

EXECUTIVE SUMMARY

Section 18.1 of the Bituminous Mine Subsidence and Land Conservation Act requires PADEP to compile, on an ongoing basis, information from mine permit applications, monitoring reports, and enforcement actions relating to surface impacts of underground bituminous coal mining. It also requires PADEP to report its findings regarding these effects to the Governor, General Assembly and Citizens Advisory Council at five-year intervals. This is the 4th such report and the second completed by a team from the University of Pittsburgh. The team brings together expertise in mine engineering, hydrogeology, and ecology.

Specifically, the University was tasked with:

- Providing a detailed analysis of the effects of underground mining on surface features during the 4th assessment period (21 August 2008 to 20 August 2013).
- Providing data-based recommendations to PADEP on the process by which information concerning the effects of underground mining is obtained and managed.

During the 4th assessment period, 31,234 acres of Pennsylvania land were undermined. This represents an 18% decline in the amount of land undermined from the 3rd Act 54 assessment, reflecting both a reduced demand for coal and the extension of the large Bailey Mine into parts of West Virginia. A total of 46 underground mines were in operation during the 4th assessment. Seven mines utilized longwall mining methods, five mines conducted pillar recovery, and the remaining 34 mines used strictly room-and-pillar mining.

The Bituminous Underground Mining Information System (BUMIS) is used by PADEP to track impacts of these mining operations on surface structures and water supplies. Unfortunately, the University's ability to readily interpret information from this database was significantly hampered by the frequent lack of unique feature identifiers and location information in BUMIS. A total of 389 reported effects on structures were recorded in BUMIS during the 4th assessment period. PADEP determined that the mine operators were liable for 61% of the reported structure effects. For water supplies, BUMIS recorded 855 reported effects on wells, springs, and ponds. The mine operator was found liable for 57% of all reported effects with a final resolution. Interestingly, 25% of these company-liable impacts occurred outside of the PADEP's Rebuttable Presumption Zone. Mine operators utilized private agreements with landowners to settle 70% of the company-liable impacts. The average time to resolution for both structure and water supply reported effects was less than one year (169 and 220 days, respectively). However, when the mine operator was found liable for water supply impacts, the time to resolution exceeded one year (415 days).

For streams, the implementation of a PADEP technical guidance document has greatly improved the ability to quantify and interpret underground mining impacts on surface waters since the 3rd assessment period. In the 4th assessment period, 96 miles of stream were undermined. Of these stream miles, 39 miles belong to streams that experienced mining-induced flow loss or pooling somewhere along their channel. The limited biology data that was available to the University indicates that both mining-induced-flow loss and pooling constitute adverse effects to the macroinvertebrate community. For streams experiencing flow loss, certain mayfly taxa appear to be especially hard hit. Declines in water quality, including increases in conductivity and pH, also accompany mining-induced flow loss impacts. On a positive note, TBS increased over time at

sites impacted by flow loss in the 4th assessment period, albeit slowly. Also, gate cut mitigation appears to be successful in restoring pooled streams to their pre-mining condition.

Because BUMIS was not designed to track the complexity of stream impacts, PADEP has struggled to develop a system for recording stream data. During the 3rd assessment period, PADEP utilized stream investigations to track the status and final resolution of all stream impacts. Following implementation of PADEP technical guidance, PADEP changed its tracking system. However, this change has resulted in scattered record keeping that requires hunting for multiple data sources in the hands of individual PADEP staff. These records lack standardization and are sometimes in narrative form without organized data reporting.

Following up on streams that were impacted during the 3rd Act 54 assessment, 51 of the 55 stream investigations from that period have been resolved. For eight of the resolved investigations (involving seven streams), the final resolution by PADEP indicates that the streams have not recovered from the mining-induced impacts. For these and other resolved cases, the University noted a lack of standardization and general inadequacy in flow data used to assess stream recovery.

Wetlands acreage actually showed a slight net increase following undermining at three longwall mines. However, the increases result from a substantial loss of original wetland acreage and creation of new wetland acreage. The original and new wetland acreage often differ functionally and thus the newly emerging and created wetlands do not entirely replace lost wetland functions. For the one mine that exhibited a net decrease in wetland acreage, two wetland mitigation projects have been proposed. However, the proposed projects do not fully replace the function of the lost wetland acreage.

Although the focus of mitigation efforts and citizen concerns is at the ground's surface, the persistent problems with some undermined water supplies, streams, and wetlands appear to be impacted by changes in groundwater flows, driven by fracturing of overburden layers and changes in movement and depth of near-surface waters. This report is the first to consider this issue. Groundwater evaluation relied predominantly on the hydrologic monitoring reports (HMRs) submitted to PADEP, reports on over 750 unique locations, with over 31,000 sampling events reported during the 4th assessment period. This is a rich data set, however it was not necessarily designed to characterize ground water impacts on comprehensive, regional scales. In order to understand how undermining impacts groundwater systems, monitoring and analysis will have to continue to evolve and improve. Such a continued improvement will allow more sophisticated and successful prevention and mitigation of impacts to citizens and to the Commonwealth. The University provides recommendations that if followed will enhance the ability to address important questions regarding the role of groundwater in subsidence-related surface and near-surface effects in the next report.

Since the submission of the 3rd Act 54 report, PADEP has increased its requirements for the submission of a wide variety of data from the mine operators in connection with the permitting and regulation of mining activities. Unfortunately, PADEP struggles with a number of problems associated with what has come to be known as "big data". The use of large amounts of data of diverse kinds requires a modern information system with explicit and enforced standards for data

acquisition, submission and management; such an information system and the accompanying data standards and management practices are missing or not enforced. The University found that, while PADEP has enhanced information gathering in a number of areas, it has lost ground since the 3rd Act 54 assessment period in the organization and accessibility of some areas of data necessary for assessing the effects of underground bituminous coal mining in Pennsylvania.

As underground mining continues in the Commonwealth, best practices for managing big data should be utilized to ensure that the land areas above underground mining are managed well. Practices such as data standardization, written protocols, standard electronic data forms and electronic submission, and especially rapid error and standards checking following data submission, can cascade through processes at PADEP and enhance the ability of PADEP to efficiently and effectively serve the Commonwealth.