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UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

MINERAL POTENTIAL REPORT FOR THE PROPOSED

MT. EMMONS LAND EXCHANGE

Grand Mesa, Uncompahgre and Gunnison National Forests, and Rio Grande National Forest, Gunnison County and Saguache County, Colorado

LANDS INVOLVED:

Approximately 550 acres of Federal land located in portions of T13S, R86W; T14S, R86W; T13S, R87W (6th PM); and approximately 625 acres of Non-Federal land in portions of T14S, R86W (6th PM); T45N, R3E; T46N R4E (NMPM)
(Appendix 1 contains detailed land descriptions)

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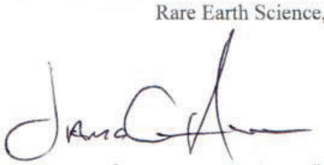

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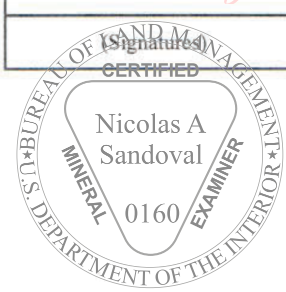

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Executive Summary for Managers

0.1 Summary

A Non-Federal Party, Mt. Emmons Mining Company (MEMC), proposed an exchange of approximately 625 acres of private lands, referred to in this report as Non-Federal Parcels, located in both Gunnison County and Saguache County, Colorado, for approximately 550 acres of National Forest System (NFS) lands, referred to as Federal Parcels. The Federal Parcels were segregated February 24, 2022, for five years from appropriation under public land and mineral laws and are located on public lands managed by the Gunnison Ranger District of the Grand Mesa, Uncompahgre and Gunnison National Forests (GMUG) located in Gunnison County, Colorado (Map 1).

The overall purpose of this land exchange is to effectively consolidate ongoing water treatment and remediation operations near the historic Keystone Mine, establish permanent non-motorized recreational access along current routes, and acquire four Non-Federal inholdings located within the GMUG and Rio Grande National Forests (RGNF) to prevent potential future development and impact on surrounding NFS lands. Upon acquisition, MEMC will place a Conservation Easement on 936 acres which includes both the Federal Parcels and adjoining parcels presently owned by MEMC. The Conservation Easement will be executed between MEMC and the Crested Butte Land Trust and, along with an *"Extinguishment Agreement–Mineral and Development Rights"* on the 936-acre area, will end future commercial mining activity on Mt. Emmons.

The United States reserves the rights to "all minerals" on the subject Federal Parcels, and MEMC owns both the surface and mineral estates of the Non-Federal Parcels (Maps 2 - 5). The objective of this Mineral Potential Report (MPR) is to assess the mineral potential of the Federal and Non-Federal Parcels associated with the proposed land exchange. In order to identify known or potential mineral management issues or concerns that could conflict with the management purposes for which the subject lands are acquired, this report provides an assessment of the likelihood of future mining claim location or solid and fluid mineral permits, licenses, or leases and associated development on the Non-Federal Parcels after the exchange. For the purposes of this report, the property naming conventions listed below will be utilized:

North Zone:
- Federal Parcels 1, 2, & 3 – Mt. Emmons Area
- Non-Federal Parcel A – Three Peaks Ranch

South Zone:
- Non-Federal Parcel B – Monchego Creek Ranch
- Non-Federal Parcel C – Sheep Creek Ranch
- Non-Federal Parcel D – Spanish Creek Ranch

0.2 Conclusions

The Federal Parcels proposed in this exchange include a high potential for locatable minerals, particularly molybdenum, including an estimated 155-million tons of mineralized porphyry averaging a grade of 0.44 percent molybdenum at a 0.2 percent cutoff, with an additional moderate to high potential for accessory silver, lead, zinc, gold, uranium, and critical minerals. Available data provides abundant direct and indirect evidence to support the existence of mineral resources with high certainty. Therefore, utilizing the United States Bureau of Land Management (BLM) Mineral Potential and Development Potential Classification Systems (Appendices 5 & 6; BLM, 1985), the locatable metallic-mineral potential, including molybdenum, lead, zinc, and copper, is high (H/D) and the potential for development is moderate (M) for the Federal Parcels (Table ES-1). Mineral exploration, historical mining activities, and geochemical anomalies indicate that the critical minerals niobium, rubidium, tin, tungsten, and zinc are identified as having a high potential (H/D) for occurrence and a moderate potential for development (M) on the Federal Parcels (Table ES-1). The potential for locatable metallic mineral and critical mineral resources at the Non-Federal Parcels is low (L/C) with correspondingly low (L) development potential (Table ES-2).

Known leasable metallurgic coal deposits, part of the Crested Butte Coal Field in the Uinta Coal Region, are located within the North Zone of the land-exchange area (Maps 17 & 18). The level of certainty that coal resources exist at Federal Parcels is high (H) and the available data provides abundant direct and indirect evidence (D) of the occurrence potential ranging in rank from high-volatile C to anthracite thermal-grade coal. Similarly, the level of certainty that coal resources exist for 160 acres at Non-Federal Parcel A is also high (H); available data for this North Zone parcel also provides abundant direct and indirect evidence (D) of occurrence potential for coal. All North Zone Federal and Non-Federal Parcels have a moderate (M) development potential (Tables ES-1 & ES-2). Within the South Zone of the land-exchange area, the occurrence for leasable coal deposits is low (L/C) and the potential for development is also low (L) for the combined 465 acres at Non-Federal Parcels B, C & D (Table ES-2).

Favorable geology and stratigraphic units containing conventional oil, natural gas, including inert carbon dioxide, nitrogen, hydrogen sulfide, helium gas, and unconventional coal bed methane are located within the Piceance Basin structural province which encompasses the North Zone of land-exchange area (Maps 19 & 20). The potential for occurrence of leasable oil and gas, including coal bed methane, is considered high (H/D), though due to variable uncertainties of existing reservoir traps, the development potential is only moderate (M) for 550 acres at the Federal Parcels and 160 acres at Non-Federal Parcel A (Tables ES-1 & ES-2). Within the South Zone of the land-exchange area, favorable geology and stratigraphic units containing oil and natural gas are located within the San Juan Sag structural province (Maps 19 & 21). The level of certainty of conventional oil and natural gas resource occurrences is considered moderate (M/B) and the potential for development is low (L) for the combined 465 acres in the South Zone at Non-Federal Parcels B, C, & D. Unconventional coalbed methane resource occurrence is considered low (L/B) and the potential for development is low (L) for the combined 465 acres at Non-Federal Parcels B, C & D (Table ES-2).

Both pumice and perlite deposits have been identified within Cochetopa Park, which includes Non-Federal Parcel B, and are reported to be among the largest unmined resources within the State of Colorado. The non-metallic industrial mineral occurrence potential of pumice and perlite is moderate (M/B) and the potential for development is also moderate (M) for 160 acres at Non-Federal Parcel B. The occurrence of other non-metallic industrial minerals is low (L/C) and the development potential is low (L) for all Federal and other Non-Federal Parcels (Tables ES-1 & ES-2).

Sand, gravel, riprap, boulders, decorative stone, and hardrock aggregate resources on the Federal and Non-Federal Parcels have a moderate occurrence potential (M) based upon abundant direct and indirect evidence (D) on the three Federal Parcels, and lesser proof (C) on the four Non-Federal Parcels. All the Federal and Non-Federal parcels have moderate (M) development potential.

No known geothermal resources or record of geothermal leases or wells were identified on the subject parcels. There are also no reported occurrences of sodium and potassium. Therefore, the potential for occurrence of these resources is low (L/C) and the potential for development is also low (L) for all 1,175 acres covered by this report.

0.3 Recommendations

This report discloses the geology and mineral potential of Federal and Non-Federal Parcels proposed for an equal value land exchange between MEMC and the United States Department of Agriculture–Forest Service (USFS). Proven and potential mineral resources estimates and market values for the proposed parcels are extremely difficult to perform and are not offered in this study. What is clear, however, is that the inherent mineral value of the Federal Parcels significantly exceeds that of the Non-Federal Parcels. The Federal Parcels comprise a total of 550 acres and have high potential for the occurrence and development of locatable metallic and critical and strategic, leasable oil and gas, and coal mineral resources. In contrast, the Non-Federal Parcels, representing a total of 625 acres, offer high potential for the occurrence and development mineral resources for only 160 acres comprising the Three Peaks Ranch Parcel with those resource types limited to leasable oil, gas and coal.

From strictly a minerals management perspective, this study very strongly recommends that surface land and mineral estate rights of all parcels in the proposed equal-value land exchange remain unsevered regardless any differences in proven or potential value. First, only by conveying 100% of combined rights to MEMC on the Federal Parcels will the USFS be fully released from regulatory oversight of these lands, allowing the company, other regulatory agencies, and the local government to streamline permits and approvals needed for critical mine reclamation and remediation actions. This is particularly true for larger actions in the area that might only minimally include portions of the three Mt. Emmons Area Parcels, as is frequently the case. Second, if MEMC were to retain some or all of its mineral rights on the Non-Federal Parcels then the USFS would be limited in its ability to implement its own contiguous land management objectives, especially those that are needed to effectively direct the pace and place of locatable, leasable, and salable minerals exploration and development on the subject parcels. Therefore, implementation of the land exchange is recommended here because the loss of high-value mineral estate on the Federal Parcels is largely offset by immeasurable minerals management benefits to the U.S. Government and the American public.

This study also recommends that appropriate due diligence be done by both USFS and MEMC to complete adequate levels of Environmental Site Assessment to identify environmental, safety, or human health risks or liabilities resulting from past activities for all of the subject parcels in the proposed land exchange. Particular close attention should be directed toward evaluation of the three Federal Parcels in the Mt. Emmons Area because of the presence of mine waste piles and the 150-year history of legacy mining on these parcels of the Ruby-Irwin Mining District.

In short, this Mineral Potential Report supports the MEMC-USFS equal-value exchange of surface land and mineral estate for the three Federal and four Non-Federal Parcels between MEMC as currently proposed.

1. Introduction

1.1 Background

The purpose of this report is to provide information concerning mineral potential, mineral activity potential, mineral estate value, and any mineral issues to aid the decision-maker and the appraiser for the Federal and Non-Federal Parcels that have been identified for exchange between USFS and MEMC, for the exchange. This exchange, prompted by the Non-Federal Party (MEMC), proposes the conveyance of private land comprising four parcels totaling approximately 625 acres to the United States, in exchange for approximately 550 acres of NFS lands, including 100% Federal mineral estate. See Section 2, below, for additional parcel descriptions. The intent of this land exchange is to provide more efficient, logical land and boundary management for better resource protection including ongoing remediation/reclamation and water-treatment activities related to the historic Keystone Mine.

The Non-Federal Party's proposal is an equal value land exchange. If it is determined that the value of the Federal and Non-Federal Parcel surface and mineral estate is not equivalent, then one or more Non-Federal Parcels could be removed from the exchange or a cash payment made to equalize the values. This exchange would occur under the authorities of the General Exchange Act of March 20, 1922 (16 U.S.C. § 485), as amended by the Act of February 28, 1925 (16 U.S.C. § 486); the Federal Land Policy and Management Act (FLPMA) of October 21, 1976 (43 U.S.C. § 1716); and the Federal Land Exchange Facilitation Act of August 20, 1988 (43 U.S.C. § 1716).

1.2 Purpose

A Mineral Potential Report (MPR) is required as part of the land conveyance process to satisfy the requirements of 36 CFR 254, Subpart A, and Forest Service Manual FSM 5400 (USFS, 2005) and Forest Service Handbooks FSH 5409.12 (USFS, 2006a) and FSH 5409.13 (USFS, 2004a). The MPR provides information on the geology, known mineral deposits/occurrences, past and present mining and mineral production, mining claims, mineral leases, mineral resource occurrence and development potential of the subject lands, and market trends for commodities with a potential to occur on the subject lands in accordance with FSM 2885.3 (USFS, 2008), and the BLM Manuals 3031 (BLM, 1985) and 3060 (BLM, 1994). This report has been reviewed by a Minerals Specialist as defined in FSH 2809.15 Chapter 10.5 (USFS, 2006c).

The MPR investigation included site visits by the authors on July 25 and 26, 2022. Fieldwork included driving and cross-county hiking inspections to identify visible evidence of historical mining features, obvious mineralized veins or coal outcrops, and other unique geologic conditions at the subject parcels and immediately adjoining lands. Field personnel compiled notes and color photographs of any important site features. Select photographs collected during the field examinations are included within Appendix 7 of this report. No sampling of geological materials, or surface- or groundwater, was performed during the field examinations.

The MPR synthesizes information obtained from published geologic and mineral-resource data for the subject lands, including available scientific literature, databases, and maps and aerial photography acquired from sources such as the BLM; Colorado Geological Survey (CGS); Colorado Division of Reclamation, Mining and Safety (DRMS); Colorado Energy & Carbon Management Commission (ECMC); Colorado State Land Board (SLB); USFS; United States Geological Survey (USGS); Gunnison and

Saguache Counties; and, various professional and industry organizations. The scope of this MPR is limited to the lands involved in this exchange as stated in Section 2., below. This report satisfies BLM and USFS requirements for mineral potential reports and utilizes the guidance and general format prescribed in Manual 3060 for *Mineral Reports–Preparation and Review* (BLM, 1994) and the *Mineral Potential Classification System* found in Manual 3031 (BLM, 1985). The conclusions of this report are limited to the management action that prompted this MPR and are not intended for any other use.

2. Lands Involved

2.1 Land Description

Three Federal Parcels designated 1, 2 & 3 include 550 acres, more or less, which are managed by GMUG. Four Non-Federal Parcels designated A, B, C, and D, comprise 625 acres, more or less, and are located within the management boundaries of the GMUG and RGNF. The general location and complete legal descriptions for the subject lands are shown on Maps 1-9 and described in Appendix 1.

Federal Parcel 1 (465.84 acres) is located on the southeast aspect of Mt. Emmons adjacent to and above eastward flowing Coal Creek (Map 2). Federal Parcel 2 (81.49 acres) is located approximately 0.25 mile to the west-northwest within upper Evans Basin immediately south of Gunsight Pass. Federal Parcel 3 (3.15 acres) is in the upper reaches of Redwell Basin, to the northeast of Gunsight Pass and north of Mt. Emmons' summit. Access to these parcels is achieved by traveling approximately 2 road miles west from the Town of Crested Butte along paved Gunnison County Road 12 (Kebler Pass Road), then using an improved unpaved road to the Keystone Mine, continuing along a steep 4-wheel-drive road, and by foot, over Gunsight Pass into Redwell Basin.

Federal Parcels	Legal Description
Federal Parcel 1 – Mt. Emmons Area (North Zone)	A parcel of land situated in sections 31 and 32, township 13 south, range 86 west; and sections 5 and 6, township 14 south, range 86 west, Sixth Principal Meridian, Gunnison County, Colorado, being more particularly described as containing 465.84 acres.
Federal Parcel 2 – Mt. Emmons Area (North Zone)	A parcel of land situated in section 36, township 13 south, range 87 west, and section 31, township 13 south, range 86 west, Sixth Principal Meridian, Gunnison County, Colorado, being more particularly described as containing 81.49 acres.
Federal Parcel 3 – Mt. Emmons Area (North Zone)	A parcel of land situated in sections 30 and 31, township 13 south, range 86 west, Sixth Principal Meridian, Gunnison County, Colorado, being more particularly described as section 30, lot 21, together with a portion of section 31, lot 12, bounded on the north by Crested Butte Lode, Mineral Survey No. 4243, the east by Germania Lode, Mineral Survey No. 4767, the south by Park City 19, Mineral Survey No. 20926, and bounded on the west by Furniture Boy Lode, Mineral Survey No. 3739, and Crested Butte Extension Lode, Mineral Survey No. 4472, containing approximately 3.15 acres.

Non-Federal Parcel A (Three Peaks Ranch) is a 160-acre inholding parcel located 5 miles south-southeast of the Federal Parcels (Map 1). Access is achieved beginning at a point roughly 15 miles north of Gunnison along paved County Road 730, then 9 miles of unpaved County Road 737. Access to Non-Federal Parcel B (Monchego Creek Ranch) is made along unpaved Saguache County Roads 14NN and 17FF from State Highway 114 located 20 miles to the north. Adjoining public lands to the north, east and south are administered by the GMUG, and undeveloped lands to the west are either privately owned or administered by the BLM. Non-Federal Parcel C (Sheep Creek Ranch) and Non-Federal Parcel D (Spanish Creek Ranch) are located roughly 4 to 5 miles north of State Highway 114 and accessed using unpaved County Road 31CC. Adjoining lands at these Non-Federal Parcels are administered by the RGNF.

Non-Federal Parcels	Legal Description
Non-Federal Parcel A – Three Peaks Ranch (North Zone)	Sixth Principal Meridian, Colorado T. 14 S., R. 86 W., sec. 28, SW1/4NW1/4 and NW1/4SW1/4; sec. 29, SE1/4NE1/4 and NE1/4SE1/4; The areas described aggregate 160 acres.
Non-Federal Parcel B – Monchego Creek Ranch (South Zone)	New Mexico Principal Meridian, Colorado T. 45 N., R. 3 E., sec. 19, lots 3 and 4, SE1/4SW1/4 and SW1/4SE1/4; The areas described aggregate 159.690 acres.
Non-Federal Parcel C – Sheep Creek Ranch (South Zone)	New Mexico Principal Meridian, Colorado T. 46 N., R. 4 E., sec. 12, S1/2SE1/4SE1/4SW1/4 and SE1/4SW1/4SE1/4SW1/4; sec. 13, W1/2NW1/4NE1/4, SW1/4NE1/4, E1/2NE1/4NW1/4, E1/2NW1/4NE1/4NW1/4, W1/2NE1/4SE1/4, E1/2NW1/4SE1/4, NW1/4SE1/4SE1/4, and N1/2SW1/4SE1/4SE1/4; The areas described aggregate 147.50 acres.
Non-Federal Parcel D – Spanish Creek Ranch (South Zone)	A parcel of land situated in sections 23, 24, 25, and 26, township 46 north, range 4 east, New Mexico Principal Meridian, Saguache County, Colorado, being that parcel of land described in Homestead Entry Survey No. 63, containing 157.99 acres.

2.2 Land Status

The NFS lands proposed in this exchange have Reserved Public Domain status within the GMUG administrative boundaries by proclamation including the mineral estates. There are no reserved or outstanding mineral rights; no active solid or fluid mineral permits, licenses, or leases; and no active mineral material permits or contracts. The surface and mineral estates for the Non-Federal Parcels proposed in this exchange are owned in fee-simple title by MEMC, and there are no known third-party severances of mineral rights on the Non-Federal Parcels (Appendices 1, 2 & 3).

3. Physiography

The Federal and Non-Federal Parcels are located within the Southern Rocky Mountains physiographic province in western Colorado, a mountainous climate zone with long winters and short summers due in part to the high elevation. Summers tend to be cool to mild with average temperatures ranging from 40° to 70° F (recorded at the Crested Butte climate station). Average winter temperatures range from -10° to 30° F, with freezing temperatures occurring as late as mid-June and as early as early-September. Prevailing winds can be significant and are typically from the west and southwest. Average annual precipitation is 24 inches with peak amounts of rain falling during thunderstorms in July, August, and September. Average annual snowfall in the project area is upwards of 200 inches with snow cover lasting into late-June on northern aspects at higher elevations. Primary streams within this area often have perennial flow, with peak flows occurring following snowmelt and spring rains.

Within the North Zone of the land exchange area, Federal Parcels 1, 2 & 3 are located about 25 miles west of the Continental Divide (Map 10), between the Coal Creek and Oh-be-Joyful drainages of the Slate and East River watersheds in the Upper Gunnison River Basin. Terrain includes rugged mountainous slopes (40- to 100-percent slopes) characterized by glaciated valleys and high cirques with subalpine forests, mountain grasslands, alpine meadows, mountain shrublands, montane forests, and areas of rock talus devoid of vegetation. Mt. Emmons, named in honor of geologist Samuel F. Emmons, tops at an elevation of 12,401-feet above mean sea level (AMSL). The Federal Parcels lie between elevations ranging from 9,210- to 12,120-feet on the slopes of Mt. Emmons within the Ruby Range of the Elk Mountains (Maps 2, 6, & 10) (USFS, 2022). Non-Federal Parcel A – Three Peaks Ranch is located between the West Elk Mountains to the west-southwest and the Elk Mountains to the north (Map 10). Terrain includes mountain grasslands, mountain shrublands, montane forest, meandering streams, and wetlands, on low to moderately sloping terrain (5- to 20-percent hillsides) within the gently sloping and southwestward-draining Carbon Creek valley. The elevation ranges between 9,190- and 9,600-feet AMSL (Maps 3 & 7).

Within the South Zone of the land exchange area, the undeveloped Non-Federal Parcel B lies along Monchego Creek (Maps 4 & 8) within the Cochetopa Creek watershed of the Upper Gunnison River Basin, with mountain grasslands and shrublands covering gentle slopes (2- to 15-percent) on the southeastern margin of Cochetopa Park. Elevations range between 9,285- and 9,600-feet AMSL and the Continental Divide runs along the Cochetopa Hills approximately 2.5 miles southeast of the parcel (Maps 4, 8 & 10). Non-Federal Parcels C & D are located along the Sheep Creek and Spanish Creek drainages, respectively, and within the Saguache Creek watershed, about 4 miles east of the Continental Divide (Maps 5, 9 & 10). The two parcels are undeveloped and within a mile of one another. The terrain is characterized by mountain grasslands, shrublands and montane forests, on gentle to moderate slopes (2-to 20-percent) with elevations ranging between 9,030- and 9,650-feet AMSL.

4. Geologic Setting

4.1 Regional Geology

The parcels considered for the proposed land exchange lie within the Southern Rocky Mountains of central Colorado and are surrounded by several major regional tectonic structures including the Elk Mountains to the north; the Sawatch Range to the east and northeast; the Piceance Basin to the northwest; the West Elk Mountains and Gunnison Uplift to the west; the San Juan Volcanic Field to the south; and the San Luis Valley, an extensional basin of the Rio Grande Rift, to the east (Map 10, Figure 5). This region includes a complex geologic history, with bedrock ranging from Precambrian-age (~1.4- to 1.8-billion years) gneiss, schist, and metamorphosed granitic rocks; Cambrian- to Paleogene-age (~530- to 40-million years) sedimentary rocks; and Late Cretaceous- to Paleogene-age (~64- to 10-million years) igneous intrusions and volcanic fields. Refer to the Geologic Time Scale in Appendix 8 for chronological correlations.

Deposition of relevant shallow-marine carbonate formations within intermountain basins began in the Devonian period, when the area was submerged by a widespread shallow sea with moderate uplands in central Colorado. This period was followed by repeated transgression-regression cycles of the sea and gradual regional uplift during the Mississippian, which allowed for the formation of several series of shallow- and deep-marine carbonates. Rapid uplift of the Ancestral Rocky Mountains was then initiated in the late Mississippian and early Pennsylvanian, creating a system of basement-cored uplifts and associated sedimentary basins. Continued uplift of the area and cyclical marine conditions throughout the later Pennsylvanian, Triassic, and Jurassic allowed for the formation of extensive units of sandstones and limestones, representing transitions between fluvial- and marine-dominated depositional regimes. During the Cretaceous Period there was continued erosion of the Ancestral Rocky Mountains and inundation by a shallow continental sea with frequent sea level changes, resulting in the accumulation of thick, laterally extensive shale and sandstone units across the area, the most relevant of which are the Mancos Shale Formation and the Mesaverde Group.

Near the end of the Cretaceous and during the Paleogene Period, widespread tectonic disturbances in the North American continental plate generated most of the major mountain uplifts and basins of the present Rocky Mountain region. Approximately 80- to 35-million-years ago, this period of mountain building in the Rocky Mountains is known as the Laramide Orogeny. During this geologic event, continental tectonic extension helped to develop intermountain structural basins where thick sequences of sedimentary rocks accumulated, some of which contain important coal, oil, and gas resources. Depositional basins within the region include the Piceance Basin in the northwestern portion of the project area; the San Juan Sag to the south; and the San Luis Basin to the east (Figs 5 & 6, Map 10).

The North Zone of the project area contains the southeastern-most extension of the Piceance Basin, a prolific oil- and gas-producing structural basin with a thick sequence of Paleozoic and Mesozoic sedimentary rocks. Several prominent high mountain peaks including Mt. Emmons, Mt. Axtell and Whetstone Mountain were formed during the Laramide Orogeny by the intrusion of dikes, sills, and laccolith stocks into these older sedimentary rocks (Map 2 & 11) (Gaskill et al., 1967). The Gunnison Uplift (Fig. 5), located southwest of the North Zone, was also elevated during this time due to renewed movements along old fault lines in the Precambrian basement which raised the Black Canyon of the Gunnison River area, resulting in about 1,200 feet of stream entrenchment.

In the South zone, igneous activity associated with the San Juan Volcanic Field (Figures 6 & 7) formed the largest volcanic field in the Southern Rocky Mountains toward the end of the Laramide Orogeny. It covers an area of more than 15,000 square miles with at least 28 known volcanic calderas that erupted a combined volume of about 15,400 cubic miles of material during the Paleogene Period (Lipman et al., 1970). The assemblage of volcanic rocks in this general area is composed mainly of Oligocene aged rhyodacite, quartz latite, and andesite as flow, tuff, and breccia deposits erupted from the La Garita, Cochetopa Park, and North Pass calderas. Beneath the Paleogene-age volcanics lies a sequence of mostly Jurassic- to Cretaceous-age sedimentary rocks within the San Juan Sag (Figs. 5 & 6), a foreland basin that also formed during the late Laramide Orogeny. Upper Cretaceous oil and natural gas reservoirs were first discovered in the San Juan Sag in 1975 (Gries, 1989).

Throughout the project area, bedrock is overlain by unconsolidated surficial deposits, including alluvium, alluvial fan deposits, talus, landslide deposits, and other surficial debris. Most of the upper-elevation stream valleys in the regional area were modified by Pleistocene glacial erosion and this same glacial activity is responsible for sculpting much of the mountain topography. Locally, the valley floors are underlain with moraine sands and gravel deposited by ice or meltwater during periods of glaciation. Holocene- to Pleistocene-age landslide deposits, colluvium, and alluvium fill stream valleys and underlie valley grasslands and shrublands (Lipman et al., 1970; Soule, 1976).

The Colorado Mineral Belt, geologically active at intervals beginning from near the time of crustal accretion in central Colorado at least 1.6-billion-years ago until the present, is a 10- to 60-mile-wide southwest-northeast trending zone of hydrothermal mineral deposits that extends across the northern half of the project area (Figure 1; Tweto and Sims, 1963; Burnell, 2015). This belt includes ore deposits thought to have been created from circulating hydrothermal waters heated by local igneous intrusions and deposited along or adjacent to structural features associated with crustal extension (Davis and Streufert, 2011).

Experiencing great geologic and mineral-resource interest since the late 1860s, numerous geochemical and geophysical studies have been conducted as part of resource assessments by government agencies and various exploration companies along the Colorado Mineral Belt and throughout the region. Regional geophysical surveys have helped to identify igneous heat sources and fault structures which provide conduits for hydrothermal mineralizing fluids. Three sets of geophysical data – gravity, aeromagnetic, and radiometric maps – were compiled from previous studies and interpreted for the GMUG National Forests and Vicinity, Colorado (Bankey, 2004). Results from these surveys have helped to delineate the West Elk and San Juan Volcanic Fields; the northeast-trending structurally controlled Colorado Mineral Belt; and the northwest-trending structurally controlled Gunnison and Uncompahgre uplifts (Rosenbaum, 1977). Additionally, there has been a considerable amount of surface and subsurface geologic mapping and geochemical sampling at varying scales. Geochemical data and associated reports completed for GMUG resource-potential studies contain analysis of 13,314 sediment samples and 5,957 rock samples derived from various USGS projects and samples collected for the National Uranium Resource Evaluation (NURE) and Hydrochemical and Stream Sediment Reconnaissance (HSSR) program (Smith, 1997; USGS, 2004). Samples were assayed for a suite of elements based on the Clarke Index for crustal abundance of selected elements (Fortescue, 1992): Antimony (Sb), Arsenic (Ar), Barium (Ba), Bismuth (Bi), Barium (Ba), Cadmium (Ca), Chlorine (Cl), Chromium (Cr), Cobalt (Co), Copper (Cu), Dysprosium (Dy), Europium (Eu), Gold (Au), Hafnium (Hf), Lanthanum (La), Lead (Pb), Lithium (Li), Lutetium (Lu), Manganese (Mn), Mercury (Hg), Molybdenum (Mo), Nickel (Ni), Niobium (Nb), Rubidium (Rb), Samarium (Sm), Scandium (Sc), Silver (Ag), Strontium (Sr), Thorium (Th), Tin (Sn), Tungsten (W), Uranium (U), Vanadium (V), Ytterbium (Yb), Zinc (Zn), and Zirconium (Zr). Mean and standard deviations of each element were calculated and used within geochemical modeling studies for the spatial identification of anomalous concentrations (Smith, 2004).

4.2 Site Geology

4.2.1 Site Geology, Federal Parcels 1, 2 & 3

Geologically, the three Federal Parcels in the North Zone are characterized by Proterozoic crystalline basement rocks mantled by Paleozoic- and Mesozoic-era sedimentary strata of the Piceance Basin. Some of these sedimentary rocks were later intruded by mid-Paleogene igneous sills, dikes, laccoliths, and stocks and cut by Laramide- to Paleogene-age faults. Faults within the area are generally steep dipping, trend northeast or north-northwest, have trace lengths of 0.25 to 2 miles, and display relatively small normal-sense offsets of less than 200 feet (Thomas and Galey, 1982). A veneer of recent Holocene- and Pleistocene-age glacial and alluvial deposits unconformably overlies much of this earlier geology (Maps 10 & 11; Soule, 1976).

The dominant bedrock units exposed in the area are the Paleocene Ohio Creek Formation (Toc) and Upper Cretaceous Mesaverde Group (Kmv) (Map 11). The Ohio Creek Member is up to 400’ thick and consists primarily of medium-grained conglomeratic sandstone with lesser amounts of interbedded sandstone, siltstone, shale, and carbonaceous shale in the middle of the unit. It is underlain by the Mesaverde Group which is a thick (1,600’ to 1,800’) sequence of interbedded sandstone, shale, coal, and carbonaceous shale. Sedimentary units in this area dip gently (10 to 20 degrees) to the southwest. Table 2 provides a list of the rock units mapped by the USGS at and near these parcels, indexed by ascending age (youngest to oldest). The Federal Parcels are all located within the Piceance Basin which contains proven gas-bearing zones in the Pennsylvanian-Permian Maroon Formation; Lower Cretaceous Dakota and related units (including the Cedar Mountain Formation and Buckhorn Conglomerate Member), Upper Cretaceous Mancos Shale and related units (including the Mowry Shale, Frontier Sandstone, Carlile Formation, Niobrara Formation, Mancos B Shale, and Mancos A Shale), Upper Cretaceous Mesaverde Group (including the Sego and Rollins Sandstone Members of the Iles Formation, and the Cameo Coal Formation); and the Paleogene Wasatch Formation. Formations bearing both oil and gas include the Triassic Chinle Formation; Jurassic Entrada Sandstone and Morrison Formations; Lower Cretaceous Dakota Formation, Upper Cretaceous Mancos Formation (Mancos Shale and Morapos Sandstone units), and Upper Cretaceous Mesaverde Group (Corcoran and Cozzette Members of the Iles Formation, and the Williams Fork Formation) (USFS, 2020).

Igneous quartz monzonite/granodiorite porphyry (Tp) dikes, sills, and stocks are exposed in Redwell Basin on the north slope of Mt. Emmons, as is a small felsite (f) breccia pipe and dike (Figure 2, Map 11) (Gaskill et al., 1967). Mineral exploration drilling has indicated that the breccia pipe is more likely a composite of felsite, igneous breccia, and rubble breccia and has suggested that the pipe vented from an unexposed rhyolite–granite porphyry intrusive complex underlying Redwell Basin at depths greater than about 3,000 feet. Past exploration also suggests that the stock underlying Redwell Basin near the surface (the Redwell Stock) is part of a much larger and deeper 16- to 18-million-year-old (Ma) granite porphyry stock that underlies Mt. Emmons and Red Lady Basin to the southeast (the Red Lady Stock) (Figure 2; Gaskill et al., 1967; Sharp, 1978; Thomas and Galey, 1982; Gaskill et al., 1987). Subsurface molybdenite was first identified in Redwell Basin on north slope of Mt. Emmons in 1970. In 1976, this initial finding led to the discovery of the richest molybdenum deposit in the area, the Mt. Emmons Molybdenum Deposit, located in Red Lady Basin on the southeast side of Mt. Emmons.

The three Federal Mt. Emmons Area Parcels are within the Ruby-Irwin Mining District where numerous geochemical and geophysical studies have been conducted by government agencies and various exploration companies as part of resource assessments and Federal Superfund projects. Additionally, there has been a considerable amount of geologic mapping and geochemical sampling, both surface and underground, at varying scales. During a period between 1974 and 2008, multiple companies, including AMAX Exploration, Cyprus-AMAX, US Energy Corp, Phelps Dodge, MEMC, and Kobex Resources, completed 190,769 feet of surface and underground diamond drilling, as well as surface and subsurface geologic mapping and sampling of the Mt. Emmons molybdenum deposit (Kobex Resources, 2007). A regional aeromagnetic survey was the only geophysical work completed at Mt. Emmons prior to the discovery of the molybdenum deposit. Anomalous magnetic highs were found associated with molybdenum, gold, silver, zinc, tungsten, copper, lead and other mineralized rocks in Redwell and Red Lady basins (Rosenbaum, 1977). Upon the discovery of magnetite associated with the ore deposits, the aeromagnetic survey data (originally flown in 1970), was reinterpreted toward identifying the deeply buried Red Lady Stock. Follow-up ground-based magnetic surveys on the southern slopes of Mt. Emmons confirmed the anomaly discovered during the reinterpretation. Other geophysical studies included a gravity survey and a complex resistivity survey. Survey results associated with the gravity survey were inconclusive. Results from the complex resistivity survey confirmed mineralization associated with sulfide ore materials along the Keystone and other local veins (Thomas and Galey, 1982).

4.2.2 Site Geology, Non-Federal Parcel A

Primary bedrock units in the Three Peaks Ranch Area include Paleogene granodiorite and quartz monzonite porphyry (Tp) of the Carbon Peak Laccolith, and shales of the Mesaverde Group (Kmv) (Map 11). Locally, bedrock contact relationships are unclear due in part to the presence of overlying unconsolidated surficial deposits, including alluvium (Qa), alluvial fan deposits (Qf), talus (Qt), landslide deposits (Qlu), and other surficial debris (Qr and Qdu). The Mt. Axtell Laccolith, located about 2 miles north-northwest of Three Peaks Ranch, is composed of both granodiorite porphyry (Tp) and granodiorite (Tg) (Map 11). Table 2 provides a list of the rock units mapped by the USGS at and near this parcel, indexed by ascending age (youngest to oldest) (Gaskill et al., 1981). In contrast to Paleogene igneous rocks of the San Juan Volcanic Field, which are largely extrusive volcanics in which hot magma flows out onto the surface as lava or explodes violently into the atmosphere, those preserved in this region are largely intrusive igneous rocks that formed by crystallization of magma cooling slowly beneath the surface of the earth (Maps 10 & 11). Mt. Axtell, Carbon Peak, and Whetstone Mountain are about 30-million years in age and represent three of the seven West Elk Mountain intrusive laccoliths, or igneous mounds fed by a volcanic pipe from below that solidified at depth (Gaskill et al., 1981).

In 1973, the USGS completed a Bouguer gravity survey in and around the West Elk Volcanic Field. A northeast- trending gravity low coincident with the Colorado Mineral Belt was identified, as well as two northeast-trending gravity ridges, which have been interpreted to represent underlying intrusive rocks (Rosenbaum, 1977). While regional gravity lows are associated with the West Elk Volcanic Field, decreasing where quartz monzonite laccoliths intrude sedimentary rocks and ash flow tuffs, gravity anomalies do not appear to be directly associated with individual laccolithic mountains such as those of the Mt. Axtell, Carbon Peak, and Whetstone Mountain laccoliths surrounding Three Peaks Ranch. In advance of the gravity survey, the USGS flew an aeromagnetic survey in 1970 covering the area surrounding Three Peaks Ranch. Results of this survey indicate that large magnetic anomalies are associated with unaltered and unmineralized laccolithic centers. Two regional NURE-HSSR sediment geochemistry samples (Nos. 5063330 and 5063330) were collected along Carbon Creek within the Three Peaks Ranch Parcel boundary. Based upon Clarke Index values (Smith, 2004), these samples include anomalous barium (Ba), cerium (Ce), lanthanum (La), and thorium (Th). While anomalous levels may indicate proximity to hydrothermal mineral deposits, it has been found that elevated background levels for these elements are common in igneous rocks such as the granodiorite porphyry found in the nearby intrusive laccoliths. Additional geochemical sampling and associated reports are not available for this area (Mutschler et al., 1981).

4.2.3 Site Geology, Non-Federal Parcel B

Located within San Juan Volcanic Field, primary bedrock units found on this parcel include the Fish Canyon Tuff (Tpbf) and Nelson Mountain Tuff (Tndn) (Table 3), which filled the Cochetopa Park Caldera as volcanic flows (Map 12, Map 21). A nearby sample within the Nelson Mountain Tuff places its age at approximately 27-million years. Locally, this volcanic bedrock is overlain by Holocene colluvium (Qc), alluvium (Qal), alluvial fan deposits (Qf), and Pleistocene glacial outwash (Qg). Additional local bedrock units include tuffaceous sediments (Tpt) of the Cochetopa Park Caldera, older caldera-related volcanics, including rhyolite (Tsc and Tcfr), andesite (Tca), and other volcaniclastic rocks (Tcv) of the Conejos Formation erupted from the adjacent North Pass Caldera (Lipman, 2012). Pumice and perlite deposits are associated with white to gray tuffs and water-reworked intra-caldera tuffaceous sediments (Tpt). Table 3 provides a list of the rock units found in the parcel vicinity, indexed by ascending age (youngest to oldest). Beneath the Paleogene-age volcanics lies sedimentary rocks that are primarily Jurassic- to Cretaceous-aged lying within the San Juan Sag (Figs. 6 & 7), a foreland basin formed during the late Laramide Orogeny. Stratigraphic units within the Sag include the Jurassic Morrison Formation (Jm), Lower Cretaceous Dakota Sandstone (Kd), Upper Cretaceous Mancos Shale (Km), and Upper Cretaceous Mesaverde Group (Kmv) (Figure 8). First discovered in 1975, oil and natural gas deposits have been found in the Mancos Shale and Mesaverde Group within the San Juan Sag (Gries, 1989).

The dominant exposed bedrock at this parcel includes volcaniclastic rocks of the younger Cochetopa Park Caldera within the greater San Luis Caldera Complex, part of the San Juan Volcanic Field (Map 10). The Cochetopa Park Caldera (Map 21) is approximately 20-miles wide with vertical subsidence up to 2,600 feet. Early caldera-fill volcanic deposits located at and near the Monchego Creek Ranch Parcel within Cochetopa Park are composed of massive aprons of coarse landslide breccia inter-fingered with intra-caldera tuffaceous sediments. Structural features include complex interactions between regional northeast-trending faults, diverse faulting associated with volcanic caldera features, the underlying San Juan Sag, and extension related to the north-south-trending Rio Grande Rift Zone (Lipman, 2012).

Cochetopa Park is marked by a large negative gravity anomaly (Drenth et al., 2012). While the source of the low remains unknown, it has been postulated that the gravity contrast is due in part with surrounding Precambrian basement rocks along the caldera margins. Regional aeromagnetic surveys produced anomalies which are not deemed significant for mineral assessments, though may indicate fault structures which provide conduits for hydrothermal mineralizing fluids. However, within the San Juan Volcanic Field, gravity data has provided a clearer delineation of structures (Bankey, 2004). One regional NURE-HSSR sediment geochemistry sample (5062996) was collected along Monchego Creek within the Monchego Creek Ranch Parcel boundary that includes anomalous barium (Ba), cerium (Ce), bismuth (Bi), zinc (Zn), and uranium (U). While anomalous levels of barium and cerium may indicate proximity to hydrothermal mineral deposits, it has been found that elevated background levels are common in igneous rocks such as rhyolite, dacite, and andesite found on and adjacent to Monchego Creek Ranch.

4.2.4 Site Geology, Non-Federal Parcels C & D

The dominant rock units exposed in the vicinity of the Sheep Creek Ranch and Spanish Creek Ranch Parcels include Paleogene-age welded outflow ignimbrite (Tfc) derived from the nearby La Garita Caldera; dacite (Tnpd) and rhyolite (Tsc and Tscn) of the Cochetopa Hills volcanic series, which filled the North Pass Caldera; andesite (Tca), dacite (Tcd), rhyolite (Tcfr) and volcaniclastic rocks (Tcv) of the Lower Conejos Formation; overlain by Holocene colluvium (Qc) (Map 13 & 21). Rocks of the Lower Conejos Formation include thick accumulations of erupted lava flows and flow breccias surrounding central volcanoes which predate the later mid-Paleogene to Oligocene central caldera cluster of the San Juan Volcanic Field. Table 3 provides a list of the rock units found at and near these parcels, indexed by ascending age (Lipman, 2012). Similar to Non-Federal Parcel B, Jurassic to Cretaceous sedimentary rocks within the San Juan Sag are known to underlie area volcanic rocks. Refer to Section 4.1 Regional Geology above for additional information regarding this Laramide stratigraphic basin.

Bedrock exposed on these parcels is represented by a diverse assemblage of flows and volcaniclastic deposits that lie between the North Pass and Bonanza Calderas of the northeastern San Juan Volcanic Field (Maps 10 & 21). This assemblage is composed mainly of rhyodacite, quartz latite and andesite flows, tuffs, and welded breccia that concurrently erupted from two volcanoes to the southwest in the La Garita Mountains, prior to the formation of the nearby caldera complexes. Faults located in this area typically trend north to northeast between calderas, potentially representing structural trends of the Rio Grande Rift Zone found within the San Luis Valley located to the southeast.

Located on the northern edge of the North Pass Caldera, these parcels lie at the intersection of northeast- and northwest-trending gravity anomalies that represent boundaries of the San Juan Volcanic Field and the Ancestral Uncompahgre Uplift, respectively (Bankey, 2004). The presence of anomalous strontium (Sr), barium (Ba), zinc (Zn), cerium (Ce), and uranium (U) in four regional NURE-HSSR sediment geochemistry samples (Nos. 5062833 through 5062836) collected near the Sheep Creek Ranch and Spanish Creek Ranch Parcels may reflect the presence of underlying igneous basement structures in this area, similar to the gravity anomalies near Monchego Creek.

5. Description of Energy and Mineral Resources

Energy and mineral resources are classified into three categories in accordance with USFS regulations at 36 CFR 228 and BLM regulations at 43 CFR 3000. These categories will be discussed below and include:

1) Locatable (i.e., metallic elements and minerals including uranium and thorium; and certain non-metallic industrial minerals including perlite and pumice)
2) Leasable (i.e., coal, oil and gas, geothermal, sodium, potassium, phosphate, etc.)
3) Saleable (i.e., mineral materials including sand, gravel, boulders, clay, and similar materials)

Each mineral category will include a discussion of the following topics as outlined in Manual 3060 (BLM, 1994):

Known Mineral Deposits and Types

- A mineral deposit is defined as "*a mineral concentration of sufficient size and grade that it might, under the most favorable circumstances, be considered to have economic potential*" (Cox and Singer, 1986). In other words, known deposits are explored mineral bodies of sufficient size and grade that someone thought, at least in the exploration phase, might be economical to develop under the most favorable of circumstances.

- Mineral deposits, also known as mineral resources, can be classified into groups based on the level of certainty of geologic information (i.e., grade, quality, quantity, thickness) and level of economic viability or profitability analyses.

Known Prospects, Mineral Occurrences, and Mineralized Areas

- A known prospect is a potential site of mineral deposits based on preliminary exploration, geology, or geophysical anomaly, but has not given evidence of economic value (Neuendorf et al., 2011).

- A known mineral occurrence is a concentration of a mineral whereby the values have not been proven by exploration, but is considered valuable by someone, or that is of scientific or technical interest (Cox and Singer, 1986).

- A mineralized area is an identified zone of rocks that display some evidence of mineralization (e.g., alteration) and perhaps bearing minerals of interest.

Mining Claims, Mineral Leases, and Mineral Permits

- A mining claim is a parcel of land for which a claimant has asserted a right of possession and the right to develop and extract a discovered, valuable, locatable mineral deposit.

- A mineral lease is a contracted sale whereby the Federal government offers a parcel of land for leasable mineral extraction for fee and payment of royalties on production. In addition to mineral leases, there could be leasable solid or fluid energy and mineral resource permits and licenses.

- A mineral permit, in this context, is a contracted sale of mineral material (saleable) to the public at fair-market value, and/or can be issued for free use to individuals, States, Counties, or other government entities (36 CFR 228 Subpart C).

Mineral Economics

- Disclosure of global and domestic mineral and energy commodity supply and demand trends and future outlooks, including domestic production, consumption, and net import/export statistics.

5.1 Locatable Minerals

Locatable minerals are minerals for which a statutory right exists to enter Public Domain Federal lands and locate a mining claim for the purpose of mineral prospecting, exploration, development, and extraction as granted by the General Mining Law of 1872, as amended. All NFS lands classified as reserved Public Domain lands are open to prospecting and developing locatable minerals unless they have been appropriated, withdrawn, or segregated from mineral location and entry (16 U.S.C. 482).

Locatable minerals include metallic minerals, certain non-metallic/industrial minerals, and "uncommon variety" mineral materials having a unique or special quality giving it a higher value. Locatable metallic minerals include, but are not limited to, gold, silver, platinum, copper, lead, zinc, molybdenum, uranium, thorium, and tungsten. Locatable non-metallic and/or industrial mineral resources include mineral commodities like fluorspar, mica, tantalum, heavy minerals in placer form, and gemstones (36 CFR 228.41(d); 43 CFR 3830.11-12). Note that uranium is a locatable hardrock mineral under the Mining Law of 1872 (30 U.S.C. §§ 21-42); however, in areas where the Federal government acquired the land, base and precious minerals including uranium, may be leasable under Title 43 CFR Part 3500 (43 CFR 3501.1).

5.1.1 Locatable Known Mineral Deposits and Types

5.1.1.1 Federal Parcels 1, 2 & 3

Historical Mineral Activity: Silver and base metals, including zinc, lead and copper, have been produced from fissure veins that occur within the historic Ruby-Irwin District beginning in the 1870s (Maps 14 & 15; Table 4; DRMS, 2022; USGS, 2022b). The principal veins historically mined within the Mt. Emmons area includes the Keystone, Micawber, and Daisy. The Keystone Mine, worked by various operators through 1974, produced silver and base metals from two northwest-trending veins and was later found to intersect the Mt. Emmons Molybdenum Deposit (Figures 3 & 4). The Micawber (or Standard) Mine was developed from adits in nearby Elk Basin and intersects the Redwell Stock molybdenum deposit, just north of the summit of Mt. Emmons. The Daisy Mine, also accessed through the Keystone Mine, is a curved vein that lies adjacent to the breccia pipe in Redwell Basin and contains similar minerals as the Keystone. Production figures for both mines are unavailable or incomplete; however, recorded production from the Ruby District after 1901 and before 1969 included about 24,000-ounces of gold, 5.2-million ounces of silver, 6.6-million pounds of copper, 30.9-million pounds of lead, 55.2-million pounds of zinc, and a few pounds of cadmium (Ludington and Ellis, 1983).

Polymetallic Veins: The proposed Mt. Emmons land-exchange parcels lie on the eastern boundary of the historic Ruby-Irwin District (Map 14), which includes previously mined hydrothermal vein deposits of silver, copper, zinc, lead and molybdenum, with minor cadmium and gold. Nearby historic mines, including the Standard, Forest Queen and Daisy mines, are located along the Keystone, Micawber-Standard and other polymetallic veins within the district (Map 15; DRMS, 2022; USFS, 2022). Additional prospects and unnamed shafts are also scattered throughout the district. While mineralogical character of the known ore deposits in the Ruby-Irwin District varies, common occurrences include argentiferous galena, pyrrhotite, pyrite, chalcopyrite, arsenopyrite, pyrargyrite and proustite (ruby-silver), rhodochrosite, rhodonite, tetrahedrite, native silver, native copper, and molybdenite (Emmons et al., 1894; Socolow, 1955; Ludington and Ellis, 1983). Accessory mineralization includes apatite, barite, calcite, cassiterite, epidote, fluorite, magnetite, monazite, topaz, tourmaline, siderite, and fluorite (Thomas and Galey, 1982; USGS, 2022b).

Through the early 1960s, the Keystone vein had been extensively explored, developed, and mined for 3,000 feet laterally and over 1,000 feet vertically (Figure 4). The vein strikes north-northwest, dips steeply to the west, and varies in width from several inches to as wide as 10 feet (Map 15). Mined vein materials consist of breccia and altered wall rock in a matrix composed of quartz with sulfide ore and lesser amounts of minor gangue minerals, and contains vugs (USBM, 1962). Sulfide ore material includes argentiferous galena, sphalerite, and chalcopyrite. Wall rock transitions from unaltered sandstone beds of the Mesaverde Group, to contact metamorphic hornfels, and propylitic to phyllitic altered rhyolite-granite porphyry of the Mt. Emmons Stock (Fig. 2; Sharp, 1978; Thomas and Galey, 1982). Initial exploration and primary access development of the Keystone vein was made by adit drifts at various elevations along the vein outcrop (Figure 3). Development of ore shoots was completed along raises, winzes, sublevels, and shrinkage stope. Mined ore and waste were transferred along the 2160 adit level to the surface and mill. During production, mine output averaged 6,000-tons per month.

Molybdenum: Unmined stockworks of molybdenite deposits found in hornfels related to contact metamorphism of igneous intrusive activity occurring in the mid- to late-Paleogene period were discovered during the early 1970s beneath Redwell and Red Lady Basins on the slopes of Mt. Emmons (Figure 2; Map 11). Development of mine tunneling on the 2,000-foot level of the Keystone Mine provided access to numerous diamond core drill stations. Underground drilling delineated and defined the inverted cup-shaped molybdenite ore zone at the mine; the data was used for resource calculations and pre-feasibility studies (Figure 3). At its shallowest point, the top of the molybdenite zone is 885 feet below the surface of Red Lady Basin, averaging 2,100 feet in width, and extends to a depth of about 1,700 feet. This unmined molybdenite ore zone is draped over the convex top of the rhyolite-granite porphyry stock and extends into altered and metamorphosed Cretaceous rocks. The USGS included the Mt. Emmons Red Lady-Redwell Basin mineral deposits as a giant porphyry system in a database compilation of "the world's largest and most important porphyry-related deposits" (Mutschler et al., 1999). Mineralization includes lead, zinc, copper, molybdenum, tungsten, and tin (Sharp, 1978), within altered Cretaceous and Paleogene sedimentary rocks of the Upper Cretaceous Mancos Shale and Mesaverde Group, and the Eocene Wasatch Formation (Paleogene age).

Uranium: Uranium was discovered during the 1950s within the Ruby-Irwin District. Prospectors located uranium in the lower part of the Eocene Wasatch Formation along Ruby Anthracite Creek, 5 miles to the west of Federal Parcels 1-3 and roughly 1 mile northwest of Kebler Pass. Later, in 1978, anomalous radioactive material was found in Paleocene Ohio Creek Formation and (or) the Eocene Wasatch Formation waste rock material on a dump at the Standard Mine (Goodknight, 1981). Sandstone-hosted uranium occurrences are found concentrated within the Ruby-Irwin Mining District. These occurrences include uranium minerals filling intergranular pore spaces and replacing carbonaceous material, quartz grains, and interstitial cements in clastic rocks, mainly sandstones. Permissive areas of uranium mineralization include feldspathic and carbonaceous sandstone units occurring interbedded with mudstones and shales. Evidence that mineralization has occurred includes anomalous geochemistry and (or) radioactivity from samples collected at mine waste dumps within the proposed Mt. Emmons land-exchange area. One sample of radioactive material taken during NURE quadrangle evaluation from a nearby mine dump at the Standard Mine contained 0.59-percent uranium (U_30_8). Other samples of mineralized rock taken during NURE quadrangle evaluation contain up to 0.035 percent uranium (U_30_8) (Bankey, 2004; Goodknight, 1981; USGS, 2022b)

Mineral Targets: Based on available reports, data and other information, there are several identified mineralized targets on both NFS lands and patented claims within the area, including Mt. Emmons (Red Lady, Lucky Jack), Keystone, Daisy, and other unnamed prospects (Map 6). Most targets are closely related to the breccia pipe, quartz monzonite porphyry, and interconnecting structural fault system. Of these targets, preliminary mineral resource estimates have been completed for the Mt. Emmons molybdenum deposit, including an indicated mineral resource of 155-million tons grading 0.44 percent molybdenite (MoS_2) at a 0.2 percent cutoff (Dowsett et al., 1981). Additional mineral targets may be located along the Keystone and Daisy base-metal veins, though no major exploration or development work has been completed since the closure of the Keystone Mine in 1974.

5.1.1.2 Non-Federal Parcel B

At Monchego Creek Ranch, locatable pumice and perlite industrial mineral deposits have been identified near the south edge of Cochetopa Dome within Cochetopa Park (Map 16). Mostly horizontal in attitude, the deposit is found to be up to 10-feet thick, exposed in road cuts, and potentially extends beneath alluvial fan deposits (Qf) found at Non-Federal Parcel B (Map 12). Large tonnages appear to be available, although of somewhat varied quality. The pumice lies on the valley floor south of Cochetopa Dome and is marked by adjacent cliffs of perlite 80- to 100-feet high. Volcanic ash is associated with the pumice, which is covered in places by as much as 2 feet of overburden. Among the largest in the State of Colorado, these proven pumice deposits are amenable to open pit or open cut methods of mining (Bush, 1951; Del Rio, 1960).

5.1.1.3 Non-Federal Parcels A, C & D

There are no known locatable mineral deposits located on the proposed Three Peaks Ranch, Spanish Creek Ranch and Sheep Creek Ranch Parcels (Bankey, 2004; Mutschler et al., 1981; Streufert et al., 1999; Wilson et al., 2000; Cappa and Wallace, 2007; BLM, 2022a; BLM, 2022c; DRMS, 2022; USGS, 2022b).

5.1.2 Locatable Known Prospects, Mineral Occurrences, and Mineralized Areas

5.1.2.1 Federal Parcels 1, 2 & 3

Additional locatable mineral occurrences upon and immediately adjacent to the proposed Mt. Emmons land-exchange parcels include prospect pits, excavations, shafts and tunnels having no recorded production. These sites are located near Gunsight Pass, the summit of Mt. Emmons, and areas of upper Redwell Basin and Red Lady Basin (Map 6, Table 5).

5.1.2.2 Non-Federal Parcel A

There are no known locatable mineral prospects, locatable mineral occurrences, or defined mineralized areas located on the proposed Three Peaks Ranch Parcel or the surrounding lands (Horton and San Juan, 2023; BLM, 2022a; BLM, 2022c; DRMS, 2022; USGS, 2022b).

5.1.2.3 Non-Federal Parcel B

There are no known locatable mineral prospects, mineral occurrences, or defined mineralized areas located on the proposed Monchego Creek Ranch Parcel (Cappa and Wallace, 2007; Horton and San Juan, 2023; BLM, 2022a; BLM, 2022c; DRMS, 2022; USGS, 2022b). Historically, perlite has been mined from small open cuts located 3 to 5 miles north of the Monchego Creek Ranch (USGS, 2022b); however, there are no active or inactive mining permits associated with either location (DRMS, 2022). No additional mining records are available. A series of north-northwest trending prospects which both tested and helped to delineate this mineral deposit are located 1 mile to the north of the proposed Monchego Creek Ranch Parcel (Map 12).

5.1.2.4 Non-Federal Parcels C & D

There are no known prospects, mineral occurrences, or defined mineralized areas located on the proposed Spanish Creek Ranch and Sheep Creek Ranch Parcels or the surrounding lands (Horton and San Juan, 2023; BLM, 2022a; BLM, 2022c; DRMS, 2022; USGS, 2022b).

5.1.3 Locatable Critical and Strategic Minerals

Critical and strategic minerals are a select group of primarily locatable minerals that change depending on several factors including technology, political climate, and global economics. Critical minerals are mineral resources that are essential to the economy and whose supply may be disrupted. Specifically, critical minerals have been defined as: (i) a non-fuel mineral or mineral material essential to the economic and national security; (ii) the supply chain of which is vulnerable to disruption; and (iii) that serves an essential function in the manufacturing of a product, the absence of which would have significant consequences for our economy or our national security. The Secretary of Interior published a "*Final List of Critical Minerals 2018*" in the Federal Register on May 18, 2018, identifying 35 critical minerals (83 FR 23295) (DOI, 2018). The finalized list is not a permanent list and is intended to be dynamic and updated periodically to reflect changing supply, demand, and concentration of production, as well as domestic policy priorities. The list was expanded in 2022 to include 50 minerals (DOI, 2022).

In 2022, the USGS updated their list of mineral commodities or commodity groups that were determined to be critical and/or strategic based on listing in one or more recent studies assessed on risk to supply and/or impact of potential supply restrictions (USGS, 2022a). Upon review of the U.S. Department of Defense 2021 Strategic and Critical Materials Review and the Defense Logistics Agency list of materials of interest, for the purposes of this report, minerals are characterized as both critical and strategic resource commodities (DOD, 2021; DLA, 2022).

5.1.3.1 Federal Parcels 1, 2 & 3

Of the minerals listed within the 2022 Mineral Commodity Summaries, niobium, rubidium, tin, tungsten, and zinc are locatable critical and strategic minerals identified as having a moderate potential for occurrence within the Mt. Emmons Area (Thomas and Galey, 1982) and along the Keystone, Micawber-Standard, and other polymetallic veins within the Ruby-Irwin Mining District (Maps 14 & 15; USGS, 2022b).

5.1.3.2 Non-Federal Parcels A, B, C & D

No known critical or strategic minerals are known to exist within, or in the immediate vicinity of, the proposed Three Peaks Ranch, Monchego Creek Ranch, Spanish Creek Ranch, and Sheep Creek Ranch Parcels (Dicken et al., 2019; Hofstra and Kreiner, 2020; Schulz et al., 2017; Schwochow and Hornbaker, 1985; USGS, 2022b).

5.1.4 Locatable Mining Claims, Leases, and Permits

5.1.4.1 Federal Parcels 1, 2 & 3

Within Federal Parcel 1, there are 15 mill sites encompassing 73 acres and 51 active unpatented lode claims encompassing 495 acres (Map 6). On Federal Parcel 2, there are 5 active unpatented lode claims encompassing 90 acres. There are no active mill sites or unpatented lode claims lying within Federal Parcel 3. There were no placer claims or tunnel sites active according to BLM MLRS records (accessed December 1, 2022). In addition to the unpatented claims on NFS lands, there are no patented claim inholdings within the proposed Mt. Emmons land-exchange boundaries. Additional land status information has been collected from BLM land records, USFS, and MEMC. There are no records of active or inactive DRMS permits within the subject parcels (DRMS, 2022). See also Table 1; Map 6; and Appendix 3.

5.1.4.2 Non-Federal Parcel A

Within the proposed Three Peaks Ranch Parcel, there are 25 mill sites (~58 acres) lying partially within Non-Federal Parcel A (Map 7) according to BLM MLRS records (accessed December 1, 2022). There are no records of any DRMS permits or BLM mineral leases within the subject parcels (DRMS, 2022; BLM, 2022a; BLM, 2022c). See also Table 1; Map 7; and Appendix 3.

5.1.4.3 Non-Federal Parcels B, C & D

Within the proposed Monchego Creek Ranch, Spanish Creek Ranch and Sheep Creek Ranch Parcels there are no active unpatented mining claims and no mill sites according to BLM MLRS records (accessed May 18, 2022). There are no records of any DRMS permits or BLM mineral leases within the subject parcels (DRMS, 2022; BLM, 2022a; BLM, 2022c). See also Table 1; Maps 8 & 9; and Appendix 3.

5.1.5 Locatable Mineral Economics

5.1.5.1 Federal Parcels 1, 2 & 3

Lands that include the proposed Mt. Emmons Area Parcels has a 150+ year history of mining activities producing an unknown amount of silver, copper, zinc, lead, and gold (Table 5). Similar to known and previously mined ore deposits, several reports have concluded that there is a potential for development of the three porphyry molybdenum deposits in the Mt. Emmons vicinity (Dowsett et al., 1981; Ganster et. al., 1981; Thomas and Galey, 1982); however, at this time, no future exploration or development of the existing mine workings has been planned. An estimated 155-million tons of mineralized porphyry averaging a grade of 0.44 percent molybdenum at a 0.2 percent cutoff, with an additional moderate to high potential for accessory silver, lead, zinc, gold, and critical minerals.

During the 1950s, uranium ore material was mined at the Yellowdog and Pearl B Claims located roughly 1 mile northwest of Kebler Pass within the Ruby-Irwin District. Workings included prospect pits and one short adit. Within stream samples, mineralized material located within the Ruby-Irwin District has been found to contain up to 0.035 percent U_3O_8 and the waste rock material at the Standard Mine contained 0.59 percent U_3O_8. However, there are presently no defined and delineated mineable resources estimates for uranium within the Mt. Emmons vicinity or the Ruby-Irwin District.

Each year the USGS publishes a report which summarizes significant trends and issues as well as export and net import reliance for several mineral and energy commodities. Production and market trends for locatable minerals known to occur within the Mt. Emmons vicinity are summarized in Appendix 4.

5.1.5.2 Non-Federal Parcel B

Mineral market trends for pumice and perlite are summarized in Appendix 4; however, based upon the limited available locatable mineral research reports, there are presently no resource estimates for the deposit located within Cochetopa Park and potentially beneath the Monchego Creek Ranch Parcel.

5.1.5.3 Non-Federal Parcels A, C & D

Based upon the locatable mineral research, there are no mineral economics to report for the Three Peaks Ranch, Spanish Creek Ranch and Sheep Creek Ranch Parcels, and the immediate vicinity of each.

5.2 Leasable Minerals and Energy Resources

Leasable energy and mineral commodities have been excluded from location under the General Mining Law of 1872 (30 U.S.C. §§ 21-42). Leasable commodities have been defined through subsequent legislation including the Mineral Leasing Act of 1920, Mineral Leasing Act for Acquired Lands of 1947 and the Geothermal Steam Act of 1970, which authorized the leasing of public lands for a fee and royalties on production payable to the Federal government. These commodities include coal, oil, gas, oil shale, gilsonite, phosphate, potassium (potash), sodium, geothermal, sulfur (in certain states), and hardrock minerals on acquired NFS lands. Note that for the purposes of this report, natural gas includes all natural occurring mixtures of gaseous hydrocarbons, consisting primarily of methane, and lower quantities of trace inert gas such as carbon dioxide, nitrogen, hydrogen sulfide, and helium gas. As noted in Section 5.1, uranium is a locatable hardrock mineral under the Mining Law of 1872 (30 U.S.C. §§ 21-42); however, in areas where the Federal government acquired the land, base and precious minerals including uranium, may be leasable under Title 43 CFR Part 3500 (43 CFR 3501.1).

5.2.1 Leasable Known Mineral Deposits and Types

There are no active mineral or energy leases located upon or within 10 miles of both the Federal and Non-Federal Parcels included in the proposed land-exchange area (ECMC, 2022; DRMS, 2022; BLM, 2022a; BLM, 2022c). For additional information on leases, refer to *Section 5.2.4 Leasable Mineral and Energy Leases, Licenses, and Permits* and *Appendix 3: Mineral & Land Records System Reports* within this report.

5.2.1.1 Federal Parcels 1, 2 & 3

In the case of leasable minerals, known mineral deposits include, but are not limited to, those contained within Known Geologic Structures (KGSs), Known Geothermal Resource Areas (KGRAs), Known Leasing Areas (KLAs), and Known Recoverable Coal Resource Areas (KRCRAs) (BLM, 1984). There are presently no published deposits of any leasable mineral or energy resources located within the proposed Mt. Emmons land-exchange area.

5.2.1.2 Non-Federal Parcels A, B, C & D

Research indicates that there are no known leasable mineral deposits located within or near the Three Peaks Ranch, Monchego Creek Ranch, Spanish Creek Ranch, and Sheep Creek Ranch Parcels (USGS, 2022b).

5.2.2 Leasable Known Prospects, Mineral Occurrences, and Mineralized Areas

5.2.2.1 Federal Parcels 1, 2 & 3

Coal: Near the proposed Federal Parcels in the Mt. Emmons Area, there are known leasable coal occurrences that are part of the Crested Butte Coal Field in the Uinta Coal Region (Maps 17 & 18). In a 35-square-mile area near the Town of Crested Butte, mineable coal resources are estimated at approximately 240-million tons (Streufert et al., 1999). Between 1884 and 1992, coal mines within 3 miles of this study area produced about 19-million tons of coal. These are thermal coals that range from high-volatile C to anthracite. Up to six coal beds 2- to 14-feet thick occur within a 250-foot zone of the Ohio Creek Member. Beneath the surface, the Red Lady Stock intrudes a portion of the Mesaverde Group where mineable coal units are located. Wall rock coal units, or those rock units within direct contact of the porphyry, have likely been metamorphically altered to create high grade anthracite coking coal within Mt. Emmons Area Federal Parcels 1-3 (Dapples, 1939).

Oil and Gas: Located along the southeastern edge of the Piceance Basin (Maps 19 & 20), hydrocarbons are generated from thick, organic-rich shales of the Mancos Formation and multiple coal zones within Mesaverde Group. Petroleum systems in this proven basin include conventional oil and natural gas, unconventional natural gas, and coalbed methane resources. Typical traps and seals within the southern Piceance Basin include both structural and stratigraphic traps. Potential reservoir rocks include the Mesaverde Group and underlying Mancos Shale (USFS, 2020). Locally, these rock formations have been uplifted, tilted, folded, fractured, and locally intruded by Paleogene igneous rocks which decreases the overall likelihood of effective vertical and lateral seals for potential oil and gas accumulations (Streufert et al., 1999). No recent oil and gas exploration has been completed within 10 miles of the Mt. Emmons vicinity. The most recent well completions in Gunnison County were recorded in 2015, within the Somerset Coal Field, located 20 miles to the west-northwest of the subject parcels (ECMC, 2022).

Geothermal: There are no known geothermal resources on or near the proposed Federal Parcels in the Mt. Emmons Area (Map 22). Hydrogeological evidence does not suggest any direct connection between groundwater in the local watershed and the geothermal spring systems feeding Conundrum Hot Springs about 12 miles to the northeast (Pearl, 1981) or the Somerset geothermal anomaly located approximately 20 miles to the west-southwest (Berkman and Watterson, 2010).

5.2.2.2 Non-Federal Parcel A

Coal: Similar to the Mt. Emmons Area and local to the proposed Three Peaks Ranch Parcel, there are known leasable coal deposits and occurrences. Known coal host rock units within the Mesaverde Group underlie a portion of this parcel. Geothermal heat, characteristic of the numerous Paleogene intrusions, including sills, and dikes, found within the adjacent Mt. Carbon, Mt. Axtell, and Whetstone Mountain laccoliths (Map 11), has helped to create high-grade anthracite coking coal resources within the area. Past-producing coal mines located just 2 miles south of the Three Peaks Ranch developed coal seams ranging between 4 and 8 feet in thickness within the Ohio Creek stratigraphic interval (Map 18) (Gaskill et al., 1987).

Oil and Gas: No known accumulations of oil or gas have been identified at the proposed Three Peaks Ranch Parcel area due to very limited past exploration efforts. While it is likely that coalbed methane gas has developed in the subsurface within local coal beds, there have been no reported occurrences within the subject parcel vicinity. Four oil and gas exploration boreholes located 6 miles to the south in Sections 21 & 28, Township 15 South, Range 86 West, were drilled to depths between 3,400 and 4,000 feet, targeting Dakota Sandstone and Entrada Sandstone hosted oil traps (Map 20). There was never any recorded production, and the wells were permanently plugged and abandoned (ECMC, 2022).

Geothermal: There are no known geothermal resources at the proposed Three Peaks Ranch Parcel and in the immediate area. Hydrogeological and structural geologic evidence (Map 22) does not suggest any direct connection between groundwater in the local watershed and regional geothermal spring systems (Pearl, 1981), or to the geothermal spring systems feeding Ranger Hot Springs and Cement Creek Warm Springs located about 8 miles to the east (Berkman and Watterson, 2010).

5.2.2.3 Non-Federal Parcel B

Coal: There are no known coal occurrences located at or near the Non-Federal Monchego Creek Ranch Parcel (Map 17). While there are presently no known favorable geologic units and/or structures conducive for feasible coal production, it should be mentioned that hypothetically there may exist favorable carbonaceous Cretaceous sedimentary rocks in the San Juan Sag beneath intra-caldera volcanic flows of rhyolite, dacite, and andesite. Regionally, the thickness of the overlying Paleogene volcanic rocks ranges from 3,000 to 10,000 feet (Gries, 1985).

Oil and Gas: The San Juan Sag is a northwest-trending sedimentary embayment bounded by Laramide uplifts including the San Juan Dome located to the west, the Archuleta Anticlinorium to the south, the San Luis/Sangre de Cristo Uplift to the east, and the Uncompahgre Uplift to the north (Figures 5 & 6). This sedimentary basin is concealed by volcanic flows originating along the eastern boundary of the San Juan Volcanic Field (Gries, 1985; Brister and Chapin, 1994). Like source rocks within the adjacent San Juan Basin, oil and gas source rocks within the San Juan Sag include marine shales of the Upper Cretaceous Mancos Formation and Lewis Shale Unit of the Mesaverde Group, along with deeper Mesozoic formations (Fig. 8) (Gries, 1985). Stratigraphic traps in the San Juan Sag are typically formed by up-dip pinch-out of porous sandstone against relatively impermeable units such as shales, coals, tight sands, or igneous features such as Paleogene dikes and sills (USFS, 2006b). While the potential for petroleum deposits exists beneath the San Juan Volcanic Field, there are presently no known wells located at or within 10 miles of the proposed Monchego Creek Ranch Parcel (Map 21; ECMC, 2022).

Geothermal: There are no known geothermal resources at the proposed Monchego Creek Ranch Parcel. While geothermal springs related to the Rio Grande Rift are located within the San Luis Valley to the southeast, hydrogeological evidence does not suggest any direct connection between groundwater in the local watershed and those systems (Reiter et al., 1975), nor to the fault-controlled geothermal systems feeding Cebolla Hot Springs and Waunita Hot Springs (Map 22) (Pearl, 1979 & 1981).

5.2.2.4 Non-Federal Parcels C & D

Coal: There are no known coal resources at the Non-Federal Spanish Creek Ranch and Sheep Creek Ranch Parcels. The nearest coal region is the Crested Butte Field, about 40 miles northwest of the two parcels (Map 17). While there are presently no known favorable geologic units and/or structures conducive for feasible coal mining, it should be mentioned that hypothetically there may exist favorable carbonaceous Cretaceous sedimentary strata included in the San Juan Sag beneath intra-caldera volcanic flows of rhyolite, dacite, and andesite. Regionally, the thickness of the overlying Paleogene volcanic rocks ranges from 3,000 to 10,000 feet (Gries, 1985).

Oil and Gas: Similar to the discussion of the San Juan Sag in Section 5.2.2.3 above, there are presently no known wells located at (or within 10 miles of) the proposed Spanish Creek Ranch and Sheep Creek Ranch Parcels (Map 21) (ECMC, 2022). Although the Sag may have the potential for containing economic oil and gas accumulations, limiting factors such as rugged terrain, poor seismic data (due to the difficulty of imaging below the shallow volcanics), abundant faulting, and igneous-related metamorphism has discouraged exploration activity in this area. Regionally, wildcat boreholes have been drilled 18 miles to the east and up to 32 miles to the south-southeast (Map 21). No commercial production, however, was ever established from these wells (ECMC, 2022).

Geothermal: There are no known geothermal resources at the proposed Spanish Creek Ranch and Sheep Creek Ranch Parcels. While geothermal springs related to the Rio Grande Rift are located within the San Luis Valley to the southeast, hydrogeological evidence does not suggest any direct connection between groundwater in the local watershed and systems associated with the Rio Grande Rift (Reiter et al., 1975). Additionally, there does no to be any hydraulic connection between the two parcels and the fault-controlled geothermal systems feeding Cebolla Hot Springs to the west and Waunita Hot Springs to the north (Map 22) (Pearl, 1979 & 1981).

5.2.3 Leasable Critical and Strategic Minerals

Not applicable – there are no leasable critical and strategic mineral commodities because there are no NFS acquired land parcels associated with this land exchange.

5.2.4 Leasable Mineral and Energy Leases, Licenses, and Permits

There are no active leasable mineral permits, energy leases or licenses, lease applications, prospect permits, applications for prospecting permits, or nominated lands for leasable sales within or adjacent to any of the Federal or Non-Federal Parcels in this land exchange proposal. This conclusion is supported by the lack of permitting or leasing records for the subject parcel (ECMC, 2022; BLM, 2022a; BLM, 2022c; DRMS, 2022).

5.2.5 Leasable Mineral Economics

5.2.5.1 Federal Parcels 1, 2 & 3

Coal: In the North Zone of the project area, approximately 240-million tons of mineable thermal coal within beds up to 14 feet thick has been estimated for the Crested Butte Coal Field (Streufert et al., 1999). The potential for up to 10,000,000 cubic yards (about 12,700,000 short tons) of high-volatile C to anthracite coal resources is calculated here based on an average coal bed thicknesses 14 feet over the combined 550-acre area (0.8 square mile) of the three Federal Parcels. The economic value of coal reserves on the Federal Parcels is primarily driven by sale price. In 2020, the average price of high volatile C bituminous to anthracite coal in 2020 display significant variability, ranging between $50 to $100 per short ton when mined underground. Costs also varied widely and were strongly influenced by transportation expenses, particularly the mode of transport (i.e. rail, barge, truck) and its dependence oil and diesel prices (Appendix 4; EIA, 2022).

Oil and Gas: Leasable natural gas resources have high resource potential on the three Federal Parcels because of known occurrences of these fluid minerals across the southeastern Piceance Basin (USFS, 2004b). While there are no records of ECMC or DRMS permits on or near the Mt. Emmons Area Parcels, natural gas is being commercially produced from favorable reservoir rocks in the Piceance Basin approximately 20 miles to the west-northwest (ECMC, 2022; DRMS, 2022; BLM, 2022a; BLM, 2022c). As of June 2022, the average U.S. price of industrial natural gas was close to $9.66 per thousand cubic feet. Future trends indicate that natural-gas consumption will decrease as more renewable electricity generation capacity comes online (Appendix 4; EIA, 2022).

5.2.5.2 Non-Federal Parcel A

Coal: Combined mineable, underground coal resources within the Crested Butte Coal Field are estimated at approximately 240-million tons (Streufert et al., 1999). Similar to Federal Parcels 1-3 in the Mt. Emmons Area, Three Peaks Ranch is located within the Crested Butte Coal Field and may contain up to 5,000,000 cubic yards (6,350,000 short tons) of high-volatile C to anthracite coal. Refer to Appendix 4 for additional leasable mineral economic information for this thermal coal resource.

Oil and Gas: There are no records of ECMC or DRMS permits at the Three Peaks Ranch Parcel and within the immediate area (ECMC, 2022; DRMS, 2022). Based on the presence of commercial natural gas production within the Piceance Basin 20 miles to the west-northwest (ECMC, 2022; BLM, 2022a), there is high potential for favorable target reservoir rocks at Three Peaks Ranch. However, future trends indicate natural-gas consumption will decrease as more renewable electricity generation capacity comes online and the economic outlook will be negatively impacted (Appendix 4; EIA, 2022).

5.2.5.3 Non-Federal Parcel B

Oil and Gas: Within the San Juan Sag, oil and gas exploration began in earnest during the late 1970s and early 1980s. Initial exploration drilling revealed highly fractured rock and thick biodegraded oil. Relative depths to favorable sedimentary host rocks beneath Paleogene volcanics have been found to be consistent and have shown that a significant potential exists for hydrocarbon reserves across the San Juan Sag (Gries, 1985); however, there are presently no published resource estimates for this underexplored area. The largest field within the San Juan Sag is the now inactive Gramps Field located 12 miles east of Chromo, Colorado in Archuleta County, where about 15-billion cubic feet of gas was produced through 1990. Oil at the Gramps Field, found within the Dakota Sandstone, is characterized as intermediate paraffinic or kerosene fuel oil (Donovan, 1978). Appendix 4 provides additional leasable mineral economic information for both petroleum oil and natural gas.

5.2.5.4 Non-Federal Parcels C & D

Oil and Gas: There are no records of ECMC or DRMS permits at the Sheep Creek and Spanish Creek Ranch Parcels or within the immediate area (ECMC, 2022; DRMS, 2022). Similar to resources and leasable mineral economics described at the Monchego Creek Ranch Parcel, favorable target reservoir rocks are located within the San Juan Sag. Future trends in natural-gas consumption will decrease as renewable energy use capacities increase, and present worldwide petroleum oil reserves are estimated to be depleted by the year 2070 (Appendix 4; EIA, 2022).

5.3 Saleable Minerals

Saleable minerals, also known as mineral materials and/or common variety minerals, have been excluded from location under the General Mining Law of 1872 by such laws as the Mineral Materials Act of 1947, as amended. This Act authorized the Federal government to sell and dispose of common variety mineral products through a contract of sale or as a free use permit. Saleable minerals include materials such as sand and gravel, boulders, riprap, dimension/building stone, etc. The disposal of these mineral commodities is regulated on NFS lands by 36 CFR 228 Subpart C and is a discretionary agency action.

5.3.1 Saleable Known Mineral Deposits and Types

Primary sources of high-quality mineral materials are typically located along valley terraces and floodplains, at the base of talus slopes, and across alluvial fans (Arbogast et al., 2011). All proposed land exchange parcels contain potential sources of saleable materials in these settings, including riprap piles, landscape and decorative stone exposures, and unconsolidated sedimentary deposits. Locally available material has been historically used for road construction and maintenance, mine site access and reclamation/remediation work, stormwater management projects, and stock pond or other earth-work stormwater management projects.

5.3.2 Saleable Known Prospects, Mineral Occurrences, and Mineralized Areas

Excavation and use of talus/landscape material at two sites for maintenance work at MEMC's water treatment plant was recently conducted on the Federal Parcels (P. Leschak, 2022). Field visits by the authors on July 25 and 26, 2022 confirmed the lack of any developed sources at each of the proposed Non-Federal Parcels.

5.3.3 Saleable Contracts and Permits

Categorical exclusions were completed in 2020 and 2021 for the excavation and use of talus/landscape material on the Federal Parcels for maintenance work at MEMC's water treatment plant but were not entered into the USFS INFRA database. On Federal Parcel 1, at least one of these borrow sites is known to have been developed in 2020, however, a formal permit may not have been issued. Upon review of the USFS NRM database records for the GMUG National Forests, there are presently no active permits or contracts within 2 miles of the boundary line of the Non-Federal Parcels (P. Leschak, 2022).

5.3.4 Saleable Mineral Economics

Although there are occurrences of certain saleable commodities surrounding most of the proposed land-exchange parcels, there has been no documented past production and only limited interest for future development. Appendix 4 includes a summary of current saleable mineral economics for sand and gravel, including boulders.

6. Potential for Energy and Mineral Resources

This report assesses both the potential for energy and mineral resource occurrence and the potential (likelihood) for energy and mineral resource development on the subject parcels. This evaluation was based on a combination of extensive literature reviews, in addition to the evaluation of geologic maps and published technical reports. These resources provided the foundation for the professional judgment used in making the following mineral potential determinations. These determinations are limited to the management action that prompted this report, and do not constitute proof of the presence or absence of an energy or mineral resource.

Mineral Occurrence Potential: The determinations of potential for the occurrence of energy and mineral resources in the proposed project area were based on a number of factors including: (1) evidence of the existence of a favorable geologic setting, either lithologic or structural; (2) evidence of the existence of a mineralized process; (3) evidence of the existence of minerals of importance in known geologic host rock or structures; (4) the existence of sufficient mining-related activities (i.e., shafts, adits, dumps, exploration boreholes, wells) within or adjacent to the area; (5) the existence of historical production; (6) proximity to active and closed mining claims and solid and fluid mineral permits, licenses, and leases; (7) proximity to areas where the mineral potential has already been determined; and (8) the likelihood of future mining claim locations or solid and fluid mineral permits, licenses, or leases and associated operations. The energy and mineral occurrence classification used in this report follows the direction provided by the *Mineral Potential Classification System* in Manual 3031, using the two-part rating system to assess both the level of occurrence potential and the level of certainty associated with the occurrence potential determinations (Appendix 5; BLM, 1985) and *Development Potential Classification System* (Appendix 6).

Mineral Development Potential: The USFS has also found the evaluation of development potential or the likelihood of development a useful and valuable tool to further inform the Authorized Officer when sufficient information is available to do so. Mineral development assessment addresses the likelihood of mining claim locations or solid and fluid mineral permits, licenses, or leases and associated operations on the Non-Federal Parcels subsequent to acquisition, in order to identify known or potential mineral management issues or concerns that could conflict with the management purposes for which the subject lands are acquired. BLM Manual 3031 (1985) acknowledges this fact and defines development potential as whether or not an occurrence or potential occurrence of an energy or mineral resource is likely to be explored or developed within a specified timespan under specified geologic and non-geologic assumptions and conditions. As such, determining the development potential of either a known or undiscovered mineral occurrence is a matter of professional judgment based on relevant factors and pertinent information available at the time (BLM, 1994). Geologic factors include, but are not limited to, those factors commonly used to determine mineral potential: geologically favorable conditions, geochemical or geophysical data of a character that might encourage further exploration, any existing documentation of exploration results or mineral deposit information (type, mineralogy, tonnage, grade), proximity to known historical workings or boreholes/wells and mines or fields/reservoirs with past production, recent exploration or development operations, and likely future exploration or development activities and methods. Non-geologic factors include, but are not limited to, location and access (including access to the mineral estate), commodity supply/demand and price trends, technological limitations or advances, project costs and economics, environmental and social considerations, and the regulatory and permitting framework for compliance with applicable laws and regulations.

The information and data presented in this report and aforementioned factors serve as the basis for the author's professional judgment in assessing development potential when available information is sufficient to make a determination. For the purposes of this report, the timespan for development potential was evaluated and disclosed using a 20-year time period, which is based on the maximum time frame for such predictions. BLM Manual 3031 does not contain a classification system for evaluating development potential. As such, the USFS uses the energy and mineral-resource development potential rating system presented within Appendix 6.

6.1 Locatable Minerals

Locatable minerals have been divided into the metallic and non-metallic/industrial mineral sections below. These two sections address all metallic minerals including uranium and thorium along with all locatable non-metallic minerals/industrial minerals as specifically outlined in the Manual 3060 (BLM, 1994) requirements.

6.1.1 Locatable Metallic Minerals

6.1.1.1 Federal Parcels 1, 2 & 3

Metallic minerals including gold, copper, molybdenum, silver, lead, zinc, and uranium have been documented as both mined and/or having potential mineral resources throughout the general vicinity of Mt. Emmons. These minerals have been explored for and developed since the 1860s, resulting in designation of the historic Ruby-Irwin Mining District. Numerous published reports identified this area as having potential for the occurrence of locatable metallic minerals. While historical production figures are unavailable or incomplete for the polymetallic vein systems, reports have identified mineral resource estimates of 155-million tons grading 0.44-percent MoS_2 at a 0.2-percent cutoff for the molybdenum deposits beneath Red Lady Basin and Redwell Basin. Additionally, rock geochemistry of samples collected on historic mine dumps within the Ruby-Irwin Mining District have locally been found to contain up to 0.59 percent uranium (U_3O_8).

The Keystone Mine and adjacent delineated porphyry-related molybdenum deposits of Mt. Emmons also have high potential for metallic mineral resources. Evidence includes the presence of numerous historical mine prospects and favorable geochemical and geophysical exploration data across the uplift, as well as reported and known mineral deposit occurrences and a history of proven commercial production at the Keystone Mine (Map 15). Known metallic mineral deposits include gold, silver, copper, lead, molybdenum, and uranium, and critical and strategic mineral deposits of tin, tungsten, and zinc.

Based upon site specific geology, past prospecting and more recent exploration activity, and proven commercial production immediately adjacent to the Federal Parcels, all portions of Federal Parcels 1-3 are considered to have high (H) potential for the same suite of locatable mineral occurrences described above. There is abundant direct and indirect evidence to support the existence of mineral resources with high certainty (D) for areas mapped with high mineral potential across the Mt. Emmons uplift. Therefore, the locatable metallic mineral occurrence potential is for the three Federal Parcels is high (H/D). The potential for development is moderate (M) based upon the sentiment, opinions, and preference of the general public living 5 miles to the east in Crested Butte coupled with the complexities associated with large mine development and permitting elements within this area (Table 6).

6.1.1.2 Non-Federal Parcels A, B, C & D

There are no known occurrences of locatable metallic mineral resources within all of the Non-Federal Parcels, and there has not been any past exploration and/or development of any metallic minerals. Available data provides direct evidence but are quantitatively minimal to support or refute the possible existence of locatable metallic mineral resources. Therefore, the metallic mineral potential for occurrence is low (L/C) and the potential for development is also low (L) within the proposed Three Peaks Ranch, Monchego Creek Ranch, Spanish Creek Ranch, and Sheep Creek Ranch Parcels (Tables 7, 8 & 9). Consequently, these low locatable metallic mineral potential occurrences have not been included on corresponding report maps.

6.1.2 Locatable Non-Metallic / Industrial Minerals

6.1.2.1 Federal Parcels 1, 2 & 3

While there are presently no known occurrences of locatable non-metallic and/or industrial mineral resources within the proposed Mt. Emmons land-exchange area, and there has not been any past exploration and/or development of any non-metallic and (or) industrial minerals, current available data provides direct evidence, but are quantitatively minimal to support or refute the possible existence of locatable non-metallic and (or) industrial mineral resources. Therefore, the non-metallic and (or) industrial mineral potential for occurrence is low (L/C) and the potential for development is low (L) at the Federal Parcels (Table 6). Again, such low mineral occurrence potential/certainty ratings occurrences have not been displayed on corresponding report maps.

6.1.2.2 Non-Federal Parcel B

While there are presently no known occurrences of locatable non-metallic and/or industrial mineral resources within the subject parcel, there has been past exploration for the industrial minerals pumice and perlite within 1 mile of the property (Del Rio, 1960). Exposures of perlite averaging 40- to 50-feet thick and 1.5 miles in length, are located on the south-facing cliffs that form the southern and southwestern edges of Cochetopa Dome. Pumice, located just south of the dome, average 80- to 100-feet thick, are found in a mostly horizontal attitude, overlain by as much as 2 feet of alluvial deposits, and cover an area up to 2-miles long and 1-mile wide. These deposits are amenable to open cut or open pit mining methods.

Current available data provides quantitative indirect evidence that these deposits may occur and extend beneath alluvium overburden on the Monchego Creek Ranch Parcel. Therefore, the non-metallic and (or) industrial mineral potential for occurrence is moderate (M/B). Based upon the relatively shallow thickness of overburden, the potential for development is moderate (M) at the proposed Monchego Creek Ranch Parcel (Table 8).

6.1.2.3 Non-Federal Parcels A, C & D

There are no known occurrences of locatable non-metallic and/or industrial mineral resources within the subject parcels, and there has not been any past exploration and/or development of any industrial minerals. Available data provides direct evidence but are quantitatively minimal to support or refute the possible existence of locatable non-metallic and/or industrial mineral resources. Therefore, the non-metallic and industrial mineral potential for occurrence is low (L/C) and the potential for development is also low (L) within the proposed Three Peaks Ranch, Spanish Creek Ranch, and Sheep Creek Ranch Parcels (Tables 7 & 9).

6.1.3 Locatable Critical and Strategic Minerals

6.1.3.1 Federal Parcels 1, 2 & 3

Known critical and strategic locatable mineral occurrences within the proposed Mt. Emmons land-exchange area include niobium, rubidium, tin, tungsten, and zinc. These minerals have historically been mined from the Keystone polymetallic vein and are known to occur in mineralization associated with the porphyry molybdenum deposits (Thomas and Galey, 1982).

The geologic environment, geochemical and geophysical data, reported and known mineral deposit occurrences, along with the abundance of historical prospects, exploration, and historical mine production from polymetallic veins found within the Keystone Mine and additional veins within the Ruby-Irwin District, including adjacent delineated porphyry-related molybdenum deposits, indicate a high (H) potential for locatable critical and strategic minerals for the proposed Federal Parcels in the Mt. Emmons Area. Based upon local geology, past prospecting, and recent exploration, all areas within the Mt. Emmons Area Parcels are considered to have a high (H) potential for the same suite of locatable mineral occurrences.

Available data provides abundant direct and indirect evidence (D) to support the possible existence of mineral resources with high (H) potential for occurrence. Therefore, the locatable critical and strategic mineral potential is high (H/D). The potential for development is considered moderate (M), for the same reasons cited in Section 6.1.1.1 for Mt. Emmons Area Parcels 1-3 (Table 6).

6.1.3.2 Non-Federal Parcels A, B, C & D

There are no known occurrences of critical and strategic mineral resources within any of the Non-Federal Parcels, and there has not been any past exploration and/or development of any critical and strategic minerals. Available data provides direct evidence but are quantitatively minimal to support or refute the possible existence of critical and strategic mineral resources. Therefore, the critical and strategic mineral potential for occurrence is low (L/C) and the potential for development is also low (L) within the proposed Three Peaks Ranch, Monchego Creek Ranch, Spanish Creek Ranch, and Sheep Creek Ranch Parcels (Tables 7, 8 & 9).

6.2 Leasable Minerals and Energy Resources

Leasable energy and mineral resources have been divided into the following sections as outlined in BLM Manual 3060 (BLM, 1994): coal, oil and gas, geothermal, sodium and potassium, and other leasable resources (i.e., phosphate, sulfur in certain states, and hardrock minerals on acquired lands, if applicable).

6.2.1 Leasable Coal

6.2.1.1 Federal Parcels 1, 2 & 3

The proposed Federal Parcels are positioned within the Crested Butte Coal Field (Maps 17 & 18), and coal host rock units are present in the Mesaverde Group. Six coal beds are distributed in a 250-foot sedimentary sequence above the base of the Mesaverde Group, and range between 0.5 and 3 feet thick. Given that the Mesaverde Group is up to 2,500 feet in thickness in northern Gunnison County (Gaskill et al., 1967; Streufert et al, 1999) and that the bedrock geology consists primarily of Ohio Creek and Mesaverde units at or near the surface on the parcels, these basal coals may be present at depths 1,000+ below ground level in the Mt. Emmons vicinity. Locally, the sedimentary section has been folded, faulted, and intruded by igneous rocks which are favorable conditions for the formation of high-volatile C bituminous to anthracite, thermal-grade coals (Tremain et al., 1996). Evidence of near-surface coal is present in the general vicinity of Mt. Emmons, just west and southwest of the Federal Parcels (Map 18), where historical underground coal mining in the Crested Butte coal field occurred between 1884 and 1992 (Streufert et al, 1999). Field site examinations, however, have found no past mine workings or coal outcrops on the subject Federal Parcels and adjoining lands. Original in-place coal resources within the Crested Butte Coal Field are estimated at some 1.56- billion short tons (Murray, 1981).

No coal leasing and (or) production has been reported within the proposed Mt. Emmons Area Parcel boundaries. While no known coal deposits have been identified or located within the immediate project area, portions of Redwell Basin have been classified as having a high resource potential for coal resources (Ludington and Ellis, 1983). The level of certainty that coal does exist in the project area is high (H) and the available data provides both direct and indirect evidence (D) to support the existence of these mineral resources. Therefore, the occurrence potential for coal is high (H/D) and the potential for development is moderate (M) (Table 6).

6.2.1.2 Non-Federal Parcel A

The Three Peaks Ranch Parcel contains identified host rock units. The local geologic conditions are favorable for coal formation and the depositional environments and structural-stratigraphic elements of Parcel A are similar to those at described for the Non-Federal Parcels. Three Peaks Ranch is within the boundary of the Crested Butte Coal Field (Maps 17 & 18), nearby historical coal mining has occurred within 2 to 5 miles of the parcel, and there is likely a thick section of the Mesaverde Group with associated basal coals buried at depth beneath the veneer of unconsolidated Quaternary surface deposits (Gaskill et al., 1987). Although this is evidence that coal is found in the vicinity, field site examinations have not observed evidence of any past mine workings or coal outcroppings on this Non-Federal Parcel or adjoining lands. Similar to the ratings for the Federal Parcels, the level of certainty that coal exists on in the area is high (H) and the available data provides both direct and indirect evidence (D) to support the existence of these mineral resources on Non-Federal Parcel A. Therefore, the potential for occurrence of coal is high (H/D) and the potential for development is moderate (M) at the proposed Three Peaks Ranch Parcel (Table 7).

6.2.1.3 Non-Federal Parcels B, C & D

These proposed land-exchange parcels do not contain any identified host rock units and the local geologic conditions are not favorable for the formation and occurrence of mineable metallurgic- or thermal-grade-coal deposits. There are no depositional sedimentary units that potentially host coals above the Tertiary volcanic rock sequences, and there are no significant igneous intrusions that could potentially uplift buried Upper Cretaceous sedimentary rocks to near-surface and surface elevations above the thick Tertiary volcanic rocks (Table 3, Maps 12 & 13). No known coal deposits have been identified or located within the Monchego Creek Ranch area. Furthermore, these lands have not been classified as prospectively valuable for coal resources (Cappa and Wallace, 2007). The level of certainty that coal does not exist in the project area is high and the available data provide abundant direct and indirect evidence to refute the possible existence of coal resources. Therefore, the potential for occurrence of coal is low (L/C) and the potential for development is low (L) at the proposed Non-Federal Monchego Creek Ranch, Sheep Creek Ranch, and Spanish Creek Ranch Parcels (Tables 8 & 9).

6.2.2 Leasable Oil and Gas

6.2.2.1 Federal Parcels 1, 2 & 3

The Mt. Emmons Area Parcels are located in the southeastern extent of the Piceance Basin structural province, which includes known conventional natural-gas and production from structural and stratigraphic traps in Upper Pennsylvanian to the Lower Paleogene rocks (Map 19). Natural gas-bearing formations within the Piceance Basin include the Pennsylvanian-Permian Maroon Formation, Lower Cretaceous Dakota Sandstone, Upper Cretaceous Mancos Shale, Upper Cretaceous Mesaverde Group, and Paleogene Wasatch Formation. Formations bearing conventional oil and gas include the Triassic Chinle Formation, Jurassic Entrada Sandstone, Jurassic Morrison Formation, Lower Cretaceous Dakota Sandstone, Upper Cretaceous Mancos Shale, and Upper Cretaceous Mesaverde Group. Unconventional Coalbed methane reservoirs are found within the Upper Cretaceous Mesaverde Group (USFS, 2020). Table 2 and Figure 7 provide a generalized geologic stratigraphic column for the North Zone Federal Parcels.

While there are no Federal, State, or private oil and gas leases at the subject parcels, nor are there present or past producing wells within their immediate vicinity, natural gas is being produced from favorable reservoir rocks in the Piceance Basin to the west-northwest (Map 20). The 2020 Draft Reasonable Foreseeable Development Scenario provides abundant direct evidence for oil and gas development within the GMUG National Forests and identifies the area at and surrounding Federal Parcels 1-3 as having a high occurrence potential for both conventional natural gas and coalbed methane (USFS, 2020). Development potential within the area is limited by steep slopes and rugged terrain which makes seismic surveying, well pad, and access road improvements difficult and expensive. Therefore, the occurrence potential for conventional oil and natural gas, as well as coalbed methane, is high (H/D) and the potential for development is moderate (M) for Federal Parcels 1-3 (Table 6).

6.2.2.2 Non-Federal Parcel A

Similar to Federal Parcels located in the vicinity of Mt. Emmons, 3 to 4 miles north, there are no Federal, State, or private oil and gas leases at the subject parcel, nor are there any present or past producing wells within the immediate vicinity (Map 20). Additionally, the 2020 Draft Reasonable Foreseeable Development Scenario provides abundant direct evidence for oil and gas development within the GMUG National Forests for the Three Peaks Ranch area as having a high occurrence potential for both conventional natural gas and coalbed methane (USFS, 2020). Though the area is bordered on three sides by mountainous laccolithic intrusions, development potential within this area may not be as limited by the more rugged terrain found at Mt. Emmons (Map 11). Therefore, the occurrence potential for conventional oil and natural gas, as well as coalbed methane is high (H/D) and the potential for development is moderate (M) for Three Peaks Ranch (Table 7).

6.2.2.3 Non-Federal Parcel B

The subject parcel is located in the San Juan Sag structural province, adjacent to and west of the San Luis Basin and northeast of the San Juan Basin (Figures 5 & 6). The Sag, a foreland sedimentary basin, formed during the late Laramide Orogeny and was modified by rifting in the middle Paleogene, and overlain by thick deposits of Oligocene volcanic rocks of the San Juan volcanic field (Map 21; Gries, 1985 and 1989). Mesozoic hydrocarbon-bearing units occurring below or capped by the overlying volcanic rocks were first discovered in the San Juan Sag in the early 1980s within the Lower Cretaceous Dakota Sandstone (USFS, 2006b). Additional oil and natural gas shows have been noted to also occur in the units of the Upper Cretaceous Mancos Shale, Jurassic Morrison Formation, and Jurassic Entrada Formation.

Although the area has good potential for containing hydrocarbon accumulations, the favorable factors are offset by the difficulties in locating hydrocarbon traps. Difficulties include rugged terrain increases expense associated with seismic surveying, the thickness of volcanic rocks which decreases seismic quality since volcanic rocks have about the same seismic velocity as the sedimentary rocks, and the technical risk of brittle fracturing and faulting of source and reservoir rocks beneath the volcanic cover. Within the immediate vicinity there are no Federal, State, or private oil and gas leases proximal to the subject parcel (BLM, 2022a; BLM, 2022c). Therefore, indirect evidence for the occurrence potential for oil and gas at Monchego Creek Ranch is moderate (M/B) and the potential for development is low (L) for Non-Federal Parcel B (Table 8). Although coals that are associated with the Upper Cretaceous Fruitland Formation (which stratigraphically overlie the Mesaverde Group), are known to exist within areas of the San Juan Sag (Gries, 1985 and 1989), there have been no reported occurrences of coal bed methane resources within borehole intersections of these formations, therefore the potential should be considered low (L/B) and the development potential low (L).

6.2.2.4 Non-Federal Parcels C & D

Similar to the Monchego Creek Ranch Parcel, the Non-Federal Sheep Creek Ranch and Spanish Creek Ranch Parcels are located on the northeastern edge of the San Juan Sag structural province and also covered by volcanic rocks of the San Juan Volcanic Field (Gries, 1985; Figures 5 & 6; Map 21). Favorable oil and natural gas potential factors are offset by the difficulties locating the traps. Regionally, one wildcat borehole has been drilled 10 miles to the southeast; however, no production has been reported and the borehole is listed as dry and abandoned (ECMC, 2022). Within the immediate vicinity there are no Federal, State, or private oil and gas leases proximal to the subject parcel (BLM, 2022a). Therefore, indirect evidence for the occurrence potential for oil and gas is moderate (M/B) and the potential for development is low (L) for the Sheep Creek Ranch and Spanish Creek Ranch Parcels (Table 9). As stated within Section 6.2.2.3 above, though favorable host rocks exist within the San Juan Sag there have been no reported borehole intersections of coal bed methane, therefore the potential as such should be considered low (L/B) and the development potential low (L).

6.2.3 Leasable Geothermal

6.2.3.1 Federal Parcels 1, 2 & 3

No known geothermal resources exist within the proposed land-exchange area and the nearest geothermal features are located 12 miles to the northeast. There are no records of geothermal leases or wells on the subject lands, and the area has not been classified as potentially valuable for geothermal production. The CGS has reported that developed geothermal resources in Colorado are local and limited, and most likely under-utilized (Streufert, 1999). Geothermal gradient models, used to quantify the depth-temperature relationship for the evaluation of geothermal resource potential, completed by the CGS indicate that Federal Parcels 1-3 and the surrounding area have a low to moderately low thermal gradient (Map 22; Berkman and Watterson, 2010). Available data provides direct evidence but are quantitatively minimal to support or refute the possible existence of geothermal resources. Therefore, the geothermal potential for occurrence is considered low (L/C) and the potential for development is also low (L) within the proposed Mt. Emmons Area Federal Parcels (Table 6).

6.2.3.2 Non-Federal Parcel A

No known geothermal resources exist within the subject parcel boundary and the nearest geothermal features, Ranger and Cement Creek Warm Springs, are located 8 miles to the east (Map 22). There are no records of geothermal leases or wells on the subject parcel, and the area has not been classified as potentially valuable for geothermal production. The CGS has reported that developed geothermal resources in Colorado are local and limited, and most likely under-utilized (Streufert, 1999). Geothermal gradient models, used to quantify the depth-temperature relationship for the evaluation of geothermal resource potential, completed by the CGS indicate that Three Peaks Ranch and the surrounding area have a low to moderately low thermal gradient (Berkman and Watterson, 2010). Available data provides direct evidence but are quantitatively minimal to support or refute the possible existence of geothermal resources. Therefore, the leasable potential for geothermal occurrences is considered low (L/C) and the potential for development is also low (L) at the proposed Three Peaks Ranch Parcel (Table 7).

6.2.3.3 Non-Federal Parcels B, C & D

There are no known geothermal resources at or within the vicinity of these parcels. There are no records of geothermal leases or wells on this parcel, and the surrounding area has not been classified as potentially valuable for geothermal production (Reiter et al., 1975). Additionally, the CGS has reported that developed geothermal resources in Colorado are local and limited, and most likely under-utilized (Streufert, 1999). Geothermal gradient models, used to quantify the depth-temperature relationship for the evaluation of geothermal resource potential, completed by the CGS indicate that Monchego Creek Ranch and the surrounding area have a low to moderately low thermal gradient (Map 22; Berkman and Watterson, 2010). Available data provides direct evidence but are quantitatively minimal to support or refute the possible existence of geothermal resources. Therefore, the leasable potential for geothermal occurrences is considered low (L/C) and the potential for development is also low (L) at the proposed Monchego Creek Ranch, Sheep Creek Ranch, and Spanish Creek Ranch Parcels (Tables 8 & 9).

6.2.4 Leasable Sodium and Potash

6.2.4.1 Federal Parcels 1, 2, & 3

Literature research and field visits did not identify the potential for any sodium or potassium deposits. The bedrock geology of this area includes igneous and metamorphic rocks, which are typically not suitable hosts for these leasable commodities. Nahcolite ($NaHCO_3$, sodium bicarbonate) and halite ($NaCl$, sodium chloride) are regionally found within facies of the Eocene-age Green River Formation in the Piceance Basin. While the Mt. Emmons vicinity occurs within the Piceance Basin, the Green River Formation is absent locally due to erosion. There are no known leases in this area (BLM, 2022a; BLM, 2022c). Available data and reports provide direct evidence indicating that no sodium and potash resources exist at the subject parcels. Therefore, the mineral and energy potential for the occurrence of sodium and potassium resources is low (L/C) and the potential for development is low (L) within the proposed Federal Mt. Emmons Area Parcels (Table 6).

6.2.4.2 Non-Federal Parcel A

Literature research and field visits did not identify the potential for any sodium or potassium deposits. The bedrock geology in this area is not a suitable host for these leasable commodities. Nahcolite ($NaHCO_3$, sodium bicarbonate) and halite ($NaCl$, sodium chloride) are regionally found within facies of the Eocene-age Green River Formation in the Piceance Basin. While Three Peaks Ranch falls within the Piceance Basin, the Green River Formation is absent locally due to erosion. There are no known leases in this area (BLM, 2022a; BLM, 2022c). Available data and reports provide direct evidence indicating that no sodium and potash resources exist at the subject parcel. Therefore, the leasable potential for the occurrence of sodium and potassium resources is low (L/C) and the potential for development is none (L) at the proposed Non-Federal Three Peaks Ranch Parcel (Table 7).

6.2.4.3 Non-Federal Parcels B, C & D

Literature research and field visits did not identify the potential for any sodium or potassium deposits. The geology of this area includes igneous rocks, which are typically not suitable hosts for these leasable commodities. There are no known leases in this area (BLM, 2022a; BLM, 2022c). Available data and reports provide direct evidence indicating that no sodium and potash resources exist at the subject parcel. Therefore, the leasable potential for the occurrence of sodium and potassium resources is low (L/C) and the potential for development is low (L) for the proposed Monchego Creek Ranch, Sheep Creek Ranch, and Spanish Creek Ranch Parcels (Tables 8 & 9).

6.2.5 Leasable Critical and Strategic Minerals

Not applicable – there are no leasable critical and strategic mineral commodities because there are no NFS acquired land parcels associated with this land exchange.

6.3 Saleable Minerals

Saleable commodities or mineral materials include petrified wood and common varieties of sand, gravel, dimension stone, volcanic cinders, clay, and similar materials. Any rock (igneous, metamorphic, or sedimentary) that meets strength and durability specifications and is not chemically reactive with cement can be used for crushed stone if a large enough volume of the rock is available. In addition, sources of crushed stone that contain a volume allowing at least 10 to 20 or more years of production, have an adequate market, a competitive transportation cost, and an acceptable environmental effect can be considered a locatable resource (Arbogast et al., 2011).

6.3.1 Federal Parcels 1, 2 & 3

The Mt. Emmons vicinity contains numerous sources for saleable materials including riprap from talus slopes, fill and gravel material from local landslide deposits, and/or crystalline rock quarry material for crushing as road base or decorative stone. Additionally, the relatively thick glacial alluvium deposits along Coal Creek could provide a possible (albeit, limited) source for sand and gravel (Map 11). There is one permitted inactive gravel pit located 1 mile to the east of Federal Parcel 1, which has been used for maintenance work at MEMC's water treatment plant. The abundance of mixed lithologies suggests that this area contains a better source of saleable materials than similar areas nearby. In addition, a small borrow site in landslide material was recently developed on Federal Parcel 1 to provide a source of fill material for maintenance and reclamation work at the MEMC Water Treatment Plant Facility. The development of saleable mineral commodities, such as sand and gravel, are usually driven by local need and transportation costs although the resources themselves can be found in many localities. Therefore, this area is considered to have a moderate (M/D) potential for the occurrence of saleable resources and the potential for development is moderate (M) for Federal Parcels 1-3 (Table 6).

6.3.2 Non-Federal Parcels A, B, C & D

These parcels contain alluvial deposits in the form of glacial alluvium, alluvial fans, and other colluvium along creeks and tributaries that could provide a source for sand and gravel (Maps 11, 12 & 13). However, there are no documented saleable sites and/or contracts for sale in the area, and there are no unique geological conditions to suggest that this area contains a better source of saleable materials than any other similar areas nearby. Available geologic map data suggests there is a moderate (M/C) potential for the occurrence of saleable resources. Based upon the location and accessibility of the Three Peaks Ranch, Monchego Creek Ranch, Spanish Creek Ranch and Sheep Creek Ranch Parcels, there is a moderate (M) potential for development at this land-exchange parcel (Tables 7, 8 & 9).

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Tables

Table ES-1: Summary of Mineral Potential for Federal Parcels

Mineral Resources	Commodities Present	Occurrence Potential / Certainty	Development Potential	Land Exchange Parcels (Acres)
Locatable				
Metallic	Mo, Au, Cu, Ag, Pb, Zn, U	H/D	M	1,2,3 (550)
Non-Metallic	Industrial minerals	L/C	L	1,2,3 (550)
Critical and Strategic	Nb, Rb, Sn, W, Zn	H/D	M	1,2,3 (550)
Leasable				
Coal	Anthracite	H/D	M	1,2,3 (550)
Oil and Gas	Coal Bed Methane	H/D	M	1,2,3 (550)
	Conventional Oil & Natural Gas	H/D	M	1,2,3 (550)
Geothermal		L/C	L	1,2,3 (550)
Sodium and Potassium		L/C	L	1,2,3 (550)
Saleable				
Mineral Materials	Sand & Gravel, Boulders	M/D	M	1,2,3 (550)

Table ES-2: Summary of Mineral Potential for Non-Federal Parcels

Mineral Resources	Commodities Present	Occurrence Potential / Certainty	Development Potential	Land Exchange Parcel (Acres)
Locatable				
Metallic		L/C	L	A,B,C,D (625)
Non-Metallic	Pumice and perlite	M/B	M	B (160)
	Industrial Minerals	L/C	L	A,C,D (465)
Critical and Strategic		L/C	L	A,B,C,D (625)
Leasable				
Coal	Anthracite	H/D	M	A (160)
		L/C	L	B,C,D (465)
Oil and Gas	Coal Bed Methane	H/D	M	A (160)
	Conventional Oil & Natural Gas	H/D	M	A (160)
	Coal Bed Methane	L/B	L	B,C,D (465)
	Conventional Oil & Natural Gas	M/B	L	B,C,D (465)
Geothermal		L/C	L	A,B,C,D (625)
Sodium and Potassium		L/C	L	A,B,C,D (625)
Saleable				
Mineral Materials	Sand & Gravel, Boulders	M/C	M	A,B,C,D (625)

Table 1: Active Mining Claims and Mill Sites

Parcel	**Placer Claims** Number (acres)	**Mill Sites** Number (acres)	**Unpatented Lode Claims** Number (acres)	**Patented Lode Claims** Number (acres)
Federal Parcel 1	0 (0)	15 (73)	51 (495)	0 (0)
Federal Parcel 2	0 (0)	0 (0)	5 (90)	0 (0)
Federal Parcel 3	0 (0)	0 (0)	0 (0)	0 (0)
Non-Federal Parcel A	0 (0)	25 (58)	0 (0)	0 (0)
Non-Federal Parcel B	0 (0)	0 (0)	0 (0)	0 (0)
Non-Federal Parcel C	0 (0)	0 (0)	0 (0)	0 (0)
Non-Federal Parcel D	0 (0)	0 (0)	0 (0)	0 (0)
Total	0 (0)	40 (131)	56 (585)	0 (0)

Table 2: List of Geologic Rock Units, North Zone

Map Unit	Unit Name	Unit Age
Qa	Alluvial deposits	Holocene
Qt, Qf	Talus, Fan Deposits	Holocene
Qs	Bog iron spring deposits	Holocene
Qr	Rock streams	Holocene & Pleistocene
Qlf	Landslide, slump, debris-flow, earthflow complex	Holocene & Pleistocene
Qlu	Landslide deposits	Holocene & Pleistocene
Qdu	Debris slopes undifferentiated	Holocene & Pleistocene
Qm	Glacial deposits	Pleistocene
Tp	Granodiorite porphyry	Oligocene
Tg	Granodiorite	Oligocene
f	Felsite	Upper Eocene
Tw	Wasatch Formation	Eocene
Toc (or Kmvo)	Ohio Creek Member - Wasatch (or Mesaverde Group)	Paleocene (or Upper Cretaceous)
Kmv	Mesaverde Group	Upper Cretaceous
Km	Mancos Shale	Upper Cretaceous
Kd	Dakota Sandstone	Lower Cretaceous
Jm	Morrison Formation	Jurassic
Je	Entrada Sandstone	Jurassic
TRc	Chinle Formation	Triassic
PIPm	Maroon Formation	Permian and Pennsylvanian

Table 3: List of Geologic Rock Units, South Zone

Map Unit	Unit Name	Unit Age
Qc	Colluvium	Holocene
Qal	Alluvial deposits	Holocene
Qf	Alluvial-fan deposits	Holocene
Ql	Landslide deposits	Holocene & Pleistocene
Qfo	Alluvial-fan deposits, older	Pleistocene
Qg	Glacial outwash and other terrace deposits	Pleistocene
Tpt	Intra-caldera fill tuffaceous sediments	Oligocene
Tfc	La Garita Caldera cycle, outflow ignimbrite	Oligocene
Tpbf	Fish Canyon Tuff, massive breccia	Oligocene
Tndn	Nelson Mountain Tuff, dacite	Oligocene
Tnpd	Cochetopa Hills volcanics, dacite	Oligocene
Tscl	Cochetopa Hills volcanics, landslide breccia	Oligocene
Tscn	Cochetopa Hills volcanics, rhyolite	Oligocene
Tbd	Bonanza Caldera cycle, dacite	Oligocene
Tsc	Saguache Creek Tuff, rhyolite	Oligocene
Tdb	Upper Conejos Formation, breccia	Oligocene
Tca	Lower Conejos Formation, andesite	Oligocene
Tcfr	Lower Conejos Formation, rhyolite	Oligocene
Tcd	Lower Conejos Formation, dacite	Oligocene
Tcv	Lower Conejos Formation, volcaniclastic rocks	Oligocene

Table 4: Historical Mining Activities in the Ruby-Irwin District
(Emmons et al., 1894; Ludington and Ellis, 1983; Socolow, 1955; Thomas and Galey, 1982)

Year	Activity
1860s	Prospectors first present in the Elk Mountains
1874	Silver mining begins in the Ruby-Irwin District
1880	Mining begins at the Keystone Mine
1950s	Uranium Prospecting in the Ruby-Irwin District
1953	Keystone Mill constructed
1970 to 1974	Molybdenum deposits discovered beneath Redwell and Red Lady Basins
1974	Production at the Keystone Mine ends
1974-2008	AMAX Exploration and others completed 190,769 feet of surface and underground diamond drilling; surface and subsurface geologic mapping & sampling; and 4,400 feet of development mine tunneling, including numerous diamond drill stations

Table 5: Known Prospects - Federal Parcels
(USGS, 2022b)

Site Name	MRDS No.	Mineral Commodity	Excavation Type-
Redwell Basin	10215334	Iron, Calcium	Trenching
Various Unknown Sites	10215189	Gold, Lead, Silver, Zinc	Shallow shafts, pits
Unknown Prospects	10134890	Copper, Lead, Silver, Zinc	Shallow pits

Table 6: Summary of Mineral Potential - Federal Parcels

Mineral Resources	Commodities Present	Occurrence Potential / Certainty	Development Potential	Acres
Locatable				
Metallic	Mo, Au, Cu, Ag, Pb, Zn, U	H/D	M	550
Non-Metallic / Industrial		L/C	L	550
Critical and Strategic	Nb, Rb, Sn, W, Zn	H/D	M	550
Leasable				
Coal	Anthracite	H/D	M	550
Oil and Gas	Coalbed Methane	H/D	M	550
	Conventional Oil & Natural Gas	H/D	M	550
Geothermal		L/C	L	550
Sodium and Potassium		L/C	L	550
Saleable				
Mineral Materials	Sand & gravel, boulders	M/D	M	550

Table 7: Summary of Mineral Potential - Non-Federal Parcel A

Mineral Resources	Commodities Present	Occurrence Potential / Certainty	Development Potential	Acres
Locatable				
Metallic		L/C	L	160
Non-Metallic / Industrial		L/C	L	160
Critical and Strategic		L/C	L	160
Leasable				
Coal	Anthracite	H/D	M	160
Oil and Gas	Coalbed Methane	H/D	M	160
	Conventional Oil & Natural Gas	H/D	M	160
Geothermal		L/C	L	160
Sodium and Potassium		L/C	L	160
Saleable				
Mineral Materials	Sand & Gravel, Boulders	M/C	M	160

Table 8: Summary of Mineral Potential - Non-Federal Parcel B

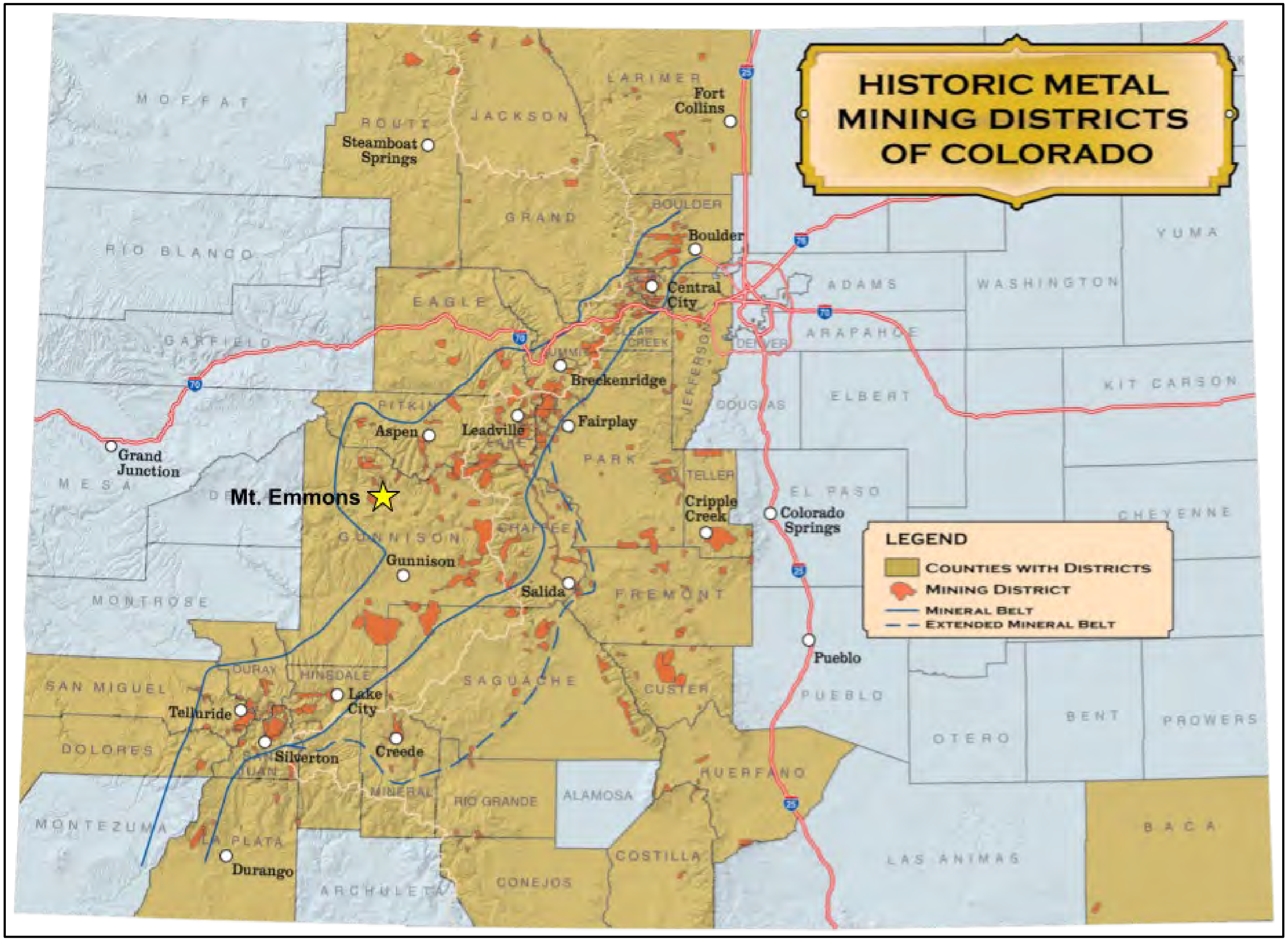
Mineral Resources	Commodities Present	Occurrence Potential / Certainty	Development Potential	Acres
Locatable				
Metallic		L/C	L	160
Non-Metallic / Industrial	Pumice, Perlite	M/B	M	160
Critical and Strategic		L/C	L	160
Leasable				
Coal		L/C	L	160
Oil and Gas	Coalbed Methane	L/B	L	160
	Conventional Oil & Natural Gas	M/B	L	160
Geothermal		L/C	L	160
Sodium and Potassium		L/C	L	160
Saleable				
Mineral Materials	Sand & Gravel, Boulders	M/C	M	160

Table 9: Summary of Mineral Potential - Non-Federal Parcels C & D

Mineral Resources	Commodities Present	Occurrence Potential / Certainty	Development Potential	Acres
Locatable				
Metallic		L/C	L	305
Non-Metallic / Industrial		L/C	L	305
Critical and Strategic		L/C	L	305
Leasable				
Coal		L/C	L	305
Oil and Gas	Coalbed Methane	L/B	L	305
	Conventional Oil & Natural Gas	M/B	L	305
Geothermal		L/C	L	305
Sodium and Potassium		L/C	L	305
Saleable				
Mineral Materials	Sand & Gravel, Boulders	M/C	M	305

Figures

Figure 1: Colorado Mineral Belt & Mining Districts, Overview
(Burnell, 2015)



Note: This figure is intended to be presented in color.

Figure 2: Block Diagram, Redwell Basin Intrusive Complex

(Sharp, 1978)

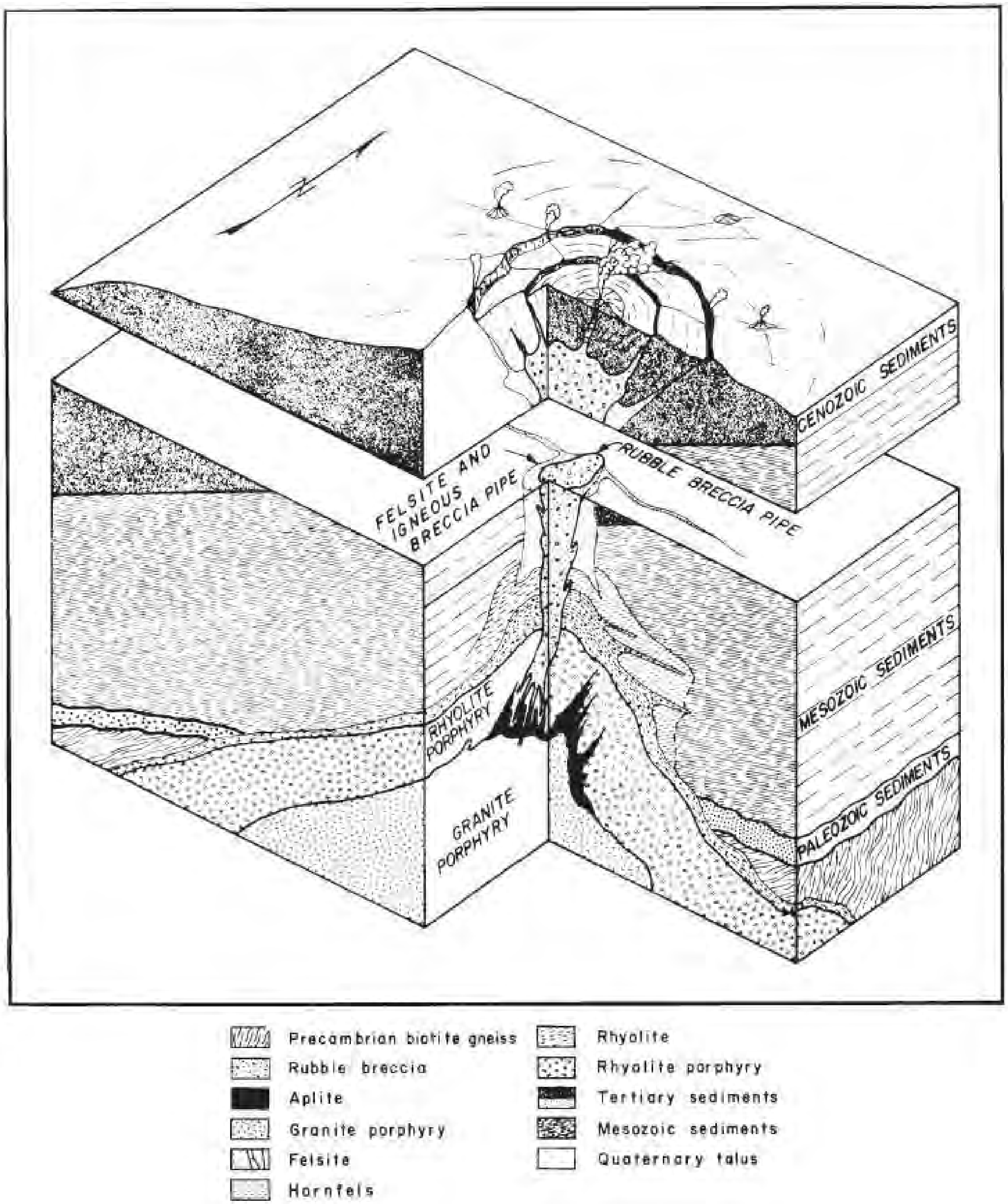
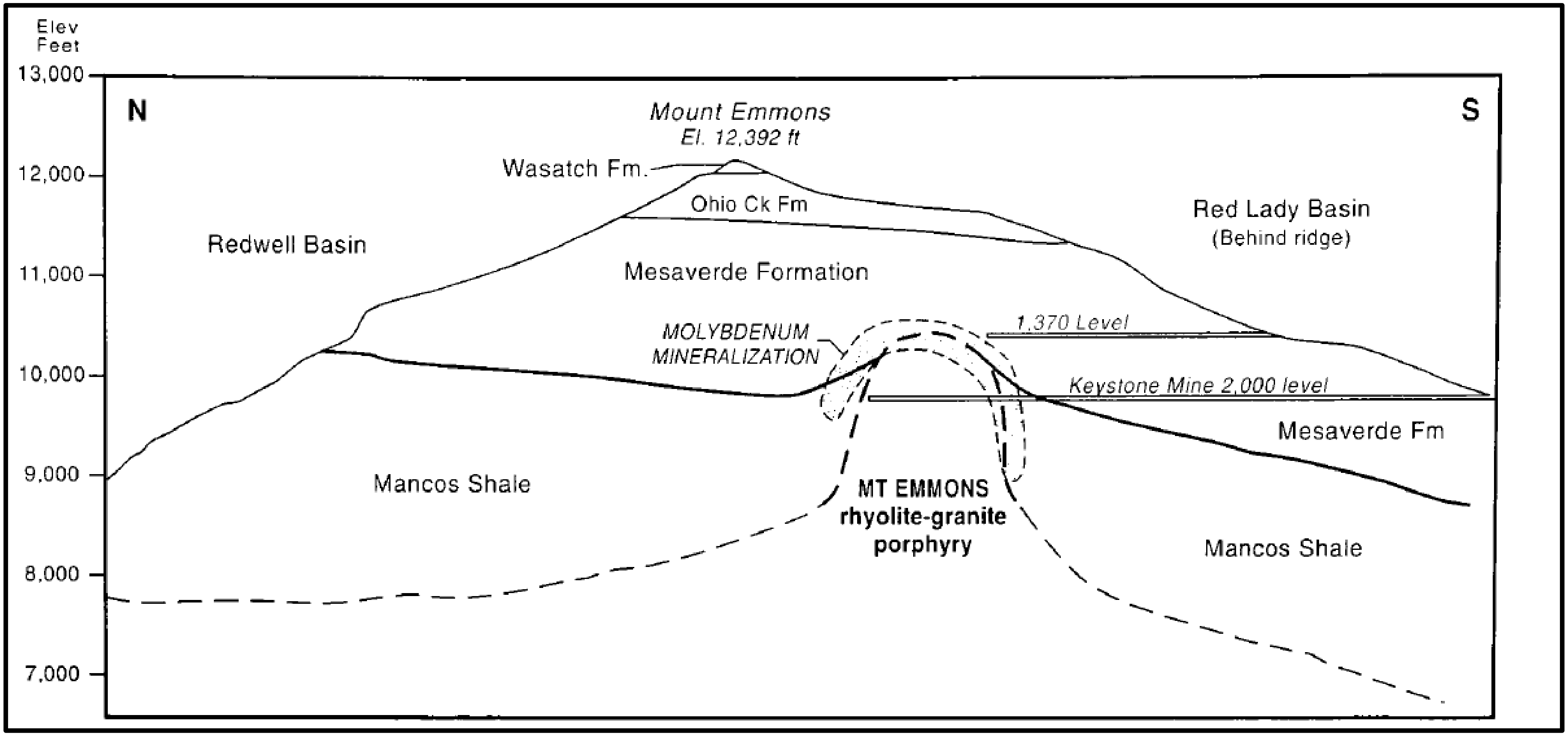


Figure 3: Generalized Cross-Section of Mt. Emmons

(Dowsett et al., 1981)



Note: area of molybdenum mineralization is located within the contact metamorphic zone as a cap of the rhyolite-granite porphyry intrusion.

Figure 4: Keystone Mine Section and Plan

(modified from USBM, 1962)

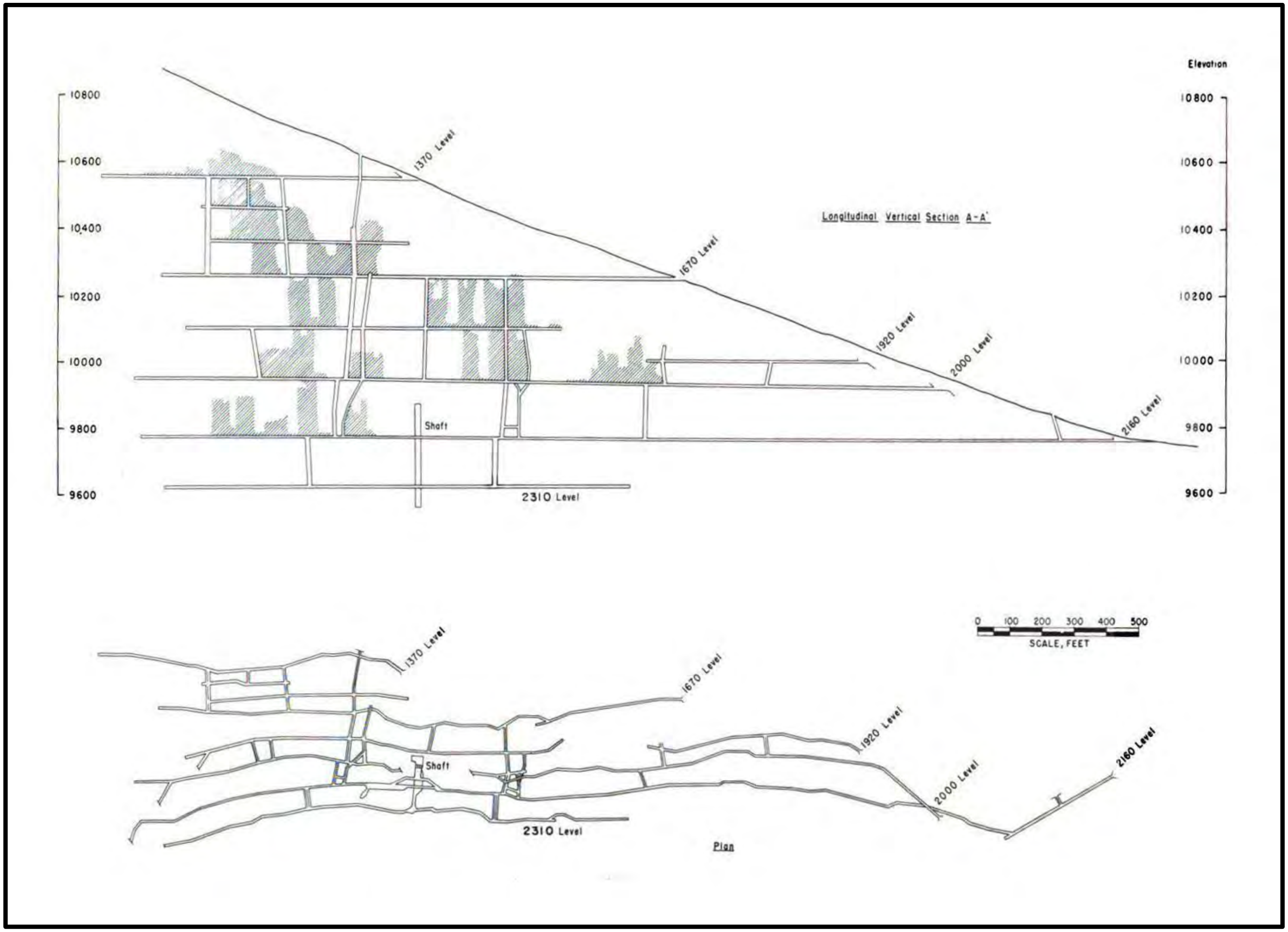


Figure 5: San Juan Sag Tectonic Map

(Gries, 1985)

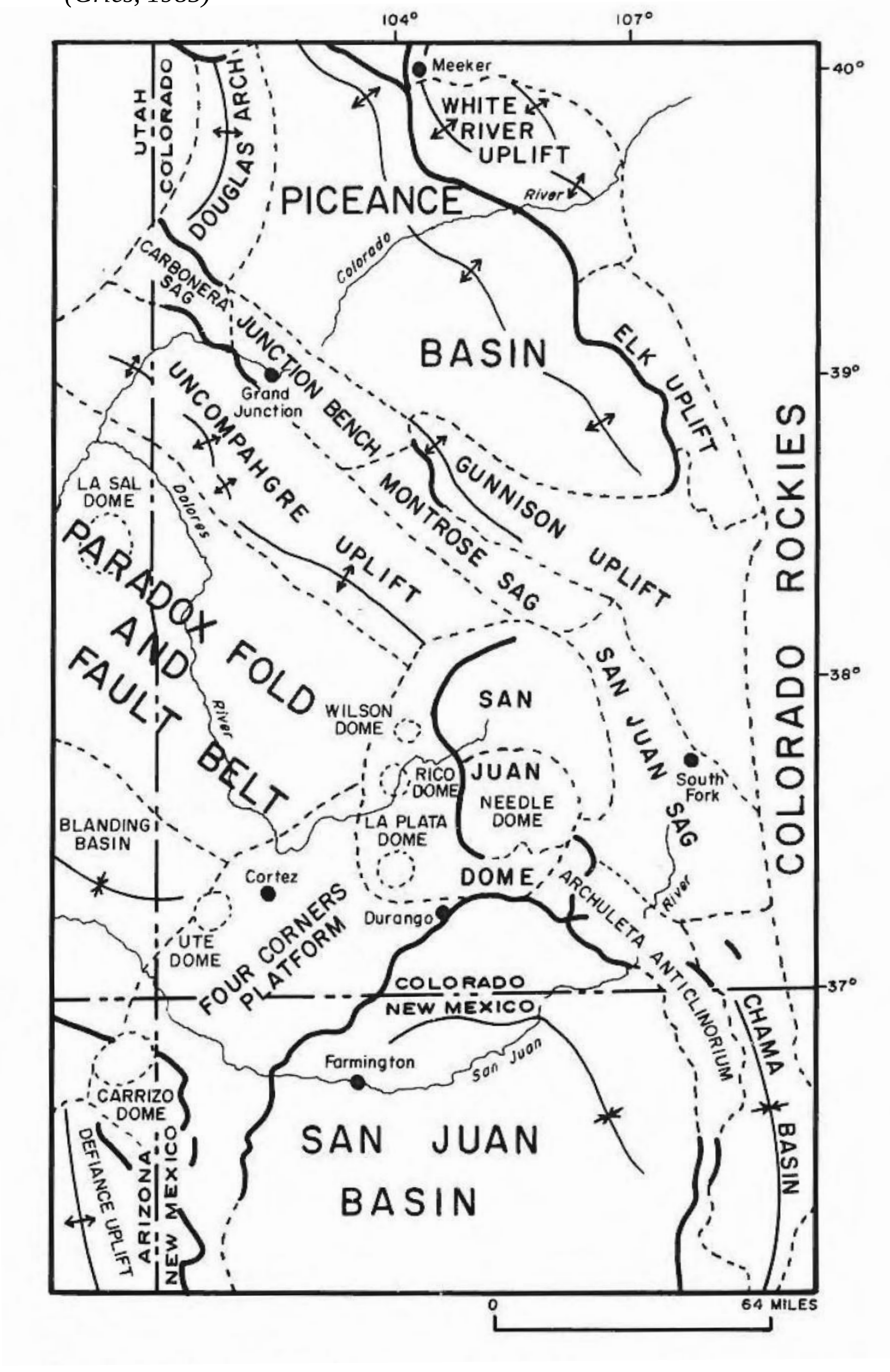


Figure 6: San Juan Sag and San Juan Volcanic Field

(Gries, 1985)

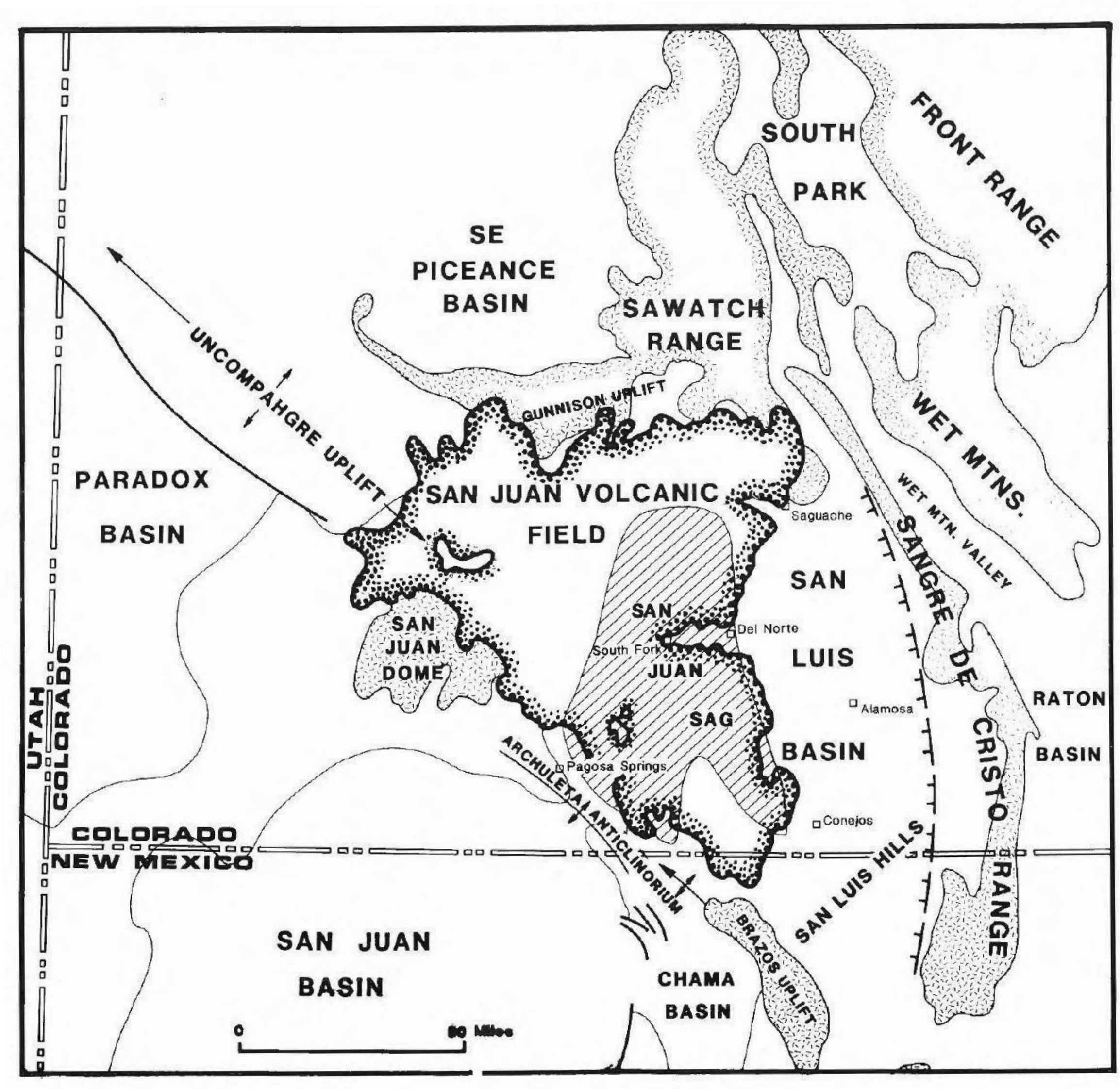


Figure 7: Generalized Geologic Rock Column, North Zone

(RMAG, 2003)

AGE	FORMATION	MEMBER	THICKNESS (ft)	DOMINANT ROCK TYPES
Quaternary	*Grand Mesa*		< 100	Gravel and Till
	Lands End		< 100	Gravel and Till
Miocene	*Basalt*		170-680	Basalt
Miocene	*Unnamed*		0-100	Sandst. & Mudrock
Eocene	*Uinta*		400+	Sandst. & Mudrock
	Green River	Parachute Creek	300-1,100	Oil Shale and Marlstone
		Garden Gulch	300-700	Mudrock, Limest. & Sandst.
		Douglas Creek	100-300	SS and Shale
	Wasatch	Shire	600-4,000	Mudrock
Paleocene		Molina	50-500	Sandstone
		Atwell Gulch	700-1,800	Mudrock
Upper Cretaceous	*Mesaverde Group* — *Williams Fork (Hunter Cyn.)*	Ohio Creek	0-100	Sandst. & Conglom.
		Undifferentiated	1,500-2,000	Sandst. & Mudrock
		Bowie Shale	300-450	Mudrock, Sandst. & Coal
	Mesaverde Group — *Iles (Mt. Garfield)*	Rollins	100-150	Sandstone
		Mancos tongue	80-120	Mudrock
		Cozzette	100-150	Sandstone
		Mancos tongue	40-80	Mudrock
		Corcoran	30-60	Sandstone
	Mancos	Juana Lopez Mbr	4,000-4,500	Mudrock and Silty Sandstone
	Dakota		80-120	Mudrock, Sandst. & Coal
L. Cretaceous	*Burro Canyon*		100-200	Sandst. & Mudrock
Jurassic	*Morrison*	Brushy Basin	200-300	Sandst. & Mudrock
		Saltwash	100-150	Sandst. & Mudrock
		Tidwell	50-120	Sandst., Mudrock & Limestone
	Wanakah		20-40	Mudrock
	Entrada		100-150	Sandstone
	Kayenta		50-80	Sandst. & Mudrock
	Wingate		250-320	Sandstone
Triassic	*Chinle*		80-120	Mudrock & Sandst.
Proterozoic (1.7-1.4 Ga)	*BLACK CANYON COMPLEX*	*GREAT UNCONFORMITY*	Feet	Schist, gneiss, pegmatite, granite, monzonite, and diorite.

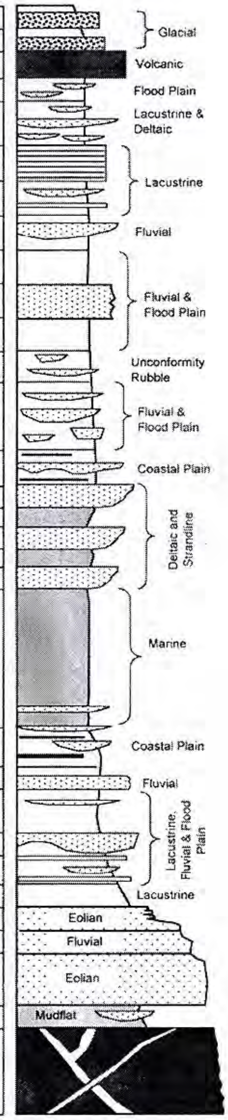
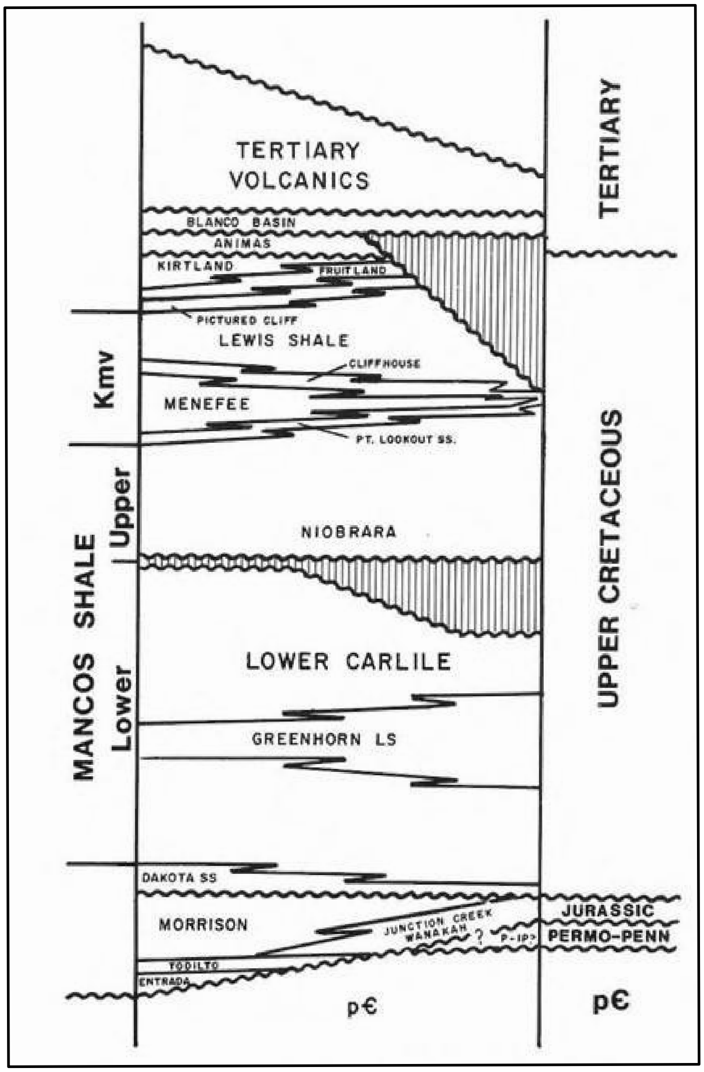


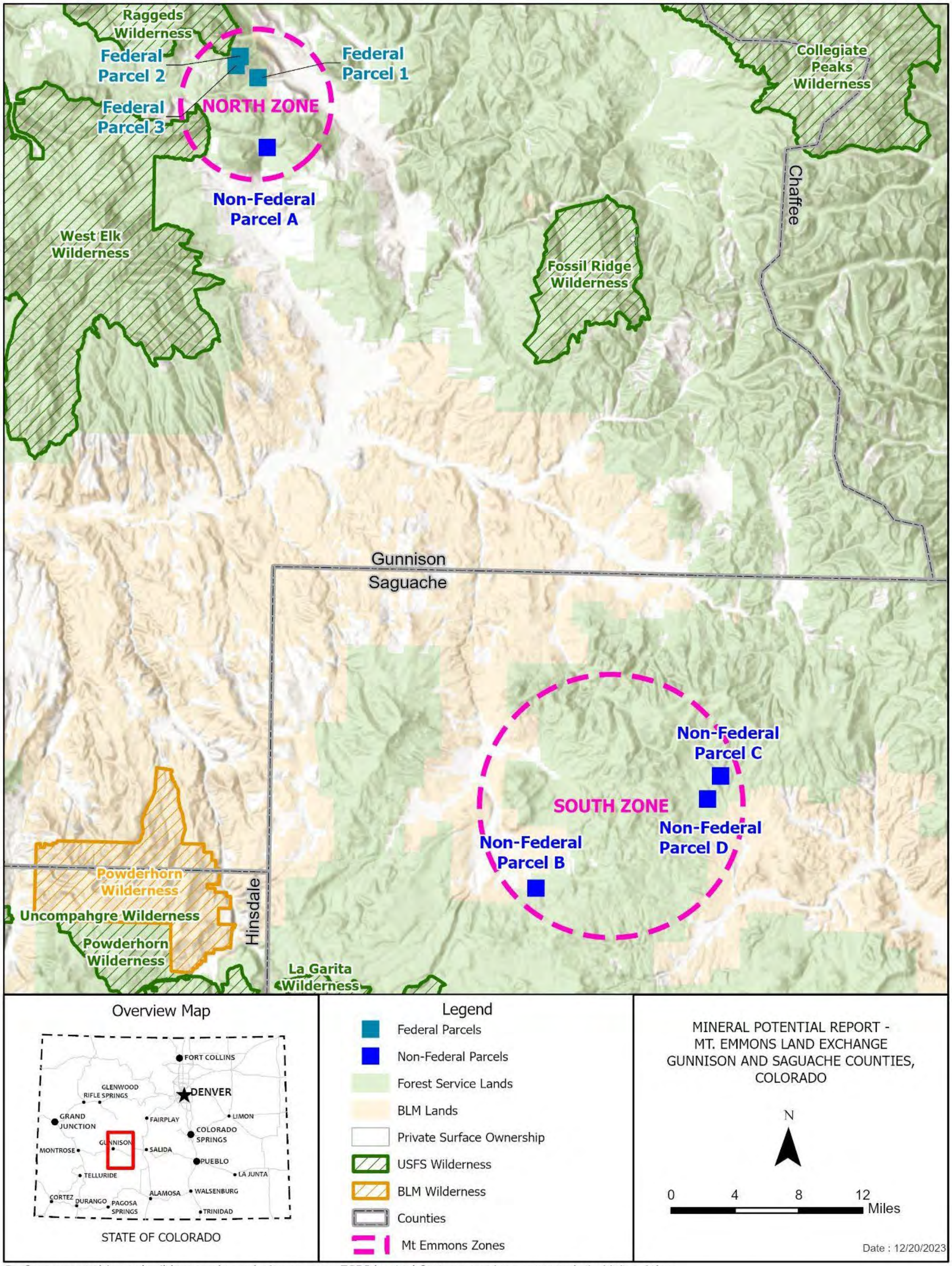
Figure 8: Generalized Geologic Rock Column, South Zone
(Gries, 1985)



Maps

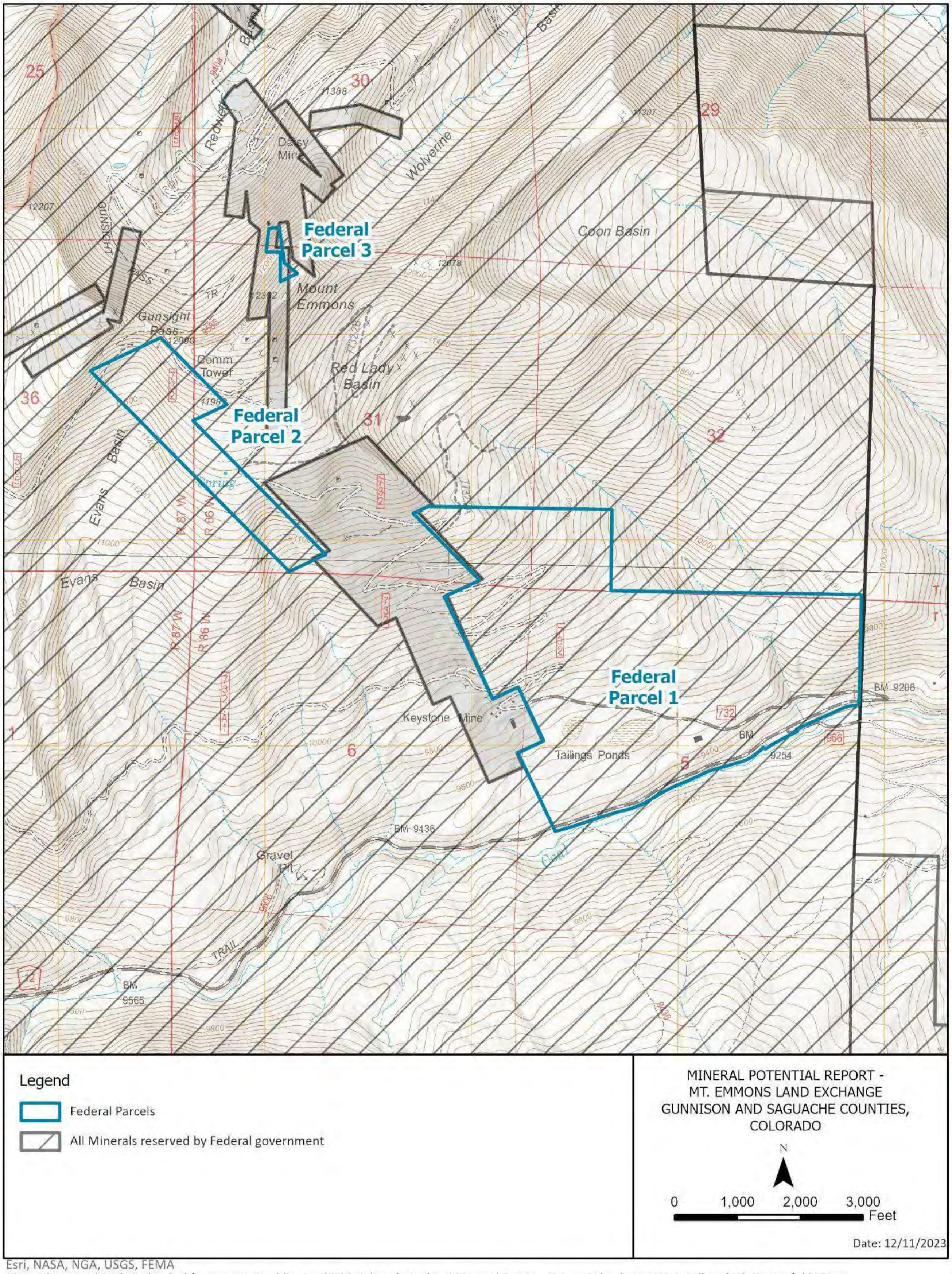
Note: Where applicable, maps included within this report intended to be presented in color.

Map 1: General Location Map



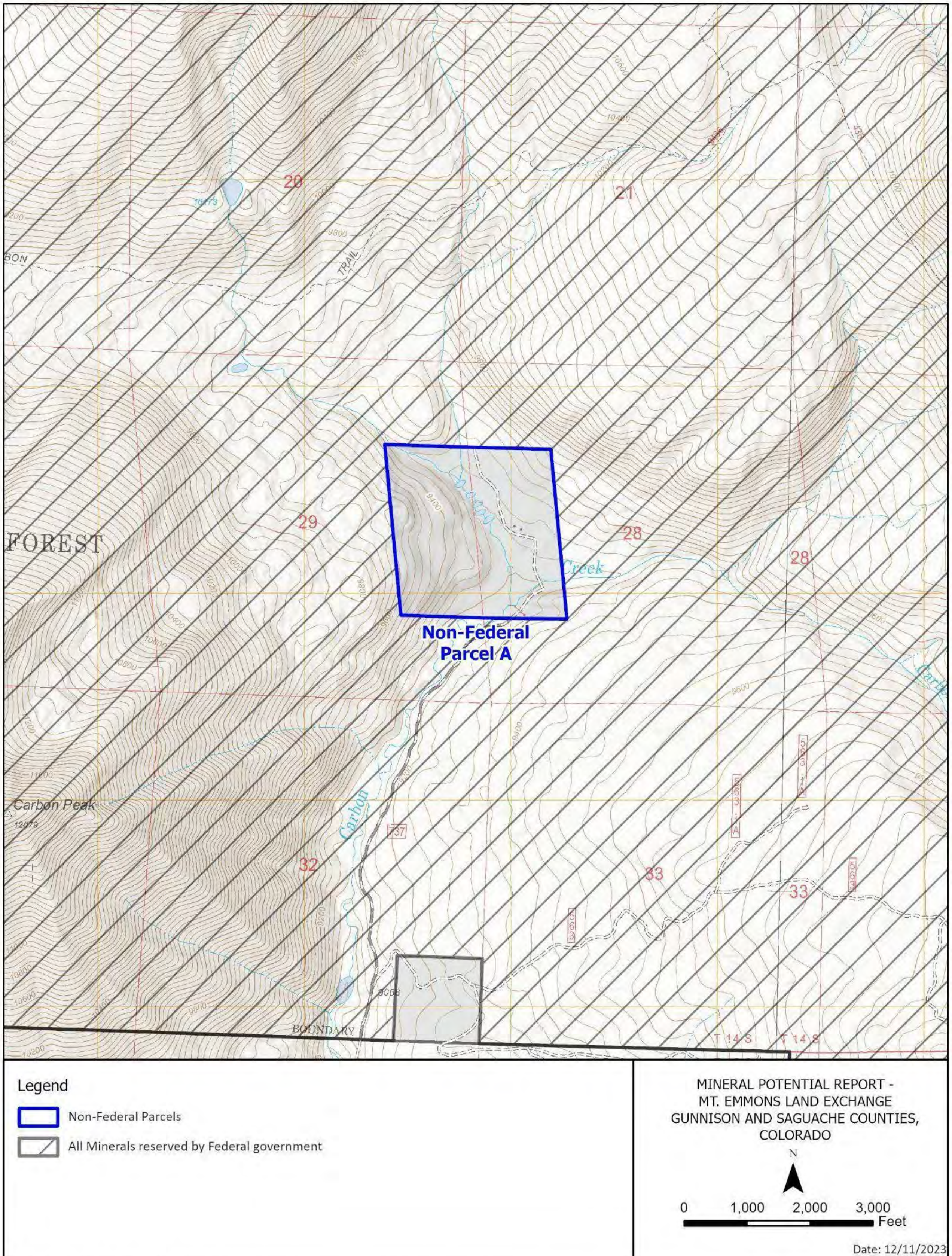
Surface ownership and wilderness boundaries source: ESRI hosted feature services accessed via Living Atlas
Esri, CGIAR, USGS

Map 2: Mineral Ownership, Federal Parcels



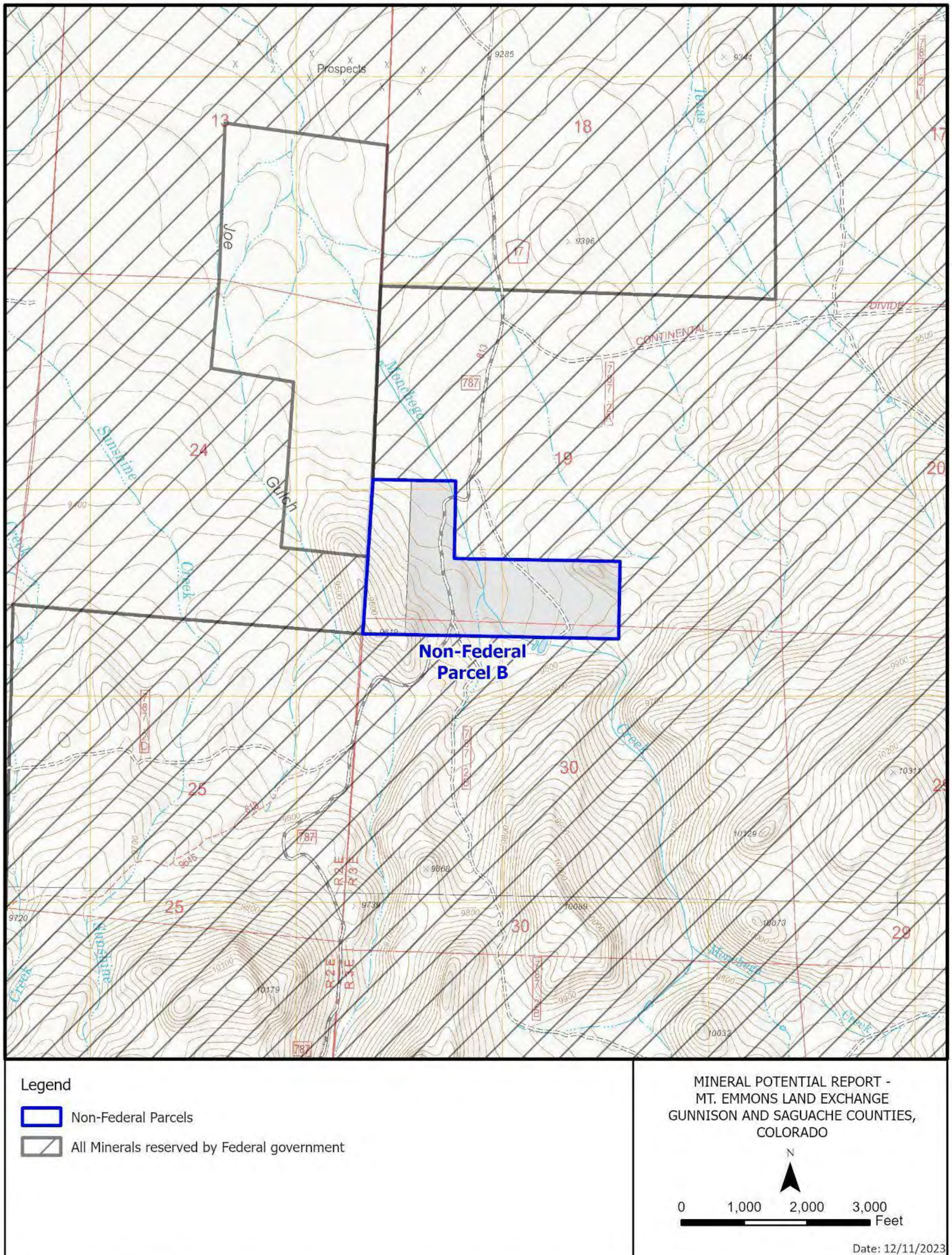
Esri, NASA, NGA, USGS, FEMA
Mineral ownership downloaded from navigator.blm.gov/BLM Colorado Federal Mineral Estate. Topographic base: Mt Axtell and Oh-Be-Joyful FSTopo

Map 3: Mineral Ownership, Non-Federal Parcel A



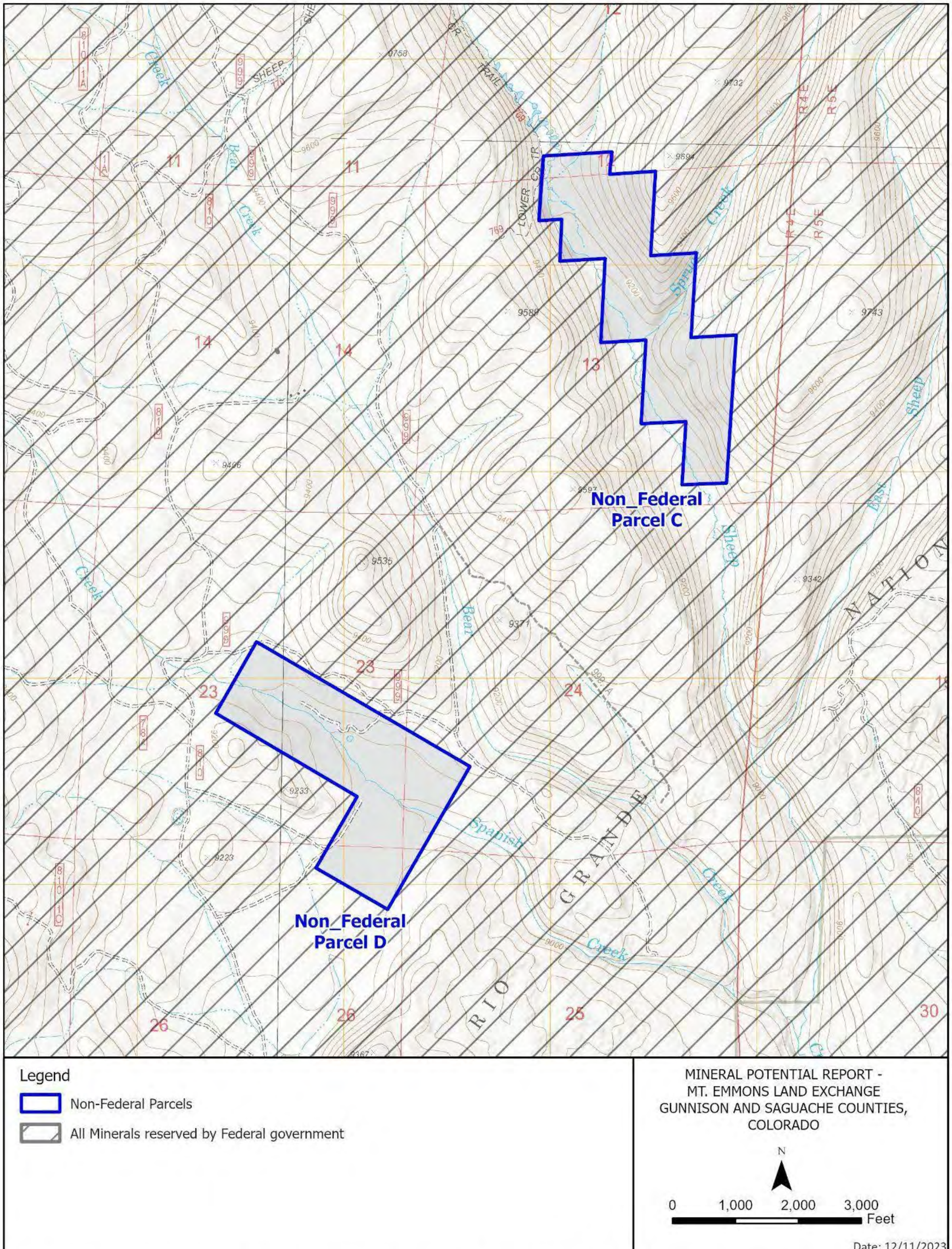
Esri, NASA, NGA, USGS, FEMA
Mineral ownership downloaded from navigator.blm.gov/BLM Colorado Federal Mineral Estate. Topographic base: Crested Butte and Oh-Be-Joyful FSTopo

Map 4: Mineral Ownership, Non-Federal Parcel B



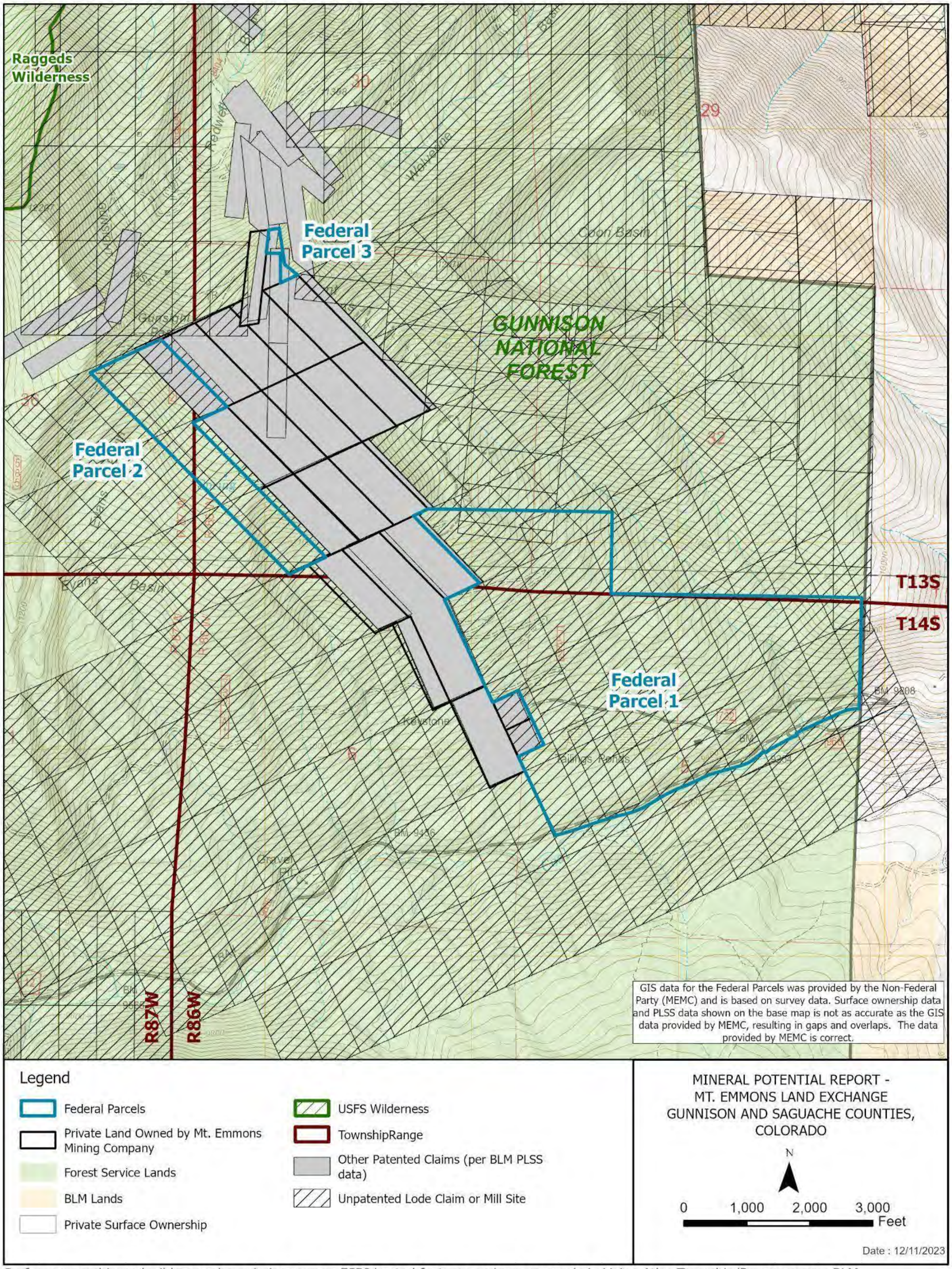
Esri, NASA, NGA, USGS, FEMA
Mineral ownership downloaded from navigator.blm.gov/BLM Colorado Federal Mineral Estate. Topographic base: Cochetopa Park and Saguache Park FSTopo

Map 5: Mineral Ownership, Non-Federal Parcels C & D



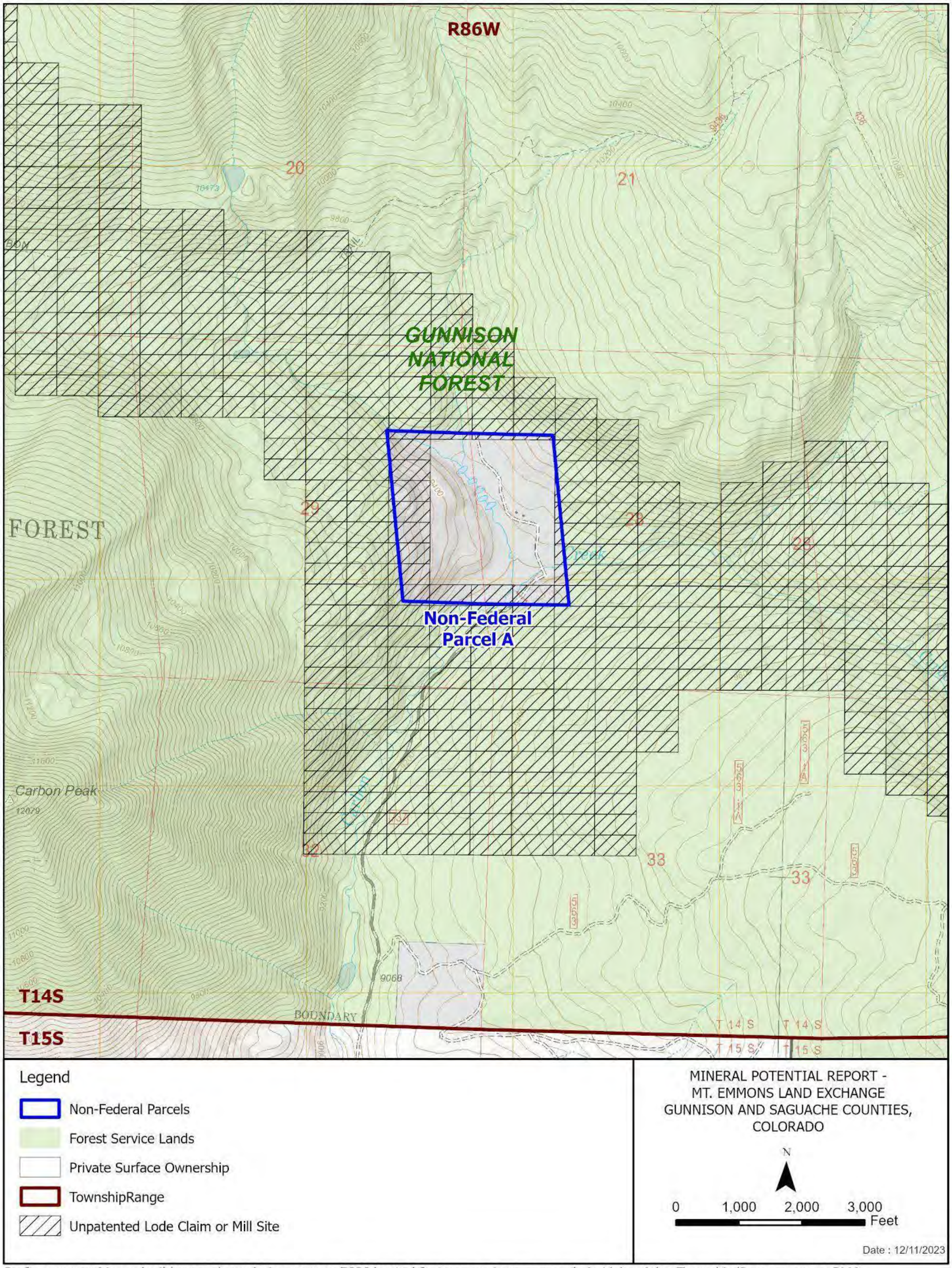
Mineral ownership downloaded from navigator.blm.gov/BLM Colorado Federal Mineral Estate. Topographic base: West Baldy, Sargents Mesa, North Pass, and Trickle Mountain FSTopo; Esri, NASA, NGA, USGS, FEMA

Map 6: Topography and Surface Ownership, Federal Parcels



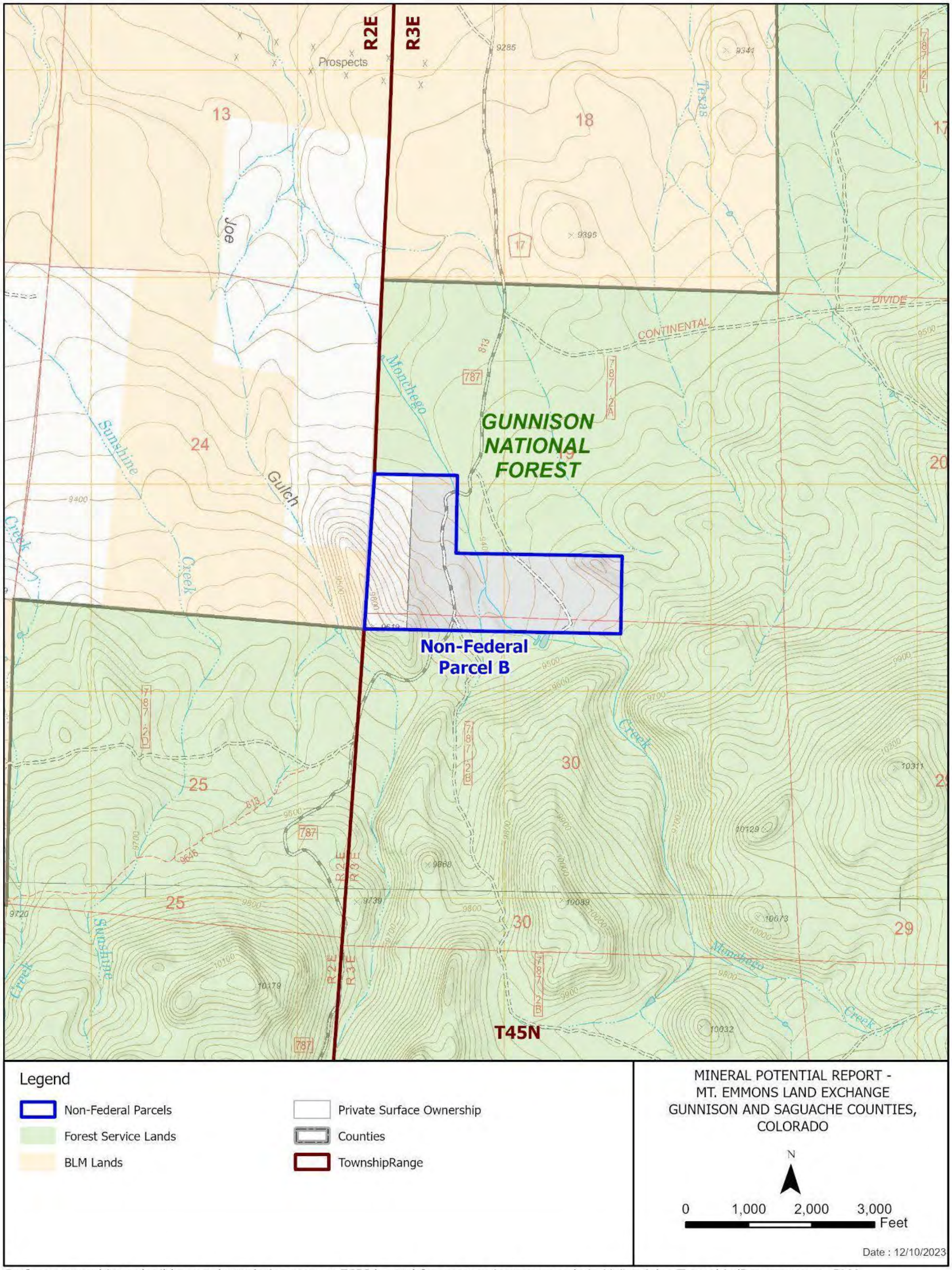
Surface ownership and wilderness boundaries source: ESRI hosted feature services accessed via Living Atlas Township/Range source: BLM.
Topographic base: Mt Axtell and Oh-Be-Joyful FSTopo; Esri, NASA, NGA, USGS, FEMA

Map 7: Topography and Surface Ownership, Non-Federal Parcel A



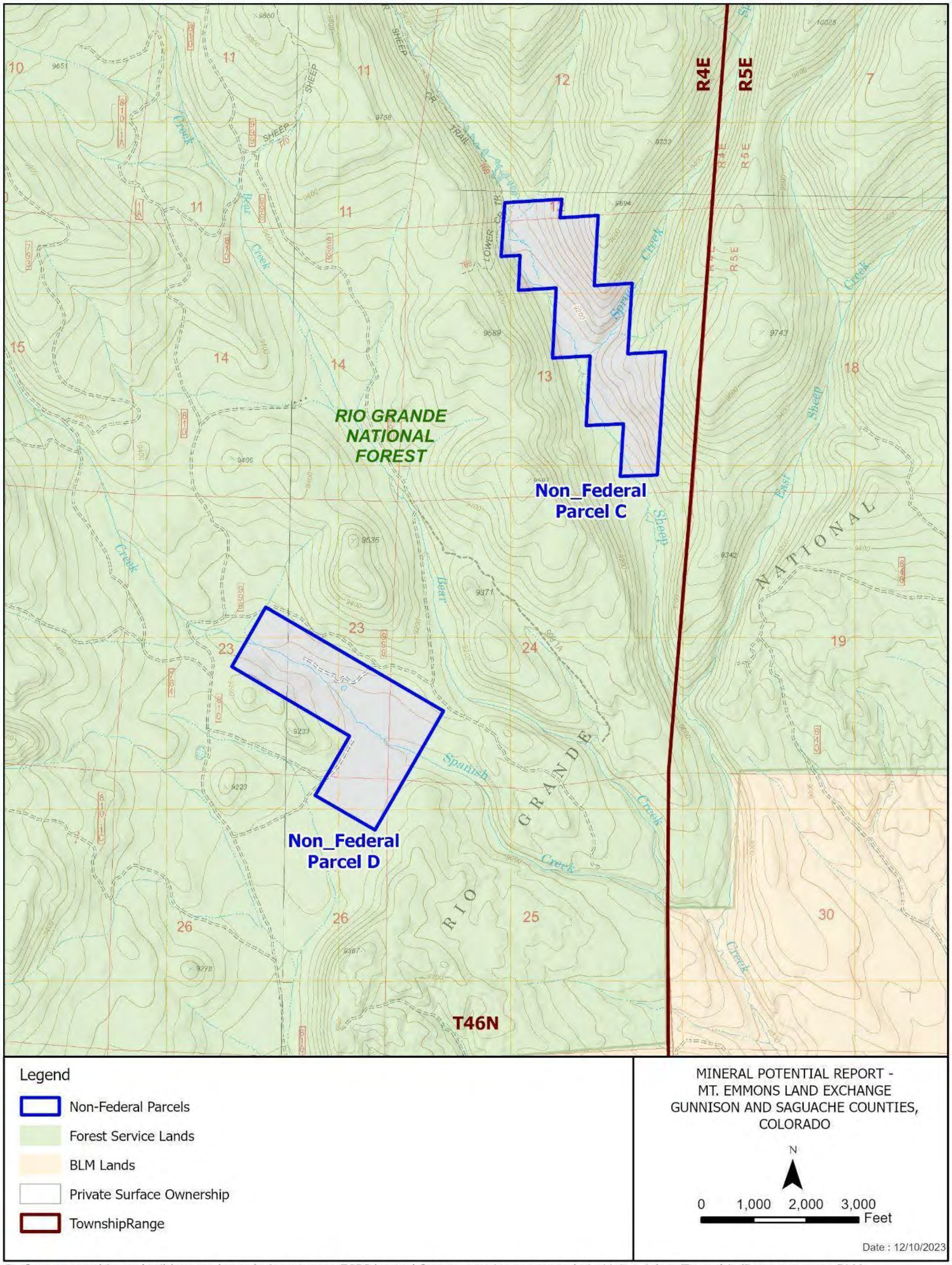
Surface ownership and wilderness boundaries source: ESRI hosted feature services accessed via Living Atlas Township/Range source: BLM.
Topographic base: Crested Butte and Oh-Be-Joyful FSTopo. Esri, NASA, NGA, USGS, FEMA

Map 8: Topography and Surface Ownership, Non-Federal Parcel B



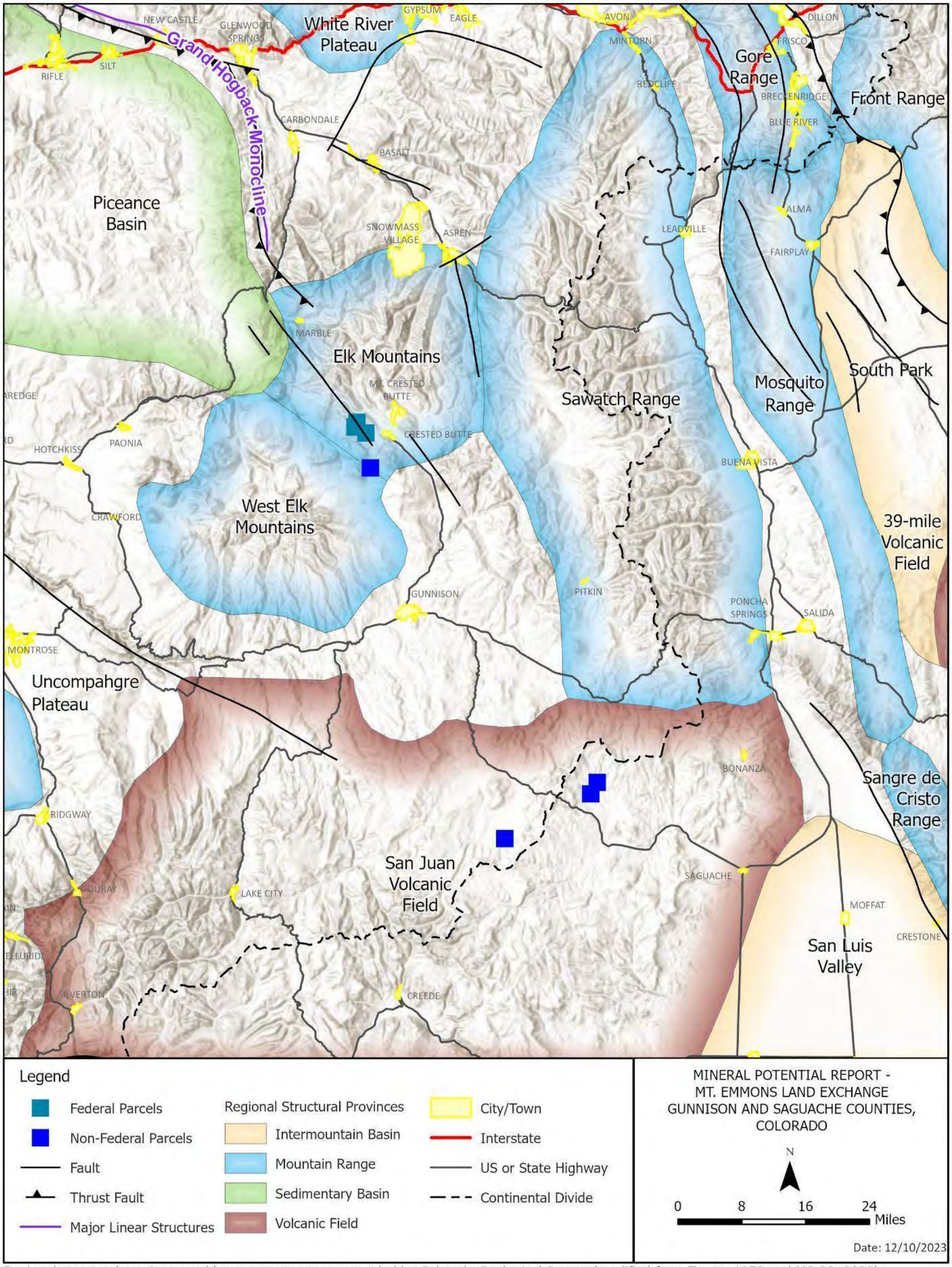
Surface ownership and wilderness boundaries source: ESRI hosted feature services accessed via Living Atlas Township/Range source: BLM.
Topographic base: Cochetopa Park and Saguache Park FSTopo. Esri, NASA, NGA, USGS, FEMA

Map 9: Topography and Surface Ownership, Non-Federal Parcels C & D



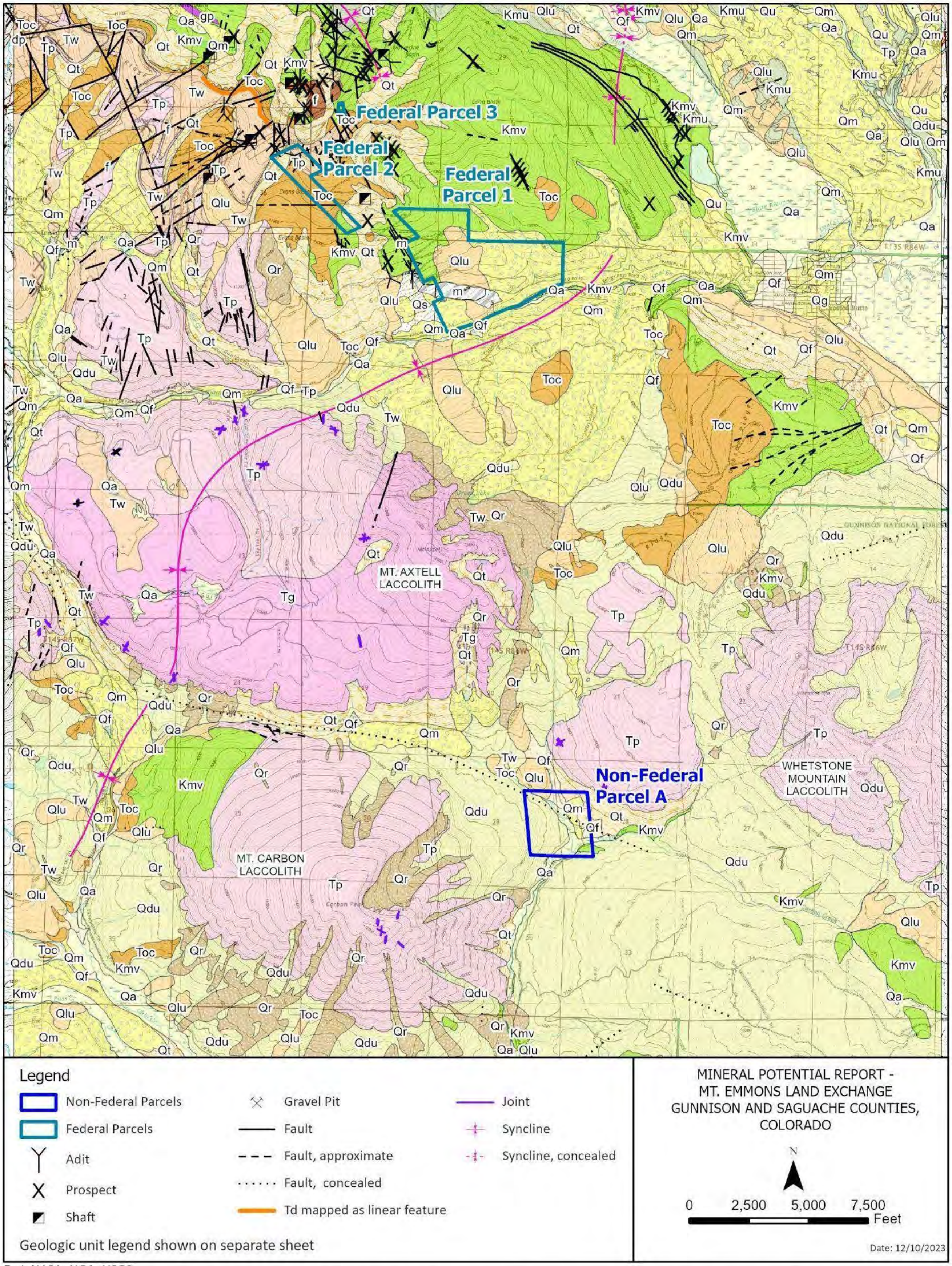
Surface ownership and wilderness boundaries source: ESRI hosted feature services accessed via Living Atlas, Township/Range source: BLM, Topographic base: Sargents Mesa, North Pass, Trickle Mountain, and West Baldy FSTopo, Esri, NASA, NGA, USGS, FEMA

Map 10: Geologic Structures and Tectonics, Overview



Regional structural provinces and basement structures provided by Colorado Geological Survey (modified from Tweto, 1979 and MS-30, 2020)
Esri, CGIAR, USGS

Map 11: Geology, North Zone



Esri, NASA, NGA, USGS
Geology modified from USGS Oh-Be-Joyful (GQ-578), Mt Axtell (GQ-1604), Crested Butte (GQ-1580), and Gothic (GQ-1689) 7.5 minute quad maps

Qa

Alluvial deposits (Holocene) –Silt, sand, gravel cobbles, and boulders in valley bottoms. Locally includes undifferentiated alluvial fan, glaciofluvial, and colluvial deposits, and peaty deposits in ponds and bogs. *

Qf

Debris and alluvial fan deposits (Holocene) –Poorly sorted silt- to boulder-size material. *

Qs

Bog iron spring deposits (Holocene) – Terraced spring and bog deposits of limonite. Includes glacial and colluvial deposits cemented by iron oxide. *

Qt

Talus deposits (Holocene) – Angular rock fragments forming talus cones, aprons, and scree slopes. Locally includes colluvial slope wash and fan deposits. Talus is gradational with boulder fields produced by frost wedging and periglacial creep on slopes of Mount Axtell, Carbon Peak, and elsewhere. *

Qr

Rock streams (Holocene and Pleistocene?) – Relatively active, lobate deposits of angular rock fragments supporting little or no vegetation. Includes coextensive talus, protalus, avalanche debris, and rock glaciers in cirque areas. Forms arcuate lobes, ridges, and levees. Gradational with felsenmeers and with vegetated debris slopes (Qdu). *

Qlu

Landslide deposits, undifferentiated (Holocene and Pleistocene?) – Derived from bedrock and (or) surficial material, includes block slump, block glide, debris slide, rockfall, debris flow, slump, and earthflow deposits. Qlu is conglomeratic sandstone debris from the Ohio Creek Formation. *

Qdu

Debris slopes, undifferentiated (Holocene and Pleistocene) – Relatively inactive but potentially unstable deposits of angular rock fragments supporting herbaceous or forest cover. Mostly rocks streams, talus, and colluvium. Locally includes slumps, landslides, debris and earthflows, till from landslides, and glacial deposits masked by coalesced rock streams in areas below cirques, such as on the northeast flank of Carbon Peak. Gradational with rock streams (Qr) and felsenmeer. *

Qg

Outwash gravels (Pleistocene) – water-deposited glacial debris which forms terraces. **

Qu

Surficial deposits, undifferentiated (Holocene and Pleistocene) – Mostly colluvial slope wash forming soil-covered, vegetated slopes. Locally includes talus and glacial deposits. Many are characterized by solifluction and by mass creep, slumps, small landslides, and earthflows on relatively unstable slopes overlying shaly bedrock. ***

Qm

Glacial Deposits (Pliestocene) – Ground moraine, morainal ridges, and dissected till remnants

f

Felsite (Upper Eocene) – white to light-gray altered quartz and feldspar rock rich in pyrite. Ferromagnesium mineral leached. Forma small breccia plug and dike in Redwell Basin. **

dp

Dacite porphyry dikes (Upper Eocene) – gray to green porphyritic dikes that contain phenocrysts of hornblende, plagioclase, and biotite in a microcrystalline matrix of plagioclase, quartz, alkalic feldspar, and augite. Cut quartz monzonite porphyry and granodiorite porphyry dikes in Ruby Range. Similar dikes cut Miocene (?) volcanic rocks southwest of map area. **

gp

Granodiorite porphyry (Upper Eocene) – light-gray porphyritic rock that contains zoned plagioclase, hornblende, and biotite phenocrysts in a microcrystalline matrix of quartz, plagioclase, and alkalic feldspar. Forms dikes and sills. Includes altered and chloritized dikes and sills adjacent to the stocks of the Ruby Range.

Tp

Quartz monzonite porphyry and granodiorite porphyry (Oligocene) – Ranges from granodiorite to quartz monzonite and quartz latite. Light-gray porphyritic rocks of variable texture and grain size. Contains phenocrysts of euhedral, commonly twinned, potassic feldspat as long as 2 in (6 cm), quartz phenocrysts as much as 0.4 in (1 – 10 cm) in diameter, and phenocrysts of plagioclase, hornblende, and biotite in a microcrystalline to medium-grained, granular matric of alkali feldspar, plagioclase quartz, biotite, and accessory amounts apatite, zircon, sphene, and iron. Forms laccoliths, sills, and dikes. *

Tg

Granodiorite (Oligocene) – Gradational with granodiorite porphyry (Tp) in the My. Axtell laccolith. Light-gray to light greenish-gray. Porphyritic, contains small phenocrysts of plagioclase, hornblende, and biotite. Similar to granodiorite-quartz monzonite porphyries (Tp), but lacks the large potassium feldspar phenocrysts and smaller quartz phenocrysts. Forms southern part of Mt. Axtell laccolith. *

Tw

Wasatch Formation (Eocene) – Thin- to massive-bedded, very coarse grained to fine-grained, gray to white, bluish, greenish, purplish, and brownish to reddish-gray, feldspathic and arkosic sandstone, siltstone, mudstone, variegated conglomerate and conglomeratic sandstone that have complex interlensing relationships. The conglomerates are mostly rounded andesite and dacite pebbles in a coarse angular-grained, andesitic matrix but include lenses and scattered pebbles of varicolored chert, quartz, quartzite, fragmented pebbles of mudstone and sandstone, and sparce pebbles of gneiss, aplite, and pink granite. Locally includes thin conglomeratic sandstone like those in the underlying Ohio Creek Member of the Mesa Verde Formation. The Wasatch sedimentary rocks in this area are a relatively near source, immature sequence of clastics. Lower part may be Paleogene age. Maximum eroded thickness about 650 ft (198 m) in this quadrangle, but formation is than 1700 ft (5198 m) thick in the Oh-Be-Joyful quadrangle (Gaskill and others, 1967). *

Toc

Ohio Creek Formation (Paleocene) – Upper part: light-gray to white friable medium-grained feldspathic conglomeratic sandstone. Pebbles are mainly chert, quartzite, and quartz, but a few igneous rock pebbles were found. Middle part: interbedded sandstone, siltstone, shale, and carbonaceous shale. Basal part: very thick and massive beds of light-gray to white feldspathic sandstone that locally contains pebble lenses and scattered pebbles like those in the upper unit; includes subordinate interbeds of sandy siltstone, silty shale, and carbonaceous shale. Thickness 400 ft (122 m). **

Kmv

Mesaverde Group (Upper Cretaceous) – Interbedded sandstone, shale, coal, and carbonaceous shale. Thickness 1600 to 1800 ft (488 to 549 m). **

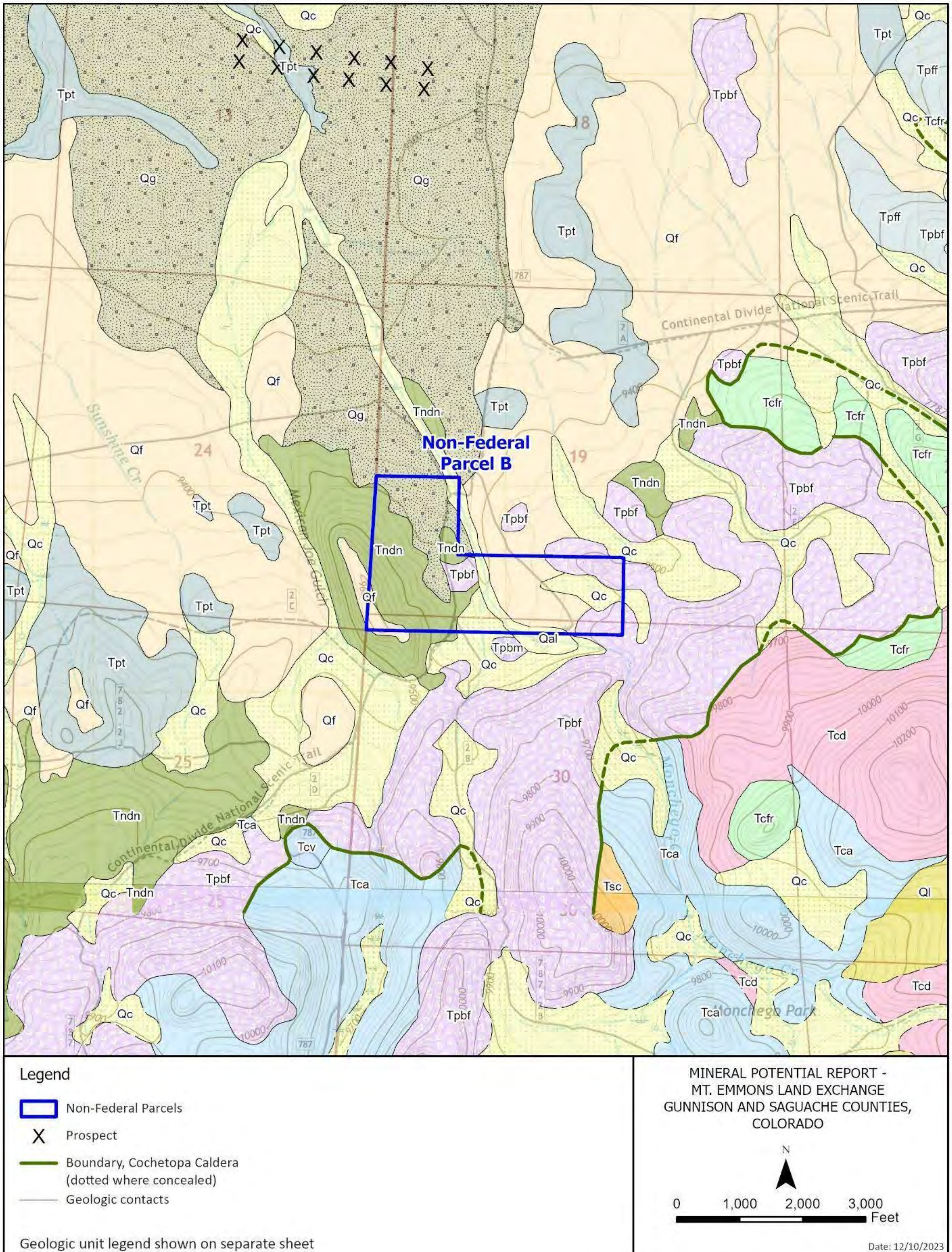
Kmu

Mancos Shape, undifferentiated (Upper Cretaceous) – Littoral marine, light- to dark-gray, thin- to thick-bedded, fine-grained to silty, calcareous, locally shaly and carbonaceous sandstone interbedded with dark-gray shales and sandy shales at the top of the formation in transitional zone underlying the Mesa Verde Formation. Mostly concealed by surficial deposits in this quadrangle. Thickness 4250 ft (1295 m). **

Mine dump

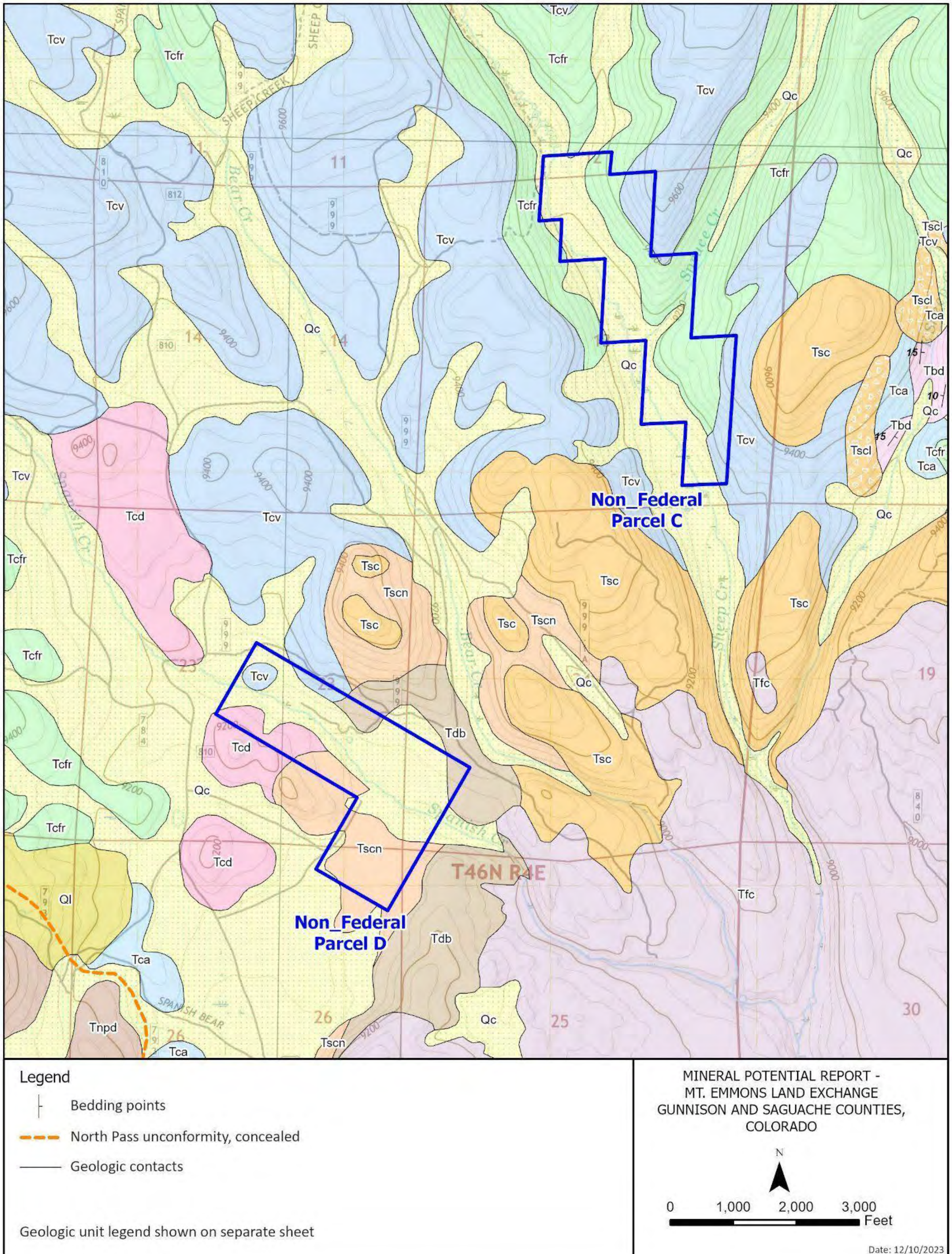
Description of Map Units from GQ-1604 (shown with *), GQ-578 (shown with **), and GQ-1689 (shown with ***)

Map 12: Geology, Non-Federal Parcel B



Esri, NASA, NGA, USGS, FEMA
Geology derived from Geologic Map of the Cochetopa Pass and North Pass Calderas, Northeastern San Juan Mountains, CO (USGS SIM-3123)

Map 13: Geology, Non-Federal Parcels C & D



Esri, NASA, NGA, USGS, FEMA

Geology derived from USGS SIM-3123- Geologic Map of the Cochetopa Park and North Pass Calderas, Northeastern San Juan Mountains, Colorado

Qal **Alluvium (Holocene)** – Silt, sand, gravel, and peaty material in valley bottoms. Locally includes small deposits of colluvium (Qc) and talus (Qt) at margins of valley bottoms

Qc **Colluvium (Holocene)** – Poorly sorted silt- to boulder-sized material on slopes and in steep valleys. Locally includes small alluvial, talus, landslide, and glacial-moraine deposits

Ql **Landslide deposits (Holocene and Pleistocene)** – Lobate accumulations of poorly sorted soil and rock debris on slopes marked by hummocky morphology and downslope-facing scarps. Derived from bedrock and glacial deposits. Includes small earth-flow, block-slump, and block-slide deposits

Qf **Alluvial-fan deposits (Holocene)** – Generally poorly sorted material, ranging in size from silt to boulders, that grades into modern colluvium in upper parts of drainages. Only large low-angle fans are shown; smaller steep fan deposits are mapped with colluvium (Qc). Fan deposits largely predate outwash of Pinedale glaciation and are mostly derived from unglaciated drainages

Qg **Glacial outwash and other terrace gravels (Pleistocene; Pinedale glaciation)** – Moderately sorted to well-sorted stratified terrace and fan deposits consisting of sand, gravel, and well-rounded boulders. In places, difficult to distinguish reliably from alluvial-fan terraces (Qf)

Qgo **Older glacial-outwash and other stream gravels (Pleistocene; pre-Pinedale glaciation)** – Deposits preserved as local erosional remnants of high-standing outwash terraces. Preserved mainly along ridge between Cochetopa Creek and Van Tassel Gulch. In places, difficult to distinguish reliably from older alluvial-fan deposits (Qfo).

Tpff **Fanglomerate with clasts of Fish Canyon Tuff** – Andesitic clasts are dominant, but scattered clasts of Fish Canyon Tuff (Tfc), as well as rare clasts of dacitic Luders Creek Tuff (Tld), are conspicuous. Best exposures are along Archuleta Creek, along the east margin of Cochetopa Park caldera. Maximum thickness >200 m.

Tpt **Intracaldera tuffaceous sediments** – White to gray tuffs and water-reworked sediments, including laminated lake-bed deposits, deltaic shallow-water sandstone in medial areas of the caldera moat, and coarser river-channel sandstone and local conglomerate in sites more proximal to inner walls of the caldera. Exposures are discontinuous and limited in vertical and lateral extent, due to weak induration of most of the unit and low topographic relief in the moat area. Widespread zeolitic alteration of originally glassy ash. $^{40}Ar/^{39}Ar$ ages on sanidine: 26.90±0.04 Ma for pumice blocks east of Cochetopa Dome; 26.83±0.05 Ma for small nonwelded ignimbrite deposit south of the dome. Based on phenocryst content, eruption of the dated tuff samples may have been associated with emplacement of the middle flow on the dome. Maximum exposed thickness >50 m.

Tpbf **Massive breccia with clasts solely of Fish Canyon Tuff** – Monolithologic breccias consisting of Fish Canyon clasts (Tfc) are exposed nearly continuously along the south and east margins of the caldera basin. Clast-supported texture, sparse matrix fines, angular blocks, and unfilled voids are consistent with modest transport distance. These slide deposits locally form rugged cliffs of well-indurated breccia, for example along the Saguache Park road in Mexican Joe Gulch, where they previously were mapped as in-place Fish Canyon Tuff (Steven and others, 1974). Small patches of similar breccia, preserved on the west caldera margin along both sides of Los Pinos Creek, are difficult to distinguish from other breccia deposits (Tfcb) of Fish Canyon clasts in the same area, which are inferred to have formed earlier in association with faulting along a graben related to subsidence of La Garita caldera. Thickness 0–200 m.

Tpbm **Breccia with sparse clasts of Carpenter Ridge Tuff** – Locally exposed breccia dominated by Fish Canyon fragments but containing mixed clast lithologies, typically less indurated than the monolithologic breccia (Tpbf) and exposed mainly as float. Distributed discontinuously along the north margin of the caldera, roughly concordantly with preserved outcrops of in-place Carpenter Ridge Tuff (Tcr) on the caldera rim. The mixed-breccia unit is best exposed west of the Samora Creek road, along the Wolverine Creek trail, and in a small roadcut along Los Pinos Creek road. Presence of Carpenter Ridge clasts in the landslide breccia assemblage is critical evidence for timing of the last major subsidence at Cochetopa Park caldera. The Carpenter Ridge clasts are densely welded red-brown tuff, characterized by sparse biotite phenocrysts. Sparse clasts of densely welded Saguache Creek Tuff (Tsc) are also locally mixed with dominant Fish Canyon blocks in the landslide deposits; clasts of Saguache Creek Tuff are distinguishable from Carpenter Ridge clasts in the field by absence of biotite. Identification of Carpenter Ridge clasts in critical localities has been confirmed by rock and phenocryst (sanidine) chemical analyses and by isotopic ages concordant with dated in-place samples of this tuff (less alkalic and 4.5 m.y. younger than Saguache Creek Tuff). $^{40}Ar/^{39}Ar$ age on sanidine from a Carpenter Ridge clast along the Los Pinos Creek road, 27.59±0.05 Ma; for clast west of Samora Creek, 27.48±0.05 Ma. Thickness 0–25 m.

Tndn **Nonwelded to partly welded dacite** – Uppermost Nelson Mountain Tuff, both within and locally outside the Cochetopa Park caldera. Yellowish-tan to gray, porous, vapor-phase-crystallized to glassy. Grades down into more welded dacitic Nelson Mountain Tuff (Tnd). Crystal rich; phenocrysts similar to welded dacite (Tnd). Mostly poorly exposed; especially well preserved on low ridge (between Mexican Joe Gulch and Monchego Creek. Thickness 0–30 m.

Tfc **Widespread welded outflow ignimbrite sheet** – Light-gray variably welded tuff, commonly forming massive rounded outcrops with columnar and sheet cooling joints. Continuously outcropping and exceptionally thick (to 300 m) where ponded within southeast side of North Pass caldera. Similarly thick and banked abruptly against andesitic lavas of the Conejos Formation southeast of McDonough Park, a feature which may record early subsidence in the Cochetopa Park area during eruption of the Fish Canyon Tuff. More discontinuously preserved and variable in thickness along northern parts of map area because of deposition along broad north-trending paleovalleys. Thickness 0–300 m.

Tdb **Mesobreccia and conglomerate** – Poorly sorted mixed clasts dominated by light-tan rhyolite and dark-gray dacite fragments derived from the Luders Creek Tuff, clasts of andesitic lava increase in relative abundance eastward. In western parts of the unit, angular slabs of dark-gray dacitic Luders Creek Tuff are as much as 10 m across; in places, distinction is difficult between essentially in-place Luders Creek Tuff and material that has suffered significant transport in secondary debris flows. Thickness 0–75 m.

Tlr **Nonwelded to partly welded rhyolite** – Lower zone of weakly welded light-tan tuff, exposed only as float on hill slopes beneath welded dacite (Tld). Sanidine phenocrysts are more sodic and homogeneous than in overlying later-erupted dacite. $^{40}Ar/^{39}Ar$ ages (sn), 32.15±0.06 Ma and 32.22±0.05 Ma. Thickness 0–75 m.

Tnpd **Dacite of East Pass Creek** – Massive flows of gray to tan crystal-rich dacite. Dominant exposed fill of the North Pass caldera. Thickest and most widespread accumulations are north of North Pass, where multiple thick flows are marked by basal vitrophyre and upper carapace-breccia zones. $^{40}Ar/^{39}Ar$ age (bi) from three flows within main body of this unit, 32.07–32.31 Ma. Individual flows are as thick as 200 m; total thickness 0–500 m.

Description of Map Units from SIM3123, 2012

Tscl **Landslide breccia of hill 9943** – Weakly indurated monolithologic breccia consisting solely of clasts of welded Saguache Creek Tuff. In addition to exposure on hill 9943 (head of Muddy Creek), exposures of similar breccia occupy paleovalleys along East Sheep Creek and Long Gulch. In Long Gulch, Fish Canyon Tuff laps onto the slide breccia, demonstrating its Oligocene age. Thickness 0–40 m.

Tsc **Nonwelded to densely welded crystal-poor rhyolite** – Variably welded light-tan to red-brown tuff. Locally grades up into more densely welded crystal-rich rhyolite (Tscc). Thickness 0–50 m.

Tscn **Nonwelded crystal-poor rhyolite** – Light-gray upper part of ignimbrite sheet that is locally sufficiently thick and distinctive to be mapped as separate zones. Thickness 0–35 m.

Tbd **Lower Dacite** – Mainly densely welded dark-gray to brown crystal-rich dacite welded tuff. Preserved as discontinuous erosional remnants of paleovalley fills along east margin of map area; more widespread farther east. Sanidine composition. $^{40}Ar/^{39}Ar$ age (sn), 33.17±0.06 Ma, on densely welded tuff that may be a megabreccia block along the northwest margin of North Pass caldera. Thickness 0–100 m.

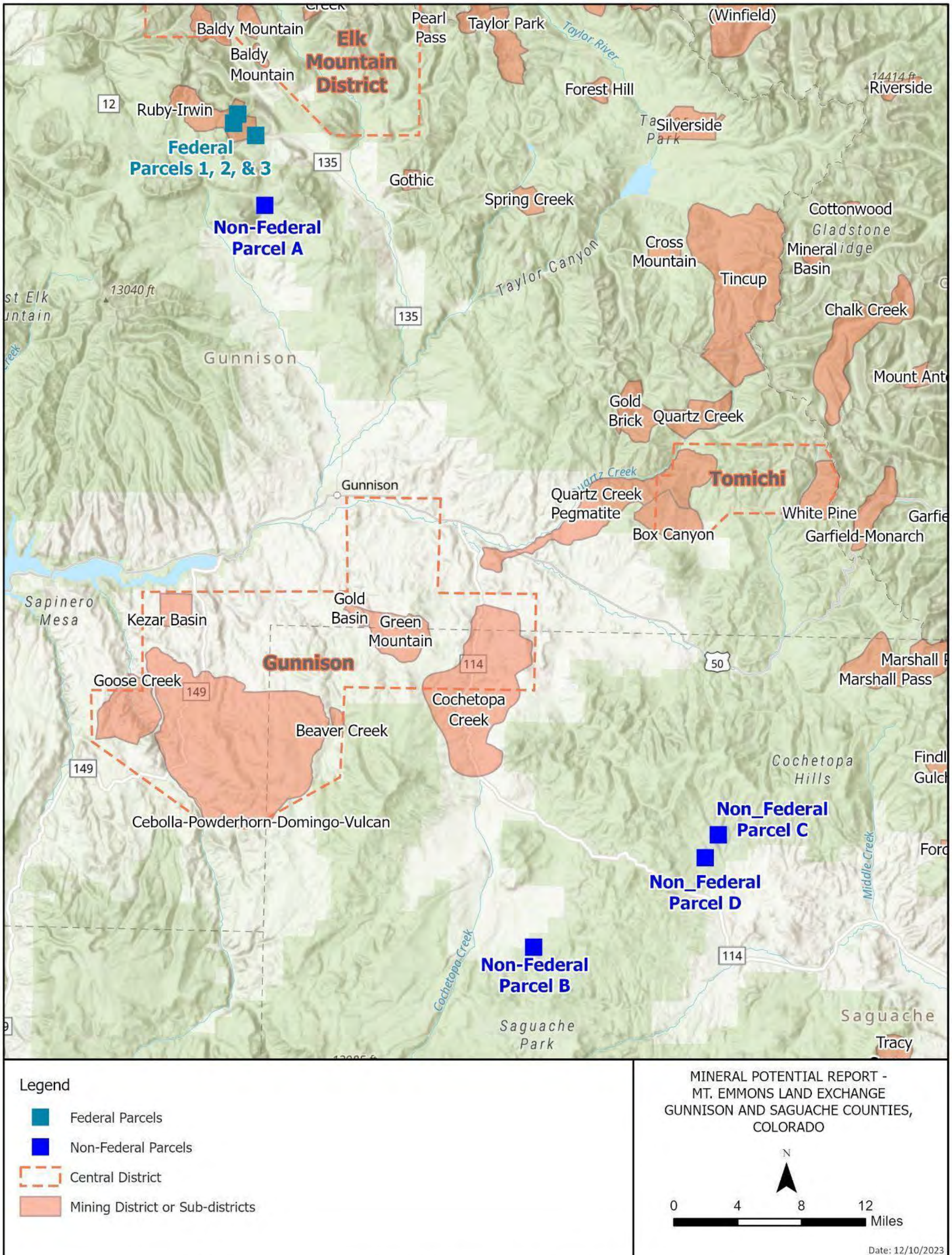
Tca **Andesite** – Finely porphyritic to aphanitic dark-gray lava flows and breccia, constituting the most voluminous Conejos Formation lithology. Individual flows are 5–40 m thick; multiple-flow accumulations are as much as several hundred meters thick on volcano flanks

Tcd **Dacite** – Gray porphyritic flow-layered lava and breccia, characterized by light color and conspicuous biotite phenocrysts. Massive, locally with flow layering or basal vitrophyre. Widely distributed, but much less abundant than andesites of Conejos Formation. Commonly high in the Conejos lava sequence. In proximity to the North Pass caldera, locally difficult to distinguish reliably from younger dacite of the caldera fill (Tnpd). Near Carnero Pass, a petrologically unusual dacite flow, containing large sanidine phenocrysts (to 2 cm), yielded an $^{40}Ar/^{39}Ar$ age of 32.71±0.10 Ma. In Needle Creek, a thick sanidine-bearing dacite flow low in the Conejos lava sequence has $^{40}Ar/^{39}Ar$ ages of 34.10±0.05 and 33.98 ±0.08 Ma, similar to the granodiorite intrusion (Tci) that cuts the lava sequence in this area. Farther west, a dacite flow, which caps Sawtooth Mountain and is interpreted to be an upper part of a volcanic construct that may postdate the Saguache Creek Tuff, has an $^{40}Ar/^{39}Ar$ age of 32.00±0.09 Ma. Thickness 0–200 m.

Tcfr **Rhyolite** – Light-gray to tan flow-layered lava and breccia. Rare crystal-rich flows (to 15–20% phenocrysts) contain sparse high-K sanidine. Especially common high in the Conejos Formation northeast of North Pass caldera. Overlain by Bonanza Tuff, so distinctly older than petrologically similar crystal-poor rhyolite of the Barret Creek assemblage (Tbfa). These flows may represent initial silicic magmatism precursor to explosive ignimbrite eruptions from Bonanza center. A large rhyolite dome along Archuleta Creek near the southwest rim of North Pass caldera, which has an $^{40}Ar/^{39}Ar$ age (sn) of 32.17±0.06 Ma, may represent precursor volcanism of the North Pass caldera cycle. An isolated sanidine-bearing rhyolite flow, near the entry to Cochetopa Canyon yielded an age of 37.13±0.09 Ma . This is the oldest silicic volcanic rock thus far dated from the San Juan region, similar in age to the voluminous Wall Mountain Tuff (Twm) erupted farther north in the SRMVF. Thickness 0–125 m.

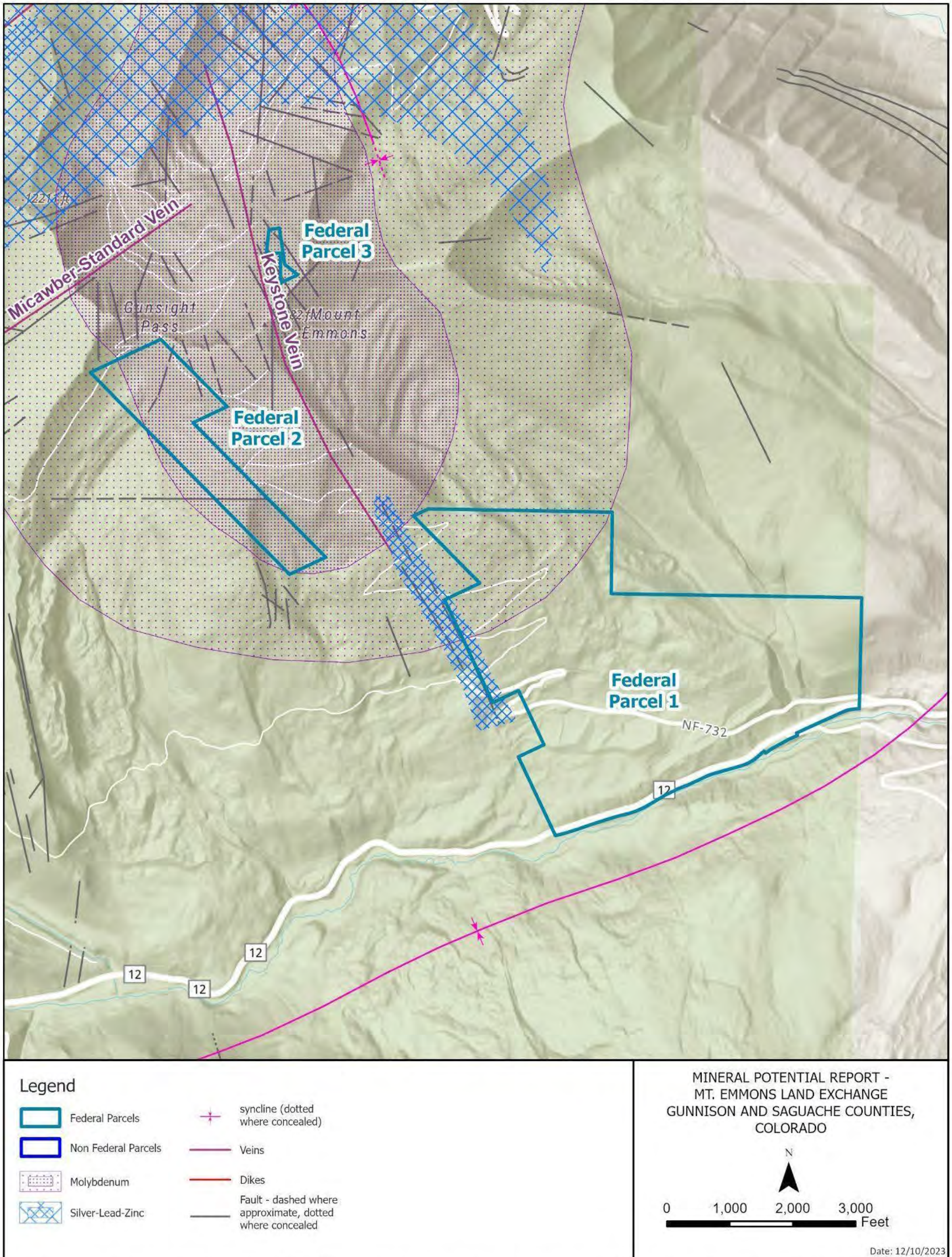
Tcv **Volcaniclastic rocks** – Mostly reworked crudely bedded to well-bedded conglomerates, sandstones, and mudflow breccias, containing clasts of dark andesite and dacite in light-gray sandy matrix. Primary dips are typically <5°. Mainly distal deposits on lower slopes of volcanic constructs; most abundant in the northern map area. Volumetrically less abundant, relative to proximal lavas, than in preserved Conejos sequence farther west and south in the San Juan region. Maximum thickness, about 200 m on east flank of Sawtooth Mountain.

Map 14: Historic Mining Districts, Overview



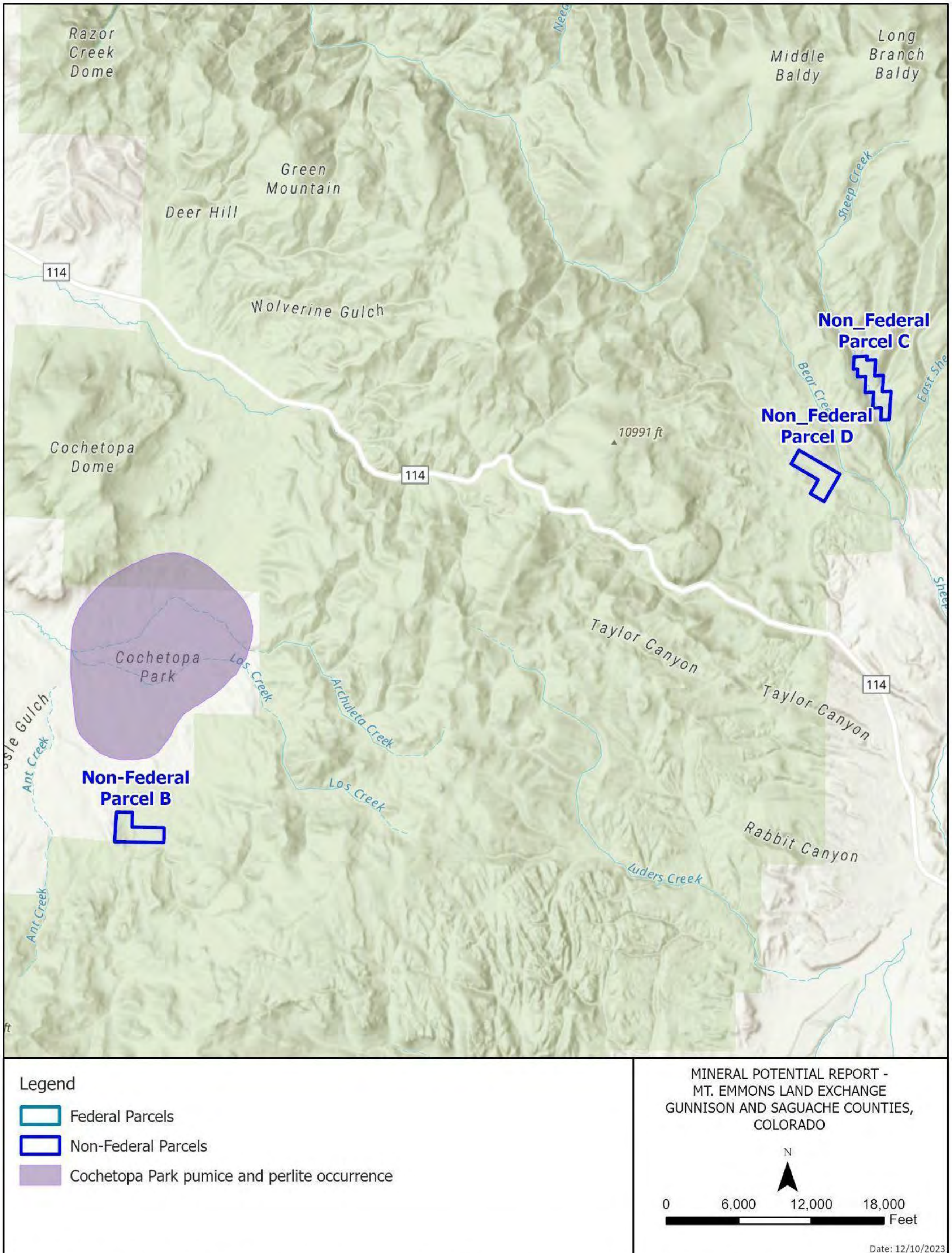
Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, Esri, CGIAR, USGS
Historic Mining Districts downloaded from Colorado Geological Survey ON-007-08D

Map 15: Locatable Mineral Occurrence Potential, Federal Parcels



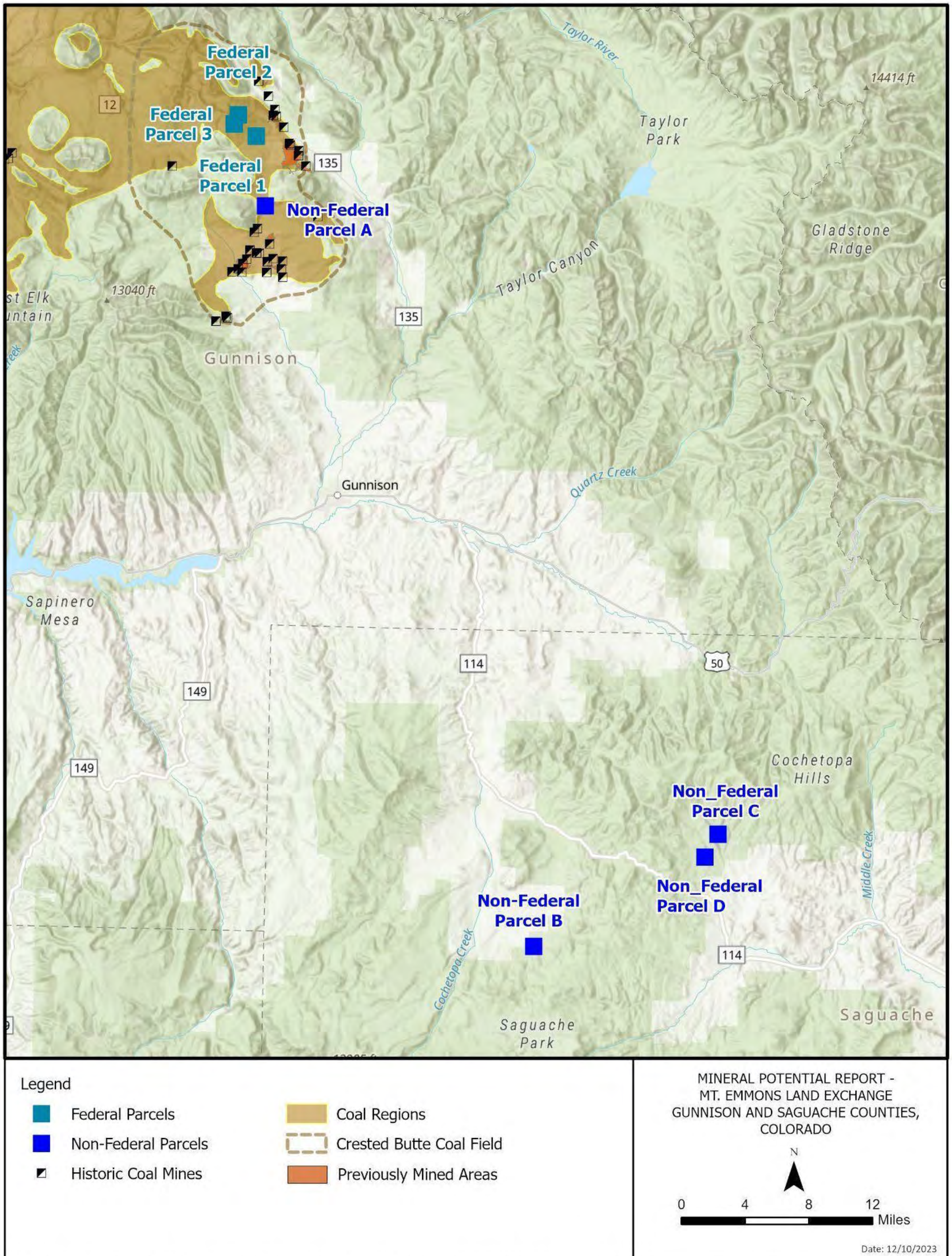
Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA, Esri, NASA, NGA, USGS, FEMA; Mineral Resource Potential from USGS Map MF-1582-A

Map 16: Locatable Mineral Occurrence Potential, South Zone



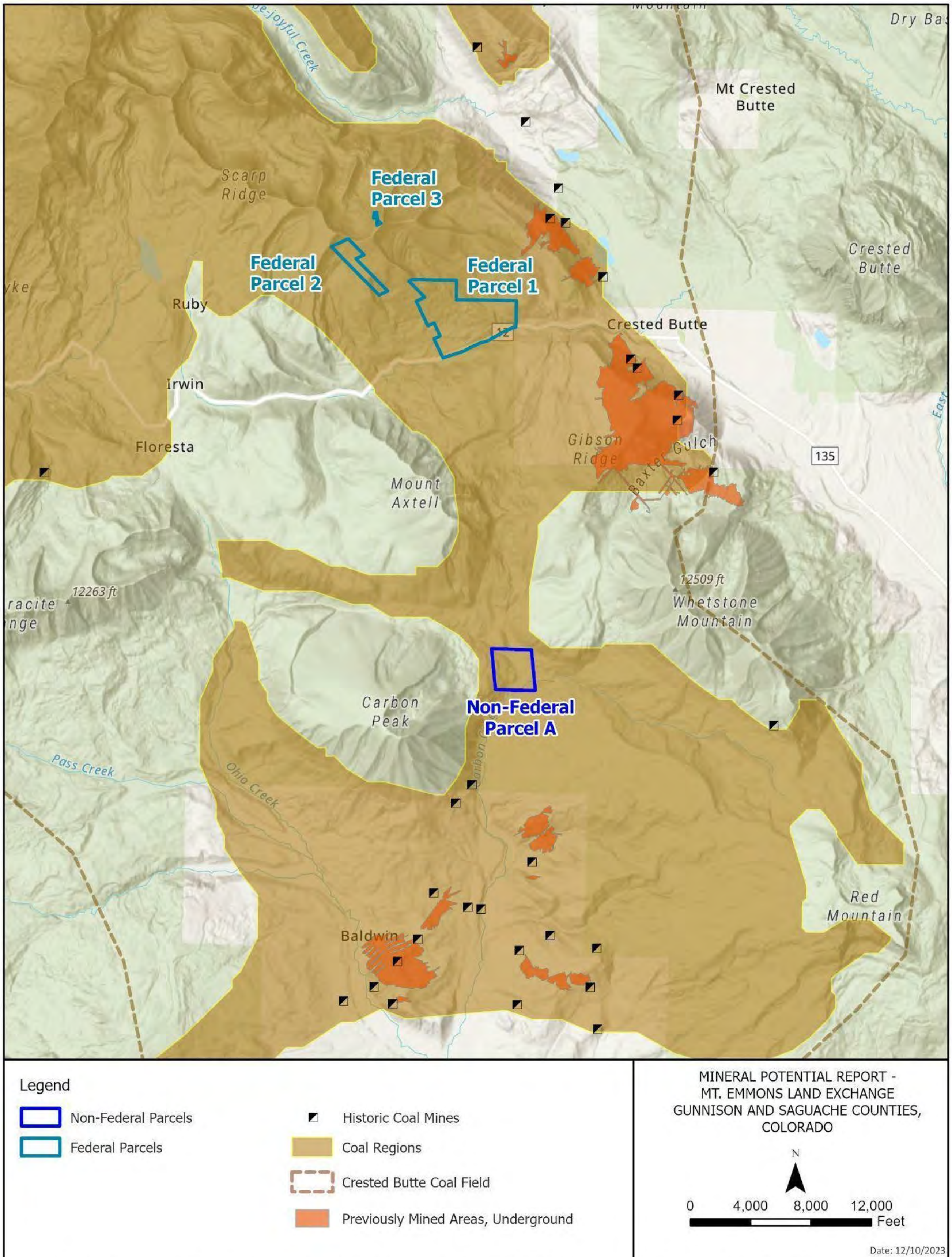
Esri, NASA, NGA, USGS, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA
Mineral Resource Potential from USGS Map MF-1582-A

Map 17: Leasable Mineral Occurrence Potential, Coal Fields, Overview



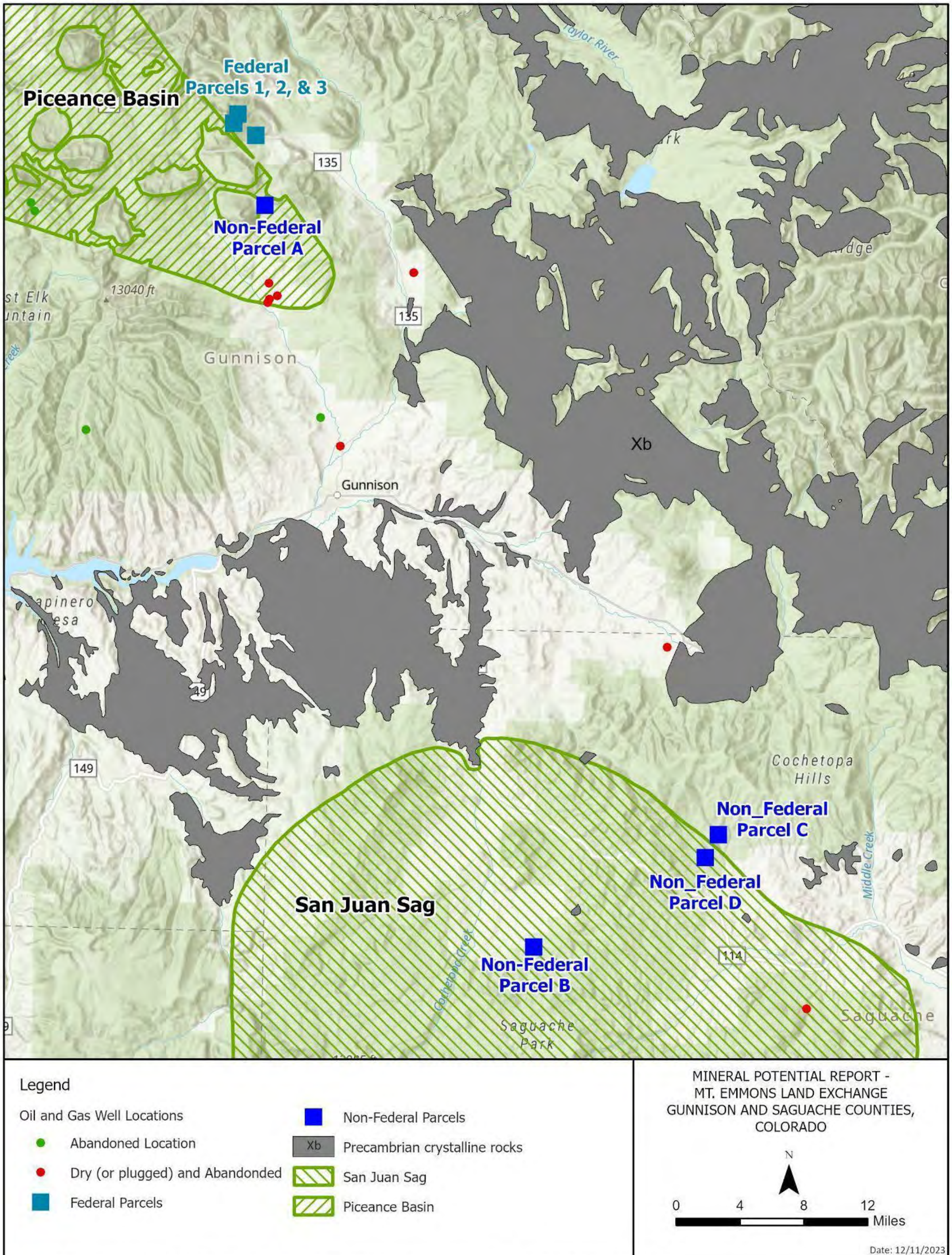
Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, Esri, CGIAR, USGS
Coal regions downloaded from Colorado Geological Survey IS-64
Historic coal mines and undermined areas from: https://cgsarcimage.mines.edu/arcgis/rest/services/cgs_services/Historic_Coal_mines/MapServer

Map 18: Leasable Mineral Occurrence Potential, Coal Fields, North Zone



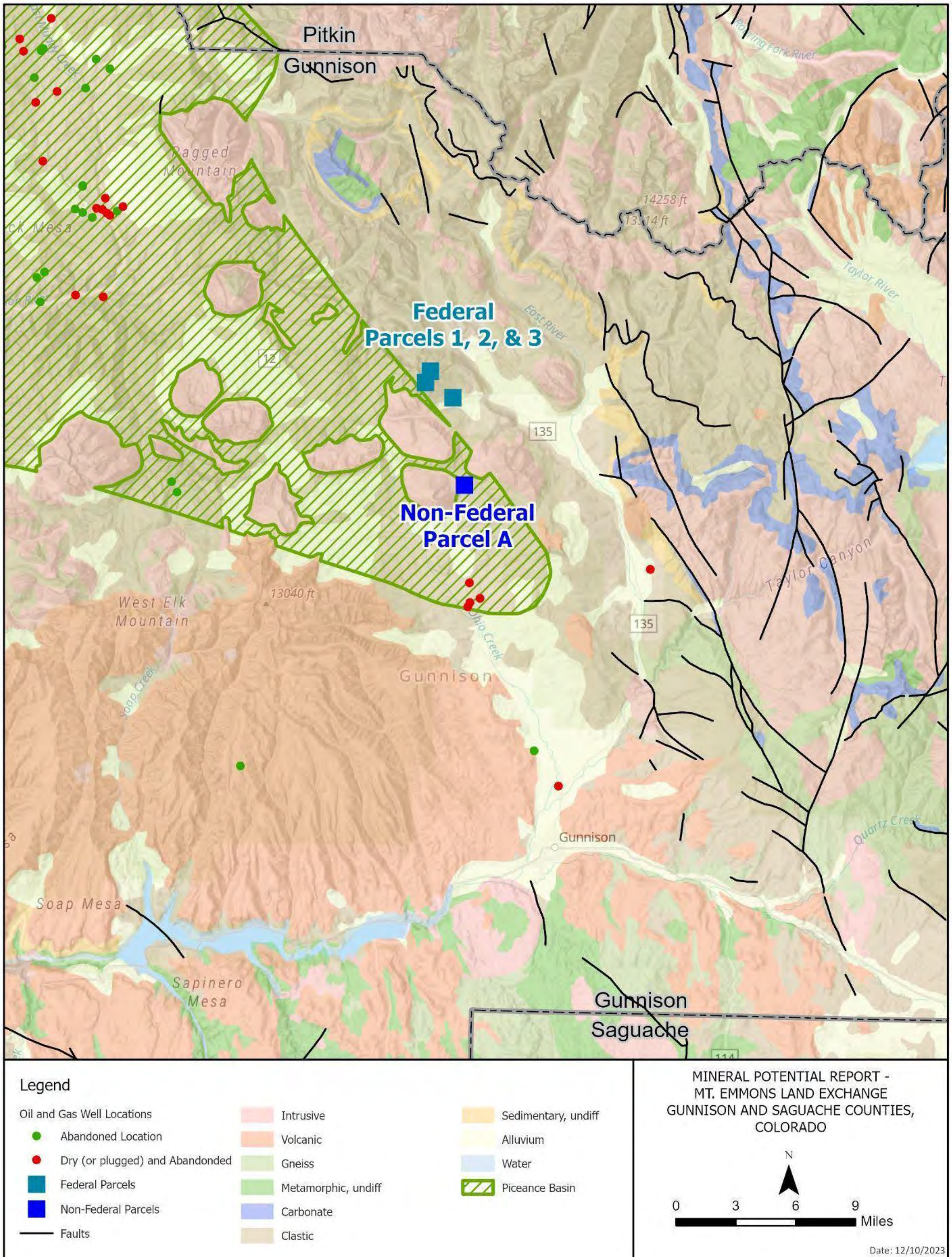
Esri, NASA, NGA, USGS, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA.
Coal regions downloaded from Colorado Geological Survey IS-64
Historic coal mines and undermined areas from: https://cgsarcimage.mines.edu/arcgis/rest/services/cgs_services/Historic_Coal_mines/MapServer

Map 19: Leasable Mineral Occurrence Potential, Oil and Gas, Overview



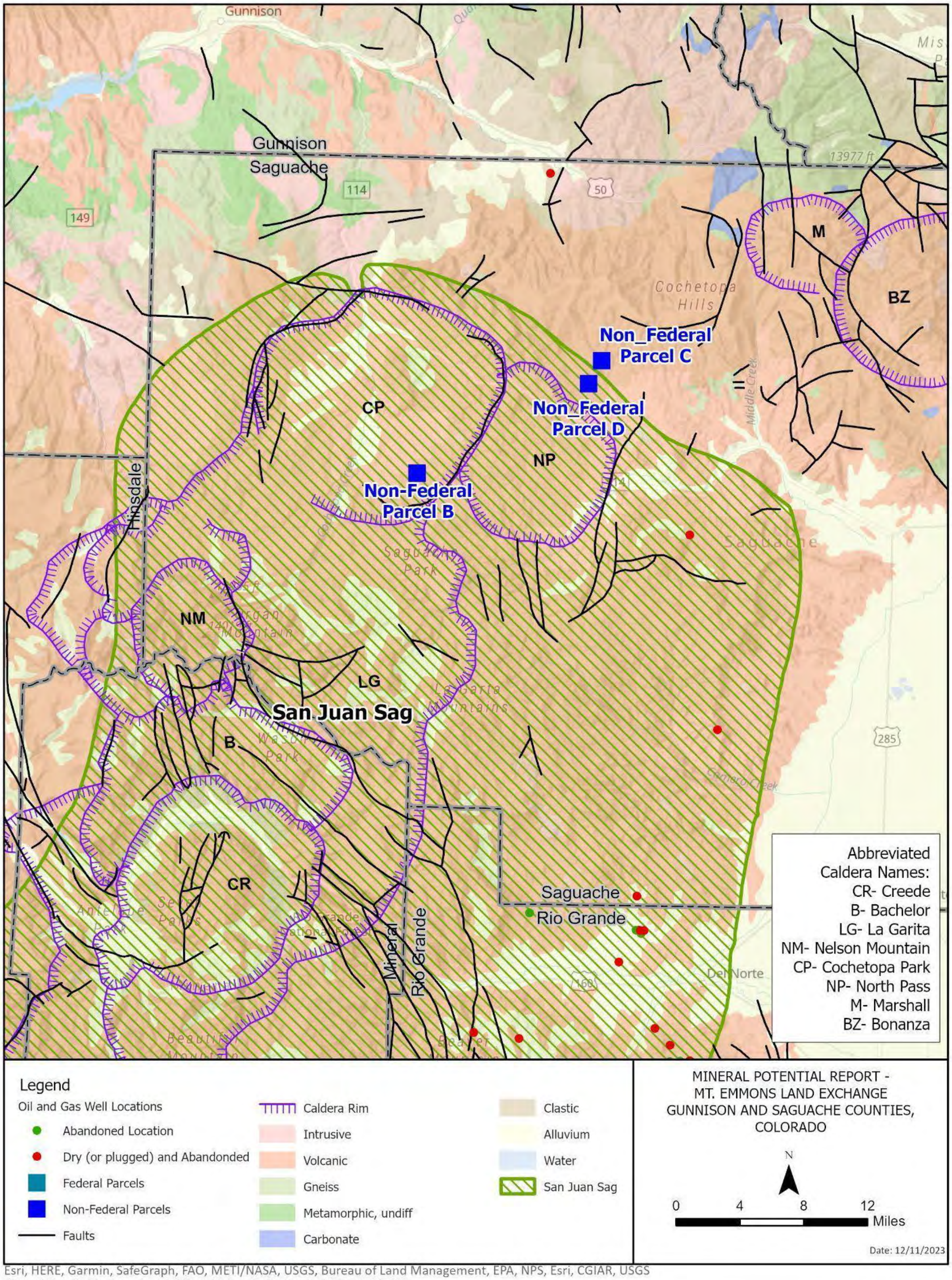
Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, Esri, CGIAR, USGS
Oil and Gas Fields downloaded from Colorado Geological Survey MS-30
Oil and Gas locations downloaded from https://cogcc.state.co.us/data2.html#/downloads

Map 20: Leasable Mineral Occurrence Potential, Oil and Gas, North Zone



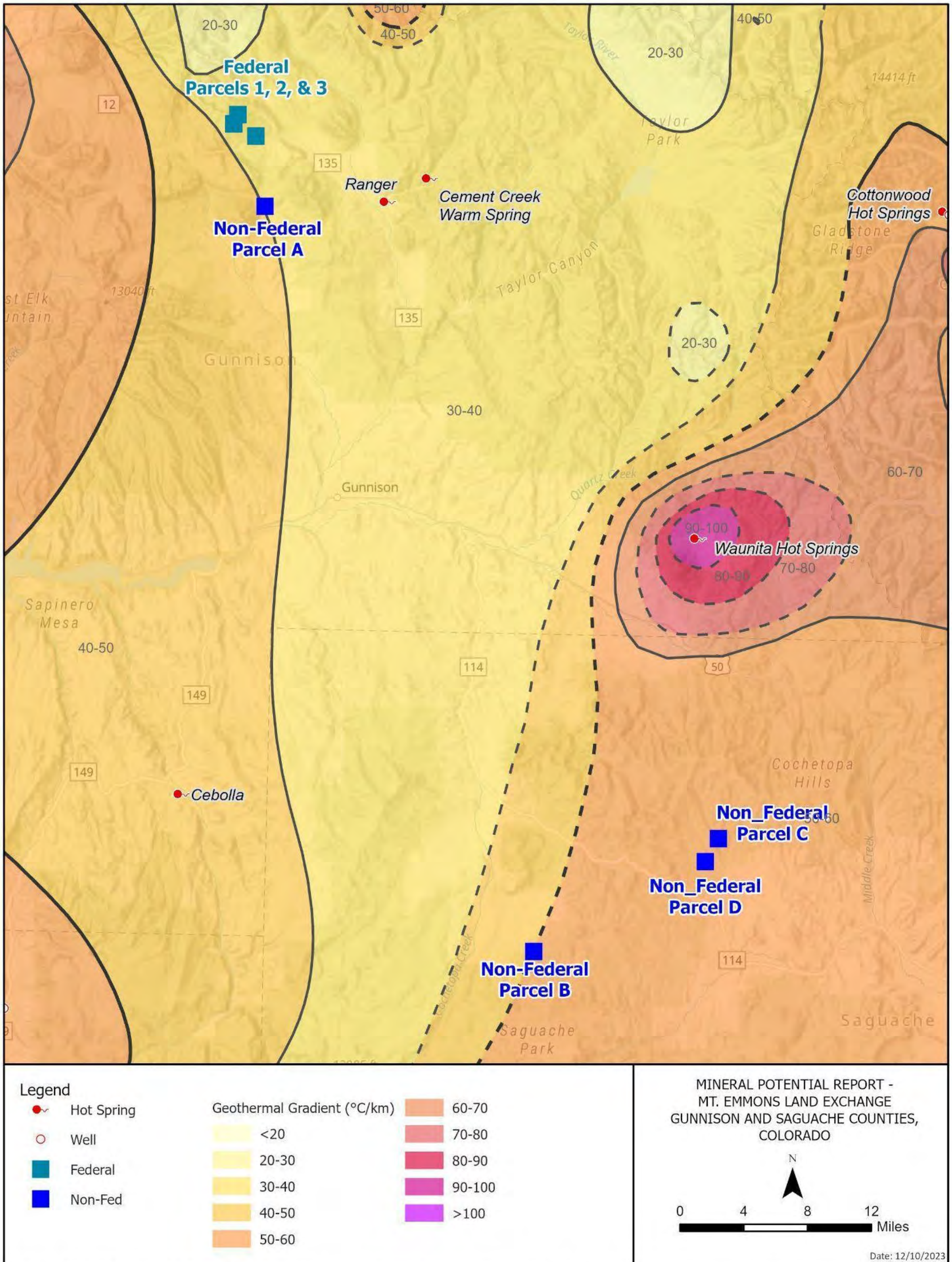
Esri, NASA, NGA, USGS, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, Bureau of Land Management, EPA, NPS
Oil and Gas Fields downloaded from Colorado Geological Survey MS-30
Oil and Gas locations downloaded from https://cogcc.state.co.us/data2.html#/downloads

Map 21: Leasable Mineral Occurrence Potential, Oil and Gas, South Zone



Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, Esri, CGIAR, USGS
Oil and Gas Fields downloaded from Colorado Geological Survey MS-30
Oil and Gas locations downloaded from https://cogcc.state.co.us/data2.html#/downloads

Map 22: Leasable Mineral Occurrence Potential, Geothermal, Overview



Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, Esri, CGIAR, USGS
Geothermal gradient downloaded from Colorado Geological Survey MS-51

Appendices

Appendix 1: Legal Descriptions for Lands Involved

<u>Non-Federal Parcel A</u>

Sixth Principal Meridian, Colorado
T. 14 S., R. 86 W.,
sec. 28, SW1/4NW1/4 and NW1/4SW1/4;
sec. 29, SE1/4NE1/4 and NE1/4SE1/4;
The areas described aggregate 160 acres.

<u>Non-Federal Parcel B</u>

New Mexico Principal Meridian, Colorado
T. 45 N., R. 3 E.,
sec. 19, lots 3 and 4, SE1/4SW1/4 and SW1/4SE1/4;
The areas described aggregate 159.690 acres.

<u>Non-Federal Parcel C</u>

New Mexico Principal Meridian, Colorado
T. 46 N., R. 4 E.,
sec. 12, S1/2SE1/4SE1/4SW1/4 and SE1/4SW1/4SE1/4SW1/4;
sec. 13, W1/2NW1/4NE1/4, SW1/4NE1/4, E1/2NE1/4NW1/4, E1/2NW1/4NE1/4NW1/4, W1/2NE1/4SE1/4, E1/2NW1/4SE1/4, NW1/4SE1/4SE1/4, and N1/2SW1/4SE1/4SE1/4;
The areas described aggregate 147.50 acres.

<u>Non-Federal Parcel D</u>

A parcel of land situated in sections 23, 24, 25, and 26, township 46 north, range 4 east, New Mexico Principal Meridian, Saguache County, Colorado, being that parcel of land described in Homestead Entry Survey No. 63 and being more particularly described as follows:

COMMENCING at the corner of sections 23, 24, 25, and 26, described in Homestead Entry Survey No. 63, a portion of land situated in being the results of a survey of an irregular bounded portion of land and being more particularly described as follows:

THENCE South 87° 22' East a distance of 4.82 chains to Corner No. 1, described in Homestead Entry Survey No. 63 and the POINT OF BEGINNING of the herein described parcel;

THENCE South 29° 4' West a distance of 9.8 chains to Corner No. 2, Homestead Entry Survey No. 63;

THENCE South 29° 4' West a distance of 6.9 chains to Corner No. 3, Homestead Entry Survey No. 63;

THENCE North 60° 55' West a distance of 19.96 chains to Corner No. 4, Homestead Entry Survey No. 63;

THENCE North 29° 4' East a distance of 6.27 chains to Corner No. 5, Homestead Entry Survey No. 63;

THENCE North 29° 4' East a distance of 13.69 chains to Corner No. 6, Homestead Entry Survey No. 63;

THENCE North 60° 26' West a distance of 39.55 chains to Corner No. 7, Homestead Entry Survey No. 63;

THENCE North 28° 44' East a distance of 19.8 chains to Corner No. 8, Homestead Entry Survey No. 63;

THENCE South 60° 35' East a distance of 41.75 chains to Corner No. 9, Homestead Entry Survey No. 63;

THENCE South 60° 35' East a distance of 17.79 chains to Corner No. 10, Homestead Entry Survey No. 63;

THENCE South 28° 56' West a distance of 19.82 acres to Corner No. 11, Homestead Entry Survey No. 63;

THENCE South 29° 4' West a distance of 3.22 chains to Corner No. 1, Homestead Entry Survey No. 63, being the **POINT OF BEGINNING**, containing 157.99 acres.

BASIS OF BEARINGS: North 87° 22' East, being the line between the corner of sections 23, 24, 25, and 26 and Corner No. 1, Homestead Entry Survey No. 63.

Federal Parcel 1

A parcel of land situated in sections 31 and 32, township 13 south, range 86 west; and sections 5 and 6, township 14 south, range 86 west, Sixth Principal Meridian, Gunnison County, Colorado, being more particularly described as follows:

COMMENCING at the intersection of the township line between sections 31 and 6, and line 1-2, Mineral Survey. No. 20825, Park City No. 20 Lode;

THENCE North 64° 28' East, along line 1-2, Mineral Survey No. 20825, Park City No. 20 Lode to Corner No. 1, Mineral Survey No. 20825, Park City No. 20;

THENCE North 45° 00’ West, along line 4-1, Mineral Survey No. 20825, Park City No. 20 Lode to Corner No. 4, Mineral Survey. No. 20825, Park City No. 20, on line 1-2, Mineral Survey No. 20825, Park City No. 30;

THENCE North 64° 28’ East, a distance of 262.12 feet along line 1-2, Mineral Survey No. 20825, Park City No. 30 Lode to Cor. No. 1, Mineral Survey No. 20825, Park City No. 30;

THENCE on a bearing easterly to the south 1/16 section corner of sections 31 and 32;

THENCE easterly to the southwest 1/16 corner of section 32;

THENCE southerly to the west 1/16th section corner of section 32 and 5;

THENCE South 89° 24’ East, along the township line to the section corner of sections 4, 5, 32, and 33;

THENCE South 0° 58’ West, along the section line between 4 and 5, to a point on the centerline of Kebler Pass Road (NFSR 606, County Road 12) and the section line between sections 4 and 5;

THENCE South 0° 58’ West, along the section line between 4 and 5 approximately 75 feet;

THENCE southwesterly for a distance of approximately 1077 feet, paralleling the center line of Kebler Pass Road at a distance of 75 feet south of said centerline;

THENCE perpendicular to the centerline of Kebler Pass Road, southeasterly a distance of 40 feet;

THENCE southwesterly for a distance of approximately 590 feet, paralleling the center line of Kebler Pass Road at a distance of 115 feet south of said centerline;

THENCE perpendicular to the centerline of Kebler Pass Road, northwesterly a distance of 40 feet;

THENCE southwesterly for a distance of approximately 3596 feet, paralleling the center line of Kebler Pass Road at a distance of 75 feet south of said centerline to a point of intersection with a southeasterly extension of line 2-1, Mineral Survey No. 20749, Jimmy Lode;

THENCE along the extended line northwesterly to the centerline of said Kebler Pass Road;

THENCE along said extended line northwesterly to Corner No. 1, Mineral Survey. No. 20749, Jimmy Lode;

THENCE North 25° 21’ West, a distance of 250 feet to Corner No. 1, Mineral Survey No. 20750, Contact Mill Site;

THENCE North 64° 39' East, a distance of 450 feet to Corner No. 2, Mineral Survey No. 20750, Contact Mill Site;

THENCE North 25° 21' West, a distance of 475 ft. dist. to Corner No. 3, Mineral Survey No. 20750, Contact Mill Site, identical with Corner No. 2, Mineral Survey No. 20750, Keystone Mill Site;

THENCE North 25° 21' West, a distance of 475 feet to Corner No. 3, Mineral Survey No. 20750, Keystone Mill Site;

THENCE South 64° 39' West, a distance of 450 feet to Corner No. 4, Mineral Survey No. 20750, Keystone Mill Site, on line 1-2, M.S. No. 20749, Jimmy Lode;

THENCE North 25° 21' West, a distance of 300 feet to Corner No. 2, Mineral Survey No. 20749, Jimmy Lode, identical with Corner No. 1, Mineral Survey No. 6523, Keystone Lode;

THENCE North 24° 45' West, a distance of 1500 feet to Corner No. 2, Mineral Survey No. 6523, Keystone Lode, on line 13-16, Mineral Survey No. 6523, My Boys Lode;

THENCE North 64° 28' East, a distance of 18.94 feet to Corner No. 2, Mineral Survey No. 20825, Park City No. 20 Lode, identical with Corner No. 13, Mineral Survey No. 6523, My Boys Lode;

THENCE North 64° 28' East, on line 1-2, Mineral Survey No. 20825, Park City No. 20 Lode to the intersection of the township line between sections 31 and 6, being the **POINT OF BEGINNING**, containing 465.84 acres.

Federal Parcel 2

A parcel of land situated in section 36, township 13 south, range 87 west, and section 31, township 13 south, range 86 west, Sixth Principal Meridian, Gunnison County, Colorado, being more particularly described as follows:

COMMENCING at Corner No. 2, Park City No. 11, Mineral Survey No. 20825;

THENCE South 64° 28' West, a distance of 300 feet on line 4-3 to Corner No. 3, Park City No. 1, Mineral Survey No. 20825

THENCE South 64° 28' West, a distance of 300 feet;

THENCE North 45° 00' West, a distance of 1500 feet;

THENCE North 44° 58' West, a distance of 3000 feet;

THENCE North 64° 29' East, a distance of 600 feet, to Corner No. 3, Park City 15 Lode, Mineral Survey 20926;

THENCE South 44° 58' East, a distance of 1500 feet, on line 3-4 to Corner No. 4, Park City 15 Lode, Mineral Survey 20926;

THENCE South 44° 58' East, a distance of 1500 feet, on line 4-3 to Corner No. 3, Park City No. 10 Lode, Mineral Survey 20926;

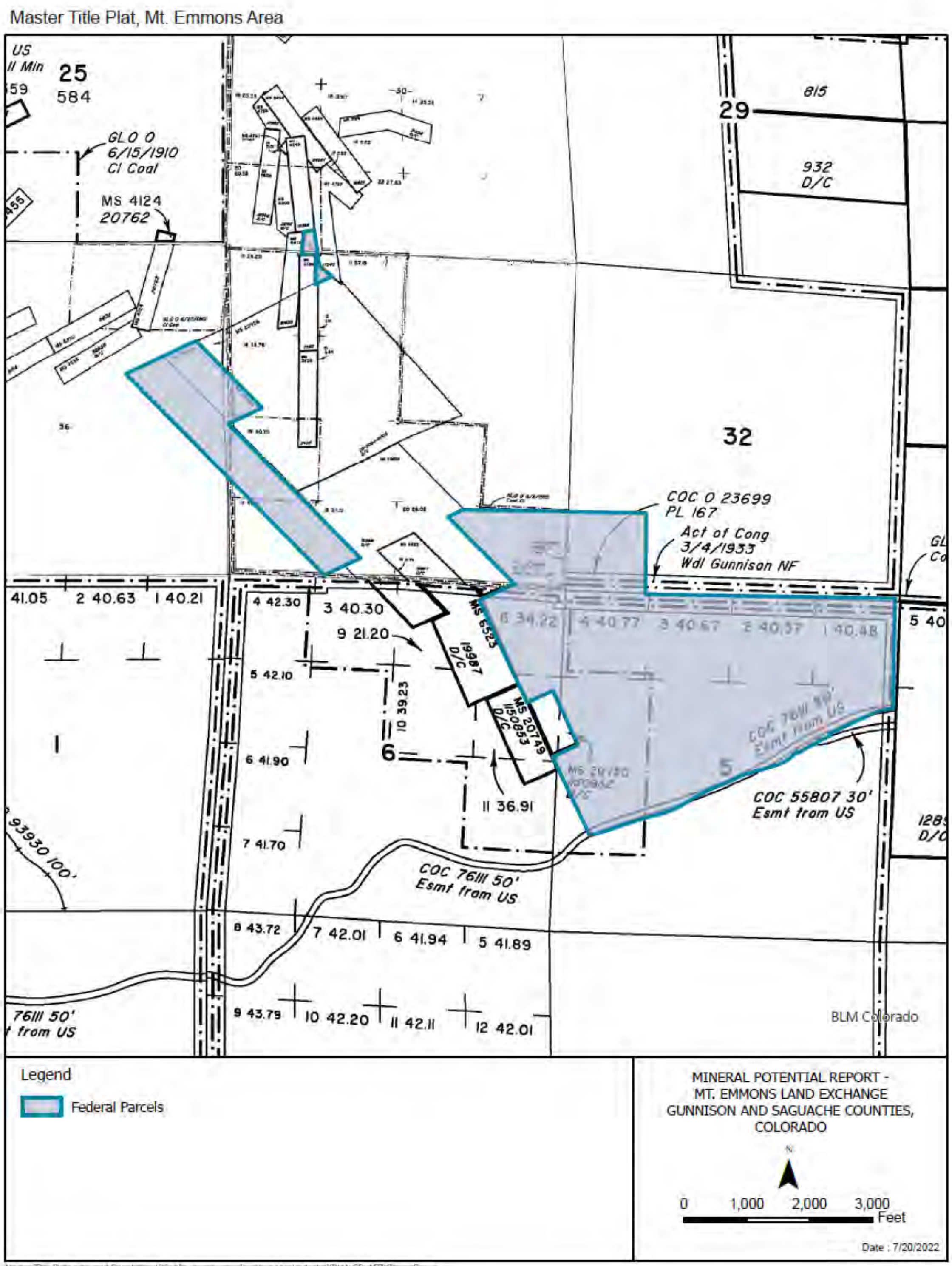
THENCE South 45° 00' East, a distance of 1500 feet, on line 3-2 to Corner No. 2, Park City 11 Lode, Mineral Survey 20825, being the **POINT OF BEGINNING**, containing 81.49 acres.

Federal Parcel 3

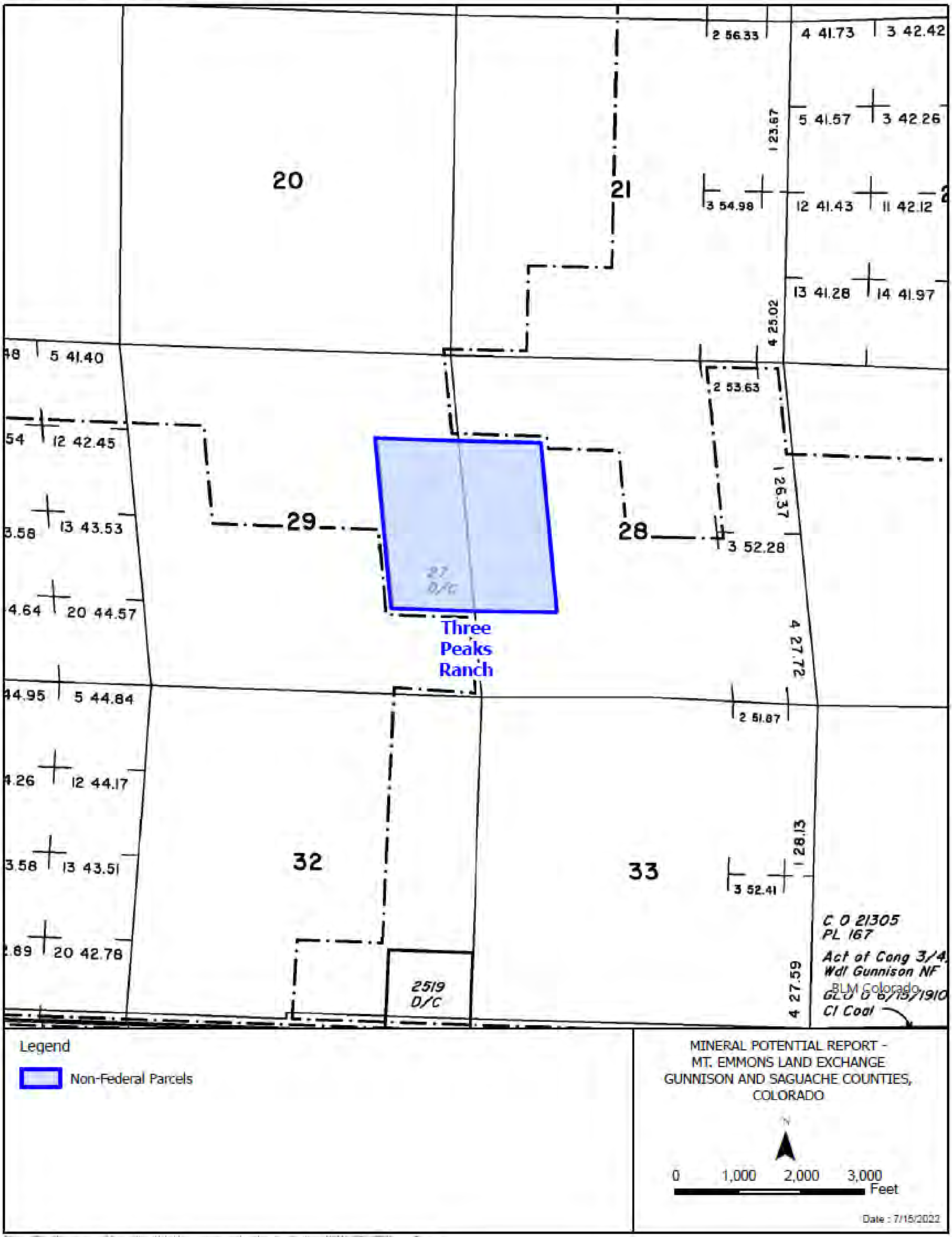
A parcel of land situated in sections 30 and 31, township 13 south, range 86 west, Sixth Principal Meridian, Gunnison County, Colorado, being more particularly described as section 30, lot 21, together with a portion of section 31, lot 12, bounded on the north by Crested Butte Lode, Mineral Survey No. 4243, the east by Germania Lode, Mineral Survey No. 4767, the south by Park City 19, Mineral Survey No. 20926, and bounded on the west by Furniture Boy Lode, Mineral Survey No. 3739, and Crested Butte Extension Lode, Mineral Survey No. 4472, containing approximately 3.15 acres, more or less.

Appendix 2: Master Title Plats

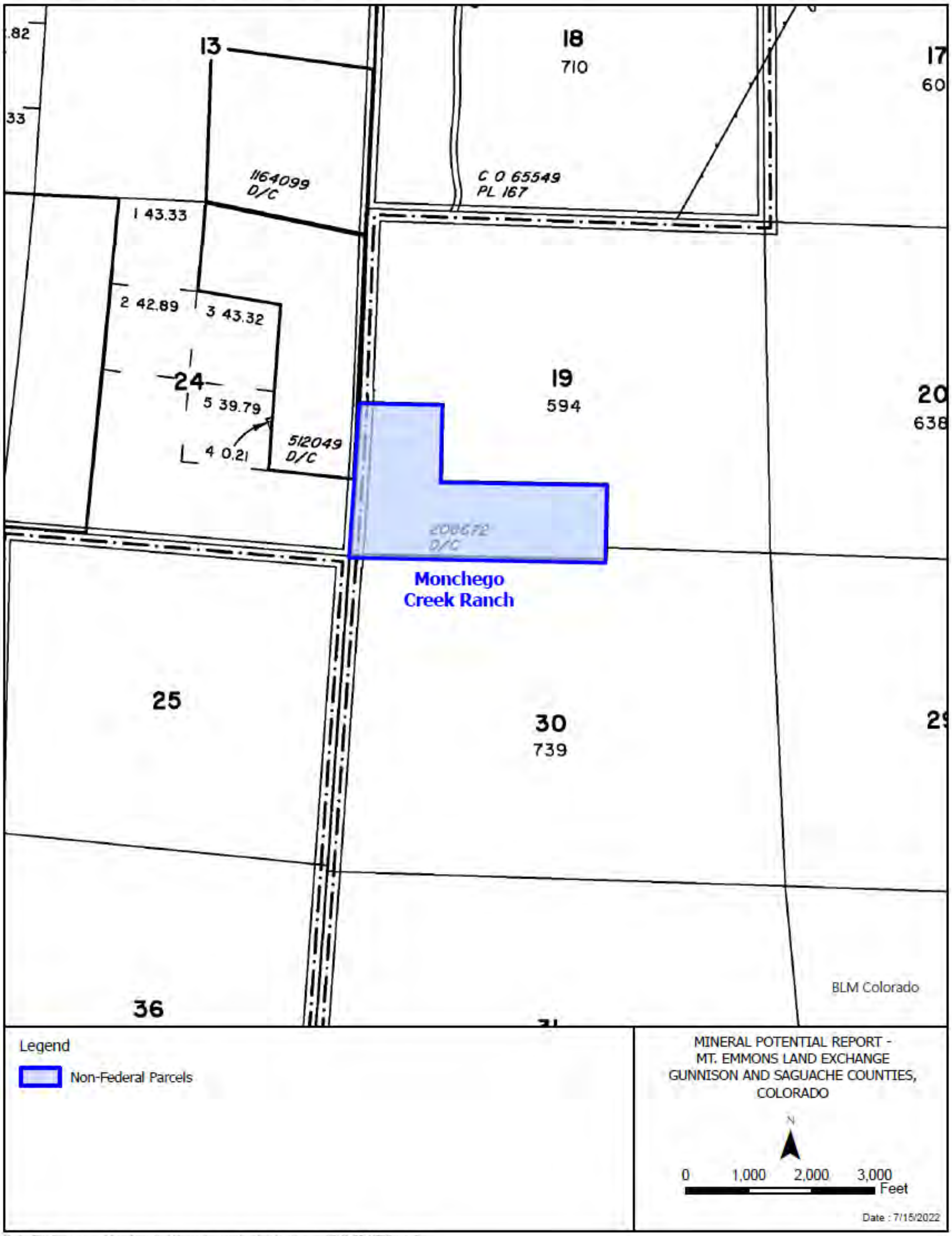
(BLM, 2022b)



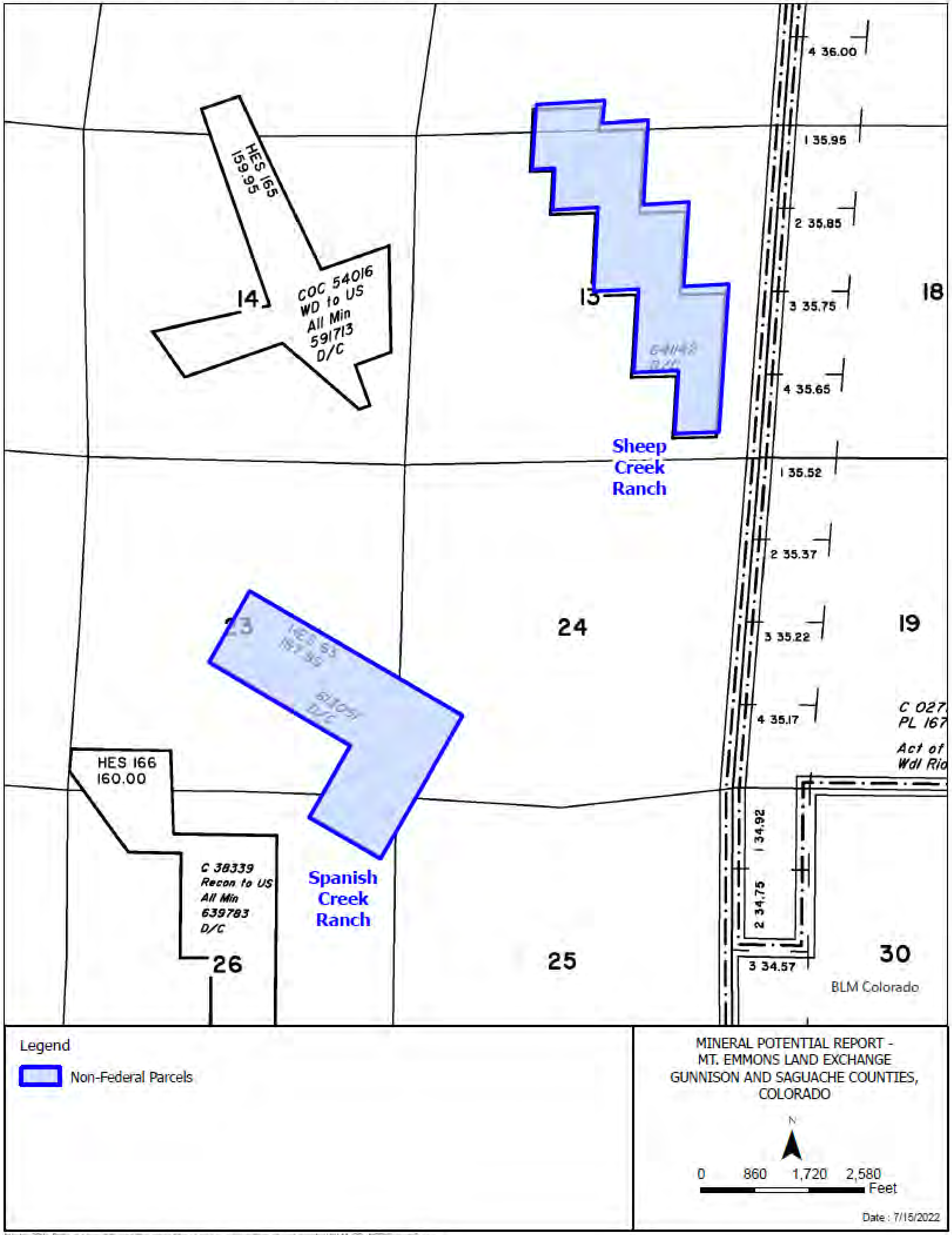
Master Title Plat, Three Peaks Ranch



Master Title Plat, Monchego Creek Ranch



Master Title Plat, Spanish Creek and Sheep Creek Ranches



Appendix 3: Mineral & Land Records System Reports

For Mining Claims and Leases (December 1st, 2022); no active leasable minerals were discovered (BLM, 2022c).

Meridian Township Range:	Section	Quadrant	Serial Number	Lead File Number	Legacy Serial Number	Legacy Lead File Number	Claim Type	Claim Name	Claimant	Date Of Location	Case Disposition	Next Pmt Due Date
6 0140S 0860W	005	SW	CO101514451	CO101514451	CMC114848	CMC114827	LODE CLAIM	CARROL	MT EMMONS MINING COMPANY	6/11/1949	ACTIVE	9/1/2023
6 0130S 0860W	031	SE	CO101317832	CO101317832	CMC124337	CMC124325	LODE CLAIM	FEL #148	MT EMMONS MINING COMPANY	9/9/1976	ACTIVE	9/1/2023
6 0130S 0860W	031	SE	CO101339042	CO101339042	CMC143985	CMC143972	LODE CLAIM	FEL #148	MT EMMONS MINING COMPANY	9/9/1976	ACTIVE	9/1/2023
6 0130S 0860W	032	SW	CO101317832	CO101317832	CMC124337	CMC124325	LODE CLAIM	FEL #148	MT EMMONS MINING COMPANY	9/9/1976	ACTIVE	9/1/2023
6 0130S 0860W	032	SW	CO101339042	CO101339042	CMC143985	CMC143972	LODE CLAIM	FEL #148	MT EMMONS MINING COMPANY	9/9/1976	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101313123	CO101313123	CMC114850	CMC114827	LODE CLAIM	FRANKIE	MT EMMONS MINING COMPANY	6/11/1949	ACTIVE	9/1/2023
6 0140S 0860W	005	SW	CO101313123	CO101313123	CMC114850	CMC114827	LODE CLAIM	FRANKIE	MT EMMONS MINING COMPANY	6/11/1949	ACTIVE	9/1/2023
6 0140S 0860W	006	NE	CO101313123	CO101313123	CMC114850	CMC114827	LODE CLAIM	FRANKIE	MT EMMONS MINING COMPANY	6/11/1949	ACTIVE	9/1/2023
6 0140S 0860W	006	NE	CO101315473	CO101315473	CMC80509	CMC80331	MILL SITE	HM #10A	MT EMMONS MINING COMPANY	5/4/1979	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101315473	CO101315473	CMC80509	CMC80331	MILL SITE	HM #10A	MT EMMONS MINING COMPANY	5/4/1979	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101421562	CO101421562	CMC80511	CMC80331	MILL SITE	HM #12	MT EMMONS MINING COMPANY	5/4/1979	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101424611	CO101424611	CMC80521	CMC80331	MILL SITE	HM #22	MT EMMONS MINING COMPANY	4/30/1979	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101313242	CO101313242	CMC80522	CMC80331	MILL SITE	HM #23	MT EMMONS MINING COMPANY	5/4/1979	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101424839	CO101424839	CMC80524	CMC80331	MILL SITE	HM #25	MT EMMONS MINING COMPANY	5/4/1979	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101424207	CO101424207	CMC80525	CMC80331	MILL SITE	HM #26	MT EMMONS MINING COMPANY	4/30/1979	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101311968	CO101311968	CMC80526	CMC80331	MILL SITE	HM #27	MT EMMONS MINING COMPANY	4/30/1979	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO101315457	CO101315457	CMC80532	CMC80331	MILL SITE	HM #33	MT EMMONS MINING COMPANY	4/30/1979	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101315457	CO101315457	CMC80532	CMC80331	MILL SITE	HM #33	MT EMMONS MINING COMPANY	4/30/1979	ACTIVE	9/1/2023

6 0140S 0860W	005	NW	CO101421086	CO101421086	CMC80533	CMC80331	MILL SITE	HM #34	MT EMMONS MINING COMPANY	4/30/1979	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101425658	CO101425658	CMC80534	CMC80331	MILL SITE	HM #35	MT EMMONS MINING COMPANY	4/30/1979	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101425672	CO101425672	CMC80538	CMC80331	MILL SITE	HM #42	MT EMMONS MINING COMPANY	4/30/1979	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO102524176	CO102524176	CMC80539	CMC80331	MILL SITE	HM #43	MT EMMONS MINING COMPANY	4/30/1979	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO102524176	CO102524176	CMC80539	CMC80331	MILL SITE	HM #43	MT EMMONS MINING COMPANY	4/30/1979	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO102524040	CO102524040	CMC80540	CMC80331	MILL SITE	HM #44	MT EMMONS MINING COMPANY	4/30/1979	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO101510596	CO101510596	CMC80543	CMC80331	MILL SITE	HM #47	MT EMMONS MINING COMPANY	4/30/1979	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO101515646	CO101515646	CMC80544	CMC80331	MILL SITE	HM #48	MT EMMONS MINING COMPANY	4/30/1979	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101515646	CO101515646	CMC80544	CMC80331	MILL SITE	HM #48	MT EMMONS MINING COMPANY	4/30/1979	ACTIVE	9/1/2023
6 0140S 0860W	005	SE	CO101515646	CO101515646	CMC80544	CMC80331	MILL SITE	HM #48	MT EMMONS MINING COMPANY	4/30/1979	ACTIVE	9/1/2023
6 0140S 0860W	005	SW	CO101515646	CO101515646	CMC80544	CMC80331	MILL SITE	HM #48	MT EMMONS MINING COMPANY	4/30/1979	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO101313121	CO101313121	CMC29380	CMC29324	LODE CLAIM	JANE #2	MT EMMONS MINING COMPANY	10/31/1977	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO101421877	CO101421877	CMC61698	CMC61696	LODE CLAIM	JANE #2	MT EMMONS MINING COMPANY	8/30/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO101423883	CO101423883	CMC3504	CMC3469	LODE CLAIM	KEY #36	MT EMMONS MINING COMPANY	9/7/1977	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO102523801	CO102523801	CMC56527	CMC56503	LODE CLAIM	KEY #36	MT EMMONS MINING COMPANY	8/7/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101423883	CO101423883	CMC3504	CMC3469	LODE CLAIM	KEY #36	MT EMMONS MINING COMPANY	9/7/1977	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO102523801	CO102523801	CMC56527	CMC56503	LODE CLAIM	KEY #36	MT EMMONS MINING COMPANY	8/7/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101510663	CO101510663	CMC56529	CMC56503	LODE CLAIM	KEY #38	MT EMMONS MINING COMPANY	8/7/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101516951	CO101516951	CMC3506	CMC3469	LODE CLAIM	KEY #38	MT EMMONS MINING COMPANY	2/16/1977	ACTIVE	9/1/2023
6 0130S 0860W	032	SW	CO101313134	CO101313134	CMC22634	CMC22628	LODE CLAIM	KEY #39	MT EMMONS MINING COMPANY	10/5/1977	ACTIVE	9/1/2023
6 0130S 0860W	032	SW	CO101317845	CO101317845	CMC3507	CMC3469	LODE CLAIM	KEY #39	MT EMMONS MINING COMPANY	9/7/1977	ACTIVE	9/1/2023
6 0130S 0860W	032	SW	CO102522727	CO102522727	CMC56530	CMC56503	LODE CLAIM	KEY #39	MT EMMONS MINING COMPANY	8/24/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101313134	CO101313134	CMC22634	CMC22628	LODE CLAIM	KEY #39	MT EMMONS MINING COMPANY	10/5/1977	ACTIVE	9/1/2023

6 0140S 0860W	005	NW	CO101317845	CO101317845	CMC3507	CMC3469	LODE CLAIM	KEY #39	MT EMMONS MINING COMPANY	9/7/1977	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO102522727	CO102522727	CMC56530	CMC56503	LODE CLAIM	KEY #39	MT EMMONS MINING COMPANY	8/24/1978	ACTIVE	9/1/2023
6 0130S 0860W	031	SE	CO101316831	CO101316831	CMC114903	CMC114827	LODE CLAIM	PARK CITY #21	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0130S 0860W	031	SE	CO101337898	CO101337898	CMC56509	CMC56503	LODE CLAIM	PARK CITY #21	MT EMMONS MINING COMPANY	8/23/1978	ACTIVE	9/1/2023
6 0130S 0860W	031	SE	CO101423842	CO101423842	CMC115513	CMC115513	LODE CLAIM	PARK CITY #21	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	006	NE	CO101316831	CO101316831	CMC114903	CMC114827	LODE CLAIM	PARK CITY #21	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	006	NE	CO101337898	CO101337898	CMC56509	CMC56503	LODE CLAIM	PARK CITY #21	MT EMMONS MINING COMPANY	8/23/1978	ACTIVE	9/1/2023
6 0140S 0860W	006	NE	CO101423842	CO101423842	CMC115513	CMC115513	LODE CLAIM	PARK CITY #21	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0130S 0860W	031	SE	CO101422041	CO101422041	CMC114914	CMC114827	LODE CLAIM	PARK CITY #42	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0130S 0860W	031	SE	CO101511759	CO101511759	CMC115524	CMC115513	LODE CLAIM	PARK CITY #42	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0130S 0860W	031	SE	CO101511810	CO101511810	CMC56512	CMC56503	LODE CLAIM	PARK CITY #42	MT EMMONS MINING COMPANY	8/23/1978	ACTIVE	9/1/2023
6 0140S 0860W	006	NE	CO101422041	CO101422041	CMC114914	CMC114827	LODE CLAIM	PARK CITY #42	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	006	NE	CO101511759	CO101511759	CMC115524	CMC115513	LODE CLAIM	PARK CITY #42	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	006	NE	CO101511810	CO101511810	CMC56512	CMC56503	LODE CLAIM	PARK CITY #42	MT EMMONS MINING COMPANY	8/23/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101422041	CO101422041	CMC114914	CMC114827	LODE CLAIM	PARK CITY #42	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101511759	CO101511759	CMC115524	CMC115513	LODE CLAIM	PARK CITY #42	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101511810	CO101511810	CMC56512	CMC56503	LODE CLAIM	PARK CITY #42	MT EMMONS MINING COMPANY	8/23/1978	ACTIVE	9/1/2023
6 0130S 0860W	031	SE	CO101316682	CO101316682	CMC56513	CMC56503	LODE CLAIM	PARK CITY #43	MT EMMONS MINING COMPANY	8/24/1978	ACTIVE	9/1/2023
6 0130S 0860W	031	SE	CO101339011	CO101339011	CMC114915	CMC114827	LODE CLAIM	PARK CITY #43	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0130S 0860W	031	SE	CO101512858	CO101512858	CMC115525	CMC115513	LODE CLAIM	PARK CITY #43	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0130S 0860W	032	SW	CO101316682	CO101316682	CMC56513	CMC56503	LODE CLAIM	PARK CITY #43	MT EMMONS MINING COMPANY	8/24/1978	ACTIVE	9/1/2023
6 0130S 0860W	032	SW	CO101339011	CO101339011	CMC114915	CMC114827	LODE CLAIM	PARK CITY #43	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0130S 0860W	032	SW	CO101512858	CO101512858	CMC115525	CMC115513	LODE CLAIM	PARK CITY #43	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023

6 0140S 0860W	006	NE	CO101316682	CO101316682	CMC56513	CMC56503	LODE CLAIM	PARK CITY #43	MT EMMONS MINING COMPANY	8/24/1978	ACTIVE	9/1/2023
6 0140S 0860W	006	NE	CO101339011	CO101339011	CMC114915	CMC114827	LODE CLAIM	PARK CITY #43	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	006	NE	CO101512858	CO101512858	CMC115525	CMC115513	LODE CLAIM	PARK CITY #43	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101316682	CO101316682	CMC56513	CMC56503	LODE CLAIM	PARK CITY #43	MT EMMONS MINING COMPANY	8/24/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101339011	CO101339011	CMC114915	CMC114827	LODE CLAIM	PARK CITY #43	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101512858	CO101512858	CMC115525	CMC115513	LODE CLAIM	PARK CITY #43	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	006	NE	CO101426460	CO101426460	CMC115526	CMC115513	LODE CLAIM	PARK CITY #44	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	006	NE	CO101514208	CO101514208	CMC56514	CMC56503	LODE CLAIM	PARK CITY #44	MT EMMONS MINING COMPANY	8/8/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101310745	CO101310745	CMC114916	CMC114827	LODE CLAIM	PARK CITY #44	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101426460	CO101426460	CMC115526	CMC115513	LODE CLAIM	PARK CITY #44	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101514208	CO101514208	CMC56514	CMC56503	LODE CLAIM	PARK CITY #44	MT EMMONS MINING COMPANY	8/8/1978	ACTIVE	9/1/2023
6 0140S 0860W	006	NE	CO101310745	CO101310745	CMC114916	CMC114827	LODE CLAIM	PARK CITY #44	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	006	NE	CO101423447	CO101423447	CMC114919	CMC114827	LODE CLAIM	PARK CITY #47	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	006	NE	CO101426262	CO101426262	CMC56515	CMC56503	LODE CLAIM	PARK CITY #47	MT EMMONS MINING COMPANY	8/8/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101313175	CO101313175	CMC115528	CMC115513	LODE CLAIM	PARK CITY #47	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101423447	CO101423447	CMC114919	CMC114827	LODE CLAIM	PARK CITY #47	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101426262	CO101426262	CMC56515	CMC56503	LODE CLAIM	PARK CITY #47	MT EMMONS MINING COMPANY	8/8/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	SW	CO101313175	CO101313175	CMC115528	CMC115513	LODE CLAIM	PARK CITY #47	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	005	SW	CO101423447	CO101423447	CMC114919	CMC114827	LODE CLAIM	PARK CITY #47	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	005	SW	CO101426262	CO101426262	CMC56515	CMC56503	LODE CLAIM	PARK CITY #47	MT EMMONS MINING COMPANY	8/8/1978	ACTIVE	9/1/2023
6 0140S 0860W	006	NE	CO101313175	CO101313175	CMC115528	CMC115513	LODE CLAIM	PARK CITY #47	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101422891	CO101422891	CMC114923	CMC114827	LODE CLAIM	PARK CITY #51	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101510554	CO101510554	CMC115532	CMC115513	LODE CLAIM	PARK CITY #51	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023

6 0140S 0860W	005	NW	CO101514365	CO101514365	CMC56517	CMC56503	LODE CLAIM	PARK CITY #51	MT EMMONS MINING COMPANY	8/7/1978	ACTIVE	9/1/2023
6 0130S 0860W	031	SE	CO101314321	CO101314321	CMC124336	CMC124325	LODE CLAIM	FEL #147	MT EMMONS MINING COMPANY	9/9/1976	ACTIVE	9/1/2023
6 0130S 0860W	031	SE	CO101320225	CO101320225	CMC143984	CMC143972	LODE CLAIM	FEL #147	MT EMMONS MINING COMPANY	9/9/1976	ACTIVE	9/1/2023
6 0130S 0860W	032	SW	CO101314321	CO101314321	CMC124336	CMC124325	LODE CLAIM	FEL #147	MT EMMONS MINING COMPANY	9/9/1976	ACTIVE	9/1/2023
6 0130S 0860W	032	SW	CO101320225	CO101320225	CMC143984	CMC143972	LODE CLAIM	FEL #147	MT EMMONS MINING COMPANY	9/9/1976	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO101519171	CO101519171	CMC272804	CMC272768	LODE CLAIM	HORIZON 37	MT EMMONS MINING COMPANY	9/2/2007	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO101316692	CO101316692	CMC61696	CMC61696	LODE CLAIM	JANE	MT EMMONS MINING COMPANY	8/28/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO102522888	CO102522888	CMC29378	CMC29324	LODE CLAIM	JANE	MT EMMONS MINING COMPANY	10/31/1977	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO101314278	CO101314278	CMC29379	CMC29324	LODE CLAIM	JANE #1	MT EMMONS MINING COMPANY	10/31/1977	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO101516817	CO101516817	CMC61697	CMC61696	LODE CLAIM	JANE #1	MT EMMONS MINING COMPANY	8/29/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO101510412	CO101510412	CMC61675	CMC61658	LODE CLAIM	KEY #30	MT EMMONS MINING COMPANY	8/17/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO101515609	CO101515609	CMC3498	CMC3469	LODE CLAIM	KEY #30	MT EMMONS MINING COMPANY	9/7/1977	ACTIVE	9/1/2023
6 0130S 0860W	032	SW	CO101314215	CO101314215	CMC56523	CMC56503	LODE CLAIM	KEY #32	MT EMMONS MINING COMPANY	8/5/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO101314215	CO101314215	CMC56523	CMC56503	LODE CLAIM	KEY #32	MT EMMONS MINING COMPANY	8/5/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO101337897	CO101337897	CMC3500	CMC3469	LODE CLAIM	KEY #32	MT EMMONS MINING COMPANY	9/7/1977	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101314215	CO101314215	CMC56523	CMC56503	LODE CLAIM	KEY #32	MT EMMONS MINING COMPANY	8/5/1978	ACTIVE	9/1/2023
6 0130S 0860W	032	SW	CO101313301	CO101313301	CMC56525	CMC56503	LODE CLAIM	KEY #34	MT EMMONS MINING COMPANY	8/5/1978	ACTIVE	9/1/2023
6 0130S 0860W	032	SW	CO102521627	CO102521627	CMC3502	CMC3469	LODE CLAIM	KEY #34	MT EMMONS MINING COMPANY	9/7/1977	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO101313301	CO101313301	CMC56525	CMC56503	LODE CLAIM	KEY #34	MT EMMONS MINING COMPANY	8/5/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO102521627	CO102521627	CMC3502	CMC3469	LODE CLAIM	KEY #34	MT EMMONS MINING COMPANY	9/7/1977	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101313301	CO101313301	CMC56525	CMC56503	LODE CLAIM	KEY #34	MT EMMONS MINING COMPANY	8/5/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO102521627	CO102521627	CMC3502	CMC3469	LODE CLAIM	KEY #34	MT EMMONS MINING COMPANY	9/7/1977	ACTIVE	9/1/2023
6 0130S 0860W	032	SW	CO101316732	CO101316732	CMC56526	CMC56503	LODE CLAIM	KEY #35	MT EMMONS MINING COMPANY	8/25/1978	ACTIVE	9/1/2023

6 0130S 0860W	032	SW	CO101426240	CO101426240	CMC22632	CMC22628	LODE CLAIM	KEY #35	MT EMMONS MINING COMPANY	10/5/1977	ACTIVE	9/1/2023
6 0130S 0860W	032	SW	CO102524043	CO102524043	CMC3503	CMC3469	LODE CLAIM	KEY #35	MT EMMONS MINING COMPANY	9/7/1977	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101316732	CO101316732	CMC56526	CMC56503	LODE CLAIM	KEY #35	MT EMMONS MINING COMPANY	8/25/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101426240	CO101426240	CMC22632	CMC22628	LODE CLAIM	KEY #35	MT EMMONS MINING COMPANY	10/5/1977	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO102524043	CO102524043	CMC3503	CMC3469	LODE CLAIM	KEY #35	MT EMMONS MINING COMPANY	9/7/1977	ACTIVE	9/1/2023
6 0130S 0860W	032	SW	CO101422221	CO101422221	CMC3505	CMC3469	LODE CLAIM	KEY #37	MT EMMONS MINING COMPANY	9/7/1977	ACTIVE	9/1/2023
6 0130S 0860W	032	SW	CO101422430	CO101422430	CMC56528	CMC56503	LODE CLAIM	KEY #37	MT EMMONS MINING COMPANY	8/24/1978	ACTIVE	9/1/2023
6 0130S 0860W	032	SW	CO102524177	CO102524177	CMC22633	CMC22628	LODE CLAIM	KEY #37	MT EMMONS MINING COMPANY	10/5/1977	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101422221	CO101422221	CMC3505	CMC3469	LODE CLAIM	KEY #37	MT EMMONS MINING COMPANY	9/7/1977	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101422430	CO101422430	CMC56528	CMC56503	LODE CLAIM	KEY #37	MT EMMONS MINING COMPANY	8/24/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO102524177	CO102524177	CMC22633	CMC22628	LODE CLAIM	KEY #37	MT EMMONS MINING COMPANY	10/5/1977	ACTIVE	9/1/2023
6 0130S 0860W	031	SE	CO101319374	CO101319374	CMC115577	CMC115513	LODE CLAIM	KEY #40	MT EMMONS MINING COMPANY	2/16/1977	ACTIVE	9/1/2023
6 0130S 0860W	031	SE	CO101424627	CO101424627	CMC3508	CMC3469	LODE CLAIM	KEY #40	MT EMMONS MINING COMPANY	2/16/1977	ACTIVE	9/1/2023
6 0130S 0860W	032	SW	CO101319374	CO101319374	CMC115577	CMC115513	LODE CLAIM	KEY #40	MT EMMONS MINING COMPANY	2/16/1977	ACTIVE	9/1/2023
6 0130S 0860W	032	SW	CO101424627	CO101424627	CMC3508	CMC3469	LODE CLAIM	KEY #40	MT EMMONS MINING COMPANY	2/16/1977	ACTIVE	9/1/2023
6 0130S 0860W	031	SE	CO101425865	CO101425865	CMC3510	CMC3469	LODE CLAIM	KEY #42	MT EMMONS MINING COMPANY	2/16/1977	ACTIVE	9/1/2023
6 0130S 0860W	031	SE	CO101516826	CO101516826	CMC115579	CMC115513	LODE CLAIM	KEY #42	MT EMMONS MINING COMPANY	2/16/1977	ACTIVE	9/1/2023
6 0130S 0860W	032	SW	CO101425865	CO101425865	CMC3510	CMC3469	LODE CLAIM	KEY #42	MT EMMONS MINING COMPANY	2/16/1977	ACTIVE	9/1/2023
6 0130S 0860W	032	SW	CO101516826	CO101516826	CMC115579	CMC115513	LODE CLAIM	KEY #42	MT EMMONS MINING COMPANY	2/16/1977	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO101311642	CO101311642	CMC56531	CMC56503	LODE CLAIM	KEY #54	MT EMMONS MINING COMPANY	8/4/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO101424892	CO101424892	CMC3522	CMC3469	LODE CLAIM	KEY #54	MT EMMONS MINING COMPANY	9/7/1977	ACTIVE	9/1/2023
6 0130S 0860W	032	SW	CO101513038	CO101513038	CMC3524	CMC3469	LODE CLAIM	KEY #56	MT EMMONS MINING COMPANY	2/18/1977	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO101313300	CO101313300	CMC56533	CMC56503	LODE CLAIM	KEY #56	MT EMMONS MINING COMPANY	8/4/1978	ACTIVE	9/1/2023

6 0140S 0860W	005	NE	CO101516831	CO101516831	CMC56535	CMC56503	LODE CLAIM	KEY #58	MT EMMONS MINING COMPANY	8/4/1978	ACTIVE	9/1/2023
6 0130S 0860W	031	SE	CO101514320	CO101514320	CMC22642	CMC22628	LODE CLAIM	KEY #70	MT EMMONS MINING COMPANY	9/9/1977	ACTIVE	9/1/2023
6 0130S 0860W	032	SW	CO101514320	CO101514320	CMC22642	CMC22628	LODE CLAIM	KEY #70	MT EMMONS MINING COMPANY	9/9/1977	ACTIVE	9/1/2023
6 0130S 0860W	031	SE	CO101315764	CO101315764	CMC115522	CMC115513	LODE CLAIM	PARK CITY #40	MT EMMONS MINING COMPANY	10/22/1950	ACTIVE	9/1/2023
6 0130S 0860W	031	SE	CO102524030	CO102524030	CMC114912	CMC114827	LODE CLAIM	PARK CITY #40	MT EMMONS MINING COMPANY	10/22/1950	ACTIVE	9/1/2023
6 0130S 0860W	032	SW	CO101315764	CO101315764	CMC115522	CMC115513	LODE CLAIM	PARK CITY #40	MT EMMONS MINING COMPANY	10/22/1950	ACTIVE	9/1/2023
6 0130S 0860W	032	SW	CO102524030	CO102524030	CMC114912	CMC114827	LODE CLAIM	PARK CITY #40	MT EMMONS MINING COMPANY	10/22/1950	ACTIVE	9/1/2023
6 0130S 0860W	031	SE	CO101316757	CO101316757	CMC115523	CMC115513	LODE CLAIM	PARK CITY #41	MT EMMONS MINING COMPANY	10/22/1950	ACTIVE	9/1/2023
6 0130S 0860W	031	SE	CO101511630	CO101511630	CMC114913	CMC114827	LODE CLAIM	PARK CITY #41	MT EMMONS MINING COMPANY	10/22/1950	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101425689	CO101425689	CMC114920	CMC114827	LODE CLAIM	PARK CITY #48	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO102523881	CO102523881	CMC115529	CMC115513	LODE CLAIM	PARK CITY #48	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	005	SW	CO101425689	CO101425689	CMC114920	CMC114827	LODE CLAIM	PARK CITY #48	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	005	SW	CO102523881	CO102523881	CMC115529	CMC115513	LODE CLAIM	PARK CITY #48	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101424450	CO101424450	CMC114922	CMC114827	LODE CLAIM	PARK CITY #50	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101514207	CO101514207	CMC115531	CMC115513	LODE CLAIM	PARK CITY #50	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	005	SW	CO101424450	CO101424450	CMC114922	CMC114827	LODE CLAIM	PARK CITY #50	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	005	SW	CO101514207	CO101514207	CMC115531	CMC115513	LODE CLAIM	PARK CITY #50	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101315466	CO101315466	CMC115533	CMC115513	LODE CLAIM	PARK CITY #52	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101339629	CO101339629	CMC114924	CMC114827	LODE CLAIM	PARK CITY #52	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	005	SW	CO101315466	CO101315466	CMC115533	CMC115513	LODE CLAIM	PARK CITY #52	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	005	SW	CO101339629	CO101339629	CMC114924	CMC114827	LODE CLAIM	PARK CITY #52	MT EMMONS MINING COMPANY	10/23/1950	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101314295	CO101314295	CMC17643	CMC17643	LODE CLAIM	PK	MT EMMONS MINING COMPANY	7/22/1977	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101314443	CO101314443	CMC115622	CMC115513	LODE CLAIM	PK	MT EMMONS MINING COMPANY	10/5/1978	ACTIVE	9/1/2023

6 0140S 0860W	005	NW	CO101339315	CO101339315	CMC61693	CMC61658	LODE CLAIM	PK	MT EMMONS MINING COMPANY	8/17/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101421411	CO101421411	CMC115510	CMC115503	LODE CLAIM	PK	MT EMMONS MINING COMPANY	7/25/1953	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101422610	CO101422610	CMC114851	CMC114827	LODE CLAIM	PK	MT EMMONS MINING COMPANY	7/25/1953	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101516836	CO101516836	CMC50628	CMC50628	LODE CLAIM	PK	MT EMMONS MINING COMPANY	10/5/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	SE	CO101314295	CO101314295	CMC17643	CMC17643	LODE CLAIM	PK	MT EMMONS MINING COMPANY	7/22/1977	ACTIVE	9/1/2023
6 0140S 0860W	005	SE	CO101314443	CO101314443	CMC115622	CMC115513	LODE CLAIM	PK	MT EMMONS MINING COMPANY	10/5/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	SE	CO101339315	CO101339315	CMC61693	CMC61658	LODE CLAIM	PK	MT EMMONS MINING COMPANY	8/17/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	SE	CO101421411	CO101421411	CMC115510	CMC115503	LODE CLAIM	PK	MT EMMONS MINING COMPANY	7/25/1953	ACTIVE	9/1/2023
6 0140S 0860W	005	SE	CO101422610	CO101422610	CMC114851	CMC114827	LODE CLAIM	PK	MT EMMONS MINING COMPANY	7/25/1953	ACTIVE	9/1/2023
6 0140S 0860W	005	SE	CO101516836	CO101516836	CMC50628	CMC50628	LODE CLAIM	PK	MT EMMONS MINING COMPANY	10/5/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	SW	CO101314295	CO101314295	CMC17643	CMC17643	LODE CLAIM	PK	MT EMMONS MINING COMPANY	7/22/1977	ACTIVE	9/1/2023
6 0140S 0860W	005	SW	CO101314443	CO101314443	CMC115622	CMC115513	LODE CLAIM	PK	MT EMMONS MINING COMPANY	10/5/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	SW	CO101339315	CO101339315	CMC61693	CMC61658	LODE CLAIM	PK	MT EMMONS MINING COMPANY	8/17/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	SW	CO101421411	CO101421411	CMC115510	CMC115503	LODE CLAIM	PK	MT EMMONS MINING COMPANY	7/25/1953	ACTIVE	9/1/2023
6 0140S 0860W	005	SW	CO101422610	CO101422610	CMC114851	CMC114827	LODE CLAIM	PK	MT EMMONS MINING COMPANY	7/25/1953	ACTIVE	9/1/2023
6 0140S 0860W	005	SW	CO101516836	CO101516836	CMC50628	CMC50628	LODE CLAIM	PK	MT EMMONS MINING COMPANY	10/5/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO101316828	CO101316828	CMC115511	CMC115503	LODE CLAIM	PK #2	MT EMMONS MINING COMPANY	7/18/1953	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO101511811	CO101511811	CMC114852	CMC114827	LODE CLAIM	PK #2	MT EMMONS MINING COMPANY	9/18/1953	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO101515620	CO101515620	CMC115623	CMC115513	LODE CLAIM	PK #2	MT EMMONS MINING COMPANY	10/5/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101316828	CO101316828	CMC115511	CMC115503	LODE CLAIM	PK #2	MT EMMONS MINING COMPANY	7/18/1953	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101511811	CO101511811	CMC114852	CMC114827	LODE CLAIM	PK #2	MT EMMONS MINING COMPANY	9/18/1953	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101515620	CO101515620	CMC115623	CMC115513	LODE CLAIM	PK #2	MT EMMONS MINING COMPANY	10/5/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	SE	CO101316828	CO101316828	CMC115511	CMC115503	LODE CLAIM	PK #2	MT EMMONS MINING COMPANY	7/18/1953	ACTIVE	9/1/2023

6 0140S 0860W	005	SE	CO101511811	CO101511811	CMC114852	CMC114827	LODE CLAIM	PK #2	MT EMMONS MINING COMPANY	9/18/1953	ACTIVE	9/1/2023
6 0140S 0860W	005	SE	CO101515620	CO101515620	CMC115623	CMC115513	LODE CLAIM	PK #2	MT EMMONS MINING COMPANY	10/5/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	SW	CO101316828	CO101316828	CMC115511	CMC115503	LODE CLAIM	PK #2	MT EMMONS MINING COMPANY	7/18/1953	ACTIVE	9/1/2023
6 0140S 0860W	005	SW	CO101511811	CO101511811	CMC114852	CMC114827	LODE CLAIM	PK #2	MT EMMONS MINING COMPANY	9/18/1953	ACTIVE	9/1/2023
6 0140S 0860W	005	SW	CO101515620	CO101515620	CMC115623	CMC115513	LODE CLAIM	PK #2	MT EMMONS MINING COMPANY	10/5/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO101317866	CO101317866	CMC115624	CMC115513	LODE CLAIM	PK #3	MT EMMONS MINING COMPANY	10/5/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO101339299	CO101339299	CMC115512	CMC115503	LODE CLAIM	PK #3	MT EMMONS MINING COMPANY	7/18/1953	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO101514391	CO101514391	CMC114853	CMC114827	LODE CLAIM	PK #3	MT EMMONS MINING COMPANY	9/18/1953	ACTIVE	9/1/2023
6 0140S 0860W	005	SE	CO101317866	CO101317866	CMC115624	CMC115513	LODE CLAIM	PK #3	MT EMMONS MINING COMPANY	10/5/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	SE	CO101339299	CO101339299	CMC115512	CMC115503	LODE CLAIM	PK #3	MT EMMONS MINING COMPANY	7/18/1953	ACTIVE	9/1/2023
6 0140S 0860W	005	SE	CO101514391	CO101514391	CMC114853	CMC114827	LODE CLAIM	PK #3	MT EMMONS MINING COMPANY	9/18/1953	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO101320224	CO101320224	CMC17644	CMC17643	LODE CLAIM	PK 2	MT EMMONS MINING COMPANY	7/22/1977	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO101420432	CO101420432	CMC50629	CMC50628	LODE CLAIM	PK 2	MT EMMONS MINING COMPANY	10/5/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO101422663	CO101422663	CMC61694	CMC61658	LODE CLAIM	PK 2	MT EMMONS MINING COMPANY	8/17/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101320224	CO101320224	CMC17644	CMC17643	LODE CLAIM	PK 2	MT EMMONS MINING COMPANY	7/22/1977	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101420432	CO101420432	CMC50629	CMC50628	LODE CLAIM	PK 2	MT EMMONS MINING COMPANY	10/5/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	NW	CO101422663	CO101422663	CMC61694	CMC61658	LODE CLAIM	PK 2	MT EMMONS MINING COMPANY	8/17/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	SE	CO101320224	CO101320224	CMC17644	CMC17643	LODE CLAIM	PK 2	MT EMMONS MINING COMPANY	7/22/1977	ACTIVE	9/1/2023
6 0140S 0860W	005	SE	CO101420432	CO101420432	CMC50629	CMC50628	LODE CLAIM	PK 2	MT EMMONS MINING COMPANY	10/5/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	SE	CO101422663	CO101422663	CMC61694	CMC61658	LODE CLAIM	PK 2	MT EMMONS MINING COMPANY	8/17/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	SW	CO101320224	CO101320224	CMC17644	CMC17643	LODE CLAIM	PK 2	MT EMMONS MINING COMPANY	7/22/1977	ACTIVE	9/1/2023
6 0140S 0860W	005	SW	CO101420432	CO101420432	CMC50629	CMC50628	LODE CLAIM	PK 2	MT EMMONS MINING COMPANY	10/5/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	SW	CO101422663	CO101422663	CMC61694	CMC61658	LODE CLAIM	PK 2	MT EMMONS MINING COMPANY	8/17/1978	ACTIVE	9/1/2023

6 0140S 0860W	005	NE	CO101422034	CO101422034	CMC50630	CMC50628	LODE CLAIM	PK 3	MT EMMONS MINING COMPANY	10/5/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO101423221	CO101423221	CMC17645	CMC17643	LODE CLAIM	PK 3	MT EMMONS MINING COMPANY	7/22/1977	ACTIVE	9/1/2023
6 0140S 0860W	005	NE	CO101511858	CO101511858	CMC61695	CMC61658	LODE CLAIM	PK 3	MT EMMONS MINING COMPANY	8/17/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	SE	CO101422034	CO101422034	CMC50630	CMC50628	LODE CLAIM	PK 3	MT EMMONS MINING COMPANY	10/5/1978	ACTIVE	9/1/2023
6 0140S 0860W	005	SE	CO101423221	CO101423221	CMC17645	CMC17643	LODE CLAIM	PK 3	MT EMMONS MINING COMPANY	7/22/1977	ACTIVE	9/1/2023
6 0140S 0860W	005	SE	CO101511858	CO101511858	CMC61695	CMC61658	LODE CLAIM	PK 3	MT EMMONS MINING COMPANY	8/17/1978	ACTIVE	9/1/2023
6 0130S 0870W	036	NE	CO101517725	CO101517725	CMC273143	CMC273068	LODE CLAIM	HORIZON 131	MT EMMONS MINING COMPANY	9/20/2007	ACTIVE	9/1/2023
6 0130S 0860W	031	SW	CO101421461	CO101421461	CMC52221	CMC52216	LODE CLAIM	PARK CITY 14	MT EMMONS MINING COMPANY	7/6/1978	ACTIVE	9/1/2023
6 0130S 0870W	036	NE	CO101421461	CO101421461	CMC52221	CMC52216	LODE CLAIM	PARK CITY 14	MT EMMONS MINING COMPANY	7/6/1978	ACTIVE	9/1/2023
6 0130S 0870W	036	NE	CO101421612	CO101421612	CMC8047	CMC8019	LODE CLAIM	PARK CITY 14	MT EMMONS MINING COMPANY	4/12/1977	ACTIVE	9/1/2023
6 0130S 0870W	036	SE	CO101421461	CO101421461	CMC52221	CMC52216	LODE CLAIM	PARK CITY 14	MT EMMONS MINING COMPANY	7/6/1978	ACTIVE	9/1/2023
6 0130S 0870W	036	SE	CO101421612	CO101421612	CMC8047	CMC8019	LODE CLAIM	PARK CITY 14	MT EMMONS MINING COMPANY	4/12/1977	ACTIVE	9/1/2023
6 0130S 0860W	031	NW	CO101511788	CO101511788	CMC8048	CMC8019	LODE CLAIM	PARK CITY 15	MT EMMONS MINING COMPANY	4/12/1977	ACTIVE	9/1/2023
6 0130S 0860W	031	NW	CO101511879	CO101511879	CMC52222	CMC52216	LODE CLAIM	PARK CITY 15	MT EMMONS MINING COMPANY	7/7/1978	ACTIVE	9/1/2023
6 0130S 0860W	031	SW	CO101511879	CO101511879	CMC52222	CMC52216	LODE CLAIM	PARK CITY 15	MT EMMONS MINING COMPANY	7/7/1978	ACTIVE	9/1/2023
6 0130S 0870W	036	NE	CO101511788	CO101511788	CMC8048	CMC8019	LODE CLAIM	PARK CITY 15	MT EMMONS MINING COMPANY	4/12/1977	ACTIVE	9/1/2023
6 0130S 0870W	036	NE	CO101511879	CO101511879	CMC52222	CMC52216	LODE CLAIM	PARK CITY 15	MT EMMONS MINING COMPANY	7/7/1978	ACTIVE	9/1/2023
6 0130S 0870W	036	SE	CO101511879	CO101511879	CMC52222	CMC52216	LODE CLAIM	PARK CITY 15	MT EMMONS MINING COMPANY	7/7/1978	ACTIVE	9/1/2023
6 0130S 0860W	031	SW	CO101340262	CO101340262	CMC53386	CMC53383	LODE CLAIM	PARK CITY 7	MT EMMONS MINING COMPANY	7/24/1978	ACTIVE	9/1/2023
6 0130S 0860W	031	SW	CO102522916	CO102522916	CMC8041	CMC8019	LODE CLAIM	PARK CITY 7	MT EMMONS MINING COMPANY	4/12/1977	ACTIVE	9/1/2023
6 0130S 0860W	031	SW	CO101310772	CO101310772	CMC52217	CMC52216	LODE CLAIM	PARK CITY 9	MT EMMONS MINING COMPANY	7/17/1978	ACTIVE	9/1/2023
6 0130S 0860W	031	SW	CO101315406	CO101315406	CMC8043	CMC8019	LODE CLAIM	PARK CITY 9	MT EMMONS MINING COMPANY	4/12/1977	ACTIVE	9/1/2023
6 0130S 0870W	036	SE	CO101310772	CO101310772	CMC52217	CMC52216	LODE CLAIM	PARK CITY 9	MT EMMONS MINING COMPANY	7/17/1978	ACTIVE	9/1/2023

6 0130S 0870W	036	SE	CO101315406	CO101315406	CMC8043	CMC8019	LODE CLAIM	PARK CITY 9	MT EMMONS MINING COMPANY	4/12/1977	ACTIVE	9/1/2023
6 0140S 0860W	029	NE	CO101564104	CO101564104	CMC277395	CMC277257	MILL SITE	CARBON 139	MT EMMONS MINING COMPANY	7/28/2009	ACTIVE	9/1/2023
6 0140S 0860W	029	NE	CO101564105	CO101564105	CMC277396	CMC277257	MILL SITE	CARBON 140	MT EMMONS MINING COMPANY	7/28/2009	ACTIVE	9/1/2023
6 0140S 0860W	028	NW	CO101564106	CO101564106	CMC277397	CMC277257	MILL SITE	CARBON 141	MT EMMONS MINING COMPANY	7/28/2009	ACTIVE	9/1/2023
6 0140S 0860W	029	NE	CO101564106	CO101564106	CMC277397	CMC277257	MILL SITE	CARBON 141	MT EMMONS MINING COMPANY	7/28/2009	ACTIVE	9/1/2023
6 0140S 0860W	029	NE	CO101564107	CO101564107	CMC277398	CMC277257	MILL SITE	CARBON 142	MT EMMONS MINING COMPANY	7/30/2009	ACTIVE	9/1/2023
6 0140S 0860W	029	NE	CO101564108	CO101564108	CMC277399	CMC277257	MILL SITE	CARBON 143	MT EMMONS MINING COMPANY	7/30/2009	ACTIVE	9/1/2023
6 0140S 0860W	029	NE	CO101564110	CO101564110	CMC277401	CMC277257	MILL SITE	CARBON 145	MT EMMONS MINING COMPANY	7/30/2009	ACTIVE	9/1/2023
6 0140S 0860W	029	NE	CO101564112	CO101564112	CMC277403	CMC277257	MILL SITE	CARBON 147	MT EMMONS MINING COMPANY	7/28/2009	ACTIVE	9/1/2023
6 0140S 0860W	029	NE	CO101564930	CO101564930	CMC277405	CMC277257	MILL SITE	CARBON 149	MT EMMONS MINING COMPANY	7/30/2009	ACTIVE	9/1/2023
6 0140S 0860W	029	SE	CO101564932	CO101564932	CMC277407	CMC277257	MILL SITE	CARBON 151	MT EMMONS MINING COMPANY	7/30/2009	ACTIVE	9/1/2023
6 0140S 0860W	029	SE	CO101564934	CO101564934	CMC277409	CMC277257	MILL SITE	CARBON 153	MT EMMONS MINING COMPANY	7/28/2009	ACTIVE	9/1/2023
6 0140S 0860W	029	SE	CO101564936	CO101564936	CMC277411	CMC277257	MILL SITE	CARBON 155	MT EMMONS MINING COMPANY	7/30/2009	ACTIVE	9/1/2023
6 0140S 0860W	029	SE	CO101564938	CO101564938	CMC277413	CMC277257	MILL SITE	CARBON 157	MT EMMONS MINING COMPANY	7/28/2009	ACTIVE	9/1/2023
6 0140S 0860W	029	SE	CO101560889	CO101560889	CMC277438	CMC277257	MILL SITE	CARBON 182	MT EMMONS MINING COMPANY	7/28/2009	ACTIVE	9/1/2023
6 0140S 0860W	028	SW	CO101560890	CO101560890	CMC277439	CMC277257	MILL SITE	CARBON 183	MT EMMONS MINING COMPANY	7/28/2009	ACTIVE	9/1/2023
6 0140S 0860W	028	SW	CO101561706	CO101561706	CMC277464	CMC277257	MILL SITE	CARBON 208	MT EMMONS MINING COMPANY	7/28/2009	ACTIVE	9/1/2023
6 0140S 0860W	028	SW	CO101561707	CO101561707	CMC277465	CMC277257	MILL SITE	CARBON 209	MT EMMONS MINING COMPANY	7/30/2009	ACTIVE	9/1/2023
6 0140S 0860W	028	NW	CO101511769	CO101511769	CMC250606	CMC250453	MILL SITE	JD #149	MT EMMONS MINING COMPANY	7/25/1998	ACTIVE	9/1/2023
6 0140S 0860W	029	NE	CO101511769	CO101511769	CMC250606	CMC250453	MILL SITE	JD #149	MT EMMONS MINING COMPANY	7/25/1998	ACTIVE	9/1/2023
6 0140S 0860W	028	NW	CO101339027	CO101339027	CMC250609	CMC250453	MILL SITE	JD #152	MT EMMONS MINING COMPANY	8/11/1998	ACTIVE	9/1/2023
6 0140S 0860W	028	NW	CO101340205	CO101340205	CMC250613	CMC250453	MILL SITE	JD #156	MT EMMONS MINING COMPANY	8/11/1998	ACTIVE	9/1/2023
6 0140S 0860W	028	NW	CO101318029	CO101318029	CMC250615	CMC250453	MILL SITE	JD #158	MT EMMONS MINING COMPANY	8/11/1998	ACTIVE	9/1/2023

6 0140S 0860W	028	NW	CO101337893	CO101337893	CMC250617	CMC250453	MILL SITE	JD #160	MT EMMONS MINING COMPANY	8/11/1998	ACTIVE	9/1/2023
6 0140S 0860W	028	NW	CO102521460	CO102521460	CMC250619	CMC250453	MILL SITE	JD #162	MT EMMONS MINING COMPANY	8/11/1998	ACTIVE	9/1/2023
6 0140S 0860W	028	NW	CO101421054	CO101421054	CMC250621	CMC250453	MILL SITE	JD #164	MT EMMONS MINING COMPANY	8/11/1998	ACTIVE	9/1/2023
6 0140S 0860W	028	SW	CO101421054	CO101421054	CMC250621	CMC250453	MILL SITE	JD #164	MT EMMONS MINING COMPANY	8/11/1998	ACTIVE	9/1/2023
6 0140S 0860W	028	SW	CO101513113	CO101513113	CMC250623	CMC250453	MILL SITE	JD #166	MT EMMONS MINING COMPANY	8/11/1998	ACTIVE	9/1/2023
6 0140S 0860W	028	SW	CO101516833	CO101516833	CMC250625	CMC250453	MILL SITE	JD #168	MT EMMONS MINING COMPANY	8/11/1998	ACTIVE	9/1/2023
6 0140S 0860W	028	SW	CO101420817	CO101420817	CMC250627	CMC250453	MILL SITE	JD #170	MT EMMONS MINING COMPANY	8/11/1998	ACTIVE	9/1/2023

Appendix 4: Mineral Economics

Locatable Mineral Economics (USGS, 2023)

Mineral Commodity	Domestic Production & Use	World Resources	Events, Trends & Issues	Prices
Copper (Cu) Locatable Mineral	Mined at 25 mines, processed at 2 smelters, 2 electrolytic refineries, 14 electrowinning facilities. In 2022, the recoverable copper content of U.S. mine production was an estimated 1.3 million tons, an increase of 6% from that in 2021, and was valued at an estimated $11 billion, 6% less than $11.7 billion in 2021. Copper and copper alloy products were used in building construction, 46%; electrical and electronic products, 21%; transportation equipment, 16%; consumer and general products, 10%; and industrial machinery and equipment, 7%.	A USGS study of copper deposits indicated, as of 2015, identified resources contained 2.1 billion tons, and undiscovered resources contained an estimate of 3.5 billion tons.	In 2022, the largest increase in mined copper output in the United States was at the Bingham Canyon Mine in Utah, where ore grades and recovery rates were higher than those in 2021. Copper production also rose significantly at the Morenci and Safford Mines in Arizona, reflecting increased mining, milling, and (or) leaching rates. Refined copper production in the United States increased by an estimated 3% in 2022 compared with that in 2021	In December 2022, the average Commodity Exchange Inc. (COMEX) copper price was $3.82 per pound, an increase of 4% from $3.68 per pound in November and a decrease of 12% from $4.33 per pound in December 2021. The average COMEX price for all of 2022 was $4.01 per pound, 6% lower than $4.24 per pound in 2021.
Lead (Pb) Locatable Mineral	Produced domestically by five mines in Missouri plus as a byproduct at two zinc mines in Alaska and two silver mines in Idaho. The value of the lead in concentrates of ore mined in 2022 was an estimated $710 million, 3% less than that in 2021. The lead-acid battery industry accounted for an estimated 92% of reported U.S. lead consumption during 2022.	Identified world resources total more than 2 billion tons. In recent years, significant resources have been identified in association with zinc and (or) silver or copper deposits in Australia, China, Ireland, Mexico, Peru, Portugal, Russia, and the United States (Alaska).	During the first 10 months of 2022, the average London Metal Exchange (LME) cash price for lead was 97 cents per pound, essentially unchanged from the annual average price in 2021. Global stocks of lead in LME-approved warehouses were 27,625 tons at the end of October, which was 49% less than those at year end 2021.	The S&P Global Platts Metals Week (Platts) average North American Market price for lead in December 2022 was $1.20 per pound, 4% more than that in the previous month and slightly lower than that in December 2021. The Platts average North American Market price for lead in 2022 was $1.17 per pound, 3% more than that in 2021.

Gold (Au) Locatable Mineral	In 2022, domestic gold mine production was estimated to be 170 tons, 9% less than that in 2021, and the value was estimated to be $10 billion. Gold was produced at more than 40 lode mines in 11 States, at several large placer mines in Alaska, and at numerous smaller placer mines (mostly in Alaska and in the Western States) Estimated global consumption was jewelry, 47%; physical bar, %; central banks and other institutions, %; official coins and medals and imitation coins, 9%; electrical and electronics, 6%; and other, 1%.	An assessment of U.S. gold resources indicated 33,000 tons of gold in identified (15,000 tons) and undiscovered (18,000 tons) resources. Nearly one-quarter of the gold in undiscovered resources was estimated to be contained in porphyry copper deposits. The gold resources in the United States; however, are only a small portion of global gold resources. Global reserves estimates are approximately 54,000,000 tons.	The estimated gold price in 2022 was unchanged from the previous record-high annual price in 2021. In 2022, worldwide gold mine production was estimated to be unchanged compared with that in 2021. Production decreases in Papua New Guinea and the United States were more than offset by production increases in Colombia, Indonesia, and Burkina Faso.	The average monthly Engelhard gold price in December 2022 increased $73.60 per troy ounce to $1,799.45 per troy ounce from the average price in November 2022. The daily price in December ranged between a low of $1,780.00 per troy ounce on December 6, and a high of $1,822.00 per troy ounce on December 30.
Silver (Ag) Locatable Mineral	In 2022, U.S. mines produced approximately 1,100 tons of silver with an estimated value of $720 million. Ag was produced at four silver mines and as a byproduct or coproduct from 31 operations. In 2022, the estimated domestic uses included physical investment, 34%; electrical and electronics, 27%; coins and medals, 13%; photovoltaics (PV), 10%; jewelry and silverware, 6%; brazing and solder, 3%; and other industrial uses, 7%.	Although silver was a principal product at several mines, silver was primarily obtained as a byproduct from lead-zinc, copper, and gold mines, in descending order of production. The polymetallic ore deposits from which silver was recovered account for more than two-thirds of U.S. and world resources of silver.	World silver mine production increased by 4% in 2022 to an estimated 26,000 tons, principally as a result of increased production from mines in Chile and other countries as silver mines were still recovering from shutdowns in 2020 in response to the coronavirus disease 2019 (COVID-19) pandemic.	In December 2022, the Engelhard average daily silver price was $23.44 per troy ounce, a 10% increase from the November 2022 average daily price of $21.23 per troy ounce, a 4% increase from that in December 2021, and a 7% decrease from that in December 2020. The daily price in December ranged between a high of $24.15 per troy ounce and low of $22.40 per troy ounce

Molybdenum (Mo) Locatable Mineral	Total U.S. mine production of molybdenum concentrate increased slightly to 42,000 tons of contained molybdenum in 2022 compared with 41,100 tons in 2021. Molybdenum ore was produced as a primary product at two mines in Colorado (i.e., Henderson and Climax), accounting for 33% of total U.S. molybdenum concentrate production. Molybdenum concentrate production from mines where molybdenum was a byproduct continued at seven U.S. operations (four in Arizona and one each in Montana, Nevada, and Utah), accounting for 67% of total U.S. molybdenum concentrate production. Three roasting plants converted molybdenite concentrate to molybdic oxide, from which intermediate products, such as ferromolybdenum, metal powder, and various chemicals, were produced.	Identified resources of molybdenum in the United States are about 5.4 million tons, and in the rest of the world, about 20 million tons. Molybdenum occurs as the principal metal sulfide in large low-grade porphyry molybdenum deposits and as an associated metal sulfide in low-grade porphyry copper deposits. Resources of molybdenum are adequate to supply world needs for the foreseeable future.	In 2022, the estimated average molybdic oxide price increased by 11% compared with that in 2021. Molybdenum prices have not reached this high of a level since 2008. Estimated U.S. imports for consumption increased by 8% compared with those in 2021. U.S. exports decreased by 12% from those in 2021. Estimated apparent consumption in 2022 increased by 96% compared with that in 2021. Global molybdenum production in 2022 was essentially unchanged compared with that in 2021. Molybdenum prices in China reached decade-high levels as molybdenum bearing steel consumption remained high. In Chile, molybdenum producers continued to struggle with persistently lower ore grades. However, molybdenum was expected to continue to make strong contributions in global power generation and infrastructure projects as countries begin to prioritize climate change.	According to CRU Group, the monthly average price range for U.S. ferromolybdenum (FeMo) was $32.944 to $33.944 per pound of molybdenum content in January 2023 compared with $25.244 to $25.778 per pound of molybdenum content in December 2022. (CRU, 2022) FeMo monthly average prices in Europe ranged from $71.933 to $72.933 per kilogram ($32.628 to $33.082 per pound) of molybdenum content in January 2023 compared with $53.844 to $54.844 per kilogram ($24.423 to $24.877 per pound) in December 2022. FeMo prices have not been this high since September 2008. U.S. molybdic oxide (MoO_3) prices ranged from $27.333 to $28.133 per pound of molybdenum content in January 2023 compared with from $22.333 to $22.678 per pound of molybdenum content in December 2022

Pumice & Perlite Locatable / Industrial Mineral	In 2022, 10 operations in five States produced pumice and pumicite. Pumice and pumicite were mined in California, Idaho, Kansas, New Mexico, and Oregon. Estimated production was 510,000 tons with an estimated processed value of about $30 million, free on board (f.o.b.) plant. That represented an increase in both quantity and value from the 2021 reported production of 504,000 tons valued at $23.2 million.	The identified U.S. resources of pumice and pumicite, estimated to be more than 25 million tons, are concentrated in the Western States. The estimated total resources (identified and undiscovered) in the Western and Great Plains States are at least 250 million tons and may total more than 1 billion tons. Large resources of pumice and pumicite have been identified on all continents.	The amount of domestically produced pumice and pumicite sold or used in 2022 was estimated to be slightly more than that in 2021. Imports and exports were estimated to have increased compared with those of 2020. Almost all imported pumice originated from Greece in 2022 and primarily supplied markets in the eastern and gulf coast regions of the United States.	Average prices reported for pumice and pumicite varies widely by use. In 2021, the estimated production was 580,000 tons with an estimated processed value of about $18.6 million, or $32 per ton.
Niobium (Nb) Critical & Strategic	Significant U.S. niobium mine production has not been reported since 1959. Companies in the United States produced niobium-containing materials from imported niobium concentrates, oxides, and ferroniobium. Niobium was consumed mostly in the form of ferroniobium by the steel industry and as niobium alloys and metal by the aerospace industry. In 2021, there was an increase in apparent consumption of niobium for high-strength low-alloy steel and superalloy applications. Major end-use distribution of domestic niobium consumption was estimated as follows: steels, about 75%, and superalloys, about 25%.	World resources of niobium are more than adequate to supply projected needs. Most of the world's identified resources of niobium occur as pyrochlore in carbonatite (igneous rocks that contain more than 50%-by-volume carbonate minerals) deposits and are outside the United States.	In 2022, U.S. niobium apparent consumption (measured in niobium content) was estimated to be 7,600 tons, a 4% increase from that in 2021. One domestic company developing its Elk Creek project in Nebraska announced the results of its 2022 feasibility study. According to the study, the mining and processing operation is expected to produce 7,350 tons per year of ferroniobium, 102 tons per year of scandium trioxide, and 12,060 tons per year of titanium dioxide over a 38-year mine life. The project would be the only niobium mine and primary niobium-processing facility in the United States.	In 2022, the estimated value of niobium consumption was $440 million, as measured by the value of imports. Currently, niobium prices average $24 per lb for standard ferroniobium metal.

Rubidium (Rb) Critical & Strategic	In 2022, no rubidium was mined in the United States; Rubidium is not a major constituent of any mineral. Rubidium concentrate is produced as a byproduct of pollucite (cesium) and lepidolite (lithium) mining and is imported from other countries for processing in the United States. Applications for rubidium and its compounds include biomedical research, electronics, specialty glass, and pyrotechnics. Specialty glasses are the leading market for rubidium; rubidium carbonate is used to reduce electrical conductivity, which improves stability and durability in fiber-optic telecommunications networks.	There were no official sources for rubidium production data in 2022. Lepidolite and pollucite, the principal rubidium - containing minerals in global rubidium reserves, can contain up to 3.5% and 1.5% rubidium oxide, respectively. Rubidium-bearing mineral resources are found in zoned pegmatites. No reliable data are available to determine reserves for specific countries; however, Australia, Canada, China, and Namibia were thought to have reserves totaling less than 200,000 tons. Existing stockpiles at multiple former mine sites have continued feeding downstream refineries.	During 2022, no rubidium production was reported globally but rubidium was thought to have been produced in China. Production of rubidium from all countries, excluding China, ceased within the past two decades. The primary processing plant of rubidium compounds globally, located in Germany, has reportedly operated far below capacity for the past few years. Recent reports indicate that with current processing rates, the world's commercial stockpiles of rubidium ore, excluding those in China, may be depleted in the near future.	In 2022, the prices for 10 grams of 99.8% (metal basis) rubidium acetate, rubidium bromide, rubidium carbonate, rubidium chloride, and rubidium nitrate were $54.81, $77.70, $52.71, $67.10, and $52.50, respectively. The price for a rubidium-plasma standard solution (10,000 micrograms per milliliter) was $61.53 for 50 milliliters and $109.20 for 100 milliliters, a 7% and 17% increase, respectively, from those in 2021.

Tin (Sn) Critical & Strategic	Tin has not been mined or smelted in the United States since 1993 and 1989, respectively. Twenty-five firms accounted for over 90% of the primary tin consumed domestically in 2022. The major uses for tin in the United States were chemicals, 23%; tinplate, 22%; alloys, 11%; solder, 10%; babbitt, brass and bronze, and tinning, 7%; bar tin, 2%; and other, 25%.	Identified resources of tin in the United States, primarily in Alaska, were insignificant compared with those of the rest of the world. World resources, principally in western Africa, southeastern Asia, Australia, Bolivia, Brazil, Indonesia, and Russia, are extensive and, if developed, could sustain recent annual production rates well into the future.	In May 2022, a copper products manufacturer based in Germany purchased a United States metals recycling company capable of processing scrap, including tin, at the rate of 100,000 tons per year. Also in May, a company announced plans to build a $340 million electronic-waste and nonferrous-metals recycling plant in Fort Wayne, IN. The facility will have the capacity to recycle up to 45,000 tons per year of feedstock; construction was expected to begin in 2023 and conclude by 2025. In June, construction began on a secondary smelter for complex recyclable materials in Richmond County, GA. The facility will have the capacity to process up to 90,000 tons per year of recyclables and will recover multiple metals, including tin. The facility, which would cost approximately $320 million to construct, was expected to begin operations in the first half of 2024.	The S&P Global Platts Metals Week average New York dealer price of Grade A tin for December 2022 was $11.70 per pound, a 13% increase from that in November 2022, and a 40% decrease from that in December 2021. For 2022, the annual average New York dealer price of Grade A tin was $15.46 per pound, a slight decrease from that in 2021. The average London Metal Exchange (LME) cash price of Grade A tin for December 2022 was $10.92 per pound, a 14% increase from that in November 2022, and a 39% decrease from that in December 2021. For 2022, the annual average London Metal Exchange (LME) cash price of Grade A tin was $14.23 per pound, a 4% decrease from that in 2021.

Tungsten (W) Critical & Strategic	No domestic production of commercial tungsten concentrates has been reported since 2015. Approximately six U.S. companies had the capability to convert tungsten concentrates, ammonium paratungstate (APT), tungsten oxide, and (or) scrap to tungsten metal powder, tungsten carbide powder, and (or) tungsten chemicals. Nearly 60% of the tungsten consumed in the United States was used in cemented carbide parts for cutting and wear-resistant applications, primarily in the construction, metalworking, mining, and oil and gas drilling industries.	World tungsten resources are geographically widespread. China ranks first in the world in terms of tungsten resources and reserves and has some of the largest deposits. Canada, Kazakhstan, Russia, and the United States also have significant tungsten resources.	World tungsten supply was dominated by production in China and exports from China. China's Government regulated its tungsten industry by limiting the number of mining and export licenses, imposing quotas on concentrate production, and placing constraints on mining and processing.	The January 2023 monthly average price for tungsten concentrate was approximately \$3.25 per pound, 6% higher than that in December 2022 and 4% lower than that in January 2022. The January 2023 monthly average price for ammonium paratungstate, European Union market, was unchanged from in December 2022 and was 3% higher than that in January 2022.
Zinc (Zn) Critical & Strategic	The estimated value of zinc mined in 2022 was about \$3.2 billion. Zinc was mined in five States at seven mining operations by five companies. Three smelter facilities, one primary and two secondary, operated by three companies, produced commercial-grade zinc metal. Of the total reported zinc consumed, most was used to produce galvanized steel, followed by brass and bronze, zinc-base alloys, and other uses.	Identified zinc resources of the world are about 1.9 billion tons.	U.S. zinc mine production increased by 9% in 2022 compared with that in 2021. According to the International Lead and Zinc Study Group, estimated global refined zinc production in 2022 was forecast to decrease by 2.7% to 13.49 million tons and estimated metal consumption to decrease by 1.9% to 13.79 million tons, resulting in a production to consumption deficit of 297,000 tons.	Zinc decreased \$1.30 per pound or 4.59% since the beginning of 2023, however has remained essentially unchanged than the price in 2021.

Locatable Mineral Economics (EIA, 2022)

Mineral Commodity	Domestic Production & Use	World Resources	Events, Trends & Issues	Prices
Uranium (U) Locatable Mineral / Mineral Fuel	Most of the uranium used in the United States is processed abroad. In 2021, 19% of SWU originated in the United States, and 81% originated in other countries. Most SWU that originated in other countries came from Russia (28%), the United Kingdom (17%), Germany (13%), and the Netherlands (11%). Commercial uranium inventories include uranium in different stages of the nuclear fuel cycle: in-process for conversion, enrichment, or fabrication. Total U.S. commercial inventories were 141.7 million pounds U3O8e at the end of 2021, up 8% from 131 million pounds at the end of 2020. Commercial nuclear power plant operators own most of the uranium inventory held in the United States. At the end of 2021, U.S. commercial nuclear power plant operators owned 108.5 million pounds of U3O8e, a 2% increase in power plant-owned inventories from the year-end 2020 level. Uranium inventories owned by U.S. suppliers of all types, including converters, enrichers, fabricators, producers, brokers, and traders, totaled 33.2 million pounds U3O8e at the end of 2021, up 37% from the end of 2020.	The vast majority of uranium delivered in 2021 was of foreign-origin with Kazakhstan the top source at 35% of total deliveries. Canadian-origin material accounted for the second-most material at 14.8% of total and Australia third with 14.4% of total deliveries. The amount of ultimately recoverable uranium depends strongly on what one would be willing to pay for it. Uranium is a widely distributed metal with large low-grade deposits that are not currently considered profitable. As of 2015, 8,000,000 tons of reserves are recoverable worldwide. Moreover, much of Canada, Greenland, Siberia and Antarctica are currently unexplored due to permafrost and may hold substantial undiscovered reserves.	Production of uranium concentrate (U3O8) remained at or near all-time lows in the United States during 2021, at 21,000 pounds, which is less than 1% of the post-2000 production high of 4.9 million pounds U3O8 in 2014. As domestic production has declined, an increasing amount of the uranium purchased for use in U.S. commercial nuclear power reactors has been from other countries.	In 2021, owners and operators of commercial nuclear power reactors bought 46.7 million pounds (lb) U3O8 equivalent (U3O8e) at an average price of $33.91/lb U3O8. Purchase volume in 2020 was only slightly higher than in 2021, although the purchase price was slightly lower—48.9 million pounds at an average price of $33.27/lb U3O8e. Most of the uranium purchased in the United States in 2021 was imported (95%), which is typical under conditions of low domestic uranium production. Kazakhstan was the top source for uranium in 2021, accounting for 35% of total U.S. uranium purchases, followed by Canada at 15% and Australia at 14%.

Leasable Mineral Economics (EIA, 2022)

Mineral Commodity	Domestic Production & Use	World Resources	Events, Trends & Issues	Prices
Coal, Bituminous to Anthracite	Anthracite contains 86%–97% carbon and has a heating value that is slightly higher on average than bituminous coal. Anthracite is the least abundant rank of coal in the United States, and it generally accounts for less than 1% of annual U.S. coal production. Anthracite coking coal, also called metallurgical coal, is used in smelting iron ore to make steel. Coking coal must be low in sulfur and requires more thorough cleaning than coal used in power plants, which makes the coal more expensive.	As of December 31, 2020, estimates of total world proved recoverable reserves of coal were about 1,156 billion short tons (or about 1.16 trillion short tons), and five countries had about 75% of the world's proven coal reserves. The top 5 countries and their % share of the world proved coal reserves as of Dec. 31, 2020: U.S., 22%; Russia, 15%; Australia, 14%; China, 14%; and India, 10%.	Higher cost of coal from underground mines reflects the more difficult mining conditions and the need for more miners. Most coal is transported by train, barge, truck, or a combination of these modes. Increases in oil and diesel fuel prices can significantly affect the cost of transportation. Demand for clean energy is likely to continue to increase, reducing demand for coal	The average annual sale prices of coal at mines by main rank of coal in 2020, in dollars per short ton (2,000 pounds) were: $50.05 bituminous; $14.43 subbituminous; $22.16 lignite; and $98.68 anthracite. In 2020, the average delivered price of coking coal to coke producers was about $127 per short ton—about 3.5 times higher than the average price of coal delivered to the electric power sector.
Natural Gas, including Coalbed Methane	The United States used about 30.28 trillion cubic feet (Tcf) of natural gas in 2021, the equivalent of about 31.35 quadrillion British thermal units (quads) and 32% of U.S. total energy consumption. Natural gas is used for manufacturing purposes in the industrial sector, to power vehicles within transportation, space and water heating in residential and commercial sectors, and for electric power generation.	As of January 1, 2020, there were an estimated 7,257 trillion cubic feet (Tcf) of total world proved reserves of natural gas. Proved reserves of natural gas are the estimated quantities that analysis of geological and engineering data demonstrate with reasonable certainty to be recoverable in future years from reservoirs under existing economic and operating conditions.	Natural gas consumption in the United States during 2022 to average 86.6 Bcf/day, the most annual U.S. natural gas consumption on record. Natural gas was crucial in meeting electricity demand peaks during record-high temperatures in summer 2022. Expect natural gas consumption in the electric power sector to decrease during the fourth quarter of 2022 and throughout 2023 as more renewable electricity generation capacity comes online.	Natural gas prices averaged $6.41 per million British thermal units (MMBtu) in the first eight months of 2022, compared with $3.43/MMBtu in 2021 and $1.86/MMBtu in 2020. Within the U.S. natural gas industrial price was $9.66 per thousand cubic feet in June 2022.

Petroleum, including Fuel Oil	The U.S. was a petroleum net exporter in 2020 and 2021. In 2021, the United States exported about 8.63 million barrels per day (b/d) and imported about 8.47 million b/d of petroleum. The U.S. remained a net crude oil importer in 2021, importing about 6.11 million b/d of crude oil and exporting about 2.90 million b/d. However, some of the crude oil that the U.S. imports is refined by U.S. refineries into petroleum products—such as gasoline, heating oil, diesel fuel, and jet fuel—that the U.S. exports. Petroleum products include gasoline, distillates such as diesel fuel and heating oil, jet fuel, petrochemical feedstocks, waxes, lubricating oils, and asphalt. The percentage of total U.S. petroleum consumption by sector in 2021 was: transportation, 67.2%; industrial, 26.9%; residential, 2.8%; commercial, 2.5%; and electric power, 0.5%.	Present world petroleum reserves are approximately 1,425 billion barrels. At the beginning of 2020, OPEC members controlled about 71% of total world proven crude oil reserves (plus lease condensate), and they accounted for 36% of total world crude oil production in 2020. The top 5 producing countries and production percentages includes: U.S., 20%; Saudi Arabia, 11%; Russia, 11%; Canada, 6%; and China, 5%. At current rates of consumption, there are an estimated 47 years remaining in total world reserves.	U.S. gross and net total petroleum imports peaked in 2005. Since 2005, increases in domestic petroleum production and increases in petroleum exports have helped to reduce annual total petroleum net imports. Presently the U.S. is the largest consumer of petroleum, estimated at 20.5 million barrels per day or a 20% share of the world total. According to the U.S. Energy Information Administration's International Energy Outlook, the global supply of crude oil, other liquid hydrocarbons, and biofuels is expected to be adequate to meet the world's demand for liquid fuels through 2050.	Crude oil spot price is forecasted at an average of $98 per barrel (b) in the fourth quarter of 2022 (4Q22) and $97/b in 2023. Crude oil prices are determined by global supply and demand. The possibility of petroleum supply disruptions and slower-than-expected crude oil production growth continues to create the potential for higher oil prices, while the possibility of slower-than-forecast economic growth creates the potential for lower prices.

Saleable Mineral Economics (USGS, 2023)

Mineral Commodity	Domestic Production & Use	World Resources	Events, Trends & Issues	Prices
Sand & Gravel, including boulders	In 2022, 960 million tons of construction sand and gravel valued at $10 billion was produced by an estimated 3,300 companies operating 6,200 pits and 200 sales and (or) distribution yards in 50 States. An estimated 42% of construction sand and gravel was used as portland cement concrete aggregates, 26% for road base and coverings, 13% for construction fill, 10% for asphaltic concrete aggregate and for other bituminous mixtures, and 6% for other miscellaneous uses. The remaining 3% was used for concrete products, filtration, golf course maintenance, plaster and gunite sands, railroad ballast, road stabilization, roofing granules, and snow and ice control. The estimated output of construction sand and gravel in the United States shipped for consumption in the first 9 months of 2022 was 724 million tons, a slight increase compared with that in the same period in 2021.	Sand and gravel resources are plentiful throughout the world. The most important commercial sources of sand and gravel have been glacial deposits, river channels, and river flood plains. Use of offshore deposits in the United States is mostly restricted to beach erosion control and replenishment. Other countries routinely mine offshore deposits of aggregates for onshore construction projects.	U.S. construction sand and gravel production was about 960 million tons in 2022, a slight increase compared with that in 2021. Apparent consumption also increased to 960 million tons. Consumption of construction sand and gravel increased in 2022 because of growth in the private and public construction markets. Long-term increases in construction aggregates demand are influenced by activity in the public and private construction sectors, as well as by construction work related to infrastructure improvements Movement of sand and gravel operations away from densely populated regions was expected to continue where zoning regulations and local sentiment discouraged them. Resultant regional shortages of construction sand and gravel and higher fuel costs could result in higher-than average price increases in industrialized and urban areas.	Due to the expense of transporting heavy materials long distances, the economic feasibility of saleable minerals is very dependent upon the proximity of their location to their final destination. Sand, gravel, and crushed stone aggregate deposits are generally developed in areas close to their end destination, often near major cities and urban centers. Depending on local economics and transportation costs, a yard of ordinary sand and gravel could yield up to an average $75 and up to $125. The price of landscape boulders varies greatly, depending on quality, acceptable appearance, size and shape. Additionally, costs of transporting and handling boulders can also greatly vary depending upon boulder size and shape, and distances to market.

Appendix 5: Mineral Potential Classification System

The energy and mineral occurrence classification used in this report follows the direction provided by the *Mineral Potential Classification System* in Manual 3031 (BLM, 1985). This classification system uses a two-part rating:

Level of Potential: Based on the geologic environment, the inferred geologic processes, mineral occurrences, and other relevant mineral information. This is a prediction for the likelihood of occurrence and does not imply that the mineral can be economically exploited or developed (BLM Manual 3031.3).

0 – None = the geologic environment, the inferred geologic processes, and the lack of mineral occurrences do not indicate potential for accumulation of mineral resources. This class shall be seldom used, and when used it should be for a specific commodity only.

L – Low = the geologic environment and the inferred geologic processes indicate a low potential for accumulation of mineral resources.

M – Moderate = the geologic environment, the inferred geologic processes, and the reported mineral occurrences or valid geochemical/geophysical anomalies indicate moderate potential for accumulation of mineral resources.

H – High = the geologic environment, the inferred geologic processes, the reported mineral occurrences and/or valid geochemical/geophysical anomalies, and the known mines or deposits indicate high potential for accumulation of mineral resources. The "known mines and deposits" do not have to be within the area classified, but have to be within the same type of geologic environment.

ND – Not Determined = unable to make a determination due to lack of useful data.

Level of Certainty: Based on the amount of direct and indirect evidence to support the interpretation of the level of potential from A through D with increasing certainty. It is a measure of the author's confidence in the data that was assessed (BLM Manual 3031.34).

A – Insufficient = the available data are insufficient and/or cannot be considered as direct or indirect evidence to support or refute the possible existence of mineral resources within the respective area.

B – Indirect = the available data provide indirect evidence to support or refute the possible existence of mineral resources.

C – Direct = the available data provide direct evidence, but are quantitatively minimal to support or refute the possible existence of mineral resources.

D – Abundant Direct = the available data provide abundant direct and indirect evidence to support or refute the possible existence of mineral resources.

Appendix 6: Development Potential Classification System

Development Potential: Manual 3031 (BLM, 1985) does not contain a classification system for evaluating development potential. As such, the USFS uses the following energy and mineral resource development potential rating system:

ND – Not Determined = Insufficient information or data available to support a determination.

L – Low = Development is unlikely to occur within the specified timeframe or reasonably foreseeable future.

M – Moderate = Development may occur sporadically but not with consistent regularity or predictability within the specified timeframe.

H – High = Development is likely to occur frequently with consistent regularity and predictability within the specified timeframe.

Appendix 7: Site Photographs

Photo 1: Federal Parcel 1. Looking SE across manmade (reclaimed) tailings ponds for the former Keystone Mine and mill area; MEMC water-treatment plant in distance (upper left of center); Mt. Crested Butte (laccolith intrusion) in upper photo left (7/25/2022).

Photo 2: Federal Parcel 1**.** Looking south-southeast across slopes of Mesaverde Group (geologic map unit Kmv); Whetstone Mountain (laccolith intrusion) located in upper right of photo (7/25/2022).

Photo 3: Federal Parcel 2. Small open non-safeguarded adit (approx. 3-foot diameter) located in the northern portion of the parcel; this portal is located in rocks of the Wasatch Formation (geologic map unit Tw) (7/25/2022).

Photo 4: Polymetallic vein material; found along the northwestern trace of the Keystone Vein between the northwest corner of Federal Parcel 1 and the southeast corner of Federal Parcel 2 (7/25/2022).

Photo 5: Federal Parcel 3. Looking downslope to the northwest into upper Redwell Basin; Gunsight Pass Road visible left of center; Oh-be-Joyful Creek drainage near top center of photo (7/25/2022).

Photo 6: Federal Parcel 3. Looking east at broken cobbles, boulders, and discontinuous weathered outcrops of Ohio Creek Formation (geologic map unit Toc) found on the northern slope aspects below Mt. Emmons summit (human for scale, near photo center)(7/25/2022).

Photo 7: View looking east-northeast into upper Redwell Basin from Gunsight Pass; outcrops of Wasatch Formation (geologic map unit Tw) are found along the ridge, cut by northwest-trending polymetallic veins, which include mineralization oxidation halos at the surface (center); outcrops of the Ohio Creek Fm (geologic map unit Toc) underlie Federal Parcel 3 at the left-center above the switchback and downslope from the summit of Mt. Emmons (7/25/2022).

Photo 8: Upper Redwell Basin from Gunsight Pass; panorama view looking to the north-northeast (7/25/2022).

Photo 9: Non-Federal Parcel A ─ Three Peaks Ranch. Overview, looking north-northwest along the Carbon Creek drainage toward nearby Mt. Axtell, which is composed primarily of granodiorite (geologic map unit Tg) and granodiorite porphyry (geologic map unit Tp) (7/25/2022).

Photo 10: Non-Federal Parcel A ─ Three Peaks Ranch. Overview, looking south-southwest across beaver ponds located within the Carbon Creek drainage; the gray slopes of Carbon Peak, composed of quartz monzonite porphyry representing the Carbon Peak Laccolith (geologic map unit Tp), are located at upper right (7/25/2022).

Photo 11: Non-Federal Parcel B ─ Monchego Creek Ranch. Overview, looking north from southern parcel boundary; ridge at right-center represents outcrops of Fish Canyon Tuff (geologic map unit Tpbf) located in the northeast corner of the parcel; Cochetopa Dome is located in distance to the left (7/26/2022).

Photo 12: Non-Federal Parcel B ─ Monchego Creek Ranch. Outcrop of Fish Canyon Tuff (geologic map unit Tpbf) located near the southeast corner of the parcel (7/26/2022).

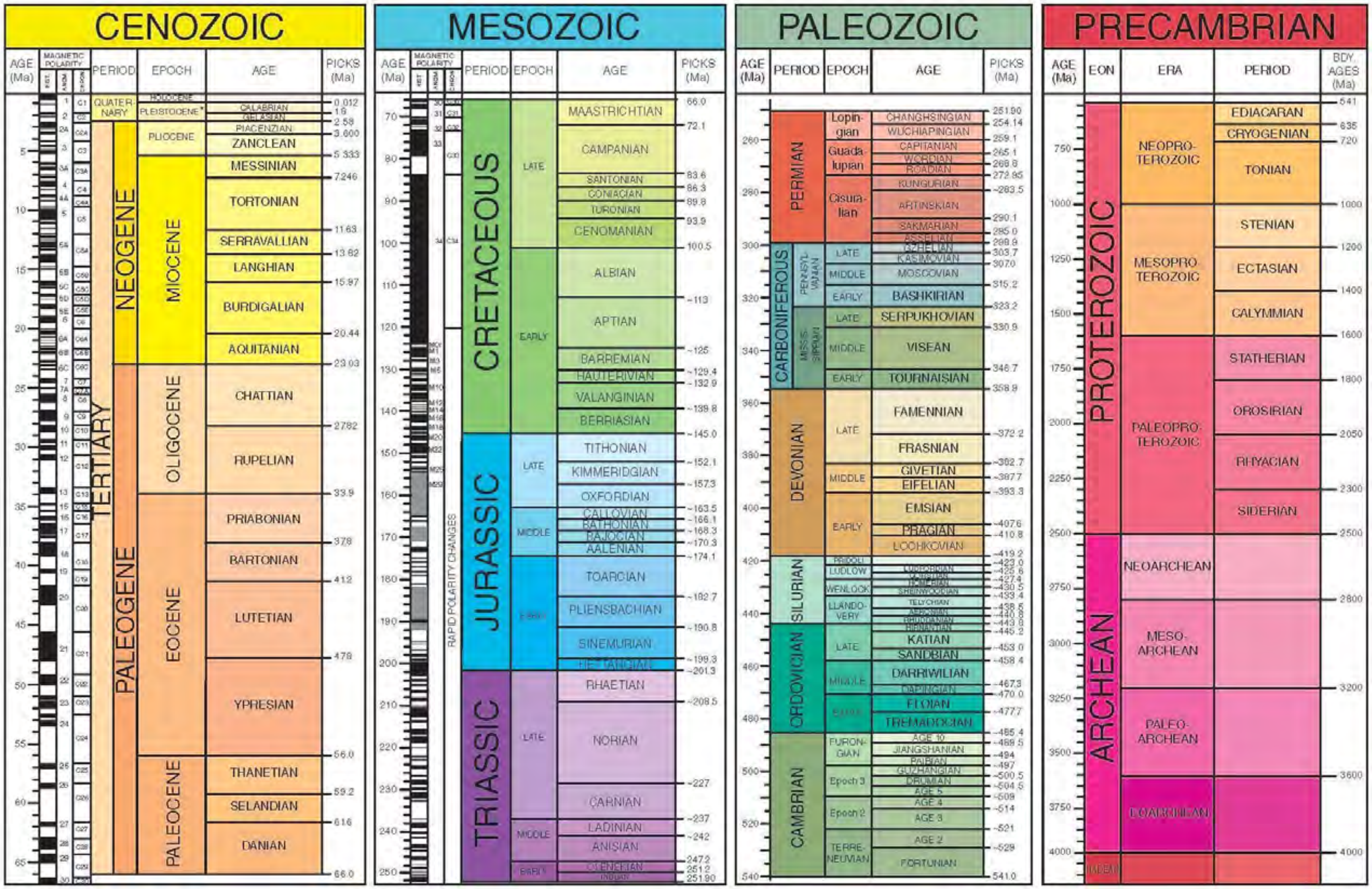
Photo 13: Non-Federal Parcel D ─ Spanish Creek Ranch. Overview, looking south from northern parcel boundary; Lookout Mountain (elevation 11,400 feet) in left background (7/26/2022).

Photo 14: Non-Federal Parcel D ─ Spanish Creek Ranch. Outcrop of Saguache Creek rhyolite (geologic map unit Tscn) located near the central corner representing the inside hinge of this L-shaped parcel (7/26/2022).

Photo 15: Non-Federal Parcel C ─ Sheep Creek Ranch. Overview, looking toward the southeast along the Sheep Creek drainage (7/26/2022).

Photo 16: Non-Federal Parcel C ─ Sheep Creek Ranch. Small outcrop of Conejos volcaniclastic rocks (geologic map unit Tcv) found along the western edge of the parcel. Quarter coin for scale (7/26/2022).

Appendix 8: Geologic Time Scale
(Walker, 2022)



Appendix 9: Preparer Resumes

We have the specific qualifications based on education, training, professional licensure, and experience to assess the mineral potential of the subject property. We meet the definition of Qualified Professional as defined in 2021 USDA Forest Service MGM Working Guide covering Standards and Procedures for Contracted Mineral Potential Reports. This report meets the supplemental standards included in:

2020 USDA Forest Service MGM Working Guide for Mineral Withdrawals and Land Conveyances

2020 USDA Forest Service MGM Instruction Guide for Mineral Potential Report Templates, and

2021 USDA Forest Service MGM Working Guide covering Standards and Procedures for Contracted Mineral Potential Reports.

Report preparer resumes are included on the following pages.

James Armstrong – Principal Geologist

James Armstrong is a geologist and environmental scientist with 29 years of residency in Colorado, who has lived in Grand Junction and Gunnison since 1998. Mr. Armstrong received a B.S. degree in Geology from Kansas State University in 1983, then spent 7 years working in various private-industry technical positions related to oil & gas exploration and production, geophysical consulting, and petroleum refining & marketing operations in the central United States, south Texas, and the Gulf of Mexico.

Since 1990, he has been employed as a consulting geologist and environmental scientist serving private-sector, nonprofit and government-agency clients primarily in Alaska, Hawaii, and the central and western United States. Mr. Armstrong is accomplished in field studies, mineral evaluations, project management and regulatory compliance, and has prepared more than one hundred mineral reports for various land transactions and conservation projects in Colorado, Florida, Kansas, Minnesota, Nebraska, New Mexico, Oklahoma, Texas, and Wyoming. He is the founder of (and a partner in) Rare Earth Science, LLC. Mr. Armstrong also co-authored and edited the revised edition of *Mineral Development and Land Conservation: A Handbook for Conservation Professionals*, published in 2011 by the Colorado Coalition of Land Trusts (now known as Keep it Colorado). His selected professional experience involving Federal land transactions includes:

- Project geologist for preparation of a Mineral Assessment Report on approximately 18,000 acres of private land in the San Luis Hills area of Costilla County, Colorado under evaluation for inclusion in the BLM San Luis Valley Field Office's jurisdiction (2014 & 2017).
- Project geologist for preparation of the draft Mineral Potential Report on roughly 35,600,000 acres within the BLM Royal Gorge Field Office's boundaries in central and eastern Colorado (2013-2015), along with a Mineral Potential Report on the Fossil Ridge II Land Exchange in the Gunnison National Forest (2019).
- Project geologist for preparation of a Mineral Assessment Report on about 400,000 acres of proposed wilderness lands in southwestern Colorado for decision-making purposes by Federal agencies (including BLM and USFS), non-profit stakeholders, and various Congressional representatives (2011).
- Project geologist for preparation of a Mineral Assessment Report on the approximately 100,000-acre Baca Grant in Saguache County, Colorado for agency (USFS and National Park Service) decision-making purposes related to mineral-rights buyout and mineral-development potential (2011).
- Project geologist and field scientist for environmental investigations on approximately 8,000 acres of abandoned mine lands and patented claims in the Elk and San Juan Mountains, and the Sawatch and Mosquito Ranges, in Colorado and 3,500 acres of mining claims in Denali National Park, Alaska for agency (USFS and National Park Service) decision-making purposes (1991-2018).
- Project scientist for environmental investigations on approximately 500 acres of Federal and Non-Federal lands included in the Husted-Maitland Land Exchange (Larimer County) and the Thistledown Small Tracts Act Land Exchange (Ouray County) in Colorado for USFS decision-making purposes (2016-2019).

Education
B.S., Geology, Kansas State University 1983
Graduate Studies, Environmental Engineering, University of Alaska – Anchorage 1993-1994
Emergency Medical Technician I, University of Alaska – Anchorage 1994

Consulting History
ENSR Consulting and Engineering (Anchorage, AK) – 1991 to 1995
Hoefler Consulting Group (Anchorage, AK) – 1995 to 1998
Harding Lawson Associates (Grand Junction, CO) – 1998 to 2000
OASIS Environmental, Inc. (Grand Junction, CO and Anchorage, AK) – 2000 to 2002
Rare Earth Science, LLC (Grand Junction and Gunnison, CO) – 2002 to present

David Barnett – Professional Geologist

David is a Certified Professional Geologist (CPG-11924) registered in good standing with the American Association of Professional Geologists. Mr. Barnett received a Bachelor of Science in Geology from Fort Lewis College in 1991, a Professional Certificate Degree in Geographic Information Science from Metropolitan State University in 2001, and has over 30-years applied project experience within geoscience, mineral exploration, and geospatial data science.

Select professional geoscience experience:

- Geologist and Geospatial Scientist for the approach development towards understanding the magnitude of fugitive methane emissions and abatement planning at Fording River Mine Extension Project, British Columbia (2021); and Murray River Underground Mine Expansion Project, British Columbia (2022).
- Geologist and Geospatial Scientist supporting planning and permitting of advanced phase exploration drill targeting activities within volcanic and sedimentary rocks of the McDermitt Caldera, Nevada-Oregon (2021).
- Geospatial Scientist providing support for Colorado Geological Survey's STATEMAP geologic map program using USGS Geologic Map Schema (GeMS) (2009-Present).
- Geologist and Geospatial Scientist for natural gas drilling environmental impact studies within the Piceance Basin, Delta and Gunnison Counties, Colorado. (2005-2007).
- Project Geologist and Geospatial Scientist for preparation of property mineral assessment reports and remoteness letters within Great Basin and Southern Rocky Mountain Cordillera regions (2002-Present).
- Geospatial Scientist for NRCS Ridgway Soil Survey Digitization, Uncompahgre Plateau Project, Bureau of Land Management, Uncompahgre Field Office (2001).
- Project Geologist for Alaska-Yukon Generative Mineral Exploration Program, including targets at: Donlin Creek in Aniak District, Alaska; Stuyahok in Marshall Mining District, Alaska; Ester Dome in Fairbanks District, Alaska; and Keno Hill District, Yukon Territory (1995-2000).
- Project Geologist for Great Basin region mineral exploration targets at: Turquoise Ridge in Potosi District, Nevada; White Pine in Bald Mountain District, Nevada; Saval-Steer Canyon in Jerritt Canyon District, Nevada; Gold Prince in Dos Cabezas District, Arizona; and other generative exploration projects (1991-1995).
- Geology lab technician and tutor, Fort Lewis College Geology Department Durango, Colorado (1989-1991)

Education & Certifications
B.Sc. Geology, Fort Lewis College, Durango, Colorado (1991)
GIS Certificate, Metropolitan State University, Denver, Colorado (2001)
Certified Professional Geologist (CPG-11924), American Institute of Professional Geologists

Professional Affiliations
Four Corners Geological Society
Grand Junction Geological Society
Rocky Mountain Association of Geologists
Society of Economic Geologists
USGS Digital Mapping Techniques Community