State of Oregon
Oregon Department of Geology and Mineral Industries
Brad Avy, State Geologist

DIGITAL DATA SERIES MILO-3

MINERAL INFORMATION LAYER FOR OREGON, RELEASE 3 (MILO-3)

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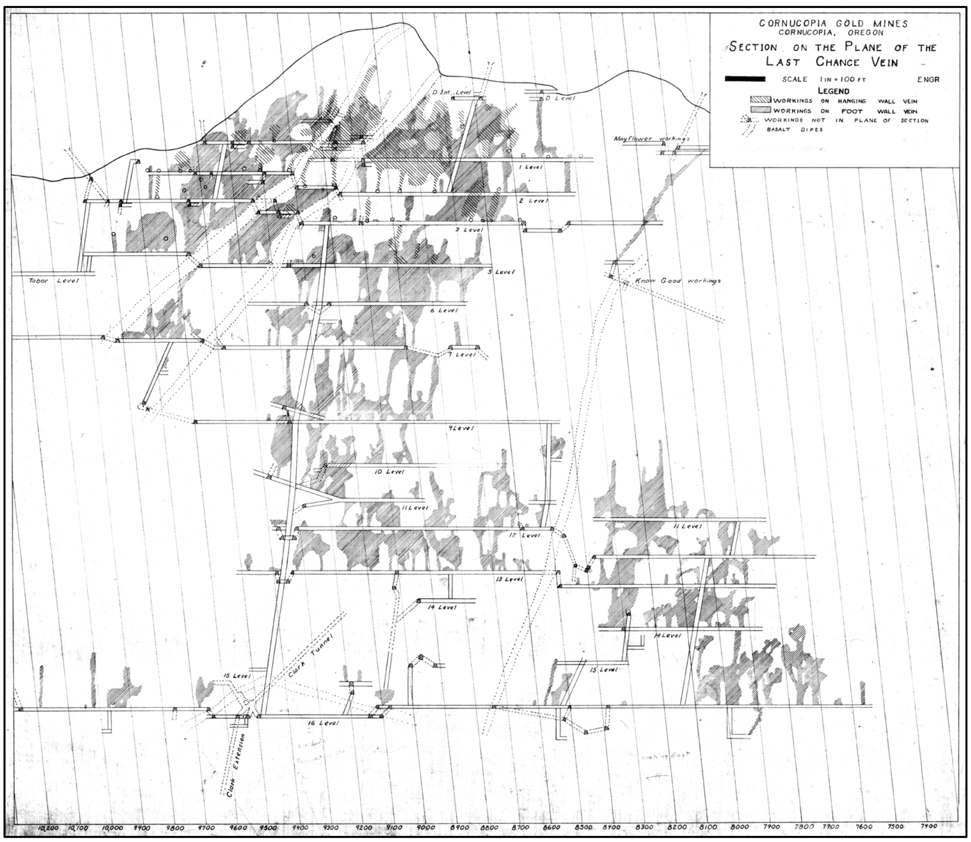

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Mining sites are included for informational purposes only and should not be used to infer acceptable or permitted land use actions. Interested parties should contact their local land use authority to verify zoning and applicable land use ordinances. Respect the rights of private property owners. Understand that recreation in or around inactive mine sites is extremely dangerous and can result in serious injury or death. Stay out and stay alive!

WHAT'S IN THIS REPORT?

MILO-3 is a geospatial database that stores and manages information regarding Oregon's mineral occurrences, prospects, and mines. The geodatabase allows users to extract, research, and display historical mining and mineral resource information.

Cover image: Map of Cornucopia Gold Mines, Cornucopia, Oregon, section on the plane of the Last Chance vein. This map is linked in MILO-3.

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GEOGRAPHIC INFORMATION SYSTEM (GIS) DATA

See the digital publication folder for files. Geodatabase is Esri® version 10.7 format.
Metadata is embedded in the geodatabase and is also provided as separate .xml format files.

MILOv3.gdb:

- **Feature dataset: MineralInformation**
  - feature class:
    - MILO
- **Feature class:**
  - LargeFormatMapPoints
- **Tabular data:**
  - CountyMineRecords
  - LargeFormatMaps
- **Relationship classes:**
  - CountyMineRecordsRC
  - LargeFormatMapsRC

Metadata:

- MILO.xml
- LargeFormatMapPoints.xml
- CountyMineRecords.xml
- LargeFormatMaps.xml

ABSTRACT

The Mineral Information Layer for Oregon, release 3 (MILO-3) is a geospatial database that stores and manages information regarding Oregon's mineral occurrences, prospects, and mines; it is the primary way in which the State extracts, researches, and displays its available historical mining and mineral resource information. The data set lists 23,316 mineral occurrences, prospects, and mines in Oregon, containing information for commodities, including metals, industrial minerals, mineral fuel, and aggregate. Additionally, MILO-3 links post-1860's historical mining records, maps, and published literature with MILO mine points statewide. These data collectively document the actions and results of Oregon's mining industry.

MILO-3 presents a mineral database that serves as the definitive source of Oregon's important mineral background information, but also (1) serves as an integral part of comprehensive study of potential mineral resources; (2) enhances a user's ability to test geologic and mineralization hypotheses using GIS analysis; and (3) supports modeling, such as efforts to locate "hidden" resources. The data contained in MILO-3 likewise are essential information for researchers, developers, and policy makers interested in environmental or mineral-hazard studies in Oregon. MILO-3 answers the fundamental question: *Where are mineral resources found in Oregon?*

This update and release of MILO-3 was supported through a grant from the National Geological and Geophysical Data Preservation Program (NGGDPP) under cooperative agreement number G18AP00102 (2018). Additional funds were provided by the State of Oregon. MILO-3 supersedes all previous MILO versions (MILOC; MILOC93; MILO-2).

1.0 INTRODUCTION

1.1 Cataloging Oregon's Mining History

Oregon has a rich mining history, dating back to the earliest discovery of gold in the territory in 1850 (Spreen, 1939; Brooks and Ramp, 1968). The initial strike of gold and numerous additional discoveries was the primary reason for the settlement and early growth of both northeastern and southwestern Oregon—the two regions where the principal deposits are found (Brooks and Ramp, 1968). Since the earliest days of Statehood in 1859, gold, other minerals, and the geologic landscape itself have remained valuable natural resources in the state.

The Oregon Department of Geology and Mineral Industries (DOGAMI) was created by the Oregon Legislature in 1937, with statutory duties to study the mineral resources of the state, provide information to the public about those resources, and support and promote mineral resource exploration and mining activities. DOGAMI, along with its predecessor, the Oregon Bureau of Mines and Geology, has collected and maintained mine files, mineral files, historical mine maps, letters, and reports from mining companies and individuals, and mining and minerals related data and publications since the agency's founding. These materials date back to the 1860s and document the actions and results of Oregon's mining industry. In recent years many of these paper mining records have been migrated to digital formats and served on the DOGAMI website, making them more accessible to a larger audience https://www.oregongeology.org/milo/ohmi.htm). While the available digital mining records are useful, the data are presented as individual collections. There is limited ability to browse by geography or other characteristics, and there is no association of mining records to DOGAMI's Mineral Information Layer for Oregon (MILO) or the Oregon Geologic Map Compilation database (OGDC). The lack of integration of the datasets makes discovery difficult and cross-referencing or seeing all available data for a mine or mineral occurrences impossible.

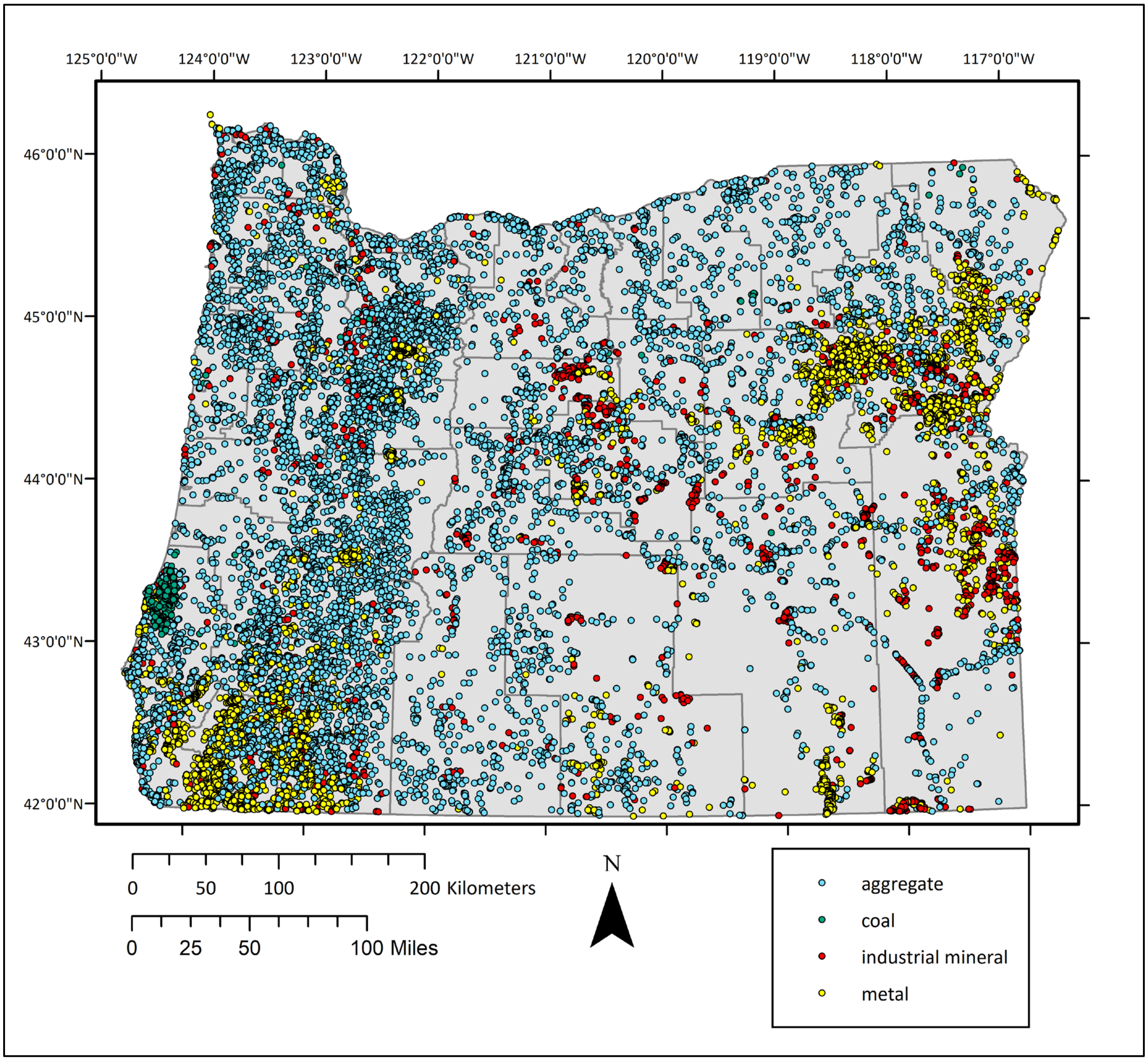
An essential component of DOGAMI's statutory mission (Oregon Revised Statute ORS 516.030) is advanced with release 3 of the Mineral Information Layer for Oregon (MILO-3), a geospatial database system that stores and manages Oregon's mining resource information and spatially displays where mineral resources are found in Oregon. The Mineral Information Layer for Oregon was first created to provide the State of Oregon with a mineral resource database (Gray, 1991, 1993; MILOC). The database was subsequently revised in release 2 by Niewendorp and Geitgey, (2010; MILO-2) to establish an updated statewide tabular and spatial mineral database, drawing on the legacy of Oregon's available mineral-related published and unpublished data. MILO-2 added a significant number of mine and prospect sites; linked mine-site locations with available commodity information, such as metals, industrial minerals, mineral fuel, and construction aggregate; added GIS capabilities allowing for spatial queries; and made the data easily accessible online. MILO-3 augments previous releases by adding additional mine and prospect records and by spatially linking historical mining records, maps, and published literature with mine and prospect points statewide. The geodatabase also provides new feature classes for the Oregon Geologic Data Compilation (OGDC), the State's authoritative source for Oregon's geologic data and a key element in the Oregon Geologic Data Standard (OGDS). MILO-3 data are housed in a single geodatabase, conforming to the National Cooperative Geologic Mapping Program (NCGMP) Geologic Map Schema (GeMS), version 2.7 (U.S. Geological Survey NCGMP, 2010, 2018). The MILO-3 geodatabase is accompanied online by a searchable web map providing unified, consistent access to statewide mineral occurrence and mining related data for researchers and the public. Indexing, cross-referencing, and publishing DOGAMI's many collections of legacy mineral occurrence and mining related data in a single modern geospatial database format and web map provides an important source of data on Oregon's mineral resources for researchers and the public. National Geological and Geophysical Data Preservation Program (NGGDPP) schema conformant metadata, exported and uploaded to the National Digital Catalog (NDC), makes the data more discoverable.

1.2 What is the Mineral Information Layer for Oregon (MILO)?

The Mineral Information Layer for Oregon (MILO) is a geospatial database that stores and manages information regarding Oregon's mineral occurrences, prospects, and mines. The data set contains information for the following commodities: metals (elements, metallic, and oxides), industrial minerals (non-metallic minerals and materials, including gemstones), mineral fuel (coal and oil shale), and aggregate (sand & gravel and stone) (**Figure 1-1**). MILO is the primary way in which the State of Oregon extracts, researches, and displays available historical mining and mineral resource information. MILO also provides reference material supporting mineral resource and environmental assessments on a local- to statewide-scale. Mine site data presented in MILO are updated internally; the last public release (MILO-2) was in 2010 (Niewendorp and Geitgey, 2010). MILO-3 supersedes all previous MILO versions including MILOC (Gray, 1991; Open-File Report O-91-08), MILOC93 (Gray, 1993; Open-File Report O-93-08), and MILO-2 (Niewendorp and Geitgey, 2010).

Although the data for MILO-3 are statewide in extent, coverage varies from county to county. The attribute table for MILO-3 likely contains some errors, but care has been taken to prevent duplications and omissions within the table and between the databases compiled for it. Additionally, mineral-related data are subject to change as new data are obtained; therefore, updates to the database are expected.

Figure 1-1. Map graphic showing the distribution of the 23,316 points in the Mineral Information Layer for Oregon (MILO-3). Each MILO mine point includes information about its site name, location, mining district, commodities, rock type, and other historical mining records. MILO mine points in the image are colored according to commodity (aggregate, coal, industrial mineral, metal).



1.3 Background

The predecessor and foundation for the Mineral Information Layer for Oregon (MILO) was a 1991 database version referred to as the Mineral Information Layer for Oregon by County (MILOC; Gray, 1991, 1993). DOGAMI published the MILOC database for the purpose of providing the State of Oregon with a mineral resource database. MILOC was originally created in dBASE III+ format, within which was information for location, commodity, and other data for a 7,899 mineral occurrences, prospects, and mines statewide. MILOC was later converted to a GIS format and renamed MILO-1 (i.e., MILO-Release 1). The GIS-based MILO-1 database was not released to the public.

Release 2 (MILO-2) was published in 2010 MILO-2 and listed 21,101 mineral occurrences, prospects, and mines (Niewendorp and Geitgey, 2010). Like MILOC, mine-site locations were linked to available commodity information, such as metals, industrial minerals, mineral fuel, and construction aggregate. The substantial increase in sites displayed in MILO-2 was chiefly the result of data extracted from several sources:

- The U.S. Geological Survey Mineral Resources Data System (MRDS), Computerized Resources Information Bank (CRIB), and U.S. Bureau of Mines' Mineral Industry Location Subsystem (MILS) main frame databases. Inclusion of these datasets resulted in the addition of approximately 700 records not presented in MILOC/MILO-1 (U.S. Geological Survey, 2005);
- Two unpublished data sets from the Oregon Department of Transportation (ODOT). These datasets listed aggregate sources and quality tests for ~2,000 sites not originally compiled in MILOC/MILO-1; and
- Mining-related marks/symbols (e.g., aggregate site[s], borrow pits, quarries, gravel pits, and mine/prospect site[s]) from the ~ 1,866 USGS 1:24,000-scale 7.5-minute topographic quadrangle maps covering Oregon. Visual inspection and heads-up digitizing of topographic quadrangle maps added nearly 9,000 sites to MILO-2.

Release 3 (MILO-3) moves the legacy MILO databases to a format consistent with the U.S. Geological Survey Geologic Map Schema (GeMS) (U.S. Geological Survey NCGMP, 2010, 2018). DOGAMI has implemented the GeMS schema as the database standard for all geologic mapping and mineral inventory projects in order to meet NCGMP requirements and to support construction of standardized nationwide geologic content. The purpose of this transition is twofold: 1) migrating the existing MILO-2 statewide mineral compilation to the GeMS format, and 2) streamlining future updates, data creation, and data maintenance.

MILO-3 lists 23,316 mineral occurrences, prospects, and mines; 2,215 points have been added beyond the 21,101 locations shown in MILO-2. The increase in sites displayed in MILO-3 is chiefly the result of data extracted from visual inspection and heads-up digitizing of prospects identified in high-resolution 1-m lidar topographic data. New points have been added in several geographic areas, including the North Santiam, Quartzville, Blue River, and Bohemia mining districts in the Western Cascades; the Greenback, Galice, and Mule Creek mining districts, and Beach area of southwest Oregon; and the Granite, Greenhorn, and Canyon mining districts of northeast Oregon (**Figure 1-1**).

The GeMS-schema-based MILO-3 geodatabase also spatially links scanned historical large-format maps (1,954 Adobe® Portable Document Format [PDF] files) and mining records and reports (4,637 Adobe® PDFs) with specific mine sites (**Figure 1-1**; see appendix **Table 7-1**). The mining data itself and linked map documents are available on a searchable and filterable web map hosted on the DOGAMI website (https://www.oregongeology.org/milo/index.htm) as well as a map service. Further, the MILO-3 feature class is linkable to the Oregon Geologic Data Compilation (OGDC-7; Franczyk and others, 2020), as part of the Geologic Data Standard of the Oregon Geographic Information Council (OGIC) Framework Data Program (see appendix **Table 7-1**).

1.4 Technical Merit

MILO-3 serves as the primary source of Oregon's important mineral background information and answers the fundamental question:

***Where are mineral resources found in Oregon*?**

Understanding the spatial distribution of mineral occurrences is an essential component leading to a comprehensive understanding of geologic relationships statewide and nationally. The information is also relevant for anyone interested in environmental studies in Oregon, including researchers, developers, and policy makers. MILO-3 provides key information useful for:

- guiding exploration to areas of mineralization, including geothermal investigation at all scales (from small-scale miners to international resource corporations);
- serving as an integral part of comprehensive study of potential mineral resource(s);
- enhancing a user's ability to test geologic and mineralization hypotheses through GIS analysis;
- supporting modeling, such as efforts to locate "hidden" hydrothermal systems;
- highlighting areas with the potential of having hazardous abandoned mine land features;
- informing land-use decisions, such as proposed building across legacy mine sites;
- identifying areas of mineralized rock and possibly compromised water sources, where heavy metals may be present in groundwater; and
- supporting studies where certain undesirable health outcomes are known to be associated with long-term exposure to a variety of different elements, minerals, and materials that occur naturally, particularly those that pose health hazards through their physical properties (e.g., asbestiform asbestos) (Niewendorp, 2011).

1.5 Disclaimer

One of the concerns about releasing mineral occurrence, prospect, and mine data is that users will have specific geographic locations of mine sites provided in the data set. Please be aware that: **Recreation in or around active or inactive mine sites is extremely dangerous and can result in serious injury or death. Stay out and stay alive!**

Although MILO-3 data have been processed successfully on a computer system at DOGAMI, no warranty expressed or implied is made regarding the accuracy or utility of the data on any other system or for general or scientific purposes, nor shall the act of distribution constitute any such warranty. This disclaimer applies both to individual use of the data and aggregate use with other data. We also urge MILO data users to pay careful attention to the contents of the metadata files associated with these data and to the compilation process and limitations described therein. DOGAMI shall not be held liable for improper or incorrect use of the data described and/or contained herein. **Data are not intended for site-specific investigations**.

2.0 MILO-3 COMPILATION METHODS

2.1 Transferring MILO-2 to the GeMS Database Schema

The conversion of MILO-2 to the U.S. Geological Survey Geologic Map Schema (GeMS) (U.S. Geological Survey NCGMP, 2010, 2018) followed the internal methodology described below and in following sections. Although one of the primary goals of this project was the schema conversion, adjustments and additions were made to the spatial data to improve the integrity of the data and to provide better feature representation. However, the methodology was developed to keep the source data as true to the original studies as possible.

The existing MILO-2 feature class was converted into the GeMS database schema in the following manner:

1. Sections of the attribute table were standardized to follow specific GeMS database schema rules.
2. Field names were converted to Pascal Case (the first letter of each word is capitalized), and any spaces or special characters were removed.
3. Any field names that contained "_ID" were reserved for primary keys.
4. A field was added that contained an identifier (ArcJoinID) to spatially relate it back to a specific geologic unit defined by its study citation and map unit label in the MapUnitPolys feature class in OGDC-7 (Franczyk and others, 2020).

2.2 Assigning Large-Format Maps to MILO-3 Mine Locations

Large-format maps in the DOGAMI Oregon Historical Mining Information collection include 1468 geologic maps and sketches, plans of underground workings, vertical sections, drill-hole maps, mining claim plat maps, and regional mine location maps (e.g., **Figure 2-1**, **Figure 2-2**). The digital records are available online at the DOGAMI Oregon Historical Mining Information site, https://www.oregongeology.org/milo/index-minemaps.htm. The documents in the collection are scans of original documents found in published and unpublished hardcopy holdings in the DOGAMI Portland and Baker City offices and former Grants Pass field office. Large-format maps were digitized at National Mine Map Repository (NMMR), Pittsburgh, Pennsylvania, and by staff at the DOGAMI Baker City Field Office. Hardcopy material was scanned and saved as Tagged Image File Format (tiff) files. Tiffs were then converted to PDF file format. Digital documents available on the DOGAMI website are organized by county and district.

Figure 2-1. Example large-format map accessible in MILO-3. Plan and vertical section of the Maxwell-Highland and Baisley Elkhorn mines, Rock Creek District, Baker County, Oregon. The original draft was created in 1916, with revisions and color added in 1954. Vertical scale of the map is 1:7,200.

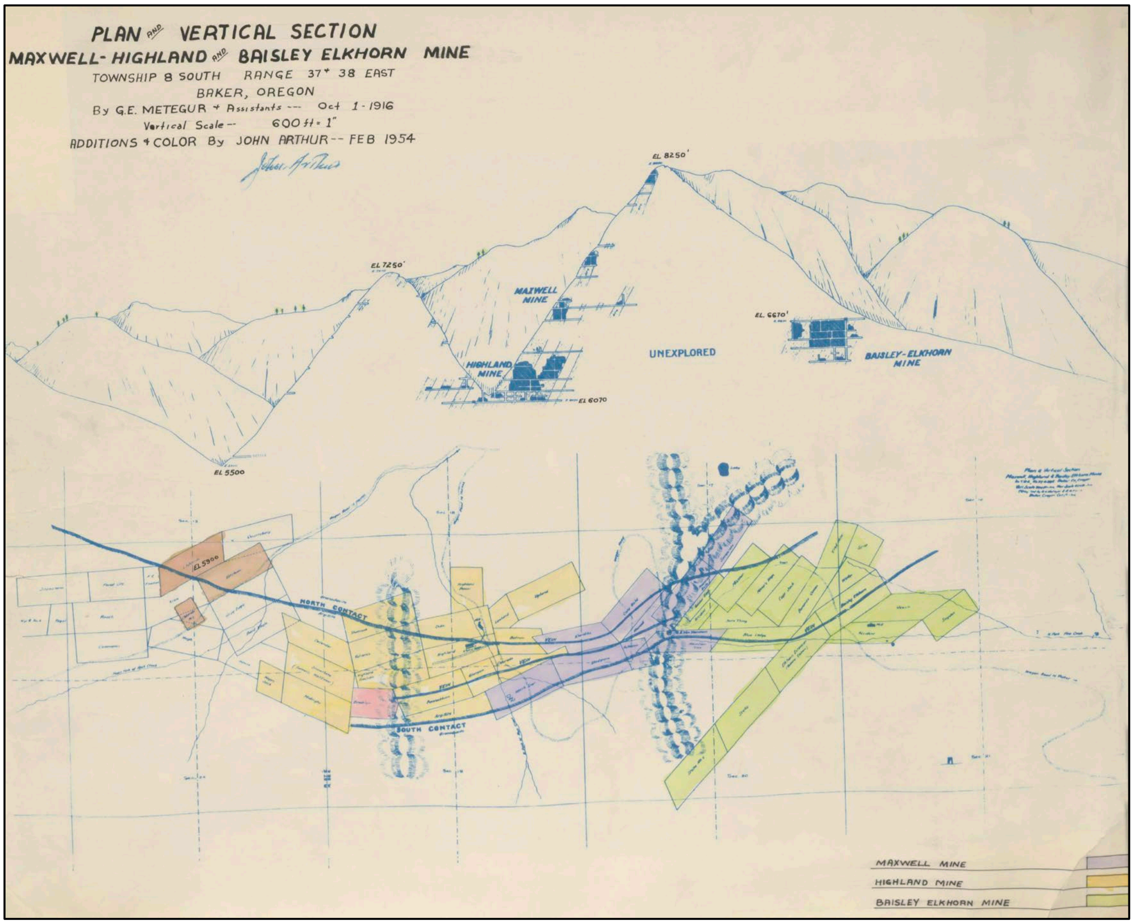
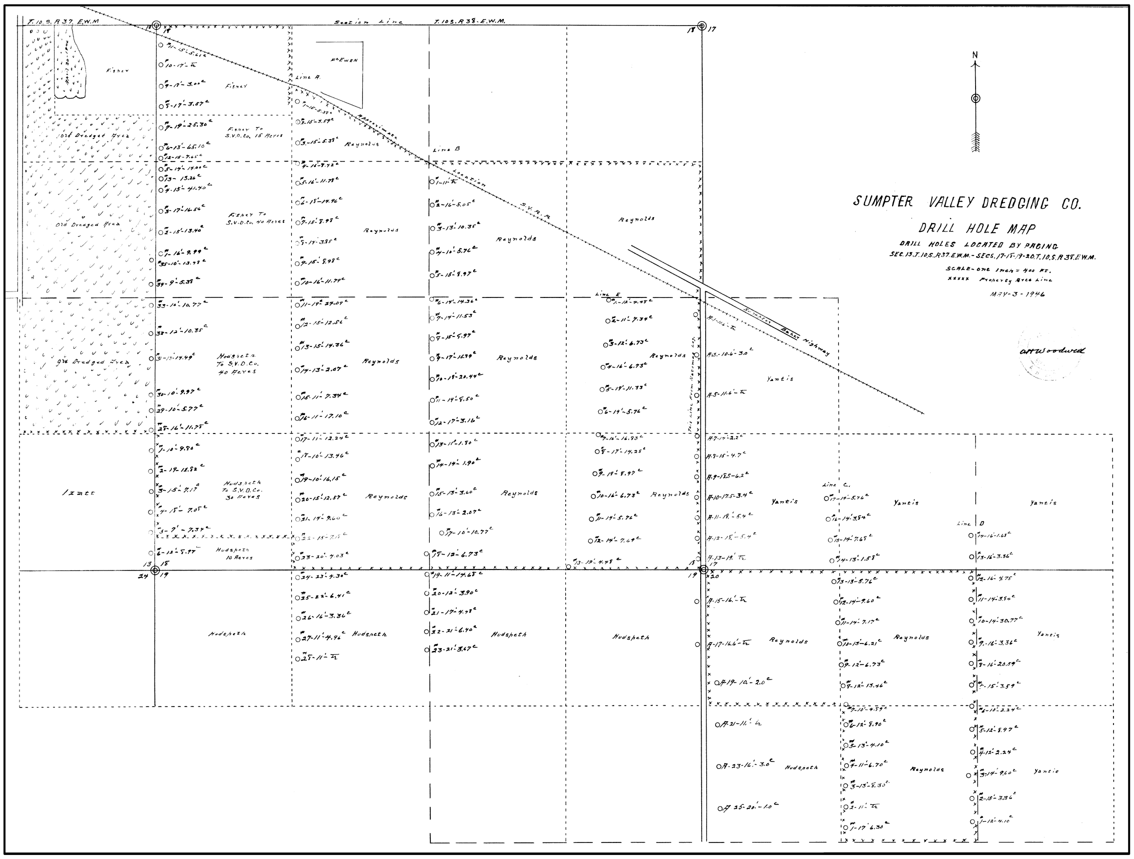


Figure 2-2. Example large-format map accessible in MILO-3. Drill hole map of the Sumpter Valley dredge tailings, Sumpter District, Baker County, Oregon, 1946. The map shows location and depth of exploration drill holes and estimated gold values in cents per yard. Scale of the map is 1:4,800.



The list below gives a general description of data inputs and geospatial processing applied to the large-format maps to link them to specific mine point(s) in MILO-3, the quadrangle(s) covered by the map, or mining district. **Table 2-1** lists the certainty level of the matching process (Esri® ArcMap™, Adobe® Bridge™).

- **Created unique IDs:** A unique identification was created for each mine point (e.g., ID_00001) in the MILO-3 feature class attribute table so joins could be created between other datasets to link back to original data (see appendix **Table 7-2**). A unique ID field (DOGAMI_No) was also created for each large-format map.
- **Matching approach:** When a large-format map was found to be associated with a MILO mine point (see matching process below), that map's unique ID was recorded in the MILO mine point's attribute table row. Similarly, the MILO mine point's unique ID was recorded in the large-format map's attribute table row. In this manner, the maps and mine points were linked to each other by using the IDs as either a primary or a foreign key. An Esri ArcGIS Spatial Join tool was run (MILO mine points within 10 meters of large-format map points) to use proximity to establish an initial relationship between both sets of points.
- **Established map scale:** Where possible, a scale was determined for each map. However, not every large-format map contained scale information.

- **Classed maps on the basis of characteristics:** A level of certainty code based on proximity, map scale, and other characteristics (**Table 2-1**) was established. Each map was assigned a code by matching the description of level of certainty.

Table 2-1. Definition for levels of match potential and certainty of match between large-format maps and MILO-3 mine points.

Levels of Certainty	Description of Match Certainty
0	No details
1	Map w/in 10 meters of a mine (large-format or no scale)
2	Scale < 1:12,000 (large scale only)
3	1 & 2 (close and large-format map)
4	Regional study (small-scale)
5	Scale > 1:12,000 (small-scale only)
9	Not in Oregon

- **Matching process:** Matching large-format maps to specific MILO mine points was accomplished by geospatially examining the proximity of map points versus mine points, then comparing mine names in MILO with mine names displayed on large-format maps. This process included looking at the map points and mine points spatially in Esri ArcMap, looking in the attribute tables for matching information in Esri ArcMap, and viewing individual map PDF files in Adobe Bridge® to get identifying information from the map. All maps in the collection were cross-checked and assigned a correlation status category (**Table 2-2**).

Table 2-2. Correlation status category table used when matching large-format maps to MILO-3 mine points.

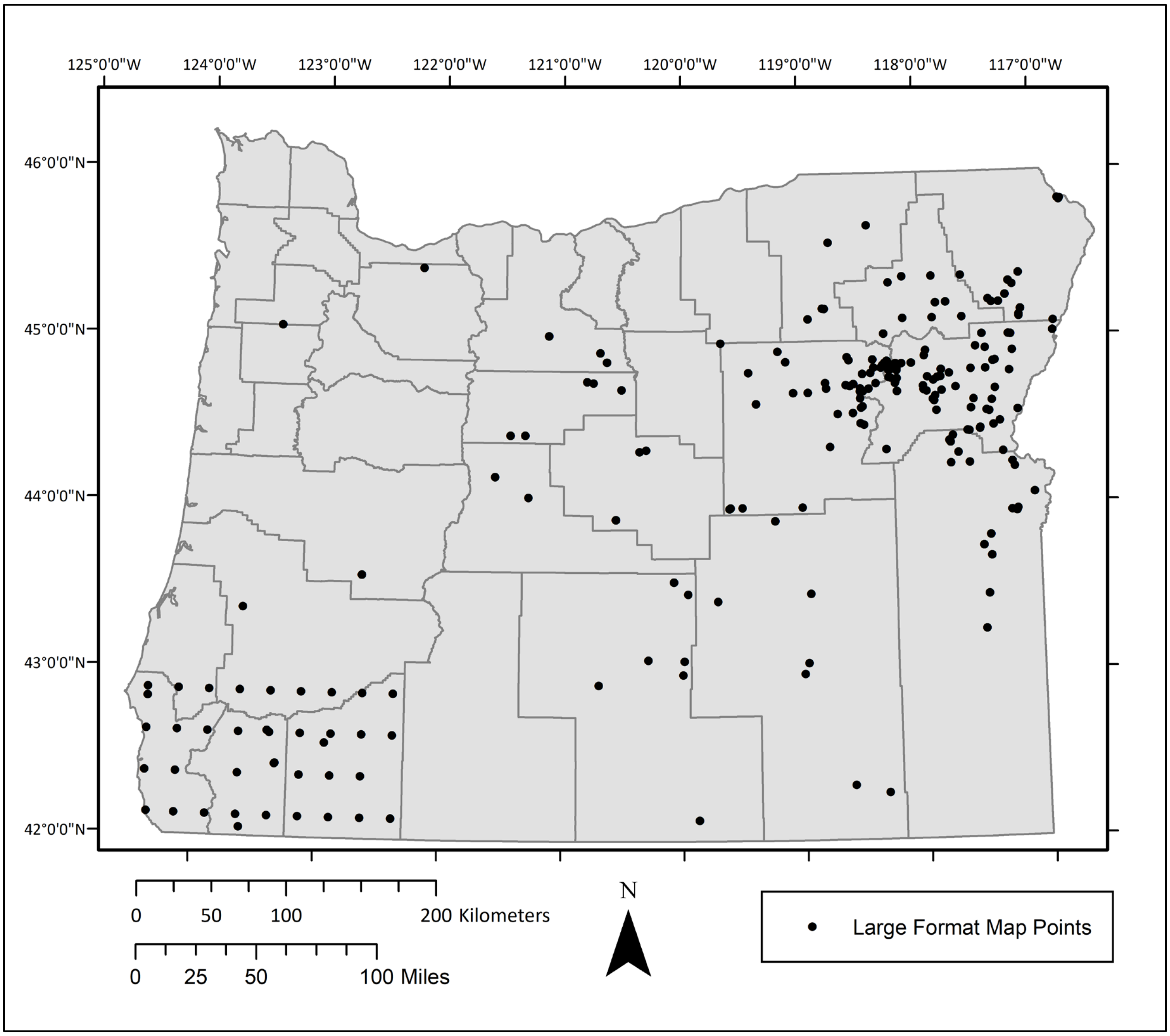
Correlation Status	Description
1	Checked, no match with a MILO mine point
2	Checked, match with single MILO mine point
2	Checked, match with multiple MILO mine points
3	Checked, topology or USGS quad map
3	Checked, geology map
3	Checked, large map without MILO mine point association
4	Checked, location correct but not enough information to link with MILO mine point
5	Checked, unknown location
6	Revisit by geologist
7	Checked, location correct, associated with district centroid. Not enough info to link with MILO mine point(s)

- **Geologist review:** After the maps had been sorted into a status category, some maps had ambiguous map locations or names. A DOGAMI geologist familiar with the MILO mine points and large-format maps examined these maps for a final matching decision.
- **Maps that matched with a mine:** There were 995 large-format maps that were associated with at least one mine. The attribute table fields for these maps were exported to a geodatabase table (LargeFormatMaps) and formatted with the following fields:
  Title |LargeFormatMap_ID | Hyperlink | Scale | Year (see appendix **Table 7-2**)
- **Maps that did not match with a mine:** Although many maps were successfully correlated with a specific MILO mine point, 473 maps did not have a specific name, owner, or distinctive identifying information to link the map with a MILO mine point. **Figure 2-3** shows locations of these maps.

These maps (LargeFormatMapPoints) remained in their point feature class format. Their attribute table fields were formatted in the same way as the large-format map geodatabase table (see appendix **Table 7-2**).

- **Duplicate checks:** There was no check for duplicates in the MILO mine point data. There were no duplicates in the large-format maps dataset.

Figure 2-3. Map showing the LargeFormatMapPoints feature class points that were not directly linked with a MILO feature class point.



2.3 Assigning County Mining Records to MILO-3 Mine Locations

Historical mining records in the DOGAMI Oregon Historical Mining Information collection include maps, letters, news clippings, photographs, and reports (e.g., **Figure 2-4**, **Figure 2-5**) from published and unpublished hardcopy holdings in the DOGAMI Portland and Baker City offices and former DOGAMI Grants Pass field office. Documents were scanned and combined into single PDFs by mine site circa 2007-2010. Digital records of this collection are organized by county and district online at https://www.oregongeology.org/milo/index-miningrecords.htm.

Figure 2-4. Example historical mining record accessible in MILO-3. DOGAMI report describing the Idol City mines of Harney County, Oregon, property visited November 24, 1939.

Visited: November 24, 1939
Nixon and Treasher.

1. Name of property: IDLE CITY MINES Harney County.
Operating company (or individual): Gold Gulch Mining Co., incorporated in Oregon in 1937.
Agent is attorney Lars Bergsvick of Portland.
Address: Burns, Oregon
Location of property: SW¼, Sec. 4, T. 21 S., R. 32 S. E
Acreage of holdings: Several groups of claims.

2. History of property: Mr. Pardee has done some drifting over a period of about 10 years and claims to have made one shipment of "ore" to Salt Lake, grossing about $2500. He had an improvised mill in which he amalgamated some gold. The shipment presumably was concentrates and and hand-picked "ore". Pardee has leased his claims to the Gold Gulch Mining Company, and C. W. Riddell hopes to combine all the properties and make a substantial development starting with a small placer operation which may carry the balance.

3. History of production: This is a camp which had some production many years ago, both in placer and in quartz, but there is no data as to the amount of either.

4. Developments: Pardee has a drift from which he produced the ore mentioned in paragraph 2. We did not visit it. There is an old incline shaft reputed to be about 100 feet deep near the Riddell camp. Riddell has recently started an adit on the west side of the gulch from the old shaft, has laid a track from the adit to the little mill he is building, and expects to mill the product. He plans to mine the bottom of the gulch with a short low-head ditch. A few hundred feet of pipe-line are in place.

5. Equipment: Small mill building containing improvised trommel, hydraulic separator, and jigs ready for installation; expect to install crusher. Set-up is inadequate and impractical. Topography: Rolling foot-hills south of Strawberry Range; relief probably 300 feet; the area is on the South Fork of Trout Creek, whose minable placer channel is 100 to 300 feet wide. Gravel is light, no large boulders. Country rock: Apparently meta-volcanics. Elevation: about 5500 feet. Timber: Scraggly pine; inside Malheur National Forest. Water: Intermittent creeks; all dry at time of visit. Snow fall: Prevents placer work about 3 months in winter. Climate: North edge of southeast Oregon semi-desert. Power: No high line or water power available.

6. Geology -- general and local: Rocks, such as seen, are mainly meta-volcanics. There is a shear zone that dips at a high angle in a westerly direction, and sulfide mineralization seems to be concentrated therein. Future of property will depend on result of needed exploration.

7. Metallurgy: Mill is a small hand-made affair. Trommel is made of 30 gal. oil drums. Some sort of a cone classifier. A jig of sorts is also present. Power seems to be a Model T Ford engine.

8. Remarks: Mill is constructed to concentrate dump material from old inclined shaft mentioned in paragraph above. Dump material alleged to carry about $6.00 in gold. There are only a few hundred tons of the dump, and it is oxidized; obviously impractical to expect a profit from re-handling this material. Placer phase may return a profit if properly operated and if values are adequate but should be considered as incidental in property

Figure 2-5. Example historical mining record accessible in MILO-3. DOGAMI report describing the Almeda and Silver Peak mines of Josephine County, Oregon, published in the *Ore.-Bin*, 1947.

Almeda Mine — Josephine Co

Vol. 9, No. 12 THE ORE.-BIN 95

December 1947 Portland, Oregon

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A RECONNAISSANCE BETWEEN THE ALMEDA AND SILVER PEAK MINES
OF SOUTHWESTERN OREGON
By
H. M. Dole* and E. M. Baldwin*

In the latter part of July a reconnaissance traverse was made from the Almeda Mine on the Rogue River in northwestern Josephine County to the Silver Peak Mine, a few miles south of Riddle, in southern Douglas County. The area which this reconnaissance concerns is roughly 6 miles in width by 20 miles in length. It is a belt of greenstones bordered by Galice slates and volcanics on the east, and Dothan sediments on the west. Within the greenstones are masses of serpentine, rhyolite, and small diorite and related intrusives.

This reconnaissance was undertaken to find out how readily the mineralized zone of these two mines could be traced in the area between and, because of the similarity of mineralization at each mine, to see if the zones could be connected. Also, it was hoped that further information could be gained on the mineral deposits of the area and to ascertain if barite in commercial quantities were indicated.

Mining and prospecting have been carried on in this region for many years. One of the first geologic studies was published by J. S. Diller (1914). Later studies by P. S. Shenon (1933) and by W. R. Lowell (1942) have given additional details on the ore deposits. W. E. Caldwell and D. Sumner (1946) studied the copper content of the Silver Peak mine waters. A study of the Mt. Reuben area has been completed by E. A. Youngberg (1947). These should be consulted as a background for a better understanding of this region.

A review of the literature shows that the ore bodies are usually found in a steeply dipping greenstone series bounded on the east by the Galice formation and on the west by the Dothan formation, all of which are considered to be of Jurassic age. The regional trend in this area is N. 20° to 40° E. for both the formations and the schistosity. Most of the zones of mineralization conform with this trend. The Silver Peak Mine appears to be an exception for according to Shenon it occurs in a schistose part of the Dothan formation. The greenstone is a series of meta-andesites and metabasalts with intercalated silicified tuffs and some chert. Several shear zones parallel the general trend and the ore bodies; alteration of the wall rock is found in the more highly sheared zones.

The ore body that crops out at the Almeda Mine is locally known as the Big Yank lode. It follows close to the contact between porphyritic dacite and slates of the Galice formation. Diller (1914) states:

> "The contact between the slates and the igneous rock, with which the Big Yank lode is associated, may be traced for over 20 miles in a direction about N. 30° E. from Briggs Creek valley to Cow Creek at Reuben spur. Although the general course is maintained with considerable regularity, there are many small variations, and the contact dips to the southeast in the same general direction as the slates. The plane of contact is generally a fault plane and is for the most part followed by the lode. The contact is apparently most irregular and the quartz porphyry[1] most cut by shearing planes in the vicinity of the ore bodies."

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[1]Called "porphyritic dacite" by Shenon (1933).
*Geologists, State Department of Geology and Mineral Industries.

To associate historical mining records with MILO mine points, a Fuzzy Lookup (Microsoft® Excel®) and GIS-based (Esri ArcMap) approach was used.

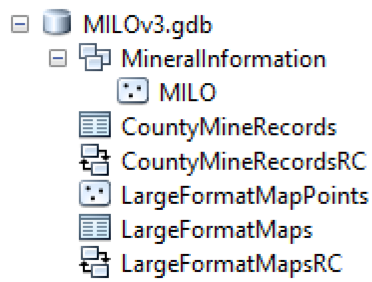
- **Unique IDs:** A unique identification was created for each MILO mine point (e.g., ID_00001) in the MILO feature class attribute table, so joins could be created between other datasets and then linked back to original data (see appendix **Table 7-2**). A unique ID was created for each of the 4,587 historical documents (e.g., HD_0001) in the historical mining records table, so joins could be made with MILO mine point(s).

- **Matching approach:** When a MILO mine point was found to be related to a historical document, the MILO mine point unique ID was recorded in the historical mining record's table row. That way they could both be linked back to each other using the IDs.
- **Initial matching process:** Prior to the matching process, spelling errors were corrected, and attributes were modified for consistency in the CommodityAbbreviation, SiteName, Synonym, MiningDistrict, and Owner fields in the MILO feature class. The MILO mine point or subject field in the historical mining records table was compared to the SiteName in the MILO attribute table using the Fuzzy Lookup Add-In for Microsoft® Excel®. The Fuzzy Lookup Add-In was developed by Microsoft® Research and performs fuzzy matching of textural data in Microsoft® Excel®. It was used to fuzzy join similar rows between two different tables. The matching process is susceptible to a wide variety of errors, including spelling inconsistencies, abbreviations, synonyms, and added/missing data. For instance, it might detect that the rows "Mr. Andrew Hill", "Hill, Andrew R." and "Andy Hill" all refer to the same underlying entity, returning a similar score along with each match. A very large portion of the MILO mine points in the MILO attribute table were not identified with a specific SiteName. For example, "prospect," "gravel pit," and other generic descriptions were not considered. Therefore, in preparation for Fuzzy Lookup, a modified list of 11,203 MILO mine sites, with specific a specific SiteName, was generated. The process of Fuzzy Lookup, considering the modified list of 11,203 MILO mine sites, generated 14,074 matches that had a similarity score of 75 percent or greater and a limitation of 20 matches of MILO mine points to each historical mining record. The modified list was then trimmed down to 4,695 likely matches where the mining record county matched the county that the MILO mine point fell within. This final step was done to avoid mismatches, where mine names matched, but where records referred to similarly named mines in different parts of the state.
- **Matching process:** A combination of visual inspections were used to match historical mining records and MILO mine points using Esri ArcMap and Adobe Bridge. Specific features examined to assign possible matches as good, neutral, or bad match were mine name, document name, districts, Public Land Survey System (PLSS) location, and commodity. This examination included looking at the MILO mine points spatially in Esri ArcMap, looking in the attribute tables for matching information in Esri ArcMap, and viewing documents in Adobe Bridge to get identifying information from the actual document. Additionally, appropriate MILO mine point IDs were manually added as a good match when verifying nearby MILO mine points. After the first pass, all neutral assigned matches were given a second look and assigned either as a good or bad match.
- **Historical mining records table:** The attribute table fields for these historical mining records were exported to a geodatabase table (CountyMineRecords) and formatted with the following fields: CountyMineRecords_ID | District | DocumentName | Hyperlink (see appendix **Table 7-3**).
- **Duplicate checks:** There was no check for duplicates in the MILO point data. There were no duplicates in the county mine records dataset.

2.4 Geodatabase and Relationship Classes

The MILO-3 geodatabase contains the MILO mine point feature class, large-format maps feature class (not linked to a MILO mine point), large-format maps geodatabase table (linked to a MILO mine point), and county mine records geodatabase table (linked to a MILO mine point). **Figure 2-6** shows the feature classes, geodatabase tables, and relationship classes in the MILO-3 geodatabase. Relationship classes in the geodatabase are established by example of "one-to-many" cardinality. This means a relationship class is established in the geodatabase, and an intermediate table serves as the crosswalk between the MILO feature class and the large-format maps and county mine records attribute table. The MILO dataset is the origin and the large-format maps, and the county mine records geodatabase tables are the destination.

Figure 2-6. Feature classes, geodatabase tables, and relationship classes (RC) in the MILO-3 geodatabase.



The intermediate tables (LargeFormatMapsRC, CountyMineRecordsRC) establish the relationships between the large-format maps, county mine records, and MILO mine point locations (MILO, LargeFormatMaps, CountyMineRecords; see appendix tables **Table 7-1**, **Table 7-2**, **Table 7-3**). The intermediate relationship class tables contain the unique IDs of the MILO mine points (primary key) and unique IDs of the large-format maps or county mine records (foreign key). Please note that there may be multiple entries for a unique MILO mine point, if that MILO mine point is associated with multiple unique large-scale maps. Likewise, there may be multiple entries for a unique large-format map if that MILO mine point is associated with multiple, unique large-format maps. The intermediate tables (LargeFormatMapsRC, CountyMineRecordsRC) were created in Microsoft® Excel® and imported into the MILO-3 geodatabase. Relationship classes in the intermediate tables were created using an ArcGIS tool (Data Management > Relationship Classes > Table To Relationship Class). Relationship class information can be accessed in the geodatabase through two methods:

- **Method 1** – In an open ArcMap session, select a mine point in the MILO feature class using the Identify tool. The upper panel of the Identify window will display the feature class and any linked county documents (**Figure 2-7**). Note that not all MILO mine records have associated large-format maps or county mine records. In the case where no records are linked with a particular mine site, the Identify tool will list the name of the LargeFormatMaps and CountyMineRecords tables: the tool queries the tables for associated records but will not return a link.
- **Method 2** – Open the attribute table of the MILO feature class or the attribute tables for the large-format map (LargeFormatMaps,) or county mine record (CountyMineRecords). Use the “select related records” button in the tool ribbon at the top of the table to determine the relationship between county mine documents and MILO mine sites (**Figure 2-8**). Similar to method 1, please note that every entry in a table (LargeFormatMaps, CountyMineRecords) has an associated mine but not every mine has an associated large-format map or county mine record in a table.

Figure 2-7. Method 1 for selecting a MILO-3 mine point in Esri ArcMap with the Identify tool and searching for linked maps and historical documents. The solid blue circle is the selected Virtue Mine in the MILO feature class. Base map is a USGS topographic map.

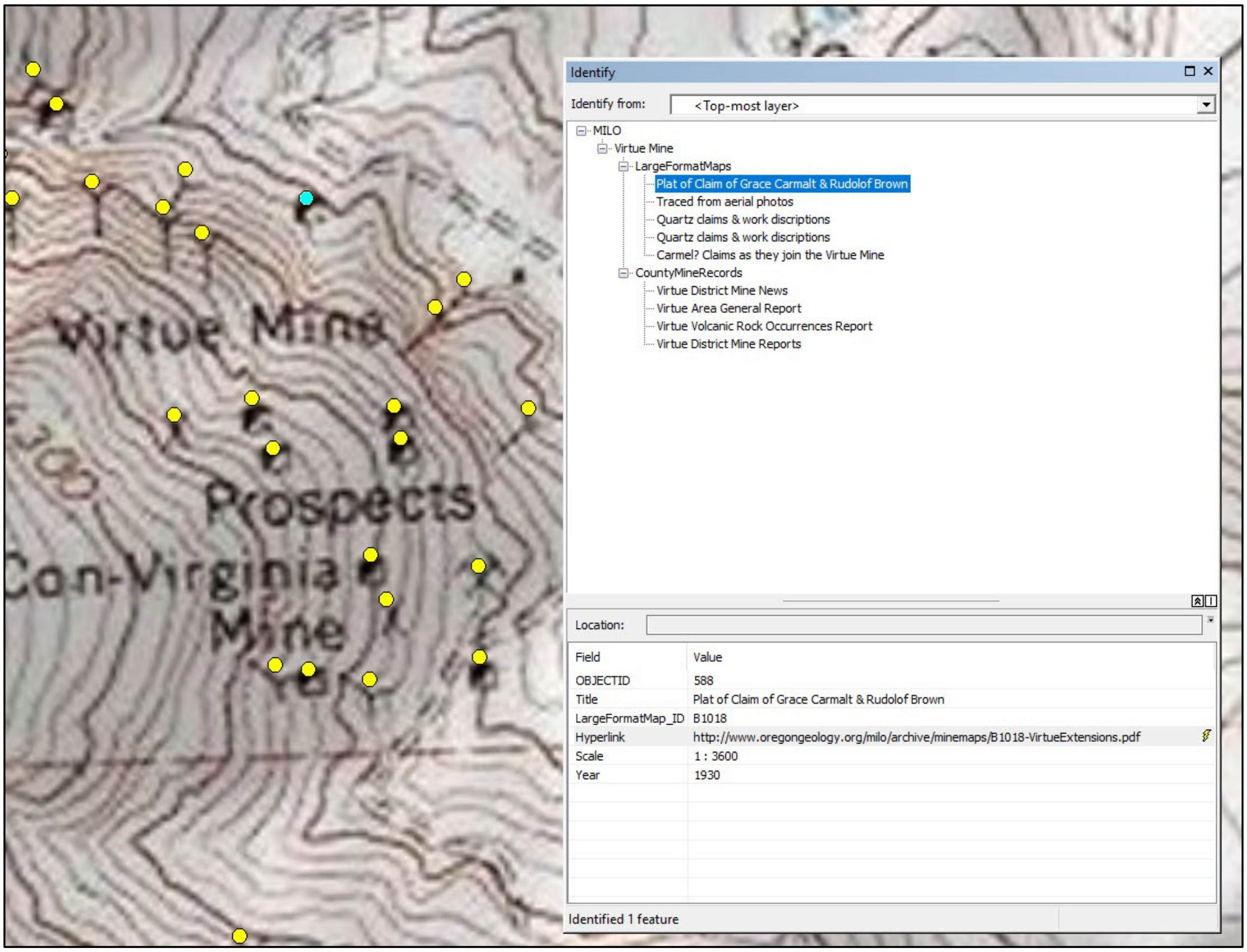
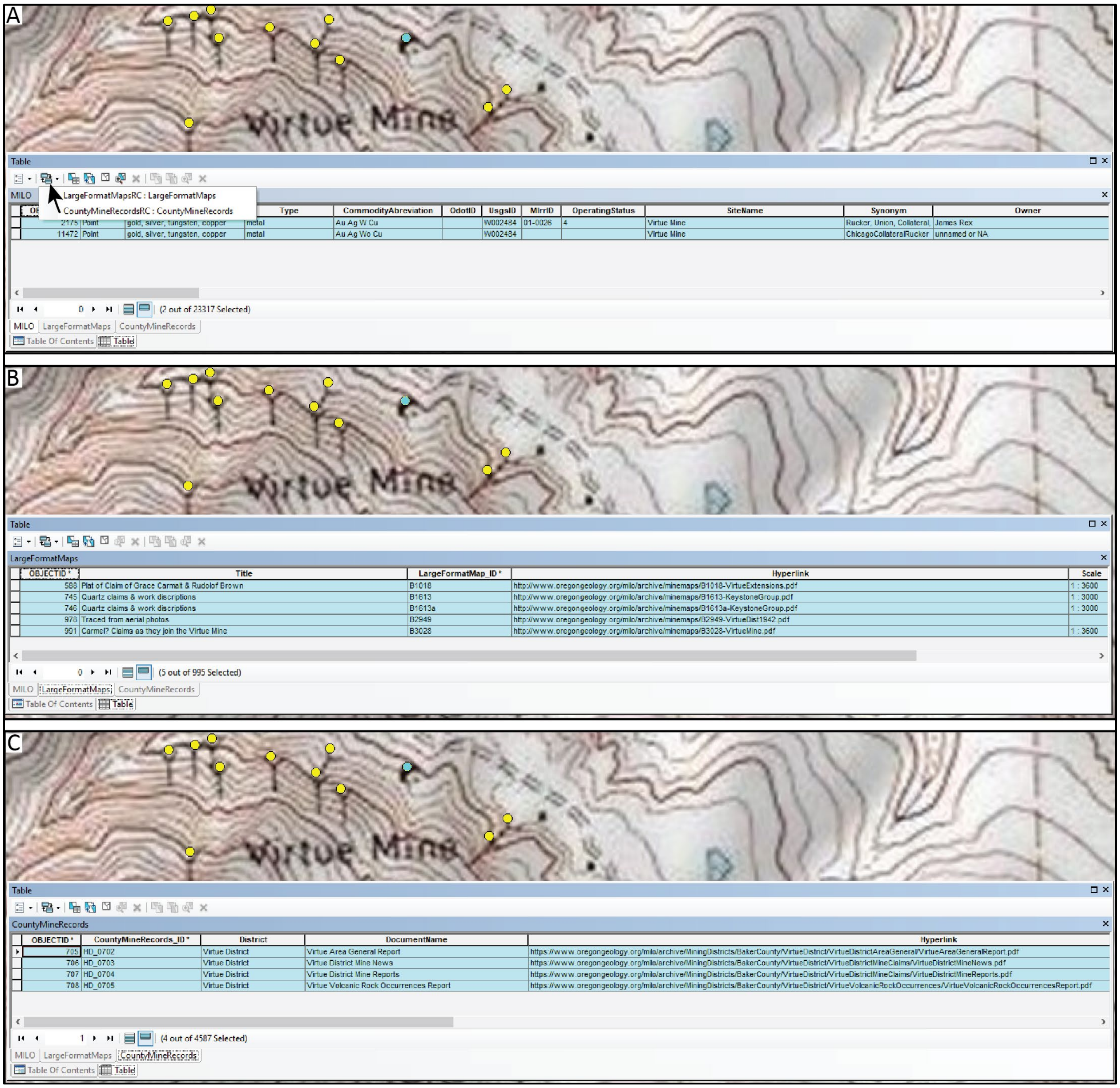


Figure 2-8. Method 2 in Esri ArcMap for determining relationships between the MILO feature class, large-format maps, and county mine records. (A) Attribute table of selected mine records for the Virtue Mine in Baker County. Black arrow in the upper left corner of the table window points to the "select related records" button. Dropdown field shows the related tables. (B) Related attribute table "LargeFormatMaps" listing large-format maps associated with the Virtue Mine points. (C) Related attribute table "CountyMineRecords" showing historical records associated with the Virtue Mine points. Hyperlinks in the LargeFormatMaps and CountyMineRecords tables connect to large-format map and county mine records hosted at https://www.oregongeology.org/milo/ohmi.htm. The solid blue circle in A-C is the selected Virtue mine site. Base map is a USGS topographic map.



3.0 METADATA

Feature class level metadata has been created for MILO-3, in accordance with the internal DOGAMI metadata standard v 1.4, a more rigorous version of the Federal Geographic Data Committee (FGDC) Content Standard for Digital Geospatial Metadata (CSDGM), version 2 (https://www.fgdc.gov/metadata/csdgm-standard). The DOGAMI internal metadata standard is compliant with the approved Oregon GIS Metadata Standard (currently v. 2.04), as prescribed by the Oregon Geospatial Enterprise Office. Each geodatabase record is augmented by NGGDPP metadata compliant fields, allowing for fast uploading of all record metadata to the National Geologic Map Database (NGMDB).

4.0 UPDATES

Updates to MILO-3 will occur upon the availability of new data or information and if staff resources and funding are available. To keep track of updates, we will use a primary release number such as the current release 3 along with a decimal number identifying the update (e.g., 3.1). When we apply major updates to the database, a new primary release number (e.g., 4) will be assigned.

Future work planned to advance MILO-3 includes:

- editing, updating, and georeferencing incomplete and poorly located data using modern 1-m lidar topography and orthophoto imagery;
- adding mine locations digitized from literature, historical records, and 1-m lidar topography;
- integrating MILO with other DOGAMI datasets, such as the Geochemical Information Layer for Oregon (GILO; Ferns and McConnell, 2005; Niewendorp and others, 2010) and the Geothermal Information Layer for Oregon (GTILO) (Niewendorp and others, 2012);
- creation of a feature class representing the point/polygon locations of mining districts in Oregon;
- spatial joining of additional mining records (**Table 4-1**);
- incorporating records of over 30,000 chemical assays that DOGAMI performed as a free service between 1937 and 1970 (**Table 4-1**); and
- adding specimen photographs available for select MILO mine sites, and
- integrating current and future DOGAMI Mineral Land Regulation and Reclamation (MLRR) records.

Making legacy mineral information available in a modern digital format is the most cost-effective first step in a comprehensive statewide mineral resource evaluation program. The merging of all historical mining information and statewide analytical data with MILO points would further our understanding of mineralization and geology statewide, aid in land use planning, environmental assessment, mineral hazard studies, and guide and potentially attract new mineral exploration to the state.

Table 4-1. Additional DOGAMI mineral and mining collections to be added to the Mineral Information Layer for Oregon (MILO) in later updates.

Collection	Description	Volume	Web Resource URL
Currently available online			
Baker County Historical Mining Claim Location Records	Placer and lode mining claim records from 1862 to 1964 held by the Baker County Recorder's Office	110 PDFs	Text list: https://www.oregongeology.org/milo/index-miningrecords.htm
Commodities	83 commodity types, from abrasives to zinc	105 PDFs	Text list: https://www.oregongeology.org/milo/index-commodities.htm
Historical Society -Gold Hill (25) -Josephine (132)	Geology-related records in historical society holdings	157 PDFs mixed materials	Text lists: https://www.oregongeology.org/milo/historical-soc-records-GoldHill.htm and https://www.oregongeology.org/milo/historical-soc-records-JOSE.htm
Oregon DMA, DMEA, OME Dockets	Defense Minerals Administration (DMA), Defense Minerals Exploration Administration (DMEA), and Office of Minerals Exploration (OME) files	103 Oregon docket records	Text list: https://www.oregongeology.org/milo/ORdockets.htm linking to Oregon dockets: https://pubs.usgs.gov/ds/1004/ds1004_docinfo.htm
"Gray Literature" and Pubs (not DOGAMI)	Unpublished reports and those published by the USGS.	9 PDFs	
Oil and Gas Well Logs	Applications, site plans, gas analyses, logs, plugging records, permits, well summaries, etc.	4,700 PDFs	Web map – not up to date: https://www.oregongeology.org/mlrr/oilgas-logs.htm
Active Permits (MLRR)	map shows mine site locations and information, including downloadable permit files: mining files, water quality files, large-format maps	3,533 permit IDs; 1,096 PDFs	Web site: https://www.oregongeology.org/mlrr/permitviewer.htm
DOGAMI mining related, series publications			Accessible in various series from https://www.oregongeology.org/pubs/index.htm
Future additions – scanned but not currently available to the public			
Assays	Over 30,000 chemical assays that the department performed as a free service between 1937 and 1970.		
Field Notebooks			
Oregon Bureau of Mines (microfiche of correspondence and mine records, circa. 1911 to 1923)			
Future scanning			
More Grants Pass office mine files and large-format maps	located in DOGAMI pub resource room		
Thin sections	Both the thin sections themselves and descriptive		

Collection	Description	Volume	Web Resource URL
	index cards; located in DOGAMI pub resource room		
Historical photos	located in DOGAMI pub resource room		
Slides	located in DOGAMI pub resource room		
Baker City field office records	1. Mine files — 7 file cabinet drawers. ~120 individual files per drawer at 20–30 8.5 x 11” sheets per file folder. Equals ~25,200 standard sheets to scan. These sheets are department records of mining production, staff correspondence regarding the mines, geology, workings, etc. Files include oversized mine maps and workings maps as well as plat maps. Also, newspaper clippings and other various related notes. Some of this material scanned and available on the DOGAMI website but not in a systematic fashion. 2. Stream sediment geochemical analyses and field notes. One file drawer and one large binder. 3. Baker County Quartz Lode Books; 23 books left to scan and add to DOGAMI website. Books #32 to 54 (1962–1964) left to scan. ~ 600 pages per oversized books. Must be photographed in house. 4. 15 large binders containing historic mine photographs, department photographs and slides. One additional large box of slides. 5. DOGAMI assay information from 1937 to 1982; 15 boxes containing two bound stacks of 8.5 x 11” sheets recording assay data. ~ 2,000 sheets per box. Perhaps as much as 30,000 data sheets. 12 additional boxes of assay records on index cards. May be as much as 14,500 cards per box for 174,000 records. Data include information on gold and silver determined by DOGAMI through fire assay method. 6. Bullion records, six volumes, bound probably 1,000-2,000 sheets in one box. Free gold shipments out of Baker County as recorded by First National Bank of Baker, Baker Branch of U.S. National Bank of Oregon and Baker Loan and Trust Company between 1890 and 1959. 7. USBM Mine maps, magnetics surveys, etc. on index card sized microfiche. Perhaps 300–500 individual pieces to digitize. 8. Mercury files, one large binder. 9. Copper files, one large binder. Intended to be DOGAMI commodity report, never published. 10. Several binders containing sediment sampling, Owyhee geology, trace element geochemistry, etc.		
Non DOGAMI materials			
BLM Mineral Plats			https://glorecords.blm.gov/search/default.aspx#searchTabIndex=0&searchByTypeIndex=1

5.0 ACKNOWLEDGMENTS

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Agencies that provided data for the original MILOC (the foundation for this release) include Bureau of Land Management (BLM), U.S. Bureau of Mines (USBM), U.S. Forest Service (USFS), U.S. Geological Survey (USGS), Oregon Department of Energy, Oregon Department of Forestry, Oregon Department of Land Conservation and Development, Department of State Lands, Oregon Department of Transportation-Highway Division, and Oregon Department of Water Resources. Also, this data set integrates selected data from DOGAMI unpublished and published mineral resource reports and maps, accuracy of which varies according to the original source(s).

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7.0 APPENDIX

Table 7-1. Mineral Information Layer for Oregon, release 3 (MILO-3) feature class fields.

Field Name	Description
Commodity	All commodities listed in the literature for this site - Major commodities present, a comma-separated list. Qualifier may follow commodity, delimited by a bracket.
Type	Commodity type: metal, industrial mineral; aggregate, coal.
CommodityAbreviation	Commodity abbreviation for major commodities present, a 'space' separated list.
ODOTID	A unique identifier that references records of information pertaining to an Oregon Department of Transportation (ODOT) owned aggregate pit/quarry or private source.
USGSID	A unique identifier that references records of information pertaining to a mineral property - U.S. Geological Survey Mineral Resources Data System (MRDS) and (CRIB).
MLRRID	The permit or site number from the Oregon Department of Geology and Mineral Industries, Mineral Land Regulation and Reclamation program. This is the unique record number.
OperatingStatus	Indicates the operating status of the site at time of last modification: 1. Mineral occurrence (no workings and/or production). 2. Raw prospect (minor workings but no production). 3. Developed prospect (workings but no production). 4. Mine (present or past producer).
SiteName	The name of the mineral deposit or mining operation. Place name on U.S. Geological Survey quadrangle map or name referenced in various published and unpublished sources.
Synonym	Other names the site has had over time, or in the case of placers, names of other gravel bars along a river segment for which one location was chosen for the site name. Name referenced in various published and unpublished sources.
Owner	Name of individual, company, or operator identified with operation.
County	County in Oregon where the site is found, single county entry.
MiningDistrict	Mining district name.
Location	Physical address or referenced to topographic point or feature.
PLSSSectionFraction	The letters or single letter that follow the subdivision of township, range, and section system. Section fraction for example NW NW NW indicates the northwest quarter of the northwest quarter of the northwest quarter of the section; a single letter such as N indicates the north half of the section.
Section	Public Land Survey System (PLSS), 1–36.
Township	Public Land Survey System (PLSS) township number and direction (N | S).
Range	Public Land Survey System (PLSS) range number and range character (E | W).
Latitude	Latitude in decimal degree or Y coordinate for center point of each point.
Longitude	Longitude in decimal degree or X coordinate for center point of each point.
TopoMap24k	U.S. Geological Survey 1:24,000-scale (24K) topographic map in Oregon where site is located.
TopoMap100k	U.S. Geological Survey 1:100,000-scale (100K) topographic map in Oregon where the site is located.
ElevationFeet	Point of reference in feet. The elevation of the site, obtained from 1-meter lidar imagery where available, or 15-minute digital elevation model.
CommoditiesProduced	Commodities produced and sold or used.
ProductSize	A broad characterization of the magnitude of production at the site.
ProductInformation	Production information.
OreMaterial	Ore material (valuable minerals or mineral material).
DepositType	General type of deposit or resource present at the site.

Field Name	Description
WorkingsType	Type of workings: underground or surface.
WorkingsDescription	Description of exploration and/or mine workings.
YearOfDiscovery	Year the mineral discovery was made.
YearProductionStarted	Year that mineral production started.
FullReference1	Bibliographic reference providing information supporting the database record. Reference #1.
ShortReference1	Publication Series Information.
Pages1	Page number of reference where site is mentioned or described.
FullReference2	Bibliographic reference providing information supporting the database record. Reference #2.
ShortReference2	Publication Series Information.
Pages2	Page number of reference where site is mentioned or described.
FullReference3	Bibliographic reference providing information supporting the database record. Reference #3.
ShortReference3	Publication Series Information.
Pages3	Page number of reference where site is mentioned or described.
FullReference4	Bibliographic reference providing information supporting the database record. Reference #4.
ShortReference4	Publication Series Information.
Pages4	Page number of reference where site is mentioned or described.
FullReference5	Bibliographic reference providing information supporting the database record. Reference #5.
ShortReference5	Publication Series Information.
Pages5	Page number of reference where site is mentioned or described.
DataSourceID	Data source identification foreign key to geologic map. Unique code for each original reference map, expressed as the first four letters of the first author's last name, first and middle initials, the year of publication, and a map identifier as needed.
MapUnit	Reference map unit label symbol taken from the original geologic reference map.
MapUnitName	Reference map unit name taken from the map legend or explanation of map units on the original geologic reference map.
ThematicUnitLabel	Geologic Merge Unit Label in previous versions of OGDC (Smith and Roe, 2015). Label (period delimited) assigned by area geologists that combines all the original map units into 7 different general geologic categories.
ThematicRockType	General geologic rock type of the geologic merge unit label, expressed by the genesis of the unit in OGDC.
ThematicAge	Age of geologic merge unit based on the geologic time scale in OGDC.
ThematicTerraneGroup	Terrane or Group Name - Stratigraphic name (formally or informally named) for the terrane or group in OGDC.
ThematicFormation	Stratigraphic name (formally or informally named) for the geologic formation in OGDC.
ThematicMember	Stratigraphic name (formally or informally named) for the member type in OGDC.
ThematicUnit	Stratigraphic name (formally or informally named) for the unit type in OGDC.
ThematicLithology	Characteristic lithology type name for the geologic merge unit label in OGDC.
ArcJoinID	Concatenation of 'DataSourceID' and 'MapUnit' fields without a space in between - for use with joins or relates of data tables in ArcGIS or other GIS software.
MILO_ID*	Primary key. Values = ID_1, ID_2, ID_3, etc. Values must be unique to the database.

Table 7-2. LargeFormatMapsPoints feature class and LargeFormatMaps geodatabase table fields.

Field Name	Description
Title	Title of scanned document.
LargeFormatMap_ID	Primary key. Values =B0001, B0002, B0003, etc. Values may be repeated in the data set.
Hyperlink	Hyperlink to the online document.
Scale	Scale of the map listed by the author reported as 1: denominator.
Year	Year the document was published or created.
MILOID	Foreign key. Values =ID_00001, ID_00002, ID_00003, etc. Values may be repeated in the data set.

Note the Field Name MILOID is part of the LargeFormatMapsRC table and corresponds to the primary key listed in the field LargeFormatMap_ID*.

Table 7-3. CountyMineRecords geodatabase table fields.

Field Name	Description
CountyMineRecords_ID*	Primary key. Values =HD_0001, HD_0002, HD_0003, etc. Values may be repeated in the data set.
District	Mining district the county mine record was assigned. Some districts are formal, but most are informal.
DocumentName	Title assigned to the scanned document.
Hyperlink	Hyperlink to the online document.
MILOID	Foreign key. Values =ID_00001, ID_00002, ID_00003, etc. Values may be repeated in the data set.

Note the Field Name MILOID is part of the CountyMineRecordsRC table and corresponds to the primary key listed in the field CountyMineRecords_ID*.