CHAPTER 14

MINE SUBSIDENCE

Underground coal mining began in Wyoming during the 1860s. Many of the early coal mines were not designed and constructed well; as a result the underground pillars failed. If enough pillars failed, the caprock in the mine would collapse, and the effects of the collapse would reach the surface in some cases. If the effects of the collapse reached the surface, a subsidence pit would form. Not all subsidence was due to poor design, however. In some cases, the pillars were pulled as mining retreated from an area. In other cases, fires would occur in the mines, resulting in a loss of strength in the pillars and caprock.

History

Significant areas have abandoned underground coal mines present (**Figure 14.1**). Coal-mine subsidence has been threatening select areas of Wyoming since the onset of mining in the 1860s. Due to the long history of underground coal mining in the state, many more undermined areas have subsided than most people imagine. A written history of mine subsidence in or near urban areas was published in the *Governor's Workshop on Mine Subsidence* proceedings held on October 31, 1986 at the University of Wyoming. The WSGS has also generated a report for each county in Wyoming on abandoned underground coal mines and hard rock mines that have been identified in the county.

Significant subsidence problems have occurred in Rock Springs, Hanna, Glenrock, Superior, Reliance, Evanston, Kemmerer, Sheridan, and Gillette. A map showing documented subsidence is shown in **Figure 14.1**.

Impacts

There has been property and infrastructure damage associated with coal-mine subsidence in Wyoming communities. The dollar amounts of the damage are not readily available. An indirect measure of the impacts is the existing cost of mitigating the hazards. The Wyoming Abandoned Mine Lands (AML) Program at Wyoming Department of Environmental Quality (DEQ) spent $85 million through 2007 mitigating the effects of mine subsidence and on mine reclamation. Additionally, the AML makes subsidence insurance available to property owners in affected communities.

Future Impacts

Although many areas of the state have already had mitigation projects designed to reduce or remove the impacts from underground mining and subsidence, subsidence may still occur in some areas. The dollar impact is impossible to predict.

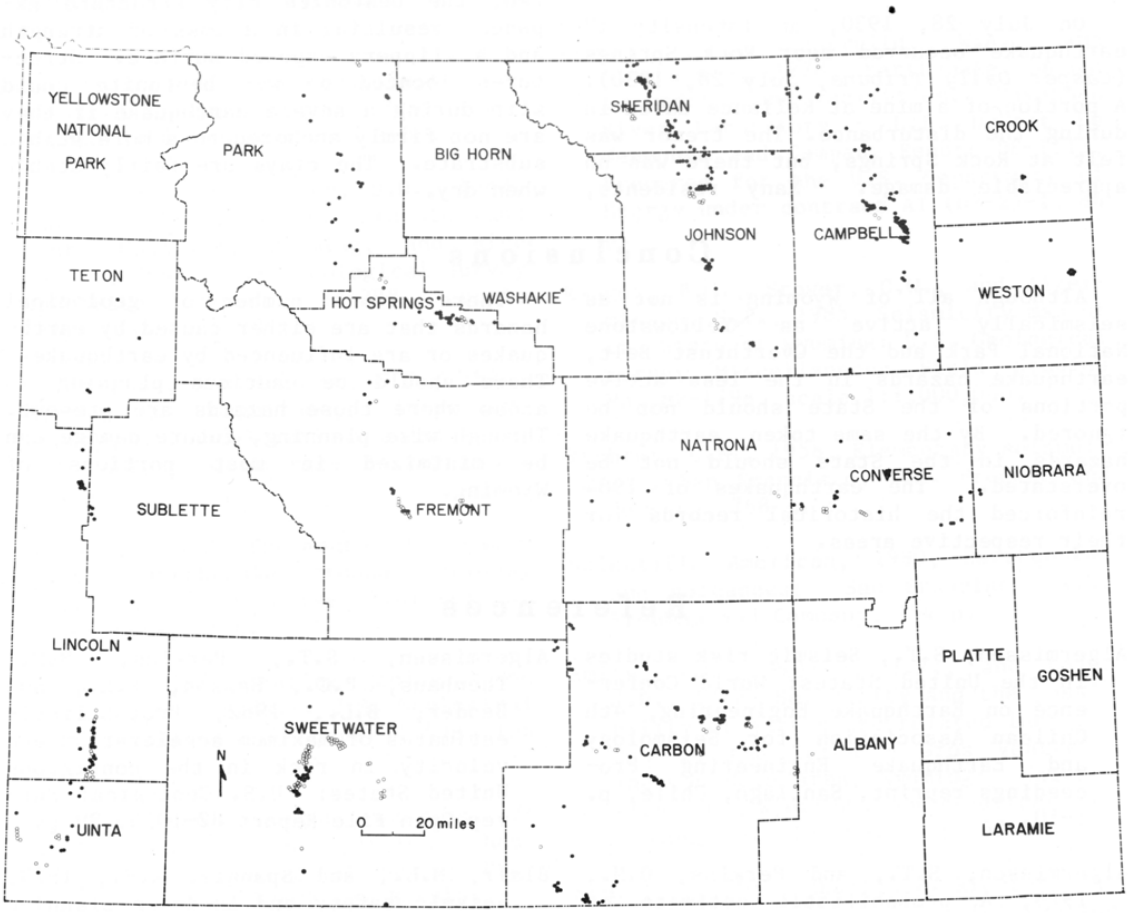

Figure 14.1—Mined-out areas and mine subsidence in Wyoming. Gray areas represent mined-out areas with subsidence. Solid areas represent mined-out areas with no known subsidence.

Local Mitigation Plan Risk Assessments

A review of the local plans reflects few consider mine subsidence to be a hazard within their borders as they do not address the hazard within their local plan. Those counties addressing the issue of mine subsidence utilize data available to them through the State Multi-Hazard Mitigation Plan. Counties addressing mine subsidence have ranked subsidence risks within their borders based on the population impacted, probability of occurrence within their borders and the property impacted.

Below is a table outlining information mined from the local plans' mine subsidence hazard sections. The table shows previous historical incidents of subsidence within each county's borders as outlined in their plans and extrapolates, based on population impacted, probability of occurrence within their borders, and property impacted, the risk perceived by each county relative to subsidence hazards. You will note all counties addressing subsidence hazard issues consider the hazard to rank as a low hazard within their borders. Most are unable to state the number of incident occurrences and also reflect minor, if any damage.

Mine Subsidence
Information Mined from Local Plans

COUNTY	Plan Y/N	Year Approved	Included in Plan	Rank-High, Medium, Low	Loss Potential	Previous Incident(s)
ALBANY	Y	2010	Y	Low	Minor	Not Stated
BIG HORN	Approvable	2010	N			
CAMPBELL	Expired	2005	N			
CARBON	Y	2008	Y	Low	Not enough info	Multiple Locations
CONVERSE	N/Draft	2005			Incomplete Information	
CROOK	N/Draft	2003	N			
FREMONT	Expired	2005	N			
GOSHEN	Y	2007	N			
HOT SPRINGS	N					
JOHNSON	Y	2008	Y	Low	Not Stated	Multiple Locations
LARAMIE	Expired	2005	Y		Incomplete Information	
LINCOLN	Y	2006	Y	Low	Minor	5
NATRONA	Approvable	2010	N			
NIOBRARA	Y	2009	N			
PARK	Y	2006	N			
PLATTE	Expired	2004	N			
SHERIDAN	Y	2009	Y	Low	Not available	Multiple Locations
SUBLETTE	Y	2008	N			
SWEETWATER	N					
TETON	Y	2009	N			
UINTA	N/Draft	2011	N			
WASHAKIE	Expired	2005	N			
WESTON	N					
NORTHERN ARAPAHO TRIBE	N					
EASTERN SHOSHONE TRIBE	N					

Locations where mine subsidence may occur are located throughout the state in both populated and unpopulated areas. Development in locations where mine subsidence occurs certainly has the potential to impact individual homes or neighborhoods. It is unknown if all locations of potential subsidence have been determined. The uncertainty regarding the locations of more potential subsidence areas means there is the possibility development may occur in a subsidence-prone location without the knowledge of contractors or developers prior to development. Given this fact, there is no way to determine with certainty the likelihood development will occur in a subsidence-prone location and therefore it's difficult to put a risk factor to this hazard as it relates to development within Wyoming's borders.

Proposed State Mitigation Projects

The following mitigation projects have been proposed by state, federal, and local entities in the process of generating the Wyoming Multi-Hazard Mitigation Plan. Chapter 22 has all proposed mitigation plans.

- The AML continues to pursue mitigation of subsurface subsidence. AML Project 60 specifically requested Statements of Interest and Scopes of Work be submitted this spring for a multi-year project pursing geotechnical investigation of subsurface subsidence statewide. The purpose of this Project is to perform investigations to assess the extent, impact, and/or possible causes of potential, current, and/or ongoing subsidence. Mine fire investigation work may include, but is not limited to, drilling, geotechnical analyses, geophysical studies,

sampling of various media, mine fire investigation, and peer review of documents, reports, and/or mitigation designs prepared by others.

- Following is a table depicting current AML projects, followed by a table of upcoming mitigation efforts funded through the AML and the time frame associated with them:

AML Project #	Project Name	AML Project #	Project Name
6A-7-16	**Rock Springs Grouting Project**	**16K-II**	**Fraser Draw Reclamation**
6A-X	Rock Springs Subsidence	**16M**	**Sagebrush/Tablestakes Reclamation**
7F-4	Carbon Coal/Hanna #3 Mine	16N	D-9 Pit Phase 2
7F5-2	Carbon Coal/Hanna #4 Mine	17.6A	Statewide Grouting
7F-6	Big Ditch/Standpipe (MP)	17.30-2	Monitoring
7-28-III	**Sandpipe Draw Reclamation**	17B-II	Phosphates/St George
9B-2	**Carissa Mine**	**17F**	**Copper Mountain Reclamation**
10B-II	Sunrise	17G	Statewide Mine Fires
10B-III	Horsecreek	**17H**	**Kemmerer Coal Reclamation**
10-III-II	River Mine	**17H-2A**	**Sweetwater County Reclamation**
12D	Weston Bentonite	17I	Statewide non Coal
16B-1-2	Bullrush Pit	17J	NE WY Coal/River Mine, Kleenburn, Plachek, Hidden Waters
16G-II	Day Loma Pit South	**17K**	**Big Horn Gypsum Mine Reclamation**
16G-III	Day Loma Pit North	**17K - Phase IV**	**Cody Sulphur Mines Mine Reclamation**
16H-III	**Sun/Snoball/Heald Areas Reclamation**	17L	Carbon/Albany Coal
16H-IV	**Green**	**17M**	Big Horn Basin Coal

	Mountain/Crooks Gap		

Upcoming AML Construction Projects		
Project #	Project Name	Proposed Project Accomplishments Schedule - 3/2010 to 2/2013
6A-IV-B	Rock Springs Monitoring	Monitor and mitigate abandoned coal mining related groundwater issues.
6A-VII	Skyline Village	Mitigate subsidence risk in Skyline Village through drilling and grouting.
7F-6	Hanna Big Ditch	Mitigation of surface water and groundwater impacts on the Town of Hanna
7-28-III	Hanna Reclamation	Mitigation of surface water and groundwater issues in the Hanna basin.
17G	Statewide Mine Fires	Mitigation efforts on multiple mine fires to control expansion and minimize surface effects
17H-1C	Kemmerer Area Coal	Reduction of coal surface mine dangerous high walls
17H-2D	Rock Springs North Coal	Closure of shafts and adits and subsidence mitigation.
17H-2E	Rock Springs South Coal	Reduction of dangerous highwalls
17J	Randall Mine	Abandoned coal mine high wall reduction
17J	Custer Armstrong	Reduction of abandoned coal mine high wall
17J	Johnson County Coal Sites	Abandoned coal mine portal closures and subsidence mitigation
17J	Acme 3 Complex	Abandoned coal mine portal closures and subsidence mitigation
17L	Carbon Area Mines	Reclamation of multiple small abandoned coal mines.

17M	Fremont County Coal	Reclamation of small abandoned coal mine sites in Fremont County and the Wind River Reservation
17.6A	Rock Springs Subsidence Mitigation	Mitigation of Tree Streets and Blairtown Park within the City of Rock Springs
17.32	Statewide Contractors	Reclamation of abandoned mine sites that require some immediacy due to health and safety hazards.

- No additional coal-mine subsidence-related projects are planned. Wyoming Abandoned Mine Lands Program at DEQ oversees mitigation and has education programs currently in effect and planned into the future.