Rupley Run AMD Watershed Assessment
State Game Lands No. 100 – Clearfield County

Technical Report Provided by Hedin Environmental through the Trout Unlimited AMD Technical Assistance Program

February 9, 2010

Project Description

The Pennsylvania Game Commission (PGC) requested technical assistance for a rapid watershed assessment for Rupley Run, a tributary to the West Branch of the Susquehanna River that flows through State Game Lands (SGL) 100 in Clearfield County. The stream is known to be polluted with mine water. The goal of this technical assistance was to determine the sources of AMD and develop baseline characteristics.

Watershed Characteristics

Rupley Run is a small stream that flows into the West Branch of the Susquehanna River 3.5 miles upstream of Karthaus and 1,000 ft upstream of the inflow of Moshannon Creek. The stream has a total mapped length of 1.5 miles and its watershed is approximately 500 acres. The stream arises on a flat plateau at 1350-1480 ft elevation and flows 5,000 ft before dropping steeply to its confluence with the West Branch at 860 ft elevation. The upper 3,500 ft of the stream are on private property, while the lower 4,500 ft are on SGL 100.

The upland portions of the watershed have been extensively surface mined. The middle portion of the stream appears to have been mined through as there are mine spoils on both sides of the creek. The SGL portion of the watershed has not been mined.

Property Ownership and Access

The upper portion of the watershed is currently owned by three individuals. The headwaters of the stream are owned by Gary Berkley and the middle section of the watershed is owned by Steve Franek and John Harvey. The Berkley and Franek properties have been surface mined. The Harvey property has not been mined. Mr. Franek was quite cooperative and provided unlimited access to his property for water sampling and assessment purposes. Mr. Berkley was not cooperative and only allowed access to his property for a single water sampling event in June 2009.

AMD Assessment

The AMD assessment was conducted by TU's technical service providers. An initial watershed reconnaissance was conducted by Alder Run Engineering (ARE) in June 2009. The ARE effort included sampling but flows were not measured. Hedin Environmental (HE) conducted additional reconnaissance in October 2009 that included sampling and

the measurement of several flow rates with pipes. TU and PADEP sampled the mouth of Rupley Run mouth in May 2009 and July 2009 as part of the recent assessment of water quality conditions in the West Branch. All water samples were analyzed by a certified laboratory.

All sampling points were identified by GPS and located onto available topographic mapping. Map 1 is taken from the USGS 7.5-minute Karthaus Quadrangle topographic map.

Rupley Run was sampled at several locations between its headwaters and mouth. Table 1 shows the chemistry of stream samples collected by this study. Map 1 shows the sampling point locations. The stream was acidic with elevated aluminum (Al) at all locations. Coldwater fisheries require pH above 5 and Al concentrations less than 0.5 mg/L. No stream segments were identified that could currently support trout due to high levels of acidity and metals.

Table 2 shows the chemistry of AMD discharges and other inflows to Rupley Run. The mine discharges are acidic and generally contaminated with high concentrations of Al and, to a lesser degree, Fe and Mn. There is a spring on the Berkley property that is not polluted. There is a pond on the Franek property that contains clean water and discharges through a pipe. The pond was discharging in October when it was sampled but there was no discharge in October.

Table 1. Rupley Run instream Samples.

Point	Map	Date	Flow	pH	Alk	Acid	Fe	Mn	Al	SO4
			gpm		mg/L					
Headwaters	10	06/17/09		4.0	0	32	0.5	2.4	2.6	89
Above Franek Pond	7	06/11/09		4.2	0	38	0.3	2.1	4.3	84
Above Franek Pond	7	10/07/09	6.3	4.0	0	47	0.4	4.0	5.2	128
SGL boundary	13	10/07/09	7.0	3.8	0	60	1.0	3.9	6.9	108
Rupley Mouth	1	05/19/09	349	3.9	0	47	0.1	1.8	5.6	83
Rupley Mouth	1	07/21/09	14	3.8	0	54	0.1	2.1	5.7	78

Table 2. AMD Discharges (labeled "D") and other sources of water in the Rupley Run watershed

Point	Map	Date	Flow	pH	Alk	Acid	Fe	Mn	Al	SO4
			gpm		mg/L					
Berkley D1	11	06/17/09		3.1	0	217	7.9	5.9	24.8	375
Berkley D2	12	06/17/09		3.0	0	329	10.0	3.7	45.8	495
Berkley Spring	9	06/17/09		5.9	8	8	1.7	0.1	1.3	13
Franek D1	4	06/11/09		3.4	0	124	0.3	5.8	15.6	285
Franek D2	5	06/11/09		3.0	0	184	1.5	5.3	19.0	368
Franek Discharge Trib	6	06/11/09		3.1	0	156	1.0	5.7	18.3	323
Franek Discharge Trib	6	10/07/09	1.0	3.3	0	148	8.4	7.3	20.0	268
Franek Pond Discharge	8	06/11/09		6.5	10	5	0.3	0.1	<0.1	11
Franek Pond Discharge	8	10/07/09	dry							

Treatment Options

All of the AMD discharges sampled in the Rupley Run watershed had low pH and contained elevated concentrations of Al, Mn, and Fe. The treatment of these waters requires the generation of alkalinity and the removal of metals. A common approach on permitted sites with AMD like that in Rupley Run is the addition of sodium hydroxide, NaOH. General design and cost information for chemical treatment can be obtained with the Office of Surface Mine's computer program, AMDTreat (www.osmre.gov). The high annual costs of NaOH treatment make it unattractive to most watershed associations. TU's experience with the PGC is that it is similarly sensitive to long-term costs and would not accept a chemical solution unless a long-term revenue source was also available.

A second chemical treatment option is to install a lime doser at the southern SGL boundary. PADEP operates several lime dosers where hydrated lime is added to directly to acidic streams. No attempt is made to manage the metals that form with neutralization. This approach is inexpensive, but it is only ecologically effective when the treated stream is large enough to allow biological benefits to develop downstream of the portion of the stream degraded by the chemical addition. Rupley Run is a small stream and it is unlikely that a viable fishery could be developed in the 4,500 ft of stream on SGL property using this treatment method. If the PGC wants to obtain more information on this approach, it should contact the PADEP Bureau of Abandoned Mine Reclamation in Ebensburg.

Passive treatment is generally the preferred approach for AMD on abandoned mine sites. The PGC has been involved in the construction of passive systems on SGL. TU is aware of successful passive treatment systems that have been constructed in the Slippery Rock Creek watershed on SGL 95 and in the Coon Run watershed on SGL 24. These passive systems treat acid mine drainage contaminated primarily with Fe. The systems use passive technologies (anoxic limestone drains, aerobic settling ponds, constructed aerobic wetlands) that are not appropriate for Rupley Run AMD because of the presence of aluminum (Al). The most common passive technology used for Al-contaminated waters is the vertical flow pond or VFP (also called SAPS, RAPS, anaerobic wetland). A VFP is a pond that contains 2-4 ft of limestone aggregate overlain with 1-2 ft of organic substrate. The pond contains an underdrain system so that water flows downward through the substrates, while maintaining a water surface in the pond 1-3 feet above the substrates. VFPs neutralize acidity and remove Al and Fe. The VFP discharge typically contains biological oxygen demand (BOD), residual Fe, and Mn, which can all be removed with subsequent flow through aerobic ponds and wetlands.

The VFP approach has been successfully used for waters with chemistry similar to the Rupley Run discharges in the Twomile Run watershed (Kettle Creek), Babb Creek watershed, and Slippery Rock Creek watershed. While the size of a VFP system depends on the acidity loading, some rough generalizations can be made. The Anna S passive treatment complex in the Babb Creek watershed has successfully treated water with 120 – 350 mg/L acidity for six years. The system requires 2-3 acres of VFP, pond, and wetland

to treat 80-100 gpm of AMD. As a rough first approximation of the scale of passive systems necessary to treat the Rupley Run discharges, the PGC should assume that one acre of area will be required for each 25-50 gpm of flow. The systems should be designed for higher flow conditions. Based on the very limited flow data, it is likely that the primary AMD discharges flow less than 50 gpm during wet weather.

All treatment systems require operation and maintenance (O&M) activities. For passive systems containing VFPs, routine O&M activities include: bi-monthly inspections; manual cleanout of pipes, channels and ditches; removal of muskrats and beavers; adjustments to water level control structures; operation of flushing systems; and water sampling. Eventually, all treatment systems require major maintenance to maintain acidity neutralization and metal removal. VFPs require substrate mixing and eventually substrate replacement. The periodicity of major maintenance varies with AMD severity. VFPs constructed for the Rupley Run AMD would likely require substrate mixing after 5-7 years and substrate replacement after 10 years. PADEP recently began to support an O&M fund that is intended to assist watershed groups with planned major maintenance activities.

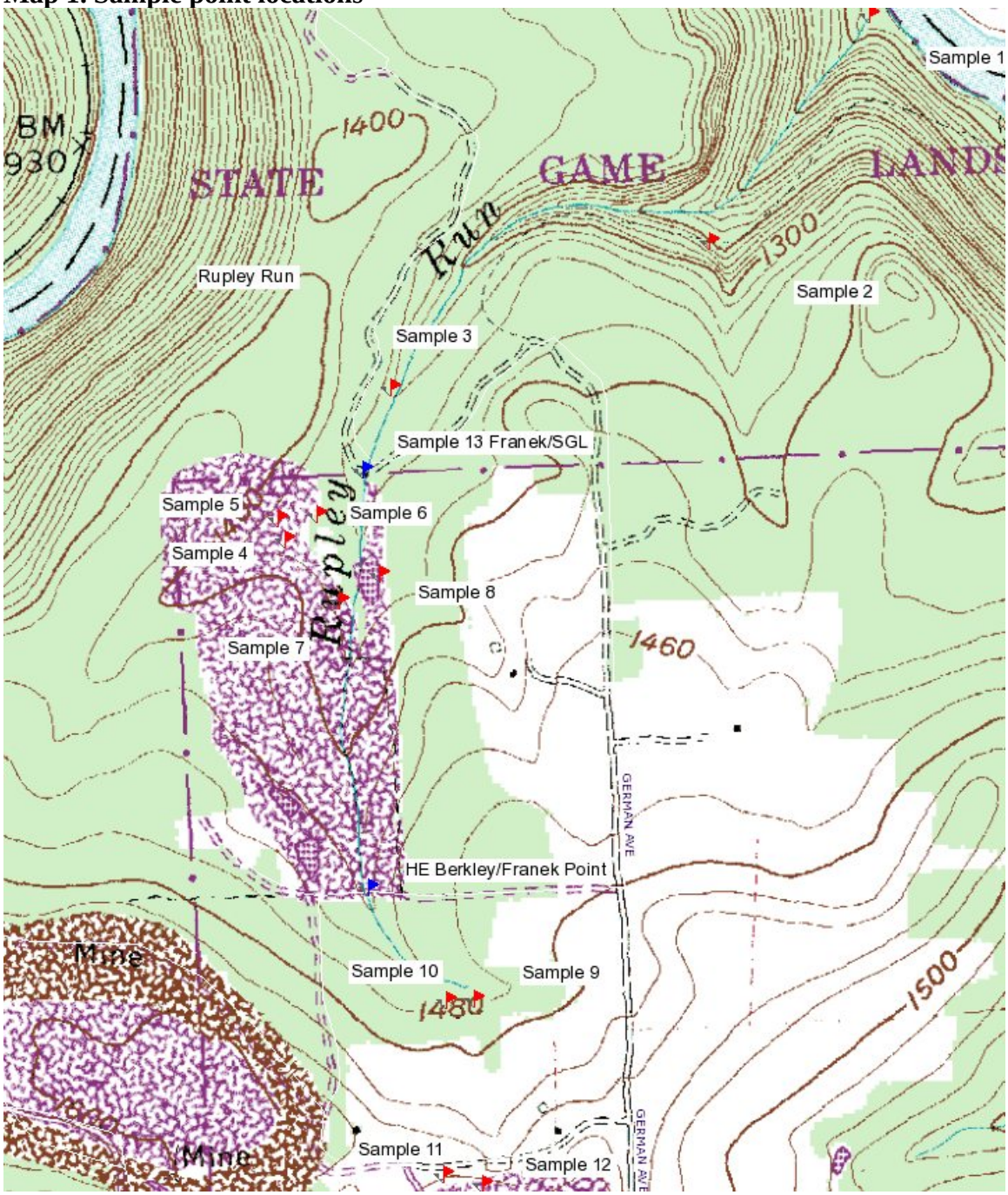
Treatment systems are designed based on AMD chemistry and flow. The chemistry of the Rupley Run AMD was characterized by this study and the general treatment strategy (VFP-type system) has been determined. The size of the system depends on the flow conditions. Effective mine drainage systems are sized for higher flow conditions. The collection of extensive flow information was not part of this project's scope and was not possible due to property access problems. The PGC needs to install pipes or flumes on the five major discharges identified in this study and obtain 12-18 months of flow information.

Passive systems should be constructed for defined AMD discharges, not for stream flows. This design feature avoids the damaging effects of extreme flow events. It also limits the size and cost of the treatment system. All of the Rupley Run AMD discharges are on private land. Advancing the restoration of Rupley will require establishing partnerships with the landowners and developing long-term easement agreements that allow treatment systems to be built and maintained on private property.

Recommendations

Rupley Run is polluted by acidic aluminum-contaminated mine discharges flowing from abandoned surface mines located on private property in the stream headwaters. The AMD is severe, but it could be treated with passive techniques that require routine O&M and periodic major maintenance. In order to develop treatment plans and costs, a monitoring program should be initiated that collects flow and chemical information for 12-18 months. With this information in hand, it will be possible to develop specific treatment plans. However, at this time, a key landowner is not willing to allow access to his property for sampling or treatment purposes. The PGC must work on this problem or the remediation of Rupley Run looks unlikely.

Map 1. Sample point locations



Blue flags mark samples collected by HE; red flags mark samples collected by ARE.