Lycoming Creek Watershed – Rapid Watershed AMD Assessment (Lycoming County)

Technical report provided by Hedin Environmental through the Trout Unlimited Technical Assistance Program TUTAG-03

March 13, 2007

I. Project Introduction

The purpose of this technical assistance was to help the Lycoming Creek Watershed Association to better quantify their AMD issues. Early in the project, Dutchman's Run became the focus of the work.

The first field visit for this project occurred in November 2005. At that time, reconnaissance was performed on Dutchman's Run and samples were taken there and at several other locations. Other sampling efforts that included HE personnel occurred in April 2006 and December 2006. Volunteers from LCWA measured the flow rate at one discharge periodically.

The following sections discuss specific aspects of this project and provide recommendations. All of the data obtained through this project is attached.

II. Lycoming Creek Water Quality

Two samples were taken on Lycoming Creek in November 2005 as part of this project. Additional data on the main stem of Lycoming Creek is presented in the report entitled "Aquatic Biological Assessment of the Lycoming Creek Watershed" (July 2005). In all cases, metals were at or below the detection limit and the stream was slightly net alkaline. It is unknown how much acidic contributions from mine drainage and acid deposition are harming the aquatic life in the main stem of Lycoming Creek.

Although mine drainage was not directly addressed and no samples were taken as part of the Lycoming Creek Watershed Strategic Restoration Plan developed by Water's Edge Hydrology in April 2006, recommendations of this plan included:

- For water quality improvement, the Association should continue to identify problem areas related to AMD and acid rain, and continue to support ongoing efforts of the PADEP Bureau of Abandoned Mined Lands to install passive treatment systems.
- Actively participate in the Dutchman's Run AMD restoration project to the greatest extent practical to address the water quality concerns in the watershed.

III. Dutchman's Run, Dutch03 Discharge Results and Recommendations

The following data exists for the Dutch03 discharge, which flows into Dutchman's Run approximately 1.3 miles upstream of the mouth. The discharge, like most of the Dutchman's Run drainage basin, is located in the McIntyre Wild Area of the Tiadaghton State Forest. Although the area is a Wild Area, mining once occurred and the mining access road remains in place. This road passes within 100 yards of the discharge location.

This data was taken by Hedin Environmental, CVI, and LCWA volunteers. Flow rates were measured using an H-flume installed in the discharge.

Table 1. Dutch03 Discharge Flow and Chemistry Data

Date	Flow (gpm)	Field pH	Lab pH	Cond (uS)	Net Acid (mg/L)	Fe (mg/L)	Mn (mg/L)	Al (mg/L)	SO4 (mg/L)
14-Nov-05		3.0	3.3	377	69	1.2	0.7	4.63	126
20-Apr-06	85	3.2	3.5	359	55	0.9	0.6	3.3	201
07-Jan-06	375	3.7							
01-Jun-06	130								
27-Jun-06	475								
20-Jul-06	305	3.1		485	*63**	1.9	0.4	3.8	
05-Sep-06	125								
24-Oct-06	290	3.3		185	*28**	0.5	0.4	0.6	
26-Nov-06	375								
Average	**270**	**3.3**	**3.4**	**352**	**54**	**1.1**	**0.5**	**3.1**	**164**
75th Percentile	**375**	**3.3**	**3.4**	**404**	**64**	**1.4**	**0.6**	**4.0**	**183**
90th Percentile	**405**	**3.6**	**3.4**	**453**	**67**	**1.7**	**0.6**	**4.4**	**194**

**This value was calculated based on metals and pH*

In addition to the data shown above, there was one sampling occasion when the flow was greater than the maximum allowed by the flume (900 gpm). This was during an extreme precipitation event and no exact flow measurement was possible. This information highlights the importance of including a high-flow bypass in the design of any treatment system for the discharge.

As shown in the table, the discharge is moderately contaminated mine drainage. However, because of the large flow rate, the pollution produced by the discharge is significant. Under average conditions, the discharge produces approximately 175 pounds per day of acidity. Under 75th percentile conditions, approximately 290 pounds per day of acidity are produced.

On April 20, 2006, a sample and flow rate were taken at the mouth of Dutchman's Run. The results are attached. These results showed that 65% of the acidity loading, 57% of the aluminum loading, and 60% of the sulfate loading present in the stream that day were being produced by the Dutch03 discharge. While these percentages likely vary under different stream conditions, it is clear that this discharge is the primary source of pollution to the stream. Treating the Dutch01 discharge to a net alkalinity of approximately 30 mg/L should result in a net neutral stream at the mouth under conditions observed that day.

Other discharges were located downstream of Dutch03, including Dutch02, which was sampled in November 2005. While the chemistry was worst than Dutch01, Dutch02 had a much lower flow rate and is located in an area that is not conducive to treatment. Several other very small seeps were also located. No action on these discharges is recommended until after the Dutch03 discharge has been addressed. It is possible that stream conditions will be improved to a level that does not require future treatment of these smaller discharges.

There are two primary passive treatment system types that would successfully treat the Dutch03 discharge. Vertical flow pond (VFP) systems are often used to treat mine drainage with aluminum. VFPs consist of open water ponds that drain down through organic substrate followed by limestone. The system discharges through a series of pipes in the bottom of the limestone. For water of this quality, no flushing pipes would be installed. The VFPs should be followed by a small pond and wetland in order to remove any organic solids that may pass through.

The other type of system is a shallow aerobic wetland with alkaline substrate. The wetland would be no more than 6 inches deep and would contain at least 6 inches of organic substrate that is heavily amended with fine limestone. The wetland would add alkalinity and retain metals. The wetland should be followed by an open limestone bed that would further boost the alkalinity of the discharge.

The following table shows a comparison of the two treatment system types. The designs are both based on the 75th percentile of flow and loading. System costs are based on similar systems that have recently been constructed elsewhere (Bernice Mine, Sullivan County and others) and include design, permitting, and construction of all treatment system elements.

Table 2. System Type Comparison

Type of System	**Alkaline Wetland**	**Vertical Flow Pond**
Acidity Removal Rate ($g/m^2/day$)	5	30
Required Area (ft^2)*	283,258	47,210
Required Area (acres)*	6.5	1.1
System Cost per ft^2	$2	$15
Total Cost (approx)	$570,000	$710,000

**These areas are for the primary treatment cells at the water line. Additional area would be required for polishing steps, berms, etc.*

The primary advantage of an alkaline wetland system is that it is a simple, natural-looking system that can provide habitat for a variety of plants, animals, and birds. Because it is shallow, it can be designed to blend with the existing landscape more readily than a VFP system. The wetland system would also be cheaper to construct. The primary drawbacks are that a much larger area is required for treatment (total area approximately 8 acres) and that treatment effectiveness can be negatively impacted by minor disruptions (muskrats, geese, extreme cold).

The primary advantage of a VFP system is that the footprint is much smaller than a wetland. In this case, a conservative performance estimate of 30 g/m^2/day of acidity removal was used because of the remote nature of the site and the moderate pollution in the discharge. Therefore, the system should provide reliable treatment with minimal maintenance. No flushing network was installed because of the low metals loading. The total system would cover approximately 2 acres, including 2 VFPs, a common pond, and berms. Treatment effectiveness is also predicted to be more stable. However, the construction cost is higher.

Both systems would require inspections approximately monthly and after extreme high flow events.

At least 12 acres of moderately sloping land exists near the discharge and below the site access road as shown on Map 1. This area is large enough to accommodate either type of treatment system discussed above.

The treatment system type should be selected in consultation with DCNR (Tiadaghton State Forest), DEP, and the LCWA.

IV. Other Tributaries to Lycoming Creek

Several other tributaries to Lycoming Creek have been identified in the past as being impacted by mine drainage. These include:

- Abbott Run
- Rock Run
    - Yellow Dog Run
    - Hound Run
    - Miners Run
- Red Run
- Frozen Run
- Little Gap Run

These stream mouths were sampled in December 2006, except for Abbott Run, which was sampled in November 2005. All tributaries were less than 10 mg/L net acidic with metals at or near the detection limits. Sulfates were 20 mg/L or less at all of these locations, indicating minimal mine drainage impacts. pH generally ranged from 5-6. By comparison, the mouth of Dutchman's Run had 50 mg/L net acidity and 100-200 mg/L sulfate and a pH of 3.5. Therefore, Dutchman's Run displays the worst chemistry of all the tributaries sampled as part of this effort.

However, other tributaries have much higher flow rates than Dutchman's Run, therefore, their pollution loading to Lycoming Creek is likely larger. High flow rates on the sampling date did not allow for flow measurements at the stream mouths.

All of the tributaries would benefit from the removal of acidity and addition of alkalinity. The best way to accomplish this is to locate and sample all individual mine drainage discharges. In some cases, it is likely that acid deposition is contributing to the acidity. However, without a full assessment, the relative importance of mine drainage and acid deposition are not known. A full mine drainage assessment is recommended. This assessment should include:

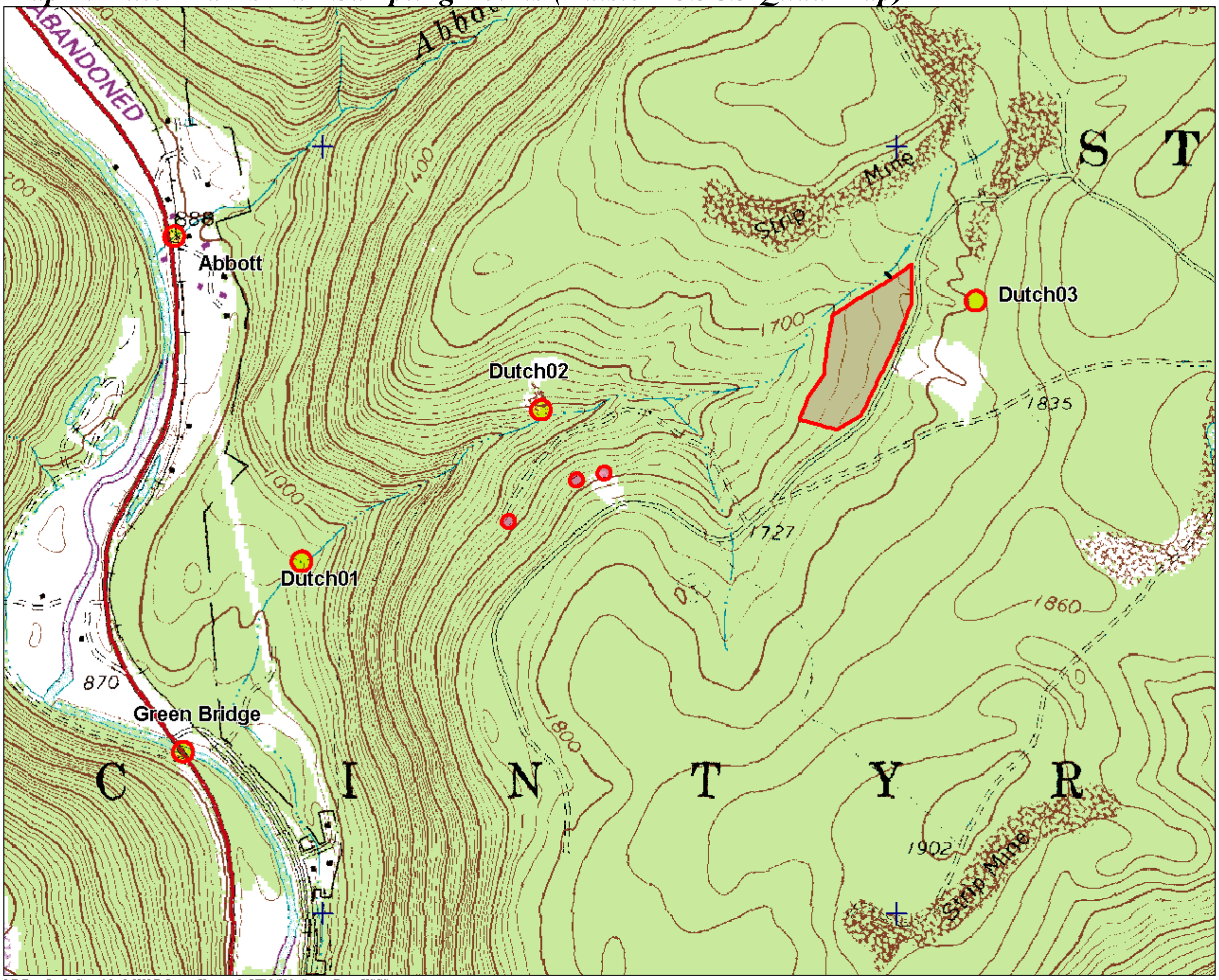
- Stream reconnaissance of all impacted tributaries to locate all discharges
- Development of a monitoring plan for:
    - All important discharges (flow and chemistry, monthly)
    - Important in-stream tributary stations (flow and chemistry, quarterly)
    - Tributary mouths (flow and chemistry, quarterly)
    - Main-stem Lycoming Creek stations (chemistry only, quarterly)
- Development of restoration goals for the watershed including all stakeholders
- Formulation of a mine drainage and acid deposition restoration plan

Assuming 35 discharge stations and 25 in-stream stations, the total cost estimated for this project, including the restoration plan, is $75,000. This cost assumes that volunteers from the LCWA assist with reconnaissance and flow device installation.

V. Summary of Recommendations

- Continued sampling at Dutchman's Run discharge Dutch03
    - Flow rate monthly
    - Chemistry samples taken and analyzed during high and low flow events
- Coordinate with DEP and DCNR to pursue treatment of Dutch03
- Coordinate with DEP to pursue a full mine drainage assessment of Lycoming Creek

Map 1: Dutchman's Run Sampling Points (Ralston USGS Quad Map)



3-D TopoQuads Copyright © 1999 DeLorme Yarmouth, ME 04096 Source Data: USGS   350 ft Scale: 1 : 12,000 Detail: 13-2 Datum: WGS84