User Guide

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Abandoned Mine Lands: Information Dashboard

CATENA ANALYTICS

One Water Solutions Institute

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EXECUTIVE MESSAGE

Catena Analytics offers powerful platforms for building accessible and scalable analytical tools and simulation models that can be accessed via desktop or mobile devices. Our team has spent that last decade developing the Environmental Resource Assessment and Management System (eRAMS), an open source technology that provides cloud-based geospatially-enabled software solutions as online services and a platform for collaboration, development, and deployment of online tools. Our services are used to assist with strategic and tactical decision making for sustainable management of land, water and energy resources. Thank you for choosing Catena Analytics and the eRAMS platform to meet your data, modeling, analysis and geospatial needs.

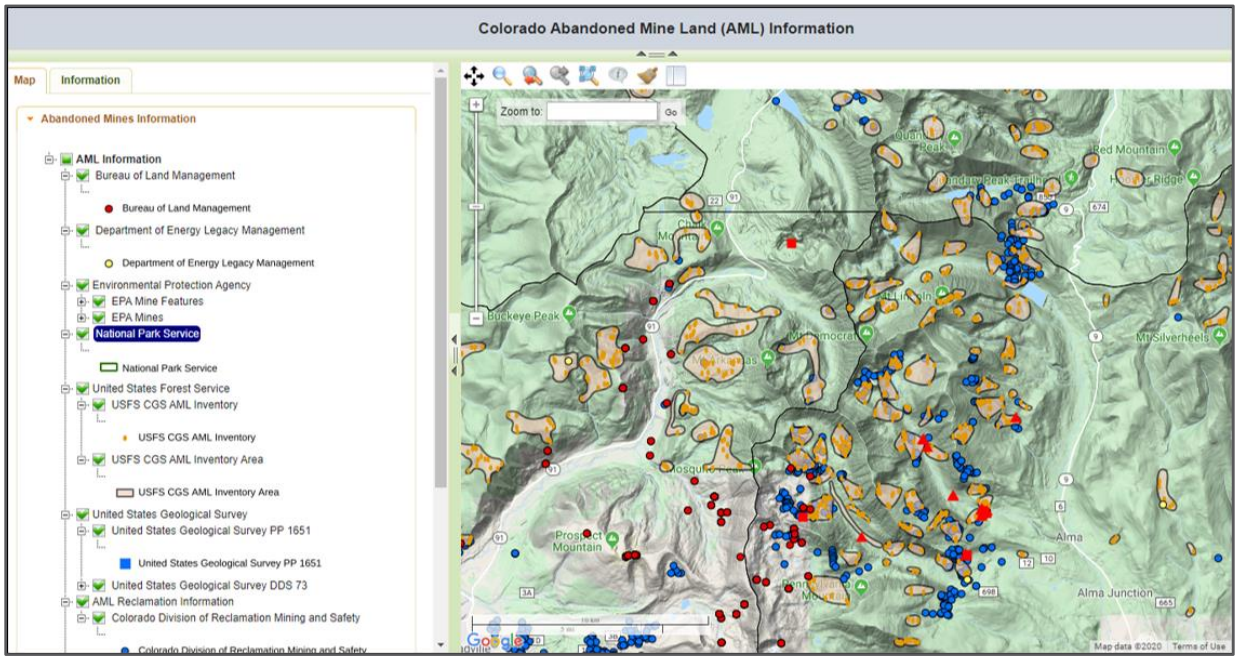
Who Should Use This Guide

This guide is a tutorial to get you started using eRAMS and the Abandoned Mine Information Dashboard. The guide provides instructions for commonly performed tasks and uses of the tool. This tool is intended for use by urban planners and water managers, academic groups, regulatory officials, consultants as well as state, local and federal agencies planning for the future of water resources.

Need Help?

After reviewing the guide if you need additional assistance we are here to help! This guide is designed to provide instruction on commonly performed operations and answers to many frequently asked questions. If you find any aspect of the tool challenging or missing information from this guide, please engage an eRAMS expert to guide you through any hurdles. Contact us at: eramsinfo@gmail.com

INTRODUCTION



PURPOSE

This interface displays abandoned mine related data from several federal and state agencies.

DESCRIPTION

The Colorado Abandoned Mine Lands Information Dashboard summarizes data provided by numerous federal and state agencies including the: Bureau of Land Management (BLM); Department of Energy (DOE) Legacy management; Environmental Protection Agency (EPA) Region 8; National Park Service; and United States Forest Service (USFS). Additional abandoned mine reclamation information was provided by the Colorado Division of Reclamation Mining and Safety (DRMS). Agencies responsible for the data can be contacted with questions.

These agencies amassed their data sets at different times over the past 30+ years. This was done using different methods, at different times and each agency has different goals and priorities regarding abandoned mine data. Therefore, it is important to note the following:

- This site is designed to present a broad set of abandoned mine features, but it is not expected to represent all abandoned mine features within the State.
- There will likely be duplicate records because multiple agencies may track the same features.
- Each agency organizes abandoned mine features and areas differently.
- Spatial information has varying levels of accuracy due to the various methods of data collection.
- Information presented on this site may change and be updated.

- Exact physical locations are estimated and the abandoned mine features are not visible when zoomed into a specific location.

Additional information about the federal abandoned mines can also be found at http://abandonedmines.gov/

DISCLAIMER

The data presented here are not intended to be used as a tool to assess risk. ANY DATA OR INFORMATION PROVIDED HERE IS PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND, WHETHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. *Data or information provided here shall be used and replied upon only at the user's sole risk, and the user agrees to indemnify and hold harmless the entities who provided the data and any other parties, its officials, officers and employees from any liability arising out of the use of the data/information provided. No warranty expressed or implied is made regarding the display or utility of the data, or for general or scientific purposes, nor shall the act of distribution constitute any such warranty. The agencies who provided these data and the Colorado Geological Survey shall not be held liable for improper or incorrect use of the data described and/or contained herein.*

DATA MANAGEMENT

To request more information, record the specific information about a point on the map and call the AML manager, with the information from the information hub, at the agency listed on their website listed below.

- Bureau of Land Management (BLM)
- Department of Energy (DOE) - Legacy Management
- Environmental Protection Agency (EPA) Region 8
- National Park Service (NPS)
- United States Forest Service (USFS)
- United States Geological Survey (USGS)
- Colorado Division of Reclamation Mining and Safety (DRMS)

SOFTWARE AVAILABILITY

Domain

https://erams.com/aml

Documentation URL

https://erams.com/catena/tools/colorado-collaborative/abandoned-mines/

System Requirements

A modern web-browser is required to connect and run CFA. Browser options include: Google Chrome v.69, Mozilla Firefox v.62, Safari v.11.1, and Microsoft Edge v.17.

Authorized Use Permission

The information contained in the Abandoned Mine Lands Information Dashboard (the "Service") is for general information purposes only. Colorado State University's One Water Solutions Institute ("CSU-OWSI") assumes no responsibility for errors or omissions in the contents of the Service. In the Service (https://erams.com/aml), you agree to hold neither the creators of the software platform nor CSU-OWSI liable for any action resulting from use or misuse of the Service. In no event shall CSU-OWSI be liable for any special, direct, indirect, consequential, or incidental damages or any damages whatsoever, whether in an action of contract, negligence or other sort, arising out of or in connection with the use of the Service or the contents of the Service. CSU-OWSI reserves the right to make additions, deletions, or modification to the contents of the Service at any time without prior notice.

GET STARTED

ACCESS THE TOOL

This tool is publicly available and can be accessed here: https://erams.com/aml

GEOGRAPHIC INTERFACE

Select Layers

Abandoned Mines Information

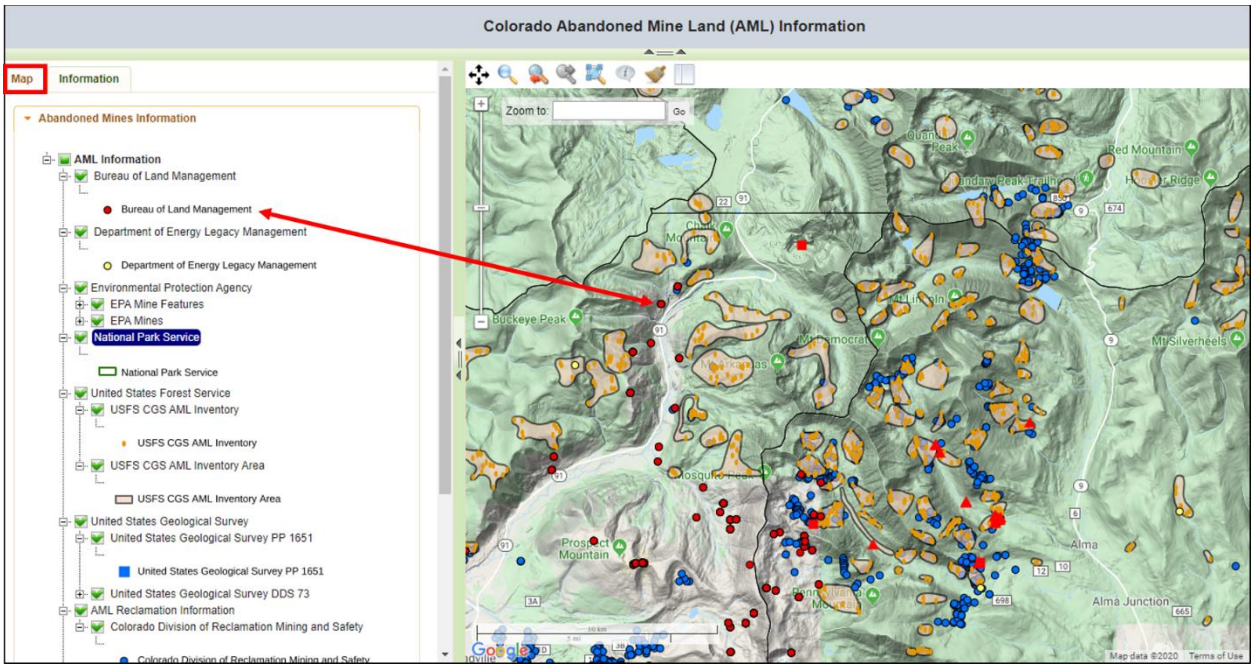


Figure 1: AML geographic information by managing agency

With the AML interface open, click the "Abandoned Mines Information" tab on the left dashboard. Here users can select from a variety of geographic layers which correspond to the agency tasked with managing those lands (Figure 1). Each agency is represented by a different color and marker on the map interface. Data are available for:

- Bureau of Land Management (BLM)
- Department of Energy (DOE) - Legacy Management
- Environmental Protection Agency (EPA) Region 8
- National Park Service (NPS)
- United States Forest Service (USFS)
- United States Geological Survey (USGS)
- Colorado Division of Reclamation Mining and Safety (DRMS)

Base Layers (optional)

With the AML interface open, click the "Map" tab on the left dashboard

1. Select the "Base Layers" tab drop-down
2. Select the desired base layer
    - Options include: None, Google, Bing or USGS National Map

Public Layers (optional)

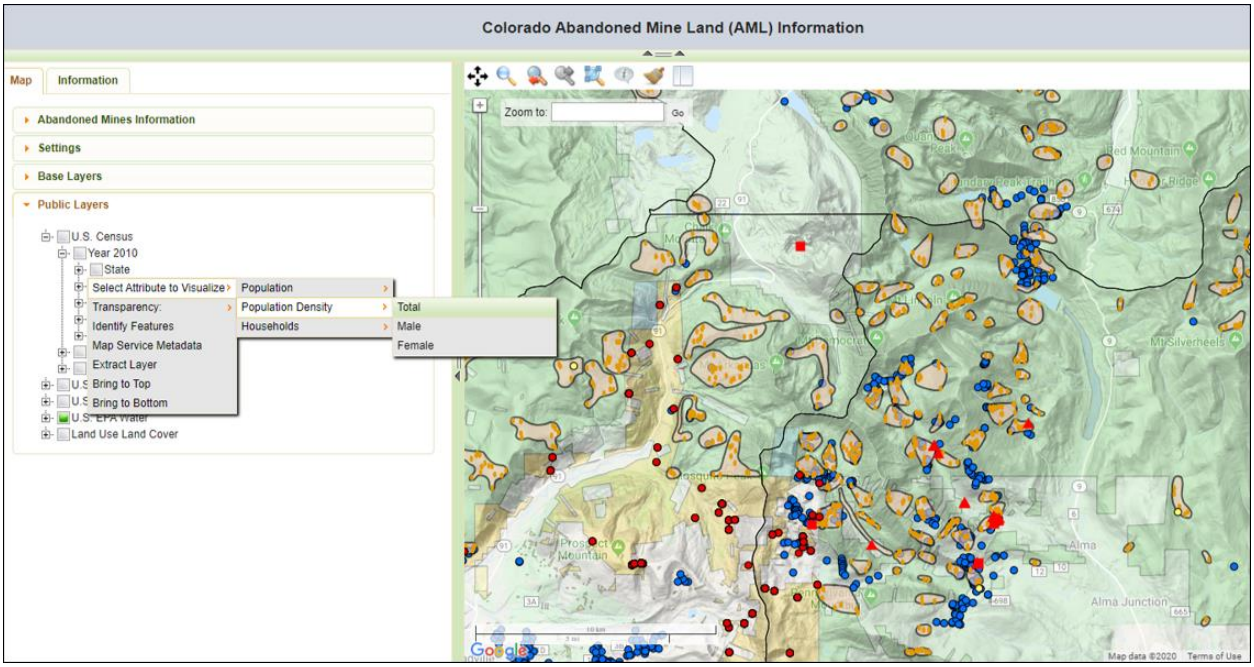


Figure 2: AML public layer options

In addition, users can also select from a variety of public geospatial layers to display on the interface (Figure 2).

1. Select the "Public Layers" tab drop-down
2. Select the desired public layer. Options include:
    - US Census
    - US Geo Data
    - US Hydro Data
    - US EPA Water Data
    - Land Use Land Cover
3. If an item is struck out with a line, it is not visible at the current scale. Zooming in will activate this layer.
4. To access additional information on the Public Layers, click on the individual layers. This will bring up a list of options:
    - Zoom to Full Extent - Zooms to the full extent of the data

- Zoom to Visible Extent - Zooms to visible extent of the data
- Transparency/DPI - The transparency slider changes the transparency of the layer. The DPI slider will change the size of the points.
- Identify Features - When selected, this activates an information tool. Draw a box around the feature to show more information about it.
- Map Service Metadata - Information about the data.
- Extract Layer - This is used to extract information from the Public Layers into the main project "Abandoned Mines Information" list of layers. From the drop down, the user can select the layer or "new layer" to place this information into. To choose the data points/features, choose the method (e.g. polygon, rectangle, etc.) you would like to use to choose the points/features on the map. Choose the features on the map using the selected tool and click the "Generate" button. This will extract the selected data as a layer into the "Abandoned Mines Information" section.

Additional Mapping Features

The eRAMS geographic interface also allows users to perform basic mapping tasks, which can be accessed from the top menu of the map interface (Figure 4):

- The  tool to allows you to pan/move on the map
- The  tool to allows you to zoom to a selected area on the map
- The  tool to allows you to zoom to the previous zoom extent
- The  tool to allows you to zoom to the next zoon extent (only available after using the zoom to previous extent)
- The  tool to allows you to zoom to the extent of all project layers
- The  tool to allows you to clear your query selection from the map
- The  tool to allows you to print the current map extent

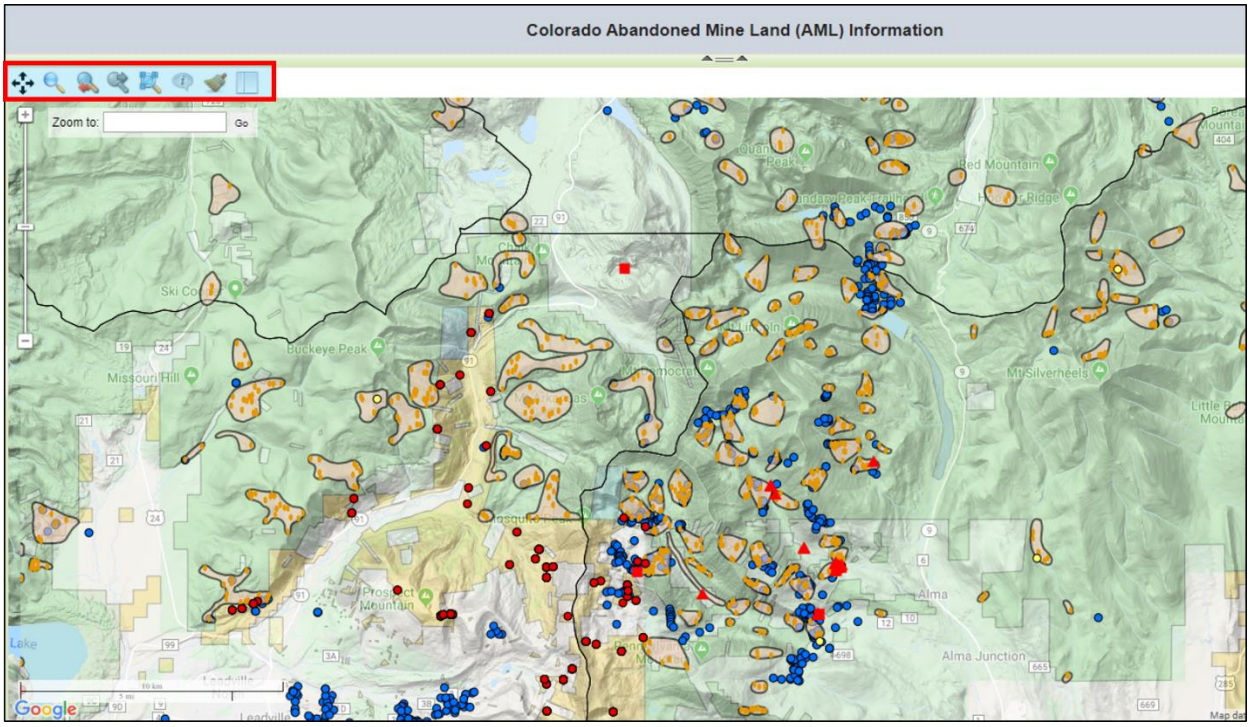


Figure 3: eRAMS mapping features

METADATA

A detailed metadata report and additional information is available here:
https://s3.amazonaws.com/erams-cdphe/Public+AML+Metadata.pdf

Mining has been a significant industry in Colorado since the 1850s. Abandoned mine land (AML) is associated with historical mining activities performed prior to the enactment of major federal and state laws that govern current mining practices. State AMLs contain physical structures, adits, shafts, waste piles, and other mining features related to the historic extraction and beneficiation of materials including precious metals, base metals, uranium, and coal. AMLs may pose physical and/or environmental hazards to the public. These associated hazards include falling, mine portal collapse, explosives, asphyxiation and degraded water quality (e.g. issues associated with drinking water, water recreation, and/or aquatic ecology). As of October 2007, the U.S. Government Accountability Office (GAO) estimated that there are about 7,300 locatable abandoned hardrock mine sites in Colorado that contain 17,000 features that pose a potential hazard to public health and safety and 150 sites with environmental degradation (GAO, 2008).

Historic mining activities were conducted in areas that are currently associated with both private and public land throughout the State. Currently, the Colorado Department of Reclamation Mining and Safety (CDRMS) works with public and private entities to reclaim AMLs. Also, several federal agencies identify, investigate, and remediating AML sites in the State. Currently, state/federal agencies collect and maintain different types of AML information depending on their mission,

budget, and location of the AMLs. Many of these agencies work together to remediate AMLs across the State and meet regularly to discuss mixed ownership AMLs (e.g. AMLs with overlapping state and/or federal property ownership).

In 2015, the Water Quality Control Division (WQCD) of the Colorado Department of Public Health and the Environment (CDPHE) approached the Colorado Geological Survey (CGS) about creating an inventory of existing AML electronic databases for the State. The primary goals of this project were to determine what AML electronic information sources exist and to develop a multi-agency information hub with input from agency stakeholders. Between 2015 and 2016, the CGS researched electronic sources of AML information, formed a multi-agency AML Steering Committee, and compiled general information associated with existing electronic AML databases. At this time, due to the differences in the existing data sets collected by some agencies (e.g. databases created separately and for different purposes), it was determined that the current general AML data sets should be shared through a GIS-based map viewer. Using a GIS platform, these existing geographical data and/or geodatabases can be viewed in conjunction with other spatial information (e.g. base maps or overlays) to determine the relationship between existing AML inventories and other geographical information.

Currently, the following agencies have provided general AML site information data sets for this project:

- Bureau of Land Management (BLM)
- Department of Energy (DOE) Legacy Management
- Environmental Protection Agency (EPA) Region 8
- National Park Service
- United States Forest Service (USFS)

Two sets of public data from the United States Geological Survey (USGS) associated with the Animas River watershed and central Western Slope were also included. Also, the Colorado Division of Reclamation Mining and Safety (CDRMS) has provided a data set associated with reclamation at AML sites.

A few AML inventories were completed within the State since the 1970's. Some of these AML inventories are working data sets and are updated with new information. Other data sets were a one- time assessment used to prioritize AML sites. The initial use of the AML information hub is to determine the geographical location of AML features identified by each agency, the types of features, and to provide contact information associated with the features. Specific information associated with these sites is not always available electronically therefore, the current status or the availability of other information may be available through each agency.

Brief AML Data Descriptions

A brief description of the data sets is provided below. Any user should view the metadata associated with each set of data provided by the agencies as well as this document.

Abandoned Mine Lands Water Quality Study

Abandoned mine sites are prevalent throughout the state of Colorado and water quality impacts from these abandoned mines is a concern. In an effort to provide the most up to date and comprehensive data regarding draining mines throughout the state, the Division of Reclamation Mining and Safety and Colorado Department of Public Health and Environment partnered to survey and sample mines across the state. The results of the study are presented on the Abandoned Mines Water Quality Webportal. Red locations were visited and have water quality data, photos and completed field survey forms, unless these mines were not discharging water at the time of visitation. Yellow and Green locations provide mine name and locational information.

Bureau of Land Management

The State BLM program addresses environmental impacts and hazardous mine openings associated with AML. The 2016 data set provided by the BLM for this project contains information associated primarily with hardrock mines and some uranium/industrial mineral mines. No metadata were included with the file. The location data are associated with general AML site locations which sometimes have multiple mine features recorded at one site.

The BLM maintains their internal Abandoned Mine Site Cleanup Module (AMSCM) database which is used to support the BLM's AML related programs and stores information about inactive and abandoned mine sites. Under a BLM 1993 directive that was designed to include common data elements/guidelines to ensure that AML was characterized consistently, AML inventories were collected during field inspections. To date, only a small percent of all BLM public lands have been inventoried with these guidelines, and the data quality of the original inventory records varies widely. Therefore, the data contained in AMSCM needs significant "cleanup" and the BLM continues to conduct field inspections at some of the AML sites to improve data quality (BLM, 2007).

DOE Legacy Management

The National Defense Authorization Act for Fiscal Year 2013 mandated that the DOE prepare a report on abandoned uranium mines which included the development of the DOE Abandoned Uranium Mine (AUM) mine database also referred to as the Defense-Related Uranium Mine (DRUM) database. The data set included here is from 2016. The metadata provided with these data is included as Attachment 1. A DRUM site can be a single feature or it may include an area containing a complex of multiple inter- related excavations.

DOE defines an abandoned uranium mine as a feature or complex developed to extract uranium ore for atomic energy defense-related activities of the United States from 1947 to 1970, as verified by purchase of ore by the U.S. Atomic Energy Commission (AEC) or other means. Some mines listed as abandoned may have been reclaimed or remediated. Others may have current operating permits

but may have abandoned mine features within the permitted area that have not been remediated. Mines associated with these categories were included in the set of legacy mines that were considered for evaluation as part of their report (DOE, 2014).

DOE will be verifying and validating the condition of defense-related uranium mine sites on BLM and USFS managed land in Colorado. The agencies will conduct field investigations at a select number of sites over the next several years. Results of these field-based efforts will be incorporated into the DRUM database (Personal Communication 1, 2016).

Environmental Protection Agency Region 8

The EPA maintains a geodatabase containing mine feature location data from multiple Superfund sites throughout Region 8. These data are updated on an as needed basis and are housed in their internal ArcGIS system. The data set included in this project is from 2016 and the metadata included with it is provided in Attachment 2. Currently, this data set provides location and other information (e.g. feature type) associated with approximately 169 mine features. These data were acquired from multiple sources, including EPA contractors, at different times. Data fields include the CERCLA identification number, location, site name, mine name, feature type, elevation, and information sources.

National Park Service

Mining and other mineral resource development have occurred in many areas throughout the U.S. that are now units of the National Park System. The NPS conducted a new AML inventory between 2010 through 2013. This inventory was completed to provide a comprehensive AML inventory, to categorize the mitigation needs, and to estimate the resources needed to address priority sites (Burghardt et. al., 2014). The data included in this project is from early 2017. Additional notes and metadata about this data set are provided in Attachment 3.

United States Forest Service

The CGS completed a field inventory of abandoned and inactive hardrock mines on USFS lands in the State between 1991 and 1999. Approximately 18,000 abandoned mine-related features were inventoried. The USFS inventory process began with an office review of existing mining and geologic literature, previous mine inventories, and current/historical maps. Mine locations from these sources were compiled onto a work map. Aerial photographs (1:24,000-scale) were examined to locate potential mine sites not identified by other sources. Water quality information was used to identify streams potentially affected by acid mine drainage or other mine-site contaminants. When the office research process was complete, geologists visited specific mine locations (Sares et. al., 2000). Additional mines not identified in the literature search were found while performing the field inventory work.

Investigated mines were grouped geographically into "inventory areas" that were given identification numbers based on the Universal Transverse Mercator (UTM) coordinate system. An inventory area usually contained one to twenty mine features that could be grouped in relation to geographic

features, such as a gulch or hillside. Mine features inventoried included adits, shafts, prospect pits, high walls, quarries, waste rock dumps, tailings, and spoils. All mine features within an inventory area were numbered sequentially (Sares et. al. 2000). Mine locations and data collected by the field geologists were entered on field forms and, subsequently, into a computer database and ArcGIS. Latitude/longitude information for each mine feature and water test were obtained by transferring mine location information from the field maps to Mylar overlays. Mine locations were then digitized from the overlays into ArcGIS (Sares et. al., 2000). Reportedly, some of the locations were also collected using a handheld GPS.

Water quality data, such as pH and conductivity, were collected at all features where water was present, such as draining adits, seepage at the toe of dumps/tailings, and standing water in shafts. Water samples were collected where field tests indicated low pH and/or high conductivity, including several areas with natural acid rock drainage. Samples were analyzed for dissolved/total metals and for selected anions. The quality of any water associated with a mine feature was also assessed in the field by determining the pH, specific conductance, and physical observations. Observable characteristics were documented including precipitates and salts in the effluent drainage, opaque or cloudy water, stressed vegetation, and absence of aquatic organisms. This information was used to assign a qualitative "Environmental Degradation Rating" to the individual mine feature. Physical mine hazards were also rated in the field (Sares et. al., 2000). The CGS USFS database is in ArcGIS and Microsoft Access. The metadata is included in Attachment 4. Additional data, metadata, and database dictionary is included on CGS's website (CGS, 2017).

United States Geological Survey Digital Data Series 73 (central Western Slope)

The USGS DDS 73 database includes information associated with reconnaissance studies of mining districts located in the central portion of the Western Slope of Colorado (Nash, 2002). These studies were conducted between 1997 and 1999. The analytical results include chemical analysis of mine dumps, mill tailings, mine drainages, and surface water. The data set includes the locations of 124 smelters, mills, and tailings included here. It also includes sample results of 160 water samples collected between 1997 and 1998 and 30 water samples collected in 1999. The data associated with this study is provided as MS Excel, tab-delimited text, and ArcGIS files. Sample locations were reportedly recorded on 1:24,000 maps and measured with a GPS unit with an accuracy of about +/- 200 feet.

United States Geological Survey Professional Paper 1651 (Animas River Watershed)

The USGS PP 1651 database is a relational database designed to assist with the evaluation the impacts from historical mining in the Animas River watershed area. The database is included as an attachment to this publication. Data are stored within an MS Access database which is used in conjunction with ArcGIS for data analysis. Metadata are included on the USGS website (USGS, 2017). Sample data in the database were collected between 1982 and 2002 (Church et. al., 2007). There are approximately 2,389 sites in the database which include the locations of mines, mills, tailings, smelters, seeps, springs, streams, sample locations, and water quality data. The ArcGIS files included in this publication include three files which contain 344 mine sites, names, references, and a summary of the

analytical laboratory results for these sites. Also, the ArcGIS files include records associated with 2,014 field sites.

Mine sites included in the database focused on the impact of these sites to the environment. Many mine sites were not included in the inventory including small prospects, sites located some distance from rivers/lakes, sites that without evidence of significant environmental impact. The locations provided in the database involved review of public records and data from the State of Colorado, USFS, BLM, USGS, CGS, and the Colorado Division of Minerals and Geology (now defunct). These locations were recorded in a digital file and one representative point was chosen to represent each site based on 1998 digital orthophoto quadrangles. USGS personnel and residents from the area familiar with study area mines verified and revised the locations based on site visits, survey plats, and local knowledge of the area. Some of the site locations were determined from written descriptions (Church et. al., 2007).

Colorado Division of Reclamation Mining and Safety

Within the Colorado Division of Reclamation, Mining and Safety (CDRMS), the Inactive Mine Reclamation Program (IMRP) was established in 1980 to address the hazards and environmental problems arising from abandoned mines in Colorado. It was instituted under the provisions in the Surface Mining Control and Reclamation Act (SMCRA) of 1977, which gives the states that have approved coal mining regulatory programs under Title V of SMCRA the ability to assume exclusive responsibility and authority to reclaim abandoned mine lands within their borders. Mines abandoned prior to 1977 are eligible for the program. The program was launched with an inventory of an estimated 23,000 abandoned mine sites and physical hazards associated with past mining activities (i.e., open adits/tunnels and high walls), throughout the state. Using this inventory, Colorado prepared a statewide reclamation plan, which was approved by the U.S. Department of the Interior, Office of Surface Mining in June of 1982. Approximately 10,058 abandoned mined features have been addressed through this program and 33 underground coal mine fires have been identified and investigated for safeguarding and control as of 2016.

The IMRP maintains the "Brasscap" database which contains an inventory of completed AML physical hazard abatements. No metadata were provided. The data set provided has multiple latitude and longitude fields therefore, the XUTM_1 and YUTM_1 fields were used to plot the locations.

Approximately 440 points were not plotted due to the absence of values in these fields. Additionally, IMRP supplies the Office of Surface Mining and Reclamation (OSMRE) with information related to their eAMLIS database. Although the Brasscap database is not an inventory of AML sites throughout the State, it contains information about completed safety closure projects related to physical hazard abatement.

Data Limitations

The Colorado Geological Survey is not responsible and shall not be liable to the user for damages of any kind arising out of the use of data or information provided by the CGS, including the

installation of the data or information, its use, or the results obtained from its use. ANY DATA OR INFORMATION PROVIDED BY THE CGS IS PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND, WITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND

FITNESS FOR A PARTICULAR PURPOSE. Data provided by other agencies also has data limitations as included in their metadata.

There is no guarantee concerning the accuracy of the data presented in this project. The quality assurance and control of these data are ongoing. Users should be aware that changes may occur throughout this process and therefore, some or parts of these data sets may no longer be applicable. Users should not use these data for critical applications without a full awareness of its limitations. Any user of these data specifically agrees not to misrepresent the data, nor to imply that changes made were approved or endorsed by the entities who provided the data. Although these data have been processed successfully on each agencies computer system, no warranty expressed or implied is made regarding thdisplay or utility of the data on any other system, or for general or scientific purposes, nor shall the act of distribution constitute any such warranty. The agencies who provided these data and the CGS shall not be held liable for improper or incorrect use of the data described and/or contained herein.

Location data may have been recorded using different methods, between data sets, with varying degrees of accuracy. These methods include aerial photographs/maps which were later digitized, handheld GPS, digitized from mine maps or from USGS quadrangles, and/or township, range, section, quarter section, quarter section. Therefore, the exact location may only be precise to some scale (e.g. 1:24,000). Also, depending on the data set, some of the location data collected were from a desktop review and no field verification of these sites was completed.

Existing electronic AML inventories include the locations of certain features that may not be a threat to human health and/or the environment. For example, small prospect pits or gravel pits (e.g. industrial minerals) may have been documented in an area but may not present a significant physical or environmental hazard.

Depending on how each database was built, it could contain duplicate data (e.g. the same point or mine feature/site may be duplicated between agency data sets). Additionally, some agencies collect the number of adits, shafts, and other mine features as one location associated with one general AML site. So, there may be multiple AML features at the same location.

It is a common misconception that each one of these locations represents an individual abandoned mine - these data sets include the locations of waste piles (piles of waste rock from the mining process), prospect pits, and other mine features. Also, a set of mine features (e.g. adits, shafts, waste piles, etc.) can be associated with one abandoned mine. Therefore, it can be difficult to determine the actual number of “abandoned mines” in the State.

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