

# **EXECUTIVE SUMMARY**

Section 18.1 of Pennsylvania's Bituminous Mine Subsidence and Land Conservation Act (BMSLCA), amended in 1994 (Act 54), requires the Pennsylvania Department of Environmental Protection (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. The law requires PADEP to report its findings regarding these effects to the Governor, General Assembly and Citizens Advisory Council at five-year intervals (BMSLCA Section 18.1(c)). This is the fifth such report and the third completed by the University of Pittsburgh (the University). The assessment team brings together expertise in mining and civil engineering, hydrogeology, and ecology.

Specifically, PADEP tasked the University with:

- Providing a detailed analysis of the effects of underground mining on surface features during the 5<sup>th</sup> assessment period (21 August 2013 to 20 August 2018).
- Evaluating the data used to identify hydrological changes associated with subsidence and to determine if outcomes are protective of citizen's right and the environment.

In this report the University has drawn primary conclusions from their analyses. These conclusions and the resultant data-based recommendations to are meant to improve implementation of Act 54. During draft review of this report, PADEP requested transfer of background material from the report to supplemental appendices to enhance their ability to use the report in evaluation and planning of their operations. Consequently, some background information and details are now included in appropriate appendices.

**Area Undermined.** During the 5<sup>th</sup> assessment period, 49 active underground bituminous coal mines undermined 28,854 acres of Pennsylvania, with 62 % of the acres classified as longwall, 29 % room-and-pillar, and 9 % pillar recovery mines. The acres undermined during the 5<sup>th</sup> assessment period represent a 7 % decline in the amount of land undermined compared to the 4<sup>th</sup> assessment period.

**Structure Effects.** Of the 3,612 total structures that were undermined by active mining operations in this assessment period, there were 455 (~15 %) with reported effects from both active and inactive mines, and 247 (or 54 %) classified as company liable with a final resolution. The remaining 208 reported effects had a company not liable final resolution (99) or are still in interim resolution (109).

**Water Supplies.** 2,353 water supplies were undermined. Of the 379 water supply reported effects (wells, springs, ponds), 192 were determined to be company liable (27 for room-and-pillar, 6 for pillar recovery, 158 for longwall, and 1 for a mine not active during the 5<sup>th</sup> assessment period).

**Land Impacts.** During the 5<sup>th</sup> assessment, at least a portion of 3,296 distinct land parcels were undermined. The 124 land reported effects represent an increase from prior assessment periods, (c.f. 108 for the 3<sup>rd</sup> assessment period and 106 for the 4<sup>th</sup> assessment period). Most (80 %) of the total land reported effects occurred over the six active longwall mines. Nearly all (95 %) of land company liable impacts occurred over longwall mines. The 43 active room-and-pillar and pillar recovery operations had only nine reported effects. Of these, eight had a final resolution

determined to be company not liable. A substantial portion of the increase in reported land impacts was found to be associated with a spike in reported effects over inactive mines.

**Groundwater.** When stream flow loss occurs, augmentation of streams commences from groundwater or local public water sources. Of 118 stream impacted by longwall mining during the 5<sup>th</sup> assessment period, 92 streams were augmented. Of those augmented, 80 were augmented using wells or wellfields. Of the 12 streams not augmented with wells, augmentation sources included water hauled by truck, public water supply, pond water, and stream water. Evaluation of groundwater impacts relies on quarterly hydrologic monitoring data. Definition of when and how to use these data to identify a groundwater effect would clarify the effectiveness of hydrologic system protections.

**Stream Impacts.** In total, 126.98 miles of streams (86.16 miles if stream segments in the 200-foot buffer zone are not included) were undermined during the 5<sup>th</sup> assessment period. Based on mining method, 46.75 miles were undermined by longwall mining, 38.89 miles by room-and-pillar mining, 0.53 miles by pillar recovery, and 40.82 miles were within the 200-ft buffer zone. During the 5<sup>th</sup> assessment period and exclusively over longwall mines, a total of 149 flow loss impacts occurred over 24.44 miles of streams, and a total of 30 pooling impacts occurred over 2.83 miles of streams.

A Stream Recovery Evaluation (SRE) report must be submitted by a mine operator following mitigation on an impacted stream before the stream can be released by the PADEP. During the 5<sup>th</sup> assessment period, 82 SRE reports were submitted to the PADEP. This represents a large increase compared to the 4<sup>th</sup> assessment period, when only 14 SRE reports were submitted. As of the end of the 5<sup>th</sup> assessment, 42 of the 82 streams were released by PADEP while the streams in the remaining 40 SRE reports had not yet been released.

**Wetlands.** Permit renewals are the primary source of wetland data and permit schedules are not synchronous with the five-year Act 54 assessment periods. Therefore, the University reports wetland analyses as aggregates of wetland effects that reflect the five-year permit period for each mine. An estimated 90.7 acres of wetland habitat were undermined by longwall mines, including wetlands within the 200-ft buffer. Of this, 48.6 acres was over longwall panels, 20.5 acres was over room-and-pillar portions, and 21.6 acres overlaid the 200-ft buffer zones surrounding longwall mining extents. Two wetland mitigation projects were reported to PADEP during this assessment period; however, both were ongoing, so final evaluation of wetland mitigation efforts is not possible.

**Emergent Effects.** The PADEP specified analyses in the defined Scope of Work (Appendix L). During the completion of these analyses, the University observed emergent trends that, while outside of the defined scope of work, are relevant findings important to the evaluation of bituminous coal mining subsidence effects in the Commonwealth of Pennsylvania. These findings are discussed in Section 11 and include: 1) changing property holding patterns above underground mining; 2) unexpected subsidence effects (far field subsidence effects and effects at closed mines); and 3) comprehensive evaluation of the hydrologic balance

**Recommendations.** Data collection as required by Act 54 has been ongoing since 1993. One of the consequences of development of data tools like the Bituminous Underground Mining Information System (BUMIS) at a relatively early stage of the computing revolution is that older tools create logistical barriers. BUMIS is used by PADEP to track impacts of mining operations on surface structures and water supplies. However, this data management system is not easily integrated with tools that have emerged since Act 54 was first passed in August of 1994. Most of the recommendations made in this report can be achieved more efficiently with fundamental investments in the primary data management tool for subsidence impacts.

Parallel with the need to modernize data tools is a need to require submission of the copious amounts of data the PADEP gathers in a form that can be seamlessly and easily integrated with BUMIS or a modernized data system. Some data (e.g., hydrologic monitoring reports) were submitted as spreadsheets early in the 5<sup>th</sup> assessment period. However, by the end of the period these submittals had reverted to hard copy documents. This is a fundamental problem that further strains limited resources.

As underground mining continues in the Commonwealth of Pennsylvania, best practices for managing big data could be utilized to ensure that the land areas above underground mining are sufficiently managed to protect the environment and citizens' rights. 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 allow efficient and effective protection of the Commonwealth and its citizens.

Better data tools are fundamental to the effective implementation of the evolving policies developed to protect the environment and citizen's rights. In particular, the protection of subsidence impacted surface waters has changed dramatically since 1994 and the beginning of the Act 54 processes. The PADEP is exploring better tools to evaluate flow losses in reaches impacted by underground mining, relying on technical assistance from the U. S. Geological Survey. Use of new tools will require augmented data analysis guidance, as proposed sampling schedules are more difficult to track and implement than the current recommended and relatively simple monitoring schedules. This is particularly important given the inconsistent monitoring observed in SRE reports.

In addition, analysis of other hydrologic system component monitoring, such as groundwater and wetlands, is not as clearly defined as surface water monitoring nor integrated into data systems. While the stream data in this assessment have, for the first time, been integrated into BUMIS, both groundwater and wetland data remain distinct. Groundwater monitoring efforts can take advantage of the revolution in sensor technology to allow collection of more frequent data and clarify the role of groundwater systems in hydrologic impacts. Similarly, if wetland gain or loss data are submitted in an electronic format, then the effort to evaluate gain or loss caused by subsidence is simplified and optimized.

Finally, the emergent trends deserve additional scrutiny. Observed subsidence impacts beyond areas predicted by industry standard modeling tools suggest standard prediction methods need to be re-evaluated to ensure citizen's rights are protected. Similarly, the changes occurring in property ownership and patterns in property transfers over mining have the potential to impact

entire communities. The net regional changes in property value and holdings have not been evaluated. Finally, as the protection of hydrologic resources has grown increasingly important to the Act 54 process, policy provisions are overlapping with other parts of PADEP and other state agencies. Development of policies that cross these boundaries to encourage comprehensive, seamless outcomes will improve protection of hydrologic systems.