APPENDIX M

SEISMIC EVENTS IN SOUTHERN WEST VIRGINIA

Appendix M
Seismic Events in Southern West Virginia

Data from the U.S. Geological Survey indicate that two rare seismic events occurred in southern West Virginia in the weeks preceding the explosion at UBB. The first was a 2.9 Magnitude event that occurred on March 27, 2010 in Logan County, approximately 27 miles away from UBB. The shallow depth and location in a historically bump-prone area of West Virginia suggests that the seismic event represents a coal pillar bump rather than an earthquake. Review of old mine maps, downloaded from the West Virginia Geologic and Economic Survey (WVGES), identified an old mine with extensive pillared works within one mile of the plotted location of the seismic event. The extensive pillared works in the abandoned mine surrounded large, square barrier-style pillars that may have experienced rapid failure after decades of degradation to reach a critical size.

The second seismic event occurred on April 4, 2010 in Braxton County, approximately 60 miles from the face of the 1 North Panel, UBB (Figure M-1). Despite the seemingly close temporal relation between the April 4 seismic event (05:19:14), and the April 5 explosion (15:02), the 60 mile interval and 34-hour time difference does not support any recognizable relationship between the two events. After the April 5, 2010 explosion, seismic events continued to be recorded in the Upshur/Randolph County area. A 2.5 magnitude seismic event was reported on August 21, 2010, with the hypocenter exactly coinciding with a gas well that is exploiting the Devonian-aged Marcellus Shale (API # 47-09703326), with a neighboring well also reported as developed to the Marcellus Shale (API # 47-09703622) (Figure M-2). Following the April 5, 2010 explosion, several seismic events were recorded in central West Virginia. A search of seismic events within 200 km of UBB indicated that six seismic events were recorded in 2010 along the crest of the Gassaway Anticline (Figure M-3). Because several of those events were reported as occurring at 0 km depth, the localized seismic activity is interpreted to be associated in some fashion with the recent increase in gas drilling in the state, and does not appear to have any recognizable association with UBB.

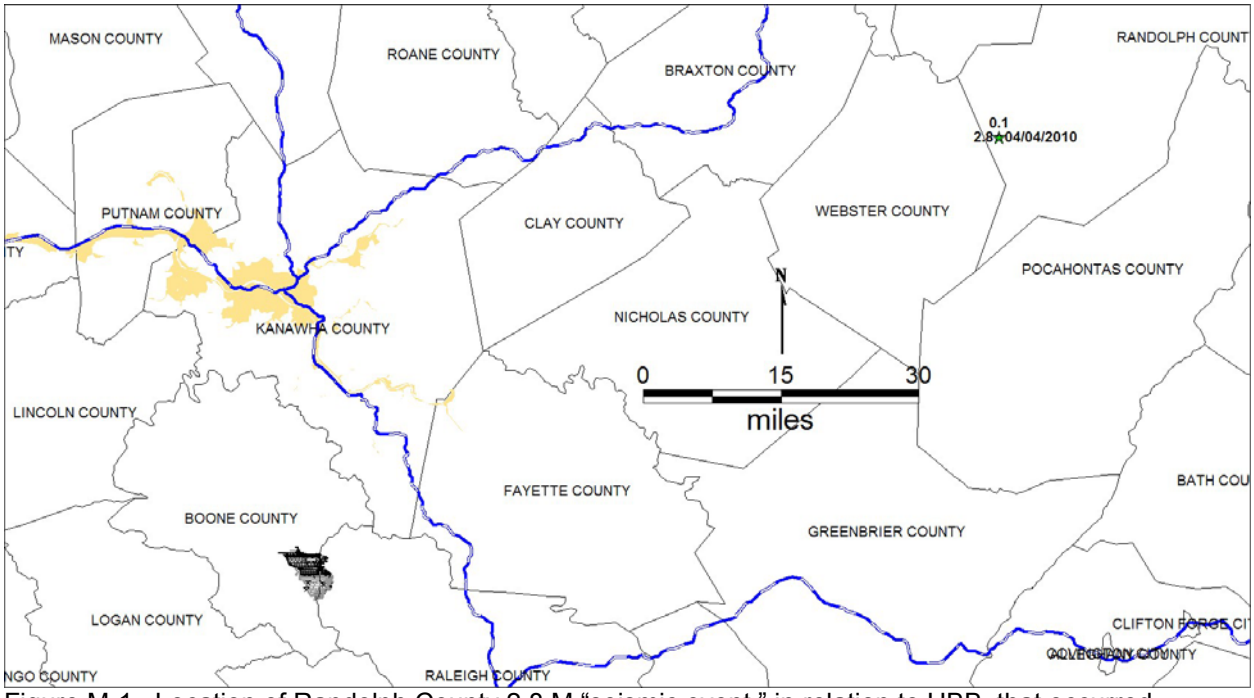

Figure M-1. Location of Randolph County 2.8 M "seismic event," in relation to UBB, that occurred on April 4, 2010. The event was essentially at the surface, only 0.1 km deep and located over 60 miles away.

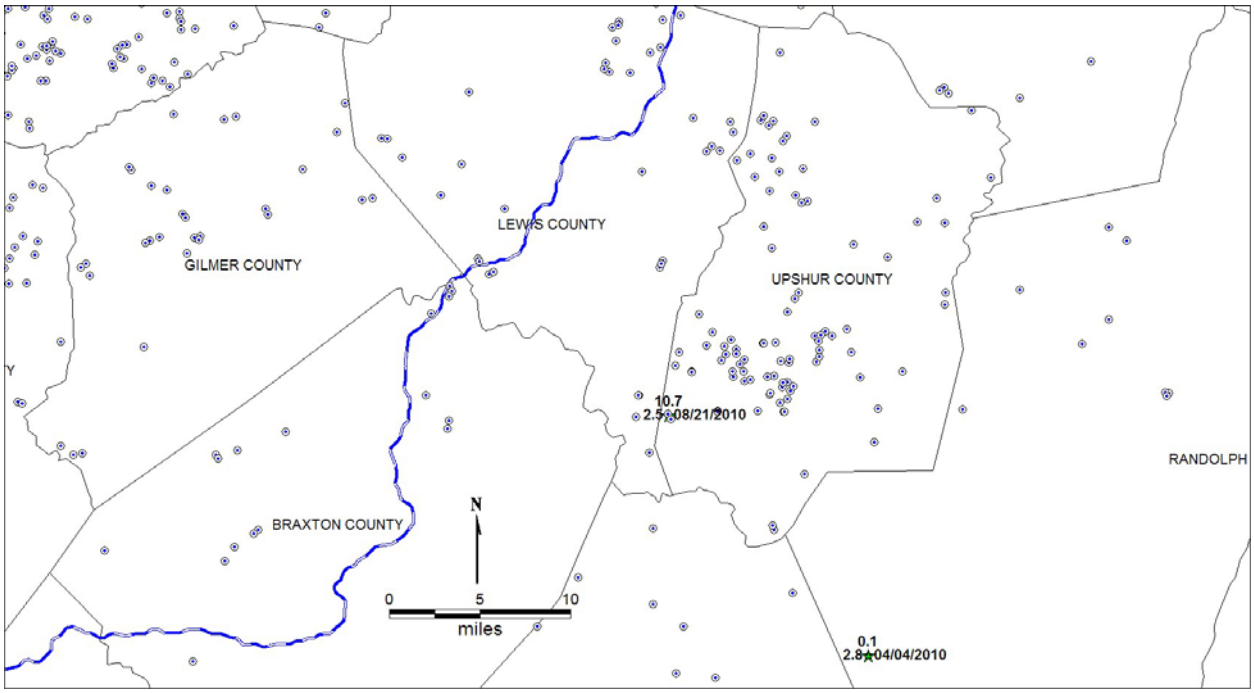

Figure M-2. Locations of seismic events in the vicinity of Upshur County shown in relation to the locations of gas wells developed to the Marcellus Shale. Event on August 21, 2010 plots directly on top of a gas well location, suggesting that increased drilling activity, possibly associated with fluid injection, is related to the increase in recorded seismic events.

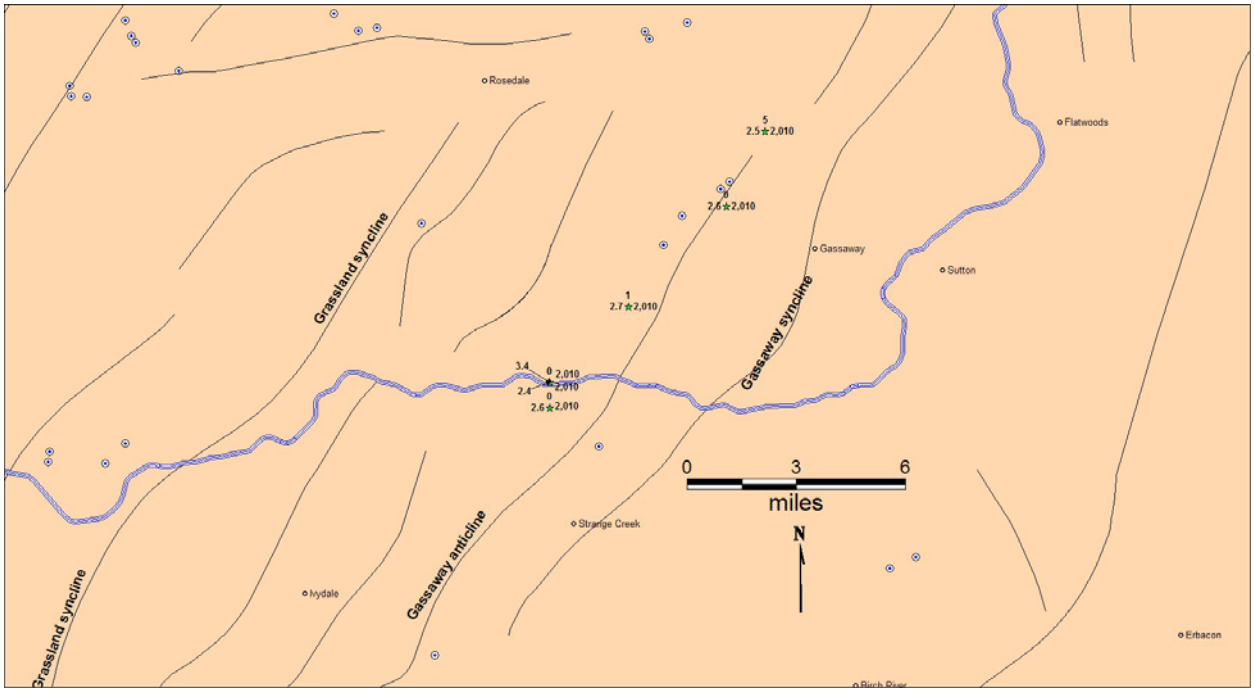

Figure M-3. Map of seismic events recorded by the USGS in 2010 in West Virginia are located along the axis of the Gassaway Anticline, dominantly occurring essentially at the ground surface. Location along anticline axis is suggestive of gas drilling-related activity. Blue circles represent the locations of gas wells drilled to the Marcellus Shale.

APPENDIX N

WVDEP SURFACE BLASTING