APPENDIX H

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MINERAL POTENTIAL REPORT

FOR

PIKE AND SAN ISABEL NATIONAL FORESTS

AND

COMANCHE AND CIMARRON NATIONAL GRASSLANDS

by

JOHN S. DERSCH, Geologist

USDA, Forest Service
Watershed, Soils, and Minerals Area Management
Lakewood, Colorado

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A. INTRODUCTION

The National Forest Management Act of 1976 requires that Land Management Plans be created for National Forest System lands. The regulations (36 CFR 219.22) state:

"Mineral exploration and development in the planning area shall be considered in the management of renewable resources. The following shall be recognized to the extent practical in the Forest planning:

(a) Active mines within the area of land covered by the forest plan;
(b) Outstanding or reserved mineral rights;
(c) The probable occurrence of various minerals, including locatable, leasable, and common variety;
(d) The potential for future mineral development and potential need for withdrawal of areas from development;
(e) Access requirements for mineral exploration and development; and
(f) The probable effect of renewable resource prescriptions and management direction on mineral resources and activities, including exploration and development."

The mineral resources assessment provides the information to document and display the foregoing in the Forest Plan, and relate it to management practices, standards, prescriptions, and alternatives.

B. ANALYSIS

A mineral potential evaluation was conducted to determine the possible existence of locatable and leasable mineral deposits on National Forest System lands. Mineral potentials were determined for metallic and non-metallic minerals and energy fuels. A set of general criteria was established which included known favorable geology and structure, known mineral occurrences and reserves (if data available), and field activity related to mineral exploration, development, and production. The "potential levels," determined as High, Medium, Low, No, and Unknown are based on today's knowledge and prices and may change at any time, depending on the mineral economy, technological advances, or further exploration. High mineral potential includes favorable geology and structure, known economically valuable mineral occurrences and reserves (if data available), and field activity. Medium mineral potential includes favorable geology and structure, known mineral occurrences with insufficient evidence of present economic value, or sub-economic deposits, and occasional activity. Low potential includes geology considered unfavorable at this time, no known mineral occurrences, explored or prospected sites determined non-economic, and little or no present activity, but does not infer the lack of mineral deposits. The No potential level indicates that the nature of the geologic environment is not favorable for the leasable commodity type indicated, no

known resources and sporadic field work. The Unknown potential level includes all areas where the geology masks the terrain limiting the ability to readily obtain information but the geologic environment could be favorable, no known resources or basic exploratory work (see Page 5 for mineral potential level matrix.)

The following eight Mineral Element Levels "rate" the potential occurrence of mineral-related activities during the life of the management plan:

1. Locatable/leasable minerals - Producing sites/known reserves
2. Locatable minerals - High/medium potential
3. Leasable minerals - High/medium potential
4. Locatable/leasable minerals - Low potential
5. Leasable Minerals - No potential
6. Leasable Minerals - Unknown potential
7. Reservations and Outstanding Rights - All levels of potential; Mineral Withdrawals
8. Salable minerals - Known areas

(See Pages 6 to 9 for a detailed description of the mineral element levels.)

The areas of known reserves and producing sites must be administered knowing that surface resource management programs will require close coordination with the mineral activity. Forest Administration will involve access, related special use permits, reclamation, and the like.

In High and Medium potential areas, any stage of exploration, production, or development can be expected to occur during the first ten years of the plan's application.

In Low potential areas, the probabilities are that any mineral activities during the first ten years of the plan will be limited to prospecting and exploration. Even if a valuable deposit is discovered, particularly a major one, it is unlikely that the necessary permits and approvals can be acquired to put it into production within the ten year period.

In the No potential areas, activities generally will be very limited for at least the first ten years of the plan.

Activities within the Unknown potential areas will probably occur during the lifetime of the plan because of the unknown aspect. Should a valuable deposit be discovered, the time frame required for permits and approvals, and to implement production plans would require a minimum of ten years. Thus activities during the first ten year period will be very limited.

Advances in exploration or production technology may result in greater activity levels in all areas, regardless of the current potential rating.

The Forest resource manager considers what types of mineral activity are likely to occur and how this activity will affect surface resource programs. The search for minerals can be expected to start from an area with

a "history of production" or "similar geologic environment" (relative to known deposits) and radiate from that point. The sequence of activities is usually prospecting, exploration, development, and production. Exploration methods include, but are not limited to, photogeology, geophysical and geochemical methods, surface drilling, and underground work. Those activities involving significant surface disturbance are normally covered by an operating plan or prospecting permit. Development and production may follow if a valuable deposit of minerals or fossil fuels is found. The methods of development for a minable mineral or fossil fuel deposit cannot be determined until knowledge of the ore body configuration, the grade and tonnage of ore, the depth of the mineralization, and other factors have been gained. Current technology requires that oil, gas, and geothermal resources be developed by wells with associated surface facilities. Approvals of operating plans for development and production are preceded by environmental analyses or, if the proposed activities are considered to be *major Federal actions affecting the environment, environmental impact* statements.

Most patented mining claims will be found in levels classified 1, 2, and 3, above. Except in Wildernesses, patentees acquire both the surface and the minerals estates. Such properties are private land in every sense of the term. The Forest Service has no direct authority over operations on such lands.

The mineral potential maps were developed by gathering data from individuals and references, plotting on overlays, and evaluating the data. Mineral expertise was sought from Federal, State, and private sectors. Some individuals outside the Forest Service who provided information were:

Ted Armbrustmacher, U.S. Geological Survey
Dave Baskin, U.S. Bureau of Mines
Max Bergendahl, AMAX, Inc.
Larry Brady, Kansas Geological Survey
Karin Budding, U.S. Geological Survey
Donna Collins, Colorado Geological Survey
Steve Craig, Bear Creek Mining Company
Claude Dean, ARCO Exploration Company
Rick Egloff, Central Rocky Mountain Mining Association
Doc Ellis, U.S. Bureau of Mines
Russ Frum, Colorado Mining Association
Eliseo Gonzalez-Urien, Noranda Exploration, Inc.
Ron Graichen, AMOCO Minerals Company
Bob Hawkins, Freeport Exploration Company
Al Hornbaker, Colorado Geological Survey
Bob Horton, Bendix Company
Bruce Johnson, U.S. Geological Survey
Steve Kluender, U.S. Bureau of Mines
Bob Lamarre, Noranda Exploration, Inc.
Dave Lindsay, U.S. Geological Survey
Bill Martin, Martin-Trost Associates
Larry McDaniel, ARCO Exploration Company
Jay Mitchell, Anaconda Company
Shirley Paul, Kansas Geological Survey

Dick Pearl, Colorado Geological Survey
Chuck Spencer, U.S. Geological Survey
Karl Starch, U.S. Bureau of Mines
Tom Steven, U.S. Geological Survey
Jack Swenson, Rocky Mountain Oil and Gas Association
Dick Taylor, U.S. Geological Survey
Tommy Thompson, Colorado State University
Margo Toth, U.S. Geological Survey
Paul Trost, Martin-Trost Associates
Ogden Tweto, U.S. Geological Survey
Mersch Ward, Homestake Mining Company
Bob Wood, U.S. Bureau of Mines

The determination of mineral resource potentials is based on available data, interpretations, and professional judgment. The information on the accompanying maps is displayed in four levels, High-Medium for locatables, and for leasables; Low for locatable and leasable, and No and Unknown for leasables.

POTENTIAL MATRIX[1/]

CRITERIA	HIGH	MEDIUM	LOW	NO	UNKNOWN
Favorable geology and structure.	Minerals occurring in several mining districts; current exploration or development activities.		Insufficient data available.	Knowledge indicates no favorability.	Lack of knowledge
Mineral occurrences and known reserves.	Occurrence being developed or high prospect of success.	Extension of known reserves or occurrence deemed probable ore deposit or producing field.	Occurrence reviewed by mineral examination and considered non-economic or undiscovered reserves.	No known resources.	No known resources.
Field activities.	Activity leading to development of a mine or field.	Seismic drilling coring, trenching.	Claims, leases, sporadic assessment work.	Sporadic field work.	Basic exploratory field work, claims, leases.

1/ All items in this matrix are of a general nature. The field activities are intended to give a basic idea of what might take place on the ground.

(J. S. DERSCH, November 1979, revised February 1984)

MINERAL ELEMENT LEVEL 1

Areas in this Level contain known producing sites or mineral reserves.

These areas are currently, or probably will be, experiencing development and production of mineral reserves. Mineral-related activities will take place during the lifetime of the plan. Exploration will search for additional reserves adjacent to, or further delineate, a known mineral deposit. Current production continues during the lifetime of the plan, depending on the mineral economy and the amount of ore remaining. Current levels of activities in these areas can be expected to remain constant or even increase. The development of private land and minerals within the Forest boundary may affect adjacent Forest land and the objectives for planned surface resource management.

Forest Action. Only surface management programs that are compatible with the mineral activities should be considered in these areas. Access to the producing sites will exist, but access and special use permits to the extended reserve areas may be needed during the first ten years of the plan.

MINERAL ELEMENT LEVEL 2

Areas in this Level contain High to Medium potential for valuable deposits of minerals locatable under the General Mining Laws. The method of developing mineral deposits remains uncertain until sufficient knowledge of the mineralization is obtained.

Activities in this Level on unpatented mining claims will include exploration, such as surface sampling, trenching, and drilling which, if significant surface disturbance results, must be covered by an operating plan. Development and production may follow if an economical ore body is delineated. The potential for mineral activities is high.

Forest Actions and Controls. Capital investments, particularly existing recreational facilities, could be jeopardized by mining operations. Mineral-related activities will usually have minimal effect on programmed goals and objectives for other resources, including timber, range, wildlife, and water. Methods of exercising the right of ingress and egress given to the miner by law shall be consistent with what is needed and with necessary surface resource protection measures. Applicable Federal and State environmental statutes will be observed. Rehabilitation should be consistent with the goals and objectives for the areas as described in the plan. Regulation of activities on mining claims, if patented and thereby no longer in Federal ownership, is under the sole jurisdiction of the State. Also to be considered are the effects of activities that take place on private lands which are adjacent to National Forest System lands.

MINERAL ELEMENT LEVEL 3

Areas in this Level contain High to Medium potential for leasable minerals. Extraction is authorized by a lease issued by the Department of the Interior, subject to Forest Service recommendations or consent, as may be applicable, and to Forest Service stipulatory requirements for surface resource protection and reclamation. Development methods for oil, gas, and geothermal resources will be by well facilities, with associated surface equipment and installations. Development methods for other types of minerals remain uncertain pending sufficient knowledge of the deposits.

Activities in this Level will be exploration, including but not limited to photogeologic mapping, seismic and resistivity work, and drilling, covered by a lease or a prospecting permit (the latter may be issued by the FS or BLM, depending on the situation).

The granting of a prospecting permit by the Forest Service does not grant any rights to or for development of a deposit should one be found. Development and production will follow if an economical mineral deposit is delineated. The potential for the occurrence of mineral-related activities is high.

Forest Actions and Controls. Capital investment, particularly developed recreational facilities, could be jeopardized as the result of mineral-related activities in and adjacent to these areas. Mineral-related activities will have minimal effects on programmed goals and objectives for other resources, including range and wildlife. The means of access shall be consistent with the leaseholder's needs and measures necessary for protection of surface resources. Applicable Federal and State environmental statutes will apply where appropriate. Rehabilitation should be consistent with the goals and objectives for the area as described in the plan.

MINERAL ELEMENT LEVEL 4

Areas in this Level have Low potential for valuable deposits of locatable and leasable minerals. The probability that mineral extraction will occur within the first ten years of the plan is low. Prospecting may or may not find valuable deposits. Even if it does, considerable time is still necessary to acquire the necessary authorizations and to prepare for production. Some areas are considered low in mineral potential, not because there is no mineralization, but because of the current lack of knowledge about the area at this time. Exploratory activities may increase in these areas if commodity demands increase, if known reserves become depleted, if new information about the genesis and geologic environments of valuable deposits is disclosed, or if new advances in exploration technology occur.

Forest Actions and Controls. All surface resource programs, including capital investments, can be implemented because mineral-related activities can be expected to have minimal effect on them.

MINERAL ELEMENT LEVEL 5

Areas in this Level are considered to have No potential for specific leasable minerals. Based on today's knowledge, mineral related activities will be very limited to non-existent. New information about the genesis and geologic environments of valuable deposits could initiate basic exploration activities, but the probability of any mineral extraction within the first ten years of the plan is very low.

Forest Actions and Controls. All surface resource programs, including capital investments, can be implemented because mineral-related activities can be expected to have minimal effect on them.

MINERAL ELEMENT LEVEL 6

Areas in this Level have Unknown potential for specific leasable commodities. These areas may have High, Medium, Low or No potential but are classed as Unknown because there is little or no data available and because the geologic environment, e.g., volcanic cover, masks the situation.

Mineral activities will be limited to basic exploration due to the unknown factor. As data are obtained, and if the mineral resource potential increases, the type and amount of activity will increase. The probability that mineral extraction will occur within the first ten years of the plan is low. Should a major discovery be found, it will take considerable time to prepare for production and obtain the necessary authorizations.

As the resources in the High and Medium potential areas are depleted, these areas will become targets for continued mineral exploration.

Forest Actions and Controls. All surface resource programs, including capital investments, can be implemented because mineral-related activities can be expected to have minimal effect on them.

MINERAL ELEMENT LEVEL 7

This Level is concerned with the mineral estate status, specifically non-Federal ownership of the minerals or withdrawals from mineral entry. Areas in this Level contain High, Medium, Low, No or Unknown potential for valuable deposits of minerals that would be locatable or leasable if in Federal ownership. Included in these areas are mineral rights reserved or outstanding in third parties. Reservations are minerals retained when the surface was acquired by the Government. Outstanding rights are minerals that were retained by transactions prior to Federal acquisition of the surface. The minerals are private or state owned ("alien") while the surface is Federal and managed by the Forest Service. Some reservations may be subject to the Secretary's rules and regulations contained in the original deed. The rules and regulations provide for some surface resource management control. Some reserved minerals will return to Federal ownership as acquired status during the life of the plan.

Activities within this Level involving reserved or outstanding minerals will be exploration, production, and development. The type of mineral sought will determine the specific action at each activity level. These actions could have a major impact on Forest surface resource management programs. The potential for mineral activities in this Level is uncertain.

All mineral withdrawals are included in this Level. Each withdrawal should be reviewed to determine whether or not it applies to the Mining Laws and/or the Mineral Leasing Laws and to determine accurately the tracts of land involved. These tracts should be shown on a map overlay. The land manager should review this overlay when an operating plan is received since the proposed activity may be affected by a withdrawal.

Forest Actions and Controls. Capital investments, particularly developed recreation, could be jeopardized as the result of mining activity in and adjacent to areas of reservations or outstanding rights. The alienated rights and mineral values must be considered in surface resource allocation proposals.

MINERAL ELEMENT LEVEL 8

This Level contains materials known as "salable" or "common varieties." Inservice use of these materials would be for building and maintaining timber sale roads and forest system roads. Common variety materials may be disposed of through special use permits with appropriately determined fees. Common varieties may include clay, sand, gravel, and some types of decorative rock. Each permit will require stipulations for protection of the surface resources. The method of development for these resources will be dependent upon the location and nature of the deposit.

Forest Actions and Controls. The sale of minerals does not limit the right of the U.S. Government to use the surface of a sale area and to issue permits and licenses that do not interfere with the purchaser's production of minerals. The land must be reclaimed as required by applicable law and the sale contract when common variety production is completed.

MINERAL ACTIVITIES

COLORADO

In 1983, approximately $350 million worth of non-fuel minerals were produced in Colorado (Starch, 1984). There is a wide range of commodities produced from the Forests, some of which are molybdenum, gold, silver, sand and gravel, coal, oil, natural gas, and gem stones.

In 1983, Colorado was the leading producer of vanadium and carbon dioxide; second in tungsten and molybdenum; third in lead; fifth in zinc; seventh in gold; eighth in silver; and tenth in iron ore. The latest rankings for energy fuel production shows Colorado tenth in natural gas, twelfth in coal, and fourteenth in crude oil. The State ranks third in uranium reserves, fifteenth in petroleum, ninth in natural gas and eighth in coal (Dept. of Energy, 1983). Mining is the fourth largest industry in the State.

SUMMARY:

There are many mining districts on the Forests, some of which are active today. The Climax Mine, which produces tungsten, tin, monazite and pyrite in addition to molybdenum, along with several small operations in the Alma-Como area, and the Monarch Quarry are currently active operations. Exploratory activity is taking place in the Upper Arkansas Valley, Sangre de Cristo Range, and South Park. In addition to the molybdenum, base and precious metals, iron, pegmatite minerals, limestone, uranium, gem minerals, and fluorspar are found on the Forests.

There is petroleum and natural gas production on the Grasslands. Geothermal potential exists at Mt. Princeton and Poncha Springs. Coal is being mined in the Spanish Peaks Area. Other leasable minerals on the Forests include carbon dioxide and potassium.

There are numerous clay deposits, areas of construction materials and dimension stone.

GEOLOGIC SETTING:

The Front Range is a broad flat-topped arch or anticline that consists of Precambrian Silver Plume and other granitic rocks. To the west is South Park, a flat-to-rolling basin consisting of sedimentary rocks occasionally appearing as hogbacks. This basin is the result of numerous uplift and erosion cycles during Mesozoic and Tertiary times (DeVoto, 1971). South Park is bordered on the west by the Mosquito Range, Arkansas Hills on the southwest, and the volcanic origin Thirty-nine Mile Mountains on the south. The Mosquito Range is a fault-block granitic system which borders the graben Upper Arkansas Valley on the east. The graben is a northern extension of the San Luis Valley, part of the Rio Grande Rift Zone (Chapin, 1971). The Sawatch Range is the western edge of the Upper Arkansas Valley.

The Sangre de Cristo Range, from Salida south to Fort Garland, is composed of tightly folded and thrust-faulted sedimentary rocks mixed with Precambrian-aged igneous and metamorphic rocks. To the south of the Front Range is the Precambrian-aged igneous and metamorphic complex Wet Mountains. The Spanish Peaks are two Tertiary intrusives composed of syenodiorite and a granodiorite porphyry (Johnson, 1968). The peaks intruded Tertiary-aged sedimentary rocks and are ringed by Tertiary-aged dikes ranging in composition from granite porphyry to diorite porphyry.

The grasslands are composed of sedimentary layers which form the Hugoton Embayment. The shallow basin, a northwestward extension of the Anadarko Basin, is controlled by the Cimarron Arch to the southwest, Apishapa Uplift to the west, and the Las Animas Arch to the north. Tertiary-aged sediments fill the major drainage areas.

LOCATABLE MINERALS:

Current mining activities can be found throughout the Forests. Development and production activities include the CF&I Monarch Limestone Quarry, several base and precious metals operations in the Alma-Como area, and the Climax Mine. Exploration activity is centered in the Sawatch, Mosquito, and Sangre de Cristo Mountains, and the South Park Area.

COLORADO MINERAL BELT

The Leadville, Salida, and South Park Ranger Districts are all located within the Colorado Mineral Belt. This area is a narrow but irregular shaped zone trending southwest from Boulder through Leadville to Durango. Most of the State's metal mining districts lie within this area.

The belt is characterized geologically by intrusive igneous rocks and associated ore deposits of Cretaceous and younger age and, in some places, by fissures and veins of northeasterly trend (Tweto and Case, 1972). The intrusive rocks typically are porphyries in stocks, laccoliths, sills, and dikes. The associated ore deposits are found as veins, replacement bodies, and stockworks. Parts of the Mineral Belt are interconnected by northeast trending Precambrian faults and shear zones. The geology within the Mineral Belt is the same as it is in adjacent areas. However, a major negative gravity anomaly found along the belt in the Leadville area suggests it is an expression of an underlying batholithic body.

Mineralizing solutions may have risen from the batholithic complex and become the source for many of the mineral deposits. The mineralization may be localized and differ in both age and composition from adjacent deposits. Areas considered as most favorable for the deposition of valuable minerals have been the intrusives of middle Tertiary age.

UPPER ARKANSAS VALLEY AREA

Within the Upper Arkansas Valley, the Leadville area has had the earliest and longest continuing mining and exploration activity (U.S. Geological Survey, 1964; Del Rio, 1960; Singewald, 1955; Behre, 1953; Vanderwilt, 1947; Emmons, et al., 1927).

Gold, silver, lead, and zinc have been produced since the 1860's primarily in the Leadville Mining District. The value of minerals produced varies, but the Leadville District, which includes the California, Iowa, Evans, and Empire Mining Districts, produced over $500 million worth of minerals. Precious and base metal ores in the Leadville area and neighboring mining districts are found in vein, stockwork, and blanket deposits. The blanket deposits are replacement mineralization in the Leadville limestone which is locally capped by a porphyry sill or shale bed.

Areas with potential for precious and base metal deposits include the Sawatch and Mosquito Ranges, particularly where past production has taken place. The increase of gold to $800 per ounce in early 1980 and continued value of around $400 per ounce started new exploration and has allowed other areas to continue. Activity today has slowed considerably due to a lower gold price and a sluggish economy.

The St. Kevin-Sugarloaf Mining District is located west of Leadville near Turquoise Lake. Silver was produced mainly from oxide ore, but locally, gold, lead, and zinc were important. The veins, which contain massive sulfides, and the granite wallrock have been strongly altered by hydrothermal action. About $12,000 of gold, silver, lead, and zinc were produced from 1933 to 1945.

The Twin Lakes (Lackawanna Gulch) Mining District produced gold and silver along with some lead and zinc. Production of the small veins was limited to the mid-1930's when about $67,000 worth of gold, silver, and lead were mined. The Tertiary age veins are found in Precambrian granite. The district is located west of Granite on Lake Fork.

Placer gold was first found in the Leadville area in 1860 (Parker, 1974a and b). Exploration continued and gold was found in the Buena Vista-Twin Lakes area. Most of the placer deposits have been reworked and redeposited by glacial action. Over 400,000 ounces of placer gold have been hydraulicked, sluiced, and dredged in Lake and Chaffee Counties.

Molybdenum from the Climax and Henderson Mines, which accounted for approximately two-thirds of the State's 1981 non-fuel mineral production, resumed production in 1984 at reduced levels. Exploration indicates additional molybdenum mineralization is located in the Clear Creek Mining District that may be economical (Barker, 1979). These areas are East Red, Winfield Peak, Middle Mountain, Cloyses Lake, Lake Fork, and Mount Hope. There are other sites in the Clear Creek District along with the Mt. Aetna-Hoffman Park area and the northern end of the Mosquito Range (U.S. Geological Survey, 1964). The ore is dispersed through areas of altered and fractured rocks commonly in or near intrusive bodies. These areas may be favorable

for large tonnage, low grade ore bodies. Molybdenum is used in steel to increase the hardness, toughness, and resistance to wear and corrosion.

The Calumet (Whitehorn) and Turret Creek Mining Districts are located about 16 miles northeast of Salida. Vanderwilt (1947) noted that gold, silver, and copper occurred in small veins but there is no recorded production for the Calumet Mining District. Iron ore was first produced in the 1880's from the Calumet Mine in the Turret Creek Mining District (U.S. Geological Survey, 1964). The mine ceased production in 1899 when the percentage of iron dropped too low to be produced economically. The ore is in Mississippian limestone adjacent to a Tertiary intrusive. Future needs for iron ore may result in further exploration of this area. Feldspar, mica, and rare-earth minerals have been produced from feldspar mining in this district (Del Rio, 1960).

The Chalk Creek Mining District includes the Alpine, Hancock, Romley, and St. Elmo areas (Dings and Robinson, 1957). Mining started in 1875 when a mill was constructed to treat ore from several mines including the Mary Murphy group of mines. The value of gold, silver, lead, copper, and zinc produced exceeded $5.9 million, 75 percent of which came from the Mary Murphy Mine. The major mines were the Mary Murphy, Iron Chest, Allie Belle, and California. The Mary Murphy Mine, which is located about two miles south of St. Elmo, consisted of pyritic quartz veins from which 110,000 ounces of gold and 971,000 ounces of silver were recovered.

The Cottonwood Mining District is located north of St. Elmo near Cottonwood Pass (Vanderwilt, 1947). There are veins carrying lead, silver, and gold in the Precambrian granite and schist, but no records of any production.

The Monarch Mining District is located south of St. Elmo on the east side of Monarch Pass (Dings and Robinson, 1957). The mineralization occurs as either bedded or irregular forms and along faults in limestone and dolomite, or as veins in the Mount Princeton quartz monzonite. The total value of precious and base metals from the district exceeds $13 million. The Garfield Mine on the east side of Taylor Gulch started in the 1880's. The replacement mineralization consisted of galena, sphalerite, pyrite, and some chalcopyrite in the Manitou dolomite. The Madonna Mine is located in the northwest slope of Monarch Ridge. The mine was discovered in 1878. Through 1950 precious and base metal production exceeded $6 million. The main ore body dimensions were about 2,000 feet in length, breadth of 80 feet, and a thickness of 40 feet. Cerrusite, silver-bearing galena, smithsonite, cerargyrite, argentite and free gold were the principal minerals mined. Today, limestone is produced from the Monarch Quarry for the CF&I Steel Corporation steelmaking operations in Pueblo. Molybdenum occurrences have been reported in the Mt. Aetna-Hoffman Park area (U.S. Geological Survey, 1964).

The Buffalo Peaks Wilderness Study Area (WSA) is located in the Mosquito Range (Hedlund and Wood, 1984; Wood, 1983). Surrounding the WSA are several mining districts including Granite on the west, Weston Pass on the northeast, and Fourmile on the south side.

The Granite Mining District is located northeast of Granite on the Chaffee-Lake County line (Vanderwilt, 1947). Silver, gold, and lead are found in pyrite-quartz-gold-tourmaline veins cutting the Precambrian granite. The Gopher Shaft, Bunker Hill Shaft, Magenta Shaft, and Granite Tunnel were driven to intersect the mines on Yankee Blade Hill. Placer gold from these areas has been found along the Arkansas River along with that of the Lost Canyon Mining District located southwest of Granite.

The Weston Pass Mining District straddles Weston Pass but the majority of the activity was on the east side (Vanderwilt, 1947). The silver, zinc, and lead ores occur as replacement deposits in the Leadville limestone. The production was apparently limited to surface enrichment. The Ruby Mine contained disseminated galena, some sphalerite, along with cerussite, calamine, and smithsonite (Del Rio, 1960).

The Fourmile Mining District is located on the southern end of the Buffalo Peaks Wilderness Study Area several miles north of Buena Vista. The quartz-pyrite-gold veins in the district were worked from 1935 through 1937 when 53.5 ounces of gold was produced and in 1940 when gold, silver, copper, lead, and zinc was mined (Vanderwilt, 1947). There is no other recorded production.

There are two mining districts in the vicinity of Trout Creek Pass, Free Gold and Trout Creek (Vanderwilt, 1947). The Free Gold Mining District consisted of several silver veins cutting Precambrian granite. Production in the early 1930's was limited to some placer gold work and mining of a few tons of low-grade gold ore. The Trout Creek Mining District, from which gold, silver, lead, and zinc were recovered during the 1930's, recorded a production value of about $1,200 (Vanderwilt, 1947). In addition to the precious and base metal recovery, feldspar, mica and rare-earth minerals have been produced from pegmatite mining (Del Rio, 1960).

Several other commodities in this area include tungsten, tin, monazite, uranium, and fluorspar. Tungsten, tin, pyrite, and monazite are by-products from mining at the Climax Mine (U.S. Geological Survey, 1964; Eckel, 1961). The Marshall Pass District, where uranium is currently being mined at the Pitch Mine on the Gunnison National Forest, extends into Chaffee County (Malan, 1959).

Some manganese deposits are associated with precious, base metal, and iron mineralization in the Leadville area (U.S. Geological Survey, 1964). The size and grade of the oxidized deposits are dependent upon form and grade of the original deposit and the alteration processes. Inferred deposits exist in the Leadville area. Manganese is used in the production of ferromanganese for steel production and in chemicals and batteries.

The Browns Canyon District is one of six major fluorspar areas in the State (U.S. Geological Survey, 1964; Del Rio, 1960). The deposit consists of veins and mineralized breccias in Precambrian granitic rocks. Production occurred from the late 1920's through the middle 1940's when about 85,000 tons of fluorspar of metallurgical and ceramic grade were shipped.

SOUTH PARK AREA

The Colorado Mineral Belt extends across the northwestern corner of this area. Along the eastern edge of the Mosquito Range are five mining districts, Consolidated Montgomery, Buckskin, Mosquito, Sacramento, and Horseshoe, which produced the major portion of the lode production from this area (Vanderwilt, 1947). The principal areas of mineralization are 1) London (southwest of Mosquito Peak), 2) Loveland (on Buckskin and Mosquito Creeks), 3) Bross-Lincoln, 4) Sacramento, and 5) Hilltop (on Fourmile Creek) (Singewald, 1947a). The ore deposits are found along the footwall of the London fault, as replacement bodies of silver and lead in the Leadville limestone, and as gold and replacement veins in the Sawatch quartzite. In Park County, the Alma Mining District, composed of the Buckskin, Consolidated Montgomery, and Mosquito Mining Districts, produced $37 million of precious and base metals (U.S. Geological Survey, 1964).

Placer deposits in Park County through 1962 have yielded about 342,000 ounces of gold worth $9.4 million (U.S. Geological Survey, 1964). The South Platte Valley, Beaver Creek, and Tarryall Creek were the principal geographic areas for the placer mining. Glaciation of lodes in the mountains to the north and west created the placer deposits. The most productive of the glacial features were the outwash gravels (Singewald, 1947b). Today there are several small operations in the Alma and Como areas. The current gold price of $400 per ounce has caused recent exploration to slow down. Any upturn in the price may revive exploration activity.

The potential for uranium occurs around the edge of South Park, particularly the northeast at Kenosha Pass. The mineralization at Kenosha Pass is found in granitic rocks either as veins or as lenses and pods adjacent to metasediments. The current lull in the economy caused both operations to permanently shut down. To the southeast, exploration geologists are looking for deposits in ancestral drainages similar to the Tallahasee Creek Project on the southeastern edge of the Thirtynine Mile volcanic field. Tarryall Springs, Thirtynine Mile Mountain, and the Arkansas Hills (Fremont County) east of Salida have potential for uranium mineralization, possibly similar to Tallahasee Creek.

Tungsten as scheelite and powellite occurs in the Tarryall Springs District northwest of Lake George (U.S. Geological Survey, 1964). The tungsten minerals occur in parallel bands of calc-silicate gneiss on the western edge of the Pikes Peak Batholith. There has been no known production.

On the southeast side of South Park is the Badger Creek Mining District (Vanderwilt, 1947). Copper mineralization has been reported, but there has been no known production.

There are numerous occurrences of fluorspar and pegmatite minerals in the South Park area (U.S. Geological Survey, 1964; Del Rio, 1960). There are fluorspar veins in the Jefferson District west of Kenosha Pass, the Lake George area, and the Silver Dollar Deposit in the Tarryall District. The pegmatite occurrences are centered in the Lake George area. The sites have been mined chiefly for feldspar, but some rare-earth minerals have been recovered from the operation in addition to beryl.

The first beryllium vein deposit in the United States to be mined was the Boomer Mine in Park County (Hawley, 1969). The mine is located on the southern edge of a fine-grained granitic intrusive, the Boomer Cupola. There are several adjacent areas, China Wall, Redskin Gulch, and Mary Lee that have inferred reserves. The metal is used in alloys and in inertial guidance systems.

PIKES PEAK AREA

This area consists of pegmatites, fluorspar deposits and gemstone occurrences. The two main areas are the St. Peter's Dome-Mount Rosa Area (U.S. Geological Survey, 1964; Del Rio, 1960) and the South Platte District (Simmons and Heinrich, 1980; U.S. Geological Survey, 1964). Gemstones such as amethyst, tourmaline, smoky quartz, amazonite, quartz crystal, and topaz can be found in the St. Peter's Dome-Mount Rosa area. The Tertiary-age fluorspar deposits in this area occur in veins and breccia fillings along faults with minor occurrences of barite, galena, sphalerite and pyrite. Rare-earth, thorium, niobium-tantalum, and beryllium minerals occur in the pegmatite zones found in the Pikes Peak granite. The Cripple Creek pegmatite province, located along the margins of the Pikes Peak Batholith west of St. Peter's Dome, contains topaz, quartz, and amazonstone, but no other economic minerals.

The South Platte District has several areas that contain fluorspar, pegmatites, and gemstones. These are the Buffalo District, South Platte Pegmatite District, and three smaller prospects located to the southeast in Douglas County. Minerals mined from these pegmatites include feldspar, quartz, fluorite, and rare-earth minerals. Deer Trail, Yammy Yogurt, Shuttle Run, Little Bill, and Madonna No. 1 are several of the pegmatites that were mined.

The Blair Athol Mining District is located about six miles northwest of Colorado Springs (Vanderwilt, 1947). During 1913 and 1914 ore mined yielded 13,276 pounds of copper. The district is located in Precambrian granite, but there was no description of the occurrence.

WET MOUNTAINS AREA

There are two mining districts in the Wet Mountains area, Fairview and Grape Creek (Vanderwilt, 1947). The Fairview Mining District is located about 12 miles southeast of Silver Cliff. There are no production records or reported occurrences. The Grape Mining District is west of the Yorkville site on Grape Creek. There are no production records, but some lead and zinc ore was mined.

The Oak Creek (Ilse, Spaulding) Mining District is located on the west side of this area around Ilse (Vanderwilt, 1947). Cerrusite deposits at the Terrible Mine on the east side of Oak Creek have been mined. The deposits are found as lenses, stringers, and small pockets in the granite and granite-gneiss bedrock. Prior to 1895, around 300,000 tons of five to eight percent lead were produced, but activity has been limited since and ceased after 1943. The Feldspar Mine is centered around a one to seven

foot barite-galena vein which outcrops for 1,000 feet on the surface in Precambrian gneiss and schist. The mine is located three miles north of Ilse on the west edge of the Wet Mountains area.

The Greenhorn Wilderness Study Area (WSA) has been studied by the U.S. Geological Survey and the U.S. Bureau of Mines (Toth and Baskin, 1984; Baskin, 1983). Stream sediment sampling indicated that barium, lanthanum, yttrium, and tungsten anomalies are present in the South Apache Creek drainage. Areas with similar Precambrian rocks have demonstrated tungsten resources even though no mineralization was noticed on the surface. The WSA is located on the southern end of the Wet Mountains area near Badito Cone.

Fluorspar, uranium, thorium, and vermiculite are found in the Wet Mountains. The Antelope Creek District consists of small fluorite veins which at one time were mined. Uranium in the Stumbling Stud Mine occurs along the Cretaceous Dakota rhyolite-sandstone contact (U.S. Geological Survey, 1964). The uranium mineralization is associated with fluorite-bearing fractures and as disseminated grains in sandstone. Thorium occurs in a northwest trending shear zone containing barium-sulfide veins within a Precambrian igneous rock complex (Del Rio, 1960). During 1958 and 1959 thorium was mined from the vein system in carbonatite rocks between Queida and Rosita. Sampling of the vein system indicated the ThO_2 content ranges from 0.02 to 12.5 percent (U.S. Geological Survey, 1964).

Vermiculite, an expandable micaceous clay used as an insulator or aggregate in concrete, occurs in veins about six miles northwest of Rye (Del Rio, 1960). The veins up to six inches thick are found in roughly vertical alteration zones in peridotite which was emplaced as dikes in Precambrian pink granite.

SPANISH PEAKS AREA

Small veins of gold, silver with some copper, and lead occurs in fissure veins around West Spanish Peak in metamorphased sedimentary rocks. Vanderwilt (1947) noted the veins also contain pyrite, sphalerite, and siderite. There are several prospects on West Spanish Peak, but the Bull's Eye Mine was the most prominent. Mine production was limited to 1908 when 168 ounces of gold and 1,176 ounces of silver were mined (Vanderwilt, 1947). Budding and Kluender (1984) found geochemical anomalies for lead, zinc, silver, copper and gold in the zone of contact metamorphosed sedimentary rocks around the intrusive of West Spanish Peak.

Placer gold was recovered in the Wahatoya Creek and on the tributaries of Apishapa River on West Spanish Peak. Recovery was limited in sampling conducted by the U.S. Bureau of Mines for the Spanish Peaks Wilderness Study Areas report.

SANGRE DE CRISTO AREA

The Cleora Mining District is located southeast of Salida on the northern end of the Sangre de Cristo Range. Chalcopyrite occurs in Precambrian schist, but there are no records of any production (Vanderwilt, 1947).

U.S. Geological Survey (1964) reported that scheelite occurs in Precambrian age copper-quartz veins of several copper mines of the Cleora Mining District.

Uranium, fluorspar, molybdenum, and copper occurrences have been reported (U.S. Geological Survey, 1964; Del Rio, 1960). Uranium occurs along the east flank of the Sangre de Cristo Range in mildly metamorphased sandstones and mudstones of Permian and Pennsylvanian age. A known bedded deposit exists in the Crestone Needles area. Poncha Pass and Poncha Springs are two fluorspar areas in Chaffee County. The deposit at Poncha Pass consists of a shear zone with fluorite and a gouge zone that cut Precambrian quartzites and schists. At one time there were at least four mines in the Poncha Pass area. The Poncha Springs fluorspar mine is a north-south trending vein in a 100 foot wide shear zone in Precambrian granite. There are no records of production from either area.

There are two molybdenum occurrences on the east side of the Sangre de Cristo Range. The Knight-Stacy prospect is a vein occurrence on the east side of Cottonwood Peak (King, personal communication). A quartz vein with pyrite, chalcopyrite, and an average of less than one percent MoS_2 is exposed on the surface. Alteration halos are visible on the surface, probably the result of an intrusive which has poked up through the sediments. The second occurrence is a pegmatite on the east side of Mosca Pass.

The Sangre de Cristo Wilderness Study Area is being jointly studied by the U.S. Geological Survey and the U.S. Bureau of Mines (Johnson, et al., 1984; Ellis, et al., 1983). Four areas of resource potential were defined by Johnson (et al., 1984). Four of the areas lie adjacent to the western edge of the Study Area on the northwest trending Sangre de Cristo Fault, totally within the Rio Grande National Forest. These areas have potential for gold, silver, iron, copper and lead. Northwest trending veins north of Blanca Peak have potential for gold, silver, and tungsten. The area around the Rito Alto stock has potential for molybdenum, copper, tungsten and gold.

COMANCHE-SPRINGFIELD AREA

The Carrizo Creek (Estelene) Mining District is located about 45 miles southwest of Springfield. Activity was limited from 1900 to 1917 when about $4,900 worth of copper ore along with some gold and silver was mined (Vanderwilt, 1947). Chalcocite, partly altered to malachite and azurite, occurs in sandstone. Del Rio (1960) noted there were plans for strip mining this deposit, but no activity has taken place to date.

LEASABLE MINERALS:

The Cottonwood Creek-Chalk Creek and Poncha Springs geothermal areas have good potential for electrical production (Pearl, 1979). Lease applications have been filed for both of the Arkansas Valley areas. Currently, production is limited to domestic uses and space heating.

The reservoir systems for both areas are similar. In the Cottonwood Creek-Chalk Creek area, the hot waters are related to the faulting and fracturing of the Mount Princeton quartzite. Surface waters descend in fault systems west of this area or in valley fill to the east and rise through the Mt. Princeton fault zone to feed local springs. Poncha Springs consists of five springs fed by waters probably from the valley fill. The complex faulting system of the area allows the waters to reach the surface.

The potential of each reservoir is dependent upon the size of area and the subsurface temperatures. The estimated subsurface temperature for Cottonwood Creek is 105° to 182°C and for Chalk Creek is 150° to 200°C. The heat content is estimated to be 3.81×10^{15} BTU's. Poncha Springs' subsurface temperature is estimated to be 115° to 145°C with a heat content of 1.911×10^{15} BTU's. Cottonwood Creek-Chalk Creek has a potential for 100 megawatts of electricity and Poncha Springs has the potential for 200 megawatts.

The Forest has two coal resource areas, South Park Field and the Raton-Mesa Region (Nielsen, 1981; Jones, et al., 1978). The South Park Field touches the Forest north of Jefferson. There is no production from the coal-bearing rocks of the Laramie Formation. The Raton-Mesa Region, a Known Recoverable Coal Resource Leasing Area, consists of the Walsenburg and Trinidad Fields. The coal-bearing rocks in this Region are the Raton and Vermejo Formations of Upper Cretaceous age. The only mining activity from the Walsenburg Field is the Viking Strip Mine, located off the Forest, which produced 37,106 tons of coal in 1981 (Colorado Mining Association, 1982). Good coking coal from the Trinidad Field is mined on the Forest. CF&I Steel Corporation's Allen and Maxwell Mines produced 661,889 tons of coal in 1981 and employed 515 people (Colorado Mining Association, 1982).

Oil and gas production activities are restricted to the Grasslands (U.S. Geological Survey and Colorado Geological Survey, 1977; U.S. Geological Survey, 1964). Currently, there are two producing and five "shut-in" gas fields in the Carrizo District. Production from the Vilas and Playa Fields for 1981 was about 2.006 million cubic feet (Colorado Oil and Gas Cons. Comm., 1982). The fields are stratigraphic traps of Pennsylvanian age.

There are several areas with high to medium potential for oil and gas (Spencer, 1983, 1979). Additional reserves in Paleozoic sediments are probable in the Hugoton Embayment area of southeastern Colorado. Assessment of the oil and gas potential in the Sangre de Cristo Range, particularly the southern part, is difficult because of the structural complexity. The Sangre de Cristo Range is a horst block of Laramide time folded and faulted Precambrian and Paleozoic rocks which are bounded on the east by the Alvardo Fault and the Wet Mountain Valley Graben, and on the west by the Sangre de Cristo Fault and the San Luis Valley Graben (Johnson, et al., 1984). This band of folded and faulted rocks crosses the Forest on a southeast trend from a point south of Mount Marcy and exiting near Medano Pass. The overthrusted zone continues to the east of Slide Mountain and on through Pass Creek Pass area. The southeast trend continues, and includes the western portion of the Spanish Peaks. Known hydrocarbon source rocks occur in Huerfano Park, but are not exposed in the Forest. The crustal shifting of the rock layers from the west may have created potential structural traps adjacent to the east side of the Forest that could contain

oil and gas reserves. A detailed analysis of the structure of this area requires subsurface and seismic profile data not presently available. If favorable rocks such as Cretaceous sandstone and shale extend under the Forest beneath the thrusting, the area underlain is relatively small and details of its subsurface structure are unknown. The eastern flank of the Sangre de Cristo Range along the Forest boundary from Slide Mountain north to Bradford should be considered medium potential (see Mineral Potential Overlay). The remainder of the Forest in the Sangre de Cristo Range is rated low potential except for the extreme northern end that is rated no potential (Spencer, 1983).

A known carbon dioxide area exists in the central portion of the Springfield District. Interest has been shown by major companies, but activities have been limited. The gas is used to flood oil and gas zones for increased production.

A potential deposit of potassium exists near Porphyry Peak southwest of Salida. Alunite is a secondary mineral formed principally from the actions of acid sulfate solutions forming replacement or disseminated-type deposits. A prospecting permit was applied for but withdrawn in 1983.

SALABLE MINERALS:

Refractory and clay shale deposits exist along the Front Range in the Dakota sandstone in Douglas County and Pueblo County (U.S. Geological Survey, 1964; Del Rio, 1960). The clays from the Rampart Range area are used for bricks, refractory goods, and stoneware. A small deposit of bentonite has been mined for local use at the Triangle-Lamberg Mine east of Salida.

Sand and gravel is available in all counties. The main sources are alluvium and terrace gravels along the South Platte and Arkansas Rivers and their tributaries. A quarry in Lake County near Sylvan Lakes has produced a sand and gravel product with uses varying from concrete to finishing work since the middle 1950's.

The Colorado Springs area has several places which produce stone, granite, and sandstone for construction purposes. A red granite quarry near Buffalo Creek has produced a dimension stone used for building in Colorado, Wyoming, and Nebraska (Del Rio, 1960).

Gem minerals, aquamarine and turquoise, have been found and mined in the Upper Arkansas Valley area. Aquamarine crystals, a form of beryl, have been recovered from the California Mine on Mount Antero (Del Rio, 1960). The beryl, possibly up to ten percent BeO, occurs in molybdenum-rich veins. The Turquoise Chief Mine is located about seven miles northwest of Leadville (Eckel, 1961). During 1935, one thousand pounds of gem-quality turquoise was mined from veins and nodules in white granite.

FUTURE AREAS FOR EXPLORATION:

In addition to the current activities described in the locatable and leasable minerals section, the following areas may be targets for future mineral exploration within the Forests and Grasslands:

1. Leadville area for precious, base, and molybdenum mineralization.

2. Clear Creek Mining District for molybdenum deposits.

3. Boreas Pass-Webster Pass area for base and precious lode and placer deposits.

4. South end of South Park and Arkansas Hills areas for uranium in ancestral drainages.

5. Mosquito Range for replacement and blanket precious and base metal deposits.

6. Glacial deposits in the South Platte and Tarryall Valleys for placer gold.

7. Geothermal energy in the Upper Arkansas Valley area.

8. Eastern flank of the Sangre de Cristo Range for uranium, oil, and gas.

9. Springfield District for oil, gas, and carbon dioxide reserves.

MINERAL ACTIVITIES

KANSAS

The mineral industry of Kansas consists of two segments--mining and manufacturing. The mining segment involves the development and production of raw minerals while the manufacturing segment concentrates on processing the commodities into semi-finished or finished products. The sand and gravel operation in Morton County contributed only slightly to the non-fuel mineral production for 1983, which was $283 million (Hill, 1984). Kansas was ranked first in the Nation for helium production, the majority of which came from the southwest corner of the State. Cement, salt, and crushed stone continue to be the leading commodities produced in the State.

Kansas ranks eighth in petroleum reserves, sixth in natural gas and twenty-first in coal (Dept. of Energy, 1983).

SUMMARY:

The potential for locatable mining activity is low.

Petroleum and natural gas account for nearly all of the mineral value produced from the Grassland. Helium and natural gas liquids are produced at local facilities. The potential for commercial salt production is low.

There is one operating sand and gravel pit.

GEOLOGIC SETTING:

The Grassland lies in the Hugoton Embayment, a shallow shelf edge on the northwestern edge of the Anadarko Basin (Rascoe, 1971). The embayment is controlled on the west by the Las Animas Arch in eastern Colorado and to the southwest by the Cimarron Arch in western Oklahoma. Tertiary-aged sediments are found in the Cimarron River drainage.

LOCATABLE MINERALS:

There is no mining claim activity at this time and the potential for such activity is considered low.

LEASABLE MINERALS:

Oil and gas is being produced from 17 oil and gas fields within the Grassland boundary (Oros, 1975). In 1982, Morton County oil production exceeded 860 thousand barrels, and gas production surpassed 12.5 million cubic feet (Paul, personal communication). Rocks of Permian, Pennsylvanian, and Upper Mississippian age are the sources for the oil and gas. In Morton County, the oil and gas reservoirs are found in stratigraphic traps.

Production methods vary within the County. Several fields are new, while older fields are using controlled water flooding for secondary recovery. The number of secondary methods of recovery will continue to increase as the rates of recovery decrease.

The potential for discovery of hydrocarbons should be considered high. The Pennsylvanian and Mississippian rocks, which are currently producing, probably contain additional reserves. Adequate formation testing has not been conducted below the current production zones, however, these rocks do have favorable conditions and structure for hydrocarbon accumulation.

About 90 percent of the ownership for oil and gas exists in reservations and outstanding rights, or non-Federal ownership. Starting in 1985, about 35 percent of the non-Federal ownership will revert back to the United States Government (Zarley, personal communication).

Helium and natural gas liquids are produced at several local facilities (McDougal, et al., 1979). Helium is processed from gas recovered from the Greenwood Gas Area and the Sparks Field. The helium potential is considered high and extends into southeast Colorado. Natural gas liquids produced include propane, ethane, liquid petroleum gas, and natural gasoline.

Two thin Permian salt beds are located in the County (Holdoway, 1978). One is the Blaine Salt, part of the Blaine Formation, and the other is the Cimarron Salt, part of the Ninnescah Formation. There is no current exploration activity or plans for development of these resources. The commercial potential is low because of impurities and minimal salt thicknesses.

SALABLE MINERALS:

There is one known sand and gravel pit operated by the Morton County Road Department (Price and Brady, 1981). The potential areas are limited to Pliocene and Pleistocene-aged materials along the major streams.

FUTURE AREAS FOR EXPLORATION:

In addition to the current activities described in the locatable and leasable mineral sections, the following areas may be targets for future mineral exploration within the Grassland.

1. Continued exploration of currently producing zones for additional oil and gas production.

2. Exploration of rocks below currently producing zones for additional oil and gas production.

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MINERAL AUTHORITY MATRIX [1/]

KINDS OF MINERALS	FEDERAL MINERAL ESTATE STATUS	
	PUBLIC DOMAIN MINERALS	ACQUIRED MINERALS
Locatable Minerals "Valuable minerals" except as noted below.	1872 U.S. Mining Law [2/] Prospector and miner have the right to search for and take valuable deposits of "locatable" minerals and to secure title to NFS lands under certain circumstances (FSM 2810). 1974 Secretary of Agriculture 36 CFR 228 Regs. Operator required to submit Notice of Intent or, when significant surface disturbance is anticipated, a Plan of Operation is required (FSM 2810).	1947 Mineral Leasing Act for Acquired Lands Mineral leasing by Interior only with Forest Service consent (FSM 2822).
Leasable Minerals Fossil fuels, other bitumens: Potassium, Sodium, Phosphate, Sulfur in La, and N.M.	1920 Mineral Land Leasing Act Mineral leasing by Interior based on recommendation of Forest Service, except coal which requires FS consent (FSM 2822).	1947 Mineral Leasing Act of Acquired Land Mineral leasing by Interior only with Forest Service consent (FSM 2822).
Geothermal Resources	1970 Geothermal Steam Act Leasing by Interior only with Forest Service consent (FSM 2822).	
Mineral Materials Common variety - sand, clay, gravel, etc.	Act of July 31, 1947 Forest Service cannot dispose of on valid claim without consent of claimant. Can dispose of if claim is declared invalid (FSM 2850).	Act of June 11, 1960 Forest Service authorized to dispose of (FSM 2850).

[1/] In addition to these Acts concerned with the disposal of minerals and mineral materials, the Forest Service is authorized to issue prospecting permits for activities covered by the Mineral Leasing Acts on lands of the National Forest System.

[2/] Includes the 1872 U.S. Mining Law, subsequent Acts of Congress, and case law governing location and patenting of mining claims on the public domain.