systems have been designed and constructed for polluted discharges with unique flows and water chemistry.

Many of these systems are the result of the dedication and hard work of government agencies and private watershed associations throughout Pennsylvania and the rest of the country. One such grassroots effort to improve water quality is taking place in western Pennsylvania. The Slippery Rock Watershed Coalition is a unique blend of citizens, industries, state and federal agencies, and colleges and universities dedicated to restoring an area in northern Butler county that has been impacted by over a century of mining. This area, called the Slippery Rock Creek Study Area, is a 27 square mile drainage basin comprising the headwaters of the Slippery Rock Creek. Every tributary within this watershed is negatively impacted by acid mine drainage which stems from over 260 known abandoned, underground mine openings and more than 15,000 acres of unreclaimed

Slippery Rock Watershed Coalition Study Area



GOOD (pH › 6, acidity ‹ alkalinity, iron ‹ 1mg/1)

ACID SENSITIVE (pH 5 to 6, sulfates‹50mg/1)

ACID MINE DRAINAGE IMPACTED (pH 5 to 6, sulfates › 50mg/1)

POLLUTED (pH ‹ 5, acidity›alkalinity, iron › 1,5mg/1)

Charles Cooper, CDS Associates Inc. engineer, overseeing the construction of a vertical flow system at the Jennings Research and Demonstration Site (Photo courtesy of Stream Restoration Inc.)

surface mines. Residents of what was once bustling mining communities located along these streams jokingly refer to the Slippery Rock Creek as "Sulfur Creek" due to the orange color of the water and stream banks.
The Pennsylvania Department of Environmental Protection, District Mining Office, Knox Office, has inventoried virtually every potentially dangerous or environmentally degrading relic of historical mining activity in this area. The result of this painstaking inventory is a collection of water quality data, detailed maps and recommended prescriptions for restoration. The Slippery Rock Watershed Coalition uses this valuable Comprehensive Mine Reclamation Strategy as a master plan to reclaim the headwaters of the Slippery Rock Creek.

The combined talents, experience, knowledge, and vast resources of all Slippery Rock Coalition members has, to date, effectively eliminated over 210 tons of metals and 335 tons of acidity from entering the Slippery Rock Creek every year. Over 1,450 gallons per minute of mine drainage are being abated and about 150 acres of land have been reclaimed. In 1998, fish were observed in a four-mile section of the creek, which has probably been devoid of most aquatic life for over a century. News of the Coalition's success has spread quickly. Community support and state funding opportunities will allow many proposed restoration projects to occur. The complete restoration of the study area may one day be achieved thanks to the cooperative efforts of a dedicated group of people.

Demonstrating Success

The goal of the Slippery Rock Watershed Coalition is to not only restore the Slippery Rock Creek to a viable fishery but also to provide educational opportunities to students of all ages and the general public. This is accomplished through partnerships with educational institutions that provide opportunities for demonstration, research, and interpretation. Students from local high schools, colleges, and universities monitor the tributaries of the study area, conduct environmental assessments, participate in system installation, and conduct valuable, ongoing research studying the long-term effectiveness of passive technology. These opportunities and all information are open to any interested group or individual.

The Jennings Environmental Education Center, a Pennsylvania state park within the Department of Conservation and Natural Resources, is one of the Coalition's several educational partners. Jennings is a truly unique acid mine drainage, research and demonstration site. It offers possibly the best working model of passive treatment techniques, most notably a uniquely designed vertical flow system, in the world.
The vertical flow system at Jennings was designed to treat water that had been unsuccessfully treated by a previously installed anoxic limestone drain and aerobic wetland. The source of the drainage is an abandoned deep mine that operated from the early 1900's to 1940's. This abandoned mine releases 30 gallons per minute of drainage containing a pH of 3, 50 milligrams per liter of iron, and 20 milligrams per liter of aluminum.

Students participating in an environmental education program at the Jennings Environmental Education Center (Photo courtesy of Jennings Environmental Education Center)

Using 300 tons of spent mushroom compost mixed with 380 tons of limestone aggregate, a 150 foot long, 50 foot wide, 6 foot deep vertical flow system was constructed. The drainage was improved, raising the pH to 7 and reducing iron and aluminum to less than 1 milligram per liter.

Students and volunteers worked side by side with engineers, designers and equipment operators to construct this innovative way of treating acid mine drainage. From its inception, this vertical flow system was designed to demonstrate research in action. Jennings offers year round educational programs that explain the passive treatment of acid mine drainage, introduce stream ecology, and interpret the cultural history of coal mining in the area. The Jennings site is open to the public 365 days a year. Interpretive exhibits at the site describe its long history and the many accomplishments that have taken place there. For more information about Jennings, the Slippery Rock Watershed Coalition, or acid mine drainage in general, call the Jennings Environmental Education Center, Monday through Friday, from 8:00 a.m. to 4:00 p.m. at (724) 794-6011.

This book does not contain the magic formula for restoring land and water to its pre-mining condition. It does, however, offer hope that progress is being made. Theories and ideas concerning abandoned mine restoration are put to the test everyday. Someday, a groundbreaking discovery may come from one of these ideas and that idea may come from the least likely source imaginable. For this reason, the Slippery Rock Watershed Coalition firmly believes that every interested and concerned citizen has something positive to contribute. It will continue to welcome any individuals with an interest in watershed restoration and share all achievements and discoveries with the world.