A road to progress? The impacts of cutting a new highway through the heavily mined hills of Southeast Ohio

Natalie A Kruse[2], Robert Kerber[2], Kimberly Brewster[1], Loraine McCosker[1]

[1]*Environmental Studies, Voinovich School of Leadership and Public Affairs, Ohio University, Athens, Ohio, USA*
[2]*RedWing Engineering, Athens, Ohio, USA*

Abstract A 10.5 mile four-lane highway will be constructed to bypass Nelsonville, Ohio and cut through lands historically mined for coal in Southern Ohio and the Wayne National Forest. Although local watersheds were impacted by mine water before construction, earth work has created new mine water discharges during both construction and coal mining associated with the construction. Streams that drain the site have been monitored for pH, acidity, alkalinity, iron, aluminum and sulfate. This paper details the new discharges, mitigation options chosen by the Ohio Department of Transportation and the first year of monitoring of impacts from the project.

Key Words Acid mine drainage, highway construction, coal mining, mine water chemistry

Introduction

Southeastern Ohio is often referred to as 'Swiss Cheese' by local residents due to extensive coal mining through the 20th century. Since the mid-1800s, surface and underground coal mining in this region has left behind abandoned mine voids, subsidence, mine spoil, and other geohazards (Harris et. al 2007). Recently, the American Recovery and Reinvestment Act ensured funding for the completion of a 10.5 mile four-lane highway slicing directly through the Swiss Cheese of Southern Ohio and the Wayne National Forest. The highway bypassing the former mining boomtown of Nelsonville, Ohio, promises to speedily carry traffic from Columbus, Ohio, to Charleston, West Virginia. Phase I of the construction has been completed and Phases II and III are scheduled to be completed by 2013 (ODOT 2010).

The construction passes through some of the most impacted former mining districts in Ohio. Challenges unique to this construction project include abandoned underground coal mines, pre-existing sources of acid mine drainage, and hilly terrain requiring extensive cuts and fills. Additionally, much of the project is located on Wayne National Forest property, which serves as habitat for the Timber Rattlesnake and the Indiana Bat, among other species and habitat of concern (ODOT 2005; Harris et. al 2007).

Historical cases of highway construction through lands mined for coal have involved the creation of new mine water discharges, such as the construction of the I-79 interchange near Pittsburgh, PA in the 1960s. Improvements in water treatment designs were required for the recent reconstruction of this interchange (Gaffney and Turko 2006). In western Pennsylvania, a majority of remined or daylighted mines demonstrated improvement or no change in acidity and metal loads, especially where overburden material was alkaline enough to increase the pH of groundwater. Alternatively, acid-producing overburden may worsen water quality at other sites (Hawkins 1998).

The Nelsonville bypass is located within the watershed of the Hocking River, a direct tributary of the Ohio River. Pre-construction water quality shows that the impacted watersheds, Monday Creek and its tributaries and several direct tributaries to the Hocking River, were impacted by mine water before construction (Table 1).

Table 1 *Pre-construction field pH values at selected sites near bypass construction (NPS 2010; USGS 2010)*

Site	Source	Site ID	Date	Field pH
Coe Hollow	NPS	CH00100	9/24/2007	2.98
Hocking River tributary (Haydenville)	USGS	392842082183600	8/29/1995	3.1
Monday Creek (mouth)	NPS	J02P07	9/18/2007	6.36
Snow Fork (mouth)	NPS	SF00010	8/18/1995	3.3

As detailed in the Final Environmental Impact Statement (FEIS) for the project, the preferred construction corridor was estimated to impact 35,776 feet (10,905 meters) of jurisdictional streams (ODOT 2005). Earth work has created new mine water discharges during both construction and coal mining associated with the construction. A seep has opened up into Coe Hollow, a tributary of Monday Creek, and another seep is entering a Hocking River tributary from a construction site near State Route 278.

Limited mitigation options exist due to the relief and extent of the bypass site. As outlined in the FEIS, mitigation and restoration projects will be developed through coordination of the Ohio Department of Transportation (ODOT), the Ohio Department of Natural Resources (ODNR), the Ohio Environmental Protection Agency (OEPA), and the Wayne National Forest (WNF). Proposed mitigation projects included treatment of acid mine drainage in Coe and Bessemer Hollows, stream bank restoration, wetland development, the incorporation of natural stream designs when relocation is required, and the use of conservation easements for riparian and stream preservation (ODOT 2005).

On the north side of the project, monitoring has been performed for four seeps arising from construction. Two limestone ditches with settlement ponds have been built and a channel has been extended to treat new seeps, although they are likely undersized. In September 2009, increases in pH discharge ranged from 3.1 to 3.8 and 2.9 to 5.1 (Kerber 2009). Other expected impacts of construction to water quality include increased erosion and sedimentation of watershed soils and increased turbidity in streams and wetlands. Erosion and sedimentation minimization measures used in construction are expected to reduce these threats to water quality (ODOT 2005).

This project serves as an important case study of large scale construction in former mining districts. Many of the challenges that will be overcome during the five year construction period will serve as lessons learned for future construction projects that impact underground workings and spoil piles.

Methods

Since the start of construction, seasonal water quality data have been collected at eleven sites within the Hocking River and Monday Creek watersheds that collect water drainage from the construction (Fig. 1). Five sites are located at tributaries entering the Hocking River. Four sites are located at the mainstem or tributaries of Monday Creek, which drains into the Hocking River. Two sites are located at the Hocking River itself, one upstream and one downstream of all sampling sites. Samples at an additional Coe Hollow seep have been difficult to collect due to the quickly transforming construction.

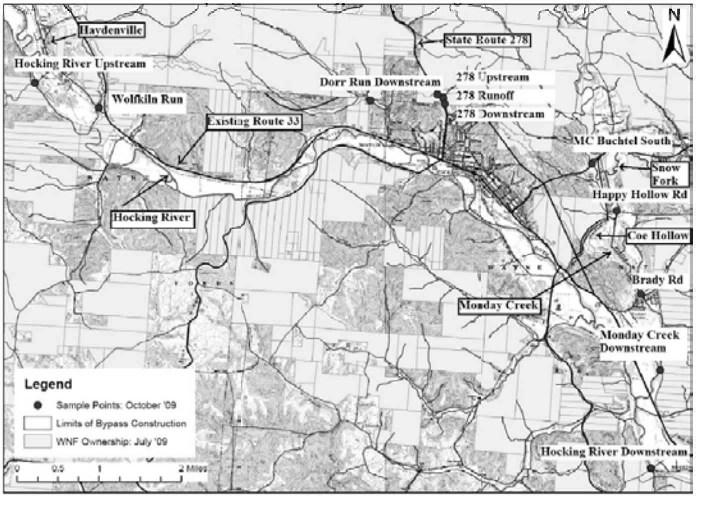

***Figure 1** Map of bypass construction and WNF property with water sampling sites, streams, and relevant place names*

In the field, parameters measured at each site were temperature, pH, specific conductivity, total dissolved solids, and Eh. Acidified and non-acidifed water samples were also collected for lab analysis of acidity, alkalinity, iron, aluminum, and sulfate.

Preliminary Results

Fall, winter, and spring water quality monitoring has shown varying pH values, although especially low pH and high acidity have been documented at the Coe Hollow and State Route 278 seeps and the Dorr Run Downstream and Wolfkiln Run sites (Fig. 2). The fall and winter samples were taken at low flow, although winter was lower flow than fall and spring sampling was done at base flow. There have been increased metal and sulfate concentrations in some locations, while at others, there are decreased acidity and metal concentrations (Fig. 3—5). Increased aluminum concentrations, likely from disturbance of spoil piles and from groundwork in clay during construction, is worrying, especially at low flow. The increased metal concentrations at Happy Hollow Road (iron) and Dorr Run (aluminum) at low flow indicate that there could be inputs from the underground working disturbed during construction, while the increased metal concentrations at SR 278 during higher flow show a potential impact from aluminum-rich construction fill.

Conclusion

It is likely that differences in water quality are due to spoil removal during earth work, mining of remaining coal, installed mitigation and pre-construction geology and soil condition. Local geological changes and construction methods also contribute to construction impact. Monitoring

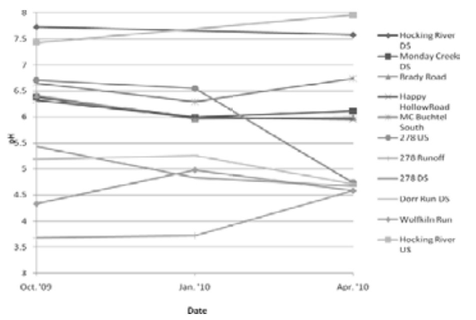

Figure 2 *Seasonal changes in pH at sampling sites*

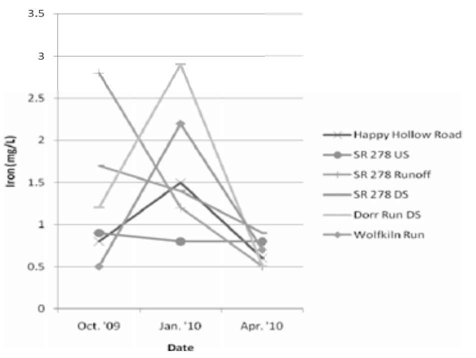

Figure 3 *Seasonal changes in iron (mg/L) at selected sampling sites*

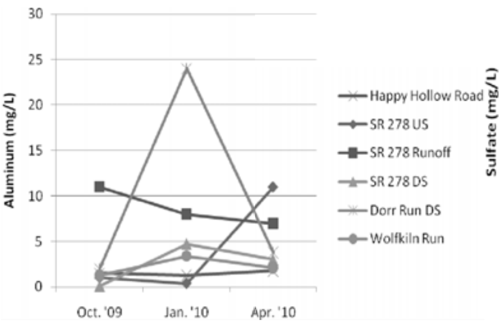

Figure 4 *Seasonal changes in aluminum (mg/L) at selected sampling sites*

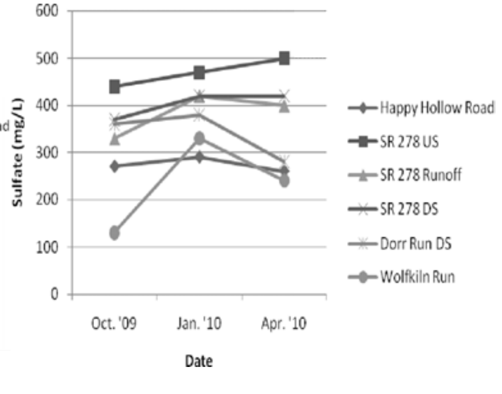

Figure 5 *Seasonal changes in sulfate (mg/L) at selected sampling sites*

during construction and after the completion of the bypass will continue to show changes both close to and further downstream and will quantify the impacts of a large highway construction project in mine lands.

Acknowledgments
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