LMS/S10693

Defense-Related Uranium Mines Location and Status Topic Report

Final

August 2014

U.S. DEPARTMENT OF ENERGY | Legacy Management

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Contents

Figures

Tables

Appendixes

Abbreviations

AEC	U.S. Atomic Energy Commission
AML	abandoned mine land
AMLIS	Abandoned Mine Land Inventory System
AMSCM	Abandoned Mine Sites Cleanup Module
AUM	abandoned uranium mine
BLM	U.S. Bureau of Land Management
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
DB	database
DOE	U.S. Department of Energy
EE/CA	Engineering Evaluation/Cost Analysis
EPA	U.S. Environmental Protection Agency
GAO	U.S. Government Accountability Office
GIS	Geographic Information System
H.R.	House Resolution
MAS	Minerals Availability System
MED	Manhattan Engineer District
μR/h	microroentgens per hour
MILS	Mineral Industry Location System
MRDS	Mineral Resources Data System
NAD27	North American Datum of 1927
NAD83	North American Datum of 1983
QA/QC	quality assurance/quality control
SMCRA	Surface Mining Control and Reclamation Act
TBD	to be determined
TENORM	technologically enhanced naturally occurring radioactive material
ULD	uranium location database
ULP	Uranium Leasing Program
UNC	United Nuclear Corporation
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
Weston	Weston Solutions Inc.

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Executive Summary

The National Defense Authorization Act for Fiscal Year 2013, enacted January 2013, mandates that the U.S. Department of Energy (DOE) prepare a report on abandoned uranium mines. Specifically, Section 3151 of the legislation requests, in part, that "The Secretary of Energy, in consultation with the Secretary of the Interior and the Administrator of the Environmental Protection Agency, shall undertake a review of, and prepare a report on, abandoned uranium mines in the United States that provided uranium ore for atomic energy defense activities of the United States." The Act also requires consultation with other relevant federal agencies, affected states and tribes, and the interested public.

DOE defines an abandoned uranium mine (previously referred to in draft reports, presentations, and the DOE website by the acronym AUM) 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. Since the primary basis of the DOE mine database is the AEC production records, defense-related uranium mines (mines) are generally associated with a patented or unpatented mining claim (established under the General Mining Law of 1872, as amended) or a lease of federal, state, tribal, or private lands. Some mines listed as abandoned may have been reclaimed or remediated. Others have current operating permits but may have abandoned mine features within the permitted area that are not yet remediated. Mines in any of these categories are included in the set of legacy mines that were considered for evaluation as part of the congressional request for this report. The entire set is labeled as mines, and additional information in the topic reports and final Report to Congress identifies the status of these mines.

A mine may be a single feature such as a surface or underground excavation, or it may include an area containing a complex of multiple, interrelated excavations. A mine may include associated mining-related features such as mine adits and portals, surface pits and trenches, highwalls, overburden or spoils piles, mine-waste rock dumps, structures, ventilation shafts, stockpile pads, mine-water retention basins or treatment ponds, close-spaced development drill holes, trash and debris piles, and onsite roads.

For this report, a mine does not include offsite impacts or features such as ore-buying stations, ore transfer stations, or ore used in structures, roads, and general fill. Some stakeholders expressed concerns about offsite features, including the U.S. Environmental Protection Agency (EPA) that noted they found access roads made from waste materials and significant waste ore at several ore transfer stations on the Navajo Nation. EPA has conducted removal actions at two of these transfer stations. DOE, however, believes the congressional intent was to limit the scope of this report to mine sites.

DOE is required to submit a Report to Congress no later than July 2014. That report will describe and analyze:

- The location of defense-related uranium mines on federal, state, tribal, and private lands, and the status of efforts to remediate or reclaim these mines.
- The extent to which mines pose a significant radiation hazard or other public health and safety threat, and cause, or have caused, water or other environmental degradation.

- A priority ranking for the reclamation and remediation of abandoned uranium mines.
- The potential cost and feasibility of reclamation and remediation in accordance with federal law.

DOE is addressing these requirements, in detail, in four topic reports. This topic report addresses the first bullet above.

Based on available information from various federal and state agency databases, tribal abandoned mine land programs, maps, and other documents, it was determined there are 4,225 mines that meet the definition above. This should be considered an approximate number, as there were duplicates in the several databases that were reviewed. Also, field visits, combined with reviews of aerial imagery and mining claim maps, showed there are sometimes numerous mines adjacent to what was recorded in the database as only one named mine site; further investigation of such sites could increase the total number of mines.

The AEC production tables list 4,140 mining records, which include claims, leases, and permits on federal, state, tribal, and private lands. These records served as the basis for the mine determination; however, these records located a particular mine only by state, county, and district. To better determine locations, these records were compared to available data that contained latitude and longitude coordinates. This review and comparison resulted in the addition of 92 mine claims to the DOE mine database. Other reviews resulted in the removal of 7 records from the database.

Having assembled the DOE mine database, DOE reviewed the data to assess data gaps, validate the data, and perform other quality assurance/quality control checks prior to creating data tables and queries for the cost and risk evaluations that are addressed in separate topic reports. Potential duplicates were identified but not excised (except for 10 in North Dakota) from the database, since not all information about a particular mine is known at this time. Fewer than 300 mines with duplicate names were identified.

Of the 4,225 mines identified, 592 have a location known by state and county and/or mining district only. The remainder (3,633) include latitude and longitude coordinates. In a few instances (26 of 592), the state name was unknown, but information included a record of ore production.

For several reasons, location coordinates for numerous mines should be reconciled. The coordinates given in a particular database may be for a mine claim boundary corner, or for the site of the original prospect and not the actual mine. Also, the reference datum varies with the age of the data source for the coordinates, resulting in a shift from apparent to actual location. Some of these discrepancies were spot-checked using aerial imagery and maps. Actual locations could be identified for many mines, including nearly all in the Medium and Large production-size categories.

The mines were assigned to production-size categories that ranged from Small (0–100 tons) to Very Large (>500,000 tons) based on the total amount of ore produced and sold to AEC. About 46 percent (1,936) are in the Small production-size category. That category also includes 82 percent (487) of the 592 mines that have an unknown location or the location is known only by county and/or mining district.

Approximately 69 percent of the mines are located in Colorado (1,539) and Utah (1,380), with another 23 percent present in Arizona (413), Wyoming (319), and New Mexico (247). The remaining mines are in the western states, along with one each in Alaska, Florida, New Jersey, and Pennsylvania. Of the total tons of uranium ore produced for defense-related purposes (75.9 million), New Mexico leads with over 35 million tons, followed by Colorado, Utah, and Wyoming, each with just over 11 million tons. Arizona produced nearly 3 million tons, and Washington produced 1.1 million.

Nearly half (2,103) of the mines are located on U.S. Bureau of Land Management lands. A sizeable number the mines are on non-federal land (518, or 12.3 percent) and land of unknown ownership (657 or 15.6 percent). The non-federal category includes land owned by local municipalities or counties and property that otherwise could not be readily linked to a federal agency.

Some mines have impacted groundwater, which can be a significant part of total cleanup cost. Other mines are in areas of high naturally occurring metal constituents in groundwater, including uranium. Some of these mines may have impacted groundwater, but in those instances, the background levels of constituents need to be accounted for in establishing cleanup standards. Information provided by EPA noted that many uranium mines in the Grants, New Mexico, Mining District operated as wet mines. Over their years of operation, water was pumped to the surface and discharged into nearby drainages, resulting in significant re-saturation and, in places, contamination of the shallow alluvium and underlying bedrock aquifers. Due to limited time and budget, DOE did not conduct site-specific evaluations of groundwater and surface water. EPA continues groundwater investigations as funding allows. The Grants Mining District is also a location of uranium mines that did not produce ore purchased by the AEC (post-1970).

Mine reclamation is typically conducted by the U.S. Bureau of Land Management or the U.S. Forest Service under their respective statutory authorities. Remediation at Superfund sites must comply with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act and be consistent with the National Contingency Plan. Cleanup efforts can range in scope from closing a portal to a full remediation of contaminants from land and water and the removal of site structures.

Approximately 85 percent (3,575) of the mines are not reclaimed or their status is unknown. There are 131 mines (about 3 percent) that are closed and 483 (approximately 11 percent) that have been or are in some stage of reclamation.

The existing database should only be used for scoping the magnitude of the mine problem, as it lacks accurate information about the exact number, size, and mine features, except AEC production data. Even the AEC production data will not reflect any mining activity that occurred after 1970.

Field visits to representative mine locations in six states demonstrated that the recorded location of many mines is not exact and also that an AEC-production claim record may reflect ore production from one mine or several mines.

Field visits to all the mines in the database should be conducted to verify size, status, and other information before any type of reclamation or remedial action begins and before preparation of accurate cost estimates for such efforts.

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1.0 Introduction

This topic report describes the development of a location and status database for defense-related uranium mines (mines) as they relate to activities by the U.S. Department of Energy (DOE) (formerly the U.S. Atomic Energy Commission [AEC]). This report is related to House Resolution (H.R.) 4310, "National Defense Authorization Act for Fiscal Year 2013," which was enacted in January 2013. Section 3151 of that legislation requests, in part, that "The Secretary of Energy, in consultation with the Secretary of the Interior and the Administrator of the Environmental Protection Agency, shall undertake a review of, and prepare a report on, abandoned uranium mines in the United States that provided uranium ore for atomic energy defense activities of the United States." That Report to Congress is provided separately. This topic report is one of four that address specific topics that are identified in the legislation.

The topics identified in H.R. 4310 include the following:

[1] The location of the mines on federal, state, tribal, and private land, accounting for (a) existing inventories undertaken by federal agencies, states, and Indian tribes, and (b) additional information available to the Secretary of Energy

[2] The extent to which the mines (a) pose, or may pose, a significant radiation hazard or other significant threat to public health and safety; and (b) have caused, or may cause, significant water quality degradation or other environmental degradation

[3] A ranking of priority by category for the remediation and reclamation of the mines

[4] The potential cost and feasibility of remediating and reclaiming, in accordance with applicable federal law, each category of mines

[5] The status of any efforts to remediate and reclaim mines

Items 1 and 5 are addressed in this topic report.

Figure 1 is a flowchart of the overall actions required to complete the Report to Congress. As this figure shows, the location and status information forms the basis for developing the Report to Congress, and it is fundamental to the other three topic reports, which address risk, ranking, and cost.

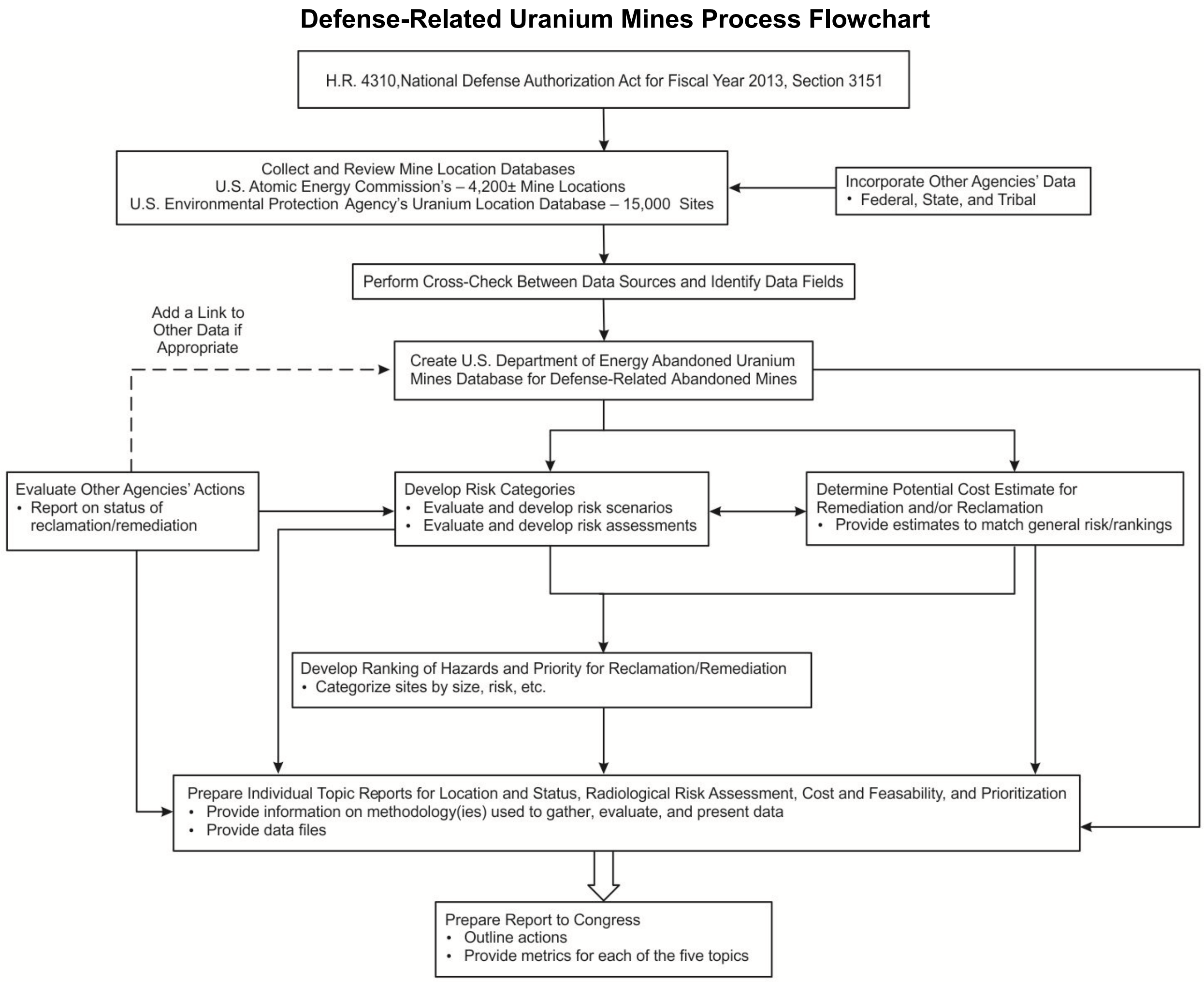

Figure 1. Flowchart of Actions for Report to Congress

2.0 History of AEC and Abandoned Uranium Mines

The AEC was created in 1946 by the Atomic Energy Act. The mines that are the focus of this congressionally mandated investigation have a production history that is generally limited to the period of 1947 to 1970 (Figure 2), which is when uranium ore production was slated for defense-related purposes. Following a brief transition period, uranium ore production then became a venture for commercial nuclear power purposes after 1970.

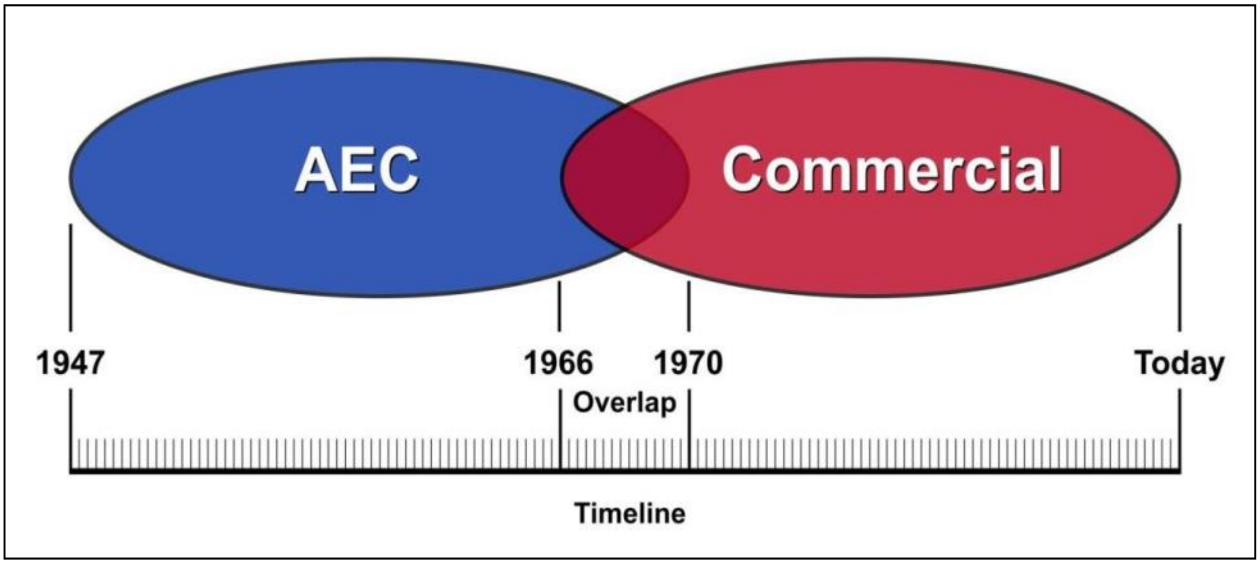

Figure 2. Timeline of Uranium Ore Production

Federal contracts for purchasing uranium concentrate (U_3O_8) to support defense activities were made by the Manhattan Engineer District (MED) from 1942 to 1946 and by the AEC from 1947 through 1970.

Deposits in southwestern Colorado and southeastern Utah were mined for radium primarily from 1913 to 1926 and for vanadium from 1936 to 1946. The spoils from this mining were reprocessed at four mills to recover uranium for MED. Radium discoveries in the 1880s in the Uravan Mineral Belt led to limited mining for radium, which was then sent to France for the Curies' research in 1898. Also, uranium was first discovered in the United States at the Wood Mine near Central City, Colorado, and 36 tons were produced from this area for radium by 1900 [Sims and others, 1963]. Only 14 percent of the early defense-related U_3O_8 came from uranium ore produced in the United States; 74 percent of the ore came from the Belgian Congo (now the Democratic Republic of the Congo, and formerly called Zaire), and the remaining 12 percent came from Canada. MED purchased 10,000 tons of U_3O_8 (uranium concentrate) a small percentage of the total produced for defense-related purposes.

Forty-two commercially operated uranium mills and processing plants produced U_3O_8 for sale to the AEC. Although AEC decided in 1958 to allow mills to sell U_3O_8 commercially, the first commercial sale did not occur until 1966.

Because of the lack of production of uranium ore in the 1940s, the AEC set the prices it would pay for ore and then set up buying stations in the uranium-producing areas to purchase the ore. The ore-buying stations were shut down after the mills were built, since the ore was taken directly to the mills. Ore-buying stations operated for varying periods from 1949 to 1962 in 11 different communities in five states (Arizona, New Mexico, South Dakota, Utah, and Wyoming).

The AEC recognized in 1962 that the private market for uranium would not be sufficient to sustain a viable domestic uranium industry by the end of 1966, when the procurement program was scheduled to end. Consequently, AEC created its stretch-out program, and from 1966 to 1970 the only concentrate it purchased was from mines/mills already in operation before 1966. Thirteen mills sold U_3O_8 to both AEC and commercial entities and continued to operate after 1970. The *Commingled Uranium-Tailings Study, Volume II, Technical Report* (DOE 1982) details the operations of the 13 mills, the percentage of U_3O_8 sold to the AEC, and the major mines that supplied each mill.

In summary, the majority of defense-related mines had an operational history between 1947 and 1970. Many of the defense-related mines continued to operate after 1970, and several sources of information document some of those mines. The list of AEC-related mines captures the defense-related portion of sales even if those mines continued to operate after 1970. Mines that operated from 1913 to 1946 were identified if possible; however, these mines represent less than 5 percent of the total production of U_3O_8 for defense-related purposes. In addition, some percentage of these mines and mine dumps were likely mined after 1946 for uranium and were consequently incorporated into the AEC-era uranium-mining operations.

History of the AEC (Key Facts and Dates)

- The Atomic Energy Act created the AEC on August 1, 1946.
- The AEC Uranium Program operated from 1947 to 1970.
- The first contracts were with the Vanadium Corporation of America mill in Naturita, Colorado, and then a Union Carbide mill in Rifle, Colorado.
- Monticello, Utah, was the location of the first and longest-operating ore-buying station (1948 to 1962).
- Thirty-two new mills were constructed and operated during the period to produce yellowcake (uranium concentrate) for sale to AEC.
- Except for some initial contracts, all mill contracts were administered through the Grand Junction, Colorado, Colorado Raw Materials Office (established in 1947).
- AEC established its stretch-out program from 1967 to 1970 to try to sustain a viable domestic uranium industry. The program allowed companies to defer part of their sales from prior years to 1967 to 1970.
- The following 11 mills participated in the stretch-out program:(1) Shiprock, New Mexico; (2) Bluewater, New Mexico; (3) Western Nuclear Inc., Wyoming; (4) Kerr-McGee Ambrosia Lake West, New Mexico; (5) Lucky Mc, Wyoming; (6) Moab, Utah; (7) Gas Hills, Wyoming; (8) Homestake, New Mexico; (9) United Nuclear Corporation (UNC), New Mexico; (10) Rifle, Colorado; and (11) Uravan, Colorado.

- The procurement program ended on December 31, 1970.
- AEC, assisted by the U.S. Geological Survey (USGS), promoted drilling between 1948 and 1956 to identify reserves:
  - Approximately 700 square miles of public domain land was withdrawn for exploration.
  - A total of 5,575,000 feet of exploratory holes were drilled. (This is a small percentage of the total feet drilled by private industry, which started drilling in the mid-1950s and, for example, drilled 9 million feet in 1 year).
- AEC, assisted by the Bureau of Public Roads, improved over 1,200 miles of roads in Arizona, Colorado, New Mexico, South Dakota, Utah, and Wyoming between 1951 and 1958.

2.1 Abandoned Uranium Mines

Abandoned uranium mines are a subset of abandoned mine lands (AMLs) that have been and are being addressed by various state and federal agencies, including the U.S. Bureau of Land Management (BLM), the U.S. Department of Interior's Office of Surface Mining, Reclamation and Enforcement, the U.S. Forest Service (USFS), the U.S. Environmental Protection Agency (EPA), the National Park Service, tribal and state-specific AML offices, and state offices with oversight of mining activities. A 2008 U.S. Government Accountability Office (GAO) report noted that more than 150,000 abandoned hard rock mines existed in the western United States. Specific to abandoned uranium mines, EPA has documented several investigations (EPA 1983, EPA 2006). The 2006 EPA report focused on technologically enhanced naturally occurring radioactive materials (TENORM)[1].) That 2006 report was part of EPA's efforts to characterize risk from TENORM sources and to identify locations of TENORM concerns. The EPA report's database identified approximately 15,000 locations associated with uranium, and it noted more than 4,000 mines that had documented uranium production. More than 20 sources were used to create EPA's uranium location database (ULD), including several national databases (e.g., the USGS Minerals Availability System/Mineral Industry Location System [MAS/MILS] and the Mineral Resources Data System [MRDS]) and databases or data tables from BLM, USFS, and state AML programs.

2.2 Geologic Setting for Uranium Deposits

Uranium deposits in the United States occur in a variety of geologic settings, and most deposits, especially the larger ones, are concentrated in major mining areas and districts. Figure 3 shows these major mining areas and districts, and Appendix A provides brief summaries of the geologic conditions associated with each. While there are other commodities present in many of these districts, the descriptions provided in Appendix A are limited to uranium. Most uranium deposits formed when oxidizing groundwater leached uranium from igneous rocks and transported it to reducing environments where the uranium precipitated and became concentrated. United States deposits can mainly be classified into four types: roll-front, tabular sandstone, solution-collapse breccia pipes, and volcanic. Many areas in Wyoming and in the south Texas mineral belt contain

[1] "Technologically enhanced" describes situations in which human activity has concentrated the radioactivity or increased the likelihood of exposure by making the radioactive material more accessible to human contact. This includes any manmade action, whether intentional or not, that result in exposure or an accumulation greater than what was naturally occurring.

linear-shaped uranium deposits that are characteristic of roll-front mineralization. Tabular to amoeba-shaped ore bodies in sandstone are characteristic of deposits in the Grants and Uravan Mineral Belts and the Maybell district. Some areas contain deposits that are different from the four types, such as the Front Range, Cochetopa, and Marshall Pass districts in Colorado that contain vein-type uranium deposits, and the Dakota lignite area where uranium was leached from overlying sediments and concentrated in lignite coal beds.

Each type of uranium deposit dictated the mine method and features needed to extract the ore. The mine types vary from shallow pits to deep underground mines to large open-pit operations, and mines in the same district are generally the same type. Figure 4 provides an overview of the location of uranium mines in the United States in relation to the main mining districts.

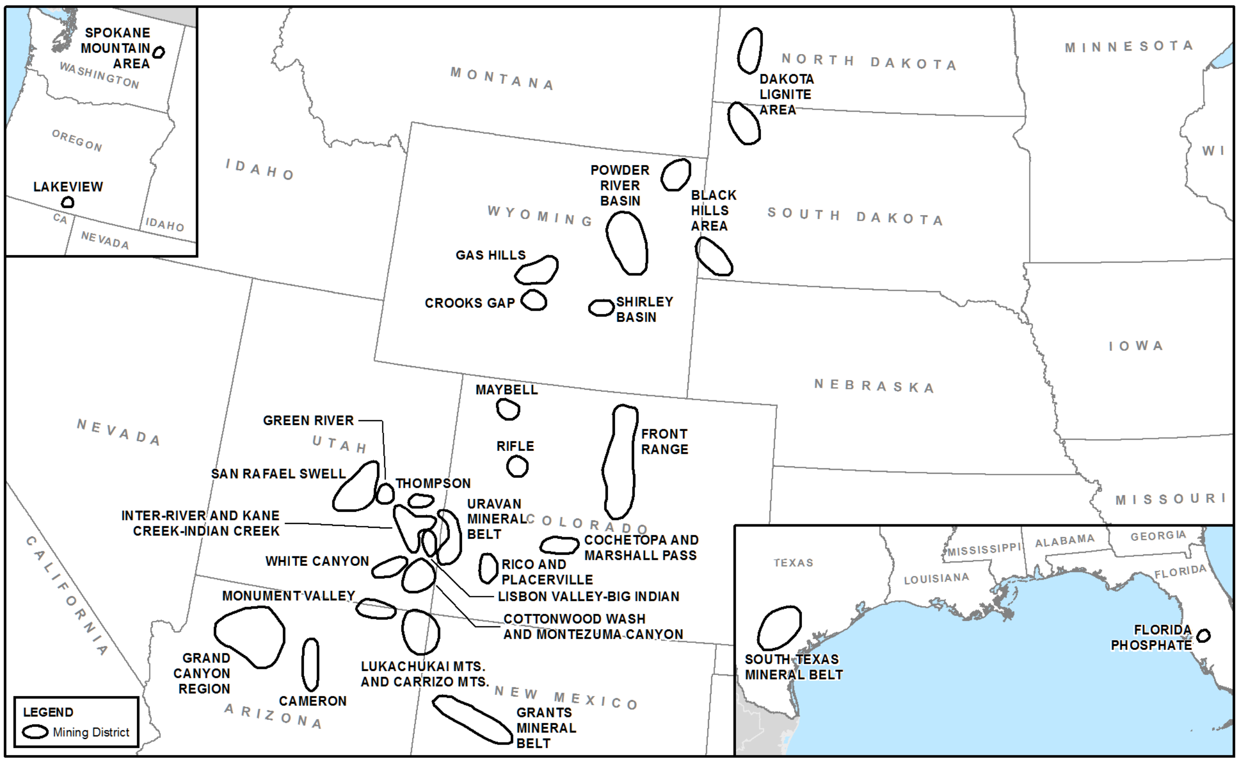

Figure 3. Uranium Mining Areas and Districts in the United States

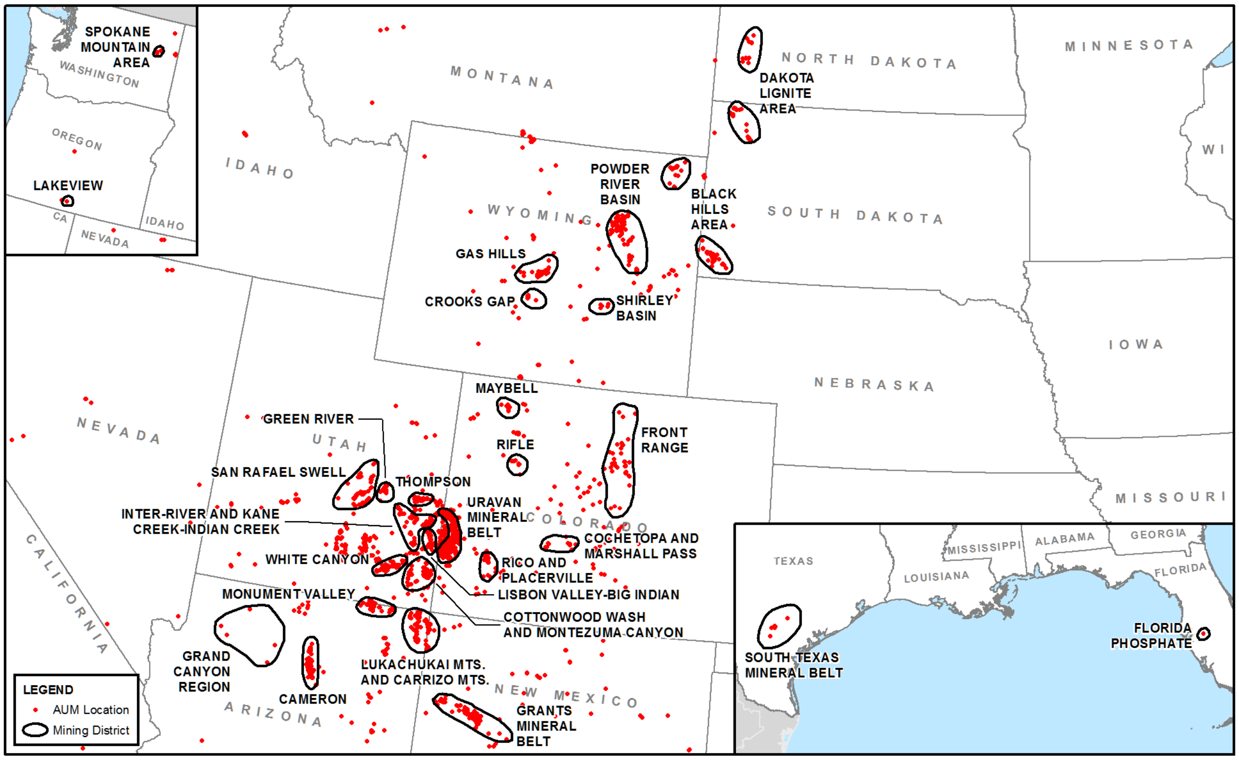

Figure 4. Locations of Uranium Mines in the United States in Relation to Mining Areas and Districts

2.3 Definition of Mine

Several definitions of the terms “mine” and “abandoned mine” are used by state and federal agencies. These definitions vary as a result of the regulatory framework under which the mine is being operated or reclaimed.

Associated with the definitions of a mine, numerous mine features are described in associated reports and other mine-related documents and correspondence, and these features might not be readily discerned by persons who are not closely familiar with mining activities or with the agency objectives of the entity describing the mine and features. Figure 5 and Figure 6 provide a simplified illustration of some of the common features associated with underground and open-pit mines.

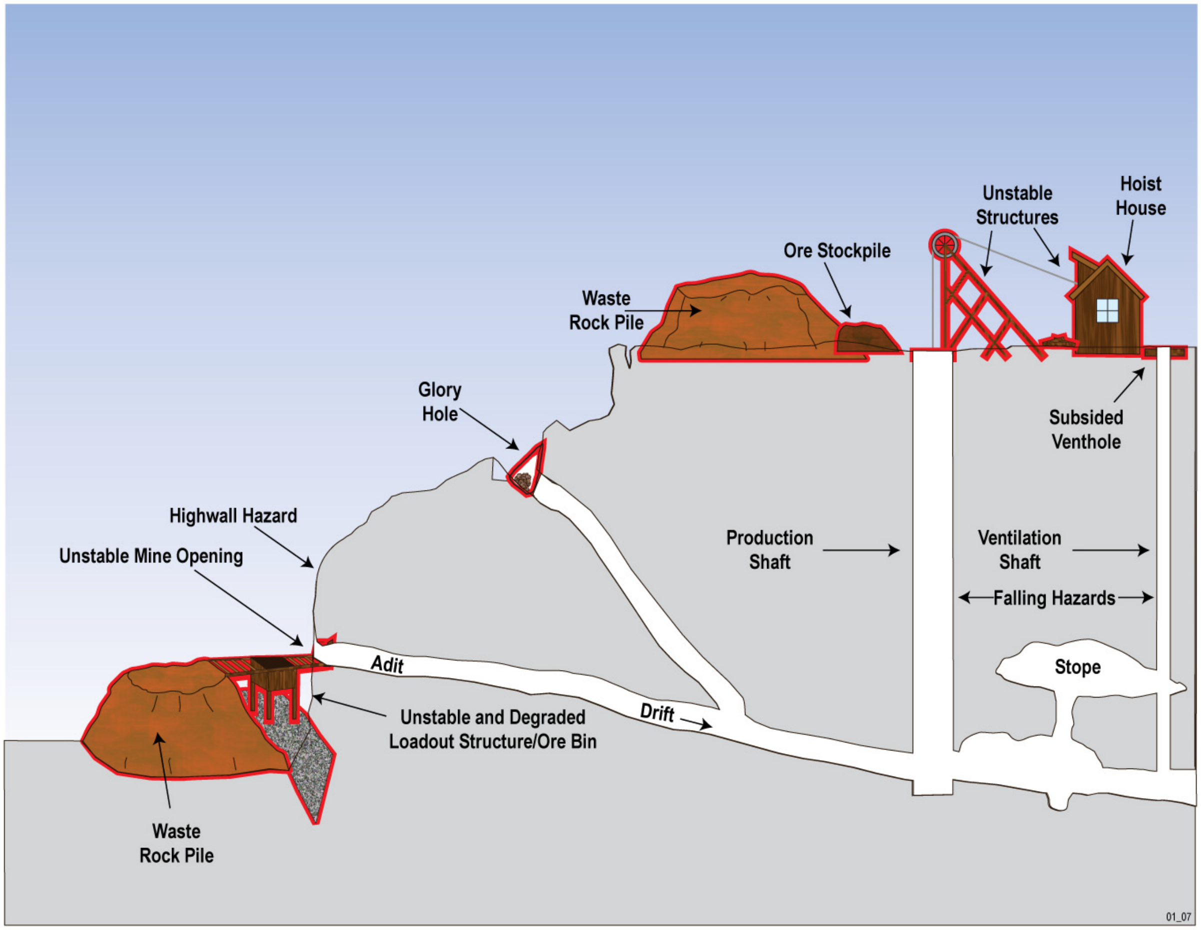

Figure 5. Common Features of Underground Mines

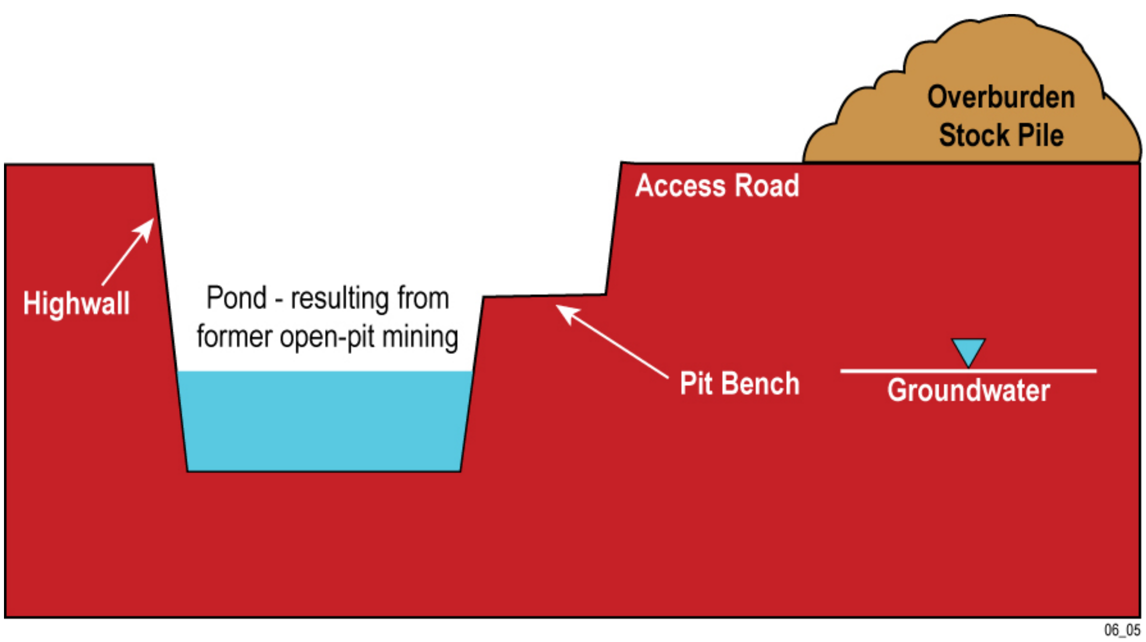

Figure 6. Common Features of Open-Pit Mines

2.3.1 DOE Definition of Defense-Related Uranium Mines

DOE defines a 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 AEC or other means.

The rest of this section provides details on the main criteria of this definition, including an explanation of geological features that might and might not be covered by this definition.

The first criterion DOE used to define a mine is evidence that the mine was developed to extract uranium ore for atomic energy defense-related activities of the United States, as verified by purchase of ore by the AEC.

Another criterion is, in general, the mine must have produced uranium ore between 1947 and 1970, which are the years when AEC purchased uranium ore. If a mine has been reclaimed or remediated or is in the process of either, the mine will still appear as a mine in the DOE mine database. Also, if an AEC-listed mine is still active, but was operational prior to 1970, that mine will be included in the DOE mine database.

A mine may be a single feature such as a surface or underground excavation, or it may include an area containing a complex of multiple, interrelated excavations. A mine may include associated features such as mine adits and portals, surface pits and trenches, highwalls, overburden or spoils piles, mine-waste rock dumps, structures, ventilation shafts, ore stockpiles and stockpile pads, mine-water retention basins or treatment ponds, close-spaced development drill holes, trash and debris piles, and onsite roads.

For this report, a mine does not include offsite impacts or features such as ore-buying stations, ore transfer stations, or ore used in structures, roads, and general fill. EPA noted that they found access roads made from waste materials and contaminated ore transfer stations on the Navajo Nation. EPA has conducted removal actions at two of these transfer stations. DOE recognizes that offsite uses may result in an unacceptable risk to the public or environment, but DOE is adhering to the congressional direction of addressing only mines as defined above.

DOE recognizes that if the majority of mines in an area are defense-related, and if no active mill was in that area after 1970, then, subject to any data indicating otherwise, all of the mines in that area would be considered "defense-related" whether or not a particular mine is included in the AEC records. There are many such areas, including Cameron, Arizona. This was confirmed by field visits to areas where other mines were discovered in the immediate area of an AEC-listed mine, and the other mines had the same characteristics as the AEC-listed mine.

Also, since the primary basis of the DOE mine database is the AEC production records, a mine is generally associated with a patented or unpatented mining claim (established under the 1872 Mining Law, as amended) or a lease of federal, state, tribal, or private lands. Some mines listed as abandoned may have been reclaimed or remediated. Others have current operating permits but may have abandoned mine features within the permitted area that are not yet remediated. Mines in any of these categories were included in the set of legacy mines that were evaluated as part of the congressional request for this report.

Figure 7 illustrates some common physical and radiological hazards associated with uranium mines.

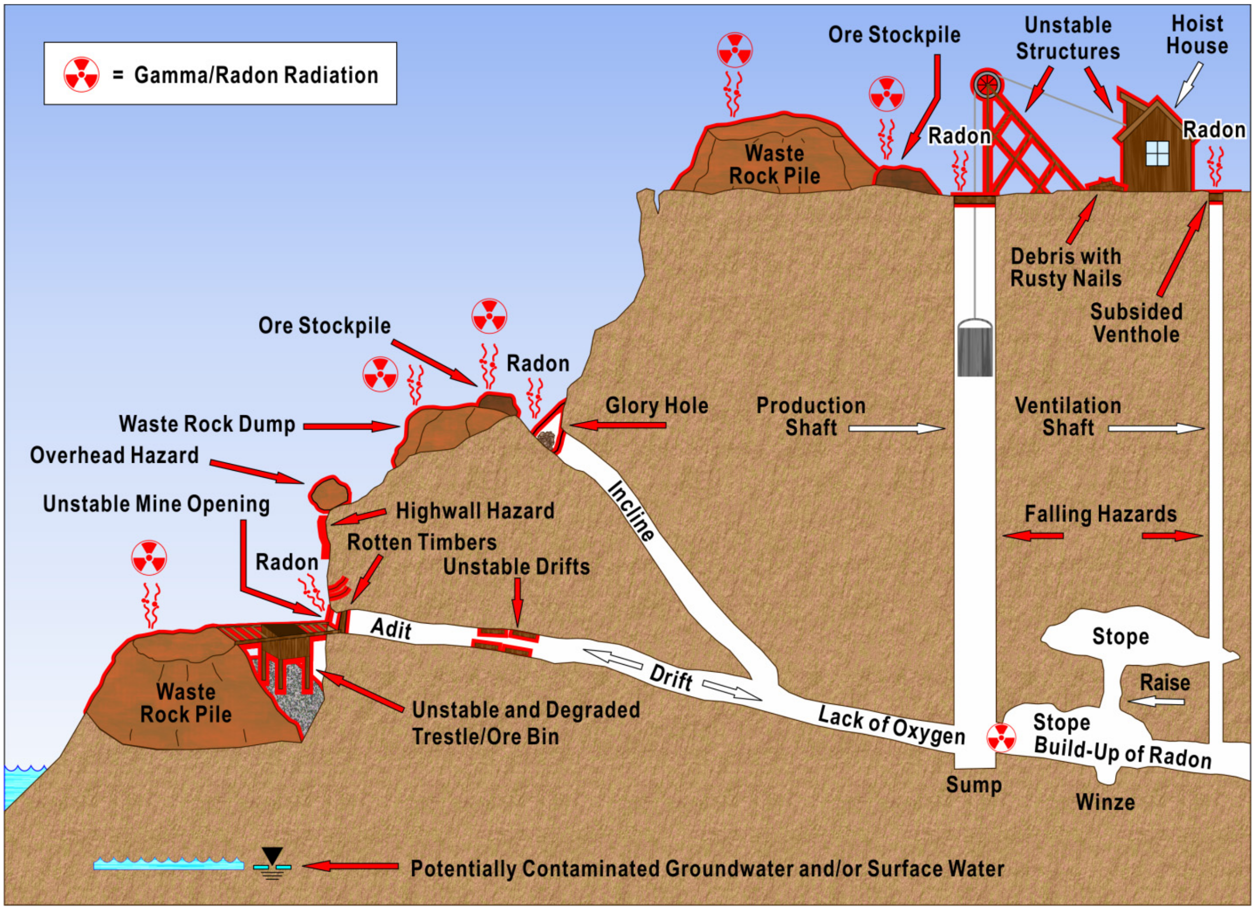

Figure 7. Physical Hazards and Pathways for Radiation Exposure

2.3.2 Other Agencies' Definitions

Most other agencies define "abandoned mined lands" rather than an "abandoned mine." These broad definitions may include sites and features that have never had mineral production associated with them. One definition, not attributed to a particular source, is the following:

> An abandoned mine (and related features, facilities, and equipment) is a mine on or affecting public lands under the jurisdiction, custody, or control of a federal agency at which, under the authority of the 1872 Mining Law (Title 30 *United States Code* Sections 22–54), persons or entities outside of the federal government conducted exploration, development, mineral extraction, processing, reclamation, maintenance, or other operations, all of which activities have ceased with (1) no evidence that the mine operator or any identified successor, claimant, operator, or other third party intends to resume those activities and (2) no other evidence of active claim or claimant activity.

2.3.2.1 EPA

According to EPA's website for AML, EPA's definition for AMLs on private lands for which EPA has regulatory authority is "those lands, waters, and surrounding watersheds where extraction, beneficiation, or processing of ores and minerals has occurred." Abandoned uranium mine lands are a subset of this and include areas where mining or processing activity is temporarily inactive. http://www.epa.gov/aml/

2.3.2.2 GAO

GAO defines an abandoned hardrock mine site as all associated facilities, structures, improvements, and disturbances at a distinct location associated with activities to support a past operation of minerals locatable under the general mining laws.
http://www.gao.gov/products/GAO-08-574T

2.3.2.3 BLM

According to BLM, abandoned mines generally include a range of mining impacts or features that may pose a threat to water quality, public safety, and/or the environment. For many abandoned mines, no current claimant of record or viable potentially responsible party exists.

The preceding definition, along with other BLM information about defining abandoned mines, is available at the following link:
http://www.blm.gov/wo/st/en/prog/more/Abandoned_Mine_Lands/frequently_asked_questions.html

BLM also provides the following definition (see http://www.blm.gov/wo/st/en/prog/more/Abandoned_Mine_Lands/About_AML/aml_glossary_and_acronyms.html):

> **Abandoned Mine:** An abandoned hardrock mine on or affecting public lands administered by the BLM, at which exploration, development, mining, reclamation, maintenance, and inspection of facilities and equipment, and other operations ceased as of January 1, 1981 (the effective date of the BLM's Surface Management regulations codified at 43 CFR Subpart 3809) with no evidence demonstrating that the miner intends to resume mining. For many abandoned mines, no current claimant of record or viable potentially responsible party exists. Abandoned mines generally include a range of mining impacts or features that may pose a threat to water quality, public safety, and/or the environment.

2.3.2.4 State AML Programs

Some states base their definition of an abandoned mine and identify mine features in accordance with the definitions used in the Abandoned Mine Land Inventory System (AMLIS) by the U.S. Department of Interior's Office of Surface Mining, Reclamation and Enforcement under the Surface Mining Control and Reclamation Act (SMCRA). SMCRA establishes high-priority sites as those posing extreme danger, typically due to the presence of hazardous physical features. Hazardous features include irrespirable air and abandoned chemicals/explosives as well as features such as mine openings and highwalls. Medium priority sites are those posing some adverse conditions; lowest priorities are those posing environmental risks. The Office of Surface Mining has distributed grants to states and tribes since its inception. Authorized SMCRA states with significant numbers of uranium mines include Colorado, New Mexico, Wyoming, and Utah; the Navajo Nation also has an authorized program. The State of Wyoming and the Navajo Nation have been certified and have directed significant amounts of SMCRA funds toward reclamation of uranium mines.

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3.0 Research of Existing and Available Databases

With 16 months to accomplish the objectives requested by Congress, DOE researched and reviewed existing available databases of AML and mine sites to create the DOE mine database. AEC records served as the starting point and were enhanced with database information provided by EPA, BLM, USGS, USFS, Navajo Nation, and several state agencies. The majority of the data was used to establish location coordinates for the mines. When other useful data (such as reclamation status) were found, those data were also captured in the DOE mine database. This section describes the main sources that were used to create the DOE mine database. Section 4.0 describes the DOE database construction and provides more detail on these and other sources used.

3.1 AEC Records

The AEC created production records for its use and, as AEC was the predecessor agency to DOE, those records were available. These records (*Summary of Uranium Production by District, Locality, and Property*, dated July 1, 1967) formed the basis of the DOE mine database. These records were available as paper copy only and contained a listing of mine names along with ore production (in tons in scientific notation [e.g., 0.05E5]) and the grade of uranium (U_3O_8) ore. Appendix B provides a few pages of these records as an example of the data provided. The listings for most records also included the name of the state and county in which the mine was located. Table 1 provides a list of available fields. Because these records included an account of uranium production (for defense purposes, since they are pre-1970), and the records belonged to AEC, these mine name listings were selected as the basis for the DOE mine database development. The AEC records are not a database but appeared to be the most complete record of defense-related uranium production available. To facilitate use of the data contained in the paper copy records, the information was transcribed into a Microsoft Excel spreadsheet.

Table 1. Data Fields from AEC Production Records

Data Field
Mine District
Mine Locality
Claim Number
Claim Name
State
County
Tons of Ore Produced
Pounds of U_3O_8
Grade %

3.2 EPA's Uranium Location Database

As noted in Section 2.1, EPA's ULD was derived from over 20 database sources (Table 2). The ULD is a compilation of data from these databases and, as such, is the most comprehensive database available for mine locations, especially for mines in the western United States. The

ULD is a part of EPA's efforts to characterize risk from TENORM sources and to identify where TENORM concerns may exist, such as waste from abandoned uranium mines. The 2006 ULD report describes how the component databases were used to compile the ULD and contains notes on the reliability of that data. The most useful data field from the ULD was mine location by latitude and longitude. (Because the ULD is a compilation of sources, numerous other fields were potentially available; see Appendix C for more information about each ULD data source and the different fields.)

Table 2. List of Data Sources for EPA's ULD

Database Source Name	ULD Database Alias
Colorado Department of Natural Resources, Division of Minerals and Geology Brass Cap Database	1
Colorado (BLM) Abandoned Mine Land Inventory	2
Colorado (USFS) Abandoned Mine Land Database	3
Mineral Resources Data System (MRDS)	4
Mineral Industry Location System (MILS)	5
Utah (BLM) Abandoned/Inactive Mine Land Inventory	6
Utah Abandoned Mine Reclamation (AMR) Database	7
Navajo Lands Project Atlas, 1994–2000	11
State of Arizona Mine Data	12
U.S. Forest Service Mine Data for Arizona	13
BLM Mine Data for Arizona and New Mexico	14
South Dakota Abandoned Mine Lands Inventory	15
California Mines on USFS Land	16
Texas Department of Health	17
New Mexico Mines Database	18
Wyoming Abandoned Mine Land	19
Nevada Bureau of Mines and Geology	20
Texas Mines from Adams & Smith Report	21
Dakotas Mines from U.S. Atomic Energy Commission Map, 1967	22
Montana State Library	23
Inactive Mineral Production Sites—University of Texas	24
Railroad Commission of Texas Uranium Mines	25

3.3 State Data

DOE requested information from various agencies in states with abandoned uranium mines, including Arizona, Colorado, New Mexico, South Dakota, Utah, Washington, and Wyoming. Table 3 provides a listing of the various state divisions, departments, bureaus, and programs that were contacted for information such as data tables, mine location maps, reclamation status, and reclamation costs associated with mines.

Table 3. State Agencies Contacted for Mine Information

State	Source of Data
Arizona	AML Program
Arizona	Geological Survey
California	Department of Conservation, AML Program
Colorado	AML Program
Colorado	Geological Survey
Montana	Bureau of Mines and Geology
Montana	Department of Environmental Quality, Abandoned Mine Bureau
Nevada	Bureau of Mines and Geology
New Mexico	Bureau of Geology and Mineral Resources
New Mexico	Energy, Minerals and Natural Resources Department
New Mexico	Mining and Minerals Division (AML Group)
New York	Department of Environmental Conservation
North Dakota	Geological Survey
South Dakota	Department of Environment and Natural Resources, Minerals and Mining Program
Texas	Bureau of Economic Geology
Texas	Railroad Commission of Texas, Surface Mining and Reclamation Division
Utah	Abandoned Mine Reclamation, Division of Oil, Gas, and Mining
Utah	Geological Survey
Washington	Geological Survey
Wyoming	Department of Environmental Quality, AML Division
Wyoming	Geological Survey

The location and status data available from state agencies varied, but examples from a few of the states are provided in Table 4 and Table 5. For the Wyoming example in Table 4, the State of Wyoming provided the requested data, although other fields are also available for some sites.

Table 4. Data Fields Provided by Wyoming AML Division

Field Name	Example
Site Name	Bridger Trail
AML Site Number	12301
Site Latitude	43.****
Site Longitude	−107.****
County	Natrona
Ownership	Public
Primary Owner	Bureau of Land Management
Primary Owner Percent	100
Public Type	Federal
Surface Mine	Yes
Underground Mine	No
Uranium	Yes
AML Status Comment	Prospect
Included in Wyoming AML Reclamation	Low Priority
Comments	

Table 5. Data Fields Provided by New Mexico Mining and Minerals Division

Field Name
Mining & Mineral ID
County
District
Name
Aliases
Township/Range/Section/Quarter-Section/USGS Quadrangle
Latitude/Longitude
UTM Northing/Easting/Zone
Point Location Reference
Surface Land Status/Minerals Land Status
Surface Ownership/Mineral Ownership
Navajo Nation AUM No./Map ID No./Agency AUM No.
Commodities Produced/Host Formation
Mining Methods
Development/Land Use
Depth of Workings/Length of Workings
Year of Initial Production/Year of Last Production/Year of Last Activity
Mining History/Last Operator/Potential Responsible Parties
Production Category/Production Ore/Production U_3O_8 (lbs.)/Comments on Production
Disturbed Area (acres)/Disturbed Area (source)
Radiation Hazards/Potential Hazardous Materials
Evidence of Potential Acid Drainage
Hydrology/Receiving Basin/Receiving Sub-basin
Reclamation Details
Current Regulatory Agency
Mining Act Reclamation Program Status/Permit No.
BLM No./CERCLIS No./USFS No./MRDS No./NRC No./ MSHA No.
References
Production Rank
Driving Directions

Abbreviations:
CERCLIS = Comprehensive Environmental Response, Compensation, and Liability Information System
MSHA = Mine Safety and Health Administration
NRC = U.S. Nuclear Regulatory Commission
UTM = Universal Transverse Mercator

Information for many of the data fields was not available or not applicable for every mine location included in a particular state-agency database.

3.4 Navajo Nation Data

Location and other relevant data were provided by EPA and the Navajo Nation AML program. Information provided in EPA's 2007 through 2011 screening reports for more than 500 abandoned uranium mines and sites on the Navajo Nation was also reviewed and incorporated as appropriate. In addition, location data in latitude and longitude and numerous data fields for various mine features were available for many of these mines, including reclamation status and surface radiological measurements, such as gamma activity in counts per minute. A listing of the EPA screening-report data fields for Navajo Nation AML sites is shown in Section 4.2.1.

3.5 Selection of Data Fields

The DOE mine database was developed in an incremental fashion based on the data that were obtained (Section 4.0). As noted in Section 3.1, the AEC records listed only the mine name, uranium production, and the state and county for location. Some of the additional sources were limited to similar location data along with reclamation status, while other additional-source databases included numerous data fields that could be of potential use. A review of the various additional-source databases, their available data fields, and their data (which was necessary to support risk evaluation and cost development) led to an expansion of the list of data fields included in the DOE mine database. The data fields that were listed in each of the EPA's ULD source databases are included in Appendix C.

After all readily available information for the fields (including those fields added during examination of the additional sources) was collected and entered into the DOE mine database, the data tables listed in Table 6 were created to categorize the data. The numerous data fields within each of these tables are shown in Appendix D. The data fields selected for these 16 tables were chosen to address the requested topics in the congressional bill and also to document the source of the information.

Limitations are associated with most of these data tables. For example, the Rad Gamma Data table is mostly from the EPA screening reports of mine sites on Navajo Nation land. The radiological data are reported in counts per minute, which is instrument-specific and cannot be correlated to other sites where standard units of microroentgens per hour (μR/h) were used. However, the information is useful from a relative standpoint of average and maximum readings compared to background.

Table 6. DOE Mines Data Tables

Table No.	Name	Description
T01	Location	Includes state, county, district, and latitude and longitude
T02	Owner Operator	Includes owner, operator, or permittee where available
T03	Production	Total tons of ore, pounds of U_3O_8, grade percent, year, etc.
T04	Mine Status	Mine closure status
T05	Mine Features	Number of pits, adits, shafts, and structures
T06	Land Ownership	Private, state, federal or tribal
T07	Cost	Source of data, year, and description
T08	Rad Gamma Data	Source measured, average and maximum, background
T09	Rad Soil Data	Range measured, units used, background values
T10	Rad Radon Data	Range, average, background, source
T11	Surface Water Data	Data availability and source of data
T12	Groundwater Data	Data availability and source of data
T13	Comments	Name of organization, person, date received
T14	Visual Check	Indication of whether mine features are visible on aerial photos or topographic maps, and comments
T15	Documents	Document name, source, and description
T99	Data Sources	Source name, type, comments, and description

Abbreviation:
rad = radiological, and is also a measurement of absorbed dose

3.6 Reliability of Data

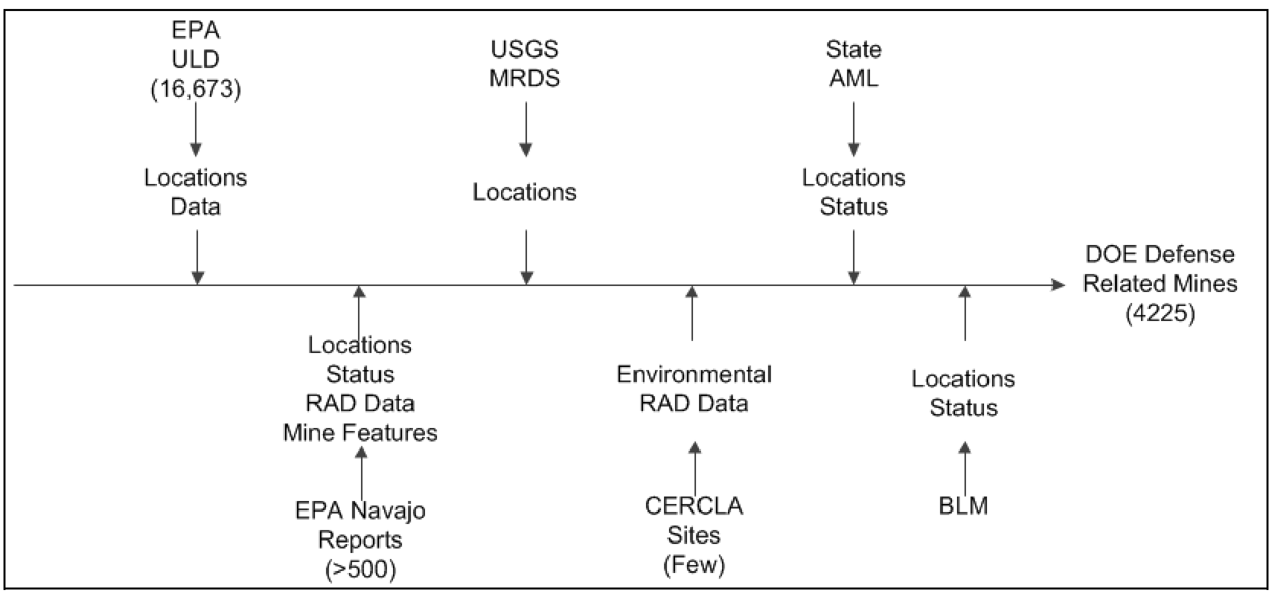
Of all the data sources encountered during research for this report, the AEC records were considered the most complete data source for mine names and production data. The AEC records are essentially a listing of contracts that covered producing mine claims, which could include any number of features. Since the H.R. 4310 legislation focuses on those mines that provided ore to the U.S. government for defense purposes, the production accounting in the contracts in the AEC records was deemed one of the most critical links for establishing evidence of defense-related production.

Location information was culled from the ULD and some of its individual data sources. These locations (latitude and longitude) were accepted as being correct, since no other means of verification was initially available. Several checks of the latitude and longitude entries were made during other data-field reviews for individual mines or group of mines from sources provided by other agencies. In those cases, if more accurate information was available, it was substituted for the original coordinates. Section 5.0 describes some of the quality assurance/quality control (QA/QC) methods used to confirm locations by matching other fields, such as whether it was plotted in the correct state and county.

4.0 Database Construction

The DOE mine database is best described as a collection of data in different formats, placed into a single flat file (spreadsheet-style). Because of the different formats of the original data, not all of the data were easily placed into the defined fields. At times, the original data are conflicting. Appendix D provides a listing of the various data tables and corresponding data fields in each.

The DOE mine database was constructed in several stages. The first step was establishing the number of mines and their locations. The second step was reconciling known mines with locations identified in EPA's ULD and other sources. The third step was determining the data fields and then populating data tables with available information. Concurrent with this step was providing a link in the database to the original source data, in case verification of specific data fields was needed and also as a reference for additional data that might not be included in the selected data fields. The fourth step was a combination of matching mine names and other source database attributes with the AEC base records. The final steps occurred after a majority of mines identified in the AEC records had been reconciled to other sources, primarily for location. These final steps included developing a process to evaluate the data, conducting data validation, identifying data gaps and other issues, and selecting production-size categories. The categories were determined by listed amounts of uranium ore production (tons of ore). Figure 8 illustrates the general development process and some of the sources used.



Abbreviations:
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
RAD = radiological

Figure 8. Database Development Process and Sources

Section 4.1 describes the process used to construct the location table, originally termed the AEC_Matches table, which started as simply a match of mine coordinates from other sources to the listings in the AEC records. Mine location is one of the most important data fields because it is associated not only with this topic report but also with the other topic reports (risk, ranking, and cost). Therefore, the construction of this portion of the database is described in significant detail.

4.1 Location Table Development

This section describes the process used to construct the main AEC_Matches table and make the data as reproducible as possible. The AEC_Matches table was created in Microsoft Excel by data entry from the AEC's *Summary of Uranium Production by District, Locality, and Property* (AEC 1967). It consisted of 4,140 AEC uranium mine records and contained the fields STATE_NAME, COUNTY_NAME, CLAIM_NAME, TONS_ORE, and LBS_U3O8. Each mine was given an auto-generated unique identification number named LM_ID. The final AEC_Matches table was imported into Microsoft Access and named T01_Location, with the LM_ID field designated as the Primary Key to link all database tables.

The LATITUDE and LONGITUDE fields were added to the AEC_Matches table for coordinates to be populated. Data source identifiers, database unique identification numbers (when available), and a YES/NO/TBD field for each data source used to identify location were added. Claim names that were exact matches (or close enough to be determined to be matches) were designated with a "YES" in the table and in the corresponding source table. Where no match was found, the field was designated with a NO. Finally, if there was a potential match but it could not be confirmed, then the field was populated with a "to be determined" (TBD). In cases where matches were found in multiple databases, then each occurrence and source was reported. The ALL_DB_Y/N field indicates whether a match has been found in the data sources examined; a YES in that field indicates that the AEC location was matched by one or more of the other sources, and a NO indicates that the AEC location was matched by none of the other sources.

The data sources were examined in the order of the following subsections.

4.1.1 EPA Uranium Location Database Compilation

A total of 1,404 positive matches and 57 TBD possible matches with location coordinates were found in the EPA_ULD data source. The ULD database contained 16,673 records that included location coordinates, a field titled "IFC ID," and a database (DB) alias. The EPA_ULD source contains 22 unique databases. The AEC_Matches table includes the following fields: ULD_IFC_ID (which is a unique ID), ULD_DB_ALIAS, EPA_ULD (with permitted values YES, NO, and TBD), and ULD_EPA_DUPLICATE. The ULD_IFC_ID and ULD_DB_ALIAS fields were populated to link the records with the DOE mine database when they are imported into Microsoft Access. In several instances, a mine was reported with multiple ULD_IFC_ID and ULD_DB_ALIAS values. All such occurrences were reported and noted with a "1" in the ULD_EPA_DUPLICATE field.

4.1.2 USGS Mineral Resources Data System

A total of 455 positive matches and 62 TBD possible matches with location coordinates were found in MRDS. The MRDS database contained 14,848 records with coordinates and a unique DEP_ID value. Only mines not positively located in the EPA_ULD data were searched for in the MRDS data, resulting in the possibility that duplicate matches are likely to exist in the multiple data sources examined. The DEP_ID values were populated to link the records with the DOE mine database when they are imported into Microsoft Access and the Geographic Information System (GIS). In several instances, a mine was reported with multiple DEP_ID values, in which case all references were recorded in the AEC_Matches table.

4.1.3 EPA 1983 Report to Congress

The EPA83 database contained 3,730 records with unique record IDs and with coordinates reported as Section, Township, Range, and Meridian. A total of 204 positive matches and 17 TBD possible matches with location coordinates were found in these data. The coordinate system values (i.e., township, range, and section) needed to be converted to latitude and longitude values, and so the EPA83 data are not considered to be as accurate as the other data sources where the coordinates provided are for specific latitude and longitude values. After importing the data into GIS, the location might be refined if the mine can be manually (visually) located on a map. The EPA83_ID field values were populated to link the records with the DOE mine database when they are imported into Microsoft Access. Only mines not positively located in EPA_ULD data were searched for in the EPA83 data, resulting in the possibility that duplicate matches are likely to exist in the multiple data sources examined. The EPA83 data include Controller Name, Mining Method, Mine Status, Production, and Depth.

All records were examined for matches and 1,062 positive matches and 70 TBD possible matches were found in the EPA83 data. Later, through examining other data sources, more accurate coordinates were established. Nonetheless, the original EPA83 matches remained linked in order to retain the additional information associated with these data.

4.1.4 Navajo Nation Abandoned Uranium Mine (AUM) Data 2007

The Navajo Nation data consisted of two tables: NN_AUM_Production_Pts containing 520 records and NN_AUM_Pts_Features containing 1,265 records. The tables contained data for Arizona, New Mexico, and Utah. Both data sets were robust, and all AEC uranium production sites from these three states were crosschecked and recorded. A total of 47 positive matches and 4 TBD possible matches with location coordinates were found in these data. The NN_AUM_PRODUCTION_PTS_ID and NN_AUM_PTS_FEATURES_ID fields were populated to link the records with the DOE mine database when they are imported into Microsoft Access. The NN_AUM_Production_Pts table contained the MINE_NAME and ALIASES fields, which were useful because in many cases several alias names are associated with an individual mine. The Navajo Nation data were a robust source of individual mine site information associated with some of the largest uranium-producing states.

In the initial examination of this Navajo Nation 2007 data, 307 positive matches and 16 TBD matches were found, based on mine names and locations. Later, through examining other data sources, more accurate coordinates were established. Nonetheless, the original matches remained linked in order to retain the additional information associated with these data.

4.1.5 BLM Colorado

This BLM Colorado data consisted of the two tables ActiveClaim_wCoords and ClosedClaim_wCoords. A total of 25 positive matches and 2 TBD possible matches with location coordinates were found in these data. The BLM-designated mine site values in the

SERIAL_NO field were populated to link the records with the DOE mine database when they are imported into Microsoft Access and GIS. These data were obtained online from BLM Colorado Geospatial Data and Metadata Statewide GIS Layers for BLM Colorado. The original data were in files named mc_120508_act and mc_120508_clo. The information files with attributes were imported into GIS and then exported into Microsoft Excel as the ActiveClaim_wCoords table and the ClosedClaim_wCoords table after the coordinates were converted into latitude and longitude.

The table ActiveClaim_wCoords (mc_120508_act) contained 13,799 rows of mine, claim, feature, and occurrence names (or records), and the table ClosedClaim_wCoords (mc_120508_clo) contained 266,388 records (including mines of various other commodities). These tables were searched only for mine sites that had not been located or that had been reported as TBD in one or more of the other data sources examined previously. (These tables were *not* searched for mines that already had been positively located in one or more of the other data sources.) This more restricted search process resulted in the 27 records (i.e., the 25 positive matches and 2 TBD matches previously mentioned) that were added to the DOE mine database from these two BLM Colorado tables.

The location coordinates in these BLM Colorado tables are reported in polygons, which means each location needs to be manually identified on maps for more accurate mine placement if possible. The original source metadata is located online at http://www.blm.gov/co/st/en/BLM_Programs/geographical_sciences/gis/GeospatialData.html.

4.1.6 Navajo Nation AUM Data 2011

The Navajo Nation AUM data source from 2011 (NN_SUMMARY) was a data table that contained 585 records for Arizona, New Mexico, and Utah. A total of 303 positive matches and 10 TBD possible matches with location coordinates were found in these data. The information in the table was robust, and it was determined that all information in the NN_SUMMARY data table about AEC uranium production sites in these three states was crosschecked and imported into the DOE mine database as appropriate.

4.1.7 New Mexico Mining and Minerals Division

The 2010-10-07_MasterAnaly.xls workbook consisted of four spreadsheets: (1) "e" had 260 records; (2) "no-Anderson, MARP, etc." had 43 records; (3) "no_no ref" had 445 records; and (4) "Mills" had 9 records. These spreadsheets were searched only for mine sites that had not been located or that had been reported as TBD in one or more of the other data sources examined previously. (These spreadsheets were *not* searched for mines that already had been positively located in one or more of the other data sources.) As a result of this search, 79 positive matches and 5 TBD possible matches with location coordinates were found.

4.1.8 BLM Abandoned Mine Sites Cleanup Module

Data from the BLM Abandoned Mine Sites Cleanup Module (AMSCM) database system was reviewed. The workbook titled "Data from Saved Query for DOE_081913.xlsx contained 6,871 records, and all were crosschecked for matches. Two new matches were found, and a total of 1,748 positive matches were identified and imported into the DOE mine database.

4.1.9 Colorado Radioactive Mineral Occurrences: Bulletin 40

Bulletin 40, published by the Colorado Geological Survey, consisted of one report and a map. Five positive matches with location coordinates were found in this source.

4.1.10 Wyoming Uranium General DOE

These data consisted of a table URANIUM GENERAL DOE.xls of Wyoming sites from AEC records that were sent to the Wyoming Department of Environmental Quality, AML Section, for review and editing. Four positive matches with location coordinates were found in these data, along with additional comments and attribute (data field) information. Wyoming AML Program personnel stated that these data were likely updated in their records but may not yet have been included in the BLM AMSCM database (noted in 4.1.8).

4.1.11 Utah Uranium Past Producers and Permitted Uranium Mines Tables

This data source consisted of the two tables UT_AGRC01_Past_Producers and UT_AGRC_01_Permitted. A total of 284 positive matches and 30 TBD possible matches with location coordinates were found in this source. All records were examined from these tables, and relevant, additional attribute data were populated in the DOE mine database.

4.1.12 Arizona Radioactive Occurrences and Uranium Production

This source consisted of a 1981 report and associated maps (GJBX-143[81]) prepared for DOE. Eighteen positive matches, based on location coordinates, were found in this source.

4.1.13 Uranium Map of Wyoming—Map Series 94

This source, published by the Wyoming Geological Survey, consisted of a map and GIS shapefiles. A total of 126 positive matches and 18 TBD possible matches, based on location coordinates, were found in this source.

4.1.14 Additional Data Sources for Location Table

A limited number of matches that provided location coordinates were identified from additional data sources, as described in the following sections.

4.1.14.1 Arizona Geographic Information Counsel (AZ_AGIC)

One positive match with location coordinates was found in this table. This table was searched only for mine sites that had not been located or that had been reported as TBD in one or more of the other data sources examined previously. (This table was *not* searched for mines that already had been positively located in one or more of the other data sources examined.)

4.1.14.2 Colorado Uranium Leasing Program (ULM_Mine)

This source consisted of two workbooks containing DOE Uranium Leasing Program (ULP) records for Colorado. The workbooks were (1) BLM Reclamation Status and Cost Data and (2) ULP Legacy Reclamation Status and Cost Data. Three positive matches and one TBD possible match with location coordinates were found in these workbooks. These workbooks were searched only for mine sites that had not been located or that had been reported as TBD in one or more of the other data sources examined previously. (These workbooks were *not* searched for mines that already had been positively located in one or more of the other data sources examined.)

4.1.14.3 Utah Automated Geographic Reference Center (UT_AGRC)

This source contained two tables, UT_AGRC_01_Past_Producers and UT_AGRC_01_Permitted. A total of 284 positive matches and 30 TBD possible matches were found in this source. All records were examined from these tables and additional attribute data were populated in the database.

4.1.14.4 Directory of Colorado Uranium and Vanadium Mining and Milling Activities Map Series 11, 1978 (MS_11 Text and Map Colorado Uranium and Vanadium Mining)

Two positive matches with location coordinates were found in these data. This source was searched only for mine sites that had not been located or that had been reported as TBD in one or more of the other data sources examined previously. (These data were *not* searched for mines that already had been positively located in one or more of the other data sources examined.)

4.1.14.5 Database of Uranium Mines, Prospects, Occurrences, and Mills in New Mexico, April 3, 2002 (URANIUM_MINES_NM)

Two positive matches and one TBD possible match with location coordinates were found in this table. This table was searched only for mine sites that had not been located or that had been reported as TBD in one or more of the other data sources examined previously. (This table was *not* searched for mines that already had been positively located in one or more of the other data sources examined.)

4.1.14.6 North Dakota Abandoned Mines Land Division

Following a review of a draft version of this report, personnel from the North Dakota AML Division reviewed the DOE mine database and identified several duplicate entries. Because of the relatively low number of duplicates, these were removed from the database. This was not the case for other states due to a much larger number of potential duplicates and lack of specific data for each of those. The end result for the North Dakota review was that the total number of mines was reduced by seven. Total uranium production was unchanged, as the different quantities assigned to duplicate mine names were combined.

4.1.15 Summary of the Location Table Data Sources Search

The original AEC_Matches table (based solely on 1967 AEC data; see Section 3.1) contained 4,140 records. During the examination of additional data sources described here (Section 4.1), 92 more records were added from Navajo Nation or EPA records and 7 were subtracted from the North Dakota tally, bringing the total to 4,225 records. Of that total, 3,427 mine locations were positively matched with the additional data sources, 206 mine locations were categorized as TBD or possible matches with the additional data sources, and 592 mine locations could not be matched with data in the additional data sources. There are 26 of the 4,225 that cannot be located due to lack of information such as mine name or state and county of the mine.

Assumptions were made where mine names were not exact matches. In some cases, a location that was initially reported as "TBD" was changed to "Yes" if a sufficient number of the additional data sources indicated confirming information. Multiple data sources spanning many years were used to create the table, and there is an inherent possibility of transcription errors in the data.

Each database table includes a data source field to link the information with the original source. The name, type, originator, description, file name, and file path of each data source are in the database table T99_Data_Sources. Whenever a document was found that contained information pertinent to the database, information about that document was added to the T99_Data_Sources table.

A Source Data Tracking workbook was created to track all sources of data examined. The status of the review process was also tracked in the Source Data Tracking workbook, which includes seven spreadsheets titled Reports, Tables, GIS, Maps, Comments, Email, and Document Review.

Table 7 lists the various data sources used to determine DOE mine locations. Many mines are present in several databases; therefore a specific number was not attributed to each data source. The data sources in Table 7 are listed in decreasing number of mine locations that were included in the DOE mine database.

4.2 Other Data Sources for Special Information

Several data sources obtained were helpful in filling data gaps regarding some mines' location and other database attributes, such as gamma readings and reclamation status. These data sources include (1) the screening reports of several hundred Navajo Nation AML sites that were prepared for EPA in 2007 and 2011, and (2) the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) reports prepared for 68 sites in New Mexico by the New Mexico Environment Department and DOE's ULP.

4.2.1 EPA's Screening Reports for Navajo Nation Sites

EPA supplied a spreadsheet, prepared by Weston Solutions Inc. (Weston), of 617 records for mines, mine sites, and other mining-related locations associated with EPA screening-report efforts that were conducted in the late-2000s (EPA 2013b). Table 8 lists the data fields that are available in a typical screening report. A comparison of these 617 records with the DOE mine database indicated that 423 of these matched by similar name. The remaining 194 that did not match were individually reviewed to determine if any should be included in the DOE mine database.

Table 7. Data Sources for Mine Locations in the DOE Mine Database

Data Source
EPA Uranium Location Database (ULD)
BLM Abandoned Mine Sites Cleanup Module (AMSCM)
USGS Mineral Resources Data System (MRDS)
Navajo Nation AUM Data 2011
Utah Uranium Past Producers Table
EPA 1983 Report to Congress
Uranium Map of Wyoming - Map Series 94
Utah Division of Oil, Gas, and Mining Uranium Locations Tables
Colorado Division of Reclamation, Mining and Safety Permitted Mines Shapefile
Navajo Nation AUM Data 2007
New Mexico Mining and Minerals Division Master Analysis Spreadsheet
T13_Comments
NN_AUM2007
Colorado Division of Reclamation, Mining and Safety Uranium Closure Spreadsheet
BLM_CO ClosedClaim_wCoords
Arizona Radioactive Occurrences and Uranium Production
Utah Permitted Uranium Mines Table
Colorado Radioactive Mineral Occurrences– Bulletin 40
Wyoming Uranium General DOE
Document Review Nmalczyk_Skyline_and Sec_32_33
Directory of Colorado Uranium and Vanadium Mining and Milling Activities
USFS, R3, NM
Preliminary Map No. 32 - Location of Uranium Mines in the Powder River Basin, Wyoming
Geology and U-V Deposits of San Rafael River Mining Area, Emery County, Utah
Open-file Report 461 - Database of Uranium Mines, Prospects, Occurrences, and Mills in New Mexico
Railroad Commission of Texas
USGS Topographic Maps
National Park Service
Area Economic Map of White Canyon (Utah) Quadrangle
From V.T. McLemore (2007): Unpublished database of the uranium mines, prospects, occurrences, and mills in New Mexico, New Mexico Bureau of Geology and Mineral Resources
Utah Geological Survey Miscellaneous Publication. 93-3, *Uranium Deposits in White Canyon Mining District, Utah*
Map Scan-3, Lisbon Valley, Utah, Provisional Edition 1987: 38109-B2-TF-024
BLM_CO ClosedClaim_wCoords and MS_11 Text and Map Colorado Uranium & Vanadium Mining, Page 3
Montana Department of Environmental Quality, Abandoned Mine Bureau
ULM_MINE_CO R032717A.cor OBJECTID 634
ULM_MINE_CO ISSUE 2070 OBJECTID 147
Engineering Evaluation/Cost Analysis (EE/CA)
Radioactive Mineral Occurrences in Nevada
Montana GIS Abandoned Mine Inventory

Table 8. Data Fields from Typical EPA Screening Report for Navajo Nation AML Sites

Field Name
EPA Mine ID
EPA All Mine ID
Mine Name
Mine Name – Alias
Region
Accessible
Access Comment
Chapter
Weston Report Type
Field Investigation Date
Contract Date
Latitude
Longitude
Start Year
End Year
Stratum
Producer
Production – Tons
U_3O_8 – lbs
U_3O_8 – percent
V_2O_5 – lbs
V_2O_5 – percent
Mine Area – Square Meters
OBS Structures Onsite
Nearby Public or Commercial Structure – 0-200 feet
Nearby Public or Commercial Structure - >200 feet
Water Table
Water Table Source
Water Sources – 0–0.25mile
Water Sources – 0.25 mile–4 miles
Mine Waste – Cubic Yards
Adits
Waste Piles
Pits
Shafts
Other Debris or Mine Features
Reclamation Status
Surface Land Status
Highest Gamma Readings counts per minute (cpm) (Gamma High)
Site Background Gamma – Average (cpm)
Gamma Range – Waste Piles (cpm)
Gamma Range (cpm)
2X Background
10X Background
Number of Gamma Measurements
Miscellaneous Information and Other Comments
Production Source
Comment
Host Rock

Abbreviations: cpm = counts per minute

The screening report for each of the 194 sites was reviewed to determine if any of the sites qualify as a mine under DOE's definition. The following categories were developed to determine which sites should be included into the DOE mine database:

- **Yes:** These mine sites should be included because (1) they were listed as having produced uranium ore during the life of the mine or (2) there were sufficient indications of mine-related features along with gamma readings greater than 10 times background to indicate uranium ore had been present.
- **No:** These mine sites should not be included. For some of the sites, the reason was because they were either listed as never producing uranium ore or no production was listed. Other reasons for not qualifying were:
  - The site was listed only as a mining claim (14 sites).
  - The site was identified as a transfer station or some type of storage site or ranch near a mine (12 sites).
  - No report was identified with the site (4 sites).
  - The site was physically inaccessible to the field crews, so no information was available or there was incomplete information or contradictory information (3 sites).
  - The period of operation was outside the time frame of producing for AEC (i.e., after 1970) (3 sites).

Based on the review, 92 of the records were added to the DOE mine database. Combined with the 423 records that matched mines already in the database, the end result was that 515, or 83 percent, of the 617 total records on the EPA screening-reports spreadsheet met the definition of a "mine" for the DOE mine database.

The other 102 records (of the 194 that were not matches initially) were not added to the database. Further research might allow some of those rejected sites to be categorized as a mine.

Comments:

- Separately, DOE was provided with 597 screening reports that Weston prepared for EPA for various Navajo Nation sites. A review confirmed that these were all included in the spreadsheet of 617 sites that was cross-walked.

- EPA identified 520 mine sites in its 2007 GIS Atlas Report and 521 mine sites in the 2013 5-Year Plan. (The numbers were different because the 5-Year Plan evaluated all of the sites in the Atlas Report except for two that were in active remediation, plus three others that had not been previously identified.) A review confirmed that all of the sites in the report and in the 5-Year Plan were included in the spreadsheet of 617 records (sites) that was cross-walked.

4.2.2 CERCLIS Reports—New Mexico

The New Mexico Environment Department identified mines in the Grants Mineral Belt (also referred to as the Grants Mining District) and conducted an onsite evaluation of the adequacy of the reclamation effort for each mine selected. The evaluations were used to identify site hazards and contamination and to prioritize remaining site reclamation. Also, these evaluations were likely conducted to determine the extent to which these mines may have contributed to the regional groundwater concerns in the Grants Mining District, as a majority of the reports detailed potential receptors for contamination and the distance to groundwater users and surface water sources. Sixty-eight reports were provided to DOE for the mine research effort.

The mines were visited and the reports were generated in the 2009 to 2012 time frame. Each report details the site physical description, targets for surface water runoff and groundwater usage, receptors (such as livestock), site ownership, and potentially responsible parties, along with recommendations for further evaluation or reclamation. Many reports included photographs of site features and maps illustrating radiological readings and associated locations. A summary table (Appendix E) was generated from the reports for input into the DOE mine database. New Mexico Mining and Minerals Division personnel provided additional input, which was included in the DOE mine database but may not be reflected in the table in Appendix E.

4.2.3 CERCLA Reports

Numerous uranium mines are either in the process of being characterized or have had reclamation completed through the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process. Documents available to the public from over 20 sites were reviewed to gather additional data. Follow-up with the lead agencies (EPA, USFS, BLM, or the U.S. National Park Service) was not performed due to the schedule constraints. Consequently, additional information might be available including a change in status from what was found on websites. Typical documentation found was in the form of Preliminary Assessments and Engineering Evaluation/Cost Analysis (EE/CA) reports. Several sites, such as the Midnite mine in Washington and Riley Pass in South Dakota, have had numerous studies performed, including risk assessments.

CERCLA sites tend to have more extensive characterization performed, mainly to analyze the exposure risk to humans and the environment from the heavy metals and radionuclides. Due to the exposure pathways, risks, and regulatory framework, CERCLA sites typically have the soils remediated and stabilized in a disposal cell (e.g., Skyline mine, Utah; and White King/Lucky Lass, Oregon).

Table 9 lists sites with CERLCA documentation that were reviewed and the relevant data that were compiled into the DOE mine database.

Table 9. Mine Sites with CERCLA Documentation That Were Reviewed

Mine Name	Location; Tribe	Agency Lead	Status of Reclamation*	Documentation/Comments
Jackpile-Paguate	New Mexico; Laguna Pueblo	EPA	Reclamation Complete	Hazard Ranking1986 Record of Decision (ROD); Proposed listing on the National Priorities List (NPL)for offsite water contamination; largest mine; 400 million tons waste rock
Section 32/33 AUM	Thoreau, New Mexico	EPA	Interim Action Complete	Preliminary Assessment
Quivera-Church Rock	New Mexico; Navajo Nation	EPA	Interim Action Complete	Expanded Site Screening; Operated 1976–1985; Not AEC related
San Mateo	New Mexico	USFS	Remediation Ongoing	EE/CA
Section 26 AUM	Haystack, New Mexico	EPA	Preparing Assessment	None; Preparing preliminary assessment
Midnite	Washington; Spokane Tribe	EPA	Design of Remedy	ROD Remedial Investigation/Feasibility Study Human & Ecological Risk Assessment
Workman Creek	Arizona	USFS	Reclamation Complete	EE/CA
King Edward	Utah	USFS		EE/CA
Riley Pass	South Dakota	USFS	Partially Remediated	EE/CA Risk Assessment
White King/ Lucky Lass	Oregon	EPA/USFS/ State	Removal Action Complete	2001 ROD Site Progress File; Conducted 5-Year review
Moonlight	Arizona; Navajo Nation	EPA	Assessment	Preliminary Assessment
Mariano Lake	New Mexico; Navajo Nation	EPA	Interim Action	Preliminary Assessment
Ruby 1-4	New Mexico; Navajo Nation	EPA	Assessment	None; Potentially responsible party (PRP) Negotiations.
Haystack-Butte (Bluewater)	New Mexico; Navajo Nation	EPA DOE	Remedial Action Complete	EPA On-Scene Coordinator's Report
Skyline	Utah; Navajo Nation	EPA	Remediation Complete	Assessment Report
Gray Daun/Firefly	Utah	USFS	Remedial Action Complete	Part of UNC Geotech-Nine Report
Mesa I	Arizona; Navajo Nation	EPA	Updating Assessment	Preliminary Assessment
Cameron Area	Arizona; Navajo Nation	EPA	Assessment Started	None; Multiple Mines-PRP Negotiation
Cove Mesa Aggregate	Arizona; Navajo Nation	EPA	Assessment	None; Not a Mine
Billy the Kid	New Mexico; Navajo Nation	EPA	Assessment	Preliminary Assessment
King Tutt	Arizona; Navajo Nation	EPA	Reassessment	Reassessment
Section 9	Arizona; Navajo Nation	EPA	Assessment In progress	Preliminary Assessment
Butterfly/Burrell	Colorado	USFS		EE/CA
Ross Adams	Alaska	USFS	Preparing EE/CA	2010 Final Site Characterization
CERCLIS– 68 NM Sites	New Mexico	State		CERCLIS Screening Reports
Juniper	California	USFS	Reclamation In-Process	EE/CA
Northeast Church Rock	New Mexico; Navajo Nation	EPA	Interim Action Complete; Remediation In-Process	EE/CA; Operated 1967–1982 (non-AEC)

* = as determined from publically available information

4.2.4 DOE's Uranium Leasing Program

Some mines that did not have a direct match between AEC records and other databases regarding location or reclamation information were identified through other DOE programs.

DOE currently administers the ULP and its 31 uranium lease tracts located in the Uravan Mineral Belt of southwestern Colorado. The ULP began in 1948 when Congress authorized the AEC to withdraw lands from the public domain for the sole purpose of exploring for, developing, and mining uranium ore bodies. Through a series of public land orders, AEC took control of approximately 500,000 acres of land in Colorado, New Mexico, Utah, and Wyoming. USGS assisted AEC in implementing a massive exploration program to identify lands that contained the most favorable geologic formations for uranium. Subsequently, AEC retained only those lands (approximately 25,000 acres) that met the most favorable criteria. DOE still administers those lands today.

In addition to administering the ULP for the past six decades, DOE has also undertaken the task of reclaiming a large number of abandoned (legacy) uranium mine sites and associated features throughout the Uravan Mineral Belt. These legacy mine sites were typically operated during the 1940s through the 1960s, at a time when operators were not required to reclaim their mine sites once mining activities were suspended.

In 1994, DOE initiated a 3-year reconnaissance program to locate and delineate (through extensive on-the-ground mapping) the legacy mine sites and associated features contained within the historically defined boundaries of its uranium lease tracts. That program ultimately identified 161 separate and distinct mine sites that required some form of site reclamation.

During that same time frame, DOE recognized the lack of regulations pertaining to the reclamation of legacy mine sites. After DOE contacted the U.S. Department of Interior, BLM Headquarters established a dialog with the various BLM field offices in southwestern Colorado (Grand Junction, Montrose, and Durango) concerning the reclamation of legacy mine sites. Ultimately, DOE collaborated with BLM to develop reclamation criteria specifically tailored to AUM sites. In November 1995, the BLM Colorado Office issued the *Closure/Reclamation Guidelines for Abandoned Uranium Mine Sites* (BLM 1995) as a supplement to the BLM document *Solid Minerals Reclamation Handbook* (H-3042-1).

Over the course of the next 5.5 years (through May 2001) and in accordance with the BLM guidance document (BLM 1995), DOE systematically reclaimed the 161 mine sites that had been identified.

In 2000, BLM requested technical and administrative assistance from DOE and its Technical Assistance Contractor in support of BLM's AML Reclamation Program. An initial letter agreement and then an Interagency Agreement were established between the two agencies to support this effort. Under the various task orders associated with the agreement, BLM requested (and funded) DOE personnel to provide assistance in (1) conducting additional inventory work on BLM mine sites and DOE-administered sites that were proposed for return to public domain and (2) reclaiming known mine sites in the public domain under BLM's administrative jurisdiction.

Mine-site inventory activities consisted of field investigations, updating inventoried mine sites in the AMLIS database, literature reviews, Global Positioning System data collection, mapping, and documentation. The AMLIS database for DOE-controlled mines sites within the three BLM areas was updated. As part of the update, DOE examined the mining claim information and the existing BLM inventory files to identify data gaps and conducted additional field investigations for BLM sites as required. From 2000 through 2008, DOE and subcontractor personnel performed reclamation activities at 182 separate BLM mine sites.

During the 1940s and 1950s, the Public Land Orders that withdrew lands from mineral entry for the exclusive use of the federal government (AEC and its successor agencies, including DOE) specifically excluded all prior-existing valid claims. During the late 1990s and early 2000s, all of the privately held, unpatented mining claims located within the withdrawal boundaries were relinquished, and the associated lands contained within those claims reverted to the DOE withdrawals. Many of those claims had mine sites on them that needed to be addressed. In the fall of 2007, DOE decided to systematically assess, and then reclaim, the 21 separate and distinct mine sites located on those prior existing claims. Those reclamation activities began in 2009 and were completed in 2011.

5.0 Validation of Data and Data Gaps

Having assembled the DOE mine database, a review of the data was conducted to assess data gaps, validate the data, and perform other QA/QC checks prior to creating data tables and queries for the cost and risk evaluations.

5.1 Duplicates in the Database

QA/QC checks were conducted on the data compiled. One check was a comparison of mine names (along with the state and county location) to determine the number of apparent duplicates. A query of the database for these three elements indicated 255 mines whose name is duplicated one or more times. These are termed "apparent duplicates" because not all information about individual mines is known. While the mine name is given as the "Ruby mine" in one data source, other sources may list a "Ruby," "Ruby 1," "Ruby 2," "Ruby Group," and so on, so that the true number of mines representative of "Ruby" is unknown. Also, there are a few instances where only the mine name and location are listed (e.g., "Ruby") but other information (e.g., ore production) is different for each record. Therefore, to avoid eliminating a mine that may be part of a group of mines, or to avoid eliminating a duplicative mine name and then losing its associated ore production value, an annotation was added that these mines are "likely duplicates." Future research will be needed prior to conducting closure work or assigning a true closure status to those mines.

Table 10 through Table 12 provide examples culled from the database where the mine name or claim name is the same but its location is in multiple states or in a different county within the same state. Also, note the alternate names, as these are sometimes unrelated to the original (see LM ID 621 in Table 10) or contradictory (see LM ID 883 in Table 12).

Table 10. Example of Same or Similar Mine Names in Two Counties in the Same State

LM ID	Claim Name	State Name	County Name	Alternate Name
251	Flat Top	Colorado	Mesa	
813	Flat Top	Colorado	Montrose	
2119	Flat Top	Utah	Emery	
2710	Flat Top	Utah	Grand	
621	Flat Top 1 2 & 3	New Mexico	McKinley	Fife and Bailey, Vilatie Hyde
3205	Flat Top LSE	South Dakota	Harding	
620	Flat Top Vilatie Hyde 4	New Mexico	McKinley	Fife and Bailey, Vilatie Hyde

Table 11. Example of Same or Similar Mine Names in Four States

LM ID	Claim Name	State Name	County Name	Alternate Name
179	Starlight	Colorado	Montrose	
1627	Starlight	Utah	San Juan	
1799	Starlight 1	Arizona	Navajo	
181	Starlight 1	Colorado	Montrose	
182	Starlight 2	Colorado	Montrose	
3387	Starlight 2	South Dakota	Fall River	
183	Starlight 4	Colorado	Montrose	
180	Starlight 8	Colorado	Montrose	

Table 12. Example of Conflicting Mine Names and Alternate Names

LM ID	Claim Name	State Name	County Name	Alternate Name
1629	Vanadium Queen	Utah	San Juan	
883	Vanadium 7	Colorado	San Miguel	Vanadium 8
874	Vanadium 8	Colorado	San Miguel	Vanadium 7
520	Vanadium King 1	Colorado	Mesa	
2147	Vanadium King 1	Utah	Emery	

A simple elimination of duplicate mine names based on matching state and county names would eliminate 292 records from the DOE mine database, but that particular elimination of duplicates has not been done. If it is later conducted, it will be important to first review associated data sources to ensure that useful data field information from the duplicate mine records is not lost. For example, a few records exist where the only noted difference is for the tons of ore produced; apparently different years were sometimes recorded on separate entries.

The issue of duplication is not restricted to the DOE mine database. It was also noted in the TENORM ULD and MRDS, where their data are also a compilation from several sources. Individual state AML programs, however, appear to have fewer duplications in the number of mines in their jurisdiction and for the mines where remedial planning is being provided.

5.2 Location Reconciliation

Mine locations provided in the AEC records were limited to state and county. Other data sources, such as the USFS and state AML listings, provided township, range, and section designations, while those in the ULD or EPA's Navajo Nation screening reports provided latitude and longitude coordinates. However, many of these latitude and longitude points have been determined (through plotting on maps and/or overlaying satellite imagery) to be distant from actual disturbed mined areas. Several reasons for this discrepancy were noted by the Wyoming AML Program Manager, when it was pointed out that the latitude and longitude may represent corner points on the original mine claim boundary or the site of an original prospect. Subsequent mining activity could have occurred several hundreds of feet or even thousands of feet from that point. Examples of this are shown in Figure 9, which provides both an aerial image and a portion of the topographic map for several mines illustrating the relative distance discrepancies between locations mapped according to the latitude and longitude provided from the data sources (i.e., the colored mine names and dots) and the actual observable ground disturbances (i.e., black printed names and mine symbols on the topographic map on the right). The Small Fry (1) and San Juan Shaft are good examples of a known distance discrepancy. The Pasco Jen Jackie and Columbia Shaft GR sites shown by colored dots are not readily attributable to a specific point since their names are not shown on the topographic map.

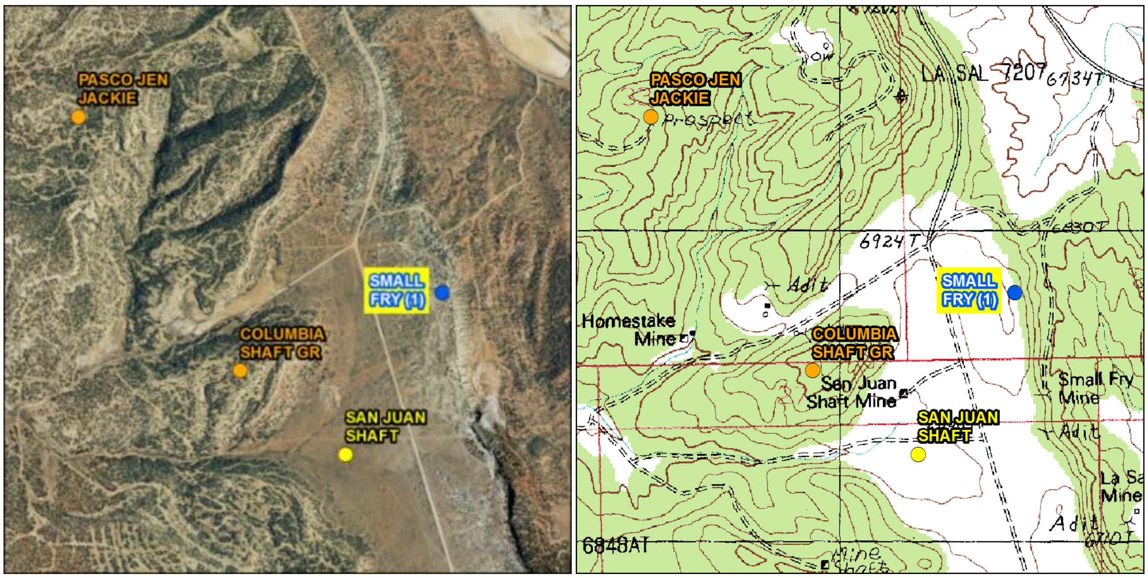


Figure 9. Discrepancy of Mine Locations

Another potential reason for given locations not plotting close to observed mined land is that the reference datum was not provided with most of the latitude and longitude data. Some states, such as Wyoming, did provide a reference; however, for many sites, it is unknown whether the North American Datum of 1927 (NAD27) or the North American Datum of 1983 (NAD83) was the reference datum. Actual location points can differ by several tens of feet or even a few hundred feet between these two reference datum systems.

5.3 Mine Land Ownership

Ownership categories and their associated boundaries are dependent on the accuracy of the data source, which factored heavily in mine location reconciliation. (The only way to definitively determine the land ownership at abandoned mines is to conduct land surveys.) The ownership category (e.g., federal, state, private, tribal) was largely determined by plotting the latitude and longitude coordinates for a particular mine along with ownership designations that have been provided on nationwide or regional scale maps. If the latitude and longitude coordinates deviate from the actual location by several hundreds of feet, then the resulting designation of ownership may be incorrect, especially where an actual ownership boundary lies near to that deviated point. Therefore, the number of AUMs attributed to a particular ownership category may conflict with the count provided by that agency or entity. This is particularly important in areas with a combination of federal, private, and tribal land, such as Grants Mineral Belt, New Mexico. Table 13 shows the number of mines by various agencies or other ownership category. As shown in Table 13, the largest percentage (49.8) of mines are located on BLM land.

A sizeable percentage includes non-federal (12.3 percent) and unknown ownership (15.6 percent). The non-federal ownership includes land owned by local municipalities or counties or that could otherwise not be linked to a federal agency. Also, the number shown for the U.S. Bureau of Indian Affairs is less than that mentioned in Section 4.2.1 for the Navajo Nation. This is because the Navajo sites include mines that are off the Navajo Nation on trust, allotment, and private lands, so it is difficult to reconcile the two.

Table 13. Breakdown of Mines by Land Ownership Category

Agency	Number of Mines	
	Count	Percent of Total
U.S. Bureau of Land Management	2,103	49.78%
Unknown	657	15.55%
Non-Federal	518	12.26%
U.S. Bureau of Indian Affairs	410	9.70%
U.S. Forest Service	369	8.73%
Private	65	1.54%
Indian Trust	37	0.88%
National Park Service	29	0.69%
State	14	0.33%
Indian Allotment	5	0.12%
U.S. Bureau of Land Management/Private	5	0.12%
Bureau of Reclamation	3	0.07%
State/Private	3	0.07%
U.S. Department of Defense	2	0.05%
U.S. Fish and Wildlife Service	2	0.05%
U.S. Bureau of Indian Affairs/State	1	0.02%
U.S. Bureau of Land Management/State/Private	1	0.02%
U.S. Forest Service/Private	1	0.02%
Total	4,225	100.00%

5.4 Satellite Imagery Review

Another QA/QC check was to verify a random number of mine locations from all but the largest size categories using satellite imagery. The locations for each mine (78 were reviewed), using latitude and longitude coordinates, were plotted on maps and also on satellite imagery of those areas. Then a visual interpretation was made to ascertain whether ground disturbances typically associated with a mine were noticeable on the imagery. These interpretations provided mixed results. As noted in Section 5.2, one of the reconciliation issues is a result of the given mine location not plotting on a map at or immediately adjacent to known mines. Therefore, results of the imagery review are skewed by that factor. In general, the Small to Small/Medium size mines were not visible on most satellite images. A few mines in these smaller size categories were observed when the mine location was confirmed by map designation and using the oblique angle viewing available on Google Earth. Appendix F contains the table of results from the review of imagery and topographic maps, and Table 14 presents a sample portion of that table.

Table 14. Example of Results from Imagery and Topographic Map Review

LM ID	Claim Name	State Name	County Name	Visual Check	Aerial	USGS Topo	Visual Check Comment	Production-Size Category
6	Bull 4	Utah	Garfield	True	Mine feature not visible	Mine feature not visible	No sign of nearby mine features on either the topo map or the aerial photo.	Small (0–100 tons)
10	F H Barney	Arizona	Unknown	True	Mine feature not visible	Mine feature not visible	No mine features seen in either view.	Small (0–100 tons)
23	Blue Moon	Colorado	San Miguel	True	Mine feature visible	Mine feature visible	This is in an area that is heavily worked over and contains many nearby mines. This location is less than a mile west of the DOE Uranium Reserve, according to the topo map.	Small/Medium (100–1,000 tons)
35	Babe Ruth	Colorado	Montrose	True	Mine feature visible	Mine feature visible	This location falls right on top of the Babe Ruth mine. It is located in the DOE Uranium Reserve.	Medium (1,000–10,000 tons)

Figure 10 through Figure 12 illustrate some of the aerial images reviewed and compared to topographic map labeling.

Figure 10 is an example where an aerial image and a topographic map both indicate a matching location for a mine, and the given coordinates correspond to the known location.

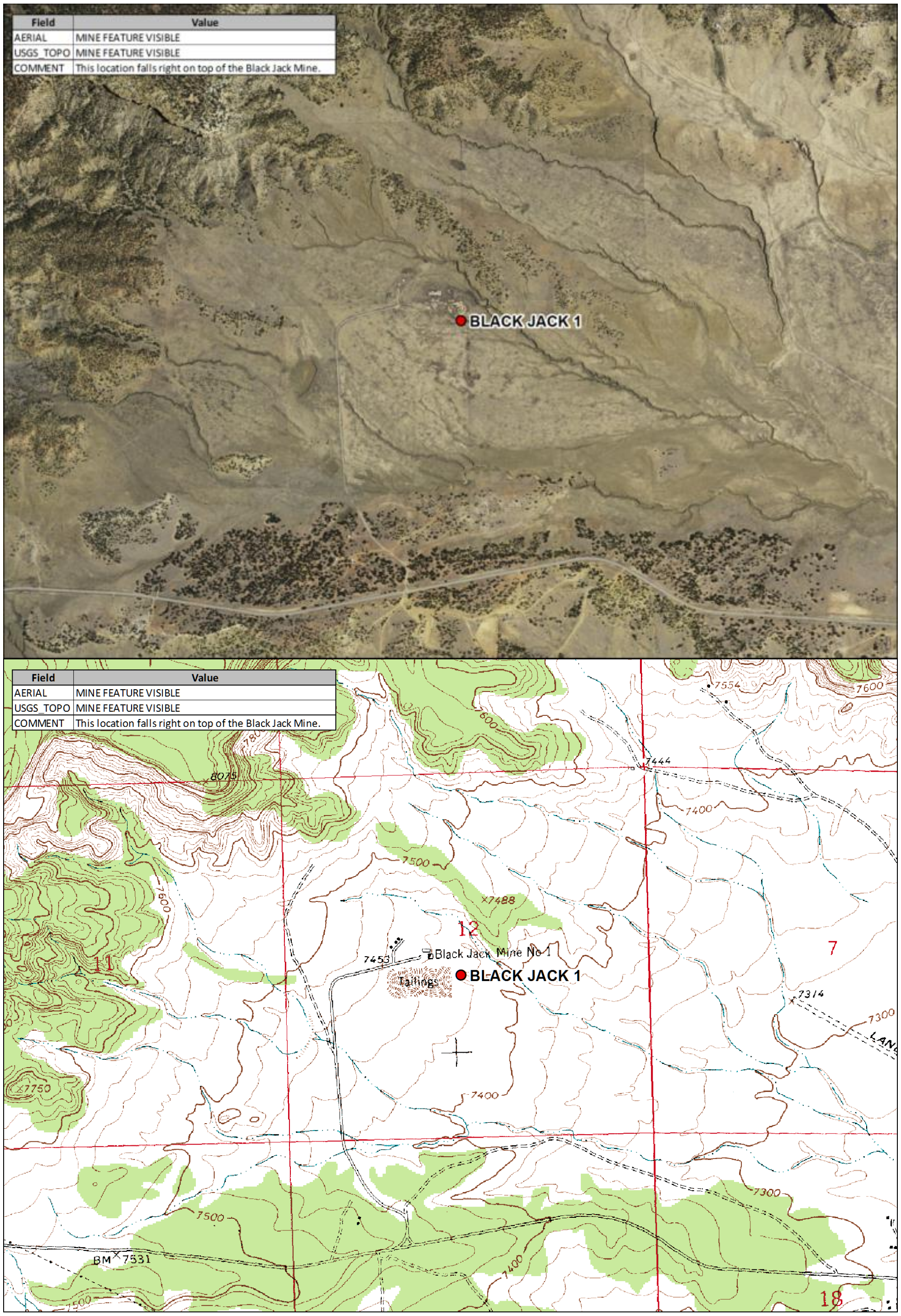


Figure 10. Example of Aerial Image and Topographic Map with Matching Indications for a Mine

Figure 11 is an example of an aerial image and a topographic map that both indicate a mine at one location (disturbed ground on image at Rundberg/Apex), and that both show no indication of a second mine (Early Day). Note that it is common for mines to have multiple names and aliases due to frequent ownership changes; this is the inference for the Rundberg/Apex mine.

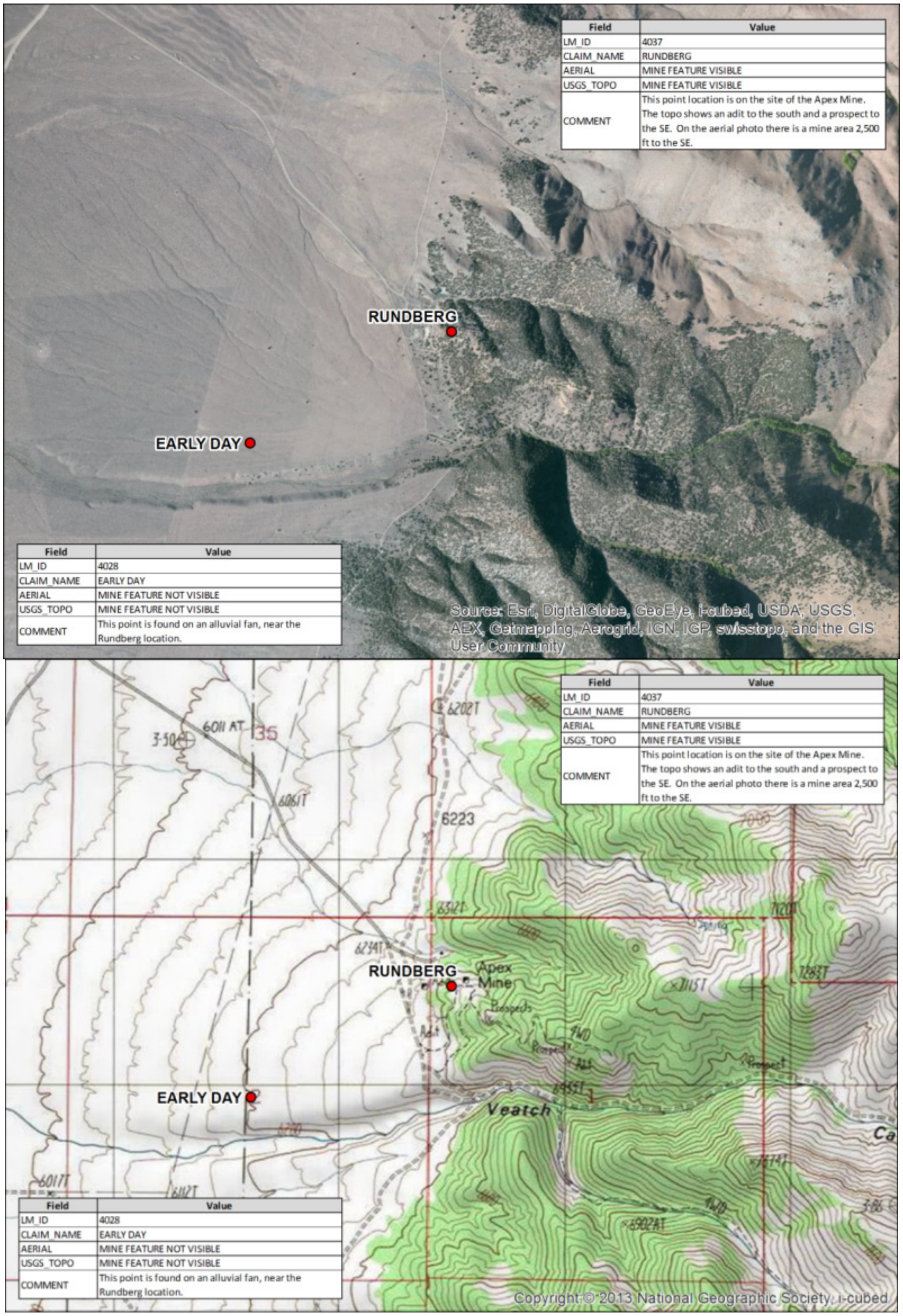


Figure 11. Example of Aerial Image and Topographic Map with Matching Locations for One Mine and No Indications of a Second Mine

Figure 12 is an example of a given mine location that is neither visible on aerial image nor labeled on the topographic map. Evidence of mining activity (see map inset with label for mine shaft) was noted approximately 2.75 miles to the southwest of the given mine location.

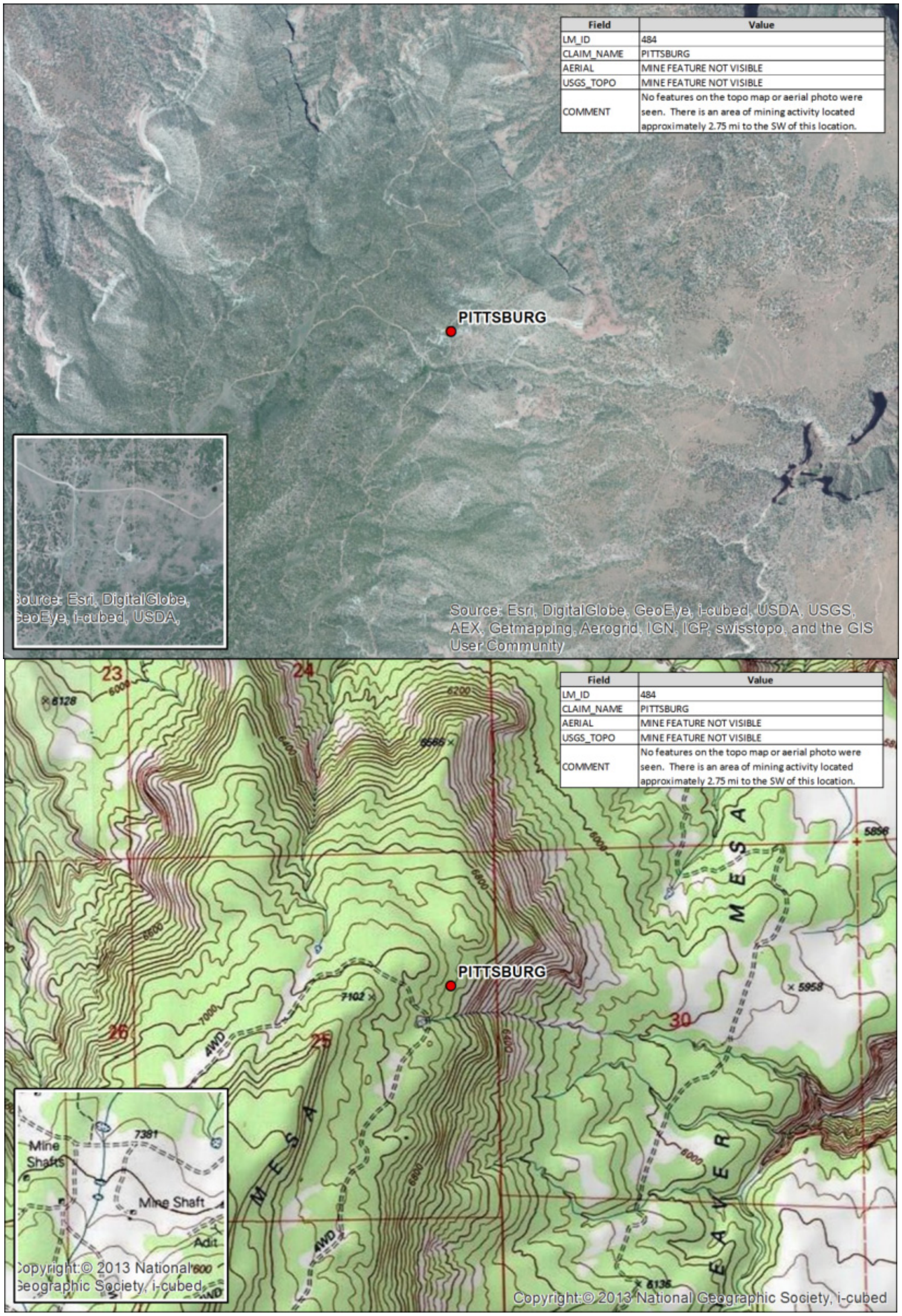


Figure 12. Example of Aerial Image and Topographic Map with Neither Showing a Given Mine Location

5.5 Investigation of Unknown-Location Records

After the mine records were matched to known databases, a significant number of mines (>1,000) remained with a known but limited-location status (i.e., no latitude and longitude values). From the available information, these known but limited-location sites were sorted by production size. Various state agencies were contacted, and other documentation was reviewed in an effort to produce better location information for the known but limited-location records. This research was focused first on larger production-size records and then worked down to the smaller production-size records. After this investigation effort, only 592 (or about 14 percent) of the mines in the DOE mine database still did not have location coordinates, even though the county and/or mining district were known for 566 of them. Nearly all of those 566 mines were in the Small and Small/Medium production-size categories.

Table 15 and Table 16 show the number of known-location AUM records by state and by production-size category. As shown in Table 16, all of the AUMs in the Large and Very Large categories have locations known by latitude and longitude. In addition, only six mines in the Medium category and one mine in the Medium/Large category are known by county or mining district only, representing less than 1 percent of each of those two categories. Also note in Table 16 that production records are included for 26 AUMs that are not attributed to a particular state. All of these unknown-location mines were in the Small and Small/Medium production-size categories.

Table 15. DOE Mine Database Records Sorted by State, Including Known Location Numbers by Coordinates or County/Mining District,

State	Number of Records	Known Location (Latitude/Longitude)	Known Location (County/Mining District)
Colorado	1,539	1,423	116
Utah	1,380	1,014	366
Arizona	413	409	4
Wyoming	319	291	28
New Mexico	247	240	7
South Dakota	155	133	22
Texas	29	22	7
Unknown	**26**	0	0
California	26	20	6
Nevada	24	22	2
Montana	19	16	3
Washington	17	12	5
North Dakota	14	14	0
Idaho	7	7	0
Oregon	4	4	0
Oklahoma	2	2	0
Alaska	1	1	0
Florida	1	1	0
New Jersey	1	1	0
Pennsylvania	1	1	0
Total	4,225	3,633	566

Note: 26 production records did not list the state; therefore, those numbers are not included in either location column tally

Table 16. DOE Mine Database Records Sorted by Production-Size Category, Including Known Location Numbers by Coordinates or County/Mining District

Production-Size Category	Total Ore Produced (tons)	Number of Mines	Known Location (Latitude/Longitude)	Known Location (County/Mining District)	Unknown State
Small	0–100	1,936	1,449	463	24
Small/Medium	100–1,000	938	847	89	2
Medium	1,000–10,000	784	771	13	0
Medium/Large	10,000–100,000	398	397	1	0
Large	100,000–500,000	82	82	0	0
Very Large	>500,000	37	37	0	0
Unknown Size		50	50	0	0
Total		4,225	3,633	566	26

Figure 13 is a graphic illustration of the various production-size categories showing the equivalent number of trucks necessary to haul that volume of ore. For common reference, a construction dump truck that is sometimes observed travelling on the streets and highways has a hauling capacity of approximately 20 tons.

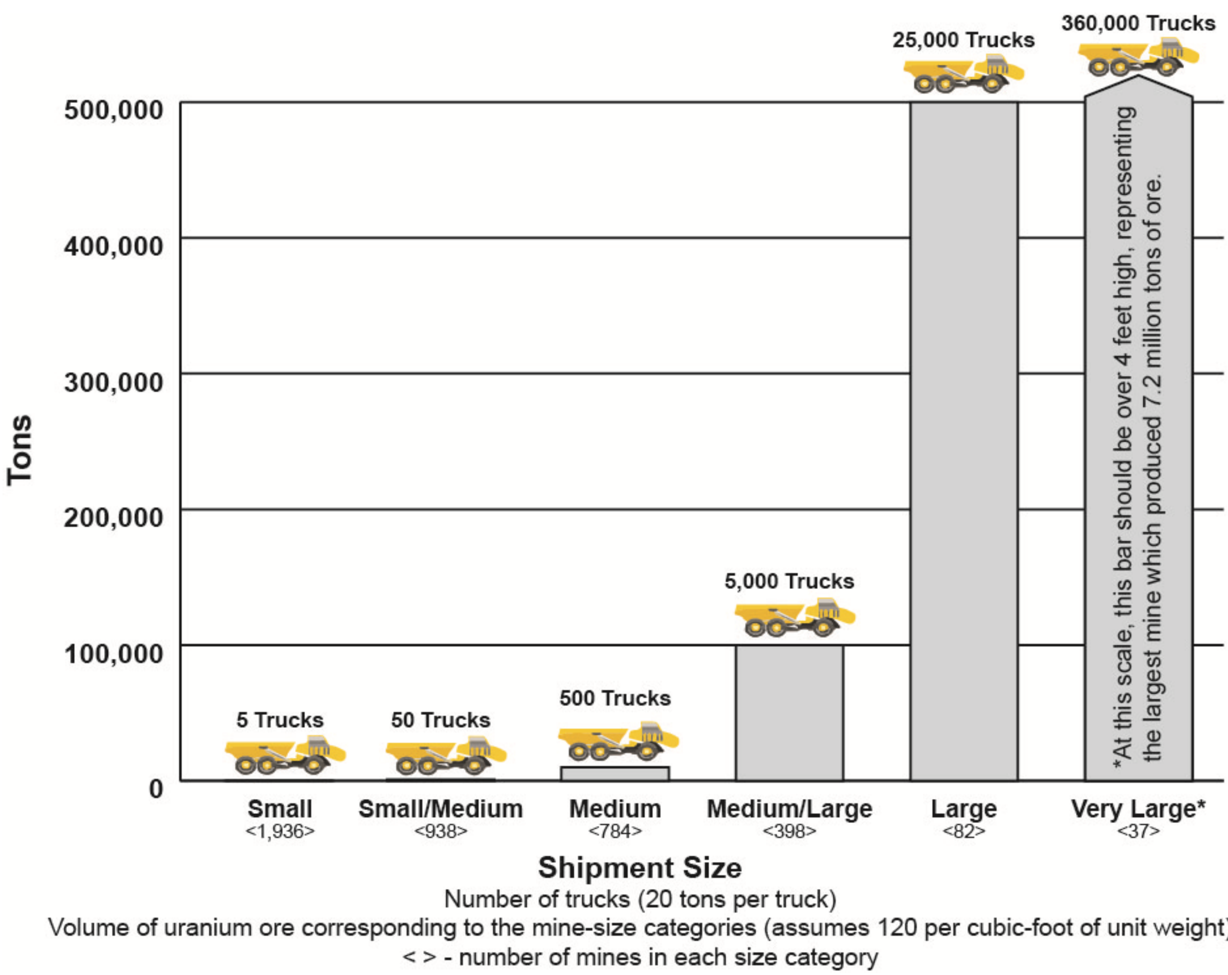


Figure 13. Illustration of Tons of Ore by Shipment Size for Various Production-Size Categories

5.6 Field Verification

This topic report (and the other three associated topic reports for risk evaluation, priority ranking, and cost) was developed primarily from available data, with only a limited amount of additional data collection and field verification activities. A limited field verification effort was conducted to support the other reports, fill in data gaps, collect additional radiological data, and validate assumptions. Fieldwork was conducted in August 2013, and 84 mine sites were visited. The mines are located on federal, state, private, and tribal lands.

As noted in Sections 3.1and 4.1, the DOE mine database was initially established from information in the AEC ore-production records. Because limited data exist for many of these individual mines, production data were used to group the mines into production-size categories. Mines are categorized based on the total amount (tons) of ore produced, as shown in Table 16. Most of the assumptions, recommendations, and conclusions about the mines are made at each production-size category level instead of at an individual mine level.

From the production-size category, a correlation was inferred between standard mine characteristics (compilation of mining-related features, including the size of waste-rock piles, number of portals, and relative mine complexity) and known mining operations. During field visits, additional secondary factors that may further categorize an individual mine—such as proximity to population and waterways, land ownership, and reclamation or remediation status—were noted.

5.6.1 Pre-existing Information

Very little data was available on the 84 mines before the field visits. Information available was primarily related to production and location, although the mine status was given for several of the mines. One mine was listed as “closed,” nine were “reclaimed,” and the remaining ones were noted as “not reclaimed” or “unknown.”

Very little radon data was available for any of the mines, and the data that were available were of limited use because the type of instrument used for measurement, the measurement location, and the measurement units were not always specified.

Gamma data were available mostly from reclaimed sites on the Navajo Nation and not from non-reclaimed sites.

The number of production claims from AEC was known for the 84 sites, but the actual number of mines was not known and may vary. The number and size of features for each mine were not known.

5.6.2 Field Investigation

The mine categories and mine attributes were analyzed to identify data gaps that need to be addressed or anomalies that need to be verified. To maximize field activities, mining regions were selected to visit. The mines in the DOE mine database in the selected regions were plotted on maps, and the map locations were coded for production-size category and for known attributes from the database. From that analysis, a list of mines of varying size categories in each region was compiled where mine access was readily available and where additional data could be collected. The information collected was used to fill data gaps or verify existing data. Fieldwork was conducted in August 2013, and 84 mine sites were visited. The following mining regions were visited:

- Black Hills Mining Area (Edgemont Area), South Dakota
- Dakota Lignite Mining Area (Slim Buttes Area), South Dakota
- Tallahassee District, Fremont County, Colorado
- Gas Hills and Crooks Gap Districts, Wyoming
- Grants Mineral Belt, New Mexico
- Lakeview District, Oregon
- Lisbon Valley–Big Indian District, Utah
- Yellow Cat District of Thompson Mining Area, Utah
- Maybell District, Moffat County, Colorado
- Uravan Mineral Belt, Colorado

Figure 14 shows these mining areas and districts and their approximate locations.

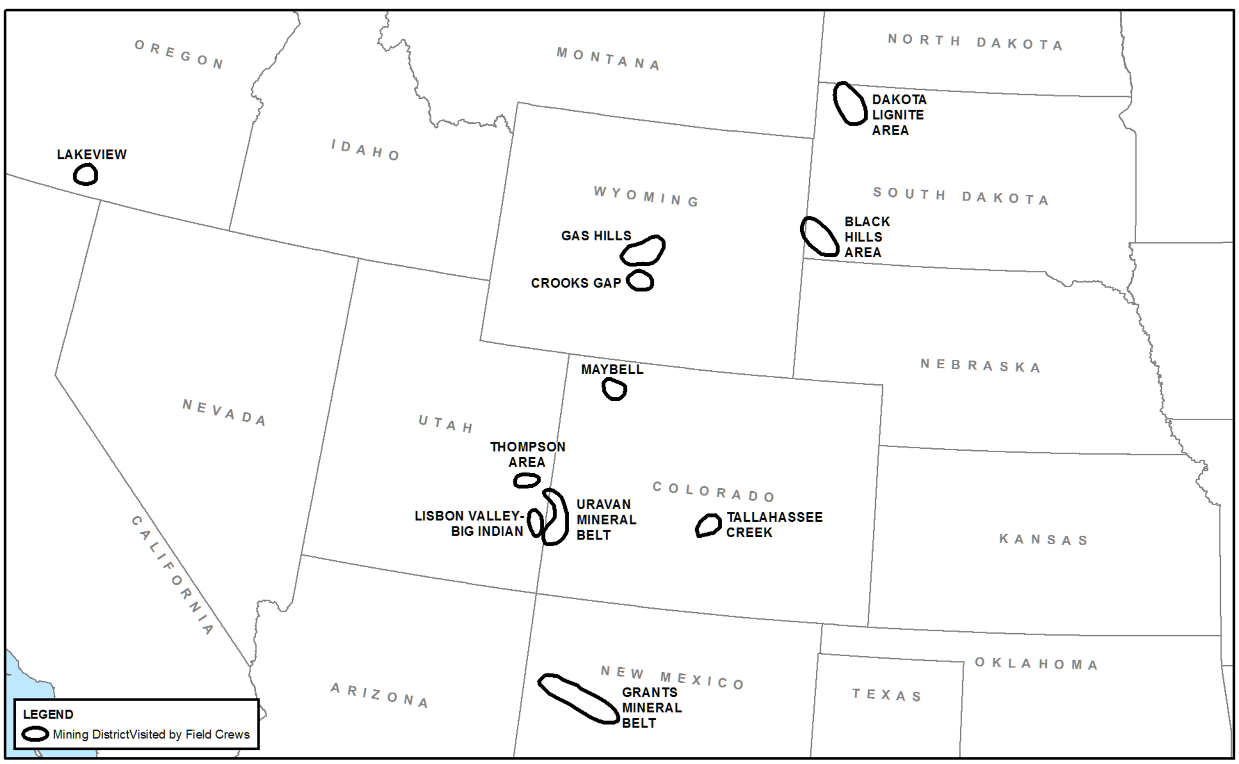


Figure 14. Representative Mining Areas and Districts Visited During Field Verification

A detailed Field Sampling Plan (Appendix G) was prepared to address the data quality objectives for the field visits. Two teams conducted the site visits, one from the DOE office in the Denver area and the other from the DOE office in Grand Junction, Colorado. Each team had experienced personnel who were familiar with the abandoned uranium mines task and had participated in previous data gathering or data source review activities. For some mine region visits, state AML program personnel either participated in the mine visits or provided information to clarify site conditions.

The fieldwork consisted of identifying mine site features and their locations; taking gamma and radon measurements (radon daughter concentrations reported as working levels) with handheld instruments; and visually assessing the degree of cleanup, if any. Using a GPS unit, the team collected location data for mining-related features associated with the site, such as mine portals, waste-rock dumps, structures, highwalls, roads, utility lines, ponds, total disturbed area, and other site features that could affect future site reclamation activities. The photographs in Figure 15 through Figure 18 show some of the features common to many mines. Additional photographs are included in the field trip reports (Appendix H) that were prepared for each mine site visited.

Figure 15. Yellow Cat District, Utah—Unstable, Unprotected Mine Opening

Figure 16. Lisbon Valley–Big Indian District, Utah—Unprotected Mine Opening

Figure 17. Grants Mineral Belt, New Mexico—Wooden Support Infrastructure (Left); Yellow Cat District, Utah—Support Infrastructure and Waste-Rock Pile (Right)

Gamma-exposure-rate measurements were collected using handheld scintillometers at selected locations at each site (Figure 18), primarily at a background location and on any waste-rock dump and ore-storage areas. Radon measurements were taken at each site as time allowed using a handheld portable meter. Radon measurements were taken to determine background levels near the waste-rock pile and at the area suspected of highest radon (i.e., near a portal or vent). The status (degree of cleanup, if any) of the mine site was also noted for assessment of potential long-term surveillance costs for mine categories.

Figure 18. Collecting Gamma Measurements at Mine Opening, Yellow Cat District, Utah

5.6.3 Field Investigation Findings

The field investigations determined or confirmed several key findings regarding locations, access, status, radiological measurements, and unusual features. Appendix H presents a summary of these data.

Access and Location

The site visits demonstrated that the existing location coordinates were often inaccurate, and access to many mines may be an issue. Locked gates prevented the field team's access to some mine sites. This occurred frequently at mines in the Grants Mining District (New Mexico), the Gas Hills District (Wyoming), and infrequently in the Maybell District (Colorado). There was not enough time and resources to research each site's access and get appropriate agreements in place prior to field trips.

Mine locations on field maps did not portray the actual location of the mine. The field team investigating the mine sites in the Grants Mining District estimated that close to 50 percent of the map-located mines were not in the right place. Errors were also found in the original databases. There were 36 located mines with the same latitude and longitude at the Yellow Cat interstate exit in Utah. These mines should have been located somewhere in the mining district. Similar occurrences were noted for 16 mines in the Henry Mountains District (Utah) and 17 mines in the San Rafael Swell District (Utah), where these mines' locations were identified with the same latitude and longitude.

There were also differences between coordinates listed in the DOE mine database and historical mine locations. A few examples from Yellow Cat included six mines located on field maps prepared from information in the database that had the wrong name or no name at all. The correct names were identified and the mine locations verified by researching old AEC mining maps.

- An unnamed NW Section 31 mine should have been the Black Stone 5 mine
- The Black Stone 5 mine should have been the Black Stone 6 mine
- The Section 32 22S 22E mine should have been the Little Pittsburg 8 mine
- The Black Ape 1&2 mine should have been the Memphis 2 & 3 and Green Lizard mines
- The Windy Point mine should have been the Juniper and Juniper 1 mines
- The Little Eva mine should have been the Paris 25 mine

The field team investigating the Gas Hills Area in Wyoming found the discrepancies between actual mine locations and latitude and longitude coordinates in the database to be incorrect for approximately 90 percent of the sites visited. Also noted was one mine (Buda Dexter) in the Black Hills area that was shown on the map prepared from database information but there was no evidence of a mine in the field.

Radiological Data

The field investigation increased knowledge of radon and gamma at the mine sites, which was useful for the radiological risk assessment topic report preparation. Radon was measured at 24 mines and used to validate assumptions for the risk assessment model. Radon measurements had a range of 0 to 118 (Working Level) with a background range of 0 to 0.01. The high reading was near a collapsed portal that was well ventilated.

Gamma activity was measured at 70 mines and was also used to validate assumptions in the risk model. Gamma readings generally fell into the expected range. The gamma exposure rates from the various mine sites visited ranged from minimums of 7 to 34 µR/h to maximums of 17 to 730 µR/h with an average range of 16 to 125 µR/h. Background gamma ranged from 7 to 30 µR/h with one outlier of 70 µR/h. High gamma readings can be obtained by placing the gamma meter near obvious pieces of ore lying on the ground, which would lead to biased results. The field teams tried to measure what they felt was representative of the area. The average gamma readings are more representative of the average annual exposure to an individual.

On individual sites where measurements were taken, approximately 70 percent of the sites that were not reclaimed had an average gamma at least 2 times background, while 70 percent of the sites that were reclaimed had average gamma less than 2 times background. Because the data set collected was not large, investigators inferred only that reclaiming waste-rock piles achieves some gamma reduction.

Mine Site Status

The status and features of each mine site varied considerably. Several mine sites were apparently mined after 1970, because the size of the site was much larger than that reported in the database. Of the selected sites visited, 27 percent were reclaimed, 30 percent were closed, 3 percent were partially reclaimed, and 40 percent were not reclaimed. The percentage of the visited sites that had closed and reclaimed status was higher than the percentage in the overall DOE mine database. This is attributed to the high percent of Wyoming sites that have been reclaimed and the number of adits closed in the Uravan Mineral Belt in Colorado and the Yellow Cat District in Utah.

Unusual Features

Many of the sites still had concrete pads, trash, and timber structures; one site had rail lines, a small locomotive engine and four ore cars; and another site a gunpowder magazine. Many sites had collapsed portals and adits and also had similar features. Most of the large open pits visited in Wyoming and Colorado still had highwalls that would be considered a physical hazard; however, several of the pits in Wyoming appeared to be reclaimed. Reclaimed mine sites visited in Wyoming were apparently so complete and successful in their reclamation that the field team had a difficult time identifying the sites.

Conclusions

Field visits to representative mine locations in six states demonstrated that the recorded location of many mines is not exact and also that an AEC-production claim record may reflect ore production from one mine or several mines.

The existing database should only be used for scoping the magnitude of the mine problem, as it lacks accurate information about the exact number, size, and mine features, except AEC production data.

Field visits to all the mines in the database should be conducted to verify size, status, and other information before any type of reclamation or remedial action begins, and before preparation of accurate cost estimates for such efforts. This is typically performed by the local agency charged with overseeing a particular mine site closure.

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6.0 Mine Status

An important element in preparing the Report to Congress is to understand the status of any mine reclamation or remediation. Understanding that status will help determine the future scope of the remaining cleanup needs and assist in identifying a range of costs to mitigate potential safety and environmental hazards. Federal, state, and tribal records and personal contacts were used to capture the status of cleanup activities. Sources included:

- EPA remediation of sites on the Navajo Nation.
- Navajo Nation AML program.
- Mines undergoing remediation under CERCLA.
- Reclamations using Surface Mining Control and Reclamation Act funds.
- State AML programs.
- National Park Service, U.S. Bureau of Reclamation, BLM, and USFS actions.
- DOE Uranium Leasing Program.

In researching mine status, it became clear that there is no national standard or approach for mine reclamation or remediation. There are differences in reclamation and remediation approaches for mines because of the disparity between missions by different agencies. Cleanup could range from simply closing a portal to full remediation of contaminants from land and water with removal of site structures and reclamation of impacted lands. Because there is not just one standard for cleanup goals, the status depends on the intent of the organization performing the cleanup. In practice, different objectives are implied by reclamation versus remediation of mines, and some common features of the activities are shown in Table 17.

Table 17. Features Common to Reclamation and Remediation

Reclamation
Physical hazards (e.g., open shafts) are mitigated
Waste rock is recontoured to reduce erosion and improve drainage
Clean soil is placed over waste rock, primarily to revegetate the site
Radiological exposure may be indirectly reduced
Remediation (includes activities involved with reclamation)
Radiological exposure/metal toxicity is directly addressed
Soil or overburden thickness attenuates gamma or radon exposure to risk-based levels
Waste rock and soil is removed and disposed of in offsite or onsite disposal cells
Ecological impacts are mitigated; surface water and groundwater, if any, are addressed

The Wyoming AML Program provided an example of one state agency's approach. They use a combination of remediation and reclamation on their mine projects. The AML group has a radiological cleanup standard that was developed specifically for the mine sites, and uranium reclamation projects were reported as having used that standard for cleanup and encapsulation of unsuitable or radiological materials present at their locations. Reclamation conducted by mining companies in compliance with the state Division of Environmental Quality–Land Quality Division permits may be different.

Many mines sites have been partly reclaimed to address safety hazards, such as closing open adits and shafts, but these sites are not considered fully reclaimed. To provide consistency for mine status, definitions were developed to differentiate various stages of remediation and reclamation, as described below.

6.1 Remediated

The following are attributes, actions, and considerations related to a remediated site:

- Typically follows the CERCLA process; efforts are targeted at reducing radiation risk (uranium, radium, gamma) to humans and the environment.
- The site is typically remediated to a soil or gamma cleanup standard, and waste material is placed in an onsite disposal cell or is disposed of offsite.
- If EPA is the lead agency, a lined cell and cover that reduces gamma to near-background levels is often required.
- Activities address ecological impacts and surface and groundwater, if impacted.
- The full CERCLA process requires Five-Year Reviews after remedial actions are complete. Review is not required for removal actions.
- Remediation may be required even after reclamation is complete.
- The National Park Service, the Navajo Nation (through EPA Region 9), BLM, and USFS may take the lead and follow the CERCLA process.

6.2 Reclaimed

The following are attributes, actions, and considerations related to a reclaimed site:

- Physical hazards are eliminated or mitigated by closing portals, adits, and vent holes.
- Bulk residual radioactive materials (such as remnants of an ore-storage pad or low-grade ore stockpiles) are placed below grade as part of the portal-closure or recontouring activities.
- Trash and debris are removed.
- Waste rock is recontoured or graded to a stable condition that minimizes the potential for future erosion and that blends in with the original site topography, and then the site is covered with enough topsoil to enhance revegetation efforts.
- Historical and culturally significant structures/features might be left.
- Activities can include knocking down steep highwalls and filling in large excavations, glory holes, and subsided areas.
- Most state programs, using Surface Mining Control and Reclamation Act funding, perform only reclamation.

6.3 In-Process

An agency is conducting ongoing activities that should lead to reclamation or remediation, such as negotiations with potentially responsible parties, a screening report, EE/CA report, or a remedial investigation/feasibility study.

6.4 Partially Reclaimed

The following are attributes, actions, and considerations related to a partially reclaimed site:

- Typically some physical hazards have been addressed.
- The reclamation/remediation is phased and not all phases are complete (e.g., only Phase 1 is complete).

6.5 Closed

The following are attributes, actions, and considerations related to a closed site:

- Portals, vents, adits, and other openings have been blocked or backfilled (or closed by bat gates) to prevent entry by humans.

6.6 Permitted

The following are attributes, actions, and considerations related to a permitted site:

- The operator has a reclamation bond with a regulatory agency.
- The mine is privately owned and the owner is responsible for reclamation/remediation. Although a claim might have been filed on BLM land, this does not mean the individual is responsible for a mine located within the claim.

6.7 Not Reclaimed (or Unknown)

The following are attributes, actions, and considerations related to a not-reclaimed site:

- No work has been performed to reclaim, remediate, or mitigate physical and environmental hazards.
- Reclamation/remediation status is typically unknown.

6.8 Summary

Table 18 provides a summary of the seven categories of mine status along with a breakdown of the count by production-size category. The table shows that 3,575 (85 percent) of the mines are not reclaimed or their reclamation/remediation status is unknown. There are 131 mines (about 3 percent) that are closed. In addition, 483 mines (approximately 11 percent) have been or are in some stage of reclamation (i.e., with a status of Remediated, Reclaimed, In-Process, or Partially Reclaimed).

Table 18. Number of Mines by Mine Status and Production-Size Category

		Production-Size Categories (Number of Mines)						
Mine Status	**Total Count**	**Small**	**Small/Medium**	**Medium**	**Medium/Large**	**Large**	**Very Large**	**Unknown Size**
Remediated	3	0	1	2	0	0	0	0
Reclaimed	432	86	94	119	68	18	29	18
In-Process	13	6	1	3	1	0	2	0
Partially Reclaimed	35	7	8	8	8	1	3	0
Closed	131	28	31	42	27	3	0	0
Permitted	36	12	5	3	10	3	3	0
Not Reclaimed (or Unknown)	3,575	1,797	798	607	284	57	0	32
Total	4,225	1,936	938	784	398	82	37	50

7.0 Issues and Data Gaps

The research for the location and status of mines has led to confirmation of what many familiar with the AML programs of various agencies know: there are many abandoned mines. Some of these are "other" (i.e., not uranium) mines that are near uranium mines. Also, some uranium mines are in the area of AEC-related mines that are not in the AEC records.

7.1 Source Database Discrepancies

The EPA's ULD has information for approximately 15,000 mines, while the DOE mine database has 4,225 mines. Some of the higher numbers in the EPA data set are attributed to the EPA's listing of mine features (waste-rock piles, adits, pits, etc.) as separate sites or records, compared to DOE's approach that these are ancillary features of one mine. In addition, EPA did not limit its database to just abandoned uranium mines. The GAO report (2008) cites the lack of a unified definition of uranium mines (the EPA data set also included uranium mills and in situ recovery plants) and suggests that the different ways that agencies count uranium mines results in differing numbers. For example, the number of sites EPA screened on the Navajo Nation was higher than what DOE reports. This difference is largely attributed to differences in definitions, plus that fact that EPA took the conservative approach of screening any site that the public considered contaminated with uranium mine waste (instead of limiting its screenings to only mines).

This report's production-size categories for mines are based on the total amount of ore produced and sold to the AEC. For any mine, the number of features and waste-rock piles was based on previous experience with the ULP, on work DOE performed for BLM, reports reviewed, and data provided by agencies contacted for this report. It is important to remember that the actual size and number of features can vary greatly (depending on the mine, the geology of area, and other variables) and are not necessarily reflective of production. For instance, a large amount of overburden may have been removed and only a small deposit was mined, resulting in a large amount of waste rock for a mine in the Small production-size category.

7.2 Multiple Mines at One Location

A common issue with the AEC records was more than one mine being associated with one mine location. Some of these mines are associated with the named mining claim from the DOE mine database, while others may have been separate, adjacent mines that were incorporated into the named mine's complex during continued exploration and development of that mine.

Figure 19 shows an area with multiple mines plotted on a topographic map. Some of the mines correspond with named locations in the DOE mine database (red text and symbols), while other mines (either named or unnamed in black text or symbols) on the map do not. These other mines can be assumed to be uranium mines if most of the mines in the area are uranium mines, but additional research would be needed to confirm this and to determine the age of the mines.

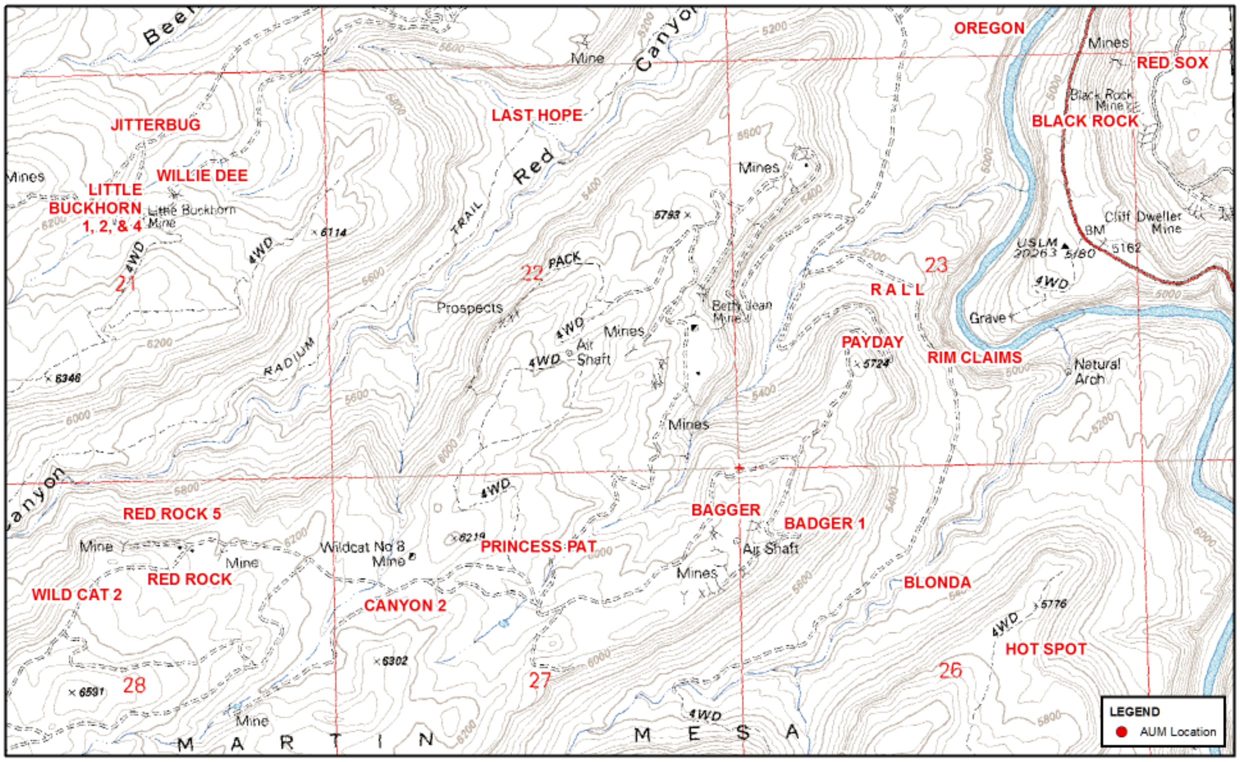

Figure 19. Example of Area with Known Uranium Mines and Other Mines

7.3 Mine-Related Features

Information from EPA screening reports and Colorado Department of Public Health and Environment radiological scans (CDPHE 2011) demonstrate that contaminated roads and sites that were used as transfer or ore-buying stations still exist. DOE recognizes they might pose a risk to the public and environment. However, these features are not addressed by this report, as they are not, by definition, a mine.

Exploratory boreholes are another item that is prevalent throughout the uranium-mining districts. Many of these boreholes were plugged at the surface following completion of drilling and probing but have since undergone subsidence, and they could pose a significant physical hazard due to their estimated numbers. Reports summarizing AEC activities state that the AEC, assisted by USGS, promoted exploratory drilling between 1948 and 1956 to identify reserves.

7.4 Historical Significance of Mine Sites

Some mines are located in areas that have been designated as historic districts, or a particular structure at a mine has been given such designation. Consequently, structures may have to be protected, and areas such as waste-rock piles or waste dumps may have to be preserved.

7.5 Mine Openings

Different state AML programs have closed (or are in process of closing) adits, portals, and similar hazards to reduce the physical hazards associated with underground mines. Many of these mines have been closed through burial with soil and rock or constructed closures (Figure 20 and Figure 21), while others have been closed with metal gates or grating (Figure 22) that prevents humans and large animals from entering but allows bats and other mammals access to nesting areas. Those barriers remove the physical threat, but radon might still be venting, resulting in radiological exposures to the public in some cases.

Figure 20. Mine Closure by Metal Door and Timbers. Lisbon Valley–Big Indian District, Utah

Figure 21. Mine Portal Closure by Concrete Blocks, Yellow Cat District, Utah

Figure 22. Top: Mine Portal Closure by Metal Gates
Bottom: Mine Vent Shaft Closure with a Large Grid Rebar Typical of "Bat Gates"

7.6 Limited Data for Groundwater Contamination

In general, there is a limited number of mines for which groundwater data are available. In addition, many are in mining districts with high natural background levels of constituents that are also present in the uranium ore body that was mined. Several screening reports and EE/CAs for individual mines have data showing that concentrations of contaminants in mine discharge water (e.g., King Edwards mine, Utah) and water in pit lakes (e.g., Midnite mine, Washington) exceed surface water standards and pose a risk to human health and the environment. Some shafts are noted to be deep enough to be below groundwater, but data were not available on whether the mine impacted groundwater quality.

EPA has conducted screening reports of mines and sites on the Navajo Nation and found springs and wells near mines in which contaminant concentrations exceed drinking water standards. However, EPA has not pursued investigating whether the AUMs impacted the groundwater or whether the high levels of contaminants were a result of naturally occurring minerals (see Five-Year Plan, EPA 2013a).

The State of New Mexico and EPA initiated a Five-Year Plan for the Grants Mining District, New Mexico (EPA 2013a). The Plan outlines actions to be taken by participating federal, state, and tribal agencies, including DOE, for addressing the impacts from legacy uranium mines and mills on surface and groundwater resources. The Plan references several studies assessing mines; however, there was not sufficient time during the preparation of this topic report to pursue the studies to determine if groundwater data are available.

Information provided by EPA (2014) noted that "ninety-seven (97) legacy uranium mines have been identified in the GMD [Grants Mining District], the majority (81) in the Ambrosia Lake sub-mining district and within the San Mateo Creek drainage basin. Forty-eight (48) of these mines were operated as wet mines, with the underground workings dewatered to allow mining of the ore. Over the years of operation, water from these 48 mines was pumped to the surface and discharged into nearby arroyos and creeks, resulting in significant re-saturation and, in places, contamination of the shallow alluvium and underlying bedrock aquifers. …Uranium, selenium and other metals are typically present at elevated concentrations in this water."

At this time, EPA Region 6 does not know what the natural background water quality is in the shallow alluvium within the San Mateo Creek drainage basin. A groundwater investigation is underway to attempt to determine this, but EPA indicates a lack of funding has hindered this effort.

Section 6.2 of the *Defense-Related Uranium Mines Assessment of Radiological Risk to Human Health and the Environment Topic Report* evaluates the potential of these mines to impact water systems by using a broad review of current nationwide resources that identify impaired waters near the mines. Using this approach, DOE identified 10 watersheds present with impaired surface water and 12 watersheds present with contaminants of concern for groundwater close to a mine. This approach did not identify impaired water bodies close to the mines within the San Mateo Creek Basin. However, in the prioritization topic report, the San Mateo Creek drainage is identified as among those with the largest amount of ore produced and in which listed waters are located (Defense-Related Uranium Mines Prioritization Report, Figure 3 and Table 21).

8.0 Additional DOE Mine Database Results

Table 19 through Table 25 were populated by performing queries of the DOE mine database.

Table 19 is a summary of mines by state with a breakdown for mine locations that are known by latitude and longitude or known only by county and/or mining district. The table is sorted by total number of mines in decreasing order. Colorado and Utah have the largest numbers of mines and the largest numbers with a location that is known only by county and/or mining district, but 84 percent of these limited-location sites are in the Small production-size category (see Table 23). Twenty-six mines (about 0.6 percent) are not listed by state and are considered true “unknowns.”

Table 19. Mine Counts by State with Known Location Information by Coordinates or County/Mining District

State	Total		Known Location (Latitude/Longitude)		Known Location (County/Mining District)	
	Count	**Percent**	**Count**	**Percent**	**Count**	**Percent**
Colorado	1,539	36.4%	1,423	92.5%	116	7.5%
Utah	1,380	32.7%	1,014	73.5%	366	26.5%
Arizona	413	9.8%	409	99.0%	4	1.0%
Wyoming	319	7.6%	291	91.2%	28	8.8%
New Mexico	247	5.8%	240	97.2%	7	2.8%
South Dakota	155	3.7%	133	85.8%	22	14.2%
Texas	29	0.7%	22	75,9%	7	24.1%
California	26	0.6%	20	76.9%	6	23.1%
Unknown	**26**	0.6%	0	0.0%	0	0.0%
Nevada	24	0.6%	22	91.7%	2	8.3%
Montana	19	0.4%	16	84.2%	3	15.8%
Washington	17	0.4%	12	70.6%	5	29.4%
North Dakota	14	0.3%	14	100.0%	0	0.0%
Idaho	7	0.2%	7	100.0%	0	0.0%
Oregon	4	0.1%	4	100.0%	0	0.0%
Oklahoma	2	0.0%	2	100.0%	0	0.0%
Alaska	1	0.0%	1	100.0%	0	0.0%
Florida	1	0.0%	1	100.0%	0	0.0%
New Jersey	1	0.0%	1	100.0%	0	0.0%
Pennsylvania	1	0.0%	1	100.0%	0	0.0%
Total	4,225	100.0%	3,633	86.0%	566	13.4%

Note: 26 production records did not list the state; therefore, those numbers are not included in either location column tally

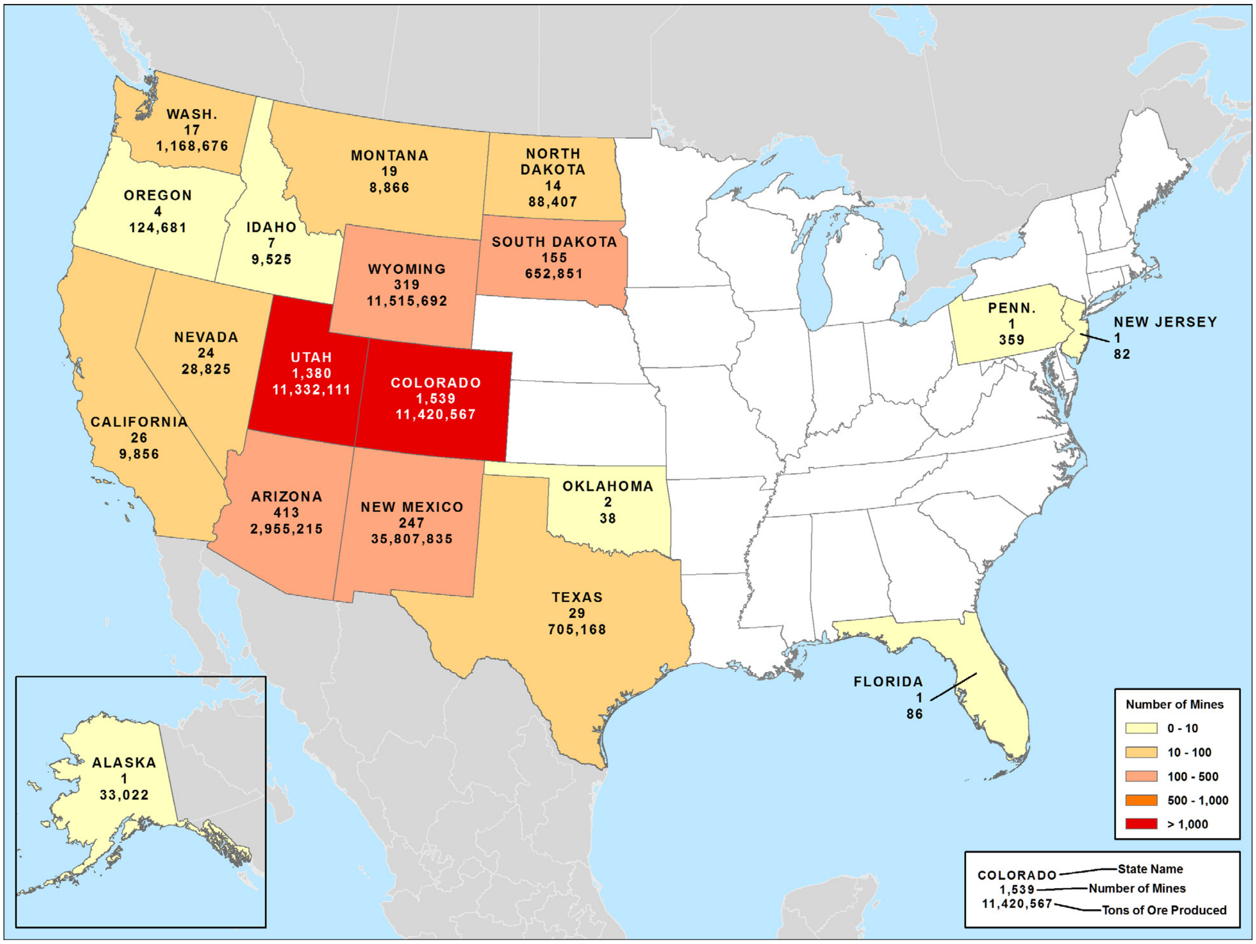

Figure 23. Illustration of Total Mines by State

Table 20 is a summary of mines by state, with production-size category data. Figure 23 uses a color scale to show the number of mines by state. Compare that to Figure 24, which uses a color scale to show total uranium ore produced by state.

Table 21 provides the number of mines by reclamation/remediation status along with production-size category. The table shows that 3,575 (85 percent) of the mines are not reclaimed or their reclamation/remediation status is unknown. There are 131 mines (about 3 percent) that are closed. In addition, 483 mines (approximately 11 percent) have been or are in some stage of reclamation (i.e., with a status of Remediated, Reclaimed, In-Process, or Partially Reclaimed).

Table 20. Mine Counts by State with Production-Size Categories

State	Total		Small		Small/Medium		Medium		Medium/Large		Large		Very Large		Unknown Size	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Alaska	1	0.02%	0	0.0%	0	0.0%	0	0.0%	1	100.0%	0	0.0%	0	0.0%	0	0.0%
Arizona	413	9.80%	162	39.2%	110	26.6%	83	20.1%	28	6.8%	4	1.0%	1	0.2%	25	6.1%
California	26	0.62%	21	80.8%	3	11.5%	2	7.7%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Colorado	1,539	36.43%	621	40.4%	378	24.6%	348	22.6%	167	11.0%	22	1.4%	3	0.2%	0	0.0%
Florida	1	0.02%	1	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Idaho	7	0.17%	1	14.3%	2	28.6%	4	57.1%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Montana	19	0.45%	10	52.6%	8	42.1%	1	5.3%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Nevada	24	0.57%	12	50.0%	8	33.3%	3	12.5%	1	4.2%	0	0.0%	0	0.0%	0	0.0%
New Jersey	1	0.02%	1	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
New Mexico	247	5.87%	78	31.1%	39	15.5%	40	15.9%	33	13.1%	17	7.2%	19	8.4%	21	8.8%
North Dakota	14	0.33%	2	14.3%	2	14.3%	5	35.7%	3	9.5%	0	0.0%	0	0.0%	2	14.3%
Oklahoma	2	0.05%	2	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Oregon	4	0.09%	1	25.0%	0	0.0%	2	50.0%	0	0.0%	1	25.0%	0	0.0%	0	0.0%
Pennsylvania	1	0.02%	0	0.0%	1	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
South Dakota	155	3.68%	71	45.8%	35	22.6%	34	21.9%	13	8.4%	2	1.3%	0	0.0%	0	0.0%
Texas	29	0.69%	6	20.7%	4	13.8%	8	27.6%	8	27.6%	3	10.3%	0	0.0%	0	0.0%
Utah	1,380	32.77%	788	57.2%	278	20.1%	190	13.8%	100	7.3%	17	1.2%	5	0.4%	2	0.1%
Washington	17	0.40%	0	0.0%	11	64.7%	3	17.6%	2	11.8%	0	0.0%	1	5.9%	0	0.0%
Wyoming	319	7.57%	135	42.3%	57	17.9%	61	19.1%	42	13.2%	16	5.0%	8	2.5%	0	0.0%
Unknown Location	**26**	0.62%	24	85.7%	2	7.7%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Total	4,225		1,936		938		784		398		82		37		50	

Table 21. Mine Counts by Mine Status with Production-Size Categories

Mine Status	Total		Small		Small/Medium		Medium		Medium/Large		Large		Very Large		Unknown Size	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Remediated	3	0.07%	0	0.0%	1	33.3%	2	66.7%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Reclaimed	432	10.22%	86	19.9%	94	21.8%	119	27.5%	68	15.7%	18	4.2%	29	6.7%	18	4.2%
In-Process	13	0.31%	6	46.2%	1	7.7%	3	23.1%	1	7.7%	0	0.0%	2	15.4%	0	0.0%
Partially Reclaimed	35	0.83%	7	20.0%	8	22.9%	8	22.9%	8	22.9%	1	2.8%	3	8.6%	0	0.0%
Closed	131	3.11%	28	21.4%	31	23.7%	42	32.1%	27	20.6%	3	2.3%	0	0.0%	0	0.0%
Permitted	36	0.85%	12	33.3%	5	13.9%	3	8.3%	10	27.8%	3	8.3%	3	8.3%	0	0.0%
Not Reclaimed or Unknown	3,575	84.62%	1,797	50.3%	798	22.3%	607	16.9%	284	7.9%	57	1.6%	0	0.17%	32	0.9%
Total	4,225		1,936		938		784		398		82		37		50	

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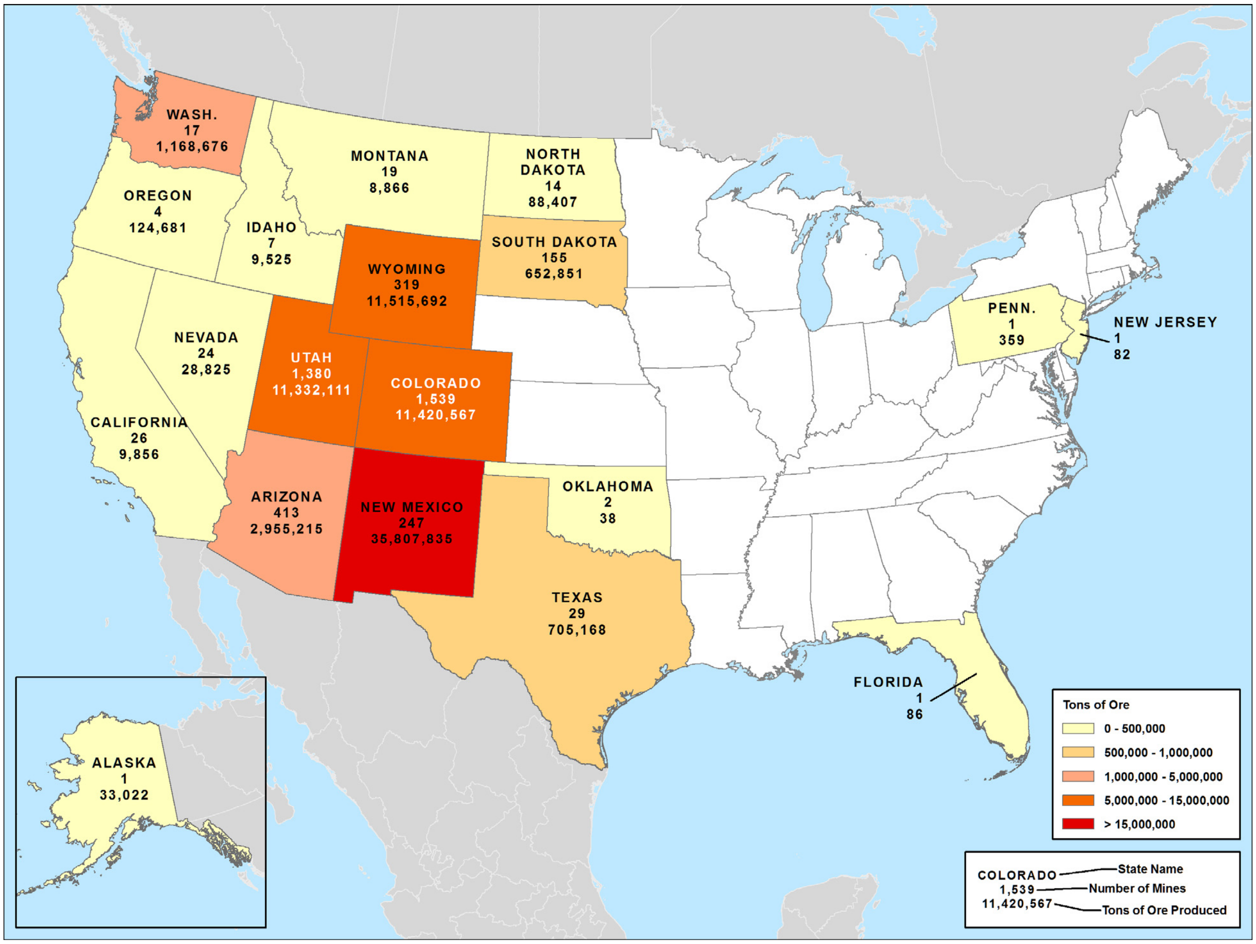

Figure 24. Illustration of Total Uranium Ore Production by State

Table 22 provides a breakdown of the total tons of ore produced and the number of mines by state. The same information is illustrated in Figure 24. Comparing Table 22 with Table 19 shows that the top five states are the same (Arizona, Colorado, New Mexico, Utah, and Wyoming) for both number of mines and tons of ore produced, but the order is not same. One reason is that total ore production from New Mexico and Wyoming was accomplished with fewer but individually larger mines.

Table 22. Mine Counts by State with Ore Production Information

State	Tons of Ore Produced	Number of Mines
Alaska	33,022	1
Arizona	2,955,215	413
California	9,856	26
Colorado	11,420,567	1,539
Florida	86	1
Idaho	9,525	7
Montana	8,866	19
Nevada	28,825	24
New Jersey	82	1
New Mexico	35,807,835	247
North Dakota	88,407	14
Oklahoma	38	2
Oregon	124,681	4
Pennsylvania	359	1
South Dakota	652,851	155
Texas	705,168	29
Unknown Location	790	**26**
Utah	11,332,111	1,380
Washington	1,168,676	17
Wyoming	11,515,692	319
Total	75,862,652	4,225

Table 23 provides a breakdown of the number of mines by production-size category. The Small production-size category has the most mines. All of the mines in the Large and Very Large production-size categories have been located by reported latitude and longitude. Nearly all of the mines (>99 percent) in the Medium and Medium/Large production-size categories have been located by reported latitude and longitude. Mines located only by county and/or mining district information are in the Small and Small/Medium production-size categories. This includes 24 mines in the Small and 2 mines in the Small/Medium category for which no state identification was provided in the records.

Table 23. Mine Counts by Production Size with Known Location and Unknown Location

Description	Production Class (Tons)	Total		Known Location (County/Mining District) and Unknown State		Known Location (Latitude/Longitude)	
		Count	Percent	Count	Percent	Count	Percent
Small	0–100	1,936	45.82%	487	25.2%	1,449	74.8%
Small/Medium	100–1,000	938	22.20%	91	9.7%	847	90.3%
Medium	1,000–10,000	784	18.56%	13	1.7%	771	98.3%
Medium/Large	10,000–100,000	398	9.42%	1	0.3%	397	99.7%
Large	100,000–500,000	82	1.94%	0	0.0%	82	100.0%
Very Large	>500,000	37	0.88%	0	0.0%	37	100.0%
Unknown Size	Unknown	50	1.18%	0	0.0%	50	100.0%
Total		4,225		592	14.0%	3,633	86.0%

Table 24 shows, in each production-size category, the number of mines that have cost information related to reclamation or remediation.

Table 24. Mines by Production-Size Category with Reclamation/Remediation Cost Information

Production-Size Category	Number of Mines	Mines with Cost Information Available
1 – Small	1,936	58
2 – Small/Medium	938	50
3 – Medium	784	122
4 – Medium/Large	398	55
5 – Large	82	4
6 – Very Large	37	3
7 – Unknown Size	50	0
Total	4,225	292

Table 25 provides a breakdown of the number of mines by known or assumed land ownership. More than 2,100 mines, or about half of the mines in the DOE mine database, are located on BLM land. The next two largest land-ownership categories are unknown ownership (with 657, or 15.6 percent of all the mines) and non-federal land (with 518, or 12.3 percent of all the mines). The non-federal category includes land owned by local municipalities or counties, along with other property that could not be readily linked to a federal agency.

Table 25. Mine Count by Land Ownership

Agency	Number of Mines	
	Count	Percent
U.S. Bureau of Land Management	2,103	49.78%
Unknown Ownership	657	15.55%
Non-Federal	518	12.26%
U.S. Bureau of Indian Affairs	410	9.70%
U.S. Forest Service	369	8.73%
Private	65	1.54%
Indian Trust	37	0.88%
National Park Service	29	0.69%
State	14	0.33%
Indian Allotment	5	0.12%
U.S. Bureau of Land Management / Private	5	0.12%
Bureau of Reclamation	3	0.07%
State/Private	3	0.07%
U.S. Department of Defense	2	0.05%
U.S. Fish and Wildlife Service	2	0.05%
U.S. Bureau of Indian Affairs / State	1	0.02%
U.S. Bureau of Land Management / State / Private	1	0.02%
U.S. Forest Service / Private	1	0.02%
Total	4,225	

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Appendix A

Geologic Conditions of Uranium Deposits in the United States

Geologic Conditions at Major Mining Districts/Areas in the United States

This appendix describes the geologic conditions of uranium deposits and types of mines in major uranium mining districts/areas in the conterminous United States.

Front Range District

This district in north-central Colorado extends for about 150 miles along the Front Range of the Southern Rocky Mountains from the Pikes Peak area northward nearly to the Wyoming border. Uranium deposits are mainly of two types: (1) numerous small deposits associated with pegmatites and disseminated in migmatites adjacent to the Precambrian Silver Plume Granite, and (2) more economically important vein deposits of Laramide (Late Cretaceous to Paleogene) age that were emplaced into Precambrian metamorphic rocks. Production from the district has been mainly from the Schwartzwalder Mine, which is the largest uranium mine in Colorado and represents the second type of deposit (it is the best example of a vein-type uranium deposit in the United States). The deposit at Schwartzwalder contains pitchblende and uraninite associated with copper sulfides, other base metal sulfides, and precious metals that occur in veins and breccia fillings along a major fault system that cuts metasedimentary rocks (mainly garnet biotite gneiss and quartzite). Ore mined before 1970 was high grade, averaging 0.6 to 0.7 % U_3O_8. Mining was by deep underground methods well below the groundwater surface.

Cochetopa and Marshall Pass Districts

These two districts in west-central Colorado contain vein-type uranium deposits along fault zones. From Gunnison, Colorado, the Cochetopa district is about 20 miles to the southeast in the northwest part of Saguache County, and the Marshall Pass district is about 40 miles to the east, just west of the Continental Divide in both Saguache and Gunnison Counties. Ore at Cochetopa is in vertical tabular bodies in brecciated and silicified Jurassic Morrison Formation sandstones along a major normal fault. Mining at Cochetopa was mainly by shallow underground and open-pit methods and was mostly above the groundwater surface.

Ore at Marshall Pass was mostly from the Pitch Mine and was hosted in brecciated Mississippian Leadville Dolomite and Pennsylvanian Belden Formation situated in a syncline along the footwall of a major reverse fault. The ore mined before 1970 was high grade, averaging about 0.5% U_3O_8, and was associated with epigenetic pyrite, marcasite, and molybdenum. Mining at Marshall Pass was mainly by underground methods that extended below the groundwater surface. Oligocene and Miocene volcanic rocks (ash-flow tuffs) overlaid the fault structures at both districts and likely provided a source of uranium to support a supergene origin for the deposits.

South Texas Mineral Belt

This 10- to 30-mile-wide mineral belt is curvilinear and is about 250 miles long, from east-central Texas to the Mexican border. The belt parallels the coast of the Gulf of Mexico and is about 80 miles inland. Most of the pre-1970 mining was in Karnes and Live Oak Counties about 50 miles southeast of San Antonio. Ore deposits are in tuffaceous sandstone and mudstone beds in several formations of middle Eocene to early Pliocene age. Most deposits have a linear trend that parallels the roll-front uranium mineralization, similar to those in Wyoming. The reducing agent for the deposits is hydrogen sulfide that rose along growth faults from gas fields. Mines are open pit, linear, 100 to 300 feet deep, and extend below the groundwater surface. Earlier mines removed oxidized ore, and unoxidized ore is deeper and downdip to the southeast.

Black Hills Area

This uranium area extends from the Edgemont mining area in southwestern South Dakota in Fall River and Custer Counties northwestward into Crook County, Wyoming, to include the Carlile and Hulett Creek mining areas. The mining areas in Wyoming are centered about 45 miles northeast of Gillette, and the area in South Dakota is a 20-mile-long belt centered about 10 miles north of Edgemont. Uranium deposits are primarily of roll-front origin. They occur in fine- to medium-grained carbonaceous sandstone of the Fall River and Lakota Formations of the Lower Cretaceous Inyan Kara Group, which dip away from the southwest flank and northern part of the Black Hills uplift. Altered rocks associated with the deposits contain hematite and limonite, and significant vanadium was recovered as a byproduct. Mining was by rim stripping and open pits, or by underground room-and-pillar methods from adits, inclines, or shafts. Rim-stripping operations and most underground mines were above the groundwater surface, and most open-pit mines extended below the groundwater surface.

Dakota Lignite Area

Uranium mines in this area were in both North Dakota and South Dakota. Mines in the Belfield area of southwestern North Dakota were in Billings, Stark, and Slope Counties, generally about 20 miles west of Dickinson. Mines in the North Cave Hills and Slim Buttes areas of northwestern South Dakota were in Harding County about 120 miles north of Rapid City. The uranium deposits are in the southwestern part of the Williston Basin in thin lignite beds in the Paleocene Fort Union Formation. Deposits occur mainly in the uppermost lignites and likely resulted from leaching of uranium from overlying Oligocene and Miocene sediments. Molybdenum is associated with the uranium and is a potential byproduct. Mining was by open pits and strip mines, mostly above the groundwater surface, and the lignite was burned to concentrate the uranium in its ash.

Maybell District

This district is in northwestern Colorado, about 20 miles west of Craig in Moffat County. Uranium deposits occur in the Miocene Browns Park Formation, which was formed in fluvial, lacustrine, and eolian environments and consists of medium- to coarse-grained sandstones. Ore bodies contain primary and secondary uranium minerals and mostly are roughly tabular and amoeba-shaped, and some ore occurs along faults. Uranium likely was derived from tuffaceous material in the Browns Park Formation and deposited in a reducing environment provided by hydrocarbons in underlying Cretaceous rocks that migrated upward along fault zones. Mining was done mainly by open pits, most of which extended below the groundwater surface.

Grants Mineral Belt

The mineral belt in Cibola and McKinley Counties of northwestern New Mexico is about 6 to 20 miles wide and 80 miles long, extending from Laguna to Gallup along the south border of the San Juan Basin in the southeastern part of the Colorado Plateau. Most uranium deposits are in the upper part of the Upper Jurassic Morrison Formation in sandstones of the Westwater Canyon and Brushy Basin Members. The sandstones were deposited in fluvial, lacustrine, and deltaic environments. Some smaller deposits are in the Cretaceous Dakota Sandstone and the Middle Jurassic, organic-rich, Todilto Limestone. Ore is concentrated in tabular, roll-front, and fault-related (redistributed, stacked) deposits. Uranium occurs mainly as epigenetic, unoxidized deposits associated with humate. Deposits range from surface outcrops to deposits more than 4,000 feet deep. Mining has been mostly underground room-and-pillar stoping (in the Ambrosia Lake subdistrict), but open-pit methods were most used for the Jackpile-Paguate deposit at the east end of the belt and for deposits in the Todilto Limestone. Most of the deep underground mines (particularly in the Ambrosia Lake subdistrict) and the deeper open-pit mines extend below the groundwater surface.

Uravan Mineral Belt

This mineral belt in southwestern Colorado in Mesa, Montrose, and San Miguel Counties is a narrow (about 10 miles wide) elongate area that extends about 75 miles from Gateway to Egnar. Uranium deposits are in the Salt Wash Member of the Upper Jurassic Morrison Formation, which was deposited as a broad alluvial fan by a distributary stream system creating interbedded fluvial sandstones and floodplain-type mudstones. Ore is mostly in thick stream channel sandstones with abundant carbonaceous material and occurs in tabular, bedded masses and in sharply defined elongate C-shaped rolls. Much of the ore is in distinctive 0.5- to 2-mile-wide cross trends normal to the axis of the mineral belt. The average uranium to vanadium (U:V) ratio in the ore is 1:5. Many small underground mines using room-and-pillar methods and a few open-pit mines characterize the mining area. Inclines and adits were used for deposits less than 300 feet deep. Most mines below 300 feet deep were wet, and deposits more than 600 feet deep were accessed by shafts.

White Canyon and Monument Valley Districts

The White Canyon district is a crescent-shaped belt about 65 miles long and 10 miles wide, centered about 40 miles west of Blanding in San Juan County of southeastern Utah. It is along the crest and west flank of the Monument Upwarp. Most ore is in the Shinarump Member, the basal member of the Upper Triassic Chinle Formation that fills channels along the courses of paleostreams that incised into the underlying Triassic Moenkopi Formation. Deposits are in carbonaceous sandstone and conglomerate beds. Significant copper and vanadium also occur in the ore. Mines are mostly underground and above the groundwater surface; a few deposits were mined by small open pits.

The Monument Valley district is in the Navajo Indian Reservation on the south nose of the Monument Upwarp. The district is arc-shaped, about 30 miles long and 10 miles wide, along the Arizona (Navajo and Apache Counties) and Utah (San Juan County) border. Kayenta, Arizona, is about 20 miles south of the center of the district. Uranium occurs in a geologic setting similar to that in the White Canyon district. Significant vanadium has also been produced from this district.

Smaller mines are underground, and several large mines are open pit; most mines were above the groundwater surface.

Lisbon Valley and Big Indian District

This district in San Juan County, southeastern Utah, in the Paradox Basin is about 40 miles southeast of Moab, Utah, on the southwest flank of the Lisbon Valley Anticline. Uranium deposits are in a northwest-striking belt about 0.5 mile wide and 15 miles long and occur in the Moss Back Member, the lowest member of the Upper Triassic Chinle Formation. Ore is in gray sandstone with interbedded mudstone and limestone pebbles and coalified wood trash that rests on truncated strata of the Permian Cutler Formation. Most mineralization is in small- to medium-sized ore bodies on the southwest side of the Lisbon Valley Fault. Most deposits were in underground mines above the groundwater surface, but more recently discovered deposits are developed by deep underground mines.

San Rafael Swell District

This district composes an arc-shaped area around the west, south, and east flanks of the San Rafael Swell, an uplift mainly in Emery County in east-central Utah. The center of the district, in the Temple Mountain area, is about 30 miles southwest of Green River, Utah. The Moss Back Member of the Upper Triassic Chinle Formation is the main host for ore in sandstone-filled scours at the base of the member. Ore also is in the Monitor Butte Member, a lower member in the Chinle Formation, in sandstone lenses filling scours in the underlying Triassic Moenkopi Formation. Vanadium has also been produced, and much of the ore in the Temple Mountain area is asphaltic. Most mines are underground and above the groundwater surface.

Grand Canyon Region

This uranium area is in northwestern Arizona in Coconino and Mohave Counties, both north and south of the Grand Canyon. Uranium deposits are hosted in solution-collapse breccia pipes that formed as sedimentary strata collapsed into dissolution caverns in the underlying Mississippian Redwall Limestone. Upward stoping through the upper Paleozoic and lower Mesozoic strata produced vertical, rubble-filled, pipe-like structures. An ore-bearing pipe (there are hundreds of them) contains high grades of uranium as well as silver, copper, lead, vanadium, zinc, cobalt, and nickel. Mining has been by deep underground methods with access by shafts. Ore bodies are typically several hundred to 1,000 feet above the regional water table.

Rifle, Placerville, and Rico Districts

The Rifle district is in Garfield County in west-central Colorado, and the Placerville and Rico districts are in San Miguel and Dolores Counties, respectively, in southwestern Colorado. Uranium in these areas is hosted mainly by the eolian Jurassic Entrada Sandstone. Some ore at the Rifle Mine, about 10 miles northeast of Rifle, is also in the Jurassic Glen Canyon Sandstone. Deposits have a high vanadium to uranium (V:U) ratio of approximately 20:1. The principal ore mineral is roscoelite, a mica that forms aggregates of flakes that coat quartz grains and fill pore spaces between grains. Mining has been by underground methods, mainly above the groundwater surface.

Cameron District

This uranium area on the Navajo Indian Reservation forms a curved belt about 2 to 5 miles wide and 20 miles long in Coconino County of northeastern Arizona about 40 miles north-northeast of Flagstaff. The Petrified Forest Member of the Upper Triassic Chinle Formation is host for most of the uranium deposits, which are elongated and lenticular and occur in friable, crossbedded, fine- to medium-grained sandstone that contains variable carbonaceous material. Some deposits are also in carbonaceous sandstone in the underlying Shinarump Member of the Chinle, where uranium-bearing fossil logs are common. Ore bodies are mostly from the surface to a depth of about 120 feet, have been mined by open-pit and shallow underground methods, and are above the groundwater surface.

Green River and Thompson Districts

The Green River district, also known as the San Rafael River area, is in Emery County about 15 miles west of Green River, Utah. Uranium and vanadium deposits are in channel sandstones in the uppermost part of the Salt Wash Member of the Jurassic Morrison Formation, are elongated in a northeast direction, and are associated with carbonaceous material. The U:V ratio in these deposits is about 1:2. Most mines were developed by underground mining methods, and deposits are as much as 1,000 feet deep, mostly above the groundwater surface.

The Thompson district is about 20 miles north of Moab in Grand County, Utah, and uranium deposits are also associated with carbonaceous material in channel sandstones of the Salt Wash Member of the Morrison Formation. The U:V ratio in these deposits is about 1:6. Most mines were developed by shallow underground methods and are above the groundwater surface.

Lakeview District

This district is in Lake County about 20 miles northwest of Lakeview in south-central Oregon. Uranium was deposited from hydrothermal fluids related to the intrusion of several rhyolitic bodies during Neogene time. Deposits are in the contact zone between the rhyolitic bodies and Miocene pyroclastic and lacustrine sediments. Ore is discontinuous in veinlets and irregular masses and is structurally controlled by shear and fracture zones. Uranium in the district was discovered in 1955, and production came mainly from the White King and Lucky Lass mines. Mining was by shallow underground and open-pit methods; most extended below the groundwater surface.

Lukachukai Mountains and Carrizo Mountains Districts

These districts are on the Navajo Indian Reservation about 25 to 50 miles west to southwest of Shiprock, New Mexico. They are mainly in northeastern Arizona (Apache County); a small part of the Carrizo Mountains district is in northwestern New Mexico (San Juan County). Uranium deposits are associated with carbonaceous material in ore bodies elongated parallel to paleostream channels in the Salt Wash Member of the Jurassic Morrison Formation. Approximately 170 properties were mined for uranium and vanadium from the districts. The U:V ratio of the Lukachukai Mountains ores is 1:4, and that ratio for the Carrizo Mountains ores is 1:9. Ore deposits are relatively shallow, mostly above the groundwater surface, and were mined by underground methods.

Cottonwood Wash and Montezuma Canyon Districts

These two districts are in southeastern Utah in southern San Juan County. From Blanding, Utah, Cottonwood Wash is approximately 6 miles to the southwest, and Montezuma Canyon is approximately 12 miles to the east. The Salt Wash Member of the Jurassic Morrison Formation is the uranium host rock for both of these districts. Although more mines (about 60) were in the Montezuma Canyon district than in the Cottonwood Wash district (about 50), production was much larger from the Cottonwood Wash district. Production from both districts was mainly from small underground mines and a few open-pit mines above the groundwater surface.

Inter-River and Kane Creek–Indian Creek Districts

The Inter-River district lies between the Green and Colorado Rivers, generally 5 to 25 miles west to southwest of Moab in the southernmost part of Grand and northernmost part of San Juan Counties of southeast Utah. Most of the 56 producing mines were in the Seven Mile and Mineral Canyon areas. Ore deposits are mainly in paleochannels of carbonaceous sandstone in the Moss Back Member of the Upper Triassic Chinle Formation that has incised into the underlying Triassic Moenkopi Formation. Mines were mostly underground and above the groundwater surface.

The Kane Creek–Indian Creek district is east of the Colorado River, generally 5 to 35 miles south of Moab, mostly in the north part of San Juan County of southeast Utah. Most mines are in deposits in shallow channels of carbonaceous sandstone in the Moss Back Member of the Upper Triassic Chinle Formation similar to the deposits in the Inter-River district. Mines were also mostly underground and above the groundwater surface.

Gas Hills District

Approximately 45 miles southeast of Riverton in central Wyoming, the Gas Hills district straddles the Natrona-Fremont County line and is on the south flank of the Wind River Basin. Host rocks for uranium ore bodies are fluvial, arkosic, carbonaceous sandstones of the Eocene Wind River Formation. Ore is mainly in roll-front deposits along the regional oxidation-reduction interface. Uranium was discovered at Gas Hills in 1953, and the district was the largest uranium producer in Wyoming prior to 1970. Most ore bodies are below the groundwater surface and have been mined by open pits; a few deeper and smaller deposits have been mined by underground methods.

Crooks Gap District

This district is about 8 miles south of Jeffrey City in the southeast corner of Fremont County in central Wyoming and is in the Green Mountains on the north flank of the Great Divide Basin. Ore bodies are hosted by altered, arkosic, carbonaceous sandstones of the Eocene Battle Spring Formation. Uranium occurs in tabular, stratiform, and roll-front types of ore bodies. Uranium was discovered at Crooks Gap in 1954, and the district was the second largest uranium producer in Wyoming prior to 1970. Most mining has been by open-pit methods in ore bodies that are at or below the groundwater surface.

Shirley Basin District

Approximately 35 air miles south of Casper, Wyoming, this district is in the northeast corner of Carbon County in southeastern Wyoming. Arkosic, carbonaceous sandstones of the Eocene Wind River Formation host the uranium. Ore bodies are in roll-front type deposits associated with large altered sandstones tongues. Uranium was discovered in Shirley Basin in 1955, and the district was the first in the United States to recover uranium by in situ leaching in 1961. Ore deposits are below the groundwater surface, and they have been mined mainly by open pits.

Powder River Basin Area

Pre-1970 production of uranium in the Powder River Basin area was from four districts, from north to south: Pumpkin Buttes, Turnercrest, Monument Hill, and Box Creek–Highland Flats. These districts are in the southwest part of the Powder River Basin in northeastern Wyoming, extending in a 60-mile-long trend from about 80 miles north of Casper to about 40 miles northeast of Casper in parts of Johnson, Campbell, and Converse Counties. Fluvial, arkosic, carbonaceous sandstones in the Eocene Wasatch Formation and underlying Paleocene Fort Union Formation are host rocks for the uranium ore bodies. Most deposits are of the roll-front type, and a few are tabular or dish-shaped deposits. Uranium was discovered in the Powder River Basin in 1952, and most pre-1970 production was from the Monument Hill district. Early mining was by underground methods; that later changed mostly to open-pit mines, and most deposits are below the groundwater surface.

Spokane Mountain Area

Uranium mines in this area are approximately 35 miles northwest of Spokane in Stevens County of northeast Washington, on the Spokane Indian Reservation. The three main deposits in the area, which were discovered in 1954 and 1955, are the Midnite and Sherwood mines on the south flank of Spokane Mountain and the small Spokane Mountain deposit on the north flank of the mountain. Uranium mineralization at the largest mine (Midnite) is in Proterozoic metasediments of the Togo Formation that form roof pendants above the Upper Cretaceous quartz monzonite of the Loon Lake batholith. Ore is in sulfide-rich reduced metasediments in troughs downwarped into the quartz monzonite and just above the intrusive contact. At Sherwood, uranium is in Upper Cretaceous to Paleocene fluvial conglomerate with carbonaceous material adjacent to the Loon Lake batholith. All three deposits were mined by open pits that extend below the groundwater surface.

Florida Phosphate District

Uranium has been produced in central Florida since the mid-1950s as a byproduct of the production of phosphoric acid fertilizer. Production is from phosphorites in the Pliocene Bone Valley Formation in what is called the land-pebble phosphate district, mainly in Polk and Hillsborough Counties about 25 to 35 miles east of Tampa. From 1978 to 2000, eight processing plants extracted uranium from wet-process phosphoric acid. The phosphorite was mined during this period near Bartow, Plant City, and East Tampa from open pits that extend below the groundwater surface.

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Appendix B

U.S. Atomic Energy Commission (AEC)
1967 Production Records

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SUMMARY OF URANIUM PRODUCTION BY DISTRICT, LOCALITY, AND PROPERTY.

DISTRICT - THOMPSONS
LOCALITY - YELLOW CAT

CLAIM	CLAIM NAME	STATE	COUNTY	TONS OF ORE	LBS OF U308	AVE. GRADE, PCT U308.
006110	AEC GROUP	43	10	0.86999998E 01	0.41900000E 02	0.241
031020	BARE SPOT	43	10	0.16299999E 02	0.13560000E 03	0.416
065352	BLACK APE 1 & 2	43	10	0.29139999E 03	0.15727999E 04	0.270
071910	BLACK JACK	43	10	0.23319999E 03	0.13438999E 04	0.288
077487	BLACK STONE 5	43	10	0.16450698E 05	0.72285993E 05	0.220
088360	BLUE BOY	43	10	0.92999998E 01	0.27900000E 02	0.150
129245	CACTUS RAT GROUP	43	10	0.10148099E 05	0.49476992E 05	0.244
129720	CACTUS RAT 4	43	10	0.29108998E 04	0.99639994E 04	0.171
174710	CIE DOG	43	10	0.33899999E 02	0.15980000E 03	0.236
188506	COBALT	43	10	0.78999999E 01	0.25400000E 02	0.161
202104	CONSTELLATION 3	43	10	0.70999999E 01	0.40200000E 02	0.283
288090	END OF TRAIL	43	10	0.62999999E 01	0.24000000E 02	0.190
308790	FLAT TOP	43	10	0.84579994E 03	0.38650997E 04	0.228
312550	FOOLS LUCK	43	10	0.75999999E 01	0.15950000E 03	1.049
340280	GLADSTONE	43	10	0.42700000E 02	0.31700000E 02	0.037
355310	GREAT DANE 1	43	10	0.10630000E 03	0.10630000E 03	0.050
357520	GREEN LIZARD 1	43	10	0.66999999E 01	0.18800000E 02	0.140
357540	GREEN LIZARD 2	43	10	0.12000000E 01	0.11700000E 02	0.487
379760	HEBER 1	43	10	0.48999999E 01	0.29900000E 02	0.305
436060	JOHN	43	10	0.85120000E 03	0.44031999E 04	0.259
436700	JOHNNIE A 1	43	10	0.21000000E 01	0.63999999E 01	0.152
447910	JUNIPER	43	10	0.68989998E 03	0.29483999E 04	0.214
448380	JUNIPER 1	43	10	0.67299999E 02	0.36910000E 03	0.274
491620	LITTLE EVA	43	10	0.12465000E 04	0.92901998E 04	0.373
496827	LITTLE LIZZARD	43	10	0.27200000E 02	0.65399999E 02	0.120
533450	LUCKY DAY	43	10	0.66999999E 01	0.17760000E 03	1.325
602657	MINERAL TREASURE	43	10	0.12880000E 03	0.45729999E 03	0.178
673510	PARIS 25	43	10	0.73999999E 01	0.43299999E 02	0.293
732100	RANCH VIEW 10	43	10	0.20000000E 01	0.10000000E 02	0.250
749639	RED VANADIUM GROUP	43	10	0.80869999E 03	0.42935999E 04	0.265
758617	RIBBON RIDGE	43	10	0.14000000E 02	0.64299999E 02	0.230
765690	SC SEC 36 RINGTAIL	43	10	0.13300999E 05	0.59945595E 05	0.225
779280	RUSTY BUCKET	43	10	0.30000000E 01	0.11600000E 02	0.193
779290	RUTH 1	43	10	0.73999999E 01	0.58999999E 01	0.040
780670	SADDLE	43	10	0.53999999E 01	0.22900000E 02	0.212
783700	SAND FLAT	43	10	0.27999999E 01	0.78999999E 01	0.141
791530	SCHOOL SECTION 2	43	10	0.20000000E 01	0.13800000E 02	0.345
793360	SC SEC 36	43	10	0.10040000E 04	0.15757300E 05	0.785
796002	SEC 2 T23S R21E	43	10	0.17214000E 04	0.66061999E 04	0.192
801434	SEC 32 22S 22E	43	10	0.24753999E 04	0.77132997E 04	0.156
815550	SILVER MOON	43	10	0.41900000E 02	0.13420000E 03	0.160
822089	SLICK ROCK 1 2 & 3	43	10	0.16130000E 03	0.75519998E 03	0.234
825340	SNOW FLAKE 1	43	10	0.68999999E 01	0.36200000E 02	0.262
826730	SOCKO 2	43	10	0.40439999E 03	0.22528000E 04	0.279
878810	TOBY GROUP	43	10	0.31999999E 01	0.21200000E 02	0.331

SUMMARY OF URANIUM PRODUCTION BY DISTRICT, LOCALITY, AND PROPERTY.

DISTRICT – SHIPROCK
LOCALITY – EAST CARRIZO

CLAIM	CLAIM NAME	STATE	COUNTY	TONS OF ORE	LBS OF U308	AVE. GRADE, PCT U308.
010640	ALONGO MINE	30	24	0.26700000E 02	0.75900000E 02	0.142
024910	B B	30	24	0.33400000E 02	0.87700000E 02	0.131
025380	B B B	30	24	C.18760000E 03	0.55310000E 03	0.147
039010	BEGAY 1	30	24	0.52955996E 04	0.23088099E 05	0.218
039012	BEGAY 2	30	24	0.45148999E 04	0.18449099E 05	0.204
046010	BETTIE 1	2	1	0.52499999E 02	0.19230000E 03	0.183
153220	CANYON VIEW	30	24	0.49670000E 03	0.36683999E 04	0.369
157608	CARSON	2	1	C.93299999E 02	0.41010000E 03	0.220
271190	EAST RESERVATION	30	24	C.66465999E 04	0.29404799E 05	0.221
375990	HARVEY BEGAY 3	2	1	0.21300000E 02	0.48700000E 02	0.114
379330	HAZEL	2	1	0.36299999E 02	0.11230000E 03	0.155
431280	JIM LEE 1	2	1	0.12040000E 03	0.28670000E 03	0.119
444150	JUNCTION	30	24	0.18200000E 02	0.38100000E 02	0.105
454960	KING 2	30	24	0.55699999E 03	0.17609000E 04	0.158
455480	KINGS 6	30	24	C.54099999E 02	0.11390000E 03	0.105
455900	KING TUTT 1	30	24	C.29009999E 03	0.10594000E 04	0.183
456840	KING TUT POINT	30	24	0.32500000E 02	0.25610000E 03	0.394
523350	LOOKOUT POINT	2	1	0.25552998E 04	0.16326199E 05	0.319
530866	LOWER CANYON	2	1	0.29048998E 04	0.97315993E 04	0.168
628960	NAKAI CHEE BEGAY	2	1	0.25719999E 03	0.74879999E 03	0.146
633090	NELSON POINT	30	24	0.26821997E 04	0.13362898E 05	0.249
655186	OAK SPGS GRAVEL TOP	2	1	C.56126995E 04	0.25037598E 05	0.223
693789	PLOT 1 RED WASH PT	2	1	0.29239999E 03	0.21439000E 04	0.367
694002	PLOT 2 KING TUTT PT	2	1	C.22330000E 03	0.14835000E 04	0.332
694070	PLOT 7 OAK SPRINGS	30	24	0.13458999E 04	0.62670996E 04	0.233
694077	PLOT 8 COTTONWOOD B	30	24	0.25020000E 03	0.12445000E 04	0.249
694082	PLOT 9 LONE STAR	30	24	C.20000000E 03	0.15349000E 04	0.384
694100	PLOT 10	2	1	C.14760000E 04	0.76383998E 04	0.259
694109	PLOT 12 SYRACUSE	2	1	C.22450000E 03	0.12029000E 04	0.268
712680	R F & R	2	1	0.19659000E 04	0.11049999E 05	0.281
773644	ROCKY FLATS MINES	2	1	C.11490000E 03	0.31390000E 03	0.137
779000	RUBEN 1	2	1	0.63999999E 02	0.28300000E 03	0.221
781140	SALT CANYON	2	1	0.42499999E 02	0.15760000E 03	0.185
783020	SAM POINT	30	24	0.51300000E 02	0.25950000E 03	0.253
790020	SCHOOL BOY CLAIM	2	1	0.10880000E 03	0.19860000E 03	0.091
807460	SHADYSIDE	30	24	0.17268999E 04	0.88400993E 04	0.256
807930	SHADYSIDE 2	30	24	0.88919997E 03	0.61827996E 04	0.348
813630	SHORTY 1	2	1	0.90899999E 02	0.28500000E 03	0.157
849800	SUNNYSIDE	2	1	C.27600000E 02	0.91299999E 02	0.165
873450	TENT 1	30	24	C.11974000E 04	0.53023999E 04	0.221
878900	TOHE THLANY BEGAY	2	1	0.22200000E 02	0.90099999E 02	0.203
880832	TONY TUCK	2	1	0.41049999E 03	0.14630000E 04	0.178
882190	TONY 1	2	1	0.22400000E 02	0.49199999E 02	0.110
901044	UPPER RED WASH	2	1	0.64149998E 03	0.20866999E 04	0.163

Appendix C

U.S. Environmental Protection Agency (EPA) Uranium Location Database Sources and Data Fields

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DOE Uranium Mine Location Database	
DISTRICT	
LOCALITY	
CLAIM_NUMBER	
CLAIM_NAME	
STATE	
COUNTY	
TONS_OF_ORE	
POUNDS_U308	
GRADE_PERCENT	
LATITUDE	Latitude decimal degrees
LONGITUDE	Longitude decimal degrees
DATUM	Datum
EPA_ICF_ID	
EPA_DB_ALIAS	
EPA_DB_UNIQUE	

ULP Data Entry Template (information from AEC documents)	
District	
Locality	
Claim No.	
Claim Name	
State	
County	
Tons of Ore	
Pounds U308	
Grade (%)	

ULD: Uranium Location Database, U.S. Environmental Protection Agency	
ICF_ID	Unique Identifier this field is used to identify and join each record in the separate databases
DB_ALIAS	A numeric reference to identify each record with its original database.
DBUNIQUE	Unique Identifier from the source database
LATITUDE	Latitude in decimal degrees
LONGITUDE	Longitude in decimal degrees
DATUM	Horizontal datum assume NAD83
COUNTY_NAM	County Name
CNTY_FIPS	Any of the standardized systems of numeric and/or alphabetic coding issued by the National Institute of Standards and Technology (NIST) an agency in the U.S. Department of Commerce
STATE_NAME	State Name
STATE_CODE	State Abbreviation
MINENAME	Mine Name as identified in the source database
QC_FLAG	Outlier Flag of “9” indicates coordinates place mine outside appropriate state boundary
ZIPCODE	A five-digit code assigned by the U.S. Postal Service to a section of a street a collection of streets

QAQC	Identifies mine locations that were reviewed for quality assurance quality control
MADS	Method accuracy and description of point location determinations. This field is obsolete since proper MAD codes have not been assigned as much of the MAD-related information is not available for the vast majority of the records.
gen_uniqll	A value of "1" in this field indicates that the record has a non-generic mine name or that it has a non-generic mine name AND a unique coordinate pair.
ident_wi	A value of "1" in this field indicates that the record contains a unique coordinate pair as compared to all other records in the source database.
ident_wo	A value of "1" in this field indicates that the record contains a unique coordinate pair as compared to all other records across all source databases.
spat_isol	A value of "1" in this field indicates that the record is spatially isolated. Spatial isolation is defined here as a uranium activity with no other uranium activity within 2400 meters (1.5 miles).
docs	A value of "1" indicates that the data source has documentation.
ident_coord	A "1" indicates that the record does not share identical coordinates with any other record in the entire database.
ident_nmAEC	A value of "1" indicates that the uranium activity shares the precise name of a uranium activity listed in the authoritative US Atomic Energy Commission's Uranium Mine and Properties Database (UMPD) within the same State.
ident_IDMILS	A "1" indicates that the record is not known to have originated from MASMILS.
ST_ptinpol	This field has the name of the state in which the point is located based on a point-in-polygon analysis.
Reliability	This field holds the cumulative reliability value – a sum of the values from the other reliability fields. Reliability in this context.
Dup_MatchID	This code is the ICF_ID code of the other ULD location that it was matched to in the duplicate removal process. For the duplicates-removed version of the database this ICF_ID should either match the one in the ICF_ID field.
Dup_MatchName	In the duplicate removal process this field was populated with either a 1.
Dup_Dist	This field records the distance (meters) between a duplicate and its keeper. For keepers, the value of this field is zero. For records not included in the duplicate identification process for various reasons.
Reclaimed	Information about reclamation status and activities. This information can be found for some sources in the original data files.
DB1:BRASSCAP	
OID	internal ID field
ICF_ID	unique ID
PROJECT_NA	Name of project area that is being inventoried
FEATURE_ID	Identification number of each feature within a project area
FEATURE_TY	Type of abandoned mine feature
COMMODITY	Product of mining efforts
COUNTYFIPS	Federal Information Processing Standards Code
COUNTYNAME	The name of the county where the mine is located
LAT_DEG	Degrees of Latitude for mine location
LAT_MIN	Minutes of Latitude for mine location
LAT_SEC	Seconds of Latitude for mine location
LONG_DEG	Degrees of Longitude for mine location
LONG_MIN	Minutes of Longitude for mine location
LONG_SEC	Seconds of Longitude for mine location
LAND_OWNER	Name of land owner
DB_ALIAS	Data source code

STATE_ID	Enter the State of Utah Abandoned Mine Reclamation number for the site. This field is 11 characters in length.
PRI_COMDTY	The entry is a numeric field with 3 spaces provided. Enter the primary commodity being mined from ORCA Commodity Code Data Dictionary 2303
UTM_ZONE	UTM zone number.
NORTHING	AML site coordinate reference.
EASTING	AML site coordinate reference.
MERIDIAN	Enter the meridian code from ORCA Data Dictionary 1703
SITE_ACRES	Enter cumulative or total acres of surface disturbance rounded to the nearest tenth excluding the access acreage. Acreage is calculated by multiplying the length by the width of the disturbance due to mining and then dividing by 43560.
REC_MINACT	If there is evidence of recent mineral activity (within the last year) select Y from the menu list. If there is no evidence of recent mineral activity then select N from the menu list. If it is unknown whether there is evidence of recent mineral activity
MINACT_DES	Describe the evidence of recent mineral activity observed (e.g., fresh cuts on working face of an open pit
NO_OP_ADIT	Enter the number of open adits found within the site. An adit is a horizontal or nearly horizontal passage (0-10 degrees) from the surface into the mine. Examples of an open adit include when the lock on a gated entry is broken when the entry has collapse
NO_CL_ADIT	Enter the number of closed adits found within the site. A closed adit is an adit that restricts the general public from entering the mine or that has been reclaimed. A closed adit may be gated blasted shut
NO_OP_INCL	Enter the number of open inclines found within the site. An incline is a sloped passage (11-65 degrees) from the surface into the mine.
NO_CL_INCL	Enter the number of closed inclines found within the site. A closed incline is an incline that restricts the general public from entering the mine or that has been reclaimed. A closed incline may be gated blasted shut
NO_OP_SHFT	Enter the number of open shafts within the site. A shaft is a vertical excavation through which a mine is worked (66 to 90 degrees). Examples of an open shaft include when debris bridges the shaft 5 to 10 feet down from the collar and/or the collapsed stope
NO_CL_SHFT	Enter the number of closed shafts found within the site. A closed shaft is a shaft that restricts the general public from entering the mine or that has been reclaimed. A closed shaft may be grated
NO_STOPES	Enter the number of stopes found within the mine site. A stope is an underground excavation formed by the removal of ore that has opened to the surface. Note location(s) of all stopes on the sketch map using the appropriate symbol from page 6 of the Check
NO_OTH_OP	Enter the number of other openings found within the mine site. Other openings are glory holes or ventilation holes
OTHER_TYPE	List the type of other openings counted. This entry is 20 characters long.
NO_TRENCH	Enter the number of trenches that are greater than 3 feet
NO_PROSP	Enter the number of prospects found within the mine site. A prospect is an area that has been explored in a preliminary way but has not given evidence of economic value. A prospect is commonly a shallow excavation (equal to or less than 10 feet deep and l
NO_OP_DH	Enter the number of open drill holes found within the mine site. A drill hole is a circular hole made by drilling. There are many drilling methods. Three common methods are percussion rotary
NO_PIT_G30	Enter the number of pits greater than 30 feet deep found within the mine site. A pit is an excavation generally circular in outline with vertical or nearly vertical walls. Note location(s) of all pits greater than 30 feet deep on the sketch map using the a
NO_PIT_L30	Enter the number of pits equal to or less than 30 feet deep that occur within the mine site. A pit is an excavation generally circular in outline with vertical or nearly vertical walls. On the sketch map
PT_HIGHWAL	Enter the total circumference of all pit high walls greater than 10 feet deep
WASDMP_L01	Enter the number of waste dumps that are less than 0.1 ac in size within the mine site. A waste dump is the area where barren or low-grade material is discarded. This material is usually dumped just beneath the level of the adit portal or shaft collar. In

WASDMP01_5	Enter the number of waste dumps that are 0.1 - 5 ac in size within the mine site. A waste dump is defined above under WASDMP_L01. Include ore stockpiles in this entry. Note location(s) of all waste dumps on the sketch map using the appropriate symbol from
WASDMP_G5	Enter the number of waste dumps that are greater 5 ac in size within the mine site. A waste dump is defined above under WASDMP_01. Include ore stockpiles in this entry. Note location(s) of all waste dumps on the sketch map using the appropriate symbol fro
TAILS_L_01	Enter the number of tailings that are less than .1 ac in size within the mine site. Mine tailings are residual materials after the ore-grade materials have been washed concentrated
TAILS_01_5	Enter the number of tailings that are greater .1 but less than 5 acres in size within the mine site. Mine tailings are defined above under TAILS_l_01. Note location(s) of all tailings on the sketch map using the appropriate symbol from page 6 of the Check
TAILS_G5	Enter the number of tailings that are greater than 5 acres in
NO_HEAPS	Enter the number of heap leach pads found within the site.
NO_DREDGE	Number of locations within the site where dredging was used to extract ore. Two methods of dredging are bucket-line and suction. A bucket-line dredge is a dredge in which the material excavated is lifted by a chain of buckets. The bucket-line dredge opera
NO_PONDS	Enter the number of ponds found within the site. A pond is a man-made surface depression holding a body of water. A pond can be lined or unlined. They can also contain freshwater pregnant solution
NO_DAMS	Enter the number of dams found within the site. A dam is a man-made feature constructed to create a pond for storage of water divert water from a watercourse into a conduit
NO_MILLS	Enter the number of mills found within the site. Note location(s) of all mill sites on the sketch map using the symbol for structures on page 6 of the Checklist with an M inside the symbol.
MILL_TYPE	Enter the appropriate number(s) for the type of mill or mills found on the mine site. The numbering convention for the types of mills found at the site is given below. If there are multiple mills at the site they are enter sequentially with no spaces nor
EQUIP_MACH	Enter the number of locations where mining equipment or machinery has been left or stored on the site. Note location(s) of all mining equipment or machinery on the sketch map using the directions on the lower right side of page 6 of the Checklist.
HEADFRAMES	Enter the number of headframes found within the site area. A headframe is a steel or wood frame at the top of a shaft which carries the pulley for the hoist. Note location(s) of headframes on the sketch map using the symbol for structures on page 6 of the
TREST_TRAM	Enter the number of trestles and tramways found within the site. A trestle is a framework of timber piles
POWERLINES	Enter the number of power lines found within the site. Power lines would be used to bring electrical power to the mining operation. These may be aviation hazards. Note location(s) of the power lines on the sketch map using the appropriate symbol from page 6
STRUCTURES	Enter the number of other structures that occur within the site. All abandoned structures except for mills headframes
STRUCT_TYP	Describe what the other structures were used for if known.
HOMESITES	Enter the number of structures used as a homesite within the site. A homesite is a structure that is used as living quarters and is currently being occupied. Note the location(s) of all homesites on the sketch map.
OTHER_FEAT	Enter feature found on the site which is not described above.
TAILS	Tailings are washed or milled ore that is too poor a grade to be treated further. Select from the menu options the appropriate description of the tailings configuration. The options provided are Confined or Unconfined
NO_SAMPLES	Enter the number of water samples taken for analysis.
BACKG_RAD	Background is the overall reading of the ore host rock formation of the area being investigated. Enter the background gamma reading in milli-roentgen per hour.
ADIT_RAD	Enter the highest gamma reading taken for all the adits and inclines within the site.
ADIT_WL	Enter the corresponding working level reading for the adit or incline recorded above under ADIT_RAD.
SHAFT_RAD	Enter the highest gamma reading taken for all the shafts for all the shafts within the mine site.
SHAFT_WL	Enter the corresponding working level reading for the shaft recorded above under SHAFT_RAD.

OTHER_RAD	Enter the highest gamma reading taken for all the other features found within the mine site.
OTHER_WL	Enter the corresponding working level reading for the other feature recorded above under OTHER_RAD.
DATE	The data logger will automatically generate the date the information is collected in the field.
FIPSCODE	Federal Information Processing Standards Code
DATEADDED	Date record was created in database.
ADDEDBY	User name or process by which the record was added to the database.
DB_ALIAS	A numeric reference to identify each record with its original database.
ADDEDBY	
OID	internal ID field
DB3: Colorado (FS) Abandoned Mine Land Database	
ICF_ID	unique ID
HDR_	Internal GIS data index used for linking geographic location records to corresponding attribute data records in Arc/Info. ArcView shape files assume that attribute records are sorted by this index to match the correct polygon data record in shape file.
STATE	USFS State code value=8 for all sites in Colorado.
UTM_ZONE	Universal Transverse Mercator (UTM) Zone in which the feature is located. Value=13. Early in the project this value was included so that areas west of 108 degrees west longitude could be uniquely located. UTM coordinates are not unique but are tied to the
XUTM	Unique X coordinate based on the X coordinate of the lower left corner of the 1000 meter UTM grid containing the majority of the inventory area. This value will range from about 138 to 765 depending on the longitude of the site.
YUTM	Unique Y coordinate based on the Y coordinate of the lower left corner of the 1000 meter UTM grid containing the majority of the inventory area. This value will range from about 4000 to 4550 depending on the latitude of the site.
AREA_ID	Unique identifier for densely mined areas where more than one inventory area may occur in the same UTM grid cell mentioned above. Values range from 1 to 3 usually and rarely 4 or more.
NO_HOLES	Number of mine features occurring in the inventory area.
NO_PILES	Number of mine dumps and similar features occurring in the inventory area.
SITENAME_1	Primary name associated with the inventory area or sites contained within it. Usually based on literature or map notations. When none were available then geographic names and relative references were used.
SITENAME_2	Secondary name associated with the inventory area or sites contained within it. Usually based on literature or map notations. When none were available then geographic names and relative references were used. References to literature sources may also be in
MAX_RADS	Maximum radiation measurement obtained within the inventory area. Consult the hole and pile records for specific information about radiation measurements units of measure and other relevant information.
COMMODITY	Code representing the class of commodity mined in the area.
COMMOD_T	Type of commodity mined in the area. Values vary depending upon the region. May include Gold or Silver
COUNTY	County in which the inventory area occurs.
WCU	Numeric identifier of EPA defined water-cataloguing unit in which the inventory area occurs.
NEAR_STRM	Name of the stream flowing nearest to the inventory area.
NEXT_STRM	Name of the stream into which NEAR_STRM flows.
RECLAIMED	Has any reclamation been done in the inventory area.
ACRES	Number of acres reclaimed.
STRUCTURE	Are there any historical structures in the inventory area.
DB_ALIAS	Data source code

DB4: Mineral Resources Data System (MRDS)	
ICF_ID	unique ID field relate to ur2002.shp
DB_ALIAS	data source ID field
LATITUDE	Latitude
LONGITUDE	Longitude
RECNO	Record Number
COUNTY_NAM	County Name
STATE_CODE	State Abbreviation
UTM_N	UTM Northing
UTM_E	UTM Easting
UTM_Z	UTM_Z
ACC	Location Precision
SITE	Name of commodity Produced
COMMOD	Commodities present
GAD	General Analytical Data
PROD	Production Size
DEV_STATUS	Development Status
YR_1ST_PRO	Year of first significant production
YR_LAST	Year of last significant production
OWNER	Present of Last owner
DEP_SIZE	Deposit Size
WORK_TYPE	Type of workings
CP_ITEM	Name of commodity Produced
CP_AMT	Cumulative Production Amount
CP_U	Units Produced
CP_YEAR	Years of Cumulative Production
ENV_COM	Environmental Comment
PROD_YEARS	Production Years
HUC	Hydrologic Unit Code 8 character replacement for the River Basin Code currently being used by the Water Resources Division of the U.S. Geological Survey.
DB5: Minerals Industry Location System (MILS)	
OID	internal ID field
ICF_ID	unique ID field relate to ur2002.shp
DB_ALIAS	data source ID field
DBUNIQUE	Unique Identifier
STATE_NAME	State Name
MINE_NAME	Mine name
TYPE	Type of operation refers to the existing/proposed type of operation at this site. It identifies the existing operation when Status equals 'Producer Past producer
STATUS	Current status of mine.
LAT	Latitude
LONG	Longitude
LATITUDE	Latitude

LONGITUDE	Longitude
POP	Precision of Point
ZONE	UTM Zone reference
DATUM	Datum
NORTHING	UTM Northing coordinate
EASTING	UTM Easting coordinate
RIVER	River Basin indicated by the River Basin Code
HUC	Hydrolic Unit Code8 character replacement for the River Basin Code currently being used by the Water Resources Division of the U.S. Geological Survey.
PLANT	Type of processing plant
YIP	Year of Initial significant Production
YLP	Year of Last Production
COMMODITY	Product of mining effort
COUNTY	County
CNTY_FIPS	Any of the standardized systems of numeric and/or alphabetic coding issued by the National Institute of Standards and Technology (NIST)an agency in the U. S. Department of Commerce
DB6: Utah (BLM) Abandoned/inactive Mine Land Inventory	
ICF_ID	unique ID
STATE	This field is 2 characters wide and is the State abbreviation as identified in ORCA data dictionary 1656
SITE_ID	The entry is five spaces in length and is a sequential number within the Resource Area which is unique for the site.
MILS_ID	The entry is the sequence number unique id from the Minerals Industry Location System
MRDS	Enter the Rec No from the Utah CRIB Data sheet. This field is 7 characters in length.
STATE_ID	Enter the State of Utah Abandoned Mine Reclamation number for the site. This field is 11 characters in length.
MINE_NAME	Enter the local mine name if known from literature research knowledge of the area
PRI_COMDTY	The entry is a numeric field with 3 spaces provided. Enter the primary commodity being mined from ORCA Commodity Code Data Dictionary 2303
UTM_ZONE	UTM zone number.
X_COORD	AML site coordinate reference.
Y_COORD	AML site coordinate reference.
SITE_ACRES	Enter cumulative or total acres of surface disturbance rounded to the nearest tenth excluding the access acreage. Acreage is calculated by multiplying the length by the width of the disturbance due to mining and then dividing by 43560.
REC_MINACT	If there is evidence of recent mineral activity (within the last year) select Y from the menu list. If there is no evidence of recent mineral activity then select N from the menu list. If it is unknown whether there is evidence of recent mineral activity
MINACT_DES	Describe the evidence of recent mineral activity observed (e.g., fresh cuts on working face of an open pit
NO_OP_ADIT	Enter the number of open adits found within the site. An adit is a horizontal or nearly horizontal passage (0-10 degrees) from the surface into the mine. Examples of an open adit include when the lock on a gated entry is broken when the entry has collapse
NO_CL_ADIT	Enter the number of closed adits found within the site. A closed adit is an adit that restricts the general public from entering the mine or that has been reclaimed. A closed adit may be gated blasted shut
NO_OP_INCL	Enter the number of open inclines found within the site. An incline is a sloped passage (11-65 degrees) from the surface into the mine.

NO_CL_INCL	Enter the number of closed inclines found within the site. A closed incline is an incline that restricts the general public from entering the mine or that has been reclaimed. A closed incline may be gated blasted shut
NO_OP_SHFT	Enter the number of open shafts within the site. A shaft is a vertical excavation through which a mine is worked (66 to 90 degrees). Examples of an open shaft include when debris bridges the shaft 5 to 10 feet down from the collar and/or the collapsed stope
NO_CL_SHFT	Enter the number of closed shafts found within the site. A closed shaft is a shaft that restricts the general public from entering the mine or that has been reclaimed. A closed shaft may be grated
NO_STOPES	Enter the number of stopes found within the mine site. A stope is an underground excavation formed by the removal of ore that has opened to the surface. Note location(s) of all stopes on the sketch map using the appropriate symbol from page 6 of the Check
NO_OTH_OP	Enter the number of other openings found within the mine site. Other openings are glory holes or ventilation holes
OTHER_TYPE	List the type of other openings counted. This entry is 20 characters long.
NO_TRENCH	Enter the number of trenches that are greater than 3 feet
NO_PROSP	Enter the number of prospects found within the mine site. A prospect is an area that has been explored in a preliminary way but has not given evidence of economic value. A prospect is commonly a shallow excavation (equal to or less than 10 feet deep and l
NO_OP_DH	Enter the number of open drill holes found within the mine site. A drill hole is a circular hole made by drilling. There are many drilling methods. Three common methods are percussion rotary
NO_PIT_G30	Enter the number of pits greater than 30 feet deep found within the mine site. A pit is an excavation generally circular in outline with vertical or nearly vertical walls. Note location(s) of all pits greater than 30 feet deep on the sketch map using the a
NO_PIT_L30	Enter the number of pits equal to or less than 30 feet deep that occur within the mine site. A pit is an excavation generally circular in outline with vertical or nearly vertical walls. On the sketch map
PT_HIGHWAL	Enter the total circumference of all pit high walls greater than 10 feet deep.
WASDMP_L01	Enter the number of waste dumps that are less than 0.1 ac in size within the mine site. A waste dump is the area where barren or low-grade material is discarded. This material is usually dumped just beneath the level of the adit portal or shaft collar. In
WASDMP01_5	Enter the number of waste dumps that are 0.1 - 5 ac in size within the mine site. A waste dump is defined above under WASDMP_L01. Include ore stockpiles in this entry. Note location(s) of all waste dumps on the sketch map using the appropriate symbol from
WASDMP_G5	Enter the number of waste dumps that are greater 5 ac in size within the mine site. A waste dump is defined above under WASDMP_01. Include ore stockpiles in this entry. Note location(s) of all waste dumps on the sketch map using the appropriate symbol fro
TAILS_L_01	Enter the number of tailings that are less than .1 ac in size within the mine site. Mine tailings are residual materials after the ore-grade materials have been washed concentrated
TAILS_01_5	Enter the number of tailings that are greater .1 but less than 5 acres in size within the mine site. Mine tailings are defined above under TAILS_l_01. Note location(s) of all tailings on the sketch map using the appropriate symbol from page 6 of the Check
TAILS_G5	Enter the number of tailings that are greater than 5 acres in
NO_HEAPS	Enter the number of heap leach pads found within the site.
NO_DREDGE	Number of locations within the site where dredging was used to extract ore. Two methods of dredging are bucket-line and suction. A bucket-line dredge is a dredge in which the material excavated is lifted by a chain of buckets. The bucket-line dredge opera
NO_PONDS	Enter the number of ponds found within the site. A pond is a man-made surface depression holding a body of water. A pond can be lined or unlined. They can also contain freshwater pregnant solution
NO_DAMS	Enter the number of dams found within the site. A dam is a man-made feature constructed to create a pond for storage of water divert water from a watercourse into a conduit
NO_MILLS	Enter the number of mills found within the site. Note location(s) of all mill sites on the sketch map using the symbol for structures on page 6 of the Checklist with an M inside the symbol.
EQUIP_MACH	Enter the number of locations where mining equipment or machinery has been left or stored on the site. Note location(s) of all mining equipment or machinery on the sketch map using the directions on the lower right side of page 6 of the Checklist.

HEADFRAME	Enter the number of headframes found within the site area. A headframe is a steel or wood frame at the top of a shaft which carries the pulley for the hoist. Note location(s) of headframes on the sketch map using the symbol for structures on page 6 of the
TREST_TRAM	Enter the number of trestles and tramways found within the site. A trestle is a framework of timber piles
POWERLINES	Enter the number of power lines found within the site. Power lines would be used to bring electrical power to the mining operation. These may be aviation hazards. Note location(s) of the power lines on the sketch map using the appropriate symbol from page 6
STRUCTURES	Enter the number of other structures that occur within the site. All abandoned structures except for mills headframes
STRUCT_TYP	Describe what the other structures were used for if known.
HOMESITES	Enter the number of structures used as a homesite within the site. A homesite is a structure that is used as living quarters and is currently being occupied. Note the location(s) of all homesites on the sketch map.
OTHER_FEAT	Enter feature found on the site which is not described above.
BACKG_RAD	Background is the overall reading of the ore host rock formation of the area being investigated. Enter the background gamma reading in milli-roentgen per hour.
ADIT_RAD	Enter the highest gamma reading taken for all the adits and inclines within the site.
ADIT_WL	Enter the corresponding working level reading for the adit or incline recorded above under ADIT_RAD.
SHAFT_RAD	Enter the highest gamma reading taken for all the shafts for all the shafts within the mine site.
SHAFT_WL	Enter the corresponding working level reading for the shaft recorded above under SHAFT_RAD.
OTHER_RAD	Enter the highest gamma reading taken for all the other features found within the mine site.
OTHER_WL	Enter the corresponding working level reading for the other feature recorded above under OTHER_RAD.
OID	internal ID field
DB_ALIAS	Data source code
DB7: Utah Abandoned Mine Reclamation (AMR) Database	
ICF_ID	unique ID
STATE	Name of the state where the mine is located
COUNTY	Name of the county where the mine is located
NAME	Mine name either derived from historical research or assigned by inventory crew
COMMODITY	Product of mining efforts
TAG_NUMBER	A concatenation of numbers describing the cadastral location of the mine and it's unique ID number. For example4372110HO1 means: Quadrant 4
NORTHING	The UTM y-coordinate in meters
EASTING	The UTM x-coordinate in meters
RECLAIMD	The date the mine was reclaimed by Utah Abandoned Mine Reclamation Program
OID	internal ID field
DB_ALIAS	Data source code
DB11:Navajo Lands	
DB11	Navajo Lands Abandoned Uranium Mines
OID	internal ID field
ICF_ID	unique ID field relate to ur2001.shp
CODE	
TYPE	

DOCS	
SKEY	
PID	
FLTZONE	
DB12: State of Arizona Mine Data	
OID	internal ID field
ICF_ID	unique ID field relate to ur2001.shp
DB_ALIAS	data source ID field
SEQ	Eight digit numerical sequence
COMMODITY	Commodity
TYPE	
LAT	Latitude
LATIDUDE	Latitude in decimal degrees
LONG	Longitude
LONGITUDE	Longitude in decimal degrees
POR	
POP	
ZONE	UTM Zone
NORTHING	UTM Northing
EASTING	UTM easting
QUADRANGLE	The name of the 7.5-minute quadrangle largest scale map on which the property is located.
MAP	
MERIDIAN	Line extending north and south on the surface of the earth between the two poles and runs along the astronomical meridian. The principal meridian is the line from which the survey township boundaries along the parallels are initiated
TOWNSHIP	A public land surveying unit. An approximately square area about six miles on a side with boundaries conforming to meridians and parallels within established limits. It is subdivided into 36 sections some of which are designed to take up the convergence o
RANGE	Any series of contiguous townships situated north and south of each other; also sections similarly situated within a township. Ranges of townships are numbered consecutively east and west from a principal meridian: thus "range 3 east" indicates the third r
SEC	
SUBDIVISION	
YOD	
DISTRICT	
CTY_ALB_	
CTY_ALB_ID	
STATE_FIPS	State FIPS: Federal Information Processing Standards(NIST)
FIPS	County FIPS: Federal Information Processing Standards(NIST)
STATE_NAME	State Name
COUNTY_NAM	County Name
SUB_REGION	
STAT_FLAG	
LAT_DEG	Latitude in degree decimals
LAT_MIN	Latitude in Minutes

LONG_DEG	Longitude in degree decimals
LONG_MIN	Longitude in minutes
LONG_SEC	Longitude in seconds
LAT_SEC	Latitude in seconds
CNTY_FIPS	FIPS: Federal Information Processing Standards(NIST)
STATE_CODE	Abbreviation
MINE_NAME	Mine Name
DB13: Abandoned and Inactive Mines (AIMS) Database, US Forest Service	
OID	internal ID field
ICF_ID	unique ID field relate to ur2001.shp
DB_ALIAS	data source ID field
MINE_NUM	The unique site numbers contain Region Forest
DISTRICT	A two-digit code which with a Region and Forest uniquely identifies a Forest Service Ranger District.
COUNTER	Forest Service Data Dictionary
ID_NUMBER	Forest Service Data Dictionary
FEDPLAN_ID	The Regional Office assigns The Federal Facility Identification number when a project is proposed. Each Region National Forest and Research Station will have a unique FFID number.
DATE_ENTRY	Forest Service Data Dictionary
DATE_SURVE	The date the survey was taken in the field.
OTHER_NAME	Any recorded name that is found in the records.
STATE_CODE	Any recorded name that is found in the records.
COUNTY_COD	County Code
MILS_SEQ_N	Indicate feature number associated with Global Positioning System location.
FEATURE_GP	Indicate feature number associated with Global Positioning System location.
LONGITUDE	Longitude in decimal degrees
LATITUDE	Latitude in decimal degrees
QUAD_NAME	The name of the 7.5-minute quadrangle largest scale map on which the property is located.
MERIDIAN	Line extending north and south on the surface of the earth between the two pole sand runs along the astronomical meridian. The principal meridian is the line from which the survey township boundaries along the parallels are initiated
TOWNSHIP	A public land surveying unit. An approximately square area about six miles on a side with boundaries conforming to meridians and parallels within established limits. It is subdivided into 36 sections some of which are designed to take up the convergence of
RANGE	Any series of contiguous townships situated north and south of each other; also sections similarly situated within a township. Ranges of townships are numbered consecutively east and west from a principal meridian: thus "range 3 east" indicates the third r
SECTION	The unit of subdivision of a township; normally a quadrangle 1 mile square with boundaries conforming to the meridians and parallels within established limits
ALQ	Aliquot: A fractional part of a Section.
ELEVATION	Elevation
LAND_OWNER	The classification of federal administration private
PRIVATE_ON	Private Only
MINING_DIS	An area or region characterized by the occurrence of specific mineral suites or the nature of mineral deposits.
MINEOWNER	Mine Owner
MINE_STATU	Mine status codes

DES_WILDER	Designated Wilderness: The land units included in the National Wilderness Preservation System that were authorized and designated by the Wilderness Act of 1964 or subsequent Acts of Congress.
SKETCH	Rough draft or outline of the site (when available).
SITE_VISIT	To officially inspect the place or scene
INDUSTRIAL	
METALS	
URANIUM	
ADITS_COUN	
DMPDRNCNT	
DUMP_COUNT	
GLRYHOLECN	
IMPOUND_CN	
INTADITS_C	
SHAFTS_CNT	
PIT_CNT	
PROS_HLE_C	
SHFTS_CNT	
TAIL_CNT	
MINE_NAME	
DB14: Mine Data from the Bureau of Land Management	
OID	internal ID field
MINE_NAME	Mine name
STATE_ID	State Location Code
COUNTY_NAM	County Name
ROAD_LOG	Driving directions
EVALUATOR	Name of site evaluator
USGS_QUAD_	Vertical distance from a datum usually mean sea level
DATE_	
OPENING_TY	
SIZE_OPENI	
DEPTH_OPEN	
NUM__OPENI	
GROUND_STA	
WASTE_PRES	
ACCESSIBIL	
POPULATED_	
VISIBILITY	
STRUCTURES	
RESCUE_DIF	
HAZARD_REC	
WATER_PRES	
WILDLIFE_U	
RECREATION	

LAND_DEVEL	
SCORE_TOTA	
FIELD_ACTI	
MERIDIAN	Line extending north and south on the surface of the earth between the two poles and runs along the astronomical meridian. The principal meridian is the line from which the survey township boundaries along the parallels are initiated
TOWNSHIP	A public land surveying unit. An approximately square area about six miles on a side with boundaries conforming to meridians and parallels within established limits. It is subdivided into 36 sections some of which are designed to take up the convergence of
RANGE	Any series of contiguous townships situated north and south of each other; also sections similarly situated within a township. Ranges of townships are numbered consecutively east and west from a principal meridian: thus "range 3 east" indicates the third r
SUBDIV	
MIT_FENCED	
RECOMMENDA	Field Notes
FIELD_NOTE	Field Notes
TYPES_OF_E	
MIT_SIGNS	
VEHICLE_AC	
WILDLIFE	
SURF_OWN	
SIGNIFICAN	
ELEVATION	
STATUS	
WASTE_ROCK	
SIZE_WASTE	
POT_WIND_E	
IND_METAL_	
WATER_NEAR	
WATER_TYPE	
H2O_PRES	
WATER_PROD	
METHOD_PRE	
GPS_CORREC	
NORTHING	UTM Northing
EASTING	UTM Easting
UTM_ZONE	UTM Zone
DATUM	Datum
XXXXXX	
MAPLTR	
GEO_STATE	State Abbreviation
DIST_RA	
SITE_ID	
MILS_ID	
STATEID	
PRI_COMDTY	

COUNTY	
MIN_OWN	
VIS_ROAD	
VIS_TRAIL	
VIS_POPUL	
DIFFICULTY	Driving conditions
HUMAN_USE	
HUMAN_DES	
REC_MINACT	
MINACT_DES	
NO_OP_ADIT	
NO_CL_ADIT	
NO_OP_INCL	
NO_CL_INCL	
NO_OP_SHFT	
NO_CL_SHFT	
NO_STOPES	
NO_OTH_OP	
OTH_TYPE	
NO_TRENCH	
TRENCH_LEN	
NO_PROSP	
NO_OP_DH	
NO_PIT_G30	
NO_PIT_L30	
PT_HIGHWAL	
WASDMP_L01	
WASDMP01_5	
WASDMP_G5	
TAILS_L_01	
TAILS_01_5	
TAILS_G5	
NO_HEAPS	
NO_DREDGE	
NO_PONDS	
NO_DAMS	
NO_MILLS	
MILL_TYPE	
NO_EXPLSV	
EXPLSV_DES	
EQUIP_MACH	
HEADFRAMES	
TREST_TRAM	
POWERLINES	

STRUCTURE_	
STRUCT_TYP	
STRUCT_CON	
STRUCT_LOK	
HOMESITES	
OTHER_FEAT	
VEG_COND	
REVEG_EVID	
REVEG_DESC	
ANIML_EVID	
ANIML_PRES	
ANIML_DES	
STAIN_SOIL	
STAIN_DESC	
SULF_MIN	
SULFMINTYP	
TAILS	
FLOW_H2O	
STAND_H2O	
TAILS_H2O	
WASTE_H2O	
ORE_H2O	
AJ_GRD_H2O	
AJ_SUR_H2O	
AM_SURFH2O	
BM_SURFH2O	
CHEM_PILES	
ACID_ODOR	
ASBESTOS	
PETROCHEMS	
DUMPSITES	
POWER_SUBS	
TRANSFORMS	
BARREL_TNK	
LEAKING	
UNDRG_STOR	
STOR_DESCR	
OTHER	
RILLS	
GULLIES	
SHEETWASH	
UNSTABL_RX	
SLOPE_INST	
WIND_EROS	

MITIG_STAT	
HAZ_MITIG	
OTHER_MIT	
MIT_COND	
MAX_PDOP	
RCVR_TYPE	
FILT_POS	
STD_DEV	
GPS_HEIGHT	
NUM_PHOTOS	Number of Photos
ICF_ID	
DB_ALIAS	
DB15: South Dakota mines	
ICF_ID	
DB_ALIAS	
SDSMT_NUM	
IDNUMBER	
REGION	
STATE	
FOREST	
RGR_DIST	
UTM_ZONE	
XUTM	
YUTM	
SITENAME_1	
SITENAME_2	
HPED	
HPMH	
COMMOD	
COMMOD_T	
QUADNAME	
QUADDATE	
COUNTY	
MINE_DIST	
SECD	
TWP	
TWPD	
RGE	
RGED	
NEAR_STRM	
NEXT_STRM	
ELEV	
SLOPE	

TERRAIN	
ACCESS_T	
ACCESS_Q	
NEAR_TOWN	
DIST_TOWN	
NEAR_ROAD	
DIST_ROAD	
DIST_DWELL	
VEG_DENSE	
VEG_T	
BATS	
RECLAIMED	
ACRES	
HIST_STR	
MAP_SCALE	
LATITUDE	
LONGITUDE	
REC_FIRST	
REC_MI	
REC_LAST	
REC_DATE	
DB16: Uranium Mines in CA	
ICF_ID	unique ID
MINEHUB_MI	
OMR_ID	seven character field is a unique identifier for a mine record
FEATURE_ID	foreign key to the FEATURE table
COUNTY_NAM	Primary county in which the mine resides. If the mine is in two or more counties this should reflect the lead agency
COMMODITY	commodity mined from the site
FILE_DATE	date the record was created
LAST_DATE	date of the last visit to the mine property
CREW_INITI	
GPS_PERSON	The initials of the person who collected the GPS data. It may be left blank if location data is not from GPS files.
NOTE_TAKER	This is the person who took notes on the mine site in the field. It may be left blank when entering data from external data sources.
DATA_ENTER	Who entered the record into the database. This is the user's database login name.
DATA_SOURC	This holds the acronym for the organization that originated the data. For instance data collected by the AMLU unit from field visits get "OMR"
DISTICT_NA	This is the name of the mining district if known.
AML_STATUS	The status of the mine as interpreted by AMLU staff.
CNTY_STATU	The status of the mine as reported by the county.
GIS_ID	This 16 character field is the link between the GIS and the mine location. It is a required field and must be unique throughout the database. It has a specific format of "LMMDDHHLYYYYLLLN". The first "L" is a letter corresponding to the GPS unit used to"
GIS_TYPE	One of three types of spatial feature: "point""line" or "polygon".

GIS_ACCURA	The spatial accuracy of the position. There are five classes of spatial accuracy to choose from. The first"15 ft."
QUAD_CODE	USGS quadrangle code.
QUAD_NAME	The name of the 7.5' USGS topo quad in which the mine lies. Mines that fall in more than one quad sheet should have the primary quadrangle map listed here.
PLSS	
ELEVATION	The elevation of the position in feet.
DDLAT	Latitude in decimal degrees.
DDLON	Longitude in decimal degrees.
TEALE_X	This is the Easting for the coordinate in the Teale Alber's projection. Its units are meters.
TEALE_Y	This is the Northing for the coordinate in the Teale Alber's projection.
TYPE	Type of feature.
CONDITION	
ATT_ACCUR	The qualitative assessment of confidence in the feature type given. For instance if the feature appeared to be a collapsed adit
X_DIM	
Y_DIM	
Z_DIM	
COLOR	Color of the feature.
ODOR	Odor of a feature.
SITE_DESCR	History of the site its overall condition
ACCESS_DES	How easy it is to access the site.
OPERATIONS	
HUMAN_ACTI	
DB17: Texas Department of Health	
ICF_ID	Unique ID field
DB_ALIAS	data source ID field
DBUNIQUE	Unique database ID field
MINE_NAME	mine name
RECLAMATIO	whether or not the mine site has been reclaimed
CITY	city name
COUNTY	county name
PERMIT	permit ID
STATE	state name
OWNER1	owner name
LATDD	latitude in decimal degrees
LONDD	longitude in decimal degrees
DB18: New Mexico Mines Database	
ICF_ID	unique ID field relate to ur2002.shp
DB_ALIAS	unique database source ID
MINE_ID	unique mine ID consisting of a prefix NM (for New Mexico)two-letter abbreviation that represents the county (see County table) followed by a unique number; each represents a site that may contain buildings
COUNTY	county name
DISTRICT_I	unique district ID

DISTRICT	Mine coal field or geographical area district name
MINE_NAME	the name of the occurrence prospect
ALIASES	other names associated with this site
TOWNSHIP	township number where mine is located
RANGE	range number where mine is located
SECTION	section number where mine is located
SUBSECTION	subsection portion where mine is located
LATITUDE	latitude in decimal degrees
LONGITUDE	longitude in decimal degrees
UTM_EASTIN	UTM easting of mine
UTM_NORTHI	UTM northing of mine
UTM_ZONE	UTM zone of mine
LOCATION_A	Comments on the accuracy of the location of the occurrence see location assurance table below. This is a text field.
POINT_OF_L	Point of reference for location position of mine see point of reference table. This is a text field.
PRODUCTION	production category
COMMODITY_	commodity category – uranium coal
COMMODITIE	commodities produced
COMMODIT_1	commodities present not produced
YEAR_OF_IN	first year of known production
YEAR_OF_LA	last year of known production
COMMENTS_O	comments on production
DEVELOPMEN	extent of development of deposit
DEPTH_OF_W	depth of workings
LENGTH_OF	length of workings
DISTURBED_	the size of the site that includes all of the disturbed or impacted areas in acres.
OPERATING_	current operating status see operating status table. This is a text field.
PRODUCTI_1	amounts of production as available. Production figures obtained from references cited.
MINING_MET	mining methods
SURFACE_LA	surface land status – federal private
MINERAL_LA	mineral land status – federal private
OWNPRIMARY_CO	primary company
ACCESS	method of access to the site see access table below.
MINING_HIS	mining history
CULTURAL_F	cultural features
HOST_FORMA	the type and formation name of the host.
AGE_OF_HOS	age of host rock
AGE_OF_MIN	age of mineralization
ROCK_TYPE	lithology hosting the deposit.
STRUCTURE	structure and character of deposit
MINERALOGY	
SIZE	size of deposit
ALTERATION	
TYPE_OF_DE	

USGS_QUADR	
ELEVATION	
METHOD_OF_	Method_of_obtaining_elevation
LAND_USE	land use – recreation residential
POTENTIAL_	potential hazardous materials
EVIDENCE_O	evidence of potential acid drainage
HYDROLOGY	
RECEIVING_	receiving stream
RECLAMATIO	
MITIGATION	mitigation status
SAMPLE_NUM	samples collected from deposit
MRDS_NUMBE	MRDS ID
OTHER_AGEN	other agency number
CHEMICAL_A	samples collected for analysis
COMMENTS	
RECOMMENDA	recommendations
REFERENCES	
INSPECTED_	inspected by
DATE_INSPE	date inspected
DATE_OF_LA	date of last modification to data record
DB19: Wyoming Mine Data	
ICF_ID	
DB_ALIAS	
SITE_NO	
PROJ_NO	
PROJ_SUF	
COUNTY	
TOWNSHIP	
RANGE	
SECTION	
MINE_NAME	
SURFACE_OW	
QUAD_P	
DIST_AREA	
REC_AREA	
REMEDIATED	
CERTIFIED	
BLM_HUC	
MINERAL_P	
CO_LAT_DIG	
CO_LON_DIG	
DATUM	

DB20: Nevada Bureau of Mines and Geology	
ICF_ID	Unique ID field
DB_ALIAS	data source ID field
DBUNIQUE	Unique database ID field
STATE_NAME	
STATE_CODE	
MINE_NAME	
DB21: Texas Mines from Adams & Smith Publication Map	
ICF_ID	Unique ID field
DB_ALIAS	data source ID field
ID	unique ID field
MINE_NAME	
REFERENCE	
STATE	
COUNTY	
DB22: Dakotas Mines from Published Map	
ICF_ID	Unique ID field
DB_ALIAS	data source ID field
ID	Unique database ID field
DEP_TYPE	deposit type either Deposit with more than 1 ft of 0.10% U3O8 or Deposit of reported ore production.
STATE	
COUNTY	
REFERENCE	
DB23: Montana State Library Mines	
ICF_ID	Unique ID field
DB_ALIAS	data source ID field
SITE	
LEGAL	
DISTRICT	
COUNTY	
USGSDRAIN	
PRIMARYDRA	
SECONDRYDR	
LAT	
LOG	
OWNERSHIP	
MINETYPE	
FEATURES	
VISIT	
OPENINGS	

DB24: Texas Inactive Mineral Production Sites – University of Texas - Austin	
ICF_ID	Unique ID field
DB_ALIAS	data source ID field
COUNTY	
LOCATION	
LATITUDE	
LONGITUDE	
MAP_NAME	
GEOLOGY	
RECLAIMED	
DB25: Railroad Commission of Texas	
ICF_ID	Unique ID field
DB_ALIAS	data source ID field
Handle	
Mine_Num	
Name_rct	
Operator	
Source	
RCT_Type	
RCTComment	
RCT_ID	
DB5	
DB17	
DB21	
DB24	
DB4_Comm	
DB5_Comm	
DB17_Comm	
DB21_Comm	
DB24_Comm	
DB4	
2002_Edit	
RCT_Edit	
RCT_AML	
ExtraCom	
Category	

Appendix D

U.S. Department of Energy
Abandoned Uranium Mines Data Fields

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Table 01. Location

ITEM	*NAME*	*VALID VALUES*	*DESCRIPTION*
TABLE:	T01_Location		
FIELDS:	LM_ID		Unique ID assigned by the Office of Legacy Management/S.M. Stoller Corporation.
	CLAIM_NAME		Mine or claim name.
	ALT_NAME		Alternate name or alias.
	STATE_NAME		State.
	COUNTY_NAME		County.
	DISTRICT		Mining district.
	LOCALITY		Locality.
	OWNER		Owner or operator.
	LATITUDE		Latitude.
	LONGITUDE		Longitude.
	COMMENT		Comment.
	DATA_SOURCE		Data source of mine location information.
	AEC_LOCATION		Did the record originate from the 1967 U.S. Atomic Energy Commission production report? (1 = yes, 0 = no)
	NN_LOCATION		Did the record originate from the Navajo Nation mine data from U.S. Environmental Protection Agency? (1 = yes, 0 = no)
	CERCLA		ID to link the record to S06_CERCLA_List.
	ALL DB_Y/N	YES	Location status.
		TBD	
		NO	

Table 02. Owner Operator

ITEM	*NAME*	*VALID VALUES*	*DESCRIPTION*
TABLE:	T02_Owner_Operator		
FIELDS:	LM_ID		Unique ID assigned by the Office of Legacy Management/S.M. Stoller Corporation.
	OWNER		
	OPERATOR		
	OWN_OPP_INFO_SOURCE		
	PERMITEE		
	PERMITEE_SOURCE		

Table 03. Production

ITEM	*NAME*	*VALID VALUES*	*DESCRIPTION*
TABLE:	T03_Production		
FIELDS:	LM_ID		Unique ID assigned by the Office of Legacy Management/S.M. Stoller Corporation.
	TONS_ORE		Tons of ore.
	POUNDS_U308		Pounds of uranium concentrate.
	GRADE_PCT		Percent grade.
	YEAR_FIRST_PROD		First year of production.
	YEAR_LAST_PROD		Last year of production.
	PRODUCTION_CLASS	0 - 100 100 - 1,000 1,000 - 10,000 10,000 - 100,000 100,000 - 500,000 > 500,000 UNKNOWN	Current production-size class.
	DESCRIPTION	1 - Small 2 - Small/Medium 3 - Medium 4 - Medium/Large 5 - Large 6 - Very Large 7 - UNKNOWN	Description of production-size class.
	PROD_INFO_SOURCE		Information source.
	PROD_COMMENT		

Table 04. Mine Status

ITEM	NAME	VALID VALUES	DESCRIPTION
TABLE:	T04_Mine_Status		
FIELDS:	LM_ID		Unique ID assigned by the Office of Legacy Management/S.M. Stoller Corporation.
	MINE_STATUS	REMEDIATED RECLAIMED PARTIALLY RECLAIMED IN PROCESS CLOSED PERMITTED NOT RECLAIMED OR UNKNOWN	Status of mine.
	STATUS_INFO_SOURCE		Data source of mine status information.
	STATUS_COMMENT		Comment.
	ORIG_MINE_STATUS		Original mine status from source database.
	ORIG_REC_STATUS		Original reclamation status from source database.

Table 05. Mine Features

ITEM	*NAME*	*VALID VALUES*	*DESCRIPTION*
TABLE:	T05_Mine_Features		
FIELDS:	LM_ID		Unique ID assigned by the Office of Legacy Management/S.M. Stoller Corporation.
	MINE_TYPE		Surface or underground?
	MINE_AREA_M2		Mine area.
	ADITS		Feature adits.
	WASTE_PILES		Feature waste piles.
	WASTE_PILE_AREA		
	WASTE_PILE_VOLUME		
	PITS		Feature pits.
	SHAFTS		Feature shafts.
	OTHER_DEBRIS_MINE_FEATURES		Other debris features.
	RECLAMATION_STATUS		Reclamation status.
	STRUCTURES		Number of structures.
	DIST_TO_ROAD		Distance in miles.
	DIST_TO_STREAM		Distance in miles.
	DIST_TO_WELL		
	DIST_TO_POP_CNTR		Distance in miles.
	FEAT_COMMENT		Comment.
	FEAT_SOURCE		Information source.

Table 06. Land Ownership

ITEM	*NAME*	*VALID VALUES*	*DESCRIPTION*
TABLE:	T06_Land_Ownership		
FIELDS:	LM_ID		Unique ID assigned by the Office of Legacy Management/S.M. Stoller Corporation.
	LAND_OWN_AGENCY		Agency.
	LAND_OWN_NAME_1		Landowner 1.
	LAND_OWN_NAME_2		Landowner 2.
	LAND_OWN_FEATURE_1		Feature 1.
	LAND_OWN_FEATURE_2		Feature 2.
	MINERAL_OWNER		
	COMMENT		Ownership comment.
	LAND_OWN_SOURCE		

Table 07. Cost

ITEM	*NAME*	*VALID VALUES*	*DESCRIPTION*
TABLE:	T07_Cost		
FIELDS:	LM_ID		Unique ID assigned by the Office of Legacy Management/S.M. Stoller Corporation.
	COST_INFO_AVAILABLE		Is cost information available? (Yes/No)
	COST		Cost.
	COST_DESCRIPTION		Description of cost.
	COST_INFO_SOURCE		Source of cost information.
	COST_COMMENT		Comment.
	COST_YEAR		Year of cost data.

Table 08. Rad Gamma Data

ITEM	*NAME*	*VALID VALUES*	*DESCRIPTION*
TABLE:	T08_Rad_Gamma_Data		
FIELDS:	LM_ID		Unique ID assigned by the Office of Legacy Management/S.M. Stoller Corporation.
	RAD_DATA_AVAILABLE		Is radiation data available? (Yes/No)
	RAD_DATA_SOURCE		Source of rad data.
	RAD_DATA_COMMENT		Comment.
	GAMMA_AVG_BACKGROUND		Average gamma background.
	GAMMA_AVG		Average gamma measurement.
	GAMMA_MAX		Maximum gamma measurement.
	GAMMA_RANGE		Gamma range.
	GAMMA_RANGE_WASTE_PILES		Gamma range for waste piles.
	GAMMA_RANGE_BACKGROUND		
	GAMMA_UNITS		Measurement units.

Table 09. Rad Soil Data

ITEM	*NAME*	*VALID VALUES*	*DESCRIPTION*
TABLE:	T09_Rad_Soil_Data		
FIELDS:	LM_ID		Unique ID assigned by the Office of Legacy Management/S.M. Stoller Corporation.
	RADIUM_RANGE		
	RADIUM_BKGRND		
	RADIUM_UNITS		
	RAD_INFO_SOURCE		
	COMMENT		

Table 10. Rad Radon Data

ITEM	*NAME*	*VALID VALUES*	*DESCRIPTION*
TABLE:	T10_Rad_Radon_Data		
FIELDS:	LM_ID		Unique ID assigned by the Office of Legacy Management/S.M. Stoller Corporation.
	RAD_DATA_AVAILABLE		
	RADON_AVG		
	RADON_RANGE		
	RADON_BKGRND		
	RADON_UNITS		
	RAD_INFO_SOURCE		
	COMMENT		

Table 11. Surface Water Data

ITEM	*NAME*	*VALID VALUES*	*DESCRIPTION*
TABLE:	T11_Surface_Water_Data		
FIELDS:	LM_ID		Unique ID assigned by the Office of Legacy Management/S.M. Stoller Corporation.
	SW_DATA_AVAILABLE		Is surface water data available? (Yes/No)
	SW_DATA_SOURCE		Source of surface water data.
	SW_DATA_COMMENT		Comment.

Table 12. Groundwater Data

ITEM	*NAME*	*VALID VALUES*	*DESCRIPTION*
TABLE:	T12_Groundwater_Data		
FIELDS:	LM_ID		Unique ID assigned by the Office of Legacy Management/S.M. Stoller Corporation.
	GW_DATA_AVAILABLE		Is groundwater data available? (Yes/No)
	GW_DATA_SOURCE		Source of groundwater data.
	GW_DATA_COMMENT		Comment.

Table 13. Comments

ITEM	*NAME*	*VALID VALUES*	*DESCRIPTION*
TABLE:	T13_Comments		
FIELDS:	LM_ID		Unique ID assigned by the Office of Legacy Management/S.M. Stoller Corporation.
	COMMENT		Comment.
	COMMENT_BY		Name of person or organization that provided the comment.
	COMMENT_SOURCE		Source of comment.
	COMMENT_DATE		Date comment received.
	ACTION_REQUIRED		Is an action required to address the comment?
	ACTION_COMPLETED		Has an action been taken to address the comment?
	ACTION_DESC		Description of the action taken.

Table 14. Visual Check

ITEM	*NAME*	*VALID VALUES*	*DESCRIPTION*
TABLE:	T14_Visual_Check		
FIELDS:	LM_ID		Unique ID assigned by the Office of Legacy Management/S.M. Stoller Corporation.
	VISUAL_CHECK		Has the mine location been visually checked against an aerial photo or U.S. Geological Survey topographic map?
	AERIAL	MINE FEATURE VISIBLE MINE FEATURE NOT VISIBLE MINE FEATURE NEARBY UNCERTAIN	Are mine features visible on the aerial photo?
	USGS_TOPO	MINE FEATURE VISIBLE MINE FEATURE NOT VISIBLE MINE FEATURE NEARBY UNCERTAIN	Are mine features visible on the U.S. Geological Survey topographic map?
	VISUAL_CHECK_COMMENT		Comment.
	CHECKED_BY		Name of person who checked the location.
	CHECKED_DATE		Date the location was checked.
	ACTION_TAKEN		Was an action taken to address the comment?
	ACTION_DESC		Description of the action taken.

Table 15. Documents

ITEM	*NAME*	*VALID VALUES*	*DESCRIPTION*
TABLE:	T15_Documents		
FIELDS:	LM_ID		Unique ID assigned by the Office of Legacy Management/S.M. Stoller Corporation.
	MINE_NAME		Claim name.
	DOCUMENT		Document name or description.
	FILE_PATH		Source location.
	COMMENT		Comment.

Table 99. Data Sources

ITEM	*NAME*	*VALID VALUES*	*DESCRIPTION*
TABLE:	T99_Data_Sources		
FIELDS:	SOURCE_NAME		
	SOURCE_TYPE		
	SOURCE_ORIGINATOR		
	SOURCE_DESCRIPTION		
	SOURCE_COMMENTS		
	FILE_NAME		
	FILE_LINK		
	SHAREPOINT_LINK		

Appendix E

Summary Table of New Mexico Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) Reports

Table E-1. New Mexico Pre-CERCLIS Reports Data for Mines with an LM ID Number

LM_ID	Date of Report	CLAIM_NAME (+Aliases)	COUNTY_ NAME	T, R, SEC	SURFACE OWNER	OPERATOR	RECLAMATION_STATUS	YEAR_FIRST_PROD	YEAR_LAST_PROD	PERMIT_ NUMBER	ADITS	STRUCTURES	SHAFTS	PITS
607	9/10/2009	Barbara J #1	McKinley		BLM	Mid-Continent Uranium Company	Not reclaimed		1968					
608	9/10/2009	Barbara J #2	McKinley		BLM	Mid-Continent Uranium Company	Not reclaimed		1968					
609	9/10/2009	Barbara J #3	McKinley		BLM	Todilto Exploration and Development	Not reclaimed		1980				1	
527	9/10/2009	Beacon Hill Gossett	McKinley		BLM	Reserve Oil and Minerals	Not reclaimed		1978					
527	9/10/2009	Beacon Hill Mine	McKinley		BLM	Farris Mines	Not reclaimed		1967				2	
541-542	9/10/2009	Blue Peak Mine	McKinley		BLM	Garcia Mines	Partially reclaimed		1965		2 +		1	
573	8/16/2010	Bucky Mine	McKinley		Private	Holly Minerals, See-Tee Mining Company, Hydro-Nuclear, Cobb Resources	Reclaimed		1980		1			
614	5/28/2010	Charlotte Site	McKinley	13N, 9W, 33	Private			1954	1956					5
615	5/28/2010	Christmas Day Site	Cibola	12N, 9W, 4	Private			1954	1956					1
529	9/10/2010	Davenport Mine	McKinley		BLM	Bailey and Fife	Not reclaimed		1966					
545	9/10/2009	Dog Mine	McKinley		BLM	Four Corners Exploration	Not reclaimed		1975			2		
576	8/17/2010	Dysart #2	McKinley	14N, 10W, 10-11	Private	Rio de Oro, Mid-Continent Uranium Corporation, Homestake-Sapin Partners, Sabre-Pinon, Cobb Nuclear, Southwest Resources	Partially reclaimed; Permitted- Shaft and hoist being used for Section 12 mine	1959	1963			2	3	
618	9/10/2009	Faith Mine	McKinley		Private	M&M Mining	Not reclaimed		1981					
621	9/10/2009	Flat Top Mine	McKinley		BLM	Bailey and Fife	Reclaimed		1966				1	
622	9/10/2009	Haystack Section 31	McKinley	13N, 9W, 31	Private	United Nuclear	Not reclaimed		1975					5
548	9/10/2009	Isabella Mine (North & South)	McKinley		North - Navajo allottee, South - BLM	North - Navajo Allottee, South - Newmont Mining	Not reclaimed						1	
626	3/15/2011	Lone Pine Mine (Lone Pine #3, Little Haystack 1-29, John 104, and Double X 3-5)	Cibola		BLM	Lone Pine Mining Company, Permian Basin Uranium Company	Not reclaimed	1954	1955		2			

Table E-1 (continued). New Mexico Pre-CERCLIS Reports Data for Mines with an LM ID Number

LM_ID	Date of Report	CLAIM_NAME (+Aliases)	OTHER_DEBRIS_MINE_FEATURES	DIST_TO_ STREAM	DIST_TO_WELLS	DIST_TO_ POP	GAMMA_UNITS	GAMMA_MAX	GAMMA_AVG	GAMMA_RANGE	GW_DATA	MISC. NOTES
607	9/10/2009	Barbara J #1	open bore hole, caved in shaft, sedimentation pond, several waste piles with erosion		0.28- irrigation	3.1	cps	625 on waste pile		54-625	Y	
608	9/10/2009	Barbara J #2	several waste piles and concrete pads		1.14- irrigation	2.3	cps	348		10-40 on waste piles	Y	
609	9/10/2009	Barbara J #3	several waste piles, concrete pad, load out area, one shaft and a well or vent shaft (over 458' deep)		0.45- irrigation	2.76	cps	1924 on load-out area		33-436 on waste piles	Y	
527	9/10/2009	Beacon Hill Gossett	numerous waste piles with erosion, open vent shaft		1.58- irrigation	1.5	cps	489			Y	
527	9/10/2009	Beacon Hill Mine	several waste piles with erosion, open shafts, scattered debris		1.25- irrigation	1.5	cps	1005		285-417 on waste piles	Y	
541-542	9/10/2009	Blue Peak Mine	Mine on mesa top, well vegetated, open vent shaft may connect to tunnels, several distinct waste piles, unmined ore-bearing sandstone outcrop		1.58- irrigation	3.65	cps	1200 at outcrop		15-679 on waste piles	Y	
573	8/16/2010	Bucky Mine	Reclamation completed 2007	600' to ephemeral Martin Draw	3.0-4.0 domestic and stock	3.0-4.0	cpm	9000 on waste rock pile		1800-9000		
614	5/28/2010	Charlotte Site	One waste pile on site. No apparent reclamation has taken place, but no buildings or structures remain.	8	>1.0	>1.0	µR/hr	100 from slab of limestone		7-100		
615	5/28/2010	Christmas Day Site	Two piles remain onsite. No apparent reclamation has taken place, but no buildings or structures remain.	8	1.0 stock watering	>1.0	µR/hr	900		270-600		
529	9/10/2010	Davenport Mine	Waste rock piles and collapsed frame structure		1.1- irrigation	1.5	cps	230		28-230	Y	
545	9/10/2009	Dog Mine	Caved decline with wooden hoist, 2 open vent holes, numerous waste piles and stock tank.		1.37- irrigation	1.78	cps	5653 in stockpiled ore area		28-789		
576	8/17/2010	Dysart #2	Headframe and hoist, substation with generator to run hoist. Previously noted waste piles are now gone.	200' to ephemeral Martin Draw	1-2- mining, 2-3- domestic		cpm			9000-20000		
618	9/10/2009	Faith Mine	Scattered waste piles, remains of load-out structure, concrete pad with power poles, and possible archeological site.		.48- stock watering	1.73	cps			15-578	Y	
621	9/10/2009	Flat Top Mine	Scattered waste piles and miscellaneous debris		.38- stock watering	1.73	cps	1065 in mineralized limestone		34-553		
622	9/10/2009	Haystack Section 31	Three open pits, two trenches, and waste piles, unstable pit highwalls.		650'- domestic	1.5	µR/hr	700		9-70		
548	9/10/2009	Isabella Mine (North & South)	North area has 1 open shaft, both areas have several waste piles.		0.8	3	cps	741			Y	
626	3/15/2011	Lone Pine Mine (Lone Pine #3, Little Haystack 1-29, John 104, and Double X 3-5)	Load-out facility, two timbered adits, and underground powder magazine remain onsite.	.25' to ephemeral Martin Draw	1-2- domestic		cps and µR/hr			150-400 (cps) and 9-70 (µR/hr)		

Table E-1 (continued). New Mexico Pre-CERCLIS Reports Data for Mines with an LM ID Number

LM_ID	Date of Report	CLAIM_NAME (+Aliases)	COUNTY_ NAME	T, R, SEC	SURFACE OWNER	OPERATOR	RECLAMATION_STATUS	YEAR_FIRST_PROD	YEAR_LAST_PROD	PERMIT_ NUMBER	ADITS	STRUCTURES	SHAFTS	PITS
549	10/8/2010	Marquez Mine	McKinley	13N, 9W, 23	Private	Farris Mines, Calumet and Hecla, Inc., United Nuclear Corporation, Kerr-McGee	Reclaimed	1957	1966		1			
577	10/8/2010	Mary #1	McKinley	14N, 10W, 11	Private	Stella Dysart and Entrada Corporation, Homestake-Sapin Partners	Reclaimed	1959	1966				1	
550	9/10/2009	Mesa Top Mine	McKinley		BLM	Holly Minerals	Not reclaimed		1958				2	
629, 630	9/10/2009	Red Bluff #1 (Red Bluff 1-5, 9 Site)	McKinley, Cibola	12N, 9W, 4	Private, BLM	Homer Scriven	Not reclaimed	1950	1964		1		1	6
594	8/16/2010	Rialto (Chill Willis)	McKinley		Private	Bailey and Fife, Farris Mines, Febco Mines, Conoco Minerals	Not reclaimed	1960	1963			3	2	1
580	3/31/2011	Sandstone	Mckinley			Phillips Petroleum, United Nuclear Corporation	Reclaimed	1959	1980				1	
582	10/8/2010	Section 12 (Dysart Group, Tana and Alto)	McKinley	14N, 10W, 12	BLM	Anderson Development Company, Stella Dysart, Hydro Nuclear Corporation, Cobb Nuclear Corporation, United Nuclear, Cobb Resources	Not reclaimed- Neutron Energy expressed interest in permitting (2010)	1961					3	
597	3/31/2011	Section 13 Mine	McKinley		Private	United Nuclear-Homestake Partners	Reclaimed	1977	1981				1	
584	10/31/2011	Section 17 Mine	Mckinley	14N, 9W, 19	Private	Kerr-McGee, Quivera Mining, Rio Algom	Reclaimed	1960	2002					
552	10/31/2011	Section 30 Mine	McKinley	14N, 9W, 30	Private	Kerr-McGee, Quivera Mining	Reclaimed	1957	1984				1	
642	10/31/2011	Section 30W Mine	McKinley	14N, 9W, 30	Private	Kerr-McGee, Quivera Mining	Reclaimed	1969	1984				1	
596	10/31/2011	Section 33 Mine	McKinley	14N, 9W, 33	Private	Kerr-McGee, Quivera Mining	Reclaimed	1959	1984				1	
598, 646	10/31/2011	Section 36 Mine	McKinley		NM Trust Land	Phillips Petroleum, Kerr-McGee	Reclaimed	1960	1984				1	
647	3/15/2011	Tohn Mine (Tohn No 13, Tohn Group, Vanadium)	Cibola		BLM	Anaconda	Not reclaimed	1954	1955					
649	10/8/2010	Vallejo Mine (Double Jerry, Section 34, Farris No.1)	McKinley		U. S. Forest Service	Farris Mines, Vallejo Mines, Samson Oil and Minerals, Penta Mining Co.	Not reclaimed	1957	1963				1	
4124	3/15/2011	Zia Mine	Cibola		U. S. Forest Service	J.M. Keeney, La Jara Mining Company, Florida Minerals, Zia Mining Company, Chena Mining Company	Not reclaimed	1952	1960		2			3

Table E-1 (continued). New Mexico Pre-CERCLIS Reports Data for Mines with an LM ID Number

LM_ID	Date of Report	CLAIM_NAME (+Aliases)	OTHER_DEBRIS_MINE_FEATURES	DIST_TO_ STREAM	DIST_TO_WELLS	DIST_TO_ POP	GAMMA_UNITS	GAMMA_MAX	GAMMA_AVG	GAMMA_RANGE	GW_DATA	MISC. NOTES
549	10/8/2010	Marquez Mine	Reclaimed in 1987.		.75-1.0- domestic		µR/hr		406.9	21-2,200		
577	10/8/2010	Mary #1	Reclaimed post-1980	2,000' to ephemeral Martin Draw	1-2- domestic		µR/hr	45				
550	9/10/2009	Mesa Top Mine	Numerous waste piles, building pads, 2 open shafts, and miscellaneous debris. Evidence of erosion.		1.0 - irrigation	1.8	cps	900		34-553		
629, 630	9/10/2009	Red Bluff #1 (Red Bluff 1-5, 9 Site)	In mines 1-5 and 9 there are 6 pits, one shaft, one open cut, and 8 waste piles.		1.0- stock watering	1	µR/hr	1,250			Y	Information provided on the size of the waste piles and the associated rad readings.
594	8/16/2010	Rialto (Chill Willis)	Seven piles, one foundation, one fenceline and miscellaneous debris	1000'	.5-1.0- domestic	0.5	µR/hr	1200 on ore pile		34-500		
580	3/31/2011	Sandstone	Reclamation completed and NMED released from further requirements in 1999.		3-4- stock watering	3-4					Y	
582	10/8/2010	Section 12 (Dysart Group, Tana and Alto)	Hoist frame and sheet metal hopper, hoist control shack, several mines buildings and large waste rock piles.		2-3 domestic		cpm	100,000		7,000-100,000		
597	3/31/2011	Section 13 Mine	Reclamation complete in 1991-1992. Remaining recontoured and capped waste rock and concrete slabs.		1-2- mining							
584	10/31/2011	Section 17 Mine	Reclamation started in 1994, completed in 2005.		1-2- mining	0.4	µR/hr			5->45		
552	10/31/2011	Section 30 Mine	Reclamation started in 1994, completed in 2005. However, has not been released by NM from closure requirements.		1-2- mining	1.8	µR/hr			5->45		Rad readings 1000X background
642	10/31/2011	Section 30W Mine	Reclamation started in 1994, completed in 2005. However, has not been released by NM from closure requirements.		1-2- mining	1.9	µR/hr			5->45		Please note in reports that locations for 30 & 30W are the same. Rad readings 1000X background.
596	10/31/2011	Section 33 Mine	Reclamation started in 1994, completed in 2005. However, has not been released by NM from closure requirements.		2-3- stock watering		µR/hr			5->45	Y	Rad readings 1000X background
598, 646	10/31/2011	Section 36 Mine	Reclamation complete in 1990.		2-3- stock watering		µR/hr			5->45	Y	Rad readings 1000X background
647	3/15/2011	Tom Mine (Tom No 13, Tom Group, Vanadium)	Rim stripping, bench cuts and waste piles	.5 to ephemeral stream	1-2- domestic		cps	900				Rad readings 10X background
649	10/8/2010	Vallejo Mine (Double Jerry, Section 34, Farris No.1)	Caved shaft, head frame and loadout area, powder magazine and waste area.	10,000' to San Mateo Creek	1-2- domestic		µR/hr			120-206		
4124	3/15/2011	Zia Mine	Underground workings, pits and trenches, and numerous waste piles.	.25 to ephemeral stream	1-2- domestic		cps			150-600		Rad readings 8X background

Table E-2. New Mexico Pre-CERCLIS Reports Data for Mines Without an LM ID Number

LM_ID	Date of Report	CLAIM_NAME (+Aliases)	COUNTY_ NAME	T, R, SEC	OWNER	OPERATOR	RECLAMATION_STATUS	YEAR_FIRST_PROD	YEAR_LAST_PROD	PERMIT_ NUMBER	ADITS	STRUCTURES	SHAFTS	PITS
	3/20/2012	Divide Mine (Part of Section 25 Mine complex)	McKinley	13N, 10W, 25	Private	Four Corners Exploration	Partially reclaimed	Never Produced	Never Produced				1	
	9/10/2009	Doris Mine	McKinley		Private	Newmont Mining	Not reclaimed		1981			2	1	
	3/15/2011	F-33 Mine Site (Section 33, Anaconda, Forest Group, and Head & Keely)	Cibola		BLM, Private	Anaconda, Farris Mining, Homestake Mining Company	Reclaimed	1951	1977		4			
	8/16/2010	Hogan Mine	McKinley	13N, 9W, 14	Private	Four Corners Exploration, United Western, United Nuclear,	Not reclaimed	1959	1962 (?)				1	
	3/23/2013	JJ #1 (L-Bar Mine)	Cibola	11N, 5W, 13,24	Private	SOHIO Western Mining Company	Reclaimed	1976	1981					
	8/16/2010	John Bully Mine	McKinley		Private	Phillips Petroleum, United Nuclear Corporation	Reclaimed	1959	1980			1		
	8/16/2010	Johnny M Mine	McKinley	13N, 8W, 7,18	Private	Kop-Ran Development Corporation, Ranchers	Not reclaimed	1976	1982			1		
	9/10/2009	Malpais Mine	McKinley		BLM	Four Corners Exploration	Not reclaimed		1961				1	
	3/31/2011	Moe #4	McKinley		NM Trust Land	L.Sutton and E. P. Moe	Not reclaimed	1961	1963					
	5/8/2012	Mount Taylor Mine	Cibola	13N, 8W, 24	Private	Gulf Mineral Resources, Chevron Resources, Rio Grande Resources Corp.	Permitted- Standby Status	1975	1990 - suspended	CI0002RE			1	
	9/10/2009	Piedre Trieste	McKinley		BLM	Todilto Exploration and Development	Not reclaimed		1981					
	9/10/2009	Poison Canyon Mine	McKinley		Private	Teton Exploration and Drilling	Not reclaimed		1978					
	3/20/2012	Rio Puerco Mine (Kerr-Mcgee, Uranium King)	Sandoval	12N, 3W, 18	BLM	Kerr-McGee, Uranium King, Karl Meyers (dba Mineral Energy and Technolgy Corp.)	Unknown-under active NPDES permit from EPA Region 6	1977	1980					
	9/10/2009	Roundy Manol Strip Mine	McKinley		Private	Rimrock Mining Company	Not reclaimed		1971					
	9/10/2009	Roundy Shaft Mine	McKinley		Private	Todilto Exploration and Development	Not reclaimed		1981				2	
	9/10/2009	Schmitt Decline Mine (Gossett Decline)	McKinley		Private	Unknown	Not reclaimed							
	10/8/2010	Section 10 Mine (Kermac, Regomex, Ambromex, Buffalo)	McKinley	14N, 10W, 10	Private	Kermac Nuclear Fuels, S&A Mining, Homestake-Sapin Partners, Cobb Resources	Not reclaimed	1959	1965				2	
	12/21/2012	Section 15 Mine	McKinley	14N, 10W, 15	Private	Homestake-Sapin Partners, Homestake Mining	Reclaimed	1958	1991				2	
	10/31/2011	Section 19 Mine	McKinley	14N, 9W, 19	Private	Kerr-McGee, Quivera, Rio Algom Mining Company	Reclaimed	1973	1984				1	

Table E-2 (continued). New Mexico CERCLIS Reports Data for Mines Without an LM ID Number

LM_ID	Date of Report	CLAIM_NAME (+Aliases)	OTHER_DEBRIS_MINE_FEATURES	DIST_TO_ STREAM	DIST_TO_WELLS	DIST_TO_ POP	GAMMA_UNITS	GAMMA_MAX	GAMMA_AVG	GAMMA_RANGE	GW_DATA	MISC. NOTES
	3/20/2012	Divide Mine (Part of Section 25 Mine complex)	One shaft, now plugged	3.5	.25 stock watering	450'	cps	400			Y	
	9/10/2009	Doris Mine	Two open declines, one caved in shaft and numerous waste piles. One archeological site present.	0.25	.6- stock watering	1	cps	823 on waste pile			Y	
	3/15/2011	F-33 Mine Site (Section 33, Anaconda, Forest Group, and Head & Keely)	All evidence of mining activity gone in September 2010	.1 to ephemeral stream	.5-1.0- stock watering		µR/hr			7-170	Y	
	8/16/2010	Hogan Mine	Open shaft, concrete pads, and supports for a headframe,miscellaneous debris	2900'	1000'- domestic	1000'	cpm	200,000		2600-50,000		
	3/23/2013	JJ #1 (L-Bar Mine)	Mostly reclaimed in 1986-87. Additional reclamation conducted in 2009 under NMMA.		4.0- domestic	4					Y	
	8/16/2010	John Bully Mine	Reclaimed and seeded 1994. Only remainign structure is abandoned electrical substation		2.0-3.0- stock watering							
	8/16/2010	Johnny M Mine	Several concrete pads, several subterrean cylindrical metal vaults		.25-.5- domestic		cpm			2800-260,000		
	9/10/2009	Malpais Mine	Open unfenced shaft and numerous materials piles		.7- stock watering	1.82	µR/hr			140-400		
	3/31/2011	Moe #4	Wooden headframe, collapsed decline and workings, numerous waste piles.	Adjacent to San Mateo Creek	1.2- domestic		µR/hr	1,100		12-1,100		
	5/8/2012	Mount Taylor Mine	Numerous buildings, main shaft and hoist, one waste rock pile, one ore stock pile and 8 water treatment		1.25- domestic	1	µR/hr	>90		50->90	Y	
	9/10/2009	Piedre Trieste	Scattered limestone piles		.40 - stock watering	0.75	cps	725			Y	
	9/10/2009	Poison Canyon Mine	Pits and recontoured mine waste piles. Some scattered debris.		1.1- stock watering	1.05	cps	121			Y	
	3/20/2012	Rio Puerco Mine (Kerr-Mcgee, Uranium King)	Original mine buildings in place under non-secure conditions, dewatering ponds and waste rock piles.	1.0 to two springs	1.0- use unknown		µR/hr	600			Y	
	9/10/2009	Roundy Manol Strip Mine	Numerous pits and waste piles.		.5- stock watering	1.15	cps	683		35-683	Y	
	9/10/2009	Roundy Shaft Mine	Two open shafts, a concrete pad and scattered limestone rock		.44- Stock watering	0.8	cps	102 -Shaft, 444 in limestone rock				
	9/10/2009	Schmitt Decline Mine (Gossett Decline)	Open and unfenced decline surrounded by waste piles		.1- stock watering	1.22	cps	2,687 on waste pile		21-2,687	Y	
	10/8/2010	Section 10 Mine (Kermac, Regomex, Ambromex, Buffalo)	Mine dump, metal shed, headframe, and ventilation shaft	2,150' to Martin Draw	2-3- domestic		µR/hr	2,057- shaft air		137-2,057		
	12/21/2012	Section 15 Mine	Reclamation completed in 1991-1992.				µR/hr			20-40		
	10/31/2011	Section 19 Mine	Reclamation started in 1994, completed in 2005. However, has not been released by NM from closure requirements.		1-2- mining	1	µR/hr			5->45	Y	Rad readings 1000X background

Table E-2 (continued). New Mexico CERCLIS Reports Data for Mines Without an LM ID Number

LM_ID	Date of Report	CLAIM_NAME (+Aliases)	COUNTY_ NAME	T, R, SEC	OWNER	OPERATOR	RECLAMATION_STATUS	YEAR_FIRST_PROD	YEAR_LAST_PROD	PERMIT_ NUMBER	ADITS	STRUCTURES	SHAFTS	PITS
	10/31/2011	Section 22 Mine	McKinley	14N, 10W, 22	Private	Kerr-McGee, Quivera, Rio Algom Mining Company	Reclaimed	1958	1984				1	
	10/31/2011	Section 23 Mine	McKinley	14N, 10W, 23	Private	United Nuclear-Homestake Partners, Homestake Mining	Reclaimed, but still listed under Permit	1959	1989	MK009RE			1	
	10/31/2011	Section 24 Mine	McKinley	14N, 10W, 24	Private	Kerr-McGee, Quivera, Rio Algom Mining Company	Reclaimed	1959	early 1980s				1	
	10/31/2011	Section 25 Mine	McKinley	14N, 10W, 25	Private	United Nuclear-Homestake, Homestake Mining	Reclaimed	1977	1981				1	1
	9/1/2009	Section 25 SEQ Mine	McKinley		Private	Amiran/Reserve Oil and Minerals	Unknown, access denied		1981					1
	3/20/2012	Section 25 Decline Mine	McKinley	13N, 10W, 25	Private	Unknown	Unknown, access denied							
	3/20/2012	Section 25 Shaft	McKinley	13N, 10W, 25	Private	Farris	Unknown, access denied		1967			1	1	
	5/23/2012	Section 27 Mine	McKinley	14N, 9W, 27	Private	United Nuclear	Partially reclaimed	1970	1977				1	
	10/31/2011	Section 35 Mine	McKinley	14N, 9W, 35	Private	Kerr-McGee, Quivera	Reclaimed	1971	1984				1	
	9/1/2009	Spencer Mine	McKinley		BLM	Koppen Mining Construction Company	Not reclaimed		1980				1	
	9/1/2009	T-20 Mine	McKinley		BLM	Bailey and Fife	Not reclaimed		1968				2	
	10/8/2010	United Western (J and M, Section 36, Lease 60-167, VCA Mine)	McKinley	14N, 10W, 36	Private	United Western Minerals, Vanadium Corporation of America, Jordan and Marshall	Reclaimed	1954	early 1960s				1	

Notes:
All distance values are in miles, except for values individually specified as feet (') or another unit of measurement.

Table E-2 (continued). New Mexico CERCLIS Reports Data for Mines Without an LM ID Number

LM_ID	Date of Report	CLAIM_NAME (+Aliases)	OTHER_DEBRIS_MINE_FEATURES	DIST_TO_ STREAM	DIST_TO_WELLS	DIST_TO_ POP	GAMMA_UNITS	GAMMA_MAX	GAMMA_AVG	GAMMA_RANGE	GW_DATA	MISC. NOTES
	10/31/2011	Section 22 Mine	Reclamation started in 1994, completed in 2005. However, has not been released by NM from closure requirements.		1-2- mining		µR/hr			5->45		According to report produced 2.2 million tons of ore- called something else in AEA db?? Rad readings 1000X background.
	10/31/2011	Section 23 Mine	Reclamation completed in 1991-1992.		1-2- mining	2.8	µR/hr			5->45		Rad readings 1000X background
	10/31/2011	Section 24 Mine	Reclamation started in 1994, completed in 2005. However, has not been released by NM from closure requirements.		1-2- mining	2.2	µR/hr			5->45		According to report produced 2 million tons of ore- called something else in AEA db?? Rad readings 1000X background.
	10/31/2011	Section 25 Mine	Reclamation completed in 1991-1992.		1-2- mining		µR/hr			5->45		Rad readings 1000X background
	9/1/2009	Section 25 SEQ Mine	Open pits, trenches, box cuts, one decline, large waste piles.		1- stock watering	0.72						
	3/20/2012	Section 25 Decline Mine	One collapsed decline	in ephemeral drainage	1-2- domestic	1,400'	cps	400			Y	
	3/20/2012	Section 25 Shaft	One shaft, headframe, hoisting shed, concrete slab, and numerous waste piles.	in ephemeral drainage	1-2- domestic		cps	4,000		1,200-4,000		
	5/23/2012	Section 27 Mine	Removal of surface structures, plugging of shaft and vents, removal of stockpiled ore. Disturbed surface		3-4- domestic	160'	µR/hr			5->45	Y	
	10/31/2011	Section 35 Mine	Reclamation started in 1994, completed in 2005. However, has not been released by NM from		2-3- stock watering		µR/hr			5->45	Y	Rad readings 1000X background
	9/1/2009	Spencer Mine	Collapsed headframe from surface drainage, concrete pads, building remains, and numerous waste piles.		1.4-stock watering		cps	607		40-607	Y	
	9/1/2009	T-20 Mine	Two collapsed shafts and numerous waste piles.		1.1- irrigation	1.5	cps	859		59-859	Y	
	10/8/2010	United Western (J and M, Section 36, Lease 60-167, VCA Mine)	Reclaimed in 1989		.5-.75- public water supply		cps	900				

Appendix F

Summary Table of Quality Assurance/Quality Control Satellite Mine Locations

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The following table is an example of the results gathered when mines in the Office of Legacy Management abandoned uranium mines database (LM AUM database) are compared to imagery maps (aerial photos) and U.S. Geological Survey (USGS) topographic (topo) maps. The comparison process is an example of quality assurance/quality control (QA/QC) procedures done for some of the data in the LM AUM database. In this example, all the results were checked in May 2013.

Table F-1. Example of a Map and Imagery Review of Mine Locations in the LM AUM Database

LM_ID	CLAIM_NAME	STATE_NAME	COUNTY_NAME	VISUAL_CHECK	AERIAL	USGS_TOPO	VISUAL_CHECK_COMMENT
6	BULL 4	UTAH	GARFIELD	TRUE	MINE FEATURE NOT VISIBLE	MINE FEATURE NOT VISIBLE	No sign of any nearby mine features on either the topo map or the aerial photo.
10	F H BARNEY	ARIZONA	UNKNOWN	TRUE	MINE FEATURE NOT VISIBLE	MINE FEATURE NOT VISIBLE	No mine features seen in either view.
23	BLUE MOON	COLORADO	SAN MIGUEL	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	This is in an area that is heavily worked over and contains many mines close by. This location is less than a mile to the west of the U.S. Department of Energy (DOE) Uranium Reserve, according to the topo map.
35	BABE RUTH	COLORADO	MONTROSE	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	This location falls right on top of the Babe Ruth mine. It is located in the DOE Uranium Reserve.
121	DEER 1	COLORADO	MONTROSE	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	This point is located near a small cleared area in a heavily worked over area. The topo map mentions air shafts nearby.
137	MINERAL JOE 1 INC	COLORADO	MONTROSE	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	This is located in a heavily worked over area, where there is likely an underground mine. There is also an open-pit mine 6,000 feet (ft) to the northwest of this point location at 38.236327N, 108.746870W.
223	DAN TAYLOR 1	ARIZONA	APACHE	TRUE	MINE FEATURE NOT VISIBLE	MINE FEATURE NOT VISIBLE	No mine feature seen.

Table F-1 (continued). Example of a Map and Imagery Review of Mine Locations in the LM AUM Database

LM_ID	CLAIM_NAME	STATE_NAME	COUNTY_NAME	VISUAL_CHECK	AERIAL	USGS_TOPO	VISUAL_CHECK_COMMENT
230	DENEH NEZ 1	NEW MEXICO	SAN JUAN	TRUE	UNCERTAIN	MINE FEATURE NOT VISIBLE	There are two small surface disturbances very near this location, but it's unclear if they are mining related.
231	ENDS JOHNSON MP 584	NEW MEXICO	SAN JUAN	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	There appears to be a prospect near this point location on the aerial photo. However, the actual Enos Johnson Mine lies about 3,000 ft to the west at 36.414104N, 109.003230W.
236	JOHN JOE 1	NEW MEXICO	SAN JUAN	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	There are two prospects located to the southwest of this location (at distances of about 1,500 and 2,300 ft away) that are visible on both the aerial photo and the topo map. However, there is nothing right at this site.
240	BLUE EAGLE 1	COLORADO	MONTEZUMA	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	There is a drill hole/pad visible on both the topo map and the aerial photo about 1,700 ft north-northwest of this point, at 37.586941N, 108.959985W.
258	P F G E	UTAH	GRAND	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	This point location is adjacent to what appears to be a tailings pile. A mine location is featured on the topo map about 900 ft to the southwest, at 38.66350N, 109.11212W.
276	BLACK ROCK 2	COLORADO	MESA	TRUE	UNCERTAIN	MINE FEATURE NOT VISIBLE	There are no mine features on the topo map for this area. Although there are no obvious mine features on the aerial photo, there are several dirt road patterns in the area that look similar to mine locations in other confirmed mine areas.
282	CEDAR POINT 2	UTAH	GRAND	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	This point location is 700 ft north of a mine label on the topo map (38.67029N, 109.06363W). There is a large concentration of disturbed areas 3,000 ft to the south and 1,500 ft to the northeast.

Table F-1 (continued). Example of a Map and Imagery Review of Mine Locations in the LM AUM Database

LM_ID	CLAIM_NAME	STATE_NAME	COUNTY_NAME	VISUAL_CHECK	AERIAL	USGS_TOPO	VISUAL_CHECK_COMMENT
484	PITTSBURG	UTAH	GRAND	TRUE	MINE FEATURE NOT VISIBLE	MINE FEATURE NOT VISIBLE	No features on the topo map or aerial photo were seen. There is an area of mining activity located about 2.75 miles to the southwest of this location at 38.67581N, 109.13701W.
531	BLACK JACK 1	NEW MEXICO	MCKINLEY	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	This location falls right on top of the Black Jack Mine.
532	BLACK JACK 2	NEW MEXICO	MCKINLEY	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	This point location falls right on top of the Black Jack No 2 Mine.
604	PAGUATE	NEW MEXICO	VALENCIA	TRUE	MINE FEATURE VISIBLE	MINE FEATURE NOT VISIBLE	This is a large mine complex covering several square miles. The location coordinates are for the nearby town. Coordinates for a large open-pit mine to the south are 35.124N, 107.374W.
1130	CLAIM 28	ARIZONA	APACHE	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	This point location is right on top of a mine feature on both the topo map and the aerial photo.
1135	JIMMY BOONE	ARIZONA	COCONINO	TRUE	MINE FEATURE NOT VISIBLE	MINE FEATURE NOT VISIBLE	No mine features are visible nearby on the topo map or the aerial view.
1652	FAR WEST	UTAH	SAN JUAN	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	There are several mine features visible within 2 miles. The location is about 800 ft to the east of the "Homestake Mine" labeled on the topo map. The topo map lists the Alice and Lisbon Mines in the vicinity, and it shows numerous mine shafts and open pit mines in the area.
1797	MONUMENT 1	ARIZONA	NAVAJO	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	The topo map shows adits and an open-pit mine in area. The feature is labeled "Monument No 2" on the topo map.
1815	MOONLIGHT	ARIZONA	NAVAJO	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	There is an open-pit mine located 4,600 ft to the west of this point location at 36.962655N, 110.285683W.

Table F-1 (continued). Example of a Map and Imagery Review of Mine Locations in the LM AUM Database

LM_ID	CLAIM_NAME	STATE_NAME	COUNTY_NAME	VISUAL_CHECK	AERIAL	USGS_TOPO	VISUAL_CHECK_COMMENT
2163	NAKAI CHEE BEGAY	NEW MEXICO	SAN JUAN	TRUE	MINE FEATURE NOT VISIBLE	MINE FEATURE NOT VISIBLE	No sign of any mine features on either view.
3183	HAPPY JACK	UTAH	SAN JUAN	TRUE	UNCERTAIN	MINE FEATURE VISIBLE	The topo map says "adit" near the location. On the aerial photo, there appear to be several surface disturbances 0.3–1.0 mile west (38.008N, 109.361W) of the location, but they don't appear to be a large mine.
3200	BILLY DALE	SOUTH DAKOTA	HARDING	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	On the topo map, the closest mine to this point location is about 2,000 ft to the northeast at 45.833182N, 103.445626W. This mine is visible on the aerial photo. The topo map also shows two mines 3,500–5,000 ft to the west.
3220	BARANKO LEASE	NORTH DAKOTA	BILLINGS	TRUE	UNCERTAIN	MINE FEATURE NOT VISIBLE	There are no mine features labeled on the topo map. However, there are two odd features on the aerial photo about 2,800 ft to the north-northeast of the point location at 47.094257N, 103.193676W.
3228	BOBCAT GROUP	SOUTH DAKOTA	HARDING	TRUE	MINE FEATURE NOT VISIBLE	MINE FEATURE NOT VISIBLE	There are no mine features at this point location on the topo map or the aerial photo.
3244	SMITH 1 LEASE	NORTH DAKOTA	BILLINGS	TRUE	MINE FEATURE NOT VISIBLE	MINE FEATURE NOT VISIBLE	There are no mine features in this area on the topo map or the aerial photo.
3245	SPIKE 1	NORTH DAKOTA	BILLINGS	TRUE	MINE FEATURE NOT VISIBLE	MINE FEATURE NOT VISIBLE	There are no mine features visible on the topo map or the aerial photo at this location.
3255	KLYM MINE SEC 26	NORTH DAKOTA	BILLINGS	TRUE	MINE FEATURE NOT VISIBLE	MINE FEATURE NOT VISIBLE	There are no visible mine features at this location. It is co-located with the Baranko Lease point location.
3260	A&H	WYOMING	CROOK	TRUE	MINE FEATURE NOT VISIBLE	MINE FEATURE NOT VISIBLE	There are no visible mine features on either the topo map or the aerial photo at this location.

Table F-1 (continued). Example of a Map and Imagery Review of Mine Locations in the LM AUM Database

LM_ID	CLAIM_NAME	STATE_NAME	COUNTY_NAME	VISUAL_CHECK	AERIAL	USGS_TOPO	VISUAL_CHECK_COMMENT
3262	ACKERMAN LEASE	WYOMING	CROOK	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	The topo map and aerial photos show a Uranium Mine 6,100 ft to the southeast of the point location at 44.791387N, 104.755048W.
3276	BUD LUCKY BUD	SOUTH DAKOTA	CUSTER	TRUE	MINE FEATURE VISIBLE	MINE FEATURE NOT VISIBLE	No feature on the topo map. On the aerial photo there is a mining operation about 2,500 ft to the northeast at 43.485447N, 103.985621W.
3311	HAUBER MINE	WYOMING	CROOK	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	This point location falls 1,200 ft to the east of a uranium mine that is seen on both the topo map and the aerial photo. The mine is located at 44.779191N, 104.822751W.
3314	HELMER RANCH	WYOMING	CROOK	TRUE	MINE FEATURE NOT VISIBLE	MINE FEATURE VISIBLE	The topo map shows there is a uranium mine 2,800 ft northeast of the point location at 44.670721N, 104.078493W. However, this mine is not visible on the aerial photo. Perhaps it's an underground mine?
3399	VALLEY VIEW 6	SOUTH DAKOTA	FALL RIVER	TRUE	MINE FEATURE VISIBLE	MINE FEATURE NOT VISIBLE	No mine features on the topo map. The closest potential mine feature on the aerial photo is about 3,200 ft southwest of the point location at 43.403649N, 103.844903W.
3403	WESTERN EDGE	SOUTH DAKOTA	FALL RIVER	TRUE	MINE FEATURE VISIBLE	MINE FEATURE NOT VISIBLE	No mine features on the topo map. The closest possible mine feature seen on the aerial photo is the feature mentioned in the Yellow Cat 1 notes.
3404	YELLOW CAT 1	SOUTH DAKOTA	FALL RIVER	TRUE	MINE FEATURE VISIBLE	MINE FEATURE NOT VISIBLE	There are no mine features on the topo map. There are several possible surface disturbances close to the point location on the aerial photo. There is a likely mine operation about 6,000 ft to the east at 43.415744N, 103.834226W.

Table F-1 (continued). Example of a Map and Imagery Review of Mine Locations in the LM AUM Database

LM_ID	CLAIM_NAME	STATE_NAME	COUNTY_NAME	VISUAL_CHECK	AERIAL	USGS_TOPO	VISUAL_CHECK_COMMENT
3531	BOSO HACKNEY	TEXAS	KARNES	TRUE	UNCERTAIN	MINE FEATURE NOT VISIBLE	The topo map shows several oil wells and quarries within a 2-mile radius, but no mine features. On the aerial photo there is a possible mine feature (28.85444N, 98.14461W) about 1 mile to the south.
3532	BUTLER LEASE O S	TEXAS	KARNES	TRUE	MINE FEATURE VISIBLE	MINE FEATURE NOT VISIBLE	There are no mine features on the topo map, but there are several oil wells and quarries within a 2-mile radius on the map. There is a possible mine noted on the aerial photo about 0.5 mile south of the site location at 28.84300N, 98.12173W.
3552	THORPE 1	OKLAHOMA	CUSTER	TRUE	MINE FEATURE VISIBLE	MINE FEATURE NOT VISIBLE	The point location is about 0.3 mile south-southeast of a surface operation located at 35.50653N, 99.16748W.
3577	LUCKY DON SEC 35	NEW MEXICO	SOCORRO	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	There is a "prospect" label about 3,400 ft to the south of this location on the topo map, but nothing at the exact location. However, there does appear to be an adit at this location.
3597	UNKNOWN	NEW MEXICO	TAOS	TRUE	MINE FEATURE NOT VISIBLE	MINE FEATURE NOT VISIBLE	No mine features seen on the aerial photo or the topo map.
3600	MIDNIGHT GROUP	NEW MEXICO	CATRON	TRUE	UNCERTAIN	MINE FEATURE VISIBLE	The topo map shows a few prospects in the area. The aerial photo shows an uncertain mine feature at this location.
3617	BULL RUSH GROUP	WYOMING	FREMONT	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	This location is in the middle of a very large mining operation.
3728	BILL & EARL CLAIMS	WYOMING	CAMPBELL	TRUE	UNCERTAIN	MINE FEATURE NOT VISIBLE	No mine features on the topo map. There are some surface disturbances 600–2,000 ft away in all directions that might be mining related, but that is unclear from the aerial photos.

Table F-1 (continued). Example of a Map and Imagery Review of Mine Locations in the LM AUM Database

LM_ID	CLAIM_NAME	STATE_NAME	COUNTY_NAME	VISUAL_CHECK	AERIAL	USGS_TOPO	VISUAL_CHECK_COMMENT
3819	SPOOK	WYOMING	CONVERSE	TRUE	MINE FEATURE VISIBLE	MINE FEATURE NOT VISIBLE	There are no mine features on the topo map. However, on the aerial photo there appear to be several drill pads or mine features within 1,000–2,000 ft of this point location.
3854	LITTLE STAR	COLORADO	MOFFAT	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	This point location falls directly on the mine feature. On the topo map there is a symbol for this location, but no description.
3860	ROB ROLLO	COLORADO	MOFFAT	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	This location is in the middle of a large surface mine.
3861	SAGE BUELLA	COLORADO	MOFFAT	TRUE	UNCERTAIN	MINE FEATURE NOT VISIBLE	This location is about 700 feet east of a possible mine feature (40.5508N, 107.97701W). It is also about 1.5 miles south of another open-pit mine (40.56479N, 107.96969W).
3868	THREE SISTERS	COLORADO	MOFFAT	TRUE	MINE FEATURE NOT VISIBLE	MINE FEATURE NOT VISIBLE	This location is in the middle of a residential neighborhood in Craig, Colorado. No mine features seen here.
3948	URANIUM AIRE 1 & 2	ARIZONA	YAVAPAI	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	This point location is in an area pockmarked with small surface disturbances. About 3,800 ft to the northeast is the Anderson mine at 34.308057N, 113.275519W.
3951	DANDY	MONTANA	CARBON	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	The topo map shows several prospects within a few thousand feet of the point location. It also shows that the Dandy Mine is about 6,200 ft west-northwest of the point location at 45.070364N, 108.433019W. The Dandy Mine can be seen on the aerial photo.
3959	BOB 6	MONTANA	CARBON	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	The topo map shows several prospects in close proximity to the point location. The Swamp Frog Mine can be seen about 1,800 ft east of the point location at 45.053561N, 108.439392W.

Table F-1 (continued). Example of a Map and Imagery Review of Mine Locations in the LM AUM Database

LM_ID	CLAIM_NAME	STATE_NAME	COUNTY_NAME	VISUAL_CHECK	AERIAL	USGS_TOPO	VISUAL_CHECK_COMMENT
3962	DANDY MARIE PERC 14	MONTANA	CARBON	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	There appears to be a mining camp/operation 1,300 ft to the southeast at 46.81559N, 113.29462W.
3979	TRI PACER	WYOMING	BIG HORN	TRUE	MINE FEATURE NOT VISIBLE	MINE FEATURE NOT VISIBLE	No mine features seen on either the topo map or the aerial photo.
3981	GREEN MONSTER	NEVADA	UNKNOWN	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	The point location is about 300 ft north of a mine feature visible on the aerial photo at 35.88854N, 115.64869W.
3989	COSO CLAIM	CALIFORNIA	INYO	TRUE	UNCERTAIN	MINE FEATURE NOT VISIBLE	On the topo map, there are some "X" prospect labels within 3,000 ft of the point location, and there are at least three mines about 10,000 ft to the southeast. On the aerial photo there is an area 2,300 ft to the northwest (36.16491N, 117.91313W) that has extensive soil disturbances where mining operations may have occurred.
4001	OWEN 5	CALIFORNIA	KERN	TRUE	MINE FEATURE VISIBLE	MINE FEATURE NOT VISIBLE	On the aerial photo there appears to be a mine 5,400 ft to the southeast, located at 35.16028N, 119.60437W.
4004	DAHL TRACT A	WASHINGTON	SPOKANE	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	The nearest mine feature on the topo map is 4,500 ft to the west of this point location (47.95010N, 117.18070W). On the aerial photo, there are a few possible mining features about 8,000 ft to the west of the point location.
4005	HEREM MOORE LEASE	WASHINGTON	SPOKANE	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	The Daybreak Mine is located about 1 mile southeast of here at N47.94338N, 117.19669W.

Table F-1 (continued). Example of a Map and Imagery Review of Mine Locations in the LM AUM Database

LM_ID	CLAIM_NAME	STATE_NAME	COUNTY_NAME	VISUAL_CHECK	AERIAL	USGS_TOPO	VISUAL_CHECK_COMMENT
4006	MIDNIGHT BOYD LEASE	WASHINGTON	STEVENS	TRUE	UNCERTAIN	MINE FEATURE NOT VISIBLE	This location is about 0.5 mile south of the nearest area cleared of trees (47.95862N, 117.94133W). There are dozens of cleared areas similar to this one within several miles of this location. It's possible that these are areas that have been previously logged.
4024	PETERS LEASE	WASHINGTON	STEVENS	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	This is a large mine that appears to have been reclaimed. The mine entrance is about 1 mile south of the location coordinates (47.87265N, 118.11387W).
4025	PINE SPRINGS	OREGON	CROOK	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	This point location is about 3,300 ft north of the nearest "prospect" label on the topo map. There are many other "prospect" labels in the area, as well as potential mine features as seen on the aerial photo.
4028	EARLY DAY	NEVADA	LANDER	TRUE	MINE FEATURE NOT VISIBLE	MINE FEATURE NOT VISIBLE	This point is found on an alluvial fan, near the Rundberg location.
4031	WHITE KING	OREGON	LAKE	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	There are two White King Mine locations co-located together.
4037	RUNDBERG	NEVADA	LANDER	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	This point location is on the site of the Apex Mine. The topo map shows an adit to the south and a prospect to the southeast. On the aerial photo there is a mine area 2,500 ft to the southeast located at 39.45583N, 117.09399W.
4042	LOLA G	CALIFORNIA	LASSEN	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	There are some "X" labels (prospects?) on the topo map about 3,200 ft to the northeast. On the aerial photo there is a potential mine site 2,500 ft south of the point location at 39.91202N, 120.00023W.

Table F-1 (continued). Example of a Map and Imagery Review of Mine Locations in the LM AUM Database

LM_ID	CLAIM_NAME	STATE_NAME	COUNTY_NAME	VISUAL_CHECK	AERIAL	USGS_TOPO	VISUAL_CHECK_COMMENT
4051	WHITE KING	OREGON	LAKE	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	The Lucky Lass mine is located about 7,000 ft to the west-northwest at 42.33592N, 120.54034W.
4058	ELK 1 DEERSTRIKE	IDAHO	CUSTER	TRUE	MINE FEATURE NOT VISIBLE	MINE FEATURE VISIBLE	There are some "X" labels (prospects?) nearby. However, there are no "mine" labels on the topo map and nothing resembling mine operations on the aerial photo.
4081	COAL CREEK GROUP	IDAHO	CUSTER	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	There are numerous "X" labels (prospects?) nearby on the topo map. The nearest "mine" label on the topo map is 9,300 ft northwest at 44.29781N, 114.84418W. On the aerial photo there is a tailings pile 3,000 ft to the east at 44.28489N, 114.82054W.
4101	PARD 1 4	WYOMING	SUBLETTE	TRUE	UNCERTAIN	MINE FEATURE NOT VISIBLE	There are no features on the topo map. On the aerial view, there is a potential mine feature about 500 ft to the south at 42.356136N, 109.071986W.
4103	PRODUCER	UTAH	BEAVER	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	This point location falls right on top of mine features on the topo map and aerial photo.
4109	RIMROCK	NEVADA	ELKO	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	There are no "mine" labels on the topo map. However, there are numerous "prospect" labels, mostly south of the point location. There are three possible tailing sites about 2,300 ft south of the point location at 41.83843N, 115.84625W.
4113	SUN VALLEY MINE	ARIZONA	COCONINO	TRUE	MINE FEATURE NOT VISIBLE	MINE FEATURE VISIBLE	There are no mine features visible on the aerial photo, but the topo map shows a prospect location about 1,200 ft to the southwest at 36.734862N, 111.787212W.

Table F-1 (continued). Example of a Map and Imagery Review of Mine Locations in the LM AUM Database

LM_ID	CLAIM_NAME	STATE_NAME	COUNTY_NAME	VISUAL_CHECK	AERIAL	USGS_TOPO	VISUAL_CHECK_COMMENT
4116	YELLOW CHIEF	UTAH	JUAB	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	This location is about 3,300 ft southwest of a mine feature seen on both the topo map and aerial photo (39.73901N, 113.17970W) and 3,000 ft west-northwest of a mine feature seen on the topo map and aerial photo at 39.73109N, 113.17617W.
4120	PHOSPHATE MINES COMPLEX	FLORIDA	POLK	TRUE	MINE FEATURE VISIBLE	MINE FEATURE VISIBLE	This point location is near the center of a phosphate mine complex that covers several square miles.

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Appendix G

Field Sampling Plan

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Abandoned Uranium Mines (AUM) Field Sampling Plan Data Quality Objectives (DQOs)

<u>Regions</u>

DQOs for the region:

- Sample AUMs in different states and geology
- Sample representative sites and some with unique features that could affect costs (open pits)
- Piggyback other trips

Rationale for selecting regions:

1. Maybell (Colorado): Easy access to train team members; unique set of large open-pit mines
2. Four Corners (Colorado and Utah): Easy access; largest concentration of AUMs and small mines
3. Grants Mineral Belt (New Mexico): Largest producing area in country; large deep underground and shallow open-pit mines
4. Wyoming: Variety of open-pit mines; opportunity to visit mines in various stages of reclamation
5. South Dakota and North Dakota: Mines associated with lignite (North Dakota) and sandstone (Edgemont, South Dakota) deposits
6. Oregon: Add diversity to states visited; piggyback disposal cell annual inspection trip; observe reclamation of large remediated sites

<u>AUMs</u>

DQOs for individual AUMs:

- Radon measurements on all sizes of sites (waste rock piles, portals)
- Gamma measurements on waste rock piles and surrounding areas
- Confirm number and size of physical hazards and features (emphasis on size/volume of waste rock piles)
- Sample of all sizes; some emphasis on small
- Sample a reclaimed site to determine the degree of reduced risk (pre- and post-gamma measurements) and success of reclamation efforts (e.g., erosion control, revegetation)
- Confirm AUM locations
- Distance to nearest structure/residence, recreational features (e.g., camping, hiking, biking, off-highway vehicle trails), and lakes or streams

Field Visits Draft Schedule

Geographic Area/Mines	Week of August 5, 2013	Week of August 12, 2013	Week of August 19, 2013	Week of August 26, 2013
Moffat County, Colorado	Grand Junction (GJ) Team/ Denver Team			
Gas Hills District, Wyoming		Denver Team		
Edgemont Mining District, South Dakota, and Dakota Plains, North Dakota			Denver Team	
Schwartzwalder Mine, Colorado				Denver Team
Uravan Mineral Belt, Colorado		GJ Team		
Grants Mineral Belt, New Mexico			GJ Team	
Lisbon Valley and Yellow Cat, Utah				GJ Team
Lucky Lass Mine, White King Mine, Oregon				GJ Team

Denver Team: Doug Hanson, Nick Malczyk, Jerry Mattson (Rad support)

GJ Team: Ed Cotter, Kyle Turley, Craig Goodknight, Anthony Martinez (Rad support)

LMS/ULM/Y00363

Final Draft Field Sampling Plan Report to Congress on Abandoned Uranium Mines

July 2013

U.S. DEPARTMENT OF ENERGY | Legacy Management

LMS/ULM/Y00363

Final Draft Field Sampling Plan
Report to Congress on Abandoned Uranium Mines

July 2013

Contents

Appendixes

Abbreviations

AUM	abandoned uranium mines
LM	Office of Legacy Management
GPS	global positioning system
JSA	Job Safety Analysis
ULP	Uranium Leasing Program

1.0 Overview

The Office of Legacy Management (LM) has been tasked with preparing a report to Congress on abandoned uranium mines (AUM) that provided uranium ore for atomic energy defense activities of the United States. In support of that task, LM will prepare four topical reports that will address: (1) data collection—status and location of the abandoned mines; (2) assessment of current and future radiation hazards, physical hazards, groundwater quality degradation, and environmental degradation; (3) risk and hazard ranking of the abandoned mines; and (4) status of efforts to reclaim and remediate the mines. These topical reports will be developed using available data, with a limited amount of additional data collection and field verification activities. This Final Draft Field Sampling Plan was developed to support those activities.

2.0 Abandoned Uranium Mines Database

The AUM Database was established to collect and compile the information contained in the U.S. Atomic Energy Commission ore-production data records, a hard-copy data set with just over 4,100 entries (“mines”). These records, once entered into electronic format, were then cross-referenced against various AUM location databases developed by federal and state agencies and tribal organizations to obtain location coordinates and other valuable information (“attributes”) pertinent to the mines. The mines were placed into categories so that assumptions, recommendations, and conclusions could be made at each “category” level. As a starting point, the mines were categorized based on the amount (tons) of ore produced, as shown below.

- Small (0–100 tons)
- Small/Medium (100–1,000 tons)
- Medium (1,000–10,000 tons)
- Medium/Large (10,000–100,000 tons)
- Large (100,000–500,000 tons)
- Very Large (greater than 500,000 tons)

From the production and size of the mine, a correlation to other mine characteristics will be inferred (compilation of mining-related features, including the existence and relative size of mine-waste-rock piles, and relative mine complexity, etc.). Additionally, secondary factors for categorizing the mines include proximity to population and water ways, land ownership, and reclamation or remediation status.

3.0 Data Collection and Field Verification

As the compilation of the AUM Database nears completion, the mine categories and the mine attributes will be analyzed to identify any data gaps that need to be addressed, or data anomalies that need to be reviewed or verified. For this analysis, LM has established the minimum review criteria for each size category of (a) 10 mines, or (b) 10 percent of the number of mines within the respective size category. During the analysis process, AUM team members will compile a list of identified mines where additional data needs to be collected or existing data needs to be verified. Subsequently, AUM team members will visit the identified mines to conduct the data-collection or field-verification activities.

3.1 Preparations for Field Activities

Prior to conducting the field visits, the AUM field team will:

[1] identify the specific mines to be visited;

[2] obtain a location map for each specific mine;

[3] obtain a listing of the existing site attributes from the AUM Database;

[4] compile a list of data needs or verification requirements;

[5] assemble the equipment (global positioning system [GPS], various radiological instruments and meters, camera, etc.) required to complete the field activities;

[6] familiarize themselves with the equipment's standard operation procedures; and

[7] familiarize themselves with the Job Safety Analysis (JSA) prepared for the Uranium Leasing Program (ULP).

Note

The ULP JSA will be utilized for the AUM field work because it already contains references to the types of hazards found at and adjacent to AUM sites. The AUM field team will also complete a Plan of the Day/Plan of the Week form, LMS form 2130, for the field work that will provide sufficient detail to delineate the work to be done and the associated schedule.

3.2 Field Collection Activities

Once the AUM field team arrives at the mine site, they will conduct a brief tailgate safety meeting to review the work to be performed and discuss the potential hazards that may be encountered. Subsequently, they will prepare to collect the required field data and verify existing conditions; each team member will be assigned to collect a specific set of data.

Using a hand-held GPS unit, the team will collect location data for all mining-related features associated with the site, including:

- mine portals (adits, shafts, inclines and declines, rim cuts, prospects);
- mine-waste-rock dumps and piles, ore-storage areas;
- ventilation holes and shafts, drill holes;
- pits and trenches;
- subsidences;
- structures;
- hiwalls;
- roads, utility poles, utility lines, tanks, wells;
- borrow areas, ponds, total disturbed area;

- artifacts, trash dumps, survey monuments; and
- other site features that may be relevant to future site reclamation and remediation activities.

The GPS unit will be set up with a defined data dictionary that will prompt the user to collect all necessary attributes for any given site feature. All features will be assessed to determine whether they present a physical safety hazard to the public in their current state.

Gamma-exposure-rate measurements will be collected from selected locations at or near the site, including, but not limited to: one or more background locations, portals, the mine-waste-rock dump, ore-storage areas, and vent-hole locations. An average background measurement for gamma should be collected on the way out of a major mine site, far enough away from features potentially constructed with mine-waste-rock material to give an adequate representation. Measurements should be taken of the road, as some roads were constructed from mine-waste-rock material and may have heightened activity, necessitating remediation.

Radon measurements will be taken at each site as time allows. At a minimum, radon measurements should be taken to determine background levels and at the area suspected of highest radon (i.e., near a portal or vent). If time allows, radon measurements should also be taken adjacent to and on top of the mine-waste-rock pile. GPS location data will be collected for all measurement locations not already collected in accordance with the above listing. A background measurement should be taken upwind from the site.

Photo documentation will be collected at the site to supplement the GPS data and other data obtained. The status of the mine features and the overall condition of the mine site will be documented in sufficient detail to capture relevant information. A photograph log will be kept for each site detailing the pictures taken that day, the direction pictures are taken from, and objects in the pictures.

The status of the mine site will also be noted, as it will be useful to note the success of past reclamation work to determine future long-term surveillance costs. If a mine has already been reclaimed, then the extent of the work should be noted (i.e., portals closed, mine-waste-rock pile recontoured and covered). The success of the vegetation and erosion mitigation on the site will be assessed.

Potential borrow areas and water sources to support future reclamation activities should be noted, along with distance to the mine. Groundwater seeps and springs in the area, which may or may not be associated with the mine, should also be noted. In addition, the team should note distance to a potential disposal cell in each watershed for defining the remediation alternative in the report.

Appendix A contains information to be considered prior to and during the collection of GPS data.
Appendix B contains an outline of the GPS data dictionary.
Appendix C contains a copy of the ULP JSA for field work.
Appendix D contains a copy of the Plan-of-the-Day/Plan of the Week form to be completed prior to each field trip.
Appendix E contains a copy of the Maybell Pits Area field map (an example of the specific site maps that will be generated for each field trip).

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Appendix A

Information to be Considered Prior to and During the Collection of GPS Data

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GPS Best Management Practices:

When collecting the coordinates of area or line features with a GPS, efforts must be made to keep moving and to avoid stopping as this will lead to lines or polygons that self-intersect. When filling out the attribute menu, pause the collection event so as to not collect multiple points on top of each other, which will create problems when post-processing. When collecting point features, monitor Positional Dilution of Precision (PDOP) and number of satellites in order to maintain as much accuracy as possible. Most of the satellites utilized by macro-grade GPS units are in geosynchronous orbits that are in the southern sky; if high PDOP or poor satellite coverage is experienced, face the GPS unit south. If satellite coverage remains poor, there may be physical features blocking reception. In this case, collect a point where coverage exists and measure the offset, which will be applied when the data is post-processed.

Inspection of Abandoned Mines and Associated Features:

The footprint of waste-rock dumps should be surveyed and all attributes should be noted, as well as photographs taken of existing vegetation and an overall view showing grade. If the waste-rock dump is tiered or steep, multiple area features should be collected, allowing a pseudo three-dimensional representation for estimation of material to be moved. Extreme caution should be exercised when traversing waste-rock dumps, as they are constructed of inherently unstable materials, often have steep grades, often have trash and other debris which pose tripping hazards, and are often a habitat for wildlife, such as snakes. The radiological/gamma activity of the waste-rock dump should be taken to determine range and average activity. If one area of a waste-rock dump or mine site is found to contain significantly higher radioactivity than the surrounding area, it is possible that is an ore-storage area. In this case, the area should be surveyed as an ore-storage pad; this allows this material to be segregated during reclamation.

Horizontal mine openings, called adits, should be collected as a point feature with all applicable attributes. The team should measure dimensions and radioactivity, and take photographs at the opening. Caution should be exercised when approaching an adit, as there are several hazards, including an unstable brow, snakes, bats, rusty nails, and tripping hazards. No entry of an adit or portal is allowed for any reason.

Shafts are vertical mine openings that were either bored or blasted. If an open shaft is located in an unstable formation, it may be undermined and the area should be treated with caution; therefore, the size of the opening will be assessed visually and the team will not get close. A location will be surveyed and an offset will be measured and utilized when the point is post-processed. If the area is considered stable, dimensions will be taken. The condition of the shaft will be noted (i.e., closed, caved, open, partially open, subsided) within the prompts of the data dictionary.

Most underground mines, with the exception of some small mines, will generally have one or more vent shafts associated with them. Typically, the larger the mine is, the more vent shafts will be present and the size of those vents will be likely to increase. To locate and identify these features, take note of the general bearing of the underground mine workings and investigate the terrain in that general direction. Power lines in the vicinity of the mine site can also be traced visually and termination poles identified. Termination poles with transformers usually were installed for powering ventilation fans attached to vent shafts. On occasion, there will be a power drop at one of these power poles—these should be surveyed and noted. Caution should be exercised when approaching these features, as runoff may have eroded the stability of the vent shaft if it is located in unstable formations. It is common for vent shafts to erode out from beneath casing and cement grout, creating an unstable condition. The team should measure dimensions and gamma radioactivity, take photographs, and attempt to estimate total depth for backfill quantity calculations. If the vent is cased, team members should note the casing material (stove pipe, oil barrels, continuously cased, etc.) and whether the casing will need to be cut off at or below ground level. It should be noted whether there is access to the vent for equipment, or if a road has to be improved.

Structures are often encountered at mine sites and should be surveyed as a point feature. The team should be take photographs and measure horizontal dimensions (estimate vertical) of the structure. The materials used for construction (i.e., wood, tar paper, stone) will be noted in the data dictionary. Caution should be exercised when inspecting structures; typical hazards include rusty nails in boards, instability of the structure (both the overhead and floor), exposure to hantavirus, and wildlife. Structures should not be entered for any reason.

Pits and trenches were used frequently in historical mining efforts where the ore was shallow, easily accessible, or overburden was easily removable. The extent of the pits and trenches should be surveyed as an area feature, and attributes such as average depth, whether it is filled with water, physical condition (i.e., open, partially closed), and revegetation status should be noted in the attributes and with photographs. Caution should be exercised when approaching these features, as the side slopes are usually steep and unstable, and wildlife may be using these as refuge.

Tanks that were utilized for storage of water or air or more recently for fuel or sewage are frequently encountered. Tanks can be found on the surface, on stilts, or buried underground. In an area where an inhabited structure existed, cisterns are common. Information collected will include an estimate of size and volume. Hazards unique to tanks include an unstable internal atmosphere, and contents harmful to the environment. Tanks should not be entered for any reason.

Although most of the water consumed by mining activities in the Southwest was trucked in from other sources, wells may be present. Wells should be surveyed and photographed, as they may be useful for groundwater sampling. Hazards unique to wells arise from opening up well-head protectors and encountering hornets, scorpions, spiders, or snakes.

On larger mine sites, utility lines (electric, gas, water, sewer) are often present and may need to be removed during reclamation activities. A line feature is set up in the data dictionary and can be used to capture the direction, extent, and type of utility lines at a mine site.

The road access from the mine to the closest maintained road will be surveyed on the way out (once the most efficient way to exit has been established). Condition of the road, width, and ease of access should be noted. Once the mine site and features have been adequately inventoried, the inspectors should have an idea of what type and size of equipment will need to be used in the reclamation activities. Road improvements needed for access by standard-sized earthmoving equipment should be assessed. (Depending on the surface owner, road improvements may not be allowed, meaning that equipment type and size may be limited by the access.)

Nearby residences and other potential habitable structures; towns; recreational facilities, such as campgrounds; streams; and lakes that are located within 5 miles should be noted to assist in the risk assessment.

Artifacts may include trash dumps, mining equipment, sweat lodges, grave sites, miner or Native American camps, arrowheads, tools, vehicles, and potentially anything more than 50 years old. Artifacts should be surveyed but not disturbed.

All other features will be noted and attributes collected as prompted by the data dictionary when using the GPS units. Hiwalls and subsidence features should be approached with extreme caution.

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Appendix B

GPS Data Dictionary

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```
Abandoned Minelands
03/28/2013

Mine_p                     Point Feature, Label 1 = Name, Label 2 = Type
   Name                    Text, Maximum Length = 30
                           Normal, Normal
   Type                    Menu, Required, Normal
      Shaft
      Adit
      Prospect
      Rim Cut
   Condition               Menu, Required, Normal
      Closed
      Caved
      Open
      Partial
      Subsided
   Opening Dimensions Text, Maximum Length = 30
                           Required, Normal
   Bearing                 Text, Maximum Length = 12
                           Normal, Normal
   Activity Level          Text, Maximum Length = 30
                           Required, Normal
   Physical Hazard         Menu, Required, Normal
      Yes
      No
   Photo Number            Text, Maximum Length = 30
                           Required, Normal

W-R-Dump_a                 Area Feature, Label 1 = Reclamation Status, Label 2 = Photo Number
   Reclamation Status Menu, Required, Normal
      Reclaimed
      Unreclaimed
   Physical Hazard         Menu, Required, Normal
      Yes
      No
   Activity Level          Text, Maximum Length = 50
                           Required, Normal
   Description             Text, Maximum Length = 100
                           Normal, Normal
   Photo Number            Text, Maximum Length = 30
                           Required, Normal

Vent_p                     Point Feature, Label 1 = Name, Label 2 = Photo Number
   Name                    Text, Maximum Length = 30
                           Normal, Normal
   Type                    Menu, Required, Normal
      Bored
      Blasted
   Structure               Menu, Required, Normal
      Cased
      Fan
      Collar
      None
   Condition               Menu, Required, Normal
      Open
      Closed
      Subsided
   Physical Hazard         Menu, Required, Normal
      Yes
      No
   Photo Number            Text, Maximum Length = 30
                           Required, Normal

Drill_Hole_p               Point Feature, Label 1 = Name, Label 2 = Type
   Name                    Text, Maximum Length = 20
                           Normal, Normal
   Type                    Menu, Required, Normal
      Stand Pipe
      Standard
   Condition               Menu, Required, Normal
      Open
      Plugged
      Subsided
```

```
   Physical Hazard     Menu, Required, Normal
      Yes
      No
   Photo Number        Text, Maximum Length = 30
                       Normal, Normal

Structure_p            Point Feature, Label 1 = Name, Label 2 = Type
   Name                Text, Maximum Length = 20
                       Normal, Normal
   Type                Menu, Required, Normal
      Building
      Foundation
      Other (Describe)
   Material            Menu, Required, Normal
      Concrete
      Earthen
      Log
      Metal
      Stone
      Tar Paper
      Timber
      Wood
      Other (Describe)
   Condition           Menu, Normal, Normal
      Good
      Fair
      Poor
      Demolished
   Physical Hazard     Menu, Required, Normal
      Yes
      No
   Dimensions          Text, Maximum Length = 50
                       Normal, Normal
   Description         Text, Maximum Length = 100
                       Normal, Normal
   Photo Number        Text, Maximum Length = 30
                       Required, Normal

Pit_or_trench_a        Area Feature, Label 1 = Name, Label 2 = Type
   Name                Text, Maximum Length = 30
                       Normal, Normal
   Type                Menu, Required, Normal
      Pit
      Trench
   Physical Hazard     Menu, Required, Normal
      Yes
      No
   Condition           Menu, Required, Normal
      Open
      Partial
      Closed
   Estimated Depth     Text, Maximum Length = 20
                       Required, Normal
   Water               Menu, Required, Normal
      Not Present
      Present
   Photo Number        Text, Maximum Length = 30
                       Required, Normal

Subsidence_p           Point Feature, Label 1 = Description, Label 2 = Physical Hazard
   Description         Text, Maximum Length = 50
                       Normal, Normal
   Dimension/Depth     Text, Maximum Length = 50
                       Normal, Normal
   Physical Hazard     Menu, Required, Normal
      Yes
      No
   Photo Number        Text, Maximum Length = 30
                       Required, Normal

Survey_Mon_p           Point Feature, Label 1 = Name, Label 2 = Type
   Name                Text, Maximum Length = 30
                       Normal, Normal
   Type                Menu, Required, Normal
```

```
      AP Corner
      Section Corner
      1/4 Corner
      1/16 Corner
      Witness Corner
      Benchmark
      Claim Corner
      Rock Monument
      USGS
      Drift-Line Marker
      Rebar Marker
   Action              Menu, Required, Normal
      Yes
      No
   Photo Number        Text, Maximum Length = 30
                       Normal, Normal

Tank_p                 Point Feature, Label 1 = Description, Label 2 = Estimated Size
   Description         Text, Maximum Length = 50
                       Required, Normal
   Estimated Size      Menu, Required, Normal
      <1000 gallons
      >1000 gallons
   Physical Hazard     Menu, Required, Normal
      Yes
      No
   Photo Number        Text, Maximum Length = 30
                       Normal, Normal

Utility_p              Point Feature, Label 1 = Type, Label 2 = Description
   Description         Text, Maximum Length = 50
                       Normal, Normal
   Type                Menu, Required, Normal
      Air Drop
      Electrical Panel
      Outhouse
      PowerDrop
      PowerPole
      SubStation
      Transformer
      Water Drop
   Physical Hazard     Menu, Required, Normal
      No
      Yes
   Photo Number        Text, Maximum Length = 30
                       Normal, Normal

Well_p                 Point Feature, Label 1 = Type, Label 2 = Physical Hazard
   Type                Menu, Required, Normal
      Gas
      Monitoring
      Water
   Physical Hazard     Menu, Required, Normal
      No
      Yes
   Photo Number        Text, Maximum Length = 30
                       Normal, Normal

Artifact_p             Point Feature, Label 1 = Description, Label 2 = Photo Number
   Description         Text, Maximum Length = 100
                       Required, Normal
   Photo Number        Text, Maximum Length = 30
                       Required, Normal

Hiwall_l               Line Feature, Label 1 = Description, Label 2 = Physical Hazard
   Description         Text, Maximum Length = 50
                       Required, Normal
   Physical Hazard     Menu, Required, Normal
      Yes
      No
   Photo Number        Text, Maximum Length = 30
                       Normal, Normal

Road_l                 Line Feature, Label 1 = Surface, Label 2 = Condition
```

```
   Type                Menu, Required, Normal
      County Road
      Secondary Road
      Drill Road
   Surface             Menu, Normal, Normal
      Paved
      Gravel
      Dirt
   Condition           Menu, Normal, Normal
      Good
      Fair
      Poor(4wd)
      ATV Only
      Foot Traffic Only
      Unpassable
   Physical Hazard     Menu, Normal, Normal
      Yes
      No
   Name                Text, Maximum Length = 50
                       Normal, Normal
   Description         Text, Maximum Length = 100
                       Normal, Normal
   Passable            Menu, Required, Normal
      Yes   Default
      No
   Photo Number        Text, Maximum Length = 30
                       Normal, Normal

Utility_l              Line Feature, Label 1 = Description, Label 2 = Type
   Description         Text, Maximum Length = 50
                       Normal, Normal
   Type                Menu, Required, Normal
      Electric
      Gas
      Septic
      Water
      Other (Describe)
   Photo Number        Text, Maximum Length = 30
                       Normal, Normal

Borrow_a               Area Feature, Label 1 = Safety Hazard, Label 2 = Description
   Safety Hazard       Menu, Required, Normal
      Yes
      No
   Description         Text, Maximum Length = 100
                       Normal, Normal
   Photo Number        Text, Maximum Length = 30
                       Normal, Normal

Ore_Storage_a          Area Feature, Label 1 = Estimated Thickness, Label 2 = Photo Number
   Physical Hazard     Menu, Required, Normal
      Yes
      No
   Estimated Thickness       Text, Maximum Length = 50
                       Required, Normal
   Description         Text, Maximum Length = 100
                       Normal, Normal
   Photo Number        Text, Maximum Length = 30
                       Normal, Normal

Pond_a                 Area Feature, Label 1 = Type, Label 2 = Description
   Type                Menu, Required, Normal
      Mine
      Stock
      Other
   Lined               Menu, Required, Normal
      Yes
      No
   Physical Hazard     Menu, Required, Normal
      Yes
      No
   Description         Text, Maximum Length = 100
                       Normal, Normal
   Photo Number        Text, Maximum Length = 30
```

```
                      Normal, Normal

Total_Dstrbd_Area_a   Area Feature, Label 1 = Description, Label 2 = Photo Number
   Description        Text, Maximum Length = 100
                      Normal, Normal
   Photo Number       Text, Maximum Length = 30
                      Normal, Normal

Trash_Dump_a          Area Feature, Label 1 = Physical Hazard, Label 2 = Photo Number
   Physical Hazard    Menu, Required, Normal
      Yes
      No
   Description        Text, Maximum Length = 100
                      Normal, Normal
   Photo Number       Text, Maximum Length = 30
                      Normal, Normal
```

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Appendix C

JSA for Field Work

Job Safety Analysis (JSA)

Descriptive Title: Uranium Leasing Program Daily Activities

General LMS ☐ or Specific Site: Uranium Lease Tracts Issuance Date: 10/25/2012 Expiration Date: 10/25/2013

Work Scope	
1.	This JSA covers routine work performed on the Uranium Lease Tracts located in Southwest Colorado. Routine work includes driving to remote locations, using ATVs/UTVs to access locations; using heavy equipment to repair roads, reclaim mine-related features, and revegetate soils; cutting brush; installing/repairing fences.
2.	Work is performed outside.
3.	Work on the lease tracts is performed year round, with specific tasks performed seasonally.
4.	Tools include ATVs/UTVs; heavy machinery such as backhoes; application of herbicides and pesticides; t-post drivers; use of concrete; and use of polyurethane foam.
5.	This work is performed by Stoller employees.

Define the Scope of Work by Individual Tasks (ISMS Core Function #1)	Analyze the Safety and Environmental Hazards (ISMS Core Function #2)	Develop and Implement Controls (ISMS Core Function #3)
Hazards common to work outside in remote locations	Vehicle Accidents	• No use of any two-way communication device while operating a vehicle. • When towing a trailer, ensure all items in truck and trailer are securely fastened and hitch is securely engaged. Check trailer lights and connections. Personnel must have completed towing safety training. • Watch for rough road conditions including rocks, brush, and well heads. • Use a spotter when backing into obscure or tight areas or when backing up with a trailer. • Do not attempt to cross extreme surfaces. • Drive vehicles on established roads or tracks. • Do not drive on roads or tracks that are extremely muddy or sandy. Reschedule the work if the road or track is unsafe.
	Medical Emergency	• At least one person in the group shall have current first aid/CPR training. • A first aid kit must be present that meets LMS requirements. • Some form of external communication must be present. Verify the method works before beginning activities. • Use the buddy system at all times when on a site. Make sure there is visual or voice contact with another person at all times.

Job Safety Analysis (JSA) (continued)

	Heat Stress	• Use the buddy system to watch for signs of heat stress in self and others; these include unusual redness, profuse sweating, or rapid pulse rate. If signs are observed or worker feels uncomfortable, take breaks as necessary in a cool or shaded location to cool down. • Drink sufficient fluids, approximately 8 ounces per hour of work.
	Cold Stress	• Use the buddy system to watch for signs of cold stress in self and others; these include uncontrollable shivering and pale skin. If signs are observed or worker feels uncomfortable, take breaks as necessary in a warm location to warm up. • Drink sufficient fluids, approximately 8 ounces per hour of work.
	Inclement Weather: Wind, Heavy Precipitation, Flooding, or Lightning	• Seek shelter when weather conditions present a threat to safe working conditions. • Suspend work any time winds cause unexpected, hazardous movement of materials or items. • Suspend work if precipitation causes unsafe conditions such as low visibility, slippery work surfaces, or electrical hazards. • Remain aware of the potential for precipitation to cause flooding, and do not cross streams or arroyos when water is more than wheel hub deep and flowing. Remain cognizant of drainages crossed as flash flooding may render them impassable and block exit. • If lightning is observed within 6 miles of the site (30 seconds between lightning strike and thunder clap), all activities are to be ceased for a minimum of 30 minutes after the last lightning strike (30/30 rule).
	Insect Bites and Stings, Snake Bites, Poisonous Plants	• Wear insect repellent, ivy block, or long sleeves as desired. • After contact with poisonous plants, wash the area thoroughly with soap and water. Seek medical attention if symptoms are severe. • Check for ticks after daily activities. • Do not attempt to harass, capture, or handle snakes or animals. Maintain a safe distance. Look for snakes in portal areas before approaching. • Be aware of hands and feet placement in areas with thick vegetation or while climbing in areas of rocky outcrops. • Wear snake chaps or gaiters in areas of high poisonous snake density or as desired. To care for someone bitten by a snake, the wound should be immediately washed and immobilized, and kept lower than the heart if possible. Seek immediate medical attention. • Never put hands into dark or obscured areas without wearing gloves.

Job Safety Analysis (JSA) (continued)

	Unexpected Encounters with Wildlife	• Be aware of surroundings; use caution when working in areas of known or suspected wildlife habitat; remain vigilant. • Pay attention to and look for wildlife activity (tracks, scat, etc.) • If wildlife is encountered, keep at, or retreat to, a safe distance and avoid contact. • Keep food and beverages inside a vehicle, with windows up and doors closed, when not eating or drinking. • Carry bear spray as desired, and use according to manufacturer's instructions.
	Unexpected Encounters with Illicit Activities	• Be aware of surroundings and watch for signs of activity; remain vigilant. • If site of recent activity is encountered, depart the area immediately and notify supervisor and local authorities. • If site of older activities is encountered, document the location of the site and photograph the suspicious activities or items. Notify supervisor and local authorities as soon as practicable.
	Unexpected Encounters with Explosives	• Be aware of surroundings; use caution and be observant for remnants of explosives. • If encountered, keep a safe distance and do not disturb item in any way; photograph and note the location. • Notify supervisor and leaseholder as soon as practicable.
	Slips, Trips, and Falls	• Establish staging area for materials and equipment, and keep all items in that area when they are not in use. • Remove or mark tripping hazards. • Walk on designated paths and routes if possible. • Be aware of uneven terrain and animal burrows. • Do not jump from equipment or vehicles. Use manufactured ladders if provided on the equipment. NO free climbing – use portable ladder and secure to the equipment. Use three points of contact when entering or exiting equipment.
	Foot Injury	• Wear safety-toed work boots with ankle support when toe-crush hazards are present. • Keep feet away from pinch points.
	Grass Fires	• Use discretion when traveling off-road in grassy areas. • If grass is determined to be dry, tall enough to contact the bottom of the vehicle, and dense enough to sustain a fire, then clear grass before driving to the location. • A fire extinguisher or shovel (for grass fires) may be used to extinguish small fires based on personnel training. Evacuate the site for large fires. • Place all used smoking materials in designated receptacle.

Job Safety Analysis (JSA) (continued)

	Head Injury	• Wear hard hat when working in areas where overhead work is being performed or head bump hazards exist.
	Hearing Damage	• Reduce noise exposure by placing generators and compressors away from work areas using extension cord/extra air hose. • Wear hearing protection when noise levels preclude a normal conversation between two people 3 feet apart, or as recommended by equipment manufacturer.
Unloading and loading equipment	Injury to Hands	• Identify safe lifting points before trying to lift objects. • Keep hands and fingers out of pinch and crush points. • Wear leather work gloves to protect hands from cuts, abrasions, blisters, etc.
	Accidents Resulting from: Unsecured Items (during loading and unloading), Backing up Equipment, and Slippery Surfaces	• Ensure all items on equipment are securely fastened prior to transport. • Use a spotter during unloading and backing equipment onto site location(s). Ensure that backup alarms are working or honk the horn and wait 5 seconds before backing up. • Evaluate slippery or slick surface condition to determine action to be taken during loading or unloading equipment. • Chock wheels before loading or unloading trailers.
	Back Injury	• Get help with heavy or awkward items. • No person shall lift more than 50 pounds without assistance. • Use proper lifting form (load close to the body, bend at the knees, keep back straight, do not rotate) when lifting, never carry a load that blocks your vision. • Use correct bending form (bend at the knees or kneel, turn entire body rather than just torso) when working close to ground or when lowering body position.
	Crushing Injury Resulting from Items Slipping/Falling while Unloading	• All non-essential personnel are to stay completely clear of the loading/offloading activity.
Refueling equipment	Fire	• Vehicles and equipment shall not be fueled with the engine running. • Allow equipment to cool prior to fueling. • Cigarettes, open flames, or other ignition sources are not allowed within 50 feet of the fueling location. • Flammable and combustible liquids shall be handled and used in NFPA-approved safety cans that have flame arresters (screens), spring-closing (self-closing) lids, and spout covers. • A fire extinguisher with ABC rating shall be at the fueling location. • Bond and ground pumps, tank vehicles, and storage tanks if the hose does not contain a bonding wire.

Job Safety Analysis (JSA) (continued)

	Spills/Leaks	• Have sorbent material and container on hand to control spilt fluids. • Inspect all hoses, hose connections, and equipment for leaks prior to operation. • To avoid fuel spills, do not over fill or top off tanks. • Maintain appropriate fuel containment area. • Contact the Environmental Compliance and Health and Safety groups for clean-up and reporting guidance for all spills from equipment, leaks from gas containers, and chemical spills. If directed, report the spill on the Incident Reporting form.
Operation of heavy equipment	Contact Between Equipment and Ground Personnel	• Equipment operators shall be aware of ground personnel at all times. • Ground personnel shall get the attention of operator prior to walking up to the equipment. • Be aware that all heavy equipment has blind spots. • Ground personnel working around heavy equipment shall wear high-visibility vests or clothing. • Before entering equipment cab, the operator shall visually inspect the area around the equipment. • For equipment that doesn't have a backup alarm, the operator shall use a spotter or honk the horn and wait 5 seconds prior to backing up. • Ground personnel shall stay at least 25 feet away from operating equipment when possible. • Utilize spotters when vision is restricted.
	Contact with Overhead Powerlines	• Note the location of any overhead lines and ensure there is at least 10 feet of clearance between the line(s) and equipment/machinery.
	Vehicle Accidents	• No use of two-way communication devices while operating a vehicle or machinery. • Do not traverse extreme slopes or areas. • Use a spotter when backing up in areas that have other vehicles or ground personnel, or when backing into obscure or tight areas. • Maintain speed below 10 mph on site.
	Fluid Leaks	• Inspect equipment and machinery, including hoses and hose connections, prior to initial use and on a daily basis thereafter for obvious leaks. • Repair leaks before item is allowed on the site, or if already onsite, immediately upon detection. • Have sorbent material and container on hand to control leaking fluids. • Contact Environmental Compliance group for proper disposal of material.

Job Safety Analysis (JSA) (continued)

	Falls when Entering, Exiting, or Servicing Equipment	• Use manufactured ladders and access points on the equipment; NO climbing around and on equipment for maintenance. • Use a portable ladder and secure to the equipment. • Maintain three points of contact.
	Injuries Resulting from Equipment Failure	• Inspect equipment daily for proper operation and free of defects. Document inspections. • Ensure all manufactured guards and safety devices are in place. • Correct defects prior to operating equipment. • Do not operate equipment on terrain exceeding equipment limitations or operator skills.
	Fires Caused by Parked Vehicle	• Do not park vehicles in dry brushy or grassy areas where hot engine parts could cause a fire.
	Unintended Vehicle Motion While in Storage	• Do not park or store vehicle on a sloped surface. If necessary, chock the wheels and secure parking brake if equipped.
Use of hand and power tools and generators	Hand Injury	• Inspect all power tools prior to use; remove from service and tag those that are unserviceable. • Wear appropriate work gloves to protect from cuts, scrapes, etc. • Keep hands and fingers out of pinch points associated with power tools. • Make sure all manufacturer supplied guards are in place, or that the tool is properly guarded. • Heed all **CAUTION** and **DANGER** decals posted on equipment.
	Eye Injury	• Wear safety glasses with side shields when flying particles or splashing liquids are present.
	Electrical Shock	• Inspect equipment prior to use and remove unserviceable cords and tools. • Use only double insulated tools. • Use GFCI protection when using outdoor outlets and generators. • Ground generators per manufacturer's recommendations. • Do not daisy chain extension cords.

Job Safety Analysis (JSA) (continued)

Work near excavations, mine shafts, or adits	Falling into an Open Excavation or Shaft	• Personnel not working in excavation shall keep a minimum distance of 6 feet away from excavation edge. Personal fall protection is required when working in proximity of an unprotected edge that is 4 feet or more above a lower level. Excavation will be sloped at 2:1 for worker protection, but above distances shall still be observed. Slope grade will be verified by competent person, such as H&S or CSS. • Ensure work areas within excavated areas have clearly defined entry and exit locations. Restrict access to open trenches, high banks and steep slopes to only necessary personnel. • Rope or cordon off around mine shafts to establish a perimeter 6 feet from the entrance. Personnel who must work within the perimeter shall wear fall protection. • Fall protection training is required.
	Hazardous Atmosphere	• No personnel shall enter an abandoned mine shaft or adit without wearing a gas monitor with audible alarm. • Gas monitor training is required.
	Exposure to Radon Gas	• This is not regulated per 10CFR835; however, as a best management practice, minimize time near portals where potential for radon build-up is possible such as non-venting mines. Radon exposure decreases rapidly with distance from the opening.
	Overhead Hazards	• Personnel shall watch for and identify overhead hazards when working near or within the brow of an inactive mine. • Personnel shall wear appropriate PPE, including hard hat. • If rock fall hazard exists, do not enter mine or work near portal.
Entry into Lessee mines	Routine Mine Hazards	• Personnel shall adhere to Lessee procedures during mine visitation. • Personnel must be trained by an MSHA certified trainer in the use of a self rescuer device, and carry one when underground.
Crossing fences	Falls, Cuts, or Abrasions	• When possible, use existing gates for ingress and egress of sites. • Open gate instead of climbing over gate. • Avoid crossing barbed-wire fences if possible. When it is necessary to cross a fence, use buddy to help get across or through ensuring no contact with barbs, and/or use protective material (e.g., matting) as a barrier between the inspector and the barbs.
Repairing wire fences	Hand and Eye Injury	• Use appropriate hand tools designed for repairing fences (fence stretcher, fence pliers, wire/bolt cutters, splicing accessories, etc.). • Inspect hand tools before using them. Tag out or dispose of defective or damaged items. • Wear safety glasses. • Wear leather work gloves to protect hands from cuts, abrasions, blisters, etc.

Job Safety Analysis (JSA) (continued)

Installing metal t-posts and rebar	Hand, Eye, Back, Foot Injury; Hearing Damage	• Use appropriate t-post driver when installing metal t-posts to repair fences, establishing monitoring locations, or points of reference. • Ensure proper footing and lifting techniques. Take regular breaks. • Keep hands and fingers out of pinch points and crush areas. • Wear leather work gloves to protect hands from cuts, abrasions, blisters, etc. • When driving metal rebar for establishing monitoring locations or points of reference, use appropriate weight hand sledgehammer. • Avoid missing or glancing blows to avoid injuries to hands and fingers. • Wear safety glasses. • Wear hearing protection at all times when t-posts or rebar are being driven. • Wear hard-toe, sturdy-sole boots with ankle support meeting ANSI Z41 specifications when installing posts and rebar.
Cutting shrubs	Hand and Eye Injury, Ear Injury	• Inspect hand tools. Tag out or dispose of defective or damaged items. • Use hand clippers, loppers, or pruning saws to cut plants at the base. • Wear safety glasses. • Wear leather or cotton work gloves to protect hands from cuts, abrasions, blisters, etc. • Wear ear protection or covering (hat or muffs) when cutting tamarisk.
Use of Polyurethane Foam Sealant	Eye and skin contact, inhalation, chemical exposure	• Wear safety glasses and gloves to avoid contact with skin or eyes. • Stand upwind while applying foam to limit overspray and inhalation potential. • Follow manufacturer's directions for application.
Spray painting posts and other surfaces	Chemical Exposure	• Stand upwind while applying spray paint or sealant. • Review MSDS and wear PPE as recommended in the MSDS.
Brush/vegetation removal using chain saw	Hearing Damage	• Hearing protection shall be worn while chain saw is in operation.
	Eye Injury	• Safety glasses or safety screen shall be worn when in the proximity of an operating chain saw.
	Injury to Extremities	• Steel toed boots, metatarsal protectors, leather gloves, sawyer chaps, and long-sleeved shirt shall be worn while operating a chain saw.

Job Safety Analysis (JSA) (continued)

ATV use	Rollovers, Cuts, Abrasions, Scratches, Head/Bodily Injuries	• Operators must successfully complete ATV Safe Operations Training. • An approved helmet, gloves, and sturdy boots are required. • Inspect ATV prior to operation. • Keep hands and fingers out of pinch points and crush areas. • Use caution when riding on hillsides and uneven terrain (use proper body positions to offset weight distribution). • Do not attempt to cross extreme surfaces and obstacles. • Avoid traversing steep slopes. • When steeper slopes are unavoidable, use winch secured to a substantial tree, rock, or deadman stake. • Use rear brakes when descending steep slopes.
Winch operation	Cuts, Abrasions, Cable Breaks, Pinch Points	• Use gloves when handling cable. • Inspect cable for damage prior to use. • Keep fingers away from roller fairlead. • Do not stand in path of cable under tension in case of failure. • Place blanket, tarp, or other similar item over the middle of the cable before activating winch. • Uninvolved personnel shall stay out of the area.
Towing an ATV trailer	Vehicle Accidents, Damage to Property	• Check hitch attachment (ensure hitch ball is correct size), trailer coupling (tow chain and clasp pin secure), and trailer tire condition and pressure. • Ensure all items on trailer are securely fastened during transport. • Ensure trailer lights are functioning properly (brake, turn signals). • Check trailer integrity and stability periodically during travel. • Use spotter for backing truck and trailer into parking lots and into tight locations • Personnel must have completed towing safety training before hauling a trailer.
Herbicide/pesticide application	Chemical Exposure, Release Into the Environment	• Only a licensed person shall apply herbicides. • The licensed person shall follow a specific JSA or procedure. • Other personnel on the site shall stay upwind or out of the area of application, and shall avoid handling materials that have been sprayed.

Job Safety Analysis (JSA) (continued)

JSA Review and Approval

Line Supervisor (Print Name)	Signature	Date
Ed Cotter, Program Lead		
H&S Representative (Print Name)	Signature	Date
Tom Maveal		
Environmental Compliance Representative (Print Name)	Signature	Date
Sandy Beranich		
Subcontractor/Worker Representative (Print Name)	Signature	Date

Job Safety Analysis (JSA) (continued)

I have reviewed, thoroughly understand, and will comply with this ISMS Core Functions Work Planning and Control Document.

Print Name	Signature	Company	Date

Job Safety Analysis (JSA) (continued)

Field Change Authorization and Review

Field Management Changes (use a separate sheet if more space is necessary)

Define New or Changed Scope of Work by Tasks (ISMS Core Function #1)	Analyze the New or Changed Hazards (ISMS Core Function #2)	Develop and Implement New Controls (ISMS Core Function #3)	Date

Line Supervisor (Print Name) | Signature | Date

Worker or Subcontractor Representative (Print Name) | Signature | Date

I acknowledge I have had the opportunity to provide input to the field change and am aware of the scope change, new or changed hazards, and associated work controls.

Print Name	Signature	Company	Date

Provide Feedback and Improvement Suggestions (ISMS Core Function #5)

Appendix D

Plan of the Day/Plan of the Week Form

Plan of the Day/Plan of the Week

Site Name: ______________________

Work Authorized by: ______________________ ______________________

Site Manager or Site Lead (print name) Site Manager or Site Lead (signature)

☐ POD ☐ POW

Date(s) Work Authorized: ______________

1. Approved Activities		
Item No.	**Activity Description**	**Responsible Person**

2. Safety, Radiological, and Environmental Precautions

1. Reference the project/activity Job Safety Analysis.
2. All workers have and are expected to use both **step back** and **stop work authority**.
3. All workers should notify their supervisor or Health and Safety representative of abnormal events.
4. Employees must notify supervisor immediately of any injury or potential injury regardless of how minor it may appear at the time.
5. Contact Health and Safety prior to entry into **any** confined space.

Plan of the Day/Plan of the Week (continued)

3. Roles and Responsibilities—Names and Phone Numbers: *This section should contain pertinent contact information and job assignments as deemed necessary by the site manager/site lead. Examples of contact information include: site managers, project leads, operations leads, construction inspector, technical monitor, and site safety supervisor. If multiple projects/activities are ongoing, the site manager/site lead may determine that each project/activity should include the respective positions. In this case, the site manager/site lead may elect to specify contact information for each project.*

4. Emergent Work: *Emergent work is new or additional work activities that are identified for performance. Emergent work requires the same level of planning and authorization as normally approved activities. Emergent work cannot be performed unless it is authorized by the site manager/site lead.*

Item No.	Activity Description/Applicable JSA/ Roles and Responsibilities	Authorization (Site Manager or Site Lead Signature)

Plan of the Day/Plan of the Week (continued)

Plan of the Day/Plan of the Week Signature Sheet

Site Name: ______________________________

Name (print)	Job Title	Company Name	Worker's Initials	Date

Appendix E

Maybell Pits Area Field Map

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Structu2	Hiwall_l	Fence_l	pit_e	Q010_Locations_for_ArcMap_20130723
fence_l	PosnLine	new_pits_l	PosnLine	
road_l	Structure_a	pit_1	new_pits	
Structure_p	Other_p	pit_2	Pit_or_t	
Survey_M	Other_p	pit_4		

N

SCALE IN FEET

1,000 500 0 1,000 2,000 3,000 4,000

U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION, COLORADO

Work Performed by
S.M. Stoller Corporation
Under DOE Contract
No. DE-AM01-07LM00060

Maybell GPS
2003

DATE PREPARED:
July 24, 2013

FILENAME:
Maybell_GPS_2003

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Appendix H

Field Trip Reports

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The table below is a summary of field trips taken to some of the individual mines in the Office of Legacy Management abandoned uranium mines database (LM AUM database). All of the field trips listed in the table occurred in August 2013. The mines in the table are presented alphabetically, first by worksheet subsection name, and then by the CLAIM_NAME column.

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Small Mines (1-100 tons)

ID	STATUS	FEATURES											
CLAIM_NAME	MINE_STATUS	MINE_AREA_M2	Tons of Ore	Pounds of U^30^8	ADITS	WASTE_ PILES	WASTE_PILE_ AREA	WASTE_PILE_ VOLUME	PITS	SHAFTS	OTHER_DEBRIS_MINE_FEATURES	MISC	STRUCTURES
Little Ann	Not Reclaimed	260000	0.2	3	1	1	13000	130000	4	0	Mine is open pits with an adit at one end of a trench.		0
Willie Dee	Closed	8700	1	1	1	1	200	600	0	0	Ore loadout, trash.		1
Dreamer	Not Reclaimed	514000	1.2	5	0	1	267000	1870000	1	0	Mine is one large open pit with several pits.	Powder magazine.	1
Waterloo	Closed	8700	6	37	1	1	200	600	0	0	Trash.		0
Unnamed mines in SW 1/4 Sec 31	Closed	243000	7	43	6	10	75000	300000	0	0	Timbered crib and some scrap metal.		1
Juniper and Juniper 1	Not reclaimed	285000	11	16	5	5	32000	130000	0	0	Five mine adits and an ore loadout structure.		1
Idiot's Delight	Not Reclaimed	12400000	15	42	0	0	0	0	7	0	Mine is several trenches and prospects along the ridgeline.		0
High Park	Not Reclaimed	610000	46	115	0	1	270000	4000000	1	0	Mine is open pit that is dry.	Wildlife guzzler.	2
Shamrock No. 1	Closed	400	58	706	2	1	30	100	0	0	Tressel.		1
Dads	Closed	400	74	391	6	6	250	500	0	1	Ore chute.		1
AEC Group	Closed	212000	87	42	4	4	11879	36000	5	0	A timbered ore chute and separate timbered load out structure remain. Two blasted mine vents have been reclaimed.		2
Averages:		**1322018**	**28**	**127**	**2**	**3**	**60869**	**587982**	**2**	**0**			**1**

Small/Medium Mines (100-1,000 tons)

ID	STATUS	FEATURES											
CLAIM_NAME	MINE_STATUS	MINE_AREA_M2	Tons of Ore	Pounds of U^30^8	ADITS	WASTE_ PILES	WASTE_PILE_ AREA	WASTE_PILE_ VOLUME	PITS	SHAFTS	OTHER_DEBRIS_MINE_FEATURES	MISC	STRUCTURES
Valley View 6	Not Reclaimed	260000	123	259	0	1	4000	20000	7	0	Mine is several shallow trenches.		0
Yellow Buck	Not Reclaimed	496000	180	371	0	7	10500	74000	7	0	Mine is several trenches scattered about.		0
Trail Wind	Partially Reclaimed	310000	186	339	0	1	84000	840000		0	Mine is open pit with numerous trenches throughout.		0
Sugarloaf West	Not reclaimed	400	357	1070	0	1	200	400	1	0	Ore chute.		1
Cycad	Not Reclaimed	200000	600	2450	0	5	53000	211000	5	0	Mine is several trenches scattered about.		0
First Chance	Not Reclaimed	350000	606	2303	0	2	161000	1,610,000	2	0	Mine is two open pits that are dry.		1
Maryjac	Not Reclaimed	400000	646	1886	0	5	15000	45000	2	0	Mine is 2 open pits and numerous trenches scattered over a large area.		0
Memphis 2 & 3 and Green Lizard	Closed	28000	744	3972	7	7	55000	164000	1	0	Several timbers are present at adit #1.		1
Averages:		**255550**	**430**	**1581**	**1**	**4**	**47838**	**370550**	**3**	**0**			**0**

Medium Mines (1,000-10,000 tons)

ID	STATUS	FEATURES											
CLAIM_NAME	MINE_STATUS	MINE_AREA_M2	Tons of Ore	Pounds of $U^{3}0^{8}$	ADITS	WASTE_ PILES	WASTE_PILE_ AREA	WASTE_PILE_ VOLUME	PITS	SHAFTS	OTHER_DEBRIS_MINE_FEATURES	MISC	STRUCTURES
Little Abner 1	Not Reclaimed	930000	1108	3668	0	4	374000	3740000	1	0	Mine is open pit with water in it.	Four buildings related to mine operations.	4
Paris 25	Closed	210000	1247	9290	2	3	16000	47000	3	0	Some scrap metal.		0
Jack 2	Not Reclaimed	40500	1394	6160	0	1	1800	7200	1	0	Mine area consists of one trench and waste pile. Are not reclaimed.		0
Mars Group	Reclaimed	20500000	1726	5352	0	0	0	0	4	0	Mine is four large open pits with reclaimed waste piles.		0
Road Hog	Not Reclaimed	33000	1981	11449	0	1	69000	207000	1	0	Mine is open pit along hillside.		0
Sec 32 13N 9W	Not reclaimed	68000	2407	9746	1	Several	2500	5000	0	0	Adit, decline that has collapsed creating two pits.	Mine timbers and metal scrap.	1
Sec 32 22S 22E	Not reclaimed	21000	2475	7713	0	0	0	0	1	0	Rim cut area.		0
Matias Peak	Not Reclaimed	550000	2610	9653	1	1	26000	260000	1	1	Mine is a large open "L" shaped pit.		0
Blue Buck Red Horse	Not Reclaimed	22000	3477	12999	0	1	7000	14000	0	0	Mine is flat area that was once a trench.		0
White Cap	Closed	Unknown	3611	12477	0	Several	5100	20300	0	1	Shaft closed but mine waste rock piles remain.	Three concrete pads and misc. timbers and scrap metal.	3
Badger	Closed	44000	4370		3	1	1000	3000	0	0	Ore bin.	Cabin.	2
Pat Sec 4 13N 10W	Not reclaimed	22000	5068	12645	3	Several	11000	44000	0	0	Mine site has not been reclaimed.	Mine waste rock contained to working-area apron below mine adits.	0
Lucky Lass	Reclaimed	80000	5569	37612	0	2	610000	7000000	1	0	Mine has been reclaimed		0
Bone Choppy	Not Reclaimed	10500000	6316	33731	0	2	1400000	72000000	2	0	Mine is two very large open pits.		0
Virginia C	Not Reclaimed	305000	6570	24635	0	1	16500	115500	1	0	Mine is open pit along hillside.		0
Billy Dale	Not Reclaimed	1500000	6828	70235	0	2	150000	1345000	1	0	Mine is one large pit with two waste rock piles.		0
Pickpocket	Partially Reclaimed	1700000	7624	54767	0	3	202000	2020000	1	0	Mine is one large pit, partially reclaimed.		0
Barbara J No. 1	Closed	Unknown	8690	52631	0	Several	20000	60000	0	1	Shaft closed but mine waste rock piles remain.	Mine timbers and metal scrap.	1
Averages:		**2029194**	**4060**	**20820**	**1**	**1**	**161772**	**4827111**	**1**	**0**			**1**

Medium/Large Mines (10,000-100,000 tons)

ID	STATUS	FEATURES											
CLAIM_NAME	MINE_STATUS	MINE_AREA_M2	Tons of Ore	Pounds of $U^3 0^8$	ADITS	WASTE_PILES	WASTE_PILE_AREA	WASTE_PILE_VOLUME	PITS	SHAFTS	OTHER_DEBRIS_MINE_FEATURES	MISC	STRUCTURES
Cactus Rat Group	Reclaimed	Unknown	10148	49477	0	0	0	0	0	0	Mine area has been reclaimed.		0
Buckhorn Mine Group	Closed	87000	10797	53655	9	5	2000	6000	0	1	Trash.		0
Ring Tail SC Sec 36	Closed	37500	14265	65072	0	1	6500	26000	0	1	Concrete pad, timbered cribbing wall, car chassis, and some scrap metal.		2
San Juan	Reclaimed	Unknown	14528	39582	0	0	0	0	0	1	Several mine vents remain open.		0
Black Stone 6	Closed	61000	16451	72286	1	2	18000	108000	0	0	Some scrap metal, primarily 55 gallon drums (9). At least three mine vents on the rock terrace above the mine site and to the east several hundred feet, one backfilled and two open.		0
Holdup	Not Reclaimed	659000	21732	77295	0	2	14000	100000	2	0	Mine is two shallow trenches.		0
Wild Goose 1	Reclaimed	11700000	27759	99939	0	0	0	0	1	0	Mine is one large open pit with reclaimed waste piles.		0
Snowball	Reclaimed	27800000	28369	79623	0	0	0	0	2	0	Mine is two large open pits with reclaimed waste piles.		2
Thunderbird Pits 9 & 31	Reclaimed	5100000	43470	141091	0	0	0	0	1	0	Mine is large open pit with reclaimed waste piles.		0
Veca Pit	Reclaimed	8000000	73502	237446	0	0	0	0	1	0	Mine is large open pit with reclaimed waste piles.		0
Andria	Reclaimed	12400000	80436	232565	0	0	0	0	1	0	Mine is one large open pit with reclaimed waste piles.		0
Averages:		**5985864**	**31042**	**104366**	**1**	**1**	**3682**	**21818**	**1**	**0**			**0**

Large Mines (100,000+ tons)

ID	STATUS	FEATURES										
CLAIM_NAME	MINE_STATUS	MINE_AREA_M2	Tons of Ore	Pounds of U^30^8	ADITS	WASTE_PILES	WASTE_PILE_AREA	WASTE_PILE_VOLUME	PITS	SHAFTS	OTHER_DEBRIS_MINE_FEATURES	MISC	STRUCTURES
Barbara J No. 3	Closed	Unknown	102128	485718	0	Several	5000	10000	0	1	Shaft closed but mine waste rock piles remain.	Concrete pad, mine timbers, and metal scrap.	2
Various Claims	Reclaimed	133500000	107774	506352	0	0	0	0	2	0	Mine is two large open pit with reclaimed waste piles.		0
White King	Reclaimed	500000	119053	352017	0	1	525000	27000000	1	0	Mine has been reclaimed		0
Hogan Sec 14	Closed	200000	129551	678510	0	Several	33000	132000	0	1	Shaft opening is partially covered.	Misc. timbers and scrap metal.	1
Rim Group	Reclaimed	6700000	156761	533090	0	0	0	0	1	0	Mine is large open pit with reclaimed waste piles.		0
Sage	Not reclaimed	12400000	197709	406909	0	6	3850000	58000000	2	0	Mine is two large pits with seven large waste rock piles.		0
Columbia Shaft GR	Reclaimed	Unknown	254433	1196335	0	0	0	0	0	1	Mine area has been reclaimed.		0
Louise	Not reclaimed	220000	265674	1772549	5	6	60000	177000	0	0	Two powder magazines, steel ore bin, steel track vehicle, cement pad, miscellaneous timber, concrete and scrap metal.		5
Big Buck 11	Closed	130000	384278	2779204	1	1	47500	190000	0	0	Fuel pump present and may indicate -the presence of an underground fuel stroage tank.		1
Gertrude	Not reclaimed	6900000	407849	914398	0	1	10,000	30,000	1	0	Dugout, powder mag.		2
Sec 17	Reclaimed	Unknown	507498	2230954	0	0	0	0	0	1	Mine has been reclaimed.		0
Big Buck 7	Not reclaimed	330000	508112	2548968	3	2	112000	336000	1	0	One adit open, two collapsed, vent partially closed, large ore rock pit area, wood and scrap metal scatterred about.		0
Rob Rollo	Not reclaimed	3600000	596700	1347891	0	1	30,000	95,000	1	0	Power lines.	Pump.	1
Branson Sec 33 14 9	Reclaimed	Unknown	1022641	3811922	0	0	0	0	0	1	Mine has been reclaimed.		0
Ann Lee Sec 28 14 9 [1,2]	Reclaimed	Unknown	1042242	4820462	0	0	0	0	0	1	Mine has been reclaimed.	Fence surrounds mine shaft.	1
Mi Vida	Not reclaimed	95000	1244122	9588148	1	1	77000	300000	0	0	Track and rail system with engine and four ore cars and large metal ore storage bin.		2
Averages:		**10285938**	**440408**	**2123339**	**1**	**1**	**296844**	**5391875**	**1**	**0**			**1**

LMS/AUM/S10980

Abandoned Uranium Mine Field Trip Report

Mine Name: Mars Group
Mine ID: LM ID 3647

October 2013

U.S. DEPARTMENT OF ENERGY | Legacy Management

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LMS/AUM/S10980

Abandoned Uranium Mine
Field Trip Report

Mine Name: Mars Group
Mine ID: 3647

October 2013

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Contents

Figure

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1.0 Introduction and Summary

Note

The purpose of this report is to (1) ascertain the status and location of the identified abandoned uranium mine (AUM) site and (2) record all immediate site information associated with the mine site, including all mine features such as adits, pits, and waste piles (whether or not they have undergone reclamation). Decisions and recommendations on any needed additional steps will be provided in a separate document.

2.0 Site Identification, Location, and Status

Located in the Gas Hills District, Natrona County, Wyoming, the Mars Group mine area is approximately 47 linear miles southeast of Riverton, Wyoming. On the south side of Riverton at the intersection of Highway 20 and Wyoming County Road 136 (Gas Hills Road) proceed east on Gas Hills Road approximately 43 miles to the intersection of Dry Creek Road. Turn left and proceed east approximately 4 miles on Dry Creek Road to an unmarked intersection. Turn right and go south approximately 4.8 miles to the Mars Group mine area located to the southeast of the intersection of the two unmarked roads.

The Mars Group mine area has been reclaimed and currently consists of four large pits with the largest pit having a high wall along the east side of the pit. Water is present in the bottom of this pit and forms a lake approximately 8.5 acres in size.

Mine ID: 3647.

Map ID: Map 47.

Mine name: Mars Group.

Other names and aliases: None.

County: Natrona.

State: Wyoming.

Latitude/longitude: 42.****, -107. **** (at top of high wall).

Nearby road and highway: 8 miles east southeast from the intersection of Dry Creek and Gas Hills Roads.

Local post office: Riverton, Wyoming.

Landowner (by agency, or note if private): U.S. Bureau of Land Management.

Number of habitable residential structures within 200 feet of mine: None.

Reported production:

- Tons of ore: 1,726
- Pounds of U_3O_8: 5,352

3.0 Summary of Radiological Readings

Mine ID/name: 3647/Mars Group.

Background gamma readings (range and average): 20 microroentgens per hour (µR/h)

Highest gamma radiation measurement: 35.1 µR/h

Range of gamma readings noted for site: 18.1–35.1 µR/h

List gamma readings by site locations:

- 23.1 µR/h About 100 feet from top of slope going into the pit – radon sample taken here.
- 23.1 µR/h About 200 feet from top of slope going into the pit.
- 18.1 µR/h Top of high wall.
- 21.8 µR/h Top of high wall.
- 25.8 µR/h Top of high wall.
- 21.2 µR/h Slope area by high wall.
- 21.8 µR/h Native soil area.
- 35.1 µR/h Waste rock area.
- 27.8 µR/h Waste rock area.
- 30.4 µR/h Waste rock area.

Results of radon measurements (short-term and/or long-term): On the slope leading down to the rim of the pit, radon short-term measurements ranged from 0 to 148 becquerels per cubic meter (Bq/m^3), and radon long-term measurements ranged from 0 to 74 Bq/m^3. WL (working Level) short-term and long-term measurements were 0 Bq/m^3.

Date and Time	Radon Short-term (Bq/m^3)	Radon Long-term (Bq/m^3)	WL Short-term	WL Long-term
8/14/2013 13:09	0	0	0	0
8/14/2013 13:19	148	74	0	0
8/14/2013 13:29	28	39	0	0
8/14/2013 13:39	56	46	0	0

Background radon measurements (if taken): Not applicable.

Range of radon measurements taken: See above.

List radon measurements by site locations: See above.

Describe any other radiological measurements: A total of 10 gamma measurements and 1 radon sample were taken in the area of this mine site.

4.0 Status of Reclamation and Mine Waste

Mine ID: 3647.

The following information was obtained from field observations collected during the August 2013 site visits and from Google Earth Pro.

4.1 Observed Reclamation Work and Status

Four large open pits with mine waste rock piles already contoured to adjacent topography. A large lake is present in the bottom of the biggest pit. Several channels about site have been rip-rapped to impede surface water flows.

Adits: None identified.

Waste Piles: None.

Estimated Volume: 0 cubic yards.

Pits: Four.

Estimated Volume: 15,400,000 cubic yards.

Shafts: None identified.

Other debris and mine features: None observed.

Significant erosion observations: None observed.

5.0 Site Observations and Environs

Distance to public-maintained road: Approximately 4.8 miles from Dry Creek Road.

Observed residential structures (number and human habitation status of structures, at the following distances from mine):

- 0 to 200 feet: None.
- 200 feet to 0.25 mile: None.

Observed public or commercial structures (schools, clinics, chapter houses, places of business and any other structures used by members of the community, at the following distances from the mine site):

- 0 to 200 feet: None.
- 200 feet to 0.25 mile: None.

Levels measured around the perimeter(s) of the identified structure(s): Not applicable.

Observed water sources (number and type of wells and surface water sources that are potentially used for human consumption, at the following distances from the mine site):

- 0 to 0.25 mile: None observed.
- 0.25 mile to 4 miles: None observed.

Sensitive environments (all sensitive environments located within visible range of the mine site, including wetlands, endangered species and habitats, and so on): None observed.

6.0 Response Action Summary

6.1 Summary of Evaluation Factors

Accessibility:

- Was the mine easily accessible to potential human activity?

  Yes.

Radiological measurements:

- Were any gamma radiation measurements collected at the mine greater than two times the site-specific background levels?

  No.

Waste piles:

- Were any unreclaimed waste piles observed at the mine with gamma radiation measurements greater than two times the site-specific background levels?

  No.

Structures:

- Were any structures observed within 200 feet of the mine?

  No.

Potential drinking water sources:

- Were any potential drinking water sources (including for livestock) observed within 4 miles of the mine?

    Yes, this mine pit and others nearby had water in them.

Reclamation:

- Was the mine reported to be previously reclaimed, or did the mine appear to be reclaimed?

    Mine site appeared to be reclaimed, although some of the reclaimed areas showed some minor erosion.

7.0 Photos

Photo 1. Looking northeast at the Mars Group pit and the surrounding reclaimed area.

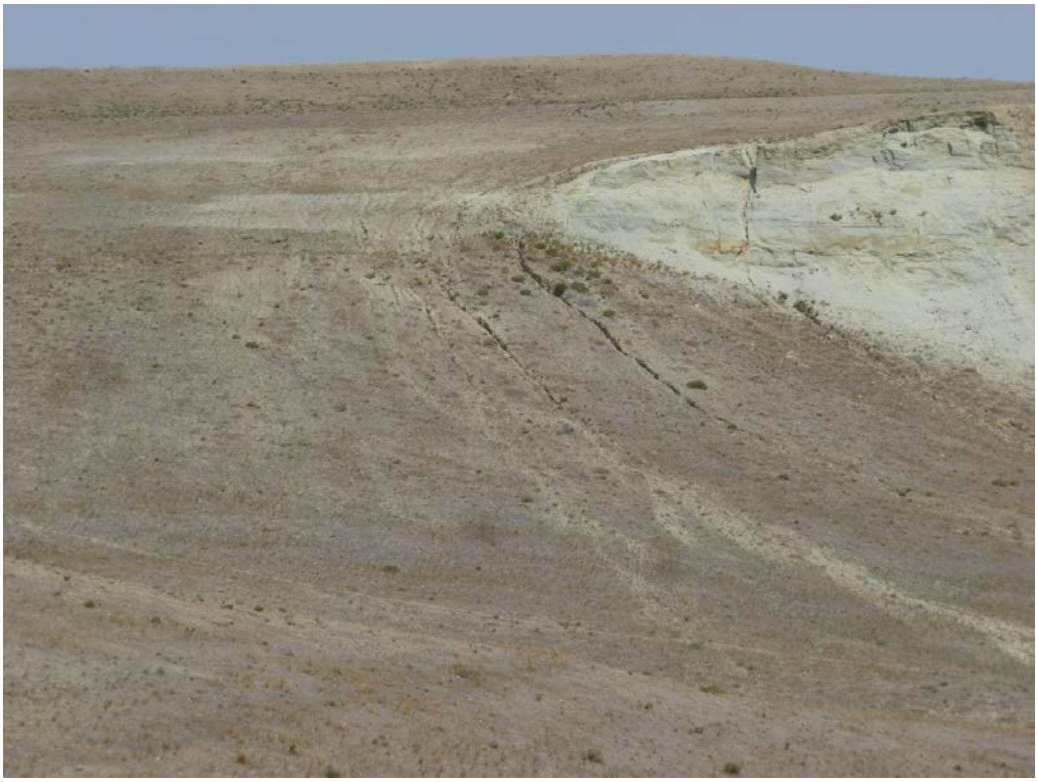

Photo 2. Minor erosion of recontoured and reclaimed area near the northeast end of high wall.

Photo 3. Recontoured and reclaimed area with channel stabilization on the north side of the Mars Group pit.

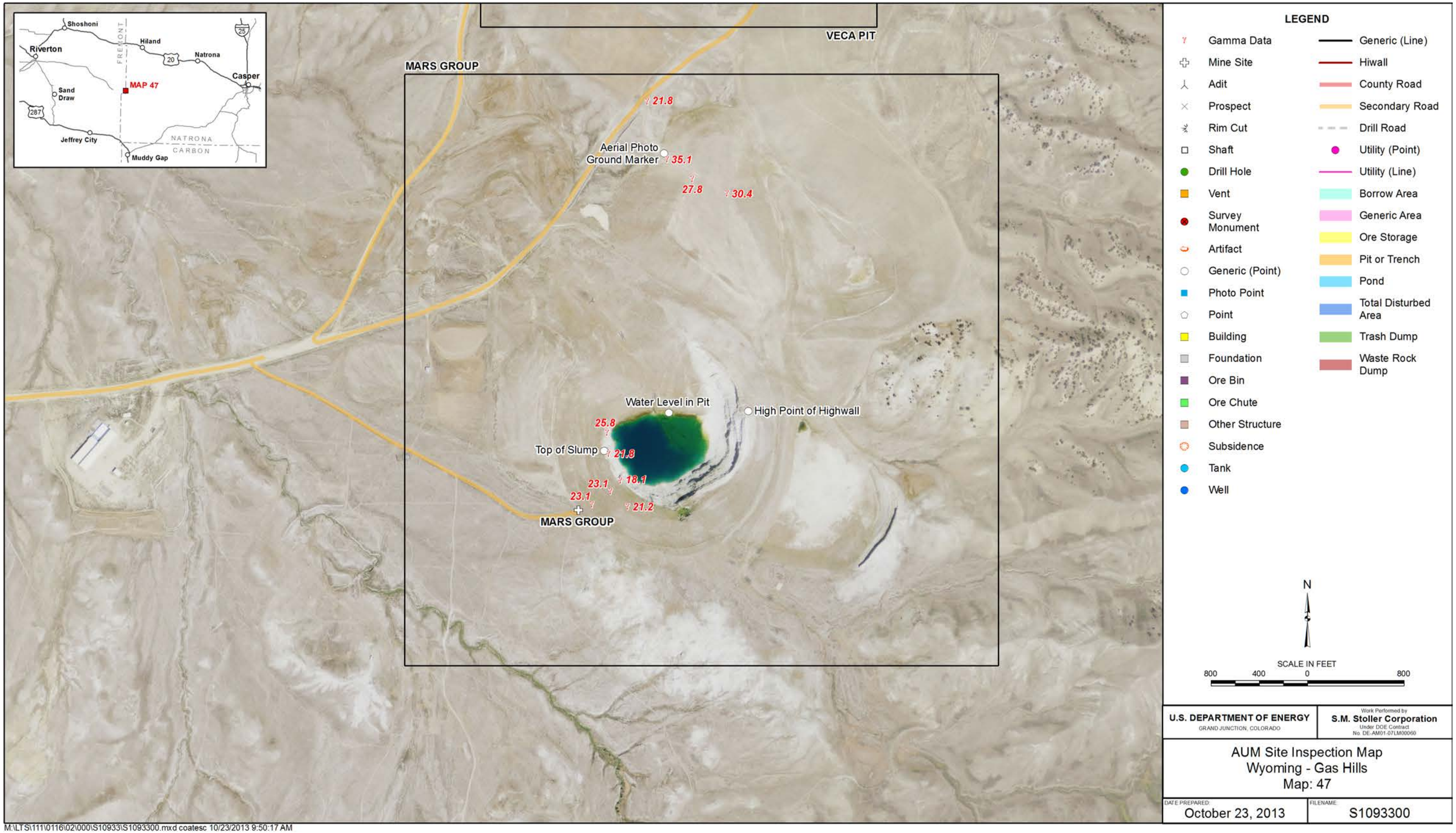

Figure 1. AUM Mars Group Site Inspection Map

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LMS/AUM/S11007

Abandoned Uranium Mine Field Trip Report

Mine Name: Paris 25
Mine ID: 2725

November 2013

U.S. DEPARTMENT OF ENERGY | Legacy Management

LMS/AUM/S11007

Abandoned Uranium Mine
Field Trip Report

Mine Name: Paris 25
Mine ID: 2725

November 2013

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Contents

Figure

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1.0 Introduction and Summary

Note

The purpose of this report is to (1) ascertain the status and location of the identified abandoned uranium mine (AUM) site and (2) record all immediate site information associated with the mine site, including all mine features such as adits, pits, and waste piles (whether or not they have undergone reclamation). Decisions and recommendations on any needed additional steps will be provided in a separate document.

The Paris 25 abandoned uranium mine (AUM) site (Figure 1) is in the Yellow Cat District, Grand County, Utah. The Paris 25 mine is an area of several partially-reclaimed mine decline trenches approximately 9 miles southeast of the I-70 Yellow Cat exit (193). At the Yellow Cat exit, go southeast on Yellow Cat Road to the second intersection (approximately 7.9 miles), turn left and go approximately 0.5 mile to the timbered ore bin on the north side of the road (Black Stone 5 mine), turn right (south) and proceed 0.5 mile past the abandoned school bus on the right and through the Unnamed Mines SW¼ of Sec 31 mine area to the Paris 25 mine area. At a low ridgeline, the Paris 25 mine consists of two decline trenches, several mine-waste rock piles, and a vent. The openings of all the decline trenches have been closed off with concrete block bulkheads. A large mine vent has been closed with a concrete curb and rebar grate.

2.0 Site Identification, Location, and Status

Mine ID: 2725.

Map ID: Map 40.

Mine name: Paris 25.

Other names and aliases: None.

County: Grand.

State: Utah.

Latitude/longitude: 38. ****, -109. **** at the decline adit in middle of the mine area.

Nearby road and highway: The Paris 25 mine area is located approximately 0.5 mile south of the Yellow Cat Road, approximately 0.5 mile east of the second intersection, and approximately 9 miles southeast of the I-70 Yellow Cat exit (193).

Local post office: Thompson Springs, Utah.

Landowner (by agency, or note if private): U.S. Bureau of Land Management.

Number of habitable residential structures within 200 feet of mine: None.

Reported production:

- Tons of ore: 7
- Pounds of U_3O_8: 43

3.0 Summary of Radiological Readings

Mine ID/name: 2725/ Paris 25.

Background gamma readings (range and average): 15 microroentgens per hour (µR/h)

Highest gamma radiation measurement: 125 µR/h

Range of gamma readings noted for site: 13–125 µR/h

List gamma readings by site locations:

- 15 µR/h at the vent.
- 35–100 µR/h around the surface pits and scrapes scattered about the area.
- 40–125 µR/h at the decline portal entrances.

Results of radon measurements (short-term and/or long-term): None taken.

Background radon measurements (if taken): None taken.

Range of radon measurements taken: None taken.

List radon measurements by site locations: None taken.

Describe any other radiological measurements: None taken.

4.0 Status of Reclamation and Mine Waste

Mine ID: 2725.

The following information was obtained from field observations collected during the August 2013 site visits and from Google Earth Pro.

4.1 Observed Reclamation Work and Status

Adits had been closed but mine-waste rock piles remained unreclaimed.

Adits: Two decline portal trenches of varying sizes with concrete block bulkheads closing the entrance.

Waste piles: Three.

- Estimated Volume: 1,700 cubic yards

Pits: Three.

- Estimated Volume: 1,300 cubic yards

Shafts: None.

Other debris and mine features: Some scrap metal.

Significant erosion observations: None observed.

5.0 Site Observations and Environs

Distance to public-maintained road: 0.2– 0.5 mile.

Observed residential structures (number and human habitation status of structures, at the following distances from mine):

- 0 to 200 feet: None.
- 200 feet to 0.25 mile: None.

Observed public or commercial structures (schools, clinics, chapter houses, places of business and any other structures used by members of the community, at the following distances from the mine site):

- 0 to 200 feet: None.
- 200 feet to 0.25 mile: None.

Levels measured around the perimeter(s) of the identified structure(s): No structures exist.

Observed water sources (number and type of wells and surface water sources that are potentially used for human consumption, at the following distances from the mine site):

- 0 to 0.25 mile: None.
- 0.25 mile to 4 miles: One, near the second intersection along Yellow Cat Road just east of the Ringtail SC Sec 36 mine.

Sensitive environments (all sensitive environments located within visible range of the mine site, including wetlands, endangered species and habitats, and so on): No sensitive environments observed.

6.0 Response Action Summary

6.1 Summary of Evaluation Factors

Accessibility:

- Was the mine easily accessible to potential human activity?

  Yes, the mine area had unrestricted access.

Radiological measurements:

- Were any gamma radiation measurements collected at the mine greater than two times the site-specific background levels?

  Yes.

Waste piles:

- Were any unreclaimed waste piles observed at the mine with gamma radiation measurements greater than two times the site-specific background levels?

  Yes.

Structures:

- Were any structures observed within 200 feet of the mine?

  No.

Potential drinking water sources:

- Were any potential drinking water sources (including for livestock) observed within 4 miles of the mine?

  Yes, one near the second intersection along Yellow Cat Road just east of the Ringtail SC Sec 36 mine.

Reclamation:

- Was the mine reported to be previously reclaimed, or did the mine appear to be reclaimed?

  The mine area had been partially reclaimed. The two decline trenches had all been closed with concrete block bulkheads placed near the entrance. Mine-waste rock piles remained unreclaimed and some scrap metal was present.

7.0 Photos

Photo 1. Paris 25 mine area portal #1 east of access road, looking west.

Photo 2. Paris 25 mine area portal #2 east of access road, looking north.

Photo 3. Paris 25 mine area alcove-type portal, looking north.

Photo 4. Paris 25 mine area waste rock piles, looking northwest.

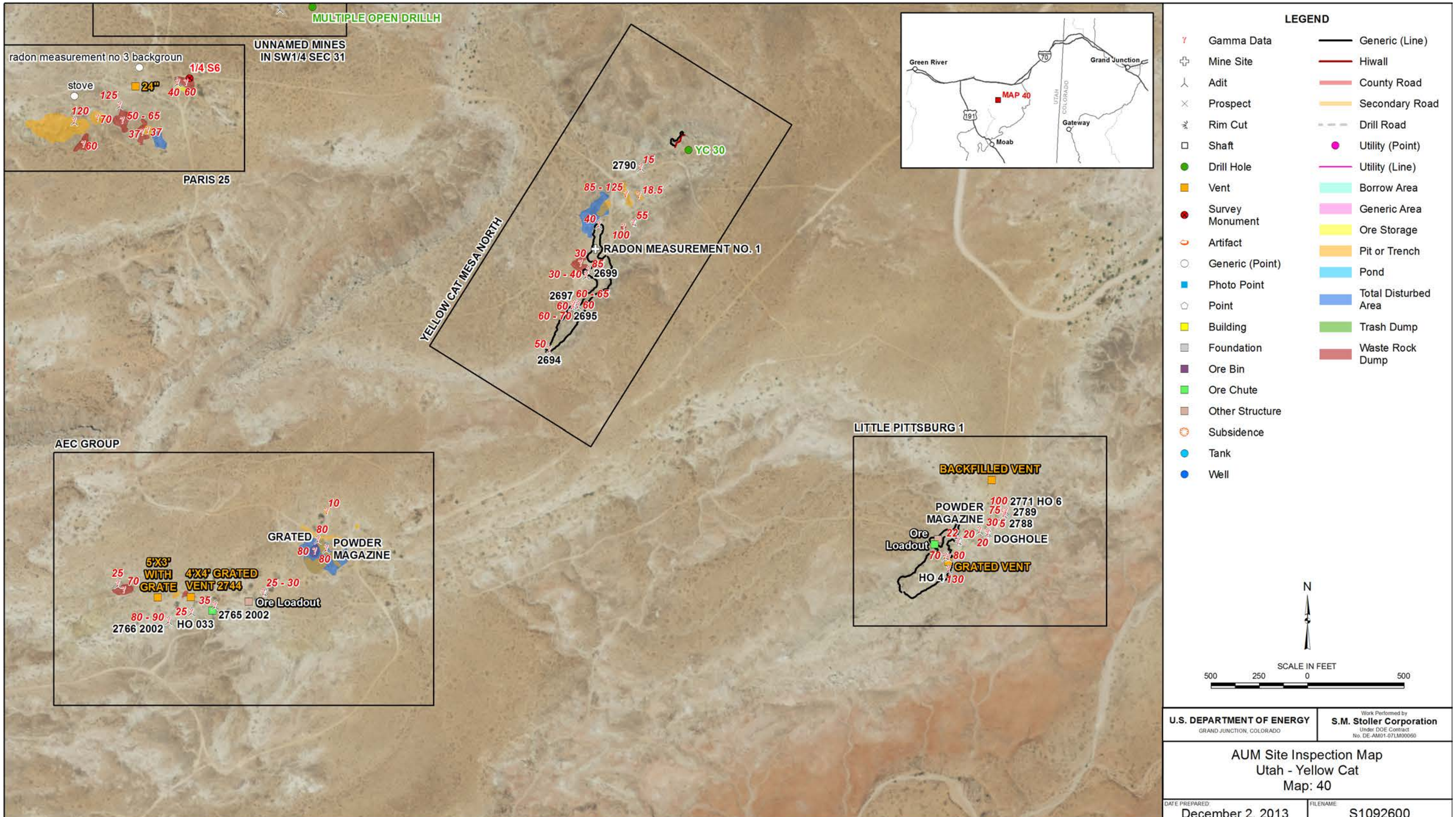

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Figure 1. AUM Paris 25 Site Inspection Map

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