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Viewpoint

West Virginia has not directed sufficient resources to treat acid mine drainage effectively

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ABSTRACT

Acid mine drainage from abandoned coal mines continues to cause major problems in the State of West Virginia (in the United States), and groups of local residents are attempting to improve water quality by managing passive treatment systems. The challenges faced by these groups in obtaining effective treatment system performance are illustrated by experiences of one such group: Friends of the Cheat. As a result of pollution from abandoned coal mines, the lower Cheat River watershed is seriously degraded. West Virginia is failing watershed groups because it provides them with capital costs to initiate and manage treatment of acid mine drainage but does not provide funds for operation and maintenance activities needed for effective treatment. To compensate for the absence of funding to address routine maintenance issues, Friends of the Cheat and other groups apply for government grants to fund retrofits projects, which themselves are not supplied with operating funds. The result is a cycle of ineffective treatment and inefficient use of resources. If West Virginia is going to rely on community-based watershed groups to clean up pollution problems from abandoned coal mines, it should provide them with the resources they need to be successful.

1. Introduction

Residents of the State of West Virginia face a long-term burden in the form of acid mine drainage (AMD) from abandoned coal mines. As a result of AMD, West Virginia contains hundreds of miles of streams that are ecologically dead. This is a reflection of "government failure", in this case the State's failure to control effectively pollution from coal mining operations that closed prior to 1977, when federal regulations to address such pollution were enacted. Today, the State is failing again because it provides limited capital costs to groups of citizen volunteers to initiate and manage treatment of AMD, but does not provide those groups sufficient funds to be effective.

Our views on this matter were shaped during the course of a multi-year study (2009–2013) of citizen-based watershed groups engaged in stream cleanup in West Virginia. A key part of our study focused on a particular watershed group: Friends of the Cheat (FOC). Compared to other watershed groups in West Virginia in 2012, FOC had the largest operating budget (approximately $850,000 per year), the largest paid staff (3 full-time, 2 part-time) and 15 AMD treatment systems under management. We reasoned that because of its size and staffing, if any of these citizen-based watershed groups would be effective at treating AMD, it would be FOC.

2. Watershed group treats water pollution from abandoned coal mines

Friends of the Cheat concentrates its AMD treatment operations on the lower portion of the Cheat River watershed; the Cheat flows north though north-central West Virginia to a point where it crosses the West Virginia-Pennsylvania state line and drains into the Monongahela River (see Fig. 1). More than 90% of the Cheat River Basin lies in West Virginia. As a result of pollution from coal mines that no longer operate, the lower Cheat is one of the most severely AMD degraded watersheds in West Virginia. The 1977 US Surface Mining Control and Reclamation Act (SMCRA) requires that, as of 1977, active coal mines reclaim their land after mining operations end, and that they not release water pollutants in the

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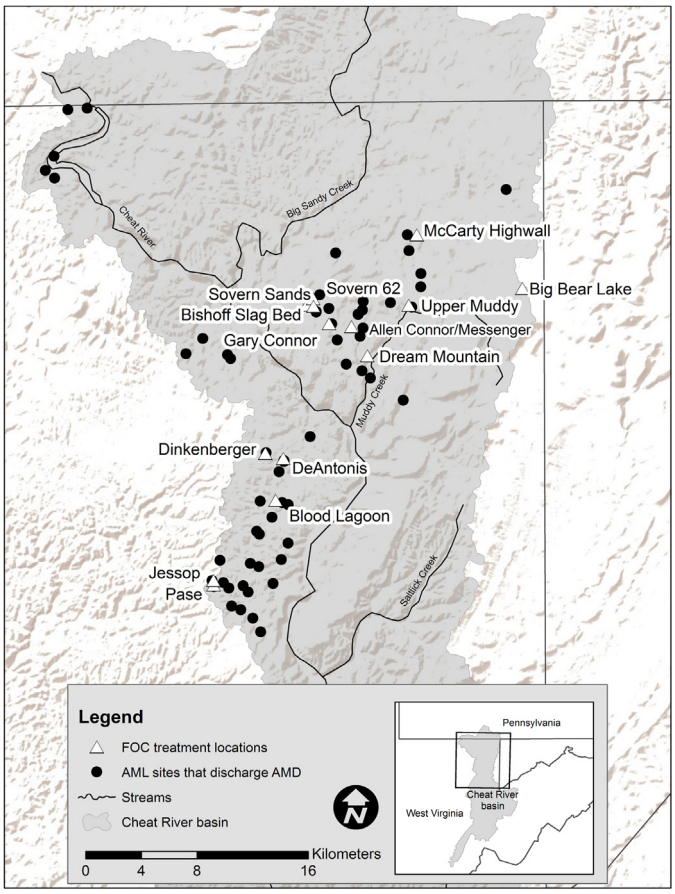

Fig. 1. Map of Cheat River basin, acid mine drainage discharges, and treatment systems.

future. Many mines that stopped operating before 1977 have been abandoned without land reclamation. The term "abandoned mine lands" (AMLs) is used to characterize these pre-SMCRA mine sites. The Cheat River Basin is scarred with over 200 AML sites. Of these, about 66 discharge AMD, and these releases are characterized by high acidity, low pH, and the presence of soluble heavy metals such as Fe, Al, and Mn (Pavlick et al., 2005).[1] The United States Environmental Protection Agency characterized many of the streams degraded by acidic drainage from abandoned mines in the lower Cheat as "effectively dead".[2] FOC is treating acid mine drainage in an attempt to bring native trout, small mouth bass and other aquatic life back to these streams.

Watershed groups in West Virginia generally rely on "passive" systems to treat AMD. These systems typically generate alkalinity to offset acid conditions using system components such as limestone leach beds and open limestone channels (Johnson and Hallberg, 2005). Passive treatment systems are viewed by some as an economic alternative to active treatment because they do not require continuous chemical inputs. For this reason, some advocates suggest that they require little maintenance, but that is often not the case. Moreover, passive system performance can be affected by variability in inflow water quality and flow rate (Zipper and Skousen, 2010).

[1] Significant mining in the area began in the early 1900s and peaked in the mid-twentieth century (cf. Anderson, 2014).

[2] The quoted phrase is from the US Environmental Protection Agency website, accessed July 15, 2014 at http://water.epa.gov/polwaste/nps/success319/wv_che.cfm.

Of the 15 systems available for treating AMD at abandoned mine land sites currently managed by FOC, almost all are passive systems. Like other watershed groups in the state, FOC relies heavily on the volunteer labor of local residents. It has a budget pieced together from fundraising events, such as the annual Cheat River Festival, as well as modest membership fees and donations from individuals and local companies. Much of the money raised supports ongoing staff and volunteer activities, such as baseline data collection, river access development, brownfields revitalization, and "rail-to-trail" projects. Funds for constructing treatment systems are provided via federal and state grant programs administered by the West Virginia Department of Environmental Protection (DEP).

3. Erratic performance of AMD treatment systems

In studying the effectiveness of the passive treatment systems managed by FOC, we restricted our attention to systems constructed prior to 2010 so that a track record of performance would be available. We also required that at least minimal water quality and flow data be available so that we could assess system performance. Since funding available to FOC for water quality monitoring is meager, the group generally has little data for tracking performance on a systematic basis. Using the aforementioned criteria, we identified five systems that were appropriate for a performance assessment. For these systems, records show highly erratic performance that is typically well below the goal of system designers: 80% reductions in acid load for 20 years.

The first system we studied – Upper Muddy (initially constructed in 2005) – contained four AMD sources with highly variable acidity inputs and metal concentrations, and flows ranging from 40 lpm to 1400 lpm. The Upper Muddy treatment system consisted of limestone leach beds connected with limestone channels that discharged into a natural wetland. System performance was erratic; e.g., a February 2011 water quality sample showed the system was removing only 4% of acidity (3 mg/L), whereas 5 months earlier, it had been reducing acidity by 46% (41 mg/L). For more than half of the 11 days on which data for assessing performance exist, acid load leaving the system was greater than acid load entering.

Signs of deterioration in Upper Muddy system performance became evident in 2005, within the first year of operation. At that time, aluminum hydroxides covered the limestone leach beds and clogged leach bed outlet structures. A 2008 storm washed out one of the leach beds completely and it remained out of operation for several months, a period during which no performance data was collected. After applying successfully for a new grant from the West Virginia DEP in 2009, FOC implemented a project to "retrofit" the original system by repairing the storm damage and responding to changes in AMD source locations. Notwithstanding the 2009 retrofit project, the system still failed to function as intended: limestone in the leach beds was buried by metal hydroxides, algae, leaves, and sediment that interfered with limestone dissolution. These obstructions diminished system performance by impeding water flow, preventing AMD from coming into contact with limestone, and decreasing retention time in beds. To compensate for the absence of funding to address these routine maintenance issues, FOC applied again for grants for retrofit projects in 2013.

The four other FOC passive treatment systems we examined showed similar high variations in performance. Assessment results are summarized in Table 1.

All five systems have significant temporal gaps in data on water quality and flow; gaps range from about nine months to more than 2.5 years. During these periods, no system performance data were collected. Moreover, the number of days on which water quality