INTRODUCTION

This chapter identifies the physical, biological, social and economic impacts of implementing the alternatives described in Chapter 2 and is organized by resource component for the reader's convenience.

AIR QUALITY

Air pollution is controlled through ambient air quality and emission standards and permit requirements established under the Federal Clean Air Act and the Montana Clean Air Act (Department of Health and Environmental Sciences 1980). Montana has adopted federal ambient air standards and has also established stricter state standards for some pollutants.

Depending on the intensity of oil and gas development, general air quality impacts could result from:

1. Exhaust from drilling rig engines.

   An air quality permit from the Montana Air Quality Bureau is required for drilling rigs if the total emissions exceed 100 tons/year of any pollutant (Air Quality Regulation (AQR) 16.8.1102(k)). Based on an analysis performed by DHES and DNRC, total rig emissions for 900 horse power and 1,100 horse power rigs are .39 and .48 tons per day respectively (assuming operations occur 100% of the time during a 105 day drilling window).

2. Exhaust from vehicular travel to and from the sites.

3. Fugitive dust from traffic on access roads.

4. Gases encountered during drilling operations which could be released through the mud system.

5. Emissions from producing wellsite processing facilities (heater/treaters, tanks, flares, etc.).

6. Emissions from the central gas processing plant to be located in Sec. 8, T. 26 N., R. 8 W.

7. Emissions from possible pipeline ruptures.

These air quality impacts were considered in all of the following alternative discussions.

Alternative 1

The central gas processing facility would create no air quality impacts as it is proposed as a non-polluting closed system (see Appendix D). A State of Montana air quality permit would be required prior to construction of the facility. Because the gas plant will be located off federal minerals, the BLM will have no approval or denial authority. A PSD (Prevention of Significant Deterioration) permit from EPA may be required depending upon whether or not emissions occur and the quantities of these emissions.

Because no new wells would be drilled, the cumulative impacts would be limited to those resulting from leaks, vehicular traffic and wellsite/processing facility emissions. These impacts are considered minor as the majority of dust emissions settle rapidly back to the ground, and leaks and wellsite emissions are insignificant when compared to drilling emissions.

Alternative 2

Drilling operations would result in minor, short-term impacts to air quality as one to three drilling rigs operate in the area. The impacts to air quality would increase due to a minor increase of various fugitive gases escaping at on-site wellheads. These impacts would not approach federal or state standards.

Assuming all the wells are drilled, and each well requires 105 days drilling time utilizing an 1100 horsepower drilling rig, the total emissions resulting from drilling would be approximately 750 tons over the life of the field. This is roughly equivalent to the total emissions generated by 75 cars driving 10,000 miles per year for a 10 year period based

on 20 miles per gallon (calculations based on information taken from State of Montana, Board of Oil and Gas Conservation, Final Programmatic Environmental Impact Statement on Oil and Gas Drilling and Production in Montana, 1989).

Alternative 3

The cumulative impacts of drilling operations would be similar to those described in Alternative 2, but proportionately less because of fewer wellsites.

The gas processing facility discussed in Alternative 1 and in Appendix D would also apply to this alternative. Because this system is designed to inject all waste gas, the emissions to the airshed should decrease from their present level, as the Gypsy Highview Plant flares waste gas.

Alternative 4

Again, the impacts of drilling operations would be similar to those described in Alternative 2, only slightly less. The cumulative emissions from drilling would be approximately 650 tons over the life of the field.

The gas processing facility discussed in Alternative 1 and in Appendix D would also apply to this alternative. The impacts to the airshed are anticipated to be less than the current impacts as discussed above under Alternative 3.

PALEONTOLOGY

Alternative 1

There will be no impact under this alternative.

Alternative 2

The impacts to paleontological resources would be minor. However, the potential for impacts would increase because of the additional roads, pipelines and wellsites.

Table 4.1 lists fossils and fossil evidence that could be disturbed and/or impacted by this alternative. The only type of fossil in the significant category (as defined in Chapter 3) are dinosaur remains which could be impacted by drill site E-4. The context and association of recent, nearby discoveries were very important in establishing certain social characteristics and behaviors of dinosaurs (Horner 1984).

Alternative 3

The impacts of this alternative would be proportionally the same as those in Alternative 2. Again the E-4 wellsite would have the potential to impact dinosaur fossils, which would be described as a significant impact (see Table 4.1).

Alternative 4

The impacts of this alternative would be the same as those described in Alternative 2 (see Table 4.1).

CULTURAL RESOURCES

Alternative 1

The potential for impacts to cultural resources would be low, even though the linear character of the pipeline construction would increase the likelihood of encountering resources. Constructing a gas plant and a short re-injection pipeline to the 1-16 well, would disturb approximately 15 acres. Powerlines would be buried adjacent to access roads and would result in no additional disturbance.

Alternative 2

As in Alternative 1, applying Standard Management Practices would keep the probability of impacts to cultural resources low. Nine step-out wells, one injection well, and six exploration wells would be drilled; impacting 80 acres. There would be 15.55 miles of new roads, 12.85 miles of reconstructed roads, and 7.15 miles of new pipeline constructed that would not be adjacent to the access roads. Using the criteria of a 50 foot right-of-way for a pipeline and 20 feet for a road, this 35.5 miles of disturbance would impact 162 acres. Powerlines would be built adjacent to the access roads and would result in no additional disturbance. If this alternative were implemented, approximately 242 acres would be disturbed. Because the previous cultural resource inventory was not highly systematic, no estimates of site density have been made. In general, the need to apply avoidance measures would increase as more acreage is disturbed; increasing the probability of locating cultural resources.

TABLE 4.1

PALEONTOLOGICAL EFFECTS[1]
ALTERNATIVES 1-4

Drill Site	Gastropods (snails)	Pelecypods (clam like)	Coquina (Broken shells, corals and organic debris)	Corals Brachiopods (clam like)	Belemnites (remains of squid-like animal, cigar shaped)	Ammonites (chambered nautilus)	Dinosaur bones	Organic trails and burrows, wood and leaf fragments
Alternative 1								
1-13	(no fossils expected)							
1-19								X
Alternative 2								
1-19								X
S-1, S-2, S-4, S-5, S-6, S-7	X	X	X					X
E-2				X				
E-3		X			X	X		
E-4		X					X	
B-1, S-3, S-8, 1-13	(no fossils expected)							
Alternative 3								
E-1, S-1, S-2	X	X	X					X
E-4		X					X	
1-19								X
Alternative 4								
1-19								X
E-1, E-5, E-6, S-1, S-2, S-4, S-5	X	X	X					X
E-2			X					
E-3		X			X	X		
E-4		X					X	
1-13, B-1, S-3, S-8	(no fossils expected)							

[1]BLM & USFS 1989

The potential for cultural resources within these 242 acres is unknown because there have been few cultural resource inventories in the area. Because the 242 acres are scattered throughout the entire EIS area, the probability of encountering resources increases.

A loss of cultural values may result from the increased number of people in the EIS area. This increase would be from two sources. The first would be from personnel brought to the area by gas field development. The second source, road improvement would create greater public access to the area. This increased access could result in increased looting/collection of archaeological sites and damage to others resulting from unauthorized off-road traffic. Impacts from enhanced public access are difficult to control, but would be minor.

Alternative 3

As in Alternative 1, applying Standard Management Practices would keep the probability of impacts to cultural resources low.

Under this alternative, one injection well, one central production facility two step out wells and two exploration wells would be drilled; impacting 35 acres. There would be 2.1 miles of new road construction, 1.75 miles of road reconstruction and 4.1 miles of new pipeline construction that would not be adjacent to the access roads. This 7.2 miles of disturbance would impact 40 acres. Powerlines would be built adjacent to access roads and would result in no additional disturbance. If this alternative were implemented, approximately 75 acres would be disturbed.

The potential for cultural resources within these 75 acres is unknown because there have been few cultural resource inventories in the area. The fact that these 75 acres are scattered throughout the entire EIS area increases the probability of encountering resources.

Losses of cultural resources, due to increased numbers of people in the EIS area, would occur as in Alternative 2, however, impacts would be minor.

Alternative 4

As in the other alternatives, applying Standard Management Practices would keep the probability of impacts to cultural resources low.

Under this alternative, one injection well one central production facility, seven step-out wells and six exploration wells would be drilled; impacting 80 acres. There would be 12.5 miles of new road, 11.4 miles of road reconstruction and 6.2 miles of new pipeline constructed that would not be adjacent to the access roads. This 30.1 miles of disturbance would impact 139 acres. Powerlines would be built adjacent to the access roads and would result in no additional disturbance. If this alternative were implemented, approximately 219 acres would be disturbed.

The potential for cultural resources within these 219 acres is unknown because there have been few cultural resource inventories in the area. The fact that these 219 acres are scattered throughout the entire EIS area increases the probability of encountering resources.

Again, cultural resources could be lost or damaged as discussed in Alternative 2, but the impacts would be minor.

SOILS

Since oil and gas development requires varying amounts of surface disturbance, some degree of soil erosion and compaction is generally unavoidable. Vegetation removal, slope steepness, soil erodibility, wind and rainfall are the primary factors contributing to soil erosion. Elimination or a reduced influence of any factor will reduce erosion. Normally, the magnitude and significance of impacts from soil erosion can be minimized by appropriate construction standards. BLM's construction standards, maintenance requirements and road and pad reclamation standards for the Blackleaf area are included in Appendix B.

Wind erosion is a problem east of the Continental Divide. The highest velocities generally are confined to the "Chinook" belt extending several tens of miles east of the Rockies. Excessive wind erosion here is also due to dry soil, sparse vegetative cover and erodible soils. Wind erosion is influenced by vegetative cover, wind velocity, soil moisture and soil surface roughness.

Equipment used in drilling oil wells is usually large and heavy enough to require an improved road, except in open terrain and rangeland. The largest equipment (deep hole rigs) is often restricted to well-built roads of moderate slope and width. Most oil development activity requires at least a bladed trail, and often a well-constructed, improved gravel road is needed. Minimal erosion would be expected from a shallow gas well (2,500 to 3,500 feet) close to an existing road and using a small mobile rig with access across flat or gently sloping terrain on sodded loamy soils. The highest erosion potential would result at a well site several miles off the nearest road, across steep terrain in Cretaceous bedrock where road requirements are extensive and the terrain difficult.

Oil drilling activity, especially equipment transport, causes soil compaction. The degree of compaction is influenced by soil texture, moisture content, organic matter, and soil structure (Barnes et al. 1971). Soils with a mixture of sand, silt and clay compacts more than a soil with more uniform particle size (Chancellor 1977). Coarse-textured sandy soils generally are more compatible than fine-grained soils (Larson et al. 1980). Soil moisture is the most critical factor in compaction. At field capacity (the amount of soil moisture remaining after a soil mass is saturated and allowed to drain freely for 24 hours) sufficient water remains in the pores to provide particle-to-particle lubrication and maximum compaction potential under load. Thus, moist soils are most susceptible to compaction. Organic matter such as roots and humus can help reduce soil compaction. In general, the greater the organic matter content, the less compaction. Grassland soils tend to have greater organic matter content than forest soils and can withstand compaction pressures better, all other factors being equal. Coarse soils withstand compaction forces better than fine ones, especially at a heavy moisture content (Emerson 1978).

Compaction severely affects plant growth by inhibiting root penetration, limiting oxygen and carbon monoxide exchange between the root zone and the atmosphere, and severely limiting the rate of water infiltration into the soil. Compaction destroys the soil's ability to sustain plant growth and creates a soil surface with a high run-off potential.

Studies by Soehne (1958) showed that tires carrying different total loads but having the same surface pressure per inch of tire resulted in dramatically different compaction pressure curves. The heaviest load produced the deepest compaction pressure. Loads of oil field equipment may easily meet the 600-pound per inch of tire width requirement of the Montana Highway Department on hard surface roads, but the use of these same vehicle and wheel combinations on unimproved or unroaded areas can cause severe soil compaction, especially if the unimproved road is wet.

Pad and pipeline construction might permanently impair natural soil productivity, especially where soils are shallow and construction requires excavating bedrock. Soil excavation results in temporary disturbance of the original soil profile and rooted vegetation. While stockpiling preserves most soil features, prolonged storage generally decreases soil fertility and vegetation viability. Some soil materials would be lost to stockpile erosion. In disturbed areas, the original soil condition and site potential are often inferior after reclamation. Reclamation of these sites often leaves excess spoil materials that introduce unnatural landforms requiring extra reclamation.

These impacts are present to varying degrees in all of the alternatives, depending on the number of acres disturbed and the soil types that are impacted.

Alternative 1

The soil impacts from construction activities in Alternative 1 would occur on 15 acres of soil type 204. This soil type has low soil stability risk associated with development.

Alternative 2

Seventy acres (29%) of the possible development in this alternative would occur on soil types with low soil stability hazards and thus low impact from development. Possible development on the remaining 172 acres (71%) would occur on soil types with moderate hazards, which would increase development costs to mitigate soil erosion, off side sediment pollution or other hazards.

About 79 acres, or 33% of the total possible development, would occur in land type 14D. This land type is characterized by rotational slump and mudflow landforms on shale parent material. The main limitation to the proposed development on this land type is the moderate cutbank slump hazard. This means that roads constructed on slopes with evidence of mass failure in the geologic past and high evidence of ground water concentration could result in mass instability on road cut and/or fill slopes. A cutbank failure could affect sediment yield if it occurred near a stream. There is presently no reliable method for estimating the quantity or frequency of mass failure that may occur, nor the proportion of soil material that could be delivered to a nearby stream. The slump hazard may be more severe where groundwater concentrations occur. The hazards on land type 14D could be overcome with special construction design measures commonly available, but would increase the cost of construction on this land type.

About 28 acres (12%) of the possible development, would occur in land type 205, which also has a moderate cutbank slump hazard and low subsoil bearing strength. However, the slump hazard is a problem only on slopes over 25%, and the slopes range down to 15% on this unit.

The mass failure hazard potential can be reduced by locating roads to avoid the hazard, by not constructing roads across steep slopes, and by keeping cut slopes under 10 feet in height. Special care should be taken at stream crossings and any areas of high water table in land types with mass failure hazard.

Limitations to road construction because of shallow, non-rippable hard rock could occur on 24 acres of land types 18 and 183. This limitation is most severe on land type 183, but only two acres of this land type would be developed.

The potential for erosion and sediment delivery from all of these soils could be mitigated by special construction design and maintenance practices.

Of the four alternatives considered, Alternative 2 would create the greatest soil stability risk associated with development. Alternative 2 would disturb the most area (242 acres) and include a greater area disturbed in the highest risk soil types (14D and 205).

Alternative 3

Forty-seven acres (63%) of the possible development in this alternative would occur on soil types with low soil stability hazards and thus low impacts from development. Possible development on the remaining 28 acres (37%) would occur on soils with moderate hazards, which would increase development costs to mitigate soil erosion and/or off site sediment pollution hazards.

About 8 acres, or 11% of the potential development, would occur on land type 14D. This land type is characterized by

rotational slump and mudflow landforms on shale parent material. The main limitation to the proposed development on this land type is the moderate cutbank slump hazard. The slump hazard may be more severe where groundwater concentrations occur. The hazards on land type 14D could be overcome with special construction design measures commonly available, but would increase the cost of construction on this land type.

About 16 acres (21%) of the possible development would occur on land type 205 which also has a moderate cutbank slump hazard and low subsoil bearing strength. This means that roads constructed on slopes with evidence of mass failure in the geologic past and high evidence of ground water concentrations could result in mass instability on road cut and/or fill slopes. A cutbank failure could affect sediment yield if it occurred near a stream. There is presently no reliable method for estimating the quantity or frequency of mass failure that may occur, nor the proportion of soil materials that could be delivered to a nearby stream. However, the slump hazard is a problem only on slopes over 25%, and the slopes range down to 15% on this landtype. Construction on this soil land type could be costly to mitigate, especially on steep slopes.

The mass failure hazard potential can be reduced by locating roads to avoid the hazard, by not constructing roads across steep slopes, and by keeping cut slopes under 10 feet in height. Special care should be taken at stream crossing and any areas of high water table in land types with cutbank slump hazard.

The potential for erosion and sediment delivery from these soils could be mitigated by special construction design and maintenance practices. Of the four alternatives considered, Alternative 3 is intermediate in area disturbed and the soil stability risk associated with development.

Alternative 4

Proposed development on 81 acres (37%) in this alternative would occur on soil types with low soil hazards and thus low impacts from development. Proposed development on the remaining 134 acres (61%) would occur on soils with moderate hazards and 4 acres (2%) on soils with severe hazards. Development costs to mitigate soil erosion, off site sediment pollution and other hazards would be much higher on these soils.

About 27 acres, or 18% of the potential development, would occur in land type 14D. This land type is characterized by rotational slump and mudflow landforms on shale parent material. This means that roads constructed on slopes with evidence of mass failure in the geologic past and high evidence of ground water concentration could result in mass instability on road cut and/or fill slopes. A cutbank failure could affect sediment yield if it occurred near a stream. There is presently no reliable method for estimating the quantity or frequency of mass failure that may occur, nor the proportion of soil material hat could be delivered to a nearby stream. The main limitation to the proposed development on this land type is the moderate cutbank slump hazard. The slump hazard may be more severe where groundwater concentrations occur. The hazards on land type 14D could be overcome with special construction design measures commonly available, but would increase the cost of construction on this land type.

Land type 205 (22 acres, 10%) also has a moderate cutbank slump hazard and low subsoil bearing strength. However, the slump hazard is a problem only on slopes over 25%, and the slopes range down to 15% on this landtype. Fifteen acres (10%) of construction activities would be scheduled in this land type.

The mass failure hazard potential can be reduced by locating roads to avoid the hazard, by not constructing roads across steep slopes, and by keeping cut slopes under ten feet in height. Special case should be taken at stream crossings and any areas of high water table in the three land types.

Shallow, non-rippable hard rock would increase road construction cost and environmental hazard on 35 acres of land types 18 and 202. The potential for erosion and sediment delivery from these soils could be mitigated by special construction design and maintenance practices.

Of the four alternatives considered, Alternative 4 would result in the second highest soil stability risk associated with development.

VEGETATION

All surface disturbing activities have the potential to impact vegetation resources. Oil and gas exploration and development usually create varying amounts of surface disturbance, depending on the size of the project and the length of time involved. When surface disturbance reduces the amount of vegetation cover, the result can be increased sedimentation in streams and riparian areas, channel degradation, and increased soil erosion.

Construction of well sites and roads would cause the primary effects on vegetation. Vegetation would be re-

moved from these areas for the life of the operation. For a successful well, a site of about 40% of the original drill site size would remain disturbed for the life of the well. However, unsuccessful drill sites can be reclaimed. Reclamation generally includes spreading topsoil and reseeding. Access roads cause a significant part of the disturbance resulting from drilling and production. Roads to unsuccessful drill sites can be reclaimed. Roads to productive wells might be upgraded for oil transport. Dust and vehicle emissions from increased vehicle traffic could further reduce growth of minor amounts of adjacent vegetation.

Gas from wells would be transported by pipeline. Pipelines would require varying amounts of vegetation disturbance depending on the size of the line. Reclamation of disturbed areas would minimize impacts from pipeline construction. If disturbed areas are prepared and seeded properly, reclamation will further reduce impacts.

The effects of oil and gas exploration and development on vegetation would be a concern: (1) when drill sites or roads are in riparian areas; (2) when drill sites or roads would be in areas that contain populations of special status plants; (3) where operations could spread or encourage the growth of weeds; (4) in case of reserve pit leakage and/or pipeline spills; (5) in the event of blowouts; or (6) operation caused wildfire.

Drilling may occur in areas that support riparian vegetation. If located in or at the head of drainages, drill sites and access roads can add sediment to streams and wetlands. Channel degradation also can occur. Heavy sediment loads or severe degradation would impact riparian vegetation. If relocation of the drill site is possible, these impacts can be reduced. The potential for significant impacts would also be associated with road construction in or adjacent to the riparian zone. Species most likely to be affected would be cottonwood, aspen, willow, and some of the more succulent forbs and grasses that are of primary importance to wildlife for food and cover. It could be conceivable that the removal of stands of large trees along the bottom could change flow patterns of the river, possibly resulting in the loss of riparian vegetation. Access routes can often be located to avoid sensitive areas. Any activity occurring in wetland or floodplain areas would be regulated by Executive Orders 11988 and 11990 (May 24, 1977), which set forth the direction and responsibility for agencies in reducing the risk of adverse impacts to these sensitive areas.

None of the alternatives would impact any known habitat of plant species classified as threatened, endangered, sensitive or of special concern. The risk of the proposed development impacting yet undiscovered rare plant populations or habitat is approximately proportional to the area disturbed for each alternative considered. Site specific surveys would need to be conducted prior to surface disturbing activities, should the project be approved. If rare plants are identified during these surveys, management requirements on a site-by-site basis will be developed to maintain viable populations of the species on the site. Measures would be taken to protect or minimize the effects on the existing populations.

Surface disturbance associated with drilling can cause weeds to spread. Of even greater concern is the long-distance transport of certain weed species by drilling equipment and vehicles. For example, spotted knapweed seeds clinging to vehicles used in infested areas could be carried to previously uninfested areas during construction activities. The entire area disturbed by construction activities would be susceptible to noxious weed infestation, increasing the risk of weed spread onto adjacent weed-free areas. Because of the linear configuration of the area impacted by road and pipeline construction, the risk of weed invasion to adjacent areas from these features would be greater than the acres might indicate. Continuous vehicle and equipment traffic on the roads and active wellsites could introduce weed seed to the area at any time, thus maintaining the risk of weed invasion throughout the life of the project. The operator would be responsible for implementing a plan to control/eradicate noxious plants, enforced by the responsible surface managing agency.

If improperly constructed, reserve pits can leak mineralized water or pit residue. If this leakage enters a streambed or drainageway, it can damage nearby vegetation or off-site vegetation. Soil contamination from oil and gas development in Montana results mainly from leaking and improperly reclaimed reserve/brine pits. Produced hydrocarbons and fuel spills occasionally cause impacts. Spills generally are not large and the materials are relatively immobile. However, there is the possibility that a chemical spill would cause a measurable effect on vegetation adjacent to areas where vehicles and machinery are operating. A chemical spill into live water could cause a loss of vegetation for a considerable distance downstream. Spills along upland roads would likely be very localized and not affect surrounding vegetation.

Well blowouts are rare accidents that can have substantial effects on vegetation. They expose vegetation to harmful gases, oil and drilling fluids. Nearby vegetation is most severely affected, and some harmful gases may travel significant distances. A 1982 blowout in Alberta provides an example of the effects of a large blowout (Energy Resources Conservation Board 1984). Oil condensate killed may trees near the drill site. Farther from the site, oil deposits reduced tree growth for two or three years. After the blowout, many trees were cut or burned to reduce

wildfire hazard. Sulphur was deposited over a wide area and interrupted normal growth rate of trees for two or three years.

The presence of petroleum products and chemicals at drill sites creates a fire hazard. Depending on its size, wildfire can have major impacts on vegetation. A wildfire would result in vegetation change on both forest and grassland vegetation types. The greatest risk of an operations-caused fire would be from road construction. Road construction activities, right-of-way slash disposal, and burning under less than optimal burning conditions could increase the risk of an uncontrolled fire. Burning and use of fire to consume right-of-way slash would be controlled by operator permit and by the State fire regulations. The risk of a worker caused fire would be small for all alternatives. Operators would be required to comply with State fire regulations and stipulations regarding fire safety.

The vegetation impacts above are appropriate to all of the alternatives considered, in varying degrees, depending on the area disturbed as discussed below.

Alternative 1

The vegetation disturbed during construction activities in Alternative 1 would occur on approximately 15 surface acres.

Alternative 1 would disturb the fewest surface acres and vegetation of the four alternatives considered. The area disturbed by the injection well and production facility would remain essentially unvegetated for the life of the project. Existing road cut and fill slopes would receive revegetation treatment as needed during the project.

The entire 15 acres of disturbance under this alternative would occur on grassland vegetation. This would reduce the forage potential of the area by about 7,500 pounds of total forage production per year, using an estimated average annual forage production rate for grasslands of 500 pounds per acre. Grazing potential would be reduced for livestock and big game animals.

Compared to the other alternatives, Alternative 1 has the lowest risk of environmental consequences to vegetation resources, because there is less area disturbed and the higher risk riparian vegetation is not affected.

Alternative 2

The vegetation disturbed during construction activities in Alternative 2 would occur on approximately 242 surface acres.

The area disturbed by new pipeline construction outside road rights-of-way and all dry wellsites and attendant roads would be revegetated by seeding as soon after construction as possible. Road cut and fill slopes would also be revegetated. The other disturbed area (road surface, well and production facility) would remain essentially unvegetated for the life of the project.

About 79 acres, or 33% of the area disturbed would occur on coniferous forest areas, and 32 acres of riparian-aspen-cottonwood-birch-willow forest and shrubland. The timber growth capability would be reduced on the commercial area disturbed by the proposed development.

Construction activities would disturb 106 acres (44%) of grassland vegetation and 24 acres of scree and rockland area. This would reduce the forage potential of the area by about 53,000 pounds of total forage production per year using an estimated annual forage production rate of 500 pounds per acre for grasslands. Grazing potential would be reduced for livestock and big game animals.

The entire 242 acres disturbed would be susceptible to noxious weed infestation. The proposed development would not impact any known sensitive plants or plant species of special concern habitat. Overall, the risk of vegetation impacts for Alternative 2 are greater than any of the other alternatives, because more area of vegetation would be disturbed during proposed development activities.

Unique features of Antelope Butte Swamp might be at risk in the case of a blow-out at S-1, or if there were leakage from the pipeline connecting wells S-1 and S-2. The probability of such an event is very low, but could have long-term adverse impacts on potential rare plant habitat. Surveys conducted prior to site-specific development would identify mitigation to protect these values.

Alternative 3

Approximately 75 acres would be disturbed in Alternative 3, the second lowest surface area and vegetation distur-

bance of the four alternatives considered. The area disturbed by new pipeline construction outside road rights-of-way and all dry wellsites and attendant roads would be revegetated by seeding as soon after construction as possible. Road cut and fill slopes would likewise receive revegetation treatment. The remaining disturbed areas would remain essentially unvegetated for the life of the project.

About 9 acres, or 12% of the area disturbed would occur on coniferous forest areas and 3 acres of riparian-aspen-cottonwood-birch-willow forest and shrubland. The timber growth capability would be reduced on the commercial forest area disturbed by the proposed development.

Construction activities would disturb 63 acres (84%) of grassland vegetation. This would reduce the forage potential for the area by about 31,500 pounds of total forage production per year using an estimated average annual forage production rate of 500 pounds per acre for grasslands. This would reduce grazing potential for livestock and big game animals.

The entire 75 acres disturbed would be susceptible to noxious weed infestation, increasing the risk of weed spread onto adjacent weed-free areas. The proposed development does not impact any known habitat of plant species of special concern. Compared to the other alternatives, Alternative 3 is intermediate in impact to vegetation resources.

Alternative 4

The vegetation disturbed during construction activities in Alternative 4 would occur on approximately 219 surface acres. The area disturbed by new pipeline construction, outside road rights-of-way and all dry wellsites and attendant roads would be revegetated by seeding as soon after construction as possible. Road cut and fill slopes would likewise receive revegetation treatment. The other disturbed areas would remain essentially unvegetated for the life of the project.

About 44 acres, or 20% of the area disturbed would occur on coniferous forest areas and 33 acres of riparian-aspen-cottonwood-birch-willow forest and shrubland. The timber growth capability would be reduced on the commercial forest area disturbed by the proposed development.

Construction activities would disturb 107 acres (48%) of grassland vegetation and 36 acres (16%) of scree and rockland area. This would reduce the forage potential of the area by about 53,000 pounds of total forage production per year using an estimated average annual forage production rate of 500 pounds per acre for grasslands. This would reduce grazing potential for livestock and big game animals.

The entire 219 acres disturbed would be susceptible to noxious weed infestation, increasing the risk of weed spread onto adjacent weed-free areas. The proposed development would not impact any known habitat of plant species of special concern. Compared to the other alternatives, Alternative 4 would have the second highest acreage of area disturbed and related vegetation impacts.

Unique features of Antelope Butte Swamp might be at risk in the case of a blowout at well S-1 or if these were leakage from the pipeline connecting wells S-1 and S-2. The probability of such an event is very low, but could have serious, long-term adverse impacts on potential rare plant habitat or grizzly habitat. Construction of the pipeline near the eastern edge of the swamp might have adverse impacts on riparian vegetation or sensitive species habitat. Surveys conducted prior to site-specific development would identify mitigation to protect these values.

LIVESTOCK

Impacts to livestock can be classified as direct or indirect. Direct impacts are those associated with vehicles and equipment, or monitoring from roadways where livestock are disturbed, moved, injured, etc. Another direct impact could result from gates being left open and having livestock mix or to wander away from authorized pastures.

Indirect impacts to livestock refer to impacts on forage, water, or the management facilities that livestock depend upon when using the public land. Any action that reduces vegetative cover will also impact the amount of forage or shelter available to livestock. Usually, the greater the amount of vegetation removed, the more animal-unit-months (AUMs) that are lost. Because nonproductive wellsites, the nonessential pad areas around producing wells and access roads are revegetated, impacts are usually temporary.

For the purposes of this EIS, 8 acres per AUM are used to calculate the forage lost, as this is an approximate state average for carrying capacity. This would represent an upper limit capacity because the productivity is probably less for the Rocky Mountain Front (10-20 acres/AUM) where much rock outcrop and noncommercial timber canopy exist.

The reader will note that not all of the projected wells are discussed in the livestock section. Wells 1-8, 1-16, 1-19, B-1, S-1, S-2, S-3 and S-4 are within the Blackleaf Wildlife Management Area (WMA). No livestock grazing is permitted within this area and these wells would not impact livestock.

Alternative 1

This alternative would impact livestock in only the Cow Creek Allotment and would result in .67 AUMs lost. Table 4.2 details the indirect impacts (AUMs lost) in this allotment.

TABLE 4.2
IMPACTS TO LIVESTOCK
(COW CREEK ALLOTMENT ONLY)[1]
ALTERNATIVE 1

Development	Miles	Acres Disturbed	AUMs Lost	Indirect Impact*	Direct Impact*
Road Reconstruction	0	0	0	None	None
Road Maintenance	0	0	0	None	None
Pipeline (adjacent to access road)	0	0	0	None	None
Pipeline (outside access road)	0	0	0	None	None
Central Production Facility	1.0 Unit	5.0	.67	Minor	Low
Total	1.0	5.0	.67		

* Minor Impact = 10 or less AUMs lost
Low Impact = 11-20 AUMs lost
Moderate Impact = 21-50 AUMs lost
Significant Impact = more than 50 AUMs lost

[1]BLM, 1989.

Of the current available forage, 5.0 acres would be lost for the life of the field.

Alternative 2

This alternative would impact livestock in four allotments (see Table 4.3) and would result in 12.9 AUMs lost; a low impact.

TABLE 4.3
IMPACTS TO LIVESTOCK[1]
ALTERNATIVE 2

Facility	Scoffin Creek[2]	Dupuyer Creek[3]	Cow Creek[4]	Chicken Coulee[5]
Exploration well	E-4	E-5, E-6	0	E-1, E-2 E-3
Acres disturbed	5	10	0	15
AUMs lost	0.6	1.2	0	1.8
Production well	0	0	1-5, 1-13	0
Acres disturbed	0	0	0	0
AUMs lost	0	0	0	0
Step-out well	0	0 0	S-5, S-6, S-7, S-8	0
Acres disturbed	0	0	20	0
AUMs lost	0	0	2.5	0
Maintenance & reconstructed roads (miles)	1.0	5.3	4.5	1.1
Acres disturbed*	2.4	12.8	11.0	2.6
AUMslost	0.3	1.6	1.4	0.3
New road (miles)	0	0	4.40	5.6
Acres disturbed	0	0	11.0	13.6
AUMs lost	0	0	1.4	1.7
Pipeline (adjacent to access road)	0	0	7.65	0
Acres disturbed**	0	0	0	0
AUMs Lost	0	0	0	0
Pipeline (outside access road)	0	0	0	0
Acres disturbed	0	0	0	0
AUMs lost	0	0	0	0
Total Acres Impacted TOTAL — 103.4	7.4	22.8	42	31.2
Total AUMs Lost TOTAL — 12.9	0.9	2.8	5.3	3.9

[1]BLM, 1989.
[2]Scoffin Creek 109 Cattle 07/01-08/31 USFS
[3]Dupuyer Creek 86 Cattle 07/01-09/10 USFS
[4]Cow Creek 102 Cattle 07/01-09/05 USFS
[5]Chicken Coulee 233 Cattle 07/01-09/30 USFS/BLM/ private

*20-foot road right-of-way
**50-foot pipeline right-of-way

Direct impacts to livestock could occur only if the projected development and exploration occurred during the 07/01-09/30 grazing period. The disturbance caused by vehicles, road building equipment and pipeline digging would cause only minor livestock movement. The increased probability of fence gates being left open could result in livestock drifting into unauthorized pastures. There is a slight risk that the increased traffic flow could cause animals to be hit by vehicles.

Indirect impacts to livestock numbers would occur through the reduction of livestock forage. It is estimated that 103.4 acres of the current available forage would be lost; those acres associated with the step-out wells are assumed to be lost for the life of the field. The acres associated with the exploration wells would be a short-term loss. Table 4.3 shows the numbers of wellsites and related activities per allotment and the associated disturbed acreages.

Alternative 3

This alternative would impact three allotments and result in 1.5 AUMs lost (see Table 4.4); a minor impact. Direct impacts to livestock would be essentially the same as described under Alternative 2. Table 4.4 shows the numbers of projects per allotment and the approximate AUMs lost.

Alternative 4

This alternative would impact four allotments and result in 12.5 AUMs lost; a low impact. It is estimated that 99.9 acres of the currently available or potential forage would be lost as explained in Alternative 2. Table 4.5 summarizes these impacts.

TABLE 4.4

IMPACTS TO LIVESTOCK[1]
ALTERNATIVE 3

Facility	Scoffin Creek	Cow Creek	Chicken Coulee
Exploration well	E-4	0	E-1
Acres disturbed	5	0	5
AUMs lost	0.6	0	0.6
Production well	0	1-5, 1-13	0
Acres disturbed	0	0	0
AUMs lost	0	0	0
Step-out well	0	0	0
Acres disturbed	0	0	0
AUMs lost	0	0	0
Maintenance and reconstructed roads (miles)	1.0	0	0
Acres disturbed	2.4	0	0
AUMs lost	0.3	0	0
New road (miles)	0	0	0.1
Acres disturbed	0	0	0.2
AUMs lost	0	0	0.03
Pipeline (adjacent to access road)	0	0	0
Acres disturbed	0	0	0
AUMs lost	0	0	0
Pipeline (outside access road)	0	0	0
Acres disturbed	0	0	0
AUMs lost	0	0	0
Total Acres Impacted TOTAL — 12.6	7.4	0	5.2
Total AUMs Lost TOTAL — 1.5	0.9	0	.63

[1]BLM, 1989.

It is estimated that 12.6 acres of the current available or potential forage would be lost as explained in Alternative 2. The total impact to livestock production would be minor.

TABLE 4.5
IMPACTS TO LIVESTOCK[1]
ALTERNATIVE 4

Facility	Scoffin Creek[2]	Dupuyer Creek[3]	Cow Creek[4]	Chicken Coulee[5]
Exploration well	E-4	E-5, E-6	0	E-1, E-2 E-3
Acres disturbed	5	10	0	15
AUMs lost	0.6	1.2	0	1.8
Production well	0	0	1-5, 1-13	0
Acres disturbed	0	0	0	0
AUMs lost	0	0	0	0
Step-out well	0	0	S-5, S-8	0
Acres disturbed	0	0	10	0
AUMs lost	0	0	1.2	0
Maintenance and reconstructed roads (miles)	1.0	5.3	3.8	1.1
Acres disturbed	2.4	12.8	9.2	2.7
AUMs lost	0.3	1.6	1.1	0.3
New road (miles)	0	0	2.9	5.7
Acres disturbed	0	0	7.0	13.8
AUMs lost	0	0	0.9	1.7
Pipeline (adjacent to access road)	0	0	2.0	0
Acres disturbed	0	0	0	0
AUMs lost	0	0	0	0
Pipeline (outside access roads)	0	0	2.0	0
Acres disturbed	0	0	12.0	0
AUMS lost	0	0	1.5	0
Total Acres Impacted TOTAL — 99.9	7.4	22.8	38.2	31.5
Total AUMs Lost TOTAL — 12.5	.9	2.9	4.8	3.9

[1]BLM, 1989.

WILDLIFE

One of the important relationships analyzed in this EIS is the relationship between wildlife and mineral development. The following information (Bromley 1985) will aid BLM's analysis and possibly the reader's understanding of the impacts to wildlife from oil and gas development.

1. "The severity of the effect is site-specific and depends on such factors as (a) the sensitivity of the species affected, (b) the nature of the disruption, (c) the characteristics and importance of the affected habitat, and (d) the availability and condition of alternative habitat."

2. "Response to disruptions varies among species and/or individuals and is dependent on numerous factors including: (a) the previous experience of the animal with a given disruption, (b) characteristics of the disruption, (c) characteristics of the habitat, (d) characteristics of the animal and/or group, and (e) timing of the disruption in relation to critical periods of the animal's life cycle."

3. "The effects of petroleum development may be most critical in certain highly sensitive situations including: (a) during times when animals are already stressed by natural conditions, (b) in habitats traditionally used by populations during critical periods of their life cycle, (c) for species whose social organization and/or behavior makes them particularly susceptible to disturbance, and (d) for certain sex/age groups of animals."

4. "An understanding of the general concepts of animal behavior and energetics is necessary to fully comprehend the consequences of petroleum development activities on wildlife."

Negative effects result when the oil and gas activity creates a disruption that causes a change in the energy and nutrient budgets of the individual animal affected. Negative effects occur in or within an influence zone of the animal's home, and are most severe when home space (habitat) is limited and/or the animal is already stressed at critical times in its life cycle.

The effect of raising the energy cost of living is at the expense of energy needed for reproduction, growth and survival (Geist 1970), and sometimes can be measured with these factors. Raises in the cost of living from disruption occur from the physiological excitement preparing the

animal for exertion, the cost of locomotion incurred when an animal attempts to escape a disruption, the loss of food intake because of this stress, and the cost of suboptimal habitat selection (Bromley 1985). Tables 4.6, 4.7 and 4.8 summarize the potential environmental disruptions resulting from oil field activities and the primary and secondary impacts which may occur from these disruptions.

Alternative 1

The locations of oil and gas activities projected in this alternative are shown on Figure 2.2 in Chapter 2 and the locations of important wildlife habitats are illustrated in Chapter 3. Combining this information resulted in Table 4.9, which illustrates those wildlife habitats with the greatest potential for impacts.

Table 4.9 and similar tables for the remaining alternatives, were developed using a 1-mile buffer (zone of influence). Buffer zones differ by species and reference source (Rocky Mountain Front Wildlife Guidelines) but generally range from greater than 1-mile to 3 miles. The most common buffer is 1 mile and that is the standard distance used for analysis in this document. Figure 4.1 illustrates the sometimes overlapping buffer zones in this alternative. The effectiveness of buffers is dependent on many factors other than distance, including topography and vegetative screening. The Cumulative Effects Model (USFS 1987) utilizes different zones of influence depending on the severity and type of activity as well as topography (see Appendix G).

If construction activities were scheduled in the fall, short-term disturbance of year-round occupants residing within the zones of influence could occur. Year-round occupants include the grizzly bear, predators, furbearers and Rocky Mountain goat. Some of the early deer and elk migrants could also be affected.

TABLE 4.6

POTENTIAL ENVIRONMENTAL DISRUPTIONS RESULTING FROM OIL FIELD ACTIVITIES[1]

	Potential environmental disruption						
Activity	**Noise**	**Aircraft**	**Human intrusion**	**Traffic and access**	**Structures and facilities**	**Alteration of vegetation/ land**	**Harmful substances**
Ground surveys			X	X			
Seismic trail clearing	X		X	X		X	
Seismic wave production/ recording	X		X				
Clearing/grading right-of-way	X		X	X		X	
Road construction	X		X	X	X	X	
Mobilization of trucks/ equipment	X		X				X
Site development (clearing/ grading)	X		X			X	
Drill pad construction	X		X			X	
Excavation of storage/ mud pits	X		X		X	X	X
Drilling and related activities	X		X				
Water supply	X		X	X	X		
Borrow pit excavation	X		X			X	
Wellhead/pump unit installation	X				X		
Construction of process/ treatment/storage facilities	X		X		X	X	

Installation of flow lines	X				X	X	
Erection of power lines	X				X	X	
Communication system development	X				X	X	
Operation of process/ treatment facilities	X		X				
Pipe stringing	X		X		X		
Trenching and pipe installation	X		X			X	
Pipe burial and backfill	X		X		X	X	
Maintenance and inspection			X				
Accidents						X	X
Secondary recovery	X		X				
Air support	X	X					
Worker accommodations			X				
Increase in local population			X	X			
Development of ancillary industry			X			X	
Well plugging	X		X				
Site restoration/revegetation	X		X				

[1]Bromley, M., 1985, Wildlife Management Implications of Petroleum Exploration and Development in Wildland Environments, USFS publication, General Technical Report INT-191.

TABLE 4.7
PRIMARY IMPACTS POTENTIALLY RESULTING FROM ENVIRONMENTAL DISRUPTIONS[1]

	Environmental Disruption						
Primary impact	**Noise**	**Aircraft**	**Human intrustion**	**Traffic and access**	**Structures and facilities**	**Alteration of vegetation/ land**	**Harmful substances**
Interruption of activity/ alarm/flight	X	X	X	X			
Avoidance/displacement	X	X	X	X	X		
Permanent loss of habitat use			X	X		X	X
Decreased reproductive success		X	X				
Interference with movement	X	X	X	X	X		
Direct mortality			X	X	X		X
Interference with courtship	X		X				
Alteration of behavior			X				
Change in community structure						X	

[1]Bromley, M., 1985.

TABLE 4.8

SECONDARY IMPACTS WHICH MAY OCCUR AS CONSEQUENCES OF PRIMARY IMPACTS[1]

	Primary impacts									
Secondary impact	Interruption of activity/ alarm/ flight	Avoidance/ displacement	Permanent loss of habitat	Decreased reproductive success	Interference with movement	Direct mortality	Nest/den abandonment	Interference with courtship	Change in community structure	Alteration of behavior
Decreased use/temporary desertion of traditional areas		X								
Shift in range		X								
Change in distribution		X								
Overutilization/overpopulation of adjacent habitat		X	X							
Use of marginal habitat		X								
Gradual range abandonment		X			X					
Inefficient use of habitat	X	X			X					
Mortality		X	X					X		
Reduced feeding efficiency	X	X								
Change in activity patterns	X	X								
Interference with/alteration of movements		X								
Decreased availability/ elimination of food source			X			X				
Inadequate nutrition					X					
Insufficient energy reserves for migration					X					
Reduction in numbers			X							

Adverse physiological effects			X		X	
Disruption of social structure/ group composition		X			X	
Reduced reproductive potential/ success	X		X		X	
Nest desertion		X				
Decrease in nest/density sites			X			
Delay/failure to den					X	
Den displacement		X				
Decreased survival/loss of young			X		X	
Increased use of alternate nests		X				
Decrease in aquatic productivity			X			
Human injury/ property damage						X
Delay/failure to reach traditional range					X	
Ease of travel					X	
Increased vulnerability to predators					X	
Interference with mating synchrony					X	

[1]Bromley, M., 1985.

TABLE 4.9

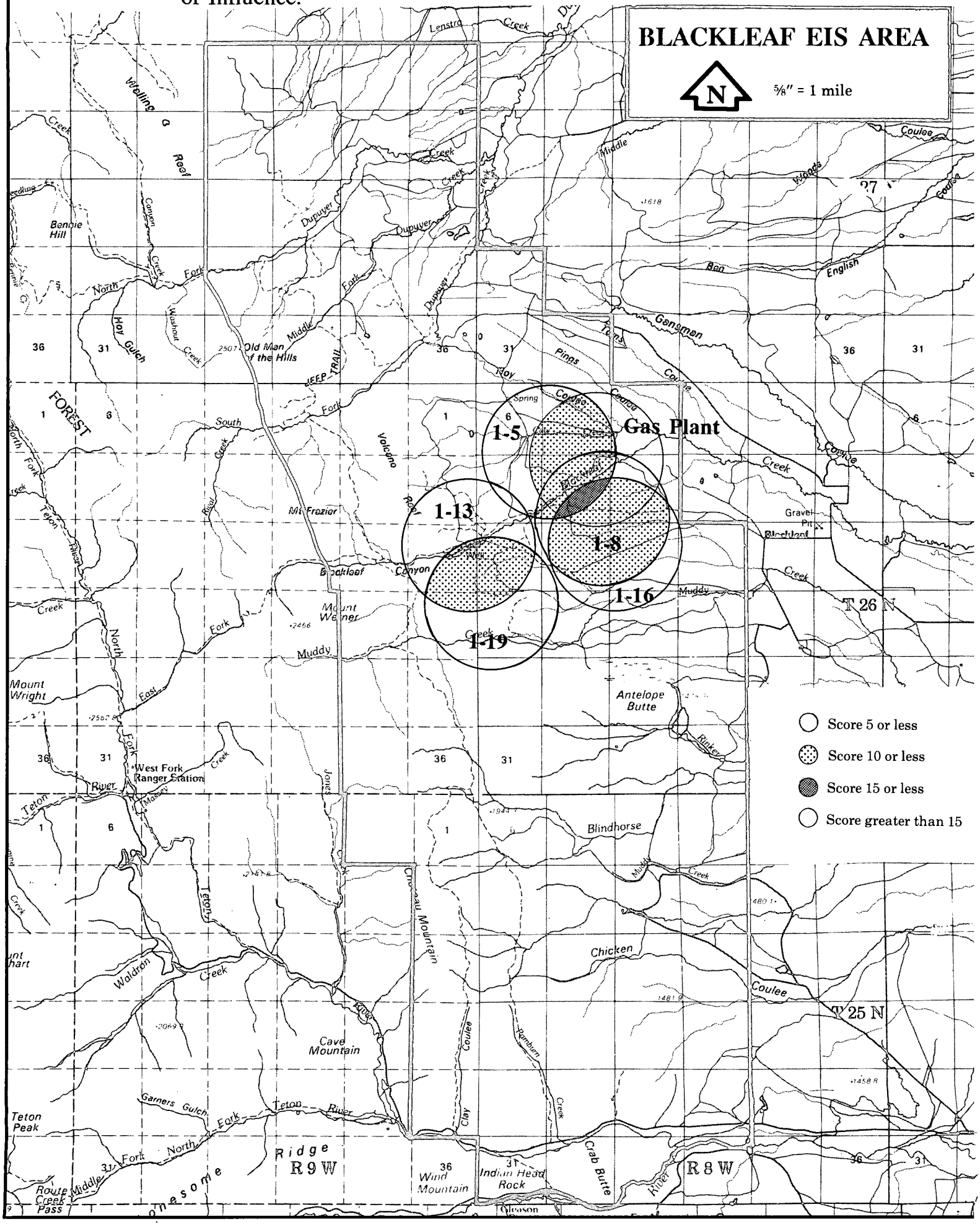
IMPORTANT HABITAT LYING WITHIN THE ZONE OF INFLUENCE (1-MILE) OF ALL ACTIVITIES PROPOSED IN ALTERNATIVE 1[1]

Species	Habitats	PRODUCERS 1-8	1-5	1-13	1-19	Gas Plant	Injection Well	Total Acres Affected
GRIZZLY BEAR	Spring Habitat Denning Habitat	2010	2010	2010	2010	2010	2010	12060
ROCKY MOUNTAIN GOAT	Occupied Yearlong Habitat			1350	700			2050
	Breeding/Kidding/ Nursery			1350	700			2050
ELK	Winter Range	2010	2010	2010	2010	2010	2010	12060
	Calving Area			540	380			920
	Migration Routes			X	X			
MULE DEER	Winter Range	1310	370	700	950	510	1570	5410
	Fall Transitional Range			370	30			400
	Migration Route			X	X			
RAPTORS	Golden Eagle			X	X			
	Prairie Falcon			X	X			
	Merlin			X	X			
	Accipiter Nesting Habitat (both occupied and potential)							
	Riparian Habitat for Raptors	X	X	X	X	X	X	
	Peregrine Falcon Potential Nesting Areas			X	X			
	Bald Eagle Winter Concentration Area							
GROUSE	Sharptailed Grouse "LEK" - All three leks lie just on the eastern edge of the EIS area.							
FISH	Fisheries (if within drainage)		X	X				
Total Acres/All Habitats								34950

X indicates that the habitat lies within the zone of influence (1-mile) of the wellsite or associated road or pipeline.

[1]BLM, 1989.

Figure 4.1 Cumulative Effects on Wildlife in Alternative One on a One-Mile Zone of Influence.



Cumulative Effects on Wildlife for Alternative 1 Based on a One-Mile Zone of Influence as Shown on Figure 4.1

	1-8	1-5	Gas Plant	1-16	1-13	1-19
Grizzly Bear (Spring range or denning habitat)	X	X	X	X	X	X
Rocky Mountain Goat (Occupied habitat or lick)					X	X
Bighorn Sheep (Winter range)						
Elk (Winter range)	X	X	X	X	X	X
Mule Deer (Winter Range)	X	X	X	X	X	X
Raptors (Prairie Falcon or Golden Eagle occupied cliffs)					X	X
Score	3	3	3	3	5	5

- Habitat delineations from the Interagency Rocky Mountain Front Wildlife Monitoring/Evaluation Program, BLM et al., 1987.

- Each site receives a score of one when a species habitat lies within one mile of the well location.

- Scores are cumulative when effects from two or more sites overlap.

Because the EIS area serves as critically important deer and elk winter range, construction activities during the winter and spring would cause the most significant negative consequences. These species are also attractants to predators, possibly including the endangered gray wolf. During the spring, the areas close to wellheads and along portions of the pipeline routes are close to Rocky Mountain goat breeding, kidding, and nursery habitat. Carrion on the big-game winter range attracts grizzly bears in the spring, and since this area is where greenup first occurs, the bears arrive immediately after den emergence. The riparian vegetation associated with Antelope Butte Swamp is also important to the grizzly during the summer and fall periods, but it is especially critical to them during the spring. Also, projected disturbance areas lie near important raptor breeding habitats which may be occupied from February to the end of July.

Piping the excess water a mile and re-injecting it would cause short-term impacts, unless the pipeline should break and spill which would also be highly unlikely. Maintenance checks, possibly weekly, at the re-injection wellsite would be a long-term disturbance associated with this project.

Implementation of Alternative 1 will not effect any of the Forest Service sensitive species. This is based on the fact that all construction will take place away from Volcano Reef (potential big-eared bat habitat) and the North and South Forks of Dupuyer Creek (potential harlequin duck habitat). The construction of the pipeline to the injection well passes across relatively flat ground, and crosses a dry creek bed. This drainage and the general lay of the land drains away from Cow Creek (pure strain cutthroat).

The keys to lessening and possibly avoiding impacts to wildlife from the activities proposed in this alternative are: to time the activities so that they do not take place when wildlife are present, or at least not during critical times in their life cycle; and to use remote monitoring of oil and gas activities. Therefore, the short-term impacts of such things as pipeline and gas plant construction, could usually be timed to avoid impacting the most important species. Activities which must occur year-round such as trucking condensate and daily manning of a central production facility, would be minor long-term disturbances.

Alternative 2

This alternative projects the greatest number of step-out and exploration wells with facilities at each producing wellsite. This would require daily to weekly visitation, with an extensive road system. and would affect the highest number of important wildlife habitats (see Table 4.10).

The greatest amount of conflict would occur in a northwest to southeast line through the center of the EIS area (the face of the Rocky Mountain Front). This is where the greatest number of important wildlife habitats overlap. This area is also of interest to industry and is where most of the projected drilling would occur.

West of this line, impacts would be significant because of the difficulty of developing access into projected sites however, fewer species would be affected. East of this line, off the toe of the slope, extremely important habitat exists (spring grizzly bear, deer and elk winter range), but access is much simpler as a road network already exists.

The degree of negative impact to wildlife would be directly proportionate to where the well is located in relation to important wildlife habitats (see Table 4.10) and how easily the drilling activity would fit into a timing window (see Figure 2.5 in Chapter 2).

Typical late summer, fall, and early winter drilling windows in the mid-July to mid-December period (and lengthened if necessary on one end or the other depending on locality) could be used to lessen drilling impacts. However, significant negative impacts would still occur, especially along the face of the Front and west of the face where so many important species' habitats overlap (see Table 4.10 and Figure 4.2).

This area lies parallel with the project's westernmost oil and gas structure. Of the 16 projected step-out or exploratory wells along this structure, all but four (E-3, E-4, E-6 and S-2) lie within a 1-mile zone of influence of virtually all important habitat categories found on the Front. The closer a wellsite is to the face, the greater the likelihood it would impact more habitats. Step-out wells S-3 through S-8 appear to be sited in areas of the highest wildlife values. Access difficulties to the sites further west (E-2, E-3, and E-5) would make it difficult to adhere to timing windows.

Wellsites located over a mile east of the face (1-5, 1-8 and S-1), eliminate most impacts to wildlife species. Much of this country is spring grizzly bear habitat as well as elk and deer winter range. Some of it also has very high riparian vegetation values. With only one new well (S-1) projected for this area, impacts would not be significant.

TABLE 4.10
IMPORTANT HABITATS LYING WITHIN THE ZONE OF INFLUENCE (1-MILE) OF ALL ACTIVITIES PROPOSED IN ALTERNATIVE 2[1]

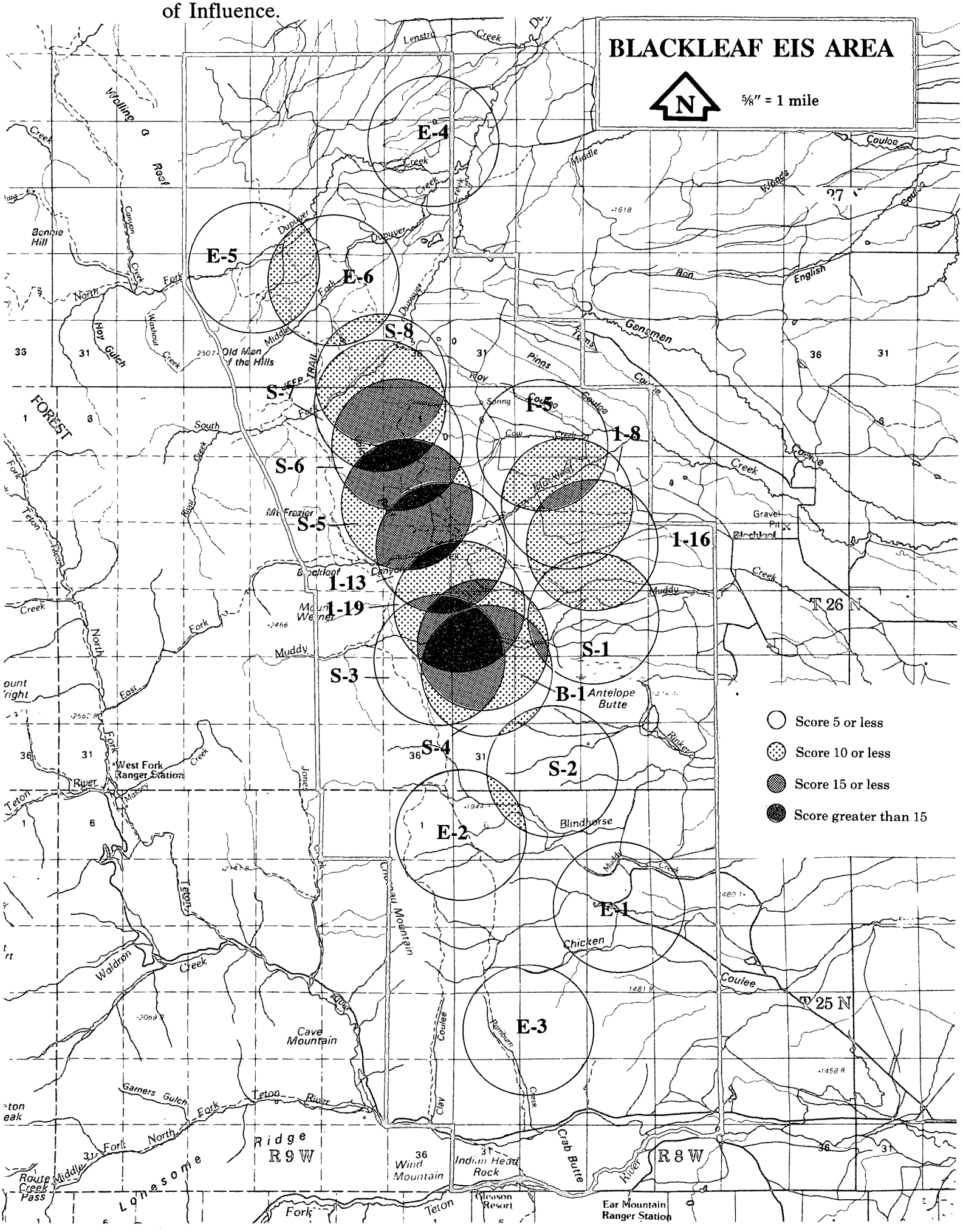
		Producers																		Total Acres
Species	**Habitats**	**1-8**	**1-5**	**1-13**	**1-19**	**B-1**	**S-1**	**S-2**	**S-3**	**S-4**	**S-5**	**S-6**	**S-7**	**S-8**	**E-1**	**E-2**	**E-3**	**E-4**	**E-5**	**E-6**	**Affected**
GRIZZLY	Spring Habitat	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	1880	2010	2010	1970	2010	38020
	Denning Habitat															130			40		170
ROCKY MOUN-TAIN GOAT	Occupied Yearlong Habitat			1350	700	650			1510	550	1130	910	710	280		530			70		8390
	Mineral Lick											X	X	X		X			X		
	Breeding/ Kidding/ Nursery			1350	700	650			1510	550	1130	910	710	280		530			70		8390
BIGHORN SHEEP	Winter Range										60	130	100	40					200		830
ELK	Winter Range	2010	2010	2010	2010	2010	1600	2010	2010	2010	2010	2010	2010	2010	130	1930		2010	2010	2010	33810
	Calving Area			540	380	635		80	400	800	820	600	280	20		125			500		5180
	Migration			X	X	X						X									
MULE DEER	Winter Range	1310	370	700	950	970	2010	1710	570	950	350				2010	230	1460	2010			15600
	Fall Transitional Range			370	30				360	30	480	210	50			1450					2980
	Migration Route			X	X			X								X	X				

RAPTORS	Golden Eagle			X	X	X		X	X	X	X	X	X	X	X	X	X			X	
	Prairie Falcon			X	X	X		X	X	X	X	X	X	X		X				X	
	Merlin			X	X	X	X	X	X	X					X	X	X	X			
	Acipiter Nesting Habitat (both occupied & potential)			X	X	X	X		X			X	X	X					X	X	
	Riparian Habitat for Raptors	X	X	X	X	X	X	X	X	X	X	X	X		X	X			X	X	
	Peregrine Falcon Potential Nesting Areas			X	X	X		X	X	X	X	X	X	X							X
	Bald Eagle Winter Concentration Area															X	X				
GROUSE	Sharptailed Grouse "LEK" - All three leks lie just on the eastern edge of the EIS area, possible slight impact from use of roads.																				
FISH	Fisheries (if within drainage)		X	X						X	X	X	X						X	X	X
Total Acres/All Habitats																					113070

X - indicates that the habitat lies within the zone of influence (1-mile) of the wellsite or associated road or pipeline.

[1]BLM, 1989.

Figure 4.2 Cumulative Effects on Wildlife in Alternative Two on a One-Mile Zone of Influence.



Cumulative Effects on Wildlife for Alternative 2 Based on a One-Mile Zone of Influence as Shown in Figure 4.2

	1-8	1-5	S-1	1-13	1-19	B-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	E-1	E-2	E-3	E-4	E-5	E-6
Grizzly Bear (Spring range or denning habitat)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Rocky Mountain Goat (Occupied habitat or lick)				X	X	X		X	X	X	X	X	X		X			X	
Bighorn Sheep (Winter range)										X	X	X	X					X	
Elk (Winter range)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
Mule Deer (Winter range)	X	X	X	X	X	X	X	X	X	X				X	X	X	X		
Raptors (Prairie Falcon or Golden Eagle occupied cliffs)				X	X	X	X	X	X	X	X	X	X		X			X	
SCORE	3	3	3	5	5	5	4	5	5	6	5	5	5	3	5	2	3	5	2

— Habitat delineations from the Interagency Rocky Mountain Front Wildlife Monitoring/Evaluation Program, BLM et al., 1987.

— Each site receives a score of one when a species habitat lies within one mile of the well location.

— Scores are cumulative when effects from two or more sites overlap.

Most drilling would last for 120 days or less (possibly two drilling periods in consecutive years, should access be extremely difficult). Thus, the impacts from drilling and associated activities, even though significant, would be temporary and short term.

Road and drill pad construction will have an effect on snag habitat and snag dependent species by the direct removal of snags. This will take place on approximately 110 acres where roads and pads will be placed in coniferous and riparian vegetation. Loss of these acres (.4% of deciduous and coniferous forest in EIS area) will not have an effect on long-term production or viability of any snag dependent species (which includes Northern 3-toed woodpecker-Forest Service management indicator species) within the EIS area.

One impact that was not addressed in Table 4.10 is the creation of access by field development. This has the potential to effect furbearers by increasing the take by trappers due to the increased access into new areas. This will not have a major effect on the populations of wolverine, lynx, bobcat or beaver because the harvest of these animals is limited by quota system by the Montana Department of Fish, Wildlife, and Parks.

The most significant impact to wildlife from full field development, as projected, would be the long-term impacts of development and production. These impacts could last for the life of the field, which is projected to be up to 25 years. The significance of the negative impacts during any given year would depend on how many and what kind of activities would be occurring. Timing windows cannot lessen many of the impacts to wildlife from production. Daily to weekly visits to wellheads and other weekly human intrusions may be necessary. At the far eastern boundary of the EIS area, little important habitat occurs and impacts from production facilities would be negligible.

Development activities located close together such as the 1-19, B-1, S-3, S-4, 1-13 and S-5 through S-8 sites (see Figure 2.5 in Chapter 2) would create significant impacts. Such impacts could reduce wildlife populations if the mitigation measures do not prove adequate. "Mammals learn to minimize encounters with humans, if harassed enough, by reducing activity to areas, habitats, and times of day where encounters with humans are minimal" (Geist 1971). This can change the ecology or reduce the size of a population by habituating animals to live in second-rate habitats (Bromley 1985). The decline of the Rocky Mountain goat population occurring in these areas already may be the result of increased and cumulative seismic activity along the Front (Joslin, G. 1986).

The combination of the B-1, S-3, and S-4 wellsites has the potential to have long lasting effects on prairie falcon and golden eagle nesting sites within the Muddy Creek canyon. This effect could result in nest abandonment, nestling survivability, nest production, or a combination of all three. The net result would be a decline in population within the Muddy Creek canyon.

The road construction, drilling, and production of the S-5, S-6, S-7 wellsites has the greatest potential to effect the Forest Service sensitive species; westslope cutthroat. Effects will result due to sediment being introduced into the head-waters of Cow Creek from road construction. Sediment loads will be transported through the steeper gradients and settle out in the gravels of low gradient portions of the stream, thereby reducing the survivability of eggs and fry within the spawning gravels. Although some decrease in habitat capability (as a function of increased sediment delivery) is probable, adequate reproduction will occur to ensure the viability of the resident population in Cow Creek.

Even though the S-5 , S-6, and S-7 well complex passes close to Volcano Reef where the potential habitat for the western big-eared bat is, there will be little to no effect on the bat due to the distance the road and wellsites are from the cliff faces (200-600 yards). The development of access could have an indirect effect on the bats by increasing the ease of access to the reef, possibly increasing the potential of disturbance by recreationists.

The S-8 well would have the potential to effect the potential harlequin duck habitat in the South Fork of Dupuyer Creek during the drilling operation. This effect would be one of potential displacement of any ducks within the zone of influence of the well. Depending on the timing of the actual drilling, displacement of the hen from a nest could result in egg loss due to predation or loss of young. If the ducklings are hatched and swimming it would mean displacement up or down stream. Placement of the actual well location could minimize this effect. This effect is very local and would not reduce the viability of the harlequin duck population on the Rocky Mountain District.

The S-8 well could also have an effect on the potential westslope cutthroat trout population by increased levels of sedimentation due to road reconstruction and pad construction. The levels of sediment will be minor however, due to the distance away from the stream and the slope (0-5%) of the land draining into the stream channel.

The E-5 and E-6 wells have the potential to effect the westslope cutthroat trout populations in the North Fork and

Middle Fork of Dupuyer Creek respectively. This effect will be in the form of introduced sediments during the road reconstruction phase of the project. Although some decrease in habitat capability (as a function of increased sediment delivery) is probable, adequate reproduction will occur to ensure the viability of the resident population in both the North and Middle Forks of Dupuyer Creek.

The cumulative effects of the S-6, S-7, and S-8 wells on bighorn sheep habitats in the South Fork Dupuyer Creek and Volcano Reef area just might be too severe for continued sheep occupancy in this area. Susceptibility of bighorns to stress-induced disturbances has been summarized by Stemp, 1983. It could even be theorized that at the mouth of Muddy Creek the 1-19, B-1, S-3 and S-4 sites could result in lowered carrying capacity for mule deer on this portion of the Blackleaf Wildlife Management Area (Ihsle-Pac et al. 1988). Reducing the number of development activities in these areas would lessen the likelihood of these thresholds being reached and would be the best mitigation possible.

Abandonment of facilities would result in some additional human disruptions near the end of the project, but would also result in the termination of development related activity and noise. Depending on the degree of man's efforts, wildlife habitat may be restored and possibly improved. Of particular importance would be those decisions concerning disposition of access roads. They could be rehabilitated, abandoned, administratively closed if publicly owned or in cooperation with private surface owners, or left for local residents to use. However, it would be likely that the wildlife values present before field development may not be totally restored, as negative impacts would be cumulative over the life of the field.

Alternative 3

Adherence to the Rocky Mountain Front Wildlife Guidelines and the Headwaters RMP/EIS would alleviate the most severe impacts in the EIS area, but would also substantially lower the number of wells that could be drilled.

Because of the great amount of overlapping habitats (see Figure 4.3), incompatibility with recommended timing windows and the anticipated difficulty of accessing such rugged terrain (Area A in Figure 2.7), only those activities proposed for the easternmost structure and three of the wells in the westernmost structure are considered in this alternative (Area B and C in Figure 2.7). Appendix F explains how these areas were defined.

Table 4.11 lists the important wildlife habitats that would be impacted by the projected activities in this alternative. Impacts from development activities in the easternmost structure were discussed in Alternative 2. Likewise, the kinds of impacts that would occur in the westernmost structure were discussed in Alternative 1. However, the four sites considered in this alternative (E-1, E-4, S-1, and S-2) east of the Front, can be easily accessed, (three are already along existing roads) and do not lie in such a large number of species habitats. Golden eagle and prairie falcon breeding and deer and elk winter range are the principal areas of conflict, and most negative impacts would be lessened by following a late summer to late fall drilling window.

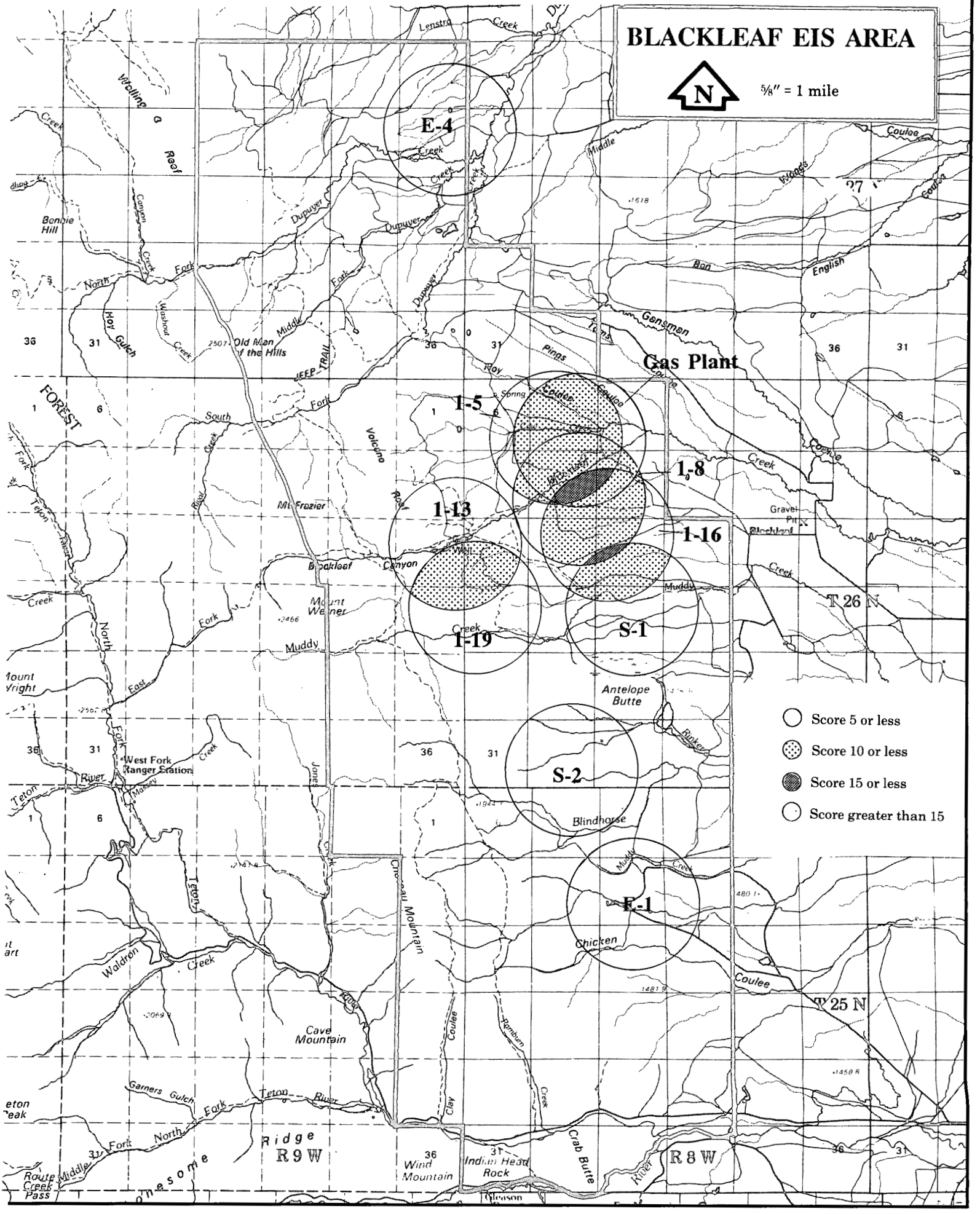
Alternative 3 will have a direct effect on snag habitat by road and well pad construction on 12 acres of coniferous and deciduous forest. This is less than .1% of the area within the EIS areas and will not effect the continued existence of any snag dependent species including the Forest Service's management indicator species, the northern 3-toed woodpecker.

Alternative 3 will have very little impact on furbearers because of the lack of new access being constructed. S-2 is the only well that will add any new access. This will not have a major effect on the harvest of the populations of wolverine, lynx, bobcat or beaver because the harvest of these animals is limited by a quota system by the Montana Department of Fish, Wildlife, and Parks.

Alternative 3 will not have an effect on any of the Forest Service sensitive species. This statement is based on the fact that all construction will take place away from Volcano Reef (potential big-eared bat habitat) and the North and South Forks of Dupuyer Creek (potential harlequin duck habitat). The construction of the pipeline to the injection well passes across relative flat ground, and crosses a dry creek bed. This drainage and the general lay of the land drains away from Cow Creek (pure strain cutthroat). E-4 is adjacent to the North Fork of Dupuyer Creek; however, the ground is almost flat (slope <5%) and there is adequate area between the well pad and the creek to provide for any filtration of sediment before it reaches the stream. The location of E-4 is east of the portion of the stream that would provide for potential harlequin duck habitat.

Operating the gas processing facility, including daily manning plus periodic checks of the re-injection well, would be the most prevalent long-term impact from the production phase of this alternative. Remote monitoring of producing wells would hold human visitation to these sites to a minimum.

Figure 4.3 Cumulative Effects on Wildlife in Alternative Three on a One-Mile Zone of Influence.



Cumulative Effects on Wildlife for Alternative 3 Based on a One-Mile Zone of Influence as Shown on Figure 4.3

	1-8	1-5	S-1	Gas Plant	Injection Well	1-13	1-19	S-2	E-1	E-4
Grizzly Bear (Spring range or denning habitat)	X	X	X	X	X	X	X	X	X	X
Rocky Mountain Goat (Occupied habitat or lick)							X	X		
Bighorn Sheep (Winter range)										
Elk (Winter range)	X	X	X	X	X	X	X	X	X	X
Mule Deer (Winter range)	X	X	X	X	X	X	X	X	X	X
Raptors (Prairie Falcon or Golden Eagle occupied cliffs)						X	X	X		
SCORE	3	3	3	3	3	4	5	5	3	3

— Habitat delineations from the Interagency Rocky Mountain Front Wildlife Monitoring/Evaluation Program, BLM et al., 1987.

— Each site receives a score of one when a species habitat lies within one mile of the well location.

— Scores are cumulative when effects from two or more sites overlap.

TABLE 4.11
IMPORTANT HABITATS LYING WITHIN THE ZONE OF INFLUENCE (1-MILE) OF ALL SITES PROPOSED IN ALTERNATIVE 3[2]

Species	Habitats	Producers										Total Acres Affected
		1-8	1-5	1-13	1-19	Gas Plant	Injection Well	S-1	S-2	E-1	E-4	
GRIZZLY BEAR	Spring Habitat	2010[1]	2010	2010	2010	2010	2010	2010	2010	2010	2010	20100
ROCKY MOUNTAIN GOAT	Occupied Yearlong Habitat			1350	700							2050
	Breeding/Kidding/Nursery			1350	700							2050
ELK	Winter Range	2010	2010	2010	2010	2010	2010	1600	2010	130	2010	17810
	Calving Area			540	380				80			1000
	Migration Routes			X	X							
MULE DEER	Winter Range	1310	370	700	950	510	1570	2010	1710	2010	2010	13150
	Fall Transitional Range			370	30							400
	Migration Routes			X	X				X			
RAPTORS	Golden Eagle			X	X				X	X		
	Prairie Falcon			X	X				X			
	Merlin			X	X			X	X	X	X	
	Acipiter Nesting Habitat (both occupied & potential)			X	X			X				
	Riparian Habitat for Raptors	X	X	X	X	X	X	X	X	X	X	
	Peregrine Falcon Potential Nesting Areas			X	X				X			
	Bald Eagle Winter Concentration Area								X			
GROUSE	Sharptailed Grouse "LEK" - All three leks lie just on the eastern edge of the EIS area, possible slight impact from use of roads.											
FISH	Fisheries (if within drainage)		X	X							X	
Total Acres/All Habitats												56560

X - indicates that the habitat lies within the zone of influence (1-mile) of the wellsite or associated road or pipeline.

[1]Acres of Habitat Influenced.

[2]BLM, 1989.

During the production phase of this field, the habitats most affected would be grizzly bear spring range, deer and elk winter range, and riparian areas important to raptors. These habitats are within the gas plant and re-injection well zone of influence

Alternative 4

All exploration and step-out wells considered in Alternative 2, except for S-6 and S-7, have been retained in this alternative, thus most of the impacts would be similar. However, some of the more significant impacts could be lessened through: (1) construction of a gas plant allowing remote monitoring of wellsites (as discussed in Alternatives 1 and 3); (2) application of a 3 1/2-month timing window based on site specific inspections and designed to mitigate adversity to the highest wildlife values; (3) institution of firm road management policies including restrictions and closures to the public; and (4) better road and wellsite placement at S-4 to avoid important deer winter range and spring grizzly bear riparian habitat.

As projected the exploratory wells in this alternative would result in unavoidable impacts to wildlife, in both the easternmost and westernmost geologic structures. Different timing windows would be selected for each site, based on importance of the area to the wildlife present (Figure 2.11 in Chapter 2). Site-specific analysis conducted for a particular Application for Permit to Drill (APD) may indicate the most suitable timing window based on that year's precipitation record, relative value of habitats at that particular site, or a multitude of other factors. BLM would select a 3 1/2-month timing window within the July 15 to December 15 period.

Completing a well, including road and pad construction and drilling in 90 days or less, has not proven to be very feasible along the Rocky Mountain Front, thus the 3 1/2-month window would be considered. Allowing more than 90 days should facilitate completing the entire process in one window, which should lessen impact to wildlife rather than having disturbance in two consecutive years. However, if the process cannot be completed in 3 1/2-months and adherence to that period prevails, a 2-year period may be required. If an extension of a couple weeks could result in completing the drilling with fewer overall impacts to wildlife, an extension could be granted. Planning road and pad construction one year and drilling the next would be necessary at the most difficult sites. Some sites might require three windows for completion, including installation of a collection pipe.

A July 15th to October 30th timing window would probably be most acceptable for activities along the face of the Front (westernmost structure) and the more back country areas where the greatest number of important wildlife habitats overlap (see Figure 4.4). This area corresponds to the exploratory wells E-2 and E-5, all step-out wells except S-1, and wells 1-13, 1-19, and B-1 (see Table 4.12). Producing the westernmost structure is generally most compatible to this window.

Even with this timing window (July 15 to October 30th, Figure 2.10) a number of species would be affected during some critical period (see Figure 4.4). However, except for grizzly bear, the timing window overlaps only at the beginning or end of an important period. In the case of the grizzly, riparian and berry foraging areas off the face of the Front and alpine and whitebark pine feeding sites behind the face would probably receive more use during this period. The more critical periods for Rocky Mountain goats would be avoided.

Bighorn sheep winter range/rutting areas may be affected beginning in mid-September, especially under Volcano Reef (S-5) and in areas close to the mouths of the South and North of Forks Dupuyer Creek (E-5 and S-8). Raptors could be affected during the final 2 weeks of their breeding cycles, at least for the two most prevalent species, prairie falcon and golden eagle, and nest abandonment or other harmful effects are not considered as likely as during earlier periods (Dubois and BLM, 1987). During the early and more severe winters, early mule deer migrants might also be slightly impacted.

In the area off the face of the Front, Rocky Mountain goat, bighorn sheep, and cliff-nesting raptor habitats do not overlap with grizzly bear habitat or deer and elk winter range. Thus, the latter three species are the ones of most concern and an August 15th to November 30th or September 1st to December 15th fall drilling window appears to be the best window available. Riparian areas, especially Antelope Butte Swamp, are important to grizzlies, but most of the berries found in the flatlands, principally *Shepherdia* under overstories of limber pine, should have passed their usefulness by September 1st. Therefore, bears may be spending more time following the phenology (the flowering of plants in relation to climate) of remaining green vegetation to higher elevation sites as well as searching for pine nuts and initiating their den sites. Mule deer and elk would be affected, possibly as early as late October, if harsh weather occurs that early. Hunting pressure may impede their movement onto flat lands this early. Wintering deer and elk would be most stressed later during January-March.

TABLE 4.12
IMPORTANT HABITATS LYING WITHIN THE ZONE OF INFLUENCE (1-MILE) OF ALL ACTIVITIES PROPOSED IN ALTERNATIVE 4[2]

		Producers																		Total Acres
Species	**Habitats**	**1-8**	**1-5**	**1-13**	**1-19**	**Pland**	**Well**	**B-1**	**S-1**	**S-2**	**S-3**	**S-4**	**S-5**	**S-8**	**E-1**	**E-2**	**E-3**	**E-4**	**E-5**	**E-6**	**Affected**
GRIZZLY BEAR	Spring Habitat	2010[1]	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	1880	2010	2010	1970	2010	38020
	Denning Habitat															130			40		170
ROCKY MOUN-TAIN GOAT	Occupied Yearlong Habitat			1350	700			650		110	1510	800	1130	280		530			70		8040
	Mineral Lick									X				X		X			X		
	Breeding/ Kidding/ Nursery			1350	700			650		110	1510	800	1130	280		530			70		8040
BIGHORN SHEEP	Winter Range												60	40				200			430
ELK	Winter Range	2010	2010	2010	2010	2010	2010	2010	1600	2010	2010	2010	2010	2010	130	1930		2010	2010	2010	35820
	Calving Area			540	380			635		250	400	1050	820	20		125			500		5320
	Migration Routes		X	X			X														
MULE DEER	Winter Range	1310	370	700	950	510	1570	970	2010	1050	570	410	350		2010	230	1460	2010			16480
	Fall Transi-tional Range			370	30					300	360	100	480			1450					3300
	Migration Route		X	X			X								X	X					

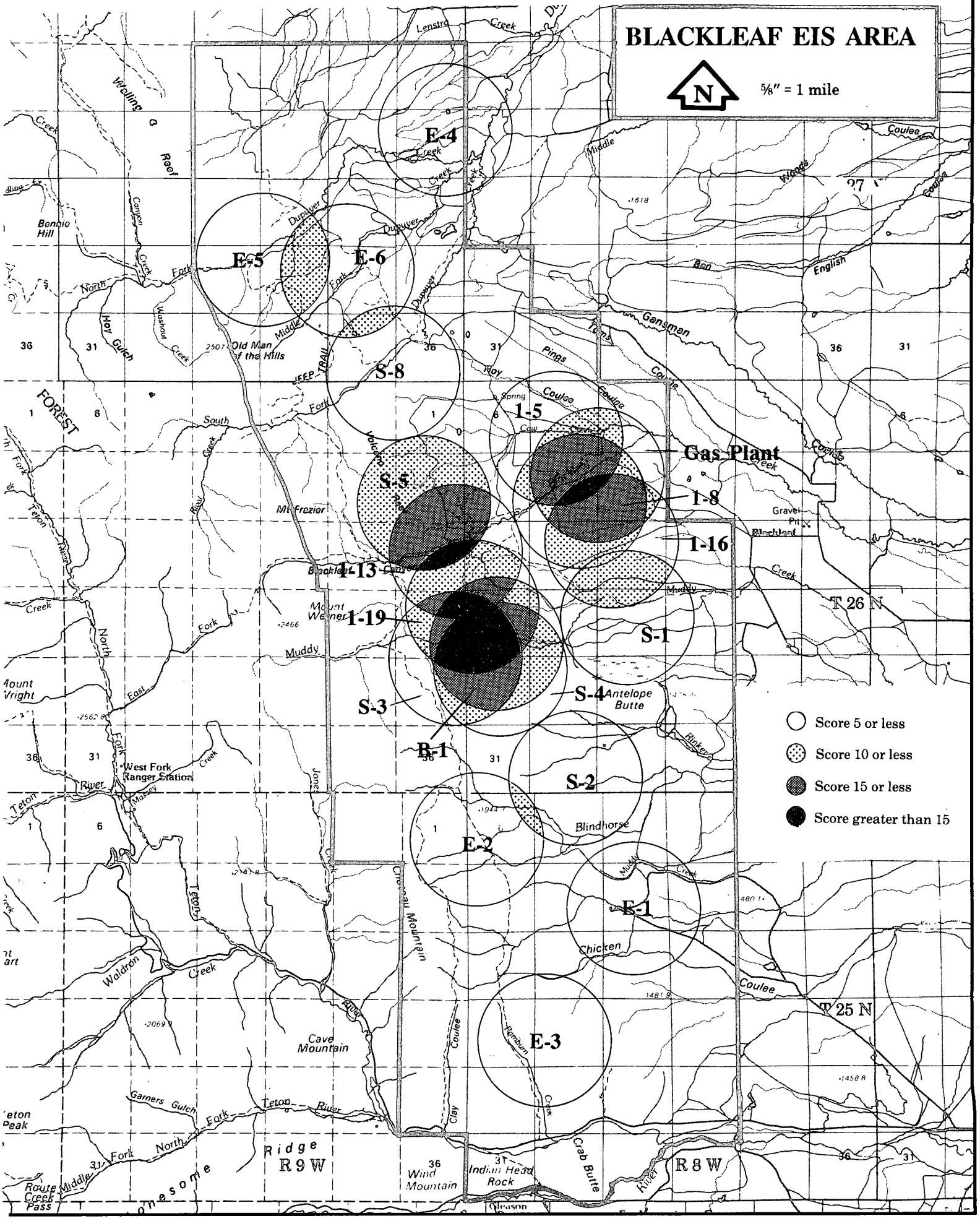
RAPTORS	Golden Eagle		X	X			X		X	X	X	X	X	X	X	X			X	X
	Prairie Falcon		X	X			X		X	X	X	X	X		X				X	
	Merlin		X	X			X	X	X	X	X			X	X	X	X			X
	Acipiter Nesting Habitat (both occupied & potential)		X	X			X	X		X	X		X						X	
	Riparian Habitat for Raptors	X	X	X	X	X	X	X	X	X	X	X		X	X			X	X	X
	Peregrine Falcon Potential Nesting Areas			X	X		X		X	X	X	X	X							X
	Bald Eagle Winter Concentra-tion Area															X	X			
GROUSE	Spartailed Grouse "LEK" - All three leks lie just on the eastern edge of the EIS area, possible slight impact from use of roads.																			
FISH	Fisheries (if within drainage)		X	X								X	X				X	X	X	

Total Acres/All Habitats 115620

X - Indicates that the habitat lies within the zone of influence (1-mile) of the wellsite or associated road or pipeline.

[1]Acres of Habitat Influenced.
[2]BLM,1989.

Figure 4.4 Cumulative Effects on Wildlife in Alternative Four on a One-Mile Zone of Influence.



Cumulative Effects on Wildlife for Alternative 4 Based on a One-Mile Zone of Influence as Shown on Figure 4.4

	1-8	1-5	Gas Plant	Injection Well	1-13	1-19	B-1	S-2	S-3	S-4	S-5	S-8	E-1	E-2	E-3	E-4	E-5	E-6
Grizzly Bear (Spring range or denning habitat)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Rocky Mountain Goat (Occupied habitat or lick)					X	X	X		X	X	X	X		X			X	
Bighorn Sheep (Winter range)											X	X					X	
Elk (Winter range)	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
Mule Deer (Winter range)	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X		
Raptors (Prairie Falcon or Golden Eagle occupied cliffs)					X	X	X	X	X	X	X	X		X			X	
SCORE	3	3	3	3	5	5	5	4	5	5	6	5	3	5	2	3	5	2

— Habitat delineations from the Interagency Rocky Mountain Front Wildlife Monitoring/Evaluation Program, BLM et al., 1987.

— Each site receives a score of one when a species habitat lies within one mile of the well location.

— Scores are cumulative when effects from two or more sites overlap.

The effects of Alternative 4 on snag dependent species, furbearers, and Forest Service sensitive species will be similar to those discussed in Alternative 2. The main difference will be the potential effects to cutthroat trout in the Cow Creek drainage. Without the drilling of S-6 and S-7 and the corresponding road construction, the degree of sedimentation that would reach the lower gradient reaches of Cow Creek will be greatly diminished, thereby reducing the potential effect on the fisheries that are present.

Drilling the S-8 well with the specified timing window will ensure that nest abandonment by harlequin ducks will not take place and the only effect would be the displacement of the hen and her brood up or down stream to avoid the disturbance.

The implementation of effective road closures will also lessen the effect of the taking of furbearers by trappers.

The long-term cumulative impacts of production over many years are the most significant and difficult to mitigate. Frequent and uncontrolled human intrusion occurring along roads to wellheads, by either the general public or company workers monitoring facilities, would significantly impact many species. Human activity at this level could possibly cause long-term avoidance of the habitats necessary to sustain a species through its yearly life cycle; the result would be the loss of individuals or perhaps whole populations.

The key to lessening the long-term impacts of production is to remotely monitor wellheads and process the gas at one plant. Reducing the number and kinds of habitats affected would not significantly change from Alternative 2 to this alternative, but the amount of negative impact during production would be significantly less.

The effects of abandonment would be similar to those discussed in Alternative 2. The differences would be that less disturbance would probably occur as fewer facilities would have to be dismantled; smaller areas reclaimed; and possibly lower quality roads may have been constructed, requiring less work to obliterate and reclaim. Less negative influence on wildlife populations may have occurred because of remote monitoring, thus, the possibility of rapid and full recovery of all wildlife would be greater.

Appendix O contains the Wildlife Monitoring Plan for the Blackleaf EIS Area.

TETON ROADLESS AREA

When this section addresses the Blackleaf-Dupuyer Unit, it is addressing that unit of the Teton Roadless Area.

Alternative 1

Under Alternative 1, one existing well (1-13) would be active on roadless lands. The only change from the present situation would be the removal of existing water tanks.

Natural Integrity

The continued production of the 1-13 well would not alter long-term ecological processes that are currently operating. The natural integrity of the Teton Roadless Area would be unaffected.

Apparent Naturalness

Removal of the condensate tanks at the 1-13 well site would reduce, but not eliminate, the unnatural appearance of this development. The remainder of the Teton Roadless Area would be unaffected by Alternative 1.

Remoteness

Alternative 1 would not alter the existing "remote" conditions in the Teton Roadless Area.

Solitude

By removing condensate tanks at the 1-13 wellsite, the number of visits the field operator would make to the 1-13 would be reduced. Conditions for solitude would be slightly enhanced. Otherwise, solitude in the Teton Roadless Area would be unaffected.

Special Features

The special biological, scenic, and geological features in the Teton Roadless Area would not be altered.

Manageability/Boundaries

Alternative 1 would not affect the high degree of manageability presently afforded by the boundaries of the Teton Roadless Area.

Special Places - Special Values

This alternative would not affect the combination of values that makes the Blackleaf area special to many people.

Cumulative Effects

This alternative would not have any substantive effect on roadless lands, and therefore would not contribute to any cumulative effects.

Alternative 2

Under Alternative 2, five new step-out wells (S-3, S-5, S-6, S-7, and S-8) and one exploratory well (E-5) would be developed on the Blackleaf Unit within the Teton Roadless Area. These six wells would require 6.6 miles of road construction and 6.6 miles of subsurface pipeline. The S-4 well on MDFWP lands would require 0.3 miles of road and pipeline on roadless lands. The road/pipeline corridor for all these wells would be 30-50 feet wide. Production facilities (condensate tanks and separation equipment) would be located at each wellsite. The 1-13 well would continue to operate and its existing production facilities would remain.

Natural Integrity

Under Alternative 2, the natural integrity of the 15,360 acre Blackleaf Unit of the Teton Roadless Area would be substantially reduced. Construction of 6.9 miles of new roads and the subsequent activity along these roads would affect long-term ecological processes in the Blackleaf Unit for the life of the field (approximately 25 years). After field abandonment, an interval of at least several decades may be required before interrupted, long-term ecological processes resume.

The long-term ecological relationships adversely affected by Alternative 2 would be those relationships between certain T & E wildlife species and their important habitats. According to the wildlife analysis on page 104 (in DEIS), activity associated with the six new wells and three new roads in the Teton Roadless Area would have "significant negative impacts" on wildlife.

Specifically, the wildlife analysis reports that activity related to producing the S-6, S-7, and S-8 wells may eliminate bighorn sheep use in the Volcano Reef and South Fork Dupuyer Areas (p. 106 in DEIS). Loss of sheep habitat may lead to population losses (p. 106 in DEIS).

The wildlife analysis also indicates that production activities related to the S-3, S-4, S-5, S-6, S-7, S-8, and E-5 wells would impact mountain goat and elk winter range and kidding/calving areas, causing these species to reduce activities to areas, habitats, and times of day where encounters with humans are minimal (p. 106, DEIS). This can change the ecology or reduce the size of a population by habituating animals to live in second rate habitats. The production activity related to these seven wells may adversely affect grizzly bears, prairie falcons, and golden eagles that use the Muddy Creek and Volcano Reef areas (pages 104-106 in DEIS). The populations of these three species may experience reductions in these areas.

Production activity related to the S-3 well and the S-4 access road on roadless lands in combination with activity around the S-4, 1-19, and B-1 wells on MDFWP lands may lower the area's ability to support mule deer (p. 106 in DEIS).

The loss of important habitat and possible population declines for four large herbivores (elk, mule deer, bighorn sheep, and mountain goat), one large omnivore (grizzly), and two carnivores (golden eagle and prairie falcon) is a direct effect to long-term ecological processes in the Blackleaf Unit of the Teton Roadless Area. Impacts on these seven species may accelerate following the drilling of each successive well. These effects (displacement and reproductive rate declines) would last for the 25-year life of the field. Species with relatively low reproductive rates like the grizzly, mountain goat, and golden eagle may take considerable time to recover. For the remaining species, recovery may occur within 10 to 20 years.

The displacement of wildlife from activity related to wells would also affect two other long-term ecological processes: the relationships between 1) herbivores and predators and 2) herbivores and native grasslands.

Reduced populations of elk, mule deer, and bighorn sheep in the Blackleaf Unit would diminish the food base available to mountain lions, wolves, grizzlies, coyotes, bobcats, and wolverines. A smaller food base may lead to reduced populations of these predators. Loss of nesting prairie falcon and golden eagle habitat may allow increases in rodent populations. Such increases may allow weasel, badger, and mink populations to rise.

Reductions in mountain goat, mule deer, elk, and bighorn sheep populations for extended periods (> 20 years) would alter the species composition of native grasslands in the Blackleaf Unit. The loss of large grazing ungulates would increase the vigor and productivity of palatable species. Over time, the percentage of these species would increase in native grassland communities. In some areas, reduced grazing pressure would hasten the development of climax rough fescue communities.

Apparent Naturalness

Construction of 6.9 miles of roads and pipeline and the installation of five new wellsite production facilities would substantially diminish apparent naturalness on approximately 2600 acres (4%) of the Teton Roadless Area.

The S-3 well production facilities and the 0.6 mile access road and pipeline to the S-3 and S-4 well would reduce the natural character of 250 acres in the Muddy Creek Canyon. The 30-50 foot wide road/pipeline corridor that accesses the S-3 and S-4 would be a dominant human intrusion in the pristine canyon. Condensate tanks (typically 12 feet wide and 20 feet high) and a building housing separation equipment with a 25-30 foot high flarestack (hinged for laydown) would also detract from the undisturbed appearance of the Muddy Creek Canyon.

The S-5, S-6, and S-7 wells would line the face of Volcano Reef. The road, pipeline, and facilities associated with these wells would diminish the apparent naturalness of 1500 acres (3%) along the east side of Volcano Reef. The 4.4 miles of new road and pipeline would add an unnatural element to this previously natural landscape. The pipeline road corridor would be visible from Highway 89, 17 miles to the east. The condensate tanks and separation facilities at each wellsite would further detract from the area's natural character, although they would be painted to blend with the natural landscape.

The S-8 well production facilities and the 0.25 miles access road and pipeline would reduce the natural character of 200 acres in the South Fork Dupuyer Canyon. The road/pipeline corridor and wellsite facilities combine to give an unnatural appearance to this area.

The 1 mile of access road to the E-5 site would slightly reduce the natural character of 640 acres in North Fork Dupuyer Creek valley. Presently, a jeep trail accesses this site. Upgrading this trail to a road would not represent a major reduction in apparent naturalness. However, the signs of human activity would be more obvious to the casual observer.

The continued presence of condensate tanks, separation facilities, and access road at the 1-13 well site would perpetuate the unnatural appearance of 60 acres in the Blackleaf canyon.

Remoteness

The construction of 6.9 miles of roads would increase accessibility and diminish remoteness on approximately 2,600 acres (4%) of the Teton Roadless Area. The S-3/S-4 access road would substantially reduce remoteness in the 250 acre Muddy Creek Canyon. The S-5/S-6/S-7 access road would eliminate remote conditions along the eastern front of Volcano Reef. Converting the existing jeep trails to roads to access the S-8 and E-5 sites would only slightly reduce remote conditions in the South Fork Dupuyer Creek and North Fork Canyons.

Solitude

The addition of 6.9 miles of roads and 5 new wellsites would reduce opportunities for solitude on the Blackleaf Unit during the life of the field. During road/pad construction and drilling, noise and human activity levels would increase (p. 124-125, DEIS). The number of annual visitor days would increase by an estimated 400% during the drilling phase.

During the production phase, there would be a reduction in noise and human activity. Despite this decline, noise and human activity levels would still be higher than before development. Increased road traffic from wellsite monitoring and condensate removal would produce intermittent daily noise along road corridors. The number of annual visitor days would be about twice the pre-project level. The areas impacted by these activities would be the Muddy Creek, South Fork Dupuyer Creek and North Fork Dupuyer Creek Canyons and Volcano Reef. Approximately 2,800 acres (4%) would no longer be suitable for people seeking solitude. Following road abandonment, conditions for solitude could be restored by road reclamation.

Special Features

Special scenic and biological features would be altered by Alternative 2. The view created by the massive, sheer limestone cliffs that line the western boundary of the project area would be changed by the S-5/S-6/S-7 access road. This road would traverse the length of the eastern slope of Volcano Reef, a dominant feature of the landscape. The aesthetic appeal of the Muddy Creek Canyon waterfall

would be reduced by the presence of a road and wellsite facilities nearby.

There would be no affects to unique plant communities in the Teton Roadless Area.

The wildlife values found in the Blackleaf Unit would be reduced. Wildlife abundance and diversity would decline. The density of prairie falcon and golden eagle nests would not remain. The continued health of the grizzly population may be affected.

Manageability/Boundaries

Implementation of Alternative 2 would reduce the Teton Roadless Area by 2,600 acres. This would be a 4% reduction for the total Teton Roadless Area and a 17% reduction in the Blackleaf Unit portion of the roadless area. The proposed activities would not create any roadless islands or peninsulas. Maintaining roadless conditions on the remaining acreage would not be more difficult because the effects are restricted to the eastern edge of the roadless area.

Special Places - Special Values

Alternative 2 would reduce several of the values that make the Blackleaf area a special place for many people. The perceived pristine character of the Rockies/High Plains transition zone would be altered. The presence of humans and their activities would be evident and detract from the special experience many people have when they visit the Blackleaf area.

Cumulative Effects

The Teton Roadless Area is part of the 866,330 acre Bear-Marshall-Scapegoat-Swan Roadless Area which is contiguous to the Bob Marshall Wilderness Complex. There are 336,620 acres of this roadless area on the Lewis and Clark National Forest, Rocky Mountain District. Since the Forest Plan was implemented in 1987, timber harvest and private access activities on the Rocky Mountain District have removed the roadless status from 320 acres in the Renshaw and Benchmark/Elk Creek Roadless Areas. The 2,600 acres affected by Alternative 2 would diminish the roadless lands on the Rocky Mountain District by an additional 0.8%.

Alternative 3

Under Alternative 3, the one existing well (1-13) would be active on roadless lands. The only change from the present situation would be the removal of existing condensate tanks.

Natural Integrity

The continued production of the existing 1-13 well would not alter long-term ecological processes that are currently operating. The natural integrity of the Teton Roadless Area would be unaffected.

Apparent Naturalness

Removal of the existing condensate tanks at the 1-13 wellsite would reduce, but not eliminate, the unnatural appearance of this gas development. The remainder of the Teton Roadless Area would be unaffected by Alternative 3.

Remoteness

Alternative 3 would not alter the existing remove conditions in the Teton Roadless Area.

Solitude

By removing condensate tanks at the 1-13 wellsite, the number of visits the field operator would make to the 1-13 would be reduced. Conditions for solitude would be slightly enhanced. Otherwise, solitude in the Teton Roadless Area would be unaffected.

Special Features

The special biological, scenic, and geological features in the Teton Roadless Area would not be altered.

Manageability/Boundaries

Alternative 3 would not affect the high degree of manageability presently afforded by the boundaries of the Teton Roadless Area.

Special Places - Special Values

This alternative would not affect the combination of values that makes the Blackleaf area special to many people.

Cumulative Effects

Alternative 3 would not produce any substantive affects to the Teton Roadless Area and therefore would not contribute to any cumulative affect.

Alternative 4

Under Alternative 2, three new step-out wells (S-3, S-5 and S-8) and one exploratory well (E-5) would be developed on the Blackleaf Unit of the Teton Roadless Area. These three wells would require 4.35 miles of road construction and 4.35 miles of subsurface pipeline. The S-4 well on MDFWP lands would require 0.3 miles of road and pipeline on roadless lands. The road/pipeline corridor for all these wells would be 30-50 feet wide. A building housing separation equipment would be situated at each wellsite. The 1-13 well would continue to operate; its condensate tanks, however, would be removed.

Natural Integrity

Under Alternative 4, the natural integrity of the Blackleaf Unit of the Teton Roadless Area would be reduced. Construction of 4.65 miles of new roads and the subsequent activity along these roads would affect long-term ecological processes in the Blackleaf Unit for the life of the field (approximately 25 years). After field abandonment, several decades may be required before interrupted long-term ecological processes resume. The long-term ecological relationships affected by Alternative 4 would be those relationships between certain wildlife species and their important habitats. According to the wildlife analysis on (p. 113 in DEIS), activity associated with the four new wells and three new roads in the Teton Roadless Area may have long-term cumulative impacts on wildlife. The degree of these impacts may be reduced if remote monitoring produces significantly less human activity along roads and at wellsites than onsite monitoring (p. 113 in DEIS).

Specifically, the wildlife analysis reports that activity related to producing the S-5, E-5 and S-8 wells would affect bighorn sheep use in the Volcano Reef, North Fork Dupuyer, and South Fork Dupuyer areas (p. 113 in DEIS).

The wildlife analysis also indicates that production activities related to the S-3, S-4, S-5, S-8, and E-5 wells would impact mountain goat and elk winter range and kidding/calving areas and may cause long-term avoidance of the habitats necessary to sustain a species through its' yearly life cycle; the result may be the loss of individuals or perhaps whole populations (pp. 113-114, DEIS). However, remote monitoring will lessen these impacts. The production activity related to these five wells was expected to affect prairie falcons and golden eagles that use the Muddy Creek and Volcano Reef areas (pp. 113-114 in DEIS). The populations of these two species may experience reductions in these areas.

Production activity related to the S-3 well and the S-4 access road on roadless lands in combination with activity around the S-4, 1-19 and B-1 wells on MDFWP lands may lower the area's ability to support mule deer (p. 113 in DEIS).

The loss of important habitat and possible population declines for four large herbivores (elk, mule deer, mountain goat, and bighorn sheep) and two carnivores (golden eagle and prairie falcon) constitute a direct, adverse affect to long-term ecological processes in the Blackleaf Unit of the Teton Roadless Area. Adverse affects to these six species would accelerate following the drilling of each successive well. These affects (displacement and reproductive rate declines) would last for the 25-year life of the field. Species with relatively low reproductive rates like the golden eagle and mountain goat may take considerable time to recover. For the remaining species recovery may occur within 10 to 20 years (p. 113 in DEIS).

The displacement of wildlife from activity related to wells would also affect two other long-term ecological processes, the relationships between 1) herbivores and predators and 2) herbivores and native grasslands.

Reduced populations of elk, mule deer, and bighorn sheep in the Blackleaf Unit would diminish the food base available to mountain lions, wolves, grizzlies, coyotes, bobcats, and wolverines. A smaller food base may lead to reduced populations of these predators. Loss of nesting prairie falcon and golden eagle habitat may allow increases in rodent populations. Such increases may allow weasel, badger, and mink populations to rise.

Reductions in mule deer, mountain goat, elk, and bighorn sheep populations for extended periods (>20 years) would alter the species composition of native grasslands in the Blackleaf Unit. The loss of large grazing ungulates would increase the vigor and productivity of palatable species.

Over time, the percentage of these species would increase in native grassland communities. In some areas, reduced grazing pressure would hasten the development of climax rough fescue communities.

Apparent Naturalness

Construction of 4.65 miles of roads and pipeline and the installation of three new wellsite production facilities would substantially diminish apparent naturalness on approximately 1,800 acres in the Teton Roadless Area's Blackleaf Unit.

The S-3 well production facilities and the 0.6 mile (on roadless lands) access road and pipeline to the S-3 and S-4 well would reduce the natural character of 250 acres in the Muddy Creek Canyon. The 30-50 feet wide road/pipeline corridor that accesses the S-3 and S-4 would be a dominant human intrusion in the pristine canyon. The building that houses separation equipment with a 25-30 feet high flarestack would also detract from the undisturbed appearance of the Muddy Creek Canyon.

The road/pipeline corridor that accesses the S-5 site building would diminish the apparent naturalness of 650 acres along the east side of Volcano Reef. The 2.9 miles of new road containing numerous switchbacks would add a major unnatural element to this natural landscape. The pipeline/road corridor would be visible from Highway 89, 17 miles to the east. The separation facilities, while painted a color to blend with the natural landscape, would further detract from the area's natural character.

The S-8 well production facilities and the 0.25 mile (on roadless lands) access road and pipeline would reduce the natural character of 200 acres in the South Fork Dupuyer Canyon. The road/pipeline corridor and wellsite facilities combine to give an unnatural appearance to this area.

The 1 mile of access road to the E-5 site would slightly reduce the natural character of 640 acres in North Fork Dupuyer Creek Valley. Presently, a jeep trail accesses this site. Upgrading this trail to a road would not represent a major reduction in apparent naturalness. However, the signs of human activity would be more obvious to the casual observer.

The continued presence of separation facilities and access road at the 1-13 wellsite would perpetuate the unnatural appearance of 60 acres in the Blackleaf Canyon.

Remoteness

The construction of 4.65 miles of roads would increase accessibility and diminish remoteness on approximately 1,800 acres (3%) of the Teton Roadless Area. The S-3/S-4 access road would reduce remoteness in the 250 acre Muddy Creek Canyon. The S-5 access road would eliminate remote conditions along a portion of Volcano Reef's eastern front. Converting the existing jeep trails to roads into access the S-8 and E-5 sites would only slightly reduce remote conditions in the South Fork Dupuyer Creek and North Fork Dupuyer Creek Canyons.

Solitude

The addition of 4.65 miles of roads and three new wellsites would reduce opportunities for solitude on the Blackleaf Unit during the life of the field. During road/pad construction and drilling, noise and human activity levels would increase (p. 124-125 DEIS). Noise would be detected 1/4-1/2 mile from construction and drilling sites (p. 125 DEIS). The number of annual visitor days would increase by an estimated 300% during the drilling phase.

During the production phase, there would be a reduction in noise and human activity. Despite this decline, noise and human activity levels would still be higher than before development. Increased road traffic from wellsite monitoring and condensate removal would produce intermittent daily noise along road corridors. The number of annual visitor days would be approximately 1.5-times the pre-project level. The areas impacted by these activities would be the Muddy Creek, South Fork Dupuyer Creek, and North Fork Dupuyer Creek Canyons and Volcano Reef. Approximately 2,000 acres would no longer be available for people seeking solitude. Following road abandonment, conditions for solitude could be restored by road reclamation.

Special Features

Special scenic and biological features would be altered by Alternative 4. The view created by the massive, sheer limestone cliffs that line the western boundary of the project area would be affected by the S-5 access road. This road would traverse 1/3 the length of the eastern slope of Volcano Reef, a dominant feature in the Blackleaf landscape. The aesthetic appeal of the Muddy Creek Canyon waterfall would be reduced by the presence of a road and wellsite facilities nearby.

There would be no affects to previously identified unique plant communities in the Teton Roadless Area.

The wildlife values found in the Blackleaf Unit would be reduced. Wildlife abundance and diversity may decline. The density of prairie falcon and golden eagle nests would not remain.

Manageability/Boundaries

Implementation of Alternative 4 would reduce the Teton Roadless Area by 1,800 acres. This would be a 3% reduction for the total Teton Roadless Area and a 12% reduction in the Blackleaf Unit portion of the roadless area. The proposed activities would not create any roadless islands or peninsulas. Maintaining roadless conditions on the remaining acreage would not be more difficult because the affected area is restricted to the eastern edge of the roadless area.

Special Places - Special Values

Alternative 4 would reduce several of the values that make the Blackleaf area a special place for many people. The perceived pristine character of the Rockies/High Plains transition zone would be altered. The presence of humans and their activities would be evident and detract from the special experience many people have when they visit the Blackleaf area.

Cumulative Effects

The Teton Roadless Area is part of the 866,330 acre Bear-Marshall-Scapegoat-Swan Roadless Area. There are 336,620 acres of this roadless area in the Lewis and Clark National Forest, Rocky Mountain District. Since the Forest Plan was implemented in 1987, timber harvest and private access activities on the Rocky Mountain District have removed the roadless status from 320 acres in the Renshaw and Benchmark/Elk Creek Roadless Areas. The 1,800 acres affected by Alternative 4 would diminish the roadless lands on the Rocky Mountain District by an additional 0.5%.

OIL AND GAS

Production values for each well in each alternative were developed using the methods and information contained in Appendix E.

Alternative 1

Under Alternative 1, only 2 of 25 federal leases in the EIS area would be developed. The lessees holding the remaining 23 leases would be denied the right to develop their leases. Additional geologic and reservoir information would not be obtained for future applications.

Central production facilities would increase pipeline costs and operating costs (due to remote monitoring and maintenance costs). The ultimate recovery of producible reserves would decrease because of fluid buildup in the well bores and increased back pressure on the well and producing formation. Inline compressors could be used to decrease the back pressure, but may not be cost effective.

The reservoir produced by the 1-5 and 1-8 wells would produce between 9.4 and 18.5 BCF of the estimated 10.4 to 29.8 BCF of recoverable reserves.

The reservoir produced by the 1-13 and 1-19 wells would produce between 4.3 and 8.5 BCF of the estimated 7.4 to 75.8 BCF of recoverable reserves.

Between 13.7 and 27.0 BCF of the estimated 110 to 284 BCF of recoverable gas in the EIS area would be produced. Table 4.13 lists the estimated high production and low production estimates and well life for each well projected in this alternative.

TABLE 4.13

ESTIMATED PRODUCTION[1]
ALTERNATIVE 1

Well No.	Location	Estimated High Production	Estimated High Production	Dates Based on High Production Under this Alternative
1-5	5-26N-8W	9.8 BCF	4.4 BCF	1983-2011
1-8	8-26N-8W	8.7 BCF	5.0 BCF	1983-2012
1-13	13-26N-9W	4.1 BCF	2.1 BCF	1991-2013
1-19	19-26N-8W	4.4 BCF	2.2 BCF	1991-2014
Totals		27.0 BCF	13.7 BCF	

[1]BLM, 1989.

Alternative 2

This alternative projects the maximum development reasonably expected. Thirteen of 25 federal leases would be developed. Wells are proposed in 10 of 11 high potential sections, 4 of 25 medium potential sections and in 1 low potential section (re-entry of a plugged well). This would result in the development, with minimal restrictions, of 6,400 high, 2,560 medium and 640 low potential acres. Substantial geologic and reservoir information would be obtained for future applications.

Because production equipment would be onsite, maximum gas recovery would occur. Equipment costs would also increase because of production equipment at each site. However, the financial gain from the additional reserves recovered would more than offset these costs. Pipelining expenses would decrease.

The reservoir produced by the 1-5 and 1-8 wells would have an additional well drilled (S-1). Total recovery from this reservoir is estimated between 10.4 and 29.8 BCF.

The reservoir produced by the 1-13 and 1-19 wells would be further evaluated by up to eight step-out wells. Production estimates for this reservoir range from 7.4 to 75.8 BCF. Total recovery from both reservoirs is estimated between 17.8 and 105.6 BCF.

Table 4.14 lists the estimated high production and low production estimates and well life for each well projected under Alternative 2.

TABLE 4.14
ESTIMATED PRODUCTION[1]
ALTERNATIVE 2

Well Number	Location	Estimated High Production	Estimated Low Production	Dates Based On High Production Under This Alternative
1-5	5-26N-8W	9.7 BCF	4.9 BCF	1983-2012
1-8	8-26N-8W	10.9 BCF	5.5 BCF	1983-2013
1-13	13-26N-9W	5.5 BCF	2.8 BCF	1991-2016
1-19	19-26N-8W	5.8 BCF	2.9 BCF	1991-2016
B-1	19-26N-8W	3.5 BCF	1.7 BCF	1991-2012
S-1	21-26N-8W	9.2 BCF	0*	1992-2021
S-2	32-26N-8W	14.7 BCF	0*	1992-2025
S-3	24-26N-9W	4.5 BCF	0*	1992-2015
S-4	30-26N-8W	13.8 BCF	0*	1993-2025
S-5	12-26N-9W	8.0 BCF	0*	1993-2021
S-6	1-26N-9W	10.0 BCF	0*	1993-2022
S-7	2-26N-9W	4.7 BCF	0*	1994-2017
S-8	35-26N-9W	5.3 BCF	0*	1994-2018
E-1	9-25N-8W	0**	0*	1994
E-2	6-25N-8W	0**	0*	1995
E-3	20-25N-8W	0**	0*	1995
E-4	13-27N-9W	0**	0*	1995
E-5	27-27N-9W	0**	0*	1996
E-6	26-27N-9W	0**	0*	1996
Totals		105.6 BCF	17.8 BCF	

*This represents the possibility of the well being a dry hole.
**This assumes the well to be a dry hole.

[1]BLM, 1989.

Alternative 3

Oil and gas development drilling would be severely limited under this alternative. Four of 25 federal leases would be developed. Only two medium potential and two high potential sections would be drilled. Additional geologic and reservoir information obtained for future applications would be minimal.

Based on the Rocky Mountain Front Guidelines, leases within Segment A of Figure 2.7 could not realistically be developed because of overlapping timing restrictions. Leases within Segment B of Figure 2.7 would have a short timing window of 90 to 120 days in which to perform drilling activities. The remaining 10% of the EIS area would be available for development subject to the Endangered Species Act restrictions and standard management practices. Timing restrictions based on RMFWG would delay drilling, pipelining, and possibly work over activities. Delays of this type increase costs, possibly decrease production quantities and may result in the premature abandonment of producing wells.

Central production facilities would cause the same impacts as those discussed in Alternative 1.

The reservoir being produced by the 1-5, 1-8 and S-1 wells would produce between 9.4 and 25.4 BCF of gas. This represents a 1.0 to 4.4 BCF reduction in produced reserves compared to Alternative 2.

Only one additional well (S-2) would be drilled in the reservoir containing the 1-13 and 1-19 wells. Total production from this reservoir would range between 4.3 and 19.5 BCF. Potentially, 2.9 to 56.3 BCF of reserves would not be produced.

Between 13.7 and 44.9 BCF of the estimated 110 to 284 BCF within the EIS area would be produced under this alternative.

Table 4.15 lists the high production and low production estimates and well life for each well projected in this alternative.

TABLE 4.15

ESTIMATED PRODUCTION[1]
ALTERNATIVE 3

Well Number	Location	Estimated High Production	Estimated Low Production	Dates Based On High Production Under This Alternative
1-8	8-26N-8W	9.8 BCF	4.4 BCF	1983-2011
1-5	5-26N-8W	8.7 BCF	5.0 BCF	1983-2012
1-13	13-26N-9W	4.1 BCF	2.1 BCF	1991-2013
1-19	19-26N-8W	4.4 BCF	2.2 BCF	1991-2014
S-1	21-26N-8W	6.9 BCF	0*	1991-2017
S-2	32-26N-8W	11.0 BCF	0*	1992-2022
E-1	9-25N-8	0**	0*	1991
E-4	13-27N-9W	0**	0*	1992
Total		44.9 BCF	13.7 BCF	

*This represents the possibility of the well being a dry hole.
**This assumes the well to be a dry hole.

[1]BLM, 1989.

Alternative 4

Under Alternative 4, 12 of 25 federal leases would be developed. Eight high potential, four medium potential and one low potential sections would be drilled. Substantial geologic and reservoir information would be obtained for future applications.

Compared to Alternative 2, two wells (S-2 and S-4) have been moved and two wells (S-6 and S-7) have been dropped. In the case of S-2, a small production decrease (0.1 BCF) results. In the S-4 case, substantial reserves would not be produced (10.0 BCF).

Timing restrictions proposed under this alternative would cause the same impacts as those discussed in Alternative 3, but to a lesser degree.

Central production facilities would cause impacts similar to those discussed in Alternative 1.

The reservoir being produced by the 1-5, 1-8, and S-1 wells would produce between 9.4 and 25.4 BCF of gas.

The reservoir produced by the 1-13, 1-19, B-1, S-2, S-3, S-4, S-5 and S-8 wells would produce between 5.6 and 42.8 BCF.

Total production from both reservoirs is estimated to range between 16.3 and 68.2 BCF.

Table 4.16 lists the high production and low production estimates and well life for each well projected in Alternative 4.

TABLE 4.16
ESTIMATED PRODUCTION[1]
ALTERNATIVE 4

Well Number	Location	Estimated High Production	Estimated Low Production	Dates Based On High Production Under This Alternative
1-5	5-26N-8W	9.8 BCF	4.4 BCF	1983-2011
1-8	8-26N-8W	8.7 BCF	5.0 BCF	1983-2012
1-13	13-26N-9W	4.1 BCF	2.1 BCF	1991-2013
1-19	19-26N-8W	4.4 BCF	2.2 BCF	1991-2014
B-1	21-26N-8W	2.6 BCF	1.3	1992-2011
S-1	21-26N-8W	6.9 BCF	0*	1992-2018
S-2	32-26N-8W	14.5 BCF	0*	1993-2025
S-3	24-26N-9W	3.4 BCF	0*	1993-2014
S-4	19-26N-8W	3.8 BCF	0*	1994-2016
S-5	12-26N-9W	6.0 BCF	0*	1994-2019
S-8	35-26N-9W	4.0 BCF	0*	1995-2017
E-1	9-25N-8W	0**	0*	1996
E-2	6-25N-8W	0**	0*	1996
E-3	20-25N-8W	0**	0*	1997
E-4	13-27N-9W	0**	0*	1998
E-5	27-27N-9W	0**	0*	1998
E-6	26-27N-9W	0**	0*	1999
Totals		68.2 BCF	15.0 BCF	

*This represents the possibility of the well being a dry hole.
**This assumes the well to be a dry hole.
[1] BLM, 1989.

SURFACE WATER

Alternative 1

This alternative would result in one short reinjection pipeline and gas plant construction. However, there is little surface water in most areas along the pipeline route because precipitation sinks rapidly into the thick beds of gravel. Minor erosion would be expected only in or adjacent to the floodplain of Blackleaf Creek because that is the only place along the pipeline route where streamflow is carried from the mountains.

The gas plant would be constructed on a cement pad. All spills would be contained on that pad, thereby minimizing the possibility of surface water contamination.

The overall impacts would be minor.

Alternative 2

This alternative assumes substantial construction or surface disturbance in order to accommodate oil and gas development, creating a moderate possibility for soil erosion and subsequent sedimentation; particularly in the more erodible land types. Much of the area, notably land type 204 (benches, fans and terraces of gravel alluvium), has little surface water because precipitation or runoff sinks rapidly into the thick beds of gravel. Erosion would be expected from construction in or adjacent to the floodplains (land type 200, defined in Appendix I) of Blackleaf Creek, Muddy Creek, Clark Fork Muddy Creek, Chicken Coulee, and the forks of Dupuyer Creek.

Other land types with high potential for sediment impacts to water quality include 201 (wetlands), 161 (certain mountain foothills), and 14D (rotational slumps and mudflows). Wetlands are especially sensitive to construction impacts and activity in these areas must include restrictions for protecting wetlands. This alternative would allow only a short stretch of road reconstruction in wetlands. Land type 161 has some erosion hazard, but would deliver little sediment to streams. Land type 14D is more extensive, mostly in front of the limestone reefs (cliffs) that dominate the landscape, but little erosion or other soil movement would be delivered to a flowing stream. When sediment is delivered to the stream from these land types, it is often soon deposited by the stream along with other material from the floodplain.

Alternative 3

This alternative provides for minimal construction or surface disturbance, creating a low possibility for soil erosion and subsequent sedimentation in the more erodible land types.

The impacts to soil types 14D, 161, 200 and 204 would be similar to those described in Alternative 2, only proportionately less.

Alternative 4

This alternative is similar to Alternative 2 in that there would be substantial construction and/or surface disturbance in order to accommodate oil and gas development, creating a moderate possibility for soil erosion and subsequent sedimentation, particularly in the more erodible land types. Because there would be two fewer wells in this alternative there would be less soil erosion and sedimentation in this alternative than Alternative 2.

GROUNDWATER

Alternative 1

Laying the reinjection pipeline from the 1-8 well to the 1-16 well would involve trenching through talus and colluvial and alluvial outwash. This could produce a temporary lowering of groundwater levels in the trench itself. It would also create a temporary increase in the turbidity and sediment in the groundwater. This would not create any impact at depth or off site because of the filtering effect of these soil types. After backfilling the trench, there would be no lasting impacts.

In the event of a pipeline leak or rupture, minor amounts of produced condensate and associated water would escape and would rise to the surface like a spring. In this alternative, the maximum amount of fluid to escape is estimated at less than 20 barrels. The fluid would flow to the surface, the condensate would readily evaporate and most portions of the produced water would percolate into the subsurface. Some water may enter aquifers such as along Blackleaf Creek, however, a spill of 20 barrels of produced water would have an imperceptible effect on the overall ground water quality as the produced water contains approximately 11,000 PPM total dissolved solids.

Pipeline leaks are generally the result of corrosion (15%), damage from external source (40%), material defects and construction (40%) and 5% miscellaneous causes (Layton, D. W. et al. 1984). In general 6% of the leaks occur along field gathering lines, 87% along transmission lines and 7% at compressor stations, dehydration and metering stations (Layton, D. W. et al. 1984). The pipelines from the 1-13 and 1-19 wells to the production facilities would be field gathering lines and have the fewest incidences of occurrence. The greatest probability of leaks would be the transmission line from the processing facility to the Montana Power pipeline, east of the EIS area.

If a gas pipeline rupture were to occur, the pressure-activated block valves on both sides of the ruptured portion of pipe close, causing an atmospheric discharge that decreases with time until the pressure within the pipe equals atmospheric pressure. Gas released from such failures would disperse in the form of an elongated puff or cloud (Layton, D. W. et al. 1984).

The probability of a field gathering pipeline leak would be .00076 leaks per mile of pipeline per year (Layton, D. W. et al. 1984). The probability of a transmission line leak would be .0018 leaks per mile of pipeline per year.

Alternative 2

The quality of groundwater intercepted during road and drill pad construction would be lowered by introducing sediment. This would be a minor impact because of the filtering effect the alluvial gravels and because little groundwater would be expected. Compaction of the road surface and drill pad would cause less infiltration and more runoff, and possibly a decreased rate of recharge. This would also be a minor impact because of the small surface acreage involved and eventual site reclamation.

Construction work in cretaceous age shales, silts and thin sandstones (E-1, E-3, E-4, E-5, E-6, S-1, S-2, S-4, S-5, S-6 and S-7) could intercept ground water and temporarily increase the turbidity. This would be a minor impact because of the low volumes of groundwater expected and the filtering effect of the water percolating back into the ground.

Construction work in unconsolidated alluvium (S-3 and S-8) would also intercept groundwater and temporarily lower groundwater quality by increasing turbidity. Because of the filtering action of these gravels, this would be a minor impact.

Construction work in Mississippian limestone (E-2) would intercept and divert groundwater to the surface. This would also be a minor impact because of the small area involved and because the intercepted water would infiltrate back into the subsurface.

Drilling fluids could enter subsurface aquifers and temporarily lower groundwater quality. This would be a localized impact that would last only during the actual drilling operation. Infiltration would be minimized because of the conductor casing placed through the surface gravels. This conductor casing is cemented in place, approximately 20 feet to 100 feet through these surface gravels. Deeper aquifers are protected through installation of surface casing (See Standard Management Practices). Surface casing is cemented in the well bore after drilling approximately 700 feet. The surface casing isolates the drilling fluid from the fresh water aquifers, preventing contamination.

Seepage from mud pits during drilling could contaminate groundwater in the vicinity of the drilling site. Drilling muds consist of bentonite clay, various hazardous and non-hazardous additives and traces of contaminants such as diesel fuel and oil.

Drill sites S-3 and S-8 would be located in unconsolidated alluvial gravels, which are very porous and water readily percolates in them. Mud pits constructed on the porous gravels could cause significant groundwater contamination, unless lined.

Drill site E-2 would involve placing mud pits on Mississippian limestone. The porosity of the limestone varies considerably. In general, drilling fluids would tend to plug pore spaces and not travel off site. Groundwater could be affected, however it would not be significant. The use of pit liners would make the risk of contamination minimal.

The discussion of pipeline leaks (chance of occurrence, impacts, etc.) as discussed in Alternative 1 also applies to this alternative.

Alternative 3

Should groundwater be intercepted during road and drill pad construction, the quality would be lowered by introducing sediment. This would not be expected to have any impact at depth or off site because of the filtering effect of the alluvial gravels. Compaction of the road surface and drill pad would cause less infiltration and more runoff, and possibly a decrease in the rate of recharge. This would not

be significant because of the small surface acreage involved and eventual site reclamation.

Drill sites E-1, E-4, S-1 and S-2 would all involve road and drill pad construction in Cretaceous age shales, silts and thin sandstones. Which contain minor amounts of groundwater. If this construction work should intercept groundwater, the water quality would be temporarily lowered by sediment entering exposed water during construction. This would not be significant because of the expected low volumes and the filtering effect once the water percolates back into the ground.

Overall, the impacts (drilling operations, mud pits, production and abandonment) would be proportionally similar to those described in Alternative 2.

The discussion of pipeline leaks (chance of occurrence, impacts, etc.) as discussed in Alternative 1 also applies to this alternative.

Alternative 4

The impacts to groundwater from this alternative would be similar to those described in Alternative 2. However, this alternative assumes two fewer wells than Alternative 2 and thus, similar but fewer impacts.

RECREATION

Alternative 1

The greatest impact created by this alternative would be construction noise heard by recreationists.

Pipeline construction activities would temporarily increase the amount of heavy equipment and vehicle traffic on existing access routes, which could inconvenience some recreationists. These activities would also increase the amount of equipment and vehicle noise heard by recreationists. These impacts would be minor and short-term.

Summer activities such as camping, motorcycle travel, horseback riding, hiking, and picnicking would be temporarily impacted. Most of this activity is spread over a large area and the interaction between construction activity and recreation activity would be minimal.

Winter recreation would not be affected, unless some phase of construction takes place during the winter. If this were to occur, it would be a minor impact.

Alternative 2

Road construction to the S-3 wellsite would reduce 80 acres from a semi-primitive to a roaded-natural setting. This could change the recreation expectations of both the public and land managers.

Road reconstruction would make existing routes more accessible and new road construction would increase motorized access into areas that were previously inaccessible.

Such construction or upgrading of existing roads could be viewed in two ways. Some people may view increased accessibility to areas previously inaccessible as an opportunity to enhance and increase recreation uses and use areas, particularly hunting and hiking. Others may view it as a detriment to recreation in that quality hunting or recreation opportunities for the area may be diminished due to increased accessibility and vehicle travel.

Although snow conditions are generally not favorable in this area for snowmobile and cross-country skiing activities, increased access could enhance those types of recreation uses.

Four step-out wells and one exploratory well would be drilled in the Teton Roadless Area. A total of 5.9 miles of new road along the eastern border of the roadless area would be constructed to serve the potential wellsites. The wells would be located in the foothills below the limestone cliffs which create a physical barrier between potential well development and the rest of the roadless area. With the exception of this activity occurring along the northeastern portion of the area, the Teton Roadless Area would remain roadless and retain its associated characteristics. Nevertheless, some would argue that access of any kind is an intrusion that is incompatible with the area's existing character.

Those recreationists seeking solitude in the vicinity of development activities would be displaced by the sights and sounds associated with exploration.

Alternative 3

The impacts of this alternative would be similar to those described in Alternative 1. However, the potential for such

impacts would increase slightly because of the increased activity in this alternative.

The short segment of new road construction could be viewed as a positive or negative impact as discussed in Alternative 2.

Alternative 4

The impacts of this alternative would be similar to those described in alternative 2. However, the potential for such impacts would decrease slightly because of the access management portion of this alternative and because this alternative projects two fewer wells than Alternative 2.

VISUAL RESOURCES

Alternative 1

This alternative would create the fewest impacts to visual resources.

As very little new surface disturbance would occur, the status quo of the area would be very nearly retained and in some instances improved. Most of the activities projected would be in keeping with current management activities, which include roads and associated oil and gas and ranch buildings and operations.

Dismantling the facilities at the four producing wells would improve the visual qualities, especially in foreground and middle ground views. The new gas processing plant would nearly be hidden from middle and background views because of the screening effect of the surrounding hills. The plant would only be noticeable from the road into the plant or the adjacent Blackleaf Creek drainage.

The existing wells and roads have been designed to fit into the landscape or are on flat land screened by topography and trees.

Alternative 2

Significant impacts to visual quality would occur with construction of the roads to the E-2, S-2, and S-5 wellsites. These roads would require a number of switchbacks through forested areas. The impacts from both of these roads would be noticeable to all viewers, fore, middle and background. As the S-5 wellsite would be located in an area with a Class III visual resource management (VRM) objective (allow visual contrast, activities may be noticeable) on the Lewis and Clark National Forest, it would be at an acceptable level, even with the noticeable scenic deterioration. The roads to the E-2 and S-2 wellsites cross through the BLM's Blind Horse Outstanding Natural Area. This area has a Class I VRM objective (all activities should be unnoticeable or blend with the landscape) and no amount of design or mitigation would reduce the visual impacts of this road to an acceptable level for this rating. The main impacts would be due to the continuous forest type found here and the number of switchbacks required to climb the imposing steep face of the Rocky Mountain Front.

The roads to and the wellsites for the E-3, S-6 and S-7 wells would create visual impacts due to the elevation and landscape types. However, only short sections of these roads should be noticeable. Mitigation of wellpads should reduce impacts to a low level for middle and background views and to an acceptable level for foreground views.

Since this alternative employs a number of facilities at each wellsite, the foreground view would be impacted.

If all the projected roads and facilities were built there would be an obvious visual contrast to what is viewed currently. However, all sites, except the E-2 and S-5 wellsites, may be acceptable to the average viewer.

Alternative 3

Since this alternative eliminates the majority of wellsites and roads which create visual impacts and adopts a remote monitoring design for well operation, there would be few impacts. The small limited facilities required for remote monitoring should blend in with the surrounding landscape.

Short-term impacts from pipelines may occur, but prompt rehabilitation and vegetation would limit these impacts in the long term.

The impacts from gas plant construction would be the same as found in Alternative 1.

Overall, the visual impacts of this alternative would be similar to, although greater than Alternative 1 due to the additional number of roads and wellsites.

Alternative 4

This alternative projects 12.25 miles of new road, 18 drill pads and 11.4 miles of road to be upgraded.

This would result in overall moderate visual impacts to the area with some fairly localized areas of significant impact. In all cases except two, construction of roads, drill pads and facilities should be within acceptable visual guidelines of the agencies. The exceptions would be the roads to the E-2 and S-2 drill sites located within the BLM's Blind Horse Outstanding Natural Area. These roads would essentially split the ONA and exceed VRM standards for this Class I area. This would therefore require a BLM Area Manager's override for these projects to proceed.

The elimination of most wellsite facilities would significantly reduce the point source problems associated with man made structures in a natural environment. Elimination of the switchback road to the S-3 well would reduce visual impacts from the main Blackleaf road. The new road to both the S-2 and S-4 wells south of Muddy Creek, would create moderate impacts to visual quality.

The new gas processing plant located on Blackleaf Creek would be virtually invisible from most major travel routes due to its location. Only the foreground view should be affected.

In summary, with the exception of the E-2 and S-2 roads, all proposals in this alternative are within Visual Resource Management thresholds.

NOISE

Alternative 1

The sources of the increased noise levels would include heavy equipment during the pipeline construction period (4 to 6 weeks) and traffic on access roads. All of these noises would be short-term.

Noise impacts from a gas plant would be minimal except during the brief construction phase (4 to 6 months), and from infrequent maintenance-related vehicular traffic.

Alternative 2

The noise level would increase in the immediate vicinity of any new wellsites and access roads. The sources of increased noise levels would include heavy equipment used during road construction, pad construction, development, production and abandonment. Most of these noises would be short-term.

Any additional drilling operations, and access road use (both during drilling and field maintenance) would be a minor noise nuisance to recreational users of the area due to its small (1/4 to 1/2 mile) influence zone and temporary 4 to 6-month nature.

The noise impact areas (areas where wildlife displacement and nuisance users would occur) are displayed on Figure 4.5 and would be similar for all the alternatives.

Alternative 3

These impacts would be similar to those described in Alternative 1, only proportionately smaller.

Alternative 4

These impacts would be similar to those described in Alternative 2, only slightly less.

TRANSPORTATION SYSTEM

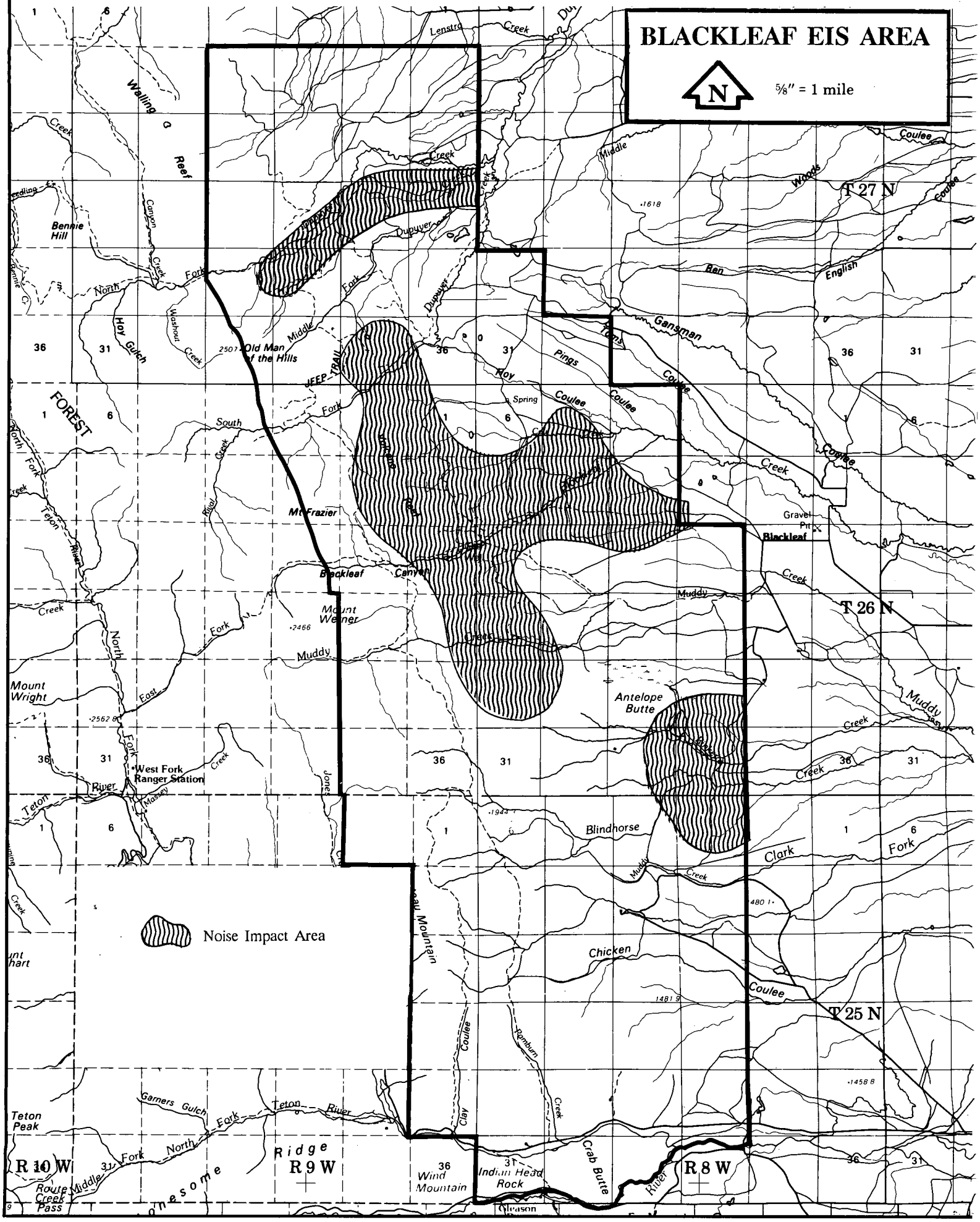
Alternative 1

This alternative would not require any additional reconstruction or construction of roads as adequate access currently exists. Also, this alternative would not require any additional access roads across private land holdings. There should be no additional impacts to the road system as overall road use would not increase.

Alternative 2

This alternative would require 12.1 miles of reconstruction to provide access for the proposed exploratory and step-out wells. These improvements would consist of improving the road template to reduce erosion problems, improving surface drainage, and minimizing additional sedimentation. Some minimal road alignment improvements would also be required to allow safe use by a typical medium-depth drilling vehicle and its support vehicles.

Figure 4.5 Noise Impact Area.



An additional 15.55 miles of new road system would be constructed to provide access to exploratory and step-out wells. These roads would consist of a 14-foot travelway located on grades in the range of 6% with brief pitches in the 10% range.

Because this alternative does not provide for road management, there is the potential for significant impacts to the road system from unlimited vehicle use by the public. Roads would tend to "washboard" and rutting during wet periods could be a significant problem. The unit operator would be most impacted and would necessarily spend extra time maintaining roads.

Alternative 3

This alternative would require 1.00 mile of reconstruction to provide access for the proposed exploratory and step-out wells. These improvements would be the same as those discussed in Alternative 2.

An additional 2.10 miles of new road system would be constructed to provide access to the federal S-2 well. This road would consist of a 14-foot travelway located on grades in the range of 6% with brief pitches in the 10% range.

This alternative would require constructing about 1.0 mile of access road across private land holdings. The road section accessing site E-4 is a portion of the North Fork of Dupuyer Creek Road which has been identified for rights-of-way acquisition in the Lewis and Clark Forest Plan. This road has been identified as a high priority acquisition for providing public access to National Forest lands and this road segment should be retained for that purpose. The road accessing producing wells 1-8 and 1-13 known as Blackleaf Road has also been identified for retention for access needs.

The general impacts would be similar to those described in Alternative 2. However, there would be fewer impacts because of less new road construction and reconstruction and the proposed road management system.

Alternative 4

This alternative would require 11.4 miles of reconstruction to provide access for the proposed exploratory and step-out wells. These improvements would be the same as discussed in Alternative 2.

An additional 12.50 miles of new road system would be constructed to provide access to exploratory and step-out wells. These roads would consist of a 14-foot travelway located on grades in the range of 6% with brief pitches in the 10% range.

Access roads would cross several private land holdings. This alternative would require about 15.3 miles of access road across various private landowners in the EIS area. The road accessing site E-5, which is known as the North Fork of Dupuyer Creek Road crosses the Boone and Crockett Club land and has been identified for rights-of-way acquisition in the Lewis and Clark Forest Plan. This road has been identified as a high priority acquisition for providing public access to National Forest lands. The road presently accessing producing wells 1-13 and 1-8, which is known as the Muddy Creek road, has also been identified as a future access need. The Bureau of Land Management has identified the lower portion of the Chicken Coulee road as a future desired access route for trail head development. This facility would be used to provide additional public access into the Blind Horse Creek Outstanding Natural Area.

These impacts would be similar to those discussed in Alternative 2. However, the road management component of the alternative significantly lessens those impacts.

HEALTH AND SAFETY

This section discusses the health and safety concerns expressed by the public in relation to oil and gas exploration and production. Concerns identified during the scoping process included; public safety; the need for emergency plans for surrounding areas in the event of a well blowout; and potential health risks to nearby communities and residents. In addition, concerns were expressed about the effects of hydrogen sulfide (H2S) emissions on vegetation and animals.

Alternative 1

Because of the very limited amount of further development allowed, there would only be a very slight increase in the potential for vehicle accidents or safety conflicts between pedestrians, equestriennes and vehicles using the same roadways. Because no further wells would be drilled, there would be no additional risk of blow-outs.

Alternative 2

This alternative allows nine new step-out wells and proposes six exploratory wells. Production facilities located on each wellsite, requiring daily to weekly maintenance visits by oil field personnel, could increase traffic conflicts and the potential for vehicle accidents. Recreationists/ tourists could be most impacted during the summer months and the fall hunting season.

Based on drilling information in the Overthrust Belt, the probability of an uncontrolled flow of gas, oil, and other well fluids into the atmosphere (a blowout) is approximately 0.24% (Lawrence Livermore National Laboratory, 1984). It is also important to note that the probability of not having a blowout is approximately 99.75%. The average duration of a blowout ranges from 1/2 day to about 10 1/2 days (Lawrence Livermore National Laboratory, 1984).

An accidental blowout could pollute the air with: 1) natural gas with hydrogen sulfide; 2) a gas composed primarily of carbon dioxide with minor hydrogen sulfide and methane; or 3) sulfur dioxide and other combustion by-products resulting from ignition of a gas composed mainly of methane. Each mixture of gases would have the potential to harm plants, animals and humans. Hydrogen sulfide is the primary gas associated with Overthrust Belt production of oil and gas in Alberta, Utah, Wyoming and in Montana's Blackleaf Canyon field along the Rocky Mountain Front.

The hydrogen sulfide concentrations for the proposed well area are anticipated to be 0.4%. High hydrogen sulfide concentrations (greater than 5%) that may be found in the Overthrust Belt are related to the occurrence of interbedded anhydrites in the Madison Group formations (Werren, 1985). Interbedded anhydrites in the Madison Group have not been found in the Blackleaf area.

An analysis of an extreme hydrogen sulfide blowout situation (15% hydrogen sulfide) combined with worst-case meteorological conditions (stable air with gas discharged at the surface without a plume), indicates that in a worst case situation, the hydrogen sulfide would exceed 300 ppm concentrations for an area about a mile surrounding the drillsite. Beyond this area, worst case hydrogen sulfide concentrations were predicted to be below 300 ppm and any changes in discharge or wind conditions would dramatically decrease the radius of significant concentrations of hydrogen sulfide (Lawrence Livermore National Laboratories, 1984).

The release of liquid materials (drilling fluids, impure formation waters, and/or oil or natural gas condensate) could also occur during a blowout. These liquids could spread some distance from the wellsite, where they may contaminate soils, vegetation and surface water. Depending on the volume released and area contaminated, degradation of soils or water quality could result. Intensive cleanup and reclamation efforts would be required, and it could be some time before vegetation would be reestablished on soils that had been contaminated with materials resulting from a blowout (Dames and Moore, 1986).

For a further discussion of the possibilities of a blowout occurrence, please refer to Appendix H.

Alternative 3

Impacts would be similar to Alternative 1, but somewhat increased due to the two additional step-out wells and two additional exploration wells.

Alternative 4

The impacts would be very similar to Alternative 2, but slightly decreased due to two less wells.

SOCIAL AND ECONOMIC

Alternative 1

Employment

Constructing a gas processing facility and one pipeline would provide temporary employment opportunities in the construction and transportation sectors of the economy. Employment opportunities could occur as early as 1990, when 102 jobs could be available for a short time. This would include those jobs directly associated with construction and other jobs supported by local expenditures. These jobs would be filled primarily by local employees. Local expenditures for goods and services could amount to $1,026,000 for construction of pipelines and facilities, dependant upon the availability of oil and gas support services in the area. Many of the job opportunities would be provided by existing services in Teton, Glacier and Cascade Counties. Table 4.17 shows employment associated with this alternative.

Production related employment would occur in the regional area. Field maintenance crew and support personnel would be needed: truckers, pumpers, and repair/custodial person-

nel. The number of direct workers at this stage of activity could be five with another seven indirect workers. This activity would benefit the existing oil and gas service and retail trade sectors (see Table 4.17).

TABLE 4.17

ESTIMATED PROJECT RELATED EMPLOYMENT OPPORTUNITIES[2] ALTERNATIVE 1

	Development/Activities			Production	
Year	Number of Wells Drilled	On-site Full-time Jobs Lasting 30-90 Days	Part-time Jobs Lasting up to 120 Days	Number of Producing Wells	Number of Direct and Indirect Jobs
1990	0	0	102[1]	12	
1991	0	0	0	4	12
1992	0	0	0	4	12
1993	0	0	0	4	12
1994	0	0	0	4	12
1995	0	0	0	4	12
1996	0	0	0	4	12
1997	0	0	0	4	12
1998	0	0	0	4	12
1999	0	0	0	4	12
2000	0	0	0	4	12

[1]Employment associated with construction of the gas processing facility and bringing the injection well on line.

[2]BLM, 1989.
Chase, R.A., et al. 1982. Expansion and Adaptation of the North Dakota Economic-Demographic Assessment Model (NEDAM) for Montana: Technical Description. Agricultural Economics Miscellaneous Report no. 61. North Dakota Agricultural Experiment Station, North Dakota State University, Fargo, N.D. 225p.

Wenner, L.N. 1981. Social and Economic Assessment of Oil and Gas Activities: Information and Guidelines. USDA Forest Service Northern Region. R1 81-01 84p.

Population

Development of natural gas could result in minor impacts to the community of Choteau, resulting from population growth associated with temporary nonlocal workers. This would occur during pipeline and facility construction as early as 1990.

The communities of Dupuyer and Bynum could also experience some short-term changes with immigration of temporary workers. Dupuyer and Bynum are close to the Blackleaf EIS area (10 to 20 miles), but do not have the services, housing and infrastructure that are available in Choteau.

Personal Earnings

The communities where workers would reside could experience a minor increase in economic activity during pipeline and facility construction. This would occur as a result of employees payroll expenditure and through company expenditures for goods and services. The impact on regional personal earnings for the period 1990 to 2000, is shown in Table 4.18.

TABLE 4.18

PROJECTED INCREASE IN ANNUAL REGIONAL EARNINGS (1986 dollars)[1] ALTERNATIVE 1

Year	Development Earnings	Production Earnings	Total
1990	608,000	183,000	791,000
1991	0	183,000	183,000
1992	0	183,000	183,000
1993	0	183,000	183,000
1994	0	183,000	183,000
1995	0	183,000	183,000
1996	0	183,000	183,000
1997	0	183,000	183,000
1998	0	183,000	183,000
1999	0	183,000	183,000
2000	0	183,000	183,000

Note: The regional area is defined as Cascade, Glacier, Lewis and Clark, Pondera, and Teton counties.

[1]BLM, 1989.
Chase, R.A., et al. 1982. Expansion and Adaptation of the North Dakota Economic-Demographic Assessment Model (NEDAM) for Montana: Technical Description: Agricultural Economics Miscellaneous Report no. 61: North Dakota Agricultural Experiment Station, North Dakota State University, Fargo, N.D. 225p.

Housing

The temporary demand for housing during construction of facilities and pipelines, could cause a minor impact in Choteau. Temporary workers generally prefer apartments, motels, mobile homes, or recreational vehicles. Most of these workers seek lodging as close to the work site as possible or within the current boundaries of, or adjacent to, incorporated towns. This reflects the service, trade, housing supply, and governmental infrastructure presently available.

Public Finance

The principle long-term fiscal affect to the economy from natural gas production would be public revenues. Production taxes on natural gas would benefit Teton County and the state. Table 4.19 shows estimates of natural gas produced from the Blackleaf EIS area and the associated royalties and taxes from 1990 to 2000.

Social Conditions

This alternative would result in minor short-term changes in employment, personal earnings and housing in the regional area of influence. While there may be individual or personal benefits associated with these changes, there is also the potential for adverse social effects; these impacts should be insignificant.

The population analysis indicates this alternative would not cause demographic changes in the area. In terms of ability to deal with potential social problems, an important community resource is the prior experience with oil and gas exploration and development. The area has had experience with exploration and development in the Blackleaf EIS area. During the last 7 years five wells were drilled, two of which are currently producing and two that are shut-in, but capable of production.

TABLE 4.19

ESTIMATE OF NATURAL GAS PRODUCED FROM THE BLACKLEAF EIS AREA, THE ASSOCIATED ROYALTIES AND STATE TAXES (valued at $1.42/MCF)[4]
1990-2000 - ALTERNATIVE 1

Year	Production MCF	Gross Value ($1.42/MCF)	Federal Mineral Receipts[1]	State Mineral Receipts[2]	Natural Gas Production Taxes[3]
1990	795,000	1,128,900	94,300	9,600	142,200
1991	1,918,400	2,724,100	251,900	17,900	301,300
1992	1,726,500	2,451,700	226,800	16,100	335,800
1993	1,553,900	2,206,500	204,200	14,500	302,200
1994	1,398,500	1,985,800	183,800	13,100	272,000
1995	1,258,600	1,787,300	165,500	11,800	244,800
1996	1,132,800	1,608,500	149,000	10,600	220,300
1997	1,019,500	1,447,700	134,200	9,600	198,300
1998	917,500	1,302,900	120,800	8,600	178,500
1999	825,800	1,172,600	108,800	7,800	160,600
2000	743,200	1,055,400	98,000	7,000	144,500

Note: This information is based on probable production from producing wells. The actual could vary significantly from that shown.

[1]Assumes a federal royalty rate of 12.5 percent plus lease payments.

[2]Based on the states participation in the Blackleaf unit and assumes a state royalty rate of 12.5 percent plus lease payments.

[3]This includes the resource indemnity trust tax, gas producers privilege and license tax, natural gas severance tax and net proceeds tax.

[4]BLM, 1989.

Alternative 2

Employment

Oil and gas development within the Blackleaf EIS area would provide short and long-term employment opportunities in the construction and transportation sectors of the economy. This employment would occur for relatively short time periods during drilling operations. The greatest impact to the area would likely occur in 1990, 1993, and 1994, when 209, 118, and 200 jobs, respectively, would be project related. Table 4.20 shows the employment associated with this alternative.

At the peak development period there would be approximately 50 full time jobs in 1990 and 1993, and 75 full time jobs in 1994 for 30 to 90-day time periods. The full time jobs would be located at two drilling sites in 1990 and 1993, and three drilling sites in 1994. These workers would include the drill rig crew, mud loggers and tool pushers. Peak local annual expenditures for goods and services would be $1,896,000 in 1994, $1,570,000 in 1990, and $1,530,000 in 1993 for drilling and road/pipeline construction. Local expenditures would depend upon the availability of oil and gas support services in the area and actual surface and subsurface conditions encountered at the time a well is drilled. These expenditures could support 159 short-term jobs in 1990, 113 short-term jobs in 1993, and 125 short-term jobs in 1994. This would include those jobs directly associated with construction and other jobs supported by local expenditures. Increases in employment opportunities would cause immigration of workers for the drill rig crew, tool pushers and mud loggers while jobs in construction, transportation and oil/gas services would benefit the existing service sectors in the regional area (see Table 4.20).

Peak road and pipeline activity would be expected in 1990, 1993 and 1994, when there would be approximately 110, 47 and 55 construction jobs, respectively, expected for approximately 120 days. These jobs would be filled primarily by local employees. There would be approximately $1,653,000 in local expenditures from construction and drilling at two wellsites in 1992.

Jobs in construction, transportation and oil/gas services would be expected in Teton, Glacier and Cascade Counties. In terms of increased numbers employed and the settlement pattern of nonlocal temporary workers, employment impacts related to development and exploration would occur primarily in Choteau, in Teton County. The greatest impact to Choteau would occur during the peak development periods when 50 temporary workers in 1990 and 1993, and 75 temporary workers in 1994, associated with on site drilling, would be within the immediate area and another 11-15 short-term workers in support services. Other communities in the area could also experience some short-term changes with immigration of temporary workers and increased employment opportunities. Temporary construction crews may not generate much local secondary employment; there are limits to how rapidly facilities and services can expand or would expand to accommodate temporary employees.

Employment related to production would occur in the regional area. Field maintenance crew and support personnel would be needed: repairmen, truckers, pumpers, and custodial personnel. Employment effects would be expected primarily in Teton, Glacier and Cascade Counties. The number of annual direct workers could be between 6 and 10 depending on the field size with another 9 to 15 annual indirect workers. This activity would benefit the existing oil and gas service and retail trade sectors (see Table 4.20).

TABLE 4.20
ESTIMATED PROJECT RELATED EMPLOYMENT OPPORTUNITIES[1]
ALTERNATIVE 2

	Development/Activities			Production	
Year	Number of Wells Drilled	On-site Full-time Jobs Lasting 30-90 Days	Part-time Jobs Lasting up to 120 Days	Number of Producing Wells	Number of Direct and Indirect Jobs
1990	2	50	159	6	15
1991	1	25	14	7	17
1992	2	50	72	9	19
1993	2	50	113	11	22
1994	3	75	125	13	25
1995	1	50	75	13	25
1996	1	25	14	13	25
1997	1	25	19	13	25
1998	1	25	16	13	25
1999	0	0	0	13	25
2000	0	0	0	13	25

[1]BLM, 1989.

Chase, R.A., et al. 1982. Expansion and Adaptation of the North Dakota Economic-Demographic Assessment Model (NEDAM) for Montana: Technical Description. Agricultural Economics Miscellaneous Report no. 61. North Dakota Agricultural Experiment Station, North Dakota State University, Fargo, N.D. 225p.

Wenner, L.N. 1981. Social and Economic Assessment of Oil and Gas Activities: Information and Guidelines. USDA Forest Service Northern Region. R1 81-01 84p.

Population

Choteau would experience moderate short-term impacts as a result of population growth associated with temporary nonlocal workers. This would occur during field development and would be for short periods when drilling occurs. At the peak development period the population of Choteau could increase by between 3 and 6% for a 30 to 90-day period. The communities of Dupuyer and Bynum could also experience some short-term changes with immigration of temporary workers. Dupuyer and Bynum are close to the Blackleaf EIS area (10 to 20 miles) but lack the services, housing and infrastructure that are available in Choteau. After the drilling activity, population changes would decrease steadily until a stable regional operational work force would be in place for production.

Production related population increases would be spread out over a larger area and would be minor. This would occur primarily in Cut Bank, Conrad, Shelby and Great Falls, where most of the oil and gas service related businesses are located.

Personal Earnings

The communities where the workers and their families reside would experience some increases in economic activity as a result of employees payroll expenditure and through company expenditures for goods and services. For the regional area, this would be less than a 1% increase in earnings during peak development. The impact on regional personal earnings for the period 1990 to 2000, are shown in Table 4.21.

Housing

The single most significant impact expected involves the temporary demand for housing during the drilling time frames. This housing impact would occur primarily in Choteau, where it is expected most temporary nonlocal workers would reside, and would be short-term, 30 to 120 days each year. Generally, these workers would not be accompanied by their families.

To a large extent, the nonlocal's choice of housing reflects the short duration of certain petroleum related activities, such as well drilling. Oil field personnel generally prefer apartments, motels, mobile homes, or recreational vehicles. Most of these workers seek lodging as close to the work site as possible or within the current boundaries of, or adjacent to, incorporated towns. This reflects the service, trade, housing supply, and governmental infrastructure presently available. If these workers are accompanied by their families, the demand for mobile homes and/or apartments may increase. Table 4.22 summarizes the housing impacts for Alternative 2.

TABLE 4.21

PROJECTED INCREASE IN ANNUAL REGIONAL EARNINGS (1986 dollars)[1] ALTERNATIVE 2

Year	Development Earnings	Production Earnings	Total
1990	916,000	183,200	1,099,200
1991	479,900	229,000	708,900
1992	438,500	229,000	667,500
1993	625,300	229,000	854,300
1994	758,400	229,000	987,400
1995	519,200	259,600	778,800
1996	242,200	259,600	501,800
1997	127,000	274,800	401,800
1998	136,500	274,800	411,300
1999	0	274,800	274,800
2000	0	274,800	274,800

Note: The regional area is defined as Cascade, Glacier, Lewis and Clark, Pondera, and Teton counties.

[1]BLM, 1989.
Chase, R.A., et al. 1982. Expansion and Adaptation of the North Dakota Economic-Demographic Assessment Model (NEDAM) for Montana: Technical Description: Agricultural Economics Miscellaneous Report no. 61: North Dakota Agricultural Experiment Station, North Dakota State University, Fargo, N.D. 225p.

TABLE 4.22
PROJECTED TEMPORARY INCREASE IN HOUSING DEMAND FOR THE COMMUNITY OF CHOTEAU DURING DEVELOPMENT AND EXPLORATION (assuming workers would not be accompanied by their families)[1]

Year	Apartment	Mobile Home	Other	Total
1990	12	12	26	50
1991	6	6	13	25
1992	12	12	26	50
1993	12	12	26	50
1994	18	18	39	75
1995	12	12	26	50
1996	6	6	13	25
1997	6	6	13	25
1998	6	6	13	25
1999	0	0	0	0
2000	0	0	0	0

[1]BLM, 1989.
Chase, R.A., et al. 1983. Profile of North Dakota's Petroleum Work Force, 1981-82. Agricultural Economics Report no. 174: North Dakota Agricultural Experiment Station, North Dakota State University, Fargo, N.D.

Public Finance

The principle long-term fiscal impact to the economy from natural gas production would be public revenues. Production taxes on natural gas would benefit Teton County and the state. Table 4.23 shows estimates of the natural gas produced from the Blackleaf EIS area and an estimate of the associated royalties and taxes from 1990 to 2000.

Social Conditions

This alternative would result in a number of short-term and long-term changes in population, employment, personal earnings, and housing in the regional area of influence. While there may be individual, personal benefits associated with these changes, there is also the potential for adverse social effects; however, these impacts are anticipated to be insignificant.

The population analysis indicates that even during periods of peak employment, there would be no major demographic changes in the area. The area would not experience significant changes in such indicators of social well being as crime rates, per capita income or education levels. With no significant long-term population increases, there would be no community service impacts (e.g., water, sewage, schools) or any impacts from traffic or law enforcement problems.

TABLE 4.23
ESTIMATE OF NATURAL GAS PRODUCED FROM THE BLACKLEAF EIS AREA THE ASSOCIATED ROYALTIES AND STATE TAXES (valued at $1.42/MCF)[4]
1990-2000 - ALTERNATIVE 2

Year	Production MCF	Gross Value ($1.42/MCF)	Federal Mineral Receipts[1]	State Mineral Receipts[2]	Natural Gas Production Taxes[3]
1990	3,205,500	4,551,800	440,400	25,900	398,000
1991	3,589,100	5,096,500	485,200	30,600	549,400
1992	5,828,500	8,276,500	873,400	32,400	1,070,700
1993	7,800,000	10,935,400	1,221,900	29,200	1,273,700
1994	7,570,600	10,750,300	1,213,400	26,300	1,376,300
1995	7,763,700	11,024,500	1,260,800	23,700	1,523,500
1996	6,987,400	9,922,100	1,134,800	21,300	1,452,200
1997	6,288,600	8,929,900	1,021,400	19,200	1,307,000
1998	5,659,800	8,036,900	919,300	17,300	1,176,300
1999	5,096,800	7,237,400	828,000	15,500	1,059,300
2000	4,699,300	6,673,000	762,400	14,500	977,200

Note: This information is based on probable production from producing wells. The actual could vary significantly from that shown.

[1]Assumes a federal royalty rate of 12.5 percent plus lease payments.
[2]Based on the states participation in the Blackleaf unit and assumes a state royalty rate of 12.5 percent plus lease payments.
[3]This includes the resource indemnity trust tax, gas producers privilege and license tax, natural gas severance tax and net proceeds tax.
[4]BLM, 1989.

In terms of ability to deal with potential social problems, an important community resource is the prior experience with oil and gas exploration and development. The area has had experience with exploration and development in the Blackleaf EIS area as discussed in Alternative 1.

Alternative 3

Employment

Oil and gas development within the Blackleaf EIS area would provide short and long-term employment opportunities in the construction and transportation sectors. Employment opportunities could occur as early as 1990, when 108 jobs could be associated with constructing a gas processing facility and bringing two shut-in wells on line. Other employment opportunities would occur in the early 1990s during drilling activity. This employment would occur for relatively short time periods during drilling operations. Table 4.24 shows the employment associated with this alternative.

Peak drilling activity would be expected to occur in 1991, when approximately 75 full time jobs would be located at three drilling sites for 30 to 90 day time periods. These workers would include the drill rig crew, mud loggers and tool pushers. Local annual expenditures for goods and services would peak in 1990 and 1991, amounting to $1,074,000 and $1,033,000, respectively, for gas plant, drilling, and road/pipeline construction. Local expenditures would depend upon the availability of oil and gas support services in the area and actual surface and subsurface conditions encountered at the time a well is drilled. These expenditures could support 70 short-term jobs, directly associated with construction and other jobs supported by local expenditures. Increases in employment opportunities would cause immigration of workers for the drill rig crew, tool pushers and mud loggers while jobs in construction, transportation and oil/gas services would benefit the existing service sectors in the regional area.

Peak pipeline activity would be expected in 1992, when approximately 59 construction jobs could be expected for approximately 120 days. These jobs would be filled primarily by local employees who would not relocate to obtain these jobs. There would be approximately $616,000 in local expenditures from construction in 1992.

Jobs in construction, transportation and oil/gas services would occur in Teton, Glacier and Cascade Counties. In terms of increased numbers employed and the settlement pattern of nonlocal temporary workers, employment impacts related to field development would occur primarily in Choteau, in Teton County. The greatest impact to Choteau would occur during the peak drilling activity when 75 workers, associated with on site drilling, would be within the immediate area and another 6 short-term workers in support services would be needed in Choteau. Other communities in the area could also experience some short-term changes with immigration of temporary workers and increased employment opportunities. Temporary construction crews may not generate much local secondary employment; there are limits to how rapidly facilities and services could expand or would expand to accommodate temporary employees.

TABLE 4.24

ESTIMATED PROJECT RELATED EMPLOYMENT OPPORTUNITIES[2] ALTERNATIVE 3

	Development/Activities			Production	
Year	Number of Wells Drilled	On-site Full-time Jobs Lasting 30-90 Days	Part-time Jobs Lasting up to 120 Days	Number of Producing Wells	Number of Direct and Indirect Jobs
1990	0	0	108[1]	4	12
1991	3	75	70	7	17
1992	0	0	59	7	17
1993	0	0	0	7	17
1994	1	25	21	8	18
1995	0	0	0	8	18
1996	0	0	1	8	18
1997	1	25	20	9	19
1998	0	0	0	9	19
1999	0	0	0	9	19
2000	0	0	0	9	19

[1]Employment associated with construction of the gas processing facility and bringing the injection well on line.

[2]BLM, 1989.

Chase, R.A., et al. 1982. Expansion and Adaptation of the North Dakota Economic-Demographic Assessment Model (NEDAM) for Montana: Technical Description. Agricultural Economics Miscellaneous Report no. 61. North Dakota Agricultural Experiment Station, North Dakota State University, Fargo, N.D. 225p.

Wenner, L.N. 1981. Social and Economic Assessment of Oil and Gas Activities: Information and Guidelines. USDA Forest Service Northern Region. R1 81-01 84p.

Production related employment would occur in the regional area. Field maintenance crew and support personnel would be needed: repairmen, truckers, pumpers, and custodial personnel. Employment impacts would be expected primarily in Teton, Glacier and Cascade Counties. The number of annual direct workers at this stage of activity could be between 5 and 8 depending on the field size with another 7 to 11 annual indirect workers. This activity would benefit the existing oil and gas service and retail trade sectors. Table 4.24 shows employment opportunities from production in the regional area of influence.

Population

Development of oil and gas would result in minor short-term impacts to Choteau; the result of population growth associated with temporary nonlocal workers. This would occur for short periods during each year when drilling occurs. At the peak development period the population of Choteau could increase by 3% for a 30 to 90 day period. The communities of Dupuyer and Bynum could also experience some short-term changes with immigration of temporary workers. Dupuyer and Bynum are close to the Blackleaf EIS area (10 to 20 miles) but lack the services, housing and infrastructure that are available in Choteau. After the drilling activity, the development and exploration related population changes would decrease steadily until a stable regional operational work force would be in place for production.

Production related population increases would be spread over a larger area and would be minor. This would occur primarily in Cut Bank, Conrad, Shelby and Great Falls where most of the oil and gas service related businesses are located.

Personal Earnings

The communities where the workers and their families reside would experience some increases in economic activity as a result of employees payroll expenditure and through company expenditures for goods and services. For the regional area this would be less than a 1% increase in earnings during peak development. The impact on regional personal earnings for the period 1990 to 2000, are shown in Table 4.25.

TABLE 4.25
PROJECTED INCREASE IN ANNUAL REGIONAL EARNINGS (1986 dollars)[1]
ALTERNATIVE 3

Year	Development Earnings	Production Earnings	Total
1990	636,600	183,200	819,800
1991	905,400	259,600	1,165,000
1992	365,100	259,600	624,700
1993	0	259,600	259,600
1994	71,800	274,800	346,600
1995	0	274,800	274,800
1996	3,300	274,800	278,100
1997	0	290,100	290,100
1998	0	290,100	290,100
1999	0	290,100	290,100
2000	0	290,100	290,100

Note: The regional area is defined as Cascade, Glacier, Lewis and Clark, Pondera, and Teton Counties.

[1]BLM, 1989.
Chase, R.A., et al. 1982. Expansion and Adaptation of the North Dakota Economic-Demographic Assessment Model (NEDAM) for Montana: Technical Description: Agricultural Economics Miscellaneous Report no. 61: North Dakota Agricultural Experiment Station, North Dakota State University, Fargo, N.D. 225p.

Housing

Field development may cause a demand for temporary housing. This housing impact would be minor, occur primarily in Choteau, where it is expected most temporary nonlocal workers would reside and would be short-term, 30 to 120 days each year.

To a large extent, the nonlocal's choice of housing reflects the short duration of certain petroleum related activities, namely well drilling. Oil field personnel generally prefer apartments, motels, mobile homes, or recreational vehicles. Most of these workers seek lodging as close to the work site as possible or within the current boundaries of, or adjacent to, incorporated towns. This reflects the service, trade, housing supply, and governmental infrastructure presently available. If these workers are accompanied by their families, the demand for mobile homes and/or apartments may increase. Table 4.26 summarizes the housing impacts for Alternative 3.

TABLE 4.26
PROJECTED TEMPORARY INCREASE IN HOUSING DEMAND FOR THE COMMUNITY OF CHOTEAU DURING DEVELOPMENT AND EXPLORATION (assuming workers would not be accompanied by their families)[1]
ALTERNATIVE 3

Year	Apartment	Mobile Home	Other	Total
1990	0	0	0	0
1991	18	18	39	75
1992	0	0	0	0
1993	0	0	0	0
1994	6	6	13	25
1995	0	0	0	0
1996	0	0	0	0
1997	6	6	13	25
1998	0	0	0	0
1999	0	0	0	0
2000	0	0	0	0

[1]BLM, 1989.
Chase, R.A., et al. 1983. Profile of North Dakota's Petroleum Work Force, 1981-82. Agricultural Economics Report no. 174: North Dakota Agricultural Experiment Station, North Dakota State University, Fargo, N.D.

Public Finance

The principle long-term fiscal impact to the economy from natural gas production would be public revenues. Production taxes on natural gas would benefit Teton County and the state. Table 4.27 shows estimates of natural gas produced from the Blackleaf EIS area and the associated royalties and taxes from 1990 to 2000.

Social Conditions

This alternative would result in a number of short-term and long-term changes in population, employment, personal earnings, and housing in the regional area of influence. While there may be individual, personal benefits associated with these changes, there is also the potential for adverse social effects, but these impacts would be insignificant.

The population analysis indicates that even during periods of peak employment, there would be no major demographic changes in the area. The area would not experience significant changes in such indicators of social well being as crime rates, per capita income or education levels. With no significant long-term population increases, there would be no community service impacts (e.g., water, sewage, schools) or any impacts from traffic or law enforcement problems.

TABLE 4.27
ESTIMATE OF NATURAL GAS PRODUCED FROM THE BLACKLEAF EIS AREA THE ASSOCIATED ROYALTIES AND STATE TAXES (valued at $1.42/MCF)[4]
1990-2000 - ALTERNATIVE 3

Year	Production MCF	Gross Value ($1.42/MCF)	Federal Mineral Receipts[1]	State Mineral Receipts[2]	Natural Gas Production Taxes[3]
1990	1,611,200	2,287,900	194,700	18,500	247,100
1991	4,315,900	6,128,600	625,900	28,200	607,300
1992	3,884,300	5,515,700	563,400	25,400	757,800
1993	3,495,900	4,964,100	507,100	22,900	682,000
1994	3,146,300	4,467,700	456,500	20,600	613,900
1995	2,831,700	4,021,000	410,900	18,600	554,700
1996	2,548,500	3,618,900	369,900	16,700	517,200
1997	2,293,600	3,257,000	333,000	15,000	465,500
1998	2,064,300	2,931,300	299,700	13,500	418,900
1999	1,797,900	2,552,900	263,000	11,400	364,200
2000	1,672,100	2,374,300	242,900	11,000	339,300

Note: This information is based on probable production from producing wells. The actual could vary significantly from that shown.

[1]Assumes a federal royalty rate of 12.5 percent plus lease payments.
[2]Based on the states participation in the Blackleaf unit and assumes a state royalty rate of 12.5 percent plus lease payments.
[3]This includes the resource indemnity trust tax, gas producers privilege and license tax, natural gas severance tax and net proceeds tax.
[4]BLM, 1989.

In terms of ability to deal with potential social problems, an important community resource is the prior experience with oil and gas exploration and development. The area has had experience with exploration and development in the Blackleaf EIS area as discussed in Alternative 1.

Alternative 4

Employment

Oil and gas development within the Blackleaf EIS area would provide short and long-term employment opportunities in the construction and transportation sectors. Employment opportunities could occur as early as 1990, when 114 jobs could be associated with constructing a gas processing facility, bringing two shut-in wells on line and drilling one well. Other employment opportunities could occur throughout the 1990s during drilling activity. This employment would occur for relatively short time periods each year during drilling operations. Table 4.28 shows the employment associated with this alternative.

Peak drilling activity would be expected to occur in 1991, when approximately 75 full time jobs would be located at three drilling sites for 30 to 90 day time periods. These workers would include the drill rig crew, mud loggers and tool pushers. Local annual expenditures for goods and services during this phase could amount to $1,228,000 for drilling and road/pipeline construction. Local expenditures would depend upon the availability of oil and gas support services in the area and actual surface and subsurface conditions encountered at the time a well is drilled. These expenditures could support 98 short-term jobs. This would include those jobs directly associated with construction and other jobs supported by local expenditures. Increases in employment opportunities would cause immigration of workers for the drill rig crew, tool pushers and mud loggers while jobs in construction, transportation and oil/gas services would benefit the existing service sectors in the regional area.

Peak road and pipeline activity would be expected in 1994, when approximately 98 construction jobs could be expected for approximately 120 days. These jobs would be filled primarily by local employees who would not relocate to obtain these jobs. There would be approximately $1,452,000 in local expenditures from construction and drilling at two wellsites in 1994.

Jobs in construction, transportation and oil/gas services would be expected in Teton, Glacier and Cascade Counties. In terms of increased numbers employed and the settlement pattern of nonlocal temporary workers, employment impacts related to development and exploration would occur primarily in Choteau, in Teton County. The greatest impact to Choteau would occur during the peak drilling activity when 75 temporary workers, associated with on site drilling, would be within the immediate area and another 11 short-term workers in support services would be needed in Choteau. Other communities in the area could also experience some short-term changes with inmigration of temporary workers and increased employment opportunities. Temporary construction crews may not generate much local secondary employment; there are limits to how rapidly facilities and services could expand or will expand to accommodate temporary employees.

TABLE 4.28

ESTIMATED PROJECT RELATED EMPLOYMENT OPPORTUNITIES[2] ALTERNATIVE 4

	Development/Activities			Production	
Year	Number of Wells Drilled	On-site Full-time Jobs Lasting 30-90 Days	Part-time Jobs Lasting up to 120 Days	Number of Producing Wells	Number of Direct and Indirect Jobs
1990	0	114[1]	12	12	4
1991	3	75	98	7	17
1992	0	0	86	7	17
1993	2	50	74	9	19
1994	2	50	119	11	22
1995	1	25	90	12	23
1996	2	50	67	14	26
1997	1	25	22	15	28
1998	1	25	20	16	29
1999	1	25	19	17	31
2000	0	0	0	17	31

[1]Employment associated with construction of the gas processing facility and bringing the injection well on line.

[2]BLM, 1989.

Chase, R.A., et al. 1982. Expansion and Adaptation of the North Dakota Economic-Demographic Assessment Model (NEDAM) for Montana: Technical Description. Agricultural Economics Miscellaneous Report no. 61. North Dakota Agricultural Experiment Station, North Dakota State University, Fargo, N.D. 225p.

Wenner, L.N. 1981. Social and Economic Assessment of Oil and Gas Activities: Information and Guidelines. USDA Forest Service Northern Region. R1 81-01 84p.

Production related employment would occur in the regional area. Field maintenance crew and support personnel are needed: repairmen, truckers, pumpers, and custodial personnel. Employment effects are expected to occur primarily in Teton, Glacier and Cascade Counties. The number of annual direct workers at this stage of activity could be between 6 or 10 depending on the field size with another 8 to 15 annual indirect workers. This activity would benefit the existing oil and gas service and retail trade sectors (see Table 4.28).

Population

Development of oil and gas would result in minor short-term impacts to the community of Choteau; the result of population growth associated with temporary nonlocal workers. This would occur for short periods while drilling occurs. At the peak development period the population of Choteau could increase by 4% for a 30 to 90-day period. The communities of Dupuyer and Bynum could also experience some short-term changes with immigration of temporary workers. Dupuyer and Bynum are close to the Blackleaf EIS area (10 to 20 miles) but lack the services, housing and infrastructure that are available in Choteau. After the drilling activity, population changes would decrease steadily until a stable regional operational work force would be in place for production.

Production related population increases would be spread out over a larger area and would be minor. This would occur primarily in Cut Bank, Conrad, Shelby and Great Falls where most of the oil and gas service related businesses are located.

Personal Earnings

The communities where the workers and their families reside would experience some increases in economic activity as a result of employees payroll expenditure and through company expenditures for goods and services. For the regional area this would be less than a 1% increase in earnings during peak development. The impact on regional personal earnings for the period 1990 to 2000 are shown in Table 4.29.

TABLE 4.29
PROJECTED INCREASE IN ANNUAL REGIONAL EARNINGS (1986 dollars)[1]
ALTERNATIVE 4

Year	Development Earnings	Production Earnings	Total
1990	657,000	183,200	840,200
1991	1,062,000	229,000	1,291,000
1992	528,000	259,600	787,600
1993	562,200	290,100	852,300
1994	872,900	305,400	1,178,300
1995	580,700	335,900	916,600
1996	556,500	335,900	892,400
1997	203,800	335,900	539,700
1998	194,900	335,900	530,800
1999	187,600	335,900	523,500
2000	0	335,900	335,900

Note: The regional area is defined as Cascade, Glacier, Lewis and Clark, Pondera, and Teton Counties.

[1]BLM, 1989.
Chase, R.A., et al. 1982. Expansion and Adaptation of the North Dakota Economic-Demographic Assessment Model (NEDAM) for Montana: Technical Description: Agricultural Economics Miscellaneous Report no. 61: North Dakota Agricultural Experiment Station, North Dakota State University, Fargo, N.D. 225p.

Housing

Field development may cause a demand for temporary housing. This housing impact would be moderate and occur primarily in Choteau, where most temporary, nonlocal workers would reside and would be short-term, 30 to 120 days each year. Table 4.30 summarizes the housing impacts for Alternative 4.

To a large extent, the nonlocal's choice of housing reflects the short duration of certain petroleum related activities, namely well drilling. Oil field personnel generally prefer apartments, motels, mobile homes, or recreational vehicles. Most of these workers seek lodging as close to the work site as possible or within the current boundaries of, or adjacent to, incorporated towns. This reflects the service, trade, housing supply, and governmental infrastructure presently available. If these workers are accompanied by their families, the demand for mobile homes and/or apartments may increase.

TABLE 4.30
PROJECTED TEMPORARY INCREASE IN HOUSING DEMAND FOR THE COMMUNITY OF CHOTEAU DURING DEVELOPMENT AND EXPLORATION (assuming workers would not be accompanied by their families)[1]
ALTERNATIVE 4

Year	Apartment	Mobile Home	Other	Total
1990	0	0	0	0
1991	18	18	39	75
1992	0	0	0	0
1993	12	12	26	50
1994	12	12	26	50
1995	6	6	13	25
1996	12	12	26	50
1997	6	6	13	25
1998	6	6	13	25
1999	6	6	13	25
2000	0	0	0	0

[1]BLM, 1989.
Chase, R.A., et al. 1983. Profile of North Dakota's Petroleum Work Force, 1981-82. Agricultural Economics Report no. 174: North Dakota Agricultural Experiment Station, North Dakota State University, Fargo, N.D.

Public Finance

The principle long-term fiscal affect to the economy from natural gas production would be public revenues. Production taxes on natural gas would benefit Teton County and the state. Table 4.31 shows estimates of natural gas produced from the EIS area and the associated royalties and taxes from 1990 to 2000.

Social Conditions

This alternative would result in a number of short-term and long-term changes in population, employment, personal earnings, and housing in the regional area of influence. While there may be individual, personal benefits associated with these changes, there is also the potential for adverse social effects, which should not be significant.

The population analysis indicates that even during periods of peak employment, this alternative would not create major demographic changes in the area. The area would not experience significant changes in such indicators of social well being as crime rates, per capita income or education levels. With no significant long-term population increases, there would be no community service impacts (e.g., water, sewage, schools) or any impacts from traffic or law enforcement problems.

TABLE 4.31
ESTIMATE OF NATURAL GAS PRODUCED FROM THE BLACKLEAF EIS AREA THE ASSOCIATED ROYALTIES AND STATE TAXES (valued at $1.42/MCF)[4]
1990-2000 - ALTERNATIVE 4

Year	Production MCF	Gross Value ($1.42/MCF)	Federal Mineral Receipts[1]	State Mineral Receipts[2]	Natural Gas Production Taxes[3]
1990	1,446,400	2,053,900	176,900	16,100	229,100
1991	4,510,900	6,405,500	660,000	31,900	619,500
1992	4,423,500	6,281,300	658,600	28,700	854,300
1993	4,872,400	6,918,900	751,100	25,800	893,200
1994	4,752,100	6,748,000	741,200	23,300	916,200
1995	4,728,800	6,714,900	747,300	20,900	907,500
1996	4,255,900	6,043,400	672,700	18,800	881,600
1997	3,830,300	5,439,000	605,500	17,000	793,500
1998	3,447,300	4,895,100	545,000	15,300	714,100
1999	3,032,100	4,305,600	482,700	12,800	627,700
2000	2,792,300	3,965,100	441,600	12,400	578,400

Note: This information is based on probable production from producing wells. The actual could vary significantly from that shown.

[1]Assumes a federal royalty rate of 12.5 percent plus lease payments.
[2]Based on the states participation in the Blackleaf unit and assumes a state royalty rate of 12.5 percent plus lease payments.
[3]This includes the resource indemnity trust tax, gas producers privilege and license tax, natural gas severance tax and net proceeds tax.
[4]BLM, 1989.

In terms of ability to deal with potential social problems, an important community resource is the prior experience with oil and gas exploration and development. The area has had experience with exploration and development in the Blackleaf EIS area as discussed in Alternative 1.

MITIGATION

The standard management practices referenced in Chapter 2 and outlined in Appendix B are applicable to all alternatives and would be enforced no matter which alternative was selected as the agencies preferred alternative.

The mitigation measures outlined below are also applicable to all alternatives. Any or all of these requirements, plus any others deemed necessary at the onsite inspection, would be included in the applicants APDs to lessen the site specific impacts for each wellsite.

Changes have been made to this section between the DEIS and FEIS. Several measures have been added, modified, or deleted to provide a level of mitigation more consistent with the types of impacts documented in the FEIS, and to eliminate duplication and inconsistencies with mitigation provided by the standard management practices in Appendix B.

Cultural Resources

C-1 In areas of high potential for cultural resources, the BLM will distribute Archeological Resources Protection Act (ARPA) information to help discourage collection of cultural resources.

C-2 Pipelines, where possible, will be buried adjacent to wellsite access roads.

Soil Resources

S-1 Where possible, the operator will avoid placing cut/fill slopes in soil type 14D (see Appendix I). If avoidance isn't possible, cut/fill slopes will be kept under 10 feet in height.

Surface Water

SW-1 Facilities constructed in soil type 161 (see Appendix I) will require careful draining and the use of slash filter strips to trap sediment and reduce erosion.

Wildlife Resources

W-1 No oil and gas disturbance will occur simultaneously in adjacent drainages within seasonally important elk habitat.

W-2 The use of roads/trails which cross or come within 1/2 mile of a mountain goat mineral lick will be restricted to non-motorized use between May 1 and July 31.

W-3 Insert doglegs or visual barriers on pipelines and roads built through dense vegetative cover areas to prevent straight corridors exceeding 1/4-mile where vegetation has been removed.

W-4 Where possible, power lines will be buried to eliminate the possibility of raptor injury and/or mortality. Markers will be installed on wires heavily used by raptors to reduce collisions with wires..

W-5 During the first six months of production or at least through the first winter, wellsites can be visited a maximum of once per day, unless problems arise or maintenance is necessary. After all problems are resolved and well production becomes "routine", wellsite visits will drop to once every three days. Any exceptions to this policy will be authorized only after further consultation involving the BLM, USFWS, MDFWP and the FS.

Vegetation Resources

V-1 Revegetate disturbed sites with native vegetation or seed mixtures appropriate for the area. Long term emphasis should be on reestablishing vegetation which is known to be important for food or cover for grizzly bears or other wildlife, and on restablishing those vegetative species which are adaptable to the site conditions and compatible with existing vegetation.

V-2 The wellsite will be excluded from domestic livestock grazing by fencing off the area until vegetative establishment is complete.

V-3 Implement practices as identified in the Noxious Weed Management EIS for the Lewis and Clark National Forest for the prevention, control and monitoring of noxious weeds. These include the following:

Maintain vegetative cover, preferably a closed plant community adapted to the site, to limit the encroachment of noxious weeds. Require prompt revegetation where mineral soil is exposed by activities, such as road construction. Apply seed for revegetation based on species adaptation to the specific site conditions, ease of establishment and seed availability.

Apply seed of competing species, adapted to the site, to areas treated for noxious weed control, where noxious weed treatment leaves soil and vegetation conditions vulnerable to re-invasion and reoccupancy by noxious weeds.

Implement noxious weed control to ensure that noxious weeds are eradicated from disturbed sites.

V-4 Prior to initiating surface disturbance institute the following measures to prevent the introduction of noxious weed seeds or plant materials:

Ensure that gravel and fill material will come from sources that are free of noxious weeds.

Ensure that construction equipment and drilling rigs are clean and free of noxious weed seeds before entering the work site.

V-5 Prior to surface disturbing activities, an on-the-ground inventory for rare plants will be conducted. If rare plants are identified, management requirements on a site-by-site basis will be developed to allow for the maintenance of viable populations of the rare plant species on the site, and to minimize the effects on existing populations.

Visual Resources

VR-1 Production stock tanks will not exceed 12 feet in height.

VR-2 Right-of-way clearing in timbered, dense shrub, and scenic areas shall be limited to a minimum width necessary to prevent interference of trees and other vegetation with the facility construction. Authorized Officer may require clearing to be "feathered or graded" with curved or undulating boundaries to lessen visual "tunnel" effect. In locations where the right-of-way enters timber, including dense shrub, from meadows or other open areas, the Authorized Officer may require clearing to be "feathered" into the timber in order to retain maximum natural vegetative patterns. Authorized Officer may require a landscape architect to assist in the design of the pipeline route.

VR-3 Where necessary, road cuts will require broken-face blasting, and then coloring the rock face with a petroleum emulsion tacifier mulch.

VR-4 Where necessary, soil cuts/fills will require a petroleum emulsion mulch or organic material mulch with low color contrast to reduce visual impacts.

VR-5 Well pads will be bermed and seeded to reduce visual contrast.

VR-6 Flare stacks will be hinged to be let down when not in use.

RECOMMENDED MITIGATION

This section (Table 4.32) lists recommended mitigation measures, by alternative, that would lessen the effects on the various resources that would result from the proposed drilling and production operations. Many of these mitigation measures are very general in nature; however, site specific mitigation will be imposed when APDs are submitted.

TABLE 4.32
IMPACTS AND MITIGATION BY ALTERNATIVE

	ALTERNATIVE 1		ALTERNATIVE 2	
Resource	**Impact**	**Mitigation**	**Impact**	**Mitigation**
Air Quality	No impacts from the central gas plant because it is a "closed system" process.	Standard Management Practice (Appendix B).	Short-term minor impacts during drilling operations. Increased moderate impacts from production facilities at each wellsite, due to increased wellhead and production facilities.	Same as Alternative 1.
Geology	No impacts.	None.	Drilling would increase subsurface geologic information.	None.
Oil and Gas	An estimated 96.3 and 257.0 BCF of natural gas would not be produced. No additional geologic or reservoir information would be gained. 23 of 25 leases would not be produced.	Standard Management Practice Lease stipulations (Appendix C).	Positive impact to companies due to maximum drilling and production. An estimated 92.2 to 178.4 BCF of natural gas would be produced. 6,400 high potential acres, 2,560 medium potential acres and 640 low potential acres would be developed. 12 of 25 leases would not be produced.	Standard Management Practice Lease Stipulations (Appendix C).
Paleontology	No impacts.	Standard Management Practice	Same as Alternative 1, but on larger scale, because of the increased number of wellsites.	Standard Management Practice
Cultural Resources	Low potential for impact as all actions proposed for areas previously disturbed. Approximately 15 acres disturbed by gas plant construction, reinjection well.	Standard Management Practice	242 acres disturbed by construction activities. Increased access/human activity may increase illegal collection of artifacts.	Standard Management Practice
Soils	Impact to 15 acres of soil types with low soil stability hazards.	Standard Management Practice	Approximately 70 acres of soil having low soil stability hazards would be affected. Approximately 172 acres of soil having moderate soil stability hazards would be affected.	Standard Management Practice

TABLE 4.32 (continued)
IMPACTS AND MITIGATION BY ALTERNATIVE

	ALTERNATIVE 1		ALTERNATIVE 2	
Resource	**Impact**	**Mitigation**	**Impact**	**Mitigation**
Vegetation	15 acres of grassland would be disturbed reducing forage potential by 4,600 lbs. forage/year.	Standard Management Practice	Approximately 79 acres of coniferous forest area would be disturbed. 106 acres of grassland vegetation would be disturbed, reducing forage potential by 53,000 lbs. forage/year. 32 acres of riparian area would be disturbed. 24 acres of rockland would be disturbed. 242 acres of disturbance susceptible to noxious weed infestation.	Standard Management Practice
Livestock	5 acres forage disturbed resulting in 0.62 AUMs lost.	Standard Management Practice	103.4 acres of forage disturbed, resulting in 12.9 AUMs lost.	Standard Management Practice
Visual	Positive impact from dismantling 1-8, 1-5, 1-13, 1-19 facilities, improving visual quality in foreground and middle grounds.	Standard Management Practice	Significant impacts from constructing roads to E-2, S-2, S-5 wellsites. Moderate impacts from E-3, S-6, S-7 wellsites and roads. Foreground view moderately impacted because of facilities at each wellsite.	Standard Management Practice
Fish and Wildlife				
(*Wildlife)				
Grizzly Bear	Spring habitat — 12,060 acres.	Late summer/early fall timing window.	Spring habitat — 38,020 acres; denning habitat — 170 acres.	Standard Management Practice
Rocky Mountain Goat	Occupied yearlong — 2,050 acres; breeding, kidding, nursery — 2,050 acres; goat year long habitat.	Avoid construction within 1 mile of occupied mountain goat year long habitat.	Occupied yearlong — 8,390 acres; breeding, kidding, nursery — 8,390 acres; mineral licks — *(5)	Late summer/early fall timing window.
Bighorn Sheep			Winter range — 530 acres.	Late summer/early fall timing window.
Elk	Winter range — 12,060 acres; calving area — 920 acres; migration routes — *(2).	Late summer/early fall timing window.	Winter range — 33,810 acres; calving area — 5,180 acres; migration routes — *(4).	Standard Management Practice

TABLE 4.32 (continued)
IMPACTS AND MITIGATION BY ALTERNATIVE

	ALTERNATIVE 1		ALTERNATIVE 2	
Resource	**Impact**	**Mitigation**	**Impact**	**Mitigation**
Mule Deer	Winter range — 5,410 acres; fall transitional range — 400 acres; migration routes — *(2).	Late summer/early fall timing window.	Winter range — 15,600 acres; fall transitional range — 2,980 acres; migration routes — *(3).	Standard Management Practice
Raptors	Breeding/nesting habitats — *(16).	Use fall timing window to lessen impacts to most species (exact dates based on site specifics of activities).	Breeding/nesting habitats — *(78).	Late summer/early fall timing window.
Fisheries	*(2).		*(9).	
*Each number represents one wellsite falling within a 1-mile zone of influence of the habitat feature.				
Teton Roadless Area (TRA)	TRA would not be impacted.	None.	Natural integrity would be reduced. Activity would diminish apparent naturalness on approximately 2,600 acres. Activity would diminish remoteness on approximately 2,600 acres. Approximately 2,800 acres would no longer be suitable for solitude. Scenic and biological features would be altered. Approximately 2,600 acres would be removed from roadless status.	None.
Surface Water	No impacts.	Standard Management Practices	Moderate increased erosion and sedimentation in floodplains and wetlands.	Standard Management Practice Use slash filter strips to trap sediment near drainage.
Groundwater	Increased turbidity and sedimentation of short-term minor impact. Minor impacts due to lowering of intercepted groundwater in pipeline trenches. No lasting effects.	None.	Minor impact during road and drill pad construction due to increased sedimentation. No lasting effect. Minimal possibility that drilling fluids would entersubsurface aquifers. Minimal possibility of impacts from subsurface disposal of produced water. Geologic record is that very little salt water is expected. Temporary increase in turbidity and sediment would be a minor impact. Less infiltration and increased run-off due to compaction. Minimal possibility of impacts from subsurface disposal of produced water.	Standard Management Practice

TABLE 4.32 (continued)
IMPACTS AND MITIGATION BY ALTERNATIVE

	ALTERNATIVE 1		ALTERNATIVE 2	
Resource	**Impact**	**Mitigation**	**Impact**	**Mitigation**
Recreation	Short-term increase in noise and additional traffic from pipeline and gas plant construction.	Complete construction prior to or after hunting seasons.	Reduction of 80 acres from semiprimitive setting to a roaded natural setting. Existing travel ways could be more accessible and create access to areas that were previously inaccessible. USFS trails 106, 124, 153 would be easier to access, possibly lessening the overall recreational experience. 5.9 miles of new road would be constructed along eastern border of Teton Roadless Area.	Standard Management Practice
Noise	Short-term increase during construction activities.	None.	Short term impacts during drilling and construction. Minor long term impacts from production noise at the wellsite and vehicle traffic to and from the wellsite by maintenance workers, tanker trucks hauling condensate, etc. Increased noise may impact wildlife.	Standard Management Practice
Transportation System	No impacts.	None.	Possibilities of increased public vehicle use of road system, causing washboarding, rutting, etc.	Standard Management Practice
Health and Safety	Slight increase in potential for vehicle accidents.	None should be necessary because of low amount of activity.	Increased potential for traffic conflicts, accidents. Very low probability of a blow-out.	Install signs along roads during heavy periods of activity. Standard Management Practice. Remote monitoring.
Economics	Negative impacts to oil and and gas industry and federal and state leasing revenue. Industry would be able to develop 2 of 25 leases. $17,000-$44,000 annual leasing revenue on undeveloped reserves not available to federal government. $8,500-$22,000 annual leasing revenue on developed reserves not available to State of Montana.	None.	*Population*—moderate short-term population growth for Choteau. Minor population increases distributed across the five-county regional zone of influence. *Employment*—short-term moderate beneficial impacts due to increased number of full-time (30-90 day period) production related workers and part-time (120-day period) non-production workers.	None.

TABLE 4.32 (continued)
IMPACTS AND MITIGATION BY ALTERNATIVE

	ALTERNATIVE 1		ALTERNATIVE 2	
Resource	**Impact**	**Mitigation**	**Impact**	**Mitigation**
			Income—communities would experience moderate, short-term increases in income due to increased personal earnings from economic activity. *Housing*—significant, short-term increase in demand for housing. Existing housing inventory adequate for increases in population due to employment opportunities. *Facilities and Services*—moderate, short-term increases in demand for community services. Existing services inventory adequate for increases in population due to employment opportunities. *Public Finance*—beneficial impacts to Teton County and State of Montana from production taxes. *Social Conditions*—insignificant, adverse impacts due to effects of short-term increases in population influencing life-style, and factors of social well-being.	

TABLE 4.32 (continued)
IMPACTS AND MITIGATION BY ALTERNATIVE

	ALTERNATIVE 3		ALTERNATIVE 4	
Resource	**Impact**	**Mitigation**	**Impact**	**Mitigation**
Air Quality	Minor short-term impacts during drilling. No impacts from "closed system" gas processing plant.	Same as Alternative 2.	Similar to Alternative 2.	Same as Alternative 2.
Geology	Same as Alternative 2.	None.	Same as Alternatives 2.	None.
Oil and Gas	An estimated 96.3 to 239.1 BCF of natural gas would not be produced. 21 of 25 leases would not be produced.	Standard Management Practices. Lease stipulations (Appendix C).	An estimated 95.0 to 215.8 BCF of natural gas would not be produced. 13 of 25 leases would not be produced.	Standard Management Practices. Lease stipulations (Appendix C).
Paleontology	Same as Alternative 1. The E-4 site has potential to effect dinosaur fossils classified as significant.	Standard Management Practice	Same as Alternative 2.	Standard Management Practice
Cultural Resources	75 acres disturbed. Other impacts same as Alternative 2.	Standard Management Practice	219 acres disturbed. Other impacts same as Alternative 2.	Standard Management Practice
Soils	Approximately 28 acres of soil characterized by moderate soil stability hazards will be affected. Approximately 47 acres have low soil stability hazards.	Standard Management Practice	Approximately 81 acres of soil characterized by low soil stability hazards would be affected. Approximately 134 acres having moderate soil stability hazards would be affected. Approximately 4 acres having severe soil stability hazards would be affected.	Standard Management Practice
Vegetation	Approximately 9 acres of coniferous forest area would be disturbed. 63 acres of grassland vegetation would be disturbed, reducing forage potential by 31,500 lbs. forage/year. 3 acres of riparian would be disturbed. These 75 acres would be susceptible to noxious weed infestation.	Standard Management Practice	Approximately 44 acres of coniferous forest area would be disturbed. 107 acres of grassland vegetation would be disturbed, reducing forage potential by 53,000 lbs. total forage/year. 35 acres of rockland and 33 acres of riparian would be disturbed. These 219 acres would be susceptible to noxious weed infestation.	Standard Management Practice
Livestock	12.6 acres of forage disturbed disturbed, resulting in 1.5 AUMs lost.	Standard Management Practice	99.9 acres of forage disturbed resulting in 12.5 AUMs lost.	Standard Management Practice

TABLE 4.32 (continued)
IMPACTS AND MITIGATION BY ALTERNATIVE

	ALTERNATIVE 3		ALTERNATIVE 4	
Resource	**Impact**	**Mitigation**	**Impact**	**Mitigation**
Visual	Impacts less than in Alternative 2, due to remote monitoring and less sites. Short-term impacts from pipelines.	Same as Alternatives 1 and 2, as applicable.	Overall moderate visual impacts with some localized areas of significant impacts. Impacts very similar to Alternative 2.	Same as Alternatives 1, 2 and 3.
Fish and Wildlife				
(*Wildlife)				
Grizzly Bear	Spring habitat — 20,000 acres.	Rocky Mountain Front Wildlife Guidelines	Spring habitat — 38,020 acres; Denning habitat — 170 acres.	Same as Alternative 1.
Rocky Mountain Goat	Occupied yearlong — 2,050 acres; breeding, kidding, nursery — 2,160 acres.	Rocky Mountain Front Wildlife Guidelines	Occupied yearlong — 7,680 acres; breeding, kidding, nursery — 7,680 acres; mineral licks — *(4).	Remote monitoring, late summer/early fall timing window.
Bighorn Sheep			Winter range — 430 acres.	Remote monitoring, late summer/early fall timing window.
Elk	Winter range — 17,810 acres; calving area — 1,000 acres; migration routes — *(2).	Rocky Mountain Front Wildlife Guidelines	Winter range — 35,820 acres; calving area — 4,900 acres; migration routes — *(4).	Remote monitoring, late summer/early fall timing window.
Mule Deer	Winter range — 13,150 acres; fall transitional range — 400 acres; migration routes — *(3).	Rocky Mountain Front Wildlife Guidelines	Winter range — 17,680 acres; fall transitional range — 2,930 acres; migration routes — *(3).	Remote monitoring, late summer/early fall timing window.
Raptors	Breeding/nesting habitats — *(29).	Rocky Mountain Front Wildlife Guidelines	Breeding/nesting habitats — *(73).	Remote monitoring, late summer/early fall timing window.
Fisheries	*(3).		*(8).	
*Each number represents one wellsite falling with a 1-mile zone of influence of the habitat feature.				
Teton Roadless Area (TRA)	Impacts are same as Alternative 1.	None.	Activity would diminish apparent naturalness on approximately 1,800 acres. Activity would diminish remoteness on approximately 1,800 acres. Approximately 2,000 acres would no longer be suitable for solitude. Scenic and biological features would be altered. Approximately 1,800 acres would be removed from roadless status.	None.

TABLE 4.32 (continued)
IMPACTS AND MITIGATION BY ALTERNATIVE

	ALTERNATIVE 3		ALTERNATIVE 4	
Resource	**Impact**	**Mitigation**	**Impact**	**Mitigation**
Surface Water	Similar to Alternative 1.	Same as Alternative 1.	Similar to Alternative 1.	Same as Alternative 2.
Groundwater	Similar but less than Alternative 2.	Same as Alternative 2.	Similar to Alternative 2.	Same as Alternative 2.
Recreation	Same as Alternative 1.	Same as Alternative 1.	Similar to Alternative 2.	Standard Management Practice
Noise	Similar to those in Alternative 1. Insignificant noise at the wellsites due to the central gas processing plant.	Same as Alternative 1.	Same as Alternative 2.	Same as Alternative 3.
Transportation System	Impacts similar to but less than Alternative 2.	Standard Management Practice	Impacts very similar to Alternative 4.	Standard Management Practice
Health and Safety	Similar to Alternative 1.	Same as Alternative 2.	Similar to Alternative 2.	Same as Alternative 2.
Economics	Impacts same as Alternative 2 for population, employment, income, housing, facilities and services, public finance and social conditions.	None.	Impacts same as Alternative 2 for population, employment, income, housing, facilities and services, public finance, and social conditions.	None.

Source: BLM 1989

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

This section discusses only those resource components that would be impacted.

Commitment of cultural resources under all alternatives would create an irreversible and irretrievable situation as they are not a renewable resource.

Rehabilitation under all alternatives would lessen visual resource impacts, but there would be some irretrievable loss of natural scenic resources in the Blackleaf area due to road and wellpad scars.

Alternative 1

Livestock

Implementation of Alternative 1 would cause the loss of approximately 4,000 lbs. of grassland forage on either a temporary or permanent basis. If permanent loss of forage occurs, this loss would not exceed .67 AUMs.

Alternative 2

Livestock

Implementation of Alternative 2 would cause the loss of approximately 29,600 lbs. of grassland forage on either a temporary or permanent basis. If permanent loss of forage occurs, this loss would not exceed 12.9 AUMs.

Teton Roadless Area

Implementation of Alternative 2 would reduce the Roadless status by 2,600 acres in the Teton Roadless Area. This would constitute a 4% land area reduction for the Roadless Area and a 17% reduction in the size of the Blackleaf Unit.

Alternative 3

Livestock

Implementation of Alternative 3 would cause the loss of approximately 6,800 lbs. of grassland forage on either a temporary or permanent basis. If permanent loss of forage occurs, this loss would not exceed 1.5 AUMs.

Alternative 4

Livestock

Implementation of the Preferred Alternative (4) would cause the loss of approximately 14,500 lbs. of grassland forage on either a temporary or permanent basis. If permanent loss of forage occurs, this loss would not exceed 12.5 AUMs under Alternative 4 proposals.

Teton Roadless Area

This alternative would remove roadless status from 1,800 acres in the Teton Roadless Area. This would constitute a 3% land area reduction for the Roadless Area and a 12% reduction in the size of the Blackleaf Unit.

UNAVOIDABLE ADVERSE IMPACTS

This section discusses only those impacts to resource components that would remain after mitigation measures have beem implemented.

Visual Resources

Road, wellpad, pipeline and facility construction activities in all alternatives would create unavoidable impacts to the visual resources of the EIS area. These impacts could be mitigated to some degree and are a function of the number and location of the individual sites.

Alternative 1

Wildlife

Based on a 1-mile zone of influence, Alternative 1 would disturb 34,950 acres of important wildlife habitats and 22 special habitat features such as mineral licks and cliff nesting sites (see Table 4.9).

Application of Interagency Rocky Mountain Front Wildlife Guidelines (BLM, et.al., 1987) pertinent to protecting habitats at each site will lessen impact significantly during site

development and pipeline construction, adherence to a late summer and fall operating window. No new exploratory wells are proposed in this alternative. During production negative influence is unavoidable during the critical periods in wildlife life cycles. Intensity of effect can be significantly restrained by implementation of a firm road management policy including road closure to the public plus remote monitoring of wells.

Adverse impacts to the gray wolf and grizzly bear for all alternatives are given in the Biological Evaluation (Appendix L). Wolves and grizzlies would be less affected by Alternative 1 than by any of the other alternatives.

Livestock

Unavoidable impacts to livestock production are almost unmeasurable in terms of animal-unit months lost: .67 AUMs. Only the Cow Creek allotment would be affected from oil-gas facility development which would disturb 5 acres.

Oil and Gas

Twenty of the 22 Federal leases would not be explored for oil and gas resources by drilling. Because of this, 84 to 92% of the estimated recoverable resources would not be produced. By not allowing development on leases already issued in the Blackleaf area, the federal government may be forced to buy back leases in the EIS area if they can't be explored.

Cultural

Adverse impacts to cultural resources would be low under Alternative 1. Impacts to cultural resources would occur only if avoidance of the resource is not feasible during pipeline construction.

Soil and Vegetation Resources

This alternative would cause unavoidable adverse impacts to soil and vegetation resources on 15 acres disturbed by well and pipeline construction activities. The area disturbed would be subject to accelerated erosion during construction activities and until stabilized by effective vegetative cover. Additional risk of land slump and mudflow would occur on unstable soil types impacted by construction. The tree and timber growth potential would be reduced on the forest land disturbed by the development. Grazing potential would be reduced for both big game animals and livestock on the grassland area disturbed. The area impacted by development would be susceptible to noxious weed infestation. Although no plant species of special concern have been identified on the area proposed for development, there is a risk of adversely affecting undiscovered rare or sensitive plant habitat during the development. See Chapter 4, Environmental Consequences, for further description of the adverse impacts associated with the proposed development.

Recreation

Impacts to recreation opportunities, resources and activities would occur under each alternative for the duration of the exploration activity.

Road and drill pad construction and the traffic, noise and emissions associated with drilling would have an unavoidable effect of all the roaded alternatives and would be considered by some to be incompatible with the roadless character of the area.

Alternative 2

Wildlife

Alternative 2 would disturb 113,070 acres of important wildlife habitat and 99 special habitat features (see Table 4.10). Application of the Interagency Wildlife Guidelines, especially appropriate timing windows would help lessen the impacts of drilling the eight step-out and six exploratory wells programmed, but some overlap in time of certain wildlife species traditional use of each site may occur and some impact would thus be unavoidable.

Impacts from production would be very difficult to mitigate in this alternative as remote monitoring is not applied. Thus, more vehicular trips would be necessary for gas field operation and greater levels of impact would be exerted on wildlife. In other words, the negative effect on each acre of disturbed habitat at each wellsite and associated road would be significantly greater than in the other three alternatives that employ remote monitoring.

Livestock

Unavoidable impacts to livestock production occur in four allotments (see Table 4.3). Loss of grassland forage due to surface disturbance accounts for 12.9 AUMs lost on at least a short-term basis (up to 5 years).

Oil and Gas

From 60 to 80% of the recoverable resources in the EIS area would not be produced under this alternative. Nine of the 22 federal leases would not be explored by drilling.

Cultural

Development under Alternative 2 could impact cultural resources through road, pipeline, and well construction. Additional impacts to cultural resources in the study area would be from increased human activity.

Soil and Vegetation Resources

Unavoidable adverse impacts would occur on 242 acres disturbed by road, well and pipeline construction. The adverse impacts would be the same as described above for Alternative 1, except a much larger area of land would be impacted.

Alternative 3

Wildlife

This alternative adheres strictly to the Interagency Wildlife Guidelines which allows the scenario described in Alternative 1, plus the addition of two step-out and two exploratory wells. The acres of wildlife habitat disturbed totals 55,560 acres which would be about half that disturbed in Alternative 2. Thirty-seven habitat features would be affected (see Table 4.11). Unavoidable impacts would be similar to those discussed for Alternative 2 except they would be less because fewer sites are programmed and remote monitoring would be a principle method of mitigation.

Livestock

Unavoidable impacts to livestock production occur in three allotments (see Table 4.4). Loss of grassland forage due to surface disturbance accounts for 1.5 AUMs lost on at least a short-term basis (up to 5 years).

Oil and Gas

Eighty-four to 86% of the estimated reserves in the EIS area would not be recovered under this alternative. Eighteen of the 22 federal leases would not be explored by drilling.

Cultural

Development under Alternative 3 could impact cultural resources through road, pipeline, and well construction. Additional impacts to cultural resources in the study area would be from increased human activity.

Soil and Vegetation Resources

Unavoidable adverse impacts, similar to those described for Alternative 1, would occur on 75 acres.

Alternative 4

Wildlife

Over 2,000 more acres of important wildlife habitats would be affected in this alternative than in Alternative 2 even though two less step-out wells are programmed. The reason for this is because remote monitoring is employed which requires disturbance to acres needed for a gas plant and reinjection well. However, the kinds of impacts that would be unavoidable are similar to the other alternatives but less severe than Alternative 2 because of remote monitoring. Ninety-two habitat features would be affected in this alternative (see Table 4.12).

Livestock

Implementation of this alternative would cause the following unavoidable adverse impacts to livestock production:

Of the 99.9 total disturbed acres, 28.98 acres are grassland acres which would cause 14,500 lbs. forage (12.5 AUMs) temporary or permanent loss to livestock. Permanent loss would occur if oil-gas production facilities were installed and used for a number of years.

Oil and Gas

Because this alternative does not allow exploration and development by drilling on parts of the EIS area and restricts production in other areas it would result in a loss of 76 to 81% of the estimated recoverable reserves contained in the EIS area. Ten of the 22 federal leases would not be explored by drilling.

Cultural

Development under Alternative 4 could impact cultural resources through road, pipeline, and well construction. Additional impacts to cultural resources in the study area would be from increased human activity.

Soil and Vegetation Resources

Unavoidable adverse impacts similar to those described for Alternative 1, would occur on 219 acres.

SHORT-TERM USE AND LONG-TERM PRODUCTIVITY

This section discusses only those resource components that would be impacted.

Visual Resources

The short-term impacts (1-2 years) from construction activities of each alternative would be severe to the visual resources of the EIS area. Using the facilities would create moderate impacts (15-20 years). Abandonment and rehabilitation of the sites would return the area to a near natural state, although some severe sites (S-2 and E-2) may create long-term impacts due to the high walls and loss of forest cover for 30-40 years following rehabilitation.

Soil and Vegetation Resources

The impacts of construction associated with the development phase of any of the alternatives would be short term, lasting only a year or two. Revegetation of impacted ground cover on disturbed sites would normally take one year, or only a few years at most. The maintenance activity associated with production wells would prolong the use and associated disturbance of roads, pipelines and well sites for about 23 years or more. With planned site rehabilitation following the completion of production, there should be no significant loss of long-term productivity resulting from the development. However, a major spill or uncontrolled blowout of saline water, oil or other toxic waste material could cause much longer term impacts and loss of productivity than is normally anticipated. The impacts of these unlikely events are discussed in Appendix H of this FEIS.

Alternative 1

Wildlife

The impacts of bringing the B-1 and I-19 wells on line and developing the reinjection well would be considered very short term (less than one month of human activity) for each site. Production of the four wells and operation of the gas plant must be considered long-term impacts. The life of each of these wells would be estimated to be about 20 years, as would be the life of this four well field. Successful reclamation of these sites upon abandonment should negate irreversible commitment of wildlife habitat and use of the affected areas.

Livestock

Forage losses to livestock use are mostly short-term, the greatest impact being immediately following construction when grassland is removed. Up to 5 years are needed to restore the grassland potential, even when allowed to rest after reseeding. Long-term production could be increased over pre-disturbance production levels by reseeding drill pads, pipelines, and roadways to quality grass-legume seed mixtures. Long-term livestock forage production would decrease only slightly if oil-gas production occurs for a lengthy period (10-20 years).

Oil and Gas

The short-term impact of this alternative to the oil and gas resource would be to reduce the amount of exploration on federal minerals in the area. The long-term impacts would be increasing development on private minerals, draining unleased federal minerals with a loss of royalties to the federal government. The oil and gas removed from the two structures would be irreversible and irretrievable impacts.

Cultural Resources

The direct impact to cultural resources (i.e. destruction during construction) would be identical for both short-term and long-term use of the EIS area. Indirect impacts from increased activity in the area would be proportional to the length of productivity and extended access to the area.

Alternative 1 with minimum construction, no new access and a one year exploration and development time frame would cause the least effect on cultural resources.

Recreation

The impacts from each alternative would include the noise, dust, traffic, and road closures that would occur during road construction and drilling. Vegetative scars would persist for decades from road disturbance until forest succession progresses.

Alternative 2

Wildlife

Impacts of exploration and abandonment at each site would be considered short term; road building and drilling less than 4 months in any one year and most often accomplished in one year and reclamation to usable wildlife habitat taking only a few years.

However, successful wells put to production must be considered long-term impacts, as would be the development of the entire Blackleaf Field. Habitat areas adjacent to service roads and around wellheads would be affected for the life of each well, estimated to average about 20 years; and also for the life of the field (42 years).

All areas disturbed could be reclaimed to effective habitat; and wildlife may return to a pattern of traditional use of the affected areas. It is possible that in some cases the chain of learned behavior may be broken and traditional use may not be reestablished such as that taught by a sow grizzly to her young.

Livestock

Forage losses to livestock use are mostly short-term, the greatest impact being immediately following construction when grassland is removed. Up to 5 years would be needed to restore the grassland potential to former levels, even when allowed to rest after reseeding. Long-term production could be increased over pre-disturbance production by reseeding drill pads, pipelines, and roadways to quality seed-legume seed mixtures. Long-term livestock forage production would decrease only slightly if oil-gas production occurs for a lengthy period (10-20 years).

Oil and Gas

The short-term impact would be to increase activity in the area. Long-term productivity would be maximized compared to any other alternative. The reserves produced from the structures would be irreversibly and irretrievably lost.

Cultural

Alternative 2, which provides for 12.85 miles of new road and exploration and development activity over an 8 year period, would increase indirect impacts to cultural resources.

Alternative 3

Wildlife

Affects would be similar to those discussed in Alternative 2 except the field would run its course in a shorter period of time, 34 years.

Livestock

Forage losses to livestock use are mostly short-term, the greatest impact being immediately following construction when grassland is removed. Up to 5 years would be needed to restore the grassland potential to former levels, even when allowed to rest after reseeding. Long-term production could be increased over pre-disturbance production levels by reseeding drill pads, pipelines, and roadways to quality grass-legume seed mixtures. Long-term livestock forage production would decrease only slightly if oil-gas production occurs for a lengthy period (10-20 years).

Oil & Gas

The short-term impact would be to discourage investment in oil and gas exploration along the Rocky Mountain Front. The long-term impact would be to reduce leasing after present leases expire. Once the government decides not to allow development of issued leases it is taking a step that may become irreversible. The reserves produced from wells drilled under this alternative would be irreversibly and irretrievably lost.

Cultural

Alternative 3 which provides for 1.3 miles of new road and exploration and development activity over an 8 year period, has the potential to increase indirect impacts to cultural resources.

Alternative 4

Wildlife

Affects are similar to Alternative 2 except not as severe as explained above. The life of the field will be similar to Alternative 2.

Livestock

Forage losses to livestock use are mostly short-term, the greatest impact being immediately following construction when grassland forage is removed. Up to 5 years would be needed to recover the grassland production potential to former levels even when allowed to rest after reseeding. Long-term production could actually be increased by reseeding drill pads, pipelines, and roadways to quality grass-legume seed mixtures. Long-term livestock forage production would decrease only if oil-gas production occurred for a long period (10-20 years).

Oil and Gas

The short-term impact would be to increase the costs of drilling the step-out and exploratory wells. The long-term impacts would be earlier abandonment of the wells with resulting loss of recoverable reserves. Resources produced would be irretrievably lost.

Cultural

Alternative 4, which provides for 12.25 miles of new road and exploration and development over a 15 year period, would cause long-term impacts to cultural resources outside of the areas of development.