The Effects of Subsidence Resulting from Underground Bituminous Coal Mining in Pennsylvania, 2013-2018

Bituminous Mine Subsidence and Land Conservation Act
Act 54 Amendments
5th Five-Year Report


Research was conducted by the University of Pittsburgh for the Pennsylvania Department of Environmental Protection

Cover photos: Top row: impact of heave on Whitethorn Run over Bailey Mine and stream after heave cut was completed (PADEP file photos); Middle row: impact of fracture reducing flow in an unnamed tributary (NoF-4.9R) over Bailey Mine and result after sealing the fracture (PADEP file photos); Bottom row, left: Mitigation for gas line over Enlow Fork Mine (photo credit: Patrick Shirey); Bottom row, right: Mitigation trench dug around house over Contura Mine (photo credit: Patrick Shirey)
Dear Mr. Shuler,

This letter accompanies the University’s 5th Act 54 assessment period report entitled “The Effects of Subsidence Resulting from Underground Bituminous Coal Mining, 2013 to 2018”. This report is the culmination of work by 19 researchers at the University of Pittsburgh and the Carnegie Museum of Natural History over a two-year period.

Thank you for the opportunity to work with you in providing this information to the citizens of the Commonwealth of Pennsylvania.

Sincerely,

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ACRONYMS AND ABBREVIATIONS

Units of measurement

% percent
cfs cubic feet per second
ft feet
ft³ cubic feet
GB gigabytes
gpm gallons per minute
in inches
lbs pounds
m meters
MA million years ago
mi miles
μmho/cm microohms per centimeter

General

Act 54 1994 amendments to BMSLCA
ArcGIS geographic information systems software produced by ESRI
AutoCAD design software produced by Autodesk
BAMR Bureau of Abandoned Mine Reclamation
BMSLCA Bituminous Mine Subsidence and Land Conservation Act
BUMIS Bituminous Underground Mining Information System
CAD computer-aided design
CDMO California District Mining Office
CMAP Coal Mining Activity Permit
CMNH Carnegie Museum of Natural History
DEM digital elevation model
EIA United States Energy Information Administration
EPA United States Environmental Protection Agency
ERRI Environmental Resources Research Institute
ESRI Environmental Systems Research Institute
GIS geographic information system
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>HMR</td>
<td>Hydrologic Monitoring Report</td>
</tr>
<tr>
<td>LiDAR</td>
<td>Light Detection and Ranging</td>
</tr>
<tr>
<td>LLC</td>
<td>limited liability corporation</td>
</tr>
<tr>
<td>MrSID</td>
<td>multi-resolution seamless image database</td>
</tr>
<tr>
<td>MSHA</td>
<td>Mine Safety and Health Administration</td>
</tr>
<tr>
<td>NAD 1983</td>
<td>North American Datum of 1983</td>
</tr>
<tr>
<td>ND</td>
<td>no data</td>
</tr>
<tr>
<td>NHD</td>
<td>National Hydrography Dataset</td>
</tr>
<tr>
<td>NWIS</td>
<td>National Water Information System</td>
</tr>
<tr>
<td>OCR</td>
<td>optical character recognition</td>
</tr>
<tr>
<td>op</td>
<td>overburden pressure</td>
</tr>
<tr>
<td>PA</td>
<td>Pennsylvania</td>
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<tr>
<td>PADEP</td>
<td>Pennsylvania Department of Environmental Protection</td>
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<td>Pennsylvania Fish &amp; Boat Commission</td>
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<td>Pennsylvania Spatial Data Access</td>
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<td>Pennsylvania Department of Transportation</td>
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<tr>
<td>PEM</td>
<td>Palustrine emergent</td>
</tr>
<tr>
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<td>Palustrine forested</td>
</tr>
<tr>
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<td>Palustrine open water</td>
</tr>
<tr>
<td>PSS</td>
<td>Palustrine scrub/shrub</td>
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<td>PSU</td>
<td>Pennsylvania State University</td>
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<tr>
<td>PUB</td>
<td>Palustrine unconsolidated bottom</td>
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<tr>
<td>QA/QC</td>
<td>quality assurance/quality control</td>
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<tr>
<td>Re</td>
<td>extraction ratio</td>
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<tr>
<td>RPZ</td>
<td>rebuttable presumption zone</td>
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<tr>
<td>SA</td>
<td>structure analysis</td>
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<tr>
<td>SD</td>
<td>standard deviation</td>
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<tr>
<td>SF</td>
<td>safety factor</td>
</tr>
<tr>
<td>SC</td>
<td>specific conductance</td>
</tr>
<tr>
<td>SID</td>
<td>seamless image database</td>
</tr>
<tr>
<td>SMCRA</td>
<td>Surface Mining Control and Reclamation Act of 1977</td>
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<tr>
<td>Sp</td>
<td>strength of coal pillar</td>
</tr>
<tr>
<td>SRE</td>
<td>Stream Recovery Evaluation</td>
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<td>SSA</td>
<td>Surface Subsidence Agent</td>
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<tr>
<td>TBS</td>
<td>Total Biological Score</td>
</tr>
<tr>
<td>TGD</td>
<td>Technical Guidance Document</td>
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<tr>
<td>TDS</td>
<td>Total Dissolved Solids</td>
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<tr>
<td>TIF</td>
<td>tagged-image format</td>
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<tr>
<td>UNT</td>
<td>Unnamed tributary</td>
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<tr>
<td>Acronym</td>
<td>Description</td>
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<td>---------</td>
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<tr>
<td>USGS</td>
<td>United State Geological Survey</td>
</tr>
<tr>
<td>UTM</td>
<td>Universal Transverse Mercator coordinate system</td>
</tr>
<tr>
<td>VPN</td>
<td>Virtual private network</td>
</tr>
<tr>
<td>WRDS</td>
<td>Water Resources Data System</td>
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