MINERALS AND GEOLOGY

Abstract: Locatable mineral development directly affects only 20 acres of the Forest at this time, and such activities are not expected to increase greatly over the life of the *Forest Plan*. Wilderness or other management area recommendations in the *Plan* could withdraw an additional 11,963 to 22,643 acres in Alternatives A, C, E, and I, and 16,095 acres in Alternative B. Alternative H recommends that an additional 504,475 acres be withdrawn to maintain and improve biodiversity, and to increase wilderness allocations. Existing withdrawals from mineral entry total approximately 496,006 acres (38.5 percent of the Forest); such areas are not available for locatable or salable mineral development.

For oil and gas leasing and development, the *Plan's* analysis area includes the entire Pawnee National Grassland (192,542) acres, BLM-managed federal minerals under private lands within the Grassland administrative boundary (21,522 acres), high potential areas on the Sulphur District (99,279 acres), and a previously leased parcel on the Redfeather District (3,760 acres). *Reasonably foreseeable development* scenarios predict 15 dry holes and 10 producing wells on the Grassland, three dry holes and two producers on the BLM-managed federal mineral estates, and three dry holes and seven producers on the mountain districts. After interim rehabilitation, total additional surface disturbance from well sites and associated roads is estimated at 73.5 acres on the Grassland, 14.7 acres on the BLM-managed lands, and up to 137 acres on the mountain districts for Alternatives A, B, C, E, and I. Alternative H would not lease the analysis areas on the mountain district, and would reduce surface disturbance on the Grassland to 53.3 acres. For all alternatives except Alternative H, the total area disturbed over time is 158 to 128 acres (present time to approximately the year 2006) of the Grassland and 110 acres annually of the mountain districts (present time to approximately the year 2006). Alternative H could disturb 158 to 116 acres.

At this time, no special use permits for salable minerals exist on the Forests or Grassland. Up to five additional acres on the Forest and five acres on the Grassland could be disturbed if permits were authorized for gravel, sand, or other common variety minerals.

Paleontological resources (fossils) are a recognized geologic resource that has been inventoried on the Pawnee National Grassland. Management will minimize the effects of development on this resource either by avoidance, or evaluation and removal.

INTRODUCTION

The Forest Service administers its minerals program to:

1. Encourage and facilitate the orderly exploration, development, and production of mineral resources within National Forest System lands,

2. Ensure that exploration, development, and production of mineral resources are conducted in an environmentally sound manner and that these activities are integrated with the planning and management of other National Forest resources (*Forest Service Manual 2802*).

The National Forests and Grassland system, by coincidence of geology and geography, is a principal storehouse of mineral and energy resources. The search for and production of these resources are statutorily authorized uses of these lands, except for lands formally withdrawn by Act of Congress or by Executive authority. Activities on the Forests and Grassland are directed by law, regulation, and other policies established by Congress, the President, the Secretaries of Agriculture and Interior, the Forest Service, the Bureau of Land Management (BLM), the State of Colorado Oil and Gas Conservation Commission (COGCC) and the state's Department of Minerals and Geology.

Two factors distinguish minerals from other forest and range resources. Unlike other resources, most minerals are nonrenewable and finite. They are also far more difficult to inventory, explore and develop.[1]

Mineral development is a controversial activity in some areas of the Forests and Grassland. Oil and gas leasing and development is a major *revision topic*, and effects of leasing are related to other *revision topics* and items. Salable mineral development is at the discretion of the Forest Service, and no issues have been raised by the public. Since locatable hardrock minerals (gold, silver, copper, etc.) are administered by the General Mining Act of 1872 and its amendments, the Forest Service cannot prohibit this activity unless areas are withdrawn from mineral entry.

The only geological topic discussed specifically in this *Forest Plan* is paleontological resources. From 1994 to 1997 these resources were inventoried on the Grassland, based on analysis of where specific geologic formations are exposed on the surface. The surveys concentrated on areas with vertebrate fossils, because collecting or disturbing fossils is prohibited on federal lands without a permit. An ongoing *memorandum of understanding* and *challenge-cost share agreement* was completed in 1996 with the Denver Museum of Natural History for cooperative paleontological resource management.

Proposed management projects will avoid known areas of vertebrate fossils or the site will be evaluated and specimens collected before disturbance occurs. Because these sites total a small acreage, the effects of proposed projects will be examined in project-specific environmental analyses rather than in this *FEIS*.

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[1] *An Analysis of the Minerals Situation in the United States: 1989 - 2040*, USDA Forest Service, 1989. General Technical Report RM-179.

LEGAL FRAMEWORK

Mineral resources are separated into three categories: locatable, leasable, and salable.

Locatable Minerals

Locatable minerals are those valuable deposits subject to exploration and development under the *General Mining Law of 1872* and its amendments. Commonly, these minerals are referred to as "hardrock" minerals, and include gold, silver, molybdenum, iron, copper, and lead. The Forest Service and the BLM cooperate in managing this resource.

The General Mining Laws apply to public domain lands that have never left federal management, and include the Forest and approximately 5,920 acres of the Grassland. Hence, lands open to operations under the Mining Laws include all areas of the Forests except those formally withdrawn from mineral entry either by Congress or the Secretary of the Interior. The withdrawn areas on the Forest as of April 1995, totaled 496,006 acres. Wilderness areas, recreation sites, the Fraser Experimental Forest, ski areas and power withdrawals (dams and reservoirs) contribute to the majority of these withdrawals. Lands remaining open to mineral entry total 793,044 acres.

After claims are recorded by the BLM, the Forest Service requires and reviews proposed Plans of Operations to ensure activities will meet environmental protection standards and provide for reclamation when the operation ceases.

Leasable Minerals

Federally owned leasable minerals may include fossil fuels (coal, oil, gas, oil shale, etc.), geothermal resources, phosphates, sulfur, and on acquired lands on the Grassland, uranium. These minerals are subject to exploration and development under leases, permits, or licenses granted by the Secretary of Interior, with Forest Service consent. The *Mineral Leasing Act of 1920* and its amendments, and the *Federal Onshore Oil and Gas Leasing Reform Act of 1989*, provide the authority and direction for management of federal leasable minerals on the Forests. These laws and the *Mineral Leasing Act for Acquired Lands of 1947* are the authorities for the Grassland.

Locatable minerals on acquired lands are subject to leasing, as provided by the *Mineral Resources on Weeks Law Lands Act of 1917*, the Presidents Reorganization Plan Number 3 of 1946, and the *Bankhead-Jones Farm Tenant Act of 1937.*

On a federal mineral lease, the lessee has a vested right to develop the mineral resource after the lease and associated stipulations have been issued. For oil and gas development on federal leases on the Forest and Grassland, the Forest Service reviews, approves, and administers the Surface Use Plan of Operations, and the BLM manages the drilling program and approves the Application for Permit to Drill (APD). The BLM leases federal minerals under private surface (split estate lands) within the Grassland administrative boundary. The BLM has the authority to

require the same mitigations on private surface as on federal surface to protect the private landowner.

For private minerals under National Forest System lands, the Colorado Oil and Gas Conservation Commission is responsible for administering the drilling program. If the exploration is successful, the resulting development may become dominant over other resource management in that area.

Salable Minerals

Salable mineral materials, or common varieties, are generally deposits of sand, clay, gravel, and stone that are used for road surfacing and building materials. Disposal of these materials is by special-use authorization, and is at the discretion of the Forest Service. Authorities for management are the *Functions Transfer Act of June 11, 1960*, for acquired lands, and the *Mineral Materials Act of July 31, 1947*, for public domain lands.

Paleontological Resources

The *Organic Act of 1897*, the *Preservation of American Antiquities Act of 1906*, and the *Federal Land Policy and Management Act of 1976* provide general authority for paleontological resources management. The Code of Federal Regulations (36 CFR 261.9 (i)) prohibits: "Excavating, damaging, or removing any vertebrate fossil or removing any paleontological resource for commercial purposes without a special use authorization."

AFFECTED ENVIRONMENT

ARAPAHO AND ROOSEVELT NATIONAL FORESTS

Locatable Minerals

The Forests have a long history of locatable mineral development. The northeastern portion of the "Colorado Mineral Belt" underlies the Clear Creek District and much of the Boulder District. Gold, silver, tungsten, molybdenum, and uranium have been recovered for over a century. Unpatented claims have been staked in a few scattered areas of the Forests for rare earths and other minerals. Mining patents (granted private ownership of mining claims) exist primarily on the Boulder and Clear Creek Districts, creating isolated areas of Forest difficult to manage (see the Intermix section).

The following areas have high and medium locatable mineral potential on the Forests:

1. Lands east of the Continental Divide and south of the Middle St. Vrain River (the Colorado Mineral Belt, containing gold, silver, molybdenum, and other precious and base metals).

2. The Willow Creek drainage and the area of the North Fork of the Colorado River northwest of Grand Lake (gold and other valuable minerals).

3. Lands between the Buckhorn and the North Fork of the Big Thompson Canyons (quartz and rare earth minerals).

4. Lands north and south of the Poudre River below the confluence with Joe Wright Creek (gold and other valuable minerals).

5. Lands near Diamond Peak and the Colorado-Wyoming state line (diamonds).

The existing major locatable mineral activities on the Forests include recreational placer mining for gold (Boulder and Clear Creek Ranger Districts), placer and lode claims for gold, and quartz mines. As of April 1995, Plans of Operation or Notices of Intent had been prepared for 29 claims and existing mines, and the total amount of disturbed surface was estimated at about 20 acres.

The State Geologic Survey completed a survey of abandoned mines on the Forests in 1993 for potential mine hazards (e.g., open shafts and collapsed slopes) and for environmental degradation (acid mine drainage). Approximately 1,200 mines were surveyed, primarily on the Clear Creek and Boulder Districts. Extreme to very dangerous mine hazards from open shafts and tunnels were found at 128 sites. By July 1997, the extreme hazards had been mitigated, and two to four high-hazard sites are being mitigated each year as funding resources allow. Environmental degradation from acid mine drainage is discussed in the Hazardous Materials section of this chapter.

Future Trends

Annually, the Forests have processed approximately 10 to15 additional Notices of Intent and Operating Plans for locatable mineral operations. This number is expected to remain constant or to increase slightly in the future.

Continued interest in commercial and recreational exploration is expected, especially if the prices of gold, silver, and other precious metals increases. Projecting longterm demand for any specific mineral is difficult because domestic demand is influenced by many factors, some of which

relate not only to the United States, but also to the world economy and geopolitical trends. Demand for individual metal-bearing minerals is volatile, but is expected to increase at a modest rate. [2]

Leasable Minerals

The last exploratory oil and gas well drilled on the Forests was in 1982 on the Sulphur Ranger District. There are no producing wells or federal leases active on the Forests at this time.

Future Trends

Although no recent development has occurred on the Forests, the industry has expressed an interest in leasing areas of the Sulphur Ranger District.

Salable Minerals

Currently, no permits for salable minerals occur on the Forests.

Future Trends

Demand for gravel and other materials is expected to increase as Colorado's population increases and people move into the mountains. Applications for development on the Forests may be submitted by the industry in the future.

PAWNEE NATIONAL GRASSLAND

Locatable Minerals

Hardrock minerals on acquired lands (lands that went from federal to private, and back to federal ownership) are managed as leasable minerals under the President's Reorganization Plan No. 3 of 1946. Because 186,622 acres of the Grassland are acquired lands and 5,920 acres are public domain (lands that have never left federal management), uranium is considered a leasable mineral and is discussed in a separate section. No other locatable minerals have been found on the Grassland, and their discovery and development are unlikely. The authority for management of locatable minerals on public domain Grassland is the General Mining Law.

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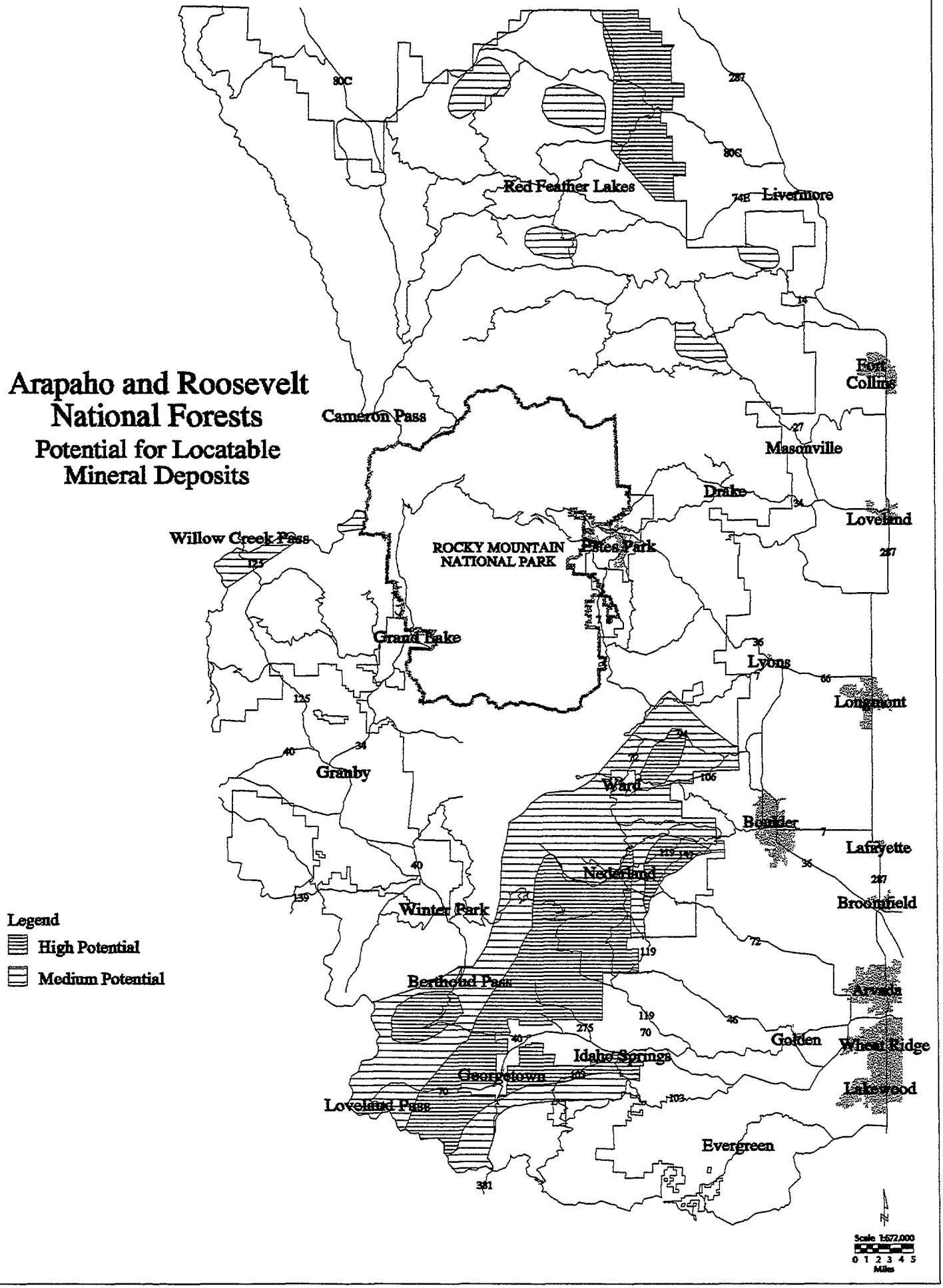
[2] *An Analysis of the Minerals Situation in the United States: 1989 - 2040*, USDA Forest Service, 1989. General Technical Report RM-179.

Figure 3.4


Arapaho and Roosevelt National Forests
Potential for Locatable Mineral Deposits
Legend
High Potential
Medium Potential
Red Feather Lakes
Livermore
Cameron Pass
Fort Collins
Masonville
Drake
Loveland
Willow Creek Pass
ROCKY MOUNTAIN NATIONAL PARK
Estes Park
Grand Lake
Lyons
Longmont
Granby
Ward
Boulder
Lafayette
Nederland
Winter Park
Broomfield
Berthoud Pass
Arvada
Golden
Wheat Ridge
Idaho Springs
Georgetown
Lakewood
Loveland Pass
Evergreen
Scale 1:672,000
0 1 2 3 4 5
Miles

Leasable Minerals

As of May 1997, 44,786 acres of the federal mineral estate on the Grassland were leased in 94 leases. Approximately 58,113 acres, or 30 percent of the Grassland, have mineral estates that are privately owned and not subject to federal leasing laws. Generally, development of the private mineral estate is dominant to Forest Service surface management, and cannot be denied by the agency. This *Forest Plan* cannot make decisions regarding private development, but mitigation measures similar to those for adjacent federal leases will be negotiated with each operator.

As of May 1997, 46 producing wells existed on the federal and private mineral estates on the Grassland, and an additional 15 plugged and abandoned wellsites or dry holes were being reclaimed. The total surface disturbance from the wellsites, associated roads, production facilities, and utilities was about 158 acres, or .08 percent of the Grassland.

Approximately 21,522 acres of federal minerals under private surface occur within the administrative boundary of the Grassland. These minerals are managed by the BLM, with input from the Forest Service when the Grassland resources could be affected by development on those lands. Although the surface is not under federal management, since the leasing is a federal action, the effects of those activities must be analyzed. Thirty producing wells occur on these private lands and disturb fewer than 75 acres of privately-owned surface.

Interest in leasing for uranium occurred on the Grassland in the late 1970s and early 1980s. An *in situ* recovery process was proposed, by which a solution would be pumped through injection wells into the geologic formation containing the uranium. The solution would pick up the uranium and be pumped back to the surface through recovery wells for processing. The leases were denied by the Forest Service because of concern for rehabilitation of the aquifers in the formation containing the uranium. However, uranium leases on state parcels adjacent to the Grassland have been granted, indicating continuing interest.

Future Trends

Since 1983, energy use has increased at a modest rate in the United States. This trend is expected to continue for the life of the *Plan* and beyond. Although the United States is a mineral-rich nation, it imports significant quantities of some minerals, including over 50 percent of its oil. The world price of oil is expected to increase during the 1990s and into the 21st century, and this should stimulate exploration and development of domestic resources. [3]

Interest in oil and gas leasing on the Grassland began to increase after completion of the Mountain Plover Management Strategy EIS and ROD in 1994. Leasing was delayed until the EIS was completed.

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[3] *An Analysis of the Minerals Situation in the United States: 1989 - 2040*, USDA Forest Service, 1989. General Technical Report RM-179.

If the economics improve for uranium, there may be renewed interest in leasing areas of the Grassland for the recovery using the *in situ* process. If leasing is proposed, the appropriate environmental analysis and NEPA documentation will be completed.

Salable Minerals

Although gravel is desirable for uses such as road surfacing, deposits on the Grassland are generally of low quality. No permits have been issued for the past ten years, but proposals may be received over the life of this *Forest Plan.*

ENVIRONMENTAL CONSEQUENCES

The effects of locatable, leasable, and salable mineral activities based on the implementation of the alternatives is discussed below, and in other sections of this chapter. The effects of other management on mineral activities are treated in this section as well. The effects of mineral activities on other resources, such as biodiversity and aquatic and riparian resources, are discussed in the sections for those resources.

Since the issuance of salable mineral permits is discretionary, the alternatives do not specifically address the effects of this management activity. However, permits will not be issued where the emphasis of the management area cannot be maintained.

LOCATABLE MINERALS

Effects on Locatable Mineral Development from Management Area Allocations

Management area allocations and the resulting possible withdrawal from mineral entry are the primary decisions in the *Forest Plan* that will affect locatable mineral development. The alternatives present different possible managements for the locatable and leasable categories of minerals. Because the General Mining Law applies, no difference in locatable activities will occur among the alternatives considered, unless additional wilderness, wild rivers, or other designated areas are created by Congress and result in withdrawals from mineral entry. Research Natural Areas (RNAs) and Special Interest Areas (SIAs) may also be withdrawn if the development potential is high or moderate, and/or such activity is inconsistent with the purposes of those RNAs and SIAs.

The withdrawn acreages by alternative are shown in the following table.

Table 3.27 Acres Potentially Withdrawn from Mineral Entry by Alternative, ARNF[a]

Management Area	Alternatives					
	A	B	C	E	H	I
Currently Withdrawn	496,006	496,006	496,006	496,006	496,006	496,006
Recommended for Wilderness MA 1.2	0	8,810	0	0	259,363	0
Core Habitats, Existing, MA 1.41	0	0	0	0	152,762	0
Core Habitats, Restoration, MA 1.42	0	0	0	0	31,338	0
Wild Rivers, Recommended, MA 1.5	0	3,121	0	11,875	3,272	0
Research Natural Areas, MA 2.2 (outside wilderness)	154	11,285	154	154	0	0
Special Interest Areas, MA 3.1	46,463	74,829	46,942	47,451	0	6,285
Corridors Connecting Core Areas, MA 3.55	0	0	0	0	57,741	0
Potential Ski-Based Resorts, MA 8.22	12,104	4,424	11,963	10,769	0	12,562
TOTAL	554,573	512,360	554,911	566,101	1,000,331	514,853
Percent of Forest	39	42	39	40	77	39

[a] Acreages withdrawn for MAs 2.2 and 3.1 will be determined for each area, and withdrawal may not be needed to protect the area. The acreage shown is the maximum, and the actual withdrawals will be much less.

Alternatives A, C, E, and I range from 11,963 to 22,643 acres of additional withdrawn acreage, based on additional recommendations for development of ski areas or wild river designation. Alternative B would add 16,095 acres, primarily from wilderness recommendations and Research Natural Areas. Alternative H has the highest additional potentially withdrawn areas, 504,475 acres.

Existing locatable mineral activities on the Forest affect approximately 20 acres. As of April 1997, Plans of Operations or Notices of Intent had been prepared for about 29 claims and existing mines. Activities may increase slightly over the life of the *Plan*, particularly related to diamond mining, existing gold and silver mines on lands adjacent to the Forest, and recreational placer mining. This *Plan* assumes development of an additional 20 acres. These activities will probably occur in the high or moderate potential areas of the Forest.

Although the Grassland has 5,920 acres of public domain that could be withdrawn from mineral entry, the potential for locatable minerals occurring is extremely low. As discussed earlier, locatable minerals on acquired lands are subject to the leasing laws, not the General Mining Law.

LEASABLE MINERALS

The alternatives present a wide range of possible management options for federal oil and gas leasing, from leasing with minimal mitigation requirements (standard lease terms, explained in *FEIS* Appendix F) in Alternatives C and I, leasing with supplemental stipulations to further protect surface resources (see Appendix F) in Alternatives A, B, and E, and minimal leasing or severe restrictions on development in Alternative H, including prohibiting surface occupancy on the lease. Alternatives B, E, and H would also result in withdrawals from leasing if recommended wild rivers and wilderness areas are designated by Congress. Other areas are generally not withdrawn from leasing since leasing is discretionary by the Forest Service, or because surface occupancy can be prohibited if necessary to protect other resource values.

Effects, Definitions, Assumptions, and Concepts Common to All Alternatives

The definitions and concepts below are useful for an understanding of the effects analysis process. Additional information on the leasing process and decisions to be made are discussed in Appendix F.

Analysis Area: The analysis area for oil and gas leasing was determined using criteria provided in *FSM WO Interim Direction 2820-93-1.* These areas contain lands with moderate or high potential for the occurrence of oil and gas, lands with leasing interest by the industry, or lands with past or existing production. The analysis examines the following lands:

1. The entire Pawnee National Grassland - 192,542 acres, and 21,522 acres of federal minerals under private surface managed by the BLM within the Grassland administrative boundary (high potential).

2. The western Sulphur District - 99,279 acres (high potential).

3. A parcel in the northwestern Redfeather District - 3,760 acres (a lease that expired in October, 1994, low potential).

The analysis areas in the Sulfur and Redfeather districts total 103,039 acres.

Withdrawals of lands from operations under the mineral leasing laws are rarely done because leasing is a discretionary action by the Forest Service. None of the analysis areas has been withdrawn from mineral leasing.

The analysis area on the mountain districts represents 11 percent of the Forests not currently withdrawn from leasing. The remaining 862,706 acres (89 percent) of the Forest have little or no known potential for oil and gas deposits nor any reasonably foreseeable development; proposals for leasing are not expected. If leases are nevertheless requested by the industry, leasing for these lands will be evaluated with the appropriate environmental analysis. The analysis area is shown in Chapter Two of the *Forest Plan*, oil and gas leasing stipulation map by Ranger District.

Grassland Surface with Private Minerals: 58,113 acres (30.1 percent) of the Grassland have private mineral estates. Private ownership is the result of previous surface owners reserving the mineral rights when the federal government purchased the surface, or third parties owning the minerals when the surface was obtained by the government. Ownership of the minerals is a deeded right. The Forest Service can negotiate mitigation measures with the estate owner or operator, but cannot prohibit surface development activities on these lands.

Grassland Surface with Federal Minerals: 134,429 acres (69.9 percent) of the Grassland has a federal mineral estate and is analyzed for possible leasing.

Private Surface with Federal Minerals: 21,522 acres of private land within the Grassland's administrative boundary have federal minerals. The BLM issues leases after consulting with the Forest Service when surface activities might affect the Grassland. The effects of development on these lands are analyzed in this document.

Geophysical Prospecting: Before submitting lease proposals, the industry may complete exploration to determine if geologic structures that may contain oil and gas deposits are present. Various scientific methods, including geophysical prospecting, may be used. Pads mounted on large trucks vibrate on the surface, sending out energy waves that reflect from geologic strata and structures. The reflections are recorded on the surface by small sensitive geophones, and the data are translated into information by computer analysis. This technique, called "vibroseis," is the geophysical exploration method generally used on the Grassland.

In the mountains, small charges detonated in shallow drill holes may provide the energy wave source for seismic data in areas inaccessible to large vehicles. Helicopters may be used to transport equipment and personnel, resulting in less impact on natural resources.

Geophysical prospecting permits will be issued on a case-by-case basis, generally subject to the same stipulations that apply to oil and gas development in the area. Exceptions may be granted in no surface occupancy (NSO) areas to determine the subsurface geologic structure for possible directional or horizontal drilling, if compatible with the management emphasis of the area. The effects of prospecting operations are considered to be minimal and temporary.

Phases of Development: The Leasing, Exploration, Drilling, Production, Field Development, and Reclamation phases are discussed in Appendix F. After the Forest Service completes a leasing analysis and determines which areas to authorize the BLM to offer for leasing, the industry may or may not lease the parcels. Although geophysical exploration to determine the potential for oil and gas bearing geologic formations may occur before or after leasing, drilling cannot occur until after the lease for the parcel has been issued. Initial wildcat drilling (drilling in an area not known to have oil and gas deposits) may result in dry holes, or may find oil and gas deposits. Additional confirmation wells may be drilled to determine the extent of the discoveries. If the discovery is economically feasible to develop, production facilities will be constructed. Field development, including additional drilling and road construction, may occur if warranted. Interim reclamation and revegetation of areas not needed for development at the wellsite can proceed concurrently with the construction of production facilities and field development. Final reclamation will be completed when the field is depleted.

Lease: A lease is an agreement between the federal government and the lessee that gives the lessee a vested right to explore, drill for, and produce oil and gas resources on a particular tract of land. The vested rights of the lessee do not override existing laws and regulations. Mitigation measures to minimize effects on surface resources are specified in the lease, 43 CFR 3101.1-2, standard lease terms, and Conditions of Approval when actual development is proposed. Federal leases on the National Forest and Grassland System lands are issued by the BLM with Forest Service authorization. Issuance of a lease does not have direct effects on surface resources. Alternatives may lease the same areas, but indirect impacts can vary greatly, depending on the supplemental stipulations on the lease, and on mitigation requirements added when development is proposed. Fewer than one out of seven to ten leases result in drilling and approximately one out of four to ten wells are successful.

Leasing Analysis: Direction for the leasing analysis is provided in 36 CFR 228.102. After areas withdrawn from leasing are removed from the analysis area (for example, through designated wilderness), the remaining areas are analyzed for their availability for leasing with needed mitigation measures. Standard lease terms (discussed below) may be sufficient, or supplementary stipulations may be needed (also discussed below). The effects of possible development are determined using *reasonably foreseeable development* scenarios and analysis assumptions to analyze amounts and locations of probable disturbed areas. The leasing analysis is used to make decisions regarding "Lands Administratively Available for Leasing" and the "Leasing Decision for Specific Lands" (discussed in Appendix F). Some areas may not be leased, if the Forest Service determines that oil and gas development is not consistent with the management emphasis of the area.

Standard Lease Terms (SLT): All federal leases contain SLT requirements that are generally sufficient to mitigate impacts of development. Specific lease terms are discussed on BLM Form 3100-11, Offer to Lease and Lease for Oil and Gas, and FS Form 2820-13, Notice for Lands of the National Forest System Under Jurisdiction of Department of Agriculture (see Appendix F). Under SLTs, development may be delayed for up to 60 days or the activities moved 200 meters

to minimize resource impacts without infringing on the lessee's lease rights (43 CFR 3101.1-2). For example, most riparian areas can be protected by moving proposed operations 200 meters.

The authorized officer will impose the fullest mitigation requirements necessary under the standard lease terms to provide adequate protection of the environment. While the lease insures certain rights to the lessee, it does not guarantee that actions will be allowed which will result in undue and unnecessary impacts to the land. It also does not preclude the authorized officer from negotiating additional protection not stipulated in the lease, if the lessee or operator will voluntarily consent to further restrictions. Heritage resources and threatened or endangered species are always protected by existing laws.

Supplemental Stipulations: Stipulations are provisions that modify standard lease rights and are made a part of the lease prior to its issue. If SLTs are not sufficient to protect surface resources, the following supplementary stipulations may be added:

A. *No Surface Occupancy (NSO)* - Occupancy of the surface on part or all of the lease is prohibited for development. Directional or horizontal drilling must be used to reach the mineral resource. This stipulation is the most restrictive and could be used to protect primitive recreation opportunities or areas with high erosion hazard soils. If the area to be protected is less than 40 acres or 400 meters across, NSO may not be needed, since the 200 meter relocation mitigation in SLTs may be sufficient.

B. *Controlled Surface Use (CSU)* - Development is authorized on the lease, but activities must be controlled due to resource concerns. An example of this would be applying additional requirements to protect visual resources or to mitigate effects on 40 to 60 percent slopes.

C. *Timing Limitation (TL)* - Development is not permitted during a specified period of less than one year long. Examples could be prohibiting development during elk calving season or when animals use winter range. This stipulation is not needed for less than 60-day delays, as SLTs are sufficient. TLs apply to drilling activities, but not to production operations.

D. *Lease Notice* - These provide more detailed information concerning limitations that already exist in law, regulation, or lease terms. Special items the lessee should consider in planning operations may also be discussed. Examples include the need for black-footed ferret surveys if prairie dog towns on the lease are impacted, or coordination requirements with the U.S. Air Force to avoid missile site communication cables on the Grassland.

Supplemental stipulations will also include conditions for waivers (lease requirement is removed permanently), exceptions (lease requirement is removed on a case-by-case basis), and modifications (lease requirement is changed permanently). An example of a waiver would be if a

tree used by raptors for nesting on a Grassland lease falls over and the NSO stipulation is no longer required. An exception could be granted if warm weather allows deer and elk to move to higher-elevation winter range earlier than usual and the timing limitation is not needed at lower elevations. Changes in stipulations such as these will not normally require NEPA documentation. However, modifications of a timing limitation such as those to increase the protection period for mountain plover nesting, or permanent removal of a significant NSO requirement, will generally require appropriate NEPA documentation and amendment of the *Forest Plan*. Changes can be proposed by the industry only when the Application for Permit to Drill is submitted. The procedure for the proposed changes is discussed in 36 CFR 228.104.

Reasonably Foreseeable Development (RFD): The Reasonably Foreseeable Development scenarios for the Forests and Grassland for the next 10 years were developed by the Forest Service R2 Regional Office and the State BLM office in April, 1995. They are based on the past history of drilling in these areas, current activity, geology, and present and projected economic and technological considerations. The detailed RFD is available on request.

The western areas of the Sulphur Ranger District lie within the geologic Colorado Parks Basin Province where the possibility of geologic structural traps for oil and gas deposits creates high potential for oil and gas discovery. One field is projected with predictions for three dry holes and five producing wells.

The Redfeather Ranger District lies within the Southwestern Wyoming Basins Province, where possible geologic traps created by overthrusting of formations have led to past industry interest. The area has low potential, but was recently leased. For the purposes of this analysis, one exploratory well and a confirmation well are analyzed.

The entire Grassland is located in the Denver Basin and is considered to have high potential for future development. Production is expected from Cretaceous sandstones, notably the Denver-Julesburg formation, with some activity in the Niobrara and Codell formations. Fifteen dry holes and ten producing wells are predicted on the Grassland surface. One dry hole and two producers are predicted on the federal minerals that are managed by the BLM under private surface within the Grassland administrative boundary. Activity will also occur on the adjacent private lands, and is included in the RFD detailed discussion.

Analysis Assumptions: While the RFD predicts the number of wells expected, analysis assumptions predict the numbers of acres disturbed per well, and other factors used to analyze potential environmental effects. These assumptions include:

Table 3.28 Analyzing Assumptions Predicting Acres Disturbed per Well

Sulphur and Redfeather Ranger Districts	Acres Disturbed
Wellsite and Production Facility (360 feet x 375 feet)	3.1 acres
Associated Roads: One mile of new road contruction at 4.2 acres/mile, assumes average side slope of 35%, road width of 14 feet and clearing width of 30 feet, and five 150 foot turnouts per mile. Two miles of road reconstruction at 3.2 acres/mile, assumes 35% side slope, road construction width of 12 feet From existing width of eight feet, five turnouts/mile.	4.2 acres 6.4 acres
Pipelines and utility lines are assumed to be in the roads.	0 acres
Total Area Disturbed Per Well	13.7 acres
Drilling will require 15 days.	
Well completion will require an additional 4 days.	
Roads constructed for development may be closed to public use.	
Revegetation of dry holes and unused disturbed areas of production facilities is expected in three years. The revegetation area of a producer will be 1.5 acres, plus 1.6 acres for a production facility. Because the revegetated area may be part of the cut and fill for the site, the entire area is considered to be disturbed for the life of the well for this analysis.	
(These assumptions are adopted from the Routt National Forest Oil and Gas Leasing EIS, June, 1993.)	
A pumper (well mechanic) will visit each well once daily, using a pickup when roads are passable, or a snowmobile in the winter when they are not. Visits will generally be for a few minutes, but could be for longer periods for well maintenance.	
Tanker trucks will visit each well 1-2 times per week to pick up oil, and require 45-60 minutes for loading.	
Geophysical prospecting by the shothole method has minimal and temporary impacts.	
Pawnee National Grassland	
Drill Site: Access will generally be on existing two-track routes and will use a designated and delineated route, (approximately 0.5 miles x 20 feet wide) Wellsite (330 feet x 330 feet)	 1.2 acres 2.5 acres
Total area disturbed per well:	3.7 acres

Producing Well: Associated Roads: Approximately .05 miles of new road construction per well, 12 foot contructed width. If the production facility is located on a contructed road, a two track route to the wellhead may be sufficient. Surface disturbed after areas no longer needed for production have been reclaimed. Pipelines and utility lines are assumed to be in the road.	.8 acres 1.0 acres 0 acres
Total area disturbed per well:	1.8 acres
Drilling will require 7-10 days.	
Well completion will require an additional 7-14 days.	
Roads constructed for development may be closed to public use, or may be added to the public road development system.	
Revegetation of dry holes and unused areas of production facilities is expected in 3-5 years, depending primarily on precipitation.	
A pumper (well mechanic) will visit each well once daily, using a pickup. Visits will generally be for a few minutes, but could be for longer periods for well maintenance.	
Tanker trucks will visit each well once every 1-2 weeks to pick up oil, and require 45-60 minutes for loading.	
Spacing may be one well to 40 acres, or for gas wells, one to 160 acres.	
Geophysical prospecting by the vibroseis method has negligible impacts.	
One of the existing producing wells on the Grassland will be plugged and abandoned each year.	

Application for Permit to Drill (APD): After the lease is issued, the operator submits an APD with the Surface Use Plan of Operations (SUPO) and drilling programs for a proposed well on the lease. The Forest Service reviews the SUPO. The BLM reviews the drilling program for federal minerals and the Colorado Oil and Gas Conservation Commission (COGCC) reviews it for private minerals. A specific APD may be denied, or Conditions of Approval (COAs) may be required as additional mitigation measures identified by the review. The APD is a contract for development if approved. On BLM managed minerals under private surface, the BLM completes the appropriate NEPA documentation, reviews and approves the drilling program and the Surface Use Plan of Operations, after consultation with the Forest Service. The appropriate bonds will be required of the operator to insure reclamation activities occur.

Monitoring and Mitigation Measures: All proposed actions will follow applicable policy and direction. This includes *Forest Plan* management area direction, standards and guidelines, standard lease terms, supplementary stipulations, if added to the lease, and conditions of approval. Forest Service, BLM, and State regulation and Onshore Orders, Notices to Lessees, and additional regulations and policies provide other requirements for oil and gas activities. All approved operations will include reasonable mitigation to avoid or mitigate environmental impacts to the fullest extent of laws and regulations.

After the lease is issued, the Forest Service can require additional mitigation measures to be added through the APD process when a proposal for development is submitted by the lessee or operator. Monitoring begins when the industry contacts the Forest Service to propose development. Forest Service, BLM (for federal minerals), COGCC (for private minerals), and the operator meet at the proposed location to discuss the development. Dirt excavation contractors, archaeologists, or geologists may also attend. Access roads, well location, dirt work, production facilities, and mitigation measures are discussed and agreed to. These requirements are then used by the industry to formulate the APD. When it is submitted, the SUPO should contain only topics discussed earlier. When the SUPO is reviewed, additional mitigation measures and COAs may be added by the Forest Service. An example of a COA could be colocation of production facilities of different wells in one location to minimize impact. However, COAs cannot infringe on the lease rights for development. Requirements such as delineating the access route, avoiding sensitive areas, and stockpiling topsoil on the site for rehabilitation are examples of standard mitigations.

The Forest Service completes the appropriate NEPA documentation on the proposed SUPO. An individual SUPO may not be approved, but since the lease is a vested right to develop the mineral resource, prohibiting that development in lease areas where occupancy is authorized may be considered a taking by the courts.

The Forest Service closely monitors development by inspecting dirt work, drilling, and construction of production facilities to insure the operator is meeting the terms of the lease and SUPO.

All dry holes, abandoned production wells, and unused areas of producing wellsites are seeded before the next growing season after drilling, construction of production facilities, or well abandonment. The reclamation of unused portions of producing wellsites protects surface resources by reducing disturbed areas. When resource concerns change after a lease has been issued, the Forest Service and BLM determine the best possible protection with the operator. In most cases, operators have been willing to cooperate when the measures are reasonable and economically feasible. However, for issues such as threatened or endangered species, mitigation is required by law, as stated in standard lease terms.

When wells are plugged and abandoned, reclamation is monitored by the Forest Service. The reclamation plan includes bringing the disturbed areas back to contour, spreading topsoil, hydromulching, adding fertilizer and other amendments as needed, and seeding with native species. Revegetation is monitored, but generally takes 3 to 5 years, depending mainly on

precipitation. Revegetation is considered satisfactory when the disturbed area has 80 percent of the desired vegetative cover compared to adjacent undisturbed lands.

Summary of Supplemental Stipulations for Oil and Gas Activities

The following table describes the resource protection mitigation measures addressed by standard lease terms and by supplementary stipulations, when additional mitigation is needed. They are the result of the leasing analysis required in 36 CFR 228.102, and **apply to federal minerals in the analysis area only**. Supplementary stipulations are added to the requirements of the standard lease terms on a case-by-case basis. As stated earlier, on private mineral estates under federal surface, the Forest Service will protect natural resources to the extent posssible with the deeded right to surface development.

Table 3.29 Stipulations and Resources Protected, ARNF and PNG

STIPULATION	RESOURCE PROTECTED
Standard Lease Terms	Air Resources. Cultural resources less than 400 meters across or less than 40 acres. Riparian/wetland areas less than 400 meters across or less than 40 acres. Special uses less than 400 meters across or less than 40 acres. Threatened and Endangered Species.
No Surface Occupancy (NSO)	Existing and historical raptor nest sites on Grassland and Sulphur and Redfeather Districts. Developed recreation sites (Management Area 8.21). Visual corridors on scenic byways and some scenic routes (MA 4.3). Nonmotorized backcountry recreation areas (MA 1.3). Motorized backcountry recreation areas (MA 3.3). Arapaho National Recreation Area (MA 3.1). Scenic corridors (MA 4.2). Fraser Experimental Forest (MA 5.31). Winter Park Ski Area (MA 8.22). Prairie Woodlands (MA 3.61). Slopes over 60%, slopes over 35% with a high mass movement potential.[a] Research natural areas (MA 2.2). Special interest areas (MA 3.1). Existing northern goshawk nests on the Redfeather and Sulphur Districts.
Controlled Surface Use (CSU)	Slopes 35-60%, slopes less than 35% with high mass movement potential, high erosive potential soils.[a] High geologic hazard and erosion potential areas.[a]

STIPULATION	RESOURCE PROTECTED
Timing Limitations (TL)	Mountain plover nesting habitat, 4/10-7/10. Deer and elk winter range, 11/15 - 4/15 and 12/1 to 3/31.[b] Existing and historical raptor nests on the Sulphur and Redfeather Districts, 3/1 to 7/30. Pawnee Grassland Deer, pronghorn, and elk calving 5/1 - 6/30[b], 3/1 - 6/30.
Lease Notices (LN)[c]	Missile cable and site avoidance on the Grassland. After mitigation measures to maintain water quality in stream courses have been implemented, the operator may be required to monitor turbidity above and below the possible disturbed area to determine if additional measures are needed. (Applies to the Mountain Districts.) The operator and Forest Service will cooperate in assessing reasonable alternatives to minimize stream crossings and road construction near streams. Paleontological resources management on the Grassland. Avoidance of sensitive plants.

[a] Large-scale maps identifying the NSO and CSU areas due to soils concerns are available at the Supervisor's Office and at the Sulphur and Redfeather Districts.

[b] Different dates are used for the Timing Limitation (TL) on the Sulphur and Redfeather Districts.

[c] Other Lease Notices may be used as needed.

The alternative stipulation maps illustrate the locations of various supplemental stipulations.

Summary of Projected Surface Disturbance Effects from Oil and Gas Activities

The tables below show the well numbers and disturbed acreages from the RFDs for each alternative. As the locations of the possible wells will be known only when an APD is submitted, the general cover type where they could occur, probable miles of road construction and reconstruction, and analysis assumptions previously discussed were used to analyze effects. Effects from the assumed well and road locations are based on the probable specifications for that facility. The acres of disturbed surface are utilized to project effects on physical and biological factors such as soil, air, water, wildlife and habitat effectiveness, and ecosystems.

On the Grassland, the shortgrass prairie would be the ecosystem affected. Development would generally be on moderately level slopes (less than 5 percent). In the Forests, development would occur in lodgepole pine and Engelmann spruce - subalpine fir forests. Wellsites would generally be on available level areas, with roads traversing slopes up to 35 percent.

The first RFD below considers that all lands analyzed will be available for leasing except the Pawnee Buttes and Crow Valley Recreation Area on the Grassland, and is applicable for Alternatives A, B, C, E, and I. Although some alternatives contain specific areas where surface occupancy is prohibited and directional or horizontal drilling would be required, no change was made in the number of wells analyzed for these alternatives due to the small number of wells expected and small acreage with the NSO stipulation.

Table 3.30 Reasonably Foreseeable Development Scenarios for Alternatives A, B, C, E, and I, ARNF and PNG

Area	Wells Projected		Oil Expected (Production in Barrels)	Natural Gas Expected (Production in 1000s of Cubic Feet)	Field Life
	Dry holes	Production Wells			
Sulphur RD	3	5	1,000,000	No prediction	10 years
Redfeather RD	0	2	No prediction	No prediction	10 years
TOTAL FOREST	3	7	1,000,000	No prediction	10 years
Pawnee NG - FS Surface, by Mineral Estate	Federal - 9	Federal - 6	Federal - 360,294	Federal - 540,441	15-20 years
	Private - 6	Private - 4	Private 238,971	Private -358,456	
Pawnee NG - BLM Minerals	3	2	121,324	181,985	15-20 years

Alternative H would not lease the high potential area on the Sulphur Ranger District or the small parcel on the Redfeather Ranger District. The prohibition of surface occupancy on over half of the federal minerals of the Grassland is assumed to reduce the RFD on federal leases by one half, but surface development of the private mineral estate under 30 percent of the Grassland cannot be prohibited. The resulting RFD is displayed in the following table.

Table 3.31 Reasonably Foreseeable Development Scenario for Alternative H, ARNF and PNG

Area	Wells Projected		Oil Expected (Production in Barrels)	Natural Gas Expected (Production in 1000s of Cubic Feet)	Field Life
	Dry holes	Production Wells			
Sulphur RD	0	0	N/A	N/A	N/A
Redfeather RD	0	0	N/A	N/A	N/A
TOTAL FOREST	0	0	N/A	N/A	N/A

Area	Wells Projected		Oil Expected (Production in Barrels)	Natural Gas Expected (Production in 1000s of Cubic Feet)	Field Life
	Dry holes	Production Wells			
Pawnee NG - FS Surface, By Mineral Estate	Federal - 5	Federal - 3	Federal - 178,433	Federal - 267,650	15-20 years
	Private - 6	Private - 4	Private - 236,400	Private - 354,600	
Pawnee NG - BLM Minerals	3	2	120,467	180,700	15-20 years

Both RFDs assume that one of the existing 45 producing wells on the Grassland will be plugged and abandoned each year. Secondary recovery activity is being used in the Lilli Field (61 wells, 32 on the Grassland) in the next few years, so well abandonment in the field will be minimal. This applies to all alternatives.

The detailed RFDs for the Forests and Grassland are available on request.

Table 3.32 Surface Disturbance by Alternative, ARNF-PNG

Alternative	District					
	Pawnee		Sulphur		Redfeather	
	Dry holes	Producers	Dry holes	Producers	Dry holes	Producers
A, B, C, E, I	55.5 acres	18.0 acres (37.0)	41.1 acres	68.5 acres	0 acres	27.4 acres
H	40.7 acres	12.6 acres (25.9)	0 acres	0 acres	0 acres	0 acres

On the Grassland, the number of acres in parentheses is the acres disturbed after drilling. The number of acres disturbed after the interim revegetation for a producing well is indicated without parentheses. Approximately half of each wellsite used for drilling is not needed for production and would be reclaimed. When the wells are plugged and abandoned, only the remaining acres will need reclamation. Wellsites in the mountains would have interim revegetation, but entire sites could require reclamation when the well is plugged, abandoned, and the site is restored to the original contour. The tables below identify the disturbance caused by specific activities.

Table 3.33 Surface Disturbance by Activity Type by Alternative for the Sulphur and Redfeather Ranger Districts, ARNF

Activity	Alternative	
	A, B, C, E, I	**H**
Wellsites/Production Facility (acres)	21.7	0
Roads/Production (acres)	74.2	0
Wellsites/Dry holes (acres)	9.3	0
Roads/Dry holes (acres)	31.8	0
TOTAL ACRES	**137**	**0**
Reconstructed Road Miles/Production	14	0
Constructed Road Miles/Production	7	0
Reconstructed Road Miles/Dry holes	6	0
Constructed Road Miles/Dry holes	3	0
TOTAL MILES	**30**	**0**

Roads associated with producing fields will likely be less than the 21 miles shown above since well locations will be concentrated.

Table 3.34 Surface Disturbance by Activity Type by Alternative, PNG

Activity	Alternative	
	A, B, C, E, I	**H**
Wellsites/Production Facility (acres)	10	7
Roads/Production (acres)	8.0	5.6
Wellsites/Dry holes (acres)	37.5	27.5
Roads/Dry holes (acres)	18.0	13.2
TOTAL ACRES [a]	**73.5**	**53.3**
Constructed Road Miles/Production	5.0	3.5
Constructed Road Miles/Dry holes	0	0

[a] Some production facilities for individual wells will be colocated, so surface disturbance may be less.

For the federal mineral estate under private land administered by the BLM on the Grassland, 11.7 acres are predicted to be disturbed by three dry holes, 7.4 acres would be initially disturbed by

two producing wells, and 3.6 acres would remain disturbed after revegetation of areas not needed for production.

Note that the predicted disturbance may occur throughout the 10 years of the RFD, and would not necessarily occur all at the same time. Also, dry holes are considered to be a temporary disturbance because reclamation is expected in three years. The total additional disturbance at one time would likely be much less than the acreage in the table.

Effects of No Federal Leasing on the Grassland and Mountain Districts

The revised *Forest Plan* does not analyze in detail the option of not leasing of the federal mineral estate by the Forest Service. Alternative H has the most extensive restrictions on development, including no leasing in the mountain Districts. However, if no leasing on the Grassland were analyzed, some development would still be likely to occur on the Grassland's private mineral estate (58,113 acres) where it cannot be prohibited by the Forest Service. Based on the percentage of the private estate to the entire Grassland and the RFD, six dry holes and four producing wells would be predicted on the Grassland surface if no federal leasing occurred. If federal oil and gas were being lost to private-estate wells, federal leases would perhaps be issued to prevent the drainage.

Effects on Oil and Gas Development from Ecosystem, Recreation, Scenery, and Other Managements

Direct effects on development vary among the alternatives, and can be categorized according to the relative restriction by mitigation measures and the potential for exploration and development. Timing limitations and controlled surface use stipulations minimize impacts on wildlife and wildlife habitat, and other resources such as soil and water. Some stipulations prohibit occupancy on steep slopes or soils with the potential for mass movement. The industry would normally avoid these areas in their site and access locations. Moving locations 200 meters or delaying drilling 60 days under the standard lease terms may slightly increase costs, but generally has minimal effects on development.

Although timing and controlled surface use limitations may create some additional costs, the prohibition of surface occupancy can greatly increase drilling and production expenses. Compared to normal vertical drilling, horizontal or directional drilling can multiply costs several times. These high costs are not conducive to wildcat or exploration drilling. On the Grassland, with mixed ownership of federal and private surfaces and mineral estates, no surface occupancy stipulations for federal surface and minerals may make development of both federal and private minerals economically unfeasible.

The following tables compare the acres with specific stipulations by alternative.

Table 3.35 Acres Available for Leasing and Stipulations for the Sulphur and Redfeather Ranger Districts, ARNF

	Alternatives					
	A	B	C	E	H	I
Standard Lease Terms	0	0	3,891	0	0	4,003
Controlled Surface Use- Soil Hazard	43,162	34,450	66,582	60,641	0	77,988
Controlled Surface Use Timing-Wildlife	24,648	12,879	5,426	4,018	0	0
Controlled Surface Use-(Slope)/CSU Soils/Timing	4,109	2,364	946	360	0	0
Controlled Surface Use-(Soils)/CSU Slope	7,494	4,318	12,341	11,057	0	15,014
TOTAL LANDS WITH OCCUPANCY	79,413	55,011	89,186	76,076	0	97,005
No Surface Occupancy-Management Area	22,081	47,144	12,035	25,244	0	3,903
No Surface Occupancy-Slope >60%	1,545	885	1,818	1,719	0	2,131
TOTAL LANDS WITH NO SURFACE OCCUPANCY	23,626	48,029	13,853	26,963	0	6,034
TOTAL LANDS NOT LEASED	0	0	0	0	103,039	0
TOTAL LANDS ANALYZED	103,039	103,039	103,039	103,039	103,039	103,039

Table 3.36 PNG Acres with Required Stipulations for Federal Leases and Desired Mitigations for Private Mineral Estates

	Alternatives					
	A	B	C	E	H	I
Standard Lease Terms	0	0	0	0	0	0
Timing (mountain plover)	186,341	174,892	185,214	168,921	67,439	185,570
Controlled Surface Use-(Slope)/Timing	620	408	608	398	137	618
TOTAL LANDS WITH OCCUPANCY	186,961	175,300	185,822	169,319	67,576	186,188

No Surface Occupancy-Management Area	5,156	14,221	3,540	20,196	108,218	6,132
No Surface Occupancy-Slope >60%	184	47	200	47	20	222
TOTAL LANDS WITH NO SURFACE OCCUPANCY	5,340	14,268	3,740	20,243	108,238	6,354
TOTAL LANDS NOT LEASED	240	2,980	2,980	2,980	16,728	0
TOTAL LANDS ANALYZED	192,542	192,542	192,542	192,542	192,542	192,542

The above acreages include 58,113 acres of private mineral estates under the Grassland. The Forest Service will negotiate for the same mitigation measures on private minerals as on the adjacent federal minerals. However, because development of the private minerals is a deeded right, the Forest Service cannot prescribe or enforce the NSO stipulation on these parcels. Mineral estate ownership maps are located at the Grassland and Supervisor's offices.

No Surface Occupancy (NSO) restrictions are used primarily to protect wildlife habitat, recreation opportunities, slopes greater than 60 percent, and visual resources. On the Sulphur Ranger District, Alternative B has the most NSO. A motorized backcountry recreation area is NSO to protect a popular and unique single-track motorcycle opportunity in a natural setting. Alternatives A and E have less acreage and Alternatives C and I have the least. The alternatives with the least restrictions and lower implementation costs for the industry would be C and I.

Alternatives A, B, and E use timing limitations to protect big game winter range and other species' needs on the two mountain Districts.

Areas with slopes greater than 60 percent or a high potential for erosion and mass movement of soils on slopes greater than 35 percent occur on the Sulphur Ranger District. These NSO areas are mixed with areas with high erosion and mass movement potential on slopes less than 35 percent or slopes of 40 to 60 percent. Large-scale maps are available showing this mix. When a lease application is submitted or a development APD is proposed, an on-site examination will determine the applicability of the stipulation. Alternatives A, B, C, E, and I utilize this stipulation.

Areas on the Sulphur and Redfeather Ranger Districts with slopes of 40 to 60 percent have a controlled surface use stipulation. An exception to the stipulation may be granted when an APD is submitted if the industry can provide measures satisfactory to the Forest Service to mitigate soil and water impacts due to slope. Alternatives A, B, C, and E utilize this stipulation.

The effects of development on the Sulphur and Redfeather Ranger Districts are eliminated in Alternative H, as none of the analysis area would be leased.

On the Grassland, all alternatives contain the timing limitation to protect the shortgrass prairie nesting habitat of the mountain plover (*Charadrius montanus*), a bird that may soon be listed as threatened or endangered. This requirement was determined in the Mountain Plover Management Strategy EIS and ROD completed in March 1994, and applies to all areas with surface occupancy. Drilling, production facility construction, and plugging and abandonment of wells are prohibited from April 10 to July 10 to protect nesting habitat.

Avoidance of common range improvements (windmills, etc.) and slopes greater than 60 percent can be accomplished by applying the mitigation measure of moving development 200 meters. The effects of these requirements on the industry are minimal, but may result in delays of development.

NSO is applied to the dispersed recreation management areas in Alternative E, prairie woodlands, the Pawnee Pioneer Trails Scenic Byway, and Research Natural Areas (RNAs) in all Alternatives except H. Alternative H applies the most NSO to 56 percent of the Grassland to protect and maintain biodiversity. Alternative H would not lease proposed RNAs. Alternative B uses NSO to protect the RNAs, the West Stoneham Archaeological District scenic byway, and prairie woodlands. Alternative E protects the scenic byway, RNAs, and dispersed recreation areas. Alternatives A uses NSO for the Pawnee Buttes area, the byway, prairie woodlands, and the existing Daves Draw RNA. Alternative I uses NSO for the Pawnee Buttes, Crow Valley, Daves Draw and the scenic byway. Alternative C uses the least NSO for the byway and RNAs.

The Pawnee Buttes area, 2,740 acres, would not be leased in Alternatives B, C, E, and H because of its unique scenic, vegetation, wildlife, geology, paleontological, and recreational values. The Crow Valley Recreation Area would not be leased in Alternatives A, B, C, and E, and totals 240 acres.

The effects of no-lease areas on the industry would be lost opportunities to develop the mineral resource and associated economic impacts. No Surface Occupancy would still allow the potential of either directional drilling from adjacent federal or private surface or allow lands to be included with other developed oil and gas production, when that development results in drainage of federal oil and gas.

The private mineral estates under the 58,113 acres of the Grassland, (30 percent) are not bound by the NSO stipulation, but the Forest Service would try to negotiate appropriate mitigation measures with the operator for surface resource protection.

Leasing of the 21,522 acres of private surface with federal minerals parcels within the administrative boundary of the Grassland is most affected by the timing limitation for the mountain plover. Leases are issued on these parcels by the BLM with Forest Service input when the Grassland and its resources may be affected. Lease proposals are considered on a case-by-case basis, as the surface may be wheat fields, abandoned croplands, or prairie available

to the mountain plover for nesting. Potential impacts from spills on private lands that drain onto the Grassland are also considered.

Effects on Oil and Gas Development from Heritage and Paleontological Resources Management

Heritage resources are protected by various laws, policies, and regulations. Before any ground-disturbing activities can occur on the Forest or Grassland, a heritage resource survey must be completed. Roads, wellsites, pipelines, production facilities, and other disturbed areas must be surveyed. Potentially significant sites must be avoided or evaluated.

Paleontological resources will be identified at the leasing decision or validation and a lease notice added, or when site-specific onsite reviews are held. The site will be evaluated or avoided by the development.

SALABLE MINERALS

Disposal of gravel, sand, clay, and other mineral materials is by special-use authorization at the discretion of the Forest Service. As of July 1997, no permits for the minerals had been authorized for the Forest or Grassland. Proposals may be submitted and approved by the Forest Service after the appropriate environmental analysis and decision documentation if such use is compatible with the direction for the management area and other surface concerns. The possible disturbed area is predicted at five acres on the Forest and five acres on the Grassland for the life of the *Forest Plan.*

CUMULATIVE EFFECTS FOR MINERAL ACTIVITIES

LOCATABLE MINERALS

Existing surface disturbance due to locatable mineral activities is 20 acres, with an additional 20 acres expected for the life of the *Forest Plan.* This total represents .005 percent of the portion of the Forests that is not withdrawn from mineral entry.

LEASABLE MINERALS

As of May 1997, there were 46 producing wells and 15 abandoned sites undergoing reclamation on the Grassland that have effects that must be considered in the RFD. At this time, the existing disturbed surface area is:

Table 3.37 Existing Development, PNG, 1997

Development	Number	Acres Disturbed
Production Facilities	27	14
Wellheads	45	23
Associated Roads	23 miles	65
Abandoned Sites	15	45
TOTAL		121

The road system in the Lilli field, a major development with 61 wells (32 of them on the Grassland), results in 10 acres more disturbance than shown in the analysis assumptions for development of 32 wells. The fields predicted in the RFD are five to six well fields, and disturbance by the road system will be less.

Because some abandoned sites and dry holes in reclamation have revegetated or the area actually disturbed was much less than the total area inside the fence, the total disturbed area for those sites is much less than the 45 acres shown in Table 3.37.

Because pipelines are often located in roads or revegetate quickly when located on the prairie, they are not considered disturbed areas. The production facilities and wellheads included in the table are considered to have satisfactory interim revegetation of larger areas disturbed by drilling but not needed for production.

The additional activity forecast in the RFD would result in additional ground disturbance on the Sulphur and Redfeather Districts and the Grassland, as described in Tables 3.33 and 3.34. Since the Sulphur and Redfeather Ranger Districts have no current development, surface disturbance of 137 acres in Alternatives A, B, C, E, and I, is considered cumulatively with other resource managements. Alternative H would not lease the analysis area in the mountain districts.

The RFD activities for the alternatives are shown in Tables 3.30 and 3.31.

The number of wells and surface-disturbed acreage for Alternatives A, B, C, E, and I for the life of the *Plan* are shown below. Assumptions are that half of the RFD will be accomplished in five years, and all of the RFD will be completed in ten years and that one existing producing well will be plugged and abandoned annually and reclaimed in three to five years. It is also assumed that the Lilli field will still be in production.

Table 3.38 Acres Disturbed in Alternatives A, B, C, E, I, PNG, 1997-2005

Year	Producing Wells	Abandoned Sites	Acres Disturbed
1997 (existing)	46	15	121
2001	46	13	115
2007	46	12	111

The acres disturbed represent .0006 of the Grassland, or less than one-tenth of one percent, of the total Grassland surface of 192,542 acres.

Table 3.39 Acres Disturbed in Alternative H, PNG, 1997-2005

Year	Producing Wells	Abandoned Sites	Acres Disturbed
1997 (existing)	46	15	121
2002	45	11	105
2007	43	10	99

The acreage disturbed is .0005 to .0006 of the Grassland, or less than one-tenth of 1 percent.

Table 3.40 Acres Disturbed in Alternatives A, B, C, E, I, ARNF, 1997-2007

Year	Producing Wells	Abandoned Sites	Acres Disturbed
1997 (existing)	0	0	0
2002	4	2	82
2007	7	1	110

The acres disturbed on the Sulphur and Redfeather Districts is .001, or one-tenth of 1 percent of the analysis area.

The private surface with federal minerals parcels managed by the BLM has an RFD of three dry hole and two producing wells over the next ten years. If one of the existing 30 such wells within the administrative boundary is abandoned annually, the number of wells will decrease to 22 by the year 2005. The surface where these wells are located is wheat fields, abandoned croplands, or prairie, and the amount of acres disturbed is considered to be minimal.

SALABLE MINERALS

No development for these materials is currently occurring on the Forest or Grassland. Five acres of surface disturbance may occur on the Forest and five acres on the Grassland for the life of the *Forest Plan.*

SUMMARY OF CUMULATIVE EFFECTS FOR MINERAL DEVELOPMENT

Tables 3.41 and 3.42 display the cumulative acres of surface disturbance on the Forest and Grassland over the life of the *Plan.* Oil and gas development is assumed to occur in the analysis area on the Sulphur and Redfeather Districts, and the locatable and salable activities may occur over the rest of the Forest where authorized. The acres on the Grassland reflect the disturbed areas existing in 1997.

Table 3.41 Cumulative Acres of Surface Disturbance on the Sulphur and Redfeather Ranger Districts from Mineral Activities, ARNF

Mineral Category	Alternative	
	A, B, C, E, I	H
Locatable	40	40
Leasable	137	0
Salable	5	5
Total	182	45
Percent of total Forest acres disturbed, not including withdrawn acres	.02	.006

Table 3.42 Cumulative Acres of Surface Disturbance on the Pawnee National Grassland from Minerals Activities

Mineral Category	Alternative	
	A, B, C, E, I	H
Locatable	0	0
Leasable	121-111	121-99
Salable	5	5

Mineral Category	Alternative	
	A, B, C, E, I	H
Total	126-116	126-104
Percent of total grassland acres disturbed	.07-.06	.07-.05

The potentially disturbed acreages are less than one-tenth of one percent of the area analyzed. Note that this activity would not occur at one time, so the acreage affected at one time would probably be less over the life of the *Forest Plan*.