

STATEMENT OF  
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BEFORE THE  
HOUSE COMMITTEE ON NATURAL RESOURCES  
SUBCOMMITTEE ON ENERGY AND MINERAL RESOURCES  
REGARDING  
USGS SCIENCE FOR EFFECTIVE ABANDONED MINE LAND REMEDIATION  
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Chairman Lamborn and Members of the Subcommittee, thank you for your invitation to discuss the importance of interdisciplinary U.S. Geological Survey (USGS) science in effective reclamation of Abandoned Mine Lands, or AML for short. My name is Geoff Plumlee, and I am a long-time geochemist with the USGS. In my statement today, I will show how the USGS's long history of mining-environmental research and data gathering in collaboration with Federal, State, industry, and citizen stakeholders helps address this complex and challenging issue. My statement will focus on hard-rock AML issues, but the USGS also has done extensive work on coal AML issues.

Early AML efforts in the late 1990's utilized databases such as the USGS Mineral Resources Data System to help identify, characterize, and prioritize abandoned mine sites for remediation. Also, in the late 1990's, the Bureau of Land Management (BLM), the U.S. Forest Service, and some States began field-based inventories of AML sites. For example, in 1995, the USGS published a map with the BLM and the Colorado Geological Survey that prioritized historical Colorado mining districts for assessment based on their geologic likelihood to produce acidic and or metal-rich mine drainage waters. The USGS worked from 1996 to 2007 with many stakeholders to develop detailed watershed-based AML assessment methodologies in Colorado's Animas River and Montana's Boulder Creek. Since the early 1990s, the USGS has also provided impartial Earth and biological science input to the U.S. Environmental Protection Agency (EPA) and other agencies about various Superfund sites and smaller sites appropriate for Good Samaritan cleanup.

Nonetheless, one continuing challenge is accurately estimating the scope of the AML problem remaining across the United States and the likelihood for individual mining sites to cause potential environmental contamination. For example, estimates of abandoned mine sites have been taken from national-scale databases that include prospect pits, gravel pits, and other sites that are not likely to have the same potential for environmental impacts as larger abandoned hard rock mine sites.

The USGS is developing an enhanced geospatial database of the mines and mineral deposits of the United States known as USMIN. USMIN captures the locations and areal extent of mine features from current and historical USGS topographic maps and satellite imagery. The same geology-based prioritization approach used in 1995 in Colorado can be applied using USMIN to help understand the national scope of AML issues and impacts. Such an effort can be substantially enhanced by integration of information from

other national databases on geology, mineral resources, hydrology, water quality, soil quality, remote sensing, ecology, and climate, many of which are USGS databases.

Further challenges are faced when determining the most cost- and technically effective approaches to AML remediation. Most AML watersheds contain unmined mineralized areas that produce natural contamination. The USGS has developed methods to help reconstruct pre-mining environmental conditions in these watersheds, because it is neither cost effective nor technically feasible to remediate to environmental conditions cleaner than were present naturally prior to mining. Interdisciplinary USGS methods help prioritize which of many AML contamination sources in a watershed could be cleaned up to have the biggest positive impacts. For example, in the early 1990's the USGS linked remote sensing, mineralogical, and geochemical studies to help prioritize historical mine waste piles for cleanup based upon their potential to generate acid-rock drainage—according to EPA, these studies saved an estimated two years and two million dollars in cleanup time and costs (Environmental Protection Agency *Advanced Measurement Initiative Workshop Report*, EPA-235-R-908-002, 1998). Linked water quality sampling and flow measurements have helped pinpoint locations and amounts of specific contaminant influxes into watershed streams. Field- and lab-based ecotoxicological measurements help assess the impacts of AML contamination on food webs and aquatic insect populations. Potential human health concerns can be inferred based on the toxic metals and minerals geologically likely to be present in mine wastes, soils, and dusts. Computer-based models help predict impacts that remediation of specific sites would have on downstream water quality and aquatic ecosystems, allowing more effective cleanup decisions. The economic and societal value of ecosystem services can be evaluated in AML watersheds, and extraction of valuable or useful metals in mine waste materials may help offset cleanup costs at some sites.

Once high priority AML sites have been identified, interdisciplinary geoscience characterization and modeling is crucial for successful remediation. For example, it is essential to understand the distribution and hydrologic interconnections of complex underground workings and fracture systems, so that remedial activities such as adit plugging at one mine do not cause unintended water releases at other mines in an area. Geologic mapping and geophysical characterization of the subsurface, geochemical and isotopic tracers to track groundwater sources and flow, and hydrologic modeling of groundwater flow are all critical tools in this regard.

Finally, many of the same USGS interdisciplinary science activities described previously can also be used to help monitor the results of site remediation on a watershed basis.

We appreciate the Subcommittee's invitation to discuss USGS science pertaining effective reclamation of AML; however, I should note that the Department of the Interior continues to review the recently introduced bills under discussion today: H.R. 3843, the Locatable Minerals Claim Location and Maintenance Fees Act of 2015 and H.R. 3844, the Energy and Minerals Reclamation Foundation Establishment Act of 2015. The Department may provide additional views on these two bills after conducting further analysis.

Thank you, Mr. Chairman, for the opportunity to provide the Subcommittee with an overview of why USGS interdisciplinary science done in collaboration with Federal, State, industry, and citizen stakeholders is an invaluable and cost-effective component of national AML reclamation activities.

## **Appendix 1—Selected links to USGS studies related to abandoned mine lands**

**USGS Abandoned Mine Lands Initiative:** <http://amli.usgs.gov/>

**USGS Mine-drainage activities:** <http://mine-drainage.usgs.gov/>

**USGS coal mine drainage activities:** <http://pa.water.usgs.gov/projects/energy/amd/>

**USGS Mineral Resources Data System:** <http://mrdata.usgs.gov/mrds/>

### **Colorado potential metal mine-drainage hazard map:**

<http://pubs.usgs.gov/of/1995/ofr-95-26/>

### **Upper Animas River CO AML Study:**

<http://amli.usgs.gov/Animas-River/index.html>

<http://pubs.usgs.gov/pp/1651/>

### **Boulder River MT AML Study:**

<http://amli.usgs.gov/Boulder-River/index.html>

<http://pubs.usgs.gov/pp/2004/1652/>

### **AML studies in California:**

<http://ca.water.usgs.gov/mercury/>

[http://ca.water.usgs.gov/projects/iron\\_mountain/](http://ca.water.usgs.gov/projects/iron_mountain/)

### **Pre-mining baselines:**

Overviews:

[http://toxics.usgs.gov/highlights/premining\\_wq.html](http://toxics.usgs.gov/highlights/premining_wq.html)

<http://www.sciencedirect.com/science/article/pii/S08832927140030966>

Questa, Red River NM: [http://pubs.usgs.gov/pp/1728/pdf/p1728\\_508.pdf](http://pubs.usgs.gov/pp/1728/pdf/p1728_508.pdf)

### **Hyperspectral remote sensing of mine wastes:**

<http://pubs.acs.org/doi/abs/10.1021/es990046w> (subscription required)

### **Synoptic water quality sampling:**

<http://ut.water.usgs.gov/publications/fs245-96/>

[http://dx.doi.org/10.1016/S0883-2927\(02\)00017-3](http://dx.doi.org/10.1016/S0883-2927(02)00017-3) (subscription required)

<http://dx.doi.org/10.1016/j.jhydrol.2013.02.031> (subscription required)

### **Adit plugging:**

Dinero Mine CO: <http://dx.doi.org/10.1016/j.apgeochem.2015.03.002> (subscription required)

### **Aquatic toxicology of waters, sediments from mining areas:**

<http://www.sciencedirect.com/science/article/pii/S0883292714001255>

(subscription required)

<http://www.sciencedirect.com/science/article/pii/S0883292714001607>  
(subscription required)

**Evaluating remedial alternatives for acid-mine drainage:**

<http://dx.doi.org/10.1021/es2038504> (subscription required)

**Mine wastes and human health:**

<http://elements.geoscienceworld.org/content/7/6/399.full.pdf+html> (subscription required)

**Valuable or useful metals from mine waters, mine wastes:**

[https://www.imwa.info/docs/imwa\\_2013/IMWA2013\\_Smith\\_470.pdf](https://www.imwa.info/docs/imwa_2013/IMWA2013_Smith_470.pdf)

<https://theconversation.com/mining-for-metals-in-societys-waste-43766>