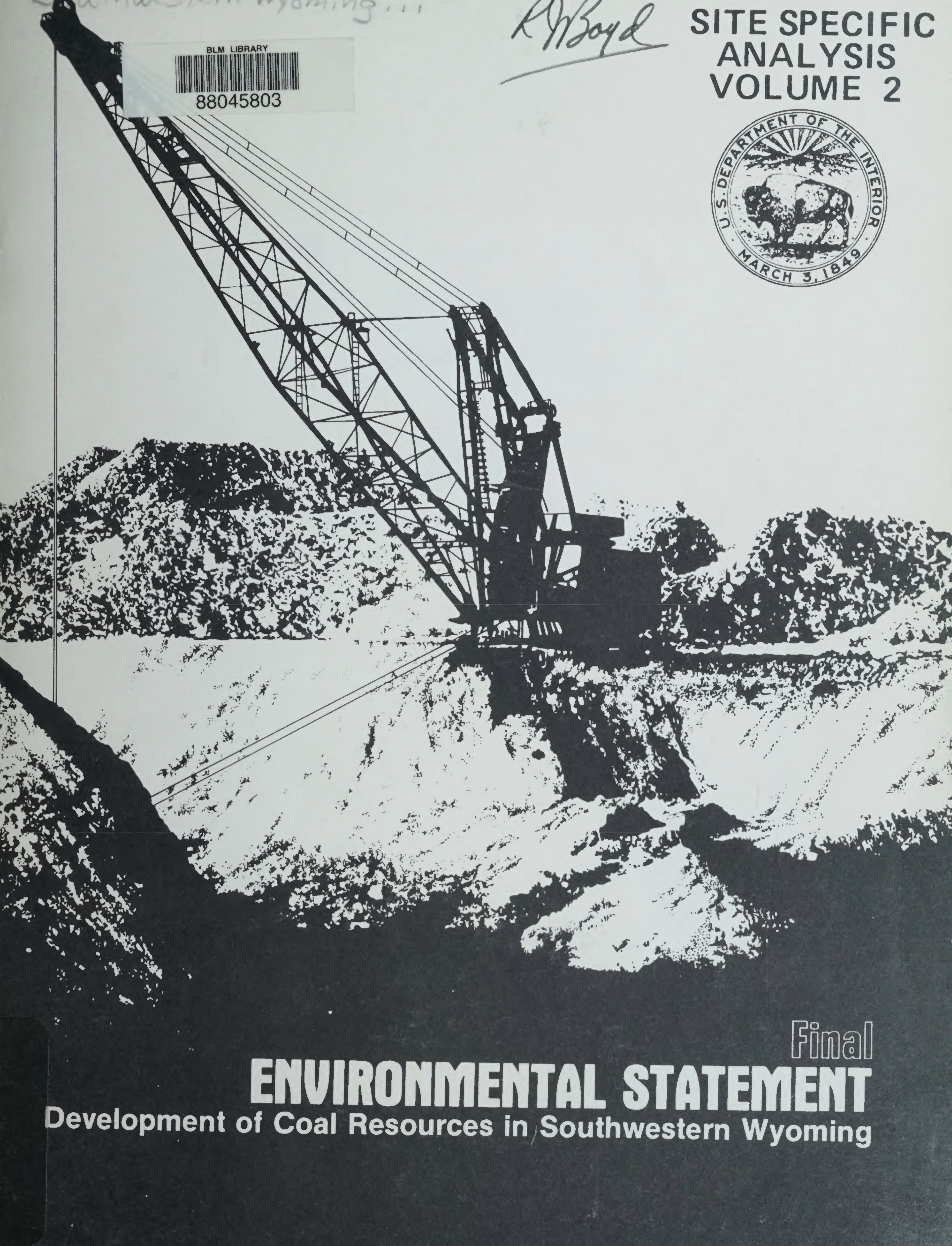
Southwestern Wyoming...

R W Boyd

SITE SPECIFIC ANALYSIS VOLUME 2



Final

ENVIRONMENTAL STATEMENT

Development of Coal Resources in Southwestern Wyoming

THIS VOLUME CONTAINS
THE FIVE SITE SPECIFIC
MINES THAT ARE PROPOSED
FOR DEVELOPMENT IN
SOUTHWESTERN, WYOMING

1. NORTH BLOCK
2. TWIN CREEK
3. SOUTH HAYSTACK
4. LONG CANYON
5. BLACK BUTTE

PROPOSED NORTH BLOCK MINE

TABLE OF CONTENTS

(VOLUME 2)
SITE SPECIFIC ANALYSES
NORTH BLOCK MINE PROPOSAL

Chapter 1	Page
DESCRIPTION OF THE PROPOSAL	NB1-1
HISTORY AND BACKGROUND	NB1-1
SURFACE MINING CONTROL AND RECLAMATION ACT	NB1-1
PROPOSED ACTION	NB1-1
Purpose and Objective	NB1-1
Location	NB1-2
Predisturbance Inventories and Analyses	NB1-2
Mine	NB1-2
Facilities	NB1-2
Support Facilities	NB1-2
Stages of Implementation	NB1-6
Mining Procedures	NB1-6
Reclamation	NB1-6
Pollution Control Methods	NB1-11
Surface Water Monitoring	NB1-11
AUTHORIZING ACTIONS	NB1-11
Bureau of Land Management (BLM)	NB1-11
Geological Survey (GS)	NB1-11
State and County	NB1-11
INTERRELATIONSHIPS	NB1-11
Relationship to Land Use Plans	NB1-11
Relationship to Other Proposed and Future Actions	NB1-11
Chapter 2	
DESCRIPTION OF THE ENVIRONMENT	NB2-1
EXISTING ENVIRONMENT	NB2-1
CLIMATE	NB2-1
Sunshine	NB2-1
Wind Fields	NB2-1
Atmospheric Temperature and Stability	NB2-1
Moisture and Evapotranspiration	NB2-1
Severe Weather Events	NB2-1
AIR QUALITY	NB2-1
GEOLOGY	NB2-2
Stratigraphy	NB2-2
Paleontology	NB2-2
Structure	NB2-2
Geologic Hazards	NB2-2
TOPOGRAPHY	NB2-2
SOILS	NB2-2
WATER RESOURCES	NB2-5
Ground Water	NB2-5
Surface Water	NB2-5
VEGETATION	NB2-11
Terrestrial Vegetation	NB2-11
Aquatic Vegetation	NB2-14
FISH AND WILDLIFE	NB2-14
General Information	NB2-14
Fishery	NB2-14
Wildlife	NB2-14
Wild Horses	NB2-15
CULTURAL RESOURCES	NB2-15
Archeological	NB2-15
Historical	NB2-17
VISUAL RESOURCES	NB2-17
RECREATIONAL RESOURCES	NB2-17
Visitor Use Data	NB2-17
Fishing	NB2-17
Hunting	NB2-17
Sightseeing	NB2-17
Specialized Activities	NB2-17
Wilderness Values	NB2-22
AGRICULTURE	NB2-22
MINERAL RESOURCES	NB2-22
Coal	NB2-22
LAND USE PLANS, CONTROLS, AND CONSTRAINTS	NB2-22

TABLE OF CONTENTS (Cont'd)

NORTH BLOCK MINE PROPOSAL

Chapter 2 (Cont'd)	Page
TRANSPORTATION NETWORKS	NB2-24
Highways	NB2-24
Railroads	NB2-24
SOCIOECONOMIC CONDITIONS	NB2-24
Population	NB2-24
Employment	NB2-24
Income	NB2-24
Infrastructure	NB2-24
Attitudes and Expectations	NB2-28
Life Styles	NB2-28
FUTURE ENVIRONMENT	NB2-31
Chapter 3	
ENVIRONMENTAL IMPACTS OF THE PROPOSED FEDERAL ACTION	NB3-1
ASSUMPTIONS AND ANALYSIS GUIDELINES	NB3-1
Assumptions	NB3-1
Guideline	NB3-1
AIR QUALITY	NB3-1
Emissions from the Proposed Mine	NB3-1
Impacts on Air Quality	NB3-3
Gaseous Pollutants	NB3-3
Visibility	NB3-3
GEOLOGY	NB3-10
Paleontology	NB3-10
Geologic Hazards	NB3-10
TOPOGRAPHY	NB3-10
SOILS	NB3-10
WATER RESOURCES	NB3-11
Ground Water	NB3-11
Surface Water	NB3-11
Water Use	NB3-12
VEGETATION	NB3-12
Terrestrial	NB3-12
Aquatic	NB3-13
Endangered and Threatened	NB3-13
FISH AND WILDLIFE	NB3-13
General Information	NB3-13
Habitat Losses	NB3-13
Carrying Capacity Losses	NB3-13
Fish and Wildlife Population Loss	NB3-18
Wild Horses	NB3-19
CULTURAL RESOURCES	NB3-19
Archeological	NB3-19
Historical	NB3-19
VISUAL RESOURCES	NB3-19
Summary of Table NB3-10A	NB3-21
RECREATIONAL RESOURCES	NB3-21
Visitor Use Data	NB3-21
Resources	NB3-21
AGRICULTURE	NB3-23
Livestock Grazing	NB3-23
Prime Farmland	NB3-23
MINERAL RESOURCES	NB3-23
Coal	NB3-23
Sand and Gravel	NB3-23
TRANSPORTATION NETWORKS	NB3-23
SOCIOECONOMIC CONDITIONS	NB3-25
Populations	NB3-25
Employment	NB3-25
Income	NB3-25
Infrastructure	NB3-25
Education	NB3-29
Social Services and Facilities	NB3-29
Attitudes and Expectations	NB3-29
Life Styles	NB3-29
Chapter 4	
MITIGATING MEASURES NOT INCLUDED IN THE PROPOSED ACTION	NB4-1
MEASURES	NB4-1
Mining and Reclamation Plan	NB4-1
Right-of-Way	NB4-2
ANALYSIS OF EFFECTIVENESS	NB4-2
MONITORING, RESEARCH AND STUDY PROGRAMS	NB4-3

TABLE OF CONTENTS (Cont'd)

NORTH BLOCK MINE PROPOSAL

Chapter 5	Page
ANY ADVERSE IMPACTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED	NB5-1
AIR QUALITY	NB5-1
GEOLOGY	NB5-2
Paleontology	NB5-2
SOILS	NB5-2
WATER RESOURCES	NB5-2
Ground Water	NB5-2
Surface Water	NB5-2
VEGETATION	NB5-2
Terrestrial	NB5-2
Aquatic	NB5-3
FISH AND WILDLIFE	NB5-3
CULTURAL RESOURCES	NB5-3
VISUAL RESOURCES	NB5-3
RECREATIONAL RESOURCES	NB5-3
Visitor Use Data	NB5-4
AGRICULTURE	NB5-4
MINERAL RESOURCES	NB5-4
TRANSPORTATION NETWORKS	NB5-4
SOCIOECONOMIC CONDITIONS	NB5-4
Population	NB5-4
Social Conditions	NB5-4
Chapter 6	
THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY	NB6-1
Chapter 7	
ANY IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED	NB7-1
Chapter 8	
ALTERNATIVES TO THE PROPOSED ACTION	NB8-1
NO ACTION	NB8-1
Air Quality	NB8-1
Fish and Wildlife Mitigation Alternative	NB8-4
Underground Mining Alternative	NB8-4
DIFFERENT UTILIZATION	NB8-4
HAMS FORK PROTECTIVE ALTERNATIVE	NB8-6
NORTH BLOCK RECLAMATION ALTERNATIVE	NB8-6
RECLAMATION METHODOLOGY ALTERNATIVE	NB8-6
DEFER ACTION ALTERNATIVE	NB8-7
PREVENT (FURTHER) DEVELOPMENT ON THE LEASE ALTERNATIVE	NB8-7
RESTRICT DEVELOPMENT ON THE LEASE ALTERNATIVE	NB8-7
ALLOW DEVELOPMENT OF SELECTED AREAS NOW UNDER LEASE	NB8-7
Chapter 9	
CONSULTATION AND COORDINATION	NB9-1
NORTH BLOCK SITE SPECIFIC APPENDIX	
SOIL ASSOCIATION MAPPING UNIT DESCRIPTIONS	NBA-1

CHAPTER 1

DESCRIPTION OF THE PROPOSAL

HISTORY AND BACKGROUND

Kemmerer Coal Company was the successful bidder for competitive coal leases W-075207 and W-0294513, located about 5 miles west of Kemmerer, Wyoming, which were issued on 2 January 1959 and 1 July 1964, respectively. Kemmerer Coal Company held prospecting permits which proved into preference right leases W-056471 and W-060274 on 1 April 1962 and 1 March 1963, respectively. The total acreage of the leases is 2,936 acres and includes acreage outside the project area.

In July 1975, Kemmerer Coal Company filed a mining and reclamation plan (Kemmerer Coal Company 1975) in accordance with 30 Code of Federal Regulations (CFR) 211 (May 1976), together with a comprehensive draft environmental impact assessment for a proposed surface open-pit coal mine, with the Office of the District Mining Supervisor, Geological Survey (USGS), in Rock Springs, Wyoming.

The leases with the Bureau of Land Management (BLM) are continuing leases, subject to reasonable readjustment of terms on a 20-year basis and all current legislation affecting federal leasing policy. All four leases provide for royalties of 15 cents per ton (2,000 pounds) for coal mined from underground operations and 17½ cents per ton (2,000 pounds) for surface-mined coal. The annual rentals provide for 25 cents the first year, 50 cents the second through the fifth years, and 1 dollar per acre for the sixth and succeeding years. The lease is subject to all current legislation affecting coal leases.

The mining plan and supporting data submitted by Kemmerer Coal Company are available for review at the Office of the District Mining Supervisor, Conservation Division, Rock Springs, Wyoming. The USGS accepted the North Block mining and reclamation plan as suitable for use in preparing an environmental statement (ES).

The coal seams of this mine incline greater than 15 degrees; however, this mine may or may not meet the qualifications set in Section 527 (Special Bituminous Coal Mines) of the Surface Mining Control and Reclamation Act of 1977 due to its physical location in relation to the existing 527 mine. However, it is being treated as a 527 Special Bituminous Mine in this site-specific ES until the question of location can be resolved. Section 527 allows for certain reclamation exemptions such as highwalls, benches, etc.

SURFACE MINING CONTROL AND RECLAMATION ACT

The mining and reclamation plan for this proposed project was submitted for review prior to passage of the Surface Mining Control and Reclamation Act (SMCRA) of 1977 (P.L. 95-87). Therefore, the plan may not fully reflect the requirements of the current law and regulations. However, it is believed that it presents sufficient data to permit analysis of the impacts that will be associated with mining in this area. Prior to departmental approval, the plan will be returned to the applicant for modification to incorporate the requirements of SMCRA. When the mining and reclamation plan is returned to the Department, it will be reevaluated to insure that it meets the requirements of SMCRA and appropriate federal regulations, and that the potential impacts are covered by this environmental statement. This procedure will facilitate the timely and efficient consideration of applications for permits under the evolving requirements of SMCRA. We believe this procedure is reasonable in view of the evolving character of the law.

The Regional ES, Chapter 3, Planning and Environmental Controls, includes reference to appropriate provisions of SMCRA, and these were incorporated into the following impact analysis to the extent possible at this time. However, it is realized that some of the adverse impacts described will be precluded by implementation and enforcement of the new law. This is especially true in regard to impacts on the water, soil, and vegetation resources. In any event, the worst possible case is covered.

PROPOSED ACTION

The proposed action before the federal government is to review and consider for approval the mining and reclamation plan and rights-of-way across public land for 4.5 miles of power/telephone line and 3.8 miles of tram road/conveyor system.

Purpose and Objective

The purpose of the proposed action is to allow the leaseholder to mine about 1.4 million tons of coal per year from public and private lands for a total of 54 million tons during the 35-year life of the mine.

The objective is to supply fuel for generation of electrical power at the proposed 4th Unit of the Naughton

Power Plant owned by the Utah Power and Light Company and scheduled to be in operation in 1983; however, this market is not currently under contract.

Location

The proposed mine would be located 5 miles west of Kemmerer, Wyoming, just north of U.S. Highway 30 (Figure NB1-1 and Map NB1-1).

The leasehold, within an area 4 miles long and 2 miles wide, is bounded by the Colorado River-Great Divide Basin on the west. A total of 2,473 acres is contained in the project area with 320 acres of private and 2,153 acres of public lands. Table NB1-1 depicts land surface and coal ownership by acres.

Predisturbance Inventories and Analyses

Specific inventories were conducted under the direction and (or) cooperation of the Kemmerer Coal Company in consultation with the BLM concerning endangered and (or) threatened plants and historical and archeological sites.

Robert Dorn, BLM plant specialist, conducted an inventory of the proposed North Block project area for proposed endangered and (or) threatened plant species. His inventory did not reveal the presence of any plants listed on the 1977 list of proposed endangered and (or) threatened plant species.

M. Ann Bennett (1974) conducted an archeological survey of part of the project area (see Chapter 2, Cultural Resources).

In 1976, Western Interpretive Services, Inc., conducted a Class I inventory for historical sites on the project area for the BLM.

A paleontological survey on the project area has not been conducted and analyses to determine physical and chemical properties of topsoil and overburden have not been conducted, or, if conducted, results have not been provided to the USGS or the BLM for inclusion in this document.

Mine

Construction at the mine would start in 1980 with 50 employees; mining would require 200 permanent employees. Delivery of the first coal is scheduled for early 1982; however, this is only speculative since no firm contracts for use of the coal exist. Table NB1-2 shows coal quality of an average coal seam on the North Block project area.

Facilities

Office and Shop

Specific design information for the office and shop complex is not available; however, 100 acres in the E½ of Section 33, T. 22 N., R. 116 W., 6th P.M., would be required.

Mining Equipment

Topsoil would be removed with dozer-scrapers. Overburden would be drilled and blasted in lifts for removal with loading shovels and then loaded into rear dump trucks. As coal is uncovered, it would be drilled, blasted, and loaded with front-end loaders into trucks for hauling to the coal handling facilities. Blasting would be done in accordance with 30 CFR 715.19, Use of Explosives.

Coal-Handling Facilities

Final design of the three truck dumps, crusher, and conveyor system has not been completed; however, these facilities would disturb no more than 40 acres each.

Support Facilities

The proposed action also includes federal approval of rights-of-way for the support facilities summarized in Table NB1-3. All actions listed on Table NB1-3 are analyzed in this ES.

Roads

A tramroad/conveyor system would run north from the Naughton Power Plant along the eastern side of the mining area to the truck dump, crusher, and office-and-shop areas. The road would be approximately 4½ miles long and would cover approximately 149 acres. Approximately 1 mile of BLM Road No. 4211 would be relocated around the north end of the mining area. This relocation would be nearly 3 miles long and would require 63 acres of right-of-way. This road would not be relocated until a public hearing was held and the relocation approved by the BLM. All haul roads would be 100 feet wide to provide for safe operation of large equipment.

Natural drainage along the roads would be maintained by metal culverts and appropriate erosion control structures. Drainage control measures would be designed in accordance with standard engineering practices and applicable rules and regulations. For safety reasons all roads other than the main access road would be considered "private"and would be used only by employees or other authorized persons.

Power and Telephone Line

Electric power (34.5 kv) would be provided by a pole line constructed along a 100-foot right-of-way from the Naughton Power Plant to a substation within the facility area, a distance of 5½ miles. This right-of-way would

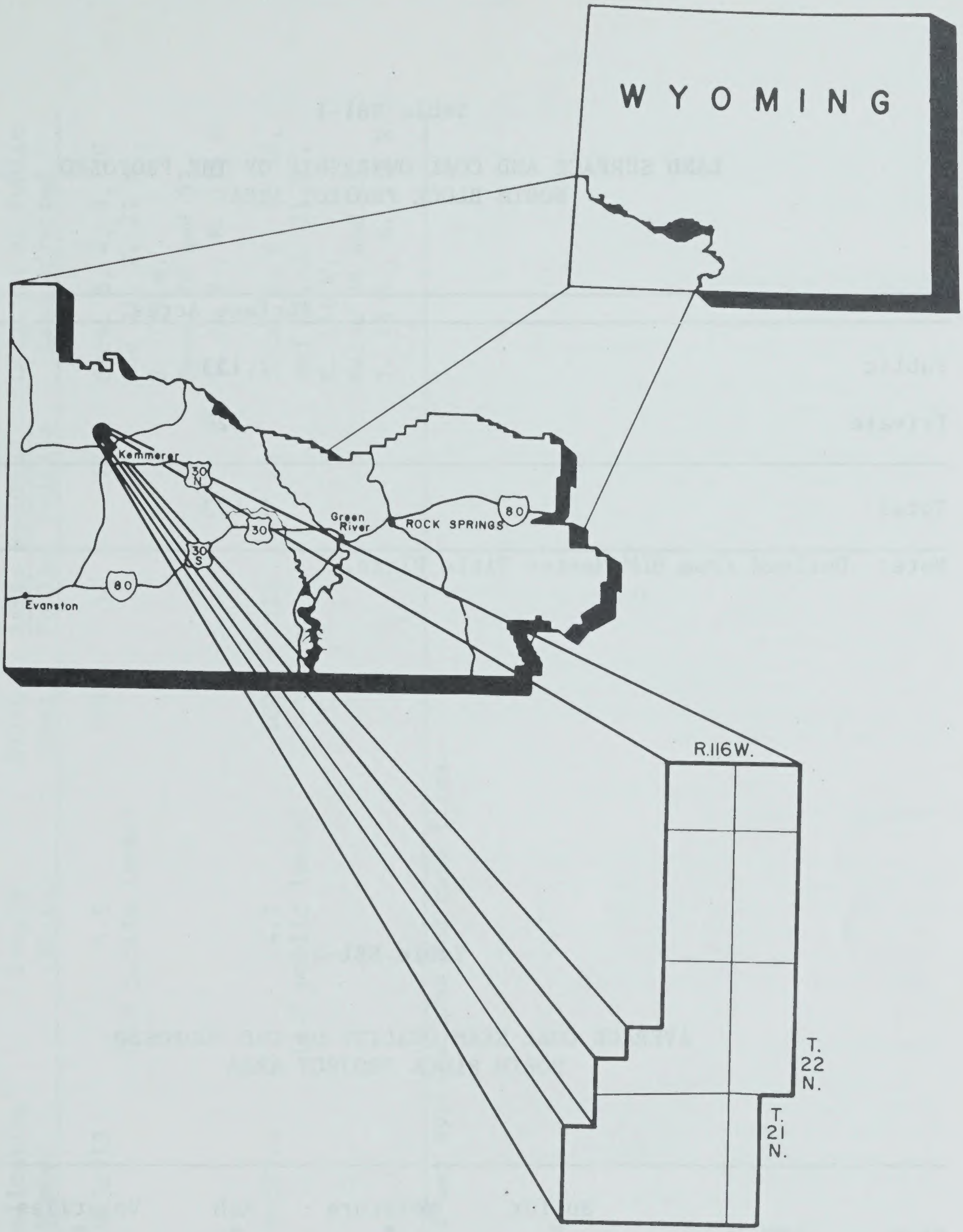


FIGURE NB 1 - 1

GENERAL LOCATION OF
PROPOSED NORTH BLOCK PROJECT AREA

Table NB1-1

LAND SURFACE AND COAL OWNERSHIP OF THE PROPOSED
NORTH BLOCK PROJECT AREA

	Surface Acres	Coal Acres
Public	2,153	2,153
Private	320	320
Total	2,473	2,473

Note: Derived from BLM Master Title Plats.

Table NB1-2

AVERAGE COAL SEAM QUALITY ON THE PROPOSED
NORTH BLOCK PROJECT AREA

Seam	BTU/lb.	Sulfur %	Moisture %	Ash %	Volatiles %	Fixed Carbon %
Average	9,550	0.61	20.95	5.26	32.65	40.77

Source: Kemmerer Coal Company 1977.

Note: On an as received by the generating plant basis.

Table NB1-3

SUPPORT FACILITIES FOR THE PROPOSED NORTH BLOCK MINE

Applicant	Facilities	Application Number	Total Length (Miles)	Width (Feet)	Acres Required		Location of Public Land Affected
					Public	Private	
Kemmerer Coal Co.	Power line and telephone line	W-52913	5.5 (4.5 public lands)	100	54	12	Secs. 3, 4, 9, 10 and 21, T. 21 N., R. 116 W. Secs. 28 and 33, T. 22 N., R. 116 W.
Kemmerer Coal Co.	Tram road and conveyor	W-52914	4.5 (3.8 public lands)	100	125	24	Secs. 3, 4, 9, 10, and 21, T. 21 N., R. 116 W. Secs. 28 and 33, T. 22 N., R. 116 W.

Note: Derived from BLM right-of-way applications and case files.

cover approximately 66 acres. A buried communication cable would be installed along the center line of the right-of-way.

Stages of Implementation

Proposed Mine Layout and Mining Sequence

Extraction of the coal reserves at the proposed North Block Mine would be conducted in three phases, beginning at the north and proceeding south. Each phase would cover a different part of the leases (Map NB1-2).

Mining would start in the SW¼ of Section 21 and progress westward into Section 20. Five pits are proposed for mining within a strip 3,000 feet wide. The truck dump, crusher, and conveyor route would be on the east side of the mining area.

Mining for Phase II would start in Section 28 in the year 1986 and would be a continuation of the same pits as mined in Phase I.

Mining for Phase III would be started in 1991 in Section 32 and continue until the year 2016. On the basis of the mining sequence, the acres of land to be disturbed are as shown in Table NB1-4.

Mining Procedures

The steeply dipping multiple coal seams dictate the flexibility associated with an open-pit, dragline with truck and shovel mining operations.

The pits are designed with the footwall slope (18 to 31 degrees) following the base of the bottom seam. Benches would be about 50- to 80-feet high and 50-feet wide.

Watercourse Diversions

The small intermittent stream at the north end of the project area would require a dam (approximately 600 feet long) and diversion ditch in Section 20. This would keep run-off water from the mining area during the first 10 years of operation.

No disturbance within 100 feet of intermittent or perennial streams would be permitted unless specifically authorized by the regulatory authority (30 CFR 715.17(d)(3)).

Water-Control Structures

All water-retention facilities, diversion ditches, and dams would be constructed to comply with applicable rules and regulations affecting such structures (30 CFR 715.17).

Topsoil Removal and Disposition

All topsoil and (or) subsoil would be stripped and stockpiled in conformance with state requirements or 30 CFR 715.16(c), whichever is most stringent. Topsoil would be removed from the affected areas by dozer-scrapers and placed in storage prior to commencement of mining operations. Depth of the topsoil ranges from near nonexistent to several feet along the drainages and eastern slopes. When mining has progressed enough, topsoil would be removed and redistributed on nearby graded disturbed ground.

Stored topsoil would have side slopes at the angle of repose. If the soil piles are left more than one growing season, a perennial vegetation would be established, otherwise an annual cereal crop would be established to protect the piles from wind and water erosion. Signs with 6-inch high letters would identify the topsoil storage areas.

Overburden Removal and Disposition

Overburden would be removed down dip as far as the overburden-to-coal ratio permits. Rotary drilling would be used in preparation for blasting with ammonia nitrate fuel oil (ANFO). Blasting would be done in accordance with 30 CFR 715.19 concerning the use of explosives. Blasted rock would be loaded by electric power shovels into off-highway trucks, then backfilled into nearby mined-out pits, if available, or to overburden storage areas. A maximum of 68,300 cubic yards of overburden would be removed per acre of surface disturbed for an approximate total of 133 million cubic yards. Storage areas other than mine workings or excavations must be approved by the regulatory agency, and these storage areas must conform with 30 CFR 715.15.

Coal Removal

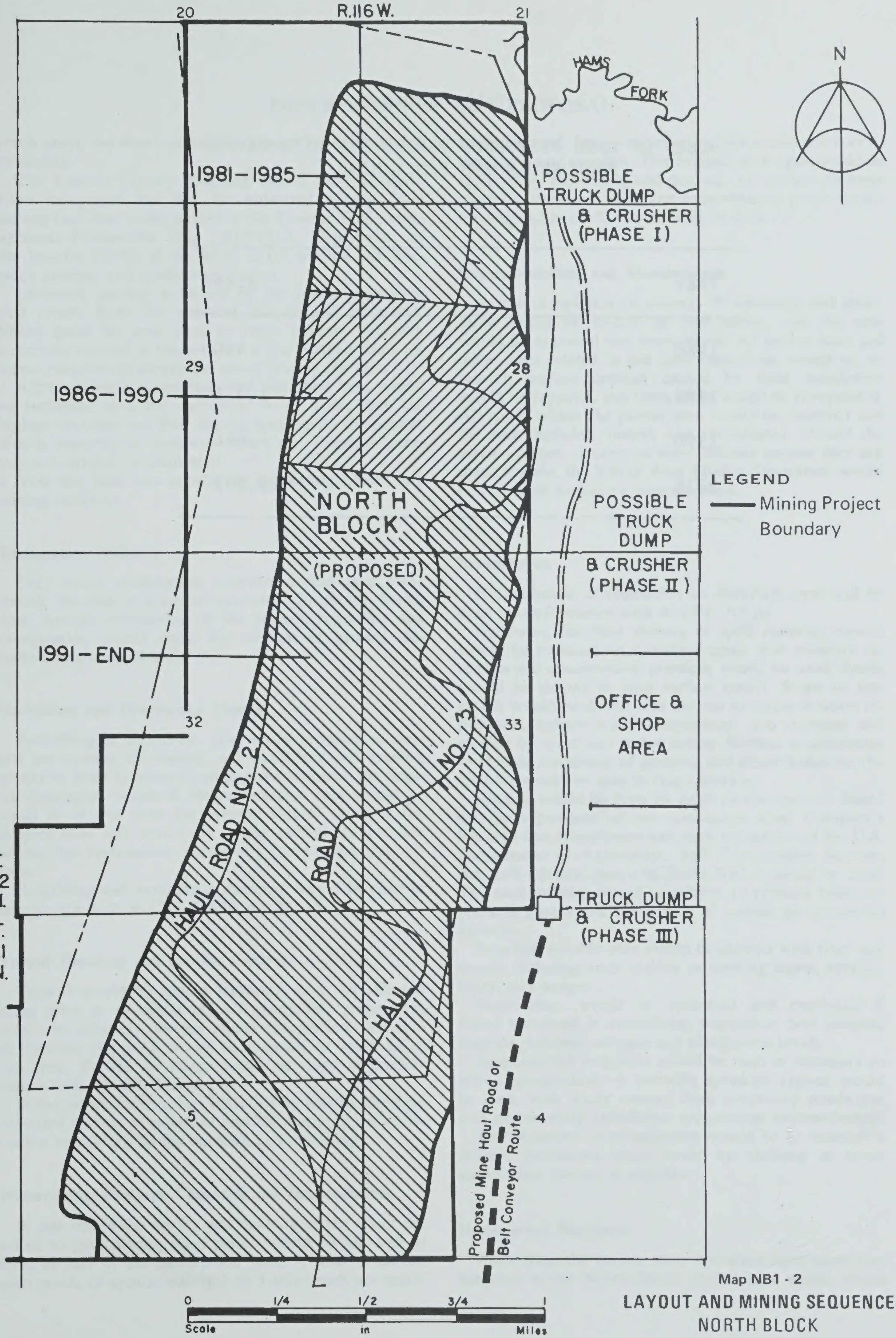
The coal would be drilled and blasted if greater than 6-feet thick and ripped if less than 6-feet thick. The broken coal would be loaded onto rear-dump haul trucks using front-end loaders and hauled to the nearest coal dumping-crushing station. From there it would be carried by conveyor to the power plant.

Reclamation

The Kemmerer Coal Company pursuant to Section 515 of the Surface Mining Control and Reclamation Act (SMCRA) and 30 CFR 715.13, would be required, to restore disturbed lands to conditions capable of supporting premining uses or higher or better uses. A mining permit would not be approved unless the applicant has demonstrated that reclamation to the proposed post mining land use can be accomplished under the mining and reclamation plan (Section 510, SMCRA).

Present and Future Land Use

The land within and adjacent to the proposed North Block project area is primarily used for livestock grazing, wildlife habitat, and outdoor recreation. In adjacent



Map NB1 - 2

LAYOUT AND MINING SEQUENCE

NORTH BLOCK

Table NB1-4

ACRES OF LAND DISTURBED DURING THE LIFE OF THE PROPOSED NORTH BLOCK MINE

Year	Acres
1980	410
1985	1,371
1990	1,646
2016	2,591

south areas, the only use for many years has been related to mining.

The Lincoln County Planning Board and the BLM have designated the area for industrial mining. Post mining land use, as designated in the Pioneer Trails Management Framework Plan (MFP)(U.S. Department of the Interior 1977b) of the BLM, is for wildlife use, livestock grazing, and outdoor recreation.

Livestock grazing is limited by the sparse vegetation that results from the semiarid climate and poor soil. Sheep graze the area once or twice a year. The only structures located in the area are a few earthen dams for water retention to supply the sheep grazing the area.

After mining is completed, the disturbed land would be reclaimed to a use equivalent to or better than the highest previous use. Post mining land use on the project area is expected to involve wildlife use, livestock grazing, and outdoor recreation at a level the land was capable of supporting before any mining occurred.

Reclamation Schedule

Only minor reclamation activities would take place during the first 3 years of operation. From the fourth year through completion of the project, regrading and revegetation would equal the amount of ground disturbed on an annual basis.

Backfilling and Overburden Dumps

Backfilling of mined-out pits would progress as new pits are opened for mining. All backfilling and grading would be done to preserve an approximation of the original drainages. Slopes in the reclamation area would be equal to or less than the average natural slope of the project area and would be gentle enough to provide access for reclamation machinery for revegetation efforts.

Backfilling and overburden dumping would be done in compliance with 30 CFR 715.14 and 715.15.

Topsoil Handling and Erosion Control

Topsoil would be spread uniformly over all affected areas prior to revegetation. All practicable precautions would be taken to prevent undue compaction. About 6 to 9 inches of topsoil would be available to cover all of the area. Topsoil handling would be done in conformance with 30 CFR 715.16.

Water erosion would be controlled by leaving the final topsoiled surface as rough as possible, working the reclamation machinery on the contour, and mulching.

Watercourse, Drainage Channels, and Impoundments

In pits where the quality and quantity of the water are suited to post mining uses, ponds would be allowed to form as part of the reclamation plan. A total of eleven such ponds of approximately 3 to 5 acres each are tentatively planned. Some temporary ponds would serve as irrigation water supplies. The original drainages would be replaced by backfilling and grading. All surface drainage channels, impoundments, and sedimentation ponds would be designed in conformance with 30 CFR 715.17.

Decommissioning and Abandonment

At the completion of mining, all buildings and structures would be broken up and buried, and the area would be regraded and revegetated. All power lines and water lines related to the mine operations would be removed, surface damage caused by their installation would be repaired, and these areas would be revegetated. All roads within the permit area would be removed and the area regraded, disced, and revegetated. Should the surface owner, county, or state officials request that any roads remain, the USGS Area Mining Supervisor would be consulted to make a determination.

Revegetation

Establishment of vegetation on disturbed areas will be done in conformance with 30 CFR 715.20.

Following the final shaping of spoil material, topsoil would be replaced on disturbed areas. Soil moisture retention and conservation practices would be used. Spoils would be shaped to limit surface runoff. Straw or hay mulch would be disced into the soil to enhance water infiltration, reduce water evaporation, and decrease soil erosion by wind and water action. Surface manipulation treatments consisting of gouging and dozer basins on the contour would be used to trap moisture.

Seeding would be done by drills on the contour. Based on the experience of the Kemmerer Coal Company's Reclamation Department and with the advice of the U.S. Department of Agriculture, Soil Conservation Service, the seed mixture shown in Table NB1-5 would be used. The seed mixture would be subject to revision based on research results and the advice of various governmental agencies.

Selected, suitable sites would be planted with trees and shrubs including such species as quaking aspen, serviceberry, and juniper.

Fertilization would be evaluated and employed if found beneficial in establishing vegetation. Soil analyses indicate deficient nitrogen and phosphorus levels.

Supplemental irrigation would be used as necessary to effect revegetation. A portable sprinkler system would be used, with water coming from temporary ponds and (or) permanently established reclamation impoundments.

The objective of revegetation would be to establish a diverse permanent plant cover by utilizing as many native plant species as possible.

Reclamation Equipment

Aside from the normal mine operating equipment, reclamation at the North Block project area would utilize

Table NB1-5

RECOMMENDED SEED MIXTURE FOR THE PROPOSED NORTH BLOCK PROJECT AREA

Species	Common Name	Lbs./Acre	Area Relationship
Agropyron dasystachyum	Thickspike wheatgrass	4	Native
Agropyron smithii	Western wheatgrass	4	Native
Agropyron cristatum	Crested wheatgrass	3	Introduced
Atriplex canescens	Fourwing saltbush	1	Native
Total		12	

farm tractors, seeders, mulchers, and sprinkler irrigation equipment.

Pollution Control Methods

The major types of potential pollution from the North Block project area are fugitive dust and suspended sediment in surface runoff. This pollution would be controlled by spraying roads and disturbed areas, revegetating disturbed areas, constructing settling ponds, and lining water-control structures to minimize erosion.

All surface drainage from the disturbed areas, including areas that have been graded, seeded, or planted, shall pass through a sedimentation pond or series of sedimentation ponds prior to leaving the project area. Sediment control measures shall be constructed prior to any surface disturbance and constructed to the standard of 30 CFR 715.17(e).

Surface Water Monitoring

Prior to approval of the mining and reclamation plan, the operator shall submit for approval by the regulatory authority a surface water monitoring program which meets the requirements of 30 CFR 715.17(b), Protection of the Hydrologic System.

AUTHORIZING ACTIONS

This section identifies governmental authorizations which would be required to fully implement the proposed North Block Mine.

A memorandum of understanding is in preparation which describes operating procedures to be followed by the BLM, the Office of Surface Mining, and the USGS concerning their areas of responsibility in the federal coal management program. This memorandum of understanding may alter the agency responsibility listed below.

Bureau of Land Management (BLM)

Before the proposed mining could occur, BLM would issue rights-of-way for 4.5 miles of power/telephone line and 3.8 miles of tramroad/conveyor system. BLM would concur with the USGS on approval of the mining and reclamation plan (Kemmerer Coal Company 1975).

U.S. Geological Survey (USGS)

The USGS would, with BLM concurrence, approve the mining and reclamation plan.

State and County

Wyoming Department of Environmental Quality (DEQ)

The Land Quality Division would issue a permit and license to mine upon its approval of a mining and reclamation plan. The Air Quality Division would issue permits to construct and permits to operate coal mines after a review of applications with regard to air contaminants and plans for control and monitoring. The Water Quality Division would issue permits to construct settling ponds and waste-water systems. The Solid Waste Division would issue construction fill permits and industrial waste facility permits for solid waste disposal during construction and operation.

Wyoming State Engineer

A certificate of appropriation of water has been obtained from the Wyoming State Engineer.

INTERRELATIONSHIPS

Relationship to Land Use Plans

BLM

The Pioneer Trails Management Framework Plan (MFP) (U.S. Department of the Interior, BLM 1977b) of the BLM recommends that 5,640 acres of public lands be made available in the vicinity of Kemmerer/Diamondville for projected residential and commercial needs due to increased population. Forty acres are to be classified for lease near Evanston for a solid waste disposal site. Future utility expansions are to be confined to existing utility system corridors whenever practical to reduce environmental impacts and maximize multiple occupancy of rights-of-way.

The Pioneer Trails MFP also recommends that mining be allowed as a land use in the coal resource areas of the proposed North Block Mine.

Relationship to Other Proposed and Future Actions

Other Coal

Two other proposed coal mines (Twin Creek and South Haystack) in the area of the proposed North Block mining operation would cause competition for the available labor market; increase rail traffic, dust, and water usage; and increase the demand on transportation and communication networks.

DESCRIPTION OF THE PROPOSAL

Naughton Power Plant

It is planned that the North Block Mine would supply the coal required by the proposed expansion of the Naughton Power Plant which is to be immediately south of the mining area.

CHAPTER 2

DESCRIPTION OF THE ENVIRONMENT

This chapter consists of two parts, existing environment and future environment. The discussion of the existing environment describes the physical, biological, and cultural environmental components which constitute the North Block site-specific environment. The discussion of the future environment focuses on the same environmental components as they would be in 1980, 1985, 1990, and at the end of mine life without federal approval of the proposed action. These descriptions provide bases for the analyses in Chapter 3, The Environmental Impacts of the Proposed Action.

EXISTING ENVIRONMENT

CLIMATE

Sunshine

The North Block project area is situated in a high plains and foothills area where the annual average percentage of sunshine can be expected to approximate the 65% statewide average.

Wind Fields

Utah Power and Light (UPL) owns a field network of four meteorological observation sites in the vicinity of its Naughton Power Plant which is located near Kemmerer in Lincoln County. The three predominant wind direction sectors at three of the UPL sites are west through northwest and constitute 40% of the annual number of hourly observations. The fourth site indicates a predominant flow in the southwest through west sectors, which accounts for about 55% of all annual observations. Secondary directional maxima are shown to occur at each of the UPL sites and are associated with north through east sector winds. The annual average wind speeds at the UPL sites range from 8 to 13 mph.

Atmospheric Temperature and Stability

The temperature in the project area, as in the entire environmental statement (ES) region, is subject to large seasonal and daily variations. Temperatures are expected to closely parallel those observed at Kemmerer over a 30-year period from 1930 through 1960, which indicate mean monthly minima/maxima of 5°F/29°F and 44°F/82°F during January and July, respectively. Temperature extremes range from -32°F to 97°F. The growing season is about 105 days per year.

Vertical temperature profiles were also obtained by UPL during seasonal field studies (Golden and Peterson 1976). Eighty-five percent of all morning soundings (79 total) contained some type of inversion (either surface-based or upper-level). Sixty-five percent of the UPL morning soundings had surface-based inversions with an average depth of 300 feet. Only 11% of the afternoon soundings (after 12:00 noon) showed inversions of any type.

Moisture and Evapotranspiration

Annual average precipitation and total snowfall should approximate the 9 inches and 55 inches, respectively, observed at Kemmerer over a period of more than 30 years.

An annual soil moisture deficit of about 10 inches is characteristic of the project area. The growing season roughly coincides with the period of high soil moisture deficit.

Severe Weather Events

The average number of thunderstorm and hail days is about 30 and 3 per year, respectively. The likelihood of tornadoes occurring in this region is very low.

AIR QUALITY

The proposed North Block project area is not in the prevailing downwind direction of pollutant dispersion from Kemmerer. Therefore, the present air quality at this location should have a rural character, and, consequently, the existing total suspended particulate levels at the project area should range from 10 to 20 micrograms per cubic meter ($\mu g/m^3$) annually and 30 to 45 $\mu g/m^3$ for 24 hours. The magnitude of these levels is less than one-third of the appropriate state standards. Based on 5 years of visual observations recorded at Fort Bridger, a representative background visual range in the vicinity of the North Block project area should be approximately 40 miles.

Concentrations of sulfur dioxide around North Block should also reflect its rural setting; i.e., levels less than 5 $\mu g/m^3$ annually and less than 25 $\mu g/m^3$ for a daily averaging period. The magnitude of these concentrations is only about 10% of the annual and 24-hour state standards. In addition, annual nitrogen dioxide concentrations should be less than 10 $\mu g/m^3$ or again only 10% of the standard.

GEOLOGY

Stratigraphy

Coals of the Hams Fork coal region, which includes the project area, lie in the Evanston, Adaville, Frontier, and Bear River Formations. Coals of the proposed project area are in the Adaville Formation of Late Cretaceous age which consists of yellow, gray, and black shale with irregular interbedded brown, white, and yellow sandstone. The formation is about 2,900 feet thick and the coal seams range in thickness from 3½ to 38 feet.

The Adaville Formation is at the surface in most of the project area. To the west it is overlain by the Evanston Formation of Paleocene and Late Cretaceous age. At the base of the Adaville Formation is the Lazeart Sandstone Member, which overlies the Hilliard Shale of Late Cretaceous age. The rocks of Cretaceous age were mostly deposited along the western edge of a broad, shallow, north-south trending seaway that crossed central North America. They are mostly marine shales, but they also include fluvial shales and sandstones and deltaic deposits including coal. Along Hams Fork in the northeast corner of the project area, the bedrock is overlain by Holocene and Pleistocene terrace and floodplain deposits.

Paleontology

The project area has not been surveyed for paleontological resources. A general summary of the principal fossiliferous formations, ages, number of known fossil localities, and general fossil types in the proposed action area is presented in Table NB2-3A.

Structure

The dominant structural features in the area are the Absaroka Thrust and the Lazeart Syncline (Figure NB2-3A). The eastward movement of the Absaroka Thrust formed the asymmetric Lazeart Syncline and, in places, has overturned the west limb of the syncline. All of the coal-bearing rocks on the lands are on the east limb of the syncline which strikes slightly east of north. The coal-bearing rocks commonly dip from 15 to 30 degrees west.

Geologic Hazards

Even though the landslide susceptibility of the rock and earth material is estimated to be high (Radbruch-Hall et al. 1976), the landslide potential of the natural surface is judged to be minimal, because the natural slopes show no evidence of earlier sliding and the rock strata generally dip into the slope.

Natural coal outcrops are weathered and have lost their more volatile and more easily ignitable constituents; therefore, the likelihood of coal ignition and combustion in the natural outcrop is low.

The proposed project area is in an area of very low seismic activity; therefore, the probability of damage from earthquakes is slight.

TOPOGRAPHY

The North Block project area is located approximately 4 miles west of Oyster Ridge in the physiographic subdivision of the region known as the Overthrust Belt. Oyster Ridge roughly delineates the eastern edge of the Overthrust Belt. The area is on the east slope of a ridge which, geomorphologically, is a southern extension of Commissary Ridge. This southern extension has been cut off from the main northern part of the ridge by Hams Fork, a perennial stream that flows southeastward across the extreme northeastern corner of the area, then, about 3 miles east of the site, turns and flows southward.

The overall aspect is of an east-sloping surface with a rolling or undulating east-west grain. The land surface is characterized by a generally parallel, eastward-flowing drainage system that flows into Hams Fork. The small valleys formed by the drainage system are 40 to 80 feet deep with moderately sloping sides and are spaced approximately 3,000 feet apart. Gradients of the watercourses and the grades of the crests of the interstream divides slope generally eastward with a drop of approximately 300 feet per mile. There are no undrained depressions in the land surface.

SOILS

A reconnaissance soil survey of the North Block project area was conducted by the Soil Conservation Service during 1976 (Map NB2-5A). The survey indicates that the soils are poorly developed due to slow weathering of the parent material in the arid to semiarid environment of the project area. There are two basic types of parent material in the area: (1) alluvium (sediments transported and deposited by water), which occupies approximately 13% of the area (321 acres), and (2) sedimentary rock (sandstone and shale), which occupies approximately 87% of the area (2,152 acres). The soils in mapping units 207, 216, 218, and part of 221 have developed on alluvium. The soils in mapping units 231, 232, and part of 221 have developed over sedimentary rock.

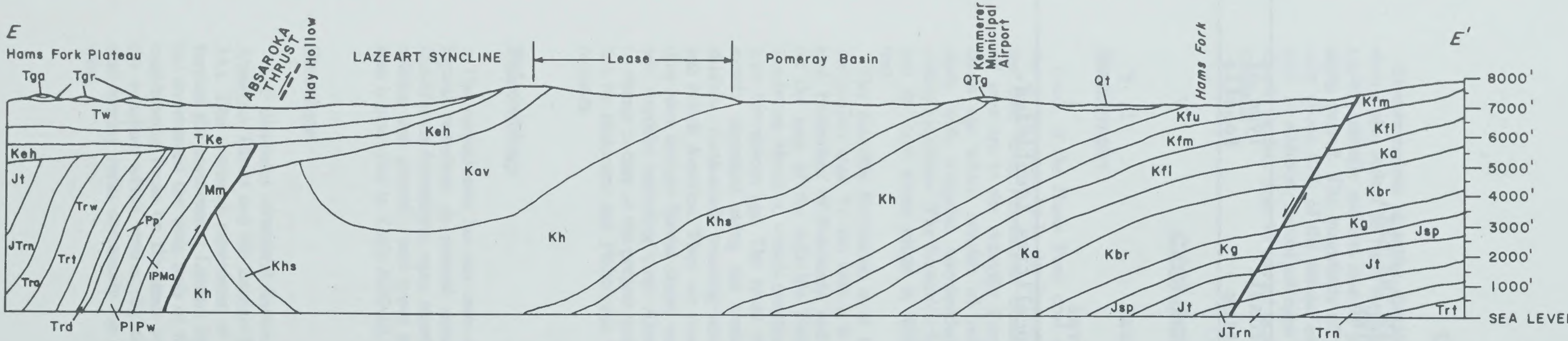
Calcium carbonates accumulate at various depths in the soils of the area, generally in lower subsoil horizons.

Table NB2-3A

SUMMARY OF FOSSILIFEROUS FORMATIONS IN THE AREA
OF THE PROPOSED NORTH BLOCK MINE

Formation	Period	Known Fossil Localities	Type of Fossils
Evanston	Paleocene	General	V
Adaville	Cretaceous	General	I, P
Hilliard Shale	Cretaceous	General	I

General = Formation produces fossils with no specific localities identified.
V = Vertebrate
I = Invertebrate
P = Paleobotanical



Qt TERRACE DEPOSITS (HOLOCENE AND PLEISTOCENE)

QTg HIGH TERRACE DEPOSITS (PLEISTOCENE OR PLIOCENE)

Tgr GREEN RIVER FORMATION (EOCENE)
Tga ANGELO MEMBER

WASATCH FORMATION (EOCENE)
Tw MAIN BODY

EVANSTON FORMATION
TKe MAIN BODY IN EASTERN PART OF MAPPED AREA AND EVANSTON FORMATION UNDIVIDED IN THE WESTERN PART (PALEOCENE AND UPPER CRETACEOUS)

Keh HAMS FORK CONGLOMERATE MEMBER (UPPER CRETACEOUS)

Kav ADAVILLE FORMATION (UPPER CRETACEOUS)

Kh HILLIARD SHALE (UPPER CRETACEOUS)

Khs SHURTLIFF SANDSTONE MEMBER

FRONTIER FORMATION (UPPER CRETACEOUS)
Kfu UPPER UNIT

Kfm MIDDLE UNIT

Kfl LOWER UNIT

Ka ASPEN SHALE (LOWER CRETACEOUS)

Kbr BEAR RIVER FORMATION (LOWER CRETACEOUS)

Kg GANNETT GROUP (LOWER CRETACEOUS)

Jsp STUMP SANDSTONE AND PREUSS RED BEDS (UPPER JURASSIC)

Jt TWIN CREEK LIMESTONE (UPPER AND MIDDLE JURASSIC)

JTrn NUGGET SANDSTONE (JURASSIC? AND AND TRIASSIC?)

Tra ANKAREH RED BEDS (UPPER TRIASSIC)

Trt THAYNES LIMESTONE (LOWER TRIASSIC)

Trw WOODSIDE RED BEDS (LOWER TRIASSIC)

Trd DINWOODY FORMATION (LOWER TRIASSIC)

Pp PHOSPHORIA FORMATION AND EQUIVALENT STRATA (PERMIAN)

PIPw WELLS FORMATION (PERMIAN AND PENNSYLVANIAN AND MISSISSIPPIAN)

IPMa AMSDEN FORMATION (PENNSYLVANIAN AND MISSISSIPPIAN)

Mm MADISON LIMESTONE (UPPER / ND LOWER MISSISSIPPIAN)

Source: Adapted from Plate 2, Rubey, Oriel, and Tracey 1975

Figure NB2 - 3A

STRUCTURE IN THE VICINITY OF THE LEASE AREA

High levels of secondary calcium carbonates are toxic to plant growth by depressing availability of some plant nutrients. The amount of organic matter in the soils is low, ranging from 0.1% to around 4%. The amount of organic matter relates to soil permeability (the ability of soil to transmit water and gases), soil fertility (ability to hold nutrients in available form for plants), and available water capacity (water held in the soil that can be readily absorbed by plant roots). Soils in the area are low in nitrogen which is an essential plant nutrient. Phosphorous is also low in some areas, but generally all other nutrients are in high enough levels for plant growth.

Soil structure of the A horizon (upper soil horizon) in the North Block soils is primarily moderate to strong granular; however, in nearly all soils the A horizon is less than 5 inches thick. The structure below the thin top layer is weak in stability and in some cases nonexistent. Populations of soil biota in the area are low due to the low levels of soil moisture throughout the year (Brady 1974). Activities of the various soil biota contribute to the development of soil structure. Stable soil structure is a part of most productive soils and is especially important on fine-textured soils for the development of soil porosity adequate for water movement into and through the soil. The predominant soil textures of the area are loams and clay loams with a high concentration of rock on the surface and within the soil profile.

Soil depths in the North Block project area range from no soil on rock outcrop to greater than 60 inches on alluvium. The moderately deep and deep loam and clay loam soils of the area (mapping units 207, 216, and 218) that have few restrictive features such as high alkalinity or calcium carbonate levels are more productive than the soils in the remainder of the area. These soils can be recognized by the vigorous growth of shrubs and grasses they support. Soils with high alkalinity and (or) soluble salt content which are scattered throughout the area have plants that are salt-tolerant. Soils with restrictive underlayers or bedrock within 20 inches of the surface (mapping units 221, 231, and 232) have plants with stunted growth due to the limitations of root penetration and (or) plants that require little water to survive.

Properties and various interpretations of the North Block area soils are listed by mapping unit in Table NB2-5A. Soil mapping units are described in the Appendix. The percentage of the various soil types within each soil mapping unit and associated soil data are also given in the Appendix. The soil types are keyed to associations of subgroups in the *handbook, Soil Taxonomy* (U.S. Department of Agriculture, Soil Conservation Service 1975).

The amount of wind erosion on soils of the North Block project area varies with the surface soil texture, vegetative cover, average wind speed, etc. The wind erosion hazard and the wind erodability groups of the North Block soils are listed by mapping unit in Table NB2-5A. At present an average of 80 tons of soil per year is removed in suspension by wind from the mining area. This value was determined by using the Soil Erodability Index for bare soil (U.S. Department of Agriculture, Soil Conservation Service 1972), the vegetative cover percentages derived from BLM watershed surveys, and estimates based on professional judgment.

Sheet erosion rates on the various mapping units as calculated by using Musgrave's equation are shown in Table NB2-5B. Some of the soils in the area are highly erosive resulting primarily from low amounts of vegetative cover on steep slopes. The average rate of erosion occurring at present on those areas that would be disturbed by mining is approximately 6 tons per acre per year.

WATER RESOURCES

Ground Water

On the lease site the Adaville Formation dips westerly into the Lazeart Syncline which with the Absaroka Thrust Fault are the dominant structural features of the area. The beds of the Adaville dip westerly about 15 degrees to 30 degrees. Ground water moves westerly down the dip through the discontinuous sandstones and coals of the Adaville and through the Lazeart Sandstone member, the basal member of the Adaville Formation. No data are available to define the relative permeabilities of the Adaville in the lease area; however, data derived from tests 4 miles south of the project area indicate that the coal is the most permeable component while the discontinuous sandstones and siltstones are much less permeable by factors of 1/500th to 1/5,000th, respectively.

The Adaville is recharged where it is exposed at the surface from infiltration of overland flow and flow in gullies and Hams Fork as well as ephemeral stream channels that cross the exposures of the more permeable materials. The mudstones, siltstones, and clays act as confining layers to the more permeable materials, and artesian conditions can be expected to prevail a short distance down dip from the exposure. In the exposure areas water table conditions prevail. About 4 miles south of the project area test holes in the Adaville obtained flowing water from geologically similar situations. However, the ground water at this site is probably similar to that in the Adaville Formation at the proposed Twin Creek Mine (see Table TC2-6A). The pit water (Table NB2-6A) contains concentrations of sulfate and total dissolved solids in excess of standards for drinking water set by the proposed Environmental Protection Agency standards of 1972.

No known springs or wells tap the Adaville in the vicinity of the proposed mine, and no ground water quality data are available except that for nearby mine pits shown in Table NB2-6A.

Surface Water

All streams that drain the mining area are ephemeral; that is, they flow only in response to precipitation. Peak flows for specific recurrence intervals are tabulated in Table NB2-6B and Figure NB2-6A. The peak flow esti-

Table NB2-5A

SOIL CHARACTERISTICS AND INTERPRETATIONS

Map Unit[1]	Map Unit Name[2]	Total Acres	Slope Range	Wind Erodability Group[3]	Erosion Hazard[4]		Source of Roadfill[4]	Suitability-Limitations for Final Cover Over Mined Land[4]	
					Wind	Water		In./Avail.	Suitability
207	Floodplain	13	0- 3	4L	Slight	Slight	Fair-Poor	60	Fair-poor-alk. sal.
216	Gravelly terraces, gently sloping	194	3-10	5	Moderate	Sl.-mod.	Fair	20-60	Poor-gravel, cobble
218	Alluvial fans, coarse, coils, sloping	103	6-10	3/5	Moderate	Sl.-mod.	Fair	10-60	Poor-gravel, cobble
221	Terrace escarpments, gently sloping to steep	86	6-30	4L/5	Sl.-mod.	Mod.-sev.	Fair	10-16	Poor-gravel, cobble
231	Residual uplands, shallow clayey soils, moderately steep and steep	1,999	10-60	3/4	Sl.Mod.	Severe	Poor	4-10	Poor-gravel, cobble-slope
232	Residual uplands, clayey soils, rolling	78	3-15	4L	Moderate	Moderate	Poor	8-12	Poor-high clay content

1 Reference Map NB2-5A, North Block Soils.
2 Unit names derived from geomorphic setting of the soil.
3 Wind Erodability Group descriptions found in U.S. Department of Agriculture, Soil Conservation Service (SCS), Handbook for Interpretations 1972, generally the higher the number the lower the erosion potential with the number range of 1 to 8.
4 Derived from U.S. Department of Agriculture, SCS, soils contract with BLM (1977).

Table NB2-5B

EXISTING SHEET EROSION

Map Unit[1]	Sheet Erosion Tons/Acre/Year
207	0.04
216	1.04
218	0.66
221	1.50
231	7.14
232	1.37

[1]Map NB2-5A.

Table NB2-6A

PARTIAL CHEMICAL ANALYSES OF WATER FROM MINE PITS IN THE ADAVILLE FORMATION NEAR THE PROPOSED NORTH BLOCK MINE

SO_4=	465	555	615	285	2700	1800	4750	760	1275	626	530
TDS							6877	1050	1730	1167	1007
TSS	4.5	6.5	15	59	5.0	7.0	14	8	22	17	28
pH	6.95	7.35					7.60	7.95	8.30	8.17	8.20
uM/cm	1480	1520	1700	1400	2400	2200					

								Range	Mean
SO_4=	3550	1550		3800	1400		880	285-4750	1555
TDS	4808	2604	1721	4790	2267	710	1267	710-6877	2501
TSS	2	5	4	19	2	2	38	2-59	14.0
pH	7.60	7.62	8.25	9.7	7.3	7.90	7.13	6.95-9.7	7.82

Source: Kemmerer Coal Company 1975.
Note: Sulphate (SO_4=), Total Dissolved Solids (TDS), Total Suspended Solids (TSS) in parts per million. Conductivity in micro mhos per centimeter (uM/cm).

Table NB2-6B

FLOW FREQUENCY CHARACTERISTICS OF 10 EPHEMERAL STREAMS IN THE NORTH BLOCK MINING AREA (AFTER LOWHAM 1976)

		Peak Flows in Cubic Feet Per Second Which Have the Indicated Frequency of Occurrence					
Stream[1]	Drainage Area Square Miles	2 years	5 years	10 years	25 years	50 years	100 years
A1	0.61	5.8	12.0	16.0	24.0	31.0	37.0
A2	0.89	8.0	16.0	22.0	32.0	41.0	50.0
A1 + A2	1.50	12.0	24.0	33.0	47.0	61.0	74.0
B	0.26	2.8	5.8	8.4	12.0	16.0	20.0
C	0.29	3.1	6.3	9.1	13.0	17.0	22.0
D	0.15	1.8	3.7	5.4	8.1	11.0	13.0
E	0.37	3.8	7.7	11.0	16.0	21.0	26.0
F	0.60	5.7	11.0	16.0	23.0	30.0	37.0
G1	0.35	3.6	7.3	11.0	15.0	20.0	25.0
G2	0.37	3.8	7.7	11.0	16.0	21.0	26.0

[1] Reference Figure NB2-6A.

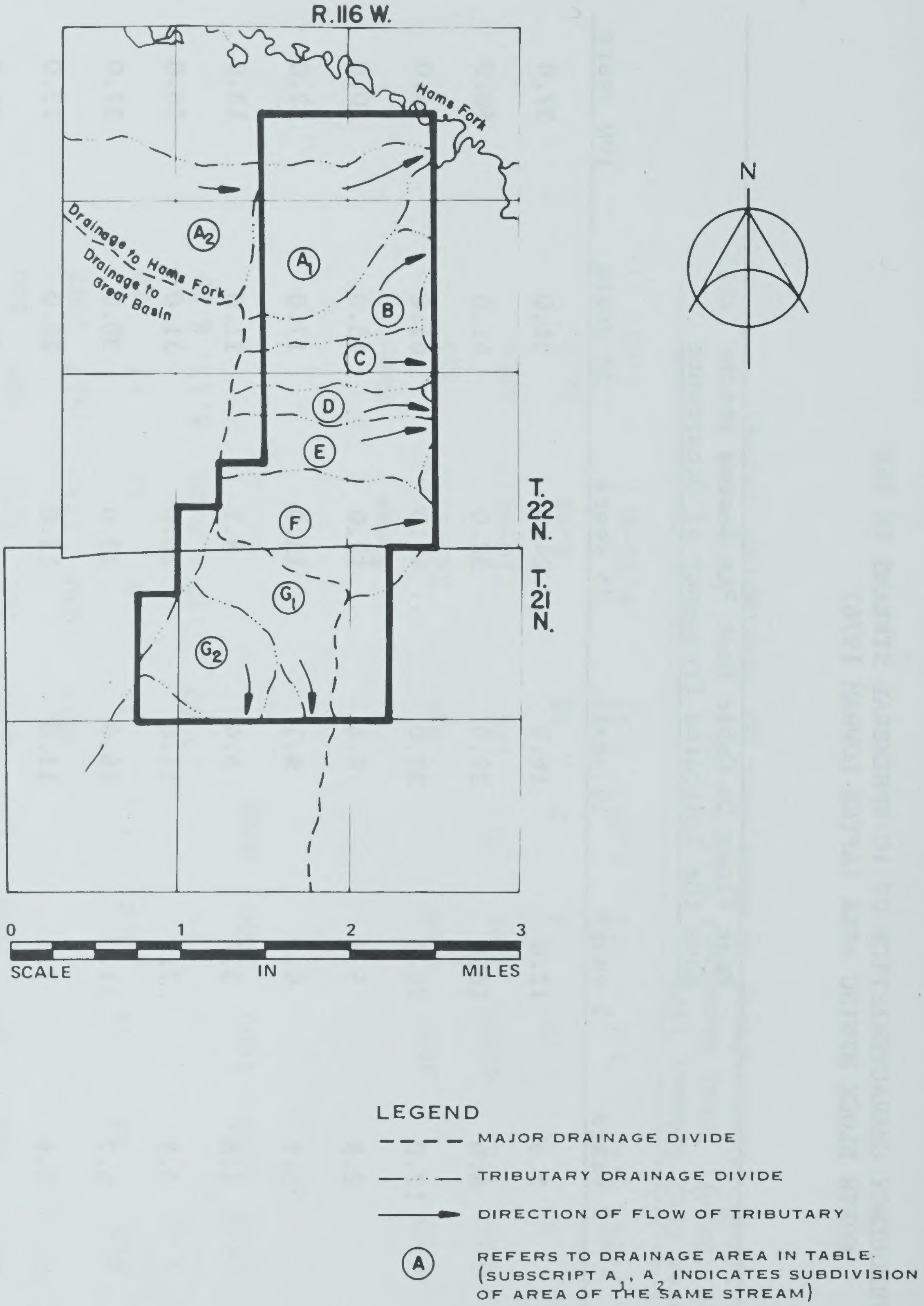


Figure NB2 - 6A

DRAINAGE AREAS OF EPHEMERAL STREAMS
CROSSING AREA
NORTH BLOCK

mates of the 10 ephemeral streams shown are based on studies and analyses of streamflow data at 131 gaging stations (Lowham 1976) and have coefficients of correlation of 0.90 to 0.93 and standard errors of ± 51 to ± 58. Standard errors are mentioned to remind the reader that these are estimates which should be revised as additional data become available.

The northeast corner of the project area lies within the flood plain of the Hams Fork, a perennial stream. The Hams Fork drainage appears to be an alluvial valley floor based on the 30 Code of Federal Regulations 710.5 definition that an "alluvial valley floor means stream-laid deposits holding streams where water availability is sufficient for subirrigation or flood irrigation agricultural activities . . ." Estimates of flow frequency characteristics of Hams Fork at the northeast corner of the proposed North Block Mine are in a drainage area 298 square miles (after Lowham 1976). Peak flows in cubic feet per second have the indicated frequency of recurrence, 2 years—1,100; 5 years—1,800; 10 years—2,100; 25 years—2,700; 50 years—3,300; and 100 years—4,000.

The average annual discharge at the site of the gage on Hams Fork at Diamond, Gaging Station Number 09224000, is 163 cubic feet per second. Peak flows on this stream are primarily from snowmelt and occur principally in May and June when about 24% and 60%, respectively, of the peaks occur (Lowham 1976).

Quality of Surface Water

Water samples were taken on Little Muddy and Twin Creek drainages, neither of which are in the area of the proposed North Block Mine and for the most part represent areas disturbed by existing mining. Table NB2-6C is a listing of partial analyses of ground water seepage from mine pits in the Adaville Formation adjacent to the proposed North Block unit and are indications of the character of the water to be expected in the North Block pits.

Analyses of runoff from the area near the proposed North Block Mine show a change in dissolved solids with time of year, Table NB2-6C, and ranges from 163 parts per million (ppm) to 7,326 ppm, sulfate ranges from 22 ppm to 5,200 ppm. Analyses of water from mine pits show total dissolved solids ranging from 710 to 6,877 ppm and averages 2,501 ppm, sulphate ranges from 385 to 2,800 ppm and averages 1,555 ppm. Samples from Hams Fork at Diamondville likewise show a change in total dissolved solids with time of year (Geological Survey (USGS) 1976).

VEGETATION

Terrestrial Vegetation

Sagebrush communities occur on about 90% (2,226 of 2,473 acres) of the project area. Five other vegetation types provide vegetative cover on the remaining 10% of the project area. Map NB2-7A shows vegetation types large enough to be mapped. Type designations and numbers are those used by the Bureau of Land Management (BLM). Plant names are from Beetle (1970). A list of plants known to occur in the North Block project area is available to the public at the Rock Springs District Office of the BLM.

Sagebrush, Type 4

Big sagebrush *(Artemisia tridentata)* is the dominant shrub on the well drained and moderately deep to deep soils of the project area. Black sagebrush *(A. nova)* is dominant on drier, more shallow soils.

Common grass species are bluegrasses *(Poa* spp.), thickspike wheatgrass *(Agropyron dasystachyum)*, and bottlebrush *squirreltail (Sitanion hystrix)*.

Wildbuckwheats *(Eriogonum* spp.), phloxes *(Phlox* spp.), and lupines *(Lupinus* spp.) are frequently occurring forbs.

Saltbush, Type 13

Plants of the saltbush type are adapted to saline and alkaline soil conditions. Nuttall saltbush *(Atriplex nuttallii)* is the most common shrub with fourwing saltbush *(A. canescens)* and shadscale saltbush *(A. confertifolia)* also present. Western wheatgrass *(A. smithii)* and alkali sacaton *(Sporobulus* airoides) are common grasses. Phloxes and *goosefoots (Chenopodium* spp.) are representative forb types.

Winterfat, Type 15

Winterfat *(Eurotia lanata)*, a half-shrub, is dominant. Thickspike wheatgrass, needleandthread *(Stipa comata)*, and Indian ricegrass *(Oryzopsis hymenoides)* provide grass cover. Some of the forbs characteristic of the type are phloxes, wildbuckwheats, and pussytoes *(Antennaria* spp.).

Mountain Shrub, Type 5

This type generally occurs just over the crest of steep ridges or hills (on north or east facing slopes) where extra moisture (snow) and soils are deposited.

Saskatoon serviceberry *(Amelanchier alnifolia)*, a shrub about 4 to 12 feet in height, is dominant. Understory composition is similar to that found in the sagebrush type.

Aspen, Type 10A

Aspen trees *(Populus tremuloides)* occur on north and east facing exposures where moisture conditions are favorable. Some of the more common understory plant species are Kentucky bluegrass *(Poa pratensis)* and two low-growing shrubs, mountain snowberry *(Symphoricarpus orephilus)* and common *juniper (Juniperus communis)*.

Table NB2-6C

CHEMICAL ANALYSES OF RUNOFF FROM AREA NEAR NORTH BLOCK MINING UNIT

Little Muddy Creek Basin Location Number	Stream	Land Location	Approx. Elev.	Remarks	Iron Total	Iron Dissolved	Sulfate	pH	Dissolved Solids	Suspended Solids	Total Solids	Collection Date
1-LM	Little Muddy	SE¼, Sec. 21,	6930	Runoff from disturbed area	3.09	.17	1400	8.45	2304	179	2483	03/13/74
		T. 21 N., R. 116 W.		mainly 1-U-D Pit (Conroy)		.12	5200	8.88	7326	8	7334	04/10/74
2-LM	Little Muddy	NW¼, Sec. 32,	6970	Runoff from disturbed area	30.0	.31	375	6.7	937	100	1037	03/12/74
		T. 21 N., R. 116 W.										
3-LM	Little Muddy	NW¼, Sec. 14,	6840	Runoff from disturbed area	16.5	10.67	22	7.2	504	2420	2924	03/13/74
		T. 20 N., R. 117 W.		(Elkol Tipple)								
4-LM	Little Muddy	SW¼, Sec. 27,	6880	Runoff from undisturbed area	8.9	7.84	47	7.6	396	976	1372	03/13/74
		T. 20 N., R. 117 W.		(Skull Point)		.62	560	7.75	1474	224	1698	04/15/74
					0.62	.14	1275	8.35	2325	8	2333	05/06/74
A-LM	North Fork	NW¼, Sec. 29,	6720	(Blazon Gap)	2.01	.78	469	7.9	704	65	769	03/12/74
	Little Muddy	T. 20 N., R. 116 W.		Downstream from No. 1-LM		.06	1400	9.0	1985	15	2000	04/18/74
				2-LM	0.07	.03	800	9.25	1121	6	1127	05/06/74
B-LM	North Fork	SW¼, Sec. 31,	6555	Downstream from No. 1-LM	2.87	.51	297	7.95	646	364	1010	03/12/74
	Little Muddy	T. 19 N., R. 116 W.		2-LM, 3-LM, 4-LM		.01	715	8.4	1314	67	1381	04/18/74
					0.42	.15		8.9	1072	23	1095	05/07/74
C-LM	Little Muddy	SW¼, Sec. 31,	6540	Albert Creek & Little Muddy	2.8	2.40	39	7.8	486	548	1034	03/13/74
		T. 19 N., R. 116 W.		Creek		.00	280	8.32	841	285	1126	04/18/74
					0.55	.11		8.6	662	222	884	05/07/74
D-LM	Little Muddy	NW¼, Sec. 5,	6535	Downstream from No. 1-LM	2.5	.15		8.7	736	220	956	05/07/74
		T. 18 N., R. 116 W.		2-LM, 3-LM, 4-LM, A-LM,	10.2	.89	110	7.85	616	519	1135	03/12/74
				B-LM, & C-LM		.00	350	8.6	911	269	1180	04/18/74

Table NB2-6C

CHEMICAL ANALYSES OF RUNOFF FROM AREA NEAR NORTH BLOCK MINING UNIT
(Continued)

Twin Creek Basin Location Number	Stream	Land Location	Approx. Elev.	Remarks	Iron Total	Iron Dissolved	Sulfate	pH	Dissolved Solids	Suspended Solids	Total Solids	Collection Date
1-TC	Twin Creek	SW¼, Sec. 36,	6950	Runoff from disturbed area	13.64	.00	260	7.90	536	1544	2080	03/19/74
		T. 21.N., R. 117 W.				.25	500	8.25	1121	215	1336	04/11/74
					0.32	.02	490	8.35	1192	18	1210	05/06/74
2-TC	Twin Creek	SW¼, Sec. 18,	7120	Runoff from undisturbed area	1.33	.34	310	8.05	885	168	1035	03/19/74
		T. 21 N., R. 116 W.				.03	650	8.09	1438	11	1449	04/12/74
					0.62	.05		8.40	1526	4	1530	05/07/74
A-TC	South Fork	NW¼, Sec. 15	6755	Downstream from No. 1-TC	6.98	1.42	160	7.80	180	740	920	03/19/74
	Twin Creek	T. 21 N., R. 117 W.				.08	450	7.68	771	357	1128	04/12/74
					0.95	.08		8.55	1016	184	1200	05/07/74
B-TC	East Fork	SW¼, Sec. 10,	6760	Downstream from No. 2-TC	4.93	.35	230	8.10	353	472	825	03/19/74
	Twin Creek	T. 21 N., R. 117 W.				.09	625	8.35	1378	135	1513	04/12/74
					0.26	.08		8.55	680	13	693	05/07/74
C-TC	Twin Creek	NE¼, Sec. 12,	6600	Downstream from No. 1-TC,	7.37	.32	143	7.95	163	684	847	03/19/74
		T. 21 N., R. 118 W.		2-TC, A-TC, B-TC		.03	335	8.00	877	281	1158	04/12/74
					2.61	.13		8.50	526	232	758	05/07/74

Note: Data supplied by Kemmerer Coal Company. Chemical data in parts per million.

Broad Leafed Trees; Riparian Type 10B

Willows *(Salix* spp.) are the most common woody plant species found along the Hams Fork in the northeast corner of the project area. Fremont and narrowleaf poplar (cottonwood) trees *(Populus fremontii)* and *(P. angustifolia)* are scattered throughout the type. Bluegrasses and wheatgrasses *(Agropyron* spp.) are important understory species.

Aquatic Vegetation

Free floating and rooted submergent and emergent plants occur in Hams Fork. Green algae, blue green algae, and diatoms are common fresh water algae forms. Rooted aquatics include vascular plants and bryophytes, plants without conducting tissues (Reid 1961).

Endangered and (or) Threatened

A survey of the project area revealed no plants proposed for endangered and (or) threatened status (Dorn 1977). The process for requesting formal consultation under Section 7 of the Endangered Species Act of 1973 was initiated for North Block with the U.S. Fish and Wildlife Service on 2 March 1978.

The U.S. Fish and Wildlife Service responded by letter dated 7 March 1978 that formal consultation cannot be conducted for unlisted species.

FISH AND WILDLIFE

General Information

Habitat Types

The following are the major habitat types found on the proposed project area and the primary wildlife species associated with each. A complete wildlife species list can be obtained from the Rock Springs District Office of the BLM.

Aquatic. No aquatic habitat exists within the project area; however, all of the drainages on the site empty into Hams Fork, a major trout fishery in the area. The major fish species present in Hams Fork are longnose dace, speckled dace, mountain sucker, Utah chub, sculpin, redside shiner, mountain whitefish, rainbow trout, and brown trout (Wyoming Game and Fish Department 1977).

Terrestrial.

Sagebrush (2,226 acres). The primary wildlife species present are sage grouse, horned lark, black-billed magpie, sage thrasher, western meadowlark, Brewer's blackbird, vesper sparrow, sage sparrow, Brewer's sparrow, longtail weasel, striped skunk, coyote, red fox, Richardson ground squirrel, Uinta ground squirrel, least chipmunk, Uinta chipmunk, deer mouse, sagebrush vole, whitetail jackrabbit, desert cottontail, mule deer, moose, and pronghorn antelope.

General. Saltbush, winterfat, mountain shrub, aspen, and broadleaf trees are habitat types which, when combined, add up to 247 acres. The primary wildlife species would be the same as those listed under the sagebrush type.

Raptors which may be seen foraging one or several habitat types are sharpshinned hawk, Cooper's hawk, red-tailed hawk, Swainson's hawk, rough-legged hawk, ferruginous hawk, golden eagle, bald eagle, marsh hawk, prairie falcon, American kestrel, great-horned owl, and long-eared owl.

Herd Units

The Wyoming Game and Fish Department has designated areas of management for big game herds. These areas are called herd units and each one contains an individual big game population. All big game population numbers and density esimates in this report are based upon herd units.

Fishery

Nongame. The primary nongame fish species present in Hams Fork are listed under the aquatic habitat type at the beginning of this section. The best population information currently available indicates there are about 2,000 fish (approximately 77 pounds) per mile of stream (personal communication, Dr. George Baxter, University of Wyoming, January 1978). This population will produce an estimated 83 pounds of fish per mile per year.

Game. The game fish present in Hams Fork are mountain whitefish, rainbow trout, and brown trout. The best population information currently available indicates there are about 1,000 fish (approximately 75 pounds) per mile of stream (personal communication, Dr. George Baxter, University of Wyoming, January 1978). This population will produce an estimated 80 pounds of fish per mile per year.

Endangered and (or) Threatened. No endangered or threatened fish species are known to exist in Hams Fork.

Wildlife

Birds

Nongame. The major songbird species found on the proposed North Block project area are listed under the major habitat types at the beginning of this section. The Wyoming Game and Fish Department breeding bird survey indicates about 19 individuals per square mile in all habitat types combined. Although these figures are average estimates for resident birds, it must be understood that nomadic arid land species (crows, certain raptors, etc.) may significantly increase these numbers.

Game. The sage grouse is the primary game bird inhabiting the proposed project area. The entire area is considered yearlong range and no strutting grounds exist on or near the project area. The North Block proposal is located within bird management section number 7 of the Seedskadee Management Unit for sage grouse. Population within this section is about 15,300 or 9 birds per square mile (Wyoming Game and Fish Department 1977).

However, there are areas (e.g., wintering areas, strutting grounds, etc.) where the density will be much greater. For example, Patterson (1952) found that on good habitat on spring range, densities were 20 to 50 birds per square mile.

Endangered and (or) Threatened. No endangered or threatened species are known to exist on the proposed project area.

Mammals

Nongame. The primary small, nongame mammals are Richardson ground squirrel, Uinta ground squirrel, least chipmunk, Uinta chipmunk, deer mouse, and whitetail jackrabbit. The only available small mammal population information for southwestern Wyoming indicates about 5 individuals per acre in the sagebrush type and about one individual per acre in the remaining habitat types (Maxell 1973).

Game. The entire proposed project area is considered summer range for mule deer (Map NB2-8A), although about twenty animals utilized the aspen stands as winter cover in the unusual winter of 1976-1977 (Wyoming Game and Fish Department 1977). The project area is within the West Green River Herd Unit which has a present deer population of 8,000 or approximately 8 deer per square mile on the summer range. By 1982, the Wyoming Game and Fish Department hopes to have a deer population of 10,000 in this herd unit.

The entire proposed project area is moose summer range with an overlap of about 216 acres of crucial winter range in the northeast corner (Wyoming Game and Fish Department 1977). About five moose utilize this area in winter (see Map NB2-8A). The project area is within the Lincoln Herd Unit for moose which has a present population of 945 and a desired population of 950. Present density is about one moose per square mile on the summer range and about six per square mile on the crucial winter/yearlong range.

Endangered and (or) Threatened. No endangered or threatened mammal species are known to inhabit the proposed project area.

Reptiles and Amphibians

General. The primary reptile species found on the proposed project area are the northern shorthorned lizard, sagebrush lizard, northern sideblotched lizard, wandering garter snake, and Great Basin gopher snake. The primary amphibian species are tiger salamander, leopard frog, and boreal toad. Table NB2-8A shows the number of species and estimated density of reptiles and amphibians in the major habitat types.

Endangered and (or) Threatened. No endangered or threatened reptile and amphibian species exist within the proposed North Block project area or surrounding vicinity.

Wild Horses

No wild horses inhabit the proposed mine site or surrounding vicinity.

CULTURAL RESOURCES

Archeological

In 1974, a partial survey of the North Block project area, 6½ square miles, was done for Kemmerer Coal Company by World-Wide Survey, Ltd., under the direction of M. Ann Bennett. Only one archeological site was discovered. Bennett suggests that because of the lack of alluvium in much of the area, additional sites may not be expected. However, where dense vegetation obscured some of the surface, there exists the possibility that other sites may be found. No estimate was given on how much of this surface was obscured.

The site (number WWS 74-01) found in the Bennett (1974) survey yielded a lanceolate projectile point and a basal fragment of a side-notched projectile point. No ceramic material was associated with the site. Other than miscellaneous flake debris, there were no other distinguishing characteristics or diagnostic artifacts.

On the basis of this side-notched projectile point fragment, a late Prehistoric date is suggested for the occupation (Mulloy 1958).

A survey from Fossil Butte National Monument (Ziemens 1973), 9 miles west of the North Block project area, suggested occupations in the late middle Prehistoric period. The lanceolate point from WWS 74-01 may suggest another late Middle component in the North Block project area.

Northwest of Kemmerer at the junction of Meadow Creek and Hams Fork, two Paleo-Indian sites were sampled in a power line survey by Wilson et al. (1973). One of the sites was a multicomponent site with middle Prehistoric period material.

East of the North Block project site are Paleo-Indian sites of considerable importance. Both the Pine Springs and Finley sites in the region were occupied during the Paleo-Indian period. Therefore, it is possible that such sites may exist in alluviated areas of the North Block project area or areas which have not been surveyed.

Seasonal or limited occupation sites are common throughout much of southwestern Wyoming. WWS 74-01 seems to be a typical example of this kind of occupation.

Metcalf's (1977b) survey data suggest that both the North Block and Twin Creek proposed mine areas have

Table NB2-8A

REPTILE AND AMPHIBIAN DENSITIES FOR MAJOR HABITAT TYPES

Habitat Type	Number of Species	Density Estimate (number per acre)
Sagebrush	4	2-3
Salt desert shrub	4	2-3
Winterfat	4	2-3
Mountain shrub	10	6-8
Aspen-cottonwood	10	6-8

Source: Personal communication, Dr. George Baxter, University of Wyoming, January 1978.

a site density of 0.61 sites per section. Using this density, the total number of sites in the 6.5 square miles of North Block is estimated to be four. The mean number of sites per section in the Overthrust Belt (see Figure R2-3C) is 2.35. This would indicate a maximum number of fifteen sites within the North Block project area.

There are no National Register sites *(Federal Register*, Vol. 42, No. 21) located in the project area.

Historical

There are no historic sites within the North Block project and right-of-way areas. Also, none of the sites on Wyoming's Preservation Plan or on the National Register *(Federal Register* Vol. 42, No. 21) lie within these areas.

VISUAL RESOURCES

The characteristic landscape of the southern portion of the North Block project area is rolling sagebrush hills and aspen filled draws. The north portion of the area drops gently into the willow covered Hams Fork bottom. The only intrusions in the area are two unimproved dirt roads and a BLM improved light duty dirt road (04211).

A person traveling either Highway 30 or Highway 233 is able to view different parts of the North Block area from different segments of these roads. Map NB2-10A depicts viewpoints and view areas along the two major highways of the area, and Figures NB2-10A, NB2-10B, and NB2-10C depict views from the viewpoints.

Based on the Bureau format for Visual Resource Inventory and Evaluation, as explained in BLM Manual 6310, three Visual Resource Management (VRM) classes have been identified in the area. The analysis from which these classes have been derived appears in the Pioneer Trails Unit Resource Analysis which is available for review at the Rock Springs District Office of the BLM.

The VRM classes identified in this area are Classes II, III, and IV (Map NB2-10B). The basic management guidelines for these visual management classes are:

Class II—Management would require that any changes in any of the basic elements (form, line, color, or texture) caused by a management activity should not be evident in the characteristic landscape.

Class III—Management would require that changes should remain subordinate to the visual strength of the existing landscape character.

Class IV—Management would require that changes may subordinate the original composition and character but must reflect what could be a natural occurrence within the characteristic landscape.

RECREATIONAL RESOURCES

Visitor Use Data

Table NB2-11A depicts estimated visitor use by activity in the North Block project area; these data were derived from visitor use estimates in the Pioneer Trails Unit Resource Analysis available at the Rock Springs District Office of BLM.

Table NB2-11B depicts the estimated general resident use by activity (based on the local population of 7,132 in 1977 for southern Lincoln County) in the North Block site and surrounding area. Data used to calculate these numbers are on file in the Rock Springs District Office of the BLM.

Fishing

Approximately one-half mile of Hams Fork passes through the North Block project area on public lands. This stream is reported to have high populations of cutthroat, brown, and rainbow trout which support excellent fisheries (U.S. Department of Interior, Bureau of Land Management 1977b). Because of the proximity to the town of Kemmerer and excellent fisheries, private landowners are reported to collect up to six dollars per day per person for access fees from fishermen.

Hunting

There are several species of game and nongame animals found throughout the area. Those animals hunted are antelope, deer, ducks, sage grouse, cottontail rabbit, ground squirrels, and coyotes. There is heavy use by hunters after sage grouse, cottontail rabbit, and rodents.

Sightseeing

The area offers little for sightseeing. Some people enjoy traveling through the area to view wildlife. Most of the sightseeing visitor use comes from people traveling the Dempsey Road (BLM 04211). Approximately 1 mile of this road crosses the area (see Map NB2-10B in the Visual Resources section).

Specialized Activities

Off-Road Vehicles

Southwest Wyoming is noted for its four-wheel drive (4-WD) country. Since Kemmerer is close, the area is frequently used to try out new recreational vehicles and test 4-WDs.

Figure NB2-10A

TYPICAL VIEW OF THE NORTHERN PART OF THE NORTH BLOCK PROJECT AREA FROM VIEWPOINTS E THROUGH F FROM HIGHWAY 233. THIS IS A CLASS II AREA.

Figure NB2-10B

TYPICAL VIEW OF THE NORTH BLOCK PROJECT AREA WHERE THE PROPOSED UTILITY CORRIDOR WOULD BE SEEN FROM VIEWPOINTS C AND D ON HIGHWAY 30. THIS IS A CLASS III AREA.

Figure NB2-10C

TYPICAL VIEW OF THE SOUTHWEST CORNER OF THE NORTH BLOCK PROJECT AREA AS SEEN FROM VIEWPOINTS A AND B ON HIGHWAY 30. THIS IS A CLASS III AREA.

Table NB2-11A

1976 "ESTIMATED" VISITOR DAYS BY ACTIVITY IN KEMMERER NORTH BLOCK AREA

Activity	Visitor Days
Fishing	20
Hunting	60
Sightseeing	20
Off-road vehicle	20
Total	120

Note: Visitor day considered to be 12 hours.

Table NB2-11B

ESTIMATED VISITOR USE BY ACTIVITY IN 1977

Activity	Visitor Days
Fishing	29,800
General[1]	29,200
Hunting	9,400
Off-road vehicle[2]	1,200
Sightseeing	9,100
Urban	18,400
Water sports	13,800
Winter sports	3,700

Note: Visitor day considered to be 12 hours.

[1] General includes camping, picnicking, etc.
[2] Estimate by ES team Outdoor Recreation Planner.

Wilderness Values

There are no areas in or near the North Block project area that have been identified as having wilderness values which meet the criteria set in Section 603 of the Federal Land Policy and Management Act of 1976.

AGRICULTURE

Livestock Grazing

The project area is within three grazing allotments: the Quaken Asp Canyon, Airport, and Rock River. (Grazing data obtained from the Rock Springs District Office of the BLM.)

About 54% (1,335 acres of 2,473 acres) of the project area is within the Airport Grazing Allotment. Two operators are licensed to graze livestock within the 5,411 acre allotment. One operator summers about 15 head of cattle (period of use: May 16 to September 30), and the other operator obtains grazing for sheep (periods of use: 475 sheep from April 13 to May 1 and 535 sheep from July 2 to July 10). In addition to licensed use, about 28,000 sheep, owned by eight livestock operators, are trailed, under BLM permit, across the Airport allotment for the purpose of changing winter/summer range. The allotment has a carrying capacity of 1,034 animal unit months (AUMs), which would allow a stocking rate of 5.2 acres per AUM.

The Quaken Asp Canyon Grazing Allotment contributes 44% (1,088 acres) of the project area acreage. The 6,643 acre allotment provides spring and summer grazing for about 700 head of sheep belonging to one operator.

Approximately 2% (50 acres) of the project area is within the large (81,198 acres) Rock Creek Grazing Allotment. Sixteen operators graze sheep and cattle within the allotment from May 1 through mid October.

Livestock water within the project area is limited to a gew undeveloped springs and to natural catchments along ephemeral springs.

Prime Farmland

Consultation with personnel of the U.S. Department of Agriculture, Soil Conservation Service, Rock Springs, Wyoming, revealed that prime farmland is not present in areas proposed for disturbance (see Regional ES, Chapter 9, Consultation and Coordination).

MINERAL RESOURCES

No important deposits of economic materials other than coal are known to occur on the proposed mine site.

Coal

The coal deposits occur in the Adaville Formation. There are 51 coal seams that range in thickness from 3½ to 38 feet on the leasehold. The individual beds locally thicken and thin or lense out, but the aggregate coal thickness remains about the same on the North Block project area. The typical Adaville coal section for the North Block project area is shown in Figure NB2-13A.

The Adaville coal in the North Block site is classified as high volatile B subbituminous. Kemmerer Coal Company analyses indicate 5.26% ash content; 40.77% fixed carbon; 0.61% sulfur; 20.95% moisture, 9,550 BTU per pound, and 32.65% volatiles.

Quantity of coal at the proposed mine site was estimated by the company at over 100 million tons. The company plans to mine at the rate of about 1.4 million tons per year for a mine life of 37 years. Extraction at this rate would consume 54 million tons of coal including a 10% loss in mining. The company reports about 25,600 tons of coal per acre.

The Kemmerer Coal Company mining plan as submitted on 25 July 1975 to the USGS shows the pits to be mined in the North Block project area. However, economics of recovery would determine if more than the proposed 54 million tons of coal would be mined. On multiple, steeply-dipping coal seams, the price-per-ton of coal determines the amount of overburden that can be removed to recover coal from the deeper portions of the dipping seams.

Sand and Gravel

An area of approximately 200 acres in the northeast corner of the proposed mining area is underlain by floodplain and terrace gravel. The terrace gravel has no present economic value.

LAND USE PLANS, CONTROLS, AND CONSTRAINTS

A number of governmental agencies exercise certain types of land and resource use controls in Lincoln County. The proposed North Block Mine includes public and private lands. The federal sector is administered by the BLM (public lands and mineral estate under certain private lands). Except where controls have specifically been delegated by statute to counties or municipalities, Wyoming retains total jurisdiction over nonpublic and privately owned lands (including mineral leasing, rights-of-way, etc.). The North Block project area contains no surface State lands. Counties have authority to effect a wide variety of controls in matters not specifically reserved to the State. The authority applies only to those portions of the county that are unincorporated. A county may regulate and restrict location and use of buildings and structures and use of lands for residency, recreation, agriculture, industry, commerce, public use, and other

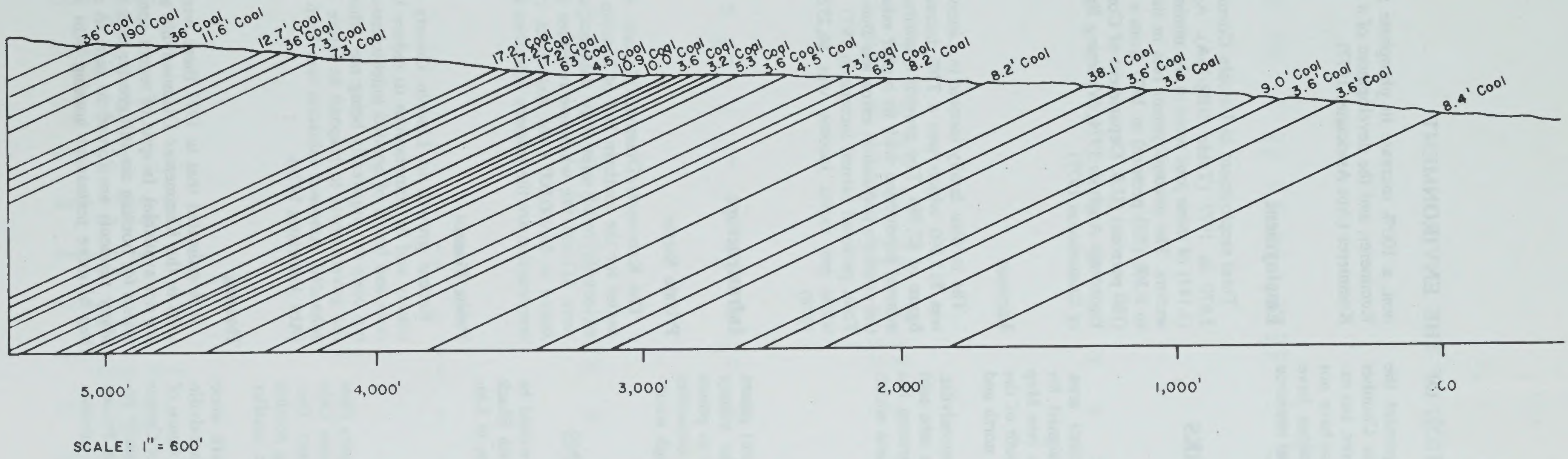


Figure NB2 - 13A

TYPICAL ADAVILLE COAL SECTION
NORTH BLOCK

purposes that are reasonably necessary to protect the public good of its citizens. Lincoln and Uinta Counties have a joint planning office located in Kemmerer, but extensive zoning and countywide planning actions have not been initiated. All of the respective jurisdictions have sufficient authority to impose effective land and resource use controls.

TRANSPORTATION NETWORKS

Highways

No highways cross the North Block project area. However, BLM road 04211, a dirt road designed for light recreation traffic, passes through this area (see Map NB2-10B). U.S. Highway 30 is located just south of the mining area and State Highway 233 is located north and east of the area.

Traffic is congested in Kemmerer/Diamondville. There were an estimated 10,900 vehicle license tabs sold in Lincoln County in 1976. Oil and gas exploration has increased the population of these two small towns which has led to the congested situations.

Railroads

The Union Pacific Railroad (Oregon Shortline) passes through Kemmerer, about 1 mile south of the mining area, and is a major shipping route from Idaho to points east. Current estimated railroad traffic and line capacities for the specific segments of the railroad through southwest Wyoming are depicted in Table NB2-14A.

SOCIOECONOMIC CONDITIONS

The social and economic environment that would be affected most significantly by the proposed North Block Mine includes the Kemmerer/Diamondville area in Lincoln County.

Population

The estimated 1977 population of Lincoln County (that portion within the ES region) was 7,132 persons (Abt Associates 1978). The population of Kemmerer/ Diamondville in that year was 3,655. The remaining portion of the county is spread out in several much smaller towns and in rural areas.

The county has experienced significant growth since 1970. The population of the Kemmerer/Diamondville area increased nearly 60% (1,363) over the 1970 figure of 2,292 (U.S. Department of Commerce, Bureau of Census 1970a). The growth in this community was primarily related to the expansion of the Viva Naughton Power Plant, a 122% increase in Lincoln County coal production, a 100% increase in phosphate production west of Kemmerer, and the development of a coke plant south of Kemmerer (Abt Associates 1977).

Employment

Total employment in Lincoln County was estimated at 3,670 in 1977 (Table NB2-15A). Approximately 31% (1,143) of these jobs were in the mining and construction sectors. The unemployment rate in the county increased to 6.3% (302 persons) in 1977 from a 1974 low of 4.7% (180 persons) (U.S. Department of Commerce, Bureau of Economic Analysis 1974; Wyoming Employment Security Commission 1977).

Income

The median family income in Lincoln County in 1977 was $13,800 which was a 77% increase over the 1970 figure of $7,796. The growth is attributable to increased mineral production with its higher salaries. Over 50% of the county's population earns less than $15,000 per year. Total personal earned income in 1977 was $44.6 million, while per capita income was $6,252 (Abt Associates 1978).

Infrastructure

Private Sector

The Kemmerer/Diamondville area is the retail trade center for the southern half of Lincoln County. Estimated county retail sales (city data not available) in 1977 were $17,300,000; wholesale revenues in 1977 were estimated at $4,600,000 (Abt Associates 1978). Mining and construction are the primary industries in the county.

Public Finance

Recent growth in Lincoln County has allowed the county and its communities to reduce both property tax rates and levels of bonded indebtedness. Current operating costs are apparently being met while the capacity of the governments to respond to future growth has been enhanced. Assessed valuation was $116.1 million in 1977 (Abt Associates 1978).

Housing

It is estimated that in 1977 there were 1,444 dwelling units in the Kemmerer/ Diamondville area (county data are not available). In spite of recent construction, the demands for housing are still greater than what is available. Many residents are forced to turn to mobile homes in lieu of more permanent housing. Abt Associates (1977)

Table NB2-14A

ESTIMATED CAPACITIES OF IDENTIFIED LINE SEGMENTS

Segment	No. of Tracks	Signaling	Length (Miles)	Estimated Capacity (trains per day)	Current Traffic (trains per day)	Estimated % Capacity
Kansas City to Topeka	2	ABS	68	55-60	44	73%
Topeka to	1	CTC	203	25-30		73%
Gibbon	2	CTC	17	70-80	22	28%
Council Bluffs to Gibbon	2	ABS	176	55-60	34	57%
Gibbon to	2	ABS	100	55-60		88%
North Platte	2	CTC	8	70-80	53	66%
North Platte to	2	ABS	182	55-60		78%
Cheyenne	2	CTC	43	70-80	47	59%
Cheyenne to	3	CTC	35	100-115		44%
Hanna	2	CTC	108	70-80	51	64%
Hanna to Rawlins	2	CTC	40	70-80	45	56%
Rawlins to	2	ABS	101	55-60		73%
Green River	2	CTC	33	70-80	44	55%
Green River to Granger	2	CTC	30	70-80	40	50%
Granger to Kemmerer	1	CTC	40	25-30	13	43%
Kemmerer to McCammon	1	CTC	174	25-30	13	43%
McCammon to Pocatello	1	CTC	174	25-30	13	43%

Table NB2-14A

ESTIMATED CAPACITIES OF IDENTIFIED LINE SEGMENTS
(Continued)

Segment	No. of Tracks	Signaling	Length (Miles)	Estimated Capacity (trains per day)	Current Traffic (trains per day)	Estimated % Capacity
Granger to Ogden	2	ABS	126	55-60		53%
	2	CTC	19	70-80	32	40%

Source: Union Pacific Railroad Company 1978.

ABS = automatic block signals
CTC = centralized traffic control

Table NB2-15A

EMPLOYMENT: LINCOLN COUNTY

	1977 Lincoln County[1]
Total employment	3,670
Proprietors	800
Farm	269
Nonfarm	531
Wage and salary	2,870
Farm	227
Nonfarm	2,643
Government	492
Private	2,151
Manufacturing	183
Mining	626
Construction	517
Transportation	210
Trade	351
Finance, insurance and real estate	40
Services	207
Other	17

Source: Abt Associates 1978.

[1]That portion of the county within the ES region.

estimates that mobile homes constitute 15%-30% of the housing in the various communities of the county.

Education

Southern Lincoln County, including the Kemmerer/Diamondville area, is served by School District 01. Its enrollment in 1977 was 912 (Abt Associates 1978). The district currently has excess classroom capacity. Table NB2-15B provides data on educational system characteristics.

Health and Social Services

The recent population expansion has put severe strains on these services. The county is short personnel and facilities frequently requiring residents to travel outside the area for treatment. Table NB2-15C shows the health services profile for Lincoln County. Mental health services are provided by the Jackson-based Western Wyoming Mental Health Association. The primary provider of social services in the county is the State Department of Health and Social Services, Division of Public Assistance and Social Services (Abt Associates 1977).

Police and Fire Protection

The Lincoln County Sheriff's Department has seventeen full-time and ten volunteer officers. The department shares its facilities with the five-man Kemmerer police force. The county jail is currently too small (Abt Associates 1978).

Kemmerer's 24-person fire department serves all of southern Lincoln County. It has an insurance rating of eight, which indicates an organized fire department with deficiencies in the fire department and water supply (Abt Associates 1978).

Water and Sewer Systems

The Kemmerer/Diamondville area (including Frontier) receives its water from the Hams Fork River and the Kemmerer Reservoir. The city owned (Kemmerer) facility can provide up to 3 million gallons of treated water per day. The system, including storage, is considered adequate (Abt Associates 1978).

Kemmerer has a 500,000 gallon per day sewage treatment facility (conventional step aeration activated sludge process). It is currently operating above capacity and is not in compliance with 1977 effluent standards (Wyoming Department of Environmental Quality 1976b). Other communities in the county have individual systems that are generally considered adequate (Abt Associates 1978).

Utilities

The Lincoln Service Company provides power to the Kemmerer/Diamondville area. It purchases its power from the Naughton Power Plant. Natural gas is obtained from the Northwest Pipeline Company through the local supply company (Wyoming Industrial Gas Company). No power supply problems are anticipated in the county in the near future (Abt Associates 1978).

Attitudes and Expectations

The attitudes and expectations of county residents are dependent upon the benefits that they expect to receive from recent growth and the local governments' abilities to cope with the pressures resulting from it. Those involved in the mining and construction sectors generally have a favorable outlook financially. They make high salaries and enjoy the benefits that accompany above average incomes. Residents employed in local services with their lower wages, persons on fixed incomes, and the poor are less optimistic. Their lower incomes make it difficult to compete for goods and services with the inflated prices arising under rapid growth conditions. Items such as adequate housing, especially the purchasing of a new home, become very difficult to attain.

Nearly all residents, however, are concerned about the shortages in services that exist in most areas. The huge increase in population has put great demands on social services (hospitals, dentists, etc.), recreation facilities, public facilities (roads, sewage systems, etc.), and consumer services. It has also led to unplanned growth that has resulted in scattered mobile home parks, traffic congestion, and other problems associated with overcrowding. These difficulties have made many residents unhappy with life in the area. Unable to get needed services and find recreational or cultural outlets, many leave causing high turnover rates in housing and jobs. Crime, drinking, and family problems have all risen.

On the other hand, the local governments have made significant efforts to remedy the situation. The county has a joint planning office with Uinta County, and comprehensive plans have been or are being prepared to control future growth. The increased population and new industry have brought in new funds to support additional services and facilities to help cope with demands (Abt Associates 1977).

Life Styles

There are two basic components to life styles in Lincoln County. The older and more permanent style is primarily rural in nature. Communities have a small-town atmosphere with life centering on outdoor activities, hard work, church, and family. The recent industrial growth has threatened this way of life. Many older residents resent it, even though they have benefited from it in terms of expanded services and higher incomes in many cases. There is also concern about maintaining the wide-open spaces associated with this area. Mining and other industrial activities would disturb the land both physically and visually.

Economic growth and increased industrialism has, however, changed much of the rural atmosphere of

Table NB2-15B

EDUCATIONAL SYSTEM CHARACTERISTICS:
LINCOLN COUNTY

	Lincoln County Kemmerer SD#1
1977 Fall Enrollment[1]	912
Number of Classroom Teachers (Full-Time Equivalent)[1]	50.5
Student/Teacher Ratios[1,3]	18.1
Total Annual Expenditures ($-millions)[1]	1.66
Average Daily Membership (ADM)[1]	922
Expenditures Per ADM[2,4] ($)	1,681
Assessed Valuation ($-millions)[1]	59
Assessed Valuation Per ADM[2,5] ($)	64,991
Number of Classrooms[1]	44

[1]Wyoming Department of Education, Division of Planning, Evaluation, and Information Services, 1977.

[2]Derived from Wyoming Department of Education data.

[3]Fall 1977 statewide average for classroom teachers - 18.4 (State Department of Education, Division of Planning, Evaluation and Information).

[4]1976-1977 statewide average expenditures per ADM - $1,721. (State Department of Education, Division of Planning, Evaluation and Information).

[5]1976-1977 statewide average assessed value per ADM - $31,143 (State Department of Education, Division of Planning, Evaluation and Information).

Table NB2-15C

HEALTH AND SOCIAL SERVICES: LINCOLN COUNTY

Personnel Facilities	Lincoln County[2] Number[1]	Lincoln County[2] Ratio Per Population Increment	State Standard Ratio Per Population Increment
Physicians	3	1:2,377	1:1,000
Nurses (employed)			
Registered nurses (RNs)	9	1:792	1:285
Licensed practical nurses (LPNs)	5	1:1,426	1:769
Public health nurses (PHNs)	1	1:7,132	1:7,660
Total	15		
Dentists	3	1:2,377	1:1,600
Optometrists	1	1:7,132	1:7,000
Hospitals	1	1:7,132	1:19,944
Hospital beds	20	1:357	1:179
Ambulances	5	1:1,426	1:3,740
Emergency rooms	1	1:7,132	1:13,296
Mental health centers	1	1:7,132	1:12,397

Sources:

[1] Interview with Dr. Gayle Robinson, Administrator, South Lincoln Hospital, Kemmerer, January 1978. (Numbers reflect personnel and facilities associated with South Lincoln Hospital only; dentists and optometrists expected.)

[2] Wyoming Division of Health and Medical Services 1977.

Kemmerer/Diamondville. Laborers from other communities, including large cities, have entered the county. They are used to more city-centered activities and have found the transition to a smaller town difficult. The increase in population has also brought many of the problems associated with larger towns (traffic, crime, noise, etc.) as well as the benefits (more services and expanded facilities). The newer population has in effect brought with it a faster pace of life, a turn towards greater industrialism, and a trend of urbanization (Abt Associates 1977).

FUTURE ENVIRONMENT

Lincoln County's population will increase from an estimated 7,132 persons in 1977 to 7,799 in 1980, due primarily to new employment opportunities in the mineral and power industries. There will be a decline in population (to an estimated 7,120 in 1985), due to construction having been completed on major projects, such as the Viva Naughton Power Plant expansion and the subsequent departure of construction workers. By 1990, the population will be an estimated 7,233 persons, a slight increase above 1977 levels.

Approximately 50% of the county's population growth will be in the Kemmerer/ Diamondville area. There will be moderate increases in personal income, retail and wholesale sales, and housing demands; however, most demands on the county's services, caused by new growth, will become insignificant after 1980.

Population changes in Lincoln County will effect corresponding changes in the use of transportation networks. It is estimated that annual vehicle license tab sales will increase from 10,900 in 1976 to 12,900 in 1978 to 1980 and then decrease to 10,900 in 1980. Annual sales in 1985 through 1990 will be an estimated 11,100, a slight increase over the 1976 level. Table NB2F-14A presents estimated increases in railroad traffic.

Estimated changes in recreational visitor use in Lincoln County through 1990 are shown in Table NB2F-11B.

Adverse and beneficial impacts to cultural and paleontological resources will show correlation with developmental and population trends.

The expanded Viva Naughton Power Plant will have a local affect on air quality (Maps R2-2A and R2-2B).

The air quality, climate, geology, topography, soils, water resources, vegetation, fish and wildlife, visual, and mineral resources of the lands comprising the North Block project area will not change appreciably through 1990 without the proposed mining.

Table NB2F-14A

ESTIMATED FUTURE RAILROAD TRAFFIC WITHOUT COAL MINING IN SOUTHWESTERN WYOMING

Segment	Estimated Capacity[1] (trains per day)	Current Traffic[1,2] (trains per day)	1980 Traffic[3,4] (trains per day)	1980 % Capacity	1985 Traffic[3,4] (trains per day)	1985 % Capacity	1990 Traffic[3,4] (trains per day)	1990 % Capacity
Kansas City to Topeka	70-80	44	48	60	56	70	65	81
Topeka to Gibbon	70-80	22	24	30	28	35	32	40
Council Bluffs to Gibbon	55-60	34	37	62	43	72	50	83
Gibbon to North Platte	70-80	53	58	73	67	84	78	98
North Platte to Cheyenne	70-80	47	51	64	60	75	69	86
Cheyenne to Hanna	70-80	51	56	70	65	81	75	94
Hanna to Rawlins	70-80	45	49	61	57	71	66	83
Rawlins to Green River	70-80	44	48	60	56	70	65	81
Green River to Granger	70-80	40	44	55	51	64	59	74
Granger to Kemmerer	25-30	13	14	47	16	53	19	63
Kemmerer to McCammon	25-30	13	14	47	16	53	19	63

Table NB2F-14A

ESTIMATED FUTURE RAILROAD TRAFFIC WITHOUT COAL MINING IN SOUTHWESTERN WYOMING
(Continued)

Segment	Estimated Capacity[1] (trains per day)	Current Traffic[1,2] (trains per day)	1980 Traffic[3,4] (trains per day)	1980 % Capacity	1985 Traffic[3,4] (trains per day)	1985 % Capacity	1990 Traffic[3,4] (trains per day)	1990 % Capacity
McCammon to Pocatello	25-30	13	14	47	16	53	19	63
Granger to Ogden	55-60	32	35	58	41	68	47	78

[1]Union Pacific Railroad Company 1978.
[2]Through freight only.
[3]Abt Associates 1978.
[4]Estimates by ES team.

Table NB2F-11B

ESTIMATED RESIDENT VISITOR USE DEMAND BY ACTIVITY
FOR YEARS 1980, 1985, AND 1990

Activity	Visitor Days 1980	Visitor Days 1985	Visitor Days 1990
Fishing	33,200	30,800	31,700
General[1]	32,500	30,800	32,000
Hunting	10,200	9,300	9,400
Off-road vehicle[2]	1,300	1,200	1,200
Sightseeing	10,000	9,400	9,700
Urban	21,200	21,200	22,600
Water sports	15,600	15,100	15,900
Winter sports	4,400	4,500	4,900

Note: Visitor day considered to be 12 hours.

[1] General includes camping, picnicking, etc.
[2] Estimate by ES team Outdoor Recreation Planner.

CHAPTER 3

THE ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

This chapter discusses the impacts that would result from implementation of the proposed North Block Mine. Impacts are linked to specific aspects of the mining and reclamation plan and are quantified to show magnitude, intensity, duration, and incidence.

This chapter also provides the bases for assessing unavoidable adverse impacts in Chapter 5.

ASSUMPTIONS AND ANALYSIS GUIDELINES

An analysis of impacts requires assumptions and guidelines for coal-related development.

Assumptions

1. Labor and equipment shortages would not significantly distort the projected levels of development.
2. No extensive delays for obtaining environmental clearances would be encountered.
3. No extensive delays for obtaining rights-of-ways (federal or private) would be encountered.
4. The reclamation of mined areas would require an estimated 9 years. This would include 4 years for backfilling, overburden shaping, seedbed preparation, planting and replanting and 5 years for plant establishment (during which time livestock and extensive big game use would be prevented).
5. Areas not disturbed by mining excavation (i.e., rights-of-way, etc.) would not require extensive backfilling and shaping and would be reclaimed in an estimated 8 years.
6. It is assumed that irrigation would be employed, if necessary, to avoid extensive delays in reclamation.

Guidelines

1. Impacts are analyzed for four time points (1980, 1985, 1990, and end of mine life).
2. Impacts lasting beyond the post mining reclamation are considered long term.
3. Table R1-6 presents projected acreages used to determine facility disturbance not given in the mining and reclamation plan.
4. Mining plant site analysis includes mine, mine facilities, and all ancillary developments (i.e., roads, power lines, railroad spurs, and ponds).
5. The proposed revegetation seeding mixture would be subject to revision based on research results at the proposed mining area and, when applicable, at other locations.
6. Successful reclamation would require the establishment of a diverse, effective, and permanent vegetative cover of native and (or) acceptable introduced species capable of supporting post mining land uses. The living plant ground cover on revegetated areas would have to equal the ground cover of living plants on approved reference areas for a minimum of 2 growing seasons.
7. Post mining land uses would primarily involve livestock grazing, wildlife habitat, and outdoor recreation (Bureau of Land Management (BLM) Pioneer Trails Management Framework Plan 1977b).
8. The BLM would design and implement appropriate grazing management systems to prevent overgrazing of reclaimed areas.

AIR QUALITY

Emissions from the Proposed Mine

The specific emission sources of the North Block Mine are presented in Table NB3-2A. From this table, it is obvious the fugitive dust emissions are included in this analysis (43 Code of Federal Regulations (CFR) 118, regulations are not applied) and therefore, represents a conservative (upper-bound) assessment of the impact of the proposed mine. However, based on state-of-the-art emission calculations and modeling techniques, this analysis reflects as accurately as possible the impacts of the mining and reclamation plan which was on file with the U.S. Geological Survey (USGS) at the time of this modeling effort.

For the contribution of wind erosion from unreclaimed and partially reclaimed land, the most probable situation would be represented by mulching and furrowing in the spring, followed by fall planting. Note that the projected emissions (Table NB3-2A) were based on the assumption that mulching and planting would be performed in the fall in a one-step operation. Surface roughness impediments to erosion (furrowing), moreover, were neglected in that analysis. If these control measures were included in the analysis, the total emissions shown in Table NB3-

Table NB3-2A

NORTH BLOCK PARTICULATE EMISSIONS

	Total Suspended Particulates (TSP) in Tons per Year			
	1980	1985	1990	End of Mine Life
Overburden removal	0	133	133	133
Ore loading	0	70	70	70
Truck dumping	0	14	14	14
Train loading	0	0	0	0
Conveying	0	7	7	7
Coal storage	0	0	0	0
Crushing (primary)	0	1	1	1
Crushing (secondary)	0	6	6	6
Overburden dump disturbance	0	50	0	375
Employee access roads	33	132	132	132
Haul roads (coal)	0	158	158	158
Haul roads (overburden)	0	40	0	60
Haul road repair	0	56	56	56
Dozers (overburden dumps)	56	56	56	56
Wind erosion	245	299	298	298
Totals	334	1,022	931	1,366

Source: ERT 1978b.

2A would be reduced by 63%, 31%, 34%, and 35% for the years 1980, 1985, 1990, and end of mine life, respectively.

As shown in the preceding paragraph, best management practices were not necessarily included in the air quality impact analysis. Only those mitigating measures discussed in the North Block mining and reclamation plan on file with the Geological Survey (USGS) at the start of this rewrite were included in the modeling. In any event, the worst-case mine situation is discussed, and best management practices would produce fewer and less intense impacts. It was not possible to include best management practices in Chapter 3, because the suggestions came in too late for modeling to be done and, if included now, would negate the continuity of the present analysis. Chapter 8 contains an air quality alternative which discusses the best management practice impacts.

Impact on Air Quality

Figures NB3-2A through NB3-2D show the mine-related suspended particulate (SP) concentrations for worst-case annual and 24-hour averages predicted by the model. Concentrations are shown to decrease rapidly with distance. Annual and 24-hour mine-related concentrations decrease to 10% of maximum values at 1 to 1.5 miles and 1.5 to 2 miles downwind of the mine, respectively.

When annual average background particulate values of 16 micrograms per cubic meter ($\mu g/m^3$) for 1980 and 15 $\mu g/m^3$ for all other years (Environmental Research and Technology (ERT) 1978a) are added to projected mine-related contributions, total levels are predicted to be greater than the annual primary National Ambient Air Quality Standard (NAAQS) of 75 $\mu g/m^3$ within 0, 0.5, 0.5, and 0.5 miles and greater than the annual Wyoming standard of 60 $\mu g/m^3$ within 0.5, 1, 1, and 1 miles of the mine for the years 1980, 1985, 1990, and end of mine life, respectively. Background concentrations are projected to contribute 70% of total TSP levels at 1 to 2.5 miles and 2.5 to 7 miles downwind from the mine for annual and 24-hour averaging periods, respectively.

If projected mine-related 24-hour SP values and background concentrations of 49 $\mu g/m^3$ for 1980 and 46 $\mu g/m^3$ for all other years are combined, concentrations are predicted to be greater than the 24-hour primary NAAQS of 260 $\mu g/m^3$ within 1, 1.5, 1, and 1.5 miles and greater than the Wyoming standard of 150 $\mu g/m^3$ within 1, 2, 2, and 2.5 miles of the mine for the years 1980, 1985, 1990, and end of mine life, respectively.

A comparison of the worst-case mine impact with Prevention of Significant Deterioration (PSD) regulations is shown in Table NB3-2B. The distances from the mining area within which predicted concentrations are higher than the specified increments are listed for annual and 24-hour averages according to PSD area classification. Concentrations greater than the Class II PSD increment are projected to occur within 1 to 1.5 miles and greater than the 24-hour increment within 2 to 5 miles of the mine.

Note that under the new PSD regulations (43 CFR 118), the violations discussed above would not occur. In fact, the surface mines would be within the applicable NAAQS and PSD regulations.

The impact of blasting and coal fires is difficult to assess, although the maximum air quality degradation would occur on a local scale. The cloud of dust produced by blasting would be short-lived, at least compared to the averaging times of the TSP standards (24 hours or greater), so that little contribution to 24-hour levels would be measured outside the mining area. The dust produced would also be initially dispersed to a great degree by the force of the blast. Blasting would generally take place during the day, when meteorological characteristics are most favorable for dispersing ground-level pollutants. Any fire on the site could significantly contaminate the air and cause a safety hazard. However, due to the high degree of fire control technologies, potential fire impacts would probably be minimal.

Gaseous Pollutants

Vehicle emissions would be the only source of gaseous air pollutants from the proposed mine. Federal and state regulations include limitations on ambient air concentrations of the vehicle-related pollutants carbon monoxide (CO), hydrocarbon (HC), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2).

Maximum predicted concentrations of CO ranged between 0.02% and 0.44% of the standard. Maximum predicted HC concentrations ranged between 0.88% and 3.44% of the standard. Maximum predicted NO_2 concentrations ranged between 0.6% and 3.0% of the standards. Maximum predicted concentrations of SO_2 ranged between 0.02% and 0.33% of the standards. The values represent predictions at less than one-half mile from the mines. Predictions were significantly less at further distances from the mines. Assuming similar vehicle activity for all western coal mines, the impact of vehicle emissions on ambient concentrations of gaseous pollutants would be minimal and insignificant compared to their respective standards.

Visibility

Using the technique discussed in the Chapter 4, Regional Technical Report (ERT 1978a), visibilities have been computed downwind from the source. Results for worst-case 24-hour SP concentrations for the years 1980, 1985, 1990, and end of mine life are shown in Table NB3-2C. Also given are the mass fractions of the total TSP for coal and soil for each year which were used to calculate the visibilities shown in Table NB3-2C. For 1980, the visibility of an observer at 1 mile downwind would be approximately 39.9 miles, assuming a background visibility of 40 miles. In general, visibility would increase with downwind distance from the mine. At 5 miles downwind, the visibility would be 39.9 miles, and at 10 miles it would reach 40 miles. The corresponding

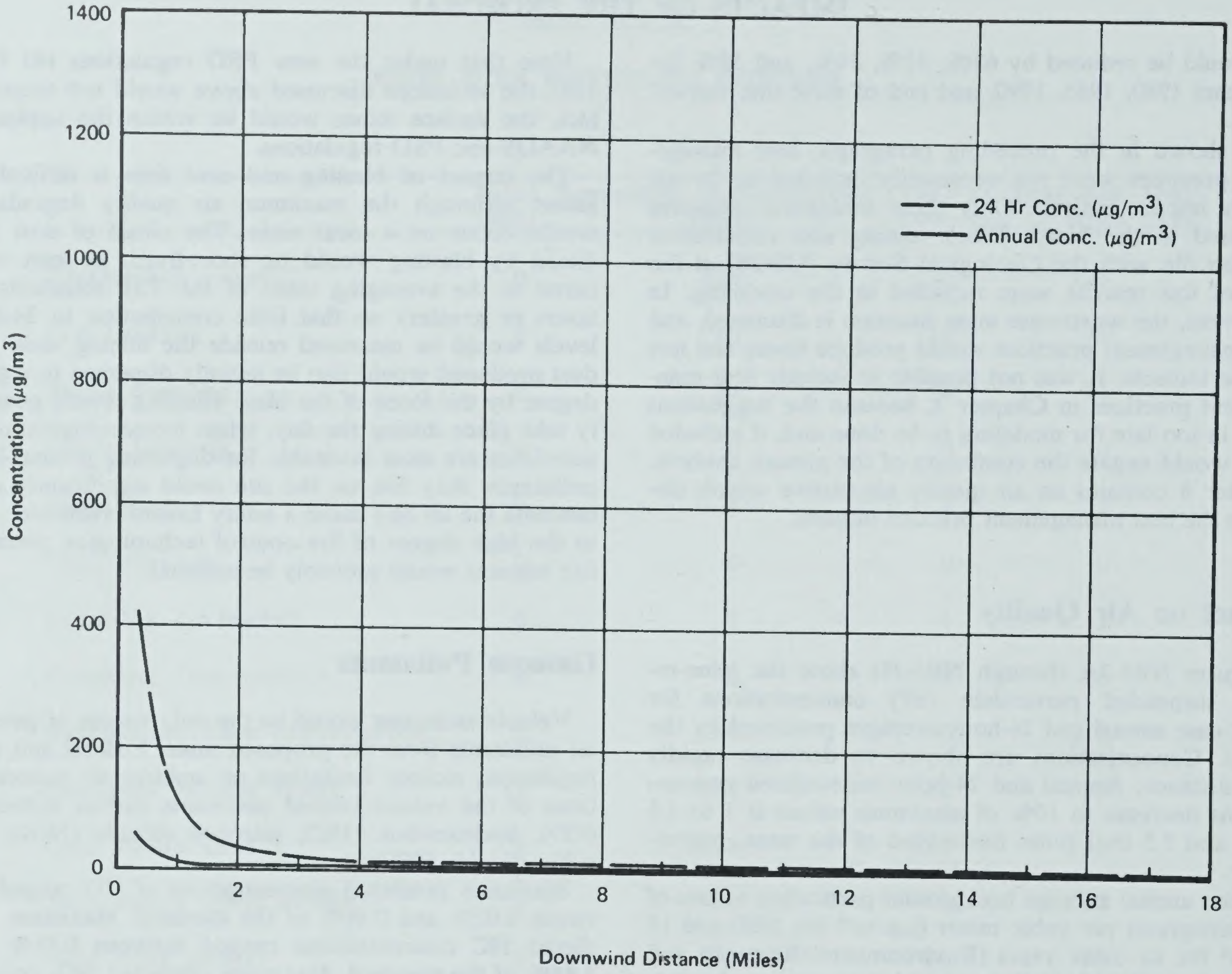


Figure NB3-2A

1980 NORTH BLOCK SP CONCENTRATIONS

Source: ERT 1978b.

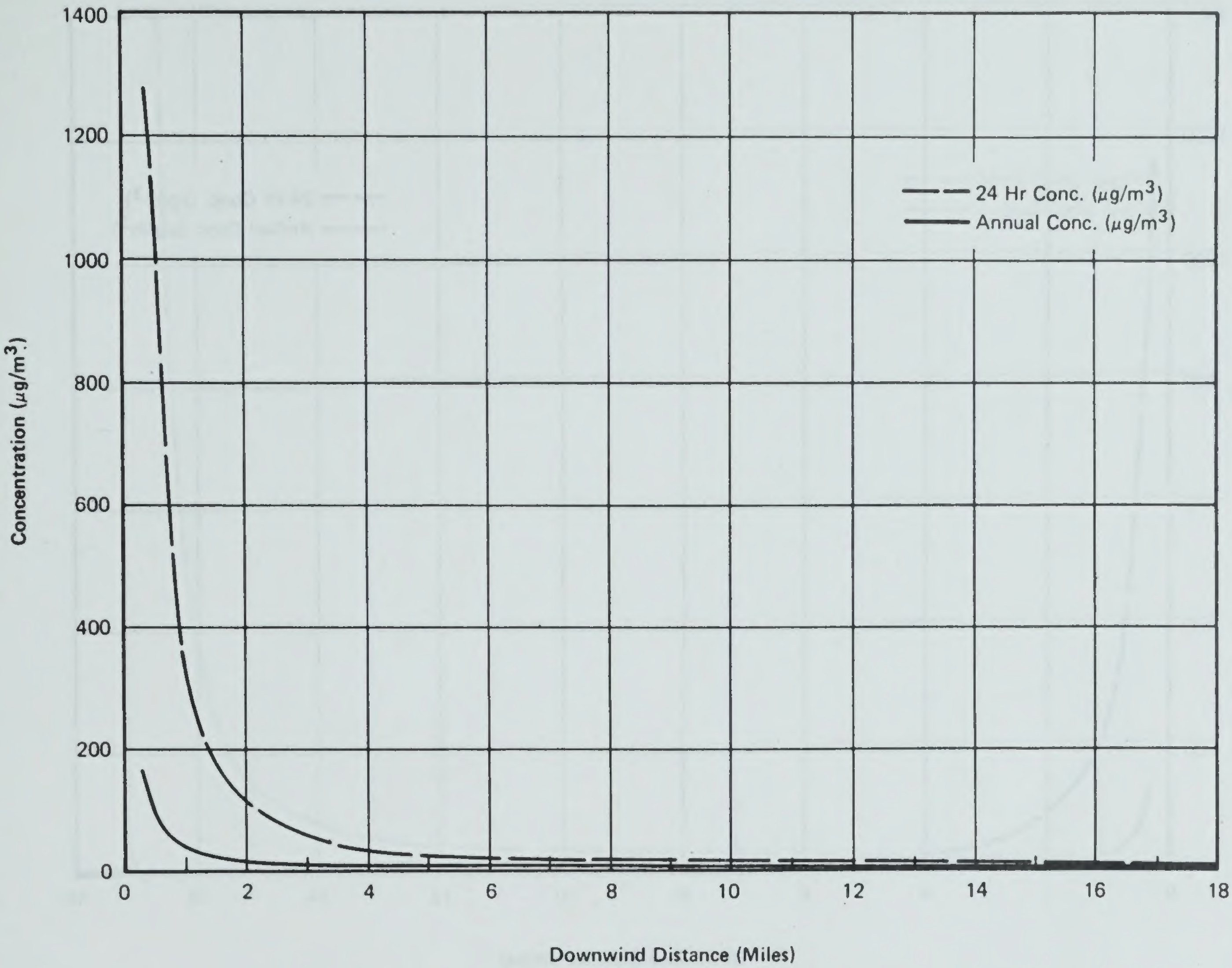


Figure NB3-2 B

1985 NORTH BLOCK SP CONCENTRATIONS

Source: ERT 1978b.

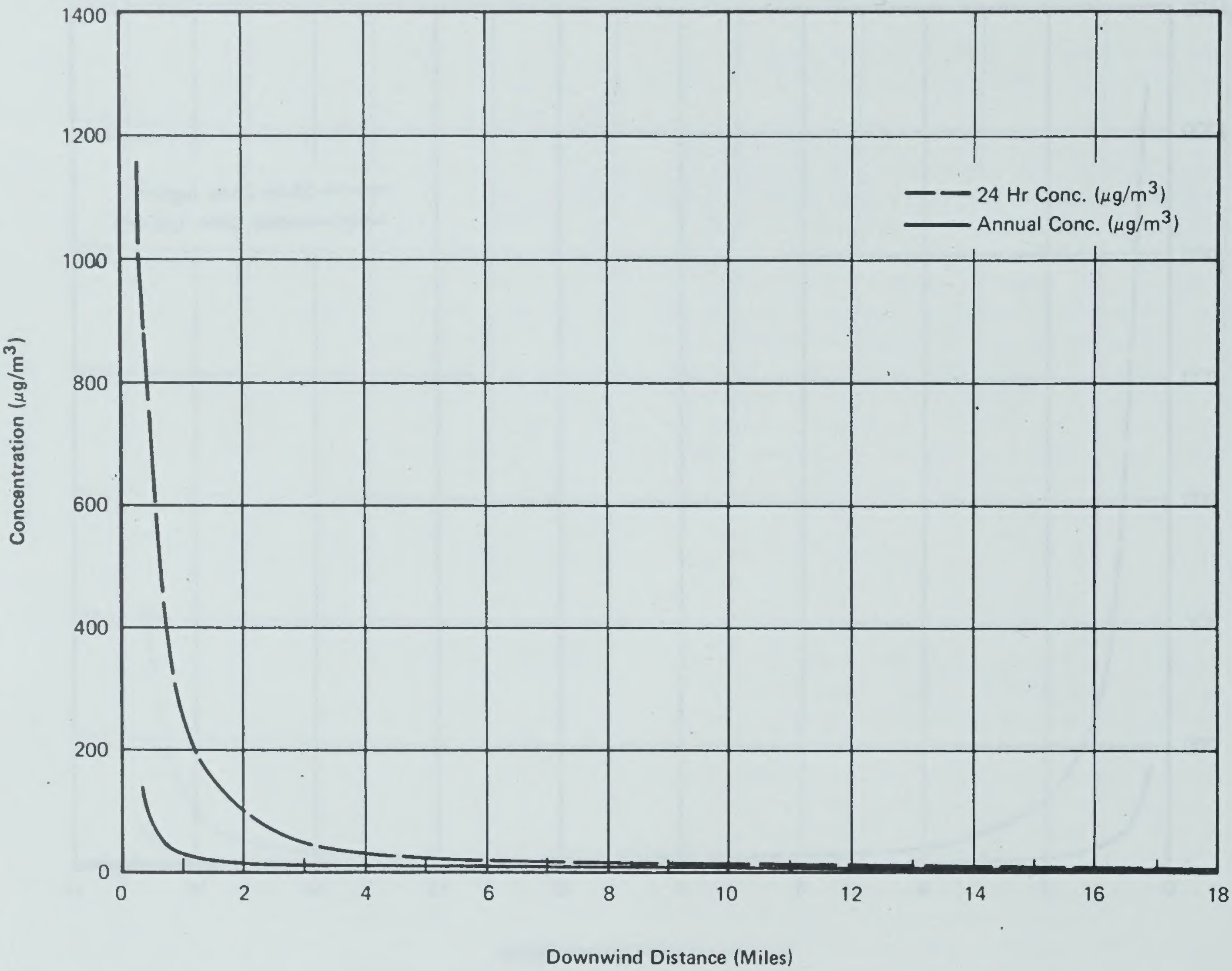


Figure NB3-2C

1990 NORTH BLOCK SP CONCENTRATIONS

Source: ERT 1978b.

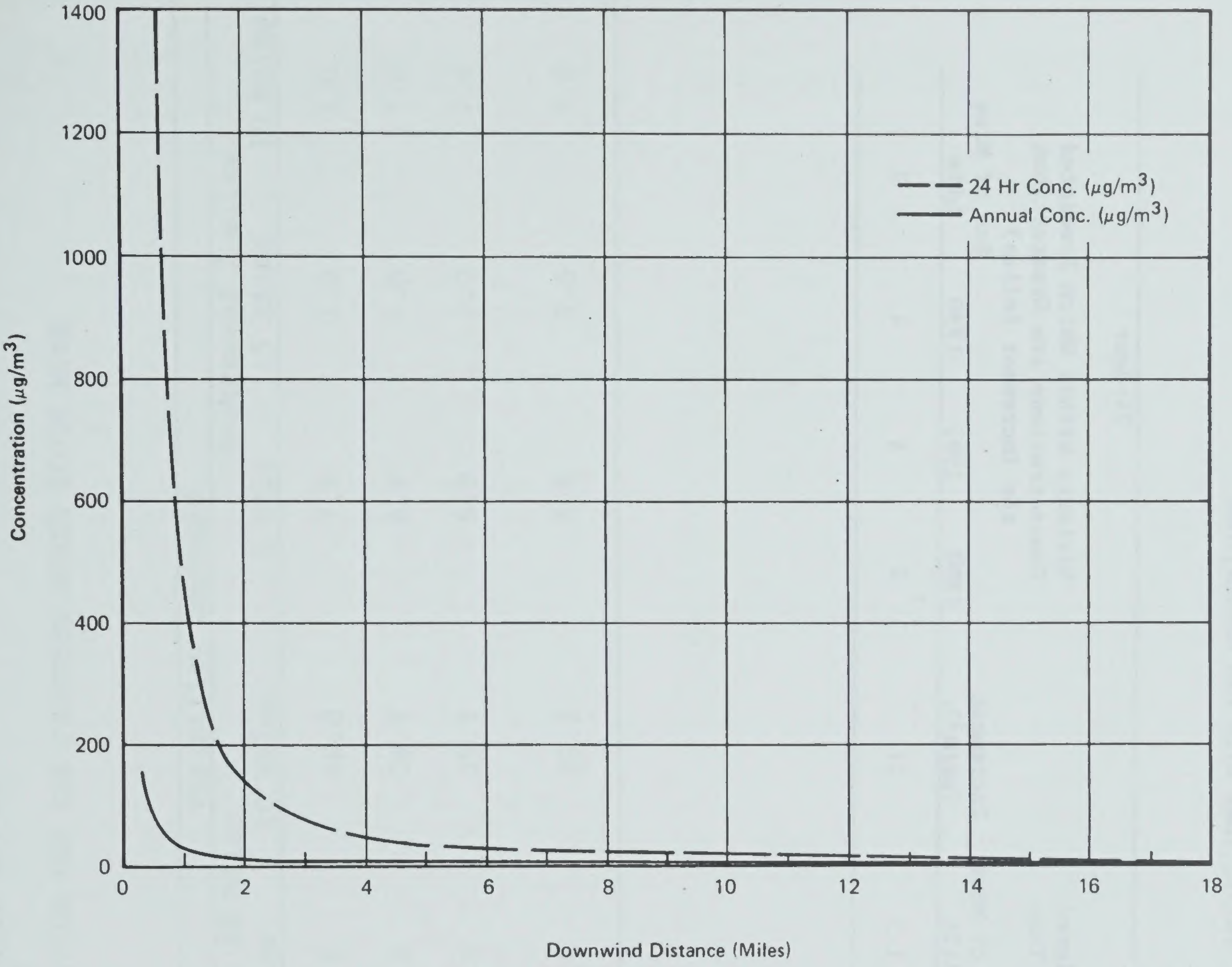


Figure NB3-2D

END OF MINE LIFE NORTH BLOCK SP CONCENTRATIONS

Source: ERT 1978b.

Table NB3-2B

COMPARISON OF WORST-CASE MODEL PREDICTIONS WITH PSD REGULATIONS

	Annual					24-Hour				
		Distance Within Which Predicted Concentrations are Greater Than the Increment (miles)					Distance Within Which Predicted Concentrations are Greater Than the Increment (miles)			
Area Classification	Increment ($\mu g/m^3$)	1980	1985	1990	End of Mine Life	Increment ($\mu g/m^3$)	1980	1985	1990	End of Mine Life
II	19	1	1.5	1.5	1.5	37	2	4	4	5

Source: ERT 1978b.

Table NB3-2C

ACROSS PLUME VISIBILITY DEGRADATION FOR THE PROPOSED NORTH BLOCK MINE

Year	Mass Fraction		Visibility Downwind					
			Background 40 Miles			Background 7 miles		
	Coal	Soil	1 Mile	5 Miles	10 Miles	1 Mile	5 Miles	10 Miles
1980	0	100	39.9	39.9	40.0	7.0	7.0	7.0
1985	10	90	39.6	39.8	39.9	6.9	7.0	7.0
1990	12	90	39.6	39.8	39.9	6.9	7.0	7.0
End of Mine Life	7	93	39.5	39.8	39.8	6.9	7.0	7.0

Source: ERT 1978b.

values, assuming a background visibility of 7 miles, are 7 miles, 7 miles, and 7 miles, respectively. Additional analysis years are given in the table.

GEOLOGY

Paleontology

Impacts to paleontological resources would consist of losses of plant, invertebrate, and vertebrate fossil materials for scientific research; public education (interpretative programs); and to other values. Losses would result from destruction, disturbance, or removal of fossil materials as a result of coal mining activities, unauthorized collection, and vandalism.

A beneficial impact of development would be the exposure of fossil materials for scientific examination and collection which otherwise may never occur except as a result of overburden clearance, exposure of rock strata, and mineral excavation.

Fossil materials of Paleocene and Cretaceous age in the Adaville, Evanston, and Hilliard Shale Formations would be impacted to variable degrees.

All exposed fossiliferous formations could also be affected by increased unauthorized fossil collecting and vandalism as a result of increased population. The extent of this impact cannot be presently assessed due to a general lack of specific data on such activities.

Due to the present lack of data and accepted evaluatory criteria for determination of a significance, no meaningful assessment can be presently made as to the extent and nature of the loss of these paleontological values to science or education, or hence to the significance of potential impacts on the fossil record.

Geologic Hazards

Because the rocks dip into the slopes, the landslide potential of the proposed mining area probably would be minimal even though the landslide susceptibility of the rock and earth material is estimated to be high (Radbruch-Hall et al. 1976). If the slopes were undercut or oversteepened, however, some caving or sliding could occur during periods of thawing or heavy rain.

Where the seams are exposed by mining, accidental or spontaneous ignition of coal could occur.

The lands are in an area of low seismic activity so the probability of damage resulting from earthquake activity is slight.

TOPOGRAPHY

The most significant impact to the topography would result from the mine excavation and from the deposition of spoil piles. Lesser disturbance would result from the construction of support facilities. By 1980, mining would not yet have begun, but the construction of support facilities would have disturbed 410 acres. The mine facilities would occupy 100 acres and would have little effect upon the topography. A tram road/conveyor system and the relocation of an existing road would occupy 149 and 63 acres, respectively. A possible impact of these roads on the topography is that the natural runoff might be channelized along the sides of the roads which could lead to the creation of gullies by increased erosion. The rights-of-way for power transmission lines, communication lines, and water pipeline would occupy 66 acres. The removal of vegetation and disturbance of soils and rock material resulting from the burial of these lines could lead to gullying as a result of the increased erosion of the loosened material.

The mine excavation and the deposition of spoil piles would cause significant and lasting changes to the topography. By 1985, by 1990, and by the end of mine life, 961, 1,236, and 2,181 acres, respectively, would have been disturbed by mining and by spoil-pile deposition. The mining operation would impose on the natural eastward-draining topography (described in Chapter 2) a pattern of generally north-south trending steep-sided ridges and valleys. The valleys would contain many elongate undrained depressions as much as 330 feet wide and 1,150 feet long. The ridges would commonly be from 750 feet to 1,200 feet apart but would range up to 1,750 feet apart. They would generally rise about 40 feet above the natural land surface and the valleys would generally be about 40 feet below the surface. The ground would be shaped to blend into the surrounding landscape.

Drainage in the disturbed area would be north and south, along the north-south valleys, to the undrained depressions or to the natural watercourses and then eastward along them. The positions of the major natural watercourses would be unchanged and their character would be unchanged except for the location of the undrained depressions on them.

The effects of topographic changes on the drainage of the project area are discussed more fully in the Water Resources section.

SOILS

Mining would result in disturbing and mixing of soil on 2,181 acres proposed for mine pits and spoil piles by the end of mine life (Table NB2-5A presents soils that would be affected). The removing, transporting, and stockpiling of topsoil would destroy natural soil structure and mix the various soil textures in the area. Removal of soil too deep in most soil areas by scrapers would result in mixing and contaminating topsoil with underlying subsoil high in soluble salts. The stockpiling process would eliminate a majority of the soil biota population in stockpiled soils. This loss would result from the scraping process and the lack of sufficient oxygen in the stockpile to sustain the biota (Brock 1966). The cumulative result of the above would be a short-term reduction in soil productivity.

Approximately 133 million cubic yards of overburden including lower soil horizons would be removed and disturbed during the 35-year life of the mine. This would destroy the subsoil horizon and parent material relationships that have been established over a long geologic time. An average of 69 acres of soil surface would be disturbed yearly during the life of the mine. An accelerated rate of erosion would occur on these areas during mining. The sediment generated during heavy rains would move off the mine permit area into surrounding areas.

An accelerated rate of wind erosion would occur on areas disturbed and being reclaimed (vegetative cover removed and not reestablished). The soil lost yearly (entering atmosphere) over the average area disturbed by mining would be approximately 320.3 tons per year an increase of 240 tons per year over that of the area prior to mining.

After reshaping the land surface, soil would be eroded by water action at an accelerated rate until such time a vegetative cover could be reestablished. The rate of water erosion on the areas with recent respread topsoil would be approximately 12 tons per acre per year (calculated using Musgrave's Equation, BLM Manual 7317.22A). This is an increase of 6 tons per acre per year over undisturbed areas. Part of this soil would be lost for the production of vegetation during reclamation. Also, some of this eroded soil would end up in the 11 permanently created ponds to be left after mining. Soil erosion would decrease as vegetation became established. With reclamation activity (machinery traffic) some soil compaction would occur resulting in less water infiltration, and, therefore, a decrease in soil productivity on compacted areas being reclaimed.

During reclamation topsoil would be spread evenly over the disturbed areas prior to revegetation. Thus, areas deficient in topsoil prior to mining would gain topsoil from sources with a surplus. The result would be some increase in soil productivity in these deficient areas. However, the increase in productivity in these localized areas would not be significant in relation to the reduction of soil productivity overall.

The construction of mine facilities, roads, and a conveyer system would require approximately 312 acres. The soil removed for construction would be lost from vegetative production for the life of the mine. At the conclusion of mining, these areas would be reclaimed, and since soil disturbance would be minor, original productivity would be attained. Population increases due to mining would result in the removal of around 100 acres of soil from production as a result of the construction of housing and support facilities.

The overall result of the mining action would be a short-term lowering of soil productivity on 2,181 acres associated with mine pits and spoil piles. Soil productivity would be lowered on 961 acres by 1985 and on 1,236 acres by 1990 due to compaction, soil loss, topsoil contamination, destruction of soil structure, and a loss of soil biota. The temporary lowering of soil productivity would affect reclamation of mined lands (see Vegetation section).

WATER RESOURCES

Ground Water

The steeply dipping sandstone lenses and the coal beds in the Adaville Formation store small amounts of ground water. These would be drained by the mining operation. Recharge to the water-bearing sandstones and coal would be impaired by the less permeable mine spoils which would be, in part, replaced in the mined-out cuts. No wells tapping the Adaville are located near the proposed mining area.

If the ground water quality of the Adaville Formation at this proposed site is similar to that at the proposed Twin Creek Mine, as suggested in the North Block site-specific ES in the Ground Water section, any water that may be recharged into the Adaville from the pits would degrade the ground water quality somewhat. However, any water in the Adaville at this site probably is unsuitable for drinking water as it presently occurs.

Surface Water

Most of the area to be mined drains to Hams Fork; less than one-third drains to the east fork of Twin Creek. Drainage would be temporarily interrupted or altered by spoil piles, mining cuts, haul roads, and a conveyor belt. Mine waters may be discharged to Hams Fork or Twin Creek drainage. Storm water runoff would erode spoil piles, shoulders of haul roads, and conveyor belt rights-of-way resulting in increased sediment discharge to Hams Fork and Twin Creek. If these streams are now carrying sediment at capacity, the additional sediment would be deposited in low velocity reaches. If the streams have the capacity to carry additional sediment, they would carry the additional load and deposit it some short distance downstream. In any instance, the character of the streams would be altered as would their ability to support aquatic life. Flow characteristics of the streams can be changed by aggrading or degrading; either would alter flow characteristics. Data are insufficent to estimate the extent of these impacts caused by the mining operations. Approximately 2,181 acres would be disturbed or altered over a 35-year planned mining period. The mining and reclamation plan (Kemmerer Coal Company 1975) shows recontoured and graded spoil piles on the flood plain of Hams Fork near the northeast corner of the project area. These could impact the flood flows of Hams Fork. The low water channel in places would be less than 200 feet from the reclaimed spoil pile. Flood flows may reach and severely erode the recontoured spoil piles. In any event, sediment discharge from the areas would be increased. Runoff characteristics of the area would be changed. Unquantifiable impacts from the proposed mining could occur to the Hams Fork drainage; believed to be an alluvial valley floor. According to 30 CFR 715.17 (j) (z) "surface coal mining operations located west of the 100th meridian west longitude shall not interrupt, discontinue, or preclude farming on alluvial valley floors and shall not materially damage the quantity or quality of surface or ground water that supplies these valley floors. . . ."

Water Use

At a production rate of 1.4×10^6 tons per year, water use would be about 70 acre-feet per year. This assumes that mining 1×10^6 tons of coal per year requires 50.4 acre-feet per year. The approximate 1,400 additional population attributable to the North Block Mine by 1985 would use about 280 acre-feet of water per year.

VEGETATION

Terrestrial

Mining would remove native vegetation on approximately 2,591 acres (see Map NB1-2). Big and (or) black sagebrush occur on about 97% (2,513 acres) and saltbush, winterfat mountain shrub, and aspen vegetation types (combined) on about 3% (78 acres) of areas proposed for disturbance.

About 410, 1,371, 1,646, and 2,591 acres would be disturbed by 1980, 1985, 1990, and 2016 (end of mine life), respectively. Revegetation of all but an estimated 55 acres (permanent livestock ponds) of the 2,591 acres would be conducted at an estimated rate of 0, 133, 328, and 1,420 acres by the same dates, respectively. (The remaining 1,116 acres would be reclaimed after mining.)

Some changes in drainages would occur as the result of mining. Overall changes in plant species composition and production would probably be minimal due to the intermittent nature of affected drainages.

Population increases as the result of mining would result in the long-term loss of vegetative production on an estimated 100 acres for housing and support facilities, primarily adjoining existing municipalities. Increased numbers of people in the area would result in additional disturbance of native vegetation, particularly by off-road vehicle use (see Recreational Resources section).

The revegetation of disturbed areas would be difficult due to many factors. Climatic conditions are severe with extremely low and high temperatures, strong winds, and low, erratic precipitation. Moisture would probably be the most limiting factor (May 1975 and Cook, Hyde, and Sims 1974), with average annual precipitation of the area estimated to be about 9 inches (see Climate section). Other problems which could hinder revegetation are less than ideal soil properties (see Soils section), competition for moisture and nutrients from undesirable weedy plant species (May 1975), steep slopes, and the loss of seeds and destruction of seedlings by small mammals (Thames ed. 1977).

Despite such problems, successful reclamation appears to have been achieved in the ES region along highway rightsof-way and on areas disturbed by oil and gas activities. Published reclamation research concerning these sites, however, is apparently not available. Natural plant succession is also in evidence on many of these sites, with the rate and extent of succession depending on site characteristics. Hodder (Thames ed. 1977), in discussing highway and mined land reclamation, considered the problems in reclaiming these types of disturbance similar in many respects and dissimilar in others. One major difference expressed was that mined spoils may be maniuplated (i.e., farmed, etc.) while roadside problem materials must be accepted as they exist.

Revegetation research in the arid southwestern United States indicates that the reclamation of coal and copper mined lands is possible under extremely harsh environmental conditions (Aldon 1978; Bengson 1977; Aldon and Springfield and DeRemer and Bach (Thames ed. 1977)).

Reclamation activities are being conducted at two active surface coal mines in the region. Seeding operations began in 1972 at the Kemmerer Coal Mine, located about 4 miles southwest of Kemmerer, Wyoming. Only 46 acres of 376 acres seeded through 1977 have received topsoil treatment (Kemmerer Coal Company 1977). This situation exists because early mining reclamation laws did not require topsoiling of mine spoils. May et al. (1971) found spoil materials at the Kemmerer Mine to be extremely variable in some properties. Values for pH ranged from 2.2 to 7.3. Some spots were high in aluminum content and extremely low in pH. The most common soil textures found were clay loams and clays. Clay soils are difficult to work into a proper seedbed and are known for poor water infiltration properties (Cook, Hyde, and Sims 1974).

The initial seeding of disturbed lands at the Jim Bridger Mine, located about 35 miles northeast of Rock Springs, Wyoming, was in 1975 (personal communication, Harley Meuret, Jim Bridger Coal Company, 1978). Topsoil has been applied to all lands being reclaimed as required by current state and federal laws. About 246 acres have been graded, topsoiled, and seeded through 1977 (Bridger Coal Company 1978).

Supplemental irrigation is being experimented with at both mines. This practice is considered essential, or probably essential, by some reclamation authorities for reclaiming mined lands in areas having low and erratic precipitation (DeRemer and Bach and Aldon and Springfield (Thames ed. 1977)). Both mining companies have in recent years adopted the use of rangeland drills for seeding operations. Drilled seeding is generally considered superior to broadcast seeding, particularly on areas where a good seedbed can be prepared (Vories ed. (1976) and Thames ed. (1977)). The use of topsoil, with some reservations, is also recognized as a beneficial treatment in achieving revegetation (Thames ed. (1977) and Vories ed. (1977)). In view of the topsoiling deficiencies at the Kemmerer Mine, the early seeding methods employed at both mines, and the short time lapse between the present time and the initial seeding conducted at the Jim Bridger Mine, it is understandable that large scale reclamation has not been achieved at either mine.

A review of current mined land reclamation literature, and analyses of resources available for reclamation indicate that the methods and procedures proposed in the North Block mining and reclamation plan (subject to compliance with SMCRA) would result in the successful reclamation of disturbed lands. However, since conclusive site-specific reclamation success data are unavailable and since reclamation success is dependent on site-specific conditions and the solving of problems either identified or yet to be identified, a reclamation alternative is presented in Chapter 8. This alternative identifies a procedure to prove the feasibility of on-site reclamation. An estimated 9 years would be required to reclaim mined areas and 8 years for lesser disturbed sites. The reclamation time estimates are based on revegetation results on semiarid to arid mined lands (Aldon 1978; Bengson 1977; Aldon and Springfield and DeRemer and Bach (Thames ed. 1977)) and on the recommended need for plants to be protected from extensive grazing during establishment (Cook, Hyde, and Sims 1974). It is assumed that supplemental irrigation would be employed when necessary to achieve seed germination and seedling establishment. Without irrigation, reclamation would be delayed during years when soil moisture is inadequate.

The achievement of reclamation earlier or later than estimated would lessen or increase impacts to living organisms and their nonliving environment due to the loss of vegetative cover and production (see Air Quality, Soils, Fish and Wildlife, Agriculture, and Water Resources sections).

Based on the proposed North Block seeding mixtures, reclaimed areas would have a general appearance of grassland. Grasses would be the most common forage class, with shrubs and forbs being reduced in density and cover as compared to premined conditions.

Natural plant succession would occur on reclaimed lands and could restore approximate premined plant cover and composition values in an estimated 30 to 50 years, as suggested by Cook (Vories ed. 1976).

Aquatic

Data are lacking with which to quantify impacts from mining activities to algae and other aquatic vegetation in seasonal drainages.

Endangered and (or) Threatened

A survey of the project area revealed no plants proposed for endangered and (or) threatened status (Dorn 1977). The process for requesting formal consultation under Section 7 of the Endangered Species Act of 1973 was initiated for North Block with the U.S. Fish and Wildlife Service 2 March 1978.

The U.S. Fish and Wildlife Service responded by letter dated 7 March 1978 that formal consultation cannot be conducted for unlisted species.

FISH AND WILDLIFE

General Information

Impacts of the proposed action upon fish and wildlife resources are summarized in Tables NB3-8A, NB3-8B, and NB3-8C. Impacts can be categorized into three general types: (1) loss of fish and wildlife habitat, (2) loss of the carrying capacity of that habitat to sustain fish and wildlife populations, and (3) loss of the fish and wildlife populations and their progeny (offspring) over the period of mining and reclamation.

The proposed mining operation would remove native vegetation from about 2,591 acres. Disturbance to the sagebrush would be 2,513 acres. Disturbance to saltbush, winterfat, mountain shrub, aspen, and broadleaf trees would be 78 acres combined.

Habitat Losses

The proposed mining operation would result in both direct and indirect losses to wildlife habitat. Direct losses would include that habitat physically disturbed by mining and related activities. Indirect losses would be that area (area of influence) that would be indirectly lost or affected. This "area of influence"would be indirectly lost or affected because of the fact that all living organisms to some degree exhibit a home range or territory and daily or seasonal migration. Hence, if an organism is impacted upon part of that home range or territory, the remaining part of that home range or territory is also impacted to a certain degree. This degree of impact can range from a slight impact of 10% to 20%, or to a total impact of 100%, depending upon the individual organism or species involved. This area of indirect loss or adversely affected fish and wildlife habitat would range in size from an area equal to the direct habitat loss of such species as a leopard frog to four or five times the area directly affected for such species as the golden eagle. An average of 4.5 times the actual disturbance was used for calculations in this report. Anticipated acreage loss in this area of influence is summarized in Table NB3-8B. Habitat losses for specific seasonal ranges for the major game species are summarized in Table NB3-8D.

Reclamation would have varying degrees of effectiveness to wildlife depending on the wildlife species involved, the plant species used, and the success of revegetation. Reclamation, however, would be difficult in southwestern Wyoming because of soil and climatic conditions (see North Block and Regional Vegetation sections and Regional Wildlife discussion of reclamation). Since quantification of the effectiveness of reclamation to wildlife is not possible with current available information, the numbers representing habitat and population losses do not reflect any post-reclamation return of either one.

Carrying Capacity Losses

As a result of the loss of the fish and wildlife habitat (vegetation and living space), there would exist a loss of that area's ability to support fish and wildlife population. This ability to support fish and wildlife population is

Table NB3-8A

SUMMARY OF IMPACTS ON FISH AND WILDLIFE RESOURCES
ON THE PROPOSED NORTH BLOCK PROJECT AREA

	Anticipated Impact of Proposed Mine		
Classification of Impacts	None	Minor	Major
Fish and wildlife habitat			x
Carrying capacity for fish and wildlife			x
Fish and wildlife populations			
Fishery			
Nongame		x	
Game		x	
Endangered and (or) threatened species	x		
Wildlife			
Birds			
Nongame			x
Game			x
Endangered and (or) threatened species	x		
Mammals			
Nongame			x
Game			x
Endangered and (or) threatened species	x		
Reptiles and amphibians			
General			x
Endangered and (or) threatened species	x		

Table NB3-8B

SUMMARY OF FISH AND WILDLIFE AREA IMPACTED BY THE PROPOSED NORTH BLOCK MINE

	Direct Loss (acres)[1]	Indirect Loss or Adversely Affected Area (acres)[2]
Fish and wildlife habitat		
1980	410	1,845
1985	1,371	6,170
1990	1,646	7,407
End of mine life	2,591	11,660
Area of fish and wildlife carrying capacity affected		
1980	410	1,845
1985	1,371	6,170
1990	1,646	7,407
End of mine life	2,591	11,660
Area in which fish and wildlife populations would be affected		
1980	410	1,845
1985	1,371	6,170
1990	1,646	7,407
End of mine life	2,591	11,660

[1] Totally (100%) affected.
[2] Data are insufficient at this time to determine the degree to which these areas (areas of influence) would be affected. It may be only slightly (10%-20%) or totally (100%), depending upon the individual species involved.

Table NB3-8C

SUMMARY OF WILDLIFE POPULATION LOSSES

	Estimated Number of Individuals Directly Lost to Proposed Action				
	1980	1985	1990	Mine Life	% of Population[2]
Wildlife					
Birds					
Nongame[1]	650	6.1T	12.6T	70T	<1%
Raptors	---	---	---	---	---
Game	20	70	90	500	.06%
Mammals					
Nongame	135T	1.263M	2.617M	13.699M	<1%
Game					
Mule deer	13	43	51	285	0.1%
Moose	8	15	25	40	0.5%
Reptiles and Amphibians	3.4T	18.3T	22T	140T	<1%

Note: All estimates are for the total population, including the progeny that would have been produced.

[1]All nongame birds except raptors.

[2]These percent figures represent the amount of regional or herd/ management unit populations that will be lost by end of mine life. Percent figures that are underlined are based on herd or management unit populations.

T = Thousands
M = Millions

Table NB3-8D

WILDLIFE

Species and Habitat	Acres Impacted by Time Periods 1980	1985	1990	End of Mine Life	% of Available Range
Sage grouse:					
Yearlong	410	1,371	1,646	2,591	0.2%
Mule Deer:					
Summer	410	1,371	1,646	2,591	0.4%
Moose:					
Summer	410	1,371	1,646	2,591	0.3%
Critical winter/yearlong	216	216	216	216	0.5%

Note: The percent figures represent the amount of range the disturbance would remove by end of mine life from the total range now available. In some cases, it was more practical to calculate percentages based on herd or management units rather than on a regional basis. These figures are underlined.

known as its "carrying capacity" The loss of this carrying capacity would range from 410 acres (area directly affected) in 1980 to 11,660 acres (area of influence) by end of mine life. The acreages on which carrying capacity loss would occur are summarized in Table NB3-8B.

Fish and Wildlife Population Loss

Introduction

There would be a loss of wildlife populations within the area to be disturbed. For example, if there are five animals per acre in a given area and 1,000 acres of that area are disturbed, loss to that population would be 5,000 individuals. In addition, there would be a loss of the populations progeny (offspring) over the period of disturbance.

See the Fish and Wildlife Population Loss Action, Chapter 4, in the Regional ES, for an explanation of the method used to calculate total population losses.

When estimating losses to the wildlife resource, it was assumed that all habitat would be at carrying capacity for the particular species being discussed. This would not necessarily be the case, and it is realized that possibly not all the wildlife occupying an area to be disturbed would be lost. However, definitive data concerning habitat condition and trend in and around proposed project areas were not available; therefore, projections as to the survival of displaced animals were not made.

Fishery

Nongame. No impacts to the nongame fishery would occur as a result of mining since no sediment would by law be allowed to be released into the Hams Fork. There would be infrequent storms, however, which would cause runoff to exceed the capacity of the sediment ponds and result in sedimentation of the Hams Fork. This could affect the fish populations through gill abrasion, covering of benthic organisms, and loss of space in pools. The numbers of fish or the area of stream affected cannot be estimated without more precise data.

Game. See Nongame above.

Wildlife

Birds.

Nongame. The primary small nongame bird species impacted would be horned lark, black-billed magpie, sage thrasher, western meadowlark, Brewer's blackbird, vesper sparrow, sage sparrow, and brewer's sparrow.

Based upon breeding bird surveys conducted by the Wyoming Game and Fish Department, the best population density estimate currently available is an average of 19 birds per square mile. Using the formula for biotic potential, the proposed mine would account for the loss of an estimated 650, 6,100, 12,600, and 70,000 birds by 1980, 1985, 1990, and end of mine life, respectively. These figures represent a minute percentage of the total population of small birds in the region.

Game. Sage grouse would be the only game bird significantly impacted by the proposed mine. There would be a loss of 410, 1,371, 1,646, and 2,591 acres of sage grouse yearlong range by 1980, 1985, 1990, and end of mine life, respectively. The end-of-mine-life figure represents approximately 0.2% of the total sage grouse habitat in bird management section 07 of the Seedskadee Management Unit. Using the assumption of an average of 9 birds per square mile, an estimate of the losses would be 20, 90, 170, and 550 birds by 1980, 1985, 1990, and end of mine life, respectively. The end-of-mine-life figure would represent about 0.06% of the production of the total population in the management unit by that mining not taken place.

Endangered and (or) Threatened. At this time and with current information, it is not anticipated that there would occur any adverse impact to any endangered and (or) threatened bird species. Under Section 7 of the Endangered Species Act of 1973, the Secretary of the Interior will grant no approval which would jeopardize the continued existence of any endangered and (or) threatened species or result in the destruction or modification of their critical habitat.

Mammals.

Nongame. The primary small nongame species affected would be Richardson ground squirrel, Uinta ground squirrel, least chipmunk, Uinta chipmunk, deer mouse, and sagebrush vole. The best population density estimates available indicate 5 animals per acre in the sagebrush type and about 1 per acre in the other habitat types combined (Maxell 1973). Using the formula for biotic potential, the proposed mine would account for the loss of an estimated 96,000, 902,000, 1,869,000, and over 9,750,000 animals and their progeny in the sagebrush type by 1980, 1985, 1990, and end of mine life, respectively. In the other types combined, losses would be an estimated 39,000, 361,000, 748,000, and 3,914,000 animals and their progeny by 1980, 1985, 1990, and end of mine life, respectively. The total losses for all habitat types combined, including the progeny which would have been produced, would be estimated at 135,000, 1,263,000, 2,617,000, and 13,699,000 animals by 1980, 1985, 1990, and end of mine life, respectively. Although these figures seem large, they are only a minute percentage of the total production of small mammal populations within the region. It is realized that small mammal populations do fluctuate greatly and that losses would vary as a result. However, habitat disturbance would remove the areas' ability to produce that peak population level until reclamation is successful.

Game. There would be a loss of 410, 1,371, 1,646, and 2,591 acres of mule deer summer range from mining by 1980, 1985, 1990, and end of mine life, respectively. The end-of-mine-life figure of 2,591 represents about 0.4% of the summar range in the West Green River Herd Unit. Mule deer losses would be estimated at 13, 43, 51, and 285 animals by 1980, 1985, 1990, and end of mine life, respectively. The loss of 285 deer would represent about

0.1% of the production of the total deer population in the herd unit by the end of mine life. These figures include the progeny which would have been produced had mining not taken place.

There would be a loss of 216 acres of moose crucial winter/yearlong range by 1980. This loss would remain constant throughout the mine life. This figure represents about 0.2% of the crucial winter/yearlong range in the Lincoln Herd Unit. There would also be a loss of 410, 1,371, and 1,646 acres of moose summer range by 1980, 1985, and 1990, respectively. The 1,646 acre loss of summer range by 1990 represents about 0.3% of the total summer range available in the herd unit. About five moose use this area in a given winter; therefore, by the end of mine life an estimated 40 moose would be lost. This figure includes the progeny which would have been produced had mining not taken place. This population loss represents about 0.5% of the production of the total population in the herd unit by the end of mine life.

Endangered and (or) Threatened. At this time and with current information, it is not anticipated that there would occur any adverse impact to any endangered and (or) threatened mammal species. Under Section 7 of the Endangered Species Act of 1973, the Secretary of the Interior will grant no approval which would jeopardize the continued existence of any endangered and (or) threatened species or result in the destruction or modification of their critical habitat.

Reptiles and Amphibians

General. The primary reptile and amphibian species impacted would be northern shorthorned lizard, sagebrush lizard, northern sideblotched lizard, wandering garter snake, and Great Basin gopher snake.

The best density estimate currently available is an average of five indifiduals per acre on the major habitat types (personal communication, Dr. George Baxter, University of Wyoming, January 1978). Using this assumption, it is estimated that 3,400, 18,300, 22,000, and 140,000 individuals would be lost by 1980, 1985, 1990, and end of mine life, respectively. These figures include the progeny which would have been produced had mining not taken place.

Endangered and (or) Threatened. No adverse impact is anticipated to any endangered and (or) threatened reptile or amphibian species.

Wild Horses

There would be no impact to wild horses.

CULTURAL RESOURCES

Impacts to cultural resources would include (1) destruction or alteration of all or part of a site; (2) isolation from or alteration of its surrounding environment; and (3) introduction of visual, audible, or atmospheric elements that are out of character with the site or alter its setting (36 CFR 800.9). These impacts may take place to both prehistoric and historical sites in the region.

The loss of cultural resource sites and the data contained therein would be a direct result of their physical destruction through land modification required in mining and associated surface facilities, access roads, rail spurs, and power lines. Site destruction could also occur through development of related events such as increased population which could lead to increased pothunting and vandalism and increased vehicular use of the land resulting in some unintentional destruction of cultural resources.

Because cultural resources are nonrenewable, the physical destruction of any cultural data or artifacts could eventually have a potentially significant impact on efforts to reconstruct the prehistory and history of the region.

Archeological

Neither of the prehistoric sites found during the 1974 survey of the proposed North Block mining area are eligible for nomination to the National Register of Historic Places using criteria found in 36 CFR 800.10. Both sites would be destroyed by mining activities.

There is no estimate of the number of acres or percentage of the 6½ square miles not surveyed. This information was not presented in the survey report. There may be archeological resources present in these areas. Destruction of uninventoried sites by mining activity could be a significant impact to archeological resources.

The potential for unknown buried archeological sites exists within the project area and associated rights-of-way. Unknown Early period and Altithermal sites would most likely have been covered with Quaternary deposits through time and, because of their scarcity, would be significant in the region if they exist. These sites are not and would not be evident before actual surface disturbance uncovered them. Any surface disturbing activity could partially or completely destroy them, and the site pass unnoticed.

The increase in pothunting, arrowhead collecting, and vandalism that would result from an increase in population would affect all known and unknown resources within the region. The significance of this impact is potentially great, since the kind of data removed by these activities, arrowheads and tools, are the major resources for dating and analyzing prehistoric activity.

Historical

There are no historical sites which would be impacted by the proposed action.

VISUAL RESOURCES

Visual resource contrast ratings were made for the North Block mining area using critical viewpoints along Highways U.S. 30 and Wyoming 233 (see Map NB2-10A, Chapter 2, Visual Resources). These ratings, summarized in Table NB3-10A, are available for review at the Rock Springs District Office of the BLM. Contrast is assessed in terms of how the proposal is expected to

Table NB3-10A

SUMMARY OF VISUAL CONTRAST RATINGS FOR NORTH BLOCK MINE

		Activity											
		Mining						Structures					
Views from Critical Viewpoints	Visual Management Class	Active Mining	Post Reclamation of Mining	Active Mining	Post Reclamation of Mining	Active Mining	Post Reclamation of Mining	Active Structures	Post Reclamation of Structures	Active Structures	Post Reclamation of Structures	Active Structures	Post Reclamation of Structures
		FEATURES BEING EVALUATED											
		Land	Land	Veg.	Veg.	Stru.	Stru.	Land	Land	Veg.	Veg.	Stru.	Stru.
A through B	III	3/29*	3/25	3/11	3/14	NA	NA	NS	NS	NS	NS	NS	NS
C through D	III	NS	NS	NS	NS	NS	NS	2/15	0/0	3/20	0/0	3/21	0/0
E through G	II	3/27	3/25	3/22	3/14	NA	NA	2/15	0/0	3/20	0/0	3/24	0/0

Visual Management Class	Maximum Acceptable Impact
Class II	2/10
Class III	2/16
Class IV	-/20

$* \frac{3}{29}$ Highest element contrast / Total score for feature

NS = Not seen from critical viewpoint.
NA = Feature not affected.

affect existing landforms, vegetative patterns, and existing structures such as power lines and buildings. Anticipated changes in form, line, color, and texture are analyzed individually in reference to landform, vegetative patterns, and structures. The resulting contrast ratings are compared to the maximum acceptable impact for the particular visual management class indicated for the land affected by the proposal. In the case of the North Block Mine, two time periods were also used, active mining and post reclamation. Further explanation of the Visual Resource Contrast Rating System (BLM Manual 6320) is also available for public review at the Rock Springs BLM District Office.

Summary of Table NB3-10A

Viewpoints A through B

The proposed operations would not meet BLM visual management objectives in this area during mining or until successful reclamation. No structures would be visible from this area. During mining the Visual Resource Management (VRM) Class would change from Class III to Class V. After reclamation and until successful revegetation, scars of strip mining would reduce the scenery quality and sensitivity and result in a change to Class IV.

Viewpoints C through D

The actual mining operations would not be seen from this area; however, haul roads, a conveyor system, and transmission lines would pass through here. These structures would not meet BLM visual management objectives as long as they are present. However, after removal and successful reclamation, they would no longer be visible.

Viewpoints E through G

The active and post-reclamation mining activities would not meet the visual quality objectives. Until successful reclamation, there would be visible signs of the mining. This would change the characteristic natural landscape to one characterized by mining activities.

The structural activities would meet the objectives with landform features, but would not meet the BLM objectives in the vegetation and structural features during the life of the project. Upon completion of mining and with successful reclamation, contrast due to structural activities would be eliminated.

During mining this area would change in VRM Class from Class II to Class V. It would be impossible to return the area's characteristic landscape after mining until successful revegetation occurs, thus the outcome would be a change to a Class IV until successful revegetation.

Until successful revegetation, BLM management visual quality objectives would not be met. However, after successful revegetation, the area would return to the VRM class that existed prior to mining.

RECREATIONAL RESOURCES

Visitor Use Data

Table NB3-11A shows the estimated change in recreation visitor day demand due to an increased resident population, created by the proposed North Block Mine, recreating in the region. Data used to derive the visitor use are available for public review at the Rock Springs District Office of the BLM.

Resources

Fishing

Access to the only section of public land on the Hams Fork would be restricted for approximately 10 miles. This would eliminate the fishing along this stretch of stream on public lands. The increased population would result in increased fisherman days through the region. This would result in a lower quality experience for all people fishing.

Hunting

Hunters would be restricted from the area, which would result in a loss of all hunter days during the mining operations on the mine area. These hunters would travel to other areas to hunt. Increased population would increase the number of persons hunting in the region. People would have to travel further from their homes to hunt big game. More people in the field would detract from the quality of the hunters' experience.

Sightseeing

As the mining displaced wildlife, there would be a decrease in opportunity for zoological sightseeing. The operations would offer opportunity for geologic and industrial interpretation of open-pit mining. The increase in sightseers to the area to see the mining would create safety hazards.

Specialized Activities

Off-Road Vehicles. Off-road vehicle use would be restricted from the mining area, which would result in a loss of visitor days on site. However, increased population would result in an increased number of people recreating in the region.

Table NB3-11A

ESTIMATED ANNUAL RESIDENT VISITOR DAYS DEMAND DUE TO POPULATION CHANGE IN LINCOLN COUNTY DUE TO THE NORTH BLOCK MINE IN 1980, 1985, AND 1990

		1980 Population: 195[1]				1985 Population: 419[1]				1990 Population: 477[1]			
Activity	1977	Without Proposed Action	Increase Due to Proposed Action	Total Projection	% of Projection Due to Proposed Action	Without Proposed Action	Increase Due to Proposed Action	Total Projection	% of Projection Due to Proposed Action	Without Proposed Action	Increase Due to Proposed Action	Total Projection	% of Projection Due to Proposed Action
Fishing	29,800	33,200	830	34,030	2.4	30,800	1,820	32,620	5.6	31,700	2,090	33,790	6.2
General[2]	29,200	32,500	810	33,310	2.4	30.800	1,820	32,620	5.6	32,000	2,110	34,110	6.2
Hunting	9,400	10,200	260	10,460	2.5	9,300	550	9,850	5.6	9,400	620	10,020	6.2
Off-road vehicles[3]	1,200	1,300	30	1,330	2.3	1,200	70	1,270	5.5	1,200	80	1,280	6.3
Sightseeing	9,100	10,000	250	10,250	2.4	9,400	550	9,950	5.5	9,700	640	10,340	6.2
Urban	18,400	21,200	530	21,730	2.4	21,200	1,250	22,450	5.6	22,600	1,490	24,090	6.2
Water sports	13,800	15,600	390	15,990	2.4	15,100	890	15,990	5.6	15,900	1,050	16,950	6.2
Winter sports	3,700	4,400	110	4,510	2.4	4,500	270	4,770	5.7	4,900	320	5,220	6.1

[1]Population change due to project (from Socioeconomic Conditions section).
[2]General includes camping, picnicking, etc.
[3]Estimated by ES Team Outdoor Recreation Planner.

General

With increased visitor use due to increased resident population, there would be a general lowering of the "primitive"quality of the overall outdoor recreation experience in the region surrounding the North Block Mine area. The recreational facilities in the town of Kemmerer would also become more crowded. The increased use would induce ranchers to restrict access across their private lands.

AGRICULTURE

Livestock Grazing

Mining would cause a cumulative loss of animal unit months (AUMs) within the Quaken Asp Canyon and Airport Grazing Allotments, estimated at 103, 921, 1,766, 6,507, and 7,407 by 1980, 1985, 1990, 2017 (end of mine life), and 2021 (end of reclamation), respectively.

The Quaken Asp Canyon Grazing Allotment would lose about 3,373 AUMs (an average of about 77 AUMs per year for 44 years) or about 9% of the AUMs which would be available without mining.

About 4,034 AUMs would be lost from the Airport Grazing Allotment. This would amount to 9% of the AUMs which would be available without mining, or an average of about 92 AUMs per year for 44 years. An additional 6% of the AUMs, which would be available without mining, would be lost (an average of about 58 AUMs per year for 23 years) if the Twin Creek mining operation is conducted.

The one livestock operator licensed to graze livestock within the Quaken Asp Canyon allotment, and the two operators licensed within the Airport allotment could probably adjust their operations to the losses of AUMs with minimal impact. The Quaken Asp Canyon AUM losses would cause the relocation or reduction of about 4.6% of 700 sheep. The Airport allotment provides but 3.5% of the AUMs needed by one operator for a 1,100 head sheep operation, and 1.3% of the AUMs needed by another operator for a 450 head cattle operation.

The Twin Creek and North Block mining activities could require periodic adjustments in the routes used for the trailing of 28,000 sheep across the Airport allotment for the purpose of changing summer/winter range use. Additional supplemental feed would need to be fed the sheep during trailing operations.

Eleven proposed ponds, formed in pits following mining, would provide livestock water and encourage better livestock distribution (see Regional, Chapter 3, Water Impoundments for a discussion of requirements for pond establishments).

Federal grazing licenses would be reduced by the appropriate number of AUMs lost on public lands as the result of mining. Restoration of grazing privileges would be made upon reclamation, as it is believed that reclaimed lands would be capable of supporting premining livestock grazing rates.

The reclaimed lands, however, would require more intensive grazing management than would be needed for undisturbed rangeland (Lang, Berg, Hodder (Vories ed. 1976)).

Prime Farmland

Consultation with personnel of the U.S. Department of Agriculture, Soil Conservation Service, Rock Springs, Wyoming, revealed that prime farmland is not present in areas proposed for disturbance (see Regional ES, Chapter 9, Consultation and Coordination).

MINERAL RESOURCES

Coal

A major impact of the proposed mine on the mineral resources at the site would be the removal of about 48.5 million tons of coal from public lands and 5.5 million tons from private lands by the year 2016. The minimum production rate from the proposed operation is currently being planned at 1.4 million tons of coal per year for a period of 35 years. The removal of this more readily recoverable coal would leave only the less accessible, less economically attractive reserves. An unknown quantity in the overburden and (or) interburden would be lost. This coal would be in seams too thin or too low a quality to be of economic interest.

Sand and Gravel

An area of approximately 200 acres in the northeast corner of the proposed mining area is underlain by floodplain and terrace gravel along Hams Fork. It is assumed that during the mining operation this gravel would be removed with the rest of the overburden and wasted.

TRANSPORTATION NETWORKS

Impacts to transportation networks in the North Block area would result from: (1) mining activities requiring relocating a BLM road, (2) transportation of coal out of and supplies into the area, and (3) increased employment and population with its increased vehicles and miles traveled.

The mining activities would require relocation of BLM road 04211. This is a high recreation use road and its relocation would not inconvenience recreationists traveling to the Dempsey Ridge area, due to the new route being built prior to destruction of the existing road.

The increased population attributable to the proposed mine would add to the congestion and number of accidents in Kemmerer/Diamondville. Table NB3-14A depicts the estimated increase in vehicle license tab sales in

Table NB3-14A

ESTIMATED VEHICLE LICENSE TAB SALES

	1976	1978-1980	1980-1985	End of 1985-Mine Life
Sales without proposed action	10,900	11,900	10,900	11,100
Sales due to proposed action	N/A	300	600	700
Sales with proposed action	N/A	12,200	11,500	11,800

N/A - Not Applicable

Lincoln County due to the North Block Mine. The increased use could induce ranchers to restrict access across their private land.

The transportation of mine supplies by vehicles would add to the traffic congestion in Kemmerer/Diamondville.

The transporting of coal from the mining area to the Naughton Plant would be by a conveyor system over the railroad and U.S. Highway 30 west of Kemmerer. There would be delays to travelers and rail traffic during the construction of the conveyor system.

SOCIOECONOMIC CONDITIONS

The primary socioeconomic impacts of the North Block Mine would be associated with increases in population, employment, and income.

Population

The populations of both that portion of Lincoln County within the ES region and the Kemmerer/Diamondville area would increase because of the new jobs made available by the construction and operation of this mine and the induced employment that would result. As shown on Table NB3-15A, the total population of Lincoln County would reach 7,710 by 1990, while Kemmerer/Diamondville's would reach 4,147. The North Block Mine would cause 477 of the county's 1990 total and 441 of Kemmerer/Diamondville's. The mine would cause slightly higher rates of growth, both countywide and in Kemmerer/Diamondville, than would otherwise occur. Between 1977 and 1980, the county's rate of growth would be greater by approximately 0.9%, and Kemmerer/Diamondville's would be nearly 1.7% greater. These rates would reduce to insignificance after 1980.

The projected increases in population (especially between 1977 and 1980) would cause a number of indirect impacts to both the public and private sectors of the county. With the closing of the North Block Mine, 200 mining jobs would be lost to Lincoln County. If other employment opportunities were not available, outmigration would occur. This would result in reduced basic employment, population, and the demand for local goods and services. These impacts should not be significant since the closing of the mine would probably be phased over a period of time, and the effects would be only temporary.

Employment

Approval of this mine would impact Lincoln County, especially the Kemmerer/ Diamondville area, by providing approximately 50 construction jobs between 1979 and 1982. Eventually, 200 permanent mining jobs would be available starting in 1982 (Kemmerer Coal Company 1976). An additional 46 jobs should also become available as induced employment to support the population increase caused by the mine (Abt Associates 1978).

These employment increases would, as mentioned earlier, result in a higher population with additional indirect impacts. These would include increases in local incomes (see Income section) and reduced unemployment (specific data not available). There would also be minor negative impacts if laborers were pulled out of other employment sectors. The high wages offered by the mining industry could cause temporary shortages in these other areas (Abt Associates 1977).

Income

Population and employment increases would cause total earned income in the county to rise significantly. Table NB3-15B shows projected income in 1980, 1985, and 1990 with approval of the North Block Mine. Earned income would eventually reach $77.8 million in 1990; the impact of the mine in 1990 would be $4.7 million. Per capita income would not be significantly affected by the mine.

Specific information is not available, but several indirect income impacts could also occur. Most of the benefits of the higher income would go to those in the mining and construction sectors; those in the local service sector, on fixed incomes, and the poor could be placed in an even less favorable financial position. This would occur if prices continue to inflate causing even more difficulties for these groups to compete for goods and services. However, increased income would cause increased consumer spending and provide benefits to the community as retail revenues and taxes to local governments increased (Abt Associates 1977 and Gilmore 1974).

Infrastructure

Private Sector

The Kemmerer/Diamondville area would continue to be the leading commercial center of southern Lincoln County. The larger population would continue to place pressures on existing services and facilities in local communities. County retail sales would increase significantly as shown on Table NB3-15C; the mine would be responsible for 6.1% ($2.3 million) of the total projected sales in 1990. Wholesale sales would also rise significantly, from an estimated $5.6 million in 1977 to $7.3 million in 1980, $9.0 million in 1985, and $12.1 million in 1990. The impact of the proposed action would be more than 6% of total sales in 1990.

Public Finance

Two impacts to local government would be likely to occur. Government expenditures could be expected to continue to increase moderately to provide more and improved services and facilities to residents, and increased revenues (through higher property valuations and more tax income) could accrue to local governments.

Table NB3-15A

(1) PROJECTED POPULATION: LINCOLN COUNTY

	1977	1980				1985				1990			
		Population Projection				Population Projection				Population Projection			
	Estimated Population	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action
Lincoln County[1]	7,132	7,799	7,994	862	195	7,120	7,539	407	419	7,233	7,710	578	477
Kemmerer/ Diamondville	3,655	3,996	4,179	524	183	3,648	4,058	403	410	3,706	4,147	492	441
Balance of county	3,477	3,803	3,815	338	12	3,472	3,481	4	9	3,527	3,563	86	36

(2) PROJECTED POPULATION ANNUAL RATES OF GROWTH: LINCOLN COUNTY

		1978-1980				1981-1985				1986-1990			
Lincoln County	N/A	3.1%	4.0%	N/A	0.9%	-1.7%	-1.1%	N/A	0.6%	0.3%	0.5%	N/A	0.2%
Kemmerer/ Diamondville	N/A	3.1%	4.8%	N/A	1.7%	-1.7%	-0.5%	N/A	1.2%	0.3%	0.4%	N/A	0.1%
Balance of county	N/A	3.1%	3.2%	N/A	0.1%	-1.7%	-1.7%	N/A	0	0.3%	0.5%	N/A	0.2%

Source: Abt Associates 1978.

Note: Cumulative Impact = projection "with" the proposed action - 1977 estimate.
Impact of the Proposed Action = projection "with" the proposed action-projection "without" the proposed action.

Table NB3-15B

PROJECTED INCOME: LINCOLN COUNTY

	1977	1980				1985				1990			
		Income Projection				Income Projection				Income Projection			
	Estimated Income	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action
Lincoln County Per capita income	$6,252	$7,272	$7,293	$1,041	$21	$8,646	$8,701	$2,449	$55	$10,105	$10,091	$3,839	-$14
Total earned income (millions)	$44.6	$56.7	$58.3	$13.7	$1.6	$61.6	$65.6	$21.0	$4.0	$73.1	$77.8	$33.2	$4.7

Source: Abt Associates 1978.

Note: Cumulative Impact = projection "with" the proposed action - 1977 estimate.
Impact of the Proposed Action = projection "with" the proposed action - projection "without" the proposed action.

Table NB3-15C

PROJECTED RETAIL AND WHOLESALE SALES: LINCOLN COUNTY
($ - Millions)

	1977	1980				1985				1990			
		Sales Projection				Sales Projection				Sales Projection			
	Estimated Sales	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action
Lincoln County													
Retail sales	$17.3	$22.2	$22.7	$5.4	$0.5	$26.4	$28.0	$10.7	$1.6	$35.1	$37.4	$20.1	$2.3
Wholesale sales	$ 5.6	$ 7.2	$ 7.3	$1.7	$0.1	$ 8.5	$ 9.0	$ 3.4	$0.5	$11.3	$12.1	$ 6.5	$0.8

Source: Abt Associates 1978.

Note: Cumulative Impact = projection "with" proposed action - 1977 estimate.
Impact of the Proposed Action = projection "with" the proposed action - projection "without" the proposed action.

Housing

The larger population caused by this mine would put significant additional damands upon housing requirements in the county. Table NB3-15D shows the additional units that would be required with approval and consequent operation of it. The Kemmerer/Diamondville area would require over 63% (275 units) of the cumulative new housing in the county. If the housing industry does not keep pace with the population growth, these housing impacts could become even more significant as the current housing situation became even more aggravated.

Education

A larger school-age population would occur during the 1977 to 1980 period because of this mine (65 student increase). Pupil expenditures, classroom demands, and pressures on student/teacher ratios would all slightly expand. They should not cause excessive adjustments since most schools in the district are operating below capacity, and the school age population would decline, along with the population, after 1980.

Social Services and Facilities

The effects of this one mine are difficult to assess because it is not known how the local governments will respond to the demands of an additional 477 people over other projected growth spread over 13 years. Many services and facilities are already being expanded or are in the planning stages. Some of these improvements may cover the effects of the mine. In any case, the mine would put some additional pressures on current services and facilities. Additional doctors, nurses, fire and police personnel and facilities, and water and sewer facilities would be required (Abt Associates 1977); however, these impacts would generally be insignificant except during the 1977 to 1980 period.

Attitudes and Expectations

Residents opposed to continued growth and disturbance of the wide-open spaces would view the mine as a further aggravation of their position. In spite of the benefits (employment and income increases), they would resent the increased population and urbanization that would occur, even though it would be slight from this one mine (see Population section). Those persons who would benefit from this one mine directly (e.g., mine employees and local merchants) would welcome the employment opportunities and higher wages they could expect to receive. Their positions would advance financially, and they would see the mine as a chance to improve the quality of their lives. Those in the lower income brackets and unable to improve their positions because of the mine could see it as further depressing their situation. They could see it as detrimental because it would continue to inflate prices, make it harder to compete for goods and services, and widen the gap between their incomes and those in the mining sector (Abt Associates 1977).

Life Styles

This one mine should not cause significant impacts to the life styles that currently exist in the county. The trend towards urbanization would continue, but as discussed in the Population section, most of this growth should occur in the Kemmerer/Diamondville area. Some would still feel, however, that it was aggravating the situation by inducing unwanted new growth (Abt Associates 1977).

Table NB3-15D

PROJECTED HOUSING DEMAND: LINCOLN COUNTY

	1977	1980				1985				1990			
		Housing Projection				Housing Projection				Housing Projection			
	Housing Units	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action
Lincoln County													
Total	NA	NA	NA	228	56	NA	NA	439	121	NA	NA	439	121
Kemmerer/ Diamondville	1,444	1,532	1,584	140	52	1,607	1,719	275	112	1,607	1,719	275	112
Single family	729	782	808	79	26	827	883	154	56	827	883	154	56
Multi family	303	315	322	19	7	326	342	39	16	326	342	39	16
Mobile homes	412	435	454	42	19	454	494	82	40	454	494	82	40
Balance of county[1]	NA	NA	NA	88	4	NA	NA	164	9	NA	NA	164	9
Single family	NA	NA	NA	56	2	NA	NA	106	5	NA	NA	106	5
Multi family	NA	NA	NA	13	1	NA	NA	23	1	NA	NA	23	1
Mobile homes	NA	NA	NA	19	1	NA	NA	35	3	NA	NA	35	3

Source: Abt Associates 1978.

Note: Cumulative Impact = projection "with" the proposed action - 1977 units.
Impact of the Proposed Action = projection "with" the proposed action - projection "without" the proposed action.

[1]Projected balance of county housing needs are not available because 1977 data are not available.

NA = Not Available

CHAPTER 4

MITIGATING MEASURES NOT INCLUDED IN THE PROPOSED ACTION

MEASURES

Mining and Reclamation Plan

U.S. Geological Survey (USGS)

North Block Mitigating Measure 1. To reduce losses of uninventoried sites in unsurveyed portions of the project area, the lessee will conduct surveys of all uninventoried portions of the project area. If sites of National Register quality are found, the Bureau of Land Management (BLM) will prepare 106 case reports on these sites.

North Block Mitigating Measure 2. To reduce losses of cultural resources from pothunting and vandalism because of increased population, the lessee will confine all vehicle use to existing roads and trails in culturally sensitive areas.

North Block Mitigating Measure 3. To reduce losses of subsurface archeological sites caused by mining and other surface disturbing activities, a qualified archeologist acceptable to the BLM will be contracted by the lessee to be present during the initial surface disturbance of all of those zones or areas of alluvium which were determined to be sensitive by inventory. The lessee may opt to conduct trenching and (or) test bore holes of identified sensitive areas prior to mining or surface disturbances using an archeologist and methodology acceptable to the BLM. If sites of National Register quality are found, the BLM will prepare 106 case reports on these sites and appropriate mitigation will be conducted in consultation with the State Historic Preservation Office (SHPO) and advisory council. Salvaging or testing of non-National Register sites will be conducted pending the professional judgment of the archeologist. Also, monitoring of sensitive areas four times a year and particularly those adjacent to areas of proposed surface disturbance whether in or outside the mining area will be required by BLM using an archeologist acceptable to the BLM.

North Block Mitigating Measure 4. The BLM and USGS are currently developing a Memorandum of Understanding relating to the protection of paleontological resources on public lands. Those agencies are also developing technical guidelines to define the resource, provide evaluatory criteria, and provide measures for protection. When finalized the provisions of these documents will serve as a basis for management of paleontological resources and appropriate protective programs.

North Block Mitigating Measure 5. To enhance the ability of reclaimed lands to support premine wildlife uses, seed mixtures used for revegetation will include plant species beneficial to the wildlife that were present prior to mining. The following are suggested plant species and seeding rates that would be beneficial to the wildlife on the proposed North Block mine area.

Clay and clay loam soils: Thickspike wheatgrass—8.0 lbs./acre, western wheatgrass—8.0 lbs./acres, Indian ricegrass--4.0 lbs./acre, big sagebrush—1.0 lbs./acre, winterfat—2.0 lbs/acre, rubber rabbitbrush—1.0 lbs./acre, and shadscale— 1.0 lbs./acre.

Sandy soils: Thickspike wheatgrass—8.0 lbs./acre, western wheatgrass—6.0 lbs./acre, Indian ricegrass—1.0 lbs./acre, big sagebrush—2.0 lbs./acre, antelope bitterbrush--2.0 lbs./acre, rubber rabbitbrush—1.0 lbs./acre, winterfat--1.0 lbs./acre, and fourwing saltbush—1.0 lbs./acre.

Saline/alkaline soils: Western wheatgrass—6.0 lbs./acre, streambank wheatgrass—6.0 lbs./acre, Indian ricegrass—6.0 lbs./acre, Nuttalls saltbush—2.0 lbs./acre, big sagebrush— 1.0 lbs./acre, shadscale-1.0 lbs./acre, and fourwing saltbush--1.0 lbs./acre.

These species may not be applicable to all areas and there may be species not listed that would be suitable. The actual seed mixture would be determined by research results at North Block proposed mine and, when applicable, from other locations. In addition, if establishment of shrub species from seed proves infeasible, planting of seedlings, tublings, and (or) plant transplanting would be required.

Wyoming Department of Environmental Quality

North Block Mitigating Measure 6. Soil mixing and leaching of salts or trace metals into potential surface and ground water sources may impact reclamation efforts. The Kemmerer Coal Company will sample water at regular intervals both upstream and downstream from points of inflow of runoff waters from mined areas. Samples will also be taken from ground water sources, from wells penetrating the mined formation and the next adjacent formation, and will be located down the ground water hydraulic gradient from the mined areas. Surface water samples will be analyzed to determine biological, chemical, and sediment content of runoff. Periodic analysis for trace metals will be made of both the dissolved constituents and the sediment load. Ground water samples will be analyzed for chemical content and for trace metals. This will reduce potential degradation of surface and ground waters from leaching of salts and (or) trace metals.

North Block Mitigating Measure 7. The applicant will submit data required under section 715.17 (3)(i) (A through E) (pertaining to Alluvial Valley Floors). These data will provide information needed to establish standards for which compliance with the Surface Mining Reclamation and Enforcement Act may be evaluated.

North Block Mitigating Measure 8. To prevent degradation of the waters of Hams Fork from surface runoff of disturbed areas, all surface drainage from disturbed areas will be required to pass through a sedimentation pond or a series of sedimentation ponds and meet state and Environmental Protection Agency water quality standards for discharge to streams before leaving the permit area.

North Block Mitigating Measure 9. To prevent water pollution and to minimize adverse effects on plant growth and land uses, any acid-forming, toxic-forming, combustible materials or any other wastes shall be covered with a minimum of 4 feet of nontoxic and noncombustible material.

North Block Mitigating Measure 10. To limit soil loss from water erosion, the lessee's mining and reclamation plan must include design and construction standards comparable to those of BLM on all required water spreaders, culverts, retention structures, dams, settling ponds, and water drainage controls. Review of these plans will be made by a qualified BLM engineer prior to approval of mine plans.

North Block Mitigating Measure 11. Several types of air quality control measures are possible to help prevent the generation of fugitive dust. The application of water to unpaved roadways is the most common method for dust control and has already been included as a design control measure in the analysis of the proposed actions. Several other control measures are available, some of which have a definite quantitative efficiency and others which are common sense measures and cannot be assessed quantitatively.

In general, fugitive dust can be controlled by watering at transfer points, such as conveyor ends or loading stations. The efficiency of this measure is dependent on the frequency of water applications, an excess of which could create the obvious safety hazards of mud on nonlevel surfaces. Hoods, connected to a ventilation and dust collection system, over sources such as crushers or sorters limit emissions from mechanical handling of coal. General cleanliness and the prevention of spills also help to reduce the amount of fugitive dust. The emissions from the above sources, however, do not contribute to ambient concentrations of total suspended particulates (TSP) as significantly as emissions from overburden removal, travel on unpaved roads, and wind erosion.

Control of fugitive dust emissions from overburden removal is not feasible due to the continuous exposure of dry subsurface material. Control of fugitive dust emissions from travel on unpaved roads is possible with several measures. Watering, with an approximate efficiency of 50%, has already been included in the design plans. Paving, or treatment with chemical stabilizers which approximate paving, could reduce fugitive dust emissions from these sources by an additional 35%. This will result in a significant reduction in cumulative regional concentrations of TSP.

Travel on unpaved roads accounts for 69% of the predicted total fugitive dust emissions from proposed mining in 1980, 59% in 1985, and 58% in 1990. Paving and chemical stabilization of unpaved access and haul roads, therefore, could reduce mine-related TSP impact on a regional basis by approximately 48% in 1980, 41% in 1985, and 40% in 1990. In lieu of paving or chemical stabilization, control of vehicular speeds can also reduce fugitive dust emissions from travel on unpaved roads. Limiting vehicular speed to 15 mph will reduce emissions by 44%, and a limit of 10 mph will reduce emissions by as much as 75%.

As shown in the preceding paragraphs, best management practices were not necessarily included in the air quality impact analysis. Only those mitigating measures discussed in the mining and reclamation plans on file with the USGS at the beginning of this rewrite were included in the modeling. In any event, the worst case mine situation is discussed, and best management practices will produce fewer and less intense impacts. It was not possible to include best management practices in Chapter 3, because the suggestions came in too late for modeling to be done, and, if included now, would negate the continuity of the present analysis. Chapter 8 contains an air quality alternative which discusses the best management practice impacts.

Right-of-Way

Bureau of Land Management

North Block Mitigating Measure 12. Visual intrusions from cuts and fills for roads, railroads, and other rights-of-way would create moderate and strong contrasts to the elements of line, form, color, and texture. The lessee will follow natural contours insofar as practicable when constructing these facilities to reduce the number of cuts and fills.

ANALYSIS OF EFFECTIVENESS

North Block Mitigating Measure 1. Uninventoried cultural resources in unsurveyed portions of the project area could be destroyed. The measure will eliminate losses of uninventoried surface sites in these areas.

North Block Mitigating Measure 2. Cultural resources would be lost to pothunting and vandalism due to increased population. The measure will reduce the possibility of additional loss.

North Block Mitigating Measure 3. Subsurface archeological sites would be destroyed by mining and associated surface disturbing activities. The measure will reduce the loss of subsurface sites.

North Block Mitigating Measure 4. Paleontological losses would occur from the destruction, disturbance, or removal of fossil materials as a result of coal mining activities, unauthorized collection, and vandalism. This measure will reduce the loss of paleontological resources by an undetermined amount.

North Block Mitigating Measure 5. This measure would enhance the return of premine habitat values and wildlife species; however, data are not available which would allow quantification of effectiveness.

North Block Mitigating Measure 6. Soil mixing and leaching of salts or trace metals into potential surface and ground water sources could impact reclamation efforts. These measures will identify the toxic and marginal materials and aid in reducing reclamation losses from salts or trace metals.

North Block Mitigating Measure 7. The proposed mining could degrade the Hams Fork drainage (believed to be an alluvial valley floor). This measure will ensure adequate data gathering needed to develop standards that would protect the Hams Fork drainage.

North Block Mitigating Measure 8. Degradation of the water of Hams Fork will occur from surface runoff of disturbed areas. This measure would be 80% effective.

North Block Mitigating Measure 9. Water pollution and adverse effects on plant growth and land uses from acid forming, toxic forming, combustible materials, and (or) any other wastes could occur. This measure will be 90% effective.

North Block Mitigating Measure 10. Excessive soil loss from water erosion could occur without adequate design for water retention and control. This measure will be 90% effective.

North Block Mitigating Measure 11. Several types of air quality control measures are possible to help prevent the generation of fugitive dust. The application of water to unpaved roadways is the most common method for dust control and has already been included as a design control measure in the analysis of the proposed actions. Several other control measures are available, some of which have a definite quantitative efficiency and others which are common sense measures and cannot be assessed quantitatively.

In general, fugitive dust can be controlled by watering at transfer points, such as conveyor ends or loading stations. The efficiency of this measure is dependent on the frequency of water applications, an excess of which could create the obvious safety hazards of mud on nonleval surfaces. Hoods, connected to a ventilation and dust collection system, over sources such as crushers or sorters limit emissions from mechanical handling of coal. General cleanliness and the prevention of spills also help to reduce the amount of fugitive dust. The emissions from the above sources, however, do not contribute to ambient concentrations of TSP as significantly as emissions from overburden removal, travel on unpaved roads, and wind erosion.

Control of fugitive dust emissions from overburden removal is not feasible due to the continuous exposure of dry subsurface material. Control of fugitive dust emissions from travel on unpaved roads is possible with several measures. Watering, with an approximate efficiency of 50%, has already been included in the design plans. Paving, or treatment with chemical stabilizers which approximate paving, could reduce fugitive dust emissions from these sources by an additional 70%. This will result in a significant reduction in cumulative regional concentrations of TSP.

Travel on unpaved roads accounts for 69% of the predicted total fugitive dust emissions from the proposed mining in 1980, 59% in 1985, and 58% in 1990. Paving and chemical stabilization of unpaved access and haul roads, therefore, could reduce mine-related TSP impact on a regional basis by approximately 48% in 1980, 41% in 1985, and 40% in 1990. In lieu of paving or chemical stabilization, control of vehicular speeds can also reduce fugitive dust emissions from travel on unpaved roads. Limiting vehicular speed to 15 mph will reduce emissions by 44%, and a limit of 10 mph will reduce emissions by as much as 75%.

North Block Mitigating Measure 12. Visual intrusions from cuts and fills for roads, railroads, and other rights-of-way would create moderate and strong contrasts to the elements of line, form, color, and texture. This measure will reduce the impacts created by the roads, railroads, and other rights-of-way from moderate and strong to weak and moderate, meeting visual resource management objectives for Class III.

Mitigating measures not included in the proposed action are summarized in Table NB4-1.

MONITORING, RESEARCH, AND STUDY PROGRAMS

In order to develop a base for future mine impact analyses, the operators will be required to provide a monitoring program both upstream and downstream from the project area for measuring runoff, chemical quality, trace metals, and sediment yield from any stream leaving the project area.

A representative of BLM will annually inspect livestock grazing areas adjacent to mining operations (1) to determine if such operations are affecting grazing patterns of the allotment, (2) to determine if any range overuse is resulting from the changes in grazing patterns that may be occurring, and (3) to determine measures to be applied to correct the overuse of the range.

As reclamation is accomplished, the compliance officers (state and federal) will conduct periodic inspections of mining areas to assure that reclamation is accomplished in accordance with an approved reclamation plan.

Reclaimed areas will be jointly inspected periodically by representatives of federal and state agencies and the operator to determine areas on which reclamation is completed and acceptable and to jointly determine corrective measures to be applied on areas where reclamation efforts have proven inadequate (e.g., seeding failure).

Table NB4-1

SUMMARY TABLE

Impact	Mitigating Measures	Residual Impacts
Loss of cultural resources on uninventoried areas	North Block number 1	Some undiscovered sites could be lost.
Loss of cultural resources from pothunting and vandalism	North Block number 2	Some cultural resources would be lost.
Loss of subsurface archeological sites	North Block number 3	An unknown number of subsurface sites could be lost.
Loss of paleontological resources from unauthorized collecting and vandalism and from authorized surface and subsurface destruction, disturbance, and removal	North Block number 4	Loss of an undetermined number of fossils.
Loss of wildlife habitat and populations	North Block number 5	Reduction in time of wildlife habitat loss and wildlife population loss.
Soil mixing and leaching of salts or trace metals into potential surface and ground water sources	North Block number 6	This measure would identify 70% to 85% of toxic and marginal material and reduce reclamation losses from salts or trace metals by 30%.
Potential degradation of the Hams Fork drainage	North Block number 7	This measure could be 90%-100% effective.
Degradation of the waters of Hams Fork	North Block number 8	This measure would be 80% effective.
Air, soil, and water pollution from toxic forming, acid forming and combustible materials	North Block number 9	This measure would be 90% effective.
Excessive soil loss from water erosion	North Block number 10	This measure would be 90% effective.
Degradation of air quality from fugitive dust	North Block number 11	This measure could reduce TSP impacts by 40% to 48%.
Construction of roads, railroads, and other rights-of-way create sharp contrasts in the basic elements of form, line, color, and texture	North Block number 12	This measure would reduce visual impacts from moderate and strong to weak and moderate.

CHAPTER 5

ANY ADVERSE IMPACTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED

This chapter presents a summary of the residual adverse impacts that would remain after considering the mitigating measures discussed in Chapter 4.

AIR QUALITY

For the North Block Mine, no optional mitigative measures are proposed. All measures proposed in the mining plans are already included in the analysis. Therefore, all reductions in concentrations associated with mitigation have already been considered in the impacts reported in Chapter 3. Unavoidable adverse impacts are then equivalent to impacts discussed in Chapter 3.

Impacts on Air Quality

When annual average background particulate values of 16 micrograms per cubic meter ($\mu g/m^3$) for 1980 and 15 $\mu g/m^3$ for all other years are added to projected mine-related contributions, the annual primary (NAAQS) of 75 $\mu g/m^3$ is predicted to be exceeded (in the worst case) within 0, 1.0, 0.5, and 0.5 miles of the active site; and the annual Wyoming standard of 60 $\mu g/m^3$ is predicted to be exceeded within 0.5, 1, 1, and 1 mile of the active site for the years 1980, 1985, 1990, and end of mine life, respectively.

If projected mine-related 24-hour suspended particulate values and background concentrations of 49 $\mu g/m^3$ for 1980 and 46 $\mu g/m^3$ for all other years are combined, the 24-hour primary NAAQS of 260 $\mu g/m^3$ is predicted to be exceeded within 1, 1.5, 1, and 1.5 miles of the active site; and the Wyoming standard of 150 $\mu g/m^3$ is predicted to be exceeded within 1, 2, 2, and 2.5 miles of the active site for the years 1980, 1985, 1990, and end of mine life, respectively.

With the application of the 43 CFR 118 regulations, the violations of the Class I increment will not occur.

A comparison of the worst-case mine impact with Prevention of Significant Deterioration regulations indicates the annual standard would be exceeded within 1, 1.5, 1.5, and 1.5 miles; and that the 24-hour standard would be exceeded within 2, 4, 4, and 5 miles of the active site for the years 1980, 1985, 1990, and end of mine life, respectively.

Two other potential sources of significant particulate emissions are associated with the North Block Mine: blasting and coal fires. The cloud of dust produced by blasting would be short-lived, at least compared to the averaging times of the total suspended particulate standards (24 hours or greater), so that little contribution to 24-hour levels would be measured outside the mine site. Coal fires could occur in spite of mitigating measures taken to prevent them. If neglected and allowed to burn out of control for long periods, they could be a significant source of pollutants. Any fire on the site could significantly contaminate the air and cause a safety hazard. However, due to a high degree of fire control technologies, potential fire impacts would probably be minimal.

If reclamation fails because of a natural catastrophe and the area disturbed by mining operations is not revegetated, particulate emissions could be increased over all predicted emission levels presented in this environmental statement (ES), although the magnitude of this increase is unknown.

Gaseous Pollutants

Mine-related nitrogen dioxide (NO_2) and sulfur dioxide (SO_2) emissions are expected to be insignificant, as discussed in Chapter 4 of the Regional Statement Component (Environmental Research and Technology 1978a); therefore, ambient pollutant concentrations have not been predicted.

Recent studies (U.S. Department of the Interior 1976) of the impact of vehicle emissions associated with western coal mines were reviewed to estimate the probable range of impact. Maximum predicted concentrations of carbon monoxide ranged between 0.02% and 0.44% of the standard. Maximum predicted hydrocarbon concentrations ranged between 0.88% and 3.44% of the standards. Maximum predicted nitrogen dioxide concentrations ranged between 0.6% and 3.0% of the standards. Maximum predicted concentrations of SO_2 ranged between 0.02% and 0.33% of the standards. The values represent predictions at less than one-half mile from the mines. Predictions were significantly less at further distances from the mines.

Visibility

For 1980, the visibility of an observer at 1 mile downwind would be approximately 39.9 miles, assuming a background visibility of 40 miles. In general, visibility would increase with downwind distance from the mine. At 5 miles downwind the visibility would be 39.9 miles, and at 10 miles it would reach 40 miles. The corresponding values, assuming a background visibility of 7 miles, are 7 miles, 7 miles, and 7 miles, respectively. Similar reductions in visibility would result in 1985, 1990, and end of mine life.

GEOLOGY

A nonquantifiable number of coal fires may be ignited in spite of routine precautions taken to prevent them. The emission of combustion products to the atmosphere from any accidental coal fires occurring during mining operations is discussed in the Air Quality sections of this ES.

Paleontology

Unavoidable destruction, disturbance, and removal of paleontological resources, both exposed and unexposed, would occur. The significance of this impact cannot be meaningfully assessed at present due to the lack of data and evaluatory criteria.

SOILS

The disturbance of soils on 2,181 acres proposed for mining and spoil storage is unavoidable. The removal, transporting, and mixing of topsoil would result in the loss of soil structure and the loss of soil biota. The removal of topsoil to an excessive depth in some areas would contaminate the topsoil with salts. The above would result in a decrease in productivity when the topsoil is used in reclamation.

Soil erosion, with associated soil loss resulting from soil moving off the area being reclaimed, would occur. The increased rate of soil erosion would be approximately 6 tons per acre per year over that of the existing environment. Also, an accelerated rate of wind erosion would occur over areas disturbed by mining and areas being reclaimed prior to the reestablishment of a vegetative cover. The increase in soil loss (in suspension) by wind erosion over the current rate would be approximately 240 tons per year. Some soil compaction would occur with machinery traffic during reclamation. This would result in a decrease in soil productivity. Approximately 100 acres of soil surface would be lost for vegetative production as a result of the construction of housing and support facilities associated with the increase in population created by mining.

Overall soil productivity of the disturbed areas (2,181 acres) when used in revegetation would decrease temporarily as a result of the mining action. This short-term decrease in soil productivity is unavoidable.

If floods were to occur when areas are in the process of being reclaimed, accelerated erosion would occur. This would result in large amounts of soil loss and could considerably lengthen the time required for vegetation reestablishment.

WATER RESOURCES

Ground Water

Locally lowered water levels in the Adaville Formation would not recover, because the highwalls and pits would not be completely refilled.

Surface Water

Sediment from the terraced open pits would be washed downstream in indeterminate quantity to Hams Fork impacting the trout fishery. If detention ponds are designed to hold flow and sediment from a 10-year storm event, the probably that their capacity to retain runoff and sediment would be exceeded over a 35-year mine life is 97½%.

VEGETATION

Terrestrial

Changes in plant species composition, cover, and density would be unavoidable if mining is approved. Mining would disturb about 2,561 acres and would require short- and long-term losses of vegetation on 2,536 and 55 acres (water impoundments), respectively. An average of 69 acres would be disturbed annually.

Population increases due to mining would result in the loss of vegetation on an estimated 100 acres used for housing and support facilities. Increased numbers of people in the area would result in additional disturbance of native vegetation, particularly by off-road vehicle use (see Recreational Resources section).

Revegetated areas would have a general appearance of grassland. Grasses would be the most common forage class, with shrubs and forbs being reduced in density and cover as compared to premined conditions.

Natural plant succession would occur on reclaimed lands and could restore approximate premined plant cover and composition values in an estimated 30 to 50 years as suggested by Cook (Vories ed. 1976).

The short- and long-term losses of vegetative cover and production on disturbed areas would affect numerous living organisms and their nonliving environment (see Air Quality, Soils, Fish and Wildlife, Visual Resources, Recreational Resources, and Agriculture sections in this chapter).

Aquatic

Storms exceeding sedimentation pond design requirements could result in an indeterminate increase in sediment transport into Hams Fork (a productive trout fishery). Additional sediment loads would raise turbidity levels. Turbidity excludes sunlight, which is necessary for submergent plant growth. Submergent plants tend to stablize silt bars and create important shelter for trout (Banks et al. 1974) (see Soils, Water Resources, and Fish and Wildlife sections).

FISH AND WILDLIFE

Wildlife habitat, carrying capacity and populations would be lost on 410, 1,371, 1,646, and 2,591 acres by 1980, 1985, 1990, and end of mine life, respectively, as a direct result of mining. Wildlife habitat, carrying capacity and populations would be adversely affected (area of influence) on 1,845, 6,170, 7,407, and 11,660 acres by 1980, 1985, 1990, and end of mine life, respectively.

Specific habitat losses would be 2,591 acres of sage grouse and mule deer summer range and 216 acres of moose crucial winter/yearlong range by the end of mine life. These acreages represent about 0.4% of the summer range available for sage grouse and mule deer in their respective management units and about 0.2% of the crucial winter/yearlong range available in the herd unit for moose.

Loss of wildlife populations would be estimated at 650, 6,100, 12,600, and 70,000 small nongame birds; 20, 70, 90, and 500 sage grouse; 135,000, 1,263,000, 2,617,000, and 13,699,000 small nongame mammals; 13, 43, 57, and 285 mule deer; and 3,400, 18,300, 22,000, and 140,000 reptiles and amphibians by 1980, 1985, 1990, and end of mine life, respectively. Losses to moose would be estimated at 40 by the end of mine life.

All of the above estimates include the progeny which would have been produced had mining not occurred.

The end of mine life population losses for sage grouse, mule deer, and moose would represent about 0.6%, .1%, and .5%, respectively, of the total population production of their particular management units by the end of mine life.

Reclamation, if successful, would mitigate some of the above losses. Quantification of such mitigation, however, is not possible with current knowledge and available information.

The habitat and population losses would be of major significance to localized populations, but, when compared to total habitat and populations within the region or herd/management unit, they would be of minor significance when based upon percentages alone.

Although it may appear that losses are of minor significance, the projected losses of populations and habitat, could, in some instances, be of critical importance to wildlife. Current data are insufficient to throughly analyze the effects of each individual habitat or population loss.

CULTURAL RESOURCES

The destruction of buried archeological sites by mining and related surface disturbing activities would probably be partially mitigated. Mitigation success would depend on such factors as successfully predicting areas of likely buried sites and the possibility of them being destroyed as a result of not being recognized. The destruction of buried sites could have a significant impact, because, if they exist, they could be important to understanding the prehistory of the region or the nation.

The archeological resources within the project area would be affected by increased pothunting and vandalism regardless of the mitigating measures that would be applied. Pothunting of archeological sites could remove important surface indications of significant buried sites. This would reduce the chances of such sites being discovered and contributing important information to the prehistory of the region.

VISUAL RESOURCES

None of the adverse visual impacts from mining of coal could be totally mitigated during active mining operations. The actual mining operations, pits, spoil piles, and topsoil storage would change the characteristic landscape in the mining area. The change in the visual qualities would drastically change the area, and the Visual Resource Management Classes would change to Class V. These impacts to form, color, and texture would be highly visible until vegetation is successfully reestablished. After reclamation there would remain changes in the characteristic landscape which would lower the scenic quality of the area. This would in turn mean the highest visual class objective achievable would be Class IV until the area is successfully revegetated. Then the area would return to the visual classes that existed prior to mining.

RECREATIONAL RESOURCES

Recreational access would remain blocked during mining in the North Block area eliminating recreation use on site at first. Access restrictions would affect fishing, hunting, sightseeing, and off-road vehicle travel. As the mine becomes developed, people would come to the area to view the mining activities.

Increased population would result in increased recreational use demand throughout the southwestern Wyoming region. This increased use would result in lowering the quality of the existing "primitive"recreational experience. Also, due to increased use in the region, ranchers would restrict access across their private lands. The recreation facilities in Kemmerer would become more crowded.

Visitor Use Data

The estimated resident recreation use demand change due to the proposed action would account for approximately 2.4%, 5.6%, and 6.2% of the total recreational use demand in Lincoln County by 1980, 1985, and 1990, respectively.

AGRICULTURE

Mining would cause a cumulative loss of animal unit months (AUMs) within the Quaken Asp Canyon and Airport grazing allotments. Cumulative estimated losses in AUMs would be 103, 921, 1,766, 6,507, and 7,407 by 1980, 1985, 1990, 2017 (end of mine life), and 2021 (end of reclamation), respectively.

The Quaken Asp Canyon grazing allotment would lose about 3,373 AUMs (an average of about 77 AUMs per year for 44 years) or about 9% of the AUMs which would be available without mining.

About 4,034 AUMs would be lost from the Airport grazing allotment. This would amount to 9% of the AUMs which would be available without mining, or an average of about 92 AUMs per year for 44 years. An additional 6% of the AUMs which would be available without mining, would be lost (an average of about 58 AUMs per year for 23 years) if the Twin Creek mining operation is conducted.

The one livestock operator licensed to graze livestock within the Quaken Asp Canyon allotment and the two operators licensed within the Airport allotment could probably adjust their operations to the losses of AUMs with minimal impact. The Quaken Asp Canyon AUM losses would effect the relocation or reduction of about 4.6% of 700 sheep. The Airport allotment provides but 3.5% of the AUMs needed by one operator for a 1,100 head sheep operation and 1.3% of the AUMs needed by another operator for a 450 head cattle operation.

The proposed North Block and Twin Creek mining activities could require periodic adjustments in the routes used for the trailing of 28,000 sheep across the Airport allotment for the purpose of changing summer/winter range use. Additional supplemental feed would need to be fed the sheep during trailing operations.

MINERAL RESOURCES

The mining and removal of coal would have an unavoidable adverse effect on the coal beds, coal resources, and coal reserves in that deposits of a nonrenewable mineral commodity would be depleted. Based on company plans, an estimated 54 million tons of coal from public and private lands would have been mined by 2016, which comprises less than 4% of the estimated economically recoverable strippable coal reserves thus far identified in Sweetwater, Lincoln, and Uinta Counties. Loss of minor amounts of coal in mining, loading, and transportation operations is unavoidable.

An unknown quantity of coal in the overburden and (or) interburden would be lost. This coal would be in seams too thin or of too low a quality to be of economic interest.

TRANSPORTATION NETWORKS

There would be an increased use of highways and other transportation facilities in the area due to increased population and mining activities. The estimated increase in vehicle license tab sales in Lincoln County due to the North Block Mine would be 3% between 1978 and 1980 and 6% between 1980 and 1990. The increased use may not change the traffic accident rate, but there would be an increase in the number of accidents due to the increased numbers of miles traveled.

There would be a need to relocate BLM road 04211 as coal mining would destroy the existing road. Some private roads in the region would be closed as ranchers limit access across their private land.

SOCIOECONOMIC CONDITIONS

Population

There would be an unavoidable increase in the population of that portion of Lincoln County within the ES region and the Kemmerer/Diamondville area if the North Block Mine is approved, constructed, and goes into production. Table NB5-15A shows the population increases that would result because of the mine; the increases would not be significant except during the 1978 to 1980 period.

Social Conditions

The increase in population could, however, have some minor indirect impacts on Lincoln County. The most evident of these would be the additional pressures on public services and facilities. More crowded conditions would require more police and fire protection; construction of additional access routes; improved or expanded sewer and water systems; and expanded medical, social, and mental services.

Table NB5-15A

PROJECTED POPULATION INCREASES CAUSED
BY THE NORTH BLOCK MINE
(LINCOLN COUNTY)

	1980	1985	1990
Lincoln County	195	419	477
Kemmerer/Diamondville	183	410	441
Balance of county	12	9	36

Source: Abt Associates 1978.

CHAPTER 6

THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The mining of 54 million tons of coal would result in short-term (a period beginning with on-site construction and ending with post-mining reclamation) and long-term (a period beginning after post-mining reclamation) losses or alterations of natural resources and the human environment.

In the short term there would be:

1. A reduction in air quality and visibility by fugitive dust and, to a much lesser extent, vehicular emissions.
2. Increased soil erosion and lowered soil productivity on about 2,181 acres.
3. The loss of an estimated 7,407 animal unit months (AUMs) due to the removal of native vegetation (does not include 100 acres of housing for which AUM data are unavailable).
4. Loss of wildlife habitat, carrying capacity and populations on 410, 1,371, 1,646, and 2,571 acres by 1980, 1985, 1990, and end of mine life, respectively, as a direct result of mining and an adverse effect (area of influence) on 1,845, 6,170, 7,407, and 11,660 acres by 1980, 1985, 1990, and end of mine life, respectively.
5. Loss of 650, 6,100, 12,600, and 70,000 small nongame birds; 20, 70, 90, and 500 sage grouse; 135,000, 1,263,000, 2,617,000, and 13,699,000 small nongame mammals; 13, 43, 57, and 285 mule deer; and 3,400, 18,300, 22,000, and 140,000 reptiles and amphibians by 1980, 1985, 1990, and end of mine life, respectively.
6. Loss of 40 moose by the end of mine life.
7. The destruction of an unquantifiable number of nonrenewable cultural resources.
8. A reduction from Visual Resource Management Classes II, III, and IV to Class V.
9. A lowering in the "primitive"quality of recreational experience due to increased population.
10. Impeded traffic movement due to increased number of vehicles.
11. A disruption of social order due to rapid population growth and subsequent changes in community structure.
12. A local lowering of the ground water level in the Adaville Formation.
13. An increase in employment opportunities and total earned income within Lincoln County.

Residual effects of mining on long-term productivity would be:

1. A loss of soil and vegetative productivity on about 100 acres planned for housing.
2. The destruction of an unquantifiable number of nonrenewable cultural resources.
3. The degradation of Visual Resource Management Classes II and III to Class IV.
4. A lowering in the "primitive"quality of recreational experiences due to increased population.
5. A local lowering of the ground water level in the Adaville Formation.
6. Impacts to an undetermined number of uninventoried exposed and unexposed fossil localities.
7. A gain in knowledge of paleontological resources due to surveys and exposure of resources which might never have been found without excavation.

CHAPTER 7

ANY IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED

Approximately 54 million tons of coal would be produced by the North Block Mine. About 6 million tons of coal would be lost and unrecoverable due to current mining methods. An unknown quantity in the overburden and (or) interburden would be lost. This coal would be in seams too thin or of too low a quality to be of economic interest.

Energy, in the forms of petroleum products and electricity, would be expended to obtain the coal. Some materials used in manufacturing mining machinery and buildings would not be recycled and thus would be lost.

Most of the air quality impacts associated with the North Block Mine would be reversed when the land is reclaimed and returned to an equivalent of the preexisting vegetative cover and general contours. The only long-term air quality impacts anticipated are those resulting from continued use of unpaved access roads after the project has been completed or halted. Since use of these roads could be stopped by blocking access or reclaiming roadbeds, no irreversible air quality impacts are predicted.

Irretrievable air quality impacts would occur. The loss of good air quality for the period of the project cannot be retrieved. During the life of the project, total suspended particulate standards may be exceeded and visibility slightly reduced in the immediate vicinity of the project.

Forage (about 7,407 animal unit months) for livestock would be lost.

Impacts would occur to an undetermined number of uninventoried exposed and unexposed fossil localities.

Wildlife habitat, carrying capacity, and populations would be lost on 410, 1,371, 1,646, and 2,591 acres by 1980, 1985, 1990, and end of mine life, respectively, as a direct result of mining. Wildlife habitat, carrying capacity, and populations would be adversely affected (area of influence) on 1,845, 6,170, 7,407, and 11,660 acres by 1980, 1985, 1990, and end of mine life, respectively.

Loss of wildlife populations would be estimated at 650, 6,100, 12,600, and 70,000 small nongame birds; 20, 70, 90, and 500 sage grouse; 135,000, 1,263,000, 2,617,000, and 13,699,000 small nongame mammals; 10, 33, 40, and 220 mule deer; and 3,400, 18,300, 22,000, and 140,000 reptiles and amphibians by 1980, 1985, 1990, and end of mine life, respectively.

Losses to moose would be estimated at 40 by the end of mine life. All the above estimates include the progeny which would have been produced had mining not occurred.

Cultural resources of unknown quality and quantity would be inadvertently destroyed.

Visual resource values would be altered; Class IV would be the highest attainable Visual Resource Management class after reclamation.

CHAPTER 8

ALTERNATIVES TO THE PROPOSED ACTION

The USGS has accepted the North Block mining and reclamation plan as adequate for environmental review and subsequent approval under 30 CFR 211 of May 1976. The Secretary's actions may be approval as proposed, rejection on various environmental or other grounds, approval in part and rejection in part, or approval subject to such additional conditions and requirements or modifications as he may impose under existing law and regulations. He may also defer decision pending submittal of additional data, compilation of required studies, or for other specific reasons.

Even after a mining and reclamation plan is approved, the regulations and lease terms require that all subsequently proposed departures and deviations therefrom be approved in advance by the Secretary. The regulations (30 CFR 211 and 700) permit the Secretary to direct that changes be made in previously approved operations. For example, changes could be ordered to accommodate new, improved, or revised administrative requirements, technological improvements, environmental concerns or requirements, or revisions of prior evaluations thereof in the light of experience or previously unknown factors.

NO ACTION

The no-action alternative includes analysis of impacts that will occur if the mining and reclamation plan and associated rights-of-way are not approved. Without mining and reclamation plan approval there will not be any environmental impacts on the leased land.

Coal from the proposed North Block Mine is presently committed to supply the proposed expansions of the Naughton Electrical Generation Power Plant (Units 4 and 5) south of Kemmerer. Without the North Block Mine other coal will have to be acquired to supply the Naughton generation plant. Such a substitution could create a shortage for other coal markets in Idaho, Oregon, and (or) Washington. If the alternate coal source were of a higher sulphur content, lower air quality from the Naughton Plant would be expected.

Both adverse and beneficial impacts will occur to paleontological resources in approximate proportion to the level of regional development and the area disturbed.

Under the no-action alternative, increased recreational use will still occur in all activities due to population increases associated with all development (Table NB8-1). The increased use will basically lower the "primitive"-quality of the recreational experience which is common to the area around the proposed North Block Mine. As a result of increased use, there will be increased recreation maintenance and cleanup costs. There will also be conflicts between local ranchers and recreationists which could result in ranchers restricting access across their private lands.

The population of the Kemmerer/Diamondville area will increase to 3,996 in 1980, decrease to 3,648 in 1985, and increase to 3,706 in 1990. Lincoln County total employment will increase to 4,110 jobs in 1980, decrease to 3,731 in 1985, increase to 3,797 in 1990. Personal earned income in the county will increase to $57.7 million in 1980, $61.6 million in 1985, and $73.1 million in 1990.

AIR QUALITY

Best Management Practices

Impact Alternative

This alternative contains recommendations which, if implemented, would reduce some of the major impacts described in Chapters 3 through 7. Bese management practices could include the following:

1. mulching and furrowing in the spring followed by fall planting differs significantly from the one-step fall planting process analyzed in Chapter 3. This measure alone could reduce total emissions from the mine by 31% to 63% depending on the year (Table NB8-2);
2. chemical stabilization of the haul roads could reduce haul road impacts by an additional 25% over that of watering the roads;
3. paving or an equivalent stabilization of all access roads could reduce access road impacts by 85% over that of unpaved access roads;
4. use of negative pressure bag houses or an equivalent method at all coal dump locations (truck to crusher and silo to railroad car) could reduce these impacts by 95% if properly engineered; and
5. the use of conveyor and transfer point coverings and, where necessary, water sprays could reduce these emissions by 75%.

Table NB8-2 is a comparison of the Chapter 3 total TSP emissions with those of best management practice emissions. About a 50% to 71% reduction in total TSP emissions is possible; however, between 31% and 63% of the reduction results from more effective management of disturbed soil during the dry summer months (mulching and furrowing). The other recommendations reduce total

Table NB8-1

COMPARISON OF IMPACTS OF NO-ACTION ALTERNATIVE AND PROPOSED ACTION IN VISITOR USE DAYS

Element and Components	1977	1980 No Action	1980 Total Projection With Proposal	1985 No Action	1985 Total Projection With Proposal	1990 No Action	1990 Total Projection With Proposal
Fishing	29,800	33,200	34,030	30,800	32,620	31,700	33,790
General[1]	29,200	32,500	33,310	30,800	32,620	32,000	34,110
Hunting	9,400	10,200	10,460	9,300	9,850	9,400	10,020
Off-road vehicle[2]	1,200	1,300	1,330	1,200	1,270	1,200	1,280
Sightseeing	9,100	10,000	10,250	9,400	9,950	9,700	10,340
Urban	18,400	21,200	21,730	21,200	22,450	22,600	24,090
Water sports	13,800	15,600	15,990	15,100	15,990	15,900	16,950
Winter sports	3,700	4,400	4,510	4,500	4,770	4,900	5,220

Note: Visitor Use Day equals 12 hours.

1 General includes camping, picnicking, etc.

2 Estimate by ES team Outdoor Recreation Planner.

Table NB8-2

COMPARISON OF CHAPTER 3 TOTAL TSP EMISSION IMPACTS
TO THOSE OF THE BEST MANAGEMENT PRACTICE ALTERNATIVE
TOTAL TSP EMISSION IMPACTS

Year	Total TSP Chapter 3 Emissions (tons/yr)	Total TSP Best Management Practice Emissions (tons/yr)	Reduction in Emissions (%)	Reduction due only to mulching and furrowing in the spring and planting in the fall (%)
1980	334	96	71	63
1985	1022	504	51	31
1990	931	424	54	34
End of Mine Life	1366	682	50	35

emissions by 8% to 20%, depending on the year analyzed.

FISH AND WILDLIFE MITIGATION ALTERNATIVE

This alternative lists recommendations which, if implemented, would greatly reduce or totally eliminate the major impacts to existing fish and wildlife resources described in Chapters 3 and 5 through 7 by enhancement of the wildlife habitat and carrying capacities of those lands adjacent to the proposed mining operations or on nearby off-site locations.

1. That all mining areas be reclaimed to wildlife habitat (Table NB8- 3as soon as possible or feasible. Reclamation would be in conformance to the post-mining land use set out in BLM's land use plans for the area. Vegetative planting and reclamation should be accomplished in consultation with the Wyoming Game and Fish Department, Wyoming Department of Environmental Quality, and U.S. Fish and Wildlife Service. The goal of reclamation should be to achieve the highest possible wildlife carrying capacity at the earliest possible date, regardless of cost. All possible tools to achieve this goal should be implemented as needed.

2. That approximately 2,600 acres of public land lying in immediate association with the proposed North Block mining area or on nearby off-site locations be set aside as a mitigation area and managed intensively for fish and wildlife resources. Selection of this mitigation area should be accomplished in consultation with the Wyoming Game and Fish Department and the U.S. Fish and Wildlife Service.

3. That the mitigation area be managed to increase its wildlife carrying capacity by at least 50%. Management tools such as water development, fertilization, vegetative manipulation, spraying, transplanting, seeding, protection of wildlife cover, and management of livestock grazing to enhance wildlife habitat should be implemented as necessary. The habitat of this mitigation area should be managed by BLM and the wildlife by the Wyoming Game and Fish Department.

4. That the mine permit will not be granted on land critical to the bald and golden eagle's ecological requirements. A qualified team of biologists from the Fish and Wildlife Service, Wyoming Game and Fish Department, and the Bureau of Land Management will judge and recommend the areas to be excluded from mining. Mine permits may be granted for these areas if regulations are adopted that provide for substitute mining practices, buffer zones, prey base, and alternate nest sites.

If this alternative is successfully implemented it is estimated that 80 to 90% of the fish and wildlife resource impacts described in Chapters 3 and 5 through 7 could be mitigated. Impacts to other resources would be the same as the proposed action.

UNDERGROUND MINING ALTERNATIVE

This alternative was not considered feasible for reasons of economy and technology. The relatively shallow overburden would not provide sufficient structural strength to maintain safe and efficient underground working conditions. The ratio of recovered coal to in-place coal would be much less than with surface mining methods.

Several coal beds within the proposed North Block Mine attain a thickness of 40 feet. Assuming that a 10 foot section could be mined safely by underground methods and that 40% of coal in the mined area was left in place to provide support and lessen the probability of surface subsidence, coal extracted would represent about 10% of the available coal in place. This rate compares to an expected recovery of 90% to 95% of the available coal in place using surface mining methods.

DIFFERENT UTILIZATION

Offsite Markets

To supply coal to other off site electrical-power generating plants would have the effect of transferring transportation and other end-use impacts elsewhere. Under this alternative a railroad spur would be constructed to the Oregon Shortline which is immediately south of the project area. Coal would be transported by rail to markets projected in the Pacific Northwest. The railroad spur would require approximately 54 acres for construction and right-of-way which would be equal to the area of land disturbed by the conveyor and tram road proposed in the mining plan. Impacts resulting from construction and use of the rail spur would, for all practical purposes, be the same as those impacts which have been described heretofore in the statement. The impacts associated with mining and reclamation would remain the same if the proposed production rate were not increased. If increased, the severity of these would also be increased.

Table NB8-3

RECOMMENDED VEGETATION FOR RECLAMATION OF NORTH BLOCK MINE

	Forbs		Shrubs[1]		Grasses or Grasslikes
1.	Wildbuckwheat (Eriogonum spp.)	1.	Fourwing saltbush (Atriplex canescens)	1.	Letterman needlegrass (Stipa Lettermanii)
2.	Fleabane (Erigeron spp.)	2.	Snowberry (Symphoricarpus spp.)	2.	Basin ryegrass (Elymus cinereus)
3.	Wallflower (Erysimum spp.)	3.	Big sagebrush (Artemisia tridentata)	3.	Thickspike wheatgrass (Agroypron dasystachyum)
4.	Oneflower helianthella (Helianthella uniflora)	4.	Serviceberry (Amelanchier spp.)	4.	Idaho fescue (Fescue Idahoensis)
5.	Creeping barberry (Berberis repens)	5.	Antelope bitterbrush (Purshia tridentata)	5.	Sedge (Carex spp.)
6.	Lupine (Lupinus spp.)	6.	Rabbitbrush (Chrysothamnus spp.)	6.	Bluegrass (Poa spp.)
		7.	Woods rose (Rosa woodsii)	7.	Bottlebrush squirreltail (Sitanion hystrix)

Note: Common and scientific plant names are according to Beetle 1970.

[1]At least 20% of the annual forage production should be browse.

HAMS FORK PROTECTION ALTERNATIVE

This alternative is to withdraw from surface mining and permanent overburden storage that portion of federal coal leases W-060274 and W-029513 within the area designated as Visual Management Class II (see the Visual Management classes map in the North Block Appendix) north of the intermittent stream in Sections 20 and 21.

If this alternative is approved the leaseholder would not be able to recover the coal in this area. He would have to locate other sites for permanent overburden storage sites. The Naughton Power Generation Plant, Unit 04, would have to locate another source of coal a few years sooner than is projected today (about 2015).

The water quality and fisheries habitat of Hams Fork and crucial moose habitat would not be degraded as described in the proposed action. The 600 foot diversion dam and the diversion ditch for the intermittent stream would not be constructed.

NORTH BLOCK RECLAMATION ALTERNATIVE

The mining and reclamation plan would be conditionally approved for a period of 10 years during which time a specific testing and monitoring program for the purpose of measuring revegetation success would be implemented by the coal mining company. In this alternative a plan describing the testing and monitoring program would be prepared by the Kemmerer Coal Company for approval by the regulatory authorities prior to its implementation.

If it cannot be demonstrated that revegetation can be successful commensurate with Public Law 95-87 (SMCRA) at the conclusion of the 10-year program, the Department of the Interior will revoke its approval for mining on federal lands.

Although current reclamation research indicates that successful reclamation can be achieved on semiarid coal mined lands, it is recognized that answers to reclamation problems are needed on a site-specific basis in order to ensure success.

This alternative, if implemented, would result in the gathering of data to show that lands proposed for mining are reclaimable within a reasonable period of time.

The Kemmerer Coal Company would be required, under the direction of state and federal reclamation regulatory and surface ownership agencies, to establish a suitable number of demonstration plots to provide evidence of revegetation success.

The demonstration plots would be established as soon as practicable following the authorization of the Department of the Interior to commence mining operations.

Impacts which would occur if revegetation could not be accomplished follows:

1. The mining company would be forced to shut down its operation on federal land.
2. A shut down of the mine would cause economic loss to the mining company from the sale of coal, loss of employment for most of the employees, and partial loss of investment in equipment and material needed to open and operate the mine for the 10-year period.
3. Areas disturbed (about 1,646 acres) during the 10-year period of mining would be unreclaimed or at best only partially reclaimed.
4. The consumer of coal from the mine would need to obtain coal from another source.
5. The reduction in labor force would cause socioeconomic impacts to the region.
6. In the event that mining would still occur on nonfederal lands, the above impacts would be lessened but would still be significant.

RECLAMATION METHODOLOGY ALTERNATIVE

This alternative lists recommendations which, if implemented, would reduce impacts on surface water quality (erosion) and air quality.

1. Backfilled slopes would be designed low and the length of slopes short.
2. All suitable topsoil and suitable overburden would be conserved for subsequent placement on disturbed areas.
3. Appropriate soil amendments would be used to improve soil structure.
4. Fertilization of topsoil would be done based on soil analyses.
5. All topsoiled areas would be mulched and additional organic matter added.
6. Supplemental irrigation would be employed for the first two growing seasons. Application rates would be based on soil moisture monitoring.

This alternative, if implemented, would result in the use of methodology that would enhance rapid establishment of vegetation. The vegetation would decrease soil erosion from water action and decrease the emission of dust from treated areas.

The grading of all disturbed areas to less than moderate slopes would enhance revegetation, but would result in such areas having less topographical diversity. Moderate and steeper slopes provide seasonal and (or) yearround habitat for wildlife and provide protection from storms for livestock and wildlife.

Care would need to be taken to avoid creating conditions unfavorable to native plant species proposed in seeding mixtures. Many of these species are adapted to soils with low to moderate productivity.

DEFER ACTION ALTERNATIVE

For proper cause, the Secretary may defer final action on this proposed mining and reclamation plan. This could include, but is not limited to, the need and time required for:

1. Modification of the proposal to correct specific administrative or technological deficiencies. (No need for additional changes or alternatives was identified during public review beyond those which are already presented.)

2. Redesign to reduce or avoid specific environmental impact. (No need for additional changes or alternatives was identified during the public review beyond those which are already presented.)

3. Acquisition of additional data to provide an improved basis for technical or environmental evaluation.

In the public review, several comments were received concerning the probability of successful reclamation. As a result the following alternative is presented:

Approval of the mining and reclamation plan would be deferred pending the Kemmerer Coal Company demonstrating on site that lands proposed for mining or other disturbance would be reclaimable within a reasonable period of time.

The principal effects of deferring action on the proposed mining and reclamation plan would be (a) a short-term delay, (b) presumably some reduction or avoidance of certain significant adverse impacts, (c) a better data base and subsequent analysis of specific adverse impacts, (d) economic loss to Kemmerer Coal Company from delay of approval, and (e) the market for which Kemmerer Coal Company has proposed to deliver coal would need to find another source of coal.

4. Further evaluation of the proposal and (or) alternatives. (No need for additional changes or alternatives was identified during the public review beyond those which are already presented.)

PREVENT (FURTHER) DEVELOPMENT ON THE LEASE ALTERNATIVE

The Secretary may reject any individual proposed activity that does not meet the requirements of applicable law and regulations under his authority, including the potential for environmental impact that could be reduced or avoided by adoption of a significantly different designed course of action by the lessee (operator). This may be accomplished by suspension of operations (if ongoing), cancellation of the lease (if environmentally acceptable development is not possible), federal acquisition of the lease, or rejection of the mining and reclamation plan. (No need for additional changes or alternatives was identified during public review beyond those which are already presented.)

RESTRICT DEVELOPMENT ON THE LEASE ALTERNATIVE

This alternative could be applied to all or a portion of the lease, as appropriate. The subject lease conveys the right to develop, produce, and market the federal coal resource if all other terms and conditions are met by the lessee. Various measures that may tend to restrict development may be taken by the Secretary at any time in the interest of conservation of the resources or in the protection of various specific environmental values in accordance with existing laws and regulations; for example, the National Historic Preservation Act of 1966, the Endangered Species Act of 1973, the Surface Mining Control and Reclamation Act of 1977, etc. (No need for additional changes or alternatives was identified during public review beyond those which are already presented.)

ALLOW DEVELOPMENT OF SELECTED AREAS NOW UNDER LEASE

This alternative would permit only selective exploration and development of existing leaseholds based on anticipated adverse environmental consequences. The decision maker has the authority and responsibility to evaluate the coal resources and impacts of mining on these leases prior to acting on the proposals. Exploration and development could be allowed only on those leaseholds, or portions thereof, that would have the lowest anticipated adverse environmental consequences. Weighing the tradeoffs of mining or precluding mining on selected tracts is part of the evaluation and decision process. Adoption of this alternative would reduce adverse effects by reducing the area in which the impacting activities could take place. (No need for additional changes or alternatives was identified during public review beyond those which are already presented.)

CHAPTER 9

CONSULTATION AND COORDINATION

See the Regional Environmental Statement (ES) for a description of the consultation and coordination efforts involved in the preparation of the ES.

NORTH BLOCK SITE SPECIFIC APPENDIX

SOIL ASSOCIATION MAPPING UNIT DESCRIPTIONS

A description of each soil association mapping unit within the North Block project area follows. These descriptions and Table NBA-1 are intended for use with the North Block soils map found in Chapter 2.

207—Floodplains

These soils occupy nearly level floodplains along Hams Fork and have developed from alluvial deposits. They are deep, well drained loams. About 40% of the soils are calcareous.

216—Gravelly Terraces, Gently Sloping and Sloping

This soil consists of well-drained loams and clay loams with very gravelly and cobbly substrata on nearly level to sloping terraces. The soil is deep and has formed an old alluvium.

218—Alluval Fans, Coarse Soils, Sloping

The majority of these soils are fine sandy loams (calcareous) occupying gently sloping alluvial fans. They are deep and well drained. Of the remaining soils, around 30% are moderately deep, well drained loams. The rest are shallow, well drained calcareous silty clays underlain by shale and fine sandy loams underlain by sandstone.

221—Terrace Escarpments, Gently Sloping to Steep

Forty percent of the mapping unit is Terrace Escarpment which consists of gravelly and cobbly alluvium on edges and faces of old high terraces. Another 40% consists of very shallow, well drained clay loams that have developed over sedimentary rock. The remaining are moderately deep to deep, well drained loams and clay loams. Rock outcrop occupies about 10% of the association. Dominant vegetation is sagebrush.

231—Residual Uplands, Shallow Clayey Soils, Moderately Steep and Steep

Soils of this unit occupy steep slopes, are shallow to very shallow, and have developed over sandstone and shale. They are well drained, silty clays over shale and fine sandy loams over sandstone. About 10% of the mapping unit is Terrace Escarpment land type and about 10% is rock outcrop. Dominant vegetation is sagebrush.

232—Residual Uplands, Clayey Soils, Rolling

The majority of these soils (60%) are very shallow, well drained and occupy gently sloping to sloping uplands. They are clay loams that have developed over calcareous sedimentary rocks. The remaining soils (30%) of the association are silty clay loams that have developed over calcareous shales. Also, there are silty clay soils (10%) in the association that have developed from alluvium.

Table NBA-1

SOIL ASSOCIATION CHARACTERISTICS

Map Unit No.	Map Unit Name[1]	% of Map Unit	Subgroup	Family	Effective Root Depth	Soil Reaction (pH)	Natural Soil Drainage	Potential Runoff	Permea-bility	Available Water Capacity
207	Floodplains	60	Aquic Fluventic Haplaborolls	Fine-loamy, mixed	20-40	7.9-8.4	Poor	Low	Moderate	Moderate
		40	Typic Ustifluvent	Coarse-loamy, mixed (calcareous) frigid	20-40	7.4-8.4	Poor	Low	Mod.-Rapid	Moderate
216	Gravelly terraces, gently sloping and sloping	100	Borollic Haplargids	Fine-loamy, mixed	20-40	7.4-9.0	Well	Low	Moderate	Moderate
218	Alluvial fans, coarse soils, sloping	50	Typic Ustifluvents	Coarse-loamy, mixed (calcareous) frigid	20-40	7.4-8.4	Well	Low	Mod.-Rapid	Moderate
		30	Aridic Argiborolls	Loamy-skeletal, mixed	20-40	7.4-8.4	Well	Moderate	Moderate	Low
		10	Lithic Ustic Torriorthents	Loamy-skeletal, mixed (calcareous), frigid	<10	7.9-8.4	Well	Moderate	Mod.-Rapid	Very Low
		10	Ustic Torriorthents	Clayey, montmorillonitic	10-20	7.9-9.0	Well	High	Slow	Very Low
221	Terrace escarpments, gently sloping to steep	40	Terrace Escarpments land type							
		30	Ustic Torriorthents	Loamy, mixed (calcareous), frigid, shallow	<10	8.2-8.4	Excessive	Low	Slow	Very Low
		15	Aridic Argiborolls	Loamy-skeletal, mixed	20-40	7.4-8.4	Well	Moderate	Moderate	Low
		10	Rock Outcrop (Sandstone and Shale)							
		5	Borrollic Haplargids	Fine-loamy, mixed	20-40	7.4-9.0	Well	Moderate	Moderate	Moderate
231	Residual uplands, shallow clayey soils, moderately steep and steep	40	Ustic Torriorthents	Clayey, montmorillonitic (calcareous), frigid shallow	10-20	7.9-9.0	Well	High	Slow	Very Low
		40	Lithic Ustic Torriorthents	Loamy-skeletal, mixed (calcareous), frigid	<10	7.9-8.4	Well	Moderate	Mod.-Rapid	Very Low
		10	Terrace Escarpments land type							
		10	Rock Outcrop (Sandstone and Shale)							

Table NBA-1

SOIL ASSOCIATION CHARACTERISTICS
(Continued)

Map Unit No.	Map Unit Name[1]	% of Map Unit	Subgroup	Family	Effective Root Depth	Soil Reaction (pH)	Natural Soil Drainage	Potential Runoff	Permea-bility	Available Water Capacity
232	Residual uplands clayey soils, rolling	60	Ustic Torriorthents	Loamy, mixed (calcareous) frigid, shallow	<10	8.2-8.4	Excessive	Low	Slow	Very Low
		30	Borollic Camborthids	Fine, montmorillonitic	10-20	7.9-9.0	Well	Moderate	Slow	Low
		10	Ustic Torriorthents	Fine, montmorillonitic	10-20	8.5-9.2	Well-Mod. Well	Moderate	Slow	Moderate

Note: Table derived from information obtained from contract with U.S. Department of Agriculture, Soil Conservation Service (1977).

[1]Unit names were derived from geomorphic setting of the soil.

Permeability

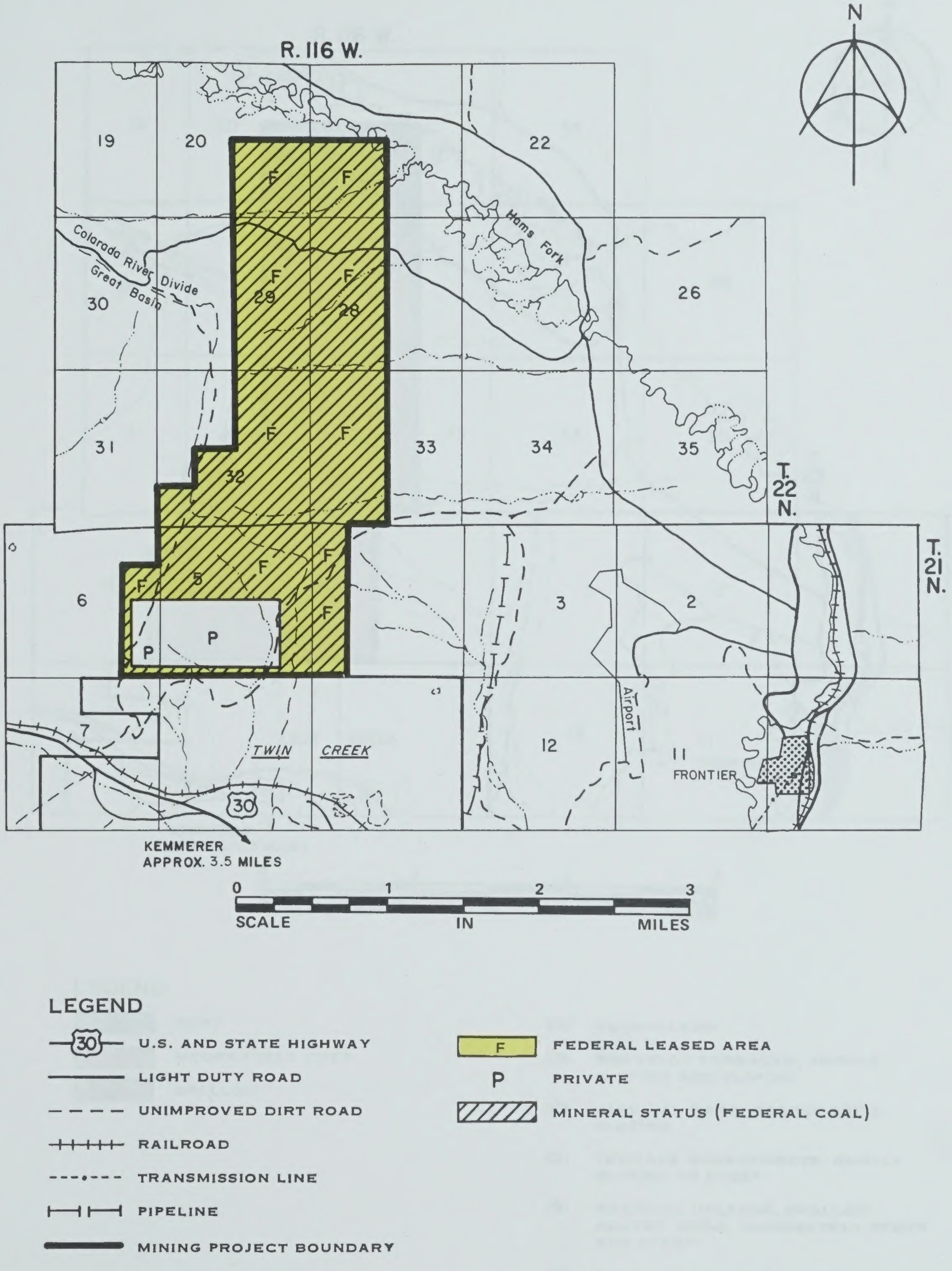
In/Hour		Class
0.06		Very Slow
0.06	0.2	Slow
0.2	0.6	Mod. Slow
0.6	2.0	Moderate
2.0	6.0	Mod. Rapid
6.0	20	Rapid
20+		Very Rapid

Available Water Capacity

In/60" Profile*		Class
0	3	Very Low
3	6	Low
6	9	Moderate
9	12	High
12+		Very High

*or to limiting layer

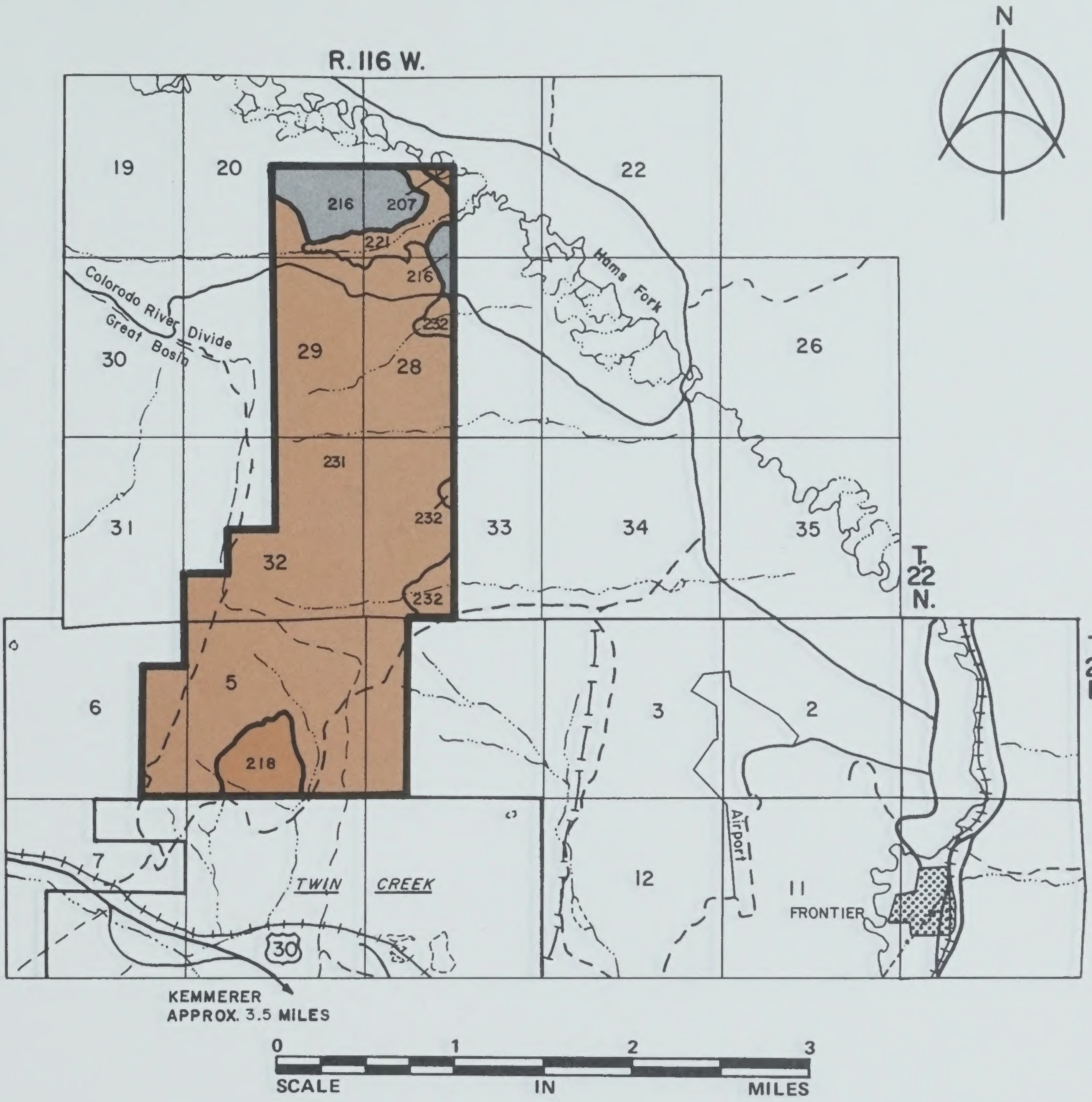
Note: Classes derived from "Supplement to Guide to Authors of Published Survey," TSC Transm. Sheet L1-1, U.S. Department of Agriculture, Soil Conservation Service (1971).



Map NB1 - 1

SURFACE AND MINERAL STATUS

NORTH BLOCK



LEGEND

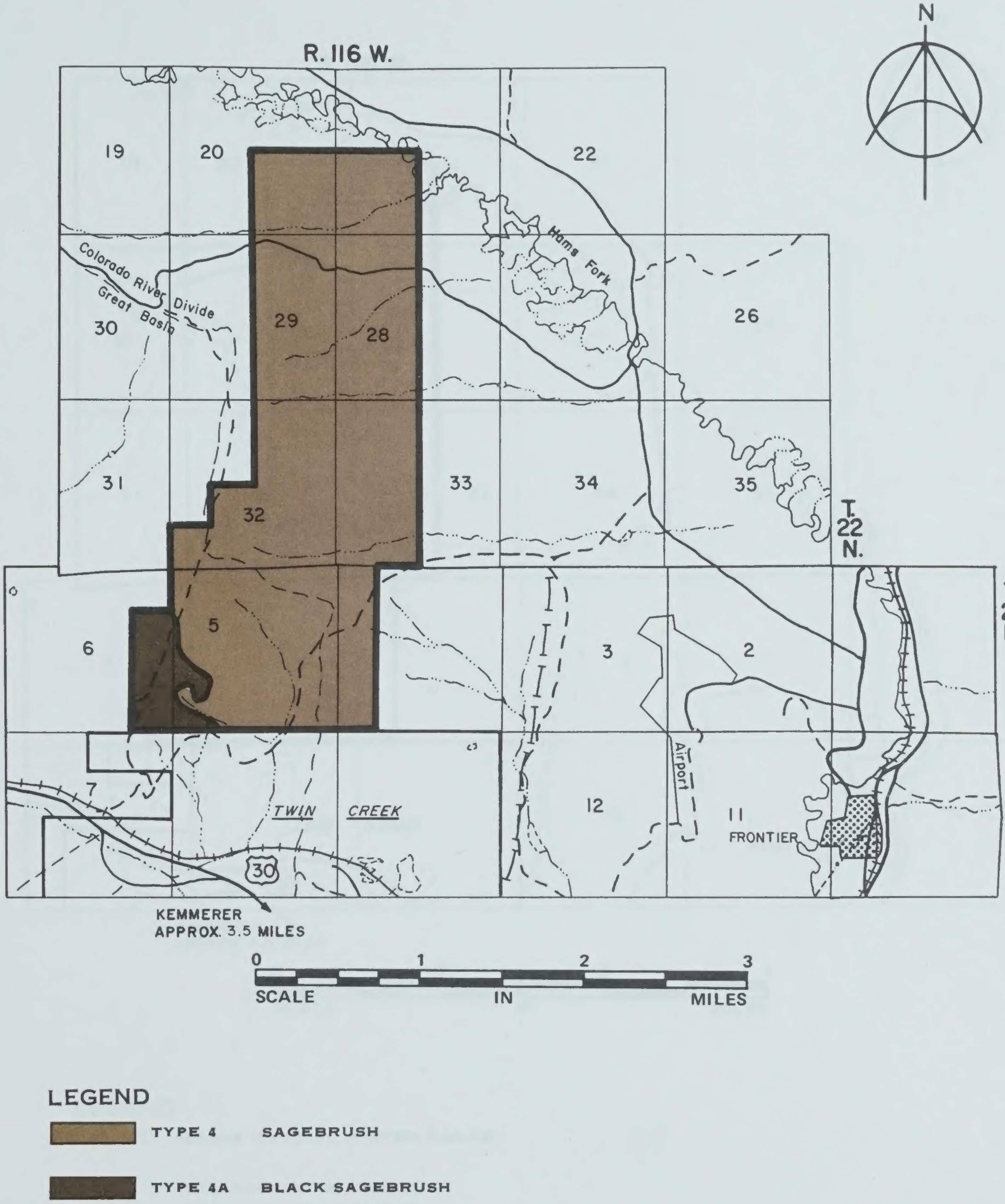
- DEEP
- MODERATELY DEEP
- SHALLOW

207	FLOODPLAINS
216	GRAVELLY TERRACES, GENTLY SLOPING AND SLOPING
218	ALLUVIAL FANS, COARSE SOILS, SLOPING
221	TERRACE ESCARPMENTS, GENTLY SLOPING TO STEEP
231	RESIDUAL UPLANDS, SHALLOW CLAYEY SOILS, MODERATELY STEEP AND STEEP
232	RESIDUAL UPLANDS, CLAYEY SOILS, ROLLING

Map NB2 - 5A

SOILS

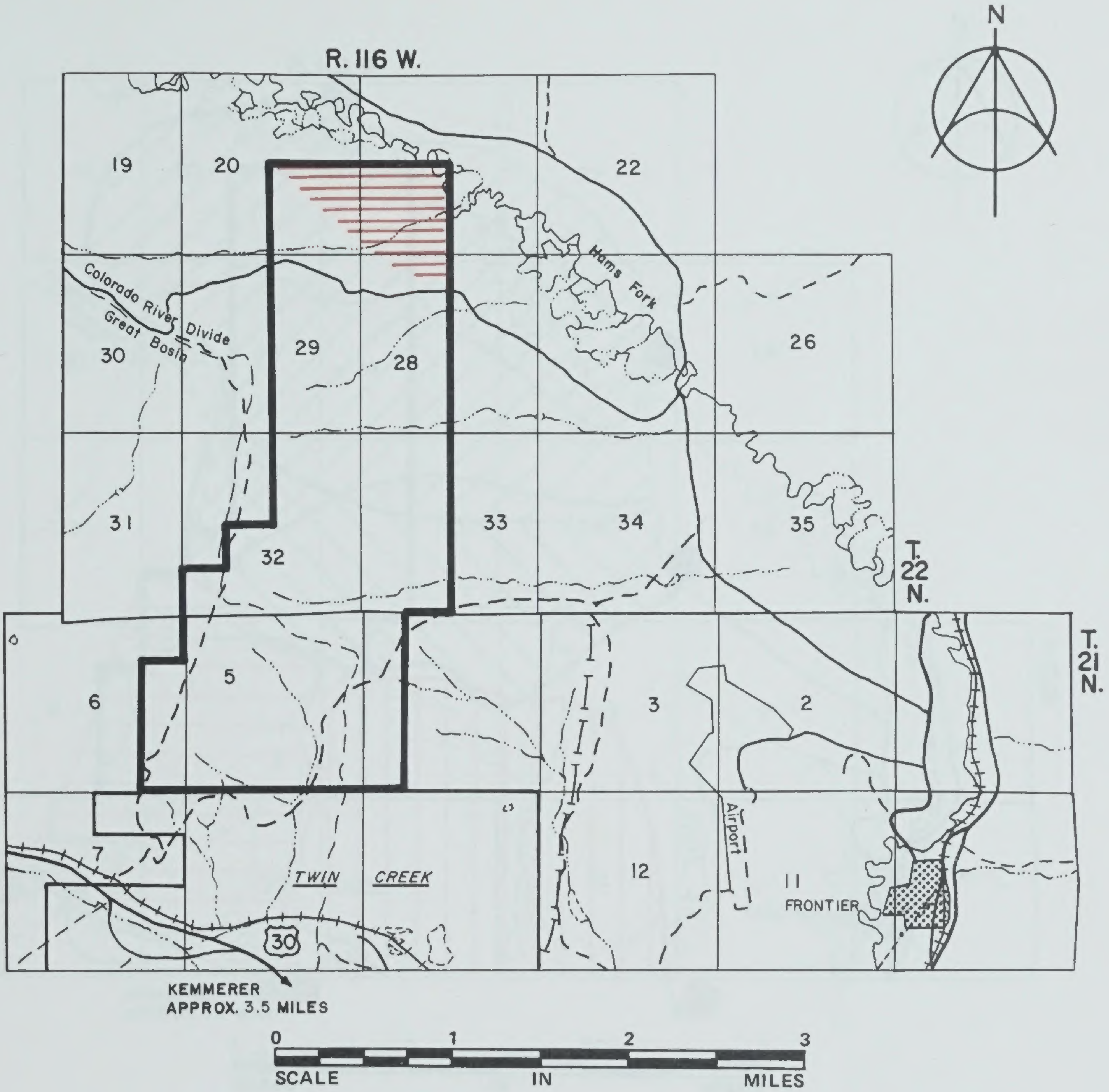
NORTH BLOCK



Map NB2 - 7A

VEGETATION TYPES

NORTH BLOCK



LEGEND

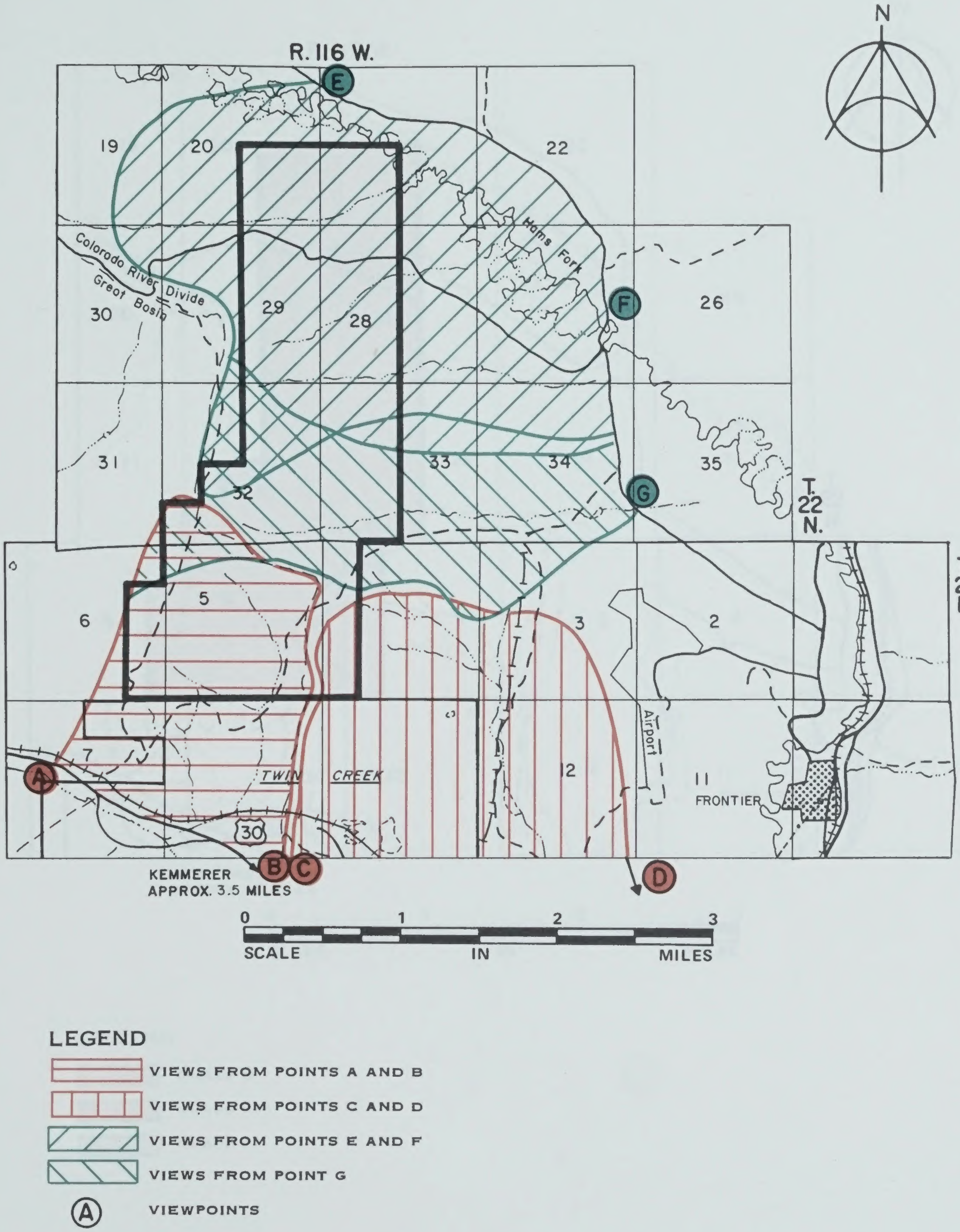
MOOSE CRUCIAL WINTER RANGE

Entire area is moose, mule deer and sage grouse summer range.

Map NB2 - 8A

ANIMAL DISTRIBUTION

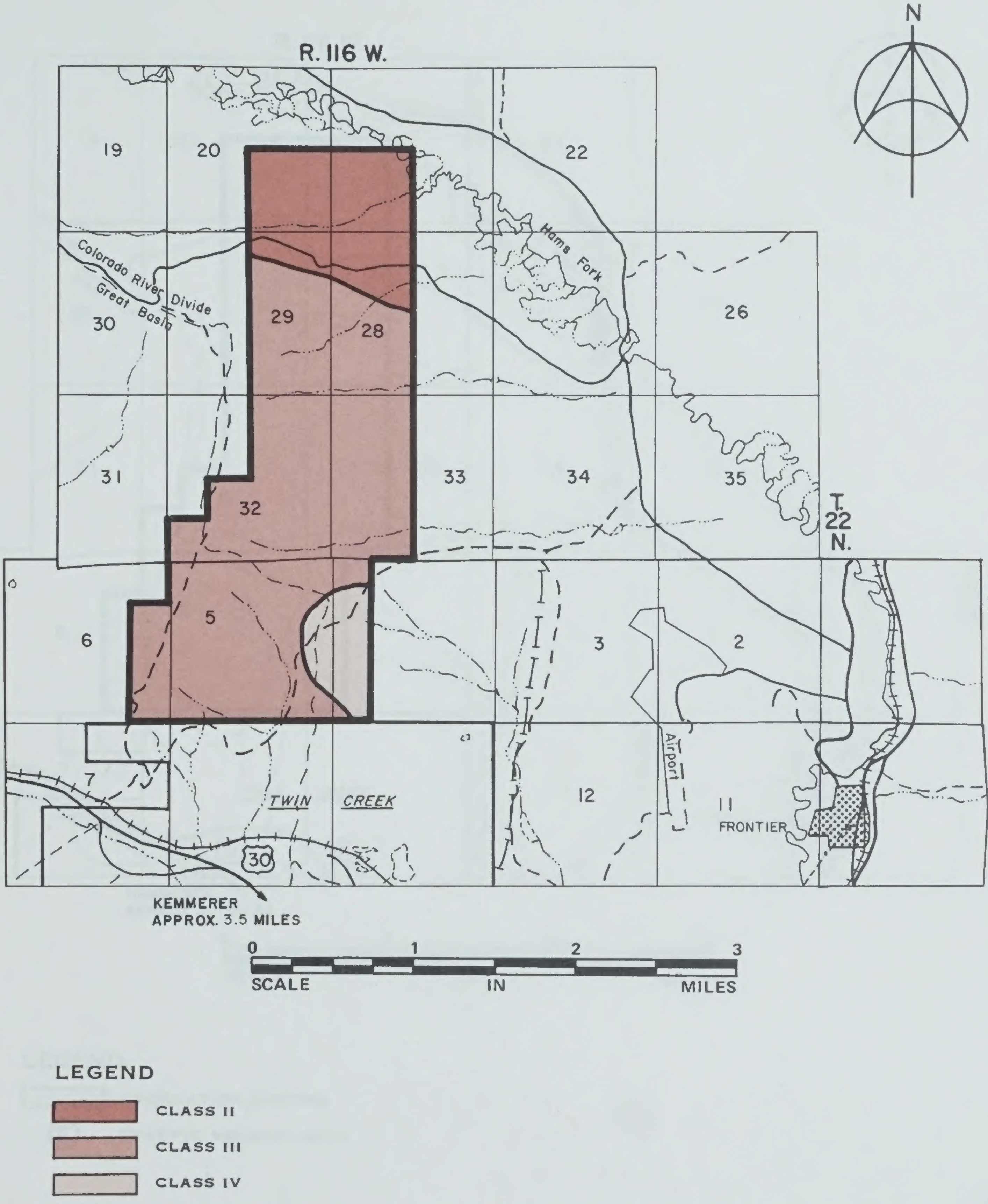
NORTH BLOCK



Map NB2 - 10A

VIEWPOINTS AND VIEWS

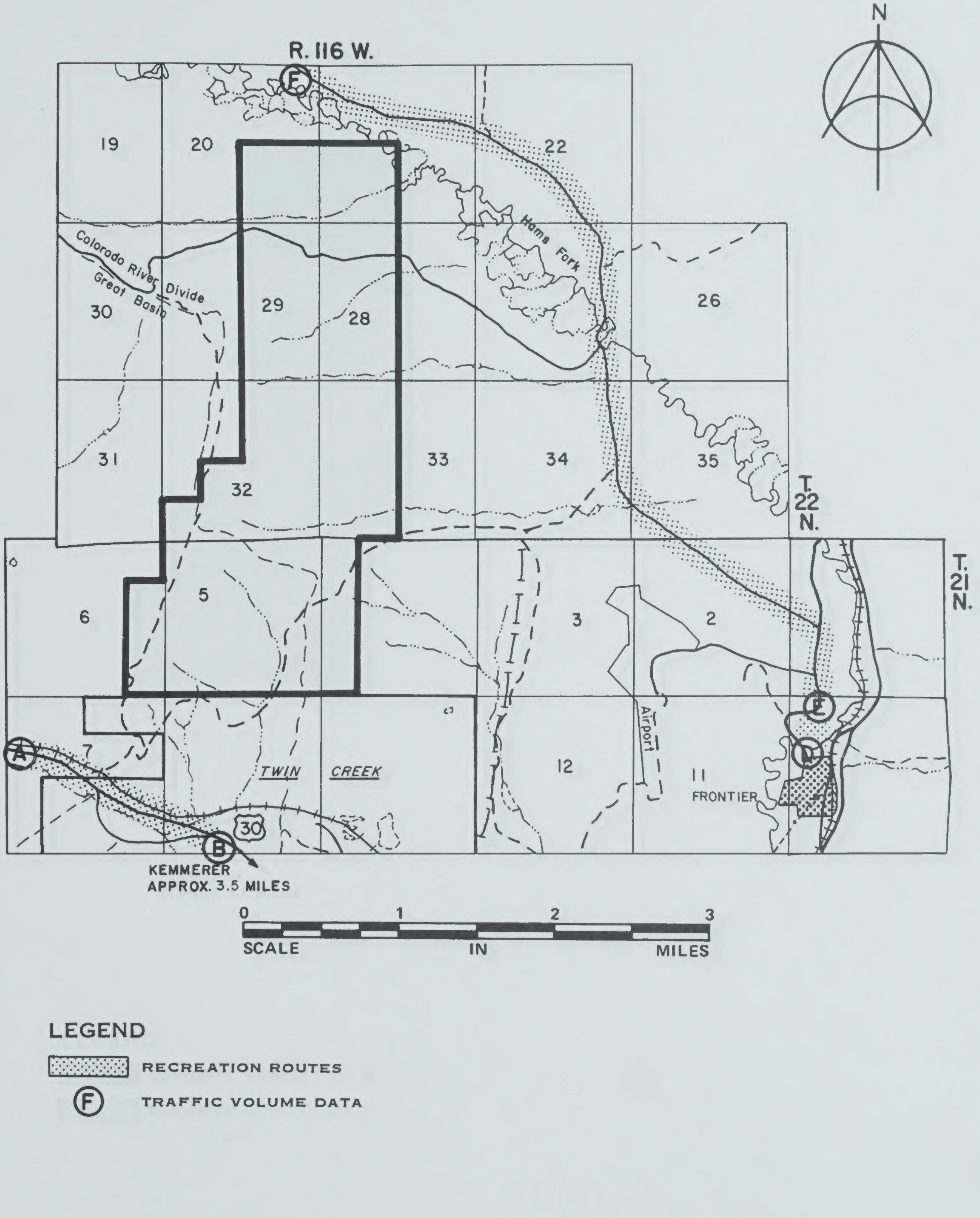
NORTH BLOCK



Map NB2 - 10B

VISUAL MANAGEMENT CLASSES

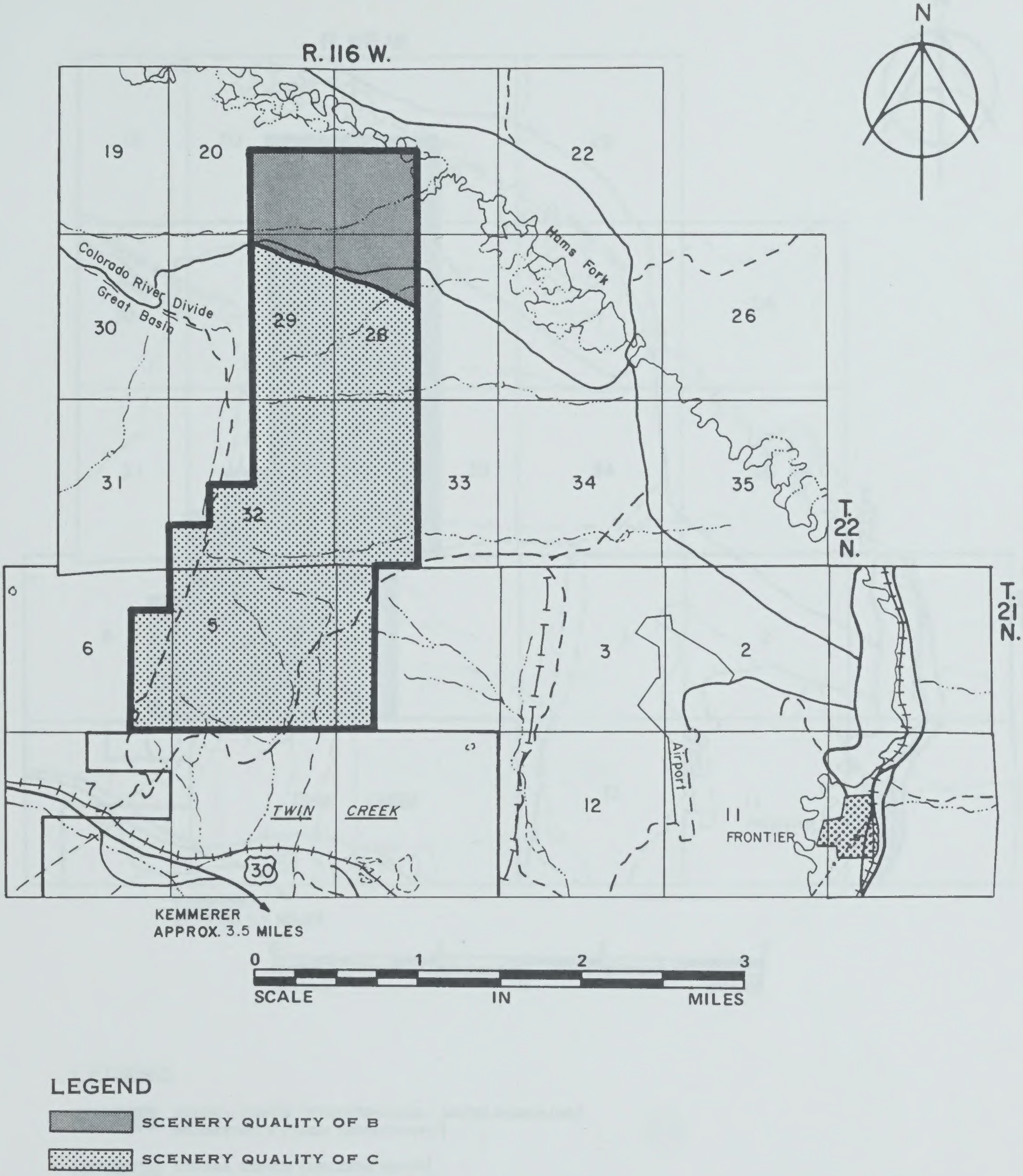
NORTH BLOCK



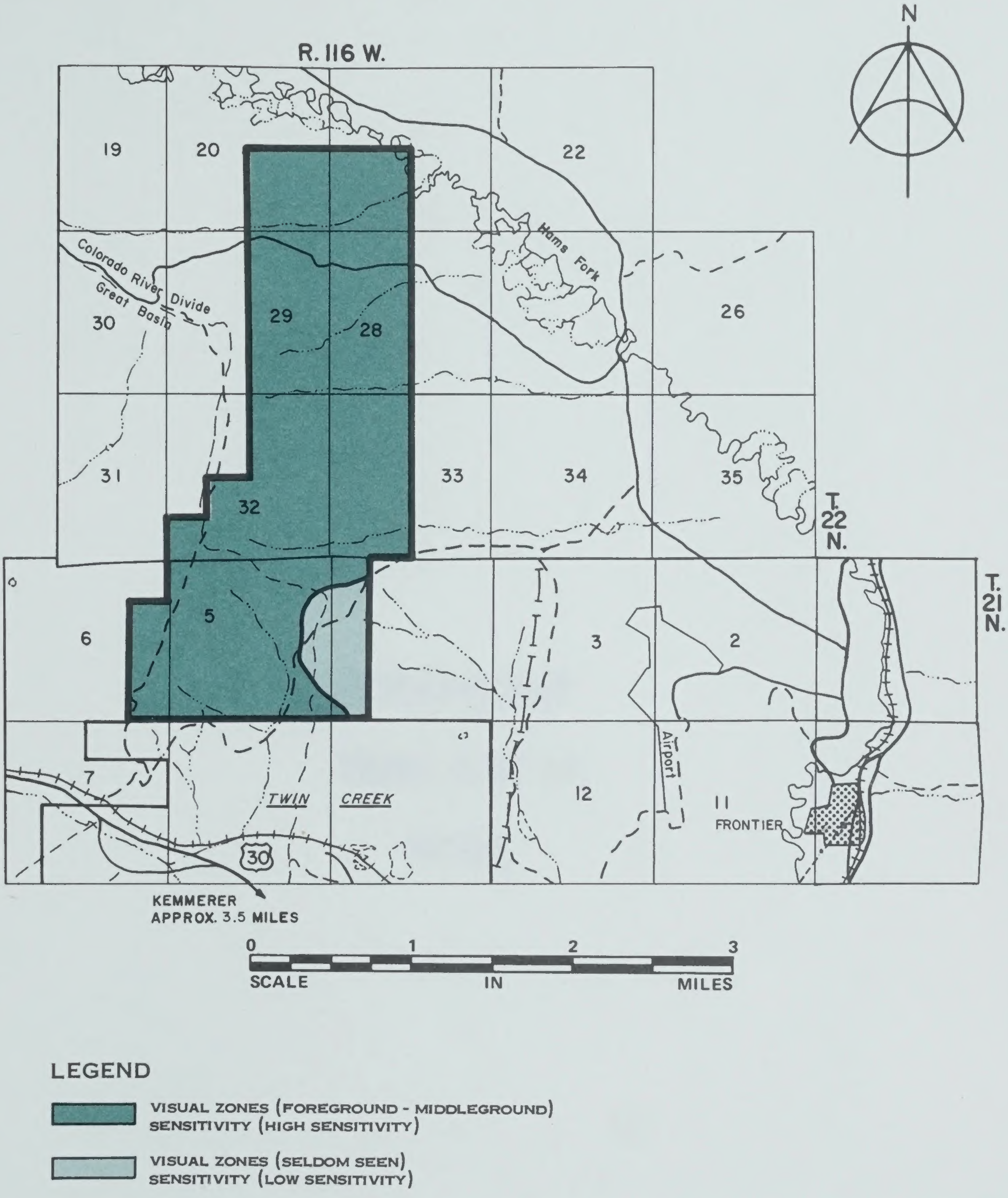
Map NB2 - 6

RECREATION TRAVEL ROUTES

NORTH BLOCK



Appendix D
SCENERY QUALITY RATINGS
NORTH BLOCK



Appendix D

VISUAL ZONES AND SENSITIVITY

NORTH BLOCK

PROPOSED

TWIN CREEK

MINE

TABLE OF CONTENTS

TWIN CREEK MINE PROPOSAL

Chapter 1	Page
DESCRIPTION OF THE PROPOSAL	TC1-1
HISTORY AND BACKGROUND	TC1-1
SURFACE MINING CONTROL AND RECLAMATION ACT	TC1-1
PROPOSED ACTION	TC1-1
Purpose and Objective	TC1-1
Location	TC1-2
Predisturbance Inventories and Analyses	TC1-2
Mine	TC1-2
Coal Quality	TC1-2
Facilities	TC1-2
Coal Mining	TC1-2
Support Facilities	TC1-6
Proposed Mine Layout and Mining Sequence	TC1-6
Mining Procedures	TC1-6
Reclamation	TC1-12
Pollution Control Methods	TC1-17
AUTHORIZING ACTIONS	TC1-17
Bureau of Land Management (BLM)	TC1-17
Geological Survey (GS)	TC1-17
Wyoming Department of Environmental Quality	TC1-17
Wyoming State Engineer	TC1-17
Wyoming Highway Department	TC1-17
INTERRELATIONSHIPS	TC1-17
Relationship to Land Use Plans	TC1-17
Relationship to Other Proposed and Future Actions	TC1-18

Chapter 2	
DESCRIPTION OF THE ENVIRONMENT	TC2-1
CLIMATE	TC2-1
Sunshine	TC2-1
Wind Fields	TC2-1
Atmospheric Temperature and Stability	TC2-1
Moisture and Evapotranspiration	TC2-1
Severe Weather Events	TC2-1
AIR QUALITY	TC2-1
GEOLOGY	TC2-2
Stratigraphy	TC2-2
Paleontology	TC2-2
Structure	TC2-2
Geologic Hazards	TC2-2
TOPOGRAPHY	TC2-2
SOILS	TC2-2
WATER RESOURCES	TC2-6
Ground Water	TC2-6
Ground Water Quality	TC2-9
Surface Water	TC2-9
Surface Water Quality	TC2-9
VEGETATION	TC2-9
FISH AND WILDLIFE	TC2-17
General Information	TC2-17
Herd Units	TC2-17
Fishery	TC2-17
Wildlife	TC2-17
Wild Horses	TC2-18
CULTURAL RESOURCES	TC2-18
Archeological	TC2-18
Historical	TC2-18
VISUAL RESOURCES	TC2-18
RECREATIONAL RESOURCES	TC2-20
Visitor Use Data	TC2-20
Hunting	TC2-20
Sightseeing	TC2-20
Specialized Activities	TC2-20
Wilderness Values	TC2-20
AGRICULTURE	TC2-20
MINERAL RESOURCES	TC2-20
LAND USE PLANS, CONTROLS, AND CONSTRAINTS	TC2-23
TRANSPORTATION NETWORKS	TC2-23
Highways	TC2-23
Railroads	TC2-23
SOCIOECONOMIC CONDITIONS	TC2-23
Population	TC2-23
Employment	TC2-27
Income	TC2-27

TABLE OF CONTENTS (Cont'd)

TWIN CREEK MINE PROPOSAL

Chapter 2 (Cont'd)	Page
Infrastructure	TC2-27
Attitudes and Expectations	TC2-31
Life Styles	TC2-31
FUTURE ENVIRONMENT	TC2-31
Chapter 3	
THE ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION	TC3-1
ASSUMPTIONS AND ANALYSIS GUIDELINES	TC3-1
Assumptions	TC3-1
Guidelines	TC3-1
AIR QUALITY	TC3-1
Emissions from the Proposed Mine	TC3-1
Impacts on Air Quality	TC3-3
Gaseous Pollutants	TC3-3
Visibility	TC3-3
GEOLOGY	TC3-10
Paleontology	TC3-10
Geologic Hazards	TC3-10
TOPOGRAPHY	TC3-10
SOILS	TC3-11
WATER RESOURCES	TC3-11
Ground Water	TC3-11
Surface Water	TC3-12
Water Uses	TC3-12
VEGETATION	TC3-12
Terrestrial	TC3-12
Aquatic	TC3-13
Endangered and Threatened	TC3-13
FISH AND WILDLIFE	TC3-13
General Information	TC3-13
Habitat Losses	TC3-17
Carrying Capacity Losses	TC3-17
Fish and Wildlife Population Loss	TC3-17
Wild Horses	TC3-19
CULTURAL RESOURCES	TC3-19
Archeological	TC3-19
Historical	TC3-20
VISUAL RESOURCES	TC3-20
Summary of Visual Contrast Ratings (Table TC3-10A)	TC3-20
RECREATIONAL RESOURCES	TC3-20
Visitor Use Data	TC3-20
Hunting	TC3-20
Sightseeing	TC3-23
Off-Road Vehicles	TC3-23
AGRICULTURE	TC3-23
Livestock Grazing	TC3-23
Prime Farmland	TC3-23
MINERAL RESOURCES	TC3-23
TRANSPORTATION NETWORKS	TC3-24
SOCIOECONOMIC CONDITIONS	TC3-24
Population	TC3-24
Employment	TC3-24
Income	TC3-24
Infrastructure	TC3-30
Education	TC3-30
Social Services and Facilities	TC3-30
Attitudes and Expectations	TC3-30
Life Styles	TC3-30

TABLE OF CONTENTS (Cont'd)

TWIN CREEK MINE PROPOSAL

Chapter 4	Page
MITIGATING MEASURES NOT INCLUDED IN THE PROPOSED ACTION	TC4-1
MEASURES	TC4-1
Mining and Reclamation Plan	TC4-1
Rights-of-Way	TC4-2
ANALYSIS OF EFFECTIVENESS	TC4-2
MONITORING, RESEARCH AND STUDY PROGRAMS	TC4-3
Chapter 5	
ANY ADVERSE IMPACTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED	TC5-1
AIR QUALITY	TC5-1
Gaseous Pollutants	TC5-1
Visibility	TC5-1
GEOLOGY	TC5-2
Paleontology	TC5-2
SOILS	TC5-2
WATER RESOURCES	TC5-2
VEGETATION	TC5-2
Terrestrial	TC5-2
FISH AND WILDLIFE	TC5-2
CULTURAL RESOURCES	TC5-2
VISUAL RESOURCES	TC5-3
RECREATIONAL RESOURCES	TC5-3
Visitor Use Data	TC5-3
AGRICULTURE	TC5-3
MINERAL RESOURCES	TC5-4
TRANSPORTATION	TC5-4
SOCIOECONOMIC CONDITIONS	TC5-4
Population	TC5-4
Social Conditions	TC5-4
Chapter 6	
THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE ENHANCEMENT OF LONG-TERM PRODUCTIVITY	TC6-1
Chapter 7	
ANY IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED	TC7-1
Chapter 8	
ALTERNATIVES TO THE PROPOSED ACTION	TC8-1
NO ACTION	TC8-1
Air Quality	TC8-1
Best Management Practices	TC8-1
FISH AND WILDLIFE MITIGATION ALTERNATIVE	TC8-4
UNDERGROUND MINING ALTERNATIVE	TC8-4
TWIN CREEK RECLAMATION ALTERNATIVE	TC8-4
RECLAMATION METHODOLOGY ALTERNATIVE	TC8-6
DEFER ACTION ALTERNATIVE	TC8-6
PREVENT (FURTHER) DEVELOPMENT ON THE LEASE ALTERNATIVE	TC8-7
RESTRICT DEVELOPMENT ON THE LEASE ALTERNATIVE	TC8-7
ALLOW DEVELOPMENT OF SELECTED AREAS NOW UNDER LEASE ALTERNATIVE	TC8-7
Chapter 9	
CONSULTATION AND COORDINATION	TC9-1
TWIN CREEK SITE SPECIFIC APPENDIX	
SOILS	TCA-1

CHAPTER 1

DESCRIPTION OF THE PROPOSAL

HISTORY AND BACKGROUND

Lands under coal lease W-075207 that are involved in this mining and reclamation plan (306 acres) are located about 3 miles west of Kemmerer, Wyoming. Kemmerer Coal Company was the successful bidder on this lease issued 2 January 1959. Rocky Mountain Energy Company and Peter Kiewit Sons' Co. jointly propose, as the Cumberland Coal Company, to exercise the option on this lease and mine the coal.

The lease with the Bureau of Land Management (BLM) is a continuing lease subject to reasonable readjustment of terms on a 20-year basis. It provides for a royalty of 17 cents a ton (2,000 pounds) for coal that is mined by open-pit methods and 15 cents a ton for coal that is mined from underground operations during the first 20 years. The annual rental is set at 25 cents per acre for the first year, 50 cents per acre for the second through the fifth year, and 1 dollar per acre for the sixth and each succeeding year during the continuance of the lease. Under Section 5 of the lease, the lessor may prescribe the steps to be taken and restoration to be made with respect to the leased lands and improvements thereon, whether or not owned by the United States. The lease is subject to provisions of all current legislation pertaining to federal coal leases.

On 1 July 1976, Cumberland Coal Company submitted a mining and reclamation plan (Rocky Mountain Energy Company 1976) in accordance with 30 Code of Federal Regulations (CFR) 211 (May 1976) to the Office of the District Mining Supervisor, U.S. Geological Survey (USGS), Rock Springs, Wyoming. The mining plan and supporting data can be reviewed by the public at that location. The plan outlines the company's proposed 16-year operation on 2,006 acres of private land and 835 acres of public land. The USGS has accepted the Twin Creek mining and reclamation plan as suitable for use in preparing an environmental statement.

The coal seams of this mine incline greater than 15 degrees and are immediately adjacent to the existing operating mine with coal seams inclining at greater than 15 degrees; therefore, the proposed Twin Creek Mine appears to qualify under Section 527 (Special Bituminous Coal Mines) of the Surface Mining Control and Reclamation Act (SMCRA) of 1977 and 30 CFR 716.4 for certain reclamation exemptions, i.e., highwalls would be allowed to remain, benches would be allowed, etc.

SURFACE MINING CONTROL AND RECLAMATION ACT

The mining and reclamation plan for this proposed project was submitted for review prior to passage of the Surface Mining Control and Reclamation Act (SMCRA) of 1977 (P.L. 95-87). Therefore, the plan may not fully reflect the requirements of the current law and regulations. However, it is believed that it presents sufficient data to permit analysis of the impacts that will be associated with mining in this area. Prior to departmental approval, the plan will be returned to the applicant for modification to incorporate the requirements of SMCRA. When the mining and reclamation plan is returned to the Department, it will be reevaluated to insure that it meets the requirements of SMCRA and appropriate federal regulations, and that the potential impacts are covered by this environmental statement. This procedure will facilitate the timely and efficient consideration of applications for permits under the evolving requirements of SMCRA. We believe this procedure is reasonable in view of the evolving character of the law.

The Regional ES, Chapter 3, Planning and Environmental Controls, includes reference to appropriate provisions of SMCRA, and these were incorporated into the following impact analysis to the extent possible at this time. However, it is realized that some of the adverse impacts described will be precluded by implementation and enforcement of the new law. This is especially true in regard to impacts on the water, soil, and vegetation resources. In any event, the worst possible case is covered.

PROPOSED ACTION

The proposed action before the federal government is to review and consider for approval the mining and reclamation plan submitted for the Twin Creek Mine and attendant rights-of-way that would permit commencement of mining operations.

Purpose and Objective

The purpose of the proposed action is to allow mining of 2.5 million tons of coal per year from 1979 through 1995 to meet part of the national energy requirements.

The objective of the proposed mining is to supply 40 million tons of coal to power plants in Idaho, Oregon, Washington, and (or) other markets which may develop in the eastern part of the United States.

Location

The Twin Creek project area, containing 2,841 acres (Table TC1-1), is located approximately 3 miles west of Kemmerer, Wyoming, on the north and south sides of U.S. Highway 30.

The project location and boundary are shown on Figure TC1-1 and Map TC1-1.

Predisturbance Inventories and Analyses

Specific inventories were conducted under the direction and (or) cooperation of the Cumberland Coal Company in consultation with the BLM concerning endangered and (or) threatened plants, archeological sites, historical sites, and paleontological locations.

Robert Dorn, BLM plant specialist, conducted an inventory of the proposed Twin Creek project area for proposed endangered and (or) threatened plant species. His inventory did not reveal the presence of any plants listed on the 1977 list of the proposed endangered and (or) threatened plant species.

The Wyoming Game and Fish Department, under contract with the BLM, collected vegetation and wildlife data within the Twin Creek project area.

M. Ann Bennet (1974 and 1975), George Zeimens (1975), and Michael D. Metcalf (1977b) conducted archeological surveys which, when combined, represent nearly 100% coverage of the project area (80 acres have not been surveyed) (see Chapter 2, Cultural Resources).

An inventory completed in 1976 for BLM by Western Interpretive Services, Inc., revealed no historical sites on the project area.

Field reconnaissance, a review of geologic and paleontological literature, and personal experience led P. O. McGrew and Thomas M. Bown (1977) to conclude that it would be extremely unlikely that fossil vertebrates would be disturbed by the Twin Creek Mine.

Analyses have been done to determine physical and chemical properties of topsoil and overburden. The analyses indicated: (1) adequate surface soil quantities and qualities for topsoil use, (2) some overburden layers with high exchangeable sodium percentage, and (3) some overburden layers with high pH.

Mine

Cumberland Coal Company proposes to open the Twin Creek Mine using conventional open-pit mining equipment. Construction at the mine is planned to start in early 1978 with 100 employees. Delivery of the first coal is scheduled for early 1979. There would be 300 permanent employees required when maximum production is reached in 1980.

Coal Quality

Coal quality is highly variable both within a single seam and between various seams. BTU values range from 9,152 to 10,367 with a weighted average of 9,958. Sulfur averages 0.82% for the total field with individual extremes of 0.3% to 3.2%. Ash averages 5.3% with a range from 2.97% to 11.96%, volatile matter averages 34.71% with a range from 31.59% to 35.68%, and carbon content averages 41.06% with a range from 37.68% to 44.30% (Rocky Mountain Energy Company 1976).

Facilities

Office and Shop

Facilities would be constructed on privately-owned land and would consist of an office building, shop, and warehouse complex covering approximately 60 acres.

One well on private land has been completed to a depth of 1,210 feet and is located in the SW¼SW¼, Section 8, T. 21 N., R. 116 W. This well yields 20 gallons per minute as artesian flow and yielded 200 gallons per minute during a 24-hour pump test. Other wells would be drilled as needed. Locations of the proposed offices and shops are shown on Map TC1-2.

Coal Mining

Topsoil would be removed with self-elevating scrapers. Overburden would be drilled and blasted in lifts for removal with 17-yard loading shovels and loaded into 120-ton rear dump trucks. Blasting would be conducted in conformance with 30 CFR 715.19 (Use of Explosives). Overburden on each bench which lies above the reach of the shovel on the dipping coal seams would be pushed by tractors to front-end loaders or loaded by backhoes from the bench above. As coal is uncovered, it would be drilled, blasted, and loaded with 18-yard front-end loaders into 50-ton trucks for hauling to the coal handling facilities at the rail loop. Other minor equipment would also be utilized including welders, compressors, pumps, and miscellaneous tools.

The coal handling facilities can be divided according to function performed as the coal is moved from the mine to rail cars for shipment.

Truck Dump and Primary Crushing Station

The coal would be hauled to the two centrally located truck dumps by end-dump trucks. The station would be sized to accommodate two trucks dumping side by side and would have at least a total surge capacity equal to approximately 3½ haul trucks. Coal would be fed out of the hopper by reciprocating feeders into the primary crusher and then onto the conveyor system. Tramp

Table TC1-1

LAND SURFACE AND COAL OWNERSHIP OF THE
PROPOSED TWIN CREEK PROJECT AREA

	Surface Acres	Coal Acres
Public	835	835
Private	2,006	1,339
State of Wyoming	0	667
Total	2,841	2,841

Note: Derived from BLM Master Title Plats.

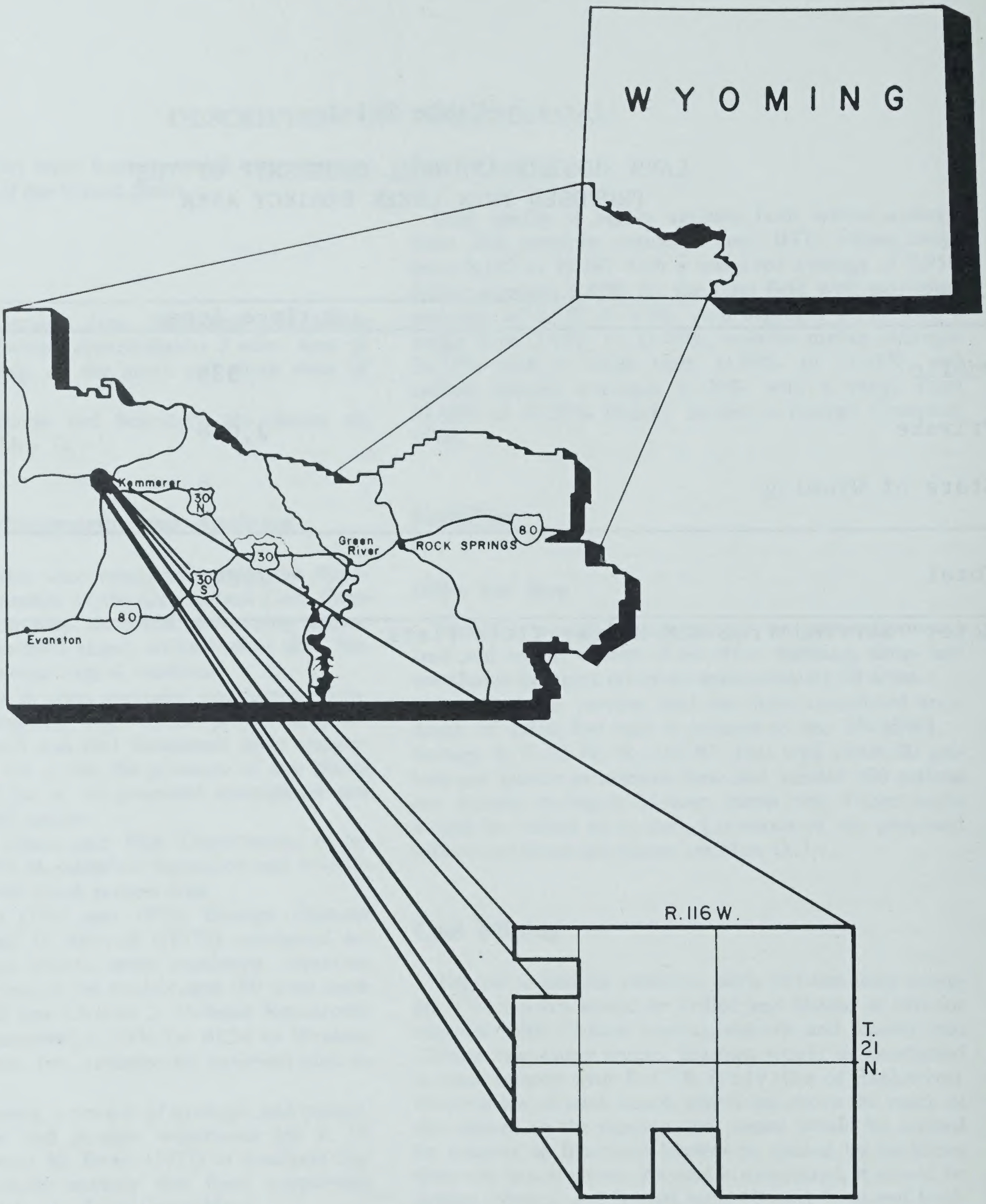
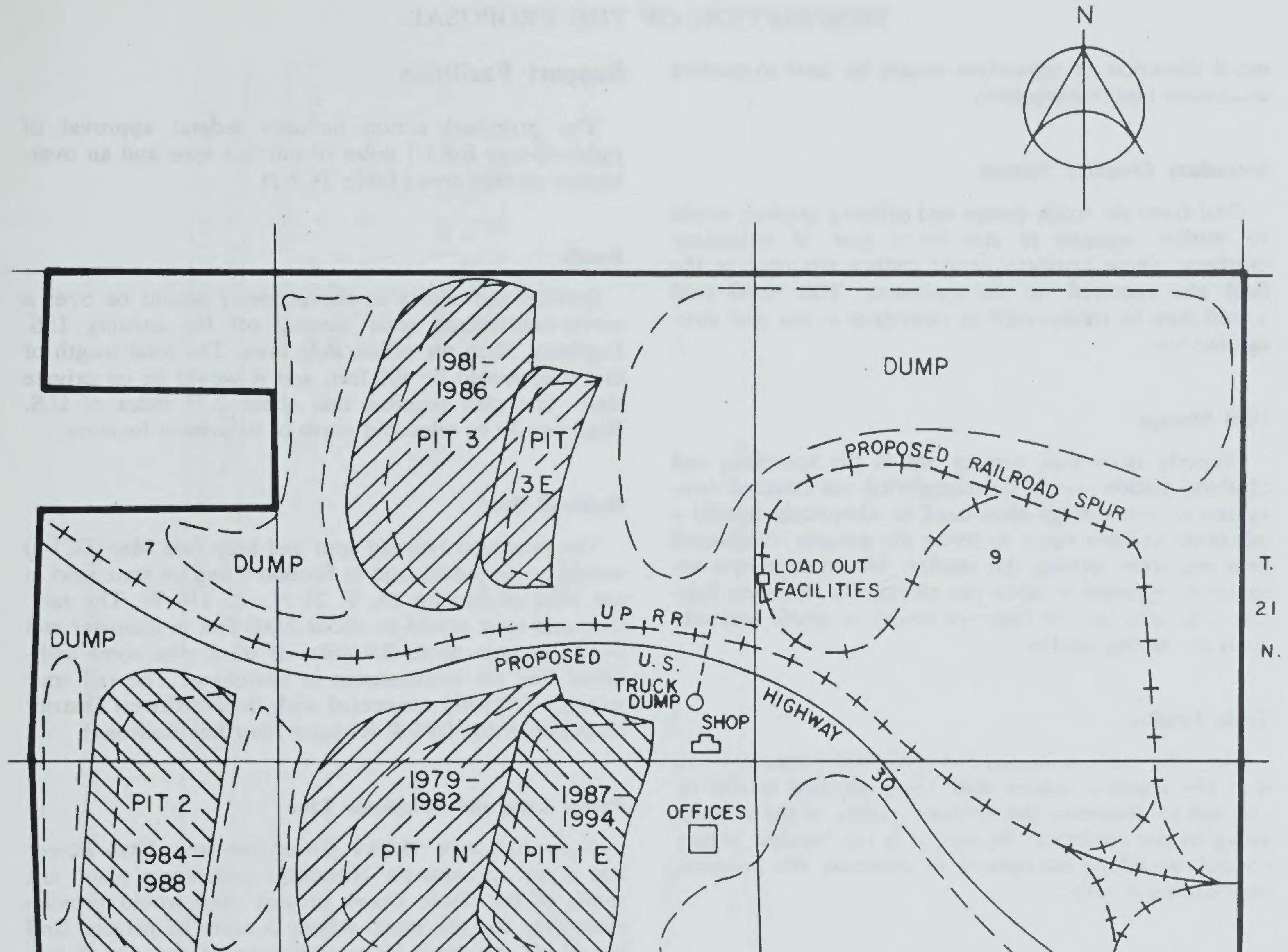


FIGURE TC 1-1

GENERAL LOCATION OF
PROPOSED TWIN CREEK PROJECT AREA



Map TC1-2
MINING SEQUENCE
TWIN CREEK

metal detection or separation would be used to protect equipment used subsequently.

Secondary Crushing Station

Coal from the truck dumps and primary crusher would be further reduced in size by a pair of secondary crushers. These crushers would reduce the coal to the final size required by the customer. This sized coal would then be transported by conveyor to the coal storage facility.

Coal Storage

Properly sized coal coming out of the screening and crushing station would be transported via covered conveyors to two storage silos sized to adequately handle a minimum volume equal to twice the amount discharged to a unit-train serving the facility. Silo storage was selected as opposed to open-pile storage to minimize fugitive coal dust and to improve ability to grade and mix coals of varying quality.

Train Loadout

The train loadout station has a twofold purpose. First, it is the location where coal being shipped would be sampled to determine the ultimate quality of the product going to the customer. Second, it is the location where control would be maintained to eliminate the potential overloading of railcars.

Conveying System

All coal movement from the truck dump to shipment in rail cars would be by the use of covered belt conveyors. All surface conveyors up through the storage belt would be 42 inches wide with the exception of the reclaim or loadout conveyor which would be 60 inches wide. Transfer points would be equipped with water spray as required.

Dust Control

The primary method to be implemented to control dust generated in the handling of coal would be the addition of water except where it would interfere with other actions such as crushing or sampling.

Haul Roads and Other Facilities

All haul roads would be designed and maintained in conformance with 30 CFR 715.17(1) to a width of 100 feet to provide for safe operation of large equipment. Drainage control measures would incorporate sound engineering practice. All water retention facilities, diversion ditches, and dams would be constructed in accordance with all applicable rules and regulations affecting such structures as found in 30 CFR 715.17.

Support Facilities

The proposed action includes federal approval of rights-of-way for 1.7 miles of railroad spur and an overburden storage area (Table TC1-2).

Roads

Service and access to the property would be over a newly-constructed road turning off the existing U.S. Highway 30 to the office/shop area. The total length of this road would be 400 feet, and it would be on private land. The plan requires that about 2.75 miles of U.S. Highway 30 be relocated north of its present location.

Railroad Spur

The proposed railroad spur and loop (see Map TC1-2) would be on public land in Section 9 and on state land in the NE¼ of Section 16, T. 21 N., R. 116 W. The rail loop and spur would be about 2,000 feet in diameter and would contain about 2.6 miles of track plus some additional line for convenience in switching. The rail spur would be directly connected with the Northwest District main line of the UPRR (Oregon Shortline Railroad).

Power Line and Telephone Line

A one-half mile 34.5-kv power line from Utah Power and Light Company's Naughton generating plant just south of the Twin Creek project area would provide electricity for the mine. About 3 acres of private land would be disturbed by construction of the power line and telephone line.

Proposed Mine Layout and Mining Sequence

Extraction of the coal reserves at the Twin Creek Mine would be from seven pits. The layout of these pits and of other pertinent features of the mine is shown on Map TC1-2.

The planned mining sequence is shown in Table TC1-3, and based on the mining sequence, the acres of land which would be disturbed are shown in Table TC1-4.

Mining Procedures

Cumberland Coal Company has chosen an open-pit, truck and shovel operation as the best mining method for maximum resource recovery of the steeply dipping coal seams on the Twin Creek project area.

Topsoil Removal and Deposition

Topsoil would be removed from all areas disturbed and would be stockpiled or placed directly in areas to be revegetated. The topsoil piles would be labeled to avoid

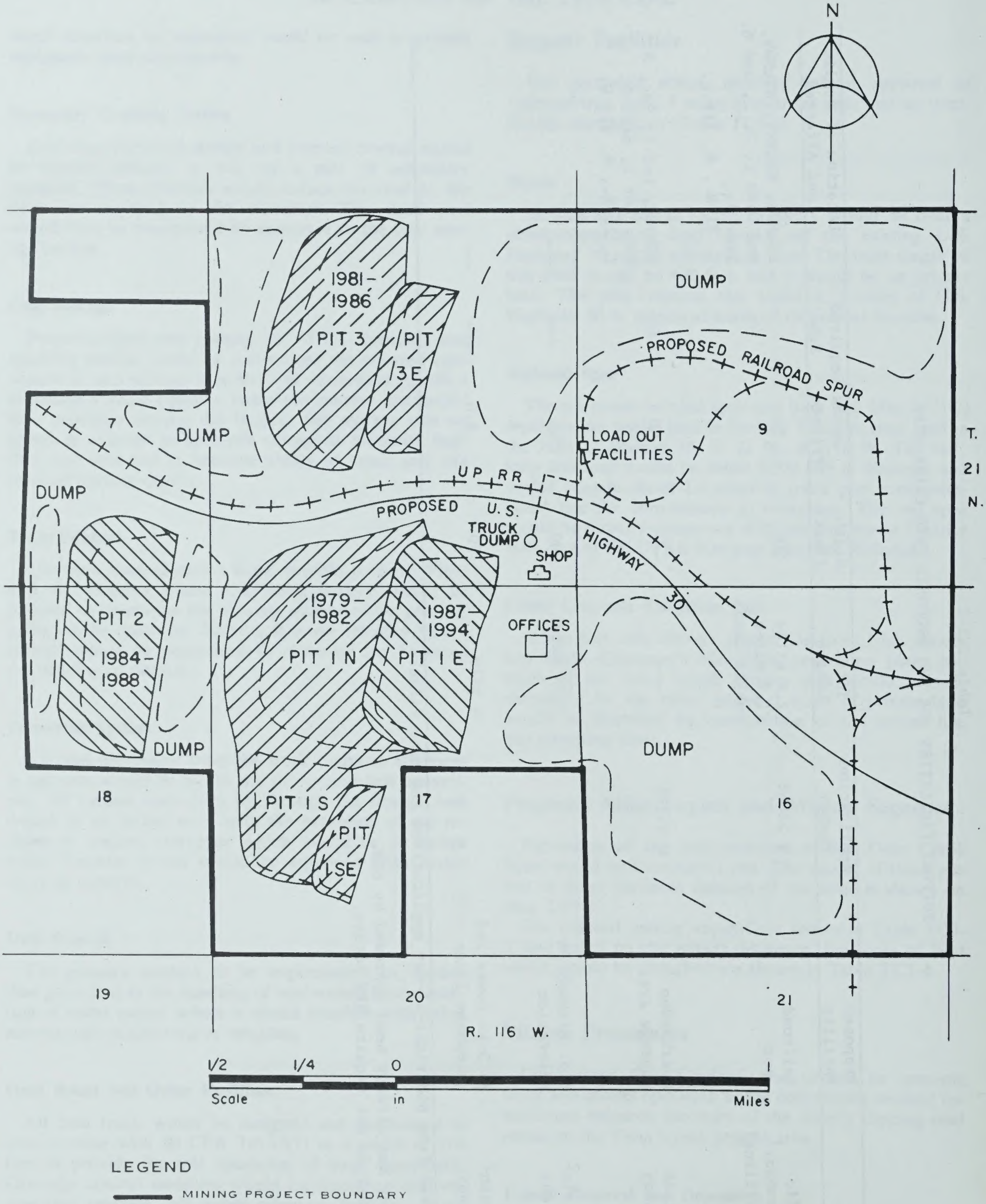
Table TC1-2

SUPPORT FACILITIES FOR THE PROPOSED TWIN CREEK MINE

Applicant	Proposed Facility	Application Number	Total Length	Width (Feet)	Acres Required Private	Acres Required Public	Location of Public Land Affected
Union Pacific Railroad Company[1] (Oregon Shortline)	Railroad spur	W 52868	2.6 miles (1.7 miles public land)	200	24	46	SE¼NW¼, NE¼SW¼, NE¼SW¼, and Lots 1, 2, 3, and 6. Sec. 9., T. 21 N., R. 116 W.
Rocky Mountain Energy Company	Overburden storage area	W 57261	---	---	0	160	NE¼NE¼, Lot 1, Sec. 8 NW¼, Lot 1, Sec. 9, T. 21 N., R. 116 W.
Rocky Mountain[2] Energy Company	U.S. Highway 30 relocation		2.75 miles	300	90	---	---
Rocky Mountain[2] Energy Company	34.5-kv power and telephone lines		½ mile	50	3.0	---	---

Note: Derived from BLM right-of-way applications and case files.

[1]Right-of-way has already been approved by BLM.
[2]Rights-of-way do not require BLM action.



Map TC1-2
MINING SEQUENCE
TWIN CREEK

Table TC1-3

PROPOSED SEQUENCE OF MINING AT THE TWIN CREEK MINE

Pit	Years
1S	1 - 2
1N (south of highway)	1 - 4
ISE	1
3	3 - 8
3E	4 - 9
2	6 - 10
1N (after highway relocation)	10 - 16
1E	9 - 16

Note: Derived from the Twin Creek Mining and Reclamation Plan (Rocky Mountain Energy Company 1976).

Table TC1-4

ACRES OF LAND DISTURBED BY YEAR AT THE PROPOSED TWIN CREEK MINE

	Public Acres Disturbed	Private Acres Disturbed
Year -1	18	140
Years 1 - 3	86	689
Years 4 - 5	258	197
Years 6 - 9	133	411
Years 10 - end of mining	0	0
Subtotal	495[1]	1,437
Total		1,932[2]

[1] The 495 acres include 320 acres for mining and 175 acres for spoils pile dump.
[2] This total does not include about 13 acres needed for construction of power and telephone lines.

contamination and would be shaped and left in a rough condition to promote moisture retention and prevent erosion. Mulching with straw or a fast-growing annual plant cover would be used to reduce erosion of the topsoil piles.

Care would be exercised to avoid movement of topsoil material when wet, particularly the heavy topsoil material. Maintaining good soil tilth is essential to establishment of permanent cover. Topsoil handling would be in conformance with 30 CFR 715.16.

Watercourse Diversions

There are no permanently flowing streams on the project area. Of the intermittent drainage channels which cross the property, the North Branch and the South Branch of the East Fork of Twin Creek drain the project area. Surface runoff from areas disturbed by mining would be prevented from directly entering natural drainages by development of a surface water control system. Thirteen ponds would be constructed to ensure that contaminated water would not be discharged. The settling ponds would be maintained throughout both the mining and reclamation stages in conformance with 30 CFR 715.17(a).

All dams and channels would be designed to specifications found in 30 CFR 715.17, approved by the Wyoming State Engineer, and approved by the Wyoming Department of Environmental Quality (DEQ) prior to construction. Total surface needed for all dams and channels would be 53 acres.

Drainage channels to control runoff from disturbed areas would generally be constructed alongside haul roads and around the boundary of the property whenever necessary to conduct runoff into small settling ponds. Construction of these ditches and ponds would take place just prior to disturbance of the area which they serve as required in 30 CFR 715.17(a).

Four major drainage channels would be constructed, two of which would divert storm runoff to both the east and west of Pit 3 (see Map TC1-2). The third would divert runoff generally northwards and thus prevent a major stream from entering Pit 2. Channel 4 would divert the South Branch of the East Fork of Twin Creek between Pits 1N and 2.

The creek beds which run approximately north-south, north of the railroad, would be replaced as closely as possible to their present location at the same hydraulic gradient and would flow into Twin Creek.

Overburden Removal and Deposition

Once the topsoil has been removed from the pit areas, overburden removal would begin. Pit depths would vary from 295 feet (Pit 1SE) to 710 feet (Pit 1N). A total of 288.3 million loose cubic yards of overburden would be moved.

Each pit area would be started at the highest elevation by opening a cut beginning at the entrance of the seam and proceeding toward the highwall. Depending on seam thickness and the distance between seams, a 40-foot bench would be started with overburden blasting in accordance with 30 CFR 715.19 concerning the use of explosives. The power shovels would drop cut into the bench and load the material by moving along the strike. The material above the seams would be either dozed into the bench floor for shovel loading or removed by the backhoes.

The overburden removal sequence is presently planned as follows: Pit 1S, Pit 1SE, a portion of Pit 1N south of the present highway, Pit 3, Pit 3E, Pit 2, Pit 1N after the highway relocation, and Pit 1E. Overburden would be removed for 2 months before coal production could begin. Spoil from Pits 1N and 1S would be hauled across a temporary overpass over U.S. Highway 30 and dumped on Section 16 in conformance with 30 CFR 715.15.

As Pits 1SE and 1S near completion, Pits 3 and 3E would be started north of the railroad with access provided by an overpass located north of the shop facility. Dumps 16, 3W, and 9 would be built to blend in with the surrounding topography.

At the conclusion of mining Pits 3 and 3E, the highway would be relocated adjacent to the railroad. Before approval to relocate the highway is given by the regulatory authority, a public meeting would be held. If approval is given for relocation, the new road would be constructed to the standards set by the Wyoming State Highway Department. The remaining area of Pit 1N would be mined in conjunction with Pit 1E and Pit 2. Initial material from Pits 1N and 1E would be used to backfill Pit 3 and 3E. Mining in Pit 2 would be completed during the backfilling of Pits 3 and 3E, and the remainder of material from Pits 1N and 1E would be used to backfill Pit 2. Pits 1S and 1SE would be backfilled with material from Pit 2. Additional material from Pit 2 would be stockpiled on top of the backfill in Pits 1 and 1SE, and west of the Pit 1N highwall for later use. At the conclusion of mining in Pit 1N, the stockpiled material would be rehandled to partially reclaim Pit 1N. Material from the Section 16 dump would be rehandled to backfill Pit 1E.

Coal Removal

The project area contains about 32 minable coal seams which dip to the west at an average of 26 degrees and range in thickness from 5 to over 60 feet.

The depth of the pits would vary from 295 feet (Pit 1SE) to 710 feet (Pit 1N). The footwall slope angle determined by the coal seam dip would range from 13 to 21 degrees. The safety bench height would be 80 feet. Bench intervals would be 40 feet. Each pit is designed so that the pit walls would be either parallel to, or perpendicular to, the bedding. All highwalls would be parallel to the bedding strike; therefore, no dipping beds would be undercut into or toward the pit, and no beds would be free to slide into the pit.

As coal is uncovered, it would be drilled and blasted (in accordance with 30 CFR 715.19) or ripped in place and dozed to the wheeled loaders for delivery to the coal truck dump that would be located off the northeast corner of Pit 1N. Another coal truck dump would be located north of the railroad for the coal coming from Pits 3 and 3E.

Reclamation

The Cumberland Coal Company pursuant to Section 515 of SMCRA and 30 CFR 715.13, would be required to restore disturbed lands to conditions capable of supporting premining uses, or higher or better uses. A mining permit would not be approved unless the applicant has demonstrated that reclamation to the proposed post mining land use can be accomplished under the reclamation plan contained in the mining and reclamation plan (Section 510, SMCRA).

Present and Future Land Use

The land within and adjacent to the proposed Twin Creek project area is used primarily for livestock grazing, wildlife habitat, and outdoor recreation.

It is the objective of the land reclamation program for the proposed Twin Creek Mine to reclaim all lands disturbed by mining and mining-related activities to a use equivalent or better than the highest previous use. Future use of the site is expected to involve wildlife use, livestock grazing and outdoor recreation at a level the land was capable of supporting before any mining occurred. All revegetation treatments and plant species used would be selected to enhance forage production for livestock.

Pit 1N would be left, and a water impoundment would develop. The south pit wall would be reduced in slope to blend into the backfilled portions of the pit and to allow for revegetation. The east face of the pit would also be recontoured to better blend into the eastern plains and to allow revegetation by use of farm machinery. The north wing wall would be covered at the dumping angle of repose to cover the coal seams going under the relocated highway. The highwall along the west portion of the pit would remain. It would be designed for long-term stability. The benches or terraces of the highwall would be covered with topsoil and revegetated.

The proposed post mining land use of wildlife habitat, livestock grazing, and outdoor recreation for public lands is in conformance with the land use decisions found in the Pioneer Trails Management Framework Plan of the BLM (U.S. Department of the Interior, BLM 1977b).

Reclamation Schedule

At the conclusion of mining, the entire area (except for the north and west walls of Pit 1N) would be recontoured and shaped to blend as closely as possible into the surrounding terrain. All spoil piles are designed to blend into surrounding topography as they are developed. Five of the pits would be completely backfilled during mining, and the mined area would be blended into the spoil piles and surrounding terrain. All slopes (except for the north and west walls of Pit 1N) would be gentle enough to provide access for farm machinery for revegetation efforts. Principal drainage patterns would not be interrupted by the final shapes in the area. Lesser drainage would be obliterated.

Table TC1-5 shows the proposed sequence of disturbed lands by area and the time schedule for reclamation.

Backfilling and Overburden Dumps

Final grading would begin with the selective placement of overburden in the worked-out pits and overburden disposal sites with the overburden haulage trucks. Overburden and spoil pile disposal sites will be in conformance with 30 CFR 715.15.

All toxic materials constituting a fire, health, or safety hazard that are uncovered or created during mining would be promptly treated or disposed of in such a manner that pollution of surface or subsurface water or threats to human or animal health and safety are prevented (30 CFR 715.14(j)). In general, the plan would be to bury such material well below the surface, yet well above present and future groundwater levels.

All spoil piles would be designed, graded, and contoured to blend in with the topography of the surrounding terrain. After grading and contouring, topsoil would be distributed over the spoil piles in preparation for revegetation.

Those pits which are completely backfilled would allow normal drainage to be restored, and the surface would be revegetated. Pit 1N would be partially filled and reclaimed to leave a watering pond. The south and east walls would be sloped to allow traversing by farm machinery. The north wall would be covered to the angle of repose for the purpose of covering the exposed coal seams. The western highwall catch benches would be covered with topsoil for revegetation. The entire area would be fenced during reclamation to prevent access by livestock. At the conclusion of reclamation, a watering pond approximately 10 acres in surface area with a potential capacity of 250 acre-feet would remain at the bottom of Pit 1N to serve wildlife and livestock needs. To reach this water, animals would have to descend approximately 500 feet on an 18 degree (32½%) slope.

Topsoil Handling and Erosion Control

Topsoil would be spread over all affected areas (except for the north and west walls of Pit 1N) prior to seeding. All possible precautions would be taken to prevent undue compaction. The topsoil would be spread in such a manner that all affected areas would receive a uniform covering. It is estimated that only about 6 to 9 inches of topsoil would be available to cover the areas. Topsoil would be handled in conformance with 30 CFR 715.16.

Table TC1-5

ACRES DISTURBED AND RECLAMATION SCHEDULE FOR THE PROPOSED TWIN CREEK MINE

Year	Dstbd. Acres Plant Fac.	Accum. Acres Plant Fac.	Dstbd. Spoil Areas	Accum. Spoil Areas	Dstbd. Acres-Haul Roads & Pit Areas	Accum. Acres-Haul Roads & Pit Areas	Dstbd. Acres-Hwy & RR Spur	Accum. Acres-Hwy & RR Spur	Dstbd. Acres-Dams, Ponds & Ditches	Accum. Acres-Dams, Ponds & Ditches	Total Acres Dstbd. Annual	Accum. Acres-Dstbd.	Seeded Acres-Annual	Accum. Acres-Seeded	Acres Dstbd. Not Seeded
- 1	60.50	60.50	12.42	12.42	15.39	15.39	70.19	70.19	0	0	158.50	158.50	0	0	158.50
+ 1	0	60.50	141.16	153.58	193.05	208.44	0	70.19	0.44	0.44	344.65	493.15	0	0	493.15
+ 2	0	60.50	74.05	227.63	72.14	280.58	0	70.19	3.27	3.71	149.46	642.61	0	0	642.61
+ 3	0	60.50	207.17	434.80	83.71	364.29	0	70.19	0	3.71	290.88	933.49	0	0	933.49
+ 4	0	60.50	98.84	533.64	140.42	504.71	90.40	160.59	0	3.71	329.66	1263.15	0	0	1263.15
+ 5	0	60.50	117.56	651.20	0	504.71	0	160.59	7.41	11.12	124.97	1388.12	69.68	69.68	1318.44
+ 6	0	60.50	18.14	669.34	64.46	569.17	0	160.59	37.72	48.84	120.36	1508.48	38.82	108.50	1399.98
+ 7	0	60.50	0	669.34	97.04	666.21	0	160.59	0	48.84	97.04	1605.52	41.98	150.48	1455.04
+ 8	0	60.50	15.02	684.36	0	666.21	0	160.59	0	48.84	15.02	1620.54[1]	170.00	320.48	1300.06
+ 9	0	60.50	111.32	795.68	196.21	862.42	0	160.59	3.79	52.63	311.32	1931.86	170.00	490.48	1441.38
+10	0	0	0	0	0	0	0	0	0	0	0	1931.86	19.23	509.71	1422.15
+11	0	0	0	0	0	0	0	0	0	0	0	1931.86	170.00	679.71	1252.15
+12	0	0	0	0	0	0	0	0	0	0	0	1931.86	69.77	748.98	1182.88
+13	0	0	0	0	0	0	0	0	0	0	0	1931.86	205.00	953.98	977.38

Table TC1-5

ACRES DISTURBED AND RECLAMATION SCHEDULE FOR THE PROPOSED TWIN CREEK MINE

Year	Dstbd. Acres Plant Fac.	Accum. Acres Plant Fac.	Dstbd. Spoil Areas	Accum. Spoil Areas	Dstbd. Acres-Haul Roads & Pit Areas	Accum. Acres-Haul Roads & Pit Areas	Dstbd. Acres-Hwy & RR Spur	Accum. Acres-Hwy & RR Spur	Dstbd. Acres-Dams, Ponds & Ditches	Accum. Acres-Dams, Ponds & Ditches	Total Acres Dstbd. Annual	Accum. Acres-Dstbd.	Seeded Acres-Annual	Accum. Acres-Seeded	Acres Dstbd. Not Seeded
+14	0	0	0	0	0	0	0	0	0	0	0	1931.86	205.00	1158.98	772.88
+15	0	0	0	0	0	0	0	0	0	0	0	1931.86	205.00	1363.98	567.88
+16	0	0	0	0	0	0	0	0	0	0	0	1931.86	205.00	1568.98	362.88
+17	0	0	0	0	0	0	0	0	0	0	0	1931.86	202.29	1771.27	160.59

Source: Rocky Mountain Energy Company 1976.

[1]This total does not include as estimated 4.5 acres needed for construction of power and telephone lines.

During shaping and contouring, the slopes would be maintained in a rough condition to minimize wind and water erosion. When the topsoil is applied in the off season for seeding of perennial species, it would be applied to windrows for protection against wind and water erosion. In highly erodible areas, oats or some other annual cover crop would be planted for soil stabilization until time to seed perennials.

At various representative locations in the permit area, topsoil and overburden samples have been collected and analyzed for constituents that might be toxic or inhibiting to plant growth. From these analyses, material in each stratum was evaluated with regard to its suitability as a medium for plant growth.

These studies have shown that the overburden in general is not nearly as viable a medium for plant growth as the topsoil. Some overburden samples have a high percentage of exchangeable sodium; phosphorus and nitrogen are deficient; and some intervals have a high clay content. The overburden has not been subject to recent plant growth and weathering cycles and, therefore, is not as suitable for vegetation purposes.

Watercourse, Drainage Channels, and Impoundments

When no longer needed, the sediment ponds and diversion structures would be removed and their locations would then be topsoiled and revegetated.

When the roads are no longer needed, each culvert would be removed and each mine haul road restored to its natural state.

Each new drainage channel would be seeded with a grass mixture to minimize erosion. At appropriate places, such as where two channels merge, rock riprap would be placed in the channel to protect against erosion.

Decommissioning and Abandonment

At the completion of mining, all buildings and structures would be dismantled and removed, all foundations would be broken up and buried, and the area would be regraded and seeded using the same plan as described for the mined lands. All power lines related to the mine's operation would be removed, any surface damage caused by their installation would be repaired, and the areas would be seeded. In general, all roads within the permit area would be removed and the areas would be regraded, disced, and seeded as previously described. Should the surface owner or county or state officials request that any roads remain, proof of such request would be submitted to the Land Quality Division of the Department of Environmental Quality and approval to lease the road would be requested.

The main overpass over the highway and the railroad would remain to provide access as long as the Kemmerer Coal Company is mining both north and south of the highway. After all mining is completed, the overpass would provide access between grazing areas for more efficient ranching operations.

Revegetation

Following final grading and shaping, the backfill material generally would be excessively compact for normal root development and percolation of water. When the upper 18 to 24 inches of this subsoil is sufficiently compact to significantly restrict root development and normal movement of soil moisture from the surface, it would be necessary to loosen it by deep ripping. Depending upon conditions and material at each site, the ripping would extend 18 to 24 inches into the zone immediately below the replaced topsoil. Usually this operation would be done after the topsoil is spread. The chisel points would be operating 24 to 30 inches below the surface in order to obtain the shattering and loosening effects in the subsoil to a depth of 18 to 24 inches. In order to reduce the potential for compaction, the ripping operation would not be done when the soil is wet. Better shattering would result from ripping if the material is relatively dry.

Mulch would be used where necessary to retard erosion and to provide a better environment for the establishment of vegetation. The type of mulch would depend upon availability and existing conditions on the surfaces being revegetated. Discing of mulch would be done on the contour to help prevent erosion and to produce a rough condition to aid in moisture retention.

Seed mixtures proposed for different sites are shown on Table TC1-6. Seeding would be done in mid-October or the latter part of April.

Where deemed necessary, consideration would be given to lifting native shrubs with a front-end loader and transplanting them in prepared spots within special use areas. However, this transplanting method may not be required, since the use of adapted nursery seedlings would more economically satisfy the revegetation goal.

Warning signs would be placed around all areas which might constitute a threat to human safety. Fences would be constructed where necessary to prevent the operation from causing possible harm to people, big game, and livestock and to protect newly seeded areas. The highwall of Pit 1N would be fenced and warning signs posted.

Freshly revegetated areas would be fenced to exclude domestic livestock. The fences would remain for a period of at least 2 years after a good vegetation cover is established. If plant establishment does not appear to be satisfactory during the first growing season, the area would be reseeded again that fall.

To enhance seedling growth and establishment, fertilizer would be applied to the reclaimed areas either at the time of seeding or at the end of the first growing season. Specific fertilization rates and timing would be decided after conducting appropriate analyses of the replaced topsoil on a given area.

It might be necessary during the first 2 years to use herbicides for control of undesirable broadleaf plants. Such necessary equipment would be available at all times to control any undesirable weed invasion and thus aid the successful establishment of permanent vegetation.

Table TC1-6

RECOMMENDED SEEDING MIXTURES IN POUNDS OF PURE LIVE SEED PER ACRE FOR THE PROPOSED TWIN CREEK PROJECT AREA

Species	Basic Mixture	Heavy Soil		Sandy Soil	Game or Browse Area
		Upland	Lowland		
Thickspike wheatgrass	2.25	1.25	1.00	2.25	2.00
Western wheatgrass, variety rosana	2.25	3.25	3.25		2.00
Big bluegrass	1.00	0.75	1.00	0.50	0.50
Beardless bluebunch wheatgrass, variety whitmar	2.25	1.50	1.25	1.25	1.00
Indian ricegrass				2.50	1.00
Common sainfoin, variety eski or remont			1.25		
Fourwing saltbush				1.25	2.25
Rose					*
Caragana					*

Source: Rocky Mountain Energy Company 1976.

*The amount used per acre would depend on the size and frequency of the areas selected.

Management of Reclaimed Areas

Once the area is reclaimed, with a satisfactory vegetation cover being well established and ready for grazing, management would be returned to the surface owner or user.

Pollution Control Methods

The two major types of potential pollution from the Twin Creek project area are fugitive dust and suspended sediments in surface runoff. Fugitive dust would be controlled by the following means:

1. Coal storage would be in closed silos.
2. Haul roads would be watered on a regular basis or other dust abatement measures such as chemical palliatives would be applied.
3. Temporary topsoil storage piles would be revegetated with quick growing annual species to reduce wind erosion.

Suspended sediments in runoff would be controlled by the following means:

1. Slopes would not be steeper than 4:1 to encourage prompt revegetation and to prevent excessive erosion.
2. Drainage or catchment ditches would be installed at the base of dump faces to divert runoff to settling ponds.
3. Settling or sediment ponds would be constructed on all drainages potentially receiving significant runoff from disturbed areas and dumps. The dams for these ponds would be constructed in accordance with sound engineering practices and would be designed to meet all applicable state and federal requirements concerning capacity and construction.
4. Dump slopes and other disturbed areas would be reclaimed at the earliest practical time to minimize exposure of barren soil materials.
5. Diversion ditches and drainage ditches across backfilled spoil materials would be lined with crushed rock or similar material to minimize erosion and downstream sediment loads.

Should unanticipated excess water be encountered during mining which would require discharge to surface waters, this water would be tested as appropriate to meet all applicable effluent limitations as presented in a National Pollutant Discharge Elimination System permit.

A surface water monitoring plan which must conform with 30 CFR 715.17(b) shall be submitted for approval by the regulatory authority.

AUTHORIZING ACTIONS

This section identifies governmental authorizations which would be required to fully implement the proposed Twin Creek Mine. A more complete description of these actions is provided in the Regional ES, Chapter 1.

A memorandum of understanding is in preparation which describes operating procedures to be followed by the BLM, the Office of Surface Mining, and the USGS concerning their areas of responsibility in the federal coal management program. This memorandum of understanding may alter the agency responsibilities listed below.

Bureau of Land Management (BLM)

BLM issued on 28 April 1976 a right-of-way authorization (W-52868) for a railroad spur, 1.7 miles long and 200 feet wide, situated within Section 9. Before mining could begin, BLM would have to approve a right-of-way authorization (W-57261) for a 160-acre overburden storage area in the NW$\frac{1}{4}$ of Section 9, T. 21 N., R. 116 W.

U.S. Geological Survey (USGS)

The USGS would, with BLM concurrence, approve the mining and reclamation plan.

Wyoming Department of Environmental Quality (DEQ)

The Land Quality Division would issue a permit and license to mine upon its approval of a mining and reclamation plan. The Air Quality Division would issue permits to construct and permits to operate coal mines after a review of applications with regard to air contaminants and plans for control and monitoring. The Water Quality Division would issue permits to construct settling ponds and waste water systems. The Solid Waste Division would issue construction fill permits and industrial waste facility permits for solid waste disposal during construction and operation.

Wyoming State Engineer

Ground water rights for the mining and coal processing operations are required.

Wyoming Highway Department

Relocation of U.S. Highway 30 and all utility line crossings of state and federal aid highways requires authorization from the Wyoming Highway Department. Public meetings would be required prior to the relocation of U.S. Highway 30.

INTERRELATIONSHIPS

Relationship to Land Use Plan

Bureau of Land Management

The Pioneer Trails Management Framework Plan (MFP) (U.S. Department of the Interior, BLM 1977b) of the BLM recommends that 5,640 acres of public lands be made available in the vicinity of Kemmerer/Diamondville for projected residential and commercial needs due to increased population. Forty acres are to be classified for lease near Evanston for a solid waste disposal site. Future utility expansions are to be confined to existing utility system corridors whenever practical to reduce environmental impacts and maximize multiple occupancy of rights-of-way. No major conflicts exist with the proposed development of the Twin Creek Mine. The Pioneer Trails MFP also recommends that mining be allowed as a use in the coal resource areas of the proposed Twin Creek Mine. Post mining land use set by this plan is for wildlife and livestock.

Relationship to Other Proposed and Future Actions

Other Coal

Two other proposed coal mines (North Block and South Haystack) in the area of the proposed Twin Creek Mine would cause competition for the available labor market. They would also increase rail traffic, dust, and water usage and increase the demand on transportation and communication networks.

Naughton Power Plant

It is planned that coal from the North Block Mine would supply the necessary coal required by the proposed expansion of the Naughton Power Plant which is to be immediately south and east of the proposed Twin Creek Mine.

CHAPTER 2

DESCRIPTION OF THE ENVIRONMENT

This chapter consists of two parts, existing environment and future environment. The discussion of the existing environment describes the physical, biological, and cultural environmental components which constitute the Twin Creek site-specific environment. The discussion of the future environment focuses on the same environmental components as they would be in 1980, 1985, 1990, and at the end of mine life without federal approval of the proposed action. These descriptions provide bases for the analyses in Chapter 3, The Environmental Impacts of the Proposed Action.

EXISTING ENVIRONMENT

CLIMATE

Sunshine

The Twin Creek project area is situated in a high plains and foothills area where the annual average percentage of sunshine can be expected to approximate the 65% statewide average.

Wind Fields

Utah Power and Light (UPL) owns a field network of four meteorological observation sites in the vicinity of its Naughton Power Plant, which is located near Kemmerer in Lincoln County. From a review of a 1-year (1 August 1974 to 1 September 1975) compilation of surface wind statistics (Golden and Petersen 1976) at these sites, the predominant wind direction and speed characteristics observed are as outlined below.

The three predominant wind direction sectors at three of the UPL sites are west through northwest and constitute 40% of the annual number of hourly observations. The fourth site indicates a predominant flow in the southwest through west sectors, which accounts for about 55% of all annual observations. Secondary directional maxima are shown to occur at each of the UPL sites and are associated with north through east sector winds. The annual average wind speeds at the UPL sites range from 8 to 13 mph.

Atmospheric Temperature and Stability

The temperature in the project area, as in the entire environmental statement (ES) region, is subject to large seasonal and daily variations. Temperatures are expected to closely parallel those observed at Kemmerer over a 30-year period from 1931 through 1960, which indicate mean monthly minima/maxima of 5°F/29°F and 44°F/82°F during January and July, respectively. Temperature extremes range from -32°F to 97°F. The growing season is about 105 days per year.

Vertical temperature profiles were also obtained by UPL during seasonal field studies (Golden and Petersen 1976). Eighty-five percent of all morning soundings (79 total) contained some type of inversion (either surface-based or upper-level). Sixty-five percent of the UPL morning soundings had surface-based inversions with an average depth of 300 feet. Only 11% of the afternoon soundings (after 12:00 noon) showed inversions of any type.

Moisture and Evapotranspiration

Annual average precipitation and total snowfall should approximate the 9 inches and 55 inches, respectively, observed at Kemmerer over a period of more than 30 years.

An annual soil moisture deficit of about 10 inches is characteristic of the project area. The growing season roughly coincides with the period of high soil moisture deficit.

Severe Weather Events

The average number of thunderstorm and hail days is about 30 and 3 per year, respectively. The likelihood of tornadoes occurring in this region is very low.

AIR QUALITY

The proposed Twin Creek project area is not in the prevailing downwind direction of pollutant dispersion from Kemmerer; therefore, the present air quality at this location should have a rural character. Consequently, the existing total suspended particulate levels at this site should range from 10 to 20 micrograms per cubic meter ($\mu g/m^3$) annually and 30 to 45 $\mu g/m^3$ for 24 hours. The magnitude of these levels is less than one-third of the appropriate state standards. Based on 5 years of visual observations recorded at Fort Bridger, Wyoming, a representative background visual range in the vicinity of the Twin Creek project area should be approximately 40 miles.

Concentrations of sulfur dioxide around Twin Creek should also reflect its rural setting; i.e., levels less than 5 $\mu g/m^3$ annually and less than 25 $\mu g/m^3$ for daily averaging period. The magnitude of these concentrations is only about 10% of the annual and 24-hour state standards. In addition, annual nitrogen dioxide concentrations should be less than 10 $\mu g/m^3$, or again only 10% of the standard.

GEOLOGY

Stratigraphy

Coals of the Hams Fork coal region lie in the Evanston, Adaville, Frontier, and Bear River Formations. Coals of the proposed project area are in the Adaville Formation of Late Cretaceous age which consists of yellow, gray, and black shale with irregular interbedded brown, white, and yellow sandstone. The formation is about 2,900 feet thick, and the workable coal seams range in thickness from 5 to 40 feet or more with one seam over 60 feet thick.

The Adaville Formation is at or near the surface in most of the project area. To the west it is overlain by the Evanston Formation of Paleocene and Late Cretaceous age. Underlying and cropping out to the east of the Adaville Formation is the Hilliard Shale of Late Cretaceous age (Figures TC2-3A and TC2-3B). Beneath the Hilliard Shale and not cropping out in the proposed project area is the coal-bearing Frontier Formation. Coals of this formation are of no current economic interest in the proposed project area because the overlying Hilliard Shale is as much as 6,000 feet thick.

The rocks of Cretaceous age were mostly deposited along the western edge of a broad, shallow, north-south trending seaway that crossed central North America. They are mostly marine shales, but they also include fluvial shales and sandstones and deltaic deposits including coal.

Paleontology

The project area was surveyed by P. O. McGrew in 1977. He concluded that, on the basis of a literature review and field investigations of the exposed strata, there is a limited possibility of encountering fossil vertebrates and that the occurring fossil invertebrates and paleobotanical remains, although abundant, are regionally widespread in well exposed deposits. A general summary of the principal fossiliferous formations, ages, number of known fossil localities, and general fossil types in the proposed mining area is presented in Table TC2-3A.

Structure

The dominant structural features in the area are the Absaroka Thrust and the Lazeart Syncline (see Figure TC2-3A). The eastward movement of the Absaroka Thrust formed the asymmetric Lazeart Syncline and, in places, has overturned the west limb of the syncline. All the coal-bearing rocks on the lands are on the east limb of the syncline which strikes slightly east of north. The coal bearing rocks commonly dip from 15 to 30 degrees west.

Geologic Hazards

Even though the landslide susceptibility of the rock and earth material is estimated to be high (Radbruch-Hall et al. 1976), the landslide potential of the natural surface is judged to be minimal because the natural slopes show no evidence of earlier sliding and the rock strata generally dip into the slope.

Natural coal outcrops are weathered and have lost their more volatile and more easily ignitable constituents; therefore, the likelihood of coal ignition and combustion in the natural outcrop is low.

The project area is in an area of very low seismic activity; therefore, the probability of damage from earthquakes is low.

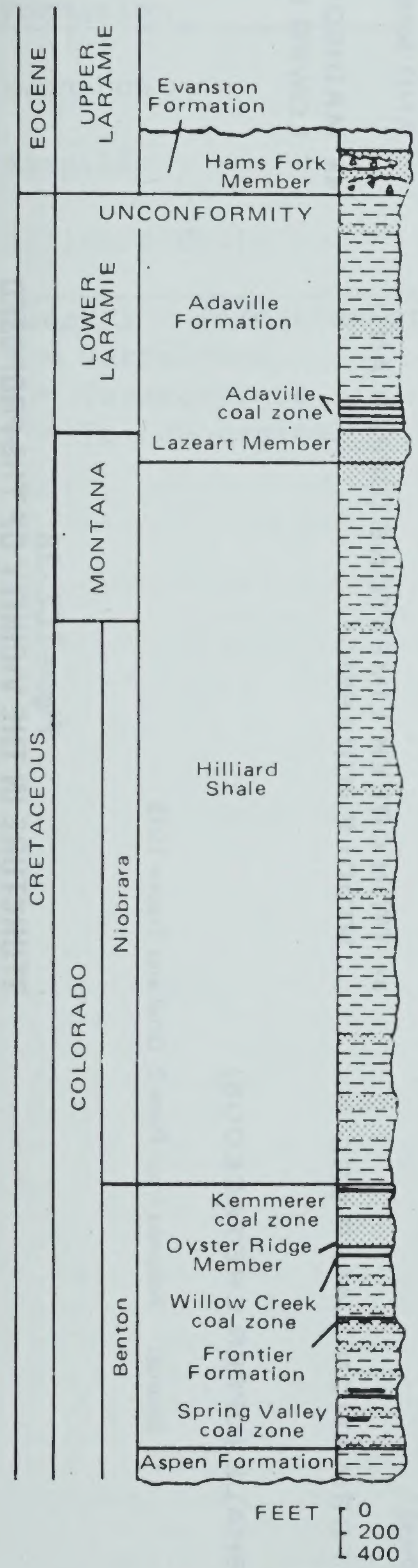
TOPOGRAPHY

The Twin Creek project area is located approximately 4 miles west of Oyster Ridge in the physiographic subdivision of the region known as the Overthrust Belt. Oyster Ridge roughly delineates the eastern edge of the Overthrust Belt. The site spans a ridge that is geomorphologically related to Commissary Ridge to the north and is bounded on the north by the North Block project area.

The ridge drains east and west with the west side sloping into the head of the valley of Twin Creek and the east side sloping into a tributary of Hams Fork, a perennial stream that flows southward about 3 miles east of the site. The ridge is a major drainage divide, with the west slope draining via Twin Creek into the Great Basin and the east slope draining via Hams Fork into the Colorado River drainage system. The upper slopes of the ridge are moderately steep and the lower slopes are gentle. Both sides of the ridge are notched by small watercourses that are tributaries of Twin Creek and Hams Fork.

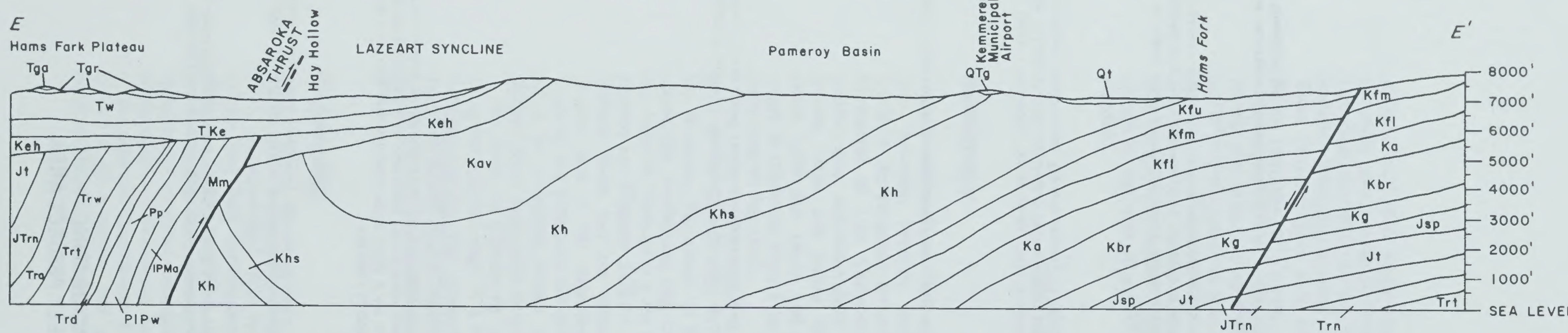
SOILS

A soils inventory of the Twin Creek project area was conducted by the Soil Conservation Service during 1976 to determine the nature and extent of soil types in the



TKe	EVANSTON FORMATION (PALEOCENE AND UPPER CRETACEOUS) — Gray siltstone, carb aceous claystone, and shaly mudstone; quartzitic siltstone, gray carbonaceous sandstone, and so dark-brown concretionary ironstone. 200+ ft (60+m) thick
Keh	Hams Fork Conglomerate Member (Upper Cretaceous) — Boulder conglomerate beds containing s boulders, cobbles, and pebbles of well-rounded quartzite, chert, and limestone and interbedded w to brown calcareous sandstone forms conspicuous boulder trains on topographic highs in wes part. As much as 1,000 ft (305 m) thick
Kav	ADAVILLE FORMATION (UPPER CRETACEOUS) — Predominantly gray-brown weathering bonaceous shale and mudstone that contains beds of yellowish-brown to reddish-brown sandst and siltstone; contains workable coal beds as much as 30ft (9m) thick (Adaville 1 coal) in lo part. 2,000 + ft (610+ m) thick
Kal	Lazeart Sandstone Member — Light grey to white fine — to coarse grained sandstone; basal par formation. About 200-400 ft. (60-120m) thick
Kh	HILLIARD SHALE (UPPER CRETACEOUS) — Dark gray to dark brown marine shale, siltstone, sandy shale; contains a few conspicuous light gray to light tan, fine-grained, resistant sandstone b in upper part. About 6,000 ft (1,830 m) thick
Kf	FRONTIER FORMATION (UPPER CRETACEOUS) UNDIFFERENTIATED
Kfu	Upper unit - Middle part consists of a prominent hogback of white to light gray weathering, oy bearing sandstone (Oyster Ridge Sandstone Member) overlain by shale and thin beds of gray sands that contains the Kemmerer coal zone; underlain by a thick shale interval that contains the Wi Creek coal zone in the Kemmerer area. About 1,200 ft (365 m)
Kfl	Lower unit - Dark gray shale, tan siltstone and brown sandstone; sandstone beds less resistant those in upper unit; contains the Spring Valley coal zone in lower part. About 1,000 ft (305 m) th
Ka	ASPEN SHALE (LOWER CRETACEOUS) — Light to dark gray siltstone and shale, quartzitic sand-stone, and porclanite; forms prominent silver-gray hogbacks. About 900 - 1,000 ft. (275-305)

Figure TC2 - 3A
PARTIAL GENERALIZED STRATIGRAPHIC SECTION OF THE PROPOSED TWIN CREEK PROJECT AREA



Qt	TERRACE DEPOSITS (HOLOCENE AND PLEISTOCENE)
QTg	HIGH TERRACE DEPOSITS (PLEISTOCENE OR PLIOCENE)
Tgr	GREEN RIVER FORMATION (EOCENE)
Tga	ANGELO MEMBER
	WASATCH FORMATION (EOCENE)
Tw	MAIN BODY
	EVANSTON FORMATION
TKe	MAIN BODY IN EASTERN PART OF MAPPED AREA AND EVANSTON FORMATION UNDIVIDED IN THE WESTERN PART (PALEOCENE AND UPPER CRETACEOUS)
Keh	HAMS FORK CONGLOMERATE MEMBER (UPPER CRETACEOUS)
Kav	ADAVILLE FORMATION (UPPER CRETACEOUS)
Kh	HILLIARD SHALE (UPPER CRETACEOUS)
Khs	SHURTLIFF SANDSTONE MEMBER
	FRONTIER FORMATION (UPPER CRETACEOUS)
Kfu	UPPER UNIT
Kfm	MIDDLE UNIT
Kfl	LOWER UNIT
Ka	ASPEN SHALE (LOWER CRETACEOUS)
Kbr	BEAR RIVER FORMATION (LOWER CRETACEOUS)
Kg	GANNETT GROUP (LOWER CRETACEOUS)
Jsp	STUMP SANDSTONE AND PREUSS RED BEDS (UPPER JURASSIC)
Jt	TWIN CREEK LIMESTONE (UPPER AND MIDDLE JURASSIC)
JTrn	NUGGET SANDSTONE (JURASSIC? AND AND TRIASSIC?)
Tra	ANKAREH RED BEDS (UPPER TRIASSIC)
Trt	THAYNES LIMESTONE (LOWER TRIASSIC)
Trw	WOODSIDE RED BEDS (LOWER TRIASSIC)
Trd	DINWOODY FORMATION (LOWER TRIASSIC)
Pp	PHOSPHORIA FORMATION AND EQUIVALENT STRATA (PERMIAN)
PIPw	WELLS FORMATION (PERMIAN AND PENNSYLVANIAN AND MISSISSIPPIAN)
IPMa	AMSDEN FORMATION (PENNSYLVANIAN AND MISSISSIPPIAN)
Mm	MADISON LIMESTONE (UPPER AND LOWER MISSISSIPPIAN)

Source: Adapted from Plate 2, Oriel and Tracey 1975.

Figure TC2 - 3B
STURCTURE IN THE VICINITY OF THE PROPOSED TWIN CREEK PROJECT AREA

Table TC2-3A

SUMMARY OF FOSSILIFEROUS FORMATIONS IN THE AREA OF THE PROPOSED TWIN CREEK MINE

Formation	Period	Known Fossil Localities	Type of Fossils
Evanston	Paleocene	General	V
Adaville	Cretaceous	General	I and P
Hilliard Shale	Cretaceous	General	I

General = Formation produces fossils with no specific localities identified.
V = Vertebrate
I = Invertebrate
P = Paleobotanical

area (Map TC2-5A). The inventory was a reconnaissance survey (as defined by BLM Manual 7312).

The survey indicates that the soils are poorly developed due to slow weathering of the parent material in the semiarid environment of the project area. There are three basic types of parent material in the area: (1) alluvium (sediments transported and deposited by water), which occupies approximately 23% of the area (653 acres); (2) sedimentary rock (sandstone and shale), which occupies approximately 71% of the area (2,017 acres); and (3) loess (wind blown silt deposits), which occupies the remaining area (171 acres). The soils in mapping units 209, 218, and part of 221 have developed on alluvium. The soils in mapping units 231, 232, and part of 221 have developed over sedimentary rock. Soil occupying mapping unit 227 has developed from loess.

Varying amounts of soluble salts occur in all the soils of the area. Specifically, calcium carbonate accumulates at various depths in the soils of the area, generally in lower subsoil horizons. High levels of secondary calcium carbonate restrict plant growth by depressing availability of some plant nutrients. The soils in mapping unit 209 are strongly alkaline (high in sodium salts). The amount of organic matter in the soils is low and ranges from 0.1% to around 10%, with the majority being below 1%. The amount of organic matter relates to soil permeability (the ability of soil to transmit water and gases), soil fertility (ability to hold nutrients in available form for plants), and available water capacity (water held in the soil that can be readily absorbed by plant roots). Soils in the area are low in nitrogen and phosphorus which are essential plant nutrients. There is a sufficient level of all other nutrients for plant growth.

Soil structure of the surface horizon in the Twin Creek soils is primarily moderate to strong granular; however, in nearly all soils the surface horizon is less than 5 inches thick. The structure below the thin top layer is weak and in some cases nonexistent. Populations of soil biota are low in the area primarily due to the low levels of soil moisture throughout the year (Brady 1974). Activities of the various soil biota contribute to the development of soil structure. Stable soil structure is a part of most productive soils and is especially important on fine-textured soils for the development of soil porosity adequate for water movement into and through the soil. The predominant soil texture of the area is loam to clay loam.

Soil depths in the Twin Creek project area vary from no soil on rock outcrop to greater than 60 inches on alluvium. The moderately deep and deep loam and clay loam soils of the area (mapping units 218 and 227) that have few restrictive features such as high alkalinity or calcium carbonate levels are more productive than the soils in the remainder of the area. These soils can be recognized by the vigorous growth of shrubs and grasses they support. Soils with high alkalinity and (or) soluble salt content (mapping unit 209) have plants that are salt tolerant. Soils with restrictive underlayers or bedrock within 20 inches of the surface (mapping units 221, 231, and 232) have plants with stunted growth due to the limitations of root penetration and (or) plants that require little water to survive.

Properties and interpretations of the Twin Creek area soils are listed by mapping unit in Table TC2-5A. A description of the soil mapping units can be found in the appendix. A breakdown by percentage of the soil types within each soil mapping unit along with associated soil data can also be found in the appendix. The soil types are keyed to associations of subgroups in the soil taxonomy (U.S. Department of Agriculture, Soil Conservation Service 1975).

The amount of wind erosion occurring at present on soils of the Twin Creek project area varies with the surface soil texture, vegetative cover, average wind speed, etc. The wind erosion hazard and wind erodability groups of the Twin Creek soils are listed by mapping unit in Table TC2-5A. At present an average of 70 tons of soil per year is being removed by wind from the mining area. This value was determined by using the Soil Erodability Index for bare soil (U.S. Department of Agriculture, Soil Conservation Service 1972), vegetative cover percentages derived from BLM Watershed surveys, and estimates based on professional judgement. The preceding value of 70 tons represents soil lost in suspension.

Sheet erosion rates on the various mapping units as calculated by using Musgrave's equation are shown in Table TC2-5B.

Some of the soils in the area are highly erosive resulting primarily from low vegetative cover on steep slopes. The average rate of erosion occurring at present on those areas that would be disturbed is approximately 4 tons per acre per year.

WATER RESOURCES

Ground Water

The Adaville Formation is the only formation exposed at the surface on the proposed mining area which is on the eastern limb of the Lazeart Syncline. The dip of the Adaville ranges from 22 degrees to 28 degrees westward and strikes about N. 10° E. Ground water occurs in the Adaville in sandstone lenses, coal seams, and in the Lazeart sandstone member which occurs at the base of the Adaville. Data from other locations in the Adaville indicate that the coal is 500 to 5,000 times more permeable, respectively, than the sandstone or shale units. Permeabilities of the coal and sandstone aquifers combined range from 8.6 to 15 gallons per day (gpd) per square foot and transmissibilities range from 2,300 to 5,700 gpd per foot. The storage coefficient ranges from 2×10^{3} to 9×10 3. *Recharge to the aquifers occurs as the result of infiltration* of overland runoff and streamflow across the outcrop of the Adaville. Shallow wells in the outcrop area tap unconfined ground water, but deeper wells and those located farther down dip tap confined (artesian) water which rises above the level at which it was encountered during drilling. Four of the test wells drilled by the mining company flowed. The shut in pressure of these wells was not measured. When the wells were visited 17 November

Table TC2-5A

SOIL CHARACTERISTICS AND INTERPRETATIONS

Map Unit[1]	Map Unit Name[2]	Total Acres	Slope Range	Wind Erodability Group[3]	Erosion Hazard[4]		Source of Roadfill[4]	Suitability-Limitations for Final Cover Over Mined Land[4]	
					Wind	Water		In./Avail.	Suitability
291	Alkali-saline land	298	0- 3	8	None	Slight	Poor	0	Unsuitable-Alk.Sal.
218	Alluvial fans, coarse soils, sloping	335	6-10	3/5	Moderate	Sl. - Mod.	Fair	10-60	Poor-Gravel, Cobble
221	Terrace escarpment, gently sloping to steep	72	6-30	4L/5	Sl.-Mod.	Mod.- Sev.	Fair	10-16	Poor-Gravel, Cobble
227	Loess soils, rolling	176	3-10	5	Slight	Moderate	Good	60	Fair
231	Residual uplands, shallow clayey soils, moderately steep to steep	886	10-60	3/4	Sl.-Mod.	Severe	Poor	4-10	Poor-Gravel, Cobble-Slope
232	Residual uplands, clayey soils, rolling	1,074	3-15	4L	Moderate	Moderate	Poor	8-12	Poor-High Clay Content

[1] Map TC2-5A, Twin Creek Soils.
[2] Unit names derived from geomorphic setting of the soil.
[3] Wind Erodability Group descriptions found in U.S. Department of Agriculture, Soil Conservation Service (SCS), Handbook for Interpretations 1972, generally the higher the number, the lower the erosion potential with the number range of 1 to 8.
[4] Derived from U.S. Department of Agriculture, SCS, soils contract with BLM (1977).

Table TC2-5B

EXISTING SHEET EROSION

Mapping Unit[1]	Sheet Erosion Tons/Acre/Year
209	0.12
218	0.90
221	1.59
227	0.49
231	6.22
232	4.24

[1]Map TC2-5A.

1977, the shutoff valves of three wells were leaking about 5 to 10 gallons per minute. There are no lands in the mining proposal which meet the criteria for alluvial valley floors.

Ground Water Quality

Ground water samples were taken at seven sites in the proposed project area. The range of mineral constituents in these water samples is tabulated on Table TC2-6A and compared with several water quality standards. Mineral constituents include sodium, calcium, magnesium, sulfate, and bicarbonate in addition to lead, iron, manganese, sulfate, aluminum, and phosphorus, which are present in excessive amounts.

Surface Water

The project area of 4.5 square miles drains to the east fork of Twin Creek, Hams Fork, and Blacks Fork (about 2 square miles to Twin Creek drainages, about 2.5 square miles to Hams Fork, and 20 acres to Blacks Fork). The Hams Fork drainage, adjacent to the project area, appears to be an alluvial valley floor, based on the 30 CFR 710.5 definition that an "alluvial valley floor means stream-laid deposits holding streams where water availability is sufficient for subirrigation or flood irrigation agricultural activities . . ." No perennial streams occur in the project area; all are ephemeral, i.e., they flow only in response to precipitation or snowmelt. Estimates of peak flows for various recurrence intervals are tabulated for eight ephemeral streams in Table TC2-6B and Figure TC2-6A. This table shows the calculated peak flow that would, on the average, be equalled or exceeded over the stated interval (Lohman 1976).

Surface Water Quality

Table TC2-6A lists the mineral constituents found in samples of surface water. Constituents present in excess of standards were iron, chloride, total dissolved solids, sulfates, and turbidity. Of these, sulfates and turbidity were present in amounts greater than 10 times the standards.

VEGETATION

Terrestrial

Sagebrush and winterfat vegetation types occur on about 46% (1,306 acres) and 41% (1,164 acres) of the 2,841 acres of the project area, respectively. Dry and wet meadows exist on about 114 acres and 87 acres, respectively, or 7% of the project area. Approximately 170 acres, 6% of the project area, have been disturbed by highway, railroad, and other activities. These areas are vegetated by introduced grass species or annual weeds such as Russian thistle, *Salsola kali*. Map TC2-7A shows vegetation types large enough to be mapped. Type designations and numbers are those used by the BLM. Plant names are according to Beetle (1970). A list of plants known to occur in the Twin Creek project area is available to the public at the Rock Springs District Office of the BLM.

Sagebrush, Type 4

Black sagebrush *(Artemisia nova)* or big sagebrush *(A.* tridentata) are dominant shrubs of the type. Thickspike wheatgrass *(Agropyron dasystachyum)*, western wheatgrass *(A.* smithii), and bottlebrush squirreltail *(Sitanion hystrix)* are abundant grasses, with bluegrasses *(Poa pratensis, P. secunda,* P. *fendleriana)*, Indian ricegrass *(Oryzopsis hymenoides)*, and Junegrass *(Koeleria cristata)* occurring frequently. Common forbs are wildbuckwheats *(Eriogonum* spp.), phloxes *(Phlox* spp.), and lupines *(Lupinus* spp.). Snowberries *(Symphoricarpus* spp.), serviceberries *(Amelanchier* spp.), and mountain *mahogany (Cercocarpus montanus)* occur within the type where exposure and moisture retention are favorable. Nuttall *saltbush (Atriplex nuttallii)*, four-wing saltbush *(A. canescens)*, and shadscale saltbush *(A. confertifolia)* are found on small, saline soil areas at lower elevations.

Winterfat, Type 15

The dominant species is winterfat *(Eurotia lanata)*, a low growing half-shrub. Grasses present include thickspike wheatgrass, western wheatgrass, needleandthread *(Stipa comata)*, and Indian ricegrass. Phloxes, wildbuckwheats, and *goldenweeds (Haplopappus* spp.) are frequently occurring forbs.

Meadow, Type 2

The wet meadows of the project area are characterized by moisture enduring plant species such as Baltic rush *(Juncus* balticus), common brookgrass *(Catabrosa aquatica)*, and *sedges (Carex* spp.).

Bottlebrush squirreltail *(Sitanion hystrix)*, Sandberg bluegrass *(Poa secunda)*, and needleandthread *(Stipa comata)*, are common plant species of dry meadows.

Aquatic Vegetation

Data for aquatic vegetation on the Twin Creek mining and reclamation site are not available.

Endangered and (or) Threatened

A survey of the project area revealed no plants proposed for endangered and (or) threatened status (Dorn 1977). The process for requesting formal consultation

Table TC2-6A

TWIN CREEK GROUND WATER QUALITY RANGES COMPARED TO VARIOUS WATER QUALITY CRITERIA

Parameter	Ground Water Range of Conc. in Samples From Proposed Lease Site	Onsite Surface Water Range of Conc. Reported	Regional Surface or Ground Water Quality	Surface Water Criteria for Public Water supplies (low value desirable high value permissible)	1962 USPH Drinking Water Criteria	Proposed Interim Primary Drinking Water Standards	Livestock Water Supply Criteria	Irrigation Water Supply Criteria (low value for continuous applic., high value for short term use)	Freshwater Organism Criteria
Uranium	<0.001-0.015								2-300
Thorium	<0.001-0.028								
Bismuth	all <0.001								
Lead	0.002-0.49		0.01-0.03	absent - 0.95	0.05	0.05	0.05	5 - 20	0.1
Thallium	<0.001-0.002								
Mercury	all <0.001					0.002			0.005
Tungsten	<0.001-0.021							46 safe	
Tantalum	<0.001-0.003								
Mafnium	<0.001-0.003								
Lutecium	<0.001-0.001								
Ytterbium	<0.001-0.009								
Erbium	<0.001-0.002								
Dysprosium	<0.001-0.008								
Terbium	<0.001-0.003								
Gadolinium	<0.001-0.002								
Europium	<0.001-0.004								
Samarium	<0.001-0.008								
Neodynium	<0.001-0.085								
Praseodymium	<0.001-0.034								
Cerium	<0.001-0.23								
Lanthanum	<0.001-0.18								
Barium	0.12 -1.6			absent - 1.0	1.0	1.0			5.0
Cesium	<0.001-0.012								
Iodine	<0.001-0.005								
Antimony	<0.001-0.003		0.0002						
Tin	<0.001-0.010							40 safe	0.6 good

Table TC2-6A

TWIN CREEK GROUND WATER QUALITY RANGES COMPARED TO VARIOUS WATER QUALITY CRITERIA
(Continued)

Parameter	Ground Water Range of Conc. in Samples From Proposed Lease Site	Onsite Surface Water Range of Conc. Reported	Regional Surface or Ground Water Quality	Surface Water Criteria for Public Water supplies (low value desirable high value permissible)	1962 USPH Drinking Water Criteria	Proposed Interim Primary Drinking Water Standards	Livestock Water Supply Criteria	Irrigation Water Supply Criteria (low value for continuous applic., high value for short term use)	Freshwater Organism Criteria
Vandaium	<0.001-0.046							10	
Titanium	0.2-14		0						
Scandium	<0.001-0.024								
Calcium	78-220	46-165	31-86(63)				1000		
Potassium	8.5-17	1-19	1.1-7.3(3.3)						50 toxic
Chlorine	13-44	27-46	0-170,000 (650)	<25-250	250		1500	100	
Phosphorus	0.23-27		0-4.7(0.36)	narrative					0.1
Silicon	7.0-711	<1-13	2.2-44(11)						
Aluminum	1.0-440							1-20	
Magnesium	45-115	11-110	17-60(33)				500	24 safe	300 toxic
Sodium	8-140	8.8-530	4.8-47(26)				2000	100-200 harmful	500 toxic
Beryllium	<0.001-0.004							0.5-1.0	
Lithium	0.07-0.51		1.0					5.0	
Gold	All <0.001								
Platinum	All <0.001								
Iridium	All <0.001								
Osmium	<0.001								
Thulium	<0.001								
Holmium	<0.001								
Telluries	<0.001								
Palladium	<0.001								
Rhodium	<0.001								
Ruthenium	<0.001								

Table TC2-6A

TWIN CREEK GROUND WATER QUALITY RANGES COMPARED TO VARIOUS WATER QUALITY CRITERIA
(Continued)

Parameter	Ground Water Range of Conc. in Samples From Proposed Lease Site	Onsite Surface Water Range of Conc. Reported	Regional Surface or Ground Water Quality	Surface Water Criteria for Public Water supplies (low value desirable high value permissible)	1962 USPH Drinking Water Criteria	Proposed Interim Primary Drinking Water Standards	Livestock Water Supply Criteria	Irrigation Water Supply Criteria (low value for continuous applic., high value for short term use)	Freshwater Organism Criteria
Cadmium	0.002-0.009		0-0.007 (0.002)*	absent - 0.01	0.01	0.01	0.01	0.005-0.05	
Silver	<0.001-0.001			absent - 0.05	0.05	0.05	0.05		0.003 toxic
Melybdenum	0.001-0.013							0.005-0.05	
Niobium	<0.001-0.063								
Zirconium	<0.001-0.69								14-300 toxic
Yttrium	<0.001-0.088								
Strontium	1.6-20								
Rubidium	0.039-0.66								
Bromine	0.004-0.047								
<Selenium	0.001-0.002	all <0.005	0	absent - 0.01	0.01	0.01	0.01	0.05	2 toxic
Arsenic	0.001-0.038		0-0.0036 (0.0016)	absent - 0.05	0.01-0.05	0.05	0.05	1 - 10	
Germanium	0.001-0.006								
Gallium	0.001-0.027								
Zinc	0.013-0.94		0.002-0.5 (0.02)	virtually absent-5	5			5 - 10 toxic	0.1-1 toxic
Copper	0.002-0.11		0.004-0.009	virtually absent-1	1.0			0.2-5	
Nickel	0.005-0.066							0.5-2	0.8 toxic
Cobalt	<0.001-0.032						100	0.2-10	
Iron	0.44-150	0.44-150	0.4-(0.2)	virtually absent-0.3 (filterable)	0.3				50
Manganese	0.13-1.2		0-2.3(0.2)	absent - 0.05 (filterable)	0.05			0.5	1.0
Chromium	<0.001-0.40		0.001-0.002	+6 absent - 0.05	+6: 0.05	0.05	5	5 - 20	+6: 0.02 "safe"

Table TC2-6A

TWIN CREEK GROUND WATER QUALITY RANGES COMPARED TO VARIOUS WATER QUALITY CRITERIA
(Continued)

Parameter	Ground Water Range of Conc. in Samples From Proposed Lease Site	Onsite Surface Water Range of Conc. Reported	Regional Surface or Ground Water Quality	Surface Water Criteria for Public Water supplies (low value desirable high value permissible)	1962 USPH Drinking Water Criteria	Proposed Interim Primary Drinking Water Standards	Livestock Water Supply Criteria	Irrigation Water Supply Criteria (low value for continuous applic., high value for short term use)	Freshwater Organism Criteria
Total Alkalinity	267-417	194-588	0-960(180)	narrative			200		>20 good
TDS	556-1750	820-1790	0-3300(500)	<200-500	500		2500		2000
TSS	11-1240		54-150(110)						
HCO_3	267-417								
CO_3	all "0"	0-84	40-41(30)						
Sulfate	155-1020	210-874	0-13,000(280)	<50-250	250		500	200	
Total hardness	462-1178	569-1020	0-2100(330)	narrative					
Turbidity	5-1000 JTU	9-18	0-375(33)	absent	5				10-50
ph (units)	7.2-7.7	8.0-9.1	7.1-9.8(7.9)	6.0-8.5					6-9
Dissolved FE	0.07-2.2		0-7.4(0.09)	0.3	0.3				50
Ferric Fe dissolved	<0.5-2.0	0.23-1.7							
Ferrous Fe dissolved	all <0.5	0.05-0.19							
Sulfide	all <0.1								
CCD	7-265		12-68(42)						
Nitrate	<.001-0.1		0-4(0.27)	virtually absent	45	10			
Total Kjeldahl Nitrogen	1.7-5.3		0.1-24(1.7)10						
Fluorine	0.64-1.3	0.72-1.8	0-6(0.4)	narrative	0.8-2.4 good	1.4-2.4 good	1.0	10	1.5
Ammonia	0.9 (1 sample only)		0-9.8(0.27)	0.01-0.5					

Table TC2-6A

TWIN CREEK GROUND WATER QUALITY RANGES COMPARED TO VARIOUS WATER QUALITY CRITERIA
(Continued)

Parameter	Ground Water Range of Conc. in Samples From Proposed Lease Site	Onsite Surface Water Range of Conc. Reported	Regional Surface or Ground Water Quality	Surface Water Criteria for Public Water supplies (low value desirable high value permissible)	1962 USPH Drinking Water Criteria	Proposed Interim Primary Drinking Water Standards	Livestock Water Supply Criteria	Irrigation Water Supply Criteria (low value for continuous applic., high value for short term use)	Freshwater Organism Criteria
SAR (calculated)	0.25-41.meq/1	0.3-24	0-56(1.7)					at 1000 umho/cm <6 meq/1	
Temperature °C	3-10	15-22	0-155(9.2)						
Sp. cond. (umho/cm)	1100 (1 sample only)	1360-2360	0-4520(870)				750-2000 permissible		
Color (Co/pt units)		14-40	0-4000(56)	<10-75	15				clear
Dissolved Oxygen		5.5-7.5	1.5-superstat(9.7)	>4-saturation					5

Sources: Rocky Mountain Energy Company 1976.

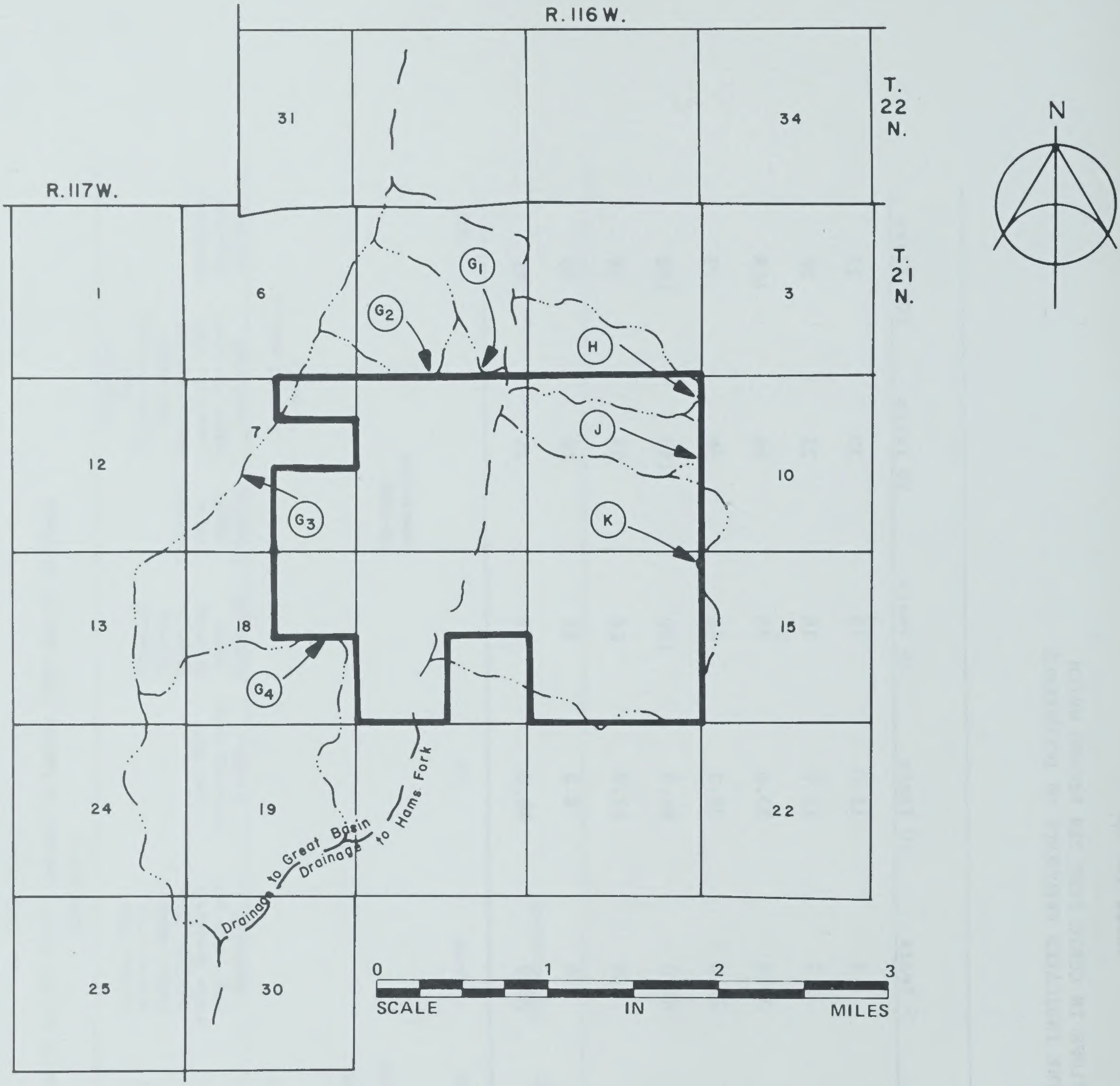
Note: Numbers in parenthesis are averages.

Table TC2-6B

PEAK FLOWS IN CUBIC FEET PER SECOND WHICH
HAVE THE INDICATED FREQUENCY OF OCCURRENCE

Stream	Drainage Area in Square Miles	2 Years	5 Years	10 Years	25 Years	50 Years	100 Years
G1	0.35	3.6	7.3	11.0	15	20	25
G2	0.37	3.8	7.7	11.0	16	21	26
G3	3.02	19.0	38.0	53.0	75	96	118
G4	1.55	12.0	23.0	32.0	46	59	73
G	5.29	33.0	61.0	84.0	120	150	180
H	0.45	3.9	8.0	12.0	17	23	28
J	0.29	2.7	5.6	8.3	12	16	20
K	2.13	14.0	28.0	40.0	57	74	91

Note: Reference Figure TC2-6A.



LEGEND

- MAJOR DRAINAGE DIVIDE
- TRIBUTARY DRAINAGE DIVIDE
- DIRECTION OF FLOW OF TRIBUTARY
- G_2 REFERS TO DRAINAGE AREA IN TABLE (SUBSCRIPT G_1, G_2 INDICATES SUBDIVISION OF AREA OF THE SAME STREAM)

Figure TC2 - 6A

DRAINAGE AREAS OF EPHEMERAL STREAMS CROSSING TWIN CREEK PROJECT AREA

under Section 7 of the Endangered Species Act of 1973 was initiated for Twin Creek with the U.S. Fish and Wildlife Service on 2 March 1978.

The U.S. Fish and Wildlife Service responded by letter dated 7 March 1978 that formal consultation cannot be conducted for unlisted species.

FISH AND WILDLIFE

General Information

Habitat Types

The following are the major habitat types found on the proposed project area and the primary wildlife species associated with each. A complete wildlife species list can be obtained from the Rock Springs District Office of the BLM.

Aquatic. No aquatic habitat exists on the proposed project area.

Terrestrial.

Sagebrush (1,306 acres). The sagebrush habitat type includes sage grouse, Say's phoebe, horned lark, black-billed magpie, house wren, sage thrasher, starling, western meadowlark, Brewer's blackbird, vesper sparrow, sage sparrow, Brewer's sparrow, desert cottontail, white-tail jackrabbit, least chipmunk, Richardson ground squirrel, Uinta ground squirrel, deer mouse, meadow vole, sagebrush vole, coyote, red fox, striped skunk, mule deer, and pronghorn antelope.

Winterfat (1,164 acres). Most, if not all, of the above listed species would be found in the winterfat habitat type.

General. Raptors which may be seen foraging in one or all habitat types are the red-tailed hawk, Swainson's hawk, rough-legged hawk, golden eagle, prairie falcon, and American kestrel.

Herd Units

The Wyoming Game and Fish Department has designated areas of management for big game herds. These areas are called herd units and each one contains an individual big game population. All big game population numbers and density estimates in this report are based upon herd units.

Fishery

No fishery exists on the proposed Twin Creek Mine.

Wildlife

Birds

Nongame. The major small nongame and songbird species are listed under the sagebrush habitat type at the beginning of this section. The Wyoming Game and Fish Department breeding bird survey indicates about 19 individuals per square mile in all habitat types combined. Although these figures are average estimates for resident species, it must be understood that nomadic arid land species (e.g., crows) may significantly increase these numbers.

Many raptors forage in the area, but no nests have been located.

Game. The primary game bird species is the sage grouse which inhabits the area yearlong (Wyoming Game and Fish Department).

No critical habitat or strutting grounds are known to occur on the proposed project area.

The Twin Creek proposal is part of both the Uinta and the Seedskadee Management Units. The northeastern three-fourths of the project area is within bird management section number 7 of the Seedskadee Management Unit. The southwestern one-fourth of the project area is within bird management section number 5 of the Uinta Management Unit. For ease of calculation, the entire area will be considered to be in the Seedskadee Management Unit. The average population of sage grouse within the management unit is about 15,300 birds or approximately 9 individuals per square mile (Wyoming Game and Fish Department 1977). However, there are areas (e.g., wintering areas, strutting grounds, etc.) where the density will be much greater.

Endangered and (or) Threatened. No endangered and (or) threatened bird species are known to exist on or near the proposed mine site.

Mammals

Nongame. The primary small nongame mammals are Richardson ground squirrel, Uinta ground squirrel, least chipmunk, deer mouse, meadow vole, and sagebrush vole. The only small nongame mammal population information available for southwestern Wyoming indicates about 5 individuals per acre in the sagebrush type (Maxell 1973). Since no information is available for the winterfat type, the above density figure will be projected over the entire area.

Game. There is about 560 acres of antelope winter/yearlong range in the southern portion of the proposed permit area (Map TC2-8A). This yearlong range is within the Carter Lease Herd Unit for antelope which has a present population of 2,500 or approximately 5 individuals per square mile of yearlong range. By 1982, the Wyoming Game and Fish Department hopes to have a population of 3,000 animals. About five to ten antelope presently use the project area. The remaining area is not considered antelope habitat (Wyoming Game and Fish Department 1977).

The entire proposed project area is considered summer range for mule deer. The northeastern three-fourths of the project area is within the West Green River Herd

Unit for deer which has a present population of 8,000 or about 8 deer per square mile. The desired population is 10,000 by 1982. The southwestern one-fourth of the project area is within the Carter Lease Herd Unit which has a present population of 3,000 or about 7 deer per square mile. The desired population is 6,300 animals by 1982. It is estimated that 10 to 20 deer use the project area during the summer months.

Endangered and (or) Threatened. No endangered and (or) threatened mammal species are known to exist on or near the proposed project area.

Reptiles and Amphibians

General. The species expected to occur on the area are the yellow-bellied racer, Great Basin gopher snake, wandering garter snake, short-horned lizard, sagebrush lizard, northern sideblotched lizard, tiger salamander, leopard frog, Great Basin spadefoot toad, and boreal toad.

The best information indicates that in the sagebrush and winterfat types there are about two to three individuals per acre (personal communication, Dr. George Baxter, University of Wyoming, January 1978).

Endangered and (or) Threatened. No endangered and (or) threatened reptile or amphibian species are known to exist within the proposed Twin Creek project area or surrounding vicinity.

Wild Horses

No wild horses inhabit the proposed mine site or surrounding vicinity.

CULTURAL RESOURCES

Archeological

Several archeological surveys have been conducted within the proposed Twin Creek project area. In 1974, M. Ann Bennett, World Wide Surveys, Inc., surveyed 640 acres in the proposed Twin Creek project area as a part of a survey conducted to the north of Twin Creek. In 1975, both George M. Ziemens, Wyoming Associate State Archeologist, and M. Ann Bennett conducted surveys in the area. The Ziemens survey covered 2,400 acres within the project area which included most of the mining area. The same year M. Ann Bennett surveyed an area to the south of Twin Creek which included 800 acres within the proposed Twin Creek project area. In 1976, Michael D. Metcalf, Western Wyoming College, surveyed an additional 640 acres within the proposed project area. All of these surveys result in a nearly 100% coverage of the proposed Twin Creek project area. All areas of proposed surface disturbances have been inventoried. Some areas have received double coverage as a result of these surveys.

Two sites have been found within the proposed area to be mined. Both consisted of flake scatters with an absence of diagnostic artifacts. Dating is not possible with present information. These sites suggest a typical single component occupation as is common throughout much of the region.

Metcalf (1977b) estimates a site density for the "Kemmerer Group"which includes North Block, Twin Creek, and some areas to the south of Twin Creek, to be 0.61 sites per section. Michael D. Metcalf suggests that the lack of topographic relief and corresponding lack of plant life diversity accounts for this low site density.

There are no sites listed on the National Register *(Federal* Register Vol. 42, No. 21) within the project area.

Historical

There are no historic sites within the Twin Creek Mine area. None of the historic sites listed on the National Register, *Federal Register* (Vol. 42, No. 21) are within the project area.

VISUAL RESOURCES

The landscape of the Twin Creek project area is typified by rolling sagebrush hills with several intermittent streams. The area is considered a utility corridor which has several light duty and unimproved roads, a major highway (U.S. Highway 30), two railroad spurs, and a pipeline passing through it. The adjacent area to the south of the proposed mine is an active strip mine. Viewpoints along U.S. Highway 30 in the project area are shown on Map TC2-10A and Figures TC2-10A and TC2-10B depict views from the viewpoints.

Based on the BLM format for Visual Resource Inventory and Evaluation (BLM Manual 6310), two Visual Resource Management (VRM) classes have been identified in the project area. The analysis from which these classes have been derived appears in the Pioneer Trails Unit Resource Analysis which is available for public review at the Rock Springs District Office of the BLM. The VRM classes identified in this area are Classes III and IV (Map TC2-10B). The basic management guidelines for these visual management classes are:

Class III—Management would permit changes in the basic elements (form, line, color, and texture) of the characteristic landscape, but would require that the changes remain subordinate to the visual strength of the existing landscape character. Figures TC2-10A and TC2-10B are examples of a Class III area.

Class IV—Management would require that changes be subordinate to the original composition and character, but must reflect what could be a natural occurrence within the characteristic landscape. The Class IV areas look the same as the Class III areas on Figures TC2-10A and TC2-10B except that the Class IV area is not seen from U.S. Highway 30.

Figure TC2-10A

VIEW OF AREA AS IT WOULD BE SEEN FROM VIEWPOINT A TO B ALONG THE RELOCATED U.S. HIGHWAY 30. THIS IS A CLASS III AREA, BUT THE CLASS IV AREAS HAVE THE SAME TYPE OF SCENERY

Figure TC2-10B

VIEW OF AREA AS IT WOULD BE SEEN FROM C TO D ALONG THE RELOCATED U.S. HIGHWAY 30. THIS IS ALSO A CLASS III AREA, WITH THE CLASS IV AREA HAVING THE SAME TYPE OF SCENERY

RECREATIONAL RESOURCES

Visitor Use Data

Table TC2-11A depicts estimated visitor use on the Twin Creek Mine project area.

Table TC2-11B depicts the estimated general resident visitor use by activity in Lincoln County which includes the proposed Twin Creek Mine. These data are based on a local population of 7,132 for southern Lincoln County in 1977. Data used to calculate visitor use are available for public review at the Rock Springs District Office of the BLM.

Hunting

Hunters pursue deer, antelope, cottontail rabbits, sage grouse, and rodents in the vicinity of the proposed Twin Creek Mine. The deer and antelope hunting is a coincidental opportunity; in other words, some days the animals are present while other days they may have moved to some other locality depending on hunting pressure and availability of water and forage.

The close proximity of the town of Kemmerer encourages fairly heavy use by hunters after sage grouse, rodents, and cottontail rabbits. According to the BLM Pioneer Trails Unit Resource Analysis, the area provides "A"quality hunting for sage grouse, cottontail, and rodents. This "A"quality rating means there are high animal populations, it's easy for hunters to move around the area, and there is good shooting opportunity once game is jumped.

Sightseeing

Wildlife offers the only sightseeing opportunity in this area as the general scenery is rolling sagebrush with a railroad passing through. The major access is U.S. Highway 30.

Specialized Activities

Off-Road Vehicle

Four-wheel drive and motorcycle enthusiasts use the area for approximately 20 visitor days a year. This use is generally by people driving through on their way to some other locality.

Wilderness Values

There are no areas in or near the proposed Twin Creek project area which have been identified as having wilderness values which meet the criteria set in Section 603 of the Federal Land Policy and Management Act of 1976.

AGRICULTURE

Livestock Grazing

Approximately 39% (1,108 acres), 29% (835 acres), and 32% (898 acres) of the project area are within the Cumberland/Uinta, Moyer, and Airport Grazing Allotments, respectively.

The Cumberland/Uinta Grazing Allotment contains about 459,302 acres and is utilized by 44 livestock operators. (Grazing data obtained from the Rock Springs District Office of the BLM.) Ten of the operators run sheep and 34 are involved in cattle operations. Approximately 37,279 animal unit months (AUMs) per year are authorized on public lands of the allotment. Seasons of use are from late April through mid January. The allotment is stocked at a rate of 7.1 acres per AUM.

Two livestock operators are licensed to graze livestock within the 5,411 acre Airport Grazing Allotment. One operator summers about 15 head of cattle (period of use: May 16 to September 30) and the other operator obtains grazing for sheep (periods of use: 475 sheep from April 13 to May 1 and 535 sheep from July 2 to July 10). In addition to licensed use, about 28,000 sheep, owned by eight livestock operators, are trailed, under BLM permit, across the Airport allotment for the purpose of changing winter/summer range. The allotment has a carrying capacity of 1,034 AUMs, which would allow a stocking rate of 5.2 acres per AUM.

Livestock belonging to one operator utilize forage of the Moyer grazing allotment. The allotment contains about 985 acres. About 2,500 head of sheep are turned in for a period of 1 week in late June. A stocking rate of 5.3 acres per AUM is allowed.

Livestock water in the proposed mining area is limited in quantity and distribution. One seasonal impoundment is in Section 9, and one in Section 16, T. 21 N., R. 116 W. The east fork of Twin Creek provides livestock water intermittently.

Prime Farmland

Consultation with personnel of the U.S. Department of Agriculture, Soil Conservation Service, Rock Springs, Wyoming, revealed that prime farmland is not present in areas proposed for disturbance (see Regional ES, Chapter 9, Consultation and Coordination).

MINERAL RESOURCES

No mineral resources, except for coal, are known to be present in the area of the proposed Twin Creek Mine.

Table TC2-11A

1976 ESTIMATED VISITOR DAYS BY ACTIVITY IN THE TWIN CREEK MINE AREA

Activity	Visitor Days
Hunting	35
Sightseeing	100
Off-road vehicle	20
Total	155

Note: Visitor day considered to be 12 hours.

Table TC2-11B

ESTIMATED RESIDENT VISITOR USE BY ACTIVITY IN 1977

Activity	Visitor Days
Fishing	29,800
General [1]	29,200
Hunting	9,400
Off-road vehicle [2]	1,200
Sightseeing	9,100
Urban	18,400
Water sports	13,800
Winter sports	3,700

[1] General includes camping, picnicking, etc.
[2] Estimate by ES team Outdoor Recreation Planner.

Coal

The coal seams in the Adaville Formation are lenticular and erratic in occurrence and quality. Many of the seams thicken and thin over a relatively short distance and may disappear completely (Figure TC2-13A). Several of the coal seams attain a thickness of 40 feet or more, and one coal seam, the Number 1 seam, exceeds 60 feet in thickness. Reportedly, there are 32 seams containing workable coal 5 feet or greater in thickness within the Twin Creek project area.

Reserves are estimated at 220 million tons (in place) under 1,000 feet or less of overburden in seams greater than 4 feet thick. Recoverable reserves of the thin, steeply dipping seams, some with high sulfur content, are estimated at between 20 and 40 million tons of coal acceptable for power production under the clean air requirements now in force.

The Twin Creek project area consists of approximately 2,006 acres of private land and 306 acres of public land, held under federal coal lease W-075207.

Pits 3 and 3E are on coal lease W-075207. The coal in Pit 3E, namely the 2C seam, is not marketable due to the high sulfur content and can only be utilized by blending with the coal mined from Pit 3. The depth of mining in Pit 3E is, therefore, limited by the amount of coal which can be used to blend and improve the quality (see Figure TC2-13A).

The base of Pit 3 is the bottom of the 4E seam. Although there are coal seams below the 4E, their depth is such that the overall stripping ratios for a deeper pit, combined with the other stripping costs on the private land south of the highway, are not acceptable economically.

LAND USE PLANS, CONTROLS, CONSTRAINTS

A number of separate governmental agencies exercise land and resource use controls in Lincoln County. The proposed Twin Creek Mine includes public, state, and private lands. The federal sector is administered by the Bureau of Land Management (national public lands and mineral estate under certain private lands). Except where controls have been specifically delegated by statute to counties or municipalities, Wyoming retains total jurisdiction over nonpublic and privately owned lands (including mineral leasing, rights-of-way, etc.). Counties have authority to effect a wide variety of controls in matters not specifically reserved to the state. The authority applies only to those portions of the county that are unincorporated. A county may regulate and restrict location and use of buildings and structures and use, condition of use, or occupancy of lands for residency, recreation, agriculture, industry, commerce, public use, and other purposes that are reasonably necessary to protect the public good of its citizens. Lincoln and Uinta Counties have a joint planning office located in Kemmerer, but extensive zoning and countywide planning actions have not been initiated. All of the respective jurisdictions (federal, state, and county) have sufficient authority to impose effective land and resource use controls.

TRANSPORTATION NETWORKS

Highway

U.S. Highway 30 crosses the middle of the Twin Creek mining area. This two-lane road is designed for moderate to heavy vehicle traffic and runs east-west from Interstate 80 through Kemmerer to Idaho (see Map TC2-10A). There are no posted weight limits on any of the bridges within the area. In 1976 there were approximately 10,900 vehicle license tabs sold in Lincoln County.

Railroads

A main line of the Union Pacific Railroad (Oregon Shortline) passes through the mining area. Current railroad traffic on the railroad system through the region is depicted on Table TC2-14A. There is a spur line running south from the main line through Section 16. This spur services the coal mine and power plant at Elkol (see Map TC2-10A).

SOCIOECONOMIC CONDITIONS

The social and economic environment that would be affected most significantly by the proposed Twin Creek Mine includes the Kemmerer/Diamondville area in Lincoln County.

Population

The estimated 1977 population of Lincoln County (that portion within the ES region) was 7,132 persons (Abt Associates 1978). The population of Kemmerer/ Diamondville in that year was 3,655. The remaining population of the county is spread out in several much smaller towns and in rural areas.

The county has experienced significant growth since 1970. The population of the Kemmerer/Diamondville area has increased 59% (1,363) over the 1970 figure of 2,292 (U.S. Department of Commerce, Bureau of Census 1970a). The growth in this community was primarily related to the expansion of the Viva Naughton Power Plant, a 122% increase in Lincoln County coal production, a 100% increase in phosphate production west of Kemmerer, and the development of a coke plant south of Kemmerer (Abt Associates 1977).

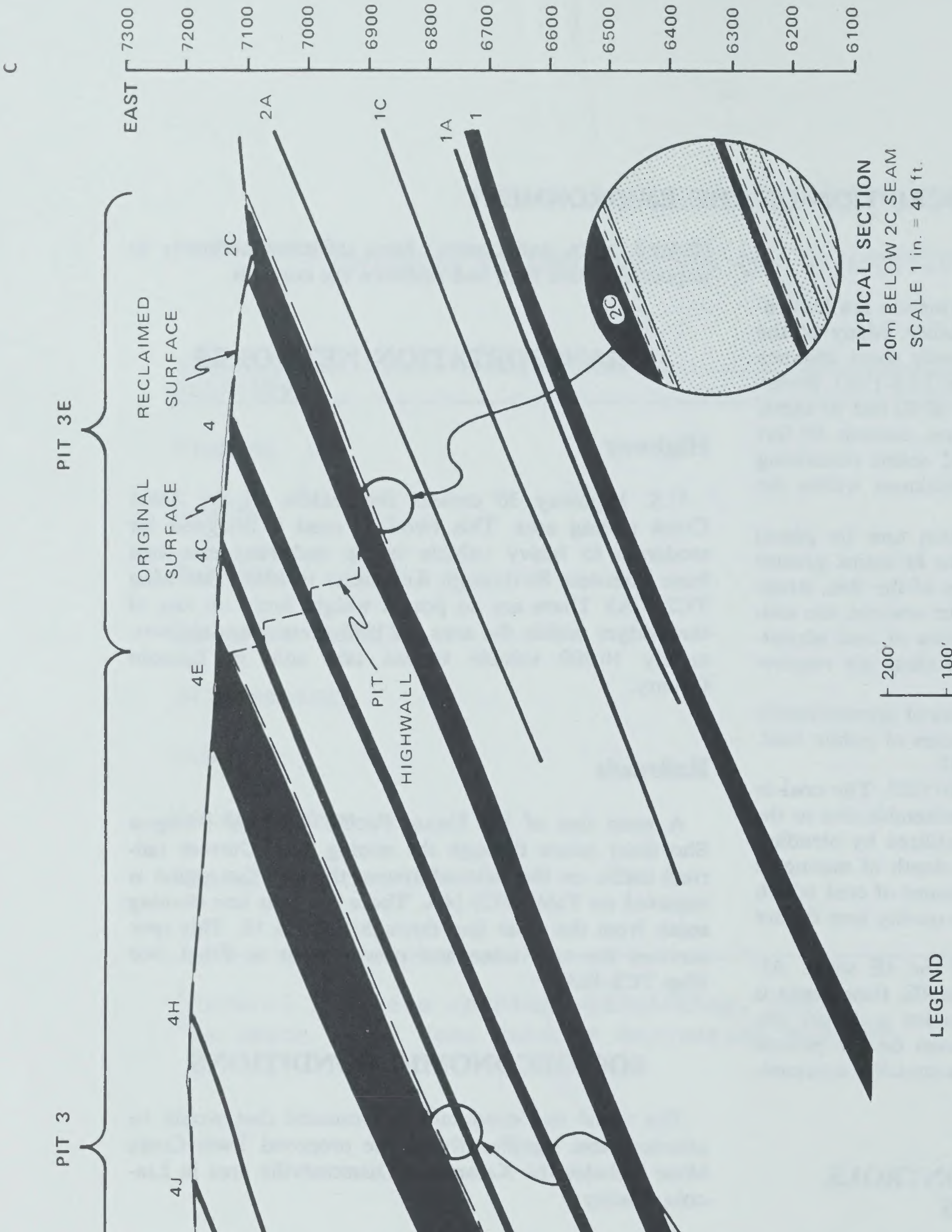


Figure TC2-13A

TWIN CREEK PROJECT
CROSS SECTION C – C'

Table TC2-14A

ESTIMATED CAPACITIES OF IDENTIFIED LINE SEGMENTS

Segment	Number of Tracks	Signaling	Length (miles)	Estimated Capacity (Trains Per Day)	Current Traffic (Trains Per Day)	Estimated % Capacity
Kansas City to Topeka	2	ABS	68	55-60	44	73%
Topeka	1	CTC	203	25-30		73%
to Gibbon	2	CTC	17	70-80	22	28%
Council Bluffs to Gibbon	2	ABS	176	55-60	34	57%
Gibbon	2	ABS	100	55-60		88%
to North Platte	2	CTC	8	70-80	53	66%
North Platte	2	ABS	182	55-60		78%
to Cheyenne	2	CTC	43	70-80	47	59%
Cheyenne	3	CTC	35	100-115		44%
to Hanna	2	CTC	108	70-80	51	64%
Hanna to Rawlins	2	CTC	40	70-80	45	56%
Rawlins	2	ABS	101	55-60		73%
to Green River	2	CTC	33	70-80	44	55%
Green River to Granger	2	CTC	30	70-80	40	50%
Granger to Kemmerer	1	CTC	40	25-30	13	43%
Kemmerer to McCammon	1	CTC	174	25-30	13	43%
McCammon to Pocatello	1	CTC	174	25-30	13	43%

Table TC2-14A

ESTIMATED CAPACITIES OF IDENTIFIED LINE SEGMENTS
(Continued)

Segment	Number of Tracks	Signaling	Length (miles)	Estimated Capacity (Trains Per Day)	Current Traffic (Trains Per Day)	Estimated % Capacity
Granger	2	ABS	126	55-60		53%
to Ogden	2	CTC	19	70-80	32	40%

Source: Union Pacific Railroad Company, 1978.

ABS = Automatic Block Signals
CTC = Centralized Traffic Control

Employment

Total employment in Lincoln County was estimated at 3,670 in 1977 (Table TC2-15A). Approximately 31% (1,146) of these jobs were in the mining and construction sectors. The unemployment rate in the county increased to 6.3% (302 persons) in 1977 from a 1974 low of 4.7% (180 persons) (U.S. Department of Commerce, Bureau of Economic Analysis 1974 and Wyoming Employment Security Commission, Research and Analysis Division 1977).

Income

The median family income in Lincoln County in 1977 was $13,800 which was a 77% increase over the 1970 figure of $7,796. The growth is attributable to increased mineral production with its higher salaries. Over 50% of the county's labor force earns less than $15,000 per year. Total personal earned income in 1977 was $44.6 million, while per capita income was $6,252 (Abt Associates 1978).

Infrastructure

Private Sector

The Kemmerer/Diamondville area is the retail trade center for the southern half of Lincoln County. Estimated county retail sales (city data not available) in 1977 were $17,300,000; wholesale revenues in 1977 were estimated at $5,600,000 (Abt Associates 1978). Mining and construction are the primary industries in the county.

Public Finance

Recent growth in Lincoln County has allowed the county and its communities to reduce both property tax rates and levels of bonded indebtedness. Current operating costs are apparently being met while the capacity of the entities to respond to future growth has been enhanced. Assessed valuation was $116.1 million in 1977 (Abt Associates 1978).

Housing

It is estimated that in 1977 there were 1,444 dwelling units in the Kemmerer/ Diamondville area (county data are not available). In spite of recent construction, the demands for housing are still greater than what is available. Many residents are forced to turn to mobile homes in lieu of more permanent housing. Abt Associates (1977) estimates that mobile homes constitute 15%-30% of housing in the various communities of the county.

Education

Southern Lincoln County including the Kemmerer/ Diamondville area is served by School District 01. Its enrollment in 1977 was 912 (Abt Associates 1978). The district currently has excess classroom capacity. Table TC2-15B provides data on educational system characteristics.

Health and Social Services

The recent population expansion has put severe strains on these services. The county is short personnel and facilities frequently requiring residents to travel outside the area for treatment. Table TC2-15C shows the health services profile for Lincoln County. Mental health services are provided by the Jackson-based Western Wyoming Mental Health Association. The primary provider of social services in the county is the State Department of Health and Social Services, Division of Public Assistance and Social Services (Abt Associates 1977).

Police and Fire Protection

The Lincoln County Sheriff's Department has seventeen full-time and ten volunteer officers. The department shares its facilities with the five-man Kemmerer police force. The county jail is currently too small (Abt Associates 1978).

Kemmerer's 24-person fire department serves all of southern Lincoln County. It has an insurance rating of eight, which indicates an organized fire department with deficiencies in the fire department and water supply (Abt Associates 1978).

Water and Sewer Systems

The Kemmerer/Diamondville area (including Frontier) receives its water from the Hams Fork and the Kemmerer Reservoir. The city owned (Kemmerer) facility can provide up to 3 million gallons of treated water per day. The system, including storage, is considered adequate (Abt Associates 1978).

Kemmerer has a 500,000 gallon per day sewage treatment facility (conventional step aeration activated sludge process). It is currently operating above capacity and is not in compliance with 1977 effluent standards (Department of Environmental Quality, Wyoming Water Pollution Control Program for Fiscal Year 1977). Other communities in the county have individual systems that are generally considered adequate (Abt Associates 1978).

Utilities

The Lincoln Service Company provides power to the Kemmerer/Diamondville area. It purchases its power from the Naughton Power Plant. Natural gas is obtained from the Northwest Pipeline Company through the local supply company (Wyoming Industrial Gas Company).

Table TC2-15A

EMPLOYMENT: LINCOLN COUNTY

	1977 Lincoln County
Total Employment	3,670
Proprietors	800
Farm	269
Nonfarm	531
Wage and salary	2,870
Farm	227
Nonfarm	2,643
Government	492
Private	2,151
Manufacturing	183
Mining	626
Construction	517
Transportation	210
Trade	351
Finance, insurance and real estate	40
Services	207
Other	17

Source: Abt Associates 1978.

Table TC2-15B

EDUCATIONAL SYSTEM CHARACTERISTICS: LINCOLN COUNTY

	Lincoln County Kemmerer SD#1
1977 fall enrollment[1]	912
Number of classroom teachers full-time equivalent)[1]	50.5
Student/teacher ratios[1,3]	18.1
Total annual expenditures ($-millions)[1]	1.66
Average daily membership (ADM)[1]	922
Expenditures per ADM[2,4] ($)	1,681
Assessed valuation ($-millions)[1]	59
Assessed valuation per ADM[2,5] ($)	64,991
Number of classrooms[1]	44

[1] Wyoming Department of Education, Division of Planning, Evaluation, and Information Services, 1977.

[2] Derived from Wyoming Department of Education data.

[3] Fall 1977 statewide average for classroom teachers - 18.4 (Wyoming Department of Education, Division of Planning, Evaluation and Information).

[4] 1976-1977 statewide average expenditures per ADM - $1,721. (Wyoming Department of Education, Division of Planning, Evaluation and Information).

[5] 1976-1977 statewide average assessed value per ADM - $31,143 (Wyoming Department of Education, Division of Planning, Evaluation and Information).

Table TC2-15C

HEALTH AND SOCIAL SERVICES: LINCOLN COUNTY

Personnel Facilities	Lincoln County[2] Number[1]	Lincoln County[2] Ratio Per Population Increment	State Standard Ratio Per Population Increment
Physicians	3	1:2,377	1:1,000
Nurses (Employed)			
Registered Nurses (RNs)	9	1:792	1:285
Licensed Practical Nurses (LPNs)	5	1:1,426	1:769
Public Health Nurses (PHNs)	1	1:7,132	1:7,660
TOTAL	15		
Dentists	3	1:2,377	1:1,600
Optometrists	1	1:7,132	1:7,000
Hospitals	1	1:7,132	1:19,944
Hospitals Beds	20	1:357	1:179
Ambulances	5	1:1,426	1:3,740
Emergency Rooms	1	1:7,132	1:13,296
Mental Health Centers	1	1:7,132	1:12,397

Sources:

[1] Interview with Dr. Gayle Robinson, Administrator, South Lincoln Hospital, Kemmerer, January 1978. (Numbers reflect personnel and facilities associated with South Lincoln Hospital only; dentists and optometrists expected.)

[2] Wyoming Division of Health and Medical Services 1977.

No power supply problems are anticipated in the county in the near future (Abt Associates 1978).

Attitudes and Expectations

The attitudes and expectations of county residents are dependent upon the benefits that they expect to receive from recent growth and the local governments' abilities to cope with the pressures resulting from it. Those involved in the mining and construction sectors generally have a favorable outlook financially. They make high salaries and enjoy the benefits that accompany above average incomes. Residents employed in local services with their lower wages, persons on fixed incomes, and the poor are less optimistic. Their lower incomes make it difficult to compete for goods and services with the inflated prices arising under rapid growth conditions. Items such as adequate housing, especially the purchasing of a new home, become very difficult to attain.

Nearly all residents, however, are concerned about the shortages in services that exist in most areas. The huge increase in population has put great demands on social services (hospitals, dentists, etc.), recreation facilities, public facilities (roads, sewage systems, etc.), and consumer services. It has also led to unplanned growth that has resulted in scattered mobile home parks, traffic congestion, and other problems associated with overcrowding. These difficulties have made many residents unhappy with life in the area. Unable to get needed services and find recreational or cultural outlets, many leave causing high turnover rates in housing and jobs. Crime, drinking, and family problems have all risen.

On the other hand, the local governments have made significant efforts to remedy the situation. The county has a joint planning office with Uinta County, and comprehensive plans have been or are being prepared to control future growth. The increased population and new industry have brought in new funds to support additional services and facilities to help cope with demands (Abt Associates 1977).

Life Styles

There are two basic components to life styles in Lincoln County. The older and more permanent style is primarily rural in nature. Communities have a small-town atmosphere with life centering on outdoor activities, hard work, church, and family. The recent industrial growth has threatened this way of life. Many older residents resent it, even though they have benefited from it in terms of expanded services and higher incomes in many cases. There is also concern about maintaining the wide-open spaces associated with this area. Mining and other industrial activities would disturb the land both physically and visually.

Economic growth and increased industrialism has, however, changed much of the rural atmosphere of Kemmerer/Diamondville. Laborers from other communities, including large cities, have entered the county. They are accustomed to more city-centered activities and have found the transition to a smaller town difficult. The increase in population has also brought many of the problems associated with larger towns (traffic, crime, noise, etc.) as well as the benefits (more services and expanded facilities). The newer population has in effect brought with it a faster pace of life, a turn towards greater industrialism, and a trend toward urbanization (Abt Associates 1977).

FUTURE ENVIRONMENT

Lincoln County's population will increase from an estimated 7,132 persons in 1977 to 7,799 in 1980, due primarily to new employment opportunities in the mineral and power industries. There will be a decline in population (to an estimated 7,120 in 1985), due to construction having been completed on major projects, such as the Viva Naughton Power Plant expansion, and the subsequent departure of construction workers. By 1990, the population will be an estimated 7,233 persons, a slight increase above 1977 levels.

Approximately 50% of the county's population growth will be in the Kemmerer/ Diamondville area. There will be moderate increases in personal income, retail and wholesale sales, and housing demands; however, most demands on the county's services, caused by new growth, will become insignificant after 1980.

Population changes in Lincoln County will effect corresponding changes in the use of transportation networks. It is estimated that annual vehicle license tab sales will increase from 10,900 in 1976 to 12,900 in 1978 to 1980, and then decrease to 10,900 in 1980 to 1985. Annual sales in 1985 through 1990 will be an estimated 11,100, a slight increase over the 1976 level. Table TC2F-14A presents estimated increases in railroad traffic.

Estimated changes in recreational visitor use in Lincoln County through 1990 are shown in Table TC2F-11A.

Adverse and beneficial impacts to cultural and paleontological resources will show correlation with developmental and population trends.

The air quality, climate, geology, topography, soils, water resources, vegetation, fish and wildlife, visual, and mineral resources of the lands comprising the Twin Creek project area will not change appreciably through 1990, without the proposed mining.

The expanded Viva Naughton Power Plant will have a local affect on air quality (see Maps R2-2A and R2-2B).

Table TC2F-14A

ESTIMATED FUTURE RAILROAD TRAFFIC WITHOUT COAL MINING IN SOUTHWEST WYOMING

Segment	Estimated Capacity[1] (trains per day)	Current Traffic[1,2] (trians per day)	1980 Traffic[3,4] (trains per day)	1980 % Capacity	1985 Traffic[3,4] (trains per day)	1985 % Capacity	1990 Traffic[3,4] (trains per day)	1990 % Capacity
Kansas City to Topeka	70-80	44	48	60	56	70	65	81
Topeka to Gibbon	70-80	22	24	30	28	35	32	40
Council Bluffs to Gibbon	55-60	34	37	62	43	72	50	83
Gibbon to North Platte	70-80	53	58	73	67	84	78	98
North Platte to Cheyenne	70-80	47	51	64	60	75	69	86
Cheyenne to Hanna	70-80	51	56	70	65	81	75	94
Hanna to Rawlins	70-80	45	49	61	57	71	66	83
Rawlins to Green River	70-80	44	48	60	56	70	65	81
Green River to Granger	70-80	40	44	55	51	64	59	74
Granger to Kemmerer	25-30	13	14	47	16	53	19	63
Kemmerer to McCammon	25-30	13	14	47	16	53	19	63
McCammon to Pocatello	25-30	13	14	47	16	53	19	63

Table TC2F-14A

ESTIMATED FUTURE RAILROAD TRAFFIC WITHOUT COAL MINING IN SOUTHWEST WYOMING
(Continued)

Segment	Estimated Capacity[1] (trains per day)	Current Traffic[1,2] (trains per day)	1980 Traffic[3,4] (trains per day)	1980 % Capacity	1985 Traffic[3,4] (trains per day)	1985 % Capacity	1990 Traffic[3,4] (trains per day)	1990 % Capacity
Granger to Ogden	55-60	32	35	58	41	68	47	78

[1]Union Pacific Railroad Company 1978.
[2]Through freight only.
[3]Abt Associates 1978.
[4]Estimates by ES team.

Table TC2F-11A

ESTIMATED RESIDENT VISITOR USE DEMAND BY ACTIVITY
FOR YEARS 1980, 1985, AND 1990

Activity	Visitor Days 1980	Visitor Days 1985	Visitor Days 1990
Fishing	33,200	30,800	31,700
General[1]	32,500	30,800	32,000
Hunting	10,200	9,300	9,400
Off-road vehicle[2]	1,300	1,200	1,200
Sightseeing	10,000	9,400	9,700
Urban	21,200	21,200	22,600
Water sports	15,600	15,100	15,900
Winter sports	4,400	4,500	4,900

Note: Visitor day considered to be 12 hours.

[1] General includes camping, picnicking, etc.
[2] Estimate by ES team Outdoor Recreation Planner.

CHAPTER 3

THE ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

This chapter discusses the impacts that would result from implementation of the proposed Twin Creek Mine. Impacts are linked to specific aspects of the mining and reclamation plan and are quantified to show magnitude, intensity, duration, and incidence.

This chapter also provides the basis for assessing unavoidable adverse impacts in Chapter 5.

ASSUMPTIONS AND ANALYSIS GUIDELINES

An analysis of impacts requires assumptions and guidelines for coal-related development.

Assumptions

1. Labor and equipment shortages would not significantly distort the projected levels of development.
2. No extensive delays would be encountered in obtaining environmental clearances.
3. No extensive delays would be encountered in obtaining rights-of-way (federal and private).
4. The reclamation of mined areas would require an estimated 9 years. This would include 4 years for backfilling, overburden shaping, seedbed preparation, planting and replanting and 5 years for plant establishment (during which time livestock and extensive big game use would be prevented).
5. Areas not disturbed by mining excavation (i.e., rights-of-way, etc.) would not require extensive backfilling and shaping and would be reclaimed in an estimated 8 years.
6. It is assumed that irrigation would be employed, if necessary, to avoid extensive delays in reclamation.

Guidelines

1. Impacts are analyzed for four time points (1980, 1985, 1990, and end of mine life).
2. Impacts remaining after mine reclamation are considered long term.
3. Mining plant site analyses include mine, mine facilities, and all ancillary developments (i.e., roads, power lines, railroad spur tracks, and ponds).
4. The proposed revegetation seeding mixture would be subject to revision based on research results at the proposed mining area and, when applicable, at other locations.
5. Successful reclamation would require the establishment of a diverse, effective, and permanent vegetative cover of native and (or) acceptable introduced species capable of supporting post mining land uses. The living plant ground cover on revegetated areas would have to equal the ground cover of living plants on approved reference areas for a minimum of two growing seasons.
6. Post mining land uses would primarily involve livestock grazing, wildlife habitat, and outdoor recreation (Bureau of Land Management (BLM) Pioneer Trails Management Framework Plan 1977b).
7. The BLM would design and implement appropriate grazing management systems to prevent overgrazing of reclaimed areas.

AIR QUALITY

Emissions from the Proposed Mine

The specific emission sources of the Twin Creek Mine are presented in Table TC3-2A. From this table, it is obvious the fugitive dust emissions are included in this analysis (43 CFR 118 regulations are not applied) and, therefore, represent a conservative (upper-bound) assessment of the impact of the proposed mine. However, based on state-of-the-art emission calculations and modeling techniques, this analysis reflects as accurately as possible the impacts of the mining and reclamation plan which was on file with the Geological Survey (USGS) at the time of this modeling effort.

For the contribution of wind erosion from unreclaimed and partially reclaimed land, the most probable situation would be represented by mulching and furrowing in the spring, followed by fall planting. Note that the projected emissions (Table TC3-2A) were based on the assumption that mulching and planting would be performed in the fall in a one-step operation. Surface roughness impediments to erosion (furrowing), moreover, were neglected in that analysis. If these control measures were included in the analysis, the total emissions shown in Table TC3-2A would be reduced by 22%, 39%, 40%, and 20% for the years 1980, 1985, 1990, and end of mine life, respectively.

As shown in the preceding paragraph, best management practices were not necessarily included in the air quality impact analysis. Only those mitigating measures

Table TC3-2A

TWIN CREEK PARTICULATE EMISSIONS

	Total Suspended Particulates in Tons per Year			
	1980	1985	1990	End of Mine Life
Overburden removal	648	648	648	648
Ore loading	125	125	125	125
Truck dumping	25	25	25	25
Train loading	3	3	3	3
Conveying	13	13	13	13
Coal storage	1	1	1	1
Crushing (primary)	1	1	1	1
Crushing (secondary)	4	4	4	4
Overburden dump disturbance	255	180	0	0
Employee access roads	1	1	1	1
Haul roads (coal)	105	105	158	158
Haul roads (overburden)	359	222	0	0
Haul road repair	56	56	56	56
Dozers (overburden dumps)	81	81	81	81
Wind erosion	729	1,702	1,434	415
Totals	2,406	3,167	2,550	1,531

Source: ERT 1978b.

discussed in the Twin Creek mining and reclamation plan on file with the USGS at the start of this rewrite were included in the modeling. In any event, the worst-case mine situation is discussed, and best management practices will produce fewer and less intense impacts. It was not possible to include best management practices in Chapter 3, because the suggestions came in too late for modeling to be done and, if included now, would negate the continuity of the present analysis. Chapter 8 contains an air quality alternative which discusses the best management practice impacts.

Impact on Air Quality

Figures TC3-2A through TC3-2D show the mine-related suspended particulate (SP) concentrations for worst-case annual and 24-hour averages predicted by the model. Concentrations are shown to decrease rapidly with distance. Annual and 24-hour mine-related concentrations decrease to 10% of maximum values at 1.5 to 3 miles and 1.5 to 2 miles downwind of the mine, respectively.

When annual average background particulate values of 16 micrograms per cubic meter ($\mu g/m^3$) for 1980 and 15 $\mu g/m^3$ for all other years (ERT 1978a) are added to projected mine-related contributions, total levels are predicted to be greater than the annual primary National Ambient Air Quality Standard (NAAQS) for 75 $\mu g/m^3$ within 1.5, 1.5, 1, and 1 miles and greater than the annual Wyoming standard of 60 $\mu g/m^3$ within 1.5, 1.5, 1.5, and 1 miles of the mine for the years 1980, 1985, 1990, and end of mine life, respectively. Background concentrations are projected to contribute 70% to TSP levels at 3 to 5.5 miles and 7 to 13.5 miles downwind from the mine for annual and 24-hour averaging periods, respectively.

If projected mine-related 24-hour SP values and background concentrations of 49 $\mu g/m^3$ for 1980 and 46 $\mu g/m^3$ for all other years are combined, concentrations are predicted to be greater than the 24-hour primary NAAQS of 260 $\mu g/m^3$ within 2.5, 2.5, 2.5, and 2 miles and greater than the Wyoming standard of 150 $\mu g/m^3$ within 4, 4.5, 4, and 2.5 miles of the mine for the years 1980, 1985, 1990, and end of mine life, respectively.

A comparison of the worst-case mine impact with Prevention of Significant Deterioration (PSD) regulations is shown in Table TC3-2B. The distances from the mining area within which predicted concentrations are higher than the specified increments are listed for annual and 24-hour averages according to PSD area classification. Concentrations greater than the Class II annual PSD increment are projected to occur within 1.5 to 3 miles and greater than the 24-hour increment within 5.5 to 9.5 miles of the mine.

Note that under the new PSD regulations (43 CFR 118), the violations discussed above would not occur. In fact, the surface mines would be within the applicable NAAQS and PSD regulations.

The impact of blasting and coal fires is difficult to assess, although maximum air quality degradation would occur on a local scale. The cloud of dust produced by blasting would be short-lived, at least compared to the averaging times of the TSP standards (24 hours or greater), so that little contribution to 24-hour levels would be measured outside the mining area. The dust produced would also be initially dispersed to a great degree by the blast. Blasting would generally take place during the day, when meteorological characteristics are most favorable for dispersing ground-level pollutants. Any fire on the site could significantly contaminate the air and cause a safety hazard. However, due to the high degree of fire control technologies, potential fire impacts would probably be minimal.

Gaseous Pollutants

Vehicle emissions would be the only source of gaseous air pollutants from the proposed mine. Federal and state regulations include limitations on ambient air concentrations of the vehicle-related pollutants carbon monoxide (CO), hydrocarbon (HC), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2).

Maximum predicted concentrations of CO ranged between 0.02% and 0.44% of the standard. Maximum predicted HC concentrations ranged between 0.88% and 3.44% of the standard. Maximum predicted NO_2 concentrations ranged between 0.6% and 3.0% of the standards. Maximum predicted concentrations of SO_2 ranged between 0.02% and 0.33% of the standards. The values represent predictions at less than one-half mile from the mines. Predictions were significantly less at further distances from the mines. Assuming similar vehicle activity for all western coal mines, the impact of vehicle emissions on ambient concentrations of gaseous pollutants would be minimal and insignificant compared to their respective standards.

Visibility

Using the technique discussed in the Chapter 4, Regional Technical Report (ERT 1978a), visibilities have been computed downwind from the source. Results for worst-case 24-hour SP concentrations for the years 1980, 1985, 1990, and end of mine life are shown in Table TC3-2C. Also given are the mass fractions of the total TSP for coal and soil for each year which were used to calculate the visibilities shown in Table TC3-2C. For 1980, the visibility of an observer at 1 mile downwind would be approximately 39.1 miles, assuming a background visibility of 40 miles. In general, visibility would increase with downwind distance from the mine. At 5 miles downwind, the visibility would be 39.6 miles, and at 10 miles it would reach 39.7 miles. The corresponding values, assuming a background visibility of 7 miles, are 6.8 miles, 6.9 miles, and 6.9 miles, respectively. Additional analysis years are given in the table.

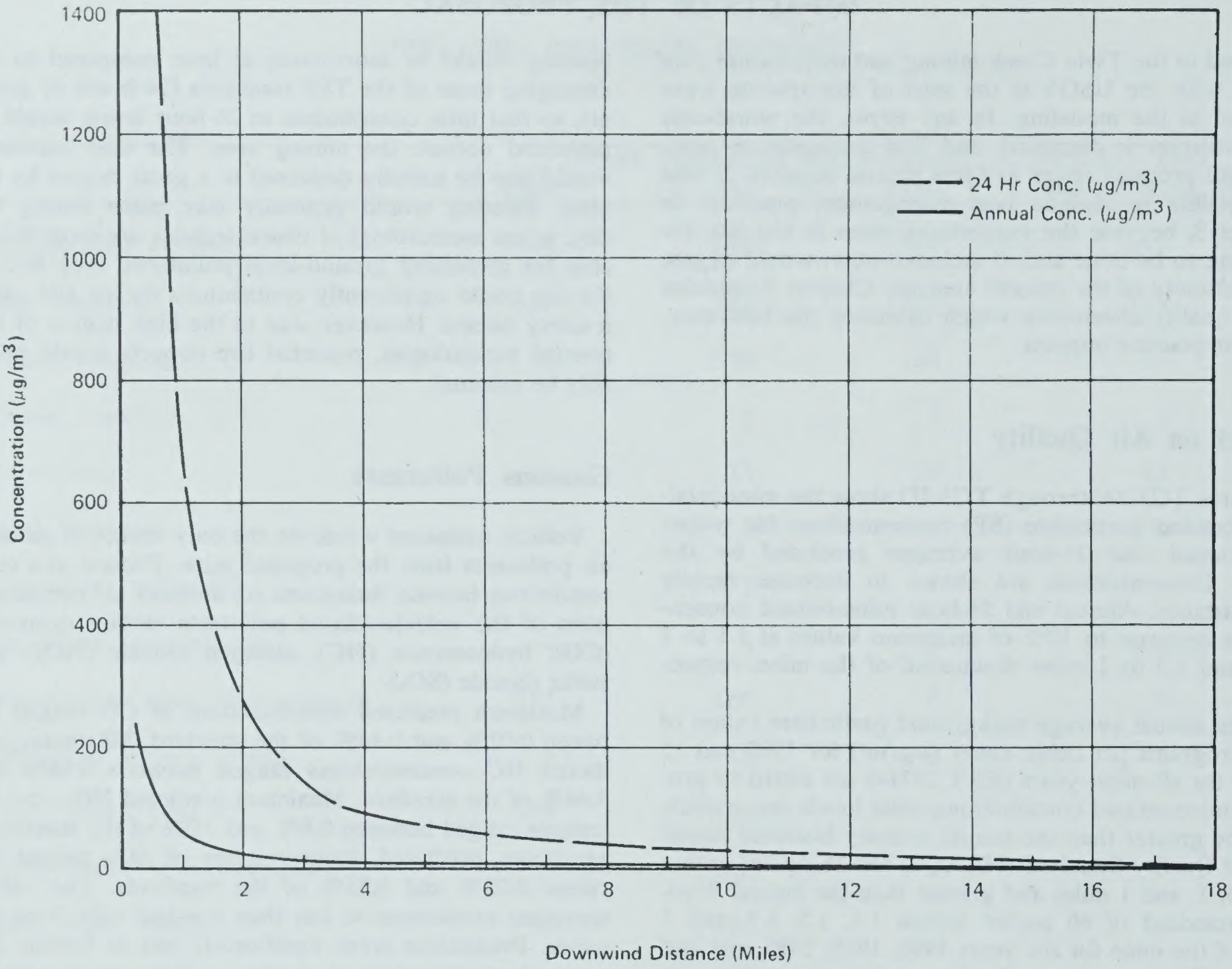


Figure TC3-2A

1980 TWIN CREEK SP CONCENTRATIONS

Source: ERT 1978b.

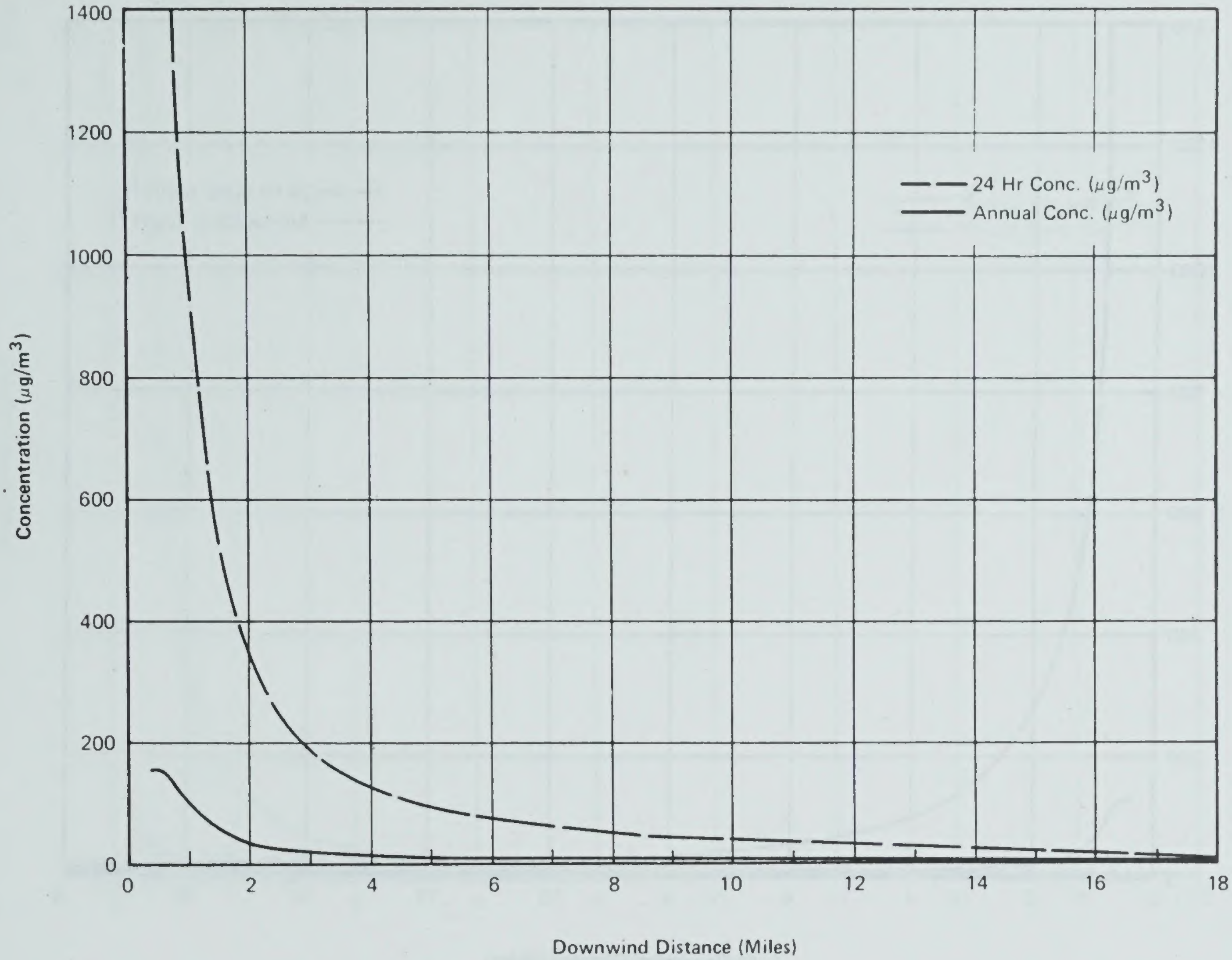


Figure TC3-2B

1985 TWIN CREEK SP CONCENTRATIONS

Source: ERT 1978b.

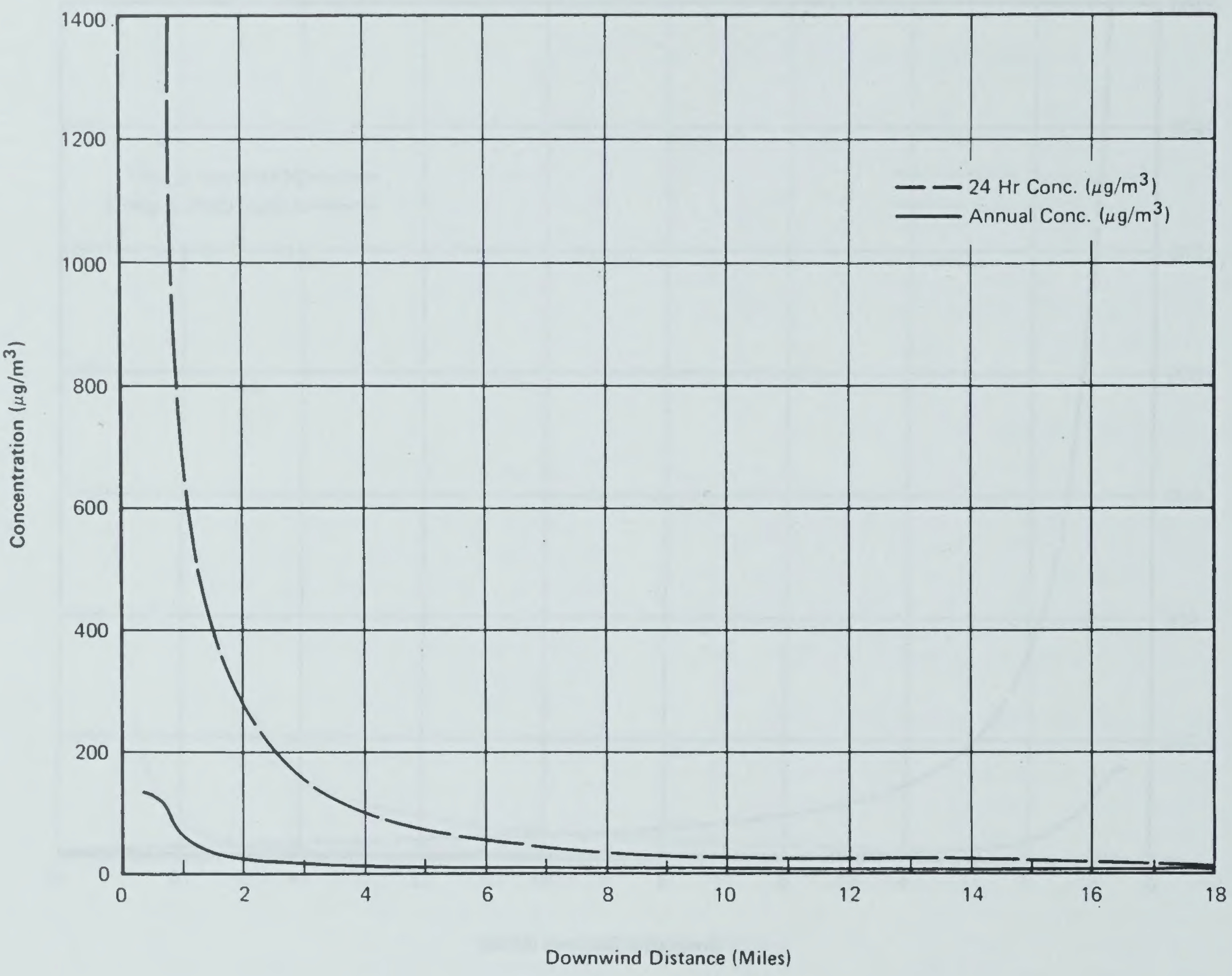


Figure TC3-2C

1990 TWIN CREEK SP CONCENTRATIONS

Source: ERT 1978b.

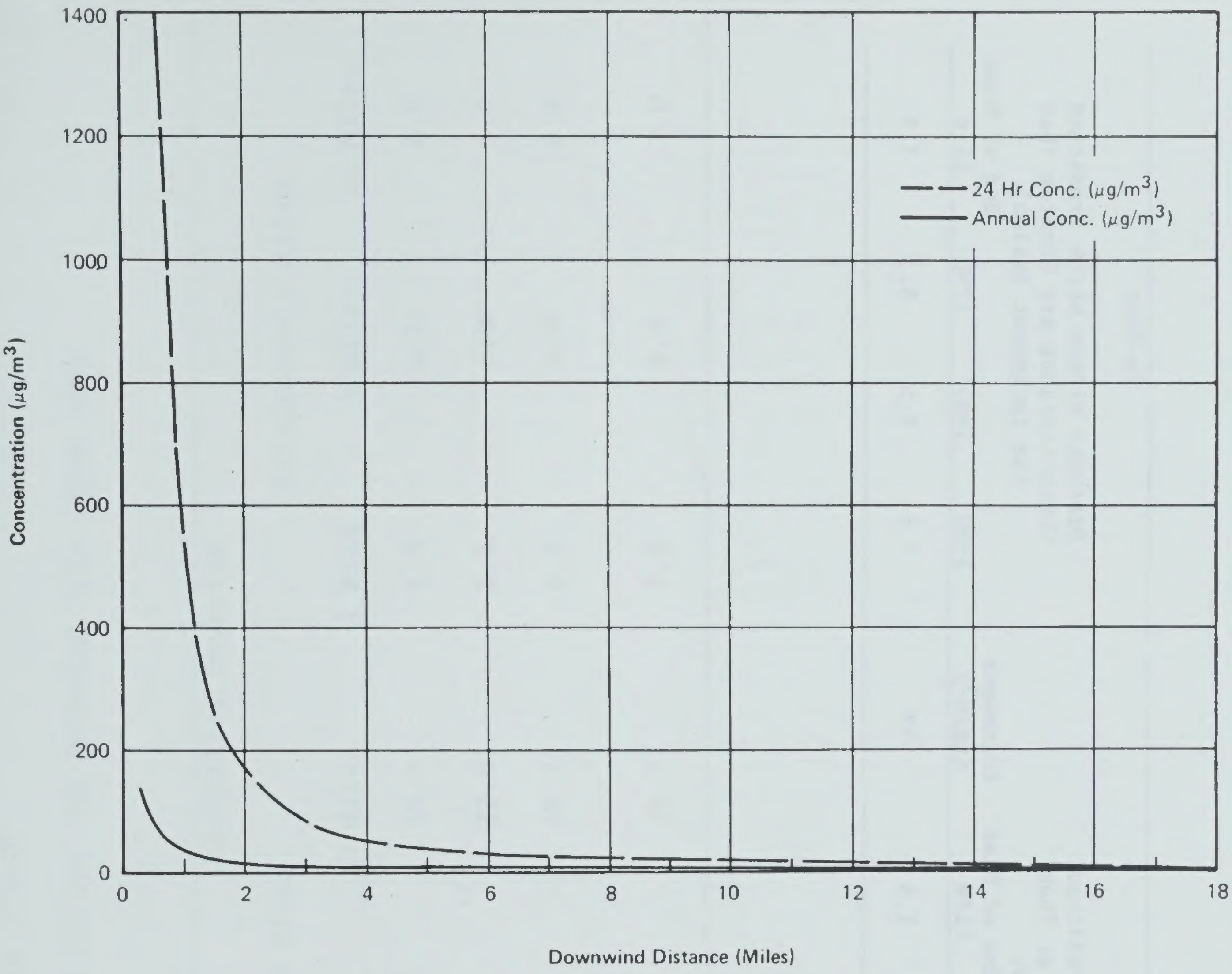


Figure TC3-2D

END OF MINE LIFE TWIN CREEK SP CONCENTRATIONS

Source: ERT 1978b.

Table TC3-2B

COMPARISON OF WORST-CASE MODEL PREDICTIONS WITH PSD REGULATIONS

	Annual					24-Hour				
		Distance Within Which Predicted Concentrations are Greater Than the Increment (miles)					Distance Within Which Predicted Concentrations are Greater Than the Increment (miles)			
Area Classification	Increment ($\mu g/m^3$)	1980	1985	1990	End of Mine Life	Increment ($\mu g/m^3$)	1980	1985	1990	End of Mine Life
II	19	2.5	3	2.5	1.5	37	7.5	9.5	8.5	5.5

Source: ERT 1978b.

Table TC3-2C

ACROSS PLUME VISIBILITY DEGRADATION FOR THE PROPOSED TWIN CREEK MINE

			Visibility Downwind					
	Mass Fraction		Background 40 Miles			Background 7 Miles		
Year	Coal	Soil	1 Mile	5 Miles	10 Miles	1 Mile	5 Miles	10 Miles
1980	7	93	39.1	39.6	39.7	6.8	6.9	6.9
1985	6	94	38.8	39.5	39.6	6.8	6.9	6.9
1990	7	93	39.0	39.6	39.7	6.8	6.9	6.9
End of mine life	12	88	39.4	39.6	39.7	6.9	6.9	7.0

Source: ERT 1978b.

GEOLOGY

Paleontology

Impacts to paleontological resources would consist of losses of plant and invertebrate fossil materials for scientific research; public education (interpretative programs); and to other values. Losses would result from destruction, disturbance, or removal of fossil materials as a result of coal mining activities, unauthorized collection, and vandalism.

A beneficial impact of development would be the exposure of fossil materials for scientific examination and collection which otherwise may never occur except as a result of overburden clearance, exposure of rock strata, and mineral excavation.

Fossil materials of Paleocene and Cretaceous age in the Adaville, Evanston, and Hilliard Shale Formations would be impacted to variable degrees.

All exposed fossilferous formations could also be affected by increased unauthorized fossil collecting and vandalism as a result of increased population. The extent of this impact cannot be presently assessed due to a general lack of specific data on such activities.

Due to the present lack of data and accepted evaluatory criteria for determination of significance, no meaningful assessment can be presently made as to the extent and nature of the loss of these paleontological values to science or education, or hence to the significance of potential impacts on the fossil record.

Geologic Hazards

Because the topography of the natural slopes shows no typical landslide forms, i.e., evidence of previous sliding, and because the rock strata dip into the slopes, the landslide potential is judged to be minimal even though the landslide susceptibility of the rock and earth material is estimated to be high (Radbruch-Hall et al. 1976). If slopes were undercut or oversteepened, however, some caving or sliding could occur during periods of thawing or heavy rain. Where the seams are exposed by mining, zones of burning coal could occur. The mining plan shows that after reclamation coal seams would not be exposed on public land; however, on privately held land the mining plan shows coal seams still exposed after reclamation in Pit 1N. There is a possibility that one or more of these seams might be ignited—either by accident or spontaneously. If this were to happen, the resulting atmospheric pollutants would affect both private and public holdings. The mining company has agreed to cover all exposed seams that are over 4 feet thick and to cover lesser seams where operationally feasible.

The lands are in an area of low seismic activity so the probability of damage resulting from earthquake activity is slight.

TOPOGRAPHY

The total area that would be disturbed by all mining and other activities connected with the proposed mining by 1990 would be 1,932 acres. The area where the impact on the topography would be most significant would be that acreage impacted by the mining itself plus that acreage impacted by the deposition of spoil piles.

Figures provided by the mining company combine the acreage that would be disturbed by mining with the acreage that would be disturbed by the construction of haul roads. The figures provided show 281, 666, and 862 acres disturbed by 1980, 1985, and 1990, respectively. It is assumed that 15% (129 acres) of the final number of acres disturbed (862 acres) would be disturbed by the construction of haul roads. It is further assumed that the haul roads would be built during the earlier phase of the project, so the same 129 acres has been subtracted from all three of the figures given in order to estimate the acreage disturbed by the mining only, and the acreage disturbed by spoil pile deposition has then been added.

By 1980, 380 acres of land would be disturbed by mining and spoil pile deposition at the site. By 1985, 1,206 acres would be disturbed by mining and spoil pile deposition. By 1990, 1,529 acres would have been disturbed by mining and spoil pile deposition. After 1990, only reclamation activities would be in progress, and there would be no further disturbance.

The overall impact on the topography would be the disruption or the complete burial to a depth of from 10 to 250 feet of the 1,529 acres disturbed by mining and by the deposition of spoil piles. In the northern part of Section 17 and in the southern part of Section 8 a large pit approximately 500 feet deep and 140 acres in area would be left open with its western limit (the highwall) being left as a series of catch benches and risers. Most of the risers would be about 80 feet high. The north wall of this pit would be left at its angle of repose of approximately 33 degrees (65%). The east and south walls would be left at slopes of approximately 18 degrees (32½%). It is expected that slopes as steep as these would be too steep for loose materials or soil deposited on them to remain in place during heavy storms.

The relocation of U.S. Highway 30 would involve only minor cuts and fills except in Section 16 where one cut would be from 15 to 20 feet deep and one fill would be from 20 to 25 feet high. The relocation of the highway could possibly lead to gullying along the right-of-way as a result of the channelization of drainage water. Gullying along the right-of-way of the telephone line as a result of the loosening of the earth and rock material would be another possibility.

Construction of a railroad spur would disturb 70 acres and its presence might lead to gullying along the right-of-way as a result of the channelization of drainage water.

All streams on the site are ephemeral. The larger streams are the North Branch and the South Branch of the East Fork of Twin Creek in the west part of the area that would be disturbed and an unnamed tributary to Hams Fork in the east part. The North and South

Branch of the East Fork of Twin Creek would, after reclamation, be left in essentially their present positions. All minor tributaries to them and all the small coulees in which they flow would be obliterated. The unnamed tributary to Hams Fork, all its minor tributary streams, and all the small coulees in which they flow would be obliterated. The reclaimed surface of the entire disturbed area would be significantly different from the original natural surface in that all but the most major topographic expression would be obliterated.

The effects of topographic changes on the drainage of the project area are discussed more fully in the Water Resources section.

SOILS

Mining within the Twin Creek project area would result in the disturbance and mixing of soil on 733 acres by 1990. (Table TC2-5A lists soils that would be affected.) The removal, transporting, and stockpiling of topsoil would destroy natural soil structure and would result in a mixing of the various soil textures. Deep removal of soil would result in mixing topsoil with underlying subsoil high in soluble salts. This would result in topsoil contamination. Also the stockpiling process would eliminate a majority of the soil biota. This loss in soil biota would result from the scraping process and the lack of sufficient oxygen supply when they become buried too deep in the stockpile to live (Brock 1966). The cumulative result of the above would be a short-term reduction in soil productivity when the topsoil is used for preparation of a seedbed.

Approximately 288 million loose cubic yards of overburden including lower soil horizons would be removed and disturbed during the 16-year life of the mine. This would result in destruction of the established subsoil horizon/parent material relationships. Surface soil would be disturbed at a higher yearly rate at the beginning of mine life than at the end. An accelerated rate of water erosion would occur on these disturbed areas; however, designed drainageways and settling ponds should hold the generated sediment on the project area during normal rainfall years.

An accelerated rate of wind erosion would occur on areas where the vegetative cover has been removed and not yet reestablished. The amount of soil lost yearly (entering atmosphere) over the average area disturbed and being reclaimed would be 320 tons per year, which is an increase of 250 tons per year over that of the area prior to mining.

After reshaping the land surface during reclamation, soil would be exposed to water action at an accelerated rate until a vegetative cover could be reestablished. The rate of water erosion on areas with recent respread topsoil would be approximately 12 tons per acre per year (calculated using Musgrave's Equation, BLM Manual 7317.22A). This is an increase of 8 tons per acre per year over the area as it exists prior to mining. A portion of this soil would be lost for the production of vegetation during reclamation. A large amount of eroded soil would end up in the permanently created pond that would remain after mining. The amount of soil erosion would decrease as vegetation became established. With reclamation activity (machinery traffic) some soil compaction would occur resulting in less water infiltration and, therefore, a decrease in soil productivity on compacted areas undergoing reclamation.

During reclamation, topsoil would be evenly spread over the disturbed areas prior to revegetation. Thus areas deficient in topsoil prior to mining would gain topsoil from sources with a surplus. The result would be some increase in soil productivity on these deficient areas. However, this increase in productivity would not be significant in relation to the reduction of soil productivity on the major portion of disturbed acreage.

Topsoil would be removed and stockpiled from all areas required for surface facilities, spoil piles, haul roads, railroad spur, and water control structures. The area affected totals 1,108 acres. After mining is complete, these areas would be reclaimed. Water erosion would occur on these areas during reclamation with approximately the same rate of erosion as the areas reclaimed over the mine pits as discussed in a previous paragraph. A small, temporary decrease in soil productivity would occur on these areas after reclamation. The construction of housing and support facilities to accommodate the population increase due to mining would result in the removal of approximately 100 acres of soil from production.

The overall result of the mining action would be a short-term lowering of soil productivity on approximately 1,529 acres. Soil productivity would be lowered on 380 acres by 1980, 1,206 acres by 1985, and 1,529 acres by 1990 due to compaction, soil loss, topsoil contamination, destruction of soil structure, and a loss of soil biota. The temporary lowering of soil productivity would affect reclamation of mined lands (see Vegetation section).

If a 10-, 25-, 50-, or 100-year flood occurs when areas are in the process of being reclaimed, an accelerated rate of erosion would occur over the amount that would occur normally. This would result in large amounts of soil loss from the surface being reclaimed. The occurrence of one of these floods during reclamation could considerably lengthen the time required for vegetation reestablishment.

WATER RESOURCES

Ground Water

The westward dipping Adaville Formation would be drained in a large area surrounding the mine, possibly to a level as low as the deepest part of the excavation; however, the layered, discontinuous sandstone within this formation is expected to yield and store only small amounts of water. Water would be supplied for the project by a well now drilled which has been tested at a discharge of 200 gallons per minute (gpm). The well flows naturally at a rate of 20 gpm. Surface coal mines in this area commonly need about 50 acre-feet of water per year per million tons of annual coal production or about 44,600 gallons per day. At the well production rate of 200 gpm, the mine could be supplied by slightly less than 3 3/4 hours of pumping each day. Consequently, water levels in the well and the surrounding aquifer would have adequate time to recover between pumping cycles and there would be little or no residual drawdown from pumping the well. The major cause of drawdown in the Adaville Formation would be from mining operations nearby at the proposed North Block Mine and to the south at the Kemmerer Coal Company operations. Recharge to the water-bearing sandstones would be impaired by the less permeable mixed shales, clays, and sandstone of the mine spoils which would be replaced in the mined out cuts.

There are no water wells within a radius of 3 miles of the mine site which tap the Adaville Formation, so no domestic, stock, municipal, or industrial wells would be affected.

No impact is expected that would lessen the quality of ground water in the Adaville Formation.

Surface Water

The mining unit surface area drains to Hams Fork, Blacks Fork, and Twin Creek, approximately one-fifth of the area to Hams and Blacks Forks in the Colorado drainage and the remainder to Twin Creek in the Great Basin drainage.

Drainage would be temporarily interrupted or altered by spoil piles, haul roads, and mine pits. Storm runoff from the area of spoil and topsoil piles would result in rapid erosion and sediments transported to the main drainages. If sediment supply is in excess of the streams carrying capacity, the excess would be deposited in the channel resulting in aggrading the stream bottom and consequent altering of the stream's flow characteristics, flood characteristics, and its ability to support aquatic life. It is possible that the flow of Hams Fork could be depleted by Pit 1N being left open. The planned bottom elevation of Pit 1N is 6,500 feet. The outcrop of the Adaville crosses Hams Fork north of the lease at an elevation of about 7,100 feet. The open pit would create a large cone of depression in the permeable coals and sandstones which could redirect ground water movement toward the open pit. The quantity of ground water which would flow into the pit is calculated to be small, calculated to be less than 0.02 acre-feet per year, which probably would evaporate from the high wall encrusting it with salts. Little, if any water, except that from a torrential rain, would collect in the proposed stock pond.

Unquantifiable impacts from the proposed mining could occur to the Hams Fork drainage, believed to be an alluvial valley floor. According to 30 CFR 715.17 (j)(2) "Surface coal mining operations located west of the 100th meridian west longitude shall not interrupt, discontinue, or preclude farming on alluvial valley floors and shall not materially damage the quantity or quality of surface or ground water that supplies these valley floors. . ."

Water Uses

Kemmerer Coal Company proposes to produce approximately 2.5 million tons of coal per year. Assuming 50.4 acre-feet of water is needed per million tons of coal produced, then Twin Creek Mine would require about 126 acre-feet of water per year.

VEGETATION

Terrestrial

The Twin Creek mining operation would remove native vegetation from about 1,932 acres. Sagebrush communities occur on about 58% (1,126 acres), winterfat communities on about 40% (773 acres), and wet meadows on about 2% (33 acres of private land) of areas proposed for disturbance. The majority of the disturbance (about 1,831 acres) would be short term, with about 101 acres subject to long-term loss of vegetative production (highway relocation, about 91 acres, and proposed stock pond, about 10 acres).

The mining and reclamation plan indicates that about 643, 1,606, 1,932, and 1,932 acres would experience loss of vegetative cover by 1980, 1985, 1990, and 1995 (end of mine life), respectively. Acreages seeded at the same benchmark dates would be approximately 0, 150, 749, and 1,771. An average of about 107 acres would be disturbed annually. Disturbed areas would range in size from about 61 acres to 280 acres (see Map TC1-2, Mining Sequence).

Some changes in drainages would occur as the result of mining. Overall changes in plant species composition and production would probably be minimal due to the intermittent nature of affected drainages.

Population increases due to mining would result in an estimated loss of about 100 acres of vegetation for housing and support facilities, primarily adjoining existing municipalities. Increased numbers of people in the area would result in additional disturbance of native vegetation, particularly by off-road vehicle use (see Recreational Resources section).

The revegetation of disturbed areas would be difficult due to many factors. Climatic conditions are severe with extremely low and high temperatures; strong winds; and low, erratic precipitation. Moisture would probably be the most limiting factor (May 1975; Cook, Hyde, and Sims 1974), with average annual precipitation of the area estimated to be about 9 inches (see Climate section). Other factors which could hinder revegetation are less than ideal soil properties (see Soils section), competition for moisture and nutrients from undesirable weedy plant species (May 1975), steep slopes, and the loss of seeds and destruction of seedlings by small mammals (Thames ed. 1977).

Despite such problems, successful reclamation appears to have been achieved in the ES region along highway rights-of-way and on areas disturbed by oil and gas activities. Published reclamation research concerning these sites, however, is apparently not available. Natural plant succession is also in evidence on many of these sites, with the rate and extent of succession depending on site characteristics. Hodder (Thames ed. 1977), in discussing highway and mined land reclamation, considered the problems in reclaiming these types of disturbance similar in many respects and dissimilar in others. One major difference expressed was that mined spoils may be manipulated (i.e., farmed, etc.), while roadside problem materials must be accepted as they exist.

Revegetation research in the arid southwestern United States indicates that the reclamation of coal and copper mined lands is possible under extremely harsh environmental conditions (Aldon 1978; Bengson1977; Aldon and Springfield and DeRemer and Bach (Thames ed. 1977)).

Reclamation activities are being conducted at two active surface coal mines in the region. Seeding operations began in 1972 at the Kemmerer Coal Mine, located about 4 miles southwest of Kemmerer, Wyoming. Only 46 acres of 376 acres seeded through 1977 have received topsoil treatment (Kemmerer Coal Company 1977). This situation exists because early mining reclamation laws did not require topsoiling of mine spoils. May et al. (1971) found spoil materials at the Kemmerer Mine to be extremely variable in some properties. Values of pH ranged from 2.2 to 7.3. Some spots were high in aluminum content and extremely low in pH. The most common soil textures found were clay loams and clays. Clay soils are difficult to work into a proper seedbed and are known for poor water infiltration properties (Cook, Hyde, and Sims 1974).

The initial seeding of disturbed lands at the Jim Bridger Mine, located about 35 miles northeast of Rock Springs, Wyoming, was in 1975 (personal communication, Harley Meuret, Jim Bridger Coal Company, 1978). Topsoil has been applied to all lands being reclaimed as required by current state and federal laws. About 246 acres have been graded, topsoiled, and seeded through 1977 (Bridger Coal Company 1978).

Supplemental irrigation is being experimented with at both mines. This practice is considered essential or probably essential, by some reclamation authorities for reclaiming mined lands in areas having low and erratic precipitation (DeRemer and Bach and Aldon and Springfield (Thames ed. 1977)). Both mining companies have in recent years adopted the use of rangeland drills for seeding operations. Drilled seeding is generally considered superior to broadcast seeding, particularly on areas where a good seedbed can be prepared (Vories ed. 1976 and Thames ed. 1977). The use of topsoil, with some reservations, is also recognized as a beneficial treatment in achieving revegetation (Thames ed. 1977 and Vories ed. 1977). In view of the topsoiling deficiencies at the Kemmerer Mine, the early seeding methods employed at both mines, and the short time lapse between the present time and the initial seeding conducted at the Jim Bridger Mine, it is understandable that large scale reclamation has not been achieved at either mine.

A review of current mined-land reclamation literature and analyses of resources available for reclamation indicate that the methods and procedures proposed in the Twin Creek mining and reclamation plan (subject to compliance with SMCRA) would result in the successful reclamation of disturbed lands. However, since conclusive site-specific reclamation success data are unavailable, and since reclamation success is dependent on site-specific conditions and the solving of problems either identified or yet to be identified, a reclamation alternative is presented in Chapter 8. This alternative identifies a procedure to prove the feasibility of on-site reclamation. An estimated 9 years would be required to reclaim strip mined areas and 8 years for other disturbed sites. The reclamation time estimates are based on revegetation results on semiarid to arid mined lands (Aldon 1978; Bengson 1977; Aldon and Springfield and DeRemer and Bach (Thames ed. 1977)) and on the recommended need for plants to be protected from extensive grazing during establishment (Cook, Hyde, and Sims 1974). It is assumed that supplemental irrigation would be employed when necessary to achieve seed germination and seedling establishment. Without irrigation, reclamation would be delayed during years when soil moisture is inadequate.

The achievement of reclamation earlier or later than estimated would lessen or increase impacts to living organisms and their nonliving environment due to the loss of vegetative cover and production (see Air Quality, Soils, Fish and Wildlife, Agriculture, and Water Resources Sections).

Based on the proposed Twin Creek seeding mixtures, reclaimed areas would have a general appearance of grassland. Grasses would be the most common forage class, with shrubs and forbs being reduced in density and cover as compared to premined conditions.

Natural plant succession would occur on reclaimed lands and could restore approximate premined plant cover and composition values in an estimated 30 to 50 years, as suggested by Cook (Vories ed. 1976).

Aquatic

Sufficient information is not available to determine if there would be any impact to the few species of algae and other aquatic vegetation present in seasonal drainages.

Endangered and (or) Threatened

A survey of the project area revealed no plants proposed for endangered and (or) threatened status (Dorn 1977). The process for requesting formal consultation under Section 7 of the Endangered Species Act of 1973 has been initiated with the U.S. Fish and Wildlife Service.

The U.S. Fish and Wildlife Service responded by letter dated 7 March 1978 that formal consultation cannot be conducted for unlisted species.

FISH AND WILDLIFE

General Information

Impacts of the proposed action upon fish and wildlife resources are summarized in Tables TC3-8A, TC3-8B, and TC3-8C. Impacts can be categorized into three general types: (1) loss of fish and wildlife habitat, (2) loss of the carrying capacity of that habitat to sustain fish and wildlife populations, and (3) loss of the fish and wildlife population and their progeny (offspring) over the period of mining and reclamation.

The proposed mining operation would remove native vegetation from about 1,932 acres. Approximately 1,126 acres would be sagebrush, 773 acres would be winterfat, and 33 acres would be wet meadows.

Table TC3-8A

SUMMARY OF IMPACTS ON FISH AND WILDLIFE RESOURCES
ON THE PROPOSED TWIN CREEK PROJECT AREA

Classification of Impacts	Anticipated Impact of Proposed Mine: None	Minor	Major
Fish and wildlife habitat			x
Carrying capacity for fish and wildlife			x
Fish and wildlife populations			
Fishery			
Nongame	x		
Game	x		
Endangered and (or) threatened species	x		
Wildlife			
Birds			
Nongame			x
Game			x
Endangered and (or) threatened species	x		
Mammals			
Nongame			x
Game			x
Endangered and (or) threatened species	x		
Reptiles and amphibians			
General			x
Endangered and (or) threatened species	x		

Table TC3-8B

SUMMARY OF FISH AND WILDLIFE AREA IMPACTED
BY THE PROPOSED TWIN CREEK MINE

	Direct Loss (acres)[1]	Indirect Loss or Adversely Affected Area (acres)[2]
Fish and wildlife habitat		
1980	643	2,894
1985	1,606	7,227
1990	1,932	8,694
End of mine life	1,932	8,694
Area of fish and wildlife carrying capacity affected		
1980	643	2,894
1985	1,606	7,227
1990	1,932	8,694
End of mine life	1,932	8,694
Area in which fish and wildlife populations would be affected		
1980	643	2,894
1985	1,606	7,227
1990	1,932	8,694
End of mine life	1,932	8,694

[1]Totally (100%) affected.
[2]Data are insufficient at this time to determine the degree to which these areas (areas of influence) would be affected. It may be only slightly (10%-20%) or totally (100%), depending upon the individual species involved.

Table TC3-8C

SUMMARY OF ESTIMATED WILDLIFE POPULATION LOSSES

	Estimated Number of Individuals Directly Lost to Proposed Action				
	1980	1985	1990	Mine Life	% of Population[2]
Wildlife					
Birds					
Nongame[1]	600	4.2T	8.5T	16.4T	<1%
Game	20	100	195	295	<1%
Mammals					
Nongame	260T	1.880M	1.956M	3.52M	<1%
Game					
Antelope	24	62	100	155	.3%
Mule deer	24	62	100	155	.2%
Reptiles and Amphibians	2.6T	10.7T	12.88T	21T	<1%

Note: All estimates are for the total population, including that progeny that would have been produced.

[1]All nongame birds except raptors.
[2]These percent figures represent the amount of regional or herd/management unit populations that will be lost by the end of mine life. Percent figures that are underlined are based on herd or management unit populations.

T = Thousands
M = Millions

Habitat Losses

The proposed mining operation would result in both direct and indirect losses to wildlife habitat. Direct losses would include that habitat physically disturbed by mining and related activities. Indirect losses would be that area (area of influence) that would be indirectly lost or affected.

This "area of influence"would be indirectly lost or affected because of the fact that all living organisms, to some degree, exhibit a home range or territory and daily or seasonal migration. Hence, if an organism is impacted upon part of that home range or territory, the remaining part of that home range or territory is also impacted to a certain degree. This degree of impact can range from a slight impact of 10%-20% to a total impact of 100%, depending upon the individual organism or species involved. This area of indirect loss or adversely affected fish and wildlife habitat would range in size from an area equal to the direct habitat loss for such species as a leopard frog to four or five times the area directly affected for such species as the golden eagle. An average of 4.5 times the actual disturbance was used for calculations in this report. Anticipated acreage loss in this area of influence is summarized in Table TC3-8B. Habitat losses for specific seasonal ranges for the major game species are summarized in Table TC3-8D.

Reclamation would have varying degrees of effectiveness to wildlife depending on the wildlife species involved, the plant species used, and the success of revegetation. Reclamation, however, would be difficult in southwestern Wyoming because of soil and climatic conditions (see Twin Creek and Regional Vegetation sections and Regional Wildlife discussion of reclamation). Since quantification of the effectiveness of reclamation to wildlife is not possible with current available information, the numbers representing habitat and population losses do not reflect any post-reclamation return of either one.

Carrying Capacity Losses

As a result of the loss of the fish and wildlife habitat (vegetation and living space) there would exist a loss of that area's ability to support fish and wildlife population. This ability to support fish and wildlife population is known as its "carrying capacity" The loss of this carrying capacity would range from 643 acres (area directly affected) in 1980 to 8,694 acres (area of influence) by end of mine life. The acreages on which carrying capacity loss would occur are summarized in Table TC3-8B.

Fish and Wildlife Population Loss

Introduction

There would be a loss of wildlife populations within the area to be disturbed. For example, if there are five animals per acre in a given area, and 1,000 acres of that area are disturbed, loss to that population would be 5,000 individuals. In addition, there would be a loss of the populations progeny (offspring) over the period of disturbance.

See Fish and Wildlife Population Loss, Chapter 4, Regional, for an explanation of the method used to calculate total population losses.

Fishery

No fishery exists on the proposed mine permit area.

Wildlife

Birds.

Nongame. The primary small nongame bird species impacted would be Say's phoebe, horned lark, sage thrasher, Brewer's blackbird, and sage sparrow.

Based upon breeding bird surveys conducted by Wyoming Game and Fish Department, the best population density estimate currently available is an average of 19 birds per square mile. Using the formula for biotic potential, the proposed mine would account for the loss of an estimated 600, 4,200, 8,500, and 16,400 birds by 1980, 1985, 1990, and end of mine life, respectively. These figures represent a minute percentage of the total population of small birds in the region.

Game. Sage grouse would be the only game bird impacted by the proposed mining operation. There would be a loss of 643, 1,606, 1,932, and 1,932 acres of sage grouse yearlong range by 1980, 1985, 1990, and end of mine life, respectively. The end of mine life figure represents approximately 0.1% of the total sage grouse habitat in bird management section 07 of the Seedskadee Management Unit. Using the assumption of an average of 9 birds per square mile, initial losses would be 9 birds. Losses, including progeny, would be estimated at 20, 100, 195, and 295 birds by 1980, 1985, 1990, and end of mine life, respectively. The loss of 295 birds would represent less than 0.01% of the total sage grouse production in the management section by the end of mine life.

Endangered and (or) Threatened. At this time and with current information, it is not anticipated that there would be any adverse impact to any endangered and (or) threatened bird species. Under Section 7 of the Endangered Species Act of 1973, the Secretary of the Interior will grant no approval which would jeopardize the continued existence of any endangered and (or) threatened species or result in the destruction or modification of their critical habitat.

Mammals.

Table TC3-8D

GAME SPECIES WILDLIFE HABITAT DISTURBANCE

Species and Habitat	Acres Impacted by Time Periods 1980	1985	1990	End of Mine Life	% of Available Range
Sage grouse:					
Yearlong	643	1,606	1,932	1,932	0.1%
Pronghorn antelope:					
Winter/yearlong	560	560	560	560	0.3%
Mule deer:					
Summer	643	1,606	1,932	1,932	0.3%

Note: The percent figures represent the amount of range the disturbance would remove by end of mine life from the total range now available. In some cases, it was more practical to calculate percentages based on herd or management units rather than on a regional basis. These figures are underlined.

Nongame. The primary small nongame mammals affected would be Richardson ground squirrel, Uinta ground squirrel, deer mouse, meadow vole, and sagebrush vole. The best population information available indicates an estimated 5 animals per acre in the sagebrush and winterfat types (Maxell 1973). Using the formula for biotic potential, the proposed mine would account for the loss of an estimated 260,000, 1,880,000, 1,956,000, and 3,520,000 animals by 1980, 1985, 1990, and end of mine life, respectively. Although these figures seem large, they are only a minute percentage of the total production of small mammal populations within the region. In addition, it is realized that small mammal populations do fluctuate greatly and that losses would vary accordingly. However, habitat disturbance would remove the areas' ability to produce that peak population until reclamation is successful.

Game. There would be a loss of about 560 acres of antelope winter/yearlong range by 1980. This figure would remain constant through the end of mine life and represents less than 0.01% of the winter/yearlong range available in the Carter Lease Herd Unit. It is estimated that about five to ten antelope use the area yearlong. Based on this assumption, it is estimated that 155 antelope would be lost over the life of the mine. The loss of 155 antelope by the end of mining would represent about 0.3% of the production of the total population in the herd unit by that time.

The proposed mine would account for the loss of 643, 1,606, 1,932, and 1,932 acres of mule deer summer range by 1980, 1985, 1990, and end of mine life, respectively. Since most of the disturbance takes place in the West Green River Herd Unit, all losses would be related to that unit. The end of mine life acreage figure represents about 0.3% of the summer range available in the herd unit.

There are an estimated ten to twenty mule deer which use the proposed area. Using this assumption, it is estimated that 155 deer would be lost over the life of the mine. The loss of 155 deer by the end of mine life would represent about 0.2% of the production of the total population in the herd unit by that time.

The above estimates include the progeny which would have been produced had mining not taken place.

Endangered and (or) Threatened. At this time and with current information, it is not anticipated that there would be any adverse impacts to any endangered and (or) threatened mammal species of any type. Under Section 7 of the Endangered Species Act of 1973, the Secretary of the Interior will grant no approval which would jeopardize the continued existence of any endangered and (or) threatened species or result in the destruction or modification of their critical habitat.

Reptiles and Amphibians.

General. The primary species impacted would be the yellow-bellied racer, Great Basin gopher snake, wandering garter snake, short-horned lizard, sagebrush lizard, northern sideblotched lizard, tiger salamander, Great Basin spadefoot toad, and boreal toad.

The best density estimate available indicates an average of 2.5 individuals per acre in both the sagebrush and winterfat types (personal communication, Dr. George Baxter, University of Wyoming, January 1978). Using this assumption, it is estimated that 2,600, 10,700, 12,880, and 21,000 individuals would be lost by 1980, 1985, 1990, and end of mine life, respectively. The above estimates include the progeny which would have been produced had mining not taken place.

Endangered and (or) Threatened. At this time and with current information available, it is not anticipated that there would be any adverse impact to any endangered and (or) threatened reptile or amphibian species.

Wild Horses

No wild horses inhabit the proposed mine site or surrounding vicinity.

CULTURAL RESOURCES

Impacts to cultural resources would include: (1) destruction or alteration of all or part of a property; (2) isolation from or alteration of its surrounding environment; and (3) introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting (36 CFR 300.9). These impacts may take place to both archeological and historical sites in the region.

The loss of cultural resource sites and the data contained therein would be a direct result of their physical destruction through land modification required in mining and associated surface facilities, access roads, rail spurs, and power lines. Site destruction could also occur through development-related events such as increased population which could lead to increases in pothunting and vandalism and increased vehicular use of the land resulting in some unintentional destruction of cultural resources.

Because cultural resources are nonrenewable, the physical destruction of any cultural data or artifacts could have a potentially signficant impact on efforts to reconstruct the prehistory and history of the region.

Archeological

A total of 2,761 acres or 97% of the 2,841 acres within the project area were intensively inventoried. One-hundred percent of the areas to be disturbed have been inventoried. Two sites were found. Both sites are threatened by proposed surface disturbances related to and including mining by 1980. Neither of the sites have been determined to be eligible for nomination to the National Register of Historic Places by the criteria established in 36 CFR 800.10.

The potential for buried archeological sites exists within the project area and associated rights-of-way. Early period and Altithermal sites would most likely have been buried by Quaternary deposits through time and, because of their scarcity, would, if present, be of particular importance. These sites are not and would not be evident before actual surface disturbance uncovered them. The proposed action could partially or completely destroy them, and a site may go unnoticed. It is impossible to evaluate the significance of uninventoried or buried sites.

The increase in pothunting, arrowhead collecting, and vandalism that would result from an increase in population would affect all known and unknown resources within the region. The significance of this impact is potentially great since the kind of data removed by these activities, arrowheads and tools, are the major resources for dating and analyzing prehistoric activity.

The projected number of sites within this area, two, is the same as the number of known resources. This is considerably below the regional average of 2.92 sites per section. Using the regional average, the projected number of sites within the project area would be ten sites. The significance of these projected sites cannot be evaluated at this time.

Historical

No historic resources are found within the proposed project area.

VISUAL RESOURCES

Visual Resource Contrast Ratings were derived for the Twin Creek project area using viewpoints along U.S. Highway 30 as critical viewpoints (see Map TC2-10A). The contrast ratings are available for review at the Rock Springs District Office of the BLM. These contrast ratings are summarized in Table TC3-10A. Explanation of the Visual Resource Contrast Rating System (BLM Manual 6320) is also available at the Rock Springs District Office of the BLM.

Contrast is assessed in terms of how the proposal is expected to affect existing physical attributes, i.e., landform, vegetative patterns, and existing structures such as power lines and buildings. Anticipated changes in form, line, color, and texture are analyzed individually in reference to landform, vegetative patterns, and structures. The resulting contrast ratings are compared to the maximum contrast limit for the particular Visual Resource Management class indicated for the land affected by the proposal. In the case of the Twin Creek Mine, two time periods were used, during active mining and post reclamation.

Summary of Visual Contrast Ratings (Table TC3-10A)

Due to the close proximity of the highway to the mining structures, the structures would create strong contrasts which would not meet the BLM visual management quality objectives for the area during the time frame of active mining. After mining the structures would be removed, thus eliminating the visual impacts temporarily created.

The activities of strip mining would also create strong contrasts to the basic elements of line, form, color, and texture. These contrasts would greatly exceed the BLM visual management quality objectives and would result in a change from Visual Management Class III to Class V. After reclamation of Pit 1N which is adjacent to the highway, the 500-foot highwall on the west side and the north slope of the pit would remain unvegetated. The strong contrast would still be evident and would not meet the BLM visual management quality objectives. This would result in a permanent Class V area.

RECREATIONAL RESOURCES

Visitor Use Data

Table TC3-11A depicts estimated change in resident recreation visitor use demand due to the proposed Twin Creek Mine. The changes are those which would result from increased population and would occur in the general region. Data used to calculate this use are available for public review at the Rock Springs District Office of the BLM.

With increased numbers of people recreating in the region, there would be conflicts between ranchers and recreationists. This conflict would result in ranchers restricting access across their private lands. The result of the restricted access would be recreationists concentrating in the areas where there are already large numbers of people recreating. This would greatly reduce the quality of experience for all the people. In areas characterized by a lower quality recreation experience there tends to be a higher frequency of litter and vandalism which results in higher maintenance costs to recreation facilities.

Hunting

Adverse impacts to wildlife hunting would result with restricted access and also with displacement of wildlife as construction and mining destroys the habitat (see the Fish and Wildlife section of this chapter). With an increased number of people using the region, ranchers would be inclined to close the roads which cross their private lands. The impact from the animals moving out and roads being closed would be a loss of hunter days on site. However, the increase in population would result in an increased demand for hunting. The result would be more people traveling farther from their homes to hunt. This would also decrease the quality of hunting experience as more people compete for the same animals.

Table TC3-10A

SUMMARY OF VISUAL CONTRAST RATINGS FOR THE PROPOSED TWIN CREEK MINE

		Activity											
		Mining						Structures					
Views from Critical Viewpoints	Visual Management Class	During Active Mining	Post Reclamation of Mining	During Active Mining	Post Reclamation of Mining	During Active Mining	Post Reclamation of Mining	Active Structures	Post Reclamation of Structures	Active Structures	Post Reclamation of Structures	Active Structures	Post Reclamation of Structures
		FEATURES BEING EVALUATED											
		Land	Land	Veg.	Veg.	Stru.	Stru.	Land	Land	Veg.	Veg.	Stru.	Stru.
A-B	III	3/28*	3/28	3/12	3/11	NA	NA	3/28	0/0	3/12	0/0	3/24	0/0
C-D	III	3/29	3/29	3/11	2/17	NA	NA	3/29	0/0	3/11	0/0	3/30	0/0

Visual Management Class	Maximum Acceptable Impact
Class II	2/10
Class III	2/16
Class IV	/20

* 3 - Highest element contrast
28 - Total score for feature

NA = Feature Not Affected

Table TC3-11A

ESTIMATED RESIDENT VISITOR DAYS DEMAND DUE TO POPULATION
CHANGE FOR THE YEARS 1980, 1985, AND 1990 IN LINCOLN COUNTY

		1980 Population: 676[1]				1985 Population: 618[1]				1990 Population: 665[1]			
Activity	1977	Without Proposed Action	Increase Due to Proposed Action	Total Projection	% of Projection Due to Proposed Action	Without Proposed Action	Increase Due to Proposed Action	Total Projection	% of Projection Due to Proposed Action	Without Proposed Action	Increase Due to Proposed Action	Total Projection	% of Projection Due to Proposed Action
Fishing	29,800	33,200	2,870	36,070	8.0	30,800	2,680	33,480	8.0	31,700	2,910	34,610	8.4
General[2]	29,200	32,500	2,820	35,320	8.0	30,800	2,670	33,470	8.0	32,000	2,940	34,940	8.4
Hunting	9,400	10,200	890	11,090	8.0	9,300	810	10,110	8.0	9,400	860	10,260	8.4
Off-road vehicle[3]	1,200	1,300	110	1,410	7.8	1,200	100	1,300	7.7	1,200	110	1,310	8.4
Sightseeing	9,100	10,000	870	10,870	8.0	9,400	820	10,220	8.0	9,700	890	10,590	8.4
Urban	18,400	21,200	1,840	23,040	8.0	21,200	1,840	23,040	8.0	22,600	2,080	24,680	8.4
Water sports	13,800	15,600	1,350	16,950	8.0	15,100	1,310	16,410	8.0	15,900	1,470	17,370	8.5
Winter sports	3,700	4,400	380	4,780	7.9	4,500	390	4,890	8.0	4,900	450	5,350	8.4

[1]Population change due to project (from Socioeconomic Conditions section).
[2]General includes camping, picnicking, etc.
[3]Estimate by ES Team Outdoor Recreation Planner.

Sightseeing

The construction and mining in the area would cause adverse impacts to recreational sightseeing values due to restricted access and relocation of the existing highway. There would also be adverse impacts to zoological sightseeing due to the displacement of wildlife species. There would be beneficial impacts for geologic and industrial interpretation as the mining operation draws persons to view the area.

Off-Road Vehicles

Adverse impacts to off-road vehicle enthusiasts would result from the restricted access to the area. This restricted access would result in a loss of visitor days to all existing recreation activities on site.

AGRICULTURE

Livestock Grazing

Mining would affect livestock grazing within the Cumberland/Uinta, Airport, and Moyer Grazing Allotments (grazing data obtained from the Rock Springs District Office of the BLM). Cumulative estimated losses in animal unit months (AUMs) would be 223, 1,378, 2,932, and 4,615 by 1980, 1985, 1990, and at end of reclamation, respectively.

About 867 acres of the Cumberland/Uinta Grazing Allotment would be disturbed and about 1,800 AUMs lost. The acreage disturbed (867 of about 459,302 acres) and AUMs lost (approximately 1,800 of about 1,423,180 AUMs) would represent insignificant percentages of acres and AUMs available. Mining would not significantly affect livestock grazing of the allotment.

About 1,338 AUMs would be lost from the Airport Grazing Allotment. This would amount to approximately 6% of the AUMs which would be available without mining, or an average of about 58 AUMs per year for 23 years. An additional 9% of the AUMs which would be available without mining would be lost (an average of about 92 AUMs per year for 44 years) if the North Block mining operation is conducted.

The two livestock companies licensed to graze livestock within the allotment could probably adjust their operations to the loss of AUMs with minimal impact, since the Airport allotment provides but 3.5% of the AUMs needed by one of the operators for a 1,000 head sheep operation and 1.3% of the AUMs needed by the other operator for a 450 head cattle operation.

The Twin Creek and North Block mining activities could require periodic adjustments in the routes used for the trailing of 28,000 sheep across the Airport allotment for the purpose of changing summer/winter range use. Additional supplemental feed would need to be fed the sheep during trailing operations.

The Moyer Grazing Allotment would be severely impacted by mining with about 58% of the grazing allotment acreage disturbed (about 567 of 985 acres). An estimated 1,477 AUMs would be lost or an average of 64 AUMs for 23 years. This loss of AUMs would require the one operator within the allotment to find other pasture for displaced livestock (about 1,280 of the 2,500 sheep grazed in the pasture for a l-week period in June would be displaced) or to effect a reduction in livestock numbers. The proposed relocation of Highway 30 would result in a permanent loss (more than 30 years) of forage production from about 91 acres of the Moyer grazing allotment.

The old portion of Highway 30 (bordering the Cumberland/Uinta allotment) would be removed and the land (about 82 acres) revegetated.

A proposed water development, within the Cumberland/Uinta Grazing Allotment, would not benefit livestock due to apparently insufficient ground water and surface water sources to provide adequate water quantity and quality (see Water Resources, Ground Water section).

Federal grazing licenses would be reduced by the appropriate number of AUMs lost on public lands as the result of mining. Restoration of grazing privileges would be made upon completion of reclamation, as it is believed that reclaimed lands would be capable of supporting premining livestock stocking rates.

The reclaimed lands, however, would require more intensive grazing management than would be needed for undisturbed rangeland (Lang, Berg, Hodder (Vories ed. 1976)).

Prime Farmland

Consultation with personnel of the U.S. Department of Agriculture, Soil Conservation Service, Rock Springs, Wyoming, revealed that prime farmland is not present in areas proposed for disturbance (see Regional,, Chapter 9, Consultation and Coordination).

MINERAL RESOURCES

The recoverable coal reserves within the federal leased area are estimated to be about 16 million tons. Although 16 years is estimated as the lifetime of the project, the mining plans show Pits 3 and 3E (the only pits shown on public land) as beginning to be refilled after the 9th year of operation. Thus, it may be assumed that mining on public land would be completed within 9 years after initial production. With production beginning in 1979, recoverable reserves on public land would be exhausted by 1988. The mining plans show Pit 3 as still being refilled until the end of the project.

A major impact of the proposed mining operation on the mineral resources of the public lands would be the removal of 16 million tons of coal within a time-span ending about 1988. The total amount of coal to be removed during the life of the mine is 40 million tons. The total amount of coal to be mined is 5 million tons by

1980, 17.5 million tons by 1985, and 30 million tons by 1990.

The removal of this more readily recoverable coal would leave only the less accessible reserves, thus rendering those reserves less economically attractive.

An unknown quantity of coal in the overburden and (or) interburden would be lost. This coal would be in seams too thin or of too low a quality to be of economic interest.

TRANSPORTATION NETWORKS

Impacts to transportation networks in the Twin Creek project area would result from: (1) mining activities requiring relocation of U.S. Highway 30, (2) transportation of coal out of and supplies into the area, and (3) increased employment and population with its increased vehicles and miles traveled.

The mining plan states that U.S. Highway 30 would be relocated during the life of the mine. During construction this would cause an inconvenience to the many people who use this highway. There would be delays in travel time, increases in vehicle/heavy equipment accidents, and possible damage to travelers' vehicles as they pass through the construction area.

There are several light use two-track roads and a BLM maintained road which pass through the area. Destruction of these roads would limit recreation access.

Transportation of coal out of the area would be by railroad. The Twin Creek Mine would add 100 trains per year east and 150 trains per year west and return of these trains to the railroad traffic. Table TC3-14A depicts the estimated increased traffic over rail segments.

The shipment of supplies by truck would add to the already overcrowded conditions on highways and streets in the Kemmerer/Diamondville area.

Increases in employment and population would also put additional vehicles on highways and streets around Kemmerer/Diamondville. Table TC3-14B depicts the increased number of vehicle license tabs that would be sold as a result of the proposed action as compared to without the proposed action. The increase of people using private roads crossing ranches may induce ranchers to close their private roads.

SOCIOECONOMIC CONDITIONS

The primary socioeconomic impacts of the Twin Creek Mine would be associated with increases in population, employment, and income.

Population

The populations of both Lincoln County (that portion in the ES region) and the Kemmerer/Diamondville area would increase because of the new jobs made available by the construction and operation of this mine and the induced employment that would result. As shown on Table TC3-15A, the total population of Lincoln County would reach 7,898 by 1990, while Kemmerer/Diamondville's would reach 4,353. The Twin Creek Mine would cause 665 of the county's 1990 total and 647 of Kemmerer/Diamondville's. The mine would cause higher rates of growth both countywide and in Kemmerer/Diamondville than would otherwise occur. Between 1977 and 1980, the county's rate of growth would be greater by approximately 3.2%, and Kemmerer/Diamondville's would be nearly 6.7% greater. These are significant, because most small communities efficiently grow at a rate of 2% to 3% annually. These rates would reduce to insignificance after 1980.

The projected increases in population (especially between 1977 and 1980) would cause a number of indirect impacts to both the public and private sectors of the county. With the closing of the Twin Creek Mine, 300 mining jobs would be lost to Lincoln County. If other employment opportunities were not available, out-migration would occur. This would result in reduced basic employment, population, and the demand for local goods and services. These impacts should not be significant since the closing of the mine would probably be phased over a period of time and the effects would be only temporary.

Employment

Approval of this mine would impact Lincoln County, especially the Kemmerer/ Diamondville area, by providing approximately 100 construction jobs between 1978 and 1980. Eventually, 300 permanent mining jobs would be available starting in 1980 (Cumberland Coal Company 1976). An additional 68 jobs should also become available as induced employment to support the population increase caused by the mine (Abt Associates 1978). These would be a significant increase in job opportunities.

These employment increases would, as mentioned earlier, result in a higher population with additional indirect impacts. These would include increases in local incomes (see Income section) and reduced unemployment (specific data not available). There would also be minor negative impacts if laborers were pulled out of other employment sectors. The high wages offered by the mining industry could cause temporary shortages in these other areas (Abt Associates 1977).

Income

Population and employment increases would cause total earned income in the county to rise significantly. Table TC3-15B shows projected income in 1980, 1985, and 1990 with approval of the Twin Creek Mine. Earned income would eventually reach $80.2 million in 1990. The impact of the mine in 1990 would be $7.1 million. Per capita income would not be significantly affected by the mine.

Table TC3-14A

ESTIMATED TRAIN VOLUME INCREASES ON TRACK SEGMENTS OF THE UNION PACIFIC RAILROAD IN AVERAGE TRAINS PER DAY

			1980				1985				1990			
Segment	Estimated[1] Capacity	Current[1,2] Traffic	Projected[4] Volume w/o Coal	Total[1] Number Coal Training	Coal Trains[4] due to P.A.	Total Volume	Projected[4] Volume w/o Coal	Total[1] Number Coal Training	Coal Trains[4] due to P.A.	Total Volume	Projected[4] Volume w/o Coal	Total[1] Number Coal Training	Coal Trains[4] due to P.A.	Total Volume
Kansas City to Topeka	55-60	44	48	2.6	0.5	48.5	56	1.8	0.5	56.5	65	1.6	0.5	65.5
Topeka to Gibbon	70-80	22	24	5.0	0.5	24.5	28	7.6	0.5	28.5	32	7.0	0.5	32.5
Council Bluffs to Gibbon	55-60	34	37	10.8	0	37	43	11.0	0	43	50	10.2	0	50
Gibbon to North Platte	70-80	53	58	16.0	0.5	58.5	67	18.4	0.5	67.5	78	17.6	0.5	78.5
North Platte to Cheyenne	70-80	47	51	12.8	0.5	51.5	60	12.2	0.5	60.5	69	11.4	0.5	69.5
Cheyenne to Hanna	70-80	51	56	13.4	0.5	56.5	65	12.8	0.5	65.5	75	11.4	0.5	75.5
Hanna to Rawlins	70-80	45	49	6.2	0.5	49.5	57	5.2	0.5	57.5	66	5.8	0.5	66.5
Rawlins to Rock Springs	70-80	44	48	6.2	0.5	48.5	56	6.2	0.5	56.5	65	6.8	0.5	65.5
Rock Springs to Green River	70-80	44	48	1.4	0.5	48.5	56	2.6	0.5	56.5	65	3.4	0.5	65.5
Green River to Granger	70-80	40	44	1.8	0.5	44.5	51	3.0	0.5	51.5	59	3.8	0.5	59.5

Table TC3-14A

ESTIMATED TRAIN VOLUME INCREASES ON TRACK SEGMENTS OF THE UNION PACIFIC RAILROAD IN AVERAGE TRAINS PER DAY
(Continued)

			1980				1985				1990			
Segment	Estimated[1] Capacity	Current[1,2] Traffic	Projected[4] Volume w/o Coal	Total[1] Number Coal Training	Coal Trains[4] due to P.A.	Total Volume	Projected[4] Volume w/o Coal	Total[1] Number Coal Training	Coal Trains[4] due to P.A.	Total Volume	Projected[4] Volume w/o Coal	Total[1] Number Coal Training	Coal Trains[4] due to P.A.	Total Volume
Granger to Kemmerer	25-30	13	14	2.6	0.5	14.5	16	4.6	0.5	16.5	19	6.8	0.5	19.5
Kemmerer to McCammon	25-30	13	14	1.4	0.8	14.8	16	2.8	0.8	16.8	19	4.0	0.8	19.8
McCammon to Pocatello	25-30	15	16	2.8	0.8	16.8	19	5.8	0.8	19.8	22	9.4	0.8	22.8

[1] Union Pacific Railroad Company 1978.
[2] Through freight only.
[3] Abt Associates 1978.
[4] Estimates by ES team.

Table TC3-14B

ESTIMATED VEHICLE LICENSE TAB SALES

	1976	1978-1980	1980-1985	1985 to End of Mine Life
Sales without proposed actions	10,900	11,900	10,900	11,100
Sales due to proposed actions	NA	1,000	900	1,000
Sales with proposed actions	NA	12,900	11,800	12,100

NA = Not Applicable

Table TC3-15A

(1) PROJECTED POPULATION: LINCOLN COUNTY

	1977	1980				1985				1990			
		Population Projection				Population Projection				Population Projection			
	Estimated Population	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action
Lincoln County	7,132	7,799	8,475	1,343	676	7,120	7,738	606	618	7,233	7,898	766	665
Kemmerer/ Diamondville	3,655	3,996	4,725	1,070	729	3,648	4,271	616	623	3,706	4,353	698	647
Balance of county	3,477	3,803	3,750	273	-53	3,472	3,467	-10	-5	3,527	3,545	68	18

(2) PROJECTED POPULATION ANNUAL RATES OF GROWTH: LINCOLN COUNTY

		1978-1980				1981-1985				1986-1990			
Lincoln County	N/A	3.1%	6.3%	N/A	3.2%	-1.7%	-1.7%	N/A	0%	0.3%		N/A	0.4%
Kemmerer/ Diamondville	N/A	3.1%	9.8%	N/A	6.7%	-1.7%	-1.9%	N/A	-0.2%	0.3%		N/A	0.4%
Balance of county	N/A	3.1%	2.6%	N/A	0.5%	-1.7%	-1.5%	N/A	0.2%	0.3%		N/A	0.4%

Source: Abt Associates 1978.

Note: Cumulative Impact = projection "with" the proposed action - 1977 estimate.
Impact of the Proposed Action = projection "with" the proposed action-projection "without" the proposed action.

N/A = Not Applicable

Table TC3-15B

PROJECTED INCOME: LINCOLN COUNTY

	1977	1980				1985				1990			
		Income Projection				Income Projection				Income Projection			
	Estimated Income	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action
Lincoln County													
Per capita income	$6,252	$7,272	$7,493	$1,241	$221	$8,646	$8,736	$2,484	$90	$10,105	$10,154	$3,902	$49
Total earned income (millions)	$44.6	$56.7	$63.5	$18.9	$6.8	$61.6	$67.6	$23.0	$6.0	$73.1	$80.2	$35.6	$7.1

Source: Abt Associates 1978.

Note: Cumulative Impacts = projection "with" the proposed action - 1977 estimate.
Impact of the Proposed Action = projection "with" the proposed action-projection "without" the proposed action.

Specific information is not available, but several indirect income impacts could also occur. Most of the benefits of the higher income would go to those in the mining and construction sectors; those in the local service sector, on fixed incomes, and the poor could be placed in an even less favorable financial position. This would occur if prices continue to inflate, making it even more difficult for these groups to compete for goods and services. However, increased income would cause increased consumer spending and provide benefits to the community as retail revenues and taxes to local governments increased (Abt Associates 1977 and Gilmore 1974).

Infrastructure

Private Sector

The Kemmerer/Diamondville area would continue to be the leading commercial center of southern Lincoln County. The larger population would continue to place pressures on existing services and facilities in local communities. County retail sales would increase significantly as shown on Table TC3-15C; the mine would be responsible for 8.4% ($3.2 million) of the total projected sales in 1990. Wholesale sales would also rise significantly, from an estimated $5.6 million in 1977 to $7.8 million in 1980, $9.3 million in 1985, and $12.4 million in 1990. The impact of the proposed action would be more than 8% of total sales in 1990.

Public Finance

Two moderate impacts to local government would be likely to occur. Government expenditures could be expected to continue to increase in order to provide more and improved services and facilities to residents, and increased revenues (through higher property valuations and more tax income) could accrue to local governments.

Housing

The larger population caused by this mine would put additional demands upon the housing industry in the county. Table TC3-15D shows the additional units that would be required with approval and consequent operation of it. The Kemmerer/ Diamondville area would require 74% (439 units) of the cumulative new housing in the county. If the housing industry does not keep pace with the population growth, these housing impacts could become significant as the present housing shortage becomes even more aggravated.

Education

A larger school-age population would occur during the 1977 to 1980 period because of this mine (228 student increase). Pupil expenditures, classroom demands, and pressures on student/teacher ratios would all slightly expand. They should not cause excessive adjustments since most schools in the district are currently operating below capacity, and the school age population would decline, along with the population, after 1980.

Social Services and Facilities

The effects of this one mine are difficult to assess because it is not known how the local governments would respond to the demands of an additional 665 people over other projected growth spread over 13 years. Many services and facilities are already being expanded or are in the planning stages. Some of these improvements may cover the effects of the mine. In any case, the mine would put some additional pressures on current services and facilities. Additional doctors, nurses, fire and police personnel and facilities, and water and sewer facilities would be required (Abt Associates 1977); however, the impacts would generally be insignificant, except during the 1977 to 1980 period.

Attitudes and Expectations

Residents opposed to continued growth and disturbance of the wide-open spaces would view the mine as a further aggravation of their position. In spite of the benefits (employment and income increases), they would resent the increased population and urbanization that would occur, even though it would be slight from this one mine (see Population section). Those persons who would benefit from the mine directly (mine employees and local merchants for example) would welcome the employment opportunities and higher wages they could expect to receive. Their positions would advance financially, and they would see the mine as a chance to improve the quality of their lives. Those in the lower income brackets and unable to improve their positions because of the mine could see it as further depressing their situation. They could see it as detrimental because it would continue to inflate prices, make it harder to compete for goods and services, and widen the gap between their incomes and those in the mining sector (Abt Associates 1977).

Life Styles

This one mine should not cause significant impacts to the life styles that currently exist in the county. The trend towards urbanization would continue, but as discussed in the Population section, most of this growth should occur in the Kemmerer/Diamondville area. Some would still feel, however, that it was aggravating the situation by inducing unwanted new growth (Abt Associates 1977).

Table TC3-15C

PROJECTED RETAIL AND WHOLESALE SALES: LINCOLN COUNTY
($ - Millions)

	1977	1980				1985				1990			
		Sales Projection				Sales Projection				Sales Projection			
	Estimated Sales	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action
Lincoln County													
Retail sales	$17.3	$22.2	$24.1	$6.8	$1.9	$26.4	$28.7	$11.4	$2.3	$35.1	$38.3	$21.0	$3.2
Wholesale sales	$5.6	$7.2	$7.8	$2.2	$0.6	$8.5	$9.3	$3.7	$0.8	$11.3	$12.4	$6.8	$1.1

Source: Abt Associates 1978.

Note: Cumulative Impact = projection "with" the proposed action - 1977 estimate.
Impact of the Proposed Action = projection "with" the proposed action-projection "without" the proposed action.

Table TC3-15D

PROJECTED HOUSING DEMAND: LINCOLN COUNTY

	1977	1980				1985				1990			
		Housing Projection				Housing Projection				Housing Projection			
	Housing Units	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action
Lincoln County[1]													
Total	NA	NA	NA	408	236	NA	NA	594	276	NA	NA	594	276
Kemmerer/ Diamondville	1,444	1,532	1,768	324	236	1,607	1,883	439	276	1,607	1,883	439	276
Single family	729	782	900	171	118	827	965	236	138	827	965	236	138
Multi family	303	315	348	45	33	326	365	62	39	326	365	62	39
Mobile homes	412	435	520	108	85	454	553	141	99	454	553	141	99
Balance of county[2]	NA	NA	NA	84	0	NA	NA	155	0	NA	NA	155	0
Single family	NA	NA	NA	54	0	NA	NA	101	0	NA	NA	101	0
Multi family	NA	NA	NA	12	0	NA	NA	22	0	NA	NA	22	0
Mobile homes	NA	NA	NA	18	0	NA	NA	32	0	NA	NA	32	0

Source: Abt Associates 1978.

Note: Cumulative Impact = projection "with" the proposed action - 1977 units.
Impact of the Proposed Action = projection "with" the proposed action-projection "without" the proposed action.

[1]Projected balance of county housing needs are not available because 1977 data are not available.
[2]Projected balance of county housing needs are not available because base year (1977) data are not available.

NA = Not Available.

CHAPTER 4

MITIGATING MEASURES NOT INCLUDED IN THE PROPOSED ACTION

MEASURES

Mining and Reclamation Plan

U.S. Geological Survey (USGS)

Twin Creek Mitigating Measure 1. To reduce losses of cultural resources from pothunting and vandalism because of increased population, Twin Creek mitigating measure 1 will be implemented. The measure states that the lessee will confine all vehicle use to existing roads and trails in culturally sensitive areas.

Twin Creek Mitigating Measure 2. To reduce losses of subsurface archeological sites caused by mining and other surface disturbing activities, a qualified archeologist acceptable to the Bureau of Land Management (BLM) and the State Historic Preservation Officer (SHPO) will be contracted by the lessee to conduct intensive inventories on the remaining unsurveyed portions of land within the proposed project area and to be present during the initial surface disturbance of all of those zones or areas of alluvium which were determined to be sensitive by inventory. The lessee may opt to conduct trenching and (or) test bore holes of identified sensitive areas prior to mining or surface disturbances using an archeologist and methodology acceptable to the BLM and SHPO. If sites of National Register quality are found, the BLM will prepare section 106 compliance case reports for each occurrence and appropriate mitigation will be conducted in consultation with the SHPO and advisory council. Salvaging or testing of non-National Register sites will be conducted pending the professional judgment of the archeologist. Monitoring four times a year of sensitive areas and particularly those adjacent to areas of proposed surface disturbance, whether in or outside the mine boundary, will also be required by the lessee using an archeologist acceptable to the BLM.

Twin Creek Mitigating Measure 3. The BLM and USGS are currently developing a Memorandum of Understanding relating to the protection of paleontological resources on public lands. Those agencies are also developing technical guidelines to define the resource, provide evaluatory criteria, and provide measures for protection. When finalized the provisions of these documents will serve as a basis for management of paleontological resources and appropriate protective programs.

Twin Creek Mitigating Measure 4. To enhance the ability of reclaimed lands to support premine wildlife uses, seed mixtures used for revegetation will include plant species beneficial to the wildlife that were present prior to mining. The following are suggested plant species and seeding rates that would be beneficial to the wildlife on the proposed North Block mining area.

Clay and clay loam soils: thickspike wheatgrass—8.0 lbs./acre, western wheatgrass—8.0 lbs./acres, Indian ricegrass--4.0 lbs./acre, big sagebrush—1.0 lbs./acre, winterfat—2.0 lbs/acre, rubber rabbitbrush—1.0 lbs./acre, and shadscale— 1.0 lbs./acre.

Sandy soils: thickspike wheatgrass—8.0 lbs./acre, western wheatgrass—6.0 lbs./acre, Indian ricegrass—1.0 lbs./acre, big sagebrush—2.0 lbs./acre, antelope bitterbrush--2.0 lbs./acre, rubber rabbitbrush—1.0 lbs./acre, winterfat--1.0 lbs./acre, and fourwing saltbush—1.0 lbs./acre.

Saline/alkaline soils: western wheatgrass—6.0 lbs./acre, streambank wheatgrass—6.0 lbs./acre, Indian ricegrass—6.0 lbs./acre, Nuttalls saltbush—2.0 lbs./acre, big sagebrush— 1.0 lbs./acre, shadscale-1.0 lbs./acre, and fourwing saltbush--1.0 lbs./acre.

These species may not be applicable to all areas, and there may be species not listed that would be suitable. The actual seed mixture would be determined by research results at the proposed Twin Creek mine and, when applicable, from other locations. In addition, if establishment of shrub species from seed proves infeasible, planting of seedlings, tublings, and (or) plant transplanting would be required.

Wyoming Department of Environmental Quality (DEQ)

Twin Creek Mitigating Measure 5. Soil mixing and leaching of salts or trace metals into potential surface and ground water sources may impact reclamation efforts. The Cumberland Coal Company will sample water at regular intervals both upstream and downstream from points of inflow of runoff waters from mined areas. Samples will also be taken from ground water sources, from wells penetrating the mined formation and the next adjacent formation and will be located down the ground water hydraulic gradient from the mined areas. Surface water samples will be analyzed to determine biological, chemical, and sediment content of runoff. Periodic analysis for trace metals will be made of both the dissolved constituents and the sediment load. Ground water samples will be analyzed for chemical content and for trace metals. This will aid in the control and the reduction of potential degradation of surface and ground waters from leaching of salts and (or) trace metals. A plan will be submitted in accordance with 30 Code of Federal Regulations (CFR) 715.17(b).

Twin Creek Mitigating Measure 6. Several types of air quality control measures are possible to help prevent the generation of fugitive dust. The application of water to unpaved roadways is the most common method for dust control and has already been included as a design control measure in the analysis of the proposed action. Several other control measures are available, some of which have a definite quantitative efficiency and others which are common sense measures and cannot be assessed quantitatively.

In general, fugitive dust can be controlled by watering at transfer points, such as conveyor ends or loading stations. The efficiency of this measure is dependent on the frequency of water application, an excess of which could create the obvious safety hazards of mud on nonlevel surfaces. Hoods, connected to a ventilation and dust collection system, over sources such as crushers or sorters limit emissions from mechanical handling of coal. General cleanliness and the prevention of spills also help to reduce the amount of fugitive dust. The emissions from the above sources, however, do not contribute to ambient concentrations of total suspended particulares (TSP) as significantly as emissions from overburden removal, travel on unpaved roads, and wind erosion.

Control of fugitive dust emissions from overburden removal is not feasible due to the continuous exposure of dry subsurface material. Control of fugitive dust emissions from travel on unpaved roads is possible with several measures. Watering, with an approximate efficiency of 50%, has already been included in the design plans. Paving, or treatment with chemical stabilizers which approximate paving, could reduce fugitive dust emissions from these sources by an additional 35%. This will result in a significant reduction in cumulative regional concentrations of TSP.

Travel on unpaved roads accounts for 69% of the predicted total fugitive dust emissions from the proposed mining in 1980, 59% in 1985, and 58% in 1990. Paving and chemical stabilization of unpaved access and haul roads, therefore, could reduce mine-related TSP impact on a regional basis by approximately 48% in 1980, 41% in 1985, and 40% in 1990. In lieu of paving or chemical stabilization, control of vehicular speeds can also reduce fugitive dust emissions from travel on unpaved roads. Limiting vehicular speed to 15 mph will reduce emissions by 44%, and a limit of 10 mph will reduce emissions by as much as 75%.

As shown in the preceding paragraphs, best management practices were not necessarily included in the air quality impact analysis. Only those mitigating measures discussed in the mining and reclamation plan on file with the USGS at the start of this rewrite were included in the modeling. In any event, the worst case mine situation is discussed, and best management practices will produce fewer and less intense impacts. It was not possible to include best management practices in Chapter 3, because the suggestions came in too late for modeling to be done and, if included now, would negate the continuity of the present analysis. Chapter 8 contains an air quality alternative which discusses the best management practice impacts.

Twin Creek Mitigating Measure 7. The applicant will submit data required under 30 CFR 715.17(3)(i)(A through E) pertaining to alluvial valley floors. These data will provide information needed to establish standards for which compliance with the Surface Mining Reclamation and Enforcement Act may be evaluated.

Twin Creek Mitigating Measure 8. In order to prevent accidental burning, coal seams will not be left exposed.

Rights-of-Way

Bureau of Land Management

Twin Creek Mitigating Measure 9. Intrusions upon visual quality by cuts and fills for roads, railroads, and other rights-of-way would create moderate and strong contrasts to the elements of line, form, color, and texture. The lessee will follow natural contours insofar as practicable when constructing these facilities to reduce the numbers of cuts and fills.

ANALYSIS OF EFFECTIVENESS

Twin Creek Mitigating Measure 1. Cultural resources would be lost to pothunting and vandalism due to increased population. The measure will reduce the possibility of some additional loss.

Twin Creek Mitigating Measure 2. Subsurface archeological sites would be destroyed by mining and associated surface disturbing activities. The measure will reduce the loss of subsurface sites. Paleontological losses will occur from the destruction, disturbance, or removal of fossil materials as a result of coal mining activities, unauthorized collection, and vandalism. This measure will reduce the loss of paleontological resources by an undetermined amount.

Twin Creek Mitigating Measure 3. Paleontological losses would occur from the destruction, disturbance, or removal of fossil materials as a result of coal mining activities, unauthorized collection, and vandalism. This measure will reduce the loss of paleontological resources by an undetermined amount.

Twin Creek Mitigating Measure 4. This measure would enhance the return of premine habitat values and wildlife species; however, data are not available which would allow quantification of effectiveness.

Twin Creek Mitigating Measure 5. Soil mixing and leaching of salts or trace metals into potential surface and ground water sources could impact reclamation efforts. This measure will identify toxic and marginal materials and aid in reducing reclamation losses from salts or trace metals.

Twin Creek Mitigating Measure 6. Fugitive dust, generated from unpaved roads, will degrade air quality. This measure would be 40% to 48% effective.

Twin Creek Mitigating Measure 7. The proposed mining could degrade the Hams Fork drainage (believed to be an alluvial valley floor). This measure will ensure adequate data gathering needed to develop standards that would protect the Hams Fork drainage.

Twin Creek Mitigating Measure 8. By requiring that all exposed coal seams be covered, the possibility of their accidental burning would be so reduced that the impact would not be significant.

Twin Creek Mitigating Measure 9. Visual intrusions from cuts and fills for roads, railroads, and other rights-of-way would create moderate and strong contrasts to the elements of line, form, color, and texture. This measure will reduce the impacts created by the roads, railroad, and other rights-of-way from moderate and strong to weak and moderate meeting VRM objectives for Class III.

Mitigating measures not included in the proposed action are summarized in Table TC4-1.

MONITORING, RESEARCH, AND STUDY PROGRAMS

To develop a base for future mine impact analyses, the operators will be required to provide a monitoring program both upstream and downstream from the project area for measuring runoff, chemical quality, trace metals, and sediment yield from any stream leaving the project area.

A representative of BLM will annually inspect livestock grazing areas adjacent to mining operations to determine if such operations are affecting grazing patterns of the allotment, to determine if any range overuse is resulting from changes in grazing patterns that may be occurring, and to determine measures to be applied to correct the overuse of the range.

As reclamation is accomplished, the compliance officer (state and federal) will conduct periodic inspections of mining areas to assure that reclamation is accomplished in accordance with an approved reclamation plan.

Reclaimed areas will be jointly inspected periodically by representatives of federal and state agencies and the operator to determine areas on which reclamation is completed and acceptable and to jointly determine corrective measures to be applied on areas where reclamation efforts have proven inadequate (e.g., seeding failure).

Table TC4-1

SUMMARY TABLE

Impact	Mitigating Measures	Residual Impact
Loss of cultural resources from vandalism and pot-hunting	Twin Creek number 1	Losses would continue.
Loss of unknown archeological information and sites from subsurface disturbing activities	Twin Creek number 2	Surface and subsurface sites would be lost and some surface sites would not be identified.
Loss of paleontological resources from unauthorized collection and vandalism and from authorized surface and subsurface destruction, disturbance, and removal	Twin Creek number 3	Loss of an undetermined number of fossils
Loss of wildlife habitat and populations	Twin Creek number 4	Reduction in time of wildlife habitat loss population loss.
Soil mixing and leaching of salts or trace metals into ground water	Twin Creek number 5	Potential decrease of up to 20% of reclamation efforts exists.
Degradation of air quality from fugitive dust	Twin Creek number 6	This measure could reduce TSP impact by 40% to 48%.
Potential degradation of the Hams Fork drainage	Twin Creek number 7	This measure could be 90% to 100% effective.
Accidental burning of coal seams	Twin Creek number 8	Potential for accidental burning so reduced that the impact would not be significant.
Moderate and strong contrasts to all basic elements due to cuts and fills	Twin Creek number 9	A reduction of moderate and strong contrasts to weak and moderate to meet VRM objectives for Class III will occur.

CHAPTER 5

ANY ADVERSE IMPACTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED

This chapter presents a summary of the residual adverse impacts that would remain after considering the mitigating measures discussed in Chapter 4.

AIR QUALITY

Impacts on Air Quality

When annual average background particulate values of 16 micrograms per cubic meter ($\mu g/m^3$) for 1980 and 15 $\mu g/m^3$ for all other years are added to projected mine-related contributions, the annual primary National Ambient Air Quality Standard (NAAQS) of 75 $\mu g/m^3$ is predicted to be exceeded (in the worst case) within 1.5, 1.5, 1, and 1 miles of the active site; and the annual Wyoming standard of 60 $\mu g/m^3$ is predicted to be exceeded within 1.5, 1.5, 1.5, and 1 miles of the active site for the years 1980, 1985, 1990, and end of mine life, respectively.

If projected mine-related 24-hour suspended particulate values and background concentrations of 49 $\mu g/m^3$ for 1980 and 46 $\mu g/m^3$ for all other years are combined, the 24-hour primary NAAQS of 260 $\mu g/m^3$ is predicted to be exceeded within 2.5, 2.5, 2.5, and 2 miles of the active site; and the Wyoming standard of 150 $\mu g/m^3$ is predicted to be exceeded within 4, 4.5, 4, and 2.5 miles of the active site for the years 1980, 1985, 1990, and end of mine life, respectively.

A comparison of the worst-case mine impact with Prevention of Significant Deterioration regulations indicates the annual standard would be exceeded within 2.5, 3, 2.5, and 1.5 miles; and that the 24-hour standard would be exceeded within 7.5, 9.5, 8.5, and 5.5 miles of the active site for the years 1980, 1985, 1990, and end of mine life, respectively.

With the application of the 43 CFR 118 regulations, the violations of the Class I increment will not occur.

Two other potential sources of significant particulate emissions are associated with the Twin Creek Mine: blasting and coal fires. The cloud of dust produced by blasting would be short-lived, at least compared to the averaging times of the total suspended particulate standards (24 hours or greater), so that little contribution to 24-hour levels would be measured outside the mine site. Coal fires could occur in spite of mitigating measures taken to prevent them. If neglected and allowed to burn out of control for long periods, they could be a significant source of pollutants. Any fire on the site could significantly contaminate the air and cause a safety hazard. However, due to a high degree of fire control technologies, potential fire impacts would probably be minimal.

If reclamation fails because of a natural catastrophe and the area disturbed by mining operations is not revegetated, particulate emissions could be increased over all predicted emission levels presented in this report, although the magnitude of this increase is unknown.

Gaseous Pollutants

Mine-related nitrogen dioxide (NO_2) and sulfur dioxide (SO_2) emissions are expected to be insignificant, as discussed in Chapter 4 of the Regional Statement Component (Environmental Research and Technology 1978a); therefore, ambient pollutant concentrations have not been predicted.

Recent studies (U.S. Department of the Interior 1976) of the impact of vehicle emissions associated with western coal mines were reviewed to estimate the probable range of impact. Maximum predicted concentrations of carbon monoxide ranged between 0.02% and 0.44% of the standard. Maximum predicted hydrocarbon concentrations ranged between 0.88% and 3.44% of the standards. Maximum predicted nitrogen dioxide concentrations ranged between 0.6% and 3.0% of the standards. Maximum predicted concentrations of SO_2 ranged between 0.02% and 0.33% of the standards. The values represent predictions at less than one-half mile from the mines. Predictions were significantly less at further distances from the mines.

Visibility

For 1980, the visibility of an observer at 1 mile downwind would be approximately 39.1 miles, assuming a background visibility of 40 miles. In general, visibility will increase with downwind distance from the mine. At 5 miles downwind the visibility would be 39.6 miles, and at 10 miles it would reach 39.7 miles. The corresponding values, assuming a background visibility of 7 miles, are 6.8 miles, 6.9 miles, and 6.9 miles, respectively. Similar reductions in visibility would result in 1985, 1990, and end of mine life.

GEOLOGY

A nonquantifiable number of coal fires may be ignited in spite of routine precautions taken to prevent them. The emission of combustion products to the atmosphere from accidental coal fires occurring during mining operations is discussed in the Air Quality sections of this environmental statement (ES).

Paleontology

Unavoidable destruction, disturbance, and removal of paleontological resources, both exposed and unexposed, would occur. The significance of this impact cannot be meaningfully assessed at present due to the lack of data and evaluatory criteria.

SOILS

The disturbance of soils on 1,529 acres proposed for mining and spoil storage is unavoidable. The removal, transporting, and mixing of topsoil would result in the loss of soil structure and a loss of soil biota. The removal of soil to excessive depth would in some areas contaminate topsoil with salts. This would result in a decrease in productivity when the topsoil is used in reclamation.

Soil erosion, with associated soil loss resulting from soil moving off the area being reclaimed, would occur. The increased rate of soil erosion would be approximately 8 tons per acre per year over that of the existing environment. Also, an accelerated rate of wind erosion would occur over areas disturbed by mining and areas being reclaimed prior to the reestablishment of a vegetative cover. The increase in soil loss (in suspension) by wind erosion over the current rate would be approximately 250 tons per year. Some soil compaction would occur as a result of machinery traffic during reclamation. This would result in a decrease in soil productivity. Around 100 acres of soil surface would be lost for vegetative production as a result of the construction of housing and support facilities associated with the increase in population created by mining.

Overall soil productivity of the disturbed areas (1,529 acres), when revegetated, would decrease temporarily as a result of the mining action. This short-term decrease in soil productivity is unavoidable.

Areas in the process of being reclaimed would erode at an accelerated rate during floods. This would result in large soil losses. The occurrence of floods during reclamation could considerably lengthen the time required for vegetation reestablishment.

WATER RESOURCES

The sediment load of streams draining the mined area would increase over what it was before mining.

Flow of Hams Fork would be depleted and water table in the Adaville would be lowered by leaving Pit 1N open to a bottom elevation of 6,500 feet.

VEGETATION

Terrestrial

Changes in plant species composition, cover, and density would be unavoidable if mining is conducted. Mining would require the short-term loss of vegetation on about 1,932 acres and the long-term loss of vegetation on about 101 acres (highway relocation, 91 acres, and stock pond construction, 10 acres). Disturbed areas would range in size from about 61 to 280 acres.

Population increases due to mining would result in the long-term loss of vegetation on an estimated 100 acres for housing and support facilities, primarily adjoining existing municipalities. Increased numbers of people in the area would result in additional disturbance of native vegetation particularly by off-road vehicle use (see Recreational Resources section).

Revegetated areas would have a general appearance of grassland. Grasses would be the most common forage class, with shrubs and forbs being reduced in density and cover as compared to premining conditions.

Natural plant succession would occur on reclaimed lands and could restore approximate premining plant cover and composition values in an estimated 30 to 50 years as suggested by Cook (Vories ed. 1976).

The temporary and permanent losses of vegetative cover and production on disturbed areas would affect numerous living organisms and their nonliving environment (see Air Quality, Soils, Fish and Wildlife, Visual Resources, Recreational Resources, and Agriculture sections in this chapter).

FISH AND WILDLIFE

Wildlife habitat, carrying capacity, and populations would be lost on 643, 1,606, 1,932, and 1,932 acres by 1980, 1985, 1990, and end of mine life, respectively, as a direct result of mining. Wildlife habitat, carrying capacity, and populations would be adversely affected (area of influence) on 2,894, 7,227, 8,694, and 8,694 acres by 1980, 1985, 1990, and end of mine life, respectively.

Specific habitat losses by the end of mining would be 1,932 acres of sage grouse yearlong range, 560 acres of antelope winter/yearlong range, and 1,932 acres of mule deer summer range. These losses represent 0.1%, less than 0.01%, and 0.3% of the range available for sage grouse, antelope, and mule deer, respectively, within their particular management or herd unit.

Loss of wildlife populations would be estimated at 600, 4,200, 8,500, and 16,400 nongame birds, 20, 100, 195, and 295 sage grouse, 260,000, 1,880,000, 1,956,000, and 3,520,000 small nongame mammals, 24, 62, 100, and 155 antelope and mule deer, and 2,600, 10,700, 12,880, and 21,000 reptiles and amphibians by 1980, 1985, 1990, and end of mine life, respectively. Population losses at the end of mine life for sage grouse, antelope, and mule deer represent about 0.01%, 0.3%, and 0.2%, respectively, of the production of the total populations within their particular management or herd unit.

Reclamation, if successful, would mitigate some of the above losses. Quantification of such mitigation, however, is not possible with current knowledge and available information.

The habitat and population losses would be of major significance to localized populations, but when compared to total habitat and populations within the region or herd/management unit they would be of minor significance when based upon percentages alone.

Although it may appear that losses are of minor significance, the projected losses of populations and habitat could, in some instances, be of critical importance to wildlife. Current data are insufficient to throughly analyze the effects of each individual habitat or population loss.

CULTURAL RESOURCES

The destruction of buried archeological sites by mining and related surface disturbing activities would probably be partially mitigated. Mitigation success would depend on such factors as successfully predicting areas of likely buried sites and the possibility of them being destroyed as a result of not being recognized. The destruction of buried sites could have a significant impact, because, if they exist, they could be important to understanding the prehistory of the region or the nation.

All archeological resources within the project area would be affected by increased pothunting and vandalism regardless of the mitigation measures that would be applied. Pothunting of archeological sites could remove important surface indications of significant buried sites. This would reduce the chances of such sites being discovered and contributing important information to the prehistory of the region.

VISUAL RESOURCES

Adverse visual impacts from mining coal would not be mitigated during active mining operations, and impact from roads, power lines, conveyor system, load out, crusher facilities, and other structures would remain until removed and the disturbed areas revegetated. The actual mining operations, pits, spoil piles, and topsoil storage would change the characteristic landscape in the mining area. The impacts to form, color, and texture would be obviously visible until vegetation is successfully reestablished. After revegetation there would remain changes in the characteristic landscape which would lower the scenic quality of the area. This would be especially true of Pit 1N. This area would remain as a Class V area even after reclamation. This would not meet BLM management quality objectives for visual resources in the area.

RECREATIONAL RESOURCES

During mining activities, recreational access would be restricted to the Twin Creek project area eliminating certain recreation use on site at first. People who are hunting, sightseeing, and driving off-road vehicles would be restricted from the active mining area for public and mine safety. As Highway 30 is relocated, recreationists traveling the route would be impacted by delays in travel time, rough roads, and construction equipment. People would come to the area to view the mining activities.

Increased population would result in increased recreational use throughout the southwestern Wyoming region. This increased use would result in lowering the quality of the existing "primitive"type of recreation experience. Due to increased use in the region, ranchers would restrict access across their private lands.

Visitor Use Data

The estimated resident recreation use demand change due to the proposed action would account for approximately 8.0%, 8.0%, and 8.4% of the total recreation use demand in Lincoln County by 1980, 1985, 1990, respectively.

AGRICULTURE

Mining would cause a loss of animal unit months (AUMs) within three grazing allotments. Cumulative estimated losses in AUMs would be 223, 1,378, 2,932, and 4,615 by 1980, 1985, 1990, and end of reclamation, respectively.

Mining would have little effect on livestock grazing within the Cumberland/ Uinta Grazing Allotment. Only 867 acres of the 459,302 acres of the allotment would be disturbed by mining.

About 1,338 AUMs would be lost from the Airport Grazing Allotment. This would amount to approximately 6% of the AUMs which would be available without mining, or an average of about 58 AUMs per year for 23 years. An additional 9% of the AUMs which would be available without mining would be lost (an average of about 92 AUMs per year for 44 years) if the North Block mining operation is conducted.

The two livestock companies licensed to graze livestock within the allotment could probably adjust their operations to the loss of AUMs with minimal impact, since the Airport allotment provides but 3.5% of the AUMs needed by one of the operators for a 1,100 head sheep operation and 1.3% of the AUMs needed by the other operator for a 450 head cattle operation.

The Twin Creek and North Block mining activities could require periodic adjustments in the routes used for the trailing of 28,000 sheep across the Airport allotment for the purpose of changing summer/winter range use. Additional supplemental feed would need to be fed the sheep during trailing operations.

The Moyer Grazing Allotment would be severely impacted by the proposed mining. Approximately 58% of the grazing allotment acreage would be disturbed (about 567 of 985 acres). An estimated 1,477 cumulative AUMs would be lost. This loss of AUMs would require the one operator permitted to graze livestock within the allotment to find other pasture. About 1,280 of 2,500 sheep grazed in the pasture for a week in June would be displaced. Relocation of Highway 30 would permanently impact about 91 acres of the Moyer allotment. Allotment boundaries might have to be changed as the result of highway relocation, due to restricted livestock movements.

MINERAL RESOURCES

The mining and removal of coal would have an impact on coal resources. Based on company plans, an estimated 40 million tons of coal would have been mined by 1995, which comprises less than about 18% of the estimated reserves in place under less than 1,000 feet of overburden.

An unknown quantity of coal in the overburden and (or) interburden would be lost. This coal would be in seams too thin or of too low a quality to be of economic interest.

TRANSPORTATION

There would be an increased use of highways and other transportation facilities in the area due to increased population and mining activities. The increased vehicle license tabs sales as a result of the proposed action would be 8% between 1978 and 1985 and would level off at 9% to the end of mine life. The increased use may not change the traffic accident rate, but there would be an increase in the number of accidents due to increased numbers of miles traveled.

There would be a need to relocate certain roads and trails as coal mining encroached upon them. This could lead to other roads being used more heavily. Some private roads would be closed as ranchers limit access across their land.

The relocation of U.S. Highway 30 would create delays in travel time for persons using the road. There would be increased heavy equipment/auto accidents during construction.

SOCIOECONOMIC CONDITIONS

Population

There would be an unavoidable increase in the population of Lincoln County and the Kemmerer/Diamondville area if the Twin Creek Mine is approved, constructed, and goes into production. Table TC5-15A shows the population increases that would result because of the mine; the increases would not be significant except during the 1978 to 1990 period.

Social Conditions

The increase in population could, however, have some minor indirect impacts on Lincoln County. The most evident of these would be the additional pressures on public services and facilities. More crowded conditions would require more police and fire protection; construction of additional access routes; improved or expanded sewer and water systems; and expanded medical, social, and mental health services.

Table TC5-15A

PROJECTED POPULATION INCREASES CAUSED
BY THE TWIN CREEK MINE
(LINCOLN COUNTY)

	1980	1985	1990
Lincoln County	676	618	665
Kemmerer/Diamondville	729	623	647
Balance of county	-53	-5	18

Source: Abt Associates 1978.

CHAPTER 6

THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The mining of 40 million tons of coal would result in short-term (a period beginning with on-site construction and ending with post-mining reclamation) and long-term (a period beginning after post-mining reclamation) alteration of natural resources and the human environment.

In the short term there would be:

1. a reduction in air quality and visibility by fugitive dust and, to a much lesser extent, vehicular emissions;

2. increased soil erosion and lowered soil productivity on about 1,529 acres;

3. the loss of an estimated 4,615 animal unit months (AUMs) due to the removal of native vegetation on 1,932 acres (does not include 100 acres for housing for which AUM data are unavailable);

4. the destruction of an unquantifiable number (probably small) of nonrenewable unknown cultural resources;

5. a reduction from Visual Resource Management (VRM) Classes III and IV to a Class V;

6. a lowering of the "primitive"quality of recreational experiences due to increased population;

7. impeded traffic movement due to increased numbers of trains and vehicles;

8. a disruption of social order due to rapid population growth and subsequent changes in community structure;

9. a loss of wildlife habitat, carrying capacity, and populations on 1,932 acres as a direct result of mining and adversely affected (area of influence) on 8,694 acres;

10. a loss of wildlife populations estimated at 16,400 small nongame birds, 295 sage grouse, 3,520,000 small nongame mammals, 155 antelope, 155 deer, and 21,000 reptiles and amphibians by end of mine life;

11. There would be an increase in employment opportunities and total earned income within Lincoln County.

Residual effects of mining on long-term productivity would be:

1. loss of soil and vegetative productivity on about 270 acres planned for housing and a large pit left in the southwest portion of the mining area;

2. the destruction of an unquantifiable number (probably small) of nonrenewable unknown cultural resources;

3. the degradation of (VRM) Classes III and IV to Class V;

4. a lowering in the "primitive"quality of recreational experiences due to the increased population;

5. impacts to an undetermined number of uninventoried exposed and unexposed fossil localities; and

6. a gain in knowledge of paleontological resources due to surveys and exposure of resources which might never have been found without excavation.

CHAPTER 7

ANY IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED

Approximately 40 million tons of coal would be produced by the Twin Creek Mine. About 4 million tons of coal would be lost and unrecoverable due to current mining methods. An unknown quality in the overburden and (or) interburden would be lost. This coal would be in seams too thin or of too low a quality to be of economic interest.

Energy, in the forms of petroleum products and electricity, would be expended to obtain the coal. Some materials used in manufacturing machinery and buildings would not be recycled and thus would be lost.

Most air quality impacts associated with the Twin Creek Mine would be reversed when the land is reclaimed and returned to an equivalent of the preexisting vegetative cover and general contours. The only long-term air quality impacts anticipated are those resulting from continued use of unpaved access roads after the project has been completed or halted. Since use of these roads could be stopped by blocking access or reclaiming roadbeds, no irreversible air quality impacts are predicted.

Irretrievable air quality impacts would occur. The loss of good air quality for the period of the project cannot be retrieved. During the life of the project, total suspended particulate standards may be exceeded and visibility reduced in the immediate vicinity of the project.

An undetermined number of uninventoried exposed and unexposed fossil localities would be lost or disturbed.

Forage (about 4,615 animal unit months) for livestock would be lost.

Some cultural resources would be destroyed.

Visual resource values would be altered; Class V would be the highest attainable Visual Resource Management class after reclamation.

Wildlife habitat, carrying capacity, and population would be lost on 1,932 acres as a direct result of mining and adversely affected (area of influence) on 8,694 acres.

Loss of wildlife populations would be estimated at 16,400 small nongame birds, 295 sage grouse, 3,520,000 small nongame mammals, 155 antelope, 155 deer, and 21,000 reptiles and amphibians by end of mine life.

CHAPTER 8

ALTERNATIVES TO THE PROPOSED ACTION

The USGS has accepted the Twin Creek mining and reclamation plan as adequate for environmental review and subsequent approval under 30 CFR 211 regulations of May 1976. The Secretary's actions may be approval as proposed, rejection on various environmental or other grounds, approval in part and rejection in part, or approval subject to such additional conditions and requirements or modifications as he may impose under existing law and regulations. He may also defer decision pending submittal of additional data, compilation of required studies, or for other specific reasons.

Even after a mining and reclamation plan is approved, the regulations and lease terms require that all subsequently porposed departures and deviations therefrom be approved in advance by the Secretary. The regulations (30 CFR 211 and 700) permit the Secretary to direct that changes be made in previously approved operations. For example, changes could be ordered to accommodate new, improved, or revised administrative requirements, technological improvements, environmental concerns or requirements, or revisions of prior evaluations thereof in the light of experience or previously unknown factors.

NO ACTION

The no-action alternative includes analysis of impacts that will occur if the mining and reclamation plan and associated rights-of-way are not approved. Without mining and reclamation plan approval, it is expected that there will not be any environmental impacts from mining on the leased land. However, that portion of the proposed project area that is located south of U.S. Highway 30 and is on private and state land could be mined as an expansion of the existing operations immediately adjacent and to the south. Such an action has not been indicated but could be done without any required federal actions and would depend upon the status of prevailing coal markets.

Coal from the proposed Twin Creek Mine is anticipated to go to markets in Idaho, Oregon, and Washington, where energy demand is continually increasing. Without the Twin Creek Mine, other coal would have to be acquired to supply these markets. Such a substitution could create a shortage in supply for other coal markets. If the alternate coal source were of a higher sulfur content, lower air quality from the power generation plants in these areas would be expected.

Both adverse and beneficial impacts will occur to paleontological resources in approximate proportion to the level of regional development and the area disturbed.

Under the no-action alternative, increased recreational activity will still occur in the Twin Creek project area due to population increases associated with other expected development (Table TC8-1). The increased activity will basically lower the "primitive"quality of the recreational experience which is common to the area around the proposed Twin Creek Mine. As a result of increased activity, there could be increased recreation maintenance and cleanup costs. There will also be conflicts between local ranchers and recreationists which could result in the ranchers restricting access across their private lands.

The population of the Kemmerer/Diamondville area would increase to 3,996 in 1980; decrease to 3,648 in 1985; and increase to 3,706 in 1990. Lincoln County total employment will increase to 4,110 jobs in 1980, decrease to 3,731 in 1985, and increase to 3,797 in 1990. Personal earned income in the county will increase to $56.7 million in 1980, $61.6 million in 1985, and $73.1 million in 1990.

AIR QUALITY

Best Management Practices

Impact Alternative

This alternative contains recommendations which, if implemented, would reduce some of the major impacts described in Chapters 3 through 7. Best management practices could include the following:

1. mulching and furrowing in the spring followed by fall planting differs significantly from the one-step fall planting process analyzed in Chapter 3. This measure along could reduce total emissions from the mine by 20% to 40% depending on the year (Table TC8-2);
2. chemical stabilization of the haul roads could reduce haul road impacts by an additional 25% over that of watering the roads;
3. paving or an equivalent stabilization of all access roads could reduce access road impacts by 85% over that of unpaved access roads;
4. use of negative pressure bag houses or an equivalent method at all coal dump locations (truck to crusher and silo to railroad car) could reduce these impacts by 95% if properly engineered; and

Table TC8-1

COMPARISON OF IMPACTS OF PROPOSED ACTION AND NO-ACTION ALTERNATIVE IN VISITOR USE DAYS

Elements and Components	1977	1980 No Action	1980 Total Projection With Proposal	1985 No Action	1985 Total Projection With Proposal	1990 No Action	1990 Total Projection With Proposal
Fishing	29,800	33,200	36,070	30,800	33,480	31,700	34,610
General[1]	29,200	32,500	35,320	30,800	33,470	32,000	34,940
Hunting	9,400	10,200	11,090	9,300	10,110	9,400	10,260
Off-road vehicle[2]	1,200	1,300	1,410	1,200	1,300	1,200	1,310
Sightseeing	9,100	10,000	10,870	9,400	10,220	9,700	10,590
Urban	18,400	21,200	23,040	21,200	23,040	22,600	24,680
Water sports	13,800	15,600	16,950	15,100	16,410	15,900	17,370
Winter sports	3,700	4,400	4,780	4,500	4,890	4,900	5,350

Note: Visitor use day considered to be 12 hours.

[1] General includes camping, picnicking, etc.
[2] Estimate by ES Team Outdoor Recreation Planner.

Table TC8-2

COMPARISON OF CHAPTER 3 TOTAL TSP EMISSION IMPACTS TO THOSE OF THE BEST MANAGEMENT PRACTICE ALTERNATIVE TOTAL TSP EMISSION IMPACTS

Year	Total TSP Chapter 3 Emissions (tons/yr)	Total TSP Best Management Practice Emissions (tons/yr)	Reductions in emissions (%)	Reduction due only to mulching and furrowing in the spring and planting in the fall (%)
1980	2406	1704	29	22
1985	3167	1793	43	39
1990	2550	1176	44	40
End of Mine Life	1531	1128	26	20

5. the use of conveyor and transfer point coverings and, where necessary, water sprays could reduce these emissions by 75%.

Table TC8-2 is a comparison of the Chapter 3 total TSP emissions with those of best management practice emissions. About a 26% to 44% reduction in total TSP emissions is possible; however, between 20% and 40% of the reduction results from more effective management of disturbed soil during the dry summer months (mulching and furrowing). The other recommendations reduce total emissions by only 2% to 7%, depending on the year analyzed.

FISH AND WILDLIFE MITIGATION ALTERNATIVE

This alternative lists recommendations which, if implemented, would greatly reduce or totally eliminate the major impacts to existing fish and wildlife resources described in Chapters 3 and 5 through 7 by enhancement of the wildlife habitat and carrying capacities of those lands adjacent to the proposed mining operations or on nearby off-site locations.

1. That all mining areas be reclaimed to wildlife habitat (Table TC8-3) as soon as possible or feasible. Reclamation would be in conformance to the post-mining land use set out in BLM's land use plans for the area. Vegetative planting and reclamation should be accomplished in consultation with the Wyoming Game and Fish Department, the Wyoming Department of Environmental Quality, and the U.S. Fish and Wildlife Service. The goal of reclamation should be to achieve the highest possible wildlife carrying capacity at the earliest possible date, regardless of cost. All possible tools to achieve this goal should be implemented as needed.

2. That approximately 3,900 acres of public land lying in immediate association with the proposed Twin Creek mining area or on nearby off-site locations be set aside as a mitigation area and managed intensively for fish and wildlife resources (Table R8-12). Selection of this mitigation area should be accomplished in consultation with the Wyoming Game and Fish Department and the U.S. Fish and Wildlife Service.

3. That the mitigation area be managed to increase its wildlife carrying capacity by at least 50%. Management tools such as water development, fertilization, vegetative manipulation, spraying, transplanting, seeding, protection of wildlife cover, and management of livestock grazing to enhance wildlife habitat should be implemented as necessary. The habitat of this mitigation area should be managed by BLM and the wildlife by the Wyoming Game and Fish Department.

4. The the mine permit will not be granted on land critical to the bald and golden eagle's ecological requirements. A qualified team of biologists from the Fish and Wildlife Service, Wyoming Game and Fish Department, and the Bureau of Land Management will judge and recommend the areas to be excluded from mining. Mine permits may be granted for these areas if regulations are adopted that provide for substitute mining practices, buffer zones, prey base, and alternate nest sites.

If this alternative is successfully implemented it is estimated that 80% to 90% of the fish and wildlife resource impacts described in Chapters 3 and 5 through 7 could be mitigated. Impacts to other resources would be the same as the proposed action.

UNDERGROUND MINING ALTERNATIVE

This alternative was not considered feasible for reasons of economy and technology. The relatively shallow overburden would not provide sufficient structural strength to maintain safe and efficient underground working conditions. The ratio of recovered coal to in-place coal would be much less than with surface mining methods.

Several coal beds within the proposed Twin Creek mining area attain a thickness of 40 feet. Assuming that a 10-foot section could be mined safely by underground methods and that 50% of coal in the mined area was left in place to provide support and lessen the probability of surface subsidence, coal extracted would represent about 10% of the available coal in place. This rate compares to an expected recovery of 90% to 95% of the in-place coal from surface mining methods.

TWIN CREEK RECLAMATION ALTERNATIVE

The mining and reclamation plan would be conditionally approved for a period of 10 years during which time

Table TC8-3

RECOMMENDED VEGETATION FOR RECLAMATION OF TWIN CREEK MINE

Forbs	Shrubs[1]	Grasses or Grasslikes
1. Wallflower (Erysimum spp.)	1. Big Sagebrush (Artemisia tridentata)	1. Thickspike wheatgrass (Agropyron dasystachyum)
2. Phlox (Phlox spp.)	2. Snowberry (Symphoricarpus spp.)	2. Bluebunch wheatgrass (Agropyron spicatum)
3. Penstemon (Penstemon spp.)	3. Antelope bitterbrush (Purshia tridentata)	3. Needlegrass (Stipa spp.)
4. Fleabane (Erigeron spp.)	4. Rabbitbrush (Chrysothamnus spp.)	4. Basin ryegrass (Elymus cinereus)
5. Sweetclover (Melilotus spp.)	5. Serviceberry (Amelanchier spp.)	5. Fescue (Festuca spp.)
6. Wildbuckwheat (Eriogonum spp.)	6. Fourwing saltbush (Atriplex canescens)	

Note: Common and scientific plant names are according to Beetle (1970).

[1] At least 20% of the annual forage production should be browse.

a specific testing and monitoring program for the purpose of measuring revegetation success would be implemented by the coal mining company. In this alternative a plan describing the testing and monitoring program would be prepared by the Cumberland Coal Company for approval by the regulatory authorities prior to its implementation.

If it cannot be demonstrated that revegetation can be successful, commensurate with Public Law 95-87 (SMCRA), at the conclusion of the 10-year program, the Department of the Interior will revoke its approval for mining on public lands.

Although current reclamation research indicates that successful reclamation can be achieved on semiarid coal mined lands, it is recognized that answers to reclamation problems are needed on a site-specific basis in order to ensure success.

This alternative, if implemented, would result in the gathering of data to show that lands proposed for mining are reclaimable within a reasonable period of time.

The Cumberland Coal Company would be required, under the direction of state and federal reclamation regulatory and surface ownership agencies, to establish a suitable number of demonstration plots to provide evidence of revegetation success.

The demonstration plots would be established as soon as practicable following the authorization of the Department of the Interior to commence mining operations.

Impacts which would occur if revegetation could not be accomplished would be as follows:

1. The mining company would be forced to shut down its operation on public land.

2. A shut down of the mine would cause economic loss to the mining company from the sale of coal, loss of employment for most of the employees, and partial loss of investment in equipment and material needed to open and operate the mine for the 10-year period.

3. Areas disturbed (about 1,932 acres) during the 10-year period of mining would be unreclaimed or at best only partially reclaimed.

4. The consumer of coal from the mine would need to obtain coal from another source.

5. The reduction in labor force would cause socioeconomic impacts to the region.

6. In the event that mining would still occur on non-public lands, the above impacts would be lessened but would still be significant.

RECLAMATION METHODOLOGY ALTERNATIVE

This alternative lists recommendations which, if implemented, would reduce impacts on surface water quality (erosion) and air quality.

1. Backfilled slopes would be designed low and the length of slopes short.

2. All suitable topsoil and suitable overburden would be conserved for subsequent placement on disturbed areas.

3. Appropriate soil amendments would be used to improve soil structure.

4. Fertilization of topsoil would be done based on soil analyses.

5. All topsoiled areas would be mulched and additional organic matter added.

6. Supplemental irrigation would be employed for the first two growing seasons. Application rates would be based on soil moisture monitoring.

This alternative, if implemented, would result in the use of methodology that would enhance rapid establishment of vegetation. The vegetation would decrease soil erosion from water action and decrease the emission of dust from treated areas.

The grading of all disturbed areas to less than moderate slopes would enhance revegetation but would result in such areas having less topographical diversity. Moderate and steeper slopes provide seasonal and (or) year-round habitat for wildlife and provide protection from storms for livestock and wildlife.

Care would need to be taken to avoid creating conditions unfavorable to native plant species proposed in seeding mixtures. Many of these species are adapted to soils with low to moderate productivity.

DEFER ACTION ALTERNATIVE

For proper cause, the Secretary may defer final action on this proposed mining and reclamation plan. This could include, but is not limited to, the need and time required for:

1. Modification of the proposal to correct specific administrative or technological deficiencies. (No need for additional changes or alternatives was identified during the public review beyond those which are already presented.)

2. Redesign to reduce or avoid specific environmental impact. (No need for additional changes or alternatives was identified during the public review beyond those which are already presented.)

3. Acquisition of additional data to provide an improved basis for technical or environmental evaluation.

In the public review, several comments were received concerning the probability of successful reclamation. As a result the following alternative is presented:

Approval of the mining and reclamation plan would be deferred pending the Cumberland Coal Company demonstrating on site that lands proposed for mining or other disturbances would be reclaimable within a reasonable period of time. The principal effects of deferring action on the proposed mining and reclamation plan would be (a) a short-term delay, (b) presumably some reduction or avoidance of certain significant adverse impacts, (c) a better data base and subsequent analysis of specific adverse impacts, (d) economic loss to Cumberland Coal Company from delay of approval, (e) the market for which Cumberland Coal Company has proposed to deliver coal would need to find another source of coal, and (f) possible reduction in the Cumberland Coal Company labor force.

4. Further evaluation of the proposal and (or) alternatives. (No need for additional changes or alternatives was identified during the public review beyond those which are already identified.)

PREVENT (FURTHER) DEVELOPMENT ON THE LEASE ALTERNATIVE

The Secretary may reject any individual proposed activity that does not meet the requirements of applicable law and regulations under his authority, including the potential for environmental impact that could be reduced or avoided by adoption of a significantly different disigned course of action by the lessee (operator). This may be accomplished by suspension of operations (if ongoing), cancellation of the lease (if environmentally acceptable development is not possible), federal acquisition of the lease, or rejection of the mining and reclamation plan. (No need for additional changes or alternatives was identified during public review beyond those which are already presented.)

RESTRICT DEVELOPMENT ON THE LEASE ALTERNATIVE

This alternative could be applied to all or a portion of the lease, as appropriate. The subject lease conveys the right to develop, produce, and market the federal coal resource if all other terms and conditions are met by the lessee. Various measures that may tend to restrict development may be taken by the Secretary at any time in the interest of conservation of the resources or in the protection of various specific environmental values in accordance with existing laws and regulations; for example, the National Historic Preservation Act of 1966, the Endangered Species Act of 1973, the Surface Mining Control and Reclamation Act of 1977, etc. (No need for additional changes or alternatives was identified during public review beyond those which are already presented.)

ALLOW DEVELOPMENT OF SELECTED AREAS NOW UNDER LEASE ALTERNATIVE

This alternative would permit only selective exploration and development of existing leaseholds based on anticipated adverse environmental consequences. The decision maker has the authority and responsibility to evaluate the coal resources and impacts of mining on these leases prior to acting on the proposals. Exploration and development could be allowed only on those leaseholds, or portions thereof, that would have the lowest anticipated adverse environmental consequences. Weighing the tradeoffs of mining or precluding mining on selected tracts is part of the evaluation and decision process. Adoption of this alternative would reduce adverse effects by reducing the area in which the impacting activities could take place. (No need for additional changes or alternatives was identified during public review beyond those which are already presented.)

CHAPTER 9

CONSULTATION AND COORDINATION

See the Regional Environmental Statement (ES) for a description of the consultation and coordination efforts involved in the preparation of the ES.

TWIN CREEK SITE-SPECIFIC ES APPENDIX

SOIL ASSOCIATION MAPPING UNIT DESCRIPTIONS

A description of each soil association mapping unit within the Twin Creek project area follows. These descriptions and Table TC-A1 are intended for use with the Twin Creek soils map found in Chapter 2.

209—Alkali-Saline Land

The majority of this unit is alkali-saline land. This land type consists of deep, somewhat poor to poorly drained, predominantly clay and clay loam soils with fluctuating water table. These soils are strongly to very strongly alkaline and slightly to strongly saline. They occupy nearly level floodplains. The remaining soils are deep, poorly drained, highly alkaline and saline. These soils are nearly level, subirrigated, and have developed from alluvium. The soils are fine textured and are wet throughout.

218—Alluvial Fans Coarse Soils Sloping

The majority of these soils are fine sandy loams (calcareous) occupying gently sloping alluvial fans. They are deep and well drained. Of the remaining soils, around 30% are moderately deep, well-drained loams. The rest are shallow, well-drained calcareous silty clays underlain by shale and fine sandy loams underlain by sandstone.

221—Terrace Escarpments Gently Sloping to Steep

Forty percent of the mapping unit is terrace escarpment which consists of gravelly and cobbly alluvium on edges and faces of old high terraces. Another 40% consists of very shallow, well-drained clay loams that have developed over sedimentary rock. The remaining are moderately deep to deep, well-drained loams and clay loams. Rock outcrop occupies about 10% of the association. Dominant vegetation is sagebrush.

227—Loess Soils Rolling

The majority of soils in this association are deep, well drained, and have developed from loess (wind-blown silt deposits). They are loams and occupy a gently sloping terrace. The remaining soils of the association are moderately deep, well-drained, gravelly and cobbly loams.

231—Residual Uplands, Shallow Clayey Soils, Moderately Steep and Steep

Soils of this unit occupy steep slopes, are shallow to very shallow, and have developed over sandstone and shale. They are well drained, silty clays over shale and fine sandy loams over sandstone. About 10% of the mapping unit is terrace escarpment land type and about 10% is rock outcrop. Dominant vegetation is sagebrush.

232—Residual Uplands, Clayey Soils, Rolling

The majority of these soils (60%) are very shallow, well drained, and occupy gently sloping to sloping uplands. They are clay loams that have developed over calcareous sedimentary rocks. About 30% of the association is composed of silty clay loams developed over calcareous shales. Silty clay soils, developed from alluvium, represent the remaining 10%.

Table TC-A1

SOIL ASSOCIATION CHARACTERISTICS

Map Unit No.	Map Unit Name[1]	% of Map Unit	Subgroup	Family	Effective Root Depth	Soil Reaction (pH)	Natural Soil Drainage	Potential Runoff	Permea- bility	Available Water Capacity
209	Alkali-saline land	50	Alkali-saline land		---	8.8-9.4	Poor	Moderate	Very Slow	Low
		30	Typic Haplaquepts	Fine-loamy, mixed	20-40	8.2-9.0	Poor	Moderate	Slow	High
		20	Typic Halaquepts	Fine-loamy, mixed	20-40	8.2-9.0	Poor	Moderate	Slow	High
218	Alluvial fans, coarse soils, sloping	50	Typic Ustifluvents	Coarse-loamy, mixed (calcareous) frigid	20-40	7.4-8.4	Well	Low	Mod.-Rapid	Moderate
		30	Aridic Argiborolls	Loamy-skeletal, mixed	20-40	7.4-8.4	Well	Moderate	Moderate	Low
		10	Lithic Ustic Torriorthents	Loamy-skeletal, mixed (calcareous), frigid	<10	7.9-8.4	Well	Moderate	Mod.-Rapid	Very Low
		10	Ustic Torriorthents	Clayey, montmorillontic (calcareous), frigid, shallow	10-20	7.9-9.0	Well	High	Slow	Very Low
221	Terrace escarpments, gently sloping to steep	40	Terrace escarpments land type							
		30	Ustic Torriorthents	Loamy, mixed (calcareous), frigid, shallow	<10	8.2-8.4	Excessive	Low	Slow	Very Low
		15	Aridic Argiborolls	Loamy-skeletal, mixed	20-40	7.4-8.4	Well	Moderate	Moderate	Low
		10	Rock outcrop (sandstone and shale)							
		5	Borrollic Haplargids	Fine-loamy, mixed	20-40	7.4-9.0	Well	Moderate	Moderate	Moderate
227	Loess soils, rolling	80	Calcic Argixerolls	Fine-silty, mixed, frigid	20-40	7.5-8.4	Well	Moderate	Moderate	Moderate
		20	Aridic Argiborolls	Loamy-skeletal, mixed	20-40	7.4-8.4	Well	Moderate	Moderate	Low
231	Residual uplands, shallow clayey soils, moderately steep and steep	40	Ustic Torriorthents	Clayey, montmorillonitic (calcareous), frigid, shallow	10-20	7.9-9.0	Well	High	Slow	Very Low
		40	Lithic Ustic Torriorthents	Loamy-skeletal, mixed (calcareous), frigid	<10	7.9-8.4	Well	Moderate	Mod.-Rapid	Very Low
		10	Terrace escarpment land type							
		10	Rock outcrop (sandstone and shale)							

Table TC-Al

SOIL ASSOCIATION CHARACTERISTICS
(Continued)

Map Unit No.	Map Unit Name[1]	% of Map Unit	Subgroup	Family	Effective Root Depth	Soil Reaction (pH)	Natural Soil Drainage	Potential Runoff	Permea-bility	Available Water Capacity
232	Residual uplands, clayey soils, rolling	60	Ustic Torriorthents	Loamy, mixed (calcareous), frigid, shallow	<10	8.2-8.4	Excessive	Low	Slow	Very Low
		30	Borrollic Camborthids	Fine, montomorillonitic	10-20	7.9-9.0	Well	Moderate	Slow	Low
		10	Ustic Torriorthents	Fine, montomorillonitic	10-20	8.5-9.2	Well-Mod.	Moderate	Slow	Moderate

Note: Table derived from information obtained from contract with U.S. Department of Agriculture Soil Conservation Service (1977).

[1]Unit names were derived from geomorphic setting of the soil.

Permeability

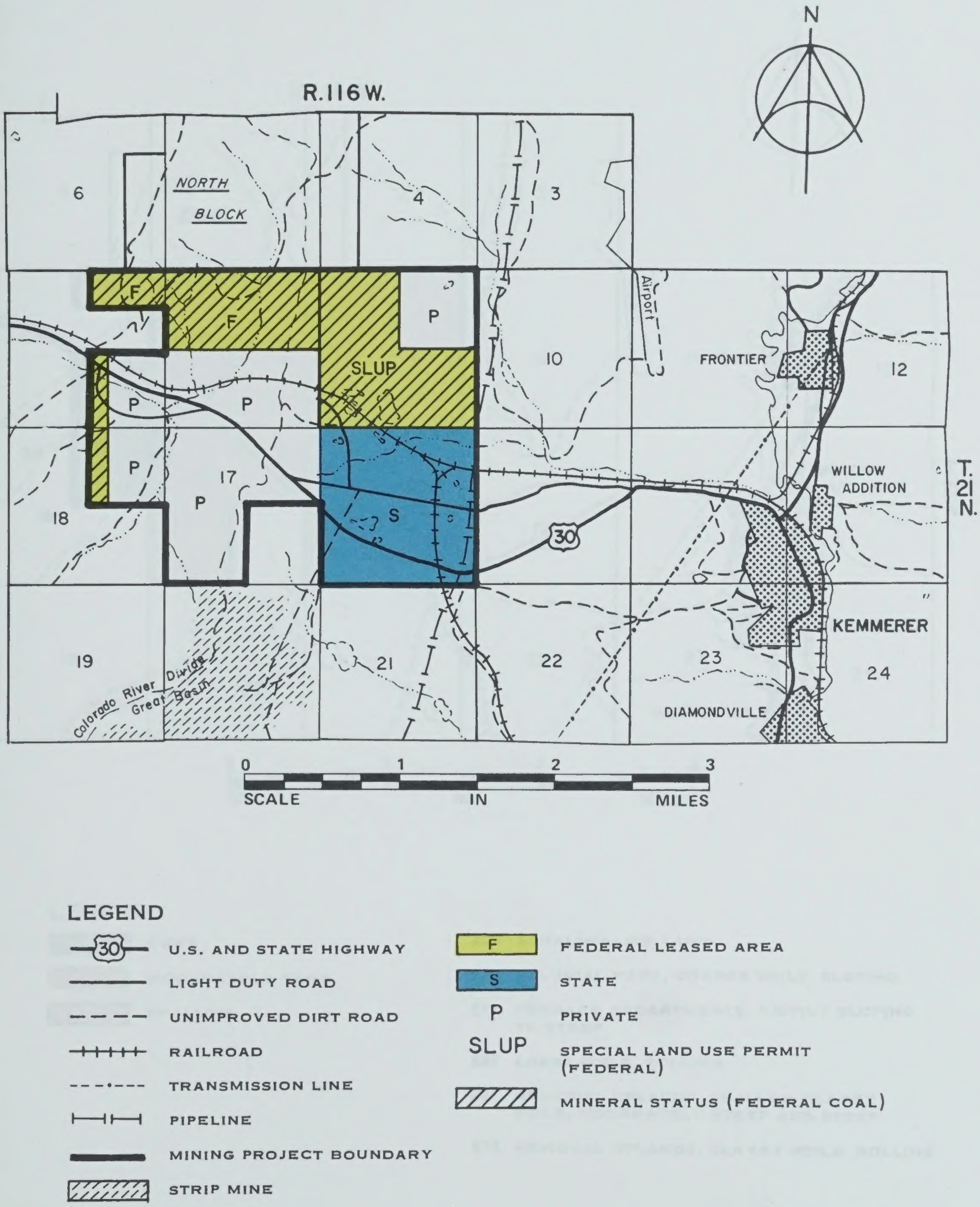
In/Hour	Class
0.06	Very Slow
0.06 - 0.2	Slow
0.2 - 0.6	Mod.-Slow
0.6 - 2.0	Moderate
2.0 - 6.0	Mod.-Rapid
6.0 -20	Rapid
20+	Very Rapid

Available Water Capacity

In/60" Profile*	Class
0 - 3	Very Low
3 - 6	Low
6 - 9	Moderate
9 -12	High
12+	Very High

*or to limiting layer

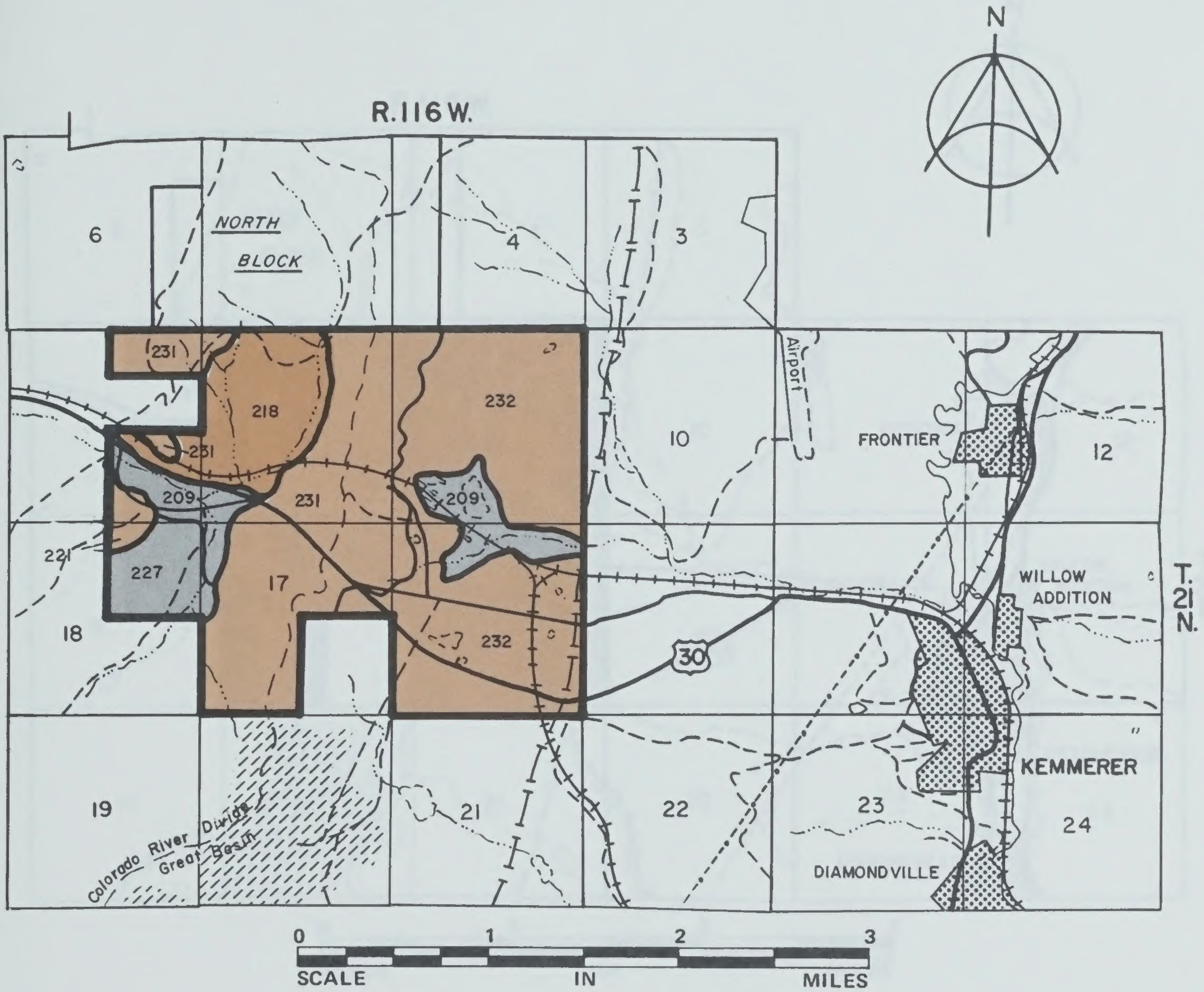
Note: Classes derived from "Supplement to Guide to Authors of Published Survey, "TSC Transm. Sheet L1-1, U.S. Department of Agriculture, Soil Conservation Service (1971).



Map TC1 - 1

SURFACE AND MINERAL STATUS

TWIN CREEK



LEGEND

- DEEP
- MODERATELY DEEP
- SHALLOW

209 ALKALI-SALINE LAND

218 ALLUVIAL FANS, COARSE SOILS, SLOPING

221 TERRACE ESCARPMENTS, GENTLY SLOPING TO STEEP

227 LOESS SOILS, ROLLING

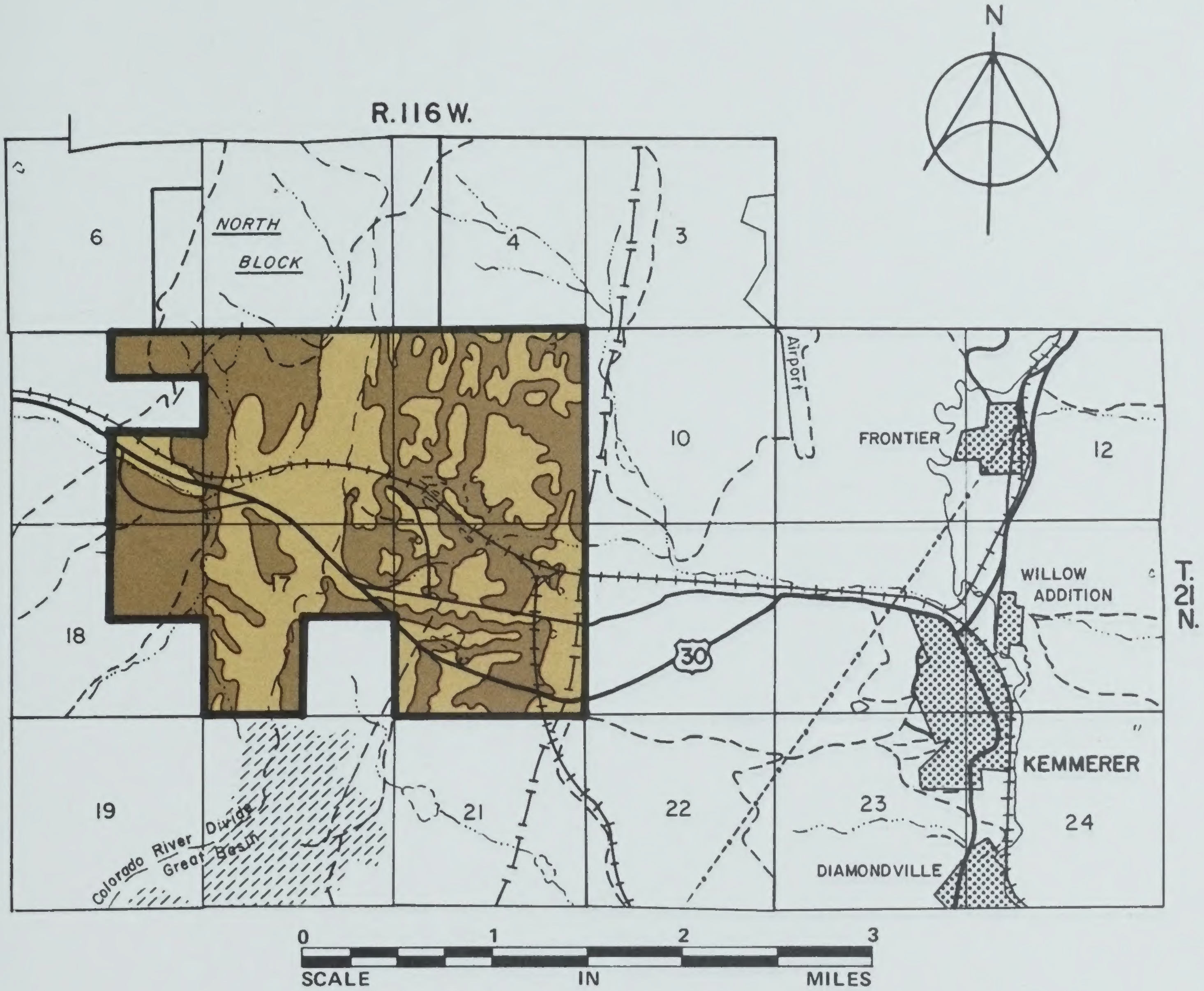
231 RESIDUAL UPLANDS, SHALLOW CLAYEY SOILS, MODERATELY STEEP AND STEEP

232 RESIDUAL UPLANDS, CLAYEY SOILS, ROLLING

Map TC2 - 5A

SOILS

TWIN CREEK



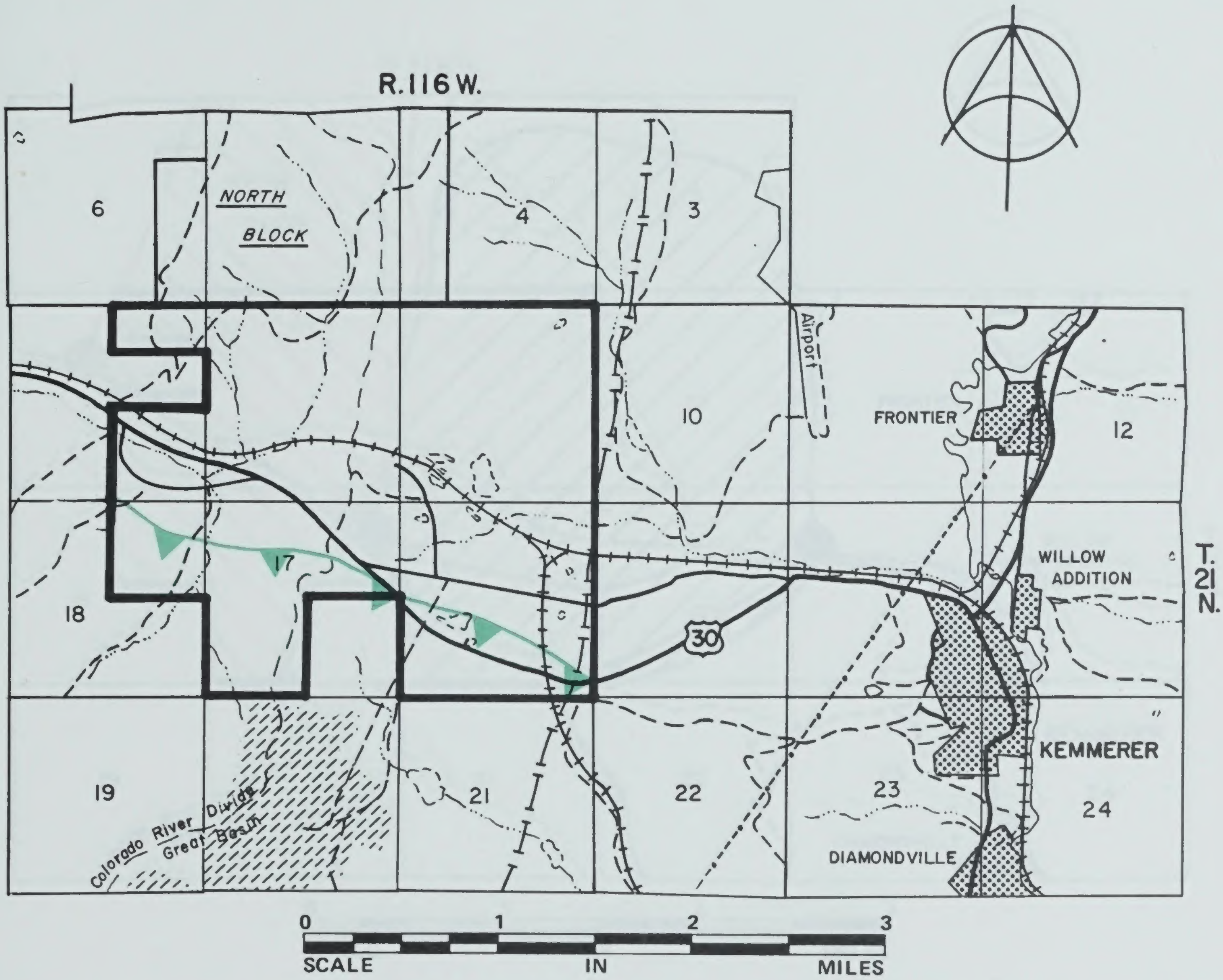
LEGEND

	TYPE 4	SAGEBRUSH
	TYPE 15	WINTERFAT

Map TC2 - 7A

VEGETATION TYPES

TWIN CREEK



LEGEND

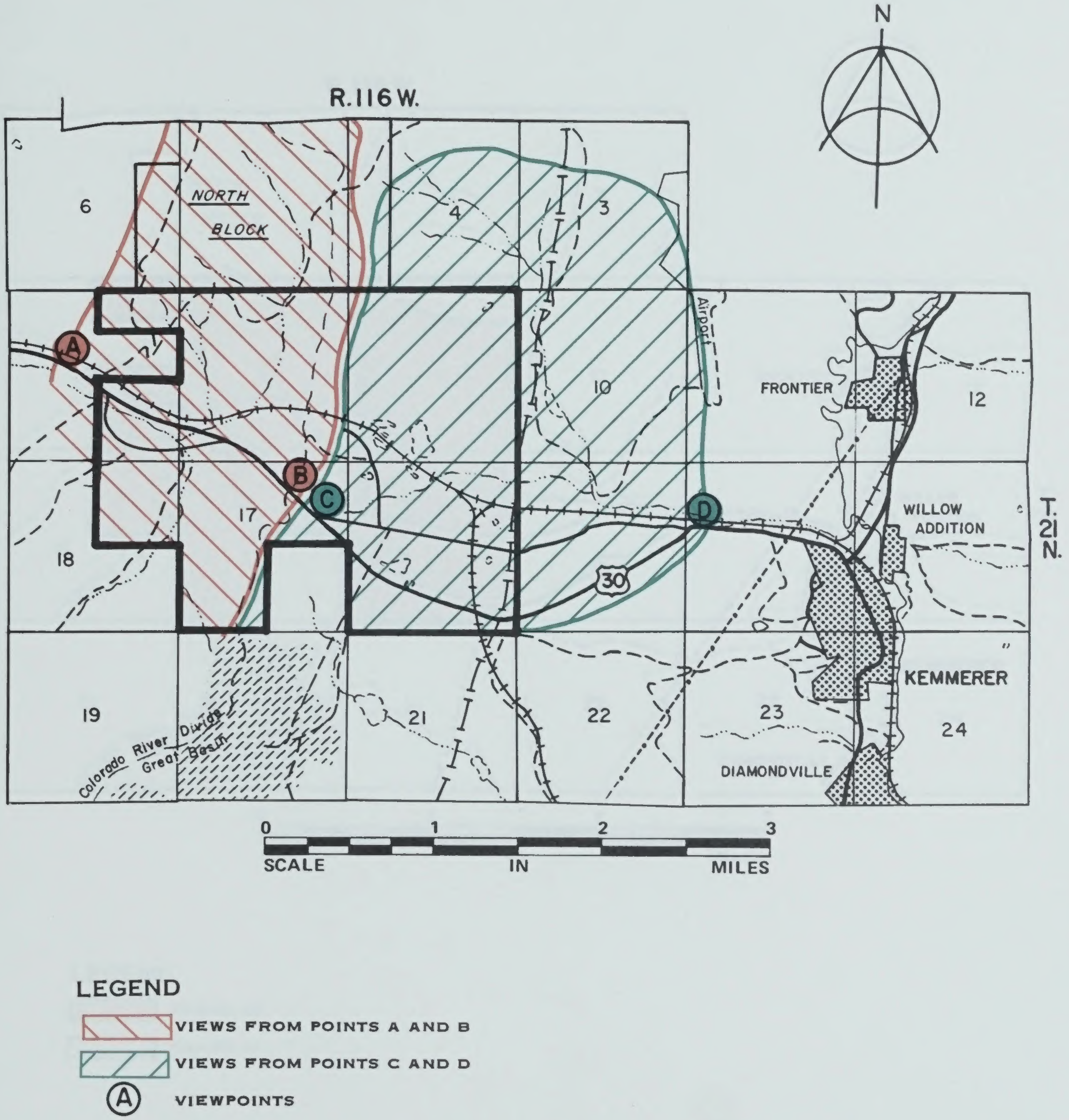
ANTELOPE WINTER AND YEARLONG RANGE

Entire area is mule deer summer range
and sage grouse summer and fall range.

Map TC2 - 8A

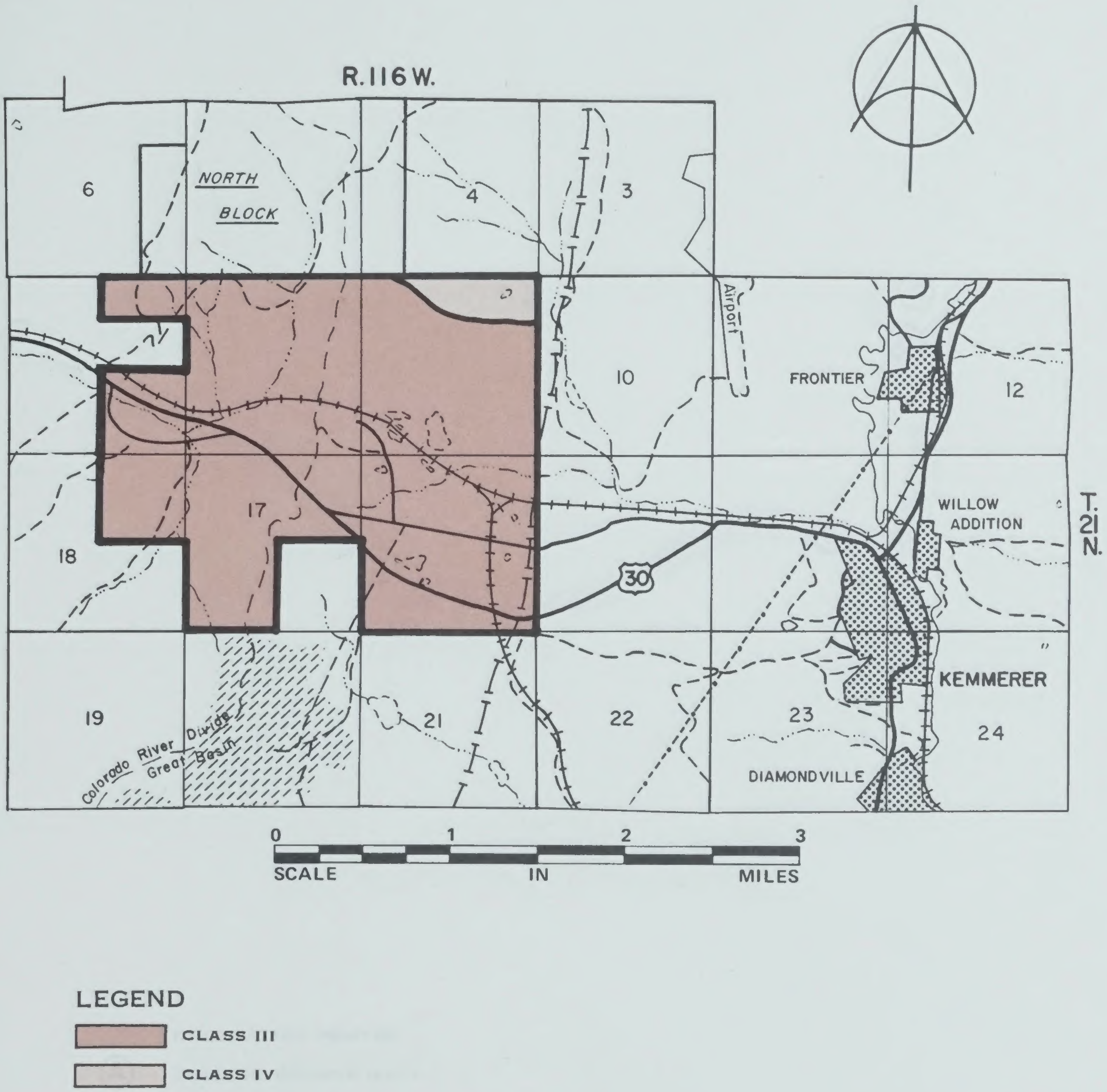
ANIMAL DISTRIBUTION

TWIN CREEK



Map TC2 - 10A

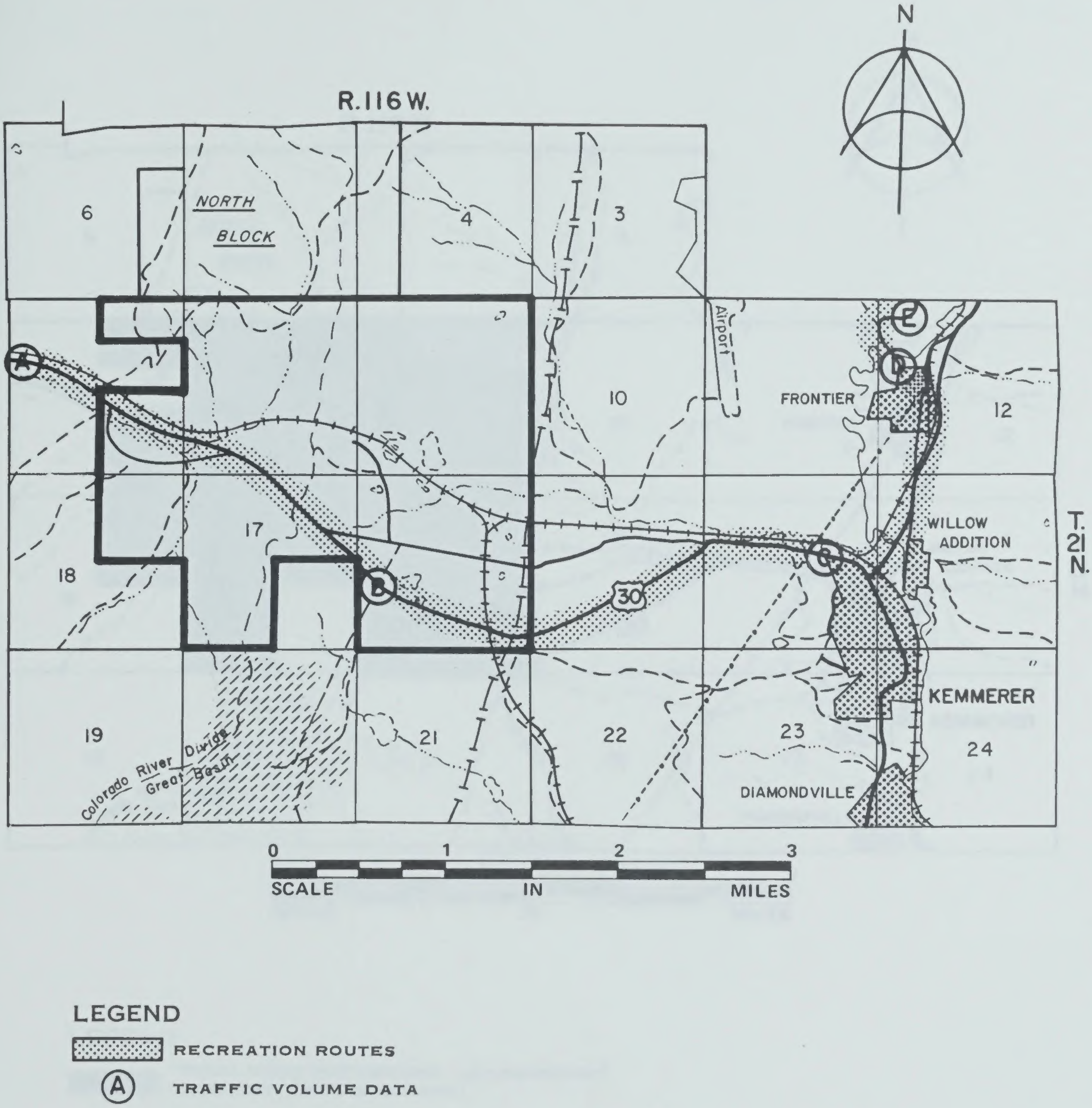
VIEWPOINTS AND VIEWS
TWIN CREEK



Map TC2 - 10B

VISUAL MANAGEMENT CLASSES

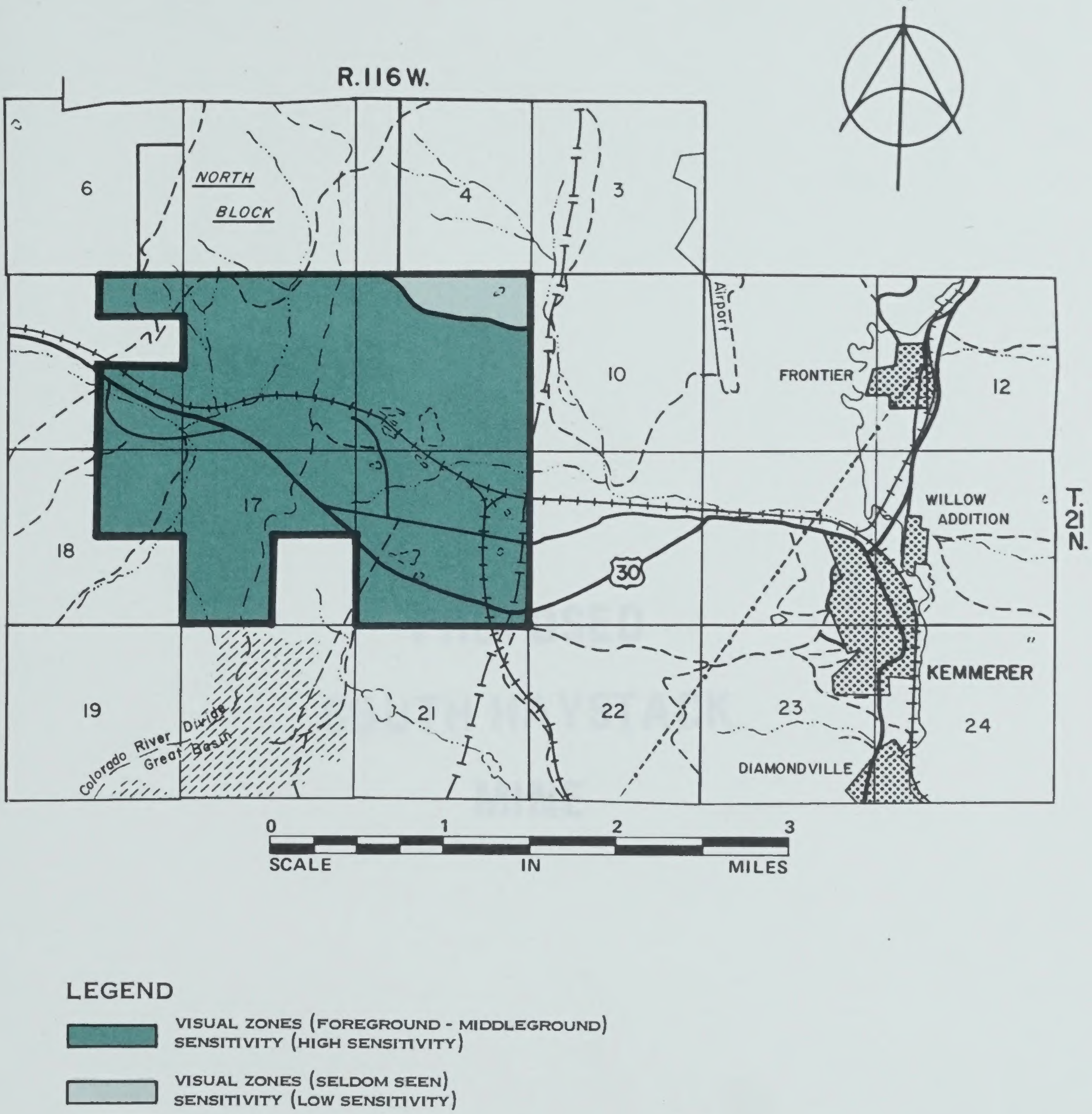
TWIN CREEK



Map TC2 - 6

RECREATION ROUTES

TWIN CREEK



Appendix D
VISUAL ZONES AND SENSITIVITY
TWIN CREEK

PROPOSED SOUTH HAYSTACK MINE

TABLE OF CONTENTS

SOUTH HAYSTACK MINE PROPOSAL

Chapter 1	Page
DESCRIPTION OF THE PROPOSAL	SH1-1
HISTORY AND BACKGROUND	SH1-1
PROPOSED ACTION	SH1-1
Purpose and Objectives	SH1-2
Location	SH1-2
Predisturbance Inventories and Analyses	SH1-2
Mine	SH1-2
Facilities	SH1-2
Support Facilities	SH1-7
POLLUTION CONTROL AND ENVIRONMENTAL MONITORING	SH1-12
Pollution Control Methods	SH1-12
AUTHORIZING ACTIONS	SH1-12
Bureau of Land Management (BLM)	SH1-14
Geological Survey (GS)	SH1-14
Wyoming Department of Environmental Quality	SH1-14
Wyoming State Engineer	SH1-14
INTERRELATIONSHIPS	SH1-14
Relationship to Land Use Plans	SH1-14
Relationship to Other Proposed and Future Actions	SH1-14
Chapter 2	
DESCRIPTION OF THE ENVIRONMENT	SH2-1
EXISTING ENVIRONMENT	SH2-1
CLIMATE	SH2-1
AIR QUALITY	SH2-1
GEOLOGY	SH2-2
Stratigraphy	SH2-2
Paleontology	SH2-2
Structure	SH2-2
Geologic Hazards	SH2-2
TOPOGRAPHY	SH2-2
SOILS	SH2-5
WATER RESOURCES	SH2-5
Ground Water	SH2-5
Ground Water Quality	SH2-8
Surface Water	SH2-8
Surface Water Quality	SH2-8
VEGETATION	SH2-8
Terrestrial Vegetation	SH2-8
Aquatic Vegetation	SH2-15
FISH AND WILDLIFE	SH2-15
General Information	SH2-15
Fishery	SH2-16
Wildlife	SH2-16
Wild Horses	SH2-18
CULTURAL RESOURCES	SH2-18
Archeological	SH2-18
Historical	SH2-22
VISUAL RESOURCES	SH2-22
RECREATIONAL RESOURCES	SH2-22
Visitor Use Data	SH2-22
Hunting	SH2-24
Sightseeing	SH2-24
Wilderness Values	SH2-24
AGRICULTURE	SH2-24
MINERAL RESOURCES	SH2-26
Coal	SH2-26
LAND USE PLANS, CONTROLS, AND CONSTRAINTS	SH2-26
TRANSPORTATION NETWORKS	SH2-26
Highways	SH2-26
Railroads	SH2-27
SOCIOECONOMIC CONDITIONS	SH2-27
Population	SH2-27
Employment	SH2-27
Income	SH2-27
Infrastructure	SH2-27
Attitudes and Expectations	SH2-33
Life Styles	SH2-36
FUTURE ENVIRONMENT	SH2-36

TABLE OF CONTENTS (Cont'd)

SOUTH HAYSTACK MINE PROPOSAL

Chapter 3	Page
ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION	SH3-1
ASSUMPTIONS AND ANALYSIS GUIDELINES	SH3-1
Assumptions	SH3-1
Guidelines	SH3-1
AIR QUALITY	SH3-1
Emissions from the Proposed Mine	SH3-1
Impact on Air Quality	SH3-3
Gaseous Pollutants	SH3-3
Visibility	SH3-3
GEOLOGY	SH3-10
Paleontology	SH3-10
Geologic Hazards	SH3-10
TOPOGRAPHY	SH3-10
SOILS	SH3-11
WATER RESOURCES	SH3-11
Ground Water	SH3-11
Surface Water	SH3-12
Water Use	SH3-12
VEGETATION	SH3-12
Terrestrial	SH3-12
Aquatic	SH3-14
Endangered and Threatened	SH3-14
FISH AND WILDLIFE	SH3-15
General Information	SH3-15
Habitat Losses	SH3-15
Carrying Capacity Losses	SH3-15
Fish and Wildlife Population Loss	SH3-15
Wild Horses	SH3-21
CULTURAL RESOURCES	SH3-21
Archeological	SH3-21
Historical	SH3-21
VISUAL RESOURCES	SH3-21
Summary of (Table SH3-10A)	SH3-22
RECREATIONAL RESOURCES	SH3-22
Visitor Use Data	SH3-22
Hunting	SH3-22
Sightseeing	SH3-22
AGRICULTURE	SH3-22
Livestock Grazing	SH3-22
Prime Farmland	SH3-25
MINERAL RESOURCES	SH3-25
TRANSPORTATION NETWORKS	SH3-25
SOCIOECONOMIC CONDITIONS	SH3-25
Population	SH3-25
Employment	SH3-29
Income	SH3-29
Infrastructure	SH3-29
Attitudes and Expectations	SH3-31
Life Styles	SH3-31
Chapter 4	
MITIGATING MEASURES NOT INCLUDED IN THE PROPOSED ACTION	SH4-1
MEASURES	SH4-1
Mining and Reclamation Plan	SH4-1
Rights-of-Way	SH4-2
ANALYSIS OF EFFECTIVENESS	SH4-2
MONITORING, RESEARCH AND STUDY PROGRAMS	SH4-3
Chapter 5	
ADVERSE IMPACTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED	SH5-1
AIR QUALITY	SH5-1
GEOLOGY	SH5-2
Paleontology	SH5-2
SOILS	SH5-2
WATER RESOURCES	SH5-2
VEGETATION	SH5-2
FISH AND WILDLIFE	SH5-2
CULTURAL RESOURCES	SH5-3
VISUAL RESOURCES	SH5-3
RECREATIONAL RESOURCES	SH5-3
Visitor Use Data	SH5-3
AGRICULTURE	SH5-3
MINERAL RESOURCES	SH5-4

TABLE OF CONTENTS (Cont'd)

SOUTH HAYSTACK MINE PROPOSAL

	Page
Chapter 5 (Cont'd)	
TRANSPORTATION NETWORKS	SH5-4
SOCIOECONOMIC CONDITIONS	SH5-4
Population	SH5-4
Social Conditions	SH5-4
Chapter 6	
THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY	SH6-1
Chapter 7	
ANY IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED	SH7-1
Chapter 8	
ALTERNATIVES TO THE PROPOSED ACTION	SH8-1
NO ACTION	SH8-1
AIR QUALITY	SH8-1
FISH AND WILDLIFE MITIGATION ALTERNATIVE	SH8-4
ALTERNATE RAILROAD SPUR ROUTES ALTERNATIVE	SH8-4
UNDERGROUND MINING ALTERNATIVE	SH8-6
SOUTH HAYSTACK RECLAMATION ALTERNATIVE	SH8-6
RECLAMATION METHODOLOGY ALTERNATIVE	SH8-6
DEFER ACTION ALTERNATIVE	SH8-7
PREVENT (FURTHER) DEVELOPMENT ON THE LEASE ALTERNATIVE	SH8-7
RESTRICT DEVELOPMENT ON THE LEASE ALTERNATIVE	SH8-7
ALLOW DEVELOPMENT OF SELECTED AREAS NOW UNDER LEASE ALTERNATIVE	SH8-7
Chapter 9	
CONSULTATION AND COORDINATION	SH9-1
SITE SPECIFIC APPENDIX	
SOIL ASSOCIATION MAPPING UNIT DESCRIPTION	SHA-1

CHAPTER 1

DESCRIPTION OF THE PROPOSAL

HISTORY AND BACKGROUND

Lands under coal lease W-060241, 1,408 acres, are about 17 miles northeast of Evanston, Wyoming, and 25 miles south-southwest of Kemmerer, Wyoming. FMC Corporation perfected this preference right lease from a prospecting permit with an effective date of 1 March 1963. Cumberland Coal Company, a joint venture between Peter Kiewit Sons' Co. and Rocky Mountain Energy Company, a subsidiary of the Union Pacific Corporation, has been exploring the lease area under agreement with FMC Corporation.

The lease with the Bureau of Land Management (BLM) is a continuing lease subject to reasonable readjustment of terms on a 20-year basis. It provides for a royalty of 17½ cents a ton (2,000 pounds) for coal that is strip mined and 15 cents a ton for coal that is mined from underground operations during the first 20 years. The annual rental is set at 25 cents per acre for the first year, 50 cents per acre for the second through the fifth year, and 1 dollar per acre for the sixth and each succeeding year during the continuance of the lease. Under Section 5 of the lease, the lessor may prescribe the steps to be taken and restoration to be made with respect to the leased lands and improvements thereon, whether or not owned by the United States.

Cumberland Coal Company, in accordance with 30 Code of Federal Regulations (CFR) 211 (May 1976), filed a comprehensive draft environmental impact assessment for a proposed surface open-pit coal mine with the Office of the District Mining Supervisor, U.S. Geological Survey (USGS). A revision of this mine plan (Cumberland Coal Company 1976), filed on 13 January 1977, describes the company's operational plan for the expected mine life of 22 years on its 1,408 acres of coal lease W-060241. The USGS has accepted the South Haystack mining and reclamation plan as suitable for use in preparing an environmental statement (ES).

The mining plan and supporting data submitted by Cumberland Coal Company are on file at the Office of the District Mining Supervisor, USGS, Conservation Division, Rock Springs, Wyoming, and can be reviewed at that location.

The coal seams of this mine incline greater than 15 degrees; however, this mine may or may not meet the qualifications set in Section 527 (Special Bituminous Coal Mines) of the Surface Mining Control and Reclamation Act of 1977 due to its physical location in relation to the existing 527 mine. However, it is being treated as a 527 Special Bituminous Mine in this site-specific ES until the question of location can be resolved. Section 527 allows for certain reclamation exemptions such as highwalls, benches, etc.

SURFACE MINING CONTROL AND RECLAMATION ACT

The mining and reclamation plan for this proposed project was submitted for review prior to passage of the Surface Mining Control and Reclamation Act (SMCRA) of 1977 (P.L. 95-87). Therefore, the plan may not fully reflect the requirements of the current law and regulations. However, it is believed that it presents sufficient data to permit analysis of the impacts that will be associated with mining in this area. Prior to departmental approval, the plan will be returned to the applicant for modification to incorporate the requirements of SMCRA. When the mining and reclamation plan is returned to the Department, it will be reevaluated to insure that it meets the requirements of SMCRA and appropriate federal regulations, and that the potential impacts are covered by this ES.

This procedure will facilitate the timely and efficient consideration of applications for permits under the evolving requirements of SMCRA. We believe this procedure is reasonable in view of the evolving character of the law.

The Regional ES, Chapter 3, Planning and Environmental Controls, includes reference to appropriate provisions of SMCRA, and these were incorporated into the following impact analysis to the extent possible at this time. However, it is realized that some of the adverse impacts described will be precluded by implementation and enforcement of the new law. This is especially true in regard to impacts on the water, soil, and vegetation resources. In any event, the worst possible case is covered.

PROPOSED ACTION

The action before the federal government is to consider for approval the mining and reclamation plan presented by the Cumberland Coal Company and to issue rights-of-way for a power line, telephone line, haul road, and a railroad spur necessary before mining operations can begin.

DESCRIPTION OF THE PROPOSAL

Purpose and Objective

The purpose of the proposed action is to allow the leaseholder to mine 2.5 to 3.5 million tons of coal per year over a projected mine life of 22 years. The objective of the proposed mining on this lease is to supply coal to steam power generation plants in Idaho, Oregon, and Washington.

Location

The proposed mine operation would be approximately 17 miles northeast of Evanston and 25 miles south-southwest of Kemmerer, Wyoming. U.S. Highway 189 runs in a northerly-southerly route and is located about 2 miles east of the proposed mining operation. The project area contains 8,080 acres (Table SH1-1).

The location of the project area is shown on Figure SH1-1 and Map SH1-1. The location of the proposed surface facilities is on private land as shown on Map SH1-2.

Predisturbance Inventories and Analyses

Specific inventories were conducted under the direction and (or) cooperation of the Cumberland Coal Company in consultation with the BLM concerning endangered and (or) threatened plants, archeological sites, historical sites, and paleontological locations.

Robert Dorn, BLM plant specialist, conducted an inventory of the proposed South Haystack project area for proposed endangered and (or) threatened plant species. His inventory did not reveal the presence of plants listed on the 1977 list of proposed endangered and (or) threatened plant species.

The U.S. Fish and Wildlife Service, Denver Research Center, under contract to the BLM Wyoming State Office began an intensive black-footed ferret survey in the South Haystack Mine area in July of 1978. The results of this survey are anticipated in October of 1978. The mining plan will not be approved until this study is completed. If it is determined black-footed ferret or other endangered and (or) threatened species exist on the mine area, the mine plan will be modified to protect the species and critical habitat.

Michael Metcalf, Consulting Archeologist, Research Associate, Western Wyoming College, in 1976 and in 1977 conducted archeological surveys and testing of the project area and rail spur rights-of-way. Testing of alluvium to ascertain the potential existence of subsurface sites began in June 1978 (see Chapter 2, Cultural Resources).

In 1976, Western Interpretive Services, Inc., conducted an historic research of the project area (see Chapter 2, Cultural Resources).

A review of paleontological literature, and personal experience led P. O. McGrew, University of Wyoming, in 1977 to conclude that it would be extremely unlikely that fossil vertebrates would be disturbed by mining at the South Haystack project area. Invertebrate and paleobotanical fossils, however, would be encountered.

Analyses have been done to determine physical and chemical properties of topsoil and overburden. The analyses assist in identifying the suitability of materials for plant growth medium and in determining possible problems with materials toxic to plants and (or) animals.

The analyses indicated adequate surface soil quantities and qualities for topsoil use. Some overburden layers were found to have one or a combination of the following: (1) high soluble salts, (2) high sodium absorption ratio values, (3) high salinity, (4) acidity, and (5) alkalinity.

Mine

Cumberland Coal Company proposes to open the South Haystack Mine using conventional stripping and mining equipment. Construction at the mine would start in 1978 with 98 employees and peak with 180 employees in 1979. Maximum production would require 260 employees by the fourth year of operation in 1984. Production is scheduled to begin in 1979 at a rate of 1.5 million tons per year. Thereafter, production is scheduled for 2.5 to 3.5 million tons per year for the life of the mine. Coal quality data are listed by seam in Table SH1-2.

Facilities

The facilities would consist of an office, change house, maintenance shop/ warehouse, lubrication/washing building, and a railroad loop with loading capabilities. The facilities complex covers approximately 100 acres (see Map SH1-2).

An on-site well would be used for domestic needs, fire-protection, dust suppression and for other uses in the shops and equipment-washing buildings.

Coal Mining Operation

Topsoil would be removed with self-elevating scrapers. Overburden would be drilled and blasted (in accordance with 30 CFR 715.19 concerning the use of explosives) in lifts for removal with 20- to 25-yard loading shovels, loading into 120-to 170-ton rear dump trucks. Overburden on benches out of reach of the shovels would be pushed by tractors to front-end loaders or loaded by backhoes from the bench above. The exposed coal would be drilled, blasted, loaded (into 50- to 100-ton trucks by 15- to 23-yard front-end loaders), and hauled to the rail loop coal handling facilities.

Truck Dump and Primary Crushing Station

The station would be sized to accommodate two trucks dumping side by side and would have a total surge capacity equal to a minimum of 3½ haul trucks. Coal would be fed out of the hopper by reciprocating feeders into the primary crusher and then onto a conveyor system. Tramp metal detection or separation would be provided to protect subsequent equipment.

Table SH1-1

LAND SURFACE AND COAL OWNERSHIP OF THE PROPOSED SOUTH HAYSTACK PROJECT AREA

	Surface Acres	Coal Acres
Public	3,010	3,010
State of Wyoming	640	640
Private	4,430	4,430
Total	8,080	8,080

Note: Derived from BLM Master Title Plats.

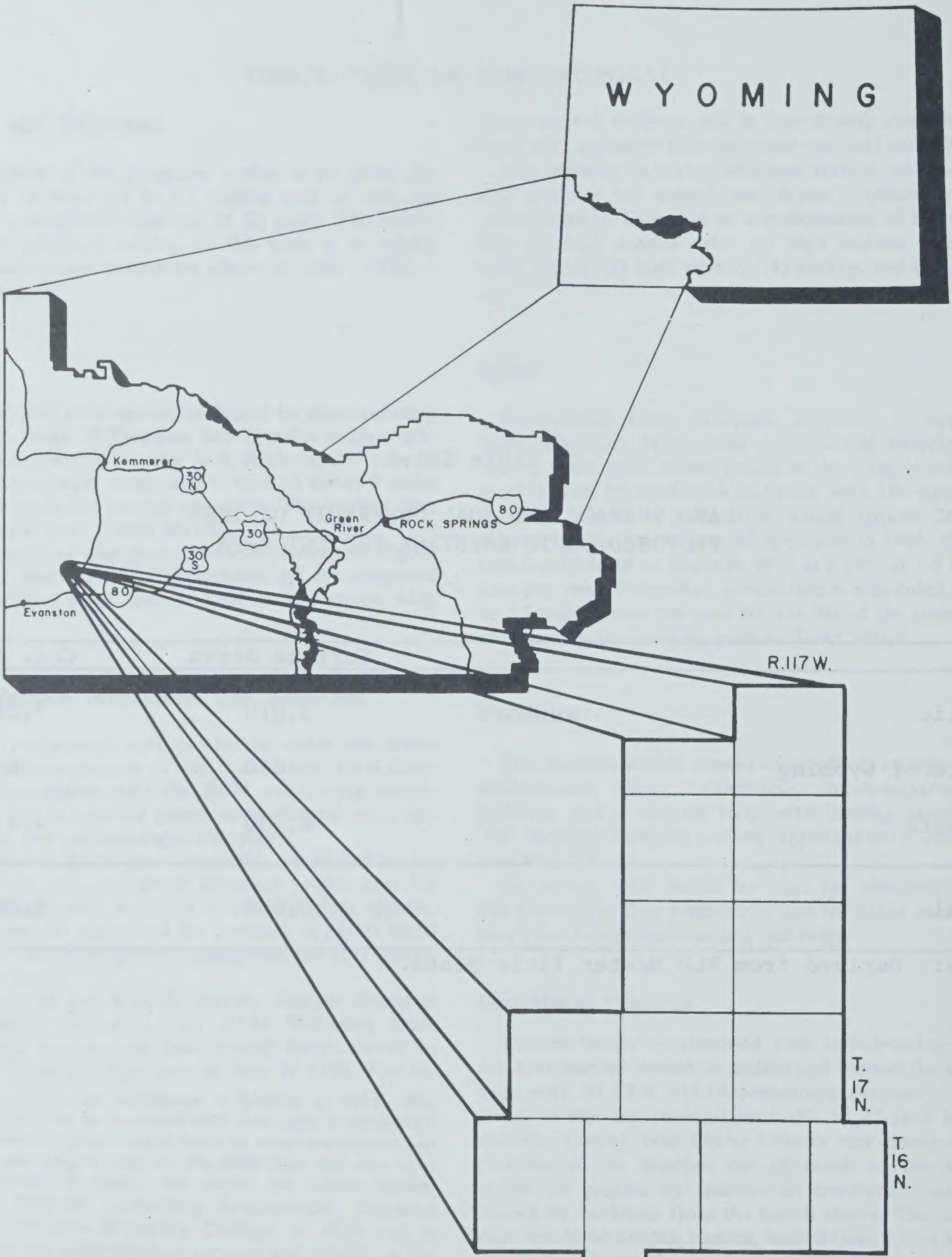
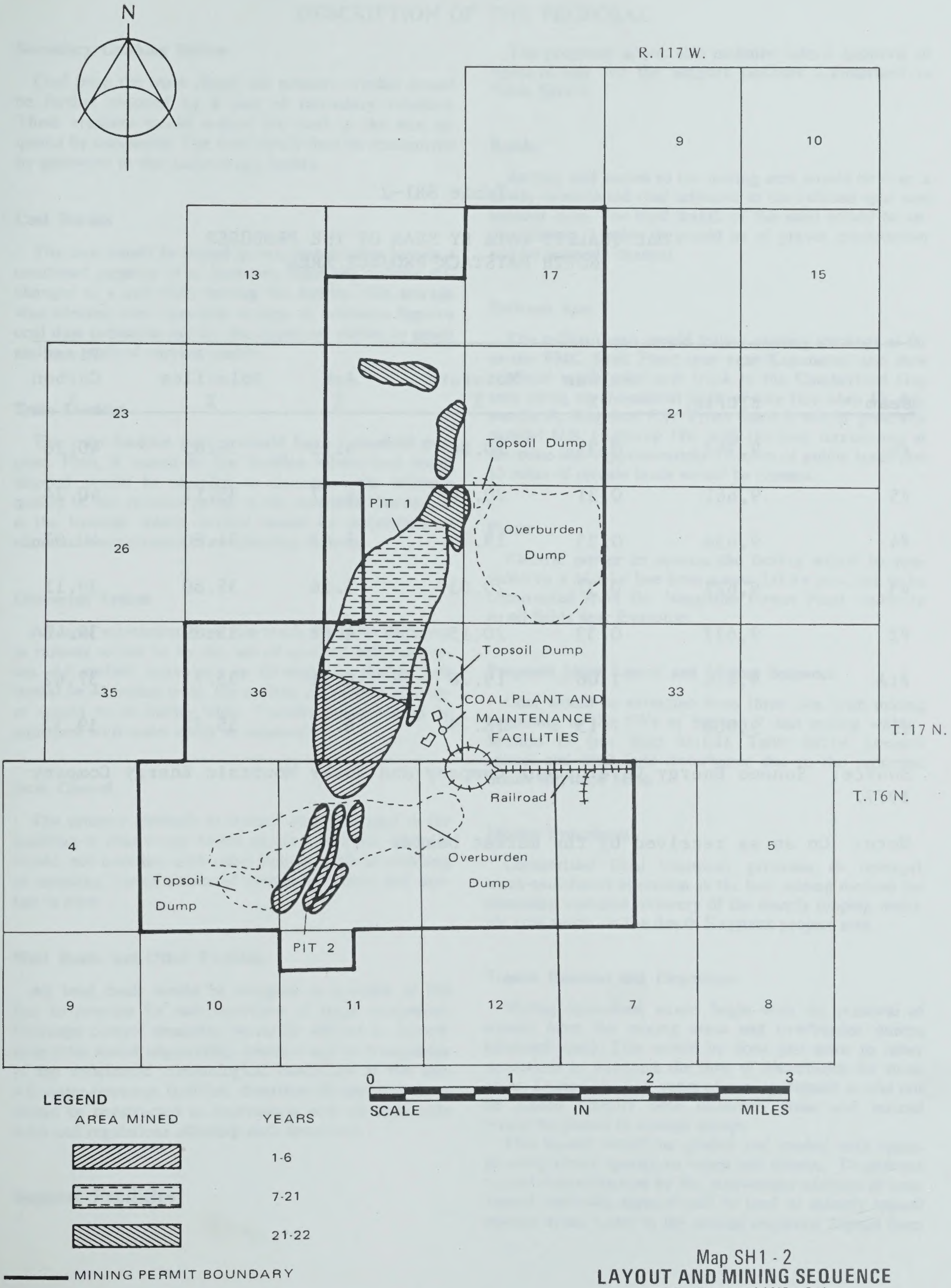


FIGURE SH 1 - 1

GENERAL LOCATION OF PROPOSED SOUTH HAYSTACK PROJECT AREA



Map SH1 - 2
LAYOUT AND MINING SEQUENCE
SOUTH HAYSTACK

Table SH1-2

COAL QUALITY DATA BY SEAM OF THE PROPOSED SOUTH HAYSTACK PROJECT AREA

Seam	BTU/lb.	Sulfur %	Moisture %	Ash %	Volatiles %	Fixed Carbon %
#6	9,762	0.33	20.04	4.15	35.65	40.16
#5	9,661	0.31	20.28	4.37	35.11	40.24
#4	9,636	0.33	19.70	5.43	34.80	40.07
#3	9,627	0.37	20.03	5.06	35.80	39.11
#2	9,627	0.33	20.15	4.48	35.89	39.48
#1A	9,416	1.06	19.78	6.91	35.71	37.62
#1	9,908	1.15	18.79	6.31	35.75	39.32

Source: Sunoco Energy Development Company and Rocky Mountain Energy Company 1977.

Note: On an as received by the market basis.

Secondary Crushing Station

Coal from the truck dump and primary crusher would be further reduced by a pair of secondary crushers. These crushers would reduce the coal to the size required by customers. The coal would then be transported by conveyor to the coal-storage facility.

Coal Storage

The coal would be stored in two storage silos having a combined capacity of at least two times the volume discharged to a unit train serving the facility. Silo storage was selected over open-pile storage to minimize fugitive coal dust emissions and for the improved ability to grade and mix coals of varying quality.

Train Loadout

The train loadout station would have a twofold purpose. First, it would be the location where coal being shipped would be sampled to determine the ultimate quality of the product going to the customer. Second, it is the location where control would be maintained to eliminate the potential of overloading railcars.

Conveying System

All coal movement from the truck dump to shipment in railcars would be by the use of covered belt conveyors. All surface conveyors up through the storage belt would be 42 inches wide; the reclaim or loadout conveyor would be 60 inches wide. Transfer points would be equipped with water spray as required.

Dust Control

The primary methods to control dust generated in the handling of coal would be the addition of water where it would not interfere with other actions such as crushing or sampling, use of a covered conveyor system, and storage in silos.

Haul Roads and Other Facilities

All haul roads would be designed to a width of 100 feet to provide for safe operation of large equipment. Drainage control measures would be utilized in accordance with sound engineering practice and in recognition of the anticipated climatological conditions at the site. All water-retention facilities, diversion ditches, and dams would be constructed in accordance with all applicable rules and regulations affecting such structures.

Support Facilities

The proposed action also includes federal approval of rights-of-way for the support facilities summarized in Table SH1-3.

Roads

Service and access to the mining area would be over a newly constructed road adjacent to the railroad spur and loadout loop. The total length of this road would be approximately 2 miles. It would be of gravel construction and be properly drained.

Railroad Spur

The railroad spur would follow existing trackage as far as the FMC Skull Point spur near Kemmerer, and then continue south over new track to the Cumberland Gap area along an abandoned right-of-way (see Map 13, Appendix A, Regional ES). From there it would generally parallel U.S. Highway 189, with the loop terminating at the mine site. Approximately 12 miles of public lands and 13 miles of private lands would be crossed.

Power

Electric power to operate the facility would be provided by a 34.5 kv line from a new 138 kv pole line to be constructed from the Naughton Power Plant southerly to oil fields near Evanston.

Proposed Mine Layout and Mining Sequence

Coal would be extracted from three pits, with mining beginning in the SW¼ of Section 2 and ending within Section 19 (see Map SH1-2). Table SH1-4 presents annual and total land disturbance due to the proposed South Haystack Mine.

Mining Procedures

Cumberland Coal Company proposes an open-pit, truck-and-shovel operation as the best mining method for maximum resource recovery of the steeply dipping multiple coal seams on the South Haystack project area.

Topsoil Removal and Disposition

Mining operations would begin with the removal of topsoil from the mining areas and overburden dumps (disposal sites). This would be done just prior to other operations to minimize the time of disturbance for these areas. During the first years of mining, topsoil would not be placed directly onto disturbed areas and instead would be placed in storage dumps.

This topsoil would be graded and seeded with rapid-growing cover species to lessen soil erosion. To prevent topsoil contamination by the inadvertant addition of non-topsoil materials, signs would be used to identify topsoil storage areas. Later in the mining sequence, topsoil from

Table SH1-3

PROPOSED SUPPORT FACILITIES FOR THE SOUTH HAYSTACK MINE

Applicant	Proposed Facilities	Application Number	Total Length (Miles)	Width (Feet)	Acres Required Public	Acres Required Private	Location of Public Land Affected
None yet	Power line and telephone line	None yet	24.0 (8.0 public land)	100	96	192	Secs. 10, 22, 28, 32, T. 17 N., R. 117 W. Secs. 12, 14, 18, T. 18 N., R. 117 W.
None yet	Road	None yet	2.2 (0.2 public land)	175	3	42	Sec. 32, T. 17 N., R. 117 W.
Oregon Shortline Railroad	Railroad spur	W-56828 W-56830	25.0 (12.0 public land)	200	288	312	Sec. 18, T. 20 N., R. 116 W. Secs. 10, 22, 28, 32, T. 17 N., R. 117 W. Secs. 12, 14, 18, T. 18 N., R. 117 W.

Table SH1-4

LAND DISTURBANCE AND RECLAMATION SCHEDULE OF THE PROPOSED SOUTH HAYSTACK MINE

Year	Mng. Fac. (Acres)	Haul Roads (Acres)	R.R. Loop & Spur (Acres)	Pits (Acres)	OB Piles (Acres)	Tpsl. Piles (Acres)	Dams & Ditches (Acres)	Acres Dstbd. each Year	Cumula-tive Dstbd. Acres	Acres Seeded each Year	Cumula-tive Seeded Acres	Net Acres Unseeded
-2	93	129	80	30		42		374	374	0	0	374
-1				289	100	43	61	493	867	0	0	867
1				41	604	32		677	1544	0	0	1544
2				42			3	45	1589	141	141	1448
3				44				44	1633	82	223	1410
4									1633	82	305	1328
5									1633	82	387	1246
6							5	5	1638	83	470	1168
7				77				77	1715	106	576	1139
8							18	18	1733	106	682	1051
9				77				77	1810	35	717	1093
10							5	5	1815	35	752	1063
11									1815	35	787	1028
12				77				77	1892	35	822	1070
13									1892	35	857	1035
14									1892	35	892	1000
15				77				77	1969	35	927	1042
16		23		73				96	2065	35	962	1103
17									2065	35	997	1068
18									2065	35	1032	1033
19				73				73	2138	35	1067	1071
20							6	6	2144	35	1102	1042
21									2144	35	1137	1007
22				141				141	2285	35	1172	1113
23									2285	340	1512	773
24									2285	190	1702	583
25									2285	583	2285[1]	0

Source: Sunoco Energy Development Company and Rocky Mountain Energy Company 1977.

[1]Does not include 138 kv power line or railroad spur acreage disturbance outside of project area.

newly disturbed areas would be placed directly over backfilled pits, instead of being stockpiled.

Watercourse Diversions

Temporary diversion and (or) interception channels would be constructed around all mining pits, overburden dumps, and topsoil stockpiles. The channels and several temporary reservoirs constructed to receive runoff would be designed to handle a flow from a 100-year 6-hour storm.

Meadow Draw would be the only major drainage in which mining would be conducted. A temporary diversion of drainage in the draw would be necessary in about the 8th year of mining. The Meadow Draw drainage would be reestablished and the diversion removed after an approximate 5-year time period.

Watercourse diversions would be designed, constructed, and maintained to prevent additional contribution of suspended solids to streamflow or to runoff outside the permit area (30 CFR 715.17(c)(3)).

Overburden Removal and Disposition

Once topsoil has been removed from pit areas, overburden removal would begin. Pit depths would range from less than 100 feet to a maximum of 800 feet, with an average overburden depth of approximately 200 feet. During the life of the mine, 353 million cubic yards of loose overburden would be moved.

During the first year of mining, all of the overburden would be placed on the dumps in Sections 1, 2, and 3 (see Map SH1-2). After year 1, as much material as possible would be placed in mined-out pits with the excess going to dumps. The pits in Sections 2 and 3 would be filled in the first 4 years of mining. In years 5 through 15, excess overburden would be placed on the dump in Section 29, and the pit in Section 19 would be used for the remainder of the mine life. Signs would be placed on these dumps to identify the nature of the material stored.

A part of the overburden material from the small pit on the east one-half of Section 19 would be used to achieve the proposed final reclamation contour in the northern part of the large pit to the south. Overburden material from the final pit would be placed in the small pit on the east one-half of Section 19, and the topographic shape of the draw which existed in the pit area prior to mining would be reestablished.

Coal Removal

There are seven coal seams of mining interest within the project area. They have been tentatively named the 1, 1A, 2, 3, 4, 5, and 6 seams.

Mining is proposed for seams 2 through 6 with some potential mining of seams 1 and 1A. Mining of seams 1 and 1A would be contingent upon marketability of this coal and would be limited to those quantities which can be blended with coal from other seams to achieve a compliance coal which does not exceed the federal sulfur emission standards for new coal-fired power plants.

The footwall slope angle of the pits would be determined by the coal seam dip which averages 20 degrees with dips as high as 55 degrees. Bench heights would be 40 to 50 feet with a safety bench every 80 to 100 feet. The pit would advance on the wingwall and would have an average slope from horizontal to 31 degrees. The average working bench width on the advancing wingwall would be 500 feet. Haulage would be routed out the footwall from the lower pit benches until the wingwall has expanded sufficiently on the middle benches to establish 8% ramp haulage on the working face.

Mining of each level on the advancing wingwall would be initiated by an electric shovel ramping down in the area where the floor of the working bench intersects the established haulage ramp. Haulage would then be rerouted over the ramp made by the shovel, and the shovel would then dig out the portion of the original ramp on the working bench. Loading equipment would work along the strike of the coal seams in the direction of the footwall. As coal is uncovered, it would be drilled, blasted, and loaded with front-end loaders into 50- to 100-ton trucks for hauling to the coal-handling facilities at the rail loop.

Reclamation

The Cumberland Coal Company, pursuant to Section 515 of SMCRA and 30 CFR 715.13, would be required to restore disturbed lands to conditions capable of supporting premining uses. A mining permit would not be approved unless the applicant has demonstrated that reclamation to the proposed post mining land use can be accomplished under the reclamation plan contained in the mining and reclamation plan (Section 510, SMCRA).

Present and Future Land Use

The land within and adjacent to the proposed South Haystack project area is used primarily for livestock grazing, wildlife habitat, and outdoor recreation.

The objective of the South Haystack reclamation plan is to reclaim land disturbed by mining to a use equivalent to or better than the highest previous use. Future use of the site is expected to involve wildlife use, livestock grazing and outdoor recreation at premining levels.

The proposed post mining land use of wildlife habitat, livestock grazing, and outdoor recreation for public lands is in conformance with the land use decisions found in the Pioneer Trails Management Framework Plan of the BLM (U.S. Department of the Interior, BLM 1977b).

Reclamation Schedule

The backfilling of pits would begin as soon as possible without interfering with the efficient and safe operation of the mining sequence. Topsoil placement, seedbed preparation, and seeding operations would generally be conducted approximately 3 years after the initial disturbance of an area and approximately 2 years after mining.

The lag time for reclamation of the final pit would be somewhat less, since backfilling would begin upon the completion of mining. The final pit area would be ready for seeding not later than 2 years following the last extraction of coal.

Reclamation activities would be conducted on overburden disposal sites where subsequent spoil disposal would not occur. Those areas needed for subsequent spoil disposal (until end of mine life) would be ready for seeding within 1 year of their final use. The proposed South Haystack Mine reclamation schedule is presented in Table SH1-4.

Backfilling and Overburden Dumps

Trucks would be used to selectively place overburden in worked-out pits and overburden disposal sites.

Poor quality overburden, as defined by the Wyoming Department of Environmental Quality, would be covered in the backfilling operation by at least 4 feet of suitable quality material before the topsoil is replaced. Once all of the overburden is in place in an area, grading would be done with bulldozers. Spoil compaction would be limited to that provided by traffic of the large trucks, bulldozers, and other heavy machinery. Contours of overburden dumps would be established by careful field supervision in order to minimize later transfer of materials to achieve the designed final contour and necessary drainage.

As overburden is removed and transported it would swell to a volume more than compensating for the volume of coal removed. Thus, as mining progresses northward in the main pit, the rate of backfilling would exceed the rate of overburden removal, causing a reduction in overall pit size. To maintain the pit at a convenient and safe size, the excess overburden from mining years 11 to 16 would be placed into a dump located in Section 29, T. 17 N., R. 117 W. The volume of this dump would be designed to compensate for overburden swell throughout the remainder of the mine life. The final objective would be to maximize the extent of backfilling and minimize the size of overburden dumps.

The final pit of the mine would be partially backfilled, and the remaining highwall reduced to form grades suitable for reclamation (less than 25%). Any depressions left in backfilled pit areas would be free-draining toward the east and north.

Topsoil Handling and Erosion Control

Topsoil would be removed and redistributed on shaped spoils with selfelevating scrapers. Topsoil replacement depth would range from 12 to 18 inches. Wherever possible, topsoil would be transported directly to areas ready for revegetation. Because of variations in pit size during the life of the mine, some topsoil storage areas would be required. Topsoil from the initial portion of each pit and from the dump area(s) would be stockpiled for use when that mining segment is complete. All stockpiles would be marked to prevent accidental mixing of topsoil and overburden materials. Topsoil stockpiles that are to remain more than 1 year would be seeded with an annual cover crop such as oats to minimize erosion.

Since the limited precipitation at the project area would be one of the most serious constraining factors on reclamation, efforts would be made to conserve all moisture possible. These efforts would include pitting of the seedbed surface to trap runoff and incorporation of straw mulch to provide increased infiltration and retention of available moisture. On all sloping areas, topsoil replacement and other equipment operations would be conducted on the contour to minimize erosion and provide maximum entrapment of runoff. On relatively level areas, topsoil would be replaced in a north-south direction and left in a relatively rough condition until just before seeding to assist in minimizing wind erosion and fugitive dust.

Fertilizer would be applied to enhance seedling growth and establishment either at the time of seeding or at the end of the first growing season. Specific fertilization rates and timing would be decided after conducting appropriate analyses of the replaced topsoil on a given area.

Where necessary during the establishment of a diverse permanent vegetation, weed control measures (herbicides, mowing, etc.) would be implemented to avoid excessive competition from undesirable species.

Grass-hay or straw mulch would be applied after seeding at a rate of 2 tons per acre. The mulch would be crimped into the ground by a disc-type packer with discs spaced approximately 8 inches apart and set to penetrate the soil 2 to 3 inches.

To minimize the impacts of topsoil erosion and sedimentation of downstream water, catchment ditches leading to sediment ponds would be installed on all dump faces, toes, and other disturbed slopes. The sediment ponds would be designed to retain the 10-year flood from the areas they drain.

Watercourse, Drainage Channels, and Impoundments

The Meadow Draw drainage would be restored in the reclaimed spoil surface to the approximate original drainage course.

The slopes between the Meadow Draw drainage and surrounding reclaimed areas would not exceed 25%. The bottom and sides of the 50-year flood channel in the drainage would be thoroughly compacted with heavy equipment to reduce infiltration into the underlying spoil material. Following compaction, the bottom and sides of the channel would be lined with a 12-inch thick layer of coarse scoria, gravel, or crushed sandstone to prevent excessive erosion. A very shallow soil layer of topsoil (about 3 inches) would be applied over the rock material to provide a seedbed. The gravel-lined portion of drainages would be seeded by broadcasting. Low lying areas adjacent to the channel would be seeded with the "In

Drainage Bottoms"mixture (see Table SH1-5) by hydroseeding or broadcasting.

No impoundments would be created in the mine pits since the pits would be entirely backfilled or, in the case of the northernmost pit, graded to create a free draining situation.

Decommissioning and Abandonment

Upon completion of mining operations, all surface facilities would be removed, railroad tracks would be removed, and these and other similarly disturbed areas would be reclaimed. Compacted areas such as access roads would be loosened to a depth of 18 inches by chiseling or other appropriate means prior to revegetation. At least 6 inches of topsoil from the final stockpile would be applied to these areas, and they would be seeded.

The railroad grade and roadways would be retained and blended into the surrounding terrain if they are deemed usable and advantageous by the surface owner. Similarly, some building structures may be left if valuable for alternate uses.

Revegetation

A permanent cover of predominantly native species would be established on disturbed areas following completion of mining.

Planting would occur each fall after mid-October. This would enable full utilization of winter and spring precipitation without risking winterkill of seedlings, which could result from earlier planting that would allow fall germination. Yearly planting would allow the reclamation program to be kept current with the mining operation, thus avoiding large areas of bare spoils.

In exceptional limited situations, specialized procedures such as broadcast seeding (as discussed for gravel-lined portions of drainages), sod transplanting, or shrub transplanting, may be conducted. These approaches are not considered necessary, however, for the basic reclamation plan and would be undertaken only to overcome specific seeding problems or to develop particular wildlife habitat conditions.

Since many of the dominant species native to the project area are available from commercial seed producers, these same species would be used to revegetate the area. These species are well adapted to the shallow soils and arid environment characteristic of the project area. The mixtures and rates to be seeded are identified in Table SH1-5.

These species are primarily native to the foothills and basins regions of southwestern Wyoming. The two introduced species included are tall wheatgrass and cicer milkvetch, both of which are well adapted to periodically moist sites in an otherwise arid environment.

Management of Reclaimed Areas

Revegetated areas would be fenced to exclude domestic livestock and big game for a period of at least 2 years after a good vegetative cover is established. Areas with unsatisfactory plant densities would be reseeded the first subsequent fall.

Once the area is reclaimed with a satisfactory vegetative cover being well established and ready for grazing, management would be returned to the surface owner or user.

POLLUTION CONTROL AND ENVIRONMENTAL MONITORING

Pollution Control Methods

The two major types of potential pollution from the South Haystack Mine are fugitive dust and suspended sediments in surface runoff. Fugitive dust would be controlled by the following means:

1. Coal storage would be in closed silos.
2. Haul roads would be watered on a regular basis or other dust-abatement measures such as applying chemical palliatives would be done.
3. Temporary topsoil storage piles would be revegetated with quick growing annual species to reduce wind erosion.

Suspended sediments in runoff would be controlled by the following:

1. Slopes would be no steeper than 4:1 to encourage prompt revegetation and to prevent excessive erosion.
2. Drainage or catchment ditches would be installed at the base of dump faces to divert runoff to settling ponds.
3. Settling or sediment ponds would be constructed on all drainages potentially receiving significant runoff from disturbed areas and dumps. The dams for these ponds would be designed to meet all applicable state and federal requirements concerning capacity and construction.
4. Dump slopes and other disturbed areas would be reclaimed at the earliest practical time to minimize exposure of barren soil materials.
5. Diversion ditches and drainage ditches across backfilled spoil materials would be lined with crushed rock or similar material to minimize erosion and downstream sediment loads.

Should unanticipated excess water, requiring discharge to surface waters be encountered during mining, this water would be tested as appropriate to meet all applicable effluent limitations as presented in a National Pollutant Discharge Elimination System permit.

A water monitoring plan designed in accordance with 30 CFR 715.17(b) would be submitted to the regulatory authority for approval.

AUTHORIZING ACTIONS

Table SH1-5

SEED MIXTURE TO BE USED ON THE PROPOSED SOUTH HAYSTACK PROJECT AREA

	Pounds Per Acre (Pure Live Seed)
On Upland Sites	
Western wheatgrass (Rosana)	3.0
Thickspike wheatgrass (Critana)	3.0
Bluebunch wheatgrass	2.0
Needleandthread	1.5
Indian ricegrass	1.0 (if available)
Bottlebrush squirreltail	1.0 (if available)
Winterfat	0.5
Big sagebrush	0.1 (if available)
Total	12.1
In Drainage Bottoms	
Western wheatgrass	4.0
Streambank wheatgrass	3.0
Tall wheatgrass (Orbit)[1]	2.0
Basin wildrye	2.0
Cicer milkvetch (Luna)[1]	1.0
Total	12.0
On Arid South- and West-Facing Dump Slopes	
Western wheatgrass (Rosana)	4.0
Indian ricegrass	2.5 (if available)
Needleandthreat	2.5
Bottlebrush squirreltail	2.0 (if available)
Fourwing saltbush	2.0
Big sagebrush	0.1 (if available)
Total	13.1

[1]An introduced species.

This section identifies governmental authorizations which would be required prior to construction and development of the proposed South Haystack Mine.

A memorandum of understanding is in preparation which describes operating procedures to be followed by the BLM, the Office of Surface Mining, and the USGS concerning their areas of responsibility in the federal coal management program. This memorandum of understanding may alter the agencies responsibilities listed below.

Bureau of Land Management (BLM)

The proposed action includes approval of right-of-way applications for 8 miles of power (138 kv)/telephone line, 0.2 miles of haul road, and 12 miles of railroad spur.

Before approval of the mining and reclamation plan, BLM would prepare Section 106 recommendations on existing or potential National Register sites (archeological and historical sites) located in the area to determine appropriate mitigating measures for those sites.

U.S. Geological Survey (USGS)

The USGS would, with BLM concurrence, approve the mining and reclamation plan.

Wyoming Department of Environmental Quality (DEQ)

The Land Quality Division would issue a permit and license to mine upon its approval of a mining and reclamation plan. The Air Quality Division would issue permits to construct and permits to operate coal mines after a review of applications with regard to air contaminants and plans for control and monitoring. The Water Quality Division would issue permits to construct settling ponds and waste water systems. The Solid Waste Division would issue construction fill permits and industrial waste facility permits for solid waste disposal during construction and operation of the mine.

Wyoming State Engineer

Water rights for the mining and coal-processing operations are required from the Wyoming State Engineer who must also authorize the proposed diversions and water impoundments.

INTERRELATIONSHIPS

Relationship to Land Use Plans

Bureau of Land Management (BLM)

The Pioneer Trails Management Framework Plan (MFP) (U.S. Department of the Interior, BLM 1977b) of the BLM recommends approval of filed mining and reclamation plans on existing leases with constraints relative to utility corridors, historic sites and trails, archeological and paleontological sites, and agricultural and visual resources.

The post mining land use for public lands would be in conformance with the land use decisions found in the Pioneer Trails MFP.

Relationship to Other Proposed and Future Actions

Other Coal

Two other proposed coal mines (North Block and Twin Creek), north of the South Haystack project area, would create competition for the available labor market; would increase rail traffic, dust, and water usage; and would increase the demand on transportation and communications networks.

Naughton Power Plant

It has been proposed that coal from the North Block mining operations would supply the necessary coal required by the proposed expansion of the Naughton Power Plant which is approximately 22 miles north of the proposed South Haystack Mine.

CHAPTER 2

DESCRIPTION OF THE ENVIRONMENT

This chapter consists of two parts, existing environment and future environment. The discussion of the existing environment describes the physical, biological, and cultural environmental components which constitute the South Haystack site-specific environment. The discussion of the future environment focuses on the same environmental components as they would be in 1980, 1985, 1990, and at the end of mine life without federal approval of the proposed action. These descriptions provide bases for the analyses in Chapter 3, The Environmental Impacts of the Proposed Action.

EXISTING ENVIRONMENT

CLIMATE

Sunshine

Since the South Haystack project area is situated in a high plains-foothills area, the annual average percentage of sunshine is expected to approximate the 65% statewide average.

Wind Fields

Utah Power & Light (UPL) owns a field network of four meteorological observation sites in the vicinity of its Naughton Power Plant which is located near Kemmerer in Lincoln County, about 22 miles north of the proposed South Haystack Mine. From a review of a 1-year (1 August 1974 to 1 September 1975) compilation of surface wind statistics (Golden and Peterson 1976) at these sites, the predominant wind direction and speed characteristics observed are as outlined below.

On an annual basis, the winds at each of the UPL sites show a tendency for directional variation. The three predominant wind direction sectors at three of the UPL sites are west through northwest and constitute 40% of the annual number of hourly observations. The fourth site indicates a predominant flow in the southwest through west sectors, which accounts for about 55% of all annual observations. Secondary directional maxima are shown to occur at each of the UPL sites and are associated with north through east sector winds. The annual average wind speeds at the UPL sites range from 8 to 13 mph.

Atmospheric Temperature and Stability

The temperature in the project area is subject to large seasonal and daily variations. Temperatures are expected to closely parallel those observed at Kemmerer over a 30-year period from 1931 through 1960, which indicate mean monthly minima/maxima of 5°F/29°F and 44°F/82°F during January and July, respectively. Temperature extremes should range from -32°F to 97°F. The growing season is about 105 days per year.

Vertical temperature profiles were also obtained by UPL during seasonal field studies (Golden and Peterson 1976). Eighty-five percent of all morning soundings (79 total) contained some type of inversion (either surface-based or upper-level). Sixty-five percent of the morning soundings had surface-based inversions with an average depth of 300 feet. Only 11% of the afternoon soundings (after 12:00 noon) showed inversions of any type.

Moisture and Evapotranspiration

Annual average precipitation and total snowfall should approximate the 9 inches and 55 inches, respectively, observed at Kemmerer over a period of more than 30 years.

An annual soil moisture deficit of about 10 inches observed at Kemmerer, should be characteristic of the project area. The growing season roughly coincides with the period of high soil moisture deficit.

Severe Weather Events

The number of thunderstorm and hail days should be about 30 and 3 per year, respectively. The likelihood of tornadoes occurring in this region is very low.

AIR QUALITY

The proposed South Haystack project area is not in the prevailing downwind direction of pollutant dispersion from Kemmerer. Therefore, the present air quality at this location should have a rural character. Consequently, the existing total suspended particulate levels at this site should range from 10 to 20 micrograms per cubic meter ($\mu g/m^3$) annually and 30 to 45 $\mu g/m^3$ for 24 hours. The magnitude of these levels are less than one-third of the appropriate state standards. Based on 5 years of visual observations recorded at Fort Bridger, Wyoming, a representative background visual range in the vicinity of the South Haystack project area should be approximately 40 miles.

Concentrations of sulfur dioxide around South Haystack should also reflect its rural setting; i.e., levels less than 5 $\mu g/m^3$ annually and less than 25 $\mu g/m^3$ with respect to a daily averaging period. The magnitude of these concentrations is only about 10% of the annual and 24-hour state standard. In addition, annual nitrogen dioxide concentrations should be less than 10 $\mu g/m^3$, again only 10% of the standard.

GEOLOGY

Stratigraphy

Coals in the area of the proposed South Haystack Mine site are present in the Adaville and Frontier Formations. A generalized stratigraphic section of the area is presented on Figure SH2-3A.

Coals proposed to be mined occur in the Upper Cretaceous Adaville Formation consisting of predominantly gray shale and mudstone interbedded with sandstones and siltstones and overlain by shallow alluvial deposits along stream courses. The basal unit of the Adaville Formation is the Lazeart Sandstone Member, a light gray to white, fine to coarse-grained sandstone between 200 and 400 feet thick. The average thickness of the Adaville Formation is about 2,000 feet. Beneath the Adaville Formation is the Upper Cretaceous Hilliard Shale consisting predominantly of light gray to light brown marine shale, siltstone, and sandy shale with a few fine-grained sandstone beds in the upper part. Above the Adaville Formation is the Upper Cretaceous Hams Fork Conglomerate Member of the Evanston Formation, consisting of boulder conglomerate beds containing small boulders, cobbles, and pebbles of well rounded quartzite, chert and limestone, and interbedded white to brown calcareous sandstone. Beneath the Hilliard Shale and not cropping out in the proposed mining area is the coal-bearing Frontier Formation. Coals of this formation are of no economic interest in the proposed mining area because the overlying Hilliard Shale is as much as 6,000 feet thick.

The rocks of Cretaceous age were mostly deposited along the western edge of a broad, shallow, north-south trending seaway that crossed central North America. They are mostly marine shales, but they also include fluvial shales and sandstones and deltaic deposits including coal.

Paleontology

The project area has not been surveyed for paleontological resources. A general summary of the principal fossiliferous formations, ages, number of known fossil localities, and general fossil types in the proposed project area is presented in Table SH2-3A.

Structure

The two most important structural features adjacent to the mine location are the Lazeart Syncline and the north-south trending Absaroka Thrust Fault, the latter forming part of the Overthrust Belt in western Wyoming. The coal seams occur in limbs of the Lazeart Syncline with the dip of the beds varying from westerly in the proposed main pit to southerly in the northernmost proposed pit. The closest thrust fault to the South Haystack project area is approximately 2½ miles to the west. Local faulting is limited to the Round Mountain Fault approximately 1 mile west of the property and to the Shurtleff Creek Fault which lies along Shurtleff and Clear Creeks. Both of these are normal faults which postdate the thrust faulting. These two faults and the Lazeart Syncline are the only features adjacent to the proposed mine which have been positively identified.

On the eastern limb of the syncline, the dip of the bedding ranges from 25 to 35 degrees to the west-northwest in the main pit. On the western limb where the northernmost pit is located, the dip is approximately 50 degrees to the south.

Geologic Hazards

Even though the landslide susceptibility of the rock and earth material is estimated to be high (Radbruch-Hall et al. 1976), the landslide potential of the natural surface is judged to be minimal because the natural slopes show no evidence of earlier sliding and the rock strata generally dip into the steeper slopes.

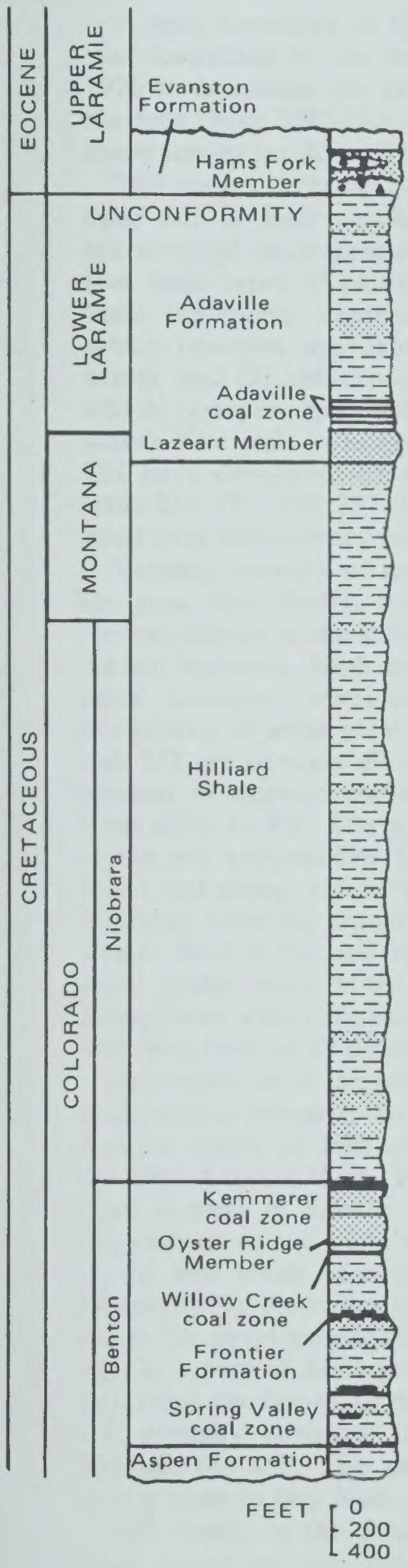
Natural coal outcrops are weathered and have lost their more volatile and more easily ignitable consituents; therefore, the likelihood of coal ignition and combustion in the natural outcrop is low.

The project area is in an area of very low seismic activity; therefore, the probability of damage from earthquakes is low.

TOPOGRAPHY

The South Haystack project area is located about 2 miles west of Oyster Ridge (locally called the Hogsback) in the physiographic subdivision of the region known as the Overthrust Belt. Oyster Ridge roughly delineates the eastern edge of the Overthrust Belt. Much of the project area comprises the western part of a gently eastward sloping (80 to 100 feet per mile), slightly undulating surface called Cumberland Flat. The balance of the area to the southwest and north is comprised of rounded hills with summits about 200 to 300 feet higher than the flats. Slopes of the hills are moderate to steep.

Watercourses in the area are roughly parallel and trend generally north-eastward with many small draws entering at right angles. Two of the principle, named watercourses within the proposed project area are Haystack Draw and Meadow Draw. Only Clear Creek, which crosses the north part of the area, is a perennial stream.



TKe — EVANSTON FORMATION (PALEOCENE AND UPPER CRETACEOUS) — Gray siltstone, carbonaceous claystone, and shaly mudstone; quartzitic siltstone, gray carbonaceous sandstone, and some dark-brown concretionary ironstone. 200+ ft (60+m) thick

Keh — Hams Fork Conglomerate Member (Upper Cretaceous) — Boulder conglomerate beds containing small boulders, cobbles, and pebbles of well-rounded quartzite, chert, and limestone and interbedded white to brown calcareous sandstone forms conspicuous boulder trains on topographic highs in western part. As much as 1,000 ft (305 m) thick

Kav — ADAVILLE FORMATION (UPPER CRETACEOUS) — Predominantly gray-brown weathering carbonaceous shale and mudstone that contains beds of yellowish-brown to reddish-brown sandstone and siltstone; contains workable coal beds as much as 30ft (9m) thick (Adaville 1 coal) in lower part. 2,000 + ft (610+ m) thick

Kal — Lazeart Sandstone Member — Light grey to white fine — to coarse grained sandstone; basal part of formation. About 200-400 ft. (60-120m) thick

Kh — HILLIARD SHALE (UPPER CRETACEOUS) — Dark gray to dark brown marine shale, siltstone, and sandy shale; contains a few conspicuous light gray to light tan, fine-grained, resistant sandstone beds in upper part. About 6,000 ft (1,830 m) thick

Kf — FRONTIER FORMATION (UPPER CRETACEOUS) UNDIFFERENTIATED

Kfu — Upper unit - Middle part consists of a prominent hogback of white to light gray weathering, oyster-bearing sandstone (Oyster Ridge Sandstone Member) overlain by shale and thin beds of gray sandstone that contains the Kemmerer coal zone; underlain by a thick shale interval that contains the Willow Creek coal zone in the Kemmerer area. About 1,200 ft (365 m)

Kfl — Lower unit - Dark gray shale, tan siltstone and brown sandstone; sandstone beds less resistant than those in upper unit; contains the Spring Valley coal zone in lower part. About 1,000 ft (305 m) thick.

Ka — ASPEN SHALE (LOWER CRETACEOUS) — Light to dark gray siltstone and shale, quartzitic sandstone, and porclanite; forms prominent silver-gray hogbacks. About 900 - 1,000 ft. (275-305)

Figure SH2 - 3A

PARTIAL GENERALIZED STRATIGRAPHIC SECTION OF THE PROPOSED SOUTH HAYSTACK PROJECT AREA

Table SH2-3A

SUMMARY OF FOSSILIFEROUS FORMATIONS IN THE AREA
OF THE PROPOSED SOUTH HAYSTACK MINE

Formation	Period	Known Fossil Localities	Type of Fossils
Evanston	Paleocene	General	V
Adaville	Cretaceous	General	I and P
Hilliard Shale	Cretaceous	General	I

General = Formation produces fossils with no specific localities identified.
V = Vertebrate
I = Invertebrate
P = Paleobotanical

All streams drain into Albert Creek, a tributary of Hams Fork.

SOILS

A soils inventory of the South Haystack project area was conducted by the Soil Conservation Service during 1976 to determine the nature and extent of soil types in the area (Map SH2-5A). The inventory was a reconnaissance survey (as defined by BLM Manual 7312).

The survey indicates that the soils are poorly developed due to slow weathering of the parent material in the semiarid environment of the project area. There are two basic types of parent material in the area: (1) alluvium (sediments transported and deposited by water), which occupies approximately 22% of the area (1,778 acres), and (2) sedimentary rocks (sandstone and shale), which occupies approximately 78% of the area (6,302 acres). The soils in mapping units 213, 229, and part of 221 have developed on alluvium. The soils in mapping units 225, 231, 236, 237, 238, and part of 221 have developed over sedimentary rock.

Varying amounts of soluble salts occur in the soils of the area. Specifically, calcium carbonate accumulates at various depths in the soils of the area, generally in lower subsoil horizons. High concentrations of secondary calcium carbonate restricts plant growth by depressing availability of some plant nutrients. The soils in mapping unit 213 are strongly alkaline (high in sodium salts). The amount of organic matter in the soils is low, ranging from 0.3% to 4%. The amount of organic matter relates to the soil permeability (the ability of a soil to transmit water and gases), soil fertility (ability to hold nutrients in available form for plants), and available water capacity (water held in the soil that can be readily absorbed by plant roots). Soils in the area are low in nitrogen and phosphorus which are essential plant nutrients. There is a sufficient level of all other nutrients for plant growth.

Soil structure of the surface horizon in the South Haystack soils is primarily moderate to strong granular; however, in nearly all soils of the area the surface horizon is less than 4 inches thick. The structure below the thin top layer is weak in stability and in some cases nonexistent. Populations of soil biota are low in the project area due to the low levels of soil moisture throughout the year (Brady 1974). Activities of the various soil biota contribute to the development of soil structure. Stable soil structure is a part of most productive soils and is especially important on fine-textured soils for the development of soil porosity adequate for water movement into and through the soil. The predominant soil texture of the area is loam to clay loam.

Soil depths in the South Haystack project area vary from no soil on rock outcrop to greater than 60 inches on alluvium. The moderately deep and deep loam and clay loam soils of the area (mapping units 229 and 238) that have few restrictive features such as high alkalinity or calcium carbonate levels are more productive than the soils in the remainder of the area. These soils can be recognized by the vigorous growth of shrubs and grasses they support. Soils with high alkalinity and (or) soluble salt content (mapping unit 213) have plants that are salt tolerant. Soils with restrictive underlayers or bedrock within 20 inches of the surface (mapping units 221, 225, 231, 236, and 237) have plants with stunted growth due to the limitations of root penetration and (or) have plants that require little water to survive.

Properties and interpretations of the South Haystack area soils are listed by mapping unit in Table SH2-5A. A description of the soil mapping units can be found in the Appendix. A breakdown by percentage of the various soil types within each soil mapping unit along with associated soil data can also be found in the Appendix. The soil types are keyed to associations of subgroups in the soil taxonomy (U.S. Department of Agriculture, Soil Conservation Service 1975).

The amount of wind erosion occurring at present on soils of the South Haystack project area varies with the surface soil texture, vegetative cover, average wind speed, etc. The wind erosion hazard and the wind erodability groups of the South Haystack soils are listed by mapping unit in Table SH2-5A. At present an average of 60 tons of soil per year is being removed by wind from the mining area. This value was determined with use of the Soil Erodability Index for bare soil (U.S. Department of Agriculture, Soil Conservation Service 1972), vegetative cover percentages derived from BLM watershed surveys, and estimates based on professional judgement. The preceding value of 60 tons represents soil lost in suspension.

Sheet erosion rates on the various mapping units as calculated by using Musgrave's equation are shown in Table SH2-5B. Some of the soils in the area are highly erosive, resulting primarily from low amounts of vegetative cover on steep slopes. The average rate of erosion occurring at present on those areas that would be disturbed by mining is approximately 7.5 tons per acre per year.

WATER RESOURCES

Ground Water

The South Haystack project area is located on the eastern and western limbs of the Lazeart Syncline. The Adaville Formation, which contains the coal measures, is exposed at the surface and dips westerly in the southern part of the project area and southerly in the extreme northern part of the area. About 2½ miles west of the project area is the Absoraka Thrust Fault. Local faulting occurs at Round Mountain and along Shurtleff Creek. Fracturing of the formation, as observed in cores, indicates that the coal has the highest degree of secondary permeability. Permeabilities of the Adaville Formation have been measured by falling head tests in test holes. The averages of these measured permeability values are: sandstone and siltstone—2.8 x 10^{-2} feet per day; mudstone—2.8 x 10^{-5} feet per day; and coal—1.4 x 10^{-1} feet per day. Analysis of an aquifer test of the Lazeart sand-

Table SH2-5A

SOIL CHARACTERISTICS AND INTERPRETATIONS

Map Unit[1]	Map Unit Name[2]	Total Acres	Slope Range	Wind Erodability Group[3]	Erosion Hazard[4]		Source of Roadfill[4]	Suitability-Limitations for Final Cover Over Mined Land[4]	
					Wind	Water		In./Avail.	Suitability
213	Alluvial fans, clayey soils, gently sloping and sloping	1,043	1-10	4	Moderate	Moderate	Poor	60	Poor-alk. sal. high clay content
221	Terrace escarpments, gently sloping to steep	642	6-30	4L/5	Sl.-Mod.	Mod.-Sev.	Poor	10-16	Poor - gravel cobble
225	Mountain tops and high plateaus, shallow soils	481	1-15	2/3	Moderate	Mod.-Sev.	Poor	0	Unsuitable - high rock content
229	Alluvial toe slopes, fine-loamy soils, gently sloping to sloping	401	2- 8	3/4L	Moderate	Slight	Fair-Poor	60	Poor-fair - gravel cobble
231	Residual uplands, shallow clayey soils, moderately steep & steep	2,967	10-60	3/4	Sl.-Mod.	Severe	Poor	4-10	Poor - gravel cobble - slope
236	Residual uplands, shallow fine-loamy soils, gently sloping to sloping	2,005	3-35	4L	Slight	Mod.-Sev.	Poor	8-12	Poor - fair
237	Residual uplands, red shallow[5] soils, juniper breaks, steep	230	10-40	5	Moderate	Mod.-Sev.	Poor	6-10	Poor - slope
238	Residual uplands, clayey soils, nearly level	251	1- 2	6	Slight	Slight	Poor	10-20	Poor - high clay content

[1]Map SH2-5A, South Haystack Soils.
[2]Unit names derived from geomorphic setting of the soil.
[3]Wind Erodability Group descriptions found in U.S. Department of Agriculture, Soil Conservation Service (SCS), Handbook for Interpretations 1972, generally the higher the number the lower the erosion potential with the number range of 1 to 8.
[4]Derived from U.S. Department of Agriculture, SCS, soils contract with BLM (1977).
[5]This soil type would not be disturbed by the proposed mining.

Table SH2-5B

EXISTING SHEET EROSION

Map Unit[1]	Sheet Erosion Tons/Acre/Year
213	0.82
221	3.84
225	3.16
229	1.37
231	11.33
236	7.83
237	14.04
238	0.21

[1] Map SH2-5A.

stone yielded permeabilities of 2.2 feet per day and 4.8 feet per day for the pumped well and an observation well. Observation well data indicated a storage coefficient of 1 x 10^{-3}. A permeability estimate of 1.0 x 10^{-1} feet per day was derived from an aquifer test of a 50-foot thickness of coal in the Adaville Formation. An estimated storage coefficient of 5.8 x 10^{-3} was made on the basis of other data from other tests in the Adaville coal.

Ground water occurs on the project area under water table and artesian conditions. Water levels in the shallower observation wells stand at a lower head than those in the deeper observation wells. Shallow ground water moves in the general direction of the slope of the topography, but the confined, deeper ground water may move down dip toward the lowest point of the Lazeart Syncline. The aquifers are the coals and to a lesser extent the sandstones and the shale and mudstone where they are fractured. The Lazeart Sandstone which occurs at the base of the Adaville is also an aquifer.

Ground water appears at the surface as spring flow; as the spring at Haystack Draw, SW¼, NE¼, Section 14, T. 16 N., R. 118 W., and near Round Mountain in the SE¼, SW¼, Section 13, T. 17 N., R. 118 W.; and as the base flow of the streams draining to the east and tributary to Albert Creek.

No wells are known to obtain water from the Adaville Formation on or near the proposed mining area. None of the lands proposed for mining are classified as alluvial valley floors.

Ground Water Quality

Analyses of water samples obtained from two springs and six wells are presented in Tables SH2-6A, SH2-6B, and SH2-6C. Total dissolved solids of ground water in test holes sampled ranged from 767 milligrams per liter (mg/l) to 1,982 mg/l and averaged 1,338 mg/l. The pH of water from test holes average 7.47 and ranged from 6.80 to 8.15; the standard deviation of 9 samples was 0.44. Total dissolved solids of samples of water from the springs ranged from 410 mg/l to 481 mg/l and averaged 456 mg/l. Water from the test well drilled in the Lazeart sandstone member of the Adaville Formation had a total dissolved solids of 1,946 mg/l, a temperature of 54°F, and a field pH of 6.95. The water from the test well drilled in the coal had a total dissolved solids of 328 mg/l, a temperature of 54°F, and a field pH of 7.55 (Table SH2-6D).

Surface Water

The project area is drained by four main eastward flowing tributaries to Albert Creek in the Colorado River drainage system. Albert Creek passes through the southeast corner of the South Haystack Mine area. The Albert Creek drainage might be an alluvial valley floor based on the 30 CFR 710.5 definition that an "alluvial valley floor means stream laid deposits holding streams where water availability is sufficient for subirrigation or flood irrigation agricultural activities . . ." The tributaries are Shurtleff and Clear Creeks which join before entering Albert Creek, an unnamed draw south of Clear Creek, Meadow Draw, and Haystack Draw. These streams flow mainly in response to precipitation and snowmelt. The streams, their drainage areas, and estimated average annual discharge are shown in Table SH2-6E.

A part of the flow of the streams is from ground water discharge provided by rejected recharge from the alluvium overlying the Adaville Formation. It is rejected because the Adaville aquifers are full and recharge and discharge are in balance; hence, any excess runs off as surface flow.

Surface Water Quality

Total dissolved solids of water samples from Albert Creek, Clear Creek, and a stock reservoir range from 195 to 1,039 mg/l. Analyses of samples of surface runoff are presented in Table SH2-6F.

VEGETATION

Terrestrial Vegetation

Sagebrush type provides ground cover on about 76% of the project area (6,100 of 8,080 acres). Eight other types occur, and in descending order of approximate acreages and percent area covered are: grassland (656 acres, 8%); saltbush (615 acres, 8%); mountain shrub (203 acres, 3%); juniper (187 acres, 2%); greasewood (179 acres, 2%); barren (98 acres, 1%); meadow (32 acres, less than 1%); and aspen (8 acres, less than 1%). Vegetation type cover map, Map SH2-7A, presents types large enough in area to be mapped. Type designations and numbers are those used by the BLM. Plant names are according to Beetle (1970). A list of plants known or believed to occur in the South Haystack project area is available to the public at the Rock Springs District Office of the BLM.

Sagebrush, Type 4

Big sagebrush *(Artemisia tridentata)* is the dominate shrub on well drained and moderately deep to deep soils of the project area. Alkali sagebrush *(A. longiloba)* communities occur on poorly drained, or tight, and highly alkaline soils.

Associated grass species are slender wheatgrass *(Agropyron* trachycaulum), bluebunch wheatgrass *(A. spicatum)*, and bluegrasses *(Poa* spp.). Frequently occurring forbs are Hooker sandwort *(Arenaria hookerii)*, pussytoes *(Antennaria* spp.), wildbuckwheats *(Eriogonum* spp.), and phloxes *(Phlox* spp.).

Table SH2-6A

SUMMARY OF ANALYSES OF WATER FROM SPRINGS NEAR THE SOUTH HAYSTACK PROJECT AREA

Parameter--units (mg/l) unless noted	SW¼, NE¼, Sec. 14, T. 16 N., R. 118 W. Haystack Draw Springs 10/4/76	10/26/76	SE¼, SW¼, Sec. 13, T. 17 N., R. 118 W. Round Mountain Spring 10/4/76	10/26/76
Calcium	54.0	61.5	72.0	67.5
Magnesium	48.5	50.0	23.0	23.0
Potassium	23.0	16.0	11.5	26.0
Sodium	45.5	40.0	62.5	58.5
PHTH alkalinity (as $CaCO_3$)	0	0	0	0
Total alkalinity (as $CaCO_3$)	320	355	210	220
pH	8.5	7.15	7.8	6.70
Temperature, ^oC		8.1		7.0
Hardness, total (mg/l as $CaCO_3$)	363	360	258	264
Chloride	43.0	45.0	19.8	38.0
Sulfate	45.8	41.0	141	165
Silica (SiO_2)	4.9	3.5	3.8	3.0
Solids, total dissolved	410	459	472	482
Solids, suspended	48.9	9.7	16.5	1.2
Solids, total	459	469	488	483
Conductivity (u-mhos/cm)		900		818
Dissolved oxygen		5.4		3.4
Ammonia (as N)		0.1		0.5
Nitrate (NO_3-N)		1.7		0.4
Total kjeldahl nitrogen		3.2		3.6
Phosphorus, ortho		0.02		0.02
Phosphorus, total		0.08		0.02
Flouride	0.8	0.6	2.40	1.70
Aluminum, total		0.6		0.04
Arsenic, total		0.003		0.0034
Boron, total		0.26		0.56
Chromium, total		<0.003		<0.003
Copper, total		<0.02		<0.03
Iron, dissolved	0.25	<0.25	0.25	<0.15
Iron, total		0.60		2.8
Lead, total		<0.01		<0.01
Mangenese, total		<0.04		0.09
Mercury, total		<0.001		<0.001
Nickel, total		0.008		0.008
Selenium, total		<0.001		<0.001
Zinc, total		<0.01		<0.01

Note: Constituent value in table is blank when not analyzed or no value obtained.

Table SH2-6B

SUMMARY OF ANALYSES OF WATER FROM SELECTED WELLS ON THE SOUTH HAYSTACK PROJECT AREA

Parameter-units (mg/l) unless noted	SE¼, NW¼, Sec. 19 T. 17 N., R. 117 W. 1020A 5/3/76	NE¼, SE¼, Sec. 19 T. 17 N., R. 117 W. 1022 5/3/76	NW¼, SE¼, Sec. 19 T. 17 N., R. 117 W. 1031 5/3/76	SW¼, NW¼, Sec. 31 T. 17 N., R. 117 W. 1015 5/3/76
Calcium	106	66.5	96.5	122
Magnesium	114	53.2	69.2	111
Potassium	22	11.6	12.6	11.4
Sodium	243	165	436	17.3
PHTH alkalinity (mg/l as $CaCO_3$)	0	0	0	0
Total alkalinity (mg/l as $CaCO_3$)	695	621	542	582
pH	7.01	7.43	7.20	6.80
Temperature				
Dissolved oxygen				
Chloride	50	46	217	24
Sulfate	586	104	642	207
Solids, total dissolved	1,599	767	1,839	881
Solids, suspended	416	419	370	747
Solids, total	2,015	1,186	2,209	1,628
Conductivity (u-mhos/cm)	2,375	1,279	2,586	1,254
Ammonia (as N)	0.62	0.87	1.03	1.9
Nitrate (NO_3-N)	0.52	0.54	0.49	0.70
Phosphorus, total	<0.02	0.13	<0.02	0.03
Flouride	1.7	1.3	0.6	0.9

Note: Constituent value in table is blank when not analyzed or no value obtained.

Table SH2-6C

SUMMARY OF ANALYSES OF WATER FROM MONITORING WELLS SH 1065 AND SH 1088, 1976

Parameter--units (mg/l) unless noted	NW¼NE¼, Sec. 19, T. 17 N., R. 117 W. Well SH 1065			SW¼NE¼, Sec. 2, T. 16 N., R. 118 W. Well SH 1088		
	5/25/76	7/27/76	10/26/76	5/25/76	7/27/76	10/26/78
Calcium	74.5	52.0	54.0		41.0	41.0
Magnesium	91.0	49.0	48.0		37.5	41.0
Potassium	13.5	18.0	21.5		33.5	32.0
Sodium	480	550	350		390	200
PHTH alkalinity (mg/l as $CaCO_3$)	0	0	0		0	0
Total alkalinity (mg/l as $CaCO_3$)	582	572	560		545	391
pH	7.3	8.15	7.75		7.95	7.65
Temperature, ^{o}C	8.5	8.5	7.5		10.5	6.1
Hardness, total (mg/l as $CaCO^3$)			333			272
Chloride	600	380	160		107	104
Sulfate	510	308	312		269	319
Solids, total dissolved	1,982	1,526	1,506		1,008	937
Solids, suspended	4,544	92.1	177		577	209
Solids, total	6,526	1,618	1,683		1,585	1,146
Conductivity (u-mhos/cm)	3,014	2,592	3,676		1,728	1,571
Flouride	1.3		1.7			0.6
Ammonia (as N)	3.4	1.2	3.7		2.6	1.8
Nitrate (NO_3-N)	0.16	0.28	0.80		0.66	4.9
Total kjeldahl nitrogen		10.6	22.7			
Phosphorus, ortho		0.03	0.08		0.15	0.10
Phosphorus, total	0.11	0.10	0.18		0.45	0.18
Aluminum, total	1.25	1.2	1.5		7.0	3.8
Arsenic, total			0.0054			0.01
Boron, total			0.22			0.48
Chromium, total			0.03			0.04
Copper, total			0.06			0.10
Iron, dissolved	4.7	0.06	<0.25		2.90	<0.25
Iron, total	5.4	2.56	4.0		6.00	6.50
Lead, total			0.09			0.57
Manganese, total	0.60	0.18	0.18		0.12	0.13
Mercury, total			<0.001			<0.001
Nickel, total	0.04	0.013	0.03		0.008	0.02
Selenium, total			<0.001			<0.001
Zinc, total	10.7	2.99	<0.01		1.10	0.30

Note: Constituent value in table is blank where not analyzed or no value obtained.

Table SH2-6D

SUMMARY OF ANALYSIS OF WATER FROM TEST WELLS DRILLED IN THE LAZEART SANDSTONE AND THE ADAVILLE COAL

Component Analyzed mg/l	Well #322 Lazeart Sandstone	Well #323 Coal
Total dissolved solids	1,946	328
Total alkalinity	21	165
Bicarbonate alkalinity	26	201
Carbonate alkalinity	0	0
Total hardness	1,161	235
Calcium	317	48
Magnesium	90	28
Sodium	51	10
Potassium	12	10
SO_4	1,221	82
Chloride	59	15
Nitrate	.08	.14
Ammonia	-.01	-.01
Total phosphate as P	.5	4.05
Fluoride	.44	.64
pH	5.6	7.5
Electrical conductance in micro mhos	2,010	483
Aluminum	-.1	-.1
Arsenic	-.005	-.005
Boron	.17	.16
Cadmium	-.005	.005
Chromium	-.02	-.02
Copper	.02	.01
Total iron	86.7	18.5
Dissolved iron	16.5	.04
Lead	.02	-.02
Manganese	.56	.08
Mercury	-.001	-.001
Nickel	.1	-.01
Selenium	-.005	-.005
Zinc	.09	.07
Barium	-.5	-.5
SAR	.65	.28
WATER QUALITY PARAMETERS MEASURED IN THE FIELD		
Temperature	$12^{o}C$	$12^{o}C$
pH	6.95	7.55
Electrical Conductance in micro mhos	1,610	300

Table SH2-6E

STREAM DRAINAGE AREAS AND ESTIMATED AVERAGE ANNUAL DISCHARGE

Stream	Drainage Area in Square Miles[1]	Estimated Average Annual Discharge in Cubic Feet Per Second
Albert Creek	175	3.9
Clear Creek and Shurtleff Creek at confluence with Albert Creek	55	1.5
Haystack Draw	10	0.8
Unnamed Draw	6	.7
Meadow Draw	5	.65

[1] Cumberland Coal Company 1976.
[2] Calculated according to Lowham (1976).

Table SH2-6F

ANALYSES OF SAMPLES OF SURFACE WATER ON AND NEAR SOUTH HAYSTACK PROJECT AREA IN 1976

Constituents	Reservoir in NW¼, NE¼, Sec. 19, T. 11 N., R. 117 W.			Albert Ck. SW¼, NW¼, Sec. 11, T. 16 N., R. 118 W.	Albert Ck. NW¼, NE¼, Sec. 10, T. 17 N., R. 117 W.	Clear Ck. SW¼, SW¼, Sec. 18 T. 17 N., R. 116 W.
	5/3/76	7/27/76	10/26/76	5/3/76	7/27/76	10/26/76
Calcium	22.6	25.0	38.0	100	69.5	64.0
Magnesium	5.9	5.5	11.5	112	78.7	48.5
Potassium	8.6	8.0	16.5	15.9	12.6	8.2
Sodium	11.2	32.5	44.0	10.3	66.0	32.5
PHTH alkalinity (mg/l as $CaCO_3$)	1.0	37.5	0	6.5	6.3	5.5
Total alkalinity (mg/l as $CaCO_3$)	84.0	127.5	205	445	375	381
pH	8.4	10.8	7.7	8.5	8.7	8.4
Temperature, ^{o}C	10.2	18.0	3.5	11.7	10.7	7.0
Hardness, total (mg/l as $CaCO_3$)			145			
Chloride	5.4	18.5	25.0	92.0	83.0	33
Sulfate	23	13.2	18.7	366	196	56
Solids, total dissolved	209	195	327	1,039	707	467
Solids, suspended	31	15.4	73	7	39	459
Solids, total	240		400	1,046	746	906
Conductivity (u-mhos/cm)	233	310	415	1,556	1,123	837
Dissolved oxygen	12.5	7.0	8.4	11.8	12.1	11.4
Ammonia (as N)	0.05	0.02	1.0	0.05	0.10	0.11
Nitrate (NO_3-N)	0.86	0.02	2.6	0.60	0.58	0.99
Total kieldahl nitrogen		2.6	8.0			
Phosphorus, ortho		0.34	0.06			
Phosphorus, total	0.36	0.49	0.26	0.04	0.02	0.04
Flouride	0.1		0.5	0.8	0.6	0.5
COD			125			
Aluminum, total	4.9	0.80	2.6	0.75	0.40	7.13
Arsenic, total			0.0038			
Boron, total			<0.02			
Chromium, total			0.01			
Copper, total			0.02			
Iron, dissolved	1.2	0.60	1.50	0.57	0.14	1.80
Iron, total	3.0	0.65	3.30	1.20	0.46	7.60
Lead, total			<0.01			
Manganese, total	0.06	0.03	0.19	0.06	0.04	0.02
Mercury, total			<0.001			
Nickel, total	0.05	0.003	0.008	0.08	0.06	0.10
Selenium, total			<0.001			
Zinc, total	0.04	0.06	<0.01	0.04	0.02	0.13

Note: All constituents in mg/l (milligrams per liter), analyses not made of those items that are blank.

DESCRIPTION OF THE ENVIRONMENT

Grassland, Type 1

Grasses form the general aspect on areas where soil conditions are less favorable for shrubs. Upland sites are dominated by slender wheatgrass and sandberg bluegrass *(Poa* secunda). Sandy sites commonly support prairie *sandreed (Calamovilfa longifolia).* Several forb species are represented with the most common being sandworts *(Arenaria* spp.), phloxes, and wildbuckwheats. Shrubs occur sporadically and are primarily sagebrushes, rabbitbrushes *(Chrysothamnus* spp.), and *snowberries (Symphoricarpos* spp.).

Saltbush, Type 13

This type generally occurs between the rolling uplands and bottomlands of the project area on soils with abundant salts. Dominant shrub species are mat saltbush *(Atriplex* corrugata) and shadscale saltbush *(A. confertifolia).*

Bottlebrush squirreltail *(Sitanion hystrix),* Sandberg bluegrass, and slender wheatgrass frequently occur. Forbs representative of the type include phloxes, sandworts, and goosefoots *(Chenopodium* spp.).

Mountain Shrub, Type 5

Higher elevation sites with deep soils and above average moisture accumulation support Utah serviceberry *(Amelanchier* utahensis) and antelope bitterbrush *(Purshia tridentata).* Utah serviceberry is often tree-like while antelope bitterbrush is a low growing shrub.

Forbs of the type reflect mesic conditions and include violets *(Viola* spp.), arrowleaf balsamroot *(Balsamorhiza* sagittata), and Indian paintbrushes *(Castilleja* spp.). Needleandthread *(Stipa comata),* bluebunch wheatgrass, and slender wheatgrass are commonly occurring grasses.

Juniper, Type 9

Utah juniper *(Juniperus osteosperma)* occurs along the western boundary of the project area at higher elevations and on shallow gravelly soils.

Associated grass species are slender wheatgrass, bluebunch wheatgrass, Indian ricegrass *(Oryzopsis hymenoides),* and bottlebrush squirreltail. Understory forbs include Douglas dustymaiden *(Chaenactis douglasii),* stemless actinea *(Hymenoxys* acaulis), hollyleaf clover *(Trifolium gymnocarpon),* and Hoods phlox *(Phlox hoodii).*

Greasewood, Type 14

Greasewood stands are found along drainageways on alkaline and saline soils. Black greasewood *(Sarcobatus vermiculatus)* is the dominant shrub.

Associated salt tolerant grasses are alkali *sacaton (Sporobolus airoides),* bottlebrush squirreltail, and alkali muhley *(Muhlenbergia asperifolia).* Forb cover is sparse with annual species of the mustard (Cruciferae) and goosefoot (Chenopodiaceae) families commonly present.

Meadow, Type 2

Vegetation of this type is adapted to above average moisture conditions such as found along watercourses and near seeps or springs.

Longstem spikerush *(Eleocharis macrostachya),* mutton bluegrass *(Poa fendler*iana), western wheatgrass *(Agropyron* smithii), bluebunch wheatgrass, slender wheatgrass, and Nebraska sedge *(Carex nebraskensis)* are characteristic meadow grass and grasslike plants. Frequently occurring forbs are prostrate knotweed *(Polygonum aviculare),* common dandelion *(Taraxacum* officinale), western yarrow *(Achillea lanulosa),* and hollyleaf clover.

Barren, Type 8

This type consists primarily of rock outcrops with little vegetative cover. Sagebrushes, mountain mahogany *(Cercocarpus* montanus), and Utah juniper are the most conspicuous kinds of vegetation.

Aspen Type, 10a

Aspen trees *(Populus tremuloides)* occur in small stands at higher elevations where deep soils have developed and moisture accumulation is high.

Understory shrubs typical of the type are common *juniper (Juniperus communis)* and snowberries. Pine *reedgrass (Calamagrostis rubescens),* bluegrasses, mountain brome *(Bromus* marginatus), columbines *(Aquilegia* spp.), geraniums *(Geranium* spp.), and lupines *(Lupinus* spp.) are typical herbaceous species.

Aquatic Vegetation

Data are not available to describe the existing environment of aquatic vegetation.

Endangered and (or) Threatened

A survey of the project area revealed no plants proposed for endangered and (or) threatened status (Dorn 1977). The process for requesting formal consultation under Section 7 of the Endangered Species Act of 1973 was initiated for South Haystack with the U.S. Fish and Wildlife Service on 2 March 1978.

The U.S. Fish and Wildlife Service responded by letter dated 7 March 1978 that formal consultation cannot be conducted for unlisted species.

FISH AND WILDLIFE

General Information

Habitat Types

The following are lists of the major habitat types on the proposed mine permit area (project area) and the primary wildlife species associated with each. A complete wildlife species list can be obtained from the Rock Springs District Office of the BLM.

Aquatic. No aquatic habitat exists on the proposed project area.

Terrestrial.

Sagebrush (6,100 acres). Species associated with sagebrush are sage grouse, horned lark, barn swallow, black-billed magpie, sage thrasher, western meadowlark, Brewer's blackbird, vesper sparrow, sage sparrow, Brewer's sparrow, longtail weasel, striped skunk, coyote, Uinta ground squirrel, least chipmunk, Great Basin pocket mouse, deer mouse, whitetail jackrabbit, desert and mountain cottontail, mule deer, and pronghorn antelope.

Grass (656 acres). Species associated with grass are sage grouse, horned lark, western meadowlark, yellow-headed blackbird, red-winged blackbird, savannah sparrow, vesper sparrow, song sparrow, longtail weasel, striped skunk, coyote, least chipmunk, Great Basin pocket mouse, northern grasshopper mouse, longtail vole, mule deer, and pronghorn antelope.

Saltbush (615 acres). Species associated with saltbush are common flicker, sage thrasher, mountain bluebird, striped skunk, coyote, whitetail prairie dog, least chipmunk, Great Basin pocket mouse, deer mouse, northern grasshopper mouse, mule deer, and pronghorn antelope.

Mountain Shrub (203 acres). Species associated with mountain shrub are loggerhead shrike, mountain bluebird, green-tailed towhee, Brewer's sparrow, longtail weasel, striped skunk, coyote, least chipmunk, deer mouse, mountain cottontail, and mule deer.

Juniper (187 acres). Species associated with juniper are sage thrasher, loggerhead shrike, green-tailed towhee, Brewer's sparrow, striped skunk, coyote, Uinta ground squirrel, least chipmunk, Great Basin pocket mouse, deer mouse, mountain cottontail, and mule deer.

Greasewood (179 acres). Species associated with greasewood are horned lark, sage thrasher, Brewer's blackbird, Brewer's sparrow, longtail weasel, striped skunk, coyote, Uinta ground squirrel, least chipmunk, deer mouse, whitetail jackrabbit, desert cottontail, mule deer, and pronghorn antelope.

General. Raptors which may be seen foraging in one or all habitat types are red-tailed hawk, Swainson's hawk, rough-legged hawk, ferruginous hawk, golden eagle, prairie falcon, and American kestrel.

Herd Units

The Wyoming Game and Fish Department has designated areas of management for big game herds. These areas are called herd units and each one contains an individual big game population. All big game population numbers and density estimates in this report are based upon herd units.

Fishery

No fishery exists on the proposed South Haystack project area.

Wildlife

Birds

Nongame. The major small nongame and songbird species found in the area are listed under the habitat types at the beginning of this section. The Wyoming Game and Fish Department breeding bird survey indicates about 20 birds per square mile in the vicinity of the project area. Although these figures are average estimates for resident species, it must be understood that nomadic arid land species (e.g., crows) may significantly increase these numbers.

Wyoming Game and Fish Department identified the nests of the prairie falcon, golden eagle, kestrel, marsh hawk, and four ferruginous hawks. Locations of the nests are shown on Map SH2-8A. All nests except that of the marsh hawk were active in the spring of 1977. Table SH2-8A shows the nesting success for 1977.

Game. The proposed mine permit area supplies summer range and crucial breeding habitat for sage grouse (Wyoming Game and Fish Department 1977). There are two major strutting grounds located in sections 17 and 19 of the project area (see Map SH2-8A). The Wyoming Game and Fish Department estimates as many as 200 males use one ground and 100 males use the other ground. There may be as many as five other grounds scattered throughout the area. These smaller grounds are probably occupied by yearling males which have been forced from larger grounds.

The South Haystack proposal is within bird management section number 5 of the Uinta Management Unit for sage grouse. The long-term average population is 4,073 or about 4 birds per square mile (Wyoming Game and Fish Department 1977). This is an average density estimate and there are areas (e.g., wintering areas, strutting grounds, nesting areas, etc.) where the density will be much greater.

Endangered and (or) Threatened. No endangered or threatened species of birds are known to exist on or near the proposed project area.

Mammals

Nongame. The major small nongame species inhabiting the proposed project area are the Uinta ground squirrel, least chipmunk, Great Basin pocket mouse, and deer mouse. The only small nongame mammal population information available for southwestern Wyoming indicates about 5 individuals per acre in the sagebrush type, about 2.5 per acre in the grass type, about 0.5 per acre in the saltbush type, and about 1.5 per acre in the greasewood

Table SH2-8A

RAPTOR NESTING SUCCESS ON THE SOUTH HAYSTACK PROJECT AREA IN 1977

Species	Number of Nests Located	Number of Young Fledged
Golden eagle	1	2
Prairie falcon	1	5
Ferruginous hawk	4	12
Marsh hawk	1	0
Kestrel	1	3
Total	8	22

Source: Cumberland Coal Company 1976.

type (Maxell 1973). No information is available for juniper or mountain shrub.

Game. The area contains mule deer summer and winter/yearlong range (see Map SH2-8A). It is estimated that the area supports up to 75 deer (Wyoming Game and Fish Department 1977). The South Haystack proposal is within the Carter Lease Herd Unit for deer which has a present population of 3,000 and a desired population of 6,300 by 1982. There is a major migration route across the southern one-half of the permit area.

The Wyoming Game and Fish Department indicates the area is antelope winter/ yearlong range (see Map SH2-8A). It is estimated that up to 75 antelope winter on the area. The project area is within the Carter Lease Herd Unit for antelope which has a present population of 2,500 and a desired population of 3,000.

Endangered and (or) Threatened. Since large numbers of whitetail prairie dogs exist on the proposed project area, the Wyoming Game and Fish Department conducted a cursory survey for black-footed ferret sign but found none.

The U.S. Fish and Wildlife Service, Denver Research Center, under contract to the BLM Wyoming State Office, began an intensive black-footed ferret survey in the South Haystack Mine area in July of 1978. The results of this survey are anticipated in October of 1978.

Reptiles and Amphibians

General. The primary species of reptiles and amphibians are leopard frog, tiger salamander, northern short-horner lizard, northern sagebrush lizard, and wandering garter snake. Table SH2-8B shows the number of species and their densities in the major habitat types.

Endangered and (or) Threatened. No endangered or threatened reptile or amphibian are known to exist on the proposed project area or surrounding vicinity.

Wild Horses

No wild horses inhabit the proposed project area or surrounding vicinity.

CULTURAL RESOURCES

Cultural resources are the fragile and nonrenewable evidence of previous human activity and occupation and are usually discussed in terms of archeological and historical values.

Archeological

Michael Metcalf, a consultant for Cumberland Coal Company, conducted the initial archeological survey of the South Haystack project area in July and August of 1976. During the summer of 1977, additional testing was done by Metcalf at sites recommended for further study. As of 8 August 1977, testing operations to determine National Register eligibility of sites in areas to be disturbed were completed. No sites of National Register potential were found in these areas using criteria found in 36 CFR 800.10.

The area surveyed, 8,300 acres, covered all of the land within the proposed project area as well as some land outside the project area. A total of 54 sites were located, mapped, and recorded by surveying in 100- to 150-foot transects. The resulting site density within the surveyed area was 4.16 sites per section.

At the end of the first field season 21 sites were recommended for testing, and no further work was recommended on the remaining 33 sites. In the second field season only five sites were tested, since the remainder were either outside areas to be disturbed or outside the mine permit boundary.

The time span of prehistoric occupation of the South Haystack project area is from the Early Prehistoric period to the Late Prehistoric period (see Table SH2-9A). Diagnostic material, recovered on over half the sites found, indicated five sites with Paleo-Indian components, eleven with Middle period components, and ten with Late period components. Three of these 26 sites are multi-component sites.

Sites located on the project area are of four types: (1) warm weather seed gathering/processing sites (evidenced by several metates found with a burial as well as seeds located in old hearths), (2) hunting camp sites indicated by numerous projectile points and butchering tools found at several locations and also by bison bone weathering out of the surface on at least one site, (3) possible multipurpose sites, and (4) one burial site. Site sizes range from small lithic scatters to large stratified sites covering one or more acres.

Twenty-five of the sites are located in areas with soft sand fill, and eight others are in fairly soft, valley floor alluvium. A large proportion of the sites are located near Albert Creek, Clear Creek, Meadow Draw, or Haystack Draw. Thirty-four sites are within one-fourth mile of a creek or draw. An especially pronounced association exists between sites and creeks or draws which bisect the north-south hogback.

Thirteen sites were found during an inventory of the rail spur right-of-way from the proposed South Haystack Mine to the Skull Point rail spur. Three of these sites were recommended for further testing; this testing has not been completed. None of the three appear to have National Register potential although additional work has been recommended for one site that is within the right-of-way (Zier 1977).

Testing of alluviated areas to determine if these areas have buried sites or would be likely to produce buried sites was begun in June 1978. The results of this study may add additional cultural resource data.

As a result of the two field seasons of work, no further work is recommended on known archeological resources in the proposed South Haystack mining area. None of those sites within areas of proposed surface disturbance are eligible for nomination to the National Register, according to criteria found in 36 CFR 800.10, nor are there

Table SH2-8B

REPTILE AND AMPHIBIAN DENSITIES FOR MAJOR HABITAT TYPES ON THE SOUTH HAYSTACK PROJECT AREA

Habitat Type	Number of Species	Density Estimate (number per acre)
Sagebrush	4	2-3
Salt desert shrub	4	2-3
Greasewood	5	2-3
Grassland and meadow	10	6-8
Mountain shrub	10	6-8
Juniper	10	6-8

Source: Personal communication, Dr. George Baxter, University of Wyoming, January 1978.

Table SH2-9A

CULTURAL RESOURCES IDENTIFIED WITHIN THE PROPOSED SOUTH HAYSTACK PROJECT AREA AND THEIR CULTURAL AFFILIATION

Period	Subphase	Number of Sites Within Mine Area	Date Before Present (B.P.)	Projectile Point Style or Cultural Group	Characteristics (Sites)
Historic		0	(1700 B.P. to present)	Shoshonean Cheyenne Gros Ventre Commanche Flathead Crow Arapahoe	Hunting and gathering; some buffalo and antelope hunting by cummunal drives, mostly marginal subsistence
Late Prehistoric		10	(2000 B.P. to 1700 B.P.)	Shoshonean Intermountain	Marginal subsistence; hunting and gathering; pottery in some sites
Middle		11			
	Late Middle		(3500 B.P. 2000 B.P.)		Hunting and gathering
	Early Middle		(4500 B.P. 3500 B.P.)	Scoggin Duncan Hanna McKean	Hunting and gathering
Altithermal			(7000 B.P. 4500 B.P.)	McKean(?)	Generally more arid period with marginal occupations suspected in limited areas
Early Prehistoric		5			
	Plano		(10000 B.P. 7000 B.P.)	Lusk Federick Cody Alberta Hell Gap Agate Basin Midland	Hunting extinct fauna (bison antiquus), bison traps, and some communal hunting suspected; collecting flora probable

Table SH2-9A

CULTURAL RESOURCES IDENTIFIED WITHIN THE PROPOSED SOUTH HAYSTACK PROJECT AREA AND THEIR CULTURAL AFFILIATION (Continued)

Period	Subphase	Number of Sites Within Mine Area	Date Before Present (B.P.)	Projectile Point Style or Cultural Group	Characteristics (Sites)
	Folsom		(11000 B.P.)	Folsom	Hunting extinct fauna (bison antiquus), bison traps, and some communal hunting suspected; collecting flora probable
	Llano		(12000 B.P. 11000 B.P.)	Clovis	Hunting extinct fauna, mammoth traps, and communal procedures suspected; collecting flora probable

any sites within the proposed mine boundaries or rights-of-way listed on the Federal Register (Vol. 42, No. 21, 1 February 1977).

Historical

A section of the original Oregon Trail passed through Cumberland Gap and proceeded westward. All traces of that trail were completely obliterated by subsequent developments at that site to more than a mile east and west of Cumberland Gap.

The historic coal mining town of Cumberland is within the right-of-way of the proposed rail spur. Only building foundations and a cemetary remain to indicate the location of this town, which was inhabited from about 1900 to 1930. This historic site is currently listed on Wyoming's Historic Preservation Plan and is eligible for nomination to the National Register.

There are no historic sites identified by Murray (1976) within the proposed project area listed on the Federal Register (Vol. 42, No. 21, 1 February 1977).

VISUAL RESOURCES

The landscape in the eastern portion of the South Haystack Mine area is characterized by gently east sloping sagebrush covered ridges. Clear Creek intermittently flows easterly through Section 17 and 18 in the northern portion of the mining area. The west half of the area is characterized by moderately steep ridges and shallow canyons. There are scattered juniper stands along the protected canyon slopes in the southwestern quarter. There are several unimproved dirt two-track roads in the area.

A person traveling U.S. Highway 189 is able to view different portions of the area from different segments of the road. Map SH2-10A depicts viewpoints along the highway, and Figures SH2-10A, SH2-10B, SH2-10C, and SH2-10D depict views from the viewpoints.

Based on the Bureau format for Visual Resource Inventory and Evaluation, as explained in BLM Manual 6310, one visual resource management (VRM) class has been identified in the South Haystack project area. The analysis from which this class has been derived is available for public review at the BLM Rock Springs District Office.

The VRM class in the South Haystack area is Class III. The basic management guideline for this class is: management would require that changes should remain subordinate to the visual strength of the existing landscape character.

RECREATIONAL RESOURCES

Visitor Use Data

Table SH2-11A depicts estimated visitor use in the South Haystack project area. Table SH2-11B depicts the estimated general resident visitor use by activity in Uinta and Lincoln Counties around the South Haystack Mine based on a population of 18,653 for these counties in 1977.

Hunting

People come to this area in the fall to hunt deer, antelope, sage grouse, and cottontail rabbits. Due to access and distance from urban centers, the hunting use is generally light. During the summer there is incidental hunting of rodents, ground squirrels, and prairie dogs as people pass through the area on their way to more attractive areas.

Sightseeing

Most of the sightseeing use in the South Haystack project area is incidental as people travel U.S. Highway 189 (Map SH2-11A). This highway is a major travel route for people traveling between Utah and Yellowstone and Grand Teton National Parks. People who actually travel to the mine site are usually looking for wildlife.

Wilderness Values

There are no areas in or near the proposed South Haystack Mine which have been identified as having wilderness values, which meet the criteria set in Section 603 of the Federal Land Policy and Management Act of 1976.

AGRICULTURE

Livestock Grazing

The project area consists of rangeland located within three grazing allotments: the Cumberland/Uinta, Haystack Draw, and Albert Creek (grazing data obtained from the Rock Springs District Office of the BLM).

Approximately 33% (2,667 acres) of the project area is within the Cumberland/ Uinta grazing allotment (total acreage 459,302 acres). This allotment is used by 44 livestock operators for the grazing of sheep and cattle (10 sheep and 34 cattle operations). Approximately 64,690 animal unit months (AUMs) per year are provided by the allotment. Livestock graze within the allotment from April 25 through January 13.

The Haystack Draw Grazing Allotment contains about 5,959 acres (2,784 public acres and 3,175 deeded acres) of which 3,070 acres are within the project area. One live-

Figure SH2-10A

VIEW OF THE SOUTH HAYSTACK AREA FROM VIEWPOINT C ON HIGHWAY 189

Figure SH2-10B

VIEW OF SOUTH HAYSTACK AREA FROM VIEWPOINT I ON HIGHWAY 189

Figure SH2-10C

VIEW OF THE SOUTH HAYSTACK AREA FROM VIEWPOINT K ON HIGHWAY 189

Figure SH2-10D

TYPICAL VIEW ALONG HIGHWAY 189 WHERE RAILROAD LINE IS PROPOSED.

Table SH2-11A

1976 ESTIMATED VISITOR DAYS BY ACTIVITY
IN THE SOUTH HAYSTACK AREA

Activity	Visitor Days
Hunting	25
Sightseeing	150
Total	175

Note: Visitor Day considered to be 12 hours.

Table SH2-11B

ESTIMATED RESIDENT VISITOR USE BY ACTIVITY
FOR 1977 BASED ON A POPULATION OF 18,653
FOR UINTA AND LINCOLN COUNTIES

Activity	Visitor Days[1]
Fishing	77,900
General[2]	76,200
Hunting	24,600
Off-road vehicle[3]	3,100
Sightseeing	23,900
Urban	48,100
Water sports	36,000
Winter sports	9,700

[1]Visitor Day consists of 12 hours.
[2]General includes camping, picnicking, etc.
[3]Estimate by Coal ES Team Outdoor Recreation Planner.

NA = Not Available

stock operator grazes sheep during late spring and summer with about 641 AUMs available per year.

The Albert Creek Grazing Allotment contains about 39,418 acres (16,418 acres publically owned and 23,000 acres state and deeded). The allotment provides about 5,400 AUMs per year for cattle and sheep owned by one operator.

Prime Farmland

Consultation with personnel of the U.S. Department of Agriculture, Soil Conservation Service, Rock Springs, Wyoming, revealed that prime farmland is not present in areas proposed for disturbance (see Regional ES, Chapter 9, Consultation and Coordination).

MINERAL RESOURCES

No mineral resources are known to be present that would conflict with coal mining in this project area.

Coal

There are seven seams of mining interest within the project area. They have been tentatively named (from basal to upper) the 1, 1A, 2, 3, 4, 5, and 6 seams. Most coal seams are very lenticular, contain numerous splits, and are highly fractured. Thickness of seams vary from less than 4 feet to over 70 feet. The number 1 seam is very localized, averages 9,908 BTU per pound, contains 1.15% sulfur, and displays highly variable thickness; hence, the sulfur in this coal could produce emissions above federal standards. Seam 1A averages 9,416 BTU per pound and contains 1.06% sulfur. This seam does, however, exhibit sufficient extent and thickness to be attractive for mining for a market not requiring a low sulfur coal. It also could serve as a blending stock to increase the reserve of compliance product. The number 2 seam displays the most consistency throughout the project area, averaging 20 to 30 feet in thickness and maintaining a consistent interval below the number 3 seam. Seams 3, 4, 5, and 6 vary in extent and thickness over the project area and converge to form a single seam at certain locations on the property. A more detailed description of the variation of the coal seams follows.

In the southern half of Section 30 and the northern half of Section 31, T. 17 N., R. 117 W., the 3, 4, 5, and 6 seams all thicken and converge to form a 75-foot coal seam. The 2 seam also thickens to over 20 feet and comes within 50 feet of the 75-foot seam. In the central area of Section 31, the 75-foot coal seam splits into two 30-foot seams; the upper seam is composed of 5 and 6, and the lower seam is composed of 3 and 4. The combined 3 and 4 seam splits into its individual increments in the southern half of the section. The 2 seam remains consistent (approximately 20 feet) throughout the section.

In the northern part of Section 2, T. 16 N., R. 118 W., the combined 5 and 6 seam splits into its individual increments and the 5 seam pinches out. The 6 seam remains fairly constant throughout the rest of the section, averaging 20 to 25 feet in thickness. In the northern half of the section, the 3 and 4 seams pinch out. The 3 seam does thicken again in the southern part of the section where it could become a minable unit. In the northern part of Section 2, the 2 seam thins slightly, but thickens again in the central and southern parts of the section where it, too, becomes a minable unit.

In the southern and central portions of Section 19, T. 17 N., R. 117 W., the 2, 3, 4, 5, and 6 seams split dramatically. Seams 4 and 5 thin into carbonaceous zones but thicken again in the northern half of the section, where they converge into a single 20-foot seam of minable coal. Also, in this area, the 6 seam thickens to form a 15-foot bench of minable coal. The 2 and 3 seams become thinner from south to north until they pinch into carbonaceous shale zones in the northern part of this section.

LAND USE PLANS, CONTROLS, CONSTRAINTS

A number of governmental agencies exercise certain types of land and resource use controls in Lincoln and Uinta Counties. The proposed South Haystack Mine includes public, state, and private lands. The federal sector is administered by the BLM (public lands and mineral estate under certain private lands). Except where controls have specifically been delegated by statute to counties or municipalities, Wyoming retains total jurisdiction over nonpublic and privately-owned lands (including mineral leasing, rights-of-way, etc.). The South Haystack Mine includes 640 acres of state lands. Counties have authority to effect a wide variety of controls in matters not specifically reserved to the state. The authority applies only to those portions of the county that are unincorporated. A county may regulate and restrict location and use of buildings and structures; condition of use; and occupancy of lands for residency, recreation, agriculture, industry, commerce, public use, and other purposes that are reasonably necessary to protect the public good of its citizens. Lincoln and Uinta Counties have a joint planning office located in Kemmerer, but extensive zoning and countywide planning actions have not been initiated. All of the respective jurisdictions (federal, state, and county) have sufficient authority to impose effective land and resource use controls.

TRANSPORTATION NETWORKS

Highways

U.S. Highway 189 passes through the southeast corner of the South Haystack project area. This highway is a wide two-lane road designed for moderate vehicle traffic. There are numerous two track roads throughout the area. In 1976, approximately 20,800 vehicle registration tabs were purchased in Lincoln and Uinta Counties.

Railroads

The nearest railroad service is about 6 miles east of the mining area. The railroad is the main east-west line of the Union Pacific Railroad (UPRR) which services Utah and eastern states. However, the "Hogsback"presents a barrier which is virtually impossible for construction of a rail spur to this line. The northwest main line of the UPRR (Oregon Shortline) passes about 25 miles north of the mining area. Current estimated railroad traffic through southwest Wyoming is shown on Table SH2-14A.

SOCIOECONOMIC CONDITIONS

The social and economic environment that would be affected most significantly by the proposed South Haystack Mine includes Uinta County and the community of Evanston. Lincoln County would also be affected, but to a lesser extent.

Population

The estimated 1977 populations of Lincoln and Uinta Counties were estimated to be 7,132 and 11,521, respectively (Abt Associates 1978). The population of Kemmerer/Diamondville in that year was 3,655, while that of Evanston was 5,918. The remaining portions of both counties are spread out in several much smaller towns and in rural areas (Table SH2-15A).

Both counties have experienced significant growth since 1970. The population of the Kemmerer/Diamondville area has increased 59% (1,363) over the 1970 figure of 2,292; Evanston's population has increased 33% (1,456) over the 1970 figure of 4,462 (U.S. Department of Commerce, Bureau of Census 1970a). The growth in these communities was primarily related to the expansion of the Viva Naughton Power Plant, a 122% increase in Lincoln County coal production, a 100% increase in phosphate production west of Kemmerer, the expansion of trona mining in Sweetwater County (workers residing in Uinta County), and the development of a coke plant south of Kemmerer (Abt Associates 1977).

Employment

Total employment in Lincoln County was estimated at 3,670 in 1977 (Table SH2-15B). Approximately 31% (1,143) of these jobs were in the mining and construction sectors. The unemployment rate in Lincoln County increased to 6.3% (302 persons) in 1977 from a 1974 low of 4.7% (180 persons). In Uinta County, total employment was estimated at 4,795 in 1977. The most important employment sectors in this county are government and transportation. The unemployment rate in 1977 was 3.9% (156 persons) (U.S. Department of Commerce, Bureau of Economic Analysis 1974 and Wyoming Employment Security Commission 1975).

Income

The median family income in Lincoln County in 1977 was $13,800 which was a 77% increase over the 1970 figure of $7,796. The growth is attributable to increased mineral production with its higher salaries. Over 50% of its labor force earns less than $15,000 per year. Personal earned income in 1977 was $44.6 million, while per capita income was $6,252. The median family income in Uinta County was $13,300 in 1977. This is a 47% increase over the 1970 figure of $9,025. Nearly 68% of the county's labor force earns less than $15,000. Personal earned income in 1975 was $39.8 million, while per capita income was $3,454 (Abt Associates 1977 and 1978).

Infrastructure

Private Sector

The Kemmerer/Diamondville area is the retail trade center for the southern half of Lincoln County. County retail sales (city data not available) in 1977 were $17,300,000, while wholesale revenues were $5,600,000. Retail trade in Uinta County was clearly centered in Evanston. Retail and wholesale sales in Uinta County in 1977 were estimated at $35,100,000 and $9,600,000, respectively (Abt Associates 1978). Many major purchases are made in Salt Lake City and Ogden, Utah, which are less than 83 miles away.

Public Finance

Recent growth in Lincoln County has allowed the county and its communities to reduce both property tax rates and levels of bonded indebtedness. Current operating costs are apparently being met while the capacity of the governments to respond to future growth has been enhanced (Abt Associates 1977). Assessed valuation was $116.1 million in 1977. Assessed valuation in Uinta County in 1977 was $31.6 million. County-level tax rates and indebtedness have increased, while individual communities have decreased tax rates (Abt Associates 1977).

Housing

It is estimated that in 1977 there were 1,444 dwelling units in the Kemmerer/ Diamondville area (Lincoln County data are not available). There were an estimated 1,568 units in Evanston. See Table SH2-15C for units in other Uinta County communities. In spite of recent construction, the demands for housing are still greater than

Table SH2-14A

ESTIMATED CAPACITIES OF IDENTIFIED LINE SEGMENTS

Segment	No. of Tracks	Signaling	Length (Miles)	Estimated Capacity (trains per day)	Current Traffic (trains per day)	Estimated % Capacity
Kansas City to Topeka	2	ABS	68	55-60	44	73%
Topeka to	1	CTC	203	25-30		73%
Gibbon	2	CTC	17	70-80	22	28%
Council Bluffs to Gibbon	2	ABS	176	55-60	34	57%
Gibbon to	2	ABS	100	55-60		88%
North Platte	2	CTC	8	70-80	53	66%
North Platte to	2	ABS	182	55-60		78%
Cheyenne	2	CTC	43	70-80	47	59%
Cheyenne to	3	CTC	35	100-115		44%
Hanna	2	CTC	108	70-80	51	64%
Hanna to Rawlins	2	CTC	40	70-80	45	56%
Rawlins to	2	ABS	101	55-60		73%
Green River	2	CTC	33	70-80	44	55%
Green River to Granger	2	CTC	30	70-80	40	50%
Granger to Kemmerer	1	CTC	40	25-30	13	43%
Kemmerer to McCammon	1	CTC	174	25-30	13	43%
McCammon to Pocatello	1	CTC	174	25-30	13	43%

Table SH2-14A

ESTIMATED CAPACITIES OF IDENTIFIED LINE SEGMENTS
(Continued)

Segment	No. of Tracks	Signaling	Length (Miles)	Estimated Capacity (trains per day)	Current Traffic (trains per day)	Estimated % Capacity
Granger to	2	ABS	126	55-60		53%
Ogden	2	CTC	19	70-80	32	40%

Source: Union Pacific Railroad Company 1978.

ABS = Automatic Block Signals
CTC = Centralized Traffic Control

Table SH2-15A

POPULATION: LINCOLN AND UINTA COUNTIES

	1977 Estimated Population
Lincoln County[1]	7,132
Kemmerer/Diamondville	3,655
Balance of county	3,477
Uinta County	11,521
Evanston	5,918
Lyman	2,392
Mountain View	677
Balance of county	2,534

Source: Abt Associates 1978.

[1]That portion of county within the ES region.

Table SH2-15B

EMPLOYMENT: LINCOLN AND UINTA COUNTIES

	Lincoln County 1977	Uinta County 1977
Total employment	3,670	4,795
Proprietors	800	815
Farm	269	325
Nonfarm	531	490
Wage and salary	2,870	3,980
Farm	227	142
Nonfarm	2,643	3,838
Government	492	1,383
Private	2,151	2,455
Manufacturing	183	181
Mining	626	122
Construction	517	231
Transportation	210	507
Trade	351	925
Finance, insurance, and real estate	40	73
Services	207	411
Other	17	5

Source: Abt Associates 1978.

Table SH2-15C

HOUSING CHARACTERISTICS: LINCOLN AND UINTA COUNTIES

County Community	Total Units	Single-Family	Multi-Family	Mobile Homes
Lincoln County	NA	NA	NA	NA
Kemmerer/ Diamondville	1,444	729	303	412
Balance of county	NA	NA	NA	NA
Uinta County	NA	NA	NA	NA
Evanston	1,568	1,064	198	306
Lyman	507	196	13	298
Mountain View	219	120	0	99
Balance of county	NA	NA	NA	NA

Source: Lincoln/Uinta Association of Governments 1977.

NA = Not Available

what is available. Many residents are forced to turn to mobile homes in lieu of more permanent housing. Abt Associates (1977) estimates that mobile homes constitute 17%-72% of housing in the various communities of the two counties.

Education

Southern Lincoln County, including the Kemmerer/Diamondville area, is served by School District 01. Its enrollment in 1977 was 912. The district currently has excess classroom capacity. Uinta County is served by three school districts, 01, 04, and 06. They are experiencing problems in several areas including capacity, condition of facilities, attracting staff, and financing needed improvements. In 1977, enrollment was 1,249 in District 01 (Evanston), 597 in District 04, and 677 in District 06 (Abt Associates 1978). Table SH2-15D provides data on educational system characteristics.

Health and Social Services

The recent population expansion in both counties has put severe strains on these services. Both counties are short personnel and facilities, frequently requiring residents to travel outside the area for treatment. Table SH2-15E shows the health services profiles for these counties. Mental health services are provided by the Jackson-based Western Wyoming Mental Health Association. The primary provider of social services in the counties is the State Department of Health and Social Services, Division of Public Assistance and Social Services (Abt Associates 1977).

Police and Fire Protection

The Lincoln County Sheriff's Department has seventeen full-time and ten volunteer officers. The department shares its facilities with the five-man Kemmerer police force. The County jail is currently too small. The Uinta County Sheriff's Department has seven officers. It expects to have adequate facilities when it moves into the new Uinta County-Evanston combined facility. The Evanston police force has a staff of eleven full time personnel and a volunteer force of eight (Abt Associates 1978).

Kemmerer's 24-person fire department serves all the southern Lincoln County. It has an insurance rating of eight, which indicates an organized fire department with deficiencies in the fire department and water supply. Evanston has one of the best volunteer fire department (39 persons) in the state with a class of six insurance rating (highest possible for a volunteer force). Lyman, Mountain View, and Fort Bridger all have inadequate fire protection because of inadequate equipment and water pressure.

Water and Sewer Systems

The Kemmerer/Diamondville area (including Frontier) receives its water from the Hams Fork and the Kemmerer Reservoir. The city-owned (Kemmerer Reservoir) facility can provide up to 3 million gallons of treated water per day. The system, including storage, is considered adequate. Evanston's water supply comes from surface sources and wells. The 4 million gallon per day system is considered adequate (Abt Associates 1978).

Kemmerer has a 500,000 gallon per day sewage treatment facility (conventional step aeration activated sludge process). It is currently operating above capacity and is not in compliance with 1977 effluent standards (Wyoming Department of Environmental Quality 1976b). Evanston has a 1.8 million gallon per day sewage system currently operating below capacity and is considered adequate most of the year. Other communities in both counties have individual systems that are generally considered adequate (Abt Associates 1977).

Utilities

The Lincoln Service Company provides power to the Kemmerer/Diamondville area. It purchases its power from the Naughton Power Plant. Natural gas is obtained from the Northwest Pipeline Company through the local supply company (Wyoming Industrial Gas Company). Utah Power and Light provides electrical power to Evanston from the company's Naughton units in Kemmerer. Outlying areas in Uinta County receive power from the Bridger Valley Electric Association. Mountain Fuel Supply Company provides both Evanston and the Bridger Valley with natural gas service. No power supply problems are anticipated in either county in the near future (Abt Associates 1978).

Attitudes and Expectations

The attitudes and expectations of both counties' residents are dependent upon the benefits that they expect to receive from recent growth and the local governments' abilities to cope with the pressures resulting from it. Those involved in the mining and construction sectors generally have a favorable outlook financially. They make high salaries and enjoy the benefits that accompany above average incomes. Residents employed in local services with their lower incomes find it difficult to compete for goods and services with the inflated prices arising under rapid growth conditions. Items such as adequate housing, especially the purchasing of a new home, become very difficult to attain.

Nearly all residents, however, are concerned about the shortages in services that exist in most areas. The huge increase in population (especially in Lincoln County) has put great demands on social services (hospitals, dentists, etc.), recreation facilities, public facilities (roads, sewage systems, etc.), and consumer services. It has also led to unplanned growth that has resulted in scattered mobile home parks, traffic congestion, and other problems associated with overcrowding. These difficulties have made many residents unhappy with life in the area. Unable to get needed services and find recreational or cultural outlets, many leave causing high turnover rates in housing

Table SH2-15D

EDUCATIONAL SYSTEM CHARACTERISTICS: LINCOLN AND UINTA COUNTIES

	Lincoln County	Uinta County		
	Kemmerer SD#1	Evanston SD#1	Mountain View SD#4	Lyman SD#6
1977 fall enrollment[1]	912	1,249	597	677
Number of classroom teachers (full-time equivalent)[1]	50.5	60.0	32.0	33.5
Student/teacher ratios[1,3]	18.1	20.8	18.7	20.2
Total annual expenditures ($-millions)[1]	1.66	1.75	0.92	1.2
Average daily membership (ADM)[1]	922	1,218	572	661
Expenditures per ADM[2,4] ($)	1,681	1,461	1,713	1,664
Assessed valuation ($-millions)[1]	59	17.2	7.2	7.1
Assessed valuation per ADM[2,5] ($)	64,991	14,122	12,483	10,893
Number of classrooms[1]	44	58	30	35

[1]Wyoming Department of Education, Division of Planning, Evaluation, and Information Services 1977.

[2]Derived from Wyoming Department of Education data.

[3]Fall 1977 statewide average for classroom teachers - 18.4 (Wyoming Department of Education, Division of Planning, Evaluation and Information).

[4]1976-1977 statewide average expenditures per ADM - $1,721 (Wyoming Department of Education, Division of Planning, Evaluation and Information).

[5]1976-1977 statewide average assessed value per ADM - $31,143 (Wyoming Department of Education, Division of Planning, Evaluation and Information).

Table SH2-15E

HEALTH AND SOCIAL SERVICES: LINCOLN AND UINTA COUNTIES

Personnel Facilities	Lincoln County Number[1]	Lincoln County Ratio Per Population Increment	Uinta County Number[2]	Uinta County Ratio Per Population Increment	State Standard Ratio Per Population Increment
Physicians	3	1:2,377	4	1:2,880	1:1,000
Nurses (employed)					
Registered nurses	9	1:792	10	1:1.152	1:285
Licensed practical nurses	5	1:1,426	4	1:2,880	1:769
Public health nurses	1	1:7,132	1	1:11,521	1:7,660
TOTAL	15		15		
Dentists	3	1:2,377	3	1:3,840	1:1,600
Optometrists	1	1:7,132	2	1:5,761	1:7,000
Hospitals	1	1:7,132	1[4]	1:11,521	1:19,944
Hospital beds	20	1:357	22	1:524	1:179
Ambulances	5	1:1,426	5	1:2,304	1:3,740
Emergency rooms	1	1:7,132	1	1:11,151	1:13,296
Mental health centers	1	1:7,132	1	1:11,151	1:12,397

Sources:

[1] Interview with Dr. Gayle Robinson, Administrator, South Lincoln Hospital, Kemmerer, January 1978. (Numbers reflect personnel and facilities associated with South Lincoln Hospital only; dentists and optometrists excepted.)

[2] Interview with Ms. Mary Emerson, Acting Administrator, Uinta Memorial Hospital, January 1978.

[3] Wyoming Division of Health and Medical Services 1977.

[4] Excluding Wyoming State Hospital, Evanston.

and jobs. Crime, drinking, and family problems have all risen.

On the other hand, the local governments have made significant efforts to remedy the situation. The two counties have a joint planning office, and comprehensive plans have been or are being prepared to control future growth. The increased population and new industry have brought in new funds to support additional services and facilities to help cope with demands (Abt Associates 1977).

Life Styles

There are two basic components to life styles in Lincoln and Uinta Counties. The older and more permanent style is primarily rural in nature. Communities have a small-town atmosphere with life centering on outdoor activities, hard work, church, and family. The recent industrial growth has threatened this way of life. Many older residents resent it, even though they have benefited from it in terms of expanded services and higher incomes in many cases. There is also concern about maintaining the wide-open spaces associated with this area. Mining and other industrial activities would disturb the land both physically and visually.

Economic growth and increased industrialism has, however, changed much of the rural atmosphere of some towns in the area. Laborers from other communities, including large cities, have entered the counties. They are used to more city-centered activities and have found the transition to a smaller town difficult. The increase in population has also brought many of the problems associated with larger towns (traffic, crime, noise, etc.) as well as the benefits (more services and expanded facilities). The newer population has in effect brought with it a faster pace of life, a turn towards greater industrialism, and a trend of urbanization (Abt Associates 1977).

FUTURE ENVIRONMENT

Lincoln County's population will increase from an estimated 7,132 persons in 1977 to 7,799 in 1980, due primarily to new employment opportunities in the mineral and power industries. There will be a decline in population (to an estimated 7,120 in 1985), due to construction having been completed on major projects, such as the Viva Naughton Power Plant expansion and the subsequent departure of construction workers. By 1990, the population will be an estimated 7,233 persons, a slight increase above 1977 levels.

Approximately 50% of the county's population growth will be in the Kemmerer/ Diamondville area. There will be moderate increases in personal income, retail and wholesale sales, and housing demands; however, most demands on the county's services, caused by new growth, will become insignificant after 1980.

Uinta County's population will increase slightly and then decrease in the 1977 through 1990 period (from an estimated 11,521 persons in 1977 to 12,381 in 1980 and from 12,214 in 1985 to 12,135 in 1990). Employment will follow similar trends. There will be moderate increases in income and trade.

Population changes in the two counties will affect corresponding changes in the use of transportation networks. It is estimated that annual vehicle license tab sales will increase from 20,800 in 1976 to 22,500 in 1978 through 1980 and then decrease to 21,600 in 1990. Table SH2F-14A illustrates estimated increased railroad traffic through 1990.

Estimated changes in recreational visitor use in Lincoln and Uinta Counties through 1990 are shown in Table SH2-11A.

Adverse and beneficial impacts to cultural and paleontological resources will show correlation with developmental and population trends.

The air quality, climate, geology, topography, soils, water resources, vegetation, fish and wildlife, visual, and mineral resources of the lands comprising the South Haystack project area will not change appreciably through 1990 without the proposed mining.

Table SH2F-14A

ESTIMATED FUTURE RAILROAD TRAFFIC WITHOUT COAL MINING IN SOUTHWEST WYOMING

Segment	Estimated Capacity[1] (trains per day)	Current Traffic[1,2] (trains per day)	1980 Traffic[3,4] (trains per day)	1980 % Capacity	1985 Traffic[3,4] (trains per day)	1985 % Capacity	1990 Traffic[3,4] (trains per day)	1990 % Capacity
Kansas City to Topeka	70-80	44	48	60	56	70	65	81
Topeka to Gibbon	70-80	22	24	30	28	35	32	40
Council Bluffs to Gibbon	55-60	34	37	62	43	72	50	83
Gibbon to North Platte	70-80	53	58	73	67	84	78	98
North Platte to Cheyenne	70-80	47	51	64	60	75	69	86
Cheyenne to Hanna	70-80	51	56	70	65	81	75	94
Hanna to Rawlins	70-80	45	49	61	57	71	66	83
Rawlins to Green River	70-80	44	48	60	56	70	65	81
Green River to Granger	70-80	40	44	55	51	64	59	74
Granger to Kemmerer	25-30	13	14	47	16	53	19	63
Kemmerer to McCammon	25-30	13	14	47	16	53	19	63
McCammon to Pocatello	25-30	13	14	47	16	53	19	63

Table SH2F-14A

ESTIMATED FUTURE RAILROAD TRAFFIC WITHOUT COAL MINING IN SOUTHWEST WYOMING
(Continued)

Segment	Estimated Capacity[1] (trains per day)	Current Traffic[1,2] (trains per day)	1980 Traffic[3,4] (trains per day)	1980 % Capacity	1985 Traffic[3,4] (trains per day)	1985 % Capacity	1990 Traffic[3,4] (trains per day)	1990 % Capacity
Granger to Ogden	55-60	32	35	58	41	68	47	78

[1]Union Pacific Railroad Company 1978.
[2]Through freight only.
[3]Abt Associates 1978.
[4]Estimates by ES team.

Table SH2F-11A

ESTIMATED RESIDENT VISITOR USE DEMAND BY ACTIVITY
FOR YEARS 1980, 1985, AND 1990

Activity	Visitor Days 1980	Visitor Days 1985	Visitor Days 1990
Fishing	85,800	83,700	84,800
General[1]	84,100	83,700	85,800
Hunting	26,500	25,200	25,100
Off-road vehicles[2]	3,300	3,200	3,200
Sightseeing	25,900	25,500	25,900
Urban	54,900	57,500	60,500
Water sports	40,300	41,100	42,700
Winter sports	11,300	12,300	13,100

Note: Visitor day considered to be 12 hours.

[1] General includes camping, picnicking, etc.
[2] Estimate by ES team Outdoor Recreation Planner.

CHAPTER 3

THE ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

This chapter discusses the impacts that would result from implementation of the proposed South Haystack Mine. Impacts are linked to specific aspects of the mining and reclamation plan and are quantified to show magnitude, intensity, duration, and incidence.

This chapter also provides the bases for assessing unavoidable adverse impacts in Chapter 5.

ASSUMPTIONS AND ANALYSIS GUIDELINES

An analysis of impacts requires establishing assumptions and guidelines for coal-related development.

Assumptions

1. Labor and equipment shortages would not significantly distort the proposed levels of development.
2. No extensive delays for obtaining environmental clearances would be encountered.
3. No extensive delays for obtaining rights-of-ways (federal or private) would be encountered.
4. The reclamation of mined areas would require an estimated 9 years. This would include 4 years for backfilling, spoil shaping, seedbed preparation, planting, and replanting and 5 years for plant establishment (during which time livestock and extensive big game use would be prevented).
5. Areas not disturbed by mining excavation (such as rights-of-way, etc.) would not require extensive backfilling and shaping and would be reclaimed in an estimated 8 years.
6. It is assumed that irrigation would be employed, if necessary, to avoid extensive delays in reclamation.

Guidelines

1. Impacts are analyzed for four time points (1980, 1985, 1990, and end of mine life).
2. Impacts remaining after mining reclamation are considered long term.
3. Mining plant site analyses include mine, mine facilities, and all ancillary development (i.e., roads, power lines, railroad spur tracks, and ponds).
4. The proposed revegetation seeding mixture would be subject to revision based on research results at the proposed mining area and, when applicable, at other locations.
5. Successful reclamation would require the establishment of a diverse, effective, and permanent vegetative cover of native and (or) acceptable introduced species capable of supporting post mining land uses. The living plant ground cover on revegetated areas would have to equal the ground cover of living plants on approved reference areas for a minimum of two growing seasons.
6. Post mining land uses would primarily involve livestock grazing, wildlife habitat, and outdoor recreation (Bureau of Land Management (BLM) Pioneer Trails Management Framework Plan 1977b).
7. The BLM would design and implement appropriate grazing management systems to prevent overgrazing of reclaimed areas.

AIR QUALITY

Emmissions from the Proposed Mine

The specific emission sources of the South Haystack Mine are presented in Table SH3-2A. From the table, it is obvious the fugitive dust emissions are included in this analysis (43 CFR 118 regulations are not applied) and, therefore, represents a conservative (upper bound) assessment of the impact of the proposed mine. However, based on state-of-the-art emission calculations and modeling techniques, this analysis reflects as accurately as possible the impacts of the mining and reclamation plan which was on file with the U.S. Geological Survey (USGS) at the time of this modeling effort.

For the contribution of wind erosion from unreclaimed and partially reclaimed land, the most probable situation would be represented by mulching and furrowing in the spring, followed by fall planting. Note that the projected emissions (Table SH3-2A) were based on the assumption that mulching and planting would be performed in the fall in a one-step operation. Surface roughness impediments to erosion (furrowing), moreover, were neglected in that analysis. If these control measures were included in the analysis, the total emissions shown in Table SH3-2A would be reduced by 22%, 21%, 24%, and 25% for the years 1980, 1985, 1990, and end of mine life, respectively.

As shown in the preceding paragraph, best management practices were not necessarily included in the air quality impact analysis. Only those mitigating measures

Table SH3-2A

SOUTH HAYSTACK PARTICULATE EMISSIONS

	Total Suspended Particulates Tons Per Year			
	1980	1985	1990	End of Mine Life
Overburden removal	382	763	763	638
Ore loading	75	150	150	125
Truck dumping	15	30	30	25
Train loading	2	3	3	3
Conveying	8	15	15	13
Coal storage	0	1	1	1
Crushing (primary)	1	2	2	1
Crushing (secondary)	2	5	5	4
Overburden dump disturbance	240	0	0	0
Employee access roads	38	32	32	32
Haul roads (coal)	16	31	31	26
Haul roads (overburden)	570	0	0	0
Haul road repair	56	56	56	56
Dozers (overburden dumps)	56	56	56	56
Wind erosion	624	453	550	486
Totals	2,085	1,597	1,694	1,466

Source: ERT 1978b.

discussed in the South Haystack mining and reclamation plan on file with the USGS at the start of this rewrite were included in the modeling. In any event, the worst case mine situation is discussed, and best management practices will produce fewer and less intense impacts. It was not possible to include best management practices in Chapter 3, because the suggestions came in too late for modeling to be done and, if included now, would negate the continuity of the present analysis. Chapter 8 contains an air quality alternative which discusses the best management practice impacts.

Impact on Air Quality

Figures SH3-2A through SH3-2D show the mine-related suspended particulate (SP) concentrations for worst-case annual and 24-hour averages predicted by the model. Concentrations are shown to decrease rapidly with distance. Annual and 24-hour mine-related concentrations decrease to 10% of maximum values at 1.5 to 2.5 miles and 1.5 to 2 miles downwind of the mine, respectively.

When annual average background particulate values of 16 micrograms per cubic meter ($\mu g/m^3$) for 1980 and 15 $\mu g/m^3$ for all other years (Environmental Research and Technology (ERT) 1978a) are added to projected mine-related contributions, total levels are predicted to be greater than the annual primary National Ambient Air Quality Standard (NAAQS) of 75 $\mu g/m^3$ within 1, 1, 1, and 1.5 miles and greater than the annual Wyoming standard of 60 $\mu g/m^3$ within 1.5, 1, 1, and 1.5 miles of the mine for the years 1980, 1985, 1990, and end of mine life, respectively. However, background concentrations are projected to contribute 70% to total total suspended particulate (TSP) levels at 7 to 10.5 miles and 7 to 9 miles downwind from the mine for annual and 24-hour averaging periods, respectively.

If projected mine-related 24-hour SP values and background concentrations of 49 $\mu g/m^3$ for 1980 and 46 $\mu g/m^3$ for all other years are combined, concentrations are predicted to be greater than the 24-hour primary NAAQS of 260 $\mu g/m^3$ within 2, 2, 2, and 2 miles, and greater than the Wyoming standard of 150 $\mu g/m^3$ within 3.5, 3, 3, and 2.5 miles of the mine for the years 1980, 1985, 1990, and end of mine life, respectively.

A comparison of the worst-case mine impact with Prevention of Significant Deterioration (PSD) regulations is shown in Table SH3-2B. The distances from the mining area within which predicted concentrations are higher than the specified increments are listed for annual and 24-hour averages according to PSD area classification. Concentrations greater than the Class II annual PSD increment are projected to occur within 2 to 3 miles and greater than the 24-hour increment within 5.5 to 7 miles of the mine.

Note that under the new PSD regulations (43 CFR 118), the violations discussed above would not occur. In fact, the surface mines would be within the applicable NAAQS and PSD regulations.

The impact of blasting and coal fires is difficult to assess, although the maximum air quality degradation would occur on a local scale. The cloud of dust produced by blasting would be short-lived, at least compared to the averaging times of the TSP standards (24 hours or greater), so that little contribution to 24-hour levels would be measured outside the mine site. The dust produced would also be initially dispersed to a great degree by the force of the blast. Blasting would generally take place during the day, when meteorological characteristics are more favorable for dispersing ground-level pollutants. Any fire on the site could significantly contaminate the air and cause a safety hazard. However, due to the high degree of fire control technologies, potential fire impacts would probably be minimal.

Gaseous Pollutants

Vehicle emissions would be the only source of gaseous air pollutants from the proposed mine. Federal and state regulations include limitations on ambient air concentrations of the vehicle-related pollutants carbon monoxide (CO), hydrocarbon (HC), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2).

Maximum predicted concentrations of CO ranged between 0.02% and 0.44% of the standard. Maximum predicted HC concentrations ranged between 0.88% and 3.44% of the standard. Maximum predicted NO_2 concentrations ranged between 0.6% and 3.0% of the standards. Maximum predicted concentrations of SO_2 ranged between 0.02% and 0.33% of the standards. The values represent predictions at less than one-half mile from the mines. Predictions were significantly less at further distances from the mines. Assuming similar vehicle activity for all western coal mines, the impact of vehicle emissions on ambient concentrations of gaseous pollutants would be minimal and insignificant compared to their respective standards.

Visibility

Using the technique discussed in Chapter 4, Regional Technical Report (ERT 1978a), visibilities have been computed downwind from the source. Results for worst-case 24-hour SP concentrations for the years 1980, 1985, 1990, and end of mine life are shown in Table SH3-2C. Also given are the mass fractions of the total TSP for coal and soil for each year which were used in calculating the visibilities shown in Table BB3-2C. For 1980, the visibility of an observer at 1 mile downwind would be approximately 39.5 miles assuming a background visibility of 40 miles. In general, visibility would increase with downwind distance from the mine. At 5 miles downwind the visibility would be 39.7 miles, and at 10 miles it would reach 39.8 miles. The corresponding values, assuming a background visibility of 7 miles, are 6.9 miles, 6.9 miles, and 7 miles, respectively. Additional analysis years are given in the table.

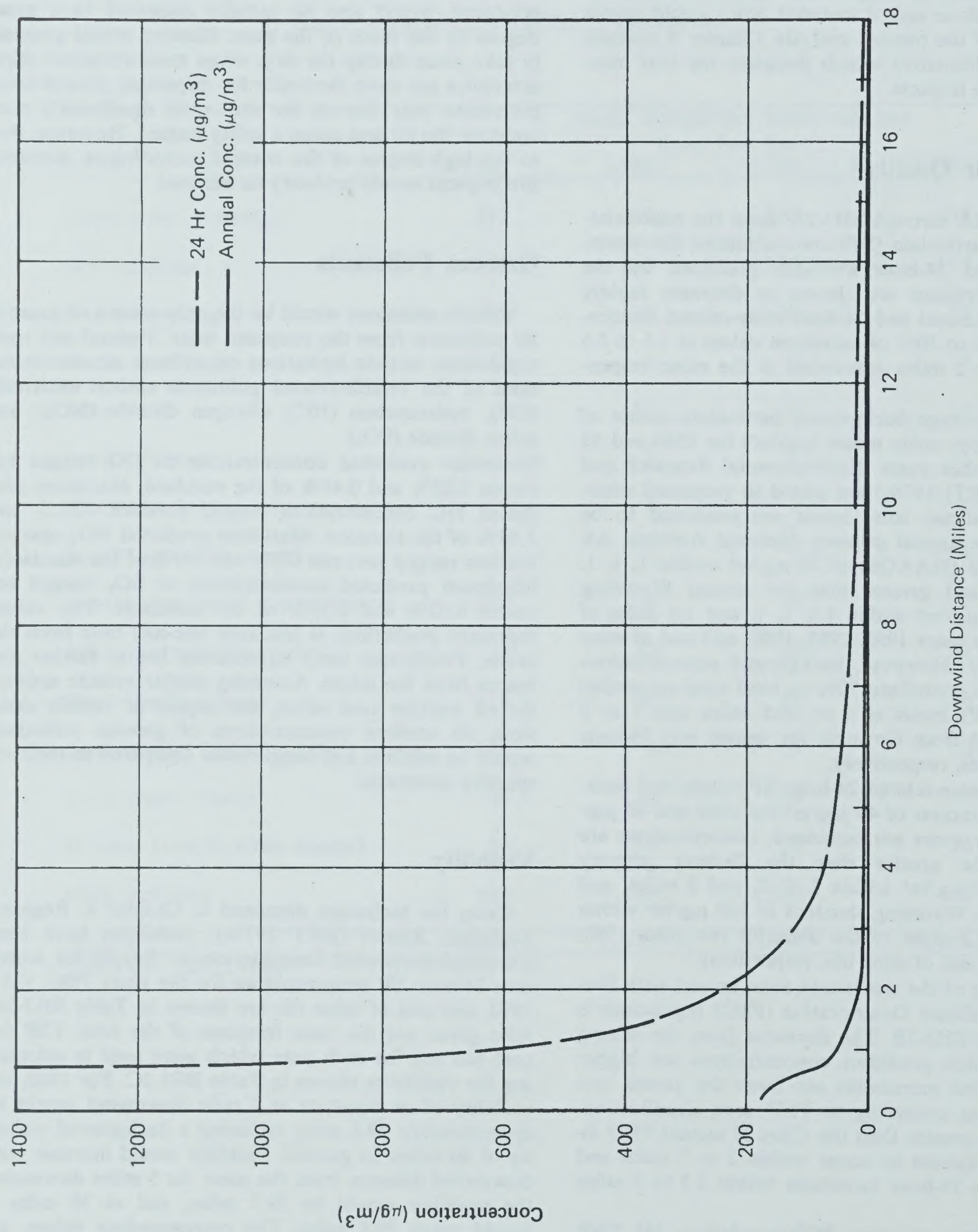


Figure SH3-2A

1980 SOUTH HAYSTACK SP CONCENTRATIONS

Source: ERT 1978a

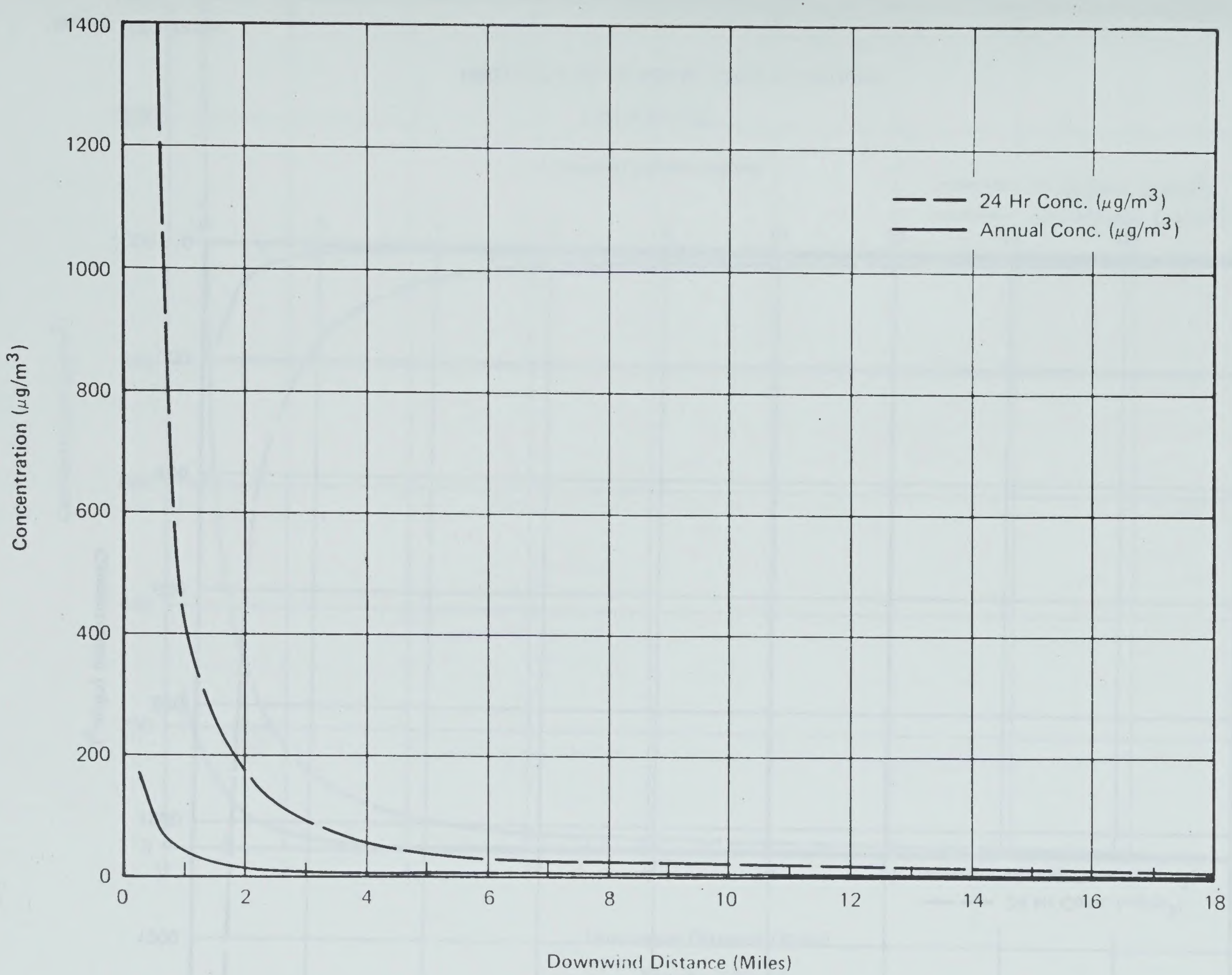


Figure SH3-2B

1985 SOUTH HAYSTACK SP CONCENTRATIONS

Source: ERT 1978a.

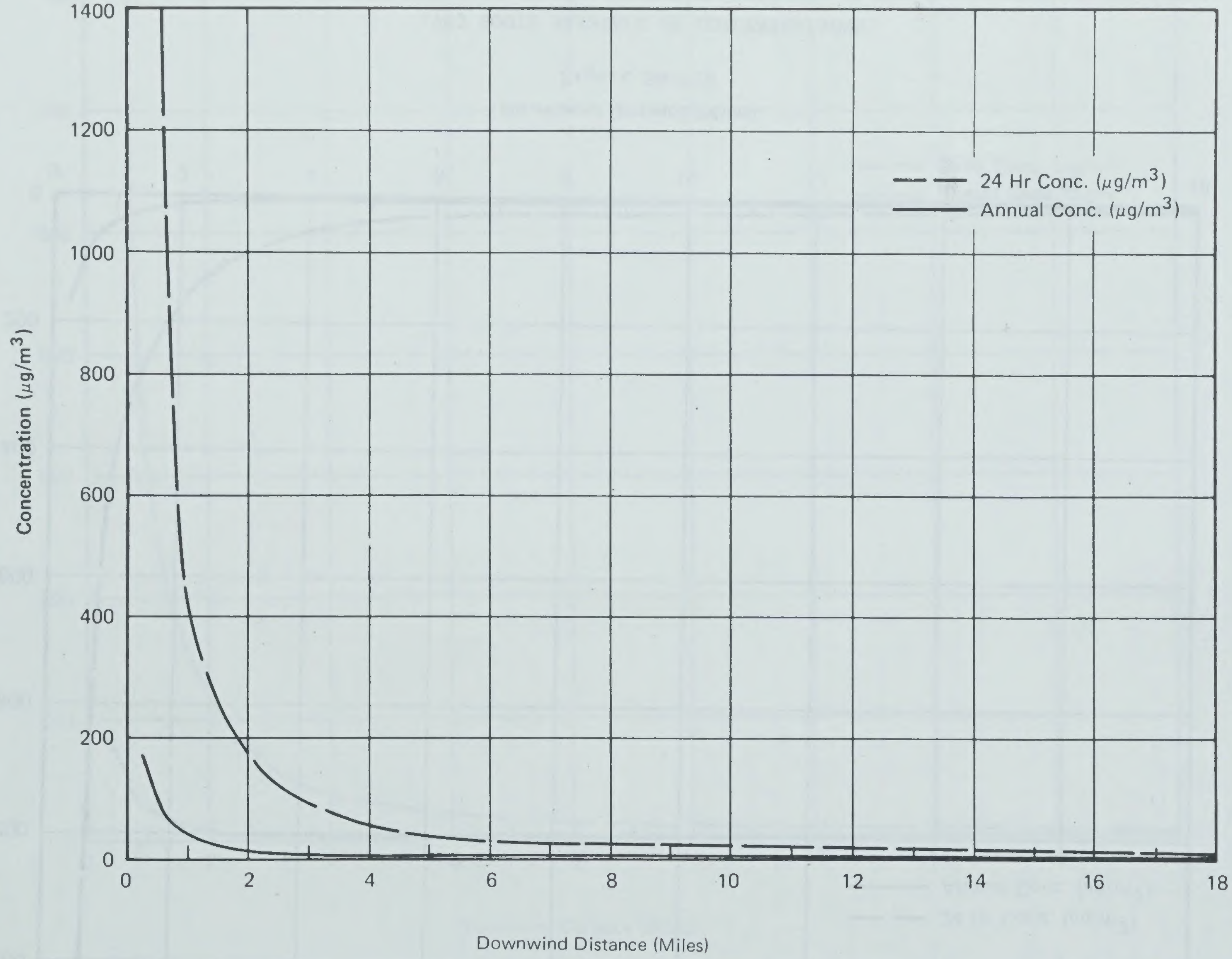


Figure SH3-2C

1990 SOUTH HAYSTACK SP CONCENTRATIONS

Source: ERT 1978a

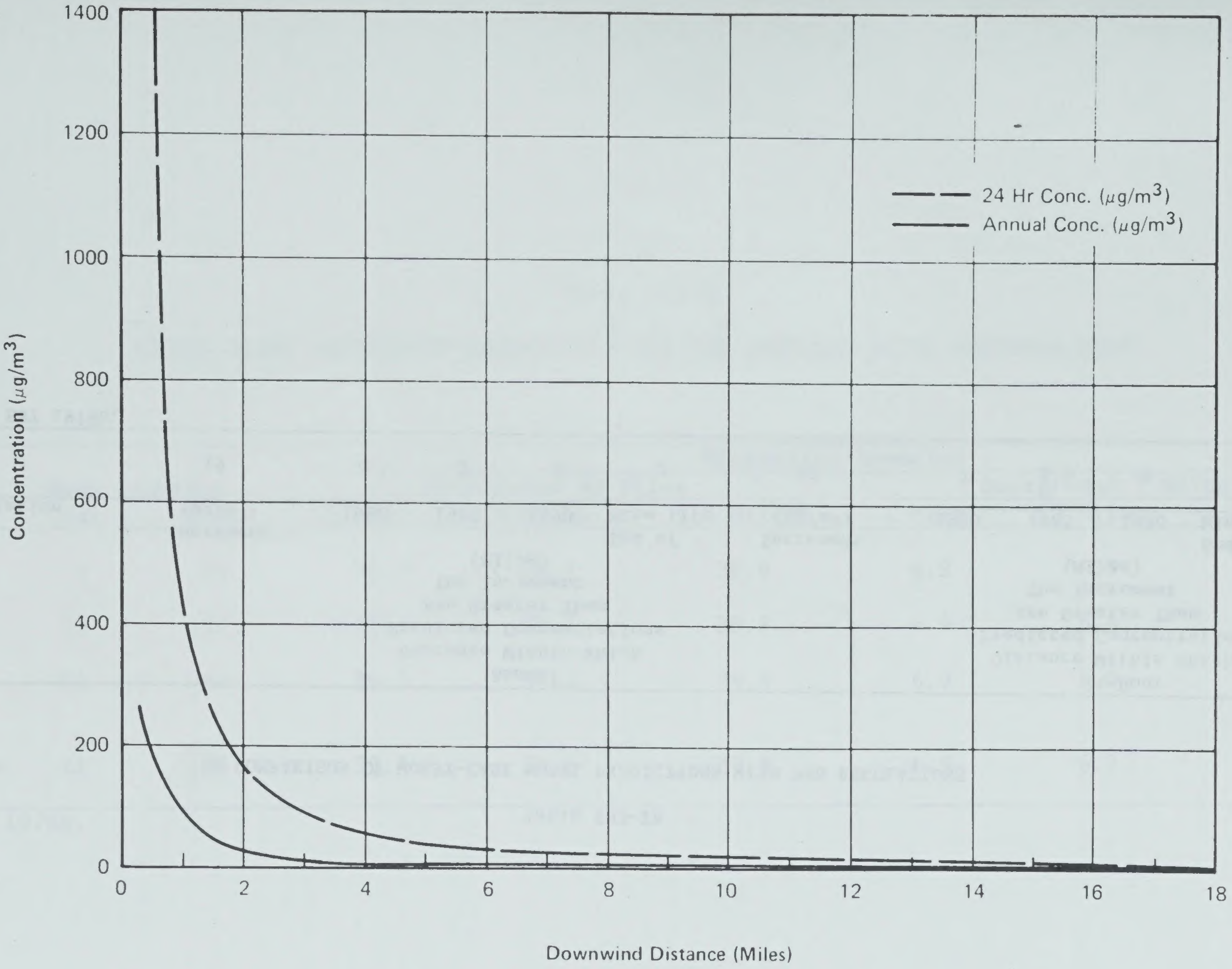


Figure SH3-2D

END OF MINE LIFE SOUTH HAYSTACK SP CONCENTRATIONS

Source: ERT 1978a.

Table SH3-2B

COMPARISON OF WORST-CASE MODEL PREDICTIONS WITH PSD REGULATIONS

		Annual Distance Within Which Predicted Concentrations Are Greater Than The Increment (Miles)					24-Hour Distance Within Which Predicted Concentrations Are Greater Than The Increment (Miles)			
Area Classification	Increment ($\mu g/m^3$)	1980	1985	1990	End of Mine Life	Increment ($\mu g/m^3$)	1980	1985	1990	End of Mine Life
II	19	2.5	2	2	3	37	7	5.5	6	5.5

Source: ERT 1978b.

Table SH3-2C

ACROSS PLUME VISIBILITY DEGRADATION FOR THE PROPOSED SOUTH HAYSTACK MINE

	Mass Fraction		Visibility Downwind					
			Background 40 Miles			Background 7 Miles		
Year	Coal	Soil	1 Mile	5 Miles	10 Miles	1 Mile	5 Miles	10 Miles
1980	6	94	39.5	39.7	39.8	6.9	6.9	7.0
1985	13	87	39.4	39.7	39.8	6.9	6.9	7.0
1990	13	87	39.3	39.7	39.8	6.9	6.9	7.0
End of Mine Life	12	88	39.4	39.8	39.8	6.9	6.9	7.0

Source: 1978b.

IMPACTS OF THE PROPOSAL

GEOLOGY

Paleontology

Impacts to paleontological resources would consist of losses of plant and invertebrate fossil materials for scientific research; public education (interpretative programs); and to other values. Losses would result from destruction, disturbance, or removal of fossil materials as a result of coal mining activities, unauthorized collection, and vandalism.

A beneficial impact of development would be the exposure of fossil materials for scientific examination and collection which otherwise may never occur except as a result of overburden clearance, exposure of rock strata, and mineral excavation.

Fossil materials of Paleocene and Cretaceous age in the Adaville, Evanston, and Hilliard Shale Formations would be impacted to variable degrees.

All exposed fossilferous formations could also be affected by increased unauthorized fossil collecting and vandalism as a result of increased population. The extent of this impact cannot be presently assessed due to a general lack of specific data on such activities.

Due to the present lack of data and accepted evaluatory criteria for determination of significance, no meaningful assessment can be presently made as to the extent and nature of the loss of these paleontological values to science or education, or hence to the significance of potential impacts on the fossil record.

Geologic Hazards

Because the topography of the natural slopes shows no evidence of previous sliding, the landslide potential is thought to be minimal, even though the landslide susceptibility of the rock and earth material is estimated to be high (Radbruch-Hall et al. 1976). If slopes were oversteepened, however, some caving or sliding could occur during periods of thawing or heavy rain. In order to insure against this potential hazard, the stability of the pit walls, based on geologic and hydrologic data collected on the proposed project area, is being assessed by the mining company as part of an intensive geotechnical study of the proposed pit design.

As presently planned, reservoir number 1 would be located on Meadow Draw immediately to the west of the highwall of Pit 1. Seepage from this water body into the rock and earth materials composing the highwall could lead to caving or sliding. A diversion ditch that would run from Meadow Draw to Haystack Draw along the top of the highwall could have a similar effect.

Where the seams are exposed by mining, zones of burning coal could occur.

The lands are in an area of low seismic activity so the probability of damage resulting from earthquake activity is slight.

TOPOGRAPHY

The total acreage that would be disturbed by the proposed mining and by all other related activities through 1990 would be 2,273 acres. Through the end of mine life this total would be 2,720 acres. Disturbance caused by activities other than the actual mining and deposition of spoil piles, such as the building of roads, railroads, and mine facilities, would have no significant lasting impact upon the topography.

The total acreage that would be disturbed by the actual mining and deposition of spoil piles would be 419 acres through 1980, 1,150 acres through 1985, 1,304 acres through 1990, and 1,745 acres by the end of mine life.

In the area mined, all the lesser topographic expression would be obliterated leaving a relatively smooth surface. The surface of the north-facing slope of Haystack Draw would be, in places, as much as 60 feet higher than the original surface. On the south-facing slope of Haystack Draw a small tributary draw would be filled with spoil to an elevation as much as 160 feet higher than that of the original surface.

To the north of Haystack Draw, the surface of the north-facing slope of Meadow Draw would be, in places, as much as 60 feet lower than the original surface.

North of Meadow Draw, a north-south trending valley (centered in Section 30, T. 17 N., R. 117 W.) that would be approximately 1 mile long and one-half mile wide at its widest point would be created. The bottom of this valley would be as much as 170 feet lower than the original surface. To the east of the valley, the eastern half of Section 29 would be buried with spoil that in places would be as much as 100 feet deep.

By 1980, 129 acres would be disturbed by the construction of haul roads and 250 acres by the construction of a railroad loop and spur. These would remain throughout the lifetime of the mine and their presence might cause gullying as a result of the possible channelization of drainage water. Such gullying, if it occurred, would not constitute a significant impact upon the topography.

By 1980, 288 acres would be disturbed by the burial of power and telephone lines. This might lead to an insignificant amount of gullying as a result of the loosening of the earth and rock material.

By 1980, 1985, 1990, and the end of mine life, 61, 64, 92, and 98 acres, respectively, would be disturbed by the construction of dams and ditches. The impact upon the topography of this construction would not be significant.

The principle watercourses in the project area would remain in their present locations and, in most places, would not be significantly disturbed. At one point on Meadow Draw the stream bed would be left at a level 25 feet lower than at present. Subsequent to the end of mine life the stream would deposit earth materials along the reach that includes this point until it had restored its bed to its approximate original profile. Neither the lowering nor the subsequent natural restoration of the stream bed would constitute a significant impact upon the drainage.

The effects of topographic changes on the drainage of the project area are discussed more fully in the Water Resources section.

SOILS

Mining would result in the disturbance and mixing of soil on areas proposed for mine pits and spoil storage sites (1,745 acres by end of mine life). (Table SH2-5A presents soils that would be affected.) The removal, transporting, and stockpiling of topsoil would destroy natural soil structure and would result in a mixing of the various soil textures. The removal of soil too deep in some areas by scrapers would result in mixing topsoil with underlying subsoil high in soluble salts. This would result in topsoil contamination. Also, the stockpiling process would eliminate a majority of the soil biota populations on those soils stockpiled. This loss in soil biota would result from the scraping process and the lack of sufficient oxygen supply when they become buried too deep in the stockpile to live (Brock 1966). The cumulative result of the above would be a short-term reduction in soil productivity when the topsoil is used for preparation of a seedbed.

Approximately 353 million loose cubic yards of overburden including lower soil horizons would be moved and disturbed during the 22-year life of the mine. This would result in destruction of the established subsoil horizon/parent material relationships. An average of 79 acres of soil surface would be disturbed yearly during the life of the mine. An accelerated rate of water erosion would occur on these disturbed areas; however, designed drainageways and settling ponds would hold the generated sediment on the project area during normal rainfall years.

An accelerated rate of wind erosion would occur on areas disturbed and being reclaimed (vegetative cover removed and not reestablished). The amount of soil lost yearly (entering atmosphere) over the average area disturbed and being reclaimed would be 320 tons per year, which is an increase of 260 tons per year over that of the area prior to mining.

If a 10-, 25-, 50-, or 100-year flood were to occur when areas are in the process of being reclaimed, an accelerated rate of erosion would occur over the amount that would occur normally. This would result in large amounts of soil loss and the occurrence of one of these floods during reclamation could considerably lengthen the time required for vegetation reestablishment.

After reshaping the land surface during reclamation, soil would be exposed to water action at an accelerated rate until a vegetative cover could be reestablished. The rate of water erosion on the areas with recent respread topsoil would be approximately 10.5 tons per acre per year (calculated using Musgrave's Equation, BLM Manual 7317.22A). This is an increase of 3 tons per acre per year over the area as it exists prior to mining. A portion of this soil would be lost for the production of vegetation during reclamation. The amount of soil erosion would decrease as vegetation became established. With reclamation activity (machinery traffic), some soil compaction would occur resulting in less water infiltration and, therefore, a decrease in soil productivity on those compacted areas undergoing reclamation.

During reclamation, topsoil would be evenly spread over the disturbed areas prior to revegetation. Thus, areas deficient in topsoil prior to mining would gain topsoil from sources with a surplus. The result would be some increase in soil productivity in these deficient areas. However, the increase in productivity in these localized areas would not be significant in relation to the reduction of soil productivity on the major portions of disturbed acreage.

The construction of mine facilities, roads, rail spur, water control structures, and topsoil storage areas would require approximately 687 acres both within and outside of the project area by the end of mine life. The soil required for the above construction would be removed from vegetative production for the life of the mine. Therefore, soil productivity of these areas would be temporarily lost until the end of mining. At the conclusion of mining these areas would undergo reclamation, and, since soil disturbance would be minor, original productivity should be readily attained. Population increase due to mining would result in the removal of approximately 100 acres of soil surface from production as a result of the construction of housing and support facilities.

The overall result of the mining action would be a short-term lowering of soil productivity on approximately 1,745 acres associated with mine pits and spoil storage sites. Soil productivity would be lowered on 419 acres by 1980, 1,150 acres by 1985, and on 1,304 acres by 1990 due to compaction, soil loss, topsoil contamination, destruction of soil structure, and a loss of soil biota. The temporary lowering of soil productivity would affect reclamation of mined lands (see Vegetation section).

WATER RESOURCES

Ground Water

Layered discontinuous sandstones and the layered coals within the Adaville Formation yield and store water that would drain into the pits as the coal is removed. Highwall and footwall stability may be a problem because of artesian pressures that would be encountered during excavation. Estimates of permeability based on instantaneous recharge tests in wells (Lohman 1972) indicate that the permeability of the coal averages 1.4×10^{-1} feet per day, the sandstone and siltstone averages 2.8×10^{-2} feet per day and the mudstone is 2.8×10^{-5} feet per day. The coal seams are about 5 times more permeable than the sandstone and siltstone. The siltstone and mudstone probably act as effective confining layers separating the more permeable coal aquifers; thus each coal seam acts as a separate aquifer. If the hydraulic head on a 1,000 foot long cutface of seams 5 and 6, which are about 42 feet thick, is reduced 250 feet, the discharge at the end of 1 day would be 16,000 gallons per day (gpd) and at the end of 1 year should be about 870 gpd (Lohman 1972). Estimated drawdown in this coal aquifer would be about 230 feet at the end of 1 year at 1,000 feet from the highwall and about 158 feet at 5,000 feet from the highwall. There are no nearby wells to be affected by this drawdown. Ground water discharge into the mines, though small, would lower the water table in the Adaville Formation. Though it is relatively simple to estimate drawdown in a single aquifer such as a coal seam; the alternately layered sequence of saturated rocks of widely ranging permeabilities and varying degrees of interconnection, or lack of it, comprising the Adaville, as well as the geologic structure in the vicinity of the mining area, combine to make the calculation of the drawdown in the whole system extremely complex and uncertain. However, no wells tap the Adaville near the mine so there would be minimal impact to the ground water system by the proposed mining operation. The two springs located near the pit may stop flowing during the mining operation. Whether or not their flow is restored after reclamation depends on whether or not the water table is completely recovered.

Surface Water

Four drainages cross the area and are tributary to Albert Creek. They are, in upstream order, Clear Creek, which is joined by Shurtleff Creek about three-fourths mile northeast of Round Mountain, an unnamed draw south of Clear Creek, Meadow Draw, and Haystack Draw. The drainage area, estimated average annual discharge, and estimated peak flows for stated recurrence intervals are shown in Table SH3-6A. These peak flow estimates are calculated using Lowham (1976). Patterson and Sommers (1966) data, as used in the mining and reclamation plan, yield estimates that are too low and will result in underdesigned channels, dams, and sediment ponds. Mining activities would cause the alteration of existing drainage patterns in mining or reclaimed areas. Original drainage can only be approximately restored. Seepage losses from streams may increase where restored drainages cross the reclaimed pit area. Such losses from surface flow would help restore the water table in the old pit area.

Storm runoff from the areas of spoil and topsoil piles during mining would result in rapid erosion and sediment transport to the creeks. If the sediment supply is in excess of the streams carrying power, the excess would be deposited in the channels resulting in aggrading and consequent altering of the streams' flow characteristic and its ability to support aquatic life. Data are insufficient to estimate the extent of these changes.

Approximately 3.2 square miles would be disturbed or altered over the life of the mine. In any event, sediment discharge from the area would be increased and runoff characteristics would be altered. Unquantifiable impacts from the proposed mining could occur to the drainages, including Albert Creek, believed to be an alluvial valley floor. According to 30 CFR 715.17(j)(2), "Surface coal mining operations located west of the 100th meridian west longitude shall not interrupt, discontinue, or preclude farming on alluvial valley floors and shall not materially damage the quantity or quality of surface or ground water that supplies these valley floors . . ."

Water Use

During the first year of operation, coal production would be 1.5 million tons per year, after which it would range from 2.5 to 3.5 million tons per year for the 22-year life of the mine. Assuming 50.4 acre-feet per year per million tons of coal mined, water use would range from 126 to 176 acre-feet per year.

VEGETATION

Terrestrial

The proposed South Haystack mining operation would remove native vegetation from about 2,720 acres. Sagebrush communities occur on about 66% (1,795 acres) of the areas proposed for disturbance. Saltbush (17%, 462 acres), grassland (6%, 163 acres), mountain shrub and greasewood (each 4% and 109 acres), and barren (3%, 82 acres) are other types which would be disturbed.

About 1,325, 2,091, 2,273, and 2,720 acres would be disturbed at the benchmark dates of 1980, 1985, 1990, and 2001 (end of mine life), respectively. Acreages reclaimed at the same benchmark dates would be approximately 0, 387, 1,011, and 2,544, respectively. An average of 124 acres would be disturbed annually. Disturbed areas would range in area from about 47 acres to 1,340 acres (see Map SH1-2, Mining Sequence).

Some changes in drainages would occur as the result of mining. Overall changes in plant species composition and production would probably be minimal due to the intermittant nature of affected drainages.

Population increases due to mining would result in an estimated loss of about 100 acres of vegetation for housing and support facilities, primarily adjoining existing municipalities. Increased numbers of people in the area would result in additional disturbance of native vegetation, particularly by off-road vehicle use (see Recreational Resources section).

The revegetation of disturbed areas would be difficult due to many factors. Climatic conditions are severe with extremely low and high temperatures; strong winds; and low, erratic precipitation. Moisture would probably be the most limiting factor (May 1975 and Cook, Hyde, and Sims 1974), with average annual precipitation of the area estimated to be about 9 inches (see Climate section). Other factors which could hinder revegetation are less than ideal soil properties (see Soils section), competition for moisture and nutrients from undesirable weedy plant species (May 1975), steep slopes, and the loss of seeds and destruction of seedlings by small mammals (Thames ed. 1977).

Table SH3-6A

FLOW FREQUENCY CHARACTERISTICS OF FIVE STREAMS IN THE SOUTH HAYSTACK MINING AREA

	Drainage Area In Square Miles	Estimated Average Annual Discharge CFS	Estimated Peak Flows for Recurrence Intervals Of (in CFS, Rounded to Two Significant Figures)					
			2 Years	5 Years	10 Years	25 Years	50 Years	100 Years
Albert Creek	175	3.9	400	890	1,400	2,200	3,000	3,900
Clear and Shurtleff Creeks at their confluence	55	1.5	260	590	930	1,500	2,700	2,700
Haystack Draw	10	0.8	140	330	520	870	1,200	1,600
Unnamed Draw South of Clear Creek	6	0.7	110	270	440	730	1,000	1,400
Meadow Draw	5	0.65	100	260	410	690	960	1,300

Note: After Lowham (1976).

CFS = cubic feet per second

Despite such problems, successful reclamation appears to have been achieved in the ES region along highway rights-of-way and on areas disturbed by oil and gas activities. Published reclamation research concerning these sites, however, is apparently not available. Natural plant succession is also in evidence on many of these sites, with the rate and extent of succession depending on site characteristics. Hodder (Thames ed. 1977), in discussing highway and mined land reclamation, considered the problems in reclaiming these types of disturbance similar in many respects and dissimilar in others. One major difference expressed was that mined spoils may be manipulated (i.e., farmed, etc.), while roadside problem materials must be accepted as they exist.

Revegetation research in the arid southwestern United States indicates that the reclamation of coal and copper mined lands is possible under extremely harsh environmental conditions (Aldon 1978; Bengson 1977; Aldon and Springfield and DeRemer and Bach (Thames ed. 1977)).

Reclamation activities are being conducted at two active surface coal mines in the region. Seeding operations began in 1972 at the Kemmerer Coal Mine, located about 4 miles southwest of Kemmerer, Wyoming. Only 46 acres of 376 acres seeded through 1977 have received topsoil treatment (Kemmerer Coal Company 1977). This situation exists because early mining reclamation laws did not require topsoiling of mine spoils. May et al. (1971) found spoil materials at the Kemmerer Mine to be extremely variable in some properties. Values for pH ranged from 2.2 to 7.3. Some spots were high in aluminum content and extremely low in pH. The most common soil textures found were clay loams and clays. Clay soils are difficult to work into a proper seedbed and are known for poor water infiltration properties (Cook, Hyde, and Sims 1974).

The initial seeding of disturbed lands at the Jim Bridger Mine, located about 35 miles northeast of Rock Springs, Wyoming, was in 1975 (personal communication, Harley Meuret, Jim Bridger Coal Company, 1978). Topsoil has been applied to all lands being reclaimed as required by current state and federal laws. About 246 acres have been graded, topsoiled, and seeded through 1977 (Bridger Coal Company 1978).

Supplemental irrigation is being experimented with at both mines. This practice is considered essential, or probably essential, by some reclamation authorities for reclaiming mined lands in areas having low and erratic precipitation (DeRemer and Bach and Aldon and Springfield (Thames ed. 1977)). Both mining companies have in recent years adopted the use of rangeland drills for seeding operations. Drilled seeding is generally considered superior to broadcast seeding, particularly on areas where a good seedbed can be prepared (Vories ed. 1976 and Thames ed. 1977). The use of topsoil, with some reservations, is also recognized as a beneficial treatment in achieving revegetation (Vories ed. 1976 and Thames ed. 1977). In view of the topsoiling deficiencies at the Kemmerer Mine, the early seeding methods employed at both mines, and the short time lapse between the present time and the initial seeding conducted at the Jim Bridger Mine, it is understandable that large scale reclamation has not been achieved at either mine.

A review of current mined-land reclamation literature and analysis of resources available for reclamation indicate that the methods and procedures proposed in the South Haystack mining and reclamation plan (subject to compliance with SMCRA) would result in the successful reclamation of disturbed lands. However, since conclusive site-specific reclamation success data are unavailable and since reclamation success is dependent on site-specific conditions and the solving of problems either identified or yet to be identified, a reclamation alternative is presented in Chapter 8. This alternative identifies a procedure to prove the feasibility of on-site reclamation. An estimated 9 years would be required to reclaim mined areas and 8 years for other disturbed sites. The reclamation time estimates are based on revegetation results on semiarid to arid mined lands (Aldon 1978; Bengson 1977; Aldon and Springfield and DeRemer and Bach (Thames ed. 1977)) and on the recommended need for plants to be protected from extensive grazing during establishment (Cook, Hyde, and Sims 1974). It is assumed that supplemental irrigation would be employed when necessary to achieve seed germination and seedling establishment. Without irrigation, reclamation would be delayed during years when soil moisture is inadequate.

The achievement of reclamation earlier or later than estimated would lessen or increase impacts to living organisms and their non-living environment due to the loss of vegetative cover and production (see Air Quality, Soils, Fish and Wildlife, Agriculture, and Water Resources sections).

Based on the proposed South Haystack seeding mixtures, reclaimed areas would have a general appearance of grassland. Grasses would be the most common forage class, with shrubs and forbs being reduced in density and cover as compared to premined conditions.

Natural plant succession would occur on reclaimed lands and could restore approximate premined plant cover and composition values in an estimated 30 to 50 years as suggested by Cook (Vories ed. 1976).

Aquatic

Sufficient information is not available to determine if there would be any impact to the few species of algae and other aquatic vegetation present in seasonal drainages.

Endangered and (or) Threatened

A survey of the project area revealed no plants proposed for endangered and (or) threatened status (Dorn 1977). Formal consultation under Section 7 of the Endangered Species Act of 1973 was initiated with the U.S. Fish and Wildlife Service on March 2, 1978.

The U.S. Fish and Wildlife Service responded by letter dated 7 March 1978 that formal consultation cannot be conducted for unlisted species.

FISH AND WILDLIFE

General Information

Impacts of the proposed action upon fish and wildlife resources are summarized in Tables SH3-8A, SH3-8B, SH3-8C. Impacts can be categorized into three general types: (1) loss of fish and wildlife habitat, (2) loss of the carrying capacity of that habitat to sustain fish and wildlife populations, and (3) loss of the fish and wildlife populations and their progeny (offspring) over the period of mining and reclamation.

The proposed mining operation would remove wildlife habitat from about 2,638 acres. Disturbance to sagebrush, saltbush, grassland, mountain shrub, and greasewood would be 1,795, 462, 163, 109, and 109 acres, respectively. There would be no disturbance to the juniper type.

Habitat Losses

The proposed mining operation would result in both direct and indirect losses to wildlife habitat. Direct losses would include that habitat physically disturbed by mining and related activities. Indirect losses would be that area (area of influence) that would be indirectly lost or affected. This "area of influence"would be indirectly lost or affected because of the fact that all living organisms to some degree exhibit a home range or territory and daily or seasonal migration. Hence, if an organism is impacted upon part of that home range or territory, the remaining part of that home range or territory is also impacted to a certain degree. This degree of impact can range from a slight impact of 10% to 20%, or to a total impact of 100%, depending upon the individual or species. This area of indirect loss or adversely affected fish and wildlife habitat would range in size from an area equal to the habitat loss for such species as a leopard frog to four or five times the area directly affected for such species as the golden eagle. Anticipated acreage loss in this area of influence is summarized in Table SH3-8B. Habitat losses for specific seasonal range for the major game species are summarized in Table SH3-8D.

Reclamation would have varying degrees of effectiveness to wildlife depending on the wildlife species involved, the plant species used, and the success of revegetation. Reclamation, however, would be difficult in southwestern Wyoming because of soil and climatic conditions (see South Haystack and Regional Vegetation sections and Regional Wildlife discussion of reclamation). Since quantification of the effectiveness of reclamation to wildlife is not possible with current available information, the numbers representing habitat and population losses do not reflect any post-reclamation return of either one.

Carrying Capacity Losses

As a result of the loss of the fish and wildlife habitat (vegetation and living space), there would exist a loss of that area's ability to support fish and wildlife population. This ability to support fish and wildlife population is known as its "carrying capacity" The loss of this carrying capacity would range from 1,321 acres (area directly affected) in 1980 to 12,240 acres (area of influence) by end of mine life. The areas on which carrying capacity loss would occur are summarized in Table SH3-8B.

Fish and Wildlife Population Loss

Introduction

There would be a loss of wildlife populations within the area to be disturbed. For example, if there are five animals per acre in a given area, and 1,000 acres of that area are disturbed; loss to that population would be 5,000 individuals. In addition, there would be a loss of the populations progeny (offspring) over the period of disturbance. See Fish and Wildlife Loss, Chapter 4, Regional, for an explanation of the method used to calculate total population losses.

When estimating losses to the wildlife resource, it was assumed that all habitat would be at carrying capacity for the particular species being discussed. This would not necessarily be the case, and it is realized that possibly not all the wildlife occupying an area to be disturbed would be lost. However, definitive data concerning habitat condition and trend in and around proposed project areas were not available; therefore, projections as to the survival of displaced animals were not made.

Fishery

Nongame. No loss to nongame fish is anticipated.

Game. No loss to game fish is anticipated.

Endangered and (or) Threatened. It is not anticipated that there would be any adverse impacts to endangered and (or) threatened fish species.

Wildlife

Birds.

Nongame. The primary small nongame bird species impacted would be horned lark, sage thrasher, western meadowlark, Brewer's blackbird, vesper sparrow, sage sparrow, and Brewer's sparrow.

Based upon breeding bird surveys conducted by the Wyoming Game and Fish Department, the best population estimate currently available is 20 birds per square mile. Using the formula for biotic potential, the proposed mine would account for the loss of an estimated 1,800, 8,900, 16,600, and 35,000 birds by 1980, 1985, 1990, and end of mine life, respectively. These figures represent a minute percentage of the total population of small nongame birds in the region.

There would be a loss of five raptor nests. Of the five nests, one would be physically eliminated and four, one

Table SH3-8A

SUMMARY OF IMPACTS ON FISH AND WILDLIFE RESOURCES ON THE PROPOSED SOUTH HAYSTACK PROJECT AREA

Classification of Impacts	Anticipated Impact of Proposed Mine: None	Minor	Major
Fish and wildlife habitat			x
Carrying capacity for fish and wildlife			x
Fish and wildlife populations			
Fishery			
Nongame	x		
Game	x		
Endangered and (or) threatened species	x		
Wildlife			
Birds			
Nongame			x
Game			x
Endangered and (or) threatened species	x		
Mammals			
Nongame			x
Game			x
Endangered and (or) threatened species	x		
Reptiles and amphibians			
General			x
Endangered and (or) threatened species	x		

Table SH3-8B

SUMMARY OF FISH AND WILDLIFE AREA IMPACTED BY THE PROPOSED SOUTH HAYSTACK MINE

	Direct Loss (acres)[1]	Indirect Loss or Adversely Affected Area (acres)[2]
Fish and wildlife habitat		
1980	1,325	5,693
1985	2,091	9,409
1990	2,273	10,228
End of mine life	2,720	12,240
Area of fish and wildlife carrying capacity affected		
1980	1,325	5,692
1985	2,091	9,409
1990	2,273	10,228
End of mine life	2,720	12,240
Area in which fish and wildlife populations would be affected		
1980	1,325	5,692
1985	2,091	9,409
1990	2,273	10,228
End of mine life	2,720	12,240

[1] Total (100%) affected.
[2] Data are insufficient at this time to determine the degree to which these areas (areas of influence) would be affected. It may be only slightly (10%-20%) or totally (100%), depending upon the individual species involved.

Table SH3-8C

SUMMARY OF ESTIMATED WILDLIFE POPULATION LOSSES

	Estimated Number of Individuals Directly Lost to Proposed Action				
	1980	1985	1990	Mine Life	% of Population[2]
Wildlife					
Birds					
Nongame[1]	1.8T	8.9T	16.6T	35T	<1%
Raptors	---	---	---	500	<1%
Game	1.4T	4.4T	7.4T	13.5T	20%
Mammals					
Nongame	482T	1.903M	2.1M	4.95M	<1%
Game	---	---	---	---	
Mule deer	75	185	300	550	1%
Antelope	75	185	300	550	3%
Reptiles and amphibians	11T	28T	30.3T	50T	<1%

Note: All estimates are for the total population, including the progeny that would have been produced.

[1]All nongame birds except raptors.
[2]These percent figures represent the amount of regional or herd/management unit populations that will be lost by end of mine life. Percent figures that are underlined are based on herd or management unit populations.
T = Thousands
M = Millions

Table SH3-8D

WILDLIFE HABITAT DISTURBANCE

Species and Habitat	Acres Impact by Time Periods 1980	1985	1990	End of Mine Life	% of Available Range
Sage grouse:					
Yearlong	1,325	2,091	2,273	2,720	.4%
Crucial nesting	1,325	2,091	2,273	2,720	20%
Pronghorn antelope;					
Summer	1,325	2,091	2,273	2,720	3%
Mule deer:					
Yearlong/winter	1,325	2,091	2,273	2,720	1%

Note: The percent figures represent the amount of range the disturbance would remove by the end of mine life from the total range now available. In some cases, it was more practical to calculate percentages based on herd or management units rather than on a regional basis. These figures are underlined.

of which is an eagle nest, would be eliminated through disturbance because of their close proximity to mining. The five nests would have the potential to produce an estimated twelve birds in a given year. Over the life of the mine (22 years), these nests would have produced an estimated 500 birds.

Game. Sage grouse would be the only game bird significantly impacted by the proposed mine. There would be a loss of 1,325, 2,091, 2,273, and 2,720 acres of sage grouse crucial-nesting and brood-rearing habitat by 1980, 1985, 1990, and end of mine life, respectively. It is not known what percentage this lost habitat is in relation to the total crucial habitat within the Uinta Management Unit; however, it is 0.4% of the total habitat available. The proposed mining operation would also eliminate two major strutting grounds, with an estimated 100 males using one and 200 males using the other. Assuming an average of three females per male, sage grouse losses from the strutting grounds and surrounding crucial nesting habitat would be estimated at 800 birds by 1980. Total losses, including progeny, would be estimated at 1,400, 4,400, 7,400, and 13,500 birds by 1980, 1985, 1990, and end of mine life, respectively. The end of mine life figure represents about 20% of the production of the total population of sage grouse within bird management section 05 of the Uinta Management Unit.

Endangered and (or) Threatened. At this time and with current information it is not anticipated that there would occur any adverse impact to any endangered and (or) threatened bird species.

Mammals.

Nongame. The primary small nongame species affected would be whitetail prairie dog, Uinta ground squirrel, least chipmunk, Great Basin pocket mouse, northern grasshopper mouse, longtail vole, and deer mouse. The best population density estimates available indicate about 5 individuals per acre in the sagebrush type, about 2.5 per acre in the grass type, about 0.5 per acre in the saltbush type and about 1.5 per acre in the greasewood type (Maxell 1973). No information is available for the mountain shrub type so an average of 2.5 per acre will be used for purposes of calculating losses. Using the formula for biotic potential, the proposed mine would account for the loss of an estimated 482,000, 1,903,000, 2,100,000, and 4,950,000 by 1980, 1985, 1990, and end of mine life, respectively. Although these figures seem large, they are only a minute percentage of the total production of small mammal populations within the region. In addition, it is realized that small mammal populations do fluctuate greatly and that losses would vary accordingly. However, habitat disturbance would remove the areas' ability to produce that peak population until reclamation is successful.

Game. proposed mine would disturb 1,325, 2,091, 2,273, and 2,720 acres of antelope summer range by 1980, 1985, 1990, and end of mine life, respectively. The end of mine life figure represents about 0.6% of the total summer range available in the Carter Lease Herd Unit. Antelope losses would be identical to mule deer losses since the area supports about 75 antelope and the annual increment is also 30%. Estimated losses for antelope, therefore, would be 75, 185, 300, and 550 animals by 1980, 1985, 1990, and end of mine life, respectively. The end of mine life figure represents about 3% of the production of the total population in the herd unit at that time. Probably some of these animals would be displaced rather than lost, but the area's ability to support that maximum observed population would be removed.

The proposed mine would eliminate 1,325, 2,091, 2,273, and 2,720 acres of mule deer winter/yearlong range by 1980, 1985, 1990, and end of mine life, respectively. The end of mine life figure represents about 0.9% of the total winter/yearlong range available in the Carter Lease Herd Unit. It is estimated that the 75 deer that usually inhabit the area would be lost by 1980. Assuming an annual increment of 30%, the total number of deer lost by 1985, 1990, and end of mine life would be estimated at 185, 300, and 550 animals, respectively. These figures include the number of progeny that would have been produced had mining not taken place. The end of mine life figure represents about 1% of the production of the total population in the herd unit at that time. There would be a disruption of the migration route in the south one-half of the permit area. Although some deer would be lost, it is anticipated that the animals would eventually go around the permit area.

Endangered and (or) Threatened. At this time and with current information, it is not anticipated that there would occur any adverse impact to any endangered and (or) threatened mammal species. However, in accordance with Section 7 of the Endangered Species Act of 1973, the BLM has officially requested formal consultation with the U.S. Fish and Wildlife Service by letter dated 2 March 1978. The only endangered mammal species for which consultation is presently being conducted is the black-footed ferret. Under Section 7 of the Endangered Species Act of 1973, the Secretary of the Interior will grant no approval which would jeopardize the continued existence of any endangered and (or) threatened species or result in the destruction or modification of their critical habitat.

The U.S. Fish and Wildlife Service, Denver Research Center, under contract to the BLM Wyoming State Office began an intensive black-footed ferret survey in the South Haystack Mine area in July of 1978. The results of this survey are anticipated in October of 1978.

Reptiles and Amphibians.

General. The primary reptile and amphibian species that would be impacted are leopard frog, tiger salamander, northern short-horned lizard, northern sagebrush lizard, and wandering garter snake.

The best density estimates currently available are an average of five individuals per acre on all habitat types found on the proposed permit area (personal communication, Dr. George Baxter, January 1978). Using this assumption, it is estimated that 11,000, 28,000, 30,300, and 50,000 individuals would be lost by 1980, 1985, 1990, and end of mine life, respectively. These figures include the progeny which would have been produced had mining not taken place.

Endangered and (or) Threatened. No adverse impact is anticipated to any endangered and (or) threatened reptile or amphibian species.

Wild Horses

No impacts to wild horses are anticipated.

CULTURAL RESOURCES

Impacts to cultural resources would include (1) destruction or alteration of all or part of a property; (2) isolation from or alteration of its surrounding environment; and (3) introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting (36 CFR 800.9). These impacts may take place to both archeological and historical sites in the region.

The loss of cultural resource sites and the data contained therein would be a direct result of their physical destruction through land modification required in mining and associated surface facilities, such as access roads, rail spurs, and power lines. Site destruction could also occur through development-related events, such as increased population which could lead to increases in pothunting and vandalism and increased vehicular use of the land resulting in some unintentional destruction of cultural resources.

Because cultural resources are nonrenewable, the physical destruction of any cultural data or artifacts could eventually have a potentially significant impact on efforts to reconstruct the prehistory and history of the region.

Archeological

A total of 24 sites are threatened with complete physical destruction by 1990: eleven by 1980, another six by 1985, and another seven by 1990. No additional sites would be threatened through the end of mine life. The remaining fifteen known sites are threatened with possible physical destruction due to their proximity to surface disturbing activities within the project area. The significance of this loss is diminished since archeological survey and testing, which has been conducted, determined these sites ineligible for inclusion on the National Register of Historic Places according to criteria found in 36 CFR 800.10.

The potential for buried archeological sites exists within the project area. Early period and Altithermal sites would most likely have been buried by Quaternary deposits through time and, because of their scarcity, would be of particular importance. These sites are not and would not be evident before actual surface disturbance uncovered them. Testing of alluviated areas may reveal some archeological resources. Success would depend on such factors as successfully predicting areas of likely buried sites and the possibility of them being destroyed as a result of not being recognized.

It is impossible to evaluate the significance of uninventoried or buried sites. Known Early period, Altithermal period, and multi-component sites are quite rare and, therefore, would be highly significant in the region. Their loss would represent a significant impact to the prehistory of the Northwest Plains and Great Basin areas.

The increase in pothunting, arrowhead collecting, and vandalism that would result from an increase in population would affect all known and unknown resources within the region. The significance of this impact is potentially great since the kind of data removed by these activities, arrowheads and tools, are the major resources for dating and analyzing prehistoric activity.

Historical

The townsite of Cumberland may receive impacts from construction of the proposed rail spur along the old railroad bed which once serviced the town and mine of Cumberland. Potential destruction of parts of the townsite could occur causing significant impacts. Visual and audible impacts would not be expected, since the railroad was once an integral part of this community.

It is unlikely that any action would impact the Oregon Trail at Cumberland Gap, since no vestige of this trail remains for at least one mile either side of Cumberland Gap.

VISUAL RESOURCES

Visual Resource Contrast Ratings were derived for the South Haystack project area using viewpoints along Highway 189 as critical viewpoints (see Visual Resources, Chapter 2). The contrast ratings are available for review at the Rock Springs District Office of the BLM. These contrast ratings are summarized in Table SH3-10A. Further explanation of the Visual Resource Contrast Rating System (BLM Manual 6320) is available in the library of the Rock Springs District Office of the BLM.

Contrast is assessed in terms of how the proposal is expected to affect existing physical attributes, i.e., landform, vegetative patterns, and existing structures, e.g., power lines and buildings. Anticipated changes in form, line, color, and texture are analyzed individually in reference to landform, vegetative patterns, and structures. The resulting contrast ratings are compared to the maximum contrast limit for the particular visual management class indicated for the land affected by the proposal. In the case of the South Haystack Mine, two time periods were used to evaluate the contrasts caused by mining. These time periods are active mining and post reclamation.

Summary of Visual Contrast Ratings (Table SH3-10A)

Viewpoints from A to B

No mining or surface activities would be visible from these viewpoints.

Viewpoint C

From this viewpoint the mining activities and surface facilities would be visible. Visible would be the spoil piles, pit head walls, buildings, roads, railroad spur, conveyor system, and crusher facilities. These activities would create strong contrasts which would not meet the management quality objectives for the area as long as the mine is in operation. However, with successful reclamation they would meet the objectives. An overall change would take place in the basic landscape character, from natural to an area characterized by past strip mining operations. This could change the visual management class from a Class III to a temporary Class V for the area. Upon successful revegetation, the area would change back to a Class III.

Viewpoints from D to H and J

The mining activities would not be seen from this stretch of road; however, the railroad spur would be next to the road and would cause a visual impact. This impact would meet the BLM visual class objectives for this area.

Viewpoints I and K

The mining activities would be quite visible from these two viewpoints. Seen would be the spoil piles, pit headwalls, and topsoil piles. These operations would create strong contrasts which would not meet the visual management objectives for the area. The mining activities would change the landscape character and would be noticeable from the highway. These post-reclamation changes would meet the BLM visual management objectives; however, there would be a change in visual management class from a Class III to a temporary Class V. After successful revegetation, the area would return to a Class III. The railroad would also be visible here but would meet the BLM visual management objectives.

RECREATIONAL RESOURCES

Visitor Use Data

Table SH3-11A depicts estimated resident recreation visitor use demand due to coal mining. The changes are those which result from increased population which would occur in Lincoln and Uinta Counties due to the proposed South Haystack Mine.

With increased numbers of people recreating in the region, there would be conflicts between ranchers and recreationists. These conflicts would result in ranchers restricting access across their private lands. The result of the restricted access and increased use would be recreationists concentrating in areas where there are already high numbers of people. This would greatly reduce the quality of the recreational experience for all the people. In areas where people have a lower quality experience, there tends to be a high frequency of litter and vandalism. This would result in higher maintenance costs of recreational facilities.

Hunting

Adverse impacts to hunting would result due to restricted hunter access and displacement of wildlife as construction and mining destroys the habitat (see Chapter 3, Fish and Wildlife). More people recreating in the region would induce ranchers to restrict access across their private lands. The impact from animals moving out and restricted access, coupled with increased hunting demand, would result in a lower quality experience for all hunters.

Sightseeing

The construction and mining in the area would cause adverse impacts to recreational sightseeing values due to restricted access. There would be some adverse impacts to zoological sightseeing due to the displacement of wildlife species. There would be beneficial impacts for geologic and industrial interpretation as the mining operations draw persons to view the area.

AGRICULTURE

Livestock Grazing

Mining would cause a cumulative loss of animal unit months (AUMs) within three grazing allotments, the Cumberland/Uinta, Haystack Draw, and Albert Creek. Cumulative estimated losses in AUMs would be 171, 1,224, 2,169, 4,353, and 5,159 by 1980, 1985, 1990, 2001 (end of mine life), and 2010 (all lands returned to livestock grazing), respectively. The Cumberland/Uinta Allotment, with about 64,690 AUMs available annually, would lose an average of about 57 AUMs per year for 30 years (annual percentage loss about 0.1%). Mining would lower the Albert Creek Allotment carrying capacity by an average of about 58 AUMs per year for 30 years. This would represent about 1.0% of the AUMs available annually without mining or 58 of 5,400 AUMs. The losses in carrying capacity would be undesirable but

Table SH3-10A

SUMMARY OF VISUAL CONTRAST RATINGS
FOR SOUTH HAYSTACK MINE

		Activity											
		Mining						Structures					
Views from Critical Viewpoints	Visual Management Class	During Active Mining	Post Reclamation of Mining	During Active Mining	Post Reclamation of Mining	During Active Mining	Post Reclamation of Mining	Active Structures	Post Reclamation of Structures	Active Structures	Post Reclamation of Structures	Active Structures	Post Reclamation of Structures
		FEATURES BEING EVALUATED											
		Land	Land	Veg.	Veg.	Stru.	Stru.	Land	Land	Veg.	Veg.	Stru.	Stru.
A - B	III	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	III	3/22*	2/13	2/12	2/13	NA	NA	3/22	0/0	2/12	0/0	3/23	2/5
D - H	III	NS	NS	NS	NS	NS	NS	2/11	0/0	2/2	0/0	2/16	2/5
I	III	3/22	2/13	2/12	2/12	NA	NA	2/11	0/0	2/2	0/0	2/16	2/5
J	III	NS	NS	NS	NS	NS	NS	2/11	0/0	2/2	0/0	2/16	2/5
K	III	3/22	2/13	2/12	2/12	NA	NA	2/11	0/0	2/2	0/0	2/16	2/5

Visual Management Class	Maximum Acceptable Impact
Class II	2/10
Class III	2/16
Class IV	-/20

* $\frac{3}{22}$ Highest element contrast / Total score for feature

NS = Not seen from critical viewpoint.
NA = Feature not affected.

Table SH3-11A

ESTIMATED RESIDENT VISITOR DAYS DEMAND DUE TO POPULATION CHANGE
FOR YEARS 1980, 1985, AND 1990 IN LINCOLN AND UINTA COUNTIES

		1980 Population: 909[1]				1985 Population: 1,927[1]				1990 Population: 1,969[1]			
Activity	1977	Without Proposed Action	Increase Due to Proposed Action	Total Projection	% of Projection Due to Proposed Action	Without Proposed Action	Increase Due to Proposed Action	Total Projection	% of Projection Due to Proposed Action	Without Proposed Action	Increase Due to Proposed Action	Total Projection	% of Projection Due to Proposed Action
Fishing	77,900	85,800	3,870	89,670	4.3	83,700	8,350	92,050	9.1	84,800	8,620	93,420	9.2
General[2]	76,200	84,100	3,790	87,890	4.3	83,700	8,340	92,040	9.1	85,800	8,710	94,510	9.2
Hunting	24,600	26,500	1,190	27,690	4.3	25,240	2,510	27,710	9.1	25,100	2,550	27,650	9.2
Off-road vehicles[3]	3,100	3,300	150	3,450	4.3	3,200	320	3,520	9.1	3,200	320	3,520	9.1
Sightseeing	23,900	25,900	1,170	27,070	4.3	25,500	2,540	28,040	9.1	25,900	2,640	28,540	9.3
Urban	48,100	54,900	2,470	57,370	4.3	57,500	5,740	63,240	9.1	60,500	6,150	66,650	9.2
Water sports	36,000	40,300	1,820	42,120	4.3	41,100	4,090	45,190	9.1	42,700	4,340	47,040	9.2
Winter sports	9,700	11,300	510	11,810	4.3	12,300	1,230	13,530	9.1	13,100	1,330	14,430	9.2

[1]Population change due to project (from Socioeconomic Conditions section).
[2]General includes camping, picnicking, etc.
[3]Estimate by ES Team Outdoor Recreation Planner.

would probably not cause significant impacts to the 44 livestock operators licensed in the Cumberland/Uinta Allotment and the 1 operator licensed in the Albert Creek Allotment. The Haystack Draw Allotment would have the highest percentage loss of AUMs, about 9%. Of 641 AUMs available annually without mining, an average of 57 AUMs per year would be lost for 30 years. This loss of AUMs would represent about 2% of the AUMs needed to support the 1,000 sheep reportedly owned by the one operator licensed to graze livestock within the grazing allotment. Although any loss in carrying capacity would be undesirable, the loss would probably not cause a significant impact to the operator.

Federal grazing licenses would be reduced by the appropriate number of AUMs lost on public lands as the result of mining. Restoration of grazing privileges would be made upon reclamation, as it is believed that reclaimed lands would be capable of supporting premining livestock stocking rates.

The reclaimed lands, however, would require more intensive grazing management than would be needed for undisturbed rangeland (Lang, Berg, Hodder (Vories ed. 1976)).

Prime Farmland

Consultation with personnel of the U.S. Department of Agriculture, Soil Conservation Service, Rock Springs, Wyoming, revealed that prime farmland is not present in areas proposed for disturbance (see Regional ES, Chapter 9, Consultation and Coordination).

MINERAL RESOURCES

A major impact of the proposed mining operation on the mineral resources at the project area would be the removal of an estimated 26 to 29 million tons of coal from public lands.

Mining is expected to begin in 1979 at the south end of the area and to proceed northward. One and one-half million tons of coal would be mined the first year after which the recoverable reserves from public land in Section 2, T. 16 N., R. 118 W., would be removed. By the eleventh year of operation mining would have progressed northward to where it is again on public land in Section 30, T. 17 N., R. 117 W. From the eleventh to the twentieth year of the operation an estimated 24.5 to 28.5 million tons of coal would be removed from that section. By 1980 approximately 4.5 million tons of coal would have been removed. By 1985 the tonnage would have increased to approximately 19.5 million, by 1990 to approximately 34.5 million tons, and by the end of mine life to approximately 60 million tons.

The removal of this more readily recoverable coal would leave only the less accessible reserves, thus rendering those reserves less economically attractive.

An unknown quantity of coal in the overburden and (or) interburden would be lost. This coal would be in seams too thin or of too low a quality to be of economic interest.

TRANSPORTATION NETWORKS

Impacts to transportation networks in the South Haystack project area would result from: (1) transportation of coal out of and supplies into the area and (2) increased employment and population with its increased vehicles and miles traveled.

There are several light use two-track roads which pass through the area. Destruction of these roads would limit recreational access. The company has proposed haul roads, railroad spurs, and a power line to pass through the South Haystack Mine area.

Transportation of coal out of the region would be by railroad. The proposed South Haystack Mine would add to the railroad traffic 150 loaded trains per year west by 1980 and 300 loaded trains by 1985 and 1990. Table SH3-14A depicts the impact on segments of rail line.

There would be a need to construct approximately 25 miles of railroad track (right-of-way is being applied for by the Union Pacific Railroad). During construction, one crossing would cause delays in travel time for people using Highway 189. During use, this crossing would create delays in travel time and would increase the chance of train/car accidents.

This railroad spur would also cross numerous unimproved and graded dirt roads and many lesser roads which are lightly used.

The shipment of supplies by truck would add to the already overcrowded conditions on the highway and streets in the Kemmerer/Diamondville and Evanston areas. It is estimated that vehicle license tab sales in Lincoln and Uinta Counties due to the South Haystack Mine would increase by 1,000 from 1978 to 1980, 2,100 during the 1980 to 1985 time period, and then to 2,200 and remain steady at this rate from 1985 to the end of mine life (Table SH3-14B). More people using private roads crossing ranches in the region may induce ranchers to close their private roads.

SOCIOECONOMIC CONDITIONS

The primary socioeconomic impacts of the South Haystack Mine would be associated with increases in population, employment, and income.

Population

The populations of both Lincoln (that portion in the ES region) and Uinta Counties would increase because of the new jobs made available by the construction and operation of this mine and the induced employment that would result. As shown on Table SH3-15A, the populations of Lincoln and Uinta Counties would reach 7,296 and 14,041, respectively, by 1990. The South Haystack Mine would cause 1,906 of Uinta County's 1990 total; the

Table SH3-14A

ESTIMATED TRAIN VOLUME INCREASES ON TRACK SEGMENTS OF THE UNION PACIFIC RAILROAD IN AVERAGE TRAINS PER DAY

			1980				1985				1990			
Segment	Estimated[1] Capacity	Current[1,2] Traffic	Projected[4] Volume w/o Coal	Total[1] Number Coal Training	Coal Trains[4] due to P.A.	Total Volume	Projected[4] Volume w/o Coal	Total[1] Number Coal Training	Coal Trains[4] due to P.A.	Total Volume	Projected[4] Volume w/o Coal	Total[1] Number Coal Training	Coal Trains[4] due to P.A.	Total Volume
Kemmerer to McCammon	25-30	13	14	1.4	0.8	14.8	16	2.8	1.6	17.6	19	4.0	1.6	20.6
McCammon to Pocatello	25-30	15	16	2.8	0.8	16.8	19	5.8	1.6	20.6	22	9.4	1.6	23.6

[1] Union Pacific Railroad Company 1978.
[2] Through freight only.
[3] Abt Associates 1978.
[4] Estimates by ES team.

Table SH3-14B

ESTIMATED VEHICLE LICENSE TAB SALES

	1976	1978-1980	1980-1985	1985-EML
Sales without proposed action	20,800	22,500	21,600	21,600
Sales due to proposed action	N/A	1,000	2,100	2,200
Sales with proposed action	N/A	23,500	23,700	23,800

N/A = Not applicable
EML = End of mine life

Table SH3-15A

(1) PROJECTED POPULATION: LINCOLN AND UINTA COUNTIES

	1977 Estimated Population	1980 Population Projection Without Proposed Action	1980 Population Projection With Proposed Action	1980 Cumulative Impact	1980 Impact of Proposed Action	1985 Population Projection Without Proposed Action	1985 Population Projection With Proposed Action	1985 Cumulative Impact	1985 Impact of Proposed Action	1990 Population Projection Without Proposed Action	1990 Population Projection With Proposed Action	1990 Cumulative Impact	1990 Impact of Proposed Action
Lincoln County	7,132	7,799	7,816	684	17	7,120	7,129	-3	9	7,233	7,296	164	63
Kemmerer-Diamondville	3,655	3,996	4,042	387	46	3,648	3,723	68	75	3,706	3,810	155	104
Balance of county	3,477	3,803	3,774	297	-29	3,472	3,406	-71	-66	3,527	3,486	9	-41
Uinta County	11,521	12,381	13,275	1,754	894	12,214	14,132	2,611	1,918	12,135	14,041	2,520	1,906
Evanston	5,918	6,360	6,780	862	420	6,274	7,153	1,235	879	6,234	7,116	1,198	882
Lyman	2,392	2,571	2,850	458	279	2,536	3,160	768	624	2,520	3,151	759	631
Mountain View	677	728	758	81	30	718	773	96	55	713	761	84	48
Balance of county	2,534	2,722	2,887	353	165	2,686	3,046	512	360	2,668	3,013	479	345

(2) PROJECTED POPULATION ANNUAL RATES OF GROWTH: LINCOLN AND UINTA COUNTIES

		1978-1980				1981-1985				1986-1990			
Lincoln County	N/A	3.1	3.2	N/A	0.1	-1.7	-1.8	N/A	-0.1	0.3	0.5	N/A	0.2
Kemmerer-Diamondville	N/A	3.1	3.5	N/A	0.4	-1.7	-1.6	N/A	0.1	0.3	0.5	N/A	0.2
Balance of county	N/A	3.1	2.8	N/A	-0.3	-1.7	-2.0	N/A	-0.3	0.3	0.5	N/A	0.2
Uinta County	N/A	2.5	5.1	N/A	2.6	-0.3	1.3	N/A	1.6	-0.1	-0.1	N/A	0
Evanston	N/A	2.5	4.6	N/A	2.1	-0.3	1.1	N/A	1.4	-0.1	-0.1	N/A	0
Lyman	N/A	2.5	6.4	N/A	3.9	-0.3	2.2	N/A	2.5	-0.1	-0.1	N/A	0
Mountain View	N/A	2.5	4.0	N/A	1.5	-0.3	0.4	N/A	0.7	-0.1	-0.3	N/A	-0.2
Balance of county	N/A	2.5	4.6	N/A	2.1	-0.3	1.1	N/A	1.4	-0.1	-0.2	N/A	-0.1

Source: Abt Associates 1978.

Note: Cumulative Impact = projection "with" the proposed action - 1977 estimate.
Impact of the Proposed Action = projection "with" the proposed action - projection "without" the proposed action.

N/A = Not Applicable

impact on Lincoln County would be insignificant. The majority of the growth in Uinta County would occur during the 1978 to 1980 period. This growth would be considered significant, because its rate would reach or exceed 4% per year, which is beyond the limit at which a small town can efficiently accommodate growth. The population impact would be insignificant after 1980. The projected increases in population during the 1978 to 1980 period would cause a number of temporary impacts to both the public and private sectors of Uinta County; Lincoln County would not be significantly impacted.

With the closing of the South Haystack Mine, 260 mining jobs would be lost to Uinta and Lincoln Counties. If other employment opportunities were not available, outmigration would occur. This would result in reduced basic employment, population, and the demand for local goods and services. These impacts should not be significant since the closing of the mine would probably be phased over a period of time and the effects would be only temporary.

Employment

Approval of this mine would impact Uinta County by providing approximately 180 construction jobs by 1979. Mine employment would stabilize by 1985 with 260 permanent jobs (Cumberland Coal Company 1976). An additional 588 jobs should also become available as induced employment to support the population increase caused by the mine. This would be a significant increase in job opportunities.

These employment increases would, as mentioned earlier, result in higher populations with additional indirect impacts. These would include increases in local incomes (see Income section) and reduce unemployment (specific data not available). There would also be minor negative impacts if laborers were pulled out of other employment sectors. The high wages offered by the mining industry could cause temporary shortages in these other areas (Abt Associates 1977).

Income

Population and employment increases would cause total personal earned income in Uinta County to rise significantly (104% by 1990). It would increase from an estimated $39.8 million in 1977 to $53.1 million in 1980, $69.1 million in 1985, and $81.1 million in 1990. Lincoln County would not be significantly impacted. The impact of the mine is not large enough to affect per capita income in either county (Abt Associates 1977).

Specific information is not available, but several indirect income impacts could also occur during the 1978 to 1980 period in Uinta County. Most of the benefits of the higher income would go to those in the mining and construction sectors; those in the local service sector, on fixed incomes, and the poor could be placed in an even less favorable financial position. This would occur as prices continue to inflate causing even more difficulties for these groups to compete for goods and services. However, increased income would cause increased consumer spending and provide benefits to the community as retail revenues and taxes to local governments increased (Abt Associates 1977 and Gilmore 1974).

Infrastructure

Private Sector

The Kemmerer/Diamondville area and Evanston would continue to be the leading commercial centers in their respective counties. The larger populations would continue to place pressures on existing services and facilities in local communities. Uinta County retail and wholesale sales would increase significantly. Retail sales would climb from an estimated $35.1 million in 1977 to $47.5 million in 1980, $66.0 million in 1985, and $85.8 million in 1990. Wholesale revenues would reach $13.0 million in 1980, $18.1 million in 1985, and $23.6 million in 1990 over an estimated 1977 figure of $9.6 million. Lincoln County would receive insignificant increases in both categories of sales (Abt Associates 1978).

Public Finance

Two impacts to local governments are likely to occur. Government expenditures could be expected to continue to increase to provide more and improved services and facilities to residents, and increased revenues through higher property valuations and more tax income could accrue to local governments. These adjustments would mostly be required in Uinta County.

Housing

The larger population caused by this mine would put additional demands upon the housing industry of both counties. Lincoln County would require only 23 additional units by 1990, but Uinta would have significant increases in demand as shown on Table SH3-15B. The larger population would cause a countywide cumulative increase of 929 units. Evanston would require 447 of them. If the housing industry does not keep pace with the population growth, these housing impacts could become even more significant as the current housing shortage became even more aggravated.

Education

Significantly larger school-age populations would occur because of this mine. Lincoln County would not be significantly affected; however, enrollment in the three districts in Uinta County would increase from 2,523 students in 1977 to 2,842 in 1980 and 2,930 in 1985. It would decrease to 2,841 in 1990, but this would still be a 12.6% increase over the 1977 figure. The proposal would

Table SH3-15B

PROJECTED HOUSING DEMAND: UINTA COUNTY

	1977	1980				1985				1990			
		Housing Projection				Housing Projection				Housing Projection			
	Housing Units	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action
Uinta County													
Total	NA	NA	NA	929	673	NA	NA	929	673	NA	NA	929	673
Evanston	1,568	1,699	2,015	447	316	1,699	2,015	447	316	1,699	2,015	447	316
Single family	1,064	1,147	1,305	241	158	1,147	1,305	241	158	1,147	1,305	241	158
Multi-family	198	212	256	58	44	212	256	58	44	212	256	58	44
Mobile homes	306	340	454	148	114	340	454	148	114	340	454	148	114
Lyman	507	560	770	263	210	560	770	263	210	560	770	263	210
Single family	196	220	283	87	63	220	283	87	63	220	283	87	63
Multi-family	13	16	27	14	11	16	27	14	11	16	27	14	11
Mobile homes	298	324	460	162	136	324	460	162	136	324	460	162	136
Mountain View	219	234	257	38	23	234	257	38	23	234	257	38	23
Single family	120	130	142	22	12	130	142	22	12	130	142	22	12
Multi-family	0	1	2	2	1	1	2	2	1	1	2	2	1
Mobile homes	99	103	113	14	10	103	113	14	10	103	113	14	10
Balance of county[1]	NA	NA	NA	181	124	NA	NA	181	124	NA	NA	181	124
Single family	NA	NA	NA	99	62	NA	NA	99	62	NA	NA	99	62
Multi-family	NA	NA	NA	19	12	NA	NA	19	12	NA	NA	19	12
Mobile family	NA	NA	NA	63	50	NA	NA	63	50	NA	NA	63	50

Source: Abt Associates 1978.

Note: Cumulative Impact = projection "with" the proposed action - 1977.
Impact of the Proposed Action = projection "with" the proposed action - projection "without" the proposed action.

[1]Projected balance of county housing needs are not available because 1977 data are not available.

NA = Not Available

be responsible for approximately 15% (420 students) of the 1990 total.

Social Services and Facilities

The effects of this one mine are difficult to assess, because it is not known how the local governments would respond to the demands of an additional 1,969 people over other projected growth spread over 13 years. Many services and facilities are already being expanded or are in the planning stages. Some of these improvements may cover the effects of the mine. In any case, the mine would put some additional pressures on current services and facilities. Additional doctors, nurses, fire and police personnel and facilities, and water and sewer facilities would be required (Abt Associates 1977); however, the impacts would generally be insignificant, except during the 1977 to 1980 period.

Attitudes and Expectations

Residents opposed to continued growth and disturbance of the wide-open spaces would view the mine as a further aggravation of their position. In spite of the benefits (employment and income increases), they would resent the increased population and urbanization that would occur, even though it would be slight from this one mine (see Population section). Those persons who would benefit from the mine directly (mine employees and local merchants for example) would welcome the employment opportunities and higher wages they could expect to receive. Their positions would advance financially, and they would see the mine as a chance to improve the quality of their lives. Those in the lower income brackets and unable to improve their positions because of the mine could see it as further depressing their situation. They could see it as detrimental because it would continue to inflate prices, make it harder to compete for goods and services, and widen the gap between their incomes and those in the mining sector (Abt Associates 1977).

Life Styles

This one mine should not cause significant impacts to the current life styles that exist in the two counties. The trend towards urbanization would continue, but as discussed in the Population section, it would not be significant except during the 1978 to 1980 period. Some would still feel, however, that it was aggravating the situation by inducing unwanted new growth (Abt Associates 1977).

CHAPTER 4

MITIGATING MEASURES NOT INCLUDED IN THE PROPOSED ACTION

MEASURES

Mining and Reclamation Plan

U.S. Geological Survey (USGS)

South Haystack Mitigating Measure 1. To reduce losses of cultural resources from pothunting and vandalism because of increased population, the lessee will confine all vehicle use to existing roads and trails in order to limit access to culturally sensitive areas.

South Haystack Mitigating Measure 2. To reduce losses of subsurface archeological sites caused by mining and other surface disturbing activities, a qualified archeologist acceptable to the Bureau of Land Management (BLM) will be contracted by the lessee to be present during the initial surface disturbance of all of those zones or areas of alluvium which were determined to be sensitive by inventory. The lessee may opt to conduct trenching and (or) test bore holes of identified sensitive areas prior to mining or surface disturbances using an archeologist and methodology acceptable to the BLM and State Historic Preservation Officer (SHPO). If National Register sites are found during this additional work, 106 compliance procedures will be conducted by BLM and appropriate mitigation will be conducted in consultation with the SHPO and advisory council. Salvaging or testing of non-National Register sites will be conducted pending the professional judgment of the archeologist. Periodic monitoring of sensitive areas and particularly those adjacent to areas of proposed surface disturbances, whether in or outside the mine boundary, will be required by the lessee using an archeologist acceptable to the BLM.

South Haystack Mitigating Measure 3. To avoid disturbance to the Cumberland Townsite a stipulation preventing occupancy or any disturbance to the property will be placed in the right-of-way approval. Periodic monitoring of the Cumberland Townsite will be conducted by professional cultural resource personnel. If physical or other adverse impacts are occurring to the property, the BLM will develop suitable mitigation for these impacts in consultation with the SHPO and Advisory Council.

South Haystack Mitigating Measure 4. The BLM and USGS are currently developing a Memorandum of Understanding relating to the protection of paleontological resources on public lands. These agencies are also developing technical guidelines to define the resource, provide evaluatory criteria, and provide measures for protection. When finalized, the provisions of these documents will serve as a basis for management of paleontological resources and appropriate protective programs.

South Haystack Mitigating Measure 5. To enhance the ability of reclaimed lands to support premine wildlife uses, seed mixtures used for revegetation will include plant species beneficial to the wildlife that were present prior to mining. The following are suggested plant species and seeding rates that would be beneficial to the wildlife on the proposed North Block Mine area.

Clay and clay loam soils: thickspike wheatgrass—8.0 lbs./acre, western wheatgrass—8.0 lbs./acres, Indian ricegrass--4.0 lbs./acre, big sagebrush—1.0 lbs./acre, winterfat—2.0 lbs/acre, rubber rabbitbrush—1.0 lbs./acre, and shadscale— 1.0 lbs./acre.

Sandy soils: thickspike wheatgrass—8.0 lbs./acre, western wheatgrass—6.0 lbs./acre, Indian ricegrass—1.0 lbs./acre, big sagebrush—2.0 lbs./acre, antelope bitterbrush--2.0 lbs./acre, rubber rabbitbrush—1.0 lbs./acre, winterfat--1.0 lbs./acre, and fourwing saltbush—1.0 lbs./acre.

Saline/alkaline soils: western wheatgrass—6.0 lbs./acre, streambank wheatgrass—6.0 lbs./acre, Indian ricegrass—6.0 lbs./acre, Nuttalls saltbush—2.0 lbs./acre, big sagebrush— 1.0 lbs./acre, shadscale-1.0 lbs./acre, and fourwing saltbush--1.0 lbs./acre.

These species may not be applicable to all areas and there may be species not listed that would be suitable. The actual seed mixture would be determined by research results at the proposed South Haystack Mine and, when applicable, from other locations. In addition, if establishment of shrub species from seed proves infeasible, planting of seedlings, tublings, and (or) plant transplanting would be required.

Wyoming Department of Environmental Quality (DEQ)

South Haystack Mitigating Measure 6. Soil mixing and leaching of salts or trace metals into potential surface and ground water sources may impact reclamation efforts. The Cumberland Coal Company will sample water at regular intervals both upstream and downstream from points of inflow of runoff waters from mined areas. Samples will also be taken from ground water sources, from wells penetrating the mined formation and the next adjacent formation, and will be located down the ground water hydraulic gradient from the mined areas. Surface water samples will be analyzed to determine biological, chemical, and sediment content of runoff. Periodic analysis for trace metals will be made of both the dissolved constituents and the sediment load. Ground water samples will be analyzed for chemical content and for trace metals. This will aid in the control and reduction of potential degradation of surface and ground waters from leaching of salts and (or) trace metals. A plan will be submitted in accordance with 30 Code of Federal Regulations (CFR) 715.17(b).

South Haystack Mitigating Measure 7. Use of Patterson and Sommers (1966) peak flow data could result in improper design of diversion ditches, channels, and storage and settling ponds. Diversion ditches, channels, and storage and settling ponds should be designed using the estimates shown in Table SH3-6A. These estimates were derived from additional data analyzed by Lowham (1976) and locally should supersede Patterson and Sommers (1966) which can still be applied on a regional (riverbasin-wide) basis.

South Haystack Mitigating Measure 8. The applicant will submit data required under 30 CFR 715.17(3)(1)(A through E) (pertaining to alluvial valley floors). These data will provide information needed to establish standards for which compliance with the Surface Mining and Reclamation and Enforcement Act may be evaluated.

South Haystack Mitigating Measure 9. Several types of air quality control measures are possible to help prevent the generation of fugitive dust. The application of water to unpaved roadways is the most common method for dust control and has already been included as a design control measure in the analysis of the proposed action. Several other control measures are available, some of which have a definite quantitative efficiency, and others which are common sense measures and cannot be assessed quantitatively.

In general, fugitive dust can be controlled by watering at transfer points, such as conveyor ends or loading stations. The efficiency of this measure is dependent on the frequency of water application, an excess of which could create the obvious safety hazards of mud on nonlevel surfaces. Hoods, connected to a ventilation and dust collection system, over sources such as crushers or sorters limit emissions from mechanical handling of coal. General cleanliness and the prevention of spills also help to reduce the amount of fugitive dust. The emissions from the above sources, however, do not contribute to ambient concentrations of total suspended particulates (TSP) as significantly as emissions from overburden removal, travel on unpaved roads, and wind erosion.

Control of fugitive dust emissions from overburden removal is not feasible due to the continuous exposure of dry subsurface material. Control of fugitive dust emissions from travel on unpaved roads is possible with several measures. Watering, with an approximate efficiency of 50%, has already been included in the design plans. Paving, or treatment with chemical stabilizers which approximate paving, could reduce fugitive dust emissions from these sources by an additional 35%. This will result in a significant reduction in cumulative regional concentrations of TSP.

Travel on unpaved roads accounts for 69% of the predicted total fugitive dust emissions from proposed mining in 1980, 59% in 1985, and 58% in 1990. Paving and chemical stabilization of unpaved access and haul roads, therefore, could reduce mine-related TSP impact on a regional basis by approximately 48% in 1980, 41% in 1985, and 40% in 1990. In lieu of paving or chemical stabilization, control of vehicular speeds can also reduce fugitive dust emissions from travel on unpaved roads. Limiting vehicular speed to 15 mph will reduce emissions by 44%, and a limit of 10 mph will reduce emissions by as much as 75%.

As shown in the preceding paragraphs, best management practices were not necessarily included in the air quality impact analysis. Only those mitigating measures discussed in the mining and reclamation plans on file with the USGS at the start of this rewrite were included in the modeling. In any event, the worst case mine situation is discussed, and best management practices will produce fewer and less intense impacts. It was not possible to include best management practices in Chapter 3, because the suggestions came in too late for modeling to be done and, if included now, would negate the continuity of the present analysis. Chapter 8 contains an air quality alternative which discusses the best management practice impacts.

Rights-of-Way

Bureau of Land Management

South Haystack Mitigating Measure 10. Intrusions from cuts and fills for roads, railroads, and other rights-of-way would create moderate and strong contrasts to the elements of line, form, color, and texture. The lessee will follow natural contours insofar as practicable when constructing these facilities to reduce the number of cuts and fills.

ANALYSIS OF EFFECTIVENESS

South Haystack Mitigating Measure 1. Cultural resources would be lost to pothunting and vandalism due to increased population. The measure will reduce the possibility of additional losses.

South Haystack Mitigating Measure 2. Subsurface archeological sites would be destroyed by mining and associated surface disturbing activities. The measure will reduce the loss of subsurface sites.

South Haystack Mitigating Measure 3. Disturbance to the Cumberland Townsite could result from rail spur construction. Avoidance of the Cumberland Townsite will protect the site and prevent any losses from occurring.

South Haystack Mitigating Measure 4. Paleontological losses would occur from the destruction, disturbance, or removal of fossil materials as a result of coal mining activities, unauthorized collection, and vandalism. This measure will reduce the loss of paleontological resources by an undetermined amount.

South Haystack Mitigating Measure 5. This measure will enhance the return of premine habitat values and wildlife species; however, data are not available which would allow quantification of effectiveness.

South Haystack Mitigating Measure 6. Soil mixing and leaching of salts or trace metals into potential surface and ground water sources could impact reclamation efforts. This measure will identify 70% to 85% of toxic and marginal material and reduce reclamation losses from salts or trace metals by 80%.

South Haystack Mitigating Measure 7. Use of Patterson and Sommers (1966) peak flow data could result in improper design of diversion ditches, channels, and storage and settling ponds. Using Lowham (1976) for calculation of peak flows shown in Table SH4-1 for the design of ditches, channels, and storage and settling ponds will use more up to date and locally applicable criteria.

South Haystack Mitigating Measure 8. The proposed mining could degrade the Albert Creek drainage (believed to be an alluvial valley floor). This measure will ensure adequate data gathering needed to develop standards that would protect the Albert Creek drainage.

South Haystack Mitigating Measure 9. Fugitive dust, generated from unpaved roads, would degrade air quality. This measure will be 40% to 48% effective.

South Haystack Mitigating Measure 10. Intrusions from cuts and fills for roads, railroads, and other rights-of-way would create moderate and strong contrasts to the elements of line, form, color, and texture. This measure will reduce the impacts created by the roads, railroad, and other rights-of-way from moderate and strong to weak and moderate meeting Visual Resource Management (VRM) objectives for Class III.

Mitigating measures not included in the proposed action are summarized in Table SH4-2.

MONITORING, RESEARCH, AND STUDY PROGRAMS

In order to develop a base for future mine impact analyses, the operators will be required to provide a monitoring program both upstream and downstream for measuring runoff, chemical quality, trace metals, and sediment yield from any stream leaving the lease area. Ground water levels in observation wells tapping the Adaville Formation and the Lazeart sandstone and the chemical quality of water in these wells should be monitored regularly. Chemical analyses of ground water should be made for standard constituents as well as trace metals. During reclamation, observation wells should be installed in areas refilled by spoil. Observation of water levels in these wells and chemical analyses of the water should be made regularly.

A representative of BLM will annually inspect livestock grazing areas adjacent to mining operations to determine if such operations are affecting grazing patterns of the allotment, to determine if any range overuse is resulting from the changes in grazing patterns that may be occurring, and to determine measures to be applied to correct the overuse of the range.

As reclamation is accomplished, the compliance officers (state and federal) will conduct periodic inspections of mining areas to assure that it is accomplished in accordance with the approved reclamation plan.

Reclaimed areas will be jointly inspected periodically by representatives of federal and state agencies and the operator to determine areas on which reclamation is completed and acceptable and to jointly determine corrective measures to be applied on areas where reclamation efforts have proven inadequate due to seeding failure, etc.

Table SH4-1

FLOW FREQUENCY CHARACTERISTICS OF FIVE STREAMS IN THE SOUTH HAYSTACK MINING AREA

	Drainage Area In Square Miles	Estimated Average Annual Discharge CFS	Estimated Peak Flows for Recurrence Intervals Of (in CFS, Rounded to Two Significant Figures)					
			2 Years	5 Years	10 Years	25 Years	50 Years	100 Years
Albert Creek	175	3.9	400	890	1,400	2,200	3,000	3,900
Clear and Shurtleff Creeks at their confluence	55	1.5	260	590	930	1,500	2,700	2,700
Haystack Draw	10	0.8	140	330	520	870	1,200	1,600
Unnamed Draw South of Clear Creek	6	0.7	110	270	440	730	1,000	1,400
Meadow Draw	5	0.65	100	260	410	690	960	1,300

Note: After Lowham (1976).

CFS - cubic feet per second

Table SH4-2

SUMMARY TABLE

Impact	Mitigating Measures	Residual Impact
Loss of cultural resources from vandalism and pot-hunting	South Haystack number 1	Most of the predicted losses will continue.
Loss of unknown archeological information and sites from surface disturbing activities	South Haystack number 2	Loss of an unquantifiable number of subsurface sites and sites in sensitive areas
Potential destruction from rail spur construction to Cumberland Townsite	South Haystack number 3	Disturbance to the townsite will be avoided.
Loss of paleontological resources and information from unauthorized collecting and vandalism and from authorized surface and subsurface destruction, disturbance, and removal	South Haystack number 4	Loss of an undetermined number of fossils
Loss of wildlife habitat and populations	South Haystack number 5	Reduction in time of wildlife habitat loss and wildlife population loss.
Soil mixing and leaching of salts or trace metals into ground water	South Haystack number 6	Potential decrease of up to 20% of reclamation efforts exists.
Improper design of diversion ditches, channels, and storage and settling ponds	South Haystack number 7	Using 1976 data shown in Table SH4-1 for design of diversion ditches, channels, and storage and settling ponds will improve this design reliability.
Potential degradation of the Albert Creek drainage	South Haystack number 8	This measure could be 90%-100% effective.
Degradation of air quality from fugitive dust	South Haystack number 9	This measure could reduce TSP impact by 40% to 48%.
Moderate and strong contrasts to all basic elements due to cuts and fills	South Haystack number 10	Reduction of moderate and strong contrasts to weak and moderate meeting VRM objectives for Class III

CHAPTER 5

ANY ADVERSE IMPACTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED

This chapter presents a summary of the residual adverse impacts that would remain after considering the mitigating measures discussed in Chapter 4.

AIR QUALITY

Impacts on Air Quality

When annual average background particulate values of 16 micrograms per cubic meter ($\mu g/m^3$) for 1980 and 15 $\mu g/m^3$ for all other years are added to projected mine-related contributions, the annual primary National Ambient Air Quality Standard (NAAQS) of 75 $\mu g/m^3$ is predicted to be exceeded (in the worst case) within 1, 1, 1, and 1.5 miles of the active site; and the annual Wyoming standard of 60 $\mu g/m^3$ is predicted to be exceeded within 1.5, 1, 1, and 1.5 miles of the active site for the years 1980, 1985, 1990, and end of mine life, respectively.

If projected mine-related 24-hour suspended particulate values and background concentrations of 49 $\mu g/m^3$ for 1980 and 46 $\mu g/m^3$ for all other years are combined, the 24-hour primary NAAQS of 260 $\mu g/m^3$ is predicted to be exceeded within 2, 2, 2, and 2 miles of the active site; and the Wyoming standard of 150 $\mu g/m^3$ is predicted to be exceeded within 3.5, 3, 3, and 2.5 miles of the active site for the years 1980, 1985, 1990, and end of mine life, respectively.

A comparison of the worst-case mine impact with Prevention of Significant Deterioration regulations indicates the annual standard would be exceeded within 2.5, 2, 2, and 3 miles; and that the 24-hour standard would be exceeded within 7, 5.5, 6, and 5.5 miles of the active site during the years 1980, 1985, 1990, and end of mine life, respectively.

With the application of the 43 CFR 118 regulations, the violations of the Class I increment would not occur.

Two other potential sources of significant particulate emissions would be associated with the South Haystack Mine: blasting and coal fires. The cloud of dust produced by blasting would be short-lived, at least compared to the averaging times of the total suspended particulate standards (24 hours or greater), so that little contribution to 24-hour levels would be measured outside the mining area. Coal fires could occur in spite of mitigating measures taken to prevent them. If neglected and allowed to burn out of control for long periods, they could be a significant source of pollutants. Any fire on the site could significantly contaminate the air and cause a safety hazard. However, due to a high degree of fire control technologies, potential fire impacts would probably be minimal.

Failure of reclamation because of a natural catastrophe would result in disturbed areas not being revegetated. This could increase particulate emissions over all predicted emission levels presented in this report, although the magnitude of such an increase is unknown.

Gaseous Pollutants

Mine-related nitrogen dioxide (NO_2) and sulfur dioxide (SO_2) emissions are expected to be insignificant, as discussed in Chapter 4 of the Regional Statement Component (Environmental Research and Technology 1978a); therefore, ambient pollutant concentrations have not been predicted.

Recent studies (U.S. Department of the Interior 1976) of the impact of vehicle emissions associated with western coal mines were reviewed to estimate the probable range of impact. Maximum predicted concentrations of carbon monoxide ranged between 0.02% and 0.44% of the standard. Maximum predicted hydrocarbon concentrations ranged between 0.88% and 3.44% of the standards. Maximum predicted nitrogen dioxide concentrations ranged between 0.6% and 3.0% of the standards. Maximum predicted concentrations of SO_2 ranged between 0.02% and 0.33% of the standards. The values represent predictions at less than one-half mile from the mines. Predictions were significantly less at further distances from the mines.

Visibility

For 1980, the visibility of an observer at 1 mile downwind would be approximately 39.5 miles, assuming a background visibility of 40 miles. In general, visibility would increase with downwind distance from the mine. At 5 miles downwind the visibility would be 39.7 miles, and at 10 miles it would reach 39.8 miles. The corresponding values, assuming a background visibility of 7 miles, are 6.9 miles, 6.9 miles, and 7 miles, respectively.

Similar reductions in visibility would result in 1985, 1990, and end of mine life.

GEOLOGY

A nonquantifiable number of coal fires may be ignited in spite of routine precautions taken to prevent them. The emission of combustion products to the atmosphere from accidental coal fires occurring during mining operations is discussed in the Air Quality sections of this environmental statement (ES).

Paleontology

Unavoidable destruction, disturbance, and removal of paleontological resources, both exposed and unexposed, would occur. The significance of this impact cannot be meaningfully assessed at present due to the lack of data and evaluatory criteria.

SOILS

The disturbance of soils on 1,745 acres proposed for mining and spoil storage is unavoidable. The removal, transporting, and mixing of topsoil would result in the loss of soil structure and a loss of soil biota. The removal of topsoil too deep in some areas could contaminate the topsoil with salts. The above would result in a decrease in productivity when the topsoil is used in reclamation.

Soil erosion, with the associated soil loss resulting from soil moving off the area being reclaimed, would occur. The increased rate of soil erosion from water action would be approximately 3 tons per acre per year over that of the existing environment. Also, an accelerated rate of wind erosion would occur over areas disturbed by mining and areas being reclaimed prior to the reestablishment of a vegetative cover. The increase in soil loss (in suspension) by wind erosion over the current rate would be approximately 260 tons per year. Some soil compaction would occur with machinery traffic during reclamation. This would result in a decrease in soil productivity. Around 100 acres of soil surface would be lost for vegetative production as a result of the construction of housing and support facilities associated with the increase in population created by the proposed mining.

Overall soil productivity of the disturbed areas (1,745 acres) would decrease temporarily as a result of the mining action. This short-term decrease in soil productivity is unavoidable.

If a 10-, 25-, 50-, or 100-year flood were to occur when areas are in the process of being reclaimed, an accelerated rate of erosion would occur over the amount that would occur normally. This would result in large amounts of soil loss, and the occurrence of one of these floods during reclamation could considerably lengthen the time required for vegetation reestablishment.

WATER RESOURCES

There would be no significant adverse impacts upon the water resources if all of the measures to which the applicant is committed and the applicable regulations of the state of Wyoming are followed.

VEGETATION

Changes in plant species composition, cover, and density would be unavoidable if mining is approved. Mining activities would require the short-term loss of vegetation on about 2,720 acres. An average of 124 acres would be disturbed annually. Disturbed areas would range in size from about 47 to 1,340 acres.

Population increases due to mining would result in the long-term loss of vegetation on an estimated 100 acres for housing and support facilities. Increased numbers of people in the area would result in additional disturbance of native vegetation, particularly by off-road vehicle use (see Recreational Resources section).

Revegetated areas would have a general appearance of grassland. Grasses would be the most common forage class, with shrubs and forbs being reduced in density and cover as compared to premining conditions.

Natural plant succession would occur on reclaimed lands and could restore approximate premining plant cover and composition values in an estimated 30 to 50 years, as suggested by Cook (Vories ed. 1976).

The short-term losses of vegetative cover and production on disturbed areas would affect numerous living organisms and their nonliving environment (see Air Quality, Soils, Fish and Wildlife, Visual Resources, Recreational Resources, and Agriculture sections).

FISH AND WILDLIFE

Wildlife habitat, carrying capacity, and populations would be lost on 1,325, 2,091, 2,273, and 2,720 acres by 1980, 1985, 1990, and end of mine life, respectively, as a direct result of mining. Wildlife habitat, carrying capacity and populations would be adversely affected (area of influence) on 5,962, 9,409, 10,228, and 12,240 acres by 1980, 1985, 1990, and end of mine life, respectively.

Specific habitat losses by the end of mine life would be 2,720 acres of sage grouse crucial breeding habitat, 2,720 acres of mule deer winter/yearlong range, and 2,720 acres of antelope summer range. This acreage represents 0.4% of the total sage grouse habitat available in bird management section number 5 of the Uinta Management Unit. The loss of 2,720 acres represents 0.9% of the mule deer winter/yearlong range and 0.6% of the antelope summer range available within their respective herd units.

Loss of wildlife populations would be estimated at 1,800, 8,900, 16,600 and 35,000 small nongame birds; 1,400, 4,400, 7,400, and 13,500 sage grouse; 0.482 million, 1.905 million, 2.1 million, and 4.95 million small nongame mammals; 75, 185, 300, and 550 mule deer; 75, 185, 300, and 550 antelope; and 11,000, 28,000, 30,300, and 50,000 reptiles and amphibians by 1980, 1985, 1990, and end of mine life, respectively. End of mine life population losses for sage grouse, mule deer, and antelope represent an estimated 20%, 1%, and 3%, respectively, of the production of their total populations by that time.

Reclamation, if successful, would mitigate some of the above losses. Quantification of such mitigation, however, is not possible with current knowledge and available information (see discussion of reclamation in Regional Wildlife and Vegetation sections).

The habitat and population losses would be of major significance to localized populations, but when compared to total habitat and populations within the region or herd/management unit they would be of minor significance when based upon percentages alone.

Although it may appear that losses are of minor significance, the projected losses of populations and habitat could, in some instances, be of critical importance to wildlife. Current data are insufficient to thoroughly analyze the effects of each individual habitat or population loss.

All the above estimates include the progeny which would have been produced had mining not occurred.

Raptor losses could not be calculated for each benchmark date. By the end of mine life, losses would be estimated at 500 raptors.

CULTURAL RESOURCES

The destruction of a few buried archeological sites by mining and related surface disturbing activities would occur. Mitigation success would depend on such factors as successfully predicting areas of likely buried sites, the amount of destruction occurring to a site as it is uncovered, and the possibility of it being completely destroyed as a result of not being recognized. The destruction of buried sites could have a significant impact.

All cultural resources within the project area would be affected by increased pothunting and vandalism regardless of mitigation measures applied. The pothunting of archeological sites could potentially remove important surface indications of significant buried sites.

VISUAL RESOURCES

All adverse visual impacts from mining of coal would not be totally mitigated during active mining operations. Roads, power lines, water lines, phone line, conveyer system, load out, crusher facilities, and other structures would remain until removed and (or) revegetated. Individually these structures would meet the Visual Resource Management (VRM) objectives for Class III, but cumulatively they would change the area to a Class V. The actual mining operations, pits, spoil piles, and topsoil storage would change the character of the landscape which would result in a change of VRM Class to a Class V. The impacts to form, color, and texture would be obviously visible until vegetation is successfully reestablished.

After successful revegetation, the impacts due to the structures would disappear. Changes would remain in the character of the landscape (evidence of strip mining); however, these changes would meet the BLM management quality objective for Class III.

RECREATIONAL RESOURCES

Recreational access would be restricted during mining in the South Haystack project area eliminating certain recreation use on site at first. As the mine becomes developed, people would come to the area to view the mining activities. Hunting and sightseeing would be affected by the access restriction.

Increased population would result in increased recreational use throughout the southwestern Wyoming region. This increased use would result in lowering the quality of the existing "primitive"type of recreational experience. Also, due to the increased use in the region, ranchers would be prompted to restrict access across their private lands.

Visitor Use Data

The estimated resident recreation use demand change due to the proposed action would account for approximately 4.3%, 9.1%, and 9.2% of the total recreation use demand in Lincoln and Uinta Counties by 1980, 1985, and 1990, respectively.

AGRICULTURE

Mining would cause a loss of animal unit months (AUMs) within three grazing allotments, the Cumberland/Uinta, Haystack Draw, and Albert Creek. Cumulative estimated losses in AUMs would be 171, 1,224, 2,169, 4,353, and 5,159 by 1980, 1985, 1990, 2001 (end of mine life), and 2010 (all lands returned to livestock grazing), respectively. The Cumberland/Uinta Allotment, with about 64,690 AUMs available annually, would lose an average of about 57 AUMs per year for 30 years (annual percentage loss about 0.1%). Mining would lower the Albert Creek Allotment carrying capacity by an average of about 58 AUMs per year for 30 years. This would represent about 1.0% of the AUMs available annually without mining or 58 of 5,400 AUMs. The losses in carrying capacity would be undesirable but would probably not cause significant impacts to the 44 livestock operators licensed in the Cumberland/Uinta Allotment and the 1 operator licensed in the Albert Creek Allotment. The Haystack Draw Allotment would have the highest percentage loss of AUMs, about 9.0%. Of 641 AUMs available annually without mining, an average of 57 AUMs per year would be lost for 30 years. This loss of AUMs would represent about 2% of the AUMs needed to support the 1,000 sheep, reportedly owned by the one operator licensed to graze livestock within the grazing allotment. Although any loss in carrying capacity would be undesirable, the loss would probably not cause a significant impact to the operator.

MINERAL RESOURCES

The mining and removal of coal would have an unavoidable adverse effect on coal resources since deposits of a nonrenewable mineral commodity would be depleted. Based on company plans, an estimated 60 (54 million recovered) million tons of coal would have been mined by 1997. This comprises less than 4% of the estimated economically recoverable strippable coal reserves thus far identified in Sweetwater, Lincoln, and Uinta Counties. Loss of minor amounts of coal in mining, loading, and transportation operations is unavoidable.

An unknown quantity of coal in the overburden and (or) interburden would be lost. This coal would be in seams too thin or of too low a quality to be of economic interest.

TRANSPORTATION NETWORKS

There would be increased use of highways and other transportation facilities in the area owing to increased population and mining activities. Estimated increased license tab sales due to increased population would be 4% between 1978 and 1980, then increase to 9% between 1980 and end of mine life.

Some private roads in the region would be closed as ranchers limit access across their land.

The railroad spur would cross numerous unimproved dirt roads, many lesser roads which are lightly used for access to oil fields, and one highway. Grade crossings or detours would be provided during construction, causing an inconvenience impact on travelers. There would be traffic tie-up problems at the railroad grade crossing during its use. There would be a potential for train/auto accidents.

SOCIOECONOMIC CONDITIONS

Population

There would be an unavoidable increase in the populations of Lincoln and Uinta Counties and their two major communities (Kemmerer/Diamondville and Evanston) if the South Haystack mine is approved, constructed, and goes into production. Table SH5-15A shows the population increases that would result because of the mine. The increases would not be significant except during the 1978 to 1980 period in Uinta County.

Social Conditions

The increase in population could, however, have some minor adverse indirect impacts on Uinta County. The most evident of these would be pressures on public services and facilities. More crowded conditions would require more police and fire protection; construction of additional access routes; improved or expanded sewer and water systems; and expanded medical, social, and mental services. These impacts would reduce to insignficance after 1980.

Table SH5-15A

PROJECTED POPULATION INCREASES CAUSED
BY THE SOUTH HAYSTACK MINE
(LINCOLN/UINTA COUNTY)

	1980	1985	1990
Lincoln County	17	9	63
Kemmerer/Diamondville	46	75	104
Balance of county	-29	-66	-41
Uinta County	894	1,918	1,906
Evanston	420	879	882
Lyman	279	624	631
Mountain View	30	55	48
Balance of county	165	360	345

Source: Abt Associates 1978.

CHAPTER 6

THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The mining of 54 million tons of coal would result in short-term (a period beginning with on-site construction and ending with post-mining reclamation) and long-term (a period beginning after post-mining reclamation) losses or alterations of natural resources and the human environment.

In the short term there would be:

1. a reduction in air quality and visibility by fugitive dust and, to a much lesser extent, vehicular emissions;
2. increased soil erosion and lowered soil productivity on about 1,745 acres;
3. the loss of an estimated 5,159 animal unit months (AUMs) due to the removal of native vegetation on 2,720 acres (does not include 100 acres for housing for which AUM data are unavailable);
4. the destruction of 24 known nonrenewable cultural resources, 15 threatened with destruction, and an unknown number of subsurface sites may be destroyed;
5. a reduction from Visual Resource Management Class III to a Class V;
6. a lowering in the "primitive"quality of recreational experiences due to increased population;
7. impeded traffic movement due to increased numbers of trains and vehicles;
8. a disruption of social order due to rapid population growth and subsequent changes in community structure;
9. the loss of wildlife habitat, carrying capacity, and populations on 1,325, 2,901, and 2,273, and 2,720 acres by 1980, 1985, 1990, and end of mine life, respectively, directly from mining and an adverse effect (area of influence) on 5,962, 9,409, 10,228, and 12,240 acres by 1980, 1985, 1990, and end of mine life, respectively;
10. the loss of an estimated 1,800, 8,900, 16,600 and 35,000 small nongame birds; 1,400, 4,400, 7,400, and 13,500 sage grouse; 0.482 million, 1.903 million, 2.1 million, and 4.95 million small nongame mammals; 75, 185, 300, and 550 mule deer; 75, 185, 300, and 550 antelope; 11,000, 28,000, 30,300, and 50,000 reptiles and amphibians by 1980, 1985, 1990, and end of mine life. Raptor losses would be estimated at 500 by the end of mine life. All of the above estimates include the progeny which would have been produced had mining not taken place.
11. there would be an increase in employment opportunities and total earned income within Lincoln and Uinta Counties.

Residual effects of mining on long-term productivity would be:

1. loss of soil and vegetative productivity on about 100 acres planned for housing associated with population growth;
2. the destruction of an unquantifiable number of nonrenewable cultural resources;
3. a lowering in the "primitive"quality of recreational experiences due to increased population;
4. impacts to an undetermined number of uninventoried exposed and unexposed fossil localities; and
5. a gain in knowledge of paleontological resources due to surveys and exposure of resources which might never have been found without excavation.

CHAPTER 7

ANY IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED

Approximately 54 million tons of coal would be produced by the South Haystack Mine. About 6 million additonal tons of coal would be lost and unrecoverable due to current mining methods. An unknown quantity in the overburden and (or) interburden would be lost. This coal would be in seams too thin or of too low a quality to be of economic interest.

Energy, in the forms of petroleum products and electricity, would be expended to obtain the coal. Some materials used in manufacturing mining machinery and buildings would not be recycled and thus would be lost.

Most air quality impacts associated with the South Haystack Mine would be reversed when the land is reclaimed and returned to an equivalent of the preexisting vegetative cover and general contours. The only long-term air quality impacts anticipated are those resulting from continued use of unpaved access roads after the project has been completed or halted. Since use of these roads could be stopped by blocking access or reclaiming roadbeds, no irreversible air quality impacts are predicted.

Irretrievable air quality impacts would occur. The loss of good air quality for the period of the project cannot be retrieved. During the life of the project, total suspended particulate standards may be exceeded and visibility reduced in the immediate vicinity of the project.

An undetermined number of uninventoried exposed and unexposed fossil localities would be lost or disturbed.

Forage (about 5,159 animal unit months) for livestock and wildlife consumption would be lost.

Wildlife habitat, carrying capacity, and populations would be lost on 1,325, 2,091, 2,273, and 2,720 acres by 1980, 1985, 1990, and end of mine life, respectively, as a direct result of mining. Wildlife habitat would be adversely affected (area of influence) on 5,962, 9,409, 10,228, and 12,240 acres by 1980, 1985, 1990, and end of mine life, respectively.

Loss of wildlife populations would be estimated at 1,800, 8,900, 16,600 and 35,000 small nongame birds; 1,400, 4,400, 7,400, and 13,500 sage grouse; 0.482 million, 1.903 million, 2.1 million, and 4.95 million small nongame mammals; 75, 185, 300, and 550 mule deer; 75, 185, 300, and 550 antelope; and 11,000, 28,000, 30,300, and 50,000 reptiles and amphibians by 1980, 1985, 1990, and end of mine life, respectively.

Raptor losses could not be calculated for each benchmark date. By the end of mine life, losses would be estimated at 500 raptors.

All of the above estimates include the progeny which would have been produced had mining not occurred.

Cultural resources would be destroyed, although mitigated, and potential increased knowledge lost owing to resources being investigated at present rather than in the future—when improved techniques would be available.

CHAPTER 8

ALTERNATIVES TO THE PROPOSED ACTION

The USGS has accepted the South Haystack mining and reclamation plan as adequate for environmental review and subsequent approval under 30 CFR 211 regulations of May 1976. The Secretary's actions may be approval as proposed, rejection on various environmental or other grounds, approval in part and rejection in part, or approval subject to such additional conditions and requirements or modifications as he may impose under existing laws and regulations. He may also defer decision pending submittal of additional data, compilation of required studies, or for other specific reasons.

Even after a mining and reclamation plan is approved, the regulations and lease terms require that all subsequently proposed departures and deviations therefrom be approved in advance by the Secretary. The regulations (30 CFR 211 and 700) permit the Secretary to direct that changes be made in previously approved operations. For example, changes could be ordered to accommodate new, improved, or revised administrative requirements, technological improvements, environmental concerns or requirements, or revisions of prior evaluations thereof in the light of experience or previously unknown factors.

NO ACTION

The no-action alternative includes analysis of impacts that will occur if the mining and reclamation plan and associated rights-of-way are not approved. Without mining and reclamation plan approval, there will be no environmental impacts from mining on the leased land.

The proposed South Haystack Mine would supply from 2.5 to 3.5 million tons of coal per year to markets in Idaho, Nevada, Oregon, and (or) Washington. Without the South Haystack Mine other coal will have to be acquired to supply these markets. Such a substitution could create a shortage for other coal markets. If the alternate coal source were of a higher sulfur content, lower air quality from the power generation plants in these areas would be expected.

Both adverse and beneficial impacts will occur to paleontological resources in approximate proportion to the level of regional development and the area disturbed.

Under the no-action alternative, increased recreational activity will still occur in the area due to population increases associated with other expected development (Table SH8-1). The increased activity will basically lower the "primitive"quality of the recreational experience which is common to the region around the proposed South Haystack Mine. As a result of increased activity, there will be increased recreational maintenance and cleanup costs. There would also be conflicts between local ranchers and recreationists which could result in ranchers restricting access across their private lands.

The population of Lincoln County will increase to 7,799 in 1980, decrease to 7,120 in 1985, and increase to 7,233 in 1990. Uinta County population will increase to 12,381 in 1980, decrease to 12,214 in 1985, and then increase to 12,135 in 1990. Total employment will increase in Lincoln County to 4,110 jobs in 1980, decline to 3,731 in 1985, and increase to 3,797 in 1990. In Uinta County it will rise to 5,153 in 1980 and then decline to 5,111 in 1985 and 5,070 in 1990. Personal earned income in Lincoln County will increase to $56.7 million in 1980, $61.6 million in 1985, and $73.1 million in 1990. Uinta's will increase to $49.2 million, $59.3 million, and $69.5 million in the same years.

AIR QUALITY

Best Management Practices

Impact Alternative

This alternative contains recommendations which, if implemented, would reduce some of the major impacts described in Chapters 3 through 7. Best management practices could include the following:

1. Mulching and furrowing in the spring followed by fall planting differs significantly from the one-step fall planting process analyzed in Chapter 3. This measure along could reduce total emissions from the mine by 21% to 25% depending on the year (Table SH8-2).
2. Chemical stabilization of the haul roads could reduce haul road impacts by an additional 25% over that of watering the roads.
3. Paving or an equivalent stabilization of all access roads could reduce access road impacts by 85% over that of unpaved access roads.
4. Use of negative pressure bag houses or an equivalent method at all coal dump locations (truck to crusher and silo to railroad car) could reduce these impacts by 95% if properly engineered.
5. The use of conveyor and transfer point coverings and, where necessary, water sprays could reduce these emissions by 75%.

Table SH8-1

COMPARISON OF IMPACTS OF PROPOSED ACTION AND NO-ACTION ALTERNATIVE IN VISITOR USE DAYS

		1980		1985		1990	
Elements and Components	1977	No Action	Total projection with Proposed action	No Action	Total projection with Proposed action	No Action	Total projection with Proposed action
Fishing	77,900	85,800	89,670	83,700	92,050	84,800	93,420
General[1]	76,200	84,100	87,890	83,700	92,040	85,800	94,510
Hunting	24,600	26,500	27,690	25,200	27,710	25,100	27,650
Off-road vehicles[2]	3,100	3,300	3,450	3,200	3,520	3,200	3,520
Sightseeing	23,900	25,900	27,070	25,500	28,040	25,900	28,540
Urban	48,100	54,900	57,370	57,500	63,240	60,500	66,650
Water sports	36,000	40,300	42,120	41,100	45,190	42,700	47,040
Winter sports	9,700	11,300	11,810	12,300	13,530	13,100	14,430

Note: Visitor use day consists of 12 hours.

[1]General includes camping, picnicking, etc.
[2]Estimate by ES team Outdoor Recreation Planner.

Table SH8-2

COMPARISON OF CHAPTER 3 TOTAL TSP EMISSION IMPACTS
TO THOSE OF THE BEST MANAGEMENT PRACTICE ALTERNATIVE
TOTAL TSP EMISSION IMPACTS

Year	Total TSP Chapter 3 Emissions (tons/yr)	Total TSP Best Management Practice Emissions (tons/yr)	Reductions in Emissions (%)	Reduction due only to mulching and furrowing in the spring and planting in the fall (%)
1980	2085	1409	32	22
1985	1597	1164	27	21
1990	1694	1189	30	24
End of Mine Life	1466	1011	31	25

Table SH8-2 is a comparison of the Chapter 3 total TSP emissions with those of best management practice emissions. About a 27% to 31% reduction in total TSP emissions is possible; however, between 21% and 25% of the reduction results from more effective management of disturbed soil during the dry summer months (mulching and furrowing). The other recommendations reduce total emissions by 6% to 10%, depending on the year analyzed.

FISH AND WILDLIFE MITIGATION ALTERNATIVE

This alternative lists recommendations which, if implemented, would greatly reduce or totally eliminate the major impacts to existing fish and wildlife resources described in Chapters 3 and 5 through 7 by enhancement of the wildlife habitat and carrying capacities of those lands adjacent to the proposed mining operations or on nearby off-site locations.

1. That all mining areas be reclaimed to wildlife habitat (Table SH8-3)species list in Chapter 8 of each site specific ES) as soon as possible or as soon as possible or feasible. Reclamation would be in conformance to the post-mining land use set out in BLM's land use plans for the area. Vegetative planting and reclamation should be accomplished in consultation with the Wyoming Game and Fish Department, the Wyoming Department of Environmental Quality, and the U.S. Fish and Wildlife Service. The goal of reclamation should be to achieve the highest possible wildlife carrying capacity at the earliest possible date, regardless of cost. All possible tools to achieve this goal should be implemented as needed.

2. That approximately 3,300 acres of public land lying in immediate association with the proposed South Haystack mining area or on nearby off-site locations be set aside as a mitigation area and managed intensively for fish and wildlife resources. Selection of this mitigation area should be accomplished in consultation with the Wyoming Game and Fish Department and the U.S. Fish and Wildlife Service.

3. That the mitigation area be managed to increase its wildlife carrying capacity by at least 50%. Management tools such as water development, fertilization, vegetative manipulation, spraying, transplanting, seeding, protection of wildlife cover, and management of livestock grazing to enhance wildlife habitat should be implemented as necessary. The habitat of this mitigation area should be managed by BLM and the wildlife by the Wyoming Game and Fish Department.

4. That the mine permit will not be granted on land critical to the bald and golden eagle's ecological requirements. A qualified team of biologists from the Fish and Wildlife Service, Wyoming Game and Fish Department, and the Bureau of Land Management will judge and recommend the areas to be excluded from mining. Mine permits may be granted for these areas if regulations are adopted that provide for substitute mining practices, buffer zones, prey base, and alternate nest sites.

If this alternative is successfully implemented, it is estimated that 80% to 90% of the fish and wildlife resource impacts described in Chapters 3 and 5 through 7 could be mitigated. Impacts to other resources would be the same as the proposed action.

ALTERNATE RAILROAD SPUR ROUTES ALTERNATIVE

Two alternate routes for the railroad spur were considered for the proposed South Haystack Mine (Carter route and Bridger Gap route).

1. The Carter route would originate at milepost 872.98 from the Union Pacific main line near Carter, Wyoming. It would run north from Carter for 8 miles before crossing Little Muddy Creek and turning west for approximately 12 miles through Cumberland Gap. After passing through Cumberland Gap, the Carter route would coincide with the proposed Cumberland Branch route. The two routes would join where the old railroad grade, which the Cumberland Branch route follows, from Kemmerer ends.

The Carter route would disturb approximately 850 acres (250 acres more than the proposed) with the construction of 35 miles of new railroad grade (assuming a right-of-way width of 200 feet). The construction would require heavy cuts and fills. The route would follow along Little Muddy Creek for approximately 12 miles and would cross the creek several times (data are not available to further quantify impacts).

2. The Bridger Gap route would begin at milepost 886.08 on the Union Pacific main line near Bridger, Wyoming. The 9.6 mile route would proceed up grade in a northwesterly direction and terminate near Bridger Gap. A conveyor system would need to be constructed from the mine to a loadout facility in Bridger Gap.

The rail spur would require considerable cutting and filling (in excess of that for the Cumberland Branch route). Based on an assumed right-of-way width of 200 feet, approximately 230 acres would be disturbed (data are unavailable to quantify the additional acreage disturbance which would be due to cuts and fills). The cuts and fills would be visible from Interstate 80. The conveyor system would cross Highway 189 and proceed up a steep ridge locally known as "The Hogsback" Construction of the conveyor system up "The Hogsback"- would create significant impacts to soils, vegetation, wildlife, and visual resources.

Table SH8-3

RECOMMENDED VEGETATION FOR RECLAMATION OF SOUTH HAYSTACK MINE

Forbs	Shrubs[1]	Grasses or Grasslikes
1. Wallflower (*Erysimum* spp.)	1. Big sagebrush (*Artemisia tridentata*)	1. Bluegrass (*Poa* spp.)
2. Phlox (*Phlox* spp.)	2. Rabbitbrush (*Chrysothamnus* spp.)	2. Thickspike wheatgrass (*Agropyron dasystachum*)
3. Fleabane (*Erigeron* spp.)	3. Snowberry (*Symphoricarpus* spp.)	3. Letterman needlegrass (*Stipa lettermanii*)
4. Wildbuckwheat (*Eriogonum* spp.)	4. Serviceberry (*Amelanchier* spp.)	4. Basin ryegrass (*Elymus cinereus*)
	5. Common chokecherry (*Prunus virginiana*)	5. Idaho fescue (*Festuca idahoensis*)
	6. Fourwing saltbush (*Atriplex canescens*)	
	7. Rockymountain maple (*Acer glabrum*)	

Note: Common and scientific plant names are according to Beetle 1970.

[1]At least 20% of the annual forage production should be browse.

UNDERGROUND MINING ALTERNATIVE

This alternative was not considered feasible for reasons of economy and technology. The relatively shallow overburden of 50 to 100 feet at the outcrop would not provide sufficient structural strength to maintain safe and efficient underground working conditions. The ratio of recovered coal to in-place coal would be much less than with surface mining methods. Underground methods would leave potentially 50% of the in-place coal unrecovered as compared to 5% to 10% using surface methods. Mine safety would be decreased as indicated by accident rates in 1972 of 0.41 fatalities per million tons mined underground compared to 0.07 fatalities per million tons of surface mining.

SOUTH HAYSTACK RECLAMATION ALTERNATIVE

The mining and reclamation plan would be conditionally approved for a period of 10 years during which time a specific testing and monitoring program for the purpose of measuring revegetation success would be implemented by the coal mining company. In this alternative a plan describing the testing and monitoring program would be prepared by the Cumberland Coal Company for approval by the regulatory authorities prior to its implementation.

If it cannot be demonstrated that revegetation can be successful commensurate with Public Law 95-87 (SMCRA) at the conclusion of the 10-year program, the Department of the Interior will revoke its approval for mining on public lands.

Although current reclamation research indicates that successful reclamation can be achieved on semiarid coal mined lands, it is recognized that answers to reclamation problems are needed on a site-specific basis in order to ensure success.

This alternative, if implemented, would result in the gathering of data to show that lands proposed for mining are reclaimable within a reasonable period of time.

The Cumberland Coal Company would be required, under the direction of state and federal reclamation regulatory and surface ownership agencies, to establish a suitable number of demonstration plots to provide evidence of revegetation success.

The demonstration plots would be established as soon as practicable following the authorization of the Department of the Interior to commence mining operations.

Impacts which would occur if revegetation could not be accomplished would be as follows:

1. The mining company would be forced to shut down its operation on public land.
2. A shut down of the mine would cause economic loss to the mining company from the sale of coal, loss of employment for most of the employees, and loss of investment in equipment and material needed to open and operate the mine for the 10-year period.
3. Areas disturbed (about 1,272 acres) during the 10-year period of mining would be unreclaimed or at best only partially reclaimed.
4. The consumer of coal from the mine would need to obtain coal from another source.
5. The reduction in labor force would cause socioeconomic impacts to the region.
6. In the event that mining would still occur on nonpublic lands, the above impacts would be lessened but would still be significant.

RECLAMATION METHODOLOGY ALTERNATIVE

This alternative lists recommendations which, if implemented, would reduce impacts on surface water quality (erosion) and air quality.

1. Backfilled slopes would be designed low and the length of slopes short.
2. All suitable topsoil and suitable overburden would be conserved for subsequent placement on disturbed areas.
3. Appropriate soil amendments would be used to improve soil structure.
4. Fertilization of topsoil would be done based on soil analyses.
5. All topsoiled areas would be mulched and additional organic matter added.
6. Supplemental irrigation would be employed for the first two growing seasons. Application rates would be based on soil moisture monitoring.

This alternative, if implemented, would result in the use of methodology that would enhance rapid establishment of vegetation. The vegetation would decrease soil erosion from water action and decrease the emission of dust from treated areas.

The grading of all disturbed areas to less than moderate slopes would enhance revegetation, but would result in such areas having less topographical diversity. Moderate and steeper slopes provide seasonal and (or) yearround habitat for wildlife and provide protection from storms for livestock and wildlife.

Care would need to be taken to avoid creating conditions unfavorable to native plant species proposed in seeding mixtures. Many of these species are adapted to soils with low to moderate productivity.

DEFER ACTION ALTERNATIVE

For proper cause, the Secretary may defer final action on this proposed mining and reclamation plan. This could include, but is not limited to, the need and time required for:

1. Modification of the proposal to correct specific administrative or technological deficiencies. (No need for additional changes or alternatives was identified during the public review beyond those which are already presented.)

2. Redesign to reduce or avoid specific environmental impact. In the public review, several comments were received concerning the impacts of this proposed mining to sage grouse strutting grounds. As a result the following alternative is presented: Approval of the mining and reclamation plan would be deferred pending the Cumberland Coal Company modification of the plan to avoid impacts to sage grouse strutting grounds.

The principal effects of deferring action on the proposed mining and reclamation plan would be (a) a short-term delay, (b) presumably some reduction or avoidance of significant adverse impacts to sage grouse strutting grounds, (c) economic loss to Cumberland Coal Company from delay of approval and loss of coal due to restriction in mining boundaries.

3. Acquisition of additional data to provide an improved basis for technical or environmental evaluation.

In the public review, several comments were received concerning the probability of successful reclamation. As a result the following alternative is presented: Approval of the mining and reclamation plan would be deferred pending the Cumberland Coal Company demonstrating on site that lands proposed for mining or other disturbances would be reclaimable within a reasonable period of time.

The principal effects of deferring action on the proposed mining and reclamation plan would be (a) a short-term delay, (b) presumably some reduction or avoidance of certain significant adverse impacts, (c) economic loss to Cumberland Coal Company from delay of approval, (d) the market for which Cumberland Coal Company has proposed to deliver coal would need to find another source of coal, and (e) possible reduction in the Cumberland Coal Company labor force.

4. Further evaluation of the proposal and (or) alternatives. (No need for additional changes or alternatives was identified during the public review beyond those which are already identified.)

PREVENT (FURTHER) DEVELOPMENT ON THE LEASE ALTERNATIVE

The Secretary may reject any individual proposed activity that does not meet the requirements of applicable laws and regulations under his authority, including the potential for environmental impact that could be reduced or avoided by adoption of a significantly different disigned course of action by the lessee (operator). This may be accomplished by suspension of operations (if ongoing), cancellation of the lease (if environmentally acceptable development is not possible), federal acquisition of the lease, or rejection of the mining and reclamation plan. (No need for additional changes or alternatives was identified during public review beyond those which are already presented.)

RESTRICT DEVELOPMENT ON THE LEASE ALTERNATIVE

This alternative could be applied to all or a portion of the lease, as appropriate. The subject lease conveys the right to develop, produce, and market the federal coal resource if all other terms and conditions are met by the lessee. Various measures that may tend to restrict development may be taken by the Secretary at any time in the interest of conservation of the resources or in the protection of various specific environmental values in accordance with existing laws and regulations; for example, the National Historic Preservation Act of 1966, the Endangered Species Act of 1973, the Surface Mining Control and Reclamation Act of 1977, etc. (No need for additional changes or alternatives was identified during public review beyond those which are already presented.)

ALLOW DEVELOPMENT OF SELECTED AREAS NOW UNDER LEASE ALTERNATIVE

This alternative would permit only selective exploration and development of existing leaseholds based on anticipated adverse environmental consequences. The decision maker has the authority and responsibility to evaluate the coal resources and impacts of mining on these leases prior to acting on the proposals. Exploration and development could be allowed only on those leaseholds, or portions thereof, that would have the lowest anticipated adverse environmental consequences. Weighing the tradeoffs of mining or precluding mining on selected tracts is part of the evaluation and decision process. Adoption of this alternative would reduce adverse effects by reducing the area in which the impacting activities could take place. (No need for additional changes or alternatives was identified during public review beyond those which are already presented.)

CHAPTER 9

CONSULTATION AND COORDINATION

See the Regional Environmental Statement (ES) for a description of the consultation and coordination efforts involved in the preparation of the ES.

SOUTH HAYSTACK SITE-SPECIFIC ES APPENDIX

SOIL ASSOCIATION MAPPING UNIT DESCRIPTIONS

A description of each soil association mapping unit within the South Haystack project area follows. These descriptions and Table SHA-1 are intended for use with the South Haystack soils map found in Chapter 2.

213—Alluvial Fans, Clayey Soils, Gently Sloping and Sloping

These soils are moderately deep to deep, well drained, calcareous, strongly alkaline silty clays on sloping alluvial fans. These soils have developed over alluvium. Dominant vegetation is greasewood.

221—Terrace Escarpments, Gently Sloping to Steep

Forty percent of the mapping unit is in Terrace Escarpment which consists of gravelly and cobbly alluvium on edges and faces of old high terraces. Another 40% consists of very shallow, well-drained clay loams that have developed over sedimentary rock. The remaining are moderately deep to deep, well drained loams and clay loams. Rock outcrop occupies about 10% of the association. Dominant vegetation is sagebrush.

225—Mountain Tops and High Plateaus, Shallow Soils

The majority of soils in this unit are very shallow to shallow, well drained, noncalcareous, very stony and channery fine sandy loams that have developed over sedimentary rock. These soils occupy moderately steep uplands. Also found in this unit are soils that are deep, well drained fine sandy loams on gently sloping alluvial fans. Rock outcrop occupies 20% of the mapping unit. Dominant vegetation is sagebrush.

229—Alluvial Toe Slopes, Fine-Loamy Soils, Gently Sloping to Sloping

These soils occupy nearly level to moderately sloping alluvial fans and toe slopes of uplands. The soils are moderately deep to deep, moderately alkaline, well-drained calcareous loams and sandy loams developed over alluvium. Slopes are from 1%-5%. Dominant vegetation is sagebrush.

231—Residual Uplands, Shallow Clayey Soils, Moderately Steep and Steep

Soils of this unit occupy steep slopes, are shallow to very shallow, and have developed over sandstone and shale. They are well drained, silty clays over shale and fine sandy loams over sandstone. About 10% of the mapping unit is Terrace Escarpment land type and about 10% is rock outcrop. Dominant vegetation is sagebrush.

236—Residual Uplands, Shallow Fine-Loamy Soils, Gently Sloping to Steep

These soils consist of shallow, well-drained, calcareous clay loams on gently sloping to steep uplands. These soils range from 3% to 30% slope and have developed over shale residium. Rock outcrop occupies 5% of the mapping unit. Dominant vegetation is saltbush.

237—Residual Uplands, Red Shallow Soils, Juniper Breaks, Steep

These soils consist of shallow, well-drained, calcareous fine sandy loams and sandy clay loams on steep slopes of upland hills and ridges. Slopes range up to 60%. These soils have developed over residium of red sandstone and shale. Rock outcrop occupies around 10% of the mapping unit. Dominant vegetation is juniper.

238—Residual Uplands, Clayey Soils, Nearly Level

These soils consist of moderately deep, well-drained, noncalcareous, mildly alkaline clay loams on nearly level residual uplands. These soils have formed on residium

Table SHA-1

SOIL ASSOCIATION CHARACTERISTICS

Map Unit No.	Map Unit Name[1]	% of Map Unit	Subgroup	Family	Effective Root Depth	Soil Reaction (pH)	Natural Soil Drainage	Potential Runoff	Permea-bility	Available Water Capacity
213	Alluvial fans, clayey soils, gently sloping and sloping	100	Ustic Torriorthents	Fine, montmorillonitic (calcareous), frigid	20-40	8.5-9.2	Well-mod. well	Moderate	Slow	Moderate
221	Terrace escarpments, gently slopint to steep	40	Terrace Escarpments land type							
		30	Ustic Torriorthents	Loamy, mixed (calcaresou) frigid, shallow	<10	8.2-8.4	Excessive	Low	Slow	Very low
		15	Aridic Argiborolls	Loamy-skeletal, mixed	20-40	7.4-8.4	Well	Moderate	Moderate	Low
		10	Rock Outcrop (sandstone and shale)							
		5	Borollic Haplargids	Fine-loamy, mixed	20-40	7.4-9.0	Well	Moderate	Moderate	Moderate
225	Mountain tops and high plateaus, shallow soils	40	Borollic Lithic Camborthids	Loamy-skeletal, mixed	<10	7.6-8.4	Well	Moderate	Mod.-rapid	Very low
		25	Lithic Ustic Torriorthents	Loamy-skeletal, mixed (calcareous), frigid	<10	7.9-8.4	Well	Moderate	Mod.-rapid	Very low
		20	Rock Outcrop (sandstone)							
		10	Ustic Torriorthents	Clayey, montmorillonitic (calcareous), frigid, shallow	10-20	7.9-9.0	Well	High	Slow	Very low
		5	Ustic Torriorthents	Coarse-loamy, mixed, nonacid, frigid	20-40	7.4-7.8	Well	Low	Mod.-rapid	Moderate
229	Alluvial toe slopes, fine-loamy soils, gently sloping to sloping	50	Borollic Haplargids	Fine-loamy, mixed	20-40	7.2-8.4	Well	Moderate	Moderate	Moderate
		50	Borollic Calciorthids	Fine-loamy, mixed	20-40	8.2-9.0	Well	Low	Moderate	Moderate

Table SHA-1

SOIL ASSOCIATION CHARACTERISTICS
(Continued)

Map Unit No.	Map Unit Name[1]	% of Map Unit	Subgroup	Family	Effective Root Depth	Soil Reaction (pH)	Natural Soil Drainage	Potential Runoff	Permea-bility	Available Water Capacity
231	Residual uplands, shallow clayey spoils, moderately steep and steep	40	Ustic Torriorthents	Clayey, montmorillonitic (calcareous), frigid shallow	10-20	7.9-9.0	Well	High	Slow	Very low
		40	Lithic Ustic Torriorthents	Loamy-skeletal, mixed (calcareous), frigid	<10	7.9-8.4	Well	Moderate	Mod.-rapid	Very low
		10	Terrace Escarpment land type							
		10	Rock Outcrop (sandstone and shale)							
236	Residual uplands, low fine-loamy soils, gently sloping to steep	95	Ustic Torriorthents	Loamy-mixed (calcareous), frigid, shallow	<10	7.9-8.4	Well	High	Slow	Very low
		5	Rock Outcrop (sandstone and shale)							
237	Residual uplands, red shallow soils, juniper breaks, steep	90	Ustic Torriorthents	Loamy, mixed (calcareous), frigid, shallow	10-20	8.0-8.4	Excessive	Moderate	Mod.-rapid	Low
		10	Rock Outcrop (sandstone and shale)							
238	Residual uplands, clayey soils, nearly level	100	Borollic Haplargids	Fine, montmorillonitic	20-30	7.4-8.4	Well	Low	Mod.-slow	Low

Note: Table derived from information obtained from contract with U.S. Department of Agriculture, Soil Conservation Service 1977.

[1]Unit names were derived from geomorphic setting of the soil.

Table SHA-1

SOIL ASSOCIATION CHARACTERISTICS
(Continued)

Permeability			Available Water Capacity	
In/Hour	Class		In/60" Profile*	Class
0.06	Very slow		0 - 3	Very low
0.06 - 0.2	Slow		3 - 6	Low
0.2 - 0.6	Mod. Slow		6 - 9	Moderate
0.6 - 2.0	Moderate		9 -12	High
2.0 - 6.0	Mod. rapid		12+	Very high
6.0 -20	Rapid			
20+	Very rapid		*or to limiting layer	

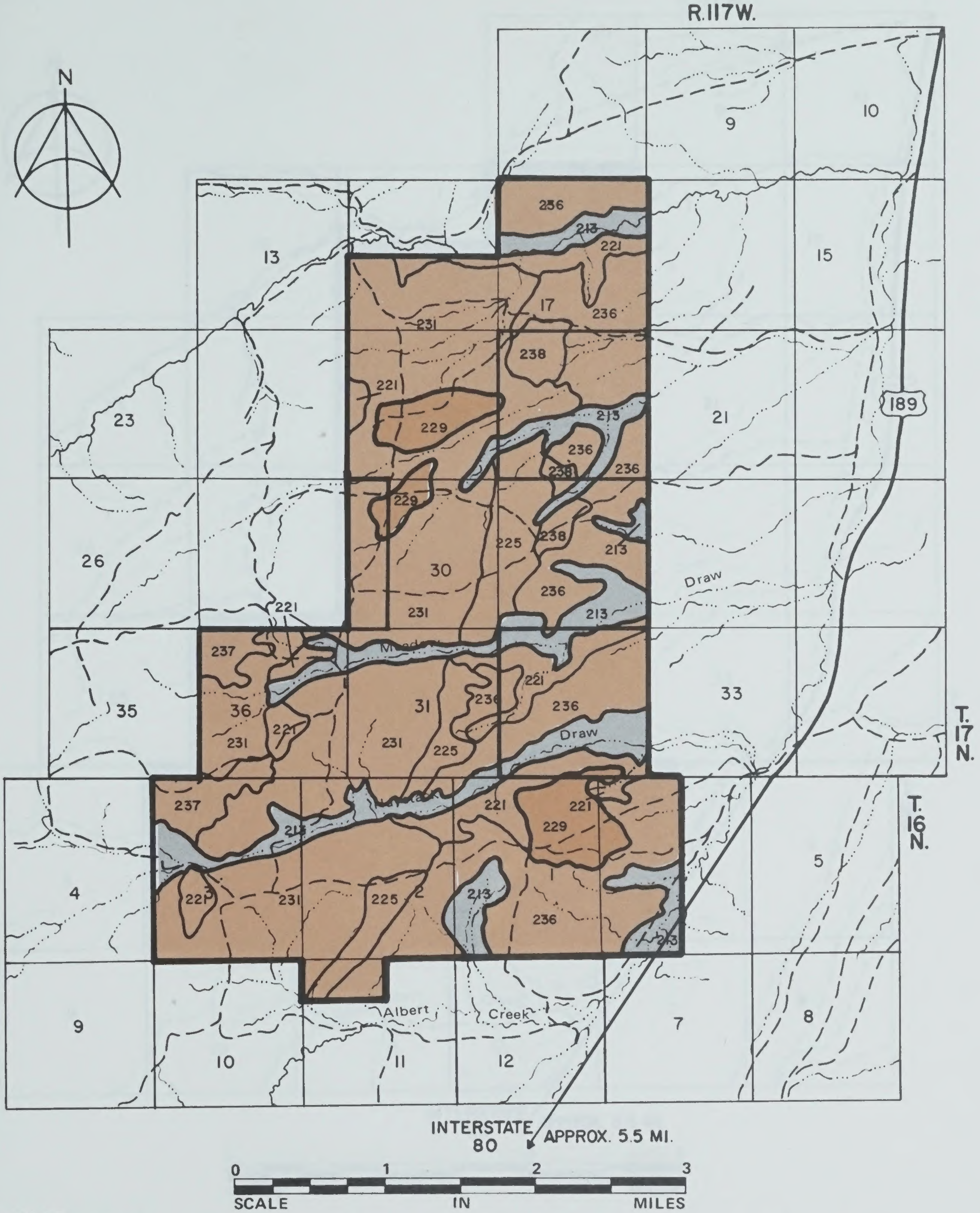
Note: Classes derived from "Supplement to Guide to Authors of Published Survey," TSC Transm. Sheet L1-1, U.S. Department of Agriculture, Soil Conservation Service, 1971.

from sandstones and occupy 1% to 2% slopes. Dominant vegetation is sagebrush.

Map SH1 - 1

SURFACE AND MINERAL STATUS

SOUTH HAYSTACK



LEGEND

DEEP

MODERATELY DEEP

SHALLOW

213 ALLUVIAL FANS, CLAYEY SOILS, GENTLY SLOPING AND SLOPING

221 TERRACE ESCARPMENTS, GENTLY SLOPING TO STEEP

225 MOUNTAIN TOPS AND HIGH PLATEAUS, SHALLOW SOILS,

229 ALLUVIAL TOE SLOPES, FINE-LOAMY SOILS, GENTLY SLOPING TO SLOPING

231 RESIDUAL UPLANDS, SHALLOW CLAYEY SOILS GENTLY SLOPING TO STEEP

236 RESIDUAL UPLANDS, SHALLOW FINE-LOAMY SOILS, GENTLY SLOPING TO STEEP

237 RESIDUAL UPLANDS, RED SHALLOW SOILS, STEEP

238 RESIDUAL UPLANDS, CLAYEY SOILS, NEARLY LEVEL

Map SH2 - 5A

SOILS

SOUTH HAYSTACK

LEGEND

TYPE 14 GREASEWOOD

TYPE 13 SALTBUSH

TYPE 9 JUNIPER

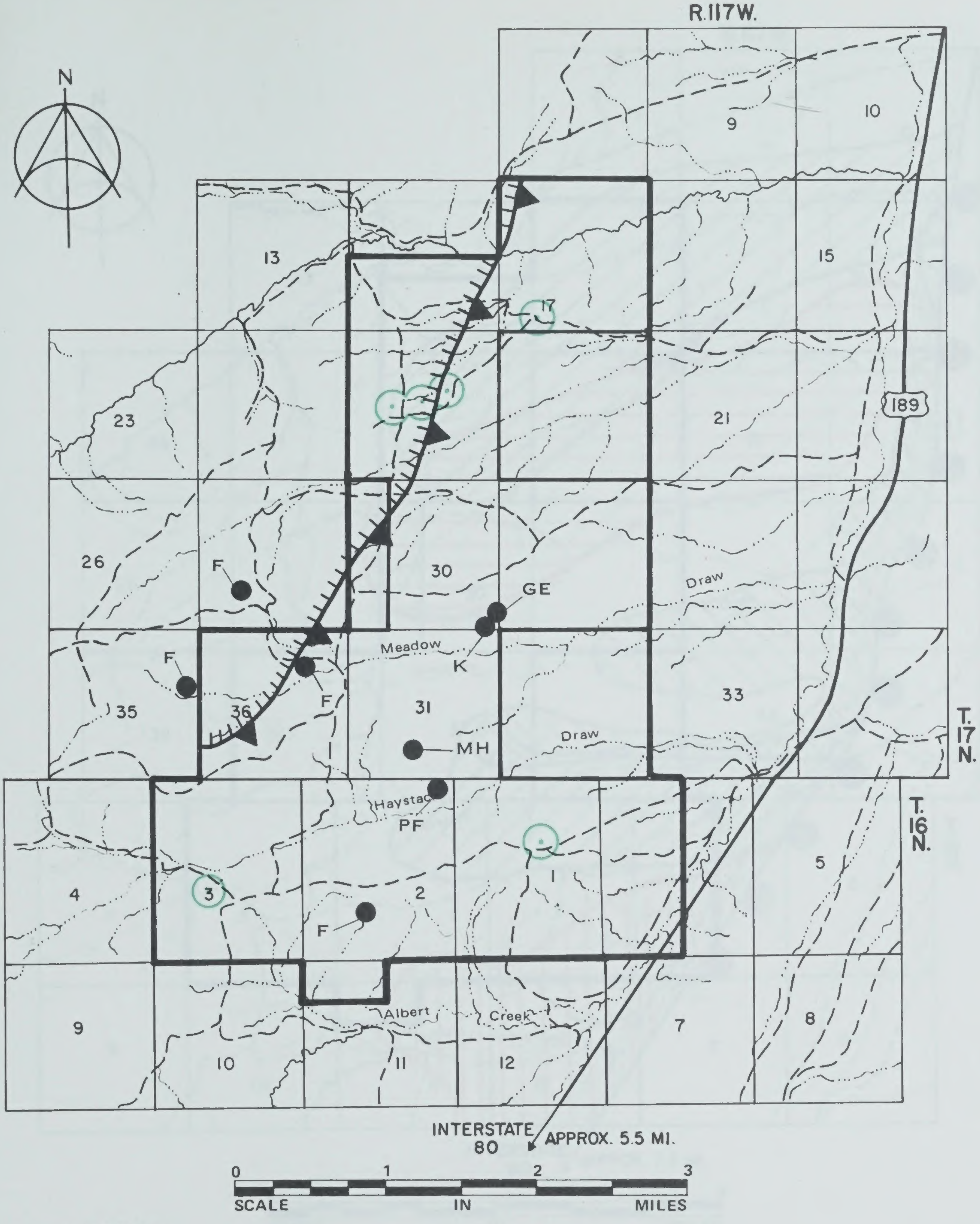
TYPE 4 SAGEBRUSH

TYPE 1 GRASSLAND

Map SH2 - 7A

VEGETATION TYPES

SOUTH HAYSTACK



LEGEND

DEER WINTER AND YEARLONG RANGE

DEER SUMMER RANGE

SAGE GROUSE STRUTTING GROUND

Entire area is antelope and sage grouse summer range.

RAPTOR NEST

PF PRAIRIE FALCON

GE GOLDEN EAGLE

K KESTREL

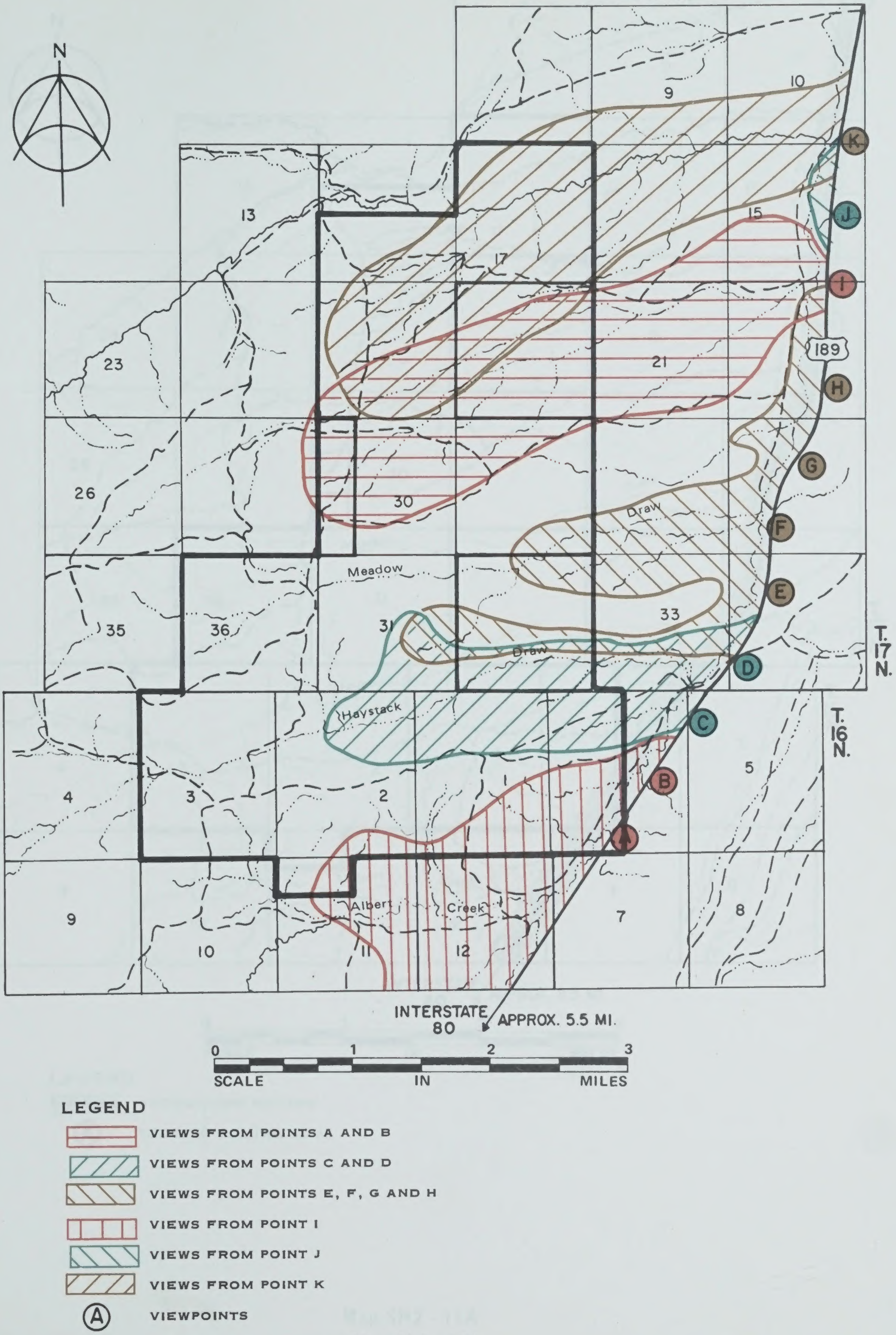
MH MARSH HAWK

F FERRUGINOUS HAWK

Map SH2 - 8A

ANIMAL DISTRIBUTION

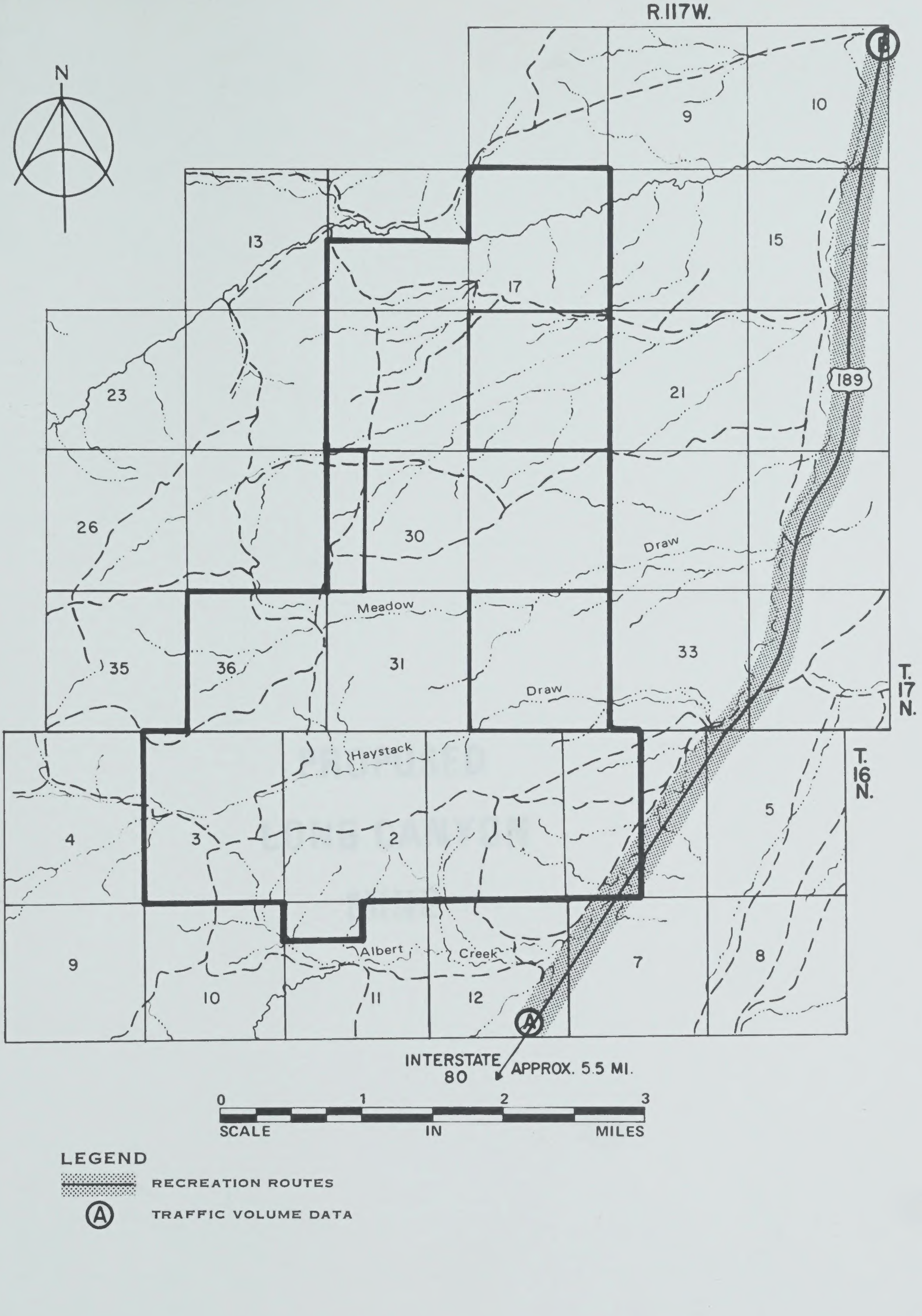
SOUTH HAYSTACK



Map Sh2 - 10A

VIEWPOINTS AND VIEWS

SOUTH HAYSTACK



Map SH2 - 11A

RECREATION ROUTES

SOUTH HAYSTACK

PROPOSED LONG CANYON MINE

TABLE OF CONTENTS

LONG CANYON MINE PROPOSAL

Chapter 1	Page
DESCRIPTION OF THE PROPOSED ACTION	LC1-1
HISTORY AND BACKGROUND	LC1-1
PROPOSED ACTION	LC1-1
Purpose	LC1-1
Location	LC1-2
Predisturbance Inventories and Analyses	LC1-2
Mine	LC1-2
Facilities	LC1-2
Support Developments	LC1-2
Stages of Implementation	LC1-9
Mining Procedures	LC1-9
Water-Control Structures	LC1-9
RECLAMATION	LC1-9
Pollution Control Methods	LC1-11
AUTHORIZING ACTIONS	LC1-11
Bureau of Land Management (BLM)	LC1-16
U.S. Geological Survey	LC1-16
State and County	LC1-16
INTERRELATIONSHIPS	LC1-16
Relationship to BLM Land Use Plans	LC1-16
Relationship to Other Proposed and Future Actions	LC1-16
Relationship to Rail Transportation	LC1-16

Chapter 2	
DESCRIPTION OF THE ENVIRONMENT	LC2-1
EXISTING ENVIRONMENT	LC2-1
CLIMATE	LC2-1
Sunshine	LC2-1
Wind Fields	LC2-1
Atmospheric Temperature and Stability	LC2-1
Moisture and Evapotranspiration	LC2-1
Severe Weather Events	LC2-1
AIR QUALITY	LC2-1
GEOLOGY	LC2-2
Stratigraphy	LC2-2
Paleontology	LC2-2
Structure	LC2-2
Geologic Hazards	LC2-2
TOPOGRAPHY	LC2-2
SOILS	LC2-2
WATER RESOURCES	LC2-4
Ground Water	LC2-4
Ground Water Quality	LC2-4
Surface Water	LC2-4
Surface Water Quality	LC2-10
VEGETATION	LC2-10
Terrestrial Vegetation	LC2-10
Aquatic Vegetation	LC2-10
FISH AND WILDLIFE	LC2-10
General Information	LC2-10
Fishery	LC2-10
Wildlife	LC2-10
Wild Horses	LC2-12
CULTURAL RESOURCES	LC2-12
Archeological	LC2-12
Historical	LC2-12
VISUAL RESOURCES	LC2-12
RECREATIONAL RESOURCES	LC2-16
Visitor Use Data	LC2-16
Hunting	LC2-16
Sightseeing	LC2-16
Wilderness Values	LC2-16
AGRICULTURE	LC2-16
MINERAL RESOURCES	LC2-16
Coal	LC2-16
Oil and Gas	LC2-18
LAND USE PLANS, CONTROLS, AND CONSTRAINTS	LC2-18
TRANSPORTATION NETWORKS	LC2-18
Highways	LC2-18
Railroad	LC2-18
SOCIOECONOMIC CONDITIONS	LC2-18

TABLE OF CONTENTS (Cont'd)

LONC CANYON MINE PROPOSAL

Chapter 2 (Cont'd)	Page
Population	LC2-18
Employment	LC2-22
Income	LC2-22
Infrastructure	LC2-22
Attitudes and Expectations	LC2-27
Life Styles	LC2-27
FUTURE ENVIRONMENT	LC2-27
Chapter 3	
ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION	LC3-1
ASSUMPTIONS AND ANALYSIS CUIDELINES	LC3-1
Assumptions	LC3-1
Cuidelines	LC3-1
AIR QUALITY	LC3-1
Emissions from the Proposed Mine	LC3-1
Impact on Air Quality	LC3-3
Gaseous Pollutants	LC3-3
Visibility	LC3-3
GEOLOGY	LC3-3
Paleontology	LC3-3
Geologic Hazards	LC3-8
TOPOCRAPHY	LC3-8
SOILS	LC3-8
WATER RESOURCES	LC3-9
Cround Water	LC3-9
Surface Water	LC3-9
Water Use	LC3-9
VECETATION	LC3-9
Terrestrial	LC3-9
Aquatic	LC3-10
Endangered and Threatened	LC3-10
FISH AND WILDLIFE	LC3-10
Ceneral Information	LC3-10
Habitat Losses	LC3-14
Carrying Capacity Losses	LC3-14
Fish and Wildlife Population Loss	LC3-14
Wild Horses	LC3-17
CULTURAL RESOURCES	LC3-17
Archeological	LC3-17
Historical	LC3-17
VISUAL RESOURCES	LC3-17
Summary of Visual Contrast Ratings (Table LC3-10A)	LC3-17
RECREATIONAL RESOURCES	LC3-19
Visitor Use Data	LC3-19
ACRICULTURE	LC3-19
Livestock Crazing	LC3-19
Prime Farmland	LC3-19
MINERAL RESOURCES	LC3-19
Coal	LC3-21
Oil and Gas	LC3-21
TRANSPORTATION NETWORKS	LC3-21
SOCIOECONOMIC CONDITIONS	LC3-21
Population	LC3-21
Employment	LC3-21
Income	LC3-26
Infrastructure	LC3-26
Social Services and Facilities	LC3-26
Attitudes and Expectations	LC3-26
Life Styles	LC3-28

TABLE OF CONTENTS

LONG CANYON MINE PROPOSAL

Chapter 4	Page
MITIGATING MEASURES NOT INCLUDED IN THE PROPOSED ACTION	LC4-1
MEASURES	LC4-1
Mining and Reclamation Plan	LC4-1
Rights-of-Way	LC4-2
ANALYSIS OF EFFECTIVENESS	LC4-2
MONITORING, RESEARCH AND STUDY PROGRAMS	LC4-3
Chapter 5	
ANY ADVERSE IMPACTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED	LC5-1
AIR QUALITY	LC5-1
GEOLOGY	LC5-1
Paleontology	LC5-1
SOILS	LC5-1
WATER RESOURCES	LC5-2
VEGETATION	LC5-2
FISH AND WILDLIFE	LC5-2
CULTURAL RESOURCES	LC5-2
VISUAL RESOURCES	LC5-3
RECREATIONAL RESOURCES	LC5-3
Visitor Use Data	LC5-3
AGRICULTURE	LC5-3
MINERAL RESOURCES	LC5-3
TRANSPORTATION	LC5-3
SOCIOECONOMIC CONDITIONS	LC5-4
Population	LC5-4
Social Conditions	LC5-4
Chapter 6	
THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY	LC6-1
Chapter 7	
ANY IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED	LC7-1
Chapter 8	
ALTERNATIVES	LC8-1
NO ACTION	LC8-1
AIR QUALITY	LC8-1
Best Management Practices	LC8-1
FISH AND WILDLIFE ALTERNATIVE	LC8-1
SURFACE FACILITY RELOCATION ALTERNATIVE	LC8-4
LONG CANYON RECLAMATION ALTERNATIVE	LC8-4
RECLAMATION METHODOLOGY ALTERNATIVE	LC8-6
DEFER ACTION ALTERNATIVE	LC8-6
PREVENT (FURTHER) DEVELOPMENT ON THE LEASE ALTERNATIVE	LC8-7
RESTRICT DEVELOPMENT ON THE LEASE ALTERNATIVE	LC8-7
ALLOW DEVELOPMENT OF SELECTED AREAS NOW UNDER LEASE ALTERNATIVE	LC8-7
Chapter 9	
CONSULTATION AND COORDINATION	LC9-1
LONG CANYON SITE SPECIFIC APPENDIX	
SOIL ASSOCIATION MAPPING UNIT DESCRIPTIONS	LCA-1

CHAPTER 1

DESCRIPTION OF THE PROPOSAL

HISTORY AND BACKGROUND

The Long Canyon Mine, located 21 miles north-northeast of Rock Springs, Wyoming (Map 1, Appendix A), is planned to be an underground mine by the Rocky Mountain Energy Company (RME) and Sunoco Energy Development Company (SUNEDCO). At full production, the Long Canyon Mine would supply about 2 million tons of coal per year to steam electric power plants in Idaho, Oregon, and Utah.

The public coal land involved was leased on 1 July 1968, under federal coal lease W-0313201 (14,680 acres; not all lease acres in project area), to Sun Oil Company and subsequently assigned to SUNEDCO (a wholly owned subsidiary of Sun Oil Company) on 1 January 1976. This lease with the Bureau of Land Management (BLM) is a continuing lease subject to a reasonable readjustment of terms on a 20-year basis. It provides for a royalty of 15 cents a ton (2,000 pounds) for the first 10 years of the lease and 17½ cents a ton for the second 10 years of the lease. The annual rental is set at 25 cents per acre for the first year; 50 cents for the second, third, fourth, and fifth years; and 1 dollar for the sixth and each succeeding year during the continuance of the lease. Rental for any year would be credited against the first royalties as they accrue. If, by the end of the fifth lease year, production royalties for any lease year have not equaled or exceeded 5 dollars an acre, the rental for the sixth and each succeeding year shall be increased from 1 dollar to 5 dollars an acre until such time as production royalties for any lease year equal or exceed the latter amount, whereupon the rental shall revert to 1 dollar per acre per year. The lease is subject to all current legislation affecting coal leases.

The federal lease also requires that a mining and reclamation plan and an environmental assessment be filed with the Office of the District Mining Supervisor, U.S. Geological Survey (USGS). A mining and reclamation plan in compliance with 30 Code of Federal Regulations (CFR) 211 (May 1976) and an environmental impact assessment for the expected 33 year life of the Long Canyon Mine was filed with the Office of the District Mining Supervisor, USGS, Conservation Division, Rock Springs, Wyoming, by SUNEDCO and RME in June 1976 (Sunoco Energy Development Company and Rocky Mountain Energy Company 1976). A revised mining and reclamation plan was filed on 28 January 1977 (Sunoco Energy Development Company and Rocky Mountain Energy Company 1977). This plan is available for public review at the Rock Springs office of the USGS. The USGS has accepted the Long Canyon mining and reclamation plan as suitable for use in preparing an environmental statement.

SURFACE MINING CONTROL AND RECLAMATION ACT

The mining and reclamation plan for this proposed project was submitted for review prior to passage of the Surface Mining Control and Reclamation Act (SMCRA) of 1977 (P.L. 95-87). Therefore, the plan may not fully reflect the requirements of the current law and regulations. However, it is believed that it presents sufficient data to permit analysis of the impacts that would be associated with mining in this area. Prior to departmental approval, the plan will be returned to the applicant for modification to incorporate the requirements of SMCRA. When the mining and reclamation plan is returned to the Department, it will be reevaluated to insure that it meets the requirements of SMCRA and appropriate federal regulations, and that the potential impacts are covered by this environmental statement (ES). This procedure will facilitate the timely and efficient consideration of applications for permits under the evolving requirements of SMCRA. We believe this procedure is reasonable in view of the evolving character of the law.

The regional ES, Chapter 3, Planning and Environmental Controls, includes reference to appropriate provisions of SMCRA, and these were incorporated into the following impact analysis to the extent possible at this time. However, it is realized that some of the adverse impacts described will be precluded by implementation and enforcement of the new law. This is especially true in regard to impacts on the water, soil, and vegetation resources. In any event, the worst possible case is covered.

PROPOSED ACTION

Purpose

The purpose of the proposed action is to consider for approval the mining and reclamation plan and the needed rights-of-way that would allow mining of approximately 63 million tons of coal at a full production rate of 2 million tons annually for a projected mine life of 33 years.

Location

The proposed mine operation would be located 21 miles north-northeast of Rock Springs, Wyoming, and 8 miles northwest of Superior, Wyoming (Map 1, Appendix A). The project area contains 31,360 acres (Table LC1-1).

Surface facilities would be constructed on public land in Section 20, T. 22 N., R. 103 W. Figure LC1-1 shows the general mine location and Map LC1-1 depicts the project boundary and mineral status.

Predisturbance Inventories and Analysis

Specific inventories have been conducted or are pending under the direction and (or) cooperation of SUNEDCO in consultation with the BLM concerning endangered and (or) threatened plants, archeological sites, and historical sites.

An inventory of the proposed Long Canyon project area for proposed endangered and (or) threatened plant species is planned for the summer of 1978.

In 1976, Michael Metcalf, Western Wyoming College, conducted an archeological survey of some lands within the project area (see Chapter 2, Cultural Resources).

Historical research by Western Interpretive Services, Inc., in 1976 revealed no historical sites on the project area.

Analyses have been done to determine physical and chemical properties of topsoil and overburden. The analyses assist in identifying the suitability of materials for plant growth medium and in determining possible problems with materials toxic to plants and (or) animals.

The analyses indicated (1) adequate surface soil quantities and qualities for topsoil use, (2) some overburden layers with high sodium adsorption ratio values, and (3) some overburden layers with high exchangeable sodium percentage.

Typical coal analysis of the number 1 coal seam is shown on Table LC1-2.

Mine

The company proposes to open the Long Canyon Mine using continuous miners for development and room and pillar mining where necessary, but with longwall mining being the preferred method to be used where feasible. Construction at the mine would start in early 1978 with 100 employees. Maximum production would require 400 employees by the fourth year of operation in 1983. Total production is estimated at 63 million tons of coal for the life of the mine. Production is presently scheduled to begin in 1980 at a rate of one-half million tons per year, increasing to an annual rate of 2 million tons per year by 1983, and continuing at that rate for the life of the mine.

Facilities

The surface facilities would consist of an office and shop complex and coal-handling facilities. Approximately 3 miles of fencing would be needed to encompass the entire mine facility and the service roads. Heavy duty cattle guards would be constructed at all access points.

Office and Shop

The surface facilities near the mine portals include an office, maintenance shop, warehouse, change house for mechanics and supervisors, hoist house, crusher building, coal preparation plant, material storage yards, employee parking lot, fuel tanks, security office, 34.5-kv substations, and a sewage treatment facility. One-quarter mile to the east-southeast would be the miners change house, parking lot, and a vertical air and man shaft. Within the area would be the potable water storage tank and the explosives storage magazines. Figure LC1-2 shows the proposed layout of these facilities.

Mining Equipment

Table LC1-3 lists the major mining equipment to be used at maximum mine development and production.

Coal Handling Facilities

Primary Crushing Station. Coal, would be conveyed into the primary crusher and screening facility as it comes from the mine.

Preparation Plant. After crushing, the coal would be moved by conveyor belt to either the outside storage pile or to the coal preparation plant and then to the storage piles. This plant, at present, is not planned; however, this plant and fine slurry pond are analysed in this statement.

Coal Storage. From the outside storage piles, designed for 60,000 tons of storage capacity (20,000 tons of this is line capacity), coal can move either to the railroad loadout station (at up to 3,500 tons per hour) or to the secondary 40,000 ton storage piles within the railroad loop.

Train Loadout. Feeder belts in a reclaim tunnel beneath the storage pile would carry the coal to the loadout station. One hundred short tons of coal would be placed in each car of the train. Trains would have between 80 and 110 cars.

Support Developments

Service and access to the property would be over a newly constructed road, a power line, telephone lines, and a railroad spur (Table LC1-4). The total length of the road and adjacent power and telephone lines would be approximately 7 miles. The road would be paved or oiled gravel construction and properly drained. The power line would be 34.5 kv overhead construction. The

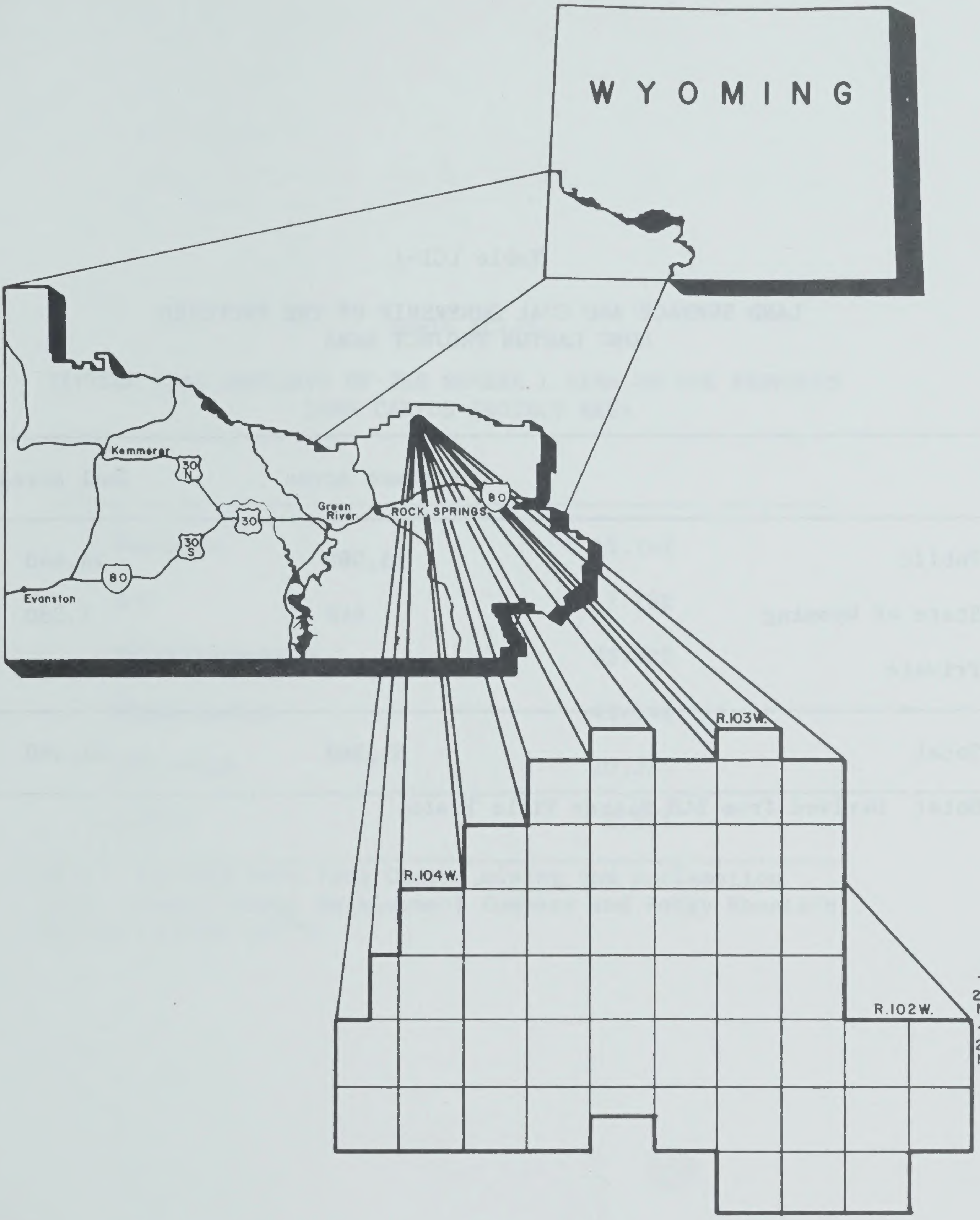


FIGURE LC 1 - 1

GENERAL LOCATION OF

PROPOSED LONG CANYON PROJECT AREA

Table LC1-1

LAND SURFACE AND COAL OWNERSHIP OF THE PROPOSED LONG CANYON PROJECT AREA

	Surface Acres	Coal Acres
Public	15,080	14,440
State of Wyoming	640	1,280
Private	15,640	15,640
Total	31,360	31,360

Note: Derived from BLM Master Title Plats.

Table LC1-2

TYPICAL COAL ANALYSIS OF THE NUMBER 1 SEAM ON THE PROPOSED LONG CANYON PROJECT AREA

Moisture	15.16%
Ash	7.78%
Volatile matter	33.92%
Fixed carbon	43.14%
BTU value	10,310
Sulfur	0.59%

Note: Derived from Long Canyon mining and reclamation plan (Sunoco Energy Development Company and Rocky Mountain Energy Company 1977).

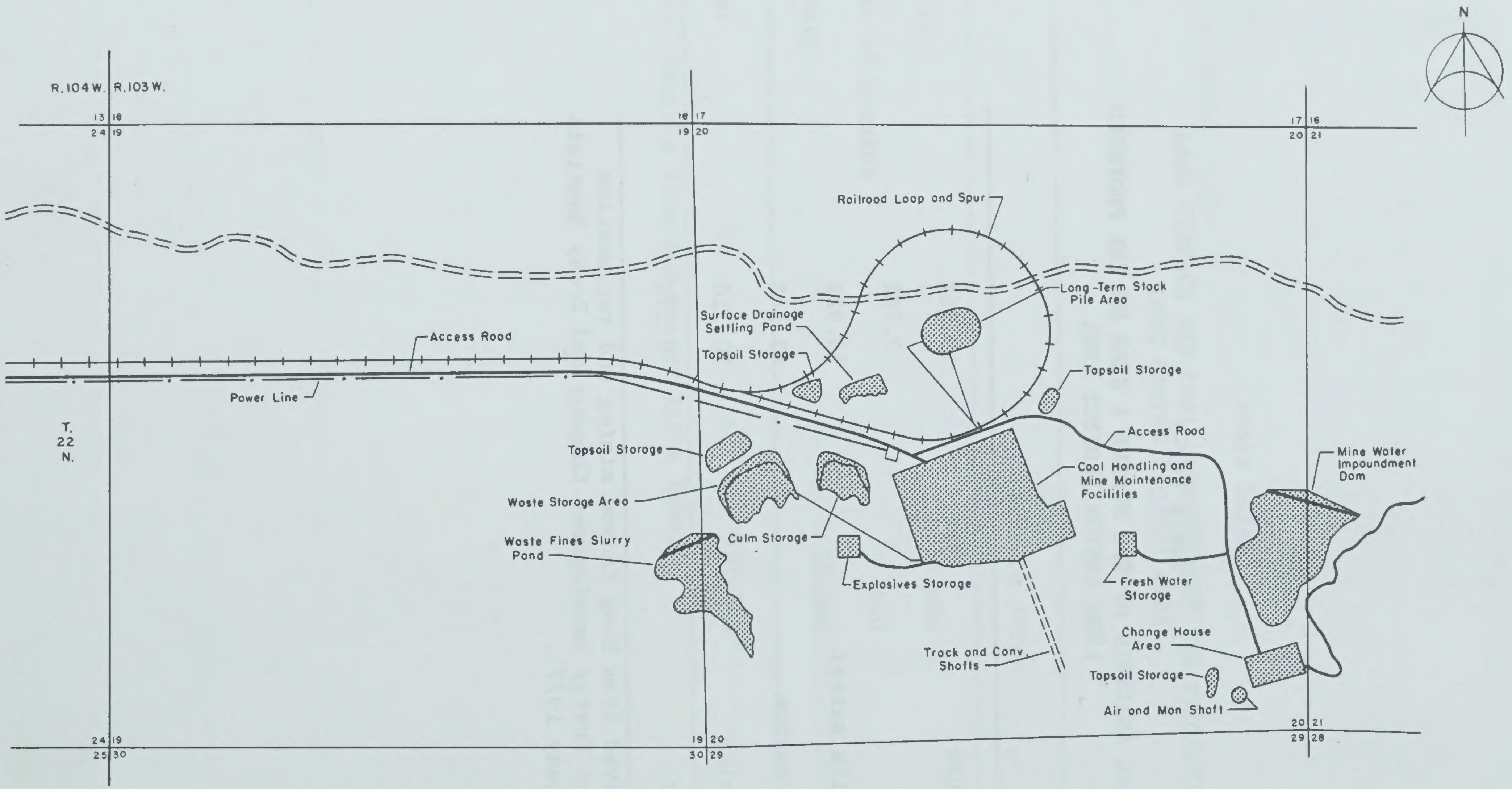


Figure LC1 - 2

LAYOUT OF SURFACE FACILITES, STORAGE AREAS, AND WATER IMPROVEMENTS

LONG CANYON

Table LC1-3

MAJOR MINING EQUIPMENT FOR PROPOSED LONG CANYON MINE

Item	Number
Production equipment[1]	
8-inch drum, 12-foot reach continuous miners	14
10-ton shuttle cars (or some bridge conveyors)	28
Twin boom roof bolters	14
Bulk rock dusters	14
Belt feeder breakers	14
7,000-foot-long, 42-inch main conveyor	1
5,000-foot-long, 42-inch submain conveyor	3
5,000-foot-long, 36-inch panel conveyors	10
Support equipment	
Single boom roof bolters	2
Portable rock dusters	2
Supply wagons, mechanic wagons, personnel carriers, boss buggies, utility vehicles	Fleet
Permissible RT tractors	3
Underground ambulances	2
Road grader	
Boom type miner	
Miscellaneous support equipment	
Surface mobile equipment	
50-ton truck crane	1
15-ton hydraulic cranes	2
Patrol grader	
10-ton trucks	2
Flat beds	
Pickup trucks	
Mechanic wagons	
D-8 dozer	
Compactor	
3½ to 10 yard front-end loaders	2
Miscellaneous surface equipment	

[1]This equipment list would be modified if the longwall mining method is used.

Table LC1-4

PROPOSED SUPPORT FACILITIES FOR THE LONG CANYON MINE

Applicant	Proposed Facilities	Application Number	Total Length (Miles)	Width (Feet)	Acres Required Public	Acres Required Private	Location of Public Land Affected
None Yet	Access road	None yet	6 (3 miles public land)	175	42	42	Secs. 22, 24, and 28, T. 22 N., R. 104 W.
None Yet	Power line and telephone line corridor	None yet	6 (3 miles public land)	100	36	36	Secs. 22, 24, and 28, T. 22 N., R. 104 W.
Union Pacific Railroad	Railroad spur	W-56821	7 (4 miles public land)	200	96	72	Secs. 22, 24, and 28, T. 22 N., R. 104 W.

Note: Derived from BLM right-of-way applications and case files.

telephone line would be buried next to the access road. The railroad spur would extend approximately 7 miles easterly from the existing U.S. Steel railroad track, which extends from Winton Junction to South Pass.

Stages of Implementation

The basic sequence of mining would be from west to east. To maximize coal resource recovery, the sequence of the mining is designed so the uppermost of the coal seams is mined out before subsidence starts from mining operations in a seam below.

The first area to be mined is bounded on the south by a major east-west graben and on the north by a lesser fault structure roughly parallel to and along Cedar Canyon. The western limit of this "select mining block"is where the number 1 coal seam pinches out, near the southeast corner of Section 19 and the northeast corner of Section 30, while the eastern limit of mining approximates the 1,000 foot overburden line.

Mining Procedures

Entry to the minable coal seams would be by twin declines with the coal production portal near the center of Section 20. The twin declines leave the portal on a bearing of S.20°E., at a 16 degree angle (3½ to 1 slope). Each decline would be 14 feet by 14 feet and would be separated by a pillar 60 feet wide. Cross entries would be set at 300 foot intervals. The twin declines would pass through the numbers 1, 7½, 7, and 9 coal seams in that sequence (Figure LC1-3). Both declines would be escapeways from the mine, and the materials decline would have suitable intake of fresh air for men to use. The conveyor belt decline would be neutral.

The set of six main entries, bearing S.70°E., would be driven at a 45 degree angle to both major and minor cleat directions. Panel entries would be perpendicular to the mains.

Main and panel entries are designed to be 16 feet wide and to equal the height of the coal seams up to a maximum of 12 feet. The main entries would be "stacked,"i.e., in the 7½ seam, the entry would be directly below its counterpart in the number 1 seam, etc. The nominal center-to-center spacing of the 16-foot wide main entries would be 100 feet.

The general sequence of mining would start in the west of the mine block and use a combination of advancing panel retreat and full retreat mining methods. During full retreat, barrier pillars and chain pillars would be extracted consistent with safe mining practice. Then full recovery could start in the next lower coal seam.

Mining would be by drum type continuous miners with shuttle cars or bridge conveyors transferring the mined coal from the face to a haulage conveyor. Each continuous mining operation would be supported by a twin boom roof bolter for roof control and a bulk type rock duster.

Ventilation would be from surface fans, with the outside air entry designed for intake and exhaust. A "U"type ventilation would be used during panel extraction. The volume and direction of air has been designed to meet Mine Safety and Health Administration and state requirements. During cold weather, up to 500,000 cubic feet per minute of preheated air would enter the mine and be distributed to all locations where miners have regular access.

Methane checks would be made in compliance with applicable federal and state regulations. Methane content would be diluted by proper ventilation to keep the level below the maximum allowable percentage in working places and airways.

There are no plans to mine the outcrop coal. Unless coal is covered by at least 200 feet of overburden, underground mining is generally not feasible because of oxidized, soft mine roof conditions. Below 1,000 feet of cover, the mining is considered too expensive. Therefore, the underground mining zone would be between 200 and 1,000 feet.

Water-Control Structures

If the mine needs to be dewatered, the water would be conducted to a settling pond on the surface where it would be stored for reuse in mine dust control. In the mine, water would be conducted away from the face area to sumps. In the sumps, coarser particulates would settle out before the water is pumped to the surface impoundment.

A mine water impoundment dam would be constructed in Sections 20 and 21 (see Figure LC1-2). The reservoir would be operated as a storage facility with a normal operating capacity of less than 20 acre-feet. Water would be pumped into the reservoir from wells and used in the mine.

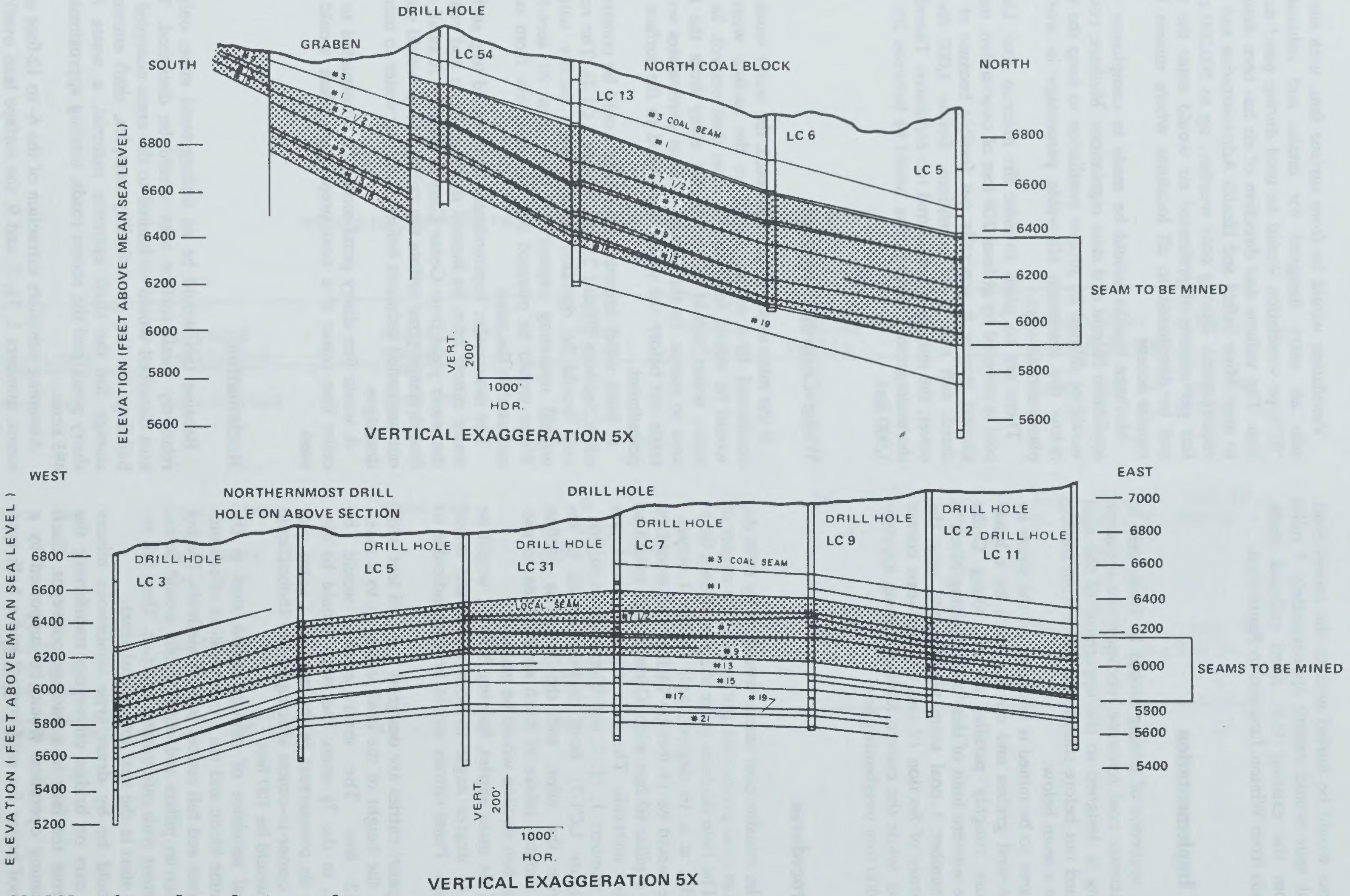
The mine water impoundment dam would trap surface water runoff from its limited drainage basin and reduce the water yield from Cedar Canyon slightly. A small surface-drainage pond within the railroad loop would settle-out suspended sediment before returning water to natural drainages.

A waste fine slurry pond would be constructed to receive fine reject if a coal preparation plant would be used.

Reclamation

Because this would be an underground mine, only a relatively small surface area would be disturbed. The area disturbed would be limited to the areas occupied by buildings for the plant facility complex, shaft entrance, storage for the shaft entrance material, a waste fine slurry pond, and the access roads, totaling approximately 493 acres.

Assuming complete extraction of the 6- to 12-foot coal seams, numbers 1, 7½, 7, and 9, the surface land overlying the mining operation should uniformly subside ap-



SOURCE: Sunoco Energy Development Company And Rocky Mountain Energy Company 1977.

Figure LC1 - 3

TYPICAL CROSS SECTIONS OF PROPOSED LONG CANYON MINE

proximately 30 feet at the center of the operation where all four coal seams would be extracted. Other areas would subside from approximately 4 to 20 feet. SUNEDCO and RME would be responsible for backfilling any holes or cracks which may appear on the surface as a result of the subsidence.

For surface disturbance resulting from coal mining operations at the Long Canyon Mine, pursuant to 30 CFR 717.11 and 715.13, SUNEDCO and RME would be required to restore disturbed lands to conditions capable of supporting premining uses or higher or better uses. A mining permit would not be approved unless the applicant has demonstrated that reclamation to the proposed post mining land use can be accomplished under the mining and reclamation plan.

Present and Future Land Use

The land within and adjacent to the proposed Long Canyon project area is used primarily for livestock grazing, wildlife habitat, and outdoor recreation. The objective of the proposed reclamation plan of the Long Canyon Mine is to reclaim land disturbed by mining to a use equivalent to or better than the highest previous use. Future use of the site is expected to involve wildlife use, livestock grazing, and outdoor recreation at a level the land was capable of supporting before any mining occurred.

The post mining land use designated in the BLM's Management Framework Plan (U.S. Department of the Interior, BLM 1977d) is for wildlife habitat, livestock grazing, and outdoor recreation.

Topsoil Handling and Erosion Control

At the time of service road and mine construction, topsoil would be removed and stockpiled for use in reclaiming the areas disturbed. After stockpiling, the topsoil would be contoured and planted with native or adapted varieties of grasses to control erosion and help prevent deterioration of the soil.

Table LC1-5 shows 33 analyses of overburden material. Mine development plans show that about 43,000 cubic yards of waste rock with a composite quality of that shown would be used as fill in suitable acres during the coal-handling facility construction.

Decommissioning and Abandonment

All surface structures would be removed and either salvaged or buried when the mine is permanently abandoned. The site would be graded to conform to the natural terrain, topdressed with a suitable material, and seeded. This would require approximately 2 years.

The water impoundment structure would be left intact when the project is permanently abandoned, if such impoundments are in concert with post mining land use as determined by the BLM, the State of Wyoming, and (or) the private landowners; otherwise, the dam would be removed and the impoundment slowly drained and then the area reseeded.

Revegetation

The seeding of the service road right-of-way and disturbed zones around the various parking facilities, plant site, and storage areas (approximately 15 acres) would be completed by the end of the first growing season after those facilities are functioning.

Native plant species, including shrubs and grasses, would be seeded (Table LC1-6).

In most areas the seeds would be planted by drill seeding. In those few areas where it may be difficult to operate the drill equipment, seeding would be accomplished by hydroseeding. Mulch would be applied at the rate of approximately 2 tons per acre, since the soil in those areas is naturally deficient in humus.

Management of Reclaimed Areas

Detailed soil analyses would be made to determine the amounts and types of fertilizer needed to hasten the reestablishment of a satisfactory plant cover on the disturbed lands.

An irrigation system is not planned at this time, but one might be used in an abnormally dry year to protect young seedlings.

Fencing would be used to protect newly revegetated areas from grazing by livestock and big game.

Pollution Control Methods

Roads would be paved and (or) sprayed with water to help minimize dust from vehicle traffic.

At point sources of emission, such as crushers, conveyor to storage, and the loadout facility, dust entrapment devices such as baghouses or dust suppression by means of liquid spray would be used to meet and maintain federal and state air pollution standards.

Human waste would be treated in a double storage lagoon. The lagoon would be designed for no discharge to the natural surface drainage.

Operational Environmental Monitoring

Hi-vol samplers would be installed at strategic locations around the mine facility area to monitor ambient conditions. A preoperational hi-vol is currently collecting background particulate data.

AUTHORIZING ACTIONS

This section identifies governmental authorizations which would be required to fully implement the proposed Long Canyon Mine. A more complete description

Table LC1-5

ANALYSIS OF OVERBURDEN MATERIAL
DRILL HOLE LC-217

Sample	Depth, feet		Saturated Soil Extract (ppm)				Soil Exchangeable (ppm)					
Number	From	To	Na	K	Ca	Mg	Na	K	Ca	Mg	C.E.C.	E.S.P.
1	0	30	120	61	260	110	52	86	2000	380	11.7	1.9
2	30	50	340	320	250	190	140	180	1900	540	13.0	4.7
3	50	60	270	270	76	42	200	260	1400	280	9.3	9.3
4	60	70	570	380	250	170	190	180	1800	220	10.5	7.9
5	70	80	230	180	210	73	80	100	1300	270	8.0	4.3
6	80	100	170	170	180	63	75	160	1700	290	10.0	3.2
7	100	110	130	110	190	74	50	73	1600	200	8.6	2.5
8	110	150	290	97	130	31	200	150	1900	230	12.7	6.9
9	150	160	640	570	470	250	140	12	1700	94	8.6	7.1
10	160	180	1600	670	680	570	280	72	1400	36	7.4	16.4
11	180	240	430	320	300	83	130	67	1600	130	8.3	6.8
12	240	250	1500	470	690	250	190	78	710	96	4.6	18.0
13	250	270	650	470	680	260	110	37	1300	84	7.8	6.2
14	270	290	1100	420	770	660	190	120	1500	12	7.5	11.0
15	290	300	870	440	490	460	180	85	1300	19	7.7	10.2
16	300	340	190	200	180	62	83	95	1600	180	9.6	3.7
17	340	360	220	190	210	58	91	90	1600	180	9.1	4.3
18	360	410	350	110	320	140	66	74	1500	180	6.0	4.8
19	410	440	390	100	180	44	170	150	1700	260	9.3	8.0
20	440	470	280	110	190	70	99	82	1600	180	8.1	5.3
21	470	490	440	130	220	59	140	89	1600	200	7.5	8.1
22	490	530	410	130	290	79	99	66	1500	150	6.9	6.3
23	530	540	900	220	770	240	140	120	1900	220	7.2	8.4
24	540	560	860	190	750	230	170	160	1900	290	9.1	8.2
25	560	580	520	110	140	33	330	160	2000	240	9.3	15.4
26	580	610	330	70	120	30	140	95	1400	210	7.6	8.0
27	610	630	450	64	72	20	390	130	1600	320	9.7	17.5
28	630	680	640	140	460	170	170	110	1800	260	7.7	9.6
29	680	690	400	94	200	59	210	130	1800	300	9.7	9.4
30	690	710	320	86	120	34	210	130	1500	260	8.9	10.2
31	710	730	810	260	490	220	160	86	1500	240	7.9	8.8
32	730	760	640	250	350	150	160	110	1600	270	8.2	8.5
33	760	778	580	230	320	130	170	130	1700	330	9.3	7.9

Table LC1-5

ANALYSIS OF OVERBURDEN MATERIAL
DRILL HOLE LC-217
(Continued)

Sample Number	NO3-N	SE	B	APB
1	43	.23	.1	6.9
2	24	.16	.7	4.1
3	4	.04	1.7	4.3
4	6	.06	.6	7.1
5	6	.04	.1	8.1
6	5	.03	.4	8.1
7	4	.04	.3	8.1
8	4	.05	.6	5.9
9	5	.03	.4	7.1
10	6	.04	.5	4.9
11	5	.04	.2	6.9
12	7	.06	.4	2.7
13	5	.07	.2	7.6
14	6	.05	.4	6.5
15	5	.03	.3	4.9
16	5	.01	.1	8.4
17	3	.03	.5	5.3
18	2	.02	.2	8.0
19	3	.04	.4	8.0
20	3	.05	.1	8.0
21	5	.07	.3	6.3
22	2	.04	.3	5.4
23	2	.03	.7	6.7
24	3	.06	.4	5.4
25	4	.05	.6	3.4
26	6	.03	.1	6.6
27	5	.04	.2	5.8
28	6	.06	.2	7.6
29	7	.03	.4	6.3
30	9	.04	.3	4.8
31	6	.05	.2	7.2
32	8	.04	.3	7.6
33	7	.03	.3	7.9

Source: Sunoco Energy Development Company and Rocky Mountain Energy Company 1977.

Note: Location: 435,812.29 N
405,110.65 E
7,045.93 Elevation
R103W T22N S-20
2350' FEL

Table LC1-5

ANALYSIS OF OVERBURDEN MATERIAL
DRILL HOLE LC-217
(Continued)

Sample Number	S.A.R.	E.C.	pH	Texture	Saturation%	Composition %SN	%SI	%CL	PHOS
1	1.6	2.6	7.7	SN/CL/LO	38.0	50	26	24	16
2	3.9	4.2	7.2	LO	37.0	35	39	26	60
3	6.2	2.3	7.3	SN/CL/LO	56.5	54	25	21	57
4	6.8	4.6	7.9	SN/CL/LO	31.2	54	13	28	1
5	3.5	2.7	8.3	SN/LO	26.0	55	26	19	1
6	2.8	2.1	7.9	CL/LO	30.1	37	35	28	1
7	2.1	2.0	7.9	LO	32.3	51	30	19	1
8	6.0	1.9	7.8	LO	36.0	49	32	19	1
9	5.9	6.9	7.7	SN/LO	20.9	65	16	19	1
10	10.8	13.0	7.5	LO	21.0	45	30	25	1
11	5.7	3.7	7.6	LO	22.8	43	37	20	1
12	12.4	10.3	7.5	LO	20.3	47	34	19	1
13	5.4	7.5	7.8	SN/LO	18.9	61	26	13	1
14	7.2	11.6	7.8	LO	19.6	40	37	23	1
15	6.8	8.8	7.8	SN/LO	20.4	62	25	13	1
16	3.1	2.4	8.1	LO	20.9	52	33	15	1
17	3.5	2.2	7.9	LO	18.9	52	34	14	1
18	4.0	3.4	7.7	LO/SN	22.7	79	13	8	1
19	6.7	2.5	7.9	SN/LO	31.8	65	23	12	1
20	4.3	2.6	7.9	SN/LO	29.9	66	22	12	1
21	6.8	3.2	8.0	SN/LO	27.2	75	15	10	1
22	5.5	3.4	7.7	SN/LO	29.0	74	16	10	1
23	7.3	7.8	7.1	SN/LO	28.4	77	14	9	1
24	7.0	7.7	7.0	SN/LO	32.0	69	20	11	1
25	10.2	2.9	7.8	SN/LO	32.9	67	22	11	1
26	6.9	2.2	8.4	SN/LO	30.2	73	17	10	1
27	11.9	2.1	8.5	SN/LO	48.8	72	18	10	1
28	6.5	5.3	7.5	SN/LO	30.4	77	14	9	1
29	6.3	3.1	7.8	SN/LO	40.5	66	22	12	1
30	6.6	2.3	8.1	SN/LO	38.2	69	20	11	1
31	7.6	6.6	7.8	SN/LO	26.5	75	15	10	1
32	7.2	5.1	8.0	SN/LO	23.4	73	17	10	1
33	6.8	4.7	7.9	SN/LO	20.5	69	20	11	1

Table LC1-6

SEED MIXTURE FOR LONG CANYON PROJECT REVEGETATION

Species	Variety	Lbs/Acre Pure Live Seed
Western wheatgrass	Rosana	4
Thickspike wheatgrass	Critana	4
Indian ricegrass	---	4
Green needlegrass	---	4
Big sagebrush	---	1
Fourwing saltbush	---	1
		18.0

of these actions is provided in the Regional ES, Chapter 1.

A memorandum of understanding is in preparation which describes operating procedures to be followed by the BLM, the Office of Surface Mining, and the USGS concerning their areas of responsibility in the federal coal management program. This memorandum of understanding may alter the agency responsibility listed below.

Bureau of Land Management (BLM)

Before approval of the mining and reclamation plan, BLM would prepare a Section 106 compliance report on existing or eligible National Register sites (archeological) located in the inventory.

Before mining could begin at Long Canyon, BLM would have to issue rights-of-way for 3 miles of access road, power line, and telephone line and 4 miles of railroad spur across Sections 22, 24, and 28, T. 22 N., R. 104 W.

U.S. Geological Survey (USGS)

The USGS would, with BLM concurrence, approve the mining and reclamation plan.

State and County

Wyoming Department of Environmental Quality (DEQ)

Air quality, solid-waste disposal, water quality, and mining and reclamation of mined land must comply with DEQ rules and regulations. Approval of the mining and reclamation plan, permits, and licenses to mine must be obtained from DEQ.

Wyoming State Engineer

Water rights, either from surface or ground water sources, for the mining and coal processing operations are required from the Wyoming State Engineer who also must authorize the proposed impoundments.

Sweetwater County

An industrial zoning permit from Sweetwater County is required to construct the mine and building complex.

INTERRELATIONSHIPS

Relationship to BLM Land Use Plans

The Salt Wells and Pilot Butte Management Framework Plans (MFPs) (U.S. Department of the Interior, BLM 1977a and 1977d) of the BLM recommend that approximately 10,500 acres of public lands be considered for lease or transfer to local government or private ownership as demands and requirements present themselves. An additional 2,560 acres could also be considered for these purposes. None of these lands are in conflict with the proposed Long Canyon Mine.

The post mining land use as designated in the MFPs is for wildlife and livestock grazing.

Relationship to the Proposed and Future Actions

The proposed development of the Black Butte Mine, east of Rock Springs, and the Winton and Reliance Mines (which require no federal action), north of Rock Springs, would create competition for the available labor; increase rail traffic, dust, and water usage; and increase the demand on transportation and communication networks. The cumulative impacts of these projects are analyzed in the Regional environmental statement.

Relationship to Rail Transportation

Coal would be transported via the proposed rail spur from the coal loading facility to the main line of the Union Pacific Railroad where it would be shipped to markets tentatively identified on the east coast and Pacific northwest. Rail volume would increase by approximately 200 loaded trains per year. Return traffic would also be 200 trains per year.

CHAPTER 2

DESCRIPTION OF THE ENVIRONMENT

This chapter consists of two parts, existing environment and future environment. The discussion of the existing environment describes the physical, biological, and cultural environmental components which constitute the Long Canyon site-specific environment. The discussion of the future environment focuses on the same environmental components as they would be in 1980, 1985, 1990, and at the end of mine life without federal approval of the proposed action. These descriptions provide bases for the analyses in Chapter 3, The Environmental Impacts of the Proposed Action.

EXISTING ENVIRONMENT

CLIMATE

Sunshine

The Long Canyon project area is situated in the intermountain basin area, where the annual percentage of possible sunshine is expected to exceed the 65% statewide average.

Wind Fields

Studies of the local climate, by private interests in the vicinity of the Jim Bridger Power Plant, 20 miles east of the Long Canyon area (Western Scientific Services, Inc., (WSSI), Crow, and Hadley 1971, 1972, 1973, and 1974), indicate that the predominant surface winds are from the southwest through west sectors.

Atmospheric Temperature and Stability

The project area is subject to large seasonal and diurnal temperature variations. Temperatures are expected to closely approximate those recorded at Rock Springs over a 22-year period, which indicate mean monthly minima/maxima of 10°F/29°F in January and 50°F/84°F in July. Temperature extremes range from about -29°F to 97°F. The growing season is about 105 days per year.

Field studies around the Jim Bridger Plant have indicated that stable atmospheric conditions, associated with nocturnal temperature inversions, occur often in this area. Out of a total sample of 96 field study days between September 1970 and August 1972, investigators found that 88% had surface based inversions (WSSI, Crow, and Hadley 1972). From September 1970 through May 1974, it was determined that the median height of the maximum depths of 109 surface-based inversions was about 700 feet (WSSI, Crow, and Hadley 1974). Finally, it was found, using a modified Turner (1964) stability classification scheme and a 1-year data base period, that on an annual basis slightly unstable atmospheric conditions occurred about 12% of the time. Neutral and stable conditions were found to occur 51% and 37% of the time, respectively.

Moisture and Evapotranspiration

Annual average precipitation probably approximates the 8.5 inches recorded at Rock Springs. A significant portion of the precipitation occurs during the spring and early summer months and results primarily from convective shower activity. Annual average snowfall is about 30 to 40 inches.

An annual soil moisture deficit of about 13 inches is probable in the mining area. The growing season roughly coincides with the period of high soil moisture deficit.

Severe Weather Events

The number of thunderstorm and hail days are about 30 and 3 days, respectively. The likelihood of tornadoes occurring is very low in this area.

AIR QUALITY

The present air quality in the vicinity of the proposed Long Canyon Mine should have a rural character. Therefore, existing total suspended particulate levels at this site should range from 10 to 20 micrograms per cubic meter ($\mu g/m^3$) annually and between 20 to 50 $\mu g/m^3$ for a daily averaging period, or one-third or less than the appropriate Wyoming standards. Based on 5 years of visual observations recorded at Rock Springs, Wyoming, an average background visual range in the vicinity of Long Canyon should be about 40 miles.

Concentrations of sulfur dioxide around Long Canyon should also reflect its rural setting; i.e., levels less than 5 $\mu g/m^3$ annually and less than 25 $\mu g/m^3$ for a daily averaging period. Thus, the magnitude of these concentrations should be only about 10% of the appropriate state standards. In addition, annual nitrogen dioxide concentrations should be less than 10 $\mu g/m^3$, or again only 10% of the state standards.

GEOLOGY

Stratigraphy

Coals proposed to be mined occur in the Rock Springs Formation of Late Cretaceous age. The formation is as much as 2,400 feet thick and is composed of interbedded gray shale; gray, brown, yellow, and white sandstone; and coal. The formation is overlain by the Ericson Formation, which is mostly gray sandstone as much as 800 feet thick, and is underlain by the Blair Formation, which is composed of gray siltstone and shale about 1,400 feet thick (see Figure R2-3A in the Regional ES).

The rocks of Cretaceous age were mostly deposited along the western edge of a broad, shallow, north-south trending seaway that crossed central North America. They are mostly marine shales, but they also include fluvial shales and sandstones and deltaic deposits including coal.

Paleontology

The project area has not been surveyed for paleontological resources. A general summary of the principal fossiliferous formations, ages, number of known fossil localities, and general fossil types in the proposed project area is presented in Table LC2-3A.

Structure

The proposed project area lies on the north end of the Rock Springs Uplift (at the northern edge of the North Baxter Basin). This anticline is approximately 60 miles long in a north-south direction and 35 miles wide in an east-west direction. Dips in the area of the proposed mine range from 200 feet per mile (2.2 degrees) on the north plunge of the anticline to over 1,000 feet per mile (12 degrees) on the west flank of the anticline.

A major fault system crosses the site in an east-northeast direction through Sections 26, 27, 28, 31, and 32, T. 22 N., R. 103 W. The system, as it affects the site, is comprised of two principal faults that are essentially parallel and a little less than one-half mile apart. The area between the faults has dropped down in relation to the areas north and south of the faults, to a level such that the coal is inaccessible between the faults.

Geologic Hazards

Even though the landslide susceptibility of the rock and earth material is estimated to be high (Radbruch-Hall et al. 1976) the landslide potential of the natural surface is judged to be minimal, because the natural slopes show no evidence of earlier sliding.

Natural coal outcrops are weathered and have lost their volatile and more easily ignitable constituents; therefore, the likelihood of coal ignition and combustion in the natural outcrop is low.

The project area is in an area of very low seismic activity; therefore, the probability of damage from earthquakes is low.

TOPOGRAPHY

The Long Canyon project area is located at the northern end of the physiographic subdivision of the region known as the Rock Springs Uplift (at the northern edge of the North Baxter Basin). The northern part of the project area is drained westward by Cedar Canyon and by its tributary canyons. The central and southern parts are drained southwestward by Long Canyon, by its largest tributary, Crooked Canyon, and by lesser tributaries to both. Several square miles in the western part of the area are drained westward by smaller canyons. The area is intricately and completely dissected by steep-walled canyons as much as 400 feet deep. Almost all drainage flows into Killpecker Creek to the west, and thence southward to Bitter Creek, then southwestward via Bitter Creek to the Green River.

Within the project area the Continental Divide crosses Sections 10 and 14, T. 22 N., R. 103 W., Section 1, T. 21 N., R. 103 W., and Sections 6 and 7, T. 21 N., R. 102 W. The small area (less than 2 square miles) that lies east of the Continental Divide drains eastward into Black Rock Creek and thence to the Great Divide Basin.

SOILS

A soils inventory of the Long Canyon project area was conducted by the Soil Conservation Service during late 1976 to determine the nature and extent of soil types in the area (Map LC2-5A). The inventory was a broad reconnaissance survey (as defined by BLM Manual 7312).

The survey indicates that the soils are poorly developed due to slow weathering of the parent material in the semiarid to arid environment of the project area. There are four basic types of parent material in the area: (1) alluvium (sediments transported and deposited by water), which occupies approximately 11% of the area (3,450 acres); (2) sedimentary rock (sandstone and shale), which occupies approximately 84% of the area (26,342 acres); (3) aeolian (wind deposited sands), which occupies approximately 3% of the area (941 acres); and (4) igneous rock of volcanic activity (pumice and Wyomingite), which occupies the remaining area (627 acres). The soils in mapping unit 117 and in most of unit 145 have developed on alluvium. The soils in mapping units 101, 124, 125, 131, 135, 146, 222, 224, 226, and a part of 143 have developed over sedimentary rock. The soils in map-

Table LC2-3A

SUMMARY OF FOSSILIFEROUS FORMATIONS IN THE AREA OF THE PROPOSED LONG CANYON MINE

Formation	Period	Known Fossil Localities	Type of Fossils
Almond	Cretaceous	General	V and P
Rock Springs	Cretaceous	General	I

General = Formation produces fossils with no specific localities identified.
V = Vertebrate
P = Paleobotanical
I = Invertebrate

ping units 234 and 235 have developed over igneous rock. The soils in mapping units 141 and parts of 143 and 145 have developed in aeolian deposits.

Varying amounts of soluble salts occur in all the soils of the area. Specifically calcium carbonate accumulates at various depths in the soils of the area, generally in the lower subsoil horizons. High levels of secondary calcium carbonate restrict plant growth by depressing the availability of some plant nutrients. The soils in mapping unit 226 have high levels of calcium carbonate. The amount of organic matter in the soils is low, ranging from 0.1% to 4%. The amount of organic matter relates to soil permeability (the ability of soil to transmit water and gasses), soil fertility (ability to hold nutrients in available form for plants), and available water capacity (water held in soils that can be readily absorbed by plant roots). Soils in the area are low in nitrogen and phosphorus which are essential plant nutrients. There is a sufficient level of all other nutrients for plant growth.

Soil structure in the Long Canyon project area is weak to moderate (in stability) in the surface soil horizon and nearly nonexistent in the subsoil horizons. Populations of soil biota are low in the area due to the low levels of soil moisture throughout the year (Brady 1974). Activities of the various soil biota contribute to the development of soil structure. Stable soil structure is necessary in most productive soils and especially necessary on fine-textured soils for the development of soil pores adequate in size for water movement into and through the soil. The predominant soil texture in the area is sandy loam.

Soil depths in the Long Canyon project area vary from no soil on rock outcrop to greater than 60 inches on alluvium. The moderately deep and deep loam and sandy loam soils of the area (mapping units 117, 141, 143, 145, and 235) that have few restrictive features such as high alkalinity or calcium carbonate levels are more productive than the soils in the remaining area. These soils can be recognized by the vigorous growth of shrubs and grasses they support. Soils with high alkalinity and (or) soluble salt content (mapping units 131 and 226) have plants that are salt tolerant. Soils with restrictive underlayers or bedrock within 20 inches of the surface (mapping units 101, 124, 125, 131, 135, 146, 222, 224, and 234) have plants with stunted growth due to the limitations of root penetration and (or) plants that require little water to survive.

Properties and interpretations of the Long Canyon area soils are listed by mapping unit in Table LC2-5A. A description of the soil mapping units can be found in the Appendix. A breakdown by percentage of the various soil types within each soil mapping unit along with associated soil data can also be found in the Appendix. The soils types are keyed to associations of subgroups in the soil taxonomy (U.S. Department of Agriculture, Soil Conservation Service 1975).

Some of the soil types in the Long Canyon project area are subject to high amounts of wind erosion. Small areas of sand dunes in the area are highly erodable by wind. Table LC2-5A shows the wind erosion hazard by mapping unit of the soils of Long Canyon. The hazard is primarily based on the surface texture and the amount of vegetative cover.

Sheet erosion rates on the various mapping units as calculated by using Musgrave's equation are shown on Table LC2-5B. The rate of erosion occurring at present on the areas to be disturbed by construction of the various mining facilities (493 acres) would be approximately 3.5 tons per acre per year. The surface soil area to be disturbed is composed of mapping units 117, 145, and a small amount of 125.

WATER RESOURCES

Ground Water

The Long Canyon project area is located on the plunging north nose of the Rock Springs Uplift. The dip of the rocks ranges from 10 to 25 degrees northwesterly to 3 to 10 degrees northeasterly. Ground water movement in the western part of the area appears to be down dip; however, data in the eastern part of the area are not well enough defined to indicate direction of ground water movement.

The Rock Springs Formation, in which mining would occur, is composed of interbedded claystone, shale, carbonaceous shale, siltstone, fine-grained sandstone, and coal. Transmissivities obtained from aquifer tests ranged in value from 0.3 to 200 square feet per day. The storage coefficient was calculated to be 2×10^{-4} which is indicative of artesian conditions.

None of the lands proposed for mining within the Long Canyon project area are classified as alluvial valley floors.

Ground Water Quality

In general, the ground water in the overlying Ericson Sandstone is much better quality than that in the Rock Springs Formation. Calcium, magnesium, and bicarbonate ions are the major constituents of the Ericson Formation while the Rock Springs is essentially a sodium bicarbonate water. Table LC2-6A shows chemical analyses of water from the Rock Springs Formation.

Surface Water

The Long Canyon project area is drained principally by Cedar Canyon, an ephemeral stream, which at its mouth drains an area of about 18 square miles. Long Canyon flows southwesterly across the southern part of the area and drains an area of about 25 square miles at the southern boundary when it leaves the lease area. The Cedar Canyon and Long Canyon drainages might be alluvial valley floors based on the 30 CFR 710.5 definition that an "alluvial valley floor means stream-laid deposits holding streams where water availablity is sufficient for

Table LC2-5A

SOIL CHARACTERISTICS AND INTERPRETATIONS

Map Unit[1]	Map Unit Name[2]	Total Acres	Slope Range	Erosion Hazard[3] Wind	Erosion Hazard[3] Water	Source of Roadfill[3]	Suitability-Limitations for Final Cover Over Disturbed Areas[3] In./Avail.	Suitability
101	Rock outcrop	891	3-30	---	Geologic	Poor	0	Unsuitable
117	Alluvial fans, sandy saline soils[4]	2,396	1- 8	Moderate	Sl.-Mod.	Good	60+	Fair
124	Residual uplands, shallow soils, nearly level to sloping	1,321	3-30	Mod.-Sev.	Moderate	Poor	10-20	Poor-Fair-Wind Erosion
125	Residual uplands,shallow soils, hilly[4]	11,243	6-30	Mod.-Sev.	Sl.-Mod.	Poor	3-15	Poor-Slope
131	Residual uplands, shallow fine-loamy soils, gently sloping and sloping	338	1- 8	Slight	Sl.-Mod.	Poor	3-15	Poor-Alk. Sal.
135	Residual uplands, shallow sandy soils, hilly	7,742	6-30	Slight	Mod.-Sev.	Poor	10-20	Poor-Fair-Slope
141	Stabilized dunes	522	2-10	Very Sev.	Slight	Good	60+	Poor-Fair-Wind Erosion
143	Stabilized dunes and residual upland soils	246	3-30	Mod.-Sev.	Moderate	Good	10-60	Poor-Fair-Wind Erosion
145	Alluvial fans, gently sloping and dunes[4]	1,259	1- 8	Mod.-Sev.	Sl.-Mod.	Good-Fair	40-60	Poor-Fair-Wind Erosion
146	Rocky, sandy ridge tops	1,966	3-30	Mod.-Sev.	Sl.-Mod.	Fair	8-40[5]	Poor-Fair-Wind Erosion-Slope
222	Residual uplands, shallow to deep soils	1,997	3-45	Sl.-Mod.	Mod.-Sev.	Poor-Fair	10-60[5]	Poor-Slope
224	Mountain tops, shallow soils, gently sloping to sloping	215	2-10	Moderate	Sl.-Mod.	Poor	10-40[5]	Fair

Table LC2-5A

SOIL CHARACTERISTICS AND INTERPRETATIONS
(Continued)

Unit[1]	Map Unit Name[2]	Total Acres	Slope Range	Precipitation Zone[3] Inches/Year	Erosion Hazard[4]		Source of Roadfill[4]	Suitability-Limitations for Final Cover Over Disturbed Areas[4]	
					Wind	Water		In./Avail.	Suitability
226	High plateaus, moderate deep calcic soils gently sloping and sloping	92	2-10	10-14	Moderate	Sl.-Mod.	Fair	10-60	Poor-Fair-Alk. Sal.
234	Mesa tops, shallow volcanic soils, gently sloping and sloping	154	1-10	10-14	Slight	Sl.-Mod.	Poor-Fair	8-40	Poor-Fair-High Rock Content
235	Mesa sideslopes, stony volcanic soils, steep	338	15-40	10-14	Slight	Severe	Fair	40-60	Poor-Slope-High Rock Content

[1]Map LC2-5A, Long Canyon Soils.
[2]Unit names derived from geomorphic setting of the soil.
[3]Refers to total precipitation.
[4]Derived from U.S. Department of Agriculture, SCS, soils contract with BLM (1977).
[5]A portion of these soils would be disturbed by the proposed action.
[6]The majority of soils in this unit have less than 20 inches of available soil for final cover.

Table LC2-5B

EXISTING SHEET EROSION RATES

Map Unit[1]	Sheet Erosion Tons/Acre/Year
101	0.00
117	0.82
124	1.88
125	10.23
131	2.60
135	7.78
141	1.91
143	1.19
145	1.39
146	1.23
222	6.63
224	2.11
226	0.85
234	0.91
235	2.29

[1]Map LC2-5A

Table LC2-6A

SUMMARY OF ANALYSIS OF WATER SAMPLES FROM MONITORING WELLS ON THE LONG CANYON PROJECT AREA

PARAMETER	LC178	LC163	LC189	LC198	LC202	LC205	30 min.[1]	48 hr.[1]	Sec. 15 Well
Constituents (mg/l)									
Calcium	5.7	4.5	100	25	5.3	7.8	8.2	15	49
Magnesium	1.4	2.9	49	38	3.6	1.3	7.7	7.4	24
Potassium	8	8.0	25						
Sodium	380	270	245	245	11	12	11	12	7
Carbonate	78	42	0.1	65	51	42	84	24	0.1
Bicarbonate	820	710	520	720	630	780	510	655	250
Chloride	18	28	35	21	28	21	4.6	8.6	21
Flouride	12	5.6	0.3	3.5	5.1	13	1.4	1.8	0.4
Sulfate	5.4	13	500	54	64	13	155	105	8.4
Nitrate (nitrogen)	0.2	0.4	0.04	0.4	0.1	0.5	0.3	0.2	0.07
Nitrite (nitrogen)	0.01	0.01	0.01	0.1	0.01	0.01			0.01
Kjeldahl (nitrogen)	1.4	0.1	0.01	0.01	0.01	0.01			0.01
Ammonia (nitrogen)	0.1	0.1	0.01	0.01	0.01	0.01			0.01
Phosphate	0.1	0.1	0.01	0.01	0.01	0.01			0.01
Silicon dioxide	5.1	6.9	4.1	3.7	6.1	5.1	16.2	0.1	5.9
Minor constituents (mg/l)									
Nonmetals									
Cyanide	0.01	0.01	0.01	0.01	0.01	0.01			0.01
Metals									
Arsenic	0.01	0.01	0.01	0.01	0.01	0.01			0.01
Barium	1.2	1.0	1.0	2.7	1.0	1.0			1.7
Aluminum	1.4	0.1	0.1	2.4	0.1	0.1	1.1	0.2	0.2
Beryllium	0.02	0.1	0.1	0.02	0.1	0.1	0.1	0.1	0.1
Cadium	0.01	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.01
Copper	0.01	0.01	0.01	0.01	0.01	0.01			0.01
Chromium (hexavelent)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Iron (total)	4.1	1.3	2.1	7.0	0.9	1.4	1.0	0.05	0.1
Lead	0.02	0.04	0.06	0.09	0.06	0.02	0.62	0.01	0.01

Table LC2-6A

SUMMARY OF ANALYSIS OF WATER SAMPLES FROM MONITORING WELLS OF THE LONG CANYON PROJECT AREA (Continued)

PARAMETER	LC178	LC163	LC189	LC198	LC202	LC205	H-1-29 30 Min.	H-1-29 48 Hr.[1]	Sec. 15 Well
Metals (continued)									
Manganese	0.2	0.02	0.3	1.6	0.06	0.4	0.05	0.05	0.4
Mercury	0.001	0.001	0.001	0.001	0.001	0.001			0.001
Molybdenum	0.05	0.1	0.1	0.05	0.1	0.1	0.05	0.05	0.05
Nickel	0.01	0.01	0.02	0.07	0.01	0.02	0.01	0.01	0.01
Selenium	0.01	0.01	0.01	0.01	0.01	0.01			0.01
Silver	0.01	0.01	0.01	0.01	0.01	0.01			
Vanadium	0.05	0.1	0.1	0.1	0.1	0.01			0.05
Zinc	0.9	0.1	0.1	0.9	0.2	0.4	0.01	0.04	
Boron	1.1	1.3	4.8	0.8	0.8	1.0	0.8	0.9	0.9
Strontium	0.2	0.2	2.8	0.5	0.2	0.09	0.1	0.2	0.4
Organic									
Phelols	0.001	0.001	0.001	0.001	0.001				0.001
Calculated values (mg/l)									
Total Alkalinity (in terms of $CaCO_3$)	735	610	430	640	560	670	485	555	205
Hardness (terms $CaCO_3$)	20	23	450	78	28	25	52	68	220
Total dissolved solids	930	830	1100	930	840	1024	820	790	330
Other data									
pH	8.3	8.0	7.3	8.3	8.0	8.2			7.6
Specific conductance (umhos/cm)	1421	1210	1610	1313	1320	1426			397

Note: All analyses from mining and reclamation plan (Sunoco Energy Development Company and Rocky Mountain Energy Company 1977).

[1]Time sample taken after pumping began.

subirrigation or flood irrigation agricultural activities..." The average annual discharge is estimated to be 1.2 cubic feet per second (cfs) (about 890 acre-feet per year). Peak flows for the stated recurrence intervals in cubic feet per second for Cedar Canyon are: 2 years—170, 5 years—400, 10 years—640, 25 years—1,100, 50 years—1,400, and 100 years—1,900. The average annual discharge of Long Canyon at the southerly boundary of the lease is estimated to be about 1.5 cfs (about 1,090 acre-feet per year). Peak flows for the stated recurrence intervals, in cubic feet per second, for Long Canyon are: 2 years—140, 10 years—710, 25 years--1,200, 50 years—1,600, and 100 years—2,100.

Surface Water Quality

No surface water quality data are available. It is assumed that surface water would be of about the same quality as that sampled at the Black Butte project area.

VEGETATION

Terrestrial Vegetation

Four vegetation types occur within the project area. Sagebrush, saltbush, greasewood, and juniper types comprise about 60% (18,876 acres), 37% (11,722 acres), 2% (662 acres), and less than 1% (100 acres), respectively, of the project area (about 31,360 acres). Map LC2-7A presents vegetation types of the project area. Plant names are from Beetle (1970). A list of plants known or believed to occur in the Long Canyon project area is available to the public at the Rock Springs District Office of the BLM.

Sagebrush, Type 4

Low sagebrush *(Artemisia arbuscula)* is dominant on dry hillsides, and big sagebrush *(A. tridentata)* is dominant in drainages.

Common understory grasses are thickspike *wheatgrass (Agropyron dasytachyum)*, bluegrasses *(Poa* spp.), and bottlebrush squirreltail *(Sitanion hystrix)*.

Frequently occurring forbs are phloxes *(Phlox* spp.), scarlet globemallow *(Sphaeralcea coccinea)*, and *goldenweeds (Haplopappus* spp.).

Saltbush, Type 13

Species of the saltbush type tolerate saline soil conditions primarily found in the project area lowlands.

Nuttall saltbush *(Atriplex nuttallii)* is the dominant shrub species. Indian ricegrass *(Oryzopsis hymenoides)*, thickspike wheatgrass, and bottlebrush squirreltail are important understory grasses. Phloxes and *goosefoots (Chenopodium* spp.) are conspicuous forbs.

Greasewood, Type 14

The dominant species of this type is black *greasewood (Sarcobatus vermiculatus)* with nuttall saltbush occurring as a subdominant. Understory cover is sparse with bottlebrush squirreltail and phloxes present. The type occurs in drainages with saline, alkaline soils.

Juniper, Type 9

The type occurs on canyon slopes in the northern portion of the project area. Utah juniper *(Juniperus utahensis)* is dominant. Limber pine *(Pinus flexilis)*, low sagebrush, and big sagebrush are associated woody plant species.

Western wheatgrass *(Agropyron smithii)*, beardless bluebunch wheatgrass *(A. spicatum inerme)*, Indian ricegrass, phloxes, and goldenweeds are herbaceous understory components.

Aquatic Vegetation

No data are available on aquatic vegetation in the area proposed for mining.

Endangered and (or) Threatened

A survey of the project area revealed no plants proposed for endangered and (or) threatened status (Dorn 1978). The process for requesting formal consultation under Section 7 of the Endangered Species Act of 1973 was initiated for Long Canyon with the U.S. Fish and Wildlife Service on 2 March 1978. The U.S. Fish and Wildlife Service responded by letter dated 7 March 1978 that formal consultation cannot be conducted for unlisted species.

FISH AND WILDLIFE

General Information

Habitat Types

The following are the major habitat types found on the proposed mine permit area (project area) and the primary wildlife species associated with each. A complete wildlife species list can be obtained from the Rock Springs District Office of the BLM.

Aquatic. No aquatic habitat exists on the proposed mine permit area.

Terrestrial.

Sagebrush (18,876 acres). Species associated with sagebrush are sage grouse, horned lark, black-billed magpie, sage thrasher, rock wren, sage sparrow, Brewer's sparrow, badger, striped skunk, coyote, Richardson ground squirrel, least chipmunk, deer mouse, whitetail jackrabbit, mountain cottontail, elk, mule deer, and pronghorn antelope.

Saltbush (11,722 acres). Species associated with saltbush are horned lark, black-billed magpie, sage thrasher, vesper sparrow, sage sparrow, Brewer's sparrow, badger, striped skunk, coyote, whitetail prairie dog, Richardson ground squirrel, least chipmunk, deer mouse, whitetail jackrabbit, mountain cottontail, mule deer, and pronghorn antelope.

Greasewood (662 acres). Species associated with the greasewood type are horned lark, black-billed magpie, sage thrasher, vesper sparrow, sage sparrow, Brewer's sparrow, badger, striped skunk, coyote, Richardson ground squirrel, least chipmunk, deer mouse, whitetail jackrabbit, mountain cottontail, mule deer, and pronghorn antelope.

Juniper (100 acres). Species associated with juniper are black-billed magpie, common flicker, pinyon jay, mountain bluebird, loggerhead shrike, badger, striped skunk, coyote, least chipmunk, deer mouse, elk, mule deer, and pronghorn antelope.

General. Raptors which may be seen in one of several habitat types are Cooper's hawk, red-tailed hawk, Swainson's hawk, rough-legged hawk, ferruginous hawk, golden eagle, marsh hawk, prairie falcon, American kestrel, great-horned owl, long-eared owl, and short-eared owl.

Herd Units

The Wyoming Game and Fish Department has designated areas of management for big game herds. These areas are called herd units and each one contains an individual big game population. All big game population numbers and density estimates in this report are based upon herd units.

Fishery

No fishery exists on the proposed Long Canyon Mine site.

Wildlife

Birds

Nongame. The major songbird species found on the proposed Long Canyon project area are listed under the major habitat types at the beginning of this section. The Wyoming Game and Fish Department's breeding bird survey indicates about 14 birds per square mile in the vicinity of the project area. Although these figures are average estimates for resident birds, it must be understood that nomadic arid land species (crows, certain raptors, etc.) may significantly increase these numbers.

The many cliffs and rock outcrops provide nesting for raptors. The Wyoming Game and Fish Department identified nests of the golden eagle, red-tailed hawk, prairie falcon, and long-eared owl within the project area, all of which were active in the spring of 1977. Immediately north of the mine permit boundary, nests of the prairie falcon and red-tailed hawk were also identified (Map LC2-8A).

Game. Sage grouse is the only game bird inhabiting the proposed project area. The entire area is classified as yearlong range and no strutting grounds have been identified (Wyoming Game and Fish Department 1977).

The proposed Long Canyon Mine is within bird management section number 12 of the Eden Management Unit for sage grouse. The long-term average population within the section is about 35,000 birds or about 17 per square mile (Wyoming Game and Fish Department 1977). This is an average density estimate and there are areas (e.g., wintering areas, strutting grounds, etc.) where the density will be much greater.

Endangered and (or) Threatened. No endangered or threatened bird species are known to exist on the proposed project area.

Mammals

Nongame. The primary small, nongame mammals are whitetail prairie dog, Richardson ground squirrel, least chipmunk, deer mouse, and whitetail jackrabbit. The only small nongame mammal population information available for southwestern Wyoming indicates about 5 individuals per acre in the sagebrush type, about 1.5 per acre in the greasewood type, and about .5 per acre in the saltbush type (Maxell 1973).

The Wyoming Game and Fish Department indicates there are over 3,200 acres of whitetail prairie dog towns on the proposed mine permit area.

Game. The proposed mine permit area provides crucial winter range for an estimated 40 elk between Cedar and Long Canyons. The remainder of the project area contains winter, winter/yearlong, and summer ranges (see Map LC2-8A).

The Long Canyon proposal is in the Steamboat Herd Unit for elk which has a present population of 1,200 and a desired population of 750 by 1982.

The proposed project area contains crucial winter/yearlong range for mule deer (see Map LC2-8A). An aerial survey in February 1976 indicated that 400 deer were wintering in Pine, Cedar, and Long Canyons (Wyoming Game and Fish Department 1977). The project area is in the Steamboat Herd Unit which has a present population of 1,500 or about 9 deer per square mile on the crucial winter range. The desired population is 2,500 deer or 15 deer per square mile.

The proposed permit area is summer range for antelope (see Map LC2-8A) and is within the Dry Lake Herd Unit. The present population is 1,000 animals or about 2 individuals per square mile on the summer range. The desired population by 1982 is 2,500 or about 5 animals per square mile (Wyoming Game and Fish Department 1977).

Endangered and (or) Threatened. The Wyoming Game and Fish Department conducted a cursory survey of

prairie dog towns in 1977 but came to no conclusions as to the presence or absence of the black-footed ferret. However, in accordance with the Endangered Species Act of 1973, the BLM has officially requested formal consultation with the U.S. Fish and Wildlife Service by letter dated 2 March 1978.

Reptiles and Amphibians

General. The primary reptile species found on the proposed project area are the northern sideblotched lizard, northern plateau lizard, sagebrush lizard, and Great Basin gopher snake. The primary amphibian species are the Great Basin spadefoot toad and boreal toad. Table LC2-8A shows the number of species and estimated density of reptiles and amphibians in the major habitat types.

Endangered and (or) Threatened. No endangered or threatened reptile or amphibian species exist within the proposed project area or surrounding vicinity.

Wild Horses

Wild horses are present in small numbers in the vicinity of the proposed mine.

CULTURAL RESOURCES

Archeological

A survey of 11,520 acres of the Long Canyon project area by Western Wyoming College recorded 59 sites containing evidence of early human activity. Miscellaneous surveys account for an additional 2,240 acres and 9 sites (Metcalf 1977a). A total of 13,120 acres or 42% of the proposed area has been surveyed and 68 sites recorded. This produces a site density of 3.17 sites per section. Based on the 3.17 sites per section found in the portion of the area that was surveyed, a potential of 79 sites remains in the 58% of the total area that has not been surveyed.

Results of the survey conducted by Metcalf (1977) included the nomination of one site to the National Register of Historic Places, 23 sites are recommended for further testing, and 40 sites where no further work is recommended. These sites are part of the 42% sample of the proposed project area.

Dating of these sites remains somewhat in question. Both Late and Middle period sites (2000 BP to 1700 BP and 4500 BP to 2000 BP, respectively) are represented. Some Early period sites (12000 BP to 7000 BP) are suspected, but diagnostic tools are missing from the assemblages.

Grinding tools, bone implements, and stone rings reflect a pattern of occupation designed to maximize subsistence efforts in an area of diversity. The significance of these sites lies in their potential to contribute archeological information concerning these prehistoric occupations that is currently almost totally lacking for the area. Further excavation may supply this much-needed information. For this reason these sites constitute a valuable archeological asset that may contribute detailed knowledge of the prehistory of the area.

The Cedar Canyon petroglyphs, a site eligible for nomination to the National Register, is a manifestation of a little known or understood form of prehistoric rock art (engravings on soft rock exposures). There is considerable divergence of opinion in regard to interpretation of these petroglyphs. They may represent either religions or secular art forms, or both. The precarious nature of the resource lies in the fact that it is subject to erosive forces of climate and similar forces due to man's interventions. In many cases the original form has been nearly obliterated by one or both of these forces. In most cases, the Cedar Canyon petroglyphs are in a reasonably good state of preservation, which enhances their value.

Historical

There are no historic sites within the Long Canyon Mine area. None of the sites on the Wyoming's Historic Preservation Plan or the National Register *(Federal Register*, Vol. 42, No. 21) lie within the lease area.

VISUAL RESOURCES

The landscape of the western portion of the Long Canyon Mine site is characterized by gently sloping sagebrush covered ridges and draws. The canyon walls become steeper in the east portion. Scattered stands of juniper and limber pine are located in the protected pockets of these steeper canyons. Deer Butte and Cabin Butte in the southeast corner of the area are mesa type buttes, with steep sides and flat tops. The intrusions throughout this area include numerous two-track dirt roads and gas well sites. There are also pipelines from the gas wells which connect into collector lines which run north-south through the area.

There are no highways passing through or near the area. However, there is a county road passing about 2 miles to the west of the area. The only access to view the area would be from this county road and then by unimproved and bladed, low quality dirt roads. Cedar Canyon is heavily viewed, as evident by the heavy vehicle use sign in the area (refer to the Visitor Use section of the Recreational Resources section of this chapter).

A person traveling the county road is able to view different portions of the area from different segments of the road. Map LC2-10A depicts viewpoints along the county road and Figures LC2-10A and LC2-10B depict views from the viewpoints. Also, Figure LC2-10C depicts the view from the mine facilities location looking towards County Road 4-17.

Based on the BLM format for Visual Resource Inventory and Evaluation, as explained in BLM Manual 6310, three Visual Resource Management (VRM) Classes have been identified in the area. The analysis from which those classes have been derived appears in the Sandy/Pilot Butte Unit Resource Analysis which is available for

Table LC2-8A

ESTIMATED REPTILE AND AMPHIBIAN DENSITY FOR MAJOR HABITAT OF THE PROPOSED LONG CANYON PROJECT AREA

Habitat Type	Number of Species	Density Estimate (number per acre)
Sagebrush	4	2-3
Salt desert shrub	4	2-3
Greasewood	5	2-3
Juniper	10	6-8

Source: Personal communication, Dr. George Baxter, University of Wyoming, January 1978.

Figure LC2-10A

VIEW FROM COUNTY ROAD 4-17 WHICH SHOWS THE TYPICAL CLASS III AND IV AREAS.

Figure LC2-10B

VIEW UP FROM CEDER CANYON FROM VIEWPOINT C TOWARDS THE MINE ENTRANCE. THIS IS A CLASS III AREA.

Figure LC2-10C

VIEW FROM MINE SITE IN CEDAR CANYON
TOWARDS COUNTY ROAD 4-17.

public review at the Rock Springs District Office of the BLM.

The (VRM) Classes identified in this area are Classes II, III, and IV (Map LC2-10B). The basic management guidelines for these visual management classes are:

Class II—Management would require that any changes should not be evident in the characteristic landscape. This would be the areas with steep canyon walls and pockets of limber pine and juniper.

Class III—Management would require that changes may be evident but should remain subordinate to the visual strength of the existing landscape character. This would be the area which is gently sloping sagebrush covered ridges and draws.

Class IV—Management would require that changes may be subordinate to the original composition and character but must reflect what could be a natural occurrence within the characteristic landscape. This is also the gently sloping sagebrush covered ridges and draws.

RECREATIONAL RESOURCES

Visitor Use Data

Table LC2-11A depicts estimated visitor use in the Long Canyon project area.

Table LC2-11B depicts the estimated resident visitor use by activity in the region around the proposed Long Canyon Mine based on an estimated population in 1977 of 41,263 for Sweetwater County. Data used to calculate these numbers are available for public review in the Rock Springs District Office of the BLM.

Hunting

Each fall the Long Canyon area is hunted heavily for big game. Most of the use is by deer hunters, but there is also some use by hunters pursuing antelope and elk. Sage grouse are hunted along the heads of the canyons in early September, but this is a minor activity.

During the winter months cottontail rabbits are hunted extensively along the dry stream channels. Coyotes are hunted and trapped throughout the entire area since the steep canyons provide excellent habitat. During the summer people drive through the canyon bottoms shooting rodents.

Sightseeing

The recreationist traveling to the Long Canyon area is usually hunting with sightseeing interests related mainly toward viewing wildlife. The wildlife species which usually attract attention are deer, elk, antelope, birds of prey, rodents, rabbits, coyotes, and bobcats. There was one reported sighting of a mountain lion in Cedar Canyon.

Wilderness Values

There are no areas in or near the proposed Long Canyon Mine which have been identified as having wilderness values which meet the criteria set in Section 603 of the Federal Land Policy and Management Act of 1976.

AGRICULTURE

Livestock Grazing

The Long Canyon project area is within the Rock Springs Grazing Allotment. The allotment has an authorized carrying capacity of about 193,140 animal unit months (AUMs) grazing. The average stocking rate is 15 acres per AUM.

Livestock (sheep and cattle) belonging to 23 operators graze within the allotment from December through April (grazing data obtained from the Rock Springs District Office of the BLM).

Limited water development (one spring and three wells) within the project area restricts livestock distribution and utilization of forage. Livestock grazing of approximately two-thirds of the project area is dependent on water being present in seasonal drainages and (or) on snow (primarily used by sheep as a source of water).

Prime Farmland

Consultation with personnel of the U.S. Department of Agriculture, Soil Conservation Service, Rock Springs, Wyoming, revealed that prime farmland is not present in areas proposed for disturbance (see Regional ES, Chapter 9, Consultation and Coordination).

MINERAL RESOURCES

Coal

Within the Paludal Member of the Rock Springs Formation, there are as many as twelve coal seams generally ranging in thickness from 2 to 10 feet, and locally thickening to as much as 16 feet; there are many seams less than 2 feet thick.

In the Long Canyon project area, the east-west trending fault essentially divides the coal-bearing rocks of the Rock Springs Formation into two distinct coal blocks. The southern block contains a large reserve of coal in six seams, 4 feet thick or thicker (the seams vary considerably in thickness). In the northern block, there is a large reserve of recoverable coal in four seams ranging in thickness from 6 to 14 feet.

The Long Canyon Mine is planned for a portion of the northern block. The four coal seams which could be

Table LC2-11A

1976 ESTIMATED VISITOR DAYS BY ACTIVITY IN THE LONG CANYON AREA

Activities	Visitor Days
Hunting	135
Sightseeing	30
Total	165

Note: Visitor Day considered to be 12 hours.

Table LC2-11B

1976 ESTIMATED VISITOR USE BY ACTIVITY IN THE REGION BASED ON A POPULATION OF 41,263 FOR SWEETWATER COUNTY

Activity	Visitor Days[1]
Fishing	172,400
General[2]	168,500
Hunting	54,500
Off-road vehicle[3]	6,700
Sightseeing	52,900
Urban	106,400
Water sports	79,600
Winter sports	21,500

[1] Visitor Day consists of 12 hours.
[2] General includes camping, picnicking, etc.
[3] Estimate by ES team Outdoor Recreation Planner.

mined from the same entry system are, from highest to lowest, numbers 1, 7½, 7, and 9. These coal beds are described in detail in the Long Canyon mining and reclamation plan, submitted to the USGS in January 1977.

The number 1 coal seam ranges from 0 to 16 feet in thickness with an average of 8 feet. Quality of the number 1 coal seam on an "as received"basis averages 10,310 BTUs, 33.92% volatile matter, 43.14% fixed carbon, 7.78% ash, 15.16% moisture, and 0.59% sulfur.

In-place coal reserves for the number 1, 7½, 7, and 9 seams in the "select mine block"were calculated by RME at 111.2 million short tons. The "select mine block"is situated north of the east-west graben fault block and was described by the operator as an area to be considered as the best place to begin mining.

Quality of the coal and in-place reserves on RME-SUNEDCO's federal coal lease W-0313201 and private ownership lands are shown in Table LC2-13A.

Oil and Gas

Except for the large coal reserves, oil and gas are the only potential mineral resources in the area of the proposed mine.

There are four producing oil and (or) gas fields in the vicinity of the Long Canyon project area. The Nitchie Gulch Field (oil and gas discovered in 1962) and Pine Canyon Field (oil and gas discovered in 1964) are about 4 and 7 miles north, respectively, of the project area. The Leucite Hills Field (gas only, discovered in 1969) and the Crooked Canyon Field (gas only, discovered in 1975, a drilling program is still underway) have producing wells within the boundaries of the project area. Most of the production is from zones more than 4,000 feet below the coal seams to be mined.

LAND USE PLANS, CONTROLS, AND CONSTRAINTS

A number of separate governmental agencies exercise certain types of land and resource use controls in Sweetwater County. The proposed Long Canyon Mine includes public, state, and private lands. The federal sector is administered by the BLM (public lands and mineral estate under certain private lands). Except where controls have specifically been delegated by statute to counties or municipalities, Wyoming retains total jurisdiction over nonpublic and privately owned lands (including mineral leasing, rights-of-way, etc). The Long Canyon Mine includes 640 acres of state land. Counties have authority to effect a wide variety of controls in matters not specifically reserved to the state. The authority applies only to those portions of the county that are unincorporated. A county may regulate and restrict location and use of buildings and structures and use, condition of use, or occupancy of lands for residency, recreation, agriculture, industry, commerce, public use, and other purposes that are reasonably necessary to protect the public good of its citizens. All of the respective jurisdictions (federal, state, and county) have sufficient authority to impose effective land and resource use controls.

TRANSPORTATION NETWORKS

Highways

County road number 4-17 passes about 2 miles to the west of the Long Canyon mine site. About 10 miles south of the site and 10 miles north of Rock Springs, this road connects to U.S. Highway 187. The county road is a wide one-lane dirt road with turnouts. There are no county roads to the project area. In 1976 there were 31,700 vehicle license tabs sold in Sweetwater County.

Railroad

The U.S. Steel spur track passes about 3 miles to the west of the mine permit boundary. This line is privately owned and operated. One daily unit train uses the track each direction hauling ore from South Pass to Winton Junction where it is delivered to the Union Pacific for shipment to the main line at Rock Springs. Estimated current use and capacities for the Union Pacific Railroad through Wyoming are included in Table LC2-14A.

SOCIOECONOMIC CONDITIONS

The social and economic environments that would be affected most significantly by the proposed Long Canyon Mine include that portion of Sweetwater County within the ES region and two major communities—Rock Springs, the county's largest city, and Green River, the county seat.

Population

The estimated 1977 population of that portion of Sweetwater County within the ES region was 41,263 persons. The populations of Rock Springs and Green River were 25,996 and 12,502, respectively. The remaining 7% (2,765) of the county's population is spread out among eleven much smaller towns and in rural areas (Abt Associates 1978).

The county has recently experienced a period of rapid growth with "boomtown"proportions (Gilmore 1974). Its population has increased 124% (22,872) over the 1970 census figure of 18,391 (U.S. Department of Commerce, Bureau of the Census 1970a). Rock Springs and Green River have had increases of 123% (14,339) and 198% (8,306), respectively, in the same period. The "boom"-conditions were primarily the result of the construction

Table LC2-13A

RESERVES AND ANALYSIS FOR EACH COAL BED OF THE PROPOSED LONG CANYON MINE

Bed Name	Average Thickness (feet)	Coal in Place (tons)	Recoverable Coal-Strippable	Recoverable Coal Underground	BTUs Per Pound	Average Coal Analysis by Percent				
						Volatiles	Ash	Moisture	Fixed Carbon	Sulfer
3	7	19,300,000	1,000,000	9,000,000	11,650	41.8	4.5	8.2	44.5	1.0
1	6	28,500,000	2,000,000	13,000,000	10,300	37.6	4.2	8.5	48.8	0.9
7½	5	11,600,000	1,000,000	5,800,000	11,630	38.0	3.9	12.5	45.0	0.6
7	6	17,800,000	1,000,000	8,400,000	11,500	38.2	3.2	13.7	44.3	0.6
9	5	24,000,000	1,000,000	11,500,000	12,150	35.1	3.7	11.0	49.3	0.9
15	7	13,400,000	1,000,000	6,200,000	11,790	37.0	4.2	11.9	46.2	0.7
17	6	14,200,000	---	7,000,000	10,700	40.7	4.5	9.1	44.9	0.8
19	4	8,300,000	---	4,000,000	10,500	36.4	4.3	8.3	50.0	1.0
Total		137,100,000	7,000,000	64,900,000						

Note: Derived from data supplied by Sunoco Energy Development Company and Rocky Mountain.

Table LC2-14A

ESTIMATED CAPACITIES OF IDENTIFIED LINE SEGMENTS

Segment	Number of Tracks	Signaling	Length (Miles)	Estimated Capacity (trains per day)	Current Traffic (Trains per day)	Estimated % Capacity
Kansas City to Topeka	2	ABS	68	55- 60	44	73%
Topeka to Gibbon	1 2	CTC CTC	203 17	25- 30 70- 80	22	73% 28%
Council Bluffs to Gibbon	2	ABS	176	55- 60	34	57%
Gibbon to North Platte	2 2	ABS CTC	100 8	55- 60 70- 80	53	88% 66%
North Platte to Cheyenne	2 2	ABS CTC	182 43	55- 60 70- 80	47	78% 59%
Cheyenne to Hanna	3 2	CTC CTC	35 108	100-115 70- 80	51	44% 64%
Hanna to Rawlins	2	CTC	40	70- 80	45	56%
Rawlins to Green River	2 2	ABS CTC	101 33	55- 60 70- 80	44	73% 55%
Green River to Granger	2	CTC	30	70- 80	40	50%
Granger to Kemmerer	1	CTC	40	25- 30	13	43%
Kemmerer to McCammon	1	CTC	174	25- 30	13	43%
McCammon to Pocatello	1	CTC	174	25- 30	13	43%

Table LC2-14A

ESTIMATED CAPACITIES OF IDENTIFIED LINE SEGMENTS
(Continued)

Segment	Number of Tracks	Signaling	Length (Miles)	Estimated Capacity (trains per day)	Current Traffic (trains per day)	Estimated % Capacity
Granger to Ogden	2	ABS	126	55- 60		53%
	2	CTC	19	70- 80	32	40%

Source: Union Pacific Railroad Company, 1978.

ABS = Automatic Block Signalization
CTC = Centralized Traffic Control

of the Jim Bridger Power Plant and an expansion of trona mining activities in the area.

Employment

Total employment in the county in 1977 was estimated at 19,653 jobs (Table LC2-15A). Employment in Rock Springs accounts for approximately 60% of county employment (Dempsey, John and Associates 1975). Approximately 49% (9,633 jobs) of 1977 total employment was in the mining and construction sectors.

The unemployment rate in the county was 4.8% (618) in 1977 (Wyoming Employment Security Commission 1977); however, Sweetwater County has consistently maintained a low rate in recent years. The ratio of local service to basic employment jobs in 1977 was 0.75 or 6,700 local service jobs to 15,633 basic employment jobs (THK Associates 1978).

Income

Personal earned income in the county was estimated at $258.4 million in 1977, while per capita income was $6,263 (Abt Associates 1978). The median family income in 1977 was $16,200—an increase of 27% ($3,408) over the 1970 figure of $12,792. This rapid increase in income was a result of the increase in the activities mentioned above.

Infrastructure

Private Sector

Rock Springs is the leading commercial center in the county. While most data predates the high growth years of 1973-1974, studies show that it captures 77% of retail revenues, 51% of service revenues, and 94% of wholesale revenues in the county (U.S. Department of Commerce, Bureau of Census, 1972a). Green River captures approximately 18% of retail revenues. County monthly retail sales in 1977 were estimated at $110.2 million, while wholesale revenues were estimated at $39.9 million (Abt Associates 1978).

Public Finance

The rapid growth of the county has increased demands on both public operating and capital expenditures in recent years. The county's response has been to increase bonded indebtedness substantially and reduce the mill levy on significantly increased valuation. Assessed valuation was $469.9 million in 1977 (Abt Associates 1978).

Housing

It is estimated that there were 10,367 dwelling units in the county in 1977 (Table LC2-15B). Rock Springs had 5,197, and Green River had 3,312 (Abt Associates 1978). In spite of recent construction, the demands for housing are still greater than what is available. Many residents are forced to turn to mobile homes in lieu of more permanent housing.

Education

There are two school districts in the county—district 01 serves Rock Springs and district 02 serves Green River. Table LC2-15C provides data on teachers and expenditures in the districts. In 1977 enrollment was 4,903 in district 01 and 3,052 in district 02. Both have current and planned excess capacity (Dempsey, John and Associates 1975 and Parker and Associates 1975a).

Health and Social Services

The recent population expansion has put severe strains on these services. The health services profile for the county for 1977 is shown on Table LC2-15D. The county is served by a new 100-bed hospital. Mental health services are provided by the Jackson-based Western Wyoming Mental Health Association. Other services are offered through the Sweetwater County Welfare Office.

Police and Fire Protection

The County Sheriff's Department has 25 officers. It has modern offices and a new jail that are currently adequate. The Rock Springs Police Department has a total force of 33. It is considered adequate, although recruitment problems exist because wages are below most larger, competing cities. The Green River Police Department has 21 employees. Its facilities are in need of expansion to support recent increases in manpower (Abt Associates 1977 and 1978).

Fire protection is provided to Rock Springs by 23 paid and 3 volunteer firemen. Outlying areas with a 6-mile radius are also served by the force. The city has a fire insurance rating of 7 (Abt Associates 1978). The town of Green River has a 31-man volunteer fire department. Outlying areas with a 6-mile radius are also served. The town has a fire insurance rating of 7 (Abt Associates 1978).

Water and Sewer Systems

Both Rock Springs and Green River receive water from the Pacific Power and Light Company. The water supply comes from the Green River and receives treatment via a micro floc filter system. The plant has a capacity of 12 million gallons per day (mgd) which is expected to be adequate until 1982 or 1983 (Abt Associates 1977).

Table LC2-15A

EMPLOYMENT: SWEETWATER COUNTY

	Estimated Employment 1977
Total employment	19,653
Proprietors	1,081
Farm	116
Nonfarm	965
Wage and salary	18,572
Farm	243
Nonfarm	18,329
Government	1,821
Private	16,508
Manufacturing	358
Mining	4,897
Construction	4,736
Transportation	1,167
Trade	2,930
Finance, insurance and real estate	217
Services	2,169
Other	34

Source: Abt Associates 1978.

Table LC2-15B

HOUSING CHARACTERISTICS: SWEETWATER COUNTY

County Community	Total Units	Single-Family	Multi-Family	Mobile Homes
Sweetwater County[1]	10,367	5,555	1,171	3,641
Rock Springs[1]	5,197	3,199	622	1,376
Green River[2]	3,312	1,783	467	1,062
Balance of county[2]	1,858	573	82	1,203

[1]Abt Associates 1978.
[2]THK Associates 1976.

Table LC2-15C

EDUCATIONAL SYSTEM CHARACTERISTICS: SWEETWATER COUNTY

	Rock Springs SD#1	Green River SD#2
1977 fall enrollment	4,903	3,052
(Number of classroom teachers full-time equivalent)[1]	259.5	145.0
Student/teacher ratios[1,3]	18.9	21.0
Total annual expeditures ($-millions)[1]	11.08	5.37
Average daily membership (ADM)[1]	4,557	2,875
Expenditures per ADM[2,4] ($)	2,429	1,857
Assessed valuation ($-millions)[1]	313	134.5
Assessed valuation per ADM[2,5] ($)	68,686	46,783
Number of classrooms	222	139

[1]Wyoming Department of Education, Division of Planning, Evaluation and Information Services, 1977.

[2]Derived from Wyoming Department of Education data.

[3]Fall 1977 statewide average for classroom teachers - 18.4 (Wyoming Department of Education, Division of Planning, Evaluation and Information).

[4]1976-1977 statewide average expenditures per ADM - $1,721 (Wyoming Department of Education, Division of Planning, Evaluation and Information).

[5]1976-1977 statewide average assessed value per ADM - $31,143 (Wyoming Department of Education, Division of Planning, Evaluation and Information).

Table LC2-15D

HEALTH AND SOCIAL SERVICES: SWEETWATER COUNTY

Personnel Facilities	Number	Ratio Per Population Increment	State Standard Ratio Per Population Increment
Physicians	14	1:2,947	1:1,000
Nurses (employed)			
Registered nurses	92	1:449	1:285
Licensed practical nurses	24	1:1,719	1:769
Public health nurses	8	1:5,158	1:7,660
TOTAL	124		
Dentists	13	1:3,174	1:1,600
Optometrists	5	1:8,253	1:7,000
Hospitals	1	1:41,263	1:19,944
Hospital beds	97	1:425	1:179
Ambulances	9	1:4,585	1:3,740
Emergency rooms	1	1:41,263	1:13,296
Mental health centers	1	1:41,263	1:12,397

Source: Wyoming Division of Health and Medical Services 1977.

Green River currently has a sewage lagoon and privately owned sewage treatment plant. The town has recently expanded its system; it has a capacity of 1.5 mgd. It should be adequate through 1990. Rock Springs sewage system has a 2.0 mgd capacity with a 1.6 mgd average 1977 daily flow (Abt Associates 1978).

Utilities

Electric power is supplied to both Rock Springs and Green River by the Pacific Power and Light Company. With the construction of the Jim Bridger Plant, the company has the potential of producing over 3,000 megawatts (two other facilities are also used). Electric power supply should not be a problem in the foreseeable future (Abt Associates 1977).

Natural gas service for both communities is supplied by the Mountain Fuel and Supply Company. It has a capacity of over 11 million cubic feet per hour coming into the area. No supply problems are anticipated at present (Abt Associates 1977).

Attitudes and Expectations

The attitudes and expectations of county residents are dependent upon the benefits that they expect to receive from recent growth and the local government's ability to cope with the pressures resulting from it. In 1970, the county was basically rural in nature. Coal mining and the railroad were the primary industries before trona mining began to expand in response to a need for a nonpolluting source of soda ash and construction of the Jim Bridger Plant began. Since then, the county has seen a rapid expansion of employment opportunities and, consequently, a rapid increase in population and income.

Those involved in the mining and construction sectors generally have a favorable outlook financially. They make high salaries and enjoy the benefits that accompany above average incomes. Residents employed in local services with their lower wages, persons on fixed income, and the poor are less optimistic. Their lower incomes make it difficult to compete for goods and services with the inflated prices arising under rapid growth conditions. Items such as adequate housing, especially the purchasing of a new home, become very difficult to attain.

Nearly all residents, however, are concerned about the shortages in services that exist in most areas. The huge increase in population has put great demands on social services (hospitals, dentists, etc.), recreation facilities, public facilities (roads, sewage systems, etc.), and consumer services. It has also led to unplanned growth that has resulted in scattered mobile home parks, traffic congestion, and other problems associated with overcrowding. These difficulties have made many residents unhappy with life in the area. Unable to get needed services and find recreational or cultural outlets, many leave causing high turnover rates in housing and jobs. Crime, drinking, and family problems have all risen.

On the other hand, the local governments have made significant efforts to remedy the situation. Rock Springs now has a city planner as does Sweetwater County. Comprehensive plans have been or are being prepared to control future growth. The increased population and new industry have brought in new funds to support additional services and facilities to help cope with demands. Rock Springs, especially, is beginning to "catch up"with its "boom,"and residents' outlooks are on the upswing (Gilmore 1974 and Abt Associates 1977).

Life Styles

There are two basic components to life styles in Sweetwater County. The older and more permanent style is a reflection of preboom years when the area was primarily rural in nature. Communities had a small-town atmosphere with life centering on outdoor activities, hard work, church, and family. The recent industrial growth has threatened this way of life. Many older residents resent it, even though they have benefited from it in terms of expanded services and higher incomes in many cases. There is also concern about maintaining the wide-open spaces; new industrial activities would disturb the land both physically and visually.

Economic growth and increased industrialism has, however, changed much of the rural atmosphere of the area. Laborers from other communities, including large cities, have entered the county. They are used to more city-centered activities and have found the transition to a smaller town difficult. The increase in population has also brought many of the problems associated with larger towns (traffic, crime, etc.) as well as the benefits (more services and expanded facilities). The newer population has in effect brought with it a faster pace of life, a turn towards greater industrialism, and a trend of urbanization (Gilmore 1974 and Abt Associates 1977).

FUTURE ENVIRONMENT WITHOUT THE PROPOSED ACTION

The portion of Sweetwater County within the ES region will grow at an estimated annual rate of 3% through 1985 and 1.5% after 1985 and through 1990. The county's population will increase from an estimated 41,263 persons in 1977 to 45,320 in 1980, 52,951 in 1985, and 57,286 in 1990. About 63% of the new growth by 1990 (10,094 persons) will occur in Rock Springs and 30% (4,856 persons) in Green River. County employment will increase from an estimated 19,653 jobs in 1977 to 21,571 in 1980, 25,453 in 1985, and 27,446 in 1990. The mining sector will nearly double in size between 1977 and 1990 (4,897 to 9,002 jobs). Personal and per capita income will reach an estimated $502.3 million (a 94% increase) and an estimated $8,768 (a 40% increase), respectively. The expected population increases will put significant additional pressures on public and private services and facilities, housing, and utilities. The governments of Sweetwater County, Rock Springs, and Green River will need to substantially increase expenditures.

DESCRIPTION OF THE FUTURE ENVIRONMENT

The upward trend in the county's population will result in increased vehicular use of roads and highways. It is estimated that annual vehicle license tab sales will increase from 31,700 in 1976 to 34,800 in 1978 through 1979 and from 40,700 in 1980 through 1984 to 44,000 in 1985 through 1990.

Table LC2F-14A presents estimated increased railroad traffic data through 1990.

Estimated changes in recreational visitor use in Sweetwater County through 1990 are shown in Table LC2F-11A.

The expanded Jim Bridger Power Plant will have a local effect on air quality (see Maps R2-2A and R2-2B).

Adverse and beneficial impacts to cultural and paleontological resources will show correlation with developmental and population trends.

The air quality, climate, geology, topography, soils, water, vegetation, fish and wildlife, visual, and mineral resources of the lands comprising the Long Canyon project area will not change appreciably through 1990 without the proposed mining.

Table LC2F-14A

ESTIMATED FUTURE RAILROAD TRAFFIC WITHOUT COAL MINING IN SOUTHWEST WYOMING

Segment	Estimated Capacity[1] (trains per day)	Current Traffic[1,2] (trians per day)	1980 Traffic[3,4] (trains per day)	1980 % Capacity	1985 Traffic[3,4] (trains per day)	1985 % Capacity	1990 Traffic[3,4] (trains per day)	1990 % Capacity
Kansas City to Topeka	70-80	44	48	60	56	70	65	81
Topeka to Gibbon	70-80	22	24	30	28	35	32	40
Council Bluffs to Gibbon	55-60	34	37	62	43	72	50	83
Gibbon to North Platte	70-80	53	58	73	67	84	78	98
North Platte to Cheyenne	70-80	47	51	64	60	75	69	86
Cheyenne to Hanna	70-80	51	56	70	65	81	75	94
Hanna to Rawlins	70-80	45	49	61	57	71	66	83
Rawlins to Green River	70-80	44	48	60	56	70	65	81
Green River to Granger	70-80	40	44	55	51	64	59	74
Granger to Kemmerer	25-30	13	14	47	16	53	19	63
Kemmerer to McCammon	25-30	13	14	47	16	53	19	63
McCammon to Pocatello	25-30	13	14	47	16	53	19	63

Table LC2F-14A

ESTIMATED FUTURE RAILROAD TRAFFIC WITHOUT COAL MINING IN SOUTHWEST WYOMING
(Continued)

Segment	Estimated Capacity[1] (trains per day)	Current Traffic[1,2] (trains per day)	1980 Traffic[3,4] (trains per day)	1980 % Capacity	1985 Traffic[3,4] (trains per day)	1985 % Capacity	1990 Traffic[3,4] (trains per day)	1990 % Capacity
Granger to Ogden	55-60	32	35	58	41	68	47	78

[1]Union Pacific Railroad Company 1978.
[2]Through freight only.
[3]Abt Associates 1978.
[4]Estimates by ES team.

Table LC2F-11A

ESTIMATED RESIDENT VISITOR USE DEMAND BY ACTIVITY
FOR YEARS 1980, 1985, AND 1990

Activity	Visitor Days[1] 1980	Visitor Days 1985	Visitor Days 1990
Fishing	192,700	229,400	250,700
General[2]	188,900	229,100	253,500
Hunting	59,400	69,100	74,300
Off-road vehicle[3]	7,400	8,700	9,400
Sightseeing	58,200	69,900	76,700
Urban	123,300	157,600	178,800
Water sports	90,600	112,500	126,200
Winter sports	25,400	33,800	38,800

[1]Visitor Day consists of 12 hours.
[2]General includes camping, picnicking, etc.
[3]Estimate by ES Team Outdoor Recreation Planner.

CHAPTER 3

THE ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

This chapter discusses the impacts that would result from implementation of the proposed Long Canyon Mine. Impacts are linked to specific aspects of the mining and reclamation plan and are quantified to show magnitude, intensity, duration, and incidence.

This chapter also provides the bases for assessing unavoidable adverse impacts in Chapter 5.

ASSUMPTIONS AND ANALYSIS GUIDELINES

An analysis of impacts requires establishing assumptions and guidelines for coal-related development.

Assumptions

1. Labor and equipment shortages would not significantly distort the proposed levels of development.
2. No extensive delays for obtaining environmental clearances would be encountered.
3. No extensive delays for obtaining rights-of-ways (federal or private) would be encountered.
4. The reclamation of disturbed areas would require an estimated 8 years. This would include 3 years for spoil shaping (extensive backfilling would not be required), seedbed preparation, planting and replanting and 5 years for plant establishment (during which time livestock and extensive big game use would be prevented).
5. It is assumed that irrigation would be employed if necessary to avoid extensive delays in reclamation.

Guidelines

1. Impacts are analyzed for four time points (1980, 1985, 1990, and end of mine life).
2. Impacts remaining after mining reclamation are considered long term.
3. Mining plant site analyses include mine facilities and all ancillary developments (i.e., roads, power lines, railroad spur, and ponds).
4. The proposed revegetation seeding mixtures would be subject to revision based on research results at the proposed mining area and, when applicable, at other locations.
5. Successful reclamation would require the establishment of a diverse, effective, and permanent vegetative cover of native and (or) acceptable introduced species capable of supporting post mining land uses. The living plant ground cover on revegetated areas would have to equal the ground cover of living plants on approved reference areas for a minimum of two growing seasons.
6. Post mining land uses would primarily involve livestock grazing, wildlife habitat, and outdoor recreation (Bureau of Land Management (BLM) Pilot Butte Management Framework Plan 1977c).
7. The BLM would design and implement appropriate grazing management systems to prevent overgrazing of reclaimed areas.

AIR QUALITY

Emissions from the Proposed Mine

The specific emission sources of the Long Canyon Mine are presented in Table LC3-2A. Emission projections from a possible operating, coal preparation plant are not presented due to data being unavailable concerning the operational phases involved in such a plant. The use of a preparation plant, and the operational phases required, would be dependent on coal quality, for which adequate data are apparently undetermined. Emissions are projected for disturbances required for the construction and operation of a preparation plant, including soil surface disturbance for siting a plant and for a waste fines slurry pond. In addition, Table NB3-2A shows that fugitive dust emissions are included in this analysis (43 CFR 118 regulations are not applied) and, therefore, represents a conservative (upper bound) assessment of the impact of the proposed mine. However, based on state-of-the-art emission calculations and modeling techniques, the analysis reflects as accurately as possible the impacts of the mining and reclamation plan which was on file with the U.S. Geological Survey (USGS) at the time of this modeling effort.

As discussed in the preceding paragraph, best management practices were not necessarily included in the air quality impact analysis. Only those mitigating measures discussed in the Long Canyon mining and reclamation plan on fil with the USGS at the start of this rewrite were included in the modeling. In any event, the worst case mine situation is discussed, and best management practices will produce fewer and less intense impacts. It was not possible to include best management practices in Chapter 3, because the suggestions came in too late for modeling to be done and, if included now, would negate

Table LC3-2A

LONG CANYON PARTICULATE EMISSIONS

	Total Suspended Particulates in Tons Per Year 1980	1985	1990	EOML
Overburden removal	0	0	0	0
Ore loading	25	100	100	100
Truck dumping	5	20	20	20
Train loading	1	2	2	2
Conveying	3	10	10	10
Coal storage	3	14	14	14
Crushing (primary)	0	1	1	1
Crushing (secondary)	0	0	0	0
Employee access roads	71	125	125	125
Haul roads (coal)	0	0	0	0
Haul roads (overburden)	0	0	0	0
Haul road repair	0	0	0	0
Dozers (overburden dumps)	0	0	0	0
Wind erosion	135	135	135	135
Totals	243	407	407	407

Source: Environmental Research and Technology (ERT) 1978b.

the continuity of the present analysis. Chapter 8 contains an air quality alternative which discusses the best management practice impacts.

Impact on Air Quality

Figures LC3-2A and LC3-2B show the mine-related suspended particulates (SP) concentrations for worst-case annual and 24-hour averages predicted by the model. Concentrations are shown to decrease rapidly with distance. Annual and 24-hour mine-related concentrations decrease to 10% of maximum values at 1.5 to 2 miles and 1.5 to 2 miles downwind of the mine, respectively.

When annual average background particulate values of 18 micrograms per cubic meter ($\mu g/m^3$) are added to projected mine-related contributions, concentrations greater than the annual primary National Ambient Air Quality Standard (NAAQS) of 75 $\mu g/m^3$ are not predicted to occur, whereas the concentrations are predicted to be greater than the annual Wyoming standard of 60 $\mu g/m^3$ within 0.5 miles of the mine for the years 1985, 1990, and end of mine life. Background concentrations are projected to contribute 70% to TSP levels at 0.5 to 1 mile and 3 to 4 miles downwind from the mine for annual and 24-hour averaging periods, respectively.

If projected mine-related 24-hour SP values and background concentrations of 35 $\mu g/m^3$ are combined, concentrations are predicted to be greater than the 24-hour primary NAAQS of 260 $\mu g/m^3$ within 0.5, 1, 1, and 1 mile and greater than the Wyoming standard of 150 $\mu g/m^3$ within 1, 1.5, 1.5, and 1.5 miles of the mine for the years 1980, 1985, 1990, and end of mine life, respectively.

A comparison of the worst-case mine impact with Prevention of Significant Deterioration (PSD) regulations is shown in Table LC3-2B. The distances from the mining area within which concentrations are predicted to be greater than the specified increments are listed for annual and 24-hour averages according to PSD area classification. Concentrations greater than the Class II annual PSD increment are projected to occur within 1 mile and greater than the 24-hour increment within 2 to 2.5 miles of the mine.

Note that under the new PSD regulations (43 CFR 118), the violations discussed above would not occur. In fact, the mine would be well within the applicable NAAQS and PSD regulations.

Gaseous Pollutants

Vehicle emissions would be the only source of gaseous air pollutants from the proposed mine. Federal and state regulations include limitations on ambient air concentrations of the vehicle-related pollutants carbon monoxide (CO), hydrocarbon (HC), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2).

The air quality impact of the emission of these pollutants would be greatest closest to the mine since all emissions would be at ground-level. Ambient concentrations were not modeled because of the lack of detailed data on vehicle use and of applicable background data for these pollutants. However, recent studies (U.S. Department of the Interior 1976) of the impact of vehicle emissions associated with western coal mines were reviewed to estimate the probable range of impact. In these studies, concentrations of the above pollutants for similar mining operations had either been modeled or estimated from standard approximation techniques. In all cases, the levels of maximum pollutant concentrations from vehicle emissions were insignificant when compared to standards.

Maximum predicted concentrations of CO ranged between 0.02% and 0.44% of the standard. Maximum predicted HC concentrations ranged between 0.88% and 3.44% of the standard. Maximum predicted NO_2 concentrations ranged between 0.6% and 3.0% of the standards. Maximum predicted concentrations of SO_2 ranged between 0.02% and 0.33% of the standards. The values represent predictions at less than one-half mile from the mines. Predictions were significantly less at further distances from the mines. Assuming similar vehicle activity for all western coal mines, the impact of vehicle emissions on ambient concentrations of gaseous pollutants would be minimal and insigificant compared to their respective standards.

Visibility

Using the technique discussed in the Chapter 4, Regional Technical Report (ERT 1978a), visibilities have been computed downwind from the source. Results for worst-case 24-hour SP concentrations for the years 1980, 1985, 1990, and end of mine life are shown in Table LC3-2C. Also given are the mass fractions of the total TSP for coal and soil for each year which were used to calculate the visibilities shown in Table NB3-2C. For 1980, the visibility of an observer at 1 mile downwind would be approximately 39.8 miles, assuming background visibility of 40 miles. In general, visibility would increase with downwind distance from the mine. At 5 miles downwind, the visibility would be 40 miles, and at 10 miles it would reach 40 miles. The corresponding values, assuming a background visibility of 7 miles, are 7 miles, 7 miles, and 7 miles, respectively. Additional analysis years are given in the table.

GEOLOGY

Paleontology

Impacts to paleontological resources would consist of losses of plant, invertebrates, and vertebrate fossil materials for scientific research; public education (interpretative programs); and to other values. Losses would result from destruction, disturbance, or removal of fossil materials as a result of coal mining activities, unauthorized collection, and vandalism.

A beneficial impact of development would be the exposure of fossil materials for scientific examination and

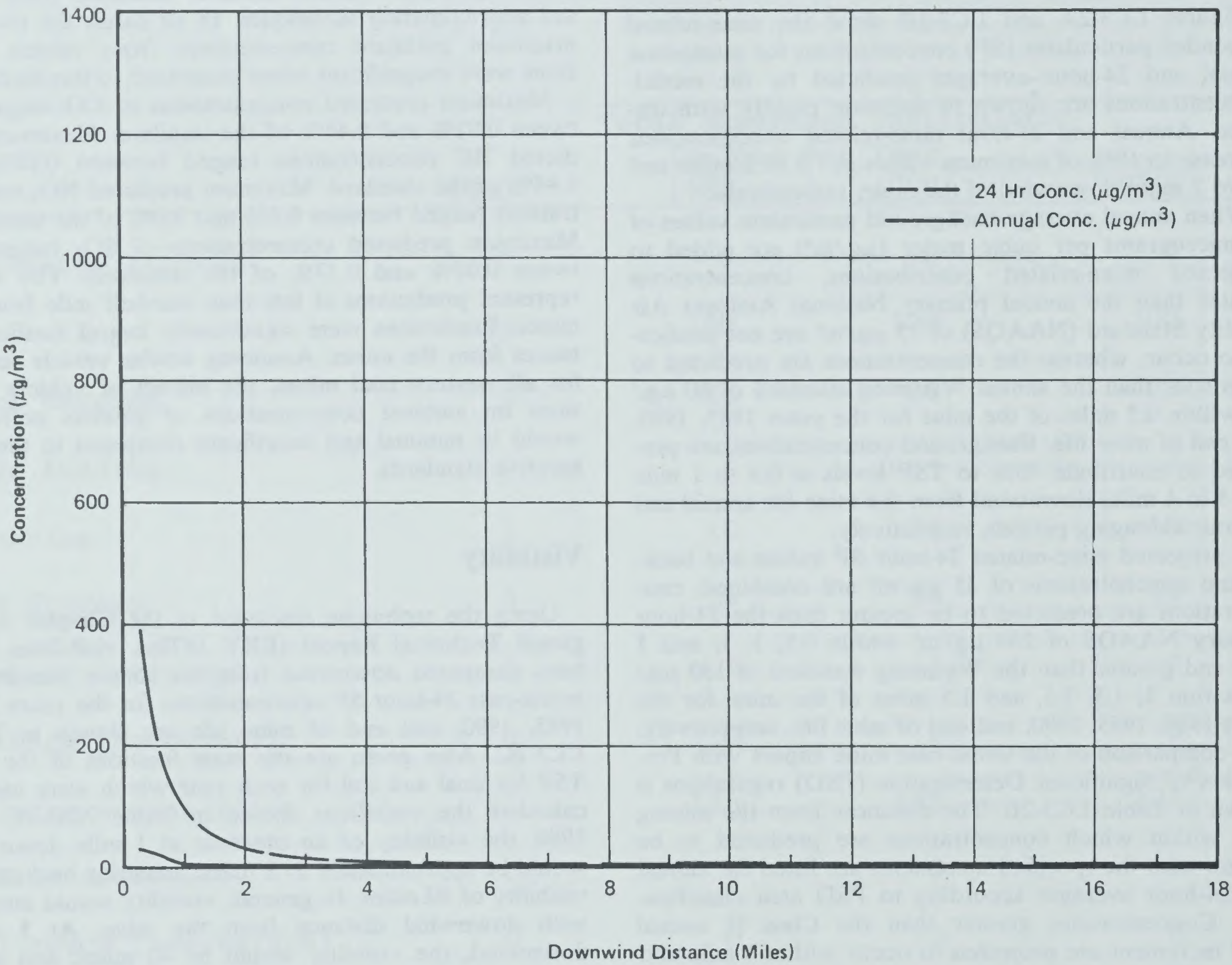


Figure LC3-2A

1980 LONG CANYON SP CONCENTRATIONS

Source: ERT 1978b.

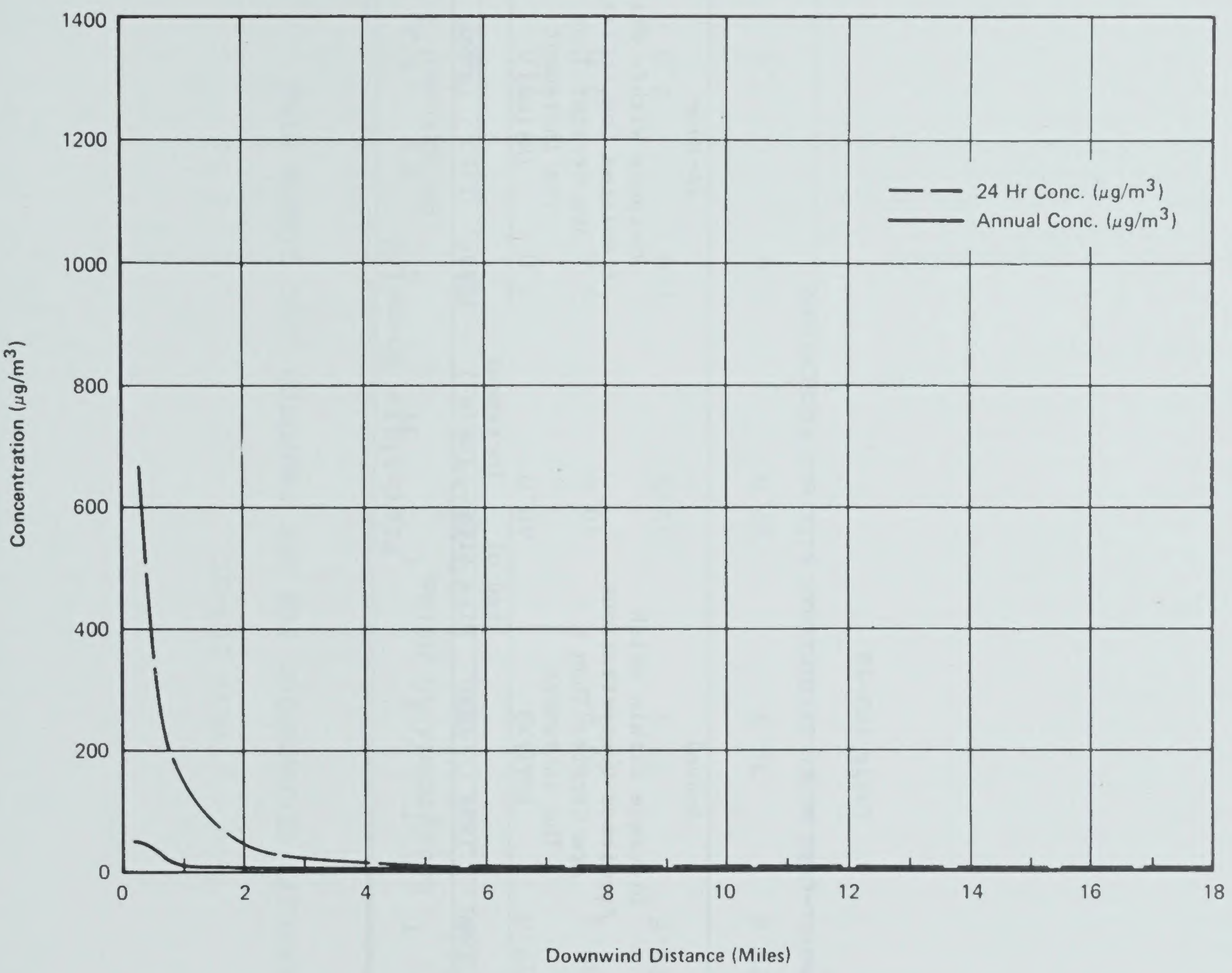


Figure LC3-2B

1985, 1990, AND END OF MINE LIFE LONG CANYON SP CONCENTRATIONS

Source: ERT 1978b.

Table LC3-2B

COMPARISON OF WORST-CASE MODEL PREDICTIONS WITH PSD REGULATIONS

	Annual					24-Hour				
		Distance Within Which Predicted Concentrations Are Greater Than The Increment (Miles)					Distance Within Which Predicted Concentrations Are Greater Than The Increment (Miles)			
Area Classification	Increment ($\mu g/m^3$)	1980	1985	1990	End of Mine Life	Increment ($\mu g/m^3$)	1980	1985	1990	End of Mine Life
II	19	1	1	1	1	37	2	2.5	2.5	2.5

Source: ERT 1978b.

Table LC3-2C

ACROSS PLUME VISIBILITY DEGRADATION FOR THE PROPOSED LONG CANYON MINE

			Visibility Downwind					
	Mass Fraction		Background 40 Miles			Background 7 Miles		
Year	Coal	Soil	1 Mile	5 Miles	10 Miles	1 Mile	5 Miles	10 Miles
1980	16	84	39.8	40.0	40.0	7.0	7.0	7.0
1985	37	63	39.8	39.9	39.9	7.0	7.0	7.0
1990	37	63	39.8	39.9	39.9	7.0	7.0	7.0
End of Mine Life	37	63	39.8	39.9	39.9	7.0	7.0	7.0

Source: ERT 1978b.

collection which otherwise may never occur except as a result of exposure of rock strata and mineral excavation.

Fossil materials of Cretaceous age in the Almond and Rock Springs Formations would be impacted to variable degrees.

All exposed fossiliferous formations could also be affected by increased unauthorized fossil collecting and vandalism as a result of increased population. The extent of this impact cannot be presently assessed due to a general lack of specific data on such activities.

Due to the present lack of data and accepted evaluatory criteria for determination of significance, no meaningful assessment can be presently made as to the extent and nature of the loss of these paleontological values to science or education, or hence to the significance of potential impacts on the fossil record.

Geologic Hazards

Because the mining is underground and longwall or continuous mining technology would be used, no geologic hazards would develop on the surface. With acceptable engineering practices, there would be no geologic hazard underground.

The project would be in an area of very low seismic activity so the probability of damage resulting from earthquake activity is slight.

TOPOGRAPHY

There would probably be little visible effect on the land surface as a result of the proposed mining because all mining would be underground using longwall or continuous mining methods. The principle effect on the topography would be subsidence. Because the mining would be relatively near-surface (200 to 900 feet), the amount of subsidence would probably equal a significant fraction of the total thickness of the beds mined, which ranges from 4 to 40 feet. Because there are many variables, the thicknesses of the four coal beds and of the overburden plus the possible degree of expansion of the overburden, it is difficult to estimate with any degree of assurance the amount of subsidence that would occur at any particular place. However, a top limit on the amount of subsidence that could be expected would be approximately 30 feet. The area subject to subsidence would be 3,680 acres. This subsidence would not be regarded as significantly adverse insofar as it relates to topography.

Because the proposed mining would be underground, the land surface would be essentially undisturbed except for subsidence and holes and cracks resulting from subsidence. Rocky Mountain Energy Company and Sunoco Energy Development Company would be responsible for backfilling any holes or cracks which may appear. All ephemeral streams would remain in their present positions. Their gradients would be increased in the eastern part of the proposed area, where minor increased downcutting could be expected, and decreased in the western part, where minor deposition would be likely. Subsidence probably would not be great enough to cause ponding of the ephemeral streams.

A 100-acre freshwater storage pond would be located on public land in Section 24, T. 22 N., R. 104 W. There would be an insignificant amount of wave erosion along the shores of this pond.

A road, a railroad, and utility lines would also cross this section. The road and utility lines would follow essentially the same corridor. The railroad would cross further to the north. A possible impact of the road and railroad might be the creation of gullies with increased erosion through the channelization of drainage water. When utility lines are buried, the devegetation and the disturbance of the soil and rock material to a depth of several feet might lead to increased erosion and gullying. This gullying would not significantly modify the overall topography.

The effects of topographic changes on the drainage of the project area are discussed more fully in the Water Resources section.

SOILS

Underground mining would result in minimal disturbance of surface soils. Approximately 493 acres of soil surface would be disturbed as a result of mining. Included would be areas required for the plant facility (300 acres), topsoil storage areas (5 acres), waste storage areas (88 acres), and a reservoir (100 acres).

Topsoil would be removed and stockpiled from all areas to be disturbed within the plant facility. The removal and stockpiling process would destroy what soil structure is present and would eliminate a majority of the soil biota population. This loss in soil biota would result from the scraping process and the lack of sufficient oxygen supply when they become buried too deep in the stockpile to live (Brock 1966). The loss of soil structure would not significantly affect water movement into the soils since the soils have a high sand content. Therefore, the loss of structure would not significantly affect reclamation of the disturbed areas.

Reclamation of all remaining disturbed areas would proceed at the end of mining. Topsoil would be replaced and seeded. This new surface would be exposed to water action at an accelerated rate until such time as a vegetative cover could be established. The rate of water erosion would be approximately 4 tons per acre per year (calculated using Musgrave's Equation, BLM Manual 7317.22A). This is an increase of 0.5 tons per acre per year over the erosion rate that exists prior to mining. A small amount of soil would be lost for the production of vegetation on these areas during reclamation.

The areas of soil surface to be disturbed by the mining operation would be out of vegetative production for the life of the mine. Population increases due to mining would result in the removal of around 500 acres of soil surface from production as a result of the construction of housing and support facilities.

Overall, the mining action would not significantly affect the soils of the Long Canyon project area. The amount of soil disturbance would be minor in all areas except for the shaft entrances that would occupy less than 1 acre. There would be a very small amount of soil loss from erosion.

If a 10-, 25-, 50-, or 100-year flood were to occur when areas are in the process of being reclaimed, an accelerated rate of erosion would occur over the amount that would occur normally. This would result in soil loss, and the occurrence of one of these floods during reclamation would also lengthen the time required for vegetation reestablishment.

WATER RESOURCES

Ground Water

The Rock Springs Formation, which is the coal-bearing unit that would be mined, is an aquifer in other places as is the overlying Ericson Formation. Six wells which tap the Ericson and Rock Springs Formations are within 0.7 to 3 miles of the perimeter of the project area. If the Rock Springs Formation is an aquifer at the mine site, water levels in these six wells may be lowered. Data are not available to determine the amount of decline. The possibility that the mine may need dewatering is stated in the mining plan. If the coal preparation plant is used, a coal slurry pond would be required. Infiltration of water with high total disolved solids would be possible to the Ericson and Rock Springs formations.

After mining is completed in an area and the roof and overburden have subsided, cracking and caving may allow surface runoff to infiltrate into the abandoned workings, which might allow some amount of recharge to the coal aquifer, but could also allow contaminants to enter the aquifer. However, there appears to be no source of pollutants that might enter the aquifer through the subsidence cracks in the Rock Springs Formation. Some potential exists for contamination of aquifers from sewage that would be collected in a double lagoon for evaporation.

Surface Water

Water from Cedar Creek drainage would be diverted to supply fresh water for drinking and personal use. To the extent of this diversion, the flow of Cedar Creek would be depleted and interrupted, thus diminishing the amount available to native vegetation and wildlife. Unquantifiable impacts from the proposed mining could occur to the Cedar and Long Canyon drainages, believed to be alluvial valley floors. According to 30 CFR 715.17(j)(z) "Surface coal mining operations located west of the 100th meridian west longitude shall not interrupt, discontinue, or preclude farming on alluvial valley floors and shall not materially damage the quantity or quality of surface or ground water that supplies these valley floors..." The mining plan states that a pipeline from Green River may be necessary to supply water for the mine. Insofar as ground surface is disturbed by excavations and backfill, access roads, and construction equipment, sediment discharge from the disturbed area would be increased. No other impacts on surface water are foreseen.

Water Use

Water use at the proposed Long Canyon Mine is estimated to be 50 acre-feet per year per million tons of coal mined. Planned production is 2 million tons per year; therefore, approximately 100 acre-feet of water per year could be required. A coal processing plant, if constructed, would require about 200 acre-feet of makeup water per year.

VEGETATION

Terrestrial

The proposed Long Canyon mining operation would remove native vegetation from about 493 acres. Approximately 68% of the disturbance (335 acres) would involve sagebrush communities, and the remaining 32% (158 acres) would involve saltbush communities. The vegetation on 410, 425, 438, and 493 acres would be removed by 1980, 1985, 1990, and end of mine life, respectively.

Population increases due to mining would result in a long-term loss of vegetative production on an estimated 500 acres for housing and support facilities, primarily adjoining existing municipalities. Increased numbers of people in the area would result in additional disturbance of native vegetation, particularly by off-road vehicle use (see Recreational Resources section).

The revegetation of disturbed areas would be difficult due to many factors. Climatic conditions are severe with extremely low and high temperatures; strong winds; and low, erratic precipitation. Moisture would probably be the most limiting factor (May 1975 and Cook, Hyde, and Sims 1974), with average annual precipitation on the area estimated to be about 8.5 inches (see Climate section). Other factors which could hinder revegetation are less than ideal soil properties (see Soils section), competition for moisture and nutrients from undesirable weedy plant species (May 1975), and the loss of seeds and destruction of seedlings by small mammals (Thames ed. 1977).

Despite such problems, successful reclamation appears to have been achieved in the ES region along highway rights-of-way and on areas disturbed by oil and gas activities. Published reclamation research concerning these sites, however, is apparently not available. Natural plant succession is also in evidence on many of these sites, with the rate and extent of succession depending on site characteristics. Hodder (Thames ed. 1977), in discussing highway and mined land reclamation, considered the problems in reclaiming these types of disturbance similar in many respects and dissimilar in others. One major difference expressed was that mined spoils may be manipulated (i.e., farmed, etc.), while roadside problem materials must be accepted as they exist.

Revegetation research in the arid southwestern United States indicates that the reclamation of coal and copper mined lands is possible under extremely harsh environmental conditions (Aldon 1978; Bengson 1977; and Aldon and Springfield and DeRemer and Bach (Thames ed. 1977)).

Reclamation activities are being conducted at two active surface coal mines in the region. Seeding operations began in 1972 at the Kemmerer Coal Mine, located about 4 miles southwest of Kemmerer, Wyoming. Only 46 acres of 376 acres seeded through 1977 have received topsoil treatment (Kemmerer Coal Company 1977). This situation exists because early mining reclamation laws did not require topsoiling of mine spoils. May, et al. (1971) found spoil materials at the Kemmerer Mine to be extremely variable in some properties. Values for pH ranged from 2.2 to 7.3. Some spots were high in aluminum content and extremely low in pH. The most common soil textures found were clay loams and clays. Clay soils are difficult to work into a proper seedbed and are known for poor water infiltration properties (Cook, Hyde, and Sims 1974).

The initial seeding of disturbed lands at the Jim Bridger Mine, located about 35 miles northeast of Rock Springs, Wyoming, was in 1975 (personal communication, Harley Meuret, Jim Bridger Coal Company, 1978). Topsoil has been applied to all lands being reclaimed as required by current state and federal laws. About 246 acres have been graded, topsoiled, and seeded through 1977 (Bridger Coal Company 1978).

Supplemental irrigation is being experimented with at both mines. This practice is considered essential, or probably essential, by some reclamation authorities for reclaiming mined lands in areas having low and erratic precipitation (DeRemer and Bach and Aldon and Springfield (Thames ed. 1977)). Both mining companies have in recent years adopted the use of rangeland drills for seeding operations. Drilled seeding is generally considered superior to broadcast seeding, particularly on areas where a good seedbed can be prepared (Vories ed. 1976 and Thames ed. 1977). The use of topsoil, with some reservations, is also recognized as a beneficial treatment in achieving revegetation (Vories ed. 1976 and Thames ed. 1977). In view of the topsoiling deficiencies at the Kemmerer Mine, the early seeding methods employed at both mines, and the short time lapse between the present time and the initial seeding conducted at the Jim Bridger Mine; it is understandable that large scale reclamation has not been achieved at either mine.

A review of current mine-land reclamation literature and analyses of resources available for reclamation indicate that the methods and procedures proposed in the Long Canyon mining and reclamation plan (subject to compliance with SMCRA) would result in the successful reclamation of disturbed lands. However, since conclusive site-specific reclamation success data are unavailable, and since reclamation success is dependent on site-specific conditions and the solving of problems either identified or yet to be identified, a reclamation alternative is presented in Chapter 8. This alternative identifies a procedure to prove the feasibility of on-site reclamation. An estimated 8 years would be required to reclaim disturbed areas (extensive backfilling would not be required). The reclamation time estimate is based on revegetation results on semiarid to arid mined lands (Aldon 1978; Bengson 1977; Aldon and Springfield and DeRemer and Bach (Thames ed. 1977)) and on the recommended need for plants to be protected from extensive grazing during establishment (Cook, Hyde, and Sims 1974). It is assumed that supplemental irrigation would be employed when necessary to achieve seed germination and seedling establishment. Without irrigation, reclamation would be delayed during years when soil moisture is inadequate.

The achievement of reclamation earlier or later than estimated would lessen or increase impacts to living organisms and their non-living environment due to the loss of vegetative cover and production (see Air Quality, Soils, Fish and Wildlife, Agriculture, and Water Resources sections).

Based on the proposed Long Canyon seeding mixtures, reclaimed areas would have a general appearance of grassland. Grasses would be the most common forage class, with shrubs and forbs being reduced in density and cover as compared to premining conditions.

Natural plant succession would occur on reclaimed lands and could restore approximate premining plant cover and composition values in an estimated 30 to 50 years, as suggested by Cook (Vories ed. 1976).

Aquatic

Sufficient information is not available to determine if there would be any impact to the few species of algae and other aquatic vegetation present in seasonal drainages.

Endangered and (or) Threatened

A survey of the project area revealed no plants proposed for endangered and (or) threatened status (Dorn 1978). Formal consultation under Section 7 of the Endangered Species Act of 1973 was initiated with the U.S. Fish and Wildlife Service on March 2, 1978. The U.S. Fish and Wildlife Service responded by letter dated 7 March 1978 that formal consultation cannot be conducted for unlisted species.

FISH AND WILDLIFE

General Information

Impacts of the proposed action upon fish and wildlife resources are summarized in Tables LC3-8A, LC3-8B, and LC3-8C. Impacts can be categorized into three gen-

Table LC3-8A

SUMMARY OF IMPACTS ON FISH AND WILDLIFE RESOURCES
ON THE PROPOSED LONG CANYON PROJECT AREA

Classification of Impacts	Anticipated Impact of Proposed Mine None	Minor	Major
Fish and wildlife habitat			x
Carrying capacity for fish and wildlife			x
Fish and wildlife populations			
Fishery			
Nongame	x		
Game	x		
Endangered and (or) threatened species	x		
Wildlife			
Birds			
Nongame		x	
Game		x	
Endangered and (or) threatened species	x		
Mammals			
Nongame		x	
Game			x
Endangered and (or) threatened species	x		
Reptiles and amphibians			
General		x	
Endangered and (or) threatened species	x		

Table LC3-8B

SUMMARY OF FISH AND WILDLIFE AREA IMPACTED
BY THE PROPOSED LONG CANYON MINE

	Direct Loss[1] (acres)	Indirect Loss or Adversely Affected Area[2] (acres)
Fish and wildlife habitat		
1980 - through end of mine life	493	2,220
Area of fish and wildlife carrying capacity affected		
1980 - through end of mine life	493	2,220
Area in which fish and wildlife populations would be affected		
1980 - through end of mine life	493	2,220

[1]Totally (100%) affected.
[2]Data are insufficient at this time to determine the degree to which these areas (areas of influence) would be affected. It may be only slightly (10%-20%) or totally (100%), depending upon the individual species involved.

Table LC3-8C

SUMMARY OF ESTIMATED WILDLIFE POPULATION LOSSES

	Estimated Number of Individuals Directly Lost to Proposed Action 1980	1985	1990	Mine Life	% of Population[2]
Wildlife					
Birds					
Nongame[1]	380.0	1.3T	2.3T	6.2T	<1%
Raptors	---	---	---	---	
Game	30.0	90.0	150.0	300.0	.04%
Mammals					
Nongame	81.4T	284.4T	488.4T	1.3M	<1%
Game					
Elk	65.0	100.0	160.0	500.0	5%
Mule deer	100.0	250.0	400.0	1.2T	2%
Antelope	3.0	8.0	13.0	35.0	0.1%
Reptiles and amphibians	1.7T	2.7T	4.3T	14.0T	<1%

Note: All estimes are for the total population, including the progeny that would have been produced.

[1] All nongame birds except raptors

[2] These percent figures represent the amount of regions or herd/management unit populations that will be lost by the end of mine life. Percent figures that are underlined are based on herd or management unit populations.

T = Thousands

M = Millions

eral types: (1) loss of fish and wildlife habitat, (2) loss of the carrying capacity of that habitat to sustain fish and wildlife populations, and (3) loss of the fish and wildlife population and their progeny (offspring) over the period of mining and reclamation.

The proposed mining operation would remove native vegetation from about 493 acres. Disturbance to the sagebrush and saltbush habitat types would be 335 acres and 158 acres, respectively. There would be no disturbance to the juniper or greasewood types.

Habitat Losses

The proposed mining operation would result in both direct and indirect losses to wildlife habitat. Direct losses would include that habitat physically disturbed by mining and related activities. Indirect losses would be that area (area of influence) that would be indirectly lost or affected. This "area of influence"would be indirectly lost or affected because of the fact that all living organisms to some degree exhibit a home range or territory and daily or seasonal migration. Hence, if an organism is impacted upon part of that home range or territory, the remaining part of that home range or territory is also impacted to a certain degree. This degree of impact can range from a slight impact of 10% to 20% or to a total impact of 100%, depending upon the individual organism or species involved. This area of indirect loss or adversely affected fish and wildlife habitat would range in size from an area equal to the direct habitat loss for such species as a leopard frog to four or five times the area of direct habitat affected for such species as the golden eagle. Anticipated acreage loss in this area of influence is summarized in Table LC3-8B. Habitat losses for specific seasonal ranges for the major game species are summarized in Table LC3-8D.

Reclamation would have varying degrees of effectiveness to wildlife depending on the wildlife species involved, the plant species used, and the success of revegetation. Reclamation, however, would be difficult in southwestern Wyoming because of soil and climate conditions (see Long Canyon and Regional Vegetation section and Regional Wildlife discussion of reclamation). Since quantification of the effectiveness of reclamation to wildlife is not possible with current available information, the numbers representing habitat and population losses do not reflect any post-reclamation return to either one.

Carrying Capacity Losses

As a result of the loss of the fish and wildlife habitat (vegetation and living space), there would exist a loss of that area's ability to support fish and wildlife population. This ability to support fish and wildlife population is known as its "carrying capacity" The loss of this carrying capacity would range from 493 acres (area directly affected) to 2,220 acres (area of influence) by 1980. The acreages on which carrying capacity losses would occur are summarized in Table LC3-8B.

Fish and Wildlife Population Loss

Introduction

There would be a loss of wildlife populations within the area to be disturbed. For example, if there are five animals per acre in a given area, and 1,000 acres of that area are disturbed; loss to that population would be 5,000 individuals. In addition, there would be a loss of the populations progeny (offspring) over the period of disturbance. See fish and wildlife loss, Chapter 4, Regional, for an explanation of the method used to calculate total population losses.

When estimating losses to the wildlife resource, it was assumed that all habitat would be near carrying capacity for the particular species being discussed. This would not necessarily be the case, and it is realized that possibly not all the wildlife occupying an area to be disturbed would be lost. However, definitive data concerning habitat condition and trend in and around proposed project areas were not available; therefore, projections as to the survival of displaced animals were not made.

Fishery

Nongame. No loss to nongame fish is anticipated.

Game. No loss to game fish is anticipated.

Endangered and (or) Threatened. It is not anticipated that there would be any adverse impacts to endangered and (or) threatened fish species.

Wildlife

Birds.

Nongame. The primary small nongame bird species impacted would be horned lark, black-billed magpie, sage thrasher, vesper sparrow, sage sparrow, and Brewer's sparrows.

Based upon breeding bird surveys conducted by the Wyoming Game and Fish Department, the best population density estimate currently available is 14 birds per square mile. Using the formula for biotic potential, the proposed mine would account for the loss of an estimated 380, 1,320, 2,260, and 6,200 birds by 1980, 1985, 1990, and end of mine life, respectively. These figures represent a minute percentage of the total population of small birds in the Long Canyon/Cedar Canyon area and the region.

It is not anticipated that there would be any impacts to raptors, since the nearest nest is over 1.5 miles from the proposed mine facilities.

Game. Sage grouse would be the only game bird impacted by the proposed mine. There would be a loss of 493 acres of sage grouse yearlong range by 1980. This loss would remain constant through the end of mine life. This acreage figure represents less than 0.03% of the

Table LC3-8D

GAME SPECIES WILDLIFE HABITAT DISTURBANCE

Species and Habitat	Acres Impacted by Time Periods 1980	1985	1990	End of Mine Life	% of Available Range
Sage grouse:					
Yearlong	493	493	493	493	.04%
Pronghorn antelope:					
Summer	493	493	493	493	0.2%
Mule deer:					
Winter/yearlong crucial	493	493	493	493	4%
Elk;					
Summer	493	493	493	493	5%

Note: The percent figures represent the amount of range the disturbance would remove by the end of mine life from the total range now available. In some cases, it was more practical to calculate percentages based on herd or management units rather than on a regional basis. These figures are underlined.

range available in bird management section 012 of the Eden Management Unit. Using the assumption of an average of 17 birds per square mile, an estimate of the losses would be 30, 90, 150, and 300 birds by 1980, 1985, 1990, and end of mine life, respectively. The end of mine life figure would represent less than 0.04% of the production of the total population of the management unit by that time.

Endangered and (or) Threatened. At this time and with current information it is not anticipated that there would occur any adverse impact to any endangered and (or) threatened bird species.

Mammals.

Nongame. The primary small nongame species affected would be whitetail prairie dog, Richardson ground squirrel, least chipmunk, and deer mouse. The best population density estimates available indicate 5 animals per acre in sagebrush and 0.5 per acre in saltbush (Maxell 1973). Using the formula for biotic potential, the proposed mine would account for the loss of an estimated 74,000, 259,000, 444,000, and 1,220,000 animals in the sagebrush type by 1980, 1985, 1990, and end of mine life, respectively. In the saltbush type, losses would be an estimated 7,400, 25,900, 44,400, and 122,000 animals by 1980, 1985, 1990, and end of mine life, respectively. The total losses for all habitat types combined, including the progeny which would have been produced, would be estimated at 81,400, 284,900, 488,400, and 1,342,000 animals by 1980, 1985, 1990, and end of mine life, respectively.

Although these figures seem large, they are only a minute percentage of the total production of small mammal populations within the region. In addition, it is realized that small mammal populations do fluctuate greatly and that losses would vary accordingly. However, habitat disturbance would remove the areas' ability to produce that peak population until reclamation is successful.

Game. There would be a loss of 493 acres of antelope summer range by 1980 and it would remain constant through the end of mine life. This loss represents less than 0.2% of the summer range available in the Dry Lake Herd Unit. There is an estimated 2 antelope per square mile; therefore, the proposed mine facilities would account for the loss of an estimated 3, 8, 13, and 35 antelope by 1980, 1985, 1990, and end of mine life, respectively. These losses include the progeny that would have been produced had mining not taken place. The end of mine life figure represents less than 0.1% of the production of the total herd by that time.

The proposed mine facilities would also be located in crucial winter range for mule deer. The Wyoming Game and Fish Department estimate 400 deer winter in Long Canyon, Cedar Canyon, and Pine Canyon which cover about 30 square miles. Assuming that 50% of the area is unavailable for use (because of rimrock areas, deep snow on north slopes, lack of adequate food, etc.) there would be an estimated 30 deer per square mile. The habitat lost including area of influence would be 2,220 acres or 3.5 square miles. The 3.5 square miles of habitat loss represents about 4% of the crucial winter/yearlong range available in the Steamboat Herd Unit for deer. Using the above assumptions, it is estimated that losses to deer would be 100, 250, 400, and 1,200 animals by 1980, 1985, 1990, and end of mine life, respectively. If comparing the production of 1,200 deer by the end of mine life with the production of the total population in the herd unit by the end of mine life, the 1,200 deer would represent about 2% of the total production of the herd unit. These losses include the progeny that would have been produced had mining not taken place.

The proposed mine would eliminate 493 acres of summer range for elk by direct disturbance. Indirect losses would be 1,480 acres of summer range and 740 acres of crucial winter/yearlong range. The disturbance of 1,480 acres of summer range represents about 0.2% of the total available summer range in the Steamboat Herd Unit. The 740 acres represents about 1% of the crucial winter/ yearlong range available in the same unit. Because of this habitat loss and the fact that elk are sensitive to human disturbance, it is anticipated that the 40 elk that use the area would be lost. When considering the young that would be produced, losses would be estimated at 65, 100, 160, and 500 animals by 1980, 1985, 1990, and end of mine life, respectively. The end of mine life figure would represent about 5% of the production of the total herd in the herd unit by that time.

Endangered and (or) Threatened. At this time and with current information, it is not anticipated that there would occur any adverse impact to any endangered and (or) threatened mammal species. However, in accordance with Section 7 of the Endangered Species Act of 1973, the BLM has officially requested formal consultation with the U.S. Fish and Wildlife Service by letter dated 2 March 1978. The only endangered mammal species for which consultation is presently being conducted is the black-footed ferret. Under Section 7 of the Endangered Species Act of 1973, the Secretary of the Interior will grant no approval which would jeopardize the continued existence of any endangered and (or) threatened species or result in the destruction or modification of their critical habitat.

Reptiles and Amphibians

General. The primary reptile and amphibian species that would be impacted are northern side-blotched lizard, northern plateau lizard, sagebrush lizard, and Great Basin gopher snake.

The best density estimates currently available are an average 2.5 individuals per acre on sagebrush and saltbush habitat types (personal communication, Dr. George Baxter, University of Wyoming, January 1978). Using this assumption, it is estimated that 1,700, 2,700, 4,300, and 14,000 individuals would be lost by 1980, 1985, 1990, and end of mine life, respectively. These figures include the progeny which would have been produced had mining not taken place.

Endangered and (or) Threatened. No adverse impact is anticipated to any endangered and (or) threatened reptile or amphibian species.

Wild Horses

No impacts to wild horses are anticipated.

CULTURAL RESOURCES

Impacts to cultural resources would include (1) destruction or alteration of all or part of a property; (2) isolation from or alteration of its surrounding environment; and (3) introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting (36 Code of Federal Regulations 800.9). These impacts may take place to both archeological and historical sites in the region.

The loss of cultural resource sites and the data contained therein would be a direct result of their physical destruction through land modification required in mining and associated surface facilities, access roads, rail spurs, power lines, as well as subsidence resulting from underground mining. Site destruction could also occur through development-related events such as increased population which could lead to increased pothunting and vandalism and increased vehicular use of the land resulting in some unintentional destruction of cultural resources.

Because cultural resources are nonrenewable, the physical destruction of any cultural data or artifacts could eventually have a potentially significant impact on efforts to reconstruct the prehistory and history of the region.

Archeological

Eleven archeological sites within the proposed Long Canyon project area are threatened by complete physical destruction by 1980 due to construction of surface facilities. No other sites are threatened by construction by 1985, 1990, or end of mine life.

Where subsidence occurs cultural resources would be affected by enhanced erosion where subsurface strata are exposed and destroying site stratigraphy by jointing and fracturing. Until the location and magnitude of this action is known, specific quantification of known sites affected cannot be determined. Unknown subsurface sites and unknown sites in unsurveyed portions of the proposed project area would also be affected by subsidence should it occur.

The potential for buried archeological sites exists within the project area and associated rights-of-way. Early period and Altithermal sites would most likely have been buried in Quaternary deposits through time and, because of their scarcity, would be of particular importance. These sites are not and would not be evident before actual surface disturbance uncovered them. This action could partially or completely destroy them, and a site may go unnoticed. It is impossible to evaluate the significance of uninventoried or buried sites. Known Early period, Altithermal, and multicomponent sites are quite rare and, therefore, would be highly significant in the region. Their loss would represent a significant impact.

Cedar Canyon petroglyphs may be affected by subsidence. Until the location and magnitude of subsidence in this area can be determined, the effects upon the Cedar Canyon petroglyphs site will not be known. In addition, the location of the underground mining in relation to the Cedar Canyon petroglyphs is not certain.

The increase in pothunting, arrowhead collecting, and vandalism that would result from an increase in population would affect all known and unknown resources within the region. The significance of this impact is potentially great, since the kind of data removed by these activities, arrowheads and tools, are the major resources for dating and analyzing prehistoric activity.

Historical

There are no known historical sites which would be impacted by the proposed Long Canyon Mine.

VISUAL RESOURCES

Visual Resource Contrast Ratings were conducted for the Long Canyon mining area using viewpoints along County Road 4-17 as critical viewpoints (see Map LC2-10A in Visual Resources, Chapter 2). The contrast ratings are available for review at the Rock Springs District Office of the BLM. These contrast ratings are summarized in Table LC3-10A. Further explanation of the Visual Resource Contrast Rating System can be found in BLM Manual 6320.

Contrast is assessed in terms of how the proposal is expected to affect existing physical attributes—landform; vegetative patterns; and existing line, color, and texture are analyzed individually in reference to landform, vegetative patterns, and structures. Resultant contrast ratings are then compared to the Visual Resource Management (VRM) Class as seen from a viewpoint. In the case of the Long Canyon Mine, two time periods, active mining and reclamation, were used to evaluate the contrasts caused by mining.

Summary of Visual Contrast Ratings (Table LC3-10A)

Viewpoints A through B

The mining activities would not be seen. Structures that would be seen are 5 miles of the railroad and 3 miles of the power line and road. During the life of the mine, these structures would create moderate to strong contrasts which would not meet the BLM management class quality objectives. The impact would be a temporary change from VRM Class IV to Class V. There would remain some visual evidence of the railroad even after reclamation. After reclamation the area would return to Class IV.

Table LC3-10A

SUMMARY OF VISUAL CONTRAST RATINGS FOR THE PROPOSED LONG CANYON MINE

		Activity											
		Mining						Structures					
Views from Critical Viewpoints	Visual management Class	During Active Mining	Post Reclamation of Mining	During Active Mining	Post Reclamation of Mining	During Active Mining	Post Reclamation of Mining	During Active Mining	Post Reclamation of Structures	During Active Mining	Post Reclamation of Structures	During Active Mining	Post Reclamation of Structures
		FEATURES BEING EVALUATED											
		Land	Land	Veg.	Veg.	Stru.	Stru.	Land	Land	Veg.	Veg.	Stru.	Stru.
A-B	IV	NS	NS	NS	NS	NS	NS	2/6*	0/0	2/13	1/2	3/21	2/4
C-F	III	NS	NS	NS	NS	NS	NS	2/6	0/0	0/0	0/0	3/14	0/0

Visual Management Class	Maximum Acceptable Impact
Class II	2/10
Class III	2/16
Class IV	/20

$* \frac{2}{6}$ Highest element contrast / Total score for feature

NS = Not seen from critical viewpoint.

Viewpoints C through F

The mining activities would not be seen. Structures that would be seen are 4 miles of access road, 5½ miles of railroad, and 3 miles of transmission line. If a person is specifically looking for something, the tops of the surface facilities would be visible from viewpoint D. The asphalt on the access road would have strong color contrast. However, the asphalt contrast would be less visible than the existing unpaved road with its high dust frequency. The utility corridor created by all these structures would create moderate to strong contrasts which would not meet the BLM management class quality objectives. The impact would be a temporary change from VRM Class III to Class V. After reclamation the area would return to Class III.

RECREATIONAL RESOURCES

Visitor Use Data

Table LC3-11A depicts estimated change in recreation visitor use demand due to coal mining. Changes are those which occur in the region due to population increases caused by the Long Canyon Mine. Data used to calculate use are available at the Rock Springs District Office of the BLM.

Because of the increased recreational use due to increased resident population, there would be a general lowering of the "primitive"quality of the overall outdoor recreation experience in the Long Canyon area. In areas where people have a lower quality experience, there tends to be a higher frequency of litter and vandalism. This in turn results in higher maintenance costs for recreational facilities.

There would be an unpredictable increased use of municipal recreational facilities in Rock Springs and Green River which would add to the already overcrowded conditions which exist.

Hunting

Adverse impacts to wildlife hunting would result due to restricted access from the facility area and displacement of wildlife, and man's activity in the area results in animals moving out and destruction of habitat. With increased numbers of people using the region, ranchers would probably restrict access from the roads which cross their private lands. The impact from the animals moving out of the area and the roads being closed would be a loss of hunter days in the area of disturbance, while the increased demand would result in an increase in hunter use in the region.

Sightseeing

The construction and mining in the area would cause adverse impacts to recreational sightseeing values due to restricted access from the facility area. There would also be adverse impacts to zoological sightseeing due to the access problem and the displacement of wildlife species and wild horses. There would be increased opportunity for geologic and industrial interpretation.

AGRICULTURE

Livestock Grazing

Mining would result in a cumulative loss of animal unit months (AUMs) in the Rock Springs Grazing Allotment. Estimated cumulative AUM losses would be 72, 216, 396, and 1,728 by 1980, 1985, 1990, and end of mine life reclamation, respectively. Federal grazing leases would be reduced by the appropriate number of AUMs lost on public lands due to the mining.

One livestock water development, a 100-acre reservoir, would remain following mining (see Regional, Chapter 3, Water Impoundments, for a discussion of requirements for pond establishment). This development would improve livestock distribution and forage utilization.

The Long Canyon mining project would cause an estimated average annual loss of 36 AUMs for 41 years. This loss combined with the loss of AUMs from the proposed Black Butte mining project (an average of 144 AUMs for 34 years) would represent but a small percentage (<1%) of the grazing allotment AUMs annually available without mining. The loss of AUMs from the proposed mining would not result in severe hardship to any of the livestock operators of the Rock Springs Grazing Allotment.

Federal grazing licenses would be reduced by the appropriate number of AUMs lost on public lands as the result of mining. Restoration of grazing privileges would be made upon reclamation, as it is believed that reclaimed lands would be capable of supporting premining livestock stocking rates.

The reclaimed lands, however, would require more intensive grazing management than would be needed for undisturbed rangeland (Lang, Berg, Hodder (Vories ed. 1976)).

Prime Farmland

Consultation with personnel of the U.S. Department of Agriculture, Soil Conservation Service, Rock Springs, Wyoming, revealed that prime farmland is not present in areas proposed for disturbance (see Regional ES, Chapter 9, Consultation and Coordination).

MINERAL RESOURCES

Table LC3-11A

ESTIMATED RESIDENT VISITOR DAYS DEMAND DUE TO POPULATION CHANGE FOR YEARS 1980, 1985, AND 1990 IN SWEETWATER COUNTY

Activity	1977	1980 Population: 614[1]				1985 Population: 2,321[1]				1990 Population: 2,326[1]			
		Without Proposed Action	Increase Due to Proposed Action	Total Projection	% of Projection Due to Proposed Action	Without Proposed Action	Increase Due to Proposed Action	Total Projection	% of Projection Due to Proposed Action	Without Proposed Action	Increase Due to Proposed Action	Total Projection	% of Projection Due to Proposed Action
Fishing	172,400	192,700	2,610	195,310	1.3	229,400	10,050	239,450	4.2	250,700	10,180	260,880	3.9
General[2]	168,500	188,900	2,560	191,460	1.3	229,100	10,050	239,150	4.2	253,500	10,300	263,800	3.9
Hunting	54,500	59,400	810	60,210	1.3	69,100	3,030	72,130	4.2	74,300	3,020	77,320	3.9
Off-road vehicles[3]	6,700	7,400	100	7,500	1.3	8,700	380	9,080	4.2	9,400	380	9,780	3.9
Sightseeing	52,900	58,200	790	58,990	1.3	69,900	3,060	72,960	4.2	76,700	3,110	79,810	3.9
Urban	106,400	123,300	1,670	124,970	1.3	157,600	6,910	164,510	4.2	178,800	7,260	186,060	3.9
Water sports	79,600	90,600	1,230	91,830	1.3	112,500	4,930	117,430	4.2	126,200	5,120	131,320	3.9
Winter sports	21,500	25,400	340	25,740	1.3	33,800	1,480	35,280	4.2	38,800	1,580	40,380	3.9

Note: Visitor day considered to be 12 hours.

[1] Population increase due to project (from Socioeconomic Conditions section).
[2] General includes camping, picnicking, etc.
[3] Estimate by ES Team Outdoor Recreation Planner.

Coal

The removal and consumption of an estimated 63 million tons of coal from this area over the life of the 33-year mining plan would result in the depletion (through use) of a nonrenewable energy source. The coal produced is expected to be exported to utility plants for production of electrical energy.

The underground mining of the coal seams by the proposed mining method would result in recovery of close to 60% of the coal. This is the most efficient method of mining the leased coal. An unknown quantity of coal in seams too thin or of too low a quality to be of economic interest would be lost.

Oil and Gas

Mining is expected to have, at most, only a temporary effect on any of the existing undepleted oil wells on the property. In the event that settlement cannot be reached between the oil well owners and the owners of the coal lease, the well must be permanently bypassed, which would result in a loss of the coal resources since it would not be economically sound to go back and mine isolated "pillars"of coal. There would be no conflict during the first 5 years of mining.

TRANSPORTATION NETWORKS

Impacts to transportation networks would be caused by: (1) construction of new transportation facilities, (2) transportation of mining supplies to the mine and coal from the Long Canyon Mine using both old and new facilities, and (3) increased employment and population with its attendant increases in vehicles and miles traveled.

The construction of the railroad spur across County Road 4-17 would create an inconvenience to many people using the road. During actual construction there would be delays in traffic. While in use the trains would delay traffic as well as increase the possibility of train/auto accidents.

Transportation of coal out of the region would be by railroad. The Long Canyon Mine would add 25 loaded trains per year to markets east and 25 loaded trains per year to markets west to the railroad traffic by 1980, this would increase to 100 to markets east and 100 to markets west by 1985, then remain at this level through 1990. Table LC3-14A depicts the estimated volumn per day on the line segments.

Locally, however, the trains would travel on a spur which would have to cross one high use county road twice, Highway 187 once, and numerous streets in Rock Springs. The ore train which now passes through Rock Springs twice a day creates traffic congestion in the city.

The shipment of supplies by trucks would add to the already overcrowded conditions on Highway 187 and other streets as they pass through Rock Springs.

The increase in employment and population would put additional vehicles on the highways and streets in Rock Springs and Green River. It is estimated that vehicle license tab sales in Sweetwater County due to the Long Canyon Mine would increase by 500 between 1978 and 1980, and then stabilize at 1,800 for the rest of the mine life (see Table LC3-14B). More people using private roads crossing ranches in the area may induce ranchers to close their private roads.

The construction and maintenance of power lines would not affect the other transportation networks in the area.

SOCIOECONOMIC CONDITIONS

The primary socioeconomic impacts of the Long Canyon Mine would be associated with increases in population, employment, and income.

Population

The populations of Sweetwater County (that portion in the ES region), Rock Springs, and Green River would increase because of the new jobs made available by the construction and operation of this mine and the induced employment that would result. As shown on Table LC3-15A, the total population of the county would reach 59,612 by 1990; 2,326 of this total would be caused by the Long Canyon Mine. The mine would cause only slight increases (less than 1%) in the annual rates of growth of the various components of the county in all time periods. However, during the 1981 to 1985 period, the mine would cause the rate of growth for most components of the county to exceed 4% per year. This would cause temporary over-population impacts on both the public and private sectors of the county, since most small communities can efficiently absorb rates of only 2% or 3% per year.

With the closing of the Long Canyon Mine, 400 mining jobs would be lost to Sweetwater County. If other employment opportunities were not available, out-migration would occur. This would result in reduced basic employment, population, and the demand for local goods and services. These impacts should not be significant, since the closing of the mine would probably be phased over a period of time and the effects would be only temporary.

Employment

Approval of this mine would impact Sweetwater County by providing approximately 100 construction jobs between 1978 and 1981. Starting in 1981, 400 permanent mining jobs would become available (Sunoco Energy Development Company 1976). An additional 726 jobs should also become available as induced employment to support the population increase caused by the mine (Abt Associates 1978).

Table LC3-14A

ESTIMATED TRAIN VOLUME INCREASES ON TRACK SEGMENTS OF THE UNION PACIFIC RAILROAD IN AVERAGE TRAINS PER DAY

			1980				1985				1990			
Segment	Estimated[1] Capacity	Current[1,2] Traffic	Projected[4] Volume w/o Coal	Total[1] Number Coal Training	Coal Trains[4] due to P.A.	Total Volume	Projected[4] Volume w/o Coal	Total[1] Number Coal Training	Coal Trains[4] due to P.A.	Total Volume	Projected[4] Volume w/o Coal	Total[1] Number Coal Training	Coal Trains[4] due to P.A.	Total Volume
Kansas City to Topeka	55-60	44	48	2.6	0	48	56	1.8	0	56	65	1.6	0	65
Topeka to Gibbon	70-80	22	24	5.0	0	24	28	7.6	0	28	32	7.0	0	32
Council Bluffs to Gibbon	55-60	34	37	10.8	0.1	37.1	43	11.0	0.5	43.5	50	10.2	0.5	50.5
Gibbon to North Platte	70-80	53	58	16.0	0.1	58.1	67	18.4	0.5	67.5	78	17.6	0.5	78.5
North Platte to Cheyenne	70-80	47	51	12.8	0.1	51.1	60	12.2	0.5	60.5	69	11.4	0.5	69.5
Cheyenne to Hanna	70-80	51	56	13.4	0.1	56.1	65	12.8	0.5	65.5	75	11.4	0.5	75.5
Hanna to Rawlins	70-80	45	49	6.2	0.1	49.1	57	5.2	0.5	57.5	66	5.8	0.5	66.5
Rawlins to Rock Springs	70-80	44	48	6.2	0.1	48.1	56	6.2	0.5	56.5	65	6.8	0.5	65.5
Rock Springs to Green River	70-80	44	48	1.4	0.1	48.1	56	2.6	0.5	56.5	65	3.4	0.5	65.5
Green River to Granger	70-80	40	44	1.8	0.1	44.1	51	3.0	0.5	51.5	59	3.8	0.5	59.5

Table LC3-14A

ESTIMATED TRAIN VOLUME INCREASES ON TRACK SEGMENTS OF THE UNION PACIFIC RAILROAD IN AVERAGE TRAINS PER DAY
(Continued)

			1980				1985				1990			
Segment	Estimated[1] Capacity	Current[1,2] Traffic	Projected[4] Volume w/o Coal	Total[1] Number Coal Training	Coal Trains[4] due to P.A.	Total Volume	Projected[4] Volume w/o Coal	Total[1] Number Coal Training	Coal Trains[4] due to P.A.	Total Volume	Projected[4] Volume w/o Coal	Total[1] Number Coal Training	Coal Trains[4] due to P.A.	Total Volume
Granger to Kemmerer	25-30	13	14	2.6	0.1	14.1	16	4.6	0.5	16.5	19	6.8	0.5	19.5
Kemmerer to McCammon	25-30	13	14	1.4	0.1	14.1	16	2.8	0.5	16.5	19	4.0	0.5	19.5
McCammon to Pocatello	25-30	15	16	2.8	0.1	16.1	19	5.8	0.5	19.5	22	9.4	0.5	22.5

[1] Union Pacific Railroad Company 1978.
[2] Through freight only.
[3] Abt Associates 1978.
[4] Estimates by ES team.

Table LC3-14B

ESTIMATED VEHICLE LICENCE TAB SALES

	1976	1978-1980	1980-1985	1985 to End of Mine Life
Registration without proposed action	31,700	34,800	40,700	44,000
Registration due to proposed action	N/A	500	1,800	1,800
Registration with proposed action	N/A	35,300	42,500	45,800

N/A = Not Applicable

Table LC3-15A

(1) PROJECTED POPULATION: SWEETWATER COUNTY

	1977	1980				1985				1990			
		Population Projection				Population Projection				Population Projection			
	Estimated Population	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action
Sweetwater County[1]	41,263	45,320	45,934	4,671	614	52,951	55,272	14,009	2,321	57,286	59,612	18,349	2,326
Rock Springs	25,996	28,552	28,992	2,996	440	33,359	35,020	9,024	1,661	36,090	37,754	11,758	1,664
Green River	12,502	13,732	13,847	1,345	115	16,044	16,480	3,978	436	17,358	17,795	5,293	437
Balance of county	2,765	3,036	3,097	332	61	3,548	3,712	947	164	3,838	4,063	1,298	225

(2) PROJECTED POPULATION ANNUAL RATES OF GROWTH: SWEETWATER COUNTY

		1978-1980				1981-1985				1986-1990			
Sweetwater County	N/A	3.3%	3.8%	N/A	0.5%	3.4%	4.1%	N/A	0.7%	1.6%	1.6%	N/A	0
Rock Springs	N/A	3.3%	3.8%	N/A	0.5%	3.4%	4.2%	N/A	0.8%	1.6%	1.6%	N/A	0
Green River	N/A	3.3%	3.6%	N/A	0.3%	3.4%	3.8%	N/A	0.4%	1.6%	1.6%	N/A	0
Balance of county	N/A	3.3%	4.0%	N/A	0.7%	3.4%	4.0%	N/A	0.6%	1.6%	1.9%	N/A	0.3%

Source: Abt Associates 1978.

Note: Cumulative Impact = projection "with" the proposed action - 1977.
Impact of the Proposed Action = projection "with" the proposed action - projection "without" the proposed action.

[1]That portion of the county within the ES region.

N/A = Not Applicable

These employment increases would, as mentioned earlier, result in a higher population with additional indirect impacts. These would include an increase in local income (see Income section) and reduced unemployment. There would also be minor negative impacts if laborers were pulled out of other employment sectors. The high wages offered by the mining industry could cause temporary shortages in these other areas (Abt Associates 1977).

Income

Population and employment increases would cause total personal earned income in the county to rise significantly. It would increase from an estimated $258.4 million in 1977 to $317.1 million in 1980, $433.2 million in 1985, and $522.9 million in 1990. The Long Canyon Mine would be responsible for 7.8% ($20.6 million) of the projected new income in 1990. Per capita income would not be significantly impacted by the mine.

Several indirect income impacts could occur. Most of the benefits of the higher income would go to those in the mining and construction sectors; those in the local service sector, on fixed incomes, and the poor could be placed in an even less favorable financial position. This would occur if prices continue to inflate causing even more difficulties for these groups to compete for goods and services. However, increased income would cause increased consumer spending and provide benefits to the community as retail revenues and taxes to local governments increased (Abt Associates 1977 and Gilmore 1974).

Infrastructure

Private Sector

Rock Springs would continue to be the leading commercial center in the county, but Green River could be expected to gain an increased share of sales revenues as its population and services expanded. County retail sales would be significantly impacted by the projected larger population and increased personal income. They are projected to reach $143.8 million in 1980, $226.6 million in 1985, and $318.9 million in 1990 from an estimated $110.2 million in 1977 (Abt Associates 1978). The mine would be responsible for the following portions of these projections: 1.3% ($1.9 million) in 1980, 4.2% ($9.5 million) in 1985, and 3.9% ($12.4 million) in 1990. Wholesale revenues would increase from an estimated $39.9 million in 1977 to $52.0 million in 1980, $82.0 million in 1985, and $115.4 million in 1990. The Long Canyon Mine would cause $4.5 million (3.9%) of the 1990 total.

Public Finance

Two moderate impacts to local governments are likely to occur. Government expenditures could be expected to continue to increase to provide more improved services and facilities to residents, and increased revenues (through higher property valuations and more tax income) could accrue to local governments. These impacts would begin to subside after 1985.

Housing

The increased population caused by this mine would put significant additional demands upon the housing industry in the county. Table LC3-15B shows the additional housing that would be required with approval and operation of it. Rock Springs would require 72% (934 homes) of the new housing requirements caused by the mine. If the housing industry does not keep pace with the population growth, these housing impacts could become even more significant as the current housing shortage became even more aggravated.

Education

A larger school-age population would occur because of this mine; however, the increases caused by it would be less than 5% of total enrollment. Pupil expenditures, classroom demands, and pressures on student/teacher ratios would probably all moderately expand. They would not cause excessive adjustments, since both school districts have current and planned excess capacity (Abt Associates 1977 and 1978).

Social Services and Facilities

The effects of this one mine are difficult to assess, because it is not known how the local governments would respond to the demands of an additional 2,326 people over other projected growth spread over 13 years. Many services and facilities are already being expanded or are in the planning stages. Some of these improvements may cover the effects of the mine. In any case, the mine would put additional pressures on current services and facilities. Some additional doctors, nurses, fire and police personnel and facilities, and water and sewer facilities would most likely be required (Abt Associates 1977).

Attitudes and Expectations

Residents opposed to continued growth and disturbance of the wide-open spaces would view the mine as a further aggravation of their position. In spite of the benefits (employment and income increases), they would resent the increased population and urbanization that would occur, even though it would not be significant from this one mine (see Population section). Those persons who would benefit from the mine directly (mine employees and local merchants) would welcome the employment opportunities and higher wages they could expect to receive. Their positions would advance financially, and they would see the mine as a chance to improve the quality of their lives. Those in the lower income brackets and unable to improve their positions because of the mine could see it as further depressing

Table LC3-15B

PROJECTED HOUSING DEMAND: SWEETWATER COUNTY

	1977	1980				1985				1990			
		Housing Projection				Housing Projection				Housing Projection			
	Housing Units	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action
Sweetwater County													
Total	10,367	12,062	12,410	2,043	348	15,381	16,461	6,094	1,080	17,245	18,547	8,180	1,302
Rock Springs	5,197	6,265	6,515	1,318	250	8,356	9,130	3,933	774	9,530	10,464	5,267	934
Single family	3,199	3,840	3,965	766	125	5,094	5,481	2,282	387	5,799	6,266	3,067	467
Multi family	622	782	819	197	37	1,096	1,212	590	116	1,272	1,412	790	140
Mobile homes	1,376	1,643	1,731	355	88	2,166	2,437	1,061	271	2,459	2,786	1,410	327
Green River	3,312	3,826	3,891	579	65	4,831	5,033	1,721	202	5,396	5,639	2,327	243
Single family	1,783	2,117	2,149	366	32	2,771	2,872	1,089	101	3,138	3,260	1,477	122
Multi family	467	529	539	72	10	649	679	212	30	717	753	286	36
Mobile homes	1,062	1,180	1,203	141	23	1,411	1,482	420	71	1,541	1,626	564	85
Balance of county	1,858	1,971	2,004	146	33	2,194	2,298	440	104	2,319	2,444	586	125
Single family	573	635	650	77	15	758	805	232	47	827	883	310	56
Multi family	82	88	90	8	2	99	104	22	5	105	111	29	6
Mobile homes	1,203	1,248	1,264	61	16	1,337	1,389	186	52	1,387	1,450	247	63

Source: Abt Associates 1978.

Note: Cumulative Impact = projection "with" the proposed action - 1977.
Impact of the Proposed Action = projection "with" the proposed action - projection "without" the proposed action.

their situation. They could see it as detrimental, because it would continue to inflate prices, make it harder to compete for goods and services, and widen the gap between their incomes and those in the mining sector (Abt Associates 1977 and Gilmore 1974).

Life Styles

This one mine should not cause significant impacts to the life styles that currently exist in the county. The trend towards urbanization would continue, but as discussed in the Population section, it would not cause the annual rates of growth of the county, Rock Springs, or Green River to rise more than 0.8%. Some would still feel, however, that it was aggravating the situation by inducing unwanted new growth and possibly hampering the county's recovery from the "boom"years of 1973-1974 (Abt Associates 1977).

CHAPTER 4

MITIGATING MEASURES NOT INCLUDED IN THE PROPOSED ACTION

MEASURES

Mining and Reclamation Plan

U.S. Geological Survey (USGS)

Before approval of mining and reclamation plans, BLM will prepare Section 106 compliance document on existing or potential National Register sites located in the inventory.

Long Canyon Mitigating Measure 1. To reduce losses of cultural resources from pothunting and vandalism because of increased population, the lessee will confine all vehicle use to existing roads and trails in culturally sensitive areas.

Long Canyon Mitigating Measure 2. To reduce impacts to the Cedar Canyon Petroglyphs, the BLM recognizing its responsibilities for the protection of significant cultural resources proposes the following:

1. Funds for accurate recordation of rock art at the Cedar Canyon Petroglyph site will be programmed for. This scientific data retrieval will alleviate the effects of natural erosion taking place at the site.

Careful steps will be taken to record all of the petroglyphs present on the panels. Measurements will be made of size, location, relationships, and variations in individual and groups of figures. Systematic photographs will be used to record realistically all the figures present. Experiments will be required to establish methods (time of day, lighting, type of film, etc.) best suited for recording this particular group of panels. Artist sketches will be used to record the panels, highlighting figures not visible in normal photographs.

Research into the methods used to carve the petroglyphs will also be conducted and the reproduction of outstanding panels via the latex mold technique will also be done.

2. Should the proposed mining extend beneath the pictographs and associated archeological site, the BLM will develop suitable mitigation for the impacts in consultation with the State Historic Preservation Officer and Advisory Council.

3. Periodic monitoring of the site by professional cultural resource personnel will be conducted. If physical or other adverse impacts are occurring to the property, the BLM will develop suitable mitigation for these impacts in consultation with the State Historic Preservation Officer and Advisory Council.

Long Canyon Mitigating Measure 3. To reduce losses of subsurface archeological sites caused by mining and other surface disturbing activities, a qualified archeologist acceptable to the Bureau of Land Management (BLM) and State Historic Preservation Officer (SHPO) will be contracted by the lessee to be present during the initial surface disturbance of all of those zones or areas of alluvium which were determined to be sensitive by inventory. The lessee may opt to conduct trenching and (or) test bore holes of identified sensitive areas prior to mining or surface disturbances using an archeologist and methodology acceptable to the BLM. If National Register quality sites are found during this additional work, Section 106 compliance procedures will be conducted and appropriate mitigation will be conducted in consultation with the SHPO and advisory council. Salvaging or testing of non-National Register sites will be conducted pending the professional judgment of the archeologist. Periodic monitoring of sensitive areas and particularly those adjacent to areas of proposed surface disturbances, whether in or outside the mine boundary, will also be required by the lessee using an archeologist acceptable to the BLM.

Long Canyon Mitigating Measure 4. To reduce losses of cultural resources from subsidence on the unsurveyed portions of the proposed project area, the lessee will conduct an intensive cultural resource inventory of the remaining unsurveyed portion of the project area. If National Register quality sites are found during this additional work, Section 106 compliance procedures will be conducted.

Long Canyon Mitigating Measure 5. The BLM and USGS are currently developing a Memorandum of Understanding relating to the protection of paleontological resources on public lands. Those agencies are also developing technical guidelines to define the resource, provide evaluatory criteria, and measures for protection. When finalized the provisions of these documents will serve as a basis for management of paleontological resources and appropriate protective programs.

Long Canyon Mitigating Measure 6. To enhance the ability of reclaimed lands to support premine wildlife uses, seed mixtures used for revegetation will include plant species beneficial to the wildlife that were present prior to mining. The following are suggested plant species and seeding rates that would be beneficial to the wildlife on the proposed Long Canyon Mine area:

Clay and clay loam soils: thickspike wheatgrass—8.0 lbs./acre, western wheatgrass—8.0 lbs./acres, Indian ricegrass--4.0 lbs./acre, big sagebrush—1.0 lbs./acre, winterfat—2.0 lbs/acre, rubber rabbitbrush—1.0 lbs./acre, and shadscale— 1.0 lbs./acre.

Sandy soils: thickspike wheatgrass—8.0 lbs./acre, western wheatgrass—6.0 lbs./acre, Indian ricegrass—1.0 lbs./acre, big sagebrush—2.0 lbs./acre, antelope bitterbrush--2.0 lbs./acre, rubber rabbitbrush—1.0 lbs./acre, winterfat--1.0 lbs./acre, and fourwing saltbush—1.0 lbs./acre.

Saline/alkaline soils: western wheatgrass—6.0 lbs./acre, streambank wheatgrass—6.0 lbs./acre, Indian ricegrass—6.0 lbs./acre, Nuttalls saltbush—2.0 lbs./acre, big sagebrush— 1.0 lbs./acre, shadscale-1.0 lbs./acre, and fourwing saltbush--1.0 lbs./acre.

These species may not be applicable to all areas, and there may be species not listed that would be suitable. The actual seed mixture will be determined by research results at the proposed Long Canyon Mine and, when applicable, from other locations. In addition, if establishment of shrub species from seed proves infeasible, planting of seedlings, tublings, and (or) plant transplanting would be required.

Wyoming Department of Environmental Quality (DEQ)

Long Canyon Mitigating Measure 7. The cracking of land surface may occur due to subsidence from underground mining. Surface runoff might be diverted into aquifers through the resulting cracks. To monitor ground water quality, ground water will be sampled down the ground water hydraulic gradient from wells penetrating the mined and adjacent formations. Chemical and trace mineral analyses will be made. A plan will be submitted in accordance with 30 Code of Federal Regulations 715.17(b).

Long Canyon Mitigating Measure 8. The applicant will submit data required under 30 CFR 715.17(3)(i) (A through E), pertaining to Alluvial Valley Floors. These data will provide information needed to establish standards for which compliance with the Surface Mining Reclamation and Enforcement Act may be evaluated.

Long Canyon Mitigating Measure 9. Several types of control measures are possible to help prevent the generation of fugitive dust. The application of water to unpaved roadways is the most common method for dust control and has already been included as a design control measure in the analysis of the proposed actions. Several other control measures are available, some of which have a definite quantitative efficiency and others which are common sense measures and cannot be assessed quantitatively.

In general, fugitive dust can be controlled by watering at transfer points, such as conveyor ends or loading stations. The efficiency of this measure is dependent on the frequency of water application, an excess of which could create the obvious safety hazards of mud on nonlevel surfaces. Hoods, connected to a ventilation and dust collection system, over sources such as crushers or sorters, limit emissions from mechanical handling of coal. General cleanliness and the prevention of spills also help to reduce the amount of fugitive dust. The emissions from the above sources, however, do not contribute to ambient concentrations of total suspended particulates (TSP) as significantly as emissions from overburden removal, travel on unpaved roads, and wind erosion.

Control of fugitive dust emissions from overburden removal is not feasible due to the continuous exposure of dry subsurface material. Control of fugitive dust emissions from travel on unpaved roads is possible with several measures. Watering, with an approximate efficiency of 50%, has already been included in the design plans. Paving, or treatment with chemical stabilizers which approximate paving, could reduce fugitive dust emissions from these sources by an additional 35%. This will result in a significant reduction in cumulative regional concentrations of TSP.

Travel on unpaved roads accounts for 69% of the predicted total fugitive dust emissions from proposed mining in 1980, 59% in 1985, and 58% in 1990. Paving and chemical stabilization of unpaved access and haul roads, therefore, could reduce mine-related TSP impact on a regional basis by approximately 48% in 1980, 41% in 1985, and 40% in 1990. In lieu of paving or chemical stabilization, control of vehicular speeds can also reduce fugitive dust emissions from travel on unpaved roads. Limiting vehicular speed to 15 mph will reduce emissions by 44%, and a limit of 10 mph will reduce emissions by as much as 75%.

As shown in the preceding paragraph, best management practices were not necessarily included in the air quality impact analysis. Only those mitigating measures discussed in the mining and reclamation plan on file with the USGS at the start of this rewrite were included in the modeling. In any event, the worst case mine situation is discussed, and best management practices will produce fewer and less intense impacts. It was not possible to include best management practices in Chapter 3, because the suggestions came in too late for modeling to be done and, if included now, would negate the continuity of the present analysis. Chapter 8 contains an air quality alternative which discusses the best management practice impacts.

Rights-of-Way

Bureau of Land Management

Long Canyon Mitigating Measure 10. Intrusions from cuts and fills for roads, railroad, and other rights-of-way would create moderate and strong contrasts to the elements of line, form, color, and texture. The lessee will follow natural contours when constructing these facilities to reduce the number of cuts and fills.

ANALYSIS OF EFFECTIVENESS

MITIGATING MEASURES

Long Canyon Mitigating Measure 1. Cultural resources would be lost to pothunting and vandalism due to increased population. This measure will reduce the possibility of additional loss.

Long Canyon Mitigating Measure 2. Potential adverse effects to the Cedar Canyon Petroglyphs from increased population and mining activity would alter or destroy the petroglyphs. These adverse effects will be mitigated.

Long Canyon Mitigating Measure 3. Subsurface archeological sites would be destroyed by mining and associated surface disturbing activities. This measure will reduce the loss of subsurface sites.

Long Canyon Mitigating Measure 4. Unsurveyed cultural resources would be lost due to subsidence. This measure will reduce losses of potentially significant unknown resources.

Long Canyon Mitigating Measure 5. Paleontological losses would occur from the destruction, disturbance, or removal of fossil materials as a result of coal mining activities, unauthorized collection, and vandalism. This measure will reduce the loss of paleontological resources by an undetermined amount.

Long Canyon Mitigating Measure 6. This measure will enhance the return of premine habitat values and wildlife species; however, data are not available which would allow quantification of effectiveness.

Long Canyon Mitigating Measure 7. The leaching of salts or trace metals into ground water sources may impact reclamation efforts. Subsidence may divert surface runoff into aquifers. This measure will identify 70% to 85% of toxic and marginal material.

Long Canyon Mitigating Measure 8. The proposed mining could degrade the Cedar and Long Canyon drainages (believed to be alluvial valley floors). This measure will ensure adequate data gathering needed to develop standards that would protect the Cedar and Long Canyon drainages.

Long Canyon Mitigating Measure 9. Fugitive dust, generated from unpaved roads, would degrade air quality. This measure will be 40% to 48% effective.

Long Canyon Mitigating Measure 10. Intrusions from cuts and fills for roads, railroad, and other rights-of-way would create moderate and strong contrasts to the elements of line, form, color, and texture. This measure will reduce the impacts created by roads, railroad, and other rights-of-way from moderate and strong to weak and moderate meeting VRM objectives for Class III.

Mitigating measures not included in the proposed action are summarized in Table LC4-1.

MONITORING, RESEARCH, AND STUDY PROGRAMS

Ground water quality will be monitored by sampling (down the ground water hydraulic gradient) and analyzing (for chemicals and trace minerals) water from wells penetrating the mined and adjacent formations.

A representative of BLM will annually inspect livestock grazing areas adjacent to mining operations to determine if such operations are affecting grazing patterns of the allotment, to determine if any range overuse is resulting from the changes in grazing patterns that may be occurring, and to determine measures to be applied to correct the overuse of the range.

The compliance officers (state and federal) will conduct periodic inspections of mining areas to assure that reclamation is accomplished in accordance with an approved reclamation plan.

Reclaimed areas would be jointly inspected periodically by representatives of federal and state agencies and the operator to determine areas on which reclamation is completed and acceptable and to jointly determine corrective measures to be applied on areas where reclamation efforts have proven inadequate (e.g., seeding failure and any subsidence problems).

Table LC4-1

SUMMARY TABLE

Impact	Mitigating Measures	Residual Impact
Loss of cultural resources due to pothunting and vandalism	Long Canyon number 1	Possible losses will be reduced.
Potential destruction or alteration of Cedar Canyon Petroglyphs	Long Canyon number 2	Losses of information from the Cedar Canyon petroglyphs would be mitigated.
Loss of unknown archeological information and sites from subsurface disturbing activities	Long Canyon number 3	Subsurface sites would be lost.
Loss of unsurveyed cultural resources from subsidence	Long Canyon number 4	Some cultural resources would be lost.
Loss of paleontological resources from unauthorized collecting and vandalism and from authorized surface and subsurface destruction, disturbance, and removal	Long Canyon number 5	An undetermined number of fossils would be lost.
Loss of wildlife habitat and populations	Long Canyon number 6	Reduction in time of wildlife habitat loss and wildlife population loss.
Soil mixing and leaching of salts or trace metals into ground water sources	Long Canyon number 7	From 70% to 85% of toxic and marginal material will be identified.
Potential degradation of the Cedar and Long Canyon drainages	Long Canyon number 8	This measure could be 90%-100% effective.
Degradation of air quality from fugitive dust	Long Canyon number 9	This measure could reduce TSP impact by 40% to 48%.
Construction of roads, railroad, and other rights-of-way create strong contrasts the basic elements of form, line, color, and texture	Long Canyon number 10	Strong contrasts will be reduced to weak and will meet VRM objectives for Class III.

CHAPTER 5

ANY ADVERSE IMPACTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED

This chapter presents a summary of the residual adverse impacts that would remain after considering the mitigating measures discussed in Chapter 4.

AIR QUALITY

Impacts on Air Quality

When annual average background particulate values of 18 micrograms per cubic meter ($\mu g/m^3$) are added to projected mine-related contributions, the annual primary National Ambient Air Quality Standard (NAAQS) of 75 $\mu g/m^3$ is not predicted to be exceeded, whereas the annual Wyoming standard of 60 $\mu g/m^3$ is predicted to be exceeded within 0.5 miles of the active site for the years 1980, 1985, 1990, and end of mine life, respectively.

If projected mine-related 24-hour suspended particulate values and background concentrations of 35 $\mu g/m^3$ are combined, the 24-hour primary NAAQS of 260 $\mu g/m^3$ is predicted to be exceeded within 0.5, 1, 1, and 1 miles of the active site; and the Wyoming standard of 150 $\mu g/m^3$ is predicted to be exceeded within 1, 1.5, 1.5, and 1.5 miles of the active site for the years 1980, 1985, 1990, and end of mine life, respectively. (These projections are based on worst-case meteorological conditions.)

A comparison of the worst-case mine impact with Prevention of Significant Deterioration regulations indicates the annual standard would be exceeded within 1, 1, 1, and 1 miles; and that the 24-hour standard would be exceeded within 2, 2.5, 2.5, and 2.5 miles of the active site for the years 1980, 1985, 1990, and end of mine life, respectively.

With the application of the 43 CFR 118 regulations, the violations of the Class I increment would not occur.

Gaseous Pollutants

Mine-related nitrogen dioxide (NO_2) and sulfur dioxide (SO_2) emissions are expected to be insignificant, as discussed in Chapter 4 of the Regional Statement Component (Environmental Research and Technology 1978a); therefore, ambient pollutant concentrations have not been predicted.

Recent studies (U.S. Department of the Interior 1976) of the impact of vehicle emissions associated with western coal mines were reviewed to estimate the probable range of impact. Maximum predicted concentrations of carbon monoxide ranged between 0.02% and 0.44% of the standard. Maximum predicted hydrocarbon concentrations ranged between 0.88% and 3.44% of the standards. Maximum predicted NO_2 concentrations ranged between 0.6% and 3.0% of the standards. Maximum predicted concentrations of SO_2 ranged between 0.02% and 0.33% of the standards. The values represent predictions at less than one-half mile from the mines. Predictions were significantly less at further distances from the mines.

Visibility

For 1980, the visibility of an observer at 1 mile downwind would be approximately 39.9 miles, assuming a background visibility of 40 miles. In general, visibility would increase with downwind distance from the mine. At 5 miles downwind the visibility would be 40 miles, and at 10 miles it would also be 40 miles. The corresponding values, assuming a background visibility of 7 miles, are 7 miles, 7 miles, and 7 miles, respectively. Similar reductions in visibility would result in 1985, 1990, and end of mine life.

GEOLOGY

Paleontology

Unavoidable destruction, disturbance, and removal of paleontological resources, both exposed and unexposed, would occur. The significance of this impact cannot be meaningfully assessed at present due to the lack of data and evaluatory criteria.

SOILS

The disturbance of 493 acres of soil associated with the mining operation is unavoidable. An accelerated rate of soil erosion would occur on areas being reclaimed. This increase in soil erosion would be one-half ton per acre per year over that of the existing environment. Soil surface of the disturbed areas would be taken out of vegetative production during the mine life. Also, approximately 500 acres of soil would be lost for vegetative production as a result of the construction of housing and support facilities associated with the increase in population created by mining.

If a 10-, 25-, 50-, or 100-year flood were to occur when areas are in the process of being reclaimed, an accelerated rate of erosion would occur over the amount that would occur normally. This would result in soil loss, and the occurrence of one of these floods during reclamation would also lengthen the time required for vegetation reestablishment.

WATER RESOURCES

Surface drainage would be permanently altered by subsidence as the pillars are removed in the underground workings. Cracking and caving would allow infiltration of surface runoff to the Rock Springs and Ericson Formations. It is not expected to affect the quality of ground water in the Ericson or Rock Springs Formations. Sediment discharge from the area would be negligible.

The coal fine slurry pond, if needed, would require approximately 200 acre-feet of make-up water per year. High total dissolved solids water could possibly infiltrate into the Ericson and Rock Springs Formations from this slurry pond.

VEGETATION

Changes in plant species composition, cover, and density would be unavoidable if mining is conducted. Mining would require the short-term loss of vegetation on about 493 acres and the long-term loss on about 100 acres for a livestock reservoir.

Population increases due to mining would result in an estimated loss of vegetation on an estimated 500 acres for housing and support facilities, primarily adjoining existing municipalities. Increased numbers of people in the area would result in additional disturbance of native vegetation particularly by off-road vehicle use (see Recreational Resources section).

Revegetated areas would have a general appearance of grassland. Grasses would be the most common forage class, with shrubs and forbs being reduced in density and cover as compared to premining conditions. Natural plant succession would occur on reclaimed lands and could restore approximate premining plant cover and composition values in an estimated 30 to 50 years as suggested by Cook (Vories ed. 1976).

The temporary and permanent losses of vegetative cover and production on disturbed areas would affect numerous living organisms and their nonliving environment (see Air Quality, Soils, Fish and Wildlife, Visual Resources, Recreational Resources, and Agriculture sections in this chapter).

FISH AND WILDLIFE

Wildlife habitat, carrying capacity, and populations would be lost on 493 acres as a direct result of mining by 1980. This is the total disturbance through the end of mine life. Wildlife habitat would be adversely affected (area of influence) on 2,220 acres.

Specific habitat losses by 1980 through the end of mining would be 493 acres each of sage grouse yearlong range, elk summer range, mule deer crucial winter/yearlong range, and antelope summer range. This acreage represents 0.03%, 0.2%, 4.0%, and 0.2% of the range available for sage grouse, elk, mule deer and antelope, respectively, in their management or herd units.

Loss of wildlife populations would be estimated at 380, 1,320, 2,260, and 6,200 small nongame birds; 30, 90, 150, and 300 sage grouse; 81,400, 284,900, 488,400, and 1,342,000 small nongame mammals; 65, 100, 160, and 500 elk; 100, 250, 400, and 1,200 mule deer; 3, 8, 13, and 35 antelope; and 1,700, 2,700, 4,300, and 14,000 reptiles and amphibians by 1980, 1985, 1990, and end of mine life, respectively.

End of mine life population losses for sage grouse, elk, mule deer, and antelope represent 0.04%, 2.0%, 5.0%, and 0.1%, respectively, of the production of the total populations within their management or herd units.

Reclamation, if successful, would mitigate some of the above losses. Quantification of such mitigation, however, is not possible with current knowledge and available information.

All the above estimates include the progeny which would have been produced had mining not occurred.

The habitat and population losses would be of major significance to localized populations, but, when compared to total habitat and populations within the region or herd/management unit, they would be of minor significance when based upon percentages alone.

Although it may appear that losses are of minor significance, the projected losses of populations and habitat, could, in some instances, be of critical importance to wildlife. Current data are insufficient to throughly analyze the effects of each individual habitat or population loss.

CULTURAL RESOURCES

All cultural resources within the project area would be affected by increased pothunting and vandalism regardless of mitigation measures applied. This destruction would reduce the amount of information which might be obtained from historical sites for interpretive purposes. The pothunting of archeological sites could potentially remove important surface indications of significant buried sites. This would reduce the chances of such sites being discovered and contributing important information to the prehistory of the region and perhaps North America.

Ground subsidence related to underground mining would cause site destruction. These sites would be thrown out of context and changes in topography could cause increased erosion of cultural resources.

The destruction of buried archeological sites by mining and related surface disturbing activities would probably be partially mitigated. Mitigation success would depend on such factors as successfully predicting areas of likely buried sites, the amount of destruction occurring to a site as it is uncovered, and the possibility of it being completely destroyed as a result of not being recognized. The destruction of buried sites could have a significant impact, because if they exist they could be important to the prehistory of the region or the nation.

VISUAL RESOURCES

All adverse visual impacts from mining of coal could not be totally mitigated during active mining operations. Roads, power lines, loadout, railroad, and other structures would remain until removed and (or) the land revegetated. The actual mining operation would not be visible, since it would be underground. After successful revegetation there would be some evidence of the road and railroad, but this evidence would not affect the Visual Resource Management classes which would return to the class which existed prior to the placement of structures. This would mean the mining would not meet BLM management objectives during the life of the mine but would after reclamation.

RECREATIONAL RESOURCES

During construction activities, recreational access would remain blocked to the Long Canyon Mine facility area, eliminating certain recreation use. Activities such as hunting and sightseeing would be restricted from the area for public and mine safety. As the mine becomes developed, people would come to the area to view the mining activities.

Increased population would result in increased recreational use demand throughout the southwestern Wyoming region. This increased use would result in lowering the quality of the existing "primitive"type of recreational experience. Ranchers in the region would also restrict access across their private lands. There would be increased use to recreational facilities in Rock Springs and Green River.

Visitor Use Data

The estimated resident recreation use demand change due to the proposed action would account for approximately 1.3%, 4.2%, and 3.9% of the total recreation use demand in Sweetwater County by 1980, 1985, and 1990, respectively.

AGRICULTURE

Mining would result in a cumulative loss of animal unit months (AUMs) in the Rock Springs Grazing Allotment. Estimated cumulative AUM losses would be 72, 216, 396, and 1,728 by 1980, 1985, 1990, and by end of reclamation, respectively.

The Long Canyon and Black Butte mining projects are both within the Rock Springs Grazing Allotment which annually produces about 193,140 AUMs. The Long Canyon mining project would cause an estimated average annual loss of 36 AUMs for 41 years. This loss combined with the loss of AUMs from the proposed Black Butte mining project (an average of 144 AUMs for 34 years) would represent but a small percentage (<1%) of the grazing allotment AUMs available without mining. The loss of AUMs from the proposed mining would not result in severe hardship to any of the livestock operators of the Rock Springs Grazing Allotment.

MINERAL RESOURCES

The mining and removal of coal would have an unavoidable effect on the coal beds, coal resources, and coal reserves since deposits of a nonrenewable mineral commodity would be depleted through use. Based on company plans, an estimated 63 million tons of coal would have been mined by 2019, which comprises less than one-half of 1% of the total identified coal reserves in Sweetwater, Lincoln, and Uinta Counties. Because of the nature of underground caving and resultant high contamination, future recovery of the abandoned 40%-50% of coal is not considered feasible with present technology and, therefore, must be considered in this analysis as lost. An unknown quantity of coal in seams too thin or of too low a quality to be of economic interest would be lost.

TRANSPORTATION

There would be increased use of highways and other transportation facilities in the area due to increased population and mining activities. Estimated increased license tab sales due to increased population would be 1% for 1978-1980, then would remain stable at 4% through the end of mine life. The increased use may not change the traffic accident rate, but there would be an increase in the number of accidents due to increased numbers of miles traveled. Some private roads would be closed as ranchers limit access across their land.

The rail spur and the existing rail line would cross numerous unimproved roads, County road no. 4-17 twice, many lesser roads which are generally used for access to oil fields, one highway, and several streets in Rock Springs. Grade crossings or detours would be provided during construction which would cause an inconvenience impact on travelers. There would be traffic tie-up problems at the railroad grade crossings, especially in Rock

Springs. There would be a potential for an increased number of train/auto accidents.

SOCIOECONOMIC CONDITIONS

Population

There would be a small unavoidable increase in the population of Sweetwater County and its two major communities (Rock Springs and Green River) if the Long Canyon Mine is approved, constructed, and goes into production. Table LC5-15A shows the population increases that would result because of the mine. While population increase may not necessarily be adverse, it would change the size of communities, reduce small-town atmospheres, and continue the trend towards greater urbanization.

Social Conditions

The increase in population could, however, have a number of adverse indirect impacts on Sweetwater County. The most evident of these would be additional pressures on public services and facilities. More crowded conditions would require more police and fire protection; construction of additional access routes; improved or expanded sewer and water systems; and expanded medical, social, and mental health services.

Table LC5-15A

PROJECTED POPULATION INCREASES CAUSED BY THE LONG CANYON MINE
(SWEETWATER COUNTY)

	1980	1985	1990
Sweetwater County	614	2,321	2,326
Rock Springs	440	1,661	1,664
Green River	115	463	437
Balance of county	61	164	225

Source: Abt Associates 1978.

CHAPTER 6

THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The mining of 63 million tons of coal would result in short-term (a period beginning with on-site construction and ending with post-mining reclamation) and long-term (a period beginning after post-mining reclamation) losses or alterations of natural resources and the human environment.

In the short term there would be:

1. a reduction in air quality and visibility by fugitive dust and, to a much lesser extent, vehicular emissions;
2. increased soil erosion and lowered soil productivity on about 493 acres;
3. the loss of an estimated 1,728 AUMs due to the removal of native vegetation on 493 acres (this does not include 500 acres for housing for which AUM data are unavailable);
4. the destruction of an unquantifiable number of nonrenewable cultural resources;
5. a reduction from Visual Resource Management Classes III and IV to Class V;
6. a lowering in the "primitive"quality of recreational experiences due to increased population;
7. impeded traffic movement due to increased numbers of trains and vehicles;
8. a disruption of social order due to rapid population growth and subsequent changes in community structure;
9. loss of wildlife habitat, carrying capacity, and populations on 493 acres as a direct result of mining and an adverse affect (area of influence) on 2,220 acres of wildlife habitat by the end of mine life;
10. loss of 380, 1,320, 2,260, and 6,200 small nongame birds; 30, 90, 150, and 300 sage grouse; 81,400, 284,900, 488,400, and 1,342,000 small nongame mammals; 65, 100, 160, and 500 elk; 100, 250, 400, and 1,200 mule deer; 3, 8, 13, and 35 antelope; and 1,700, 2,700, 4,300, and 14,000 reptiles and amphibians by 1980, 1985, 1990, and end of mine life, respectively; and
11. There would be an increase in employment opportunities and total earned income within Sweetwater County.

Residual effects of mining on long-term productivity would be:

1. loss of soil and vegetative production on about 600 acres planned for a pond and housing;
2. the destruction of an unquantifiable number of nonrenewable cultural resources;
3. a lowering of the "primitive"quality of recreational experiences due to increased population;
4. impacts to an undetermined number of uninventoried exposed and unexposed fossil localities; and
5. a gain in knowledge of paleontological resources due to surveys and exposure of resources which might never have been found without excavation.

CHAPTER 7

ANY IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED

Approximately 63 million tons of coal would be produced by the Long Canyon Mine. About 63 million tons of coal would be lost and unrecoverable due to current mining methods. An unknown quantity of coal in seams too thin or too low a quality to be of economic interest would be lost.

Energy, in the forms of petroleum products and electricity, would be expended to obtain the coal. Some materials used in manufacturing mining machinery and buildings would not be recycled and thus would be lost.

Most of the air quality impacts associated with the Long Canyon Mine would be reversed when the land is reclaimed. The only long-term air quality impacts anticipated are those resulting from continued use of unpaved access roads after the project has been completed or halted. Since use of these roads could be stopped by blocking access or reclaiming roadbeds, no irreversible air quality impacts are predicted.

Irretrievable air quality impacts would occur. The loss of good air quality for the period of the project cannot be retrieved. During the life of the project, total suspended particulate standards may be exceeded and visibility reduced in the immediate vicinity of the project.

An undetermined number of uninventoried exposed and unexposed fossil localities would be lost or damaged.

Forage (about 1,728 animal unit months) for livestock and wildlife consumption would be lost.

Wildlife habitat, carrying capacity, and populations would be lost on 493 acres as a direct result of mining by 1980. This is the total disturbance through the end of mine life. Wildlife habitat would be adversely affected (area of influence) on 2,220 acres.

Loss of wildlife populations would be estimated at 380, 1,320, 2,260, and 6,200 small nongame birds; 30, 90, 150, and 300 sage grouse; 81,400, 284,900, 488,400, and 1,342,000 small nongame mammals; 65, 100, 160, and 500 elk; 100, 250, 400, and 1,200 mule deer; 3, 8, 13, and 35 antelope; and 1,700, 2,700, 4,300, and 14,000 reptiles and amphibians by 1980, 1985, 1990, and end of mine life, respectively.

All of the above estimates include the progeny which would have been produced had mining not occurred.

Cultural resources could be inadvertantly destroyed.

Visual resource values would be altered; Class III would be the highest attainable Visual Resource Management class after reclamation.

CHAPTER 8

ALTERNATIVES TO THE PROPOSED ACTION

The USGS has accepted the Long Canyon mining and reclamation plan as adequate for environmental review and subsequent approval under 30 CFR 211 of May 1976. The Secretary's actions may be aproval as proposed, rejection on various environmental or other grounds, approval in part and rejection in part, or approval subject to such additional conditions and requirements or modifications as he may impose under existing laws and regulations. He may also defer decision pending submittal of additional data, compilation of required studies or for other specific reasons.

Even after a mining and reclamation plan is approved, the regulations and lease terms require that all subsequently proposed departures and deviations therefrom be approved in advance by the Secretary. the regulations (30 CFR 211 and 700) permit the Secretary to direct that changes be made in previously approved operations. For example, changes could be ordered to accommodate new, improved, or revised administrative requirements, technological improvements, environmental concerns or requirements, or revisions of prior evaluations thereof in the light of experience or previously unknown factors.

NO ACTION

The no-action alternative includes analysis of impacts that will occur if the mining and reclamation plan and associated rights-of-way are not approved. Without mining and reclamation plan approval, there will be no environmental impacts from mining on the leased land.

Coal from the proposed Long Canyon Mine is intended to supply 2 million tons per year to markets in Idaho, Oregon, and Utah. Without the Long Canyon Mine, other coal will have to be acquired to supply these markets. Such a substitution could create a shortage for other coal markets. If the alternate coal source were of a higher sulfur content, lower air quality from the power generation plants in these areas would be expected.

Both adverse and beneficial impacts will occur to paleontological resources in approximate proportion to the level of regional development and the area disturbed.

Under the no action alternative, increased recreational activity will still occur in the area due to population increases associated with other expected development (Table LC8-1). The increased activity will basically lower the "primitive"quality of the recreational experience which is common to the area around the proposed Long Canyon Mine. As a result of increased activity, there will be increased recreational maintenance and cleanup costs.

The population of Sweetwater County will increase to 45,320 in 1980, 52,951 in 1985, and 57,286 in 1990. Employment in Sweetwater County will increase to 21,571 jobs in 1980, 25,453 in 1985, and 27,446 in 1990. Personal earned income in Sweetwater County will increase to $310.6 million in 1980, $414.9 million in 1985, and $502.3 million in 1990. Rock Springs and Green River will absorb most of these increases.

AIR QUALITY

Best Management Practices

Impact Alternative

This alternative contains recommendations which, if implemented, would reduce some of the major impacts described in Chapters 3 through 7. Best management practices could include the following:

1. The open coal pile emissions could be reduced by about 90% if the coal surface is chemically stabilized with a crusting agent.
2. Chemical stabilization of the haul roads could reduce haul road impacts by an additional 25% over that of watering the roads.
3. Paving or an equivalent stabilization of all access roads could reduce access road impacts by 85% over that of unpaved access roads.
4. Use of negative pressure bag houses or an equivalent method at all coal dump locations (truck to crusher and silo to railroad car) could reduce these impacts by 95% if properly engineered.
5. The use of conveyor and transfer point coverings and, where necessary, water sprays could reduce these emissions by 75%.

Table BB8-2 is a comparison of the Chapter 3 total TSP emissions with those of best management practice emissions. About a 29% to 37% reduction in total TSP emissions is possible.

FISH AND WILDLIFE ALTERNATIVE

Table LC8-1

COMPARISON OF IMPACTS OF PROPOSAL AND NO-ACTION ALTERNATIVE IN VISITOR DAYS

Elements and Components	1977	1980 No Action	1980 Total Projection With Proposal	1985 No Action	1985 Total Projection With Proposal	1990 No Action	1990 Total Projection With Proposal
Fishing	172,400	192,700	195,310	229,400	239,450	250,700	260,880
General[1]	168,500	188,900	191,460	229,100	239,150	253,500	263,800
Hunting	54,500	59,400	60,210	69,100	72,130	74,300	77,320
Off-road vehicles[2]	6,700	7,400	7,500	8,700	9,080	9,400	9,780
Sightseeing	52,900	58,200	58,990	69,900	72,960	76,700	79,810
Urban	106,400	123,300	124,970	157,600	164,510	178,800	186,060
Water sports	79,600	90,600	91,830	112,500	117,430	126,200	131,320
Winter sports	21,500	25,400	25,740	33,800	35,280	38,800	40,380

Note: Visitor Day consists of 12 hours.

[1]General includes camping, picnicking, etc.
[2]Estimate by ES team Outdoor Recreation Planner.

Table LC8-2

COMPARISON OF CHAPTER 3 TOTAL TSP EMISSION IMPACTS
TO THOSE OF THE BEST MANAGEMENT PRACTICE ALTERNATIVE
TOTAL TSP EMISSION IMPACTS

Year	Total TSP Chapter 3 Emissions (tons/yr)	Total TSP Best Management Practice Emissions (tons/yr)	Reduction in Emissions (%)
1980	243	172	29
1985	407	258	37
1990	407	258	37
End of Mine Life	407	258	37

This alternative lists recommendations which, if implemented, would greatly reduce or totally eliminate the major impacts to existing fish and wildlife resources described in Chapters 3 through 7 by enhancement of the wildlife habitat and carrying capacities of those lands adjacent to the proposed mining operations or on nearby off-site locations.

1. That all mining areas be reclaimed to wildlife habitat (Table LC8-3) as soon as possible or feasible. Reclamation would be in conformance to the post-mining land use set out in BLM's land use plans for the area. Vegetative planting and reclamation should be accomplished in consultation with the Wyoming Game and Fish Department, the Wyoming Department of Environmental Quality, and the U.S. Fish and Wildlife Service. The goal of reclamation should be to achieve the highest possible wildlife carrying capacity at the earliest possible date, regardless of cost. All possible tools to achieve this goal should be implemented as needed.

2. That approximately 1,000 acres of public land lying in immediate association with the proposed Long Canyon mining area or on nearby off-site locations be set aside as mitigation area and managed intensively for fish and wildlife resources (Table R8-12). Selection of this mitigation area should be accomplished in consultation with the Wyoming Game and Fish Department and the U.S. Fish and Wildlife Service.

3. That the mitigation area be managed to increase its wildlife carrying capacity by at least 50%. Management tools such as water development, fertilization, vegetative manipulation, spraying, transplanting, seeding, protection of wildlife cover, and management of livestock grazing to enhance wildlife habitat should be implemented as necessary. The habitat of this mitigation area should be managed by BLM and the wildlife by the Wyoming Game and Fish Department.

4. That the mine permit will not be granted on land critical to the bald and golden eagle's ecological requirements. A qualified team of biologists from the Fish and Wildlife Service, Wyoming Game and Fish Department, and the Bureau of Land Management will judge and recommend the areas to be excluded from mining. Mine permits may be granted for these areas if regulations are adopted that provide for planning substitute mining practices, buffer zones, prey base, and alternate nest sites.

If this alternative is successfully implemented, it is estimated that 80% to 90% of the fish and wildlife resource impacts described in Chapters 3 and 5 through 7 could be mitigated. Impacts to other resources would be the same as the proposed action.

SURFACE FACILITY RELOCATION ALTERNATIVE

This alternative would require revision of the Long Canyon mining and reclaimation plan for subsequent environmental impact analysis. The revised mining and reclamation plan would identify a facilities site located to the south of the Long Canyon/Cedar Canyon hydrographic divide and present redefined underground mining boundaries that would insure no surface subsidence of the Cedar Canyon area.

The strategic relocation of the facilities site and the changed underground mining boundaries would result in lessened impacts to crucial elk winter range, mule deer concentration areas, raptor nesting habitat, and visual resources. Intensive archeological surves would be needed prior to location selection in order to identify the resource and provide for its protection.

The relocation of the facilities site and changes in underground mining boundaries might or might not be feasible from an economic and (or) technical aspect.

Such an alternative, if adopted and if mining were to be approved based on such a revised mining and reclamation plan, would result in the bypassing of coal under the Cedar Canyon area.

LONG CANYON RECLAMATION ALTERNATIVE

The mining and reclamation plan would be conditionally approved for a period of 10 years during which time a specific testing and monitoring program for the purpose of measuring revegetation success would be implemented by the coal mining company. In this alternative a plan describing the testing and monitoring program would be prepared by the Sunoco Energy Development Company and Rocky Mountain Energy Company for approval by the regulatory authorities prior to its implementation.

If it cannot be demonstrated that revegetation can be successful commensurate with Public Law 95-87 (SMCRA) at the conclusion of the 10-year program, the Department of the Interior will revoke its approval for mining on public lands.

Although current reclamation research indicates that successful reclamation can be achieved on semiarid coal mined lands, it is recognized that answers to reclamation problems are needed on a site-specific basis in order to ensure success.

Table LC8-3

RECOMMENDED VEGETATION FOR RECLAMATION OF LONG CANYON MINE

Forbs	Shrubs[1]	Grasses or Grasslikes
1. Hoods phlox (*Phlox hoodii*)	1. Big sagebrush (*Artemisia tridentata*)	1. Bluegrass (*Poa* spp.)
2. Wildbuckwheat (*Eriogonum* spp.)	2. Rabbitbrush (*Chrysothamnus* spp.)	2. Thickspike wheatgrass (*Agropyron dasystachyum*)
3. Wallflower (*Erysimum* spp.)	3. Black sagebrush (*Artemisia nova*)	3. Basin ryegrass (*Elymus cinereus*)
4. Fleabane (*Erigeron* spp.)	4. Antelope bitterbrush (*Purshia tridentata*)	4. Carex (*Carex* spp.)
5. Spineless hopsage (*Grayia spinosa*)	5. Fourwing saltbush (*Atriplex canescens*)	5. Needlegrass (*Stipa* spp.)
6. Stemless actinea (*Hymenoxys acaulis*)	6. Black greasewood (*Sarcobatus vermiculatus*)	6. Idaho fescue (*Festuca idahoensis*)
		7. Indian ricegrass (*Oryzopsis hymenoides*)

Note: Common and scientific plant names are according to Beetle (1970).

[1] At least 20% of the annual forage production should be browse.

This alternative, if implemented, would result in the gathering of data to show that lands proposed for mining are reclaimable within a reasonable period of time.

The Sunoco Energy Development Company and Rocky Mountain Energy Company would be required, under the direction of state and federal reclamation regulatory and surface ownership agencies, to establish a suitable number of demonstration plots to provide evidence of revegetation success.

The demonstration plots would be established as soon as practicable following the authorization of the Department of the Interior to commence mining operations.

Impacts which would occur if revegetation could not be accomplished would be as follows:

1. The mining company would be forced to shut down its operation on public land.
2. A shut down of the mine would cause economic loss to the mining company from the sale of coal, loss of employment for most of the employees, and partial loss of investment in equipment and material needed to open and operate the mine for the 10-year period.
3. Areas disturbed (about 493 acres) during the 10-year period of mining would be unreclaimed or at best only partially reclaimed.
4. The consumer of coal from the mine would need to obtain coal from another source.
5. The reduction in labor force would cause socioeconomic impacts to the region.
6. In the event that mining would still occur on non-public lands, the above impacts would be lessened but would still be significant.

RECLAMATION METHODOLOGY ALTERNATIVE

This alternative lists recommendations which, if implemented, would reduce impacts on surface water quality (erosion) and air quality.

1. Backfilled slopes would be designed low and the length of slopes short.
2. All suitable topsoil and suitable overburden would be conserved for subsequent placement on disturbed areas.
3. Appropriate soil amendments would be used to improve soil structure.
4. Fertilization of topsoil would be done based on soil analyses.
5. All topsoiled areas would be mulched and additional organic matter added.
6. Supplemental irrigation would be employed for the first two growing seasons. Application rates would be based on soil moisture monitoring.

This alternative, if implemented, would result in the use of methodology that would enhance rapid establishment of vegetation. The vegetation would decrease soil erosion from water action and decrease the emission of dust from treated areas.

The grading of all disturbed areas to less than moderate slopes would enhance revegetation but would result in such areas having less topographical diversity. Moderate and steeper slopes provide seasonal and (or) year-round habitat for wildlife and provide protection from storms for livestock and wildlife.

Care would need to be taken to avoid creating conditions unfavorable to native plant species proposed in seeding mixtures. Many of these species are adapted to soils with low to moderate productivity.

DEFER ACTION ALTERNATIVE

For proper cause, the Secretary may defer final action on this proposed mining and reclamation plan. This could include, but is not limited to, the need and time required for:

1. Modification of the proposal to correct specific administration or technological deficiencies. (No need for additional changes or alternatives was identified during the public review beyond those which are already presented.)
2. Redesign to reduce or avoid specific environmental impact. (No need for additional changes or alternatives was identified during the public review beyond those which are already presented.)
3. Acquistion of additional data to provide an improved basis for technical or environmental evaluation.

In the public review, several comments were received concerning the probability of successful reclamation. As a result the following alternative is presented: Approval of the mining and reclamation plan would be deferred pending Rocky Mountain Energy Company and Suneco Energy Development Company demonstrating on site that lands proposed for mining or other disturbances would be reclaimable within a reasonable period of time.

The principal effects of deferring action on the proposed mining and reclamation plan would be (a) a short-term delay, (b) presumably some reduction or avoidance of certain significant adverse impact, (c) a better data base and subsequent analysis of specific adverse impacts, (d) economic loss to Rocky Mountain Energy Company and Sunoco Energy Development Company from delay of approval, (e) the market for which Rocky Mountain Energy Company and Sunoco Energy Development Company have proposed to deliver coal would need to find another source of coal, and (f) possible reduction of the applicants' labor force.

In the public review a comment was received concerning the impacts of a possible coal preparation plant on the Long Canyon Mine. As a result the following alternative is presented: Approval of the mining and reclamation plan would be deferred pending acquistion of data by the applicants for the need and extent of coal preparation.

The principal effects of deferring action on the proposed mining and reclamation plan would be (a) a short-term delay, (b) a better data base and subsequent analysis of adverse air and water quality impacts, and (c) economic loss to the applicant from delay of approval.

4. Further evaluation of the proposed and (or) alternatives. (No need for additional changes or alternatives was identified during the public review beyond those which are already presented.)

PREVENT (FURTHER) DEVELOPMENT ON THE LEASE ALTERNATIVE

The Secretary may reject any individual proposed activity that does not meet the requirements of applicable law and regulations under his authority, including the potential for environmental impact that could be reduced or avoided by adoption of a significantly different disigned course of action by the lessee (operator). This may be accomplished by suspension of operations (if ongoing), cancellation of the lease (if environmentally acceptable development is not possible), federal acquisition of the lease, or rejection of the mining and reclamation plan. (No need for additional changes or alternatives was identified during public review beyond those which are already presented.)

RESTRICT DEVELOPMENT ON THE LEASE ALTERNATIVE

This alternative could be applied to all or a portion of the lease, as appropriate. The subject lease conveys the right to develop, produce, and market the federal coal resource if all other terms and conditions are met by the lessee. Various measures that may tend to restrict development may be taken by the Secretary at any time in the interest of conservation of the resources or in the protection of various specific environmental values in accordance with existing laws and regulations; for example, the National Historic Preservation Act of 1966, the Endangered Species Act of 1973, the Surface Mining Control and Reclamation Act of 1977, etc. (No need for additional changes or alternatives was identified during public review beyond those which are already presented.)

ALLOW DEVELOPMENT OF SELECTED AREAS NOW UNDER LEASE ALTERNATIVE

This alternative would permit only selective exploration and development of existing leaseholds based on anticipated adverse environmental consequences. The decision maker has the authority and responsibility to evaluate the coal resources and impacts of mining on these leases prior to acting on the proposals. Exploration and development could be allowed only on those leaseholds, or portions thereof, that would have the lowest anticipated adverse environmental consequences. Weighing the tradeoffs of mining or precluding mining on selected tracts is part of the evaluation and decision process. Adoption of this alternative would reduce adverse effects by reducing the area in which the impacting activities could take place. (No need for additional changes or alternatives was identified during public review beyond those which are already presented.)

CHAPTER 9

CONSULTATION AND COORDINATION

See the regional Environmental Statement (ES) for a description of the consultation and coordination efforts involved in the preparation of the ES.

LONG CANYON SITE SPECIFIC ES APPENDIX

SOIL ASSOCIATION MAPPING UNIT DESCRIPTIONS

A description of each soil association mapping unit within the Long Canyon project area follows. These descriptions and Table LCA-1 are intended for use with the Long Canyon soils map found in Chapter 2.

101—Rock Outcrop

This unit consists of steep to vertical rocky escarpments (80%) and associated very shallow soils (20%). The rock escarpments are made up of sandstone and shale. The soils in the unit are very shallow fine sandy loams. Slopes of the unit range from 3% to 30%. Annual precipitation is from 7 to 9 inches.

117—Alluvial Fans, Sandy Saline Soils

These are fine sandy loams (calcareous) of nearly level to gently sloping alluvial fans. They are deep, well drained, moderately alkaline, and saline soils formed in alluvium. Slopes range from 1% to 8% and annual precipitation is from 7 to 9 inches.

124—Residual Uplands, Shallow Soils, Nearly Level to Sloping

These are shallow soils formed on plateaus and upland mesas in the 7 to 9 inch precipitation zone. They are nearly all less than 20 inches deep with poorly developed profiles. All are calcareous throughout and have developed over sandstone. Rock outcrop occupies about 5% of this association. Vegetation is mostly low sagebrush and sparse grasses.

125—Residual Uplands, Shallow Soils, Hilly

These are soils of sloping to steep and hilly areas that have developed over calcareous sedimentary rocks. Soil textures within this unit vary from sandy loam to silty clay. These soils are well drained and occur in the 7 to 9 inch precipitation zone. Slopes range from 6% to 30%. Rock outcrop occupies about 15% of this association.

131—Residual Uplands, Shallow Fine-Loamy Soils, Gently Sloping and Sloping

These are shallow, well drained, strongly alkaline, loamy soils that have formed from shale. Slopes are from 1% to 8% for most of the area, but also included are short, steep rocky ravines and escarpments. Annual precipitation is from 7 to 9 inches.

135—Residual Uplands, Shallow Sandy Soils, Hilly

These are primarily shallow, well drained, fine sandy to sandy loams formed from sedimentary rocks. These soils are calcareous and are in the 7 to 9 inch precipitation zone. Slope ranges from 6% to 30%. About 20% is sandstone rock outcrop.

141—Stabilized Dunes

This association consists of dune sand that has been stabilized by vegetation (sagebrush, rabbitbrush, and grasses) in the 7 to 9 inch precipitation zone. The hold that vegetation has on these sand areas is very fragile. The slightest disturbance to the vegetation (such as a vehicle passing over the area) can cause a blow out (wind-excavated depression).

143—Stabilized Dunes and Residual Uplands

This unit consists of undulating to hilly residual uplands with intermittent sand dunes. The uplands are shallow to moderately deep, well drained, sandy loams formed from sedimentary rocks. The dunes are excessively drained, wind deposited, loamy and fine sands over sedimentary rocks. Annual precipitation ranges from 7 to 9 inches.

145—Alluvial Fans, Gently Sloping and Dunes

This unit consists of undulating and rolling sand dunes (30%) in complex with nearly level to gently sloping alluvial soils on alluvial fans (70%). The dunes are deep,

Table LCA-1

SOIL ASSOCIATION CHARACTERISTICS

Map Unit No.	Map Unit Name[1]	% of Map Unit	Subgroup	Family	Effective Root Depth	Soil Reaction (pH)	Natural Soil Drainage	Potential Runoff	Permea-bility	Available Water Capacity
101	Rock outcrop	80	Rock Outcrop (sandstone and shale)		---	---	---	High	---	---
		20	Inclusions of very shallow fine sandy loam soils							
117	Alluvial fans, sandy saline soils	100	Typic Torriorthents	Coarse-loamy, mixed (calcareous), frigid	60+	8.0-8.8	Intermittent Drainage-Floods	Moderate	Mod.-Rapid	Low
124	Residual uplands, shallow soils, nearly level to sloping	40	Typic Torriorthents	Loamy, mixed (calcareous), shallow, frigid	10-20	8.0-8.4	Excessive	High	Mod.-Rapid	Very Low
		20	Lithic Torriorthents	Loamy, mixed (calcareous), frigid	<10	8.2-8.4	Excessive	High	Mod.-Rapid	Very Low
		20	Typic Calciorthids	Coarse-loamy, mixed, frigid	20-40	8.0-9.4	Well Drained	High	Mod.-Rapid	Low
		10	Lithic Torriorthents	Loamy, mixed (calcareous), frigid	10-20	7.4-8.4	Excessive	High	Mod.-Rapid	Very Low
		10	Inclusions are deep fine sandy loams, deep loamy sands, moderately deep fine sandy loams, shallow and very shallow loamy soils, and rock outcrop.							
125	Residual uplands, shallow soils, hilly	40	Typic Torriorthents	Loamy, mixed (calcareous), shallow, frigid	10-20	8.0-8.4	Excessive	High	Moderate	Very Low
		20	Typic Torriorthents	Loamy-skeletal, mixed (calcareous), frigid	10-20	8.5-9.2	Excessive	High	Rapid	Very Low
		15	Rock Outcrop (sandstone)							
		10	Lithic Torriorthents	Loamy, mixed (calcareous), shallow, frigid	<10	8.2-8.4	Excessive	High	Mod.-Rapid	Very Low
		10	Typic Torriorthents	Loamy, mixed (calcareous), frigid	<10	8.0-9.0	Excessive	High	Moderate	Very Low
		5	Inclusions are deep fine sandy loams, deep loamy sands, and moderately deep loams.							
131	Residual uplands, shallow fine-loamy soils, gently sloping and sloping	50	Typic Torriorthents	Loamy, mixed (calcareous), shallow, frigid	<10	8.5-9.2	Excessive	High	Moderate	Very Low
		30	Typic Torriorthents	Loamy, mixed (calcareous), shallow, frigid	10-20	8.5-9.2	Excessive	High	Moderate	Very Low
		20	Inclusions are shallow and very shallow sandy loams, moderately deep and shallow loamy soils, and rock outcrop.							

Table LCA-1

SOIL ASSOCIATION CHARACTERISTICS
(Continued)

Map Unit No.	Map Unit Name[1]	% of Map Unit	Subgroup	Family	Effective Root Depth	Soil Reaction (pH)	Natural Soil Drainage	Potential Runoff	Permea- bility	Available Water Capacity
135	Residual uplands, shallow sandy soils, hilly	40	Typic Torriorthents	Loamy, mixed (calcareous), shallow, frigid	10-20	8.0-8.4	Excessive	High	Moderate	Very Low
		20	Typic Torriorthents	Coarse-loamy, mixed (calcareous), frigid	20-40	8.4-8.8	Well Drained	Moderate	Mod.-Rapid	Low
		20	Rock Outcrop (sandstone)							
		10	Typic Torriorthents	Coarse-loamy, mixed (calcareous), frigid	40+	8.2-8.5	Well Drained	Moderate	Mod.-Rapid	Moderate
		10	Inclusions are deep loamy sands and shallow and very shallow channery sandy loams							
141	Stabilized dunes	100	Typic Torripsamments	Mixed, frigid	60+	7.2-8.0	Excessive	Low	Rapid	Low
143	Stabilized dunes and residual uplands	40	Typic Torripsamments	Mixed (calcareous), frigid	40+	8.0-8.4	Excessive	Low	Rapid	Low
		20	Typic Torriorthents	Loamy, mixed (calcareous), shallow, frigid	10-20	8.0-8.4	Excessive	High	Mod.-Rapid	Very Low
		20	Typic Calciorthids	Coarse-loamy, mixed, frigid	20-40	8.0-8.4	Well Drained	Moderate	Mod.-Rapid	Low
		20	Inclusions are deep fine sandy loams, very shallow channery sandy loams and rock outcrop							
145	Alluvial fans, gently sloping and dunes	70	Typic Torriorthents	Coarse-loamy, mixed (calcareous), frigid	60+	8.0-8.8	Well	Low-Mod.	Mod.-Rapid	Low
		30	Typic Torripsamments	Mixed (calcareous), frigid	40+	8.0-8.4	Excessive	Low	Rapid	Low
146	Rocky sandy ridge tops	40	Typic Torripsamments	Mixed (calcareous), frigid	40+	8.0-8.4	Excessive	Low	Rapid	Low
		20	Rock outcrop (gray sandstone)							
		20	Typic Torriorthents	Loamy, mixed (calcareous) shallow, frigid	10-20	8.0-8.4	Excessive	Mod.-High	Mod.-Rapid	Very Low
		20	Lithic Torriorthents	Loamy, mixed (calcareous) frigid	<10	8.2-8.4	Excessive	High	Mod.-Rapid	Very Low

Table LCA-1

SOIL ASSOCIATION CHARACTERISTICS
(Continued)

Map Unit No.	Map Unit Name[1]	% of Map Unit	Subgroup	Family	Effective Root Depth	Soil Reaction (pH)	Natural Soil Drainage	Potential Runoff	Permea-bility	Available Water Capacity
222	Residual uplands, shallow to deep soils, sloping to steep	40	Ustic Torriorthents	Loamy, mixed (calcareous) shallow, frigid	10-20	7.0-8.0	Well	Moderate	Mod.-Rapid	Very Low
		15	Rock Outcrop (Sed. rocks and some coal seams)							
		10	Ustic Torriorthents	Loamy, mixed (calcareous), frigid, shallow	10-20	8.0-8.4	Well	Mod.-High	Moderate	Very Low
		10	Lithic Ustic Torriorthents	Loamy, mixed, frigid	<10	7.0-8.0	Well	High	Moderate	Very Low
		10	Ustic Torriorthents	Coarse-loamy, mixed, frigid	40+	8.0-8.6	Well	Moderate	Mod.-Rapid	Moderate
		15	Inclusions are deep and moderately deep fine sand, moderately deep and deep fine sandy loams, and very shallow loam and loamy sand soils							
224	Mountain tops, shallow soils, gently sloping to sloping	30	Ustic Torriorthents	Loamy, mixed (calcareous), frigid, shallow	10-20	7.8-8.0	Well	Moderate	Mod.-Rapid	Very Low
		30	Lithic Ustic Torriorthents	Loamy-skeletal, mixed (calcareous), frigid	<10	7.9-8.4	Well	Moderate	Mod.-Rapid	Very Low
		10	Ustic Torriorthents	Loamy, mixed (calcareous), frigid, shallow	10-20	7.9-8.4	Well	Mod.-High	Slow	Very Low
		10	Borollic Calciorthids	Coarse-loamy, mixed	20-40	7.9-9.0	Well	Moderate	Mod.-Rapid	Low
		10	Ustic Torripsamments	Mixed, frigid	40+	7.2-7.4	Excessive	Low	Rapid	Low
		10	Inclusions are deep fine sandy loams, moderately deep fine sands, shallow loamy sands, and rock outcrop							
226	High plateaus, moderately deep calcic soils, gently sloping and sloping	50	Borollic Calciorthids	Coarse-loamy, mixed	20-40	8.0-8.8	Well	Low	Mod.-Rapid	Low
		20	Ustic Torriorthents	Loamy, mixed (calcareous), frigid shallow	10-20	7.6-8.0	Well	Low-Mod.	Mod.-Rapid	Very Low
		10	Borollic Haplargids	Fine-loamy, mixed	20-40	8.0-8.4	Well	Moderate	Moderate	Low
		10	Ustic Torriorthents	Coarse-loamy, mixed (calcareous), frigid	40+	8.0-8.6	Well	Low	Mod.-Rapid	Moderate
		10	Inclusions are deep loamy sands and fine sands, shallow loamy soils and rock outcrop							

Table LCA-1

SOIL ASSOCIATION CHARACTERISTICS
(Continued)

Map Unit No.	Map Unit Name[1]	% of Map Unit	Subgroup	Family	Effective Root Depth	Soil Reaction (pH)	Natural Soil Drainage	Potential Runoff	Permea-bility	Available Water Capacity
234	Mesa tops, shallow volcanic soils, gnetly sloping and sloping	25	Borollic Lithic Calciorthids	Loamy, mixed	10-20	8.0-8.6	Well	Moderate	Mod.-Rapid	Very Low
		20	Borollic Calciorthids	Loamy-skeletal, mixed	20-40	8.0-8.8	Well	Low	Mod.-Rapid	Very Low
		15	Lithic Ustic Torriorthents	Loamy, mixed, frigid	10-20	7.6-8.0	Well	Low	Mod.-Rapid	Very Low
		15	Lithic Ustic Torriorthents	Loamy-skeletal, mixed frigid	<10	7.6-8.0	Well	Moderate	Mod.-Rapid	Very Low
		10	Ustic Torriorthents	Coarse-loamy, mixed, frigid	20-40	7.6-8.4	Well	Low	Mod.-Rapid	Low
		10	Rock Outcrop (Wyomingite and Pumice)							
		5	Inclusions are shallow and moderately deep dark fine sandy loams and deep fine sandy loams							
235	Mesa sideslopes stony volcanic soils, steep	30	Aridic Haplaborolls	Loamy-skeletal, mixed	40+	7.4-8.0	Well	Mod.-High	Mod.-Rapid	Low
		20	Aridic Haplaborolls	Coarse-loamy, mixed	40+	7.2-8.0	Well	High	Moderate	Moderate
		20	Aridic Argiborolls	Fine-loamy, mixed	40+	7.4-8.2	Well	High	Moderate	Moderate
		10	Pachic Haplaborolls	Loamy-skeletal	40+	7.2-8.2	Well	Mod.-High	Mod.-Rapid	Low
		5	Rock Outcrop (Wyomingite and Pumice)							
		15	Inclusions are deep, stony sandy loams and moderately deep loamy soils. Also included in this unit are level butte tops too small to delineate. The soils on these level butte tops are shallow and very shallow sandy loam and loamy soils.							

Note: Table derived from information obtained from contract with U. S. Department of Agriculture, Soil Conservation Service, 1977.

1 Unit names were derived from geomorphic setting of the soil.

Permeability

In/Hour	Class
0/06	Very Slow
0.06 - 0.2	Slow
0.2 - 0.6	Mod. Slow
0.6 - 2.0	Moderate
2.0 - 6.0	Mod. Rapid
6.0 -20	Rapid
20+	Very Rapid

Available Water Capacity

In/60" Profile*	Class
0 - 3	Very Low
3 - 6	Low
6 - 9	Moderate
9 -12	High
12+	Very High

*or to limiting layer

Note: Classes derived from "Supplement to Guide to Authors of Published Survey," TSC Transm. Sheet L1-1, U.S. Department of Agriculture, Soil Conservation Service, 1971.

excessively drained, wind deposited, loamy sand and fine sands deposited over alluvium. The alluvial soils are deep, well drained, strongly alkaline and saline, fine sandy loams formed in alluvium. Annual precipitation ranges from 7 to 9 inches.

146—Rocky, Sandy Ridge Tops

This unit consists of gently sloping to moderately steep residual uplands. Soils are deep, excessively drained, wind deposited, loamy sands and fine sands (40%). The remaining are very shallow to shallow, well drained, sandy loams formed from sedimentary rocks. Rock outcrops occupy about 20% of this unit. Annual precipitation ranges from 7 to 9 inches.

222—Residual Uplands, Shallow to Deep Soils, Sloping to Steep

These soils are located in gently sloping to steep residual uplands dissected by alluvial draws. Most (75%) are calcareous, they grade from deep (25%) and moderately deep (25%) to shallow (50%). The majority are formed in residuum from sedimentary rock and the deep soils are formed on old alluvium. Most are sandy textured. Annual precipitation ranges from 10 to 14 inches.

224—Mountaintops, Shallow Soils, Gently Sloping to Sloping

These soils are mostly (95%) shallow soils on the tops of flat topped buttes and mountains in the 10- to 14-inch precipitation zone. They have sandy loam textures and are mostly calcareous. These soils are well drained and are formed in residuum from sedimentary rock.

226—High Plateaus, Moderately Deep Calcic Soils, Gently Sloping and Sloping

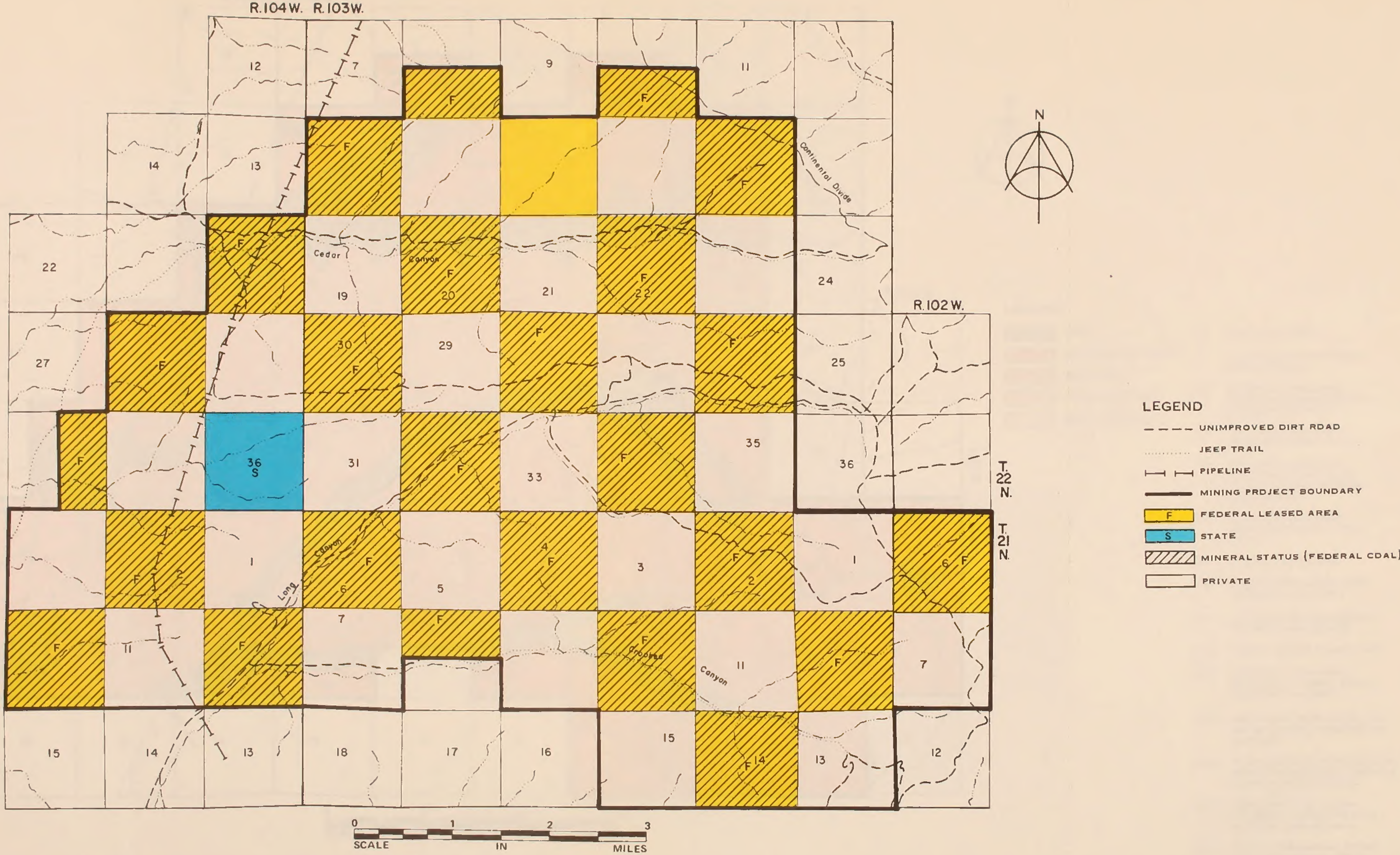
These soils are from shallow to moderately deep, well drained, fine sandy loams developed from sedimentary rock. A small amount (10%) are deep, well drained, fine sandy loams developed from alluvium. Annual precipitation is from 10 to 14 inches.

234—Mesa Tops, Shallow Volcanic Soils, Gently Sloping and Sloping

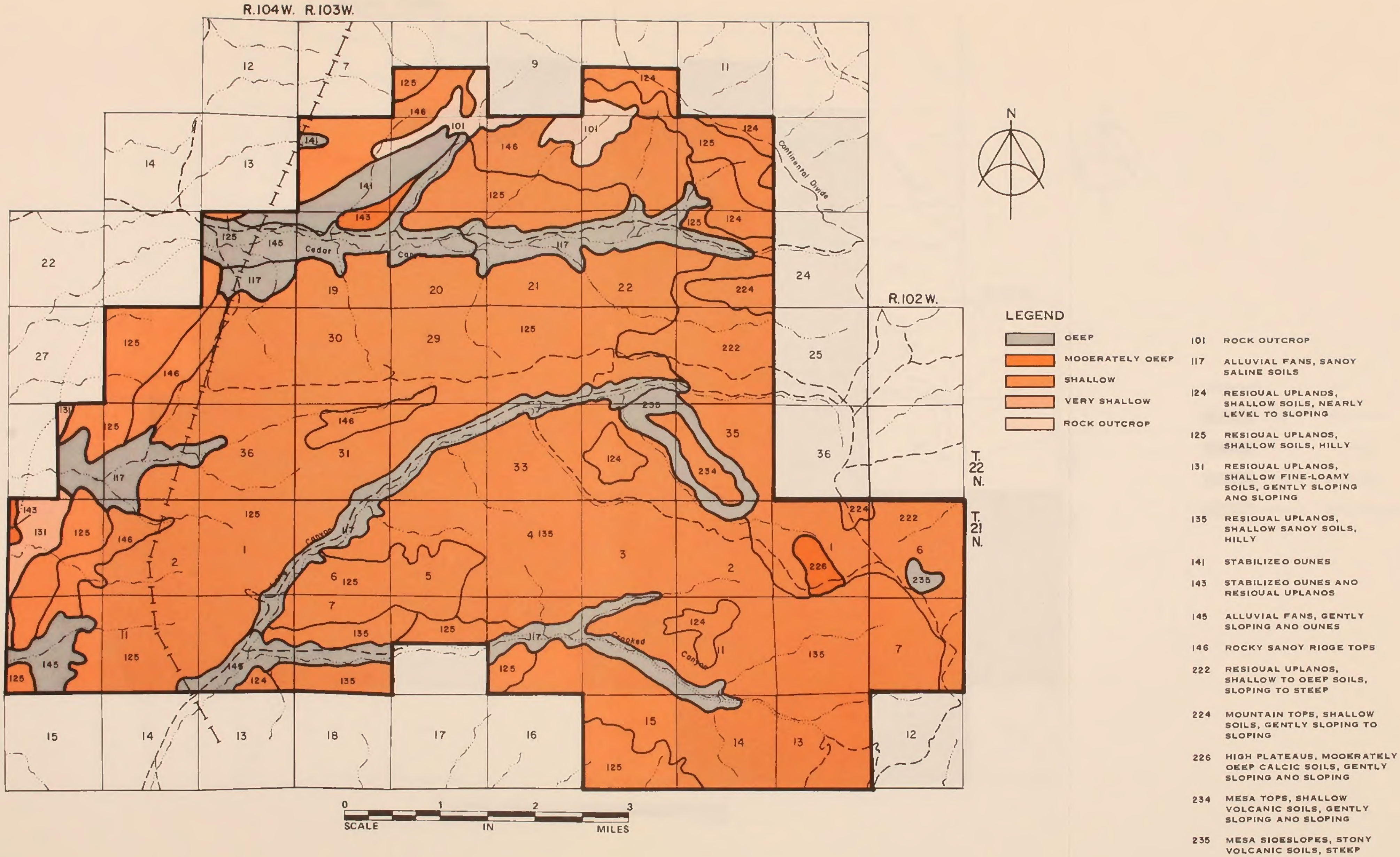
These soils are from shallow to moderately deep, well drained, sandy loams and gravelly fine sandy loams developed from Wyomingite and pumice volcanic residuum. Slopes are from 1% to 10% and annual precipitation is from 10 to 14 inches.

235—Mesa Sideslopes, Stony Volcanic Soils, Steep

These soils are deep, well drained, fine sandy loams and stony sandy loams developed from localized alluvium and residuum from volcanic Wyomingite and pumice. Slopes range from 15% to 40% and annual precipitation is from 11 to 14 inches.



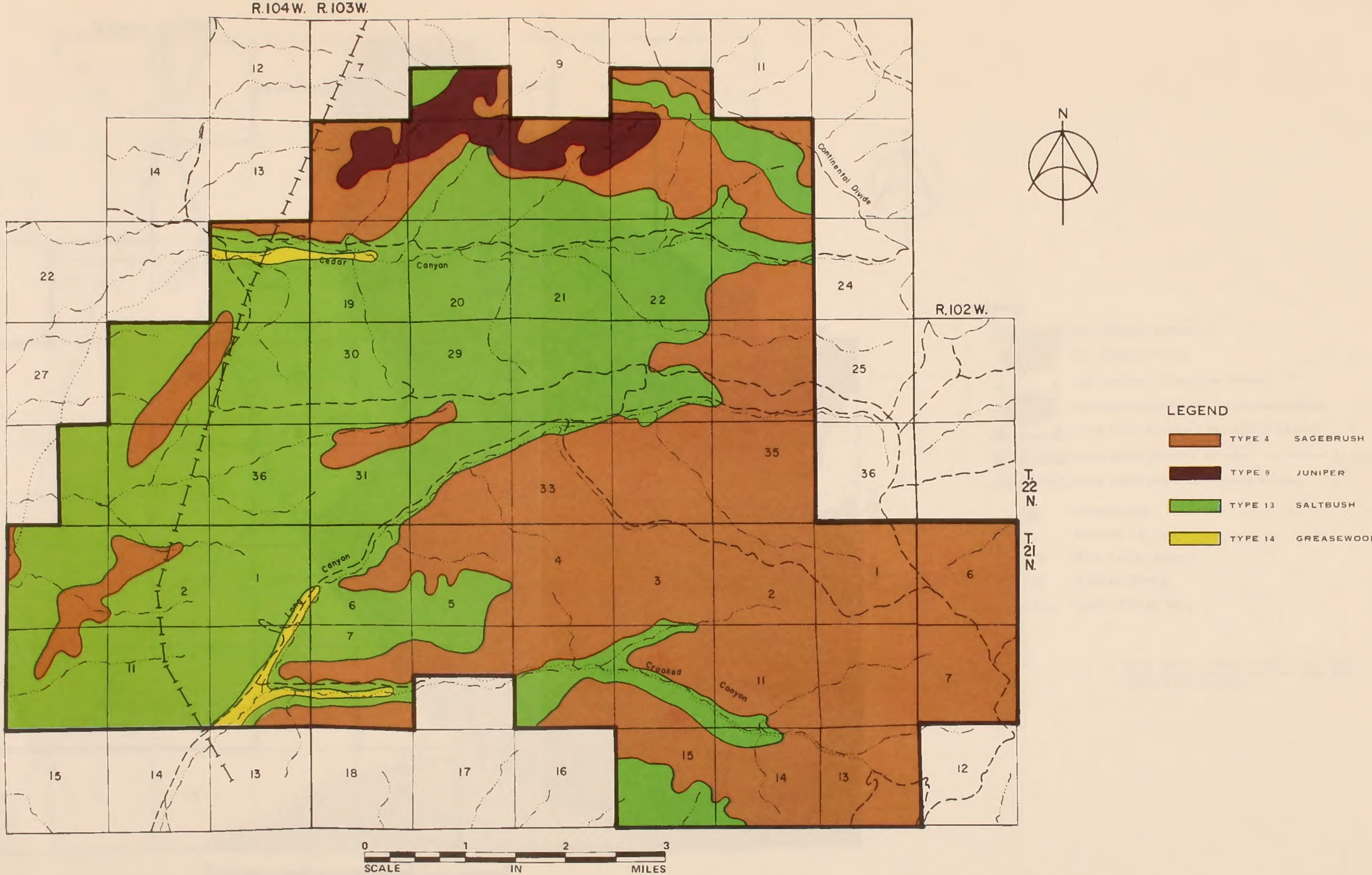
Map LC1 - 1
SURFACE AND MINERAL STATUS
LONG CANYON



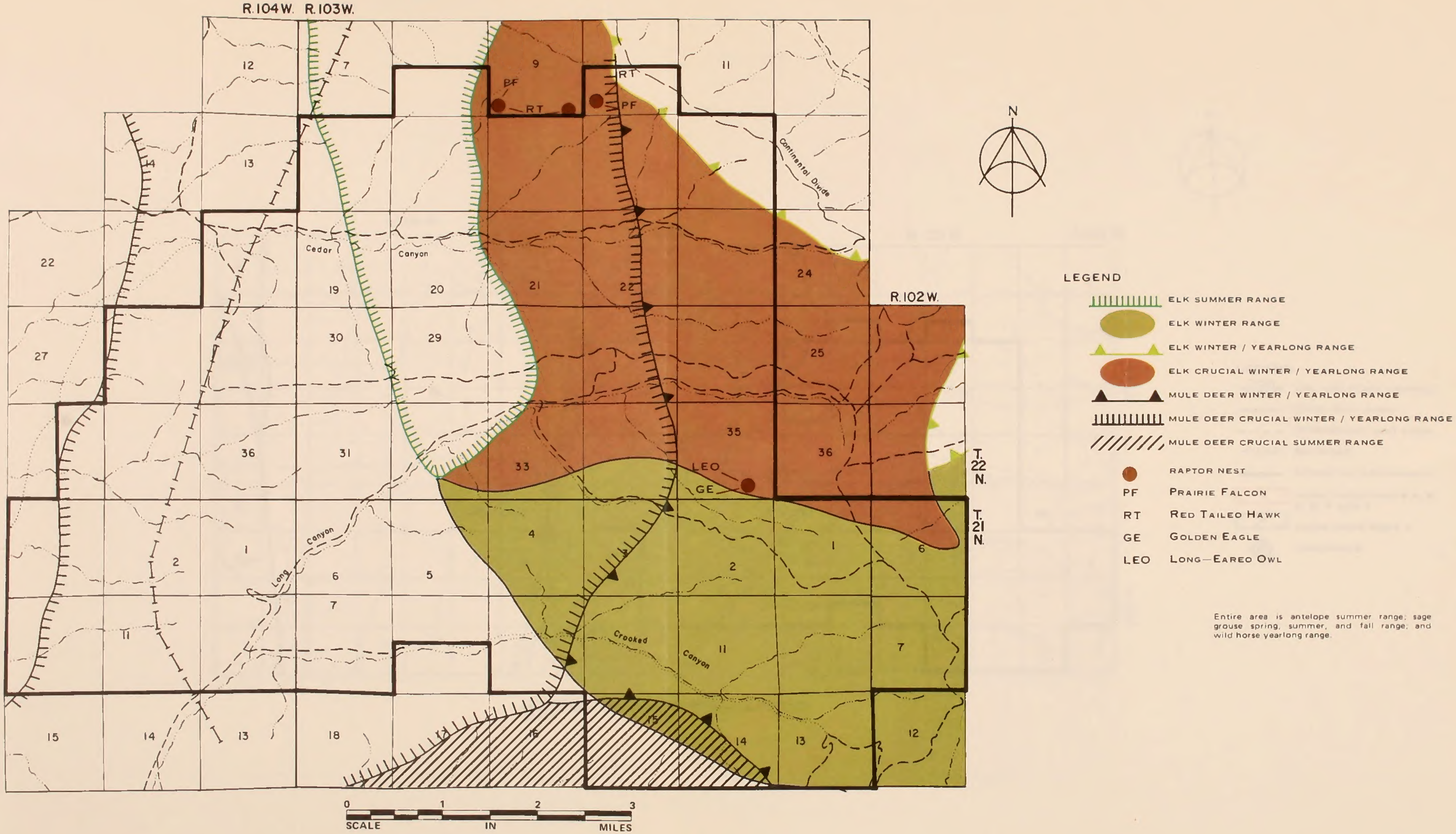
Map LC2 - 5A

SOILS

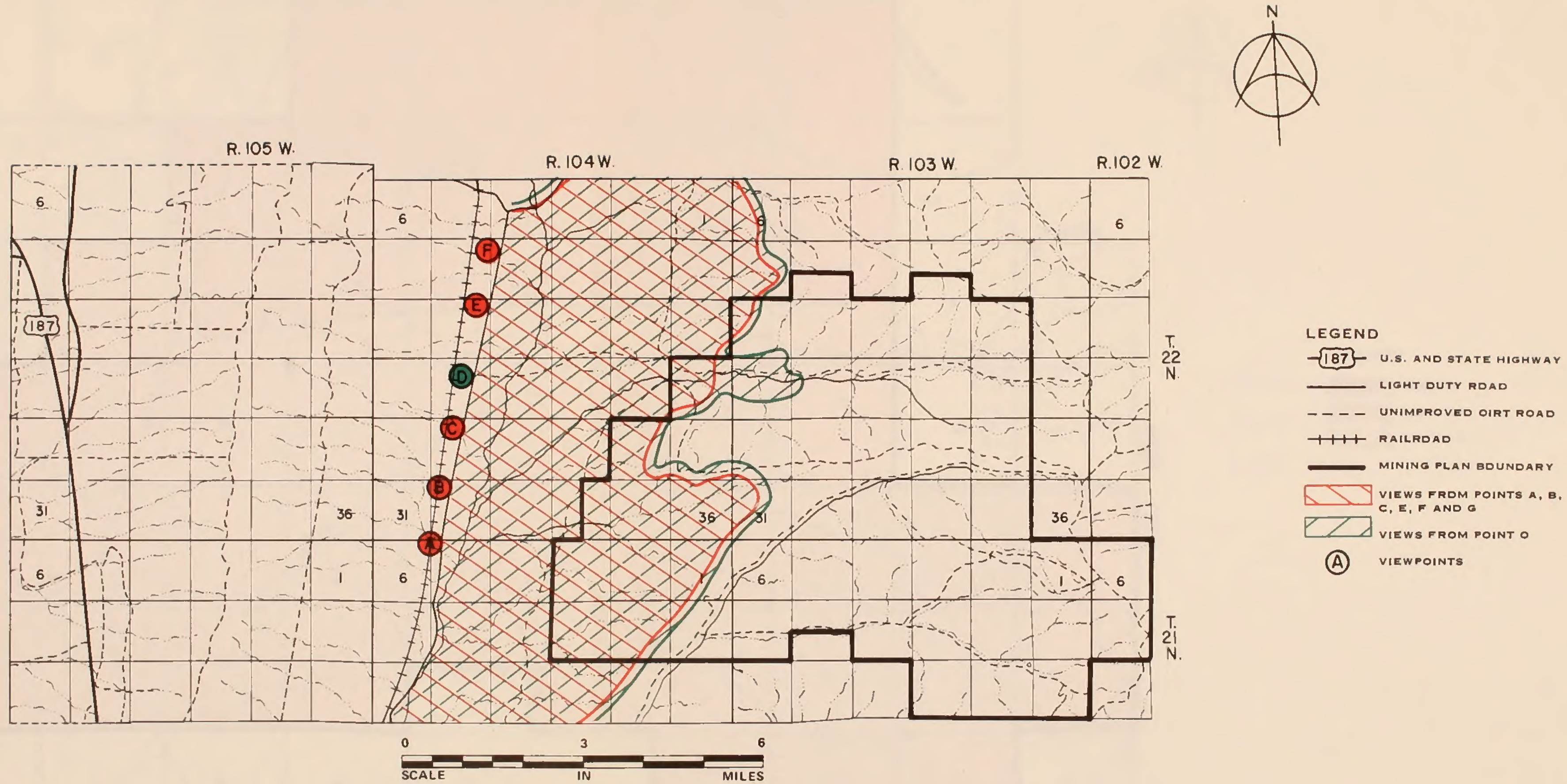
LONG CANYON



Map LC2 - 7A
VEGETATION TYPES
LONG CANYON



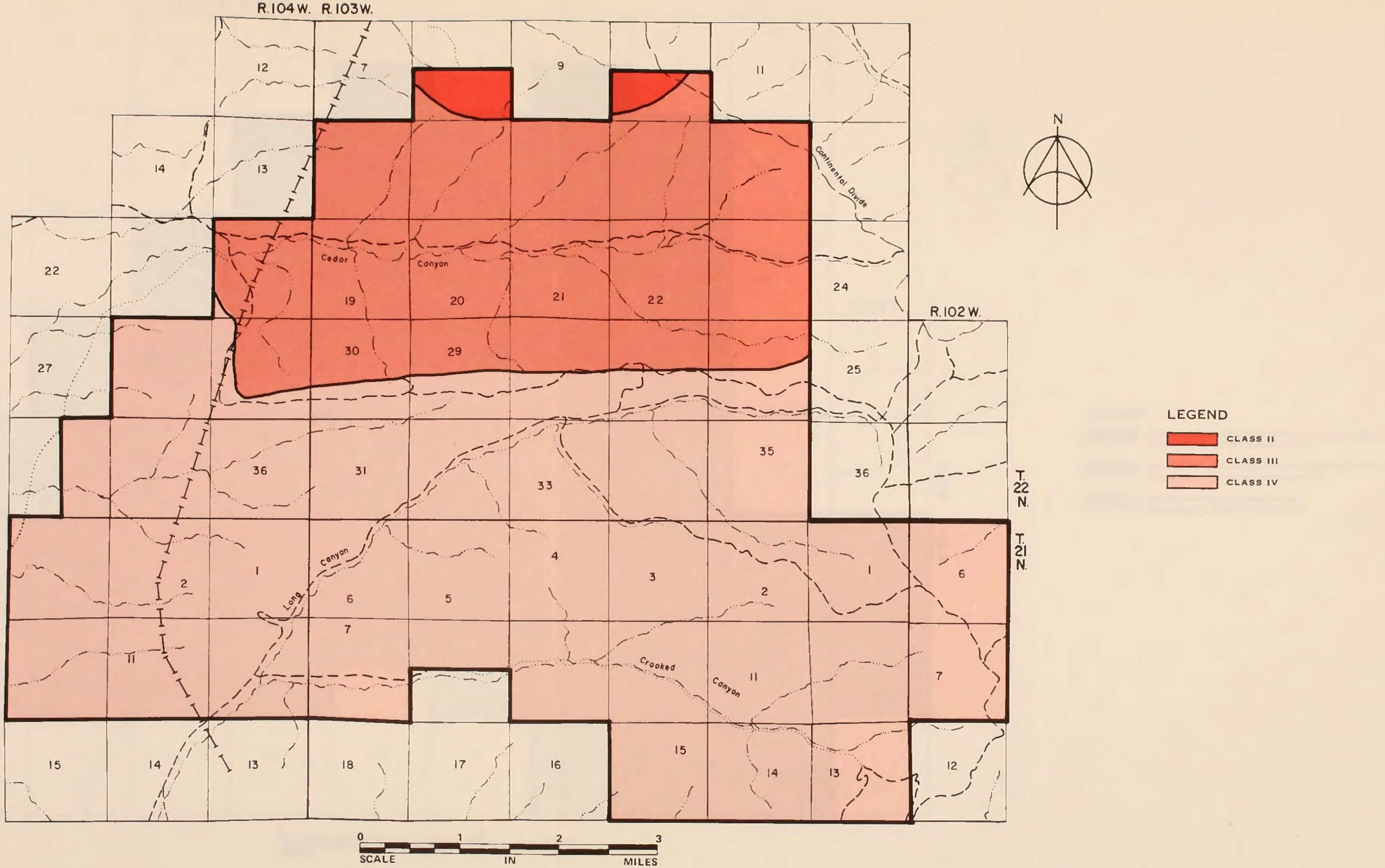
Map LC2 - 8A
ANIMAL DISTRIBUTION
LONG CANYON



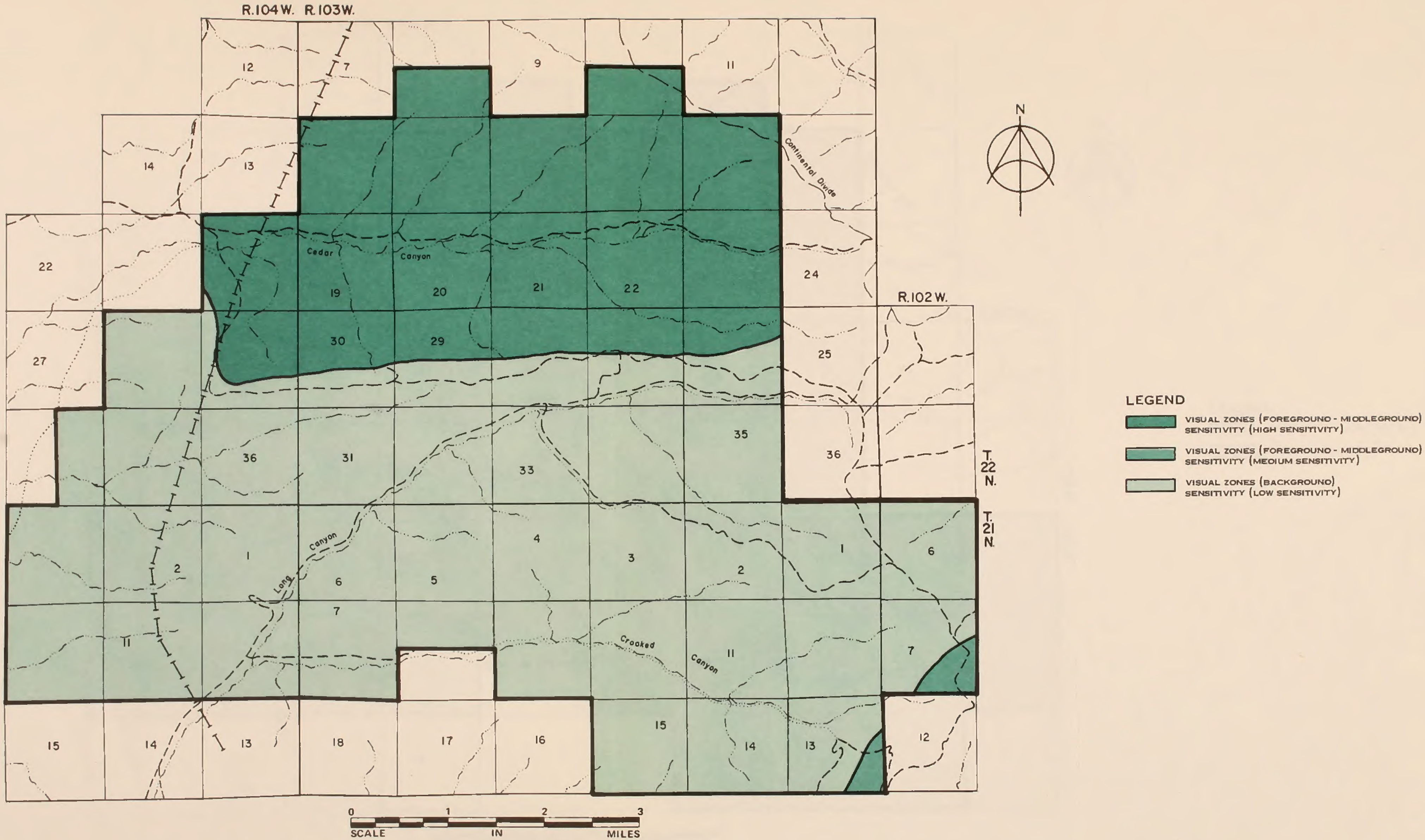
Map LC2 - 10A

VIEWPOINTS AND VIEWS

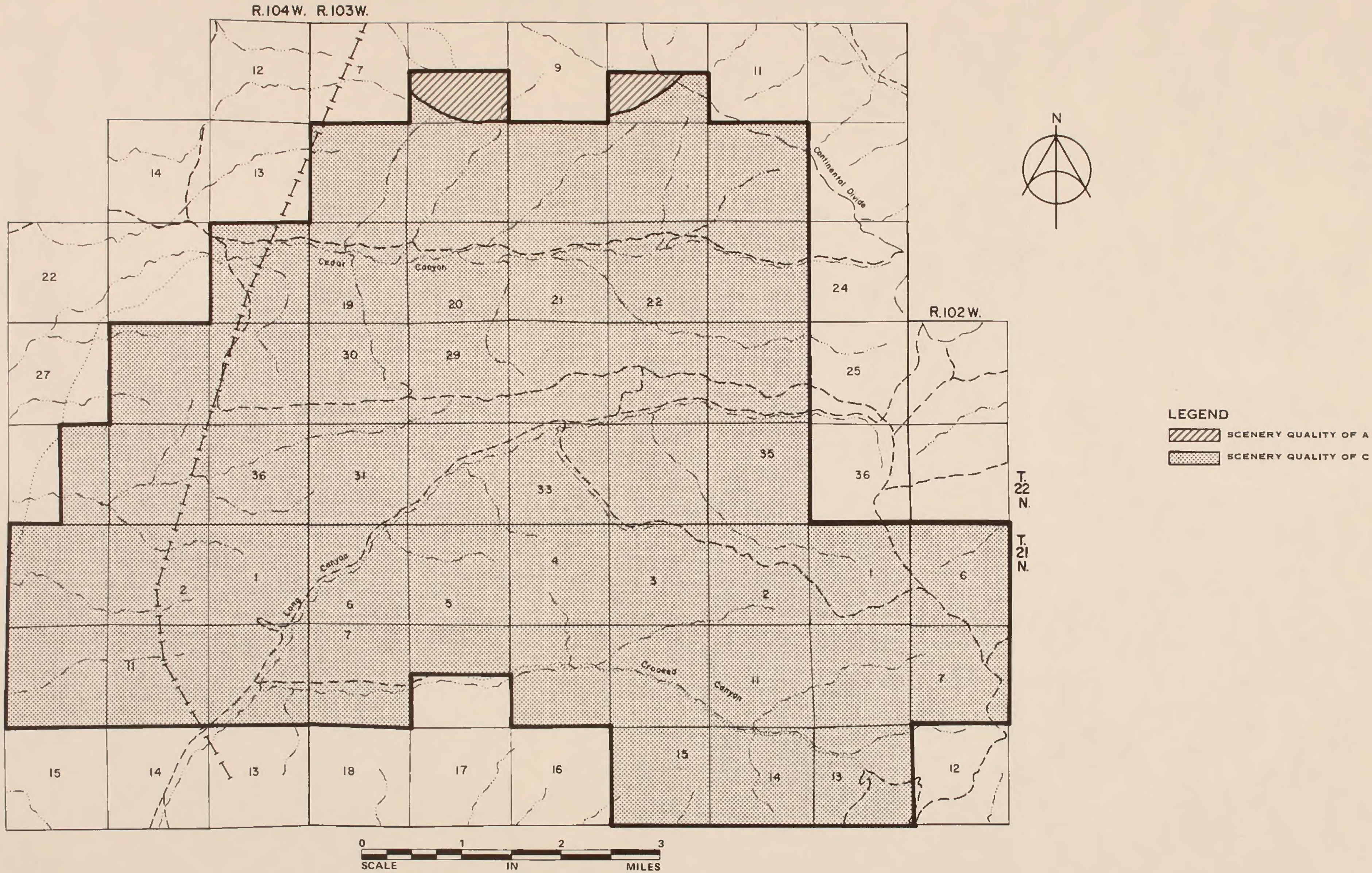
LONG CANYON



Map LC2 - 10B
VISUAL MANAGEMENT CLASSES
LONG CANYON



Appendix D
VISUAL ZONES AND SENSITIVITY
LONG CANYON



Appendix D
SCENERY QUALITY RATINGS
LONG CANYON

PROPOSED
BLACK BUTTE
MINE

TABLE OF CONTENTS

BLACK BUTTE MINE PROPOSAL

Chapter 1	Page
DESCRIPTION OF THE PROPOSAL	BB1-1
HISTORY AND BACKGROUND	BB1-1
PROPOSED ACTION	BB1-1
Purpose and Objective	BB1-1
Location	BB1-2
Predisturbance Inventories and Analyses	BB1-2
Mine	BB1-2
Facilities	BB1-2
Support Facilities	BB1-7
Proposed Mine Layout and Mining Sequence	BB1-9
Mining Procedures	BB1-9
Reclamation	BB1-14
Pollution Control Methods	BB1-20
AUTHORIZING ACTIONS	BB1-20
Bureau of Land Management (BLM)	BB1-20
Geological Survey (GS)	BB1-20
State and County	BB1-20
INTERRELATIONSHIPS	BB1-20
Relationship to Land Use Plans	BB1-20
Relationship to Other Proposed and Future Actions	BB1-20
Relationship to Rail Transportation	BB1-20
Chapter 2	
DESCRIPTION OF THE ENVIRONMENT	BB2-1
EXISTING ENVIRONMENT	BB2-1
CLIMATE	BB2-1
Sunshine	BB2-1
Wind Fields	BB2-1
Atmospheric Temperature and Stability	BB2-1
Moisture	BB2-1
Evapotranspiration	BB2-1
Severe Weather Events	BB2-1
AIR QUALITY	BB2-2
GEOLOGY	BB2-2
Stratigraphy	BB2-2
Paleontology	BB2-2
Structure	BB2-2
Geologic Hazards	BB2-2
TOPOGRAPHY	BB2-4
SOILS	BB2-4
WATER RESOURCES	BB2-7
Ground Water	BB2-7
Surface Water	BB2-7
VEGETATION	BB2-14
FISH AND WILDLIFE	BB2-14
General Information	BB2-14
Herd Units	BB2-16
Fishery	BB2-16
Wildlife	BB2-16
Wild Horses	BB2-20
CULTURAL RESOURCES	BB2-20
Archeological	BB2-20
Historical	BB2-24
VISUAL RESOURCES	BB2-24
RECREATIONAL RESOURCES	BB2-28
Visitor Use Data	BB2-28
Hunting	BB2-28
Sightseeing	BB2-28
Off-Road Vehicles	BB2-28
Wilderness Values	BB2-28
AGRICULTURE	BB2-28
MINERAL RESOURCES	BB2-28
Coal	BB2-31
Oil and Gas	BB2-31
LAND USE PLANS, CONTROLS, CONSTRAINTS	BB2-31
TRANSPORTATION NETWORKS	BB2-31
SOCIOECONOMIC CONDITIONS	BB2-31
Population	BB2-36
Employment	BB2-36
Income	BB2-36
Infrastructure	BB2-36
Attitudes and Expectations	BB2-40
Life Styles	BB2-40
FUTURE ENVIRONMENT	BB2-40

Chapter 3	Page
ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION	BB3-1
ASSUMPTIONS AND ANALYSIS GUIDELINES	BB3-1
Assumptions	BB3-1
Guidelines	BB3-1
AIR QUALITY	BB3-1
Emissions from the Proposed Mine	BB3-1
Impact on Air Quality	BB3-3
Gaseous Pollutants	BB3-3
Visibility	BB3-3
GEOLOGY	BB3-10
Paleontology	BB3-10
Geologic Hazards	BB3-10
TOPOGRAPHY	BB3-10
SOILS	BB3-10
WATER RESOURCES	BB3-11
Ground Water	BB3-11
Surface Water	BB3-13
Water Uses	BB3-13
VEGETATION	BB3-13
Terrestrial	BB3-13
Aquatic	BB3-16
Endangered and Threatened	BB3-16
FISH AND WILDLIFE	BB3-16
General Information	BB3-16
Habitat Losses	BB3-16
Carrying Capacity Losses	BB3-16
Fish and Wildlife Population Loss	BB3-16
Wild Horses	BB3-22
CULTURAL RESOURCES	BB3-22
Archeological	BB3-22
Historical	BB3-23
VISUAL RESOURCES	BB3-23
Summary of Visual Contrast Ratings (TABLE BB3-10A)	BB3-23
RECREATIONAL RESOURCES	BB3-23
Visitor Use Data	BB3-23
AGRICULTURE	BB3-26
Livestock Grazing	BB3-26
Prime Farmland	BB3-26
MINERAL RESOURCES	BB3-26
TRANSPORTATION NETWORKS	BB3-26
SOCIOECONOMIC CONDITIONS	BB3-29
Population	BB3-29
Employment	BB3-29
Income	BB3-29
Infrastructure	BB3-29
Attitudes and Expectations	BB3-32
Life Styles	BB3-32

Chapter 4	
MITIGATING MEASURES NOT INCLUDED IN THE PROPOSED ACTION	BB4-1
MEASURES	BB4-1
Mining and Reclamation Plan	BB4-1
U.S. Geological Survey	BB4-1
Wyoming Department of Environmental Quality	BB4-1
Bureau of Land Management	BB4-2
ANALYSIS OF EFFECTIVENESS	BB4-2
MONITORING, RESEARCH, AND STUDY PROGRAMS	BB4-3

TABLE OF CONTENTS (Cont'd)

BLACK BUTTE MINE PROPOSAL

Chapter 5	Page
ANY ADVERSE IMPACTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED	BB5-1
AIR QUALITY	BB5-1
GEOLOGY	BB5-2
Paleontology	BB5-2
SOILS	BB5-2
WATER RESOURCES	BB5-2
Ground Water	BB5-2
Surface Water	BB5-2
VEGETATION	BB5-2
FISH AND WILDLIFE	BB5-2
CULTURAL RESOURCES	BB5-3
Archeological	BB5-3
Historical	BB5-3
VISUAL RESOURCES	BB5-3
RECREATIONAL RESOURCES	BB5-3
Visitor Use Data	BB5-4
AGRICULTURE	BB5-4
MINERAL RESOURCES	BB5-4
TRANSPORTATION NETWORKS	BB5-4
SOCIOECONOMIC CONDITIONS	BB5-4
Population	BB5-4
Social Conditions	BB5-4
Chapter 6	
THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MANS ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY	BB6-1
Chapter 7	
ANY IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED	BB7-1
Chapter 8	
ALTERNATIVES TO THE PROPOSED ACTION	BB8-1
NO ACTION	BB8-1
AIR QUALITY	BB8-1
Best Management Practices	BB8-1
FISH AND WILDLIFE MITIGATION ALTERNATIVE	BB8-4
UNDERGROUND MINING ALTERNATIVE	BB8-4
BLACK BUTTE RECLAMATION ALTERNATIVE	BB8-4
RECLAMATION METHODOLOGY ALTERNATIVE	BB8-6
DEFER ACTION ALTERNATIVE	BB8-6
PREVENT (FURTHER) DEVELOPMENT ON THE LEASE ALTERNATIVE	BB8-6
RESTRICT DEVELOPMENT ON THE LEASE ALTERNATIVE	BB8-7
ALLOW DEVELOPMENT OF SELECTED AREAS NOW UNDER LEASE ALTERNATIVE	BB8-7
Chapter 9	
CONSULTATION AND COORDINATION	BB9-1
BLACK BUTTE SITE SPECIFIC APPENDIX	
SOIL ASSOCIATION MAPPING UNIT DESCRIPTIONS	BBA-1

CHAPTER 1

DESCRIPTION OF THE PROPOSAL

HISTORY AND BACKGROUND

Rosebud Coal Sales, Inc., a wholly owned subsidiary of Peter Kiewit Sons' Co., held federal prospecting permits W-6266, W-6267, W-6352, W-6353, and W-15392 which were converted into coal lease W-6266, issued on 1 April 1976. The Bureau of Land Management (BLM) completed revision of Environmental Analysis Record Number 49-040-4-11 on 5 March 1976, prior to the conversion of the prospecting permits to the coal lease. Lands under coal lease number W-6266, 14,902.11 acres, are located about 25 miles east of Rock Springs, Wyoming (Map 1, Appendix A). The total acreage of the leases is 14,902.11 acres and includes acreage outside the project area.

This lease was assigned to Black Butte Coal Company on 1 September 1976. Black Butte Coal Company is a joint venture of Wytana, Inc., a subsidiary of Peter Kiewit Sons' Co., and Bitter Creek Coal Company, a subsidiary of Rocky Mountain Energy Company.

The lease with the BLM is a continuing lease, subject to reasonable readjustment of terms on a 20-year basis. It provides for a royalty of 10% of the gross value of the coal produced, but not less than 50 cents per ton (2,000 pounds surface mined) for coal mined during the first 10 lease years and not less than 60 cents per ton for the second 10 lease years. The annual advance rental is set at 3 dollars per acre. The lease is subject to all current legislation affecting coal leases.

In June 1976, Black Butte Coal Company filed a mining and reclamation plan for a proposed surface (strip/open-pit) coal mine with the District Mining Supervisor, U.S. Geological Survey (USGS), Rock Springs, Wyoming. A revision of the mining and reclamation plan (Black Butte Coal Company 1977) was filed on 4 February 1977. Both plans are in conformance with 30 Code of Federal Regulations (CFR) 211 (May 1976). The plans include baseline data and a description of a mining plan contemplated for application on a portion (11,650 acres) of Black Butte Coal Company's coal lease W-6266. The revised mining and reclamation plan describes the company's initial 5-year operational plan for the expected mine life of 26 years on public, state, and private lands. The mining plan and supporting data submitted by the Black Butte Coal Company can be reviewed by the public at the Office of the District Mining Supervisor, USGS, Conservation Division, Rock Springs, Wyoming. The USGS accepted the Black Butte mining and reclamation plan as suitable for use in preparing an environmental statement (ES).

SURFACE MINING CONTROL AND RECLAMATION ACT

The mining and reclamation plan for this proposed project was submitted for review prior to passage of the Surface Mining Control and Reclamation Act (SMCRA) of 1977 (P.L. 95-87). Therefore, the plan may not fully reflect the requirements of the current law and regulations. However, it is believed that it presents sufficient data to permit analysis of the impacts that will be associated with mining in this area. Prior to departmental approval, the plan will be returned to the applicant for modification to incorporate the requirements of SMCRA. When the mining and reclamation plan is returned to the Department, it will be reevaluated to insure that it meets the requirements of SMCRA and appropriate federal regulations, and that the potential impacts are covered by this ES. This procedure will facilitate the timely and efficient consideration of applications for permits under the evolving requirements of SMCRA. We believe this procedure is reasonable in view of the evolving character of the law.

The regional ES, Chapter 3, Planning and Environmental Controls, includes reference to appropriate provisions of SMCRA, and these were incorporated into the following impact analysis to the extent possible at this time. However, it is realized that some of the adverse impacts described will be precluded by implementation and enforcement of the new law. This is especially true in regard to impacts on the water, soil, and vegetation resources. In any event, the worst possible case is covered.

PROPOSED ACTION

The action before the federal government is to consider for approval the mining and reclamation plan presented by the Black Butte Coal Company and to issue the necessary rights-of-way so that coal mining operations can begin.

Purpose and Objective

The purpose of this proposed action is to allow mining of 6.3 million tons of coal per year to meet part of the national energy requirements between 1979 and 2004, the projected end of mine life.

The objective of the proposed mining on this lease is to supply, for electrical power generation, 3.3 million tons of coal per year to an existing power plant of Commonwealth Edison Company of Chicago and 3 million tons per year to a power plant proposed for construction by Idaho Power and Light Company.

Location

The Black Butte Mine would be located south of Interstate 80 near Point of Rocks, Wyoming. The northwest corner of the property is approximately 25 miles (by highway) east of Rock Springs, Wyoming. The project area contains 36,600 acres (Table BB1-1).

The location of the Black Butte project area is shown on Figure BB1-1 and Map BB1-1.

Predisturbance Inventories and Analyses

Specific inventories were conducted under the direction and (or) cooperation of the Black Butte Coal Company in consultation with the BLM concerning endangered and (or) threatened plants and animals, raptor nesting sites, archeological sites, historical sites, and paleontological localities.

Robert Dorn, BLM plant specialist, conducted an inventory of the proposed Black Butte project area for proposed endangered and (or) threatened plant species. His inventory did not reveal the presence of any plants listed on the 1977 list of proposed endangered and (or) threatened species.

A specific study was conducted by Black Butte Mine personnel to determine the existence or absence of the black-footed ferret. The results of this study did not reveal the presence or suspected presence of this animal. In June of 1978 an intensive black-footed ferret survey was undertaken by the U.S. Fish and Wildlife Service, Denver Research Center, in the area of the proposed Black Butte Mine. The results of this survey are anticipated by October 1978. The mining plan will not be approved until this study is completed. If it is determined black-footed ferret or other endangered and (or) threatened species exist on the mine area, the mine plan will be modified to protect the species and critical habitat.

The Wyoming State Game and Fish Commission conducted an inventory of raptor nesting sites on and adjacent to the proposed project area (see Chapter 2, Fish and Wildlife).

An intensive archeological survey was conducted during 1974 and 1975 by Michael Metcalf, Consulting Archeologist, Research Associate, Western Wyoming College (see Chapter 2, Cultural Resources).

Black Butte Coal Company has agreed to (1) restrict off-road vehicular usage both on private and public lands within mine permit boundaries, (2) prohibit collection of artifacts by employees, and (3) notify proper authorities should any cultural artifacts be discovered in the course of mining operations and to cease operations in or about the site pending examination.

In August of 1975, Black Butte Coal Company retained Fay Metcalf of Boulder, Colorado, to conduct an historical survey of the proposed project area. Research was done in order to ascertain the potential significance of physical remains of historical sites found during the archeological survey. In response to this survey, the Black Butte Coal Company would fence and post signs at Black Buttes stage station, Black Buttes cemetery, and structures at Black Buttes Coal Mine 01 when and if Black Butte Coal Company acquires this privately-owned land.

In 1977, Jason A. Lillegraven, Curator, The Geological Museum, University of Wyoming, conducted a field reconnaissance of exposed rock within the proposed mine boundaries. Explorations for fossil vertebrate localities were designed to assess: (1) the scientific potential of the fossil-bearing rocks of the local area and (2) the likely impact upon the science of paleontology of the proposed mining operations.

Analyses have been made and additional analyses are planned prior to mining to determine physical and chemical properties of topsoil and overburden, their suitability for plant growth, and possible problems with materials toxic to plants and (or) animals.

The analyses performed thus far indicate adequate surface soil quantities and qualities for topsoil use. Some overburden strata were found to have one or a combination of the following: (1) high sodium absorption ratio values, (2) high soluble salt levels, (3) potentially acid materials, (4) high boron levels, (5) high nickel levels, and (6) possibly high lead levels.

Mine

The company proposes to open the Black Butte Mine using conventional stripping and mining equipment. Construction at the mine would start in early 1978 with approximately 150 employees. Maximum production would require 320 employees by the third year of operation in 1981. Total production is estimated at 146 million tons of coal during the 26-year life of the mine. Production is presently scheduled to begin in 1979 at a rate of 3.3 million tons per year. Thereafter, production is scheduled for 6 to 7 million tons per year until 1999, and then 3.3 million tons per year for the remainder of the life of the mine. Coal quality of the Black Butte project area is listed in Table BB1-2.

Facilities

Mine facilities would consist of an office, shop, and warehouse complex and a railroad loop with unit train loading capabilities. The Union Pacific Railroad (UPRR) crosses the project area diagonally from northwest to southeast.

The office, shop, and plant complex would be located in Section 33, T. 19 N., R. 100 W., which is private land (103 acres), and in Section 4, T. 18 N., R. 100 W., which is public land (152 acres) (Figure BB1-2).

Truck Dump and Primary Crushing Station

Table BB1-1

LAND SURFACE AND COAL OWNERSHIP OF THE PROPOSED BLACK BUTTE PROJECT AREA

	Surface Acres	Coal Acres
Public	12,930	11,650
State of Wyoming	160	1,440
Private	23,510	23,510
Total	36,600	36,600

Note: Derived from BLM Master Title Plats.

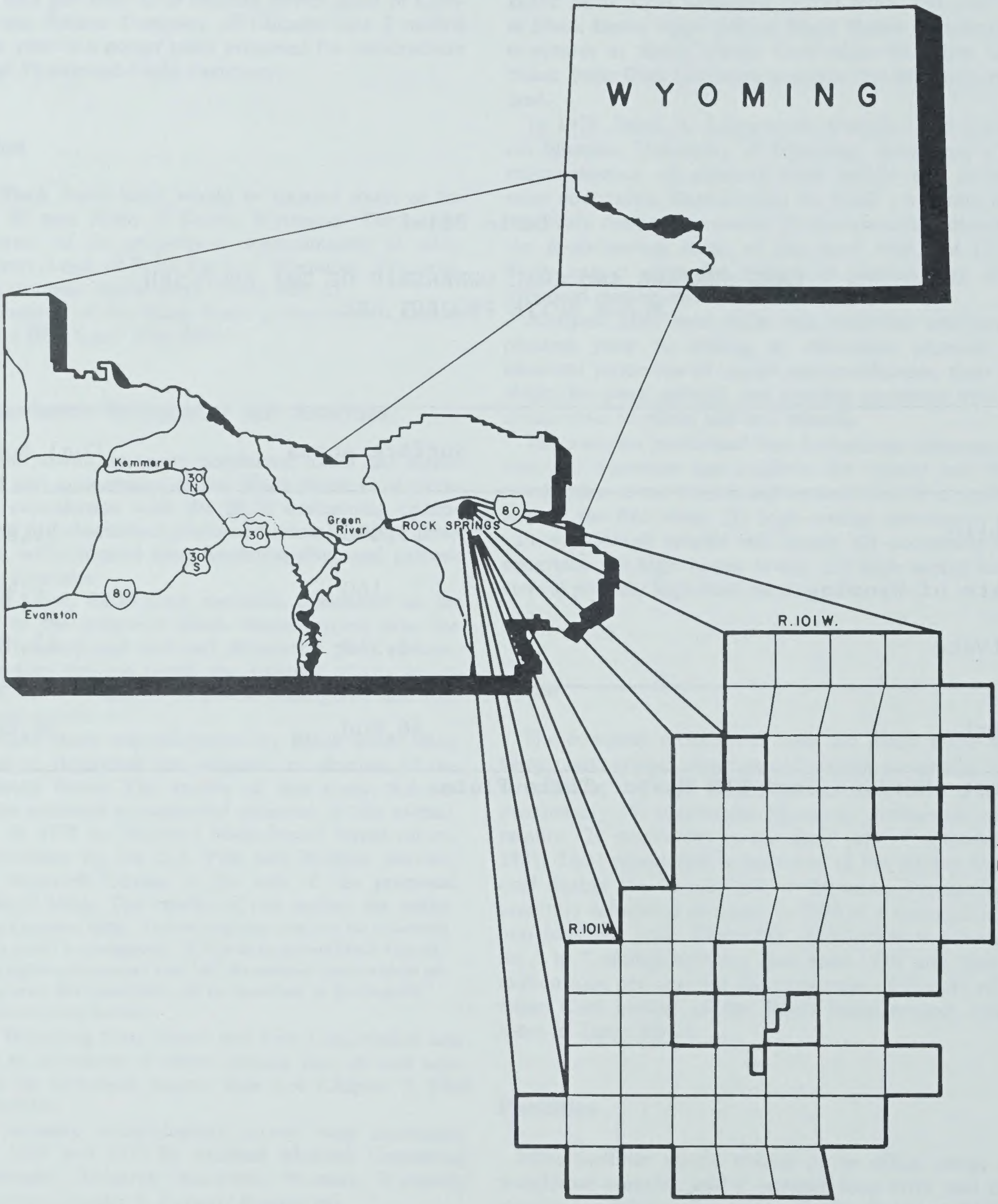


FIGURE BB 1-1
GENERAL LOCATION OF
PROPOSED BLACK BUTTE PROJECT AREA

Table BB1-2

COAL QUALITY OF THE PROPOSED BLACK BUTTE MINE

	Wasatch	Ft. Union	Lance	Almond	Weighted Average
BTU	9,594	9,603	9,745	10,020	9,674
% Sulphur	1.03	0.41	0.63	0.54	0.52
% Ash	8.53	7.78	5.86	7.57	7.25
% Moisture	18.92	19.25	20.70	17.72	19.37
Fluid ash fusion temp. ^{o}F	2,230	2,226	2,091	2,375	2,216

Source: Derived from the Black Butte mining and reclamation plan (Black Butte Coal Company 1977).

Note: On an as received by the market basis.

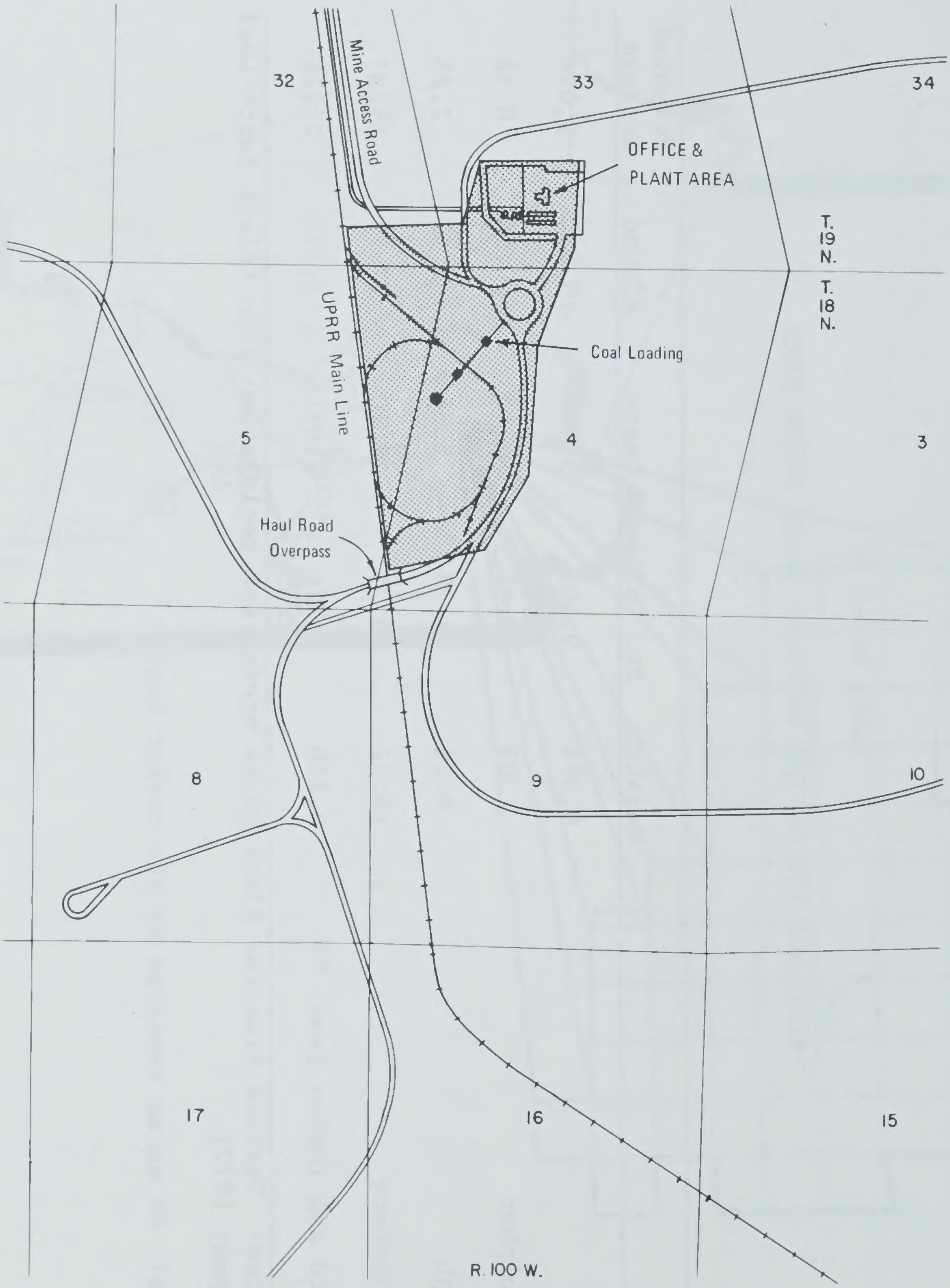


Figure BB1 - 2

BLACK BUTTE OFFICE, SHOP, AND PLANT LAYOUT

The coal would be hauled to the centrally located truck dump by bottom-dump type trucks. The station would be large enough to accommodate two trucks dumping side by side and would have at least a total surge capacity equal to approximately $3\frac{1}{2}$ haul trucks. Coal would be carried out of the hopper by reciprocating feeders, fed into the primary crusher, and then fed onto a conveyor system. Tramp metal separation would be provided to protect equipment.

Secondary Crushing Station

Coal from the truck dump and primary crusher would be further reduced by a pair of secondary crushers. These crushers would reduce the coal to the size required by the customer. The coal would then be transported by conveyor to the coal storage facility.

Coal Storage

Properly-sized coal coming out of the screening and crushing station would be transported via covered conveyors to storage silos large enough to adequately handle a minimum of four times the volume discharged to a unit train serving the facility. Silo storage was selected as opposed to open-pit storage to minimize fugitive coal dust and for improved ability to grade and mix coals of varying quality.

Train Loadout

The train loadout station would have a twofold purpose. First, it would be the location where coal being shipped would be sampled to determine the ultimate quality of the product going to the customer. Second, it would be the location where control would be maintained to avoid overloading of railcars.

Conveyor System

All coal movement from the truck dump to the railcars would be by covered belt conveyors. All surface conveyors would be 60 inches wide. Detergent solutions would be used at transfer points to control dust.

Haul Roads and Other Facilities

Haul roads would be designed for the continuous use of the 120-ton coal haulers and would be surfaced with scoria or clinker material. This material would be obtained from private lands within the project area. Should private sources be depleted, materials from public lands would be used in accordance with existing BLM procedures for salable materials. Reclamation of these disturbed areas would be concurrent with adjacent mining operations.

Haul roads would be constructed 80 feet wide for equipment other than draglines and 100 feet wide to accommodate dragline movements. The haul-road network would be designed to serve as broad an area as possible with a minimum of surface disturbance. Haul roads would be constructed within existing corridors where possible or along new corridors in conjunction with the power transmission network. The haul roads would be designed in conformance with 30 CFR 715.17(1).

Support Facilities

The proposed action also includes federal approval of rights-of-way for the support facilities summarized in Table BB1-3.

Roads

A gravel access road to the mine area would be constructed from an interchange to be constructed on Interstate 80 in Sections 3 and 4, T. 19 N., R. 100 W., and would extend south approximately 3 miles to the facilities complex. This road would cross public lands in Sections 16 and 20, T. 19 N., R. 100 W. Permanent roads constructed on public lands would be designed to BLM or higher standards. The company has made application to the BLM for rights-of-way across these lands. The plans for the interchange have been designed and approved by the Wyoming Highway Department.

A major haul road would be constructed paralleling the access road to serve the northern parts of the mining area. After completion of the access road, public use of the road would be regulated to facilitate operations and to protect the public from hazards associated with the mining activities. Measures to be taken would include warning signs and fencing.

Railroad Spur

The proposed railroad spur would be located on public lands in Section 4, and on private lands in Section 5, T. 18 N., R. 100 W. It would be a loop approximately 2,200 feet in diameter and contain about 9,000 feet of track. The rail spur would be directly connected with the main line of the UPRR.

Power Lines

Two power lines would be constructed to serve major equipment in the various mining areas. Power to the mine would come from an existing transformer in Section 14, T. 19 N., R. 101 W., and would be transmitted to the office-plant complex via a 34.5-kv power line within the existing corridor of the main line of the UPRR. From this central point, distribution loops and spurs would be constructed as necessary to serve the active mine areas. The extension of the electrical transmission system to any given area would be undertaken approximately 1 year prior to initial disturbances in the area. All mine-related power lines would be constructed in accordance with standards established in the U.S. De-

Table BB1-3

PROPOSED SUPPORT FACILITIES FOR THE BLACK BUTTE MINE

Applicant	Facility	Application Number	Total Length	Width (Feet)	Acres Required Public	Acres Required Private	Location of Public Land Affected
Pacific Power & Light	Electric power line	W-52509	5.6 Miles	25	12	5	Sections 30 and 32, T. 19 N., R. 100 W., Sections 14 and 24, T. 19 N., R. 101 W.
Mountain Bell Telephone Company	Telephone line	W-53961	6.1 Miles (4.3 miles public land)	16	7	5	Sections 16, 20, and 32, T. 19 N., R. 100 W.
Union Pacific Railroad Company	Railroad spur	W-49684	4.5 Miles (2.2 miles public land)	200	45	50	Section 4, T. 18 N., R. 100 W., and Section 32, T. 19 N., R. 100 W.
Black Butte Coal Co.	Water truck filling station	W-55778	890 Feet	450	9	0	Section 8, T. 18 N., R. 100 W.
Black Butte Coal Co.	Access roads	W-55777	3 Miles (2 miles public land)	100	36	18	Section 8, T. 18 N., R. 100 W., and Section 20, T. 19 N., R. 100 W.
Black Butte Coal Co.	Electric power line	W-55776	1.7 Miles	50	10	0	Section 14, T. 18 N., R. 100 W., and Sections 24 and 26, T. 19 N., R. 100 W.
None Yet	Relocate existing power lines (2)	None yet	10 Miles	100	168	72	
None Yet	Relocate existing pipelines (3)	None yet	17,000 Feet	50	37	21	

Note: Derived from BLM right-of-way applications, case files, and ES Team projections.

partment of Agriculture's bulletin, *REA Bulletin 61-10*, to reduce accidental electrocutions of raptors.

Telephone Line

A telephone line would be buried next to the access road to provide service to the mining area.

Water Truck Filling Station

An area of approximately 9 acres would be used to construct a 500,000 gallon storage reservoir and necessary access. The location is in Section 8, T. 18 N., R. 100 W. The water source is an uncapped free-flowing well.

Proposed Mine Layout and Mining Sequence

Coal would be mined from the areas identified by capital letter designations on Map BB1-2: A, B, D, E, F, G, H, I, J, L, M, and N.

Areas A, B, D, E, H, I, and J are proposed dragline operation areas. Areas F, G, and M are proposed truck-shovel operations. The others would be mined by either truck-shovel, dragline, or scraper (only where impossible to mine by truck-shovel or dragline techniques).

Tables BB1-4 and BB1-5 detail activities for years 1 through 25. Coal production would begin at an annual rate of 3.3 million tons per year and escalate to a planned average rate of 6.3 million tons. Table BB1-5 and the mining plan description in this chapter detail the mining sequence.

Mining Procedures

The Black Butte Coal Company has chosen a dragline, truck-shovel, and scraper operation as the best method for maximum recovery of the coal from the dipping, multiple coal seams that occur in the three geologic formations to be mined in the Black Butte project area.

Topsoil Removal and Disposition

The first activity in any given mine area would be the removal of topsoil from roadway locations, spoil storage areas, and the initial portions of the mine area itself. Topsoil would be removed by rubber-tired scrapers and initially would be stockpiled outside the mine area. At some point, as mining and reclamation progress through an area, topsoil would begin to be taken up ahead of mining and placed directly on regraded surface behind the mining in a continuous operation.

Any topsoil piles expected to be in place for greater than 1 year would be stabilized by seeding and would be tested periodically to ensure continuing viability as a plant growth medium. Topsoil handling would be done in conformance with 30 CFR 715.16.

Watercourse Diversions

In the D-north area, a ditch 4,050 feet long and 36 feet wide would be constructed to divert runoff to the west of the mining activities. In the D-south area, a flat-bottomed ditch 2,300 feet long and 42 feet wide would be constructed to direct runoff around the eastern and southern boundaries of the mining area. This ditch would discharge into the Bitter Creek drainage system.

In H-south, two ditches would be constructed, one 4,100 feet long and 28 feet wide and the other 5,450 feet long and 9 feet wide. The northernmost ditch would carry water around the operation to the north, while the remaining ditch would collect runoff from the eastern side of the mining area and carry it to the south, discharging into the Bitter Creek drainage. A retention pond not yet designed would be constructed at the point of discharge if the sediment content of the water flowing through the ditch dictated it.

In area J-north, one small drainage area would be filled and thus eliminated by mining activities. Drainage areas JN-2 and JN-3 would be rerouted across the mined-out areas once mining advanced to a point where this would be feasible. A retention pond of 3.04 acre-feet capacity covering 0.32 acres would be constructed.

A proposed settling pond location has been selected in area F to control drainage from the dump areas on the northern end of the project area. This pond would have a holding capacity of 3.61 acre-feet and would occupy 0.4 acres of land. Surface water diversions would meet standards set in 30 CFR 715.17(a). A surface watering plan designed to standards in 30 CFR 715.16(b) would be submitted to the regulatory authority for approval.

Overburden Removal and Disposition

Throughout the life of the mine a total of 951 million cubic yards of overburden would be moved. The coal company would use two techniques for overburden excavation. A dragline would be used where geologic structure and topography permit. Truck and shovel would be utilized where geologic structure is more complicated, multiseam coal occurs, and topography is rugged. A third, less economical method is excavation by scraper. This method would be used only where it is impossible to use the above techniques.

Due to the requirement for coal blending from the three formations to be mined, two 70-cubic yard draglines and one 20-yard shovel would be placed in operation. A second shovel would also be utilized, the exact size of which is not yet determined. However, for purposes of the Black Butte mining and reclamation plan, scheduling and engineering has been based on a 20-cubic yard machine, since it approximates the expected size range.

The overburden and coal would be drilled and blasted where necessary in accordance with 30 CFR 715.19 regulations concerning the use of explosives. The necessary explosive used would be a mixture of prilled amonium nitrate and fuel oil (ANFO).

Table BB1-4

CONTRACTED PRODUCTION COMMITMENTS
(x 1 MILLION TONS)

	Commonwealth Edison[1]		Idaho Power and Light Company[2]		Total[3] Scheduled
Year	Contract	Sched. Prod.	Contract	Sched. Prod.	Production
1979	3.0	3.3	0.0	0.0	3.3
1980	3.0	3.3	1.9125	2.1038	5.4
1981	3.0	3.3	3.555	3.9105	7.2
1982	3.0	3.3	3.3	3.6300	6.9
1983	3.0	3.3	3.3	3.6300	6.9
1984	3.0	3.3	3.3	3.3661	6.7
1985	3.0	3.3	3.3	3.3	6.6
1986	3.0	3.3	3.3	3.3	6.6
1987	3.0	3.3	3.3	3.3	6.6
1988	3.0	3.3	3.3	3.3	6.6
1989	3.0	3.0	3.3	3.3	6.3
1990	3.0	3.0	3.3	3.3	6.3
1991	3.0	3.0	3.3	3.3	6.3
1992	3.0	3.0	3.3	3.3	6.3
1993	3.0	3.0	3.3	3.3	6.3
1994	3.0	3.0	3.3	3.3	6.3
1995	3.0	3.0	3.3	3.3	6.3
1996	3.0	3.0	3.3	3.3	6.3
1997	3.0	3.0	3.3	3.3	6.3
1998	3.0	3.0	3.3	3.3	6.3
1999			3.3	3.3	3.3
2000			3.3	3.3	3.3
2001			3.3	3.3	3.3
2002			3.3	3.3	3.3
2003			3.3	3.3	3.3
2004			3.3	3.3	3.3
Total	60.0	63.0	81.3675	82.64040	145.6

Source: Black Butte Coal Company 1977.

[1]Commonwealth Edison may vary contract tonnages by 10% in any year, but maximum contract tonnage cannot exceed 63 million tons.
[2]Idaho Power and Light Company may vary contract tonnages by 10% in any year, but maximum contract tonnage cannot exceed 82,640,410 tons.
[3]Totals are rounded for convenience.

Table BB1-5

DISTURBANCE, MINING, AND RECLAMATION SCHEDULE OF THE PROPOSED BLACK BUTTE MINE

Year(s)	Location	Acres Disturbed	Acres Seeded	Acres Dist. Unseeded	Accum. Acres Distrubed	Accum. Acres Seeded	Coal Produced (x 1MM Tons)	Total Coal Produced (x 1MM Tons)	Overburden Moved (Cu. Yds.)	Total Overburden Moved (Cu. Yds.)
1978-	Off/Shop	535	---	535	535	---	---	---	---	---
1979	D-North	46	---	46	46	---	---	---	.90	.90
Total[1]		581	---	581	581	---				
1980-	D-South	437	337	100	437	337	5.90	5.90	54.40	55.30
1984	J-North	266	199	67	266	199	4.30	10.20	38.10	93.40
	H-South	386	185	201	386	185	6.80	17.00	72.80	166.20
	D-North	118	93	71	164	93	3.30	20.80	11.60	177.80
	F	959	408	551	959	408	8.90	29.70	73.30	251.10
Total[1]		2,166	1,222	1,525	2,747	1,222				
1985-	J-North	575	586	56	841	785	4.70	34.40	100.00	351.10
1989	H-South	182	292	91	568	477	1.30	35.70	17.00	368.10
	H-North	1,879	1,879	---	1,879	1,879	9.50	45.20	27.00	395.10
	B	185	156	29	185	156	4.20	49.40	56.00	451.10
	F	596	931	261	1,555	1,339	7.70	57.10	57.50	508.60
	M	636	282	354	636	282	5.70	62.80	42.50	551.10
Total		4,053	3,966	1,612	6,800	5,188				
1990-	J-North	632	688	---	1,473	1,473	0.50	63.30	3.00	554.10
1994	I	931	904	27	931	904	8.10	71.40	47.00	601.10
	B	328	357	---	513	513	5.80	77.20	17.50	618.60
	A	435	435	---	435	435	8.30	85.50	25.00	643.60
	L	327	284	43	327	284	2.50	88.00	7.50	651.10
	G	141	141	---	141	141	1.20	89.20	19.50	670.60
	M	354	571	137	990	853	5.10	94.30	80.50	751.10
Total		3,148	3,252	1,508	9,948	8,440				
1995-	I	933	960	---	1,864	1,864	9.50	103.80	25.20	776.30
1999	J-South	245	182	63	245	182	9.30	113.10	24.80	801.10
	L	307	350	---	634	634	2.00	115.10	14.80	815.90
	D-North	137	186	22	301	279	4.80	119.90	35.20	851.10
	M	191	328	---	1,181	1,181	5.90	125.80	100.00	951.10
Total		1,813	1,935	1,386	11,761	10,375				

Table BB1-5

DISTURBANCE, MINING, AND RECLAMATION SCHEDULE OF THE PROPOSED BLACK BUTTE MINE
(Continued)

Year(s)	Location	Acres Disturbed	Acres Seeded	Acres Dist. Unseeded	Accum. Acres Distrubed	Accum. Acres Seeded	Coal Produced (x 1MM Tons)	Total Coal Produced (x 1MM Tons)	Overburden Moved (Cu. Yds.)	Total Overburden Moved (Cu. Yds.)
2000-2004	J-South	289	293	59	534	475	7.20	133.00	100.00	1,051.10
	N	680	680	---	680	680	4.40	137.40	47.50	1,098.60
	E	693	644	49	693	644	4.90	142.30	52.50	1,151.10
Total		1,662	1,639	1,409	13,423	12,014				
2005-	J-South	156	198	17	690	673	2.80	145.10	100.00	1,251.00
	E	263	299	13	956	943	0.50	145.60	100.00	1,351.10
Total		419	454	1,374	13,842	12,468				
2006-2007	Final Reclamation	---	1,374	---	13,842	13,842[2]	---	---	---	---

Source: Black Butte Coal Company 1977.

[1]In the first 5 years of mining activities 2,747 acres (2,166 + 581) would be disturbed in the office-shop complex, D-North area, D-South area, J-North area, H-South area, and F area.

[2]Acreage figure does not include 294 acres which would be disturbed by power line and pipeline relocation in 1988 and 1989, respectively.

The typical dragline operation would be preceded by the leveling of blasted overburden to facilitate the machine movement. The first cut to be made (box cut) would consist of the excavation of the overburden down to the surface of coal and spoiling to the side along the highwall. Each highwall would be cut to an approximate ½:1 slope to a bench at a depth dependent on the overall depth of the overburden. This bench would be approximately 10 feet in width and would be to minimize the hazards of highwall sloughing. From this bench to the surface of the coal, the ½:1 slope would continue. As the overburden spoil is placed, dozers would immediately commence grading in preparation for reclamation. Final grading, however, could not be achieved until several cuts had been completed. Upon completion of the box cut, the dragline would move to a "turnover cut" This cut would proceed parallel to the box cut, and the spoil excavated would be placed in the portion of the box cut from which coal has been removed. Each cut would be approximately parallel to the strike and, as completed, the dragline would move over down dip to commence the next parallel cut. During excavation of the box cut, the dragline would also cut ramps for use in haulage. These ramps would be placed about 3,000 feet apart and would leave the excavation roughly perpendicular to the strike.

To the extent that the extended nature of the pit area permits, the dragline operation would be maintained continuously in one formation. However, due to short pits and the need for coal blending, there would be instances when the dragline would complete a cut in one area and would move to another area. While overburden excavation proceeds in the second area, coal mining operations would remove the coal from the initial area. Upon completion of excavation in the second area, the dragline would then be moved back to the first area, and coal mining would begin in the area just vacated. This procedure would facilitate scheduling and the blending of coal.

A truck-shovel operation, however, is quite different. After the blasting of overburden in a shovel area, excavation would commence moving along strike for the full width of the pit area. Initially, a ramp would be dug to facilitate haulage of the overburden to an area approximately 1,500 feet behind the excavation. The shovel would dig in benches approximately 30 feet high. Each bench would be excavated to the extent necessary to allow secondary benches, or more benches as needed. This procedure would permit relatively level haul and coal mining to occur concurrently with overburden removal. As the pit excavation proceeds down strike and coal removal follows, the overburden would be placed in an area immediately following the coal removal, thus allowing almost immediate grading and reclamation.

As with the dragline operation, the truck-shovel operation must also meet coal blending requirements. This means that throughout the life of the mine, it would be necessary to vacate one pit area and initiate operations in another. This, too, would be of a cyclical nature. In no event would any pit area be left dormant for a period exceeding 5 years.

All spoil would be graded as soon as possible following excavation and would be brought to slopes not exceeding 3½:1. While top grading in dragline spoil would occur immediately following placement, full slope reduction would be delayed until the completion of the third cut to allow the filling of low areas between permanent spoil piles to develop a flatter topography. Grading would be accomplished through the use of rubber-tired scrapers and dozers.

The construction of spoil slopes for truck-shovel operation would be accomplished primarily through the use of the trucks. Final grading would be accomplished through the use of motor graders and dozers.

Although twelve pits exist in the Black Butte Coal Company's mining plan, only four areas would require mining at the edge of the outcrop, E, F-G, L, and M. All other areas would also include outcrops, but in each instance mining would occur across the outcrop which is shallow and is, at worst, gently rolling terrain.

Of the four areas to be mined at the outcrop, F-G and M would be excavated by trucks and shovels and E and L by dragline. Spoil would be cast beyond the edge of the outcrop. As reclamation proceeds, a slope from the toe of the farthest spoil to the crest of the regraded surface would be established at 3½:1 or flatter.

In areas F-G and M no spoil would be placed beyond the edge of the outcrop. As mining operations occur, the sandstone outcrop would be sheared down to the bottom of the coal, leaving a flat surface. Upon reclamation, the mined out area would be refilled with overburden. Slopes at 3½:1 or flatter, depending on terrain, would be established for final reclamation.

Coal Removal

Once the overburden has been removed and the coal seams (5 feet to 25 feet in thickness) exposed in an area, the coal would be drilled and blasted where necessary using ANFO (in accordance with 30 CFR 715.19). A cast type primer would be placed near the bottom of the drilled holes and attached to a primer cord. The hole would then be filled to the desired height with ANFO which would then be detonated.

The broken coal would be loaded by a front-end loader into 120-ton bottom dump trucks and hauled to the processing plant for crushing, storage, and loading into unit trains.

In late 1978, initial overburden stripping activities would begin in the D-north truck-shovel area, uncovering 500,000 tons of coal.

In 1979 (year 1), stripping would continue in the D-north truck-shovel area, with coal production scheduled at 1.8 million tons for the year. Also in 1979, the first of two 70-cubic yard draglines would begin work in the D-south area. This dragline is scheduled to complete three cuts in 1979, producing 1.5 million tons of coal. Total coal production in 1979 would be 3.3 million tons (see Table BB1-4).

In 1980 (year 2), the truck-shovel operation would continue in the D-north area, producing 0.65 million tons of coal. From the D-south dragline area, 2.1 million tons of coal would be produced. Also, in 1980 the second dragline would begin work in the H-south area, producing 1.3 million tons of coal in that year, and the second truck-shovel operation would begin in area F producing 1.35 million tons of coal. Total 1980 coal production would be 5.4 million tons.

In 1981 (year 3), mining activities would continue in the same areas as in 1980, with D-south production at 2.66 million tons, D-north at 1.26 million tons, H-south at 1.78 million tons, and F at 1.5 million tons. Thus, total production for 1981 would be 7.2 million tons.

In 1982 (year 4), mining could conclude in the D-north truck-shovel area early in the year and continue in area F. Approximately 2 million tons of coal would be produced by the truck-shovel operations in 1982. Dragline number 1 would complete mining in D-south and move to the N-north area, completing six cuts in that area and producing a total of 3.28 million tons of coal in 1982. Dragline number 2 would continue stripping in H-south producing 1.62 million tons. Total production for 1982 would be 6.9 million tons.

In 1983 (year 5), the final year of the 5-year plan, all three stripping activities would continue in their respective locations with a total coal production of 6.9 million tons.

Coal production for years 6 through 26 would follow the overburden removal schedule (see Table BB1-5).

Two electrical transmission lines (230 and 34.5 kv) and three parallel natural gas lines would need to be relocated in order for mining to be conducted in pits B and M and A in 1987 and 1989, respectively.

Reclamation

The Black Butte Coal Company pursuant to Section 515 of SMCRA and 30 CFR 715.13, would be required to restore disturbed lands to conditions capable of supporting premining uses or higher or better uses. A mining permit would not be approved unless the applicant has demonstrated that reclamation to the proposed mining land use can be accomplished under the reclamation plan contained in the permit application (Section 510, SMCRA).

Present and Future Land Use

The land within and adjacent to the proposed Black Butte project area is used primarily for livestock grazing, wildlife habitat, and outdoor recreation.

The objective of the Black Butte Coal Company's reclamation plan is to reclaim land disturbed by mining to a use equivalent to or better than the highest previous use. Future use of the site is expected to involve wildlife use, livestock grazing, and outdoor recreation at a level the land was capable of supporting before any mining occurred. The post mining land use designated in the BLM's Salt Wells and Pilot Butte Management Framework Plans (U.S. Department of the Interior, BLM 1977c and 1977d) is for wildlife habitat, livestock grazing, and outdoor recreation.

Reclamation Schedule

Following mining, spoil ridges would be recontoured using one or two bulldozers, leaving the surfaces in a roughened condition to prevent slippage of the topsoil after it is replaced. All slopes would be reduced to a $3\frac{1}{2}$:1 or less grade.

After recontouring, rubber-tired scrapers would place topsoil onto the regraded surface. A minimum of 10 inches of topsoil would be laid on and disced to prepare a seedbed. This topsoil would be obtained either from a topsoil stockpile or directly from the land surface as part of a continuous topsoil removal and replacement operation.

Backfilling of pits would begin as soon as possible without interfering with the efficient and safe operation of the mining sequence. Once started, backfilling would be an ongoing process with final grading of backfilled pits and permanent dumps starting as soon as the approximate final grade is reached.

Any materials toxic to plant growth would be buried at sufficient depth (minimum of 4 feet) to prevent topsoil contamination.

Topsoil placement and seedbed preparation would be conducted shortly before each area is to be seeded. Topsoil handling and seedbed preparation would be done in conformance with 30 CFR 715.16 and 715.20. In this way, most mined out areas would be ready for seeding about 3 years after initial disturbance and approximately 2 years after mining.

Out-of-pit overburden disposal sites would be reclaimed during the later stages of mining since portions of the disposal areas would be in use until almost the end of mine operations. The configuration of disposal dumps would be designed to facilitate subsequent reclamation, and it would be possible to start the grading and replacing of topsoil on portions of the disposal sites while other parts are still in use. In any event, disposal sites would be designed to meet standards set in 30 CFR 715.15 and would be graded, topsoiled, and ready for seeding within 1 year after their final use.

Table BB1-6 provides an estimated schedule for reclamation activities.

Backfilling and Overburden Dumps

Reclamation would begin in the D area approximately 2 years following initial stripping. When adequate pit space behind the stripping activities is generated by the coal loading operation, the overburden trucks would begin backfilling the mined-out pit. Simultaneously, the reclamation crews would begin backfilling the mined-out pit and begin grading and reclaiming the dump area. After the dump area has been reclaimed, the reclamation crews would begin grading the backfilled portions of the mined-out pit, and reclamation would, thereafter, continue concurrently with mining.

Backfilling and reclamation for the H-south area would be conducted contemporaneously with mining and at the end of the initial 5 years of operation are scheduled to have reached the tenth cut.

Table BB1-6

RECLAMATION SCHEDULE OF THE PROPOSED BLACK BUTTE PROJECT AREA

Year	Acres Disturbed	Accum. Acres Disturbed	Acres Seeded	Accum. Acres Seeded
1978	535	535	0	0
1979	46	581	0	0
1980	396	977	73	73
1981	422	1,399	268	341
1982	461	1,860	293	634
1983	523	2,383	355	989
1984	364	2,747	233	1,222
1985	722	3,469	666	1,888
1986	1,056	4,525	736	2,624
1987	728	5,253	1,106	3,730
1988	813	6,066	738	4,468
1989	734	6,800	720	5,188
1990	601	7,401	641	5,829
1991	783	8,184	794	6,623
1992	821	9,005	959	7,582
1993	466	9,471	393	7,975
1994	477	9,948	465	8,440
1995	401	10,349	418	8,858
1996	223	10,572	213	9,071
1997	316	10,888	357	9,428
1998	581	11,469	419	9,847
1999	292	11,761	528	10,375
2000	244	12,005	234	10,609
2001	287	12,292	260	10,869
2002	468	12,760	385	11,254
2003	301	13,061	386	11,640
2004	362	13,423	374	12,014
2005	419	13,842	454	12,468
2006	0	13,842[1]	1,374	13,842

Source: Black Butte Coal Company 1977.

Note: Includes private and public land.

[1]Acreage figure does not include 294 acres which would be disturbed by power line and pipeline relocation in 1988 and 1989, respectively, and 109 acres approved by BLM for post mining livestock/wildlife ponds.

Backfilling and grading would have reached cut eight by the end of the initial 5 years with area J-north having been in operation 1½ years.

As area F pit is developed, the overburden would be placed in spoil area B to the west of the outcrop. Overburden would be placed in spoil area A during further development as well as in spoil area B. When sufficient room is developed in the bottom of the pit, backfilling of the area F pit concurrent with stripping would begin. Overburden material may have to again be placed in dump areas outside of the mining area when backfilling catches up with stripping.

Backfilling and grading would be done in conformance with 30 CFR 715.14.

Topsoil Handling and Erosion Control

Topsoil would be removed and redistributed on backfilled spoils with self-elevating scrapers. Topsoil depths would range from approximately 11 inches on mine area L to approximately 32 inches on mine area D. Wherever possible, topsoil would be transported directly to areas ready for revegetation. Because of variations in pit size during the life of the mine, some topsoil storage areas would be required. Topsoil from the initial portion of each pit and from the dump area(s) would be stockpiled for use when that mining segment is complete. All stockpiles would be marked to prevent accidental mixing of topsoil and overburden materials. Topsoil stockpiles remaining more than 1 year would be seeded with an annual cover crop such as oats to minimize erosion.

Since the limited precipitation at the project site would be one of the most serious constraining factors on reclamation, efforts would be made to conserve all moisture possible. These efforts would include pitting of the seedbed surface to trap runoff and incorporation of straw mulch to provide increased infiltration and retention of available moisture. On all sloping areas, topsoil replacement and other equipment operations would be conducted on the contour to minimize erosion and provide maximum entrapment of runoff.

Fertilizer would be used if necessary. Its use would be based on soil analysis, available precipitation, and determinations from site-specific trials.

After planting, grass-hay or straw mulch would be applied at a rate of 2 tons per acre. The mulch would be crimped into the ground by a disc-type packer. Discs would be spaced approximately 8 inches apart and set to penetrate the soil 2 or 3 inches.

To minimize the impacts of topsoil erosion and sedimentation, catchment ditches leading to sediment ponds would be installed on all dump faces, toes, and other disturbed slopes. The sediment ponds would be designed to retain all surface runoff from the mined areas, including that of a 10-year flood.

Watercourse, Drainage Channels, and Impoundments

When no longer needed, the sediment ponds and diversion structures would be removed and their locations would then be topsoiled and revegetated. Each new drainage channel would be seeded with a grass mixture to minimize erosion. Eight permanent water impoundments totaling about 109 acres would be constructed in the various mining areas as shown in Table BB1-7. The main purpose of these impoundments is to allow better distribution of livestock grazing after mining.

No mine or processing waste would be used in the construction of such facilities. The purpose of the impoundments is to settle out sediment before releasing the water into natural streams.

Surface water diversion structures and sediment ponds would be constructed in conformance with 30 CFR 715.17.

Decommissioning and Abandonment

Upon completion of mining operations, all surface facilities would be removed, railroad tracks would be removed, and these and other similarly disturbed areas would be reclaimed. Compacted areas such as access roads would be loosened to a depth of 18 inches by chiseling or other appropriate means prior to revegetation. At least 10 inches of topsoil from the final stockpile would be applied to these areas and they would be seeded.

Planting and Revegetation

A permanent diverse cover of predominantly native species would be established on retopsoiled land by drill seeding with locally grown, genotypical seed, when available. All seed would be at least 90% pure. Table BB1-8 presents proposed seed mixtures.

The seeding would be accomplished in April through May or September through October. If the first seeding is not completely successful, additional measures would be taken to ensure plant establishment. Fertilization, mulching, and supplemental irrigation, if necessary, would be used to obtain a self-sustaining stand of vegetation.

Management of Reclaimed Areas

Freshly revegetated areas would be fenced to exclude domestic livestock and big game for a period of at least 2 years after a good vegetative cover is established. Once the area is reclaimed with a satisfactory vegetative cover being well established and ready for grazing, management would be returned to the surface owner or user.

Reclamation Equipment

Aside from the normal mine-operating equipment, reclamation at the proposed Black Butte project area would utilize the equipment listed in Table BB1-9.

Table BB1-7

PROPOSED WATER IMPOUNDMENTS FOR THE BLACK BUTTE PROJECT AREA

Mining Area	Size of Impoundments (Acres)
A	38.27
D	1.58
E	3.66
F	11.71
G	7.89
H	12.54
I	5.72
J	27.65
Total	109.02

Note: Derived from Black Butte Mining and Reclamation Plan (Black Butte Coal Comapny 1977).

Table BB1-8

PROPOSED SEED MIXTURES FOR THE
BLACK BUTTE PROJECT AREA

Soil Type	Species	Variety	Lbs./Acre Pure Live Seed
Sandy	Thickspike wheatgrass	Critana	7
	Indian ricegrass	Paloma	6
	Fourwing saltbush	Whitetana	1
	Witmar wheatgrass	Whitemar beardless	6
	Big sagebrush	Wyomingensis	2
	Rubber rabbitbrush		2
		Total	24
Clay	Western wheatgrass	Rosana	5
	Streambank wheatgrass	Sodar	7
	Whitmar wheatgrass	Whitmar beardless	5
	Pubescent wheatgrass	Topar	3
	Rubber rabbitbrush		1
	Shadscale		1
		Total	22
Alkaline/saline	Fourwing saltbush	Whitetana	1
	Western wheatgrass	Rosana	7
	Streambank wheatgrass	Sodar	7
	Pubescent wheatgrass	Topar	3
	Shadscale		2
		Total	20

Source: Black Butte Coal Company 1977.

Note: Depending on seed availability and (or) site-specific analyses, some species substitution and (or) additions to mixtures would be made such as: green needlegrass added to appropriate mixtures, winterfat added to appropriate mixtures, alkali sacaton and (or) alkali dropseed used to replace pubescent wheatgrass, Nuttall saltbush added and (or) used to replace fourwing saltbush.

Table BB1-9

RECLAMATION EQUIPMENT FOR
PROPOSED BLACK BUTTE PROJECT

Quantity	Item
1	Crawler tractor, size D-9 (or similar)
1	Rubber-tired tractor, with wide front-end
1	Motor patrol or comparable equipment for leveling replaced topsoil
1	Rangeland drill or comparable drill with independently hinged discs and with depth bands
1	Pitting machine or disc gouger
1	Cut-away disc for crimping mulch
1	Tractor-mount or portable weed sprayer
1	Ripping implement for crawler tractor

Source: Black Butte Coal Company 1977.

Pollution Control Methods

The major sources for pollution at the Black Butte project area would be from fugitive dust and suspended sediment in surface runoff. The methods proposed for controlling this pollution include immediate revegetation of disturbed areas, covering coal storage areas, watering haul roads, and constructing settling ponds for removing sediment.

A surface water monitoring plan in conformance with 30 CFR 715.17(b) has been submitted to the USGS and Wyoming State Department of Environmental Quality for approval.

AUTHORIZING ACTIONS

This section identifies governmental authorizations which would be required to fully implement the proposed Black Butte Mine. A more complete description of these actions is provided in the Regional analysis, Chapter 1.

A memorandum of understanding is in preparation which describes operating procedures to be followed by the BLM, the Office of Surface Mining, and the USGS concerning their areas of responsibility in the federal coal management program. This memorandum of understanding may alter the agencies responsibilities listed below.

Bureau of Land Management (BLM)

Before mining could begin at Black Butte, BLM would have to issue rights-of-way for 2 miles of roads, 2.2 miles of railroad spur, 7.3 miles of power line, 4.3 miles of telephone line, and one water truck filling station. In addition, BLM would prepare Section 106 compliance case reports on existing or potential National Register sites identified by survey.

U.S. Geological Survey (USGS)

USGS would, with BLM concurrence, approve the Black Butte mining and reclamation plan (Black Butte Coal Company 1977).

State and County

Wyoming Department of Environmental Quality (DEQ)

The Land Quality Division has issued a permit and license to mine on 27 December 1977 after its approval of a mining and reclamation plan. The Air Quality Division has also issued permits to construct and permits to operate coal mines after a review of applications with regard to air contaminants and plans for control and monitoring. The Water Quality Division has issued permits to construct settling ponds and waste water systems. The Solid Waste Division has issued construction fill permits and industrial waste facility permits for solid waste disposal during construction and operation.

Wyoming State Engineer

Groundwater rights for the mining and coal processing operations are required and have been acquired from the Wyoming State Engineer.

Sweetwater County

An industrial zoning permit to construct the mine and building complex is required and has been approved by Sweetwater County.

INTERRELATIONSHIPS

Relationship to Land Use Plans

Bureau of Land Management

The Salt Wells and Pilot Butte Management Framework Plans (MFPs) (U.S. Department of the Interior, BLM 1977c and 1977d) of the BLM recommend that approximately 10,500 acres of public lands be considered for lease or transfer to local government or private ownership as demands and requirements present themselves. An additional 2,560 acres within the proximity of existing communities could also be considered for these purposes if necessary. None of these actions would be in conflict with the proposed Black Butte Mine.

The Salt Wells and Pilot Butte MFPs designated the post mining land use of the proposed mining area to be wildlife habitat and livestock use.

Relationship to Other Proposed and Future Actions

The proposed development of the Long Canyon Mine, north of Rock Springs, together with the development of the Winton and Reliance Mines (no federal action required), also north of Rock Springs, would (1) create competition for the available labor market; (2) increase rail traffic, dust, and water usage; and (3) increase the demand on transportation and communication networks.

Relationship to Rail Transportation

The coal would be transported from the coal loading facility rail loop directly to the UPRR main line where it would be taken to markets in Idaho and Illinois. This project would increase the number of trains traveling to the east and west (loading and return traffic) by about 25 per week.

CHAPTER 2

DESCRIPTION OF THE ENVIRONMENT

This chapter consists of two parts, existing environment and future environment. The discussion of the existing environment describes the physical, biological, and cultural environmental components which constitute the Black Butte site-specific environment. The discussion of the future environment focuses on the same environmental components as they would be in 1980, 1985, 1990, and at the end of mine life without federal approval of the proposed action. These descriptions provide bases for the analyses in Chapter 3, The Environmental Impacts of the Proposed Action.

EXISTING ENVIRONMENT

CLIMATE

Sunshine

Because the Black Butte project area is situated in the intermountain basin area, the annual percentage of possible sunshine is expected to exceed the 65% statewide average.

Wind Fields

Privately funded studies of the local climate have been conducted in the vicinity of the Jim Bridger Power Plant, which is located about 10 miles north of the Black Butte project area (WSSI, Crow, and Hadley 1971, 1972, 1973, and 1974). Their analyses have indicated that the predominant surface winds are from the southwest through west sectors, as is the case at the Rock Springs Airport. Additional surface wind statistics have been compiled during 1975 near Point of Rocks, Wyoming, which is in the immediate vicinity of the project area (Krablin and McNaughton 1977). On an annual basis, winds are predominantly from the southwest through west-northwest with secondary peaks from the east-southeast and northeast directions. The annual average wind speed is approximately 6 mph.

Atmospheric Temperature and Stability

The project area is subject to large seasonal and diurnal temperature variations. Temperatures are expected to closely approximate those recorded at Rock Springs for a 22-year period, which indicate mean monthly minima/maxima of 10°F/29°F in January and 50°F/84°F in July. Temperature extremes range from about -29°F to 97°F. Point of Rocks, Wyoming, recorded extremes of -26°F and 89°F during 1975. The growing season is expected to be about 100 to 110 days per year.

Field studies around the Jim Bridger Power Plant have indicated that stable atmospheric conditions associated with nocturnal temperature inversions occur often in this area. In fact, out of a total sample of 96 field study days between September 1970 and August 1972, investigators found that 88% had surface-based inversions (WSSI, Crow, and Hadley 1972). During the period from September 1970 through May 1974, they determined that the median height of 109 surface-based inversions was about 700 feet (WSSI, Crow, and Hadley 1974). Finally, they found, using a modified Turner (1964) stability classification scheme and a 2-year data base period, that on an annual basis slightly unstable atmospheric conditions occurred about 12% of the time. Neutral and stable conditions were found to occur 51% and 37% of the time, respectively.

Moisture

The annual average relative humidity during 1975 at Point of Rocks was 58% (Krablin and McNaughton 1977). Precipitation during 1975 was 9 inches at Point of Rocks and 8.5 inches at Rock Springs. A significant portion of the precipitation occurs during the spring and early summer months and results primarily from convective shower activity. Annual average snowfall is estimated to be around 30 to 40 inches.

Evapotranspiration

An annual soil moisture deficit of approximately 13 inches is characteristic of the project area. The growing season roughly coincides with the period of high soil moisture deficit.

Severe Weather Events

The average annual numbers of thunderstorm and hail days are approximately 30 and 3, respectively. The likelihood of tornadoes occurring in this area is very low.

AIR QUALITY

The present air quality in the vicinity of the proposed Black Butte Mine should have a rural character. Therefore, the existing total suspended particulate (TSP) levels in this area should range from 10 to 20 $\mu g/m^3$ annually and between 25 to 50 $\mu g/m^3$ for a 24-hour averaging period, or one-third or less than the appropriate Wyoming standards. The TSP sampler, A-13, is situated in a rural area in close proximity to the proposed Black Butte project area (see Map R2-2A). An annual mean TSP concentration of 13 $\mu g/m^3$ was recorded at A-13 during 1975 with a maximum 24-hour TSP concentration of 43 $\mu g/m^3$. Based on 5 years of visual observations recorded at Rock Springs, an average background visual range in the vicinity of Black Butte should be about 40 miles. Concentrations of SO_2 around Black Butte should also reflect its rural setting i.e., levels less than 5 $\mu g/m^3$ on an annual basis and less than 25 $\mu g/m^3$ for a daily averaging period. Thus, the magnitude of these concentrations should be only about 10% of the appropriate state standards. In addition, annual NO_2 concentrations should be less than 10 $\mu g/m^3$ or again only about 10% of the state standards.

GEOLOGY

Stratigraphy

Six formations crop out within the proposed project area: the Wasatch Formation of Eocene age; the Fort Union Formation of Paleocene age; and the Lance Formation, Lewis Shale, Almond Formation, and Ericson Formation of Late Cretaceous age. Alluvium of Quaternary age is also present. The Wasatch Formation is approximately 200 feet thick and is composed of interbedded tan and gray shale, white to cream colored sandstone, and thin coal beds. The Fort Union Formation is somewhat less than 800 feet thick and is composed of interbedded light colored sandstone, light and dark gray shale, and coal. The Lance Formation is 900 feet thick in the north but thinner to the south. It consists of interbedded thin sandstone, dark gray shale, carbonaceous shale, and coal. The Lewis Shale consists of 1,000 to 2,000 feet of drab and dark colored marine shale with some thin sandstone beds and concretionary beds just below the Lewis-Lance contact. The Almond Formation is 300 to 350 feet thick and is composed of interbedded brown and light gray or cream-colored sandstone, sandy shale, clay, and coal. The Ericson Formation is 530 to 680 feet thick and consists of prominent, cliff-forming upper and lower sandstone units separated by a less resistant "rusty zone" Near the middle, the formation is composed of interbedded conglomeratic sandstone, siltstone, and carbonaceous shale. Thin lenticular beds of lignite and coal are common in the lower sandstone unit (see Figure R2-3A in the Regional ES).

The rocks of Cretaceous age were mostly deposited along the western edge of a broad, shallow, north-south trending seaway that crossed central North America. They are mostly marine shales, but they also include fluvial shales and sandstones and deltaic deposits including coal. The rocks of Tertiary age are entirely continental in origin. They were deposited in intermontane basins in swamps and lakes and on floodplains during mountain building episodes of the Middle Rocky Mountains. They are mostly fluvial sandstones and shales, but the coal was deposited in swamps. Surficial alluvial deposits of Quaternary age are present in the valleys of the larger streams.

Paleontology

The project area was surveyed by Lillegraven (1977). Field investigations identified 139 fossil vertebrate rock localities. A general summary of the principal fossiliferous formations, ages, number of known fossil localities, and general fossil types in the proposed project area is presented in Table BB2-3A.

Structure

The Rock Springs Uplift was formed during the Laramide orogeny, between 40 and 90 million years ago, when compressional forces caused extensive folding and faulting of rock units. It has a long structural history involving at least five periods of uplift with intervening periods of erosion. Gentle upwarping movements first took place in the Late Cretaceous period. These were followed by a major uplift at the close of the Cretaceous period. Following a long period of erosion, renewed minor uplifting took place several times in the early Tertiary period. The last and largest uplift, which resulted in present-day structural configurations, took place in the middle Tertiary period. The late Tertiary history of the Rock Springs Uplift includes volcanic activity in the Leucite Hills and additional cycles of erosion.

The Black Butte project area lies on the east flank of the Rock Springs Uplift. The beds dip to the east at 2° to 6°, away from the axis of the north-south trending anticline. The northern part of the area has four or five major normal faults and numerous minor faults. Displacement along these faults ranges from a few feet to hundreds of feet. The southern half of the area has no large-scale faults. Southeast of Patrick Draw, which lies along the southeast boundary of the project area, the Rock Springs Uplift grades into the Washakie Basin. This transition is marked by the presence of members of the Green River Formation. Regionally, the beds dip gently (almost horizontally) to the southeast into the basin.

Geologic Hazards

Even though the landslide susceptibility of the rock and earth material is estimated to be high (Radbruch-

Table BB2-3A

SUMMARY OF VERTEBRATE AND PALEOBOTANICAL FOSSIL LOCALITIES IN THE AREA OF THE PROPOSED BLACK BUTTE MINE

Formation	Period	Known Fossil Localities
Fort Union	Paleocene	30
Lance	Cretaceous	107
Almond	Cretaceous	2

Hall, D.H., et al. 1976), the landslide potential of the natural surface is judged to be minimal because the strata dip into the steeper slopes and no evidence of earlier sliding has been reported.

Natural coal outcrops are weathered and have lost their more volatile and more easily ignitable constituents; therefore, the likelihood of coal ignition and combustion in the natural outcrop is low.

The project area is in an area of very low seismic activity; therefore, the probability of damage from earthquakes is low.

TOPOGRAPHY

The Black Butte project area is located on the eastern flank of the physiographic subdivision of the region known as the Rock Springs Uplift. Eastwarddipping sandstone beds of Cretaceous and Tertiary age form hogbacks that are, in places, as much as 300 feet high. The west slopes are generally very steep and in places form high cliffs. The east slopes are relatively flat, gently sloping surfaces.

All of the project area is drained by Bitter Creek and its tributaries. Bitter Creek flows through the middle of the project area from southeast to northwest and then flows to the Green River which is about 40 miles to the west, passing through the city of Rock Springs en route. A large number of streams in the project area flow eastward down the dip slope into Bitter Creek. Streams east of Bitter Creek must flow westward against the dip and consequently are fewer in number and more widely spaced. In the project area, Bitter Creek is a perennial stream along some reaches with subsurface flow through the alluvium between these reaches. All other streams are ephemeral and unnamed.

SOILS

A soils inventory of the Black Butte project area was conducted by the Soil Conservation Service during the summers of 1974 and 1975 to determine the nature and extent of the soil types in the area (Map BB2-5A). The inventory was a reconnaissance survey (as defined by BLM Manual 7312).

The survey indicates that the soils are poorly developed due to slow weathering of the parent material in the arid to semiarid environment of the project area. There are three basic types of parent material in the area: (1) alluvium (sediments transported and deposited by water), which occupies approximately 30% of the area (10,980 acres); (2) sedimentary rock (sandstone and shale), which occupies approximately 69% of the area (25,254 acres); and (3) aeolian (wind deposited sands), which occupies the remaining area (366 acres). The soils in mapping units 113, 115, 117, 127, 181, and 182 have developed on alluvium. The soils in mapping units 101, 123, 124, 125, 131, 135, 246, and part of 143 have developed over sedimentary rock. About one-half the soils in mapping unit 143 have developed from wind deposited sands.

Varying amounts of soluble salts occur in all the soils of the area. Specifically calcium carbonate accumulates at various depths in the soils of the area, generally in lower subsoil horizons. High concentrations of secondary calcium carbonate restricts plant growth by depressing availability of some plant nutrients. The soils in mapping units 113, 115, 127, 181, and 182 are strongly alkaline (high in sodium salts). The amount of organic matter in the soils is low, ranging from 0.1% to 3.0%. The amount of organic matter relates to soil permeability (the ability of soil to transmit water and gasses), soil fertility (ability to hold nutrients in available form for plants), and available water capacity (water held in the soil that can be readily absorbed by plant roots). Soils in the area are low in nitrogen and phosphorus which are essential plant nutrients. There is a sufficient level of all other nutrients for plant growth.

Soil structure in the Black Butte project area is weak to moderate in the surface soil horizon which is generally very thin and soil structure is nearly nonexistent in the subsoil horizons. Populations of soil biota in the area are low due to the low levels of soil moisture throughout the year (Brady 1974). Activities of the various soil biota contribute to the development of soil structure. Stable soil structure is generally a part of all productive soils and is especially important in fine-textured soils. The predominant soil texture in the area is sandy loam.

Soil depths in the Black Butte project area vary from no soil on rock outcrop to greater than 60 inches on alluvium. The moderately deep and deep loam and sandy loam soils of the area (mapping units 117, 123, and 143) that have few restrictive features such as high alkalinity or calcium carbonate levels are more productive than the soils in the remainder of the area. These soils can be recognized by the vigorous growth of shrubs and grasses they support. Soils with high alkalinity and (or) soluble salt content (mapping units 113, 115, 127, 131, 181, and 182) have plants that are salt-tolerant. Soils with restrictive underlayers or bedrock within 20 inches of the surface (mapping units 101, 124, 125, 131, 135, and 246) have plants with stunted growth due to limited root penetration and (or) plants that require little water to survive.

Properties and interpretations of the Black Butte area soils are listed by mapping unit in Table BB2-5A. A description of the soil mapping units can be found in the Appendix. A breakdown by percentage of the soil types within each soil mapping unit along with associated soil data can be also found in the Appendix. The soil types are keyed to associations of subgroups in the soil taxonomy (U.S. Department of Agriculture, Soil Conservation Service 1975).

The amount of wind erosion occurring at present on soils of the Black Butte project area varies with the surface soil texture, vegetative cover, average wind speed, etc. The wind erosion hazard and the wind erodability groups of the Black Butte soils are listed by mapping unit in Table BB2-5A. At present an average of 180 tons of soil per year is being removed by wind from the

Table BB2-5A

SOIL CHARACTERISTICS AND INTERPRETATIONS

Map Unit[1]	Map Unit Name[2]	Total Acres	Slope Range	Precipitation Zone[3] Inches/Year	Wind Erodability Group[4]	Erosion Hazard[5]		Source of Roadfill[5]	Suitability-Limitations for Final Cover Over Mined Land[5]	
						Wind	Water		In./Avail.	Suitability
101	Rock Outcrop	2,416	3-30	7-9	8	---	Geologic	Poor	0	Unsuitable
113	Vegetated Playas[6]	73	0- 1	7-9	4	Slight	Slight	Poor	60+	Poor-Alk. Sal.
115	Alluvial Fans, Fine-loamy soils	2,086	0- 3	7-9	3-4L	Slight	Slight	Fair	60+	Poor-Alk. Sal.
117	Alluvial Fans, sandy saline soils	6,698	1- 8	7-9	2-3	Moderate	Sl.-Mod.	Good	60+	Fair
123	Residual Uplands, moderately deep soils, gently sloping to sloping	1,244	1- 6	7-9	3	Moderate	Moderate	Fair	10-30	Fair-Wind Erosion
124	Residual Uplands, shallow soils nearly level to sloping	2,709	3-30	7-9	3	Mod.-Sev.	Moderate	Poor	10-20	Poor-Fair-Wind Erosion
125	Residual Uplands, shallow soils hilly	16,433	6-30	7-9	3-4L	Mod.-Sev.	Sl.-Mod.	Poor	3-15	Poor-Slope
127	Slickspots, playas, and Dunes	110	0- 3	7-9	2-3	Mod.-Sev.	Slight	Poor	60+	Poor-Alk. Sal., Wind Erosion
131	Residual Uplands, shallow fine-loamy soils	330	1- 8	7-9	4L	Slight	Sl.-Mod.	Poor	3-15	Poor-Alk. Sal.
135	Residual Uplands, shallow sandy soils, hilly	915	6-30	7-9	3	Slight	Mod.-Sev.	Poor	10-20	Poor-Fair-Slope
143	Stabilized Dunes and Residual Uplands	952	3-30	7-9	2-3	Mod.-Sev.	Moderate	Good	10-60	Poor-Fair Wind Erosion
181	Alluvial Fans, fine and fine-silty soils	1,720	0- 2	7-9	4L	Slight	Slight	Poor	60+	Poor-Alk. Sal.

Table BB2-5A

SOIL CHARACTERISTICS AND INTERPRETATIONS
(Cont'd)

Map Unit[1]	Map Unit Name[2]	Total Acres	Slope Range	Precipitation Zone[3] Inches/Year	Wind Erodability Group[4]	Erosion Hazard[5]		Source of Roadfill[5]	Suitability-Limitations for Final Cover Over Mined Land[5]	
						Wind	Water		In./Avail.	Suitability
182	Alluvial Fans, sodic soils	183	0- 3	7-9	3	Moderate	Moderate	Fair-Poor	60+	Poor-Alk. Sal., Wind Erosion
246	Rocky, Sandy Ridge Tops[6] Ustic Zone	732	3-30	10-14	1-2	Severe	Mod.-Sev.	Poor	3-20	Poor-Fair Wind Erosion

[1]Map BB2-5A, Black Butte Soils.
[2]Unit names derived from geomorphic setting of the soil.
[3]Refers to total precipitation.
[4]Wind Erodability Group descriptions found in U.S. Department of Agriculture, Soil Conservation Service (SCS), Handbook for Interpretations 1972, generally higher the number the lower the erosion potential with the number range of 1 to 8.
[5]Derived from U.S. Department of Agriculture, SCS, soils contract with BLM (1977).
[6]These soil types would not be disturbed by the mining action.

mining area. This value was determined by using the Soil Erodability Index for bare soil (U.S. Department of Agriculture, Soil Conservation Service 1972), vegetative cover percentages derived from BLM watershed surveys, and estimates based on professional judgment. The preceding value of 180 tons represents soil lost in suspension.

Sheet erosion rates on the various mapping units as calculated by using Musgrave's Equation are shown in Table BB2-5B.

Some of the soils in the area are highly erosive resulting primarily from low amounts of vegetative cover at steep slopes. The average rate of erosion occurring at present on those areas that would be disturbed by mining is approximately 5 tons per acre per year.

WATER RESOURCES

Ground Water

Ground water conditions have been little disturbed by man. Water levels in observation wells in southwestern Wyoming indicate that recharge and discharge from aquifers in the area are in balance and that there has been no significant withdrawal from storage in excess of recharge. Recharge to the aquifers occurs from runoff from snowmelt, precipitation, and streamflow. Discharge from the aquifers is by evaporation, transpiration (from plants), seepage to streams, underflow along stream channels, and consumptive use by a few wells. The main regional movement of ground water from the Black Butte project area seems to be to the southeast, down dip to the Washakie Basin.

Ground water at the Black Butte project area occurs in the alluvium of Bitter Creek and the Fort Union, Lance, and Almond Formations. A test hole in the Wasatch Formation was dry. These aquifers are principally of sandstone, shale, and coal. Shallow ground water movement is from the highlands to the alluvium of Bitter Creek. Where mining is planned, ground water movement appears to be locally controlled principally by topography, in contrast to the regional movement. Yields of wells drilled near the project area range from 10 to 15 gallons per minute (gpm) in the shallowest to 500 gpm for some of the deeper wells. A well in the SW¼SW¼ of Section 8, T. 18 N., R. 100 W., is reported to be 4,923 feet deep and penetrates the Mesaverde group and bottoms in the Baxter Shale. The well is reported to be plugged at 1,300 feet and flows at about 500 gpm (personal communication, J. Wilson, Mine Manager, 7 June 1978). Water levels range from 10 feet in wells tapping water in alluvium to as much as 177 feet in deeper wells. Ground water is regionally under artesian pressure, but is locally unconfined in the outcrop-recharge areas. There are no known aquifers in the alluvium of the Bitter Creek drainage which would be disrupted significantly by mining.

The characteristics of the individual aquifers cover a wide range in thickness, distribution, sorting, grain size, cementation, and clay and silt content. Their water yielding, transmitting, and storing abilities similarly cover a wide range. The aquifers of importance in the Black Butte project area are in the Lance, Fort Union, and Almond Formations and the alluvium.

Transmissivities and storage coefficients (listed in Table BB2-6A) were assigned to each of the water-bearing formations on the basis of tests run by the Black Butte Coal Company and their consultants (Black Butte Coal Company, Surface Mine Permit Application and Mine Plan, June 1976, on file at the Rock Springs, Wyoming, office of the USGS).

Transmissivity is the ability of an aquifer to transmit water. The units are cubic feet per day per foot width of aquifer under a hydraulic gradient of one foot per foot which reduces to the commonly used square feet per day.

Coefficient of storage is the amount of water released from storage within the aquifer when the water level in the aquifer falls 1 foot in a 1 square foot column.

Eight privately owned water wells are within 3 miles of the project area and are registered with the Wyoming State Engineer. Priorities on two wells date from 1916. Twenty-one water wells are located within the project area; of these, all but one are to be used for monitoring water levels in the several aquifers during and after mining operations. The one remaining well is an industrial well and is permitted for 50 gpm.

Quality of Ground Water

Ground water is mainly of sodium bicarbonate type; the major constituents are sodium, bicarbonate, and sulfate. The poorest quality water is in the alluvium of Bitter Creek and in the Lance Formation. The Fort Union and Almond Formations have similar water chemistry and their water is of slightly better quality than the other two aquifers. Table BB2-6B shows the range of concentration of the constituents of ground water in the Fort Union, Almond, and Lance Formations and alluvium of Bitter Creek.

Surface Water

Bitter Creek and its tributaries at the downstream boundary of the project area drain an area of 625 square miles. Although there is some spring flow to the mainstem stream, as well as a flow of about 0.9 cubic feet per second (cfs) from an abandoned well in Section 8, T. 18 N., R. 100 W., most flow in Bitter Creek is in response to precipitation and snowmelt. The average annual discharge is estimated according to the method of Lowham (1976) to be about 6,500 acre-feet per year. The Bitter Creek drainage might be an alluvial valley floor based on the 30 CFR 710.5 definition that an "alluvial valley floor means stream-laid deposits holding streams where water availability is sufficient for subirrigation or flood irrigation agricultural activities . . ."

Estimates of the frequency of flows of a given recurrence interval for the whole basin above the point where

Table BB2-5B

EXISTING SHEET EROSION

Map Unit[1]	Sheet Erosion Tons/Acre/Year
101	0.00
113	0.29
115	0.43
117	0.79
123	1.39
124	3.13
125	10.16
127	.50
131	2.84
135	6.70
143	1.26
181	.47
182	.51
246	1.07

[1] Map BB2-5A

Table BB2-6A

TRANSMISSIVITIES OF AQUIFERS IN THE BLACK BUTTE PROJECT AREA

Formation		S Storage Coefficient	T Transmissivity Ft^2/day
Alluvium		0.02	6.175
Lance:	sandstone	$5x10^{-5}$	0.110
	coal	$5x10^{-4}$	1.840
Fort Union:	sandstone	$9x10^{-5}$	0.320
	coal	$9x10^{-5}$	2.350
Almond		$5x10^{-5}$	1.365

Note: Data from Black Butte Coal Company.

Table BB2-6B

CHEMICAL ANALYSIS OF GROUND WATER FROM THE BLACK BUTTE PROJECT AREA
FORT UNION FORMATION

Constituent	Range	Mean	Constituent	Range	Mean
As	<0.007-0.11	0.02	Al	0.04-3.5	1.15
Cu	<0.01-0.27	0.02	NH_3	0.0	0.0
C	3.5-330	103.46	TKN	0.1-3.3	1.88
Cn (cyanide)	0.002-11	1.11	Oil/grease	0.0-15	2.49
Fe	0.0-16	2.13	Sulfide	0.004-13	2.78
Mn	0.0-0.18	0.14	Total solids	1,420-7,290	2,771.82
Phenols	<0.001-0.075	0.01	TDS	1,290-7,260	2,484.55
Zn	0.06-6.9	0.57	Slds. suspd.	24-1,100	196.73
MBAS	<0.01-0.96	0.11	CO_3	160-1,000	512.36
Cd	0.01	0.01	Total alkin.	270-4,200	418
CR	0.01	0.1	PO_4	0.02-0.69	0.24
Pb	0.01-0.4	0.12	Ca	6.8-220	62.09
Se	0.001	0.001	Mg	4.0-210	45.45
Ag	0.5	0.5	Na	204-1,900	915.53
pH	6.9-8.9	7.95	K	4.0-11.0	7.71
Conductance	1,850-9,030	3,348.18	Bicarbonate	330-2,100	116.75
$CaCO_3$	33-1,400	333.32	Sulfate	130-2,300	785.45
Na%	60-97	88.39	Chloride	43-2,000	301.5
Boron	0.3-1.3	0.63	Nitrate	0.0-14	1.13
Silica	6.4-11.0	8.86	Fluoride	0.6-8.6	1.57
COD	15-140	65.52	NTU	3.0-250	63.4
Color	0.0-50	18.5			

Note: All constituents in milligrams per liter unless otherwise noted. Data from Black Butte Coal Company.

Table BB2-6B

CHEMICAL ANALYSIS OF GROUND WATER FROM THE BLACK BUTTE PROJECT AREA
ALMOND FORMATION
(Continued)

Constituent	Range	Mean	Constituent	Range	Mean
As	<0.007	0.007	Al	1,401.8	1.6
Cu	<0.01	0.01	NH_3	0.0	0.0
C	1.0-342	153	TKN	1.4-2.2	1.8
Cn (Cyanide)	0.008	0.008	Oil/grease	0.1-12	3.58
Fe	0.51026	1.40	Sulfide	8.6-9.1	8.85
Mn	0.0-0.37	0.21	Total solids	2,060-3,680	2,716.67
Phenols	<0.001	0.001	TDS	1,970-3,650	2,585
Zn	<0.02-0.09	0.04	Solids susp.	16-408	131.33
MBAS	<0.01	0.01	CO_3	310-820	627.33
Cd	<0.01	0.01	Total alkin.	1,400	1,400
Cr	<0.1	0.1	PO_4	0.01-0.25	0.13
Pb	<0.1	0.1	Ca	13-430	151
Se	<0.001	0.001	Mg	15-390	140.83
Ag	<0.5	0.5	Na	48-730	495.17
pH	7.3-9.0	8.2	K	9.3-48	21.18
Conductance	2,630-3,970	3,190	Bicarbonate	640-1,580	1,195
$CaCO_3$	92-2,700	960.33	Sulfate	280-2,200	990.5
Na%	3.7-93	47.43	Chloride	45-91	66.33
Boron	0.9	0.9	Nitrate	0.0-0.4	0.15
Silica	7.7-8.0	7.85	Fluoride	1.2-1.7	1.45
COD	21-89	55	NTU	40-59	49.5
Color	20-40	30			

Note: All constituents in milligrams per liter unless otherwise noted. Data from Black Butte Coal Company.

Table BB2-6B

CHEMICAL ANALYSIS OF GROUND WATER FROM THE BLACK BUTTE PROJECT AREA
LANCE FORMATION
(Continued)

Constituent	Range	Mean	Constituent	Range	Mean
As	<0.007-0.02	0.008	Al	0.02-3.4	1.6
Cu	<0.01-0.06	0.01	NH_3	0.0	0.0
C	0.0-652	182.62	TKN	0.7-5.8	2.49
Cn (Cyanide)	<0.002-0.008	0.007	Oil/grease	0.0-7.0	1.87
Fe	0.0-29	3.61	Sulfide	0.0-18.0	7.49
Mn	0.0-1.0	0.23	Total solids	33.0-7,670	3,427
Phenols	0.001	0.001	TDS	29.8-7,390	3,284.21
Zn	<0.02-0.96	0.14	Solids susp.	16.288	186.58
MBAS	<0.01-0.03	0.01	CO_3	168-1,400	358.68
Cd	<0.01	0.01	Total alkin.	300-2,300	1,372
Cr	<0.01	0.1	PO_4	0.08-1.6	0.48
Pb	<0.01-0.07	0.16	Ca	5.6-480	33.87
Se	<0.001	0.001	Mg	2.2-830	53.65
Ag	<0.5	0.5	Na	510-1,800	1,108.37
pH	7.4-8.9	8.54	K	3.0-21	7.12
Conductance	2.060-6,470	4,136.84	Bicarbonate	310-2,000	1,532.21
$CaCO_3$	35-4,600	304.21	Sulfate	12-4,600	1,130.79
Na%	19-98	7,279	Chloride	24-1,100	252.89
Boron	0.9-1.5	1.16	Nitrate	0.0-11.0	0.81
Silica	6.4-12	8.16	Fluoride	0.C-5.1	2.05
COD	14-202	61.89	NTU	4-190	56.9
Color	10-500	47.78			

Note: All constituents in milligrams per liter unless otherwise noted. Data from Black Butte Coal Company.

Table BB2-6B

CHEMICAL ANALYSIS OF GROUND WATER FROM THE BLACK BUTTE PROJECT AREA
ALLUVIUM OF BITTER CREEK
(Continued)

Constituent	Range	Mean	Constituent	Range	Mean
As	0.007	0.007	Al	0.9-2.3	1.55
Cu	0.001-0.08	0.003	NH_3	0.0-0.17	0.04
C	4.5-166	73.08	TKN	0.7-4.4	2.35
Cn (cyanide)	0.008	0.008	Oil/grease	0.0-16	2.97
Fe	0.4-20	3.81	Sulfide	0.7-2.0	1.15
Mn	0.0-2.7	1.10	Total solids	3,950-66,900	31,523
Phenols	0.001-0.006	0.002	TDS	3,860-66,600	31,191
Zn	0.03-1.1	0.29	Solids susp.	1-1,960	322.5
MBAS	0.01-0.04	0.02	CO_3	264-610	426
Cd	0.01-0.06	0.03	Total alkin.	460-780	620
Cr	0.1	0.1	PO_4	0.04-0.1	0.08
Pb	0.1-0.5	0.250	Ca	210-800	505.9
Se	0.001	0.001	Mg	140-1,800	8,995
Ag	0.5	0.5	Na	720-20,000	8,843.5
pH	7.5-8.2	7.8	K	3.5-35	15.97
Conductance	4,030-38,100	17,163	Bicarbonate	540-1,200	858.9
$CaCO_3$	670-9,600	4,968	Sulfate	1,900-15,000	6,236
Na%	55-82	70.75	Chloride	400-27,000	12,019.5
Boron	0.3-0.8	0.55	Nitrate	0.1-0.8	0.4
Silica	8.3-10	9.0	Flouride	1.0-9.0	4.23
COD	12-377	253	NTU	3-90	22.18
Color	10-70				

Note: All constituents in milligrams per liter unless otherwise noted. Data from Black Butte Coal Company.

Bitter Creek leaves the project area are given in the following tabulation. Peak flows in cfs have the indicated frequency of recurrence: 2 years—660; 5 years—1,400; 10 years—2,100; 25 years—3,400; 50 years—4,100; 100 years—5,700.

Surface Water Quality

The chemical quality of flow in Bitter Creek ranges widely with time and the volume of flow. Chemically the water is similar to the ground water in that it is principally a sodium bicarbonate water. Table BB2-6C shows the range of constituents of water samples of Bitter Creek at Station A at the downstream boundary of the project area and Station B at the upstream boundary of the project area. Data on sediment transport are lacking in the project area. Observation indicates that the area is actively being eroded and the creek generally carries heavy concentrations of sediment even at low flow.

VEGETATION

Sagebrush, saltbush, greasewood, and juniper types comprise about 62% (22,692 acres), 31% (11,346 acres), 5% (1,830 acres), and 2% (732 acres) of the project area (about 36,600 acres), respectively (Map BB2-7A). Type designations and numbers are those used by the BLM. Plant names are from Beetle (1970). A list of plants known or believed to occur in the Black Butte project area is available to the public at the Rock Springs District Office of the BLM.

Terrestrial Vegetation

Sagebrush, Type 4

Sagebrushes generally occur on the well drained and moderately deep to deep soils of the proposed mining area. Big sagebrush *(Artemisia tridentata)* is the most common dominant species with black sagebrush *(A. nova)* present on drier, more shallow soil sites. Subdominant shrubs included *rabbitbrushes (Chrysothamnus* spp.), shadscale saltbush *(Artriplex* confertifolia), and Nuttall saltbush *(A. nuttallii)*.
Thickspike wheatgrass *(Agropyron dasystachum), bluegrasses (Poa* spp.), bottlebrush squirreltail *(Sitanion hystrix)*, and Indian ricegrass *(Oryzopsis hymenoides)* are commonly occurring grasses. Other grasses present are bluebunch wheatgrass *(A.* spicatum), prairie junegrass *(Koeleria cristata)*, cheatgrass brome *(Bromus tectorum)*, and needleandthread *(Stipa comata)*.

Forbs representative of the type are *wildbuckwheats (Eriogonum* spp.), penstemons *(Penstemon* spp.), Indian paintbrushes *(Castilleja* spp.), asters *(Aster* spp.), *milkvetches (Astragalus* spp.), and phloxes *(Phlox* spp.).

Saltbush, Type 13

Saltbush occurs in areas with saline soil conditions. The principal shrub species is Nuttall saltbush. Other shrubs are black greasewood *(Sarcobatus vermiculatus)*, Douglas rabbitbrush *(Chrysothamnus viscidiflorus)*, big sagebrush, black sagebrush, and shadscale saltbush. Understory grasses include bluegrasses, bottlebrush squirreltail, alkali *sacaton (Sporobolus airoides)*, and Indian ricegrass. Milkvetches, common halogeton *(Halogeton glomeratus)*, goldenweeds *(Haplopappus* spp.), phloxes, asters, and goosefoots *(Chenopodium* spp.) are representative forbs.

Greasewood, Type 14

The dominant species of this type is black greasewood, with Nuttall saltbush occurring as a subdominant. Understory cover is sparse with bottlebrush squirreltail and phloxes often present. This type commonly occurs in drainages where high saline-alkaline soil conditions exist.

Aquatic Vegetation

Sufficient baseline data are not available to describe the existing environment for aquatic vegetation.

Endangered and (or) Threatened

A survey of the project area revealed no plants proposed for endangered and (or) threatened status (Dorn 1977). The process for requesting formal consultation under Section 7 of the Endangered Species Act of 1973 was initiated for Black Butte with the U.S. Fish and Wildlife Service on 2 March 1978.

The U.S. Fish and Wildlife Service responded by letter dated 7 March 1978 that formal consultation cannot be conducted for unlisted species.

FISH AND WILDLIFE

General Information

Habitat Types

The following are lists of the major habitat types on the proposed mine permit area and the primary fish and wildlife species associated with each. A complete wildlife species list can be obtained from the Rock Springs District Office of the BLM.

Aquatic. Aquatic habitat consists of intermittent stream (about 9 miles) which supports speckled dace and mountain sucker.

Terrestrial.

Sagebrush (22,692 acres). Species associated with sagebrush are sage grouse, horned lark, black-billed magpie,

Table BB2-6C

CHEMICAL ANALYSIS OF WATER FROM BITTER CREEK ON THE BLACK BUTTE PROJECT AREA

Constituent	Station A Range	Mean	Constituent	Station B Range	Mean
Fe	0.44- 3.90	1.38	Fe	0.16- 3.20	1.33
Mn	0.05- 0.40	0.17	Mn	0.07- 0.80	0.27
Zn	0.02- 0.03	0.02	Zn	0.01- 0.05	0.02
pH	7.70- 8.60	8.1	pH	7.20- 8.60	8.1
Conductance	868.00-2120.00	1513	Conductance	1310.00-15500.00	4178.33
$CaCO_3$	240.00- 760.00	424	$CaCO_3$	225.00- 2700.00	749
Na%	15.00- 58.00	42	Na%	12.00- 85.00	77
Solids total	990.00-1660.00	1306	Solids total	1100.00-19500.00	4543.33
TDS	584.00-1580.00	1176	TDS	1480.00-19400.00	6137.5
Ca	63.00- 160.00	100	Ca	39.00- 250.00	88.33
Mg	17.00- 85.00	42.8	Mg	25.00- 510.00	127.2
Na	63.00- 310.00	175.4	Na	212.00- 5500.00	1615.5
K	4.00- 8.40	6	K	2.30- 19.00	6.18
Bicarbonate	62.00- 420.00	23.24	Bicarbonate	300.00- 610.00	447.52
Sulfate	290.00- 830.00	580	Sulfate	400.00- 6500.00	1878
Chloride	24.00- 68.00	38.25	Chloride	72.00- 6000.00	1580.5
Nitrate	0.10- 0.95	0.95	Nitrate	0.10- 0.30	0.22
Flouride	0.50- 1.00	0.67	Flouride	1.00- 5.80	2.3
Cu	0.01- 0.03	0.02	Cu	0.01 0.03	0.01

Note: All constituents in milligrams per liter except conductance which is in micro mhos per centimeter and pH which is in pH units.

sage thrasher, Brewer's blackbird, vesper sparrow, sage sparrow, Brewer's sparrow, badger, coyote, striped skunk, whitetail prairie dog, Richardson ground squirrel, least chipmunk, deer mouse, whitetail jackrabbit, desert cottontail, mule deer, and pronghorn antelope.

Saltbush (11,346 acres). Species associated with saltbush are horned lark, rock wren, sage thrasher, sage sparrow, Brewer's sparrow, badger, coyote, striped skunk, whitetail prairie dog, Richardson ground squirrel, least chipmunk, deer mouse, whitetail jackrabbit, desert cottontail, and pronghorn antelope.

Greasewood (1,830 acres). Species associated with greasewood are horned lark, sage sparrow, Brewer's sparrow, badger, coyote, striped skunk, least chipmunk, deer mouse, whitetail jackrabbit, desert cottontail, and pronghorn antelope.

Juniper (732 acres). Species Associated with juniper are Brewer's blackbird, loggerhead shrike, red-shafted flicker, striped skunk, coyote, and mule deer.

General. The following raptors may be seen foraging in one or several habitat types: red-tailed hawk, Swainson's hawk, rough-legged hawk, ferruginous hawk, golden eagle, bald eagle, prairie falcon, and American kestrel.

Herd Units

The Wyoming Game and Fish Department has designated areas of management for big game herds. These areas are called herd units and each one contains an individual big game population. All big game population numbers and density estimates in this ES are based upon herd units.

Fishery

Introduction

The major aquatic feature of the area is Bitter Creek which is an intermittent stream with poor water quality due to silt and high water temperature. For a more detailed discussion of water quality, see Water Resources section. About 9 miles of the stream flows within the proposed project area.

Nongame

The major species of fish present are the speckled dace and mountain sucker. Data from the Wyoming Game and Fish Department (1977) show standing crops of 39,000 speckled dace per hectare and 4,625 mountain sucker per hectare which converts to 97,500 and 11,562 fish per acre, respectively.

Game

No game fish inhabit the Bitter Creek drainage.

Endangered and (or) Threatened

No endangered or threatened fish are known to inhabit the Bitter Creek drainage.

Wildlife

Birds

Nongame. The major songbird species found on the proposed Black Butte project area are listed under the major habitat types at the beginning of this section. The best available information is from breeding bird surveys conducted by the Wyoming Game and Fish Department which indicate about 27 birds per square mile in and around the project area. Although these figures are average estimates for resident birds, it must be understood that nomadic arid land species (e.g., crows) may significantly increase these numbers.

The most common raptor in the area is the golden eagle. Population estimates range from five to ten permanent eagle residents. Table BB2-8A shows the other raptor species observed and their abundance classification.

Table BB2-8B shows raptor nesting data from 1975, 1976, and 1977. Locations of these nests are shown on Map BB2-8A.

Game. The only upland game bird occupying the project area is the sage grouse. The Wyoming Game and Fish Department identified three strutting grounds south of the mine permit area. Of the three grounds two are more than 2 miles from the southern boundary and one is approximately one-eighth mile from the southeastern corner (see Map BB2-8A).

The Black Butte proposal is within bird management section number 14 of the Flaming Gorge Management Unit. The long-term average population is 10,182 or 4 birds per square mile. This is an average density estimate and there are areas (e.g., wintering areas, strutting grounds, etc.) where the density will be much greater.

Endangered and (or) Threatened. Possible peregrine falcon sightings have been made on Black Buttes which are located about 2 miles west of the proposed project area. In 1972, Dick Randall (personal communication, January 1978) reported two adult and two fledgling peregrine falcons on the northwest side of the buttes. In 1973, Rod Ogilvie (personal communication, March 1977) reported an adult peregrine falcon on the west side of the buttes. On 19 March 1977, the buttes were visited by Rod Ogilvie and biologists from BLM and U.S. Fish and Wildlife Service, and no falcons were observed. The area was again visited by BLM biologists on 18 May 1977 and 5 April 1978, and no birds were observed.

Mammals

Nongame. The primary small, nongame mammals are whitetail prairie dog, Richardson ground squirrel, least chipmunk, deer mouse, and whitetail jackrabbit. The

Table BB2-8A

RAPTOR SPECIES AND ABUNDANCE CLASSIFICATION

Raptor Species	1975 (Sightings)	1976 (Sightings)	Classification
1. Northern bald eagle	3	2	uncommon
2. Marsh hawk	3	4	uncommon
3. Swainson's hawk	1	---	rare
4. Rough-legged hawk	3	4	uncommon
5. Ferruginous hawk	1	8	uncommon
6. Sparrowhawk	1	9	common
7. Red-tailed hawk	1	16	common
8. Goshawk	3	1	uncommon

Source: Black Butte Coal Company 1977.

Table BB2-8B

RAPTOR NEST RECORD DATA
SPRING - SUMMER 1975-1976-1977

Species	Location	Number Fledged
	1975	
Prairie falcon	SW¼, Sec. 9, T. 18 N., R. 100 W.	4
Prairie falcon	NW¼, Sec. 5, T. 18 N., R. 100 W.	3
Prairie falcon	SE¼, Sec. 24, T. 18 N., R. 100 W.	4
Golden eagle	N½, Sec. 9, T. 18 N., R. 101 W.	2
Golden eagle	NE¼, Sec. 11, T. 18 N., R. 101 W.	Unknown
Golden eagle	NW¼, Sec. 14, T. 18 N., R. 101 W.	Unknown
Sparrowhawk	SW¼, Sec. 9, T. 18 N., R. 100 W.	Unknown
Golden eagle	SW¼, Sec. 9, T. 18 N., R. 100 W.	Unknown
Golden eagle	NE¼, Sec. 9, T. 18 N., R. 101 W.	Unknown
Possible ferruginous hawk	SE¼, Sec. 22, T. 19 N., R. 100 W.	Unknown
	1976	
Prairie falcon	SW¼, Sec. 9, T. 18 N., R. 100 W.	5
Ferruginous hawk	NW¼, Sec. 5, T. 17 N., R. 100 W.	3
Golden eagle	NW¼, Sec. 30, T. 18 N., R. 100 W.	1
Golden eagle	N½, Sec. 4, T. 18 N., R. 100 W.	1
Unknown	NW¼, Sec. 1, T. 17 N., R. 101 W.	Unknown
Unknown	NW¼, Sec. 1, T. 17 N., R. 101 W.	Unknown
Redtailed hawk	NW¼, Sec. 36, T. 20 N., R. 101 W.	5
Redtailed hawk	NW¼, Sec. 33, T. 20 N., R. 101 W.	4

Table BB2-8B

RAPTOR NEST RECORD DATA
SPRING - SUMMER 1975-1976-1977
(Continued)

Species	Location[1]	Status[2]
	1977	
Prairie falcon	SW¼NW¼, Sec. 1, T. 18 N., R. 101 W.	Active
Prairie falcon	NE¼NW¼, Sec. 11, T. 18 N., R. 101 W.	Inactive
Golden eagle	SE¼NE¼, Sec. 4, T. 18 N., R. 100 W.	Active
Golden eagle	SW¼SE¼, Sec. 33, T. 19 N., R. 100 W.	Inactive
American kestrel	NW¼SE¼, Sec. 4, T. 18 N., R. 100 W.	Active
American kestrel	NE¼NE¼, Sec. 9, T. 18 N., R. 100 W.	Active
Golden eagle	SW¼NE¼, Sec. 9, T. 18 N., R. 100 W.	Inactive
Golden eagle	SW¼SE¼, Sec. 9, T. 18 N., R. 100 W.	Inactive
American kestrel	NW¼SE¼, Sec. 9, T. 18 N., R. 100 W.	Active
Prairie falcon	SE¼SW¼, Sec. 9, T. 18 N., R. 100 W.	Active
Ferruginous hawk	NW¼NW¼, Sec. 16, T. 18 N., R. 100 W.	Active
Golden eagle	SW¼NW¼, Sec. 14, T. 18 N., R. 100 W.	Used by ferruginous
Ferruginous hawk	NW¼SE¼, Sec. 10, T. 18 N., R. 100 W.	Inactive-old
Ferruginous hawk	NW¼SE¼, Sec. 10, T. 18 N., R. 100 W.	Inactive-old
Ferruginous hawk	NW¼SE¼, Sec. 10, T. 18 N., R. 100 W.	Inactive-old
Ferruginous hawk	NW¼NW¼, Sec. 36, T. 19 N., R. 100 W.	Active-nest Failure
Golden eagle	SW¼SW¼, Sec. 20, T. 18 N., R. 100 W.	Inactive
Prairie falcon	SE¼NE¼, Sec. 30, T. 18 N., R. 100 W.	Inactive-old
Golden eagle	NE¼SE¼, Sec. 30, T. 18 N., R. 100 W.	Active
American kestrel	NE¼SW¼, Sec. 30, T. 18 N., R. 100 W.	Inactive
American kestrel	SE¼SW¼, Sec. 30, T. 18 N., R. 100 W.	Active
Ferruginous hawk	SW¼SE¼, Sec. 32, T. 18 N., R. 100 W.	Inactive
Ferruginous hawk	SW¼SE¼, Sec. 32, T. 18 N., R. 100 W.	Inactive
Ferruginous hawk	NE¼SE¼, Sec. 32, T. 18 N., R. 100 W.	Active
Ferruginous hawk	SW¼NW¼, Sec. 33, T. 18 N., R. 100 W.	Inactive-old
Ferruginous hawk	SE¼NW¼, Sec. 33, T. 18 N., R. 100 W.	Inactive-very old
Ferruginous hawk	NE¼NW¼, Sec. 33, T. 18 N., R. 100 W.	Inactive-old
Ferruginous hawk	NE¼NW¼, Sec. 33, T. 18 N., R. 100 W.	Inactive-old
Golden eagle	NE¼NE¼, Sec. 33, T. 18 N., R. 100 W.	Active
Prairie falcon	NW¼SW¼, Sec. 27, T. 19 N., R. 100 W.	Active
Golden eagle	SW¼SE¼, Sec. 8, T. 19 N., R. 100 W.	Active
Golden eagle- 3 nests	SW¼SE¼, Sec. 8, T. 19 N., R. 100 W.	All 3 nests Inactive
Ferruginous hawk	SW¼SW¼, Sec. 5, T. 18 N., R. 100 W.	Inactive

Source: Black Butte Coal Company 1977.

[1]Location refers to Sixth Principal Meridian Wyoming.
[2]Number of young fledged not available. Data from Wyoming Game and Fish Department.

only small nongame mammal population information available for southwestern Wyoming indicates about 5 individuals per acre in the sagebrush type, about 0.5 per acre in the saltbush type, and about 1.5 per acre in the greasewood type (Maxell 1973).

Game. Almost the entire project area is mule deer winter/yearlong range (Map BB2-8B). Deer populations are low in the proposed mine permit area which is indicated by the fact that only one deer was observed within the project area since 1974. Lack of cover is the primary limiting factor (Wyoming Game and Fish Department 1977). All other deer sightings were made to the west of the project area where groups of up to 32 individuals were observed.

The northeastern one-third of the proposed project area is winter and yearlong habitat for antelope. The remainder is summer range (see Map BB2-8B). Conditions on all ranges in this area are considered fair. Water is considered the single most important factor restricting antelope distribution in the project area. During hot summer and fall days, the antelope depend on Bitter Creek and an uncapped water well which feeds the creek. There are at least 100 antelope within the proposed project area in summer and about 900 in winter (Wyoming Game and Fish Department 1977). The project area is within the Black Butte-Kenney Rim Herd Unit which has a present population of 1,000 antelope and a desired population of 1,500 by 1982.

Endangered and (or) Threatened. The Wyoming Game and Fish Department indicates that no evidence of black-footed ferret sign was found during their survey in 1977, but that extremely high numbers of prairie dogs occur in the proposed project area.

Another survey was conducted by Black Butte Mine personnel for the black-footed ferret as suggested by Clark (1975) and Snow (1972). Each of three study sites was visited between the hours of 0500 and 0800 and then again between the hours of 1800 and 2130 for 5 consecutive days. No black-footed ferret nor any sign of the animal was observed. The U.S. Fish and Wildlife Service, Denver Research Center, under contract to the BLM, Wyoming State Office, began an intensive black-footed ferret survey in the general area of the proposed Black Butte Mine in June 1978. The results of this survey are anticipated in October 1978.

Reptiles and Amphibians

General. The primary reptile species found on the proposed project area are the northern shorthorned lizard, northern plateau lizard, northern cliff lizard, wandering garter snake, and Great Basin gopher snake. The primary amphibian species is the tiger salamander. Table BB2-8C shows the number of species and estimated density of reptiles and amphibians in the major habitat types.

Endangered and (or) Threatened. No endangered or threatened reptile and amphibian species exist within the proposed mine permit boundary or surrounding vicinity.

Wild Horses

Information from the BLM indicates the mining site is seldom used by wild horses. Few horses have been sighted since observation of the area began in early 1974.

CULTURAL RESOURCES

Archeological

Archeological investigations in the area have been scattered and sporadic until recently. Recent cultural resource investigations in the area have been undertaken to comply with Section 106 of the Historic Preservation Act of 1966 and Section 2(b) of Executive Order 11593, "Protection and Enhancement of the Cultural Environment" These inventories have been important in developing a chronology for this area, which is marginal to the Northwest Plains, Great Basin, and Northwest Interior Plateau. The chronology established by Mulloy (1958) compares favorably with evidence accumulated so far. Stylistic changes in artifact types, particularly projectile points, provide the basis for dividing archeological sites into five general categories. These are summarized in Table BB2-9A.

The Black Butte project area was surveyed for archeological and historical resources during the 1974 and 1975 field seasons. Areas of proposed mine activity were surveyed intensively in 100- to 150-foot transects. Limited and extensive testing of sites to determine National Register eligibility was carried out in the 1975 field season. Of the proposed 36,600 acre project area, 52% was surveyed. Of the proposed disturbed areas, 100% has been intensively surveyed including a buffer zone around those areas. The total acreage surveyed was 18,914 acres. Much of the discovered archeological material has been recovered. Approximately 185 sites lie within the project area. Fifty-five sites were intensively collected, 40 were tested, and 7 sites underwent intensive testing to determine National Register eligibility. No vertically stratified sites were discovered. Site density for the surveyed area was 4.35 sites per section.

All sites were identified as surface sites representing single occupations. The size varied from a simple lithic scatter, confined to about a 25-foot diameter, to a large multicomponent site extending over half a mile. Most sites ranged from about 50- to 100-yards in overall diameter. Several flake concentrations seemed to represent single occupations. Ten quarry sites were found where the raw materials necessary for producing tools were procured. Thirty-five sites had fire pits associated with lithic debris and two sites were identified as tepee ring sites.

Four sites from the Early Prehistoric period, 12000 to 7000 B.P., were inventoried. Projectile points typical of this period are Clovis, Folsom, and Eden-Scottsbluff. These and other artifacts are usually associated with extinct Pleistocene megafauna, i.e., mammoth, *Bison antiquus* and *Bison* occidentales. These sites are significant

Table BB2-8C

ESTIMATED REPTILE AND AMPHIBIAN DENSITY FOR MAJOR HABITAT TYPES

Habitat Type	Number of Species	Density Estimate (number per acre)
Sagebrush	4	2-3
Salt desert shrub	4	2-3
Greasewood	5	2-3
Juniper	10	6-8

Source: Personal communication, Dr. George Baxter, University of Wyoming, January 1978.

Table BB2-9A

PREHISTORIC CHRONOLOGY WITHIN PROPOSED BLACK BUTTE PROJECT AREA

Period	Subphase	Number of Sites Within Project Area	Date Before Present (B.P.)	Projectile Point Style or Cultural Group	Characteristics (Sites)
Historic		4	(1700 B.P. to present	Shoshonean Cheyenne Gros Ventre Commanche Flathead Crow Arapahoe	Hunting and gathering; some buffalo and antelope hunting by communal drives, mostly marginal subsistence
Late Prehistoric		0.43	(2000 B.P.--1700)	Shoshonean Intermountain	Marginal subsistence; hunting and gathering; pottery in some sites
Middle	Late Middle	29	(3500 B.P.--2000 B.P.)		Hunting and gathering
	Early Middle	8	(4500 B.P.--3500 B.P.)	Scoggin Duncan Hanna McKean	Hunting and gathering
Altithermal		2	(7000 B.P.--4500 B.P.)	McKean (?)	Generally a more arid period with marginal occupations suspected in limited areas
Early Prehistoric	Plano	4	(10000 B.P.--7000 B.P.)	Lusk Federick Cody Alberta Hell Gap Agate Basin Midland	Hunting extinct fauna (Bison antiquus); bison traps and some communal hunting suspected; collecting flora probable

Table BB2-9A

PREHISTORIC CHRONOLOGY WITHIN PROPOSED BLACK BUTTE PROJECT AREA
(Continued)

Period	Subphase	Number of Sites Within Project Area	Date Before Present (B.P.)	Projectile Point Style or Cultural Group	Characteristics (Sites)
	Folsom		(11000 B.P.)	Folsom	Hunting extinct fauna (Bison antiquus); bison traps and some communal hunting suspected; collecting flora probable
	Llano		(12000 B.P.--11000 B.P.)	Clovis	Hunting extinct fauna; mammoth traps and communal procedures suspected; collecting flora probable

because of their scarcity and age. Evidence accumulated so far suggests the presence of a significant number of Paleo-Indian sites in southwestern Wyoming.

The Altithermal period, from 7000 to 4500 B.P., is generally thought to represent a cultural hiatus in most of the Great Plains, and particularly in the northwestern periphery of the Plains. Metcalf (1975) suggests there may have been marginal occupation of southwestern Wyoming during this period of elevated temperatures and intensive drought. Two of the sites inventoried by Metcalf at Black Buttes have been assigned to the Altithermal period.

Thirty-seven Middle period sites, dating from 4500 to 2000 B.P., were found at Black Buttes. Eight sites had artifacts associated with the McKean complex, Early Middle period, and 29 were associated with the Late Middle period.

The Late period, from 2000 B.P. to A.D. 1700, reflects an established pattern of hunting and gathering, yet the variety of traits suggests considerable cultural diversity. Projectile points, grinding slabs, and pottery are commonly associated with Late period sites. Most sites in this period are single component sites, containing fire pits, tepee rings, or suggestions of quarrying activities and subsistence activities. Three of the 43 late Prehistoric period sites had ceramic material which has been tentatively identified as belonging to the Intermountain style. Two of these sites had tepee rings. Ceramic styles suggest affinities with Shoshone or Fremont cultures. The Shoshone are known to have been the dominant group in this area (Cowie 1958) although Commanche, Flathead, Crow, Arapahoe, Gros Ventre, Cheyenne, and Sioux are known to have encroached upon southwestern Wyoming during raiding, hunting, or trading.

No archeological sites within the proposed Black Butte project area have been nominated to the National Register of Historic Places, and such nominations are not anticipated. An estimated 17,686 acres remain unsurveyed within the project area.

Historical

To aid discussion of the historic sites within the proposed Black Butte project area, the period has been divided into four broad catagories. They are: the Fur Trade and Early Exploration period, 1812-1841; the Acquisition, Emigration, Transportation, Communication, and Early Military History period, 1842-1869; the Settlement and Development period, 1869-1925; and the Recent Historical period, since 1925.

Certainly the Black Butte project area was traversed and trapped from 1812 to 1841, but little remains of these early activities. Rendezvous are known to have occurred to the south and west of the project area, but none are recorded for Black Butte.

The Oregon Trail (later the California Trail and Mormon Trail) lies to the north of the Black Butte project area. In 1862, a stage route through the Black Butte project area avoided Indian problems which had plagued the Pony Express and an early stage line which followed the Oregon Trail route. The Overland Stage route followed about the same route as does Interstate 80 today. The Overland Stage Company established stations at 15-mile intervals along the route to provide fresh horses and lodging for passengers during the trip. One of these, the Black Butte station, lies within the mine permit boundary. Close by are two others, Point of Rocks station, to the north, and Big Pond, to the south. The station at Point of Rocks has been partially restored; the others are ruins.

The Settlement and Development period, 1869-1925, occurred after completion of the railroad, and much intensive settlement and development was railroad related. Coal mined nearby supplied the railroad. The Gibraltar Mine, the old Black Butte Mine, and the Hallville Mine were established to supply the Union Pacific Railroad with coal. These developments made this area important in those times. Now most of these old underground mines are in ruins, and their locations are marked by slag piles, building foundations, and ruined walls of old structures. These mines continued production until the early 1900s. Because the Winton, Superior, Dines, and Reliance Mines were more profitable, the old mines were closed.

Ranching and farming did not have as strong an impact as mineral production. When the demand for coal declined because of the railroad's change to diesel fuel, the prosperity of nearby towns declined. Recently the renewed importance of coal has rejuvenated the prosperity of the area.

Black Butte Stage Station, Gibraltar Mine, and Hallville Mine, listed on the Wyoming Historic Preservation Plan, have been determined eligible for nomination to the National Register of Historic Places. Table BB2-9B lists these historic sites with their period of importance. These sites lie within or near the project area.

VISUAL RESOURCES

The landscape of the Black Butte project area is typified by rolling sage-covered hills bisected by the wide greasewood bottom of Bitter Creek. Scattered juniper stands occur on the steeper ridges in the southwest corner at the foot of Black Butte. As evidenced by seismograph roads and numerous well sites, the project area has been extensively explored for oil and gas. Buried pipelines transport oil and gas from producing wells in the southern part of the project area. The northern part is a utility corridor since Interstate 80 power transmission lines, and several gas lines cross it. The main east-west line of the Union Pacific Railroad runs through the center of the project area in a northwest-southeast direction. Viewpoints along the major routes of the project area are shown on Map BB2-10A, and Figures BB2-10A, BB2-10B, and BB2-10C show views from these viewpoints.

Based on the BLM format for Visual Resources Inventory and Evaluation (BLM Manual 6310), two visual resource management (VRM) classes have been identified in the project area. The analysis from which these classes

Table BB2-9B

SUMMARY OF HISTORIC SITES WITHIN BLACK BUTTE PERMIT AREA
AND IN PROXIMITY TO THAT AREA

Period II--Acquisition, Emigration, Transportation, Communication, and Early Military Period (1842-1869).		
National register Sites (Federal Register, Vol. 42, No. 21, Tues., Feb. 1, 1977)		
Point of Rocks Stage Station	Building	Partially restored
Wyoming Historic Inventory or Nominations in Process		
Big Pond Stage Station	Building	Deteriorated
Black Buttes Stage Station	Building	Deteriorated
Overland Trail	Trail	Variable
Period III - Settlement and Development Period (1869-1925).		
Wyoming Historic Inventory or Nominations in Process		
Hallville	Town/mine structures	Deteriorated
Gibraltar Mine	Town/mine structures	Deteriorated
Black Butte Mine	Mine structure	Deteriorated

Figure BB2-10A

TYPICAL VIEW FROM INTERSTATE 80 LOOKING SOUTH INTO THE PROPOSED BLACK BUTTE MINE AREA. THIS IS A CLASS III AREA.

Figure BB2-10B

VIEW OF THE FACILITIES SITE AS SEEN FROM THE UNION PACIFIC RAILROAD. THE SITE IS A CLASS IV AREA.

Figure BB2-10C

TYPICAL VIEW FROM VIEWPOINT D ON THE UNION PACIFIC RAILROAD LOOKING SOUTH. THIS IS AN EXAMPLE OF THE CLASS IV AREAS IN THE PROPOSED BLACK BUTTE MINING AREA.

have been derived appears in the Salt Wells Unit Resource Analysis which can be reviewed by the public at the Rock Springs District Office of the BLM. The VRM classes identified in this area are Classes III and IV (see Map BB2-10B). The basic management guidelines for these visual management classes are:

Class III—Management would require that changes in the basic elements (form, line, color, and texture) may be evident in the characteristic landscape; however, the changes should remain subordinate to the visual strength of the existing landscape character. Figure BB2-10A is an example of a Class III area.

Class IV—Management would require that changes may be subordinate to the original composition and character, but must reflect what could be a natural occurrence within the characteristic landscape. Figures BB2-10B and BB2-10C are examples of VRM Class IV areas.

RECREATIONAL RESOURCES

Visitor Use Data

Table BB2-11A depicts the estimated visitor use by activity in the proposed Black Butte Mine project area.

Table BB2-11B depicts the estimated general resident visitor use by activity in the ES region which includes the proposed Black Butte Mine. These data are based on a population of 41,263 for Sweetwater County in 1977. The data used to derive these numbers are available for public review at the Rock Springs District Office of the BLM.

Hunting

During the summer people enjoy traveling to the country to shoot ground squirrels and prairie dogs. In September, the antelope season draws hunters to the field. This area supplies a small antelope population for hunters. October brings deer hunters. However, in 1970 when the Wyoming Game and Fish Department made this a four-point or better buck area, hunting pressure dropped to about one-half of what it was when it was open for any antlered deer.

Rabbit hunters travel to the area along Bitter Creek to pursue cottontail after the first hard freeze. This season lasts from the first of September to the end of February.

In the past the Sweetwater County Wool Growers have offered a bounty of $10 each for coyote. In recent years the value of coyote hides has increased drastically to approximately $35 for a prime hide in 1975 and 1976 to $65 in 1977. This has encouraged people to travel to the area in winter to pursue coyote.

Sightseeing

The Overland Trail, which crosses the area, has been obliterated by a county road. People interested in history enjoy traveling along the old trail's corridor. The remains of the old Black Butte Stage Station, on private land, is in the center of the proposed Black Butte mining area. People passing through the area enjoy viewing wildlife.

Specialized Activities

Off-Road Vehicles

There are many oil and gas exploration roads located throughout the Black Butte project area. These roads were used quite extensively by persons with four-wheel drive vehicles for sightseeing.

Wilderness Values

There are no areas in or near the proposed Black Butte Mine area with identified wilderness values which meet the criteria set in Section 603 of the Federal Land Policy and Management Act of 1976.

AGRICULTURE

Livestock Grazing

The project area is within and represents about 2% of the surface acreage (about 36,600 of 1,797,178 acres) of the Rock Springs Grazing Allotment. The allotment provides year-round grazing for livestock (sheep and cattle) belonging to 23 operators. The allotment stocking rate is 15 acres per animal unit month (AUM). (Grazing data obtained from the Rock Springs District Office of the BLM.)

Livestock water within the project area is provided by wells, seasonal catchments, and Bitter Creek, an intermittent stream. Sheep make extensive use of snow as a source of water.

Prime Farmland

Consultation with personnel of the U.S. Department of Agriculture, Soil Conservation Service, Rock Springs, Wyoming, revealed that prime farmland is not present in areas proposed for disturbance (see Regional ES, Chapter 9, Consultation and Coordination).

MINERAL RESOURCES

Table BB2-11A

1976 ESTIMATED VISITOR DAYS BY ACTIVITY IN THE BLACK BUTTE AREA

Activity	Visitor Days
Hunting	165
Sightseeing	50
Off-road vehicle	20
Total	235

Note: Visitor day considered to be 12 hours.

Table BB2-11B

ESTIMATED RESIDENT VISITOR USE BY ACTIVITY IN THE ES REGION BASED ON A POPULATION OF 41,263 FOR SWEETWATER COUNTY IN 1977

Activity	Visitor Days
Fishing	172,400
General[1]	168,500
Hunting	54,500
Off-road vehicles[2]	6,700
Sightseeing	52,900
Urban recreation	106,400
Water sports	79,600
Winter sports	21,500

Note: Visitor day considered to be 12 hours.

[1]General includes camping, picnicking, etc.
[2]Estimate by ES Team Outdoor Recreation Planner.

Coal

The coal beds of interest are in the Fort Union, Lance, and Almond Formations. The Fort Union Formation is an 800-foot thick sequence of alternating light colored sandstones, gray and dark shales, and coal. In the northern part of the project area, the formation has thick beds of high quality coal, but only one minable coal bed occurs at any one locality. This coal seam is named the Black Butte bed. It varies in thickness from 26 feet in the northern section of the area to 10 feet at the south end.

The 750 foot thick Lance Formation consists of alternating light colored sandstones, gray and dark shales, and coal. The principal coal seam in the Lance is called the Gibraltar bed. It is 10 feet thick in the northern part of the area and thins to 5 feet in the south.

The Almond is the oldest coal-bearing formation that crops out in the Black Butte Mine area. It is 700 to 900 feet thick, and consists primarily of brown and light gray or cream colored sandstone, sandy shale, and clay. The Almond coal seam ranges from 10 to 12 feet thick in the center of the area to a point 2 miles northward, where the seam splits into a 7-foot and 5-foot bed with 10 feet of interburden.

Table BB2-13A shows the USGS estimated recoverable reserves (strippable to 150-foot highwall) in May 1975. Table BB2-13B shows the Black Butte Coal Company estimated recoverable reserves, computed with 90% recovery factor. The coal quality as reported by Black Butte is shown in Table BB1-2.

The underground coal reserves on federal coal lease W-6266 as estimated by the Black Butte Coal Company are as follows: underground in-place reserves—75,152,400 tons; underground minable reserves—62,318,800 tons; underground recoverable reserves—29,595,000 tons.

Black Butte Coal Company does not plan to mine coal by underground methods within the time frame of this environmental statement.

Oil and Gas

There are many oil and gas wells on the Black Butte project area that are unproductive and as a result have been plugged and capped. However, four producing oil and gas wells operated by Chandler and Associates would interfere with planned mining operations. The four producing wells operated by Chandler and Associates are listed in Table BB2-13C.

It is Black Butte Coal Company's responsibility to resolve this matter, possibly by establishing a buffer zone, large enough to allow stability and protection to the well, and bypassing coal in the mining process.

LAND USE PLANS, CONTROLS, CONSTRAINTS

Several governmental agencies exercise certain types of land and resource use controls in Sweetwater County. The proposed Black Butte Mine includes public, state, and private lands. The federal sector is administered by the BLM (public lands and mineral estate under certain private lands). Except where controls have specifically been delegated by statute to counties or municipalities, Wyoming retains total jurisdiction over nonpublic and privately owned lands (including mineral leasing, rights-of-way, etc.) is governed by Wyoming law. The Black Butte Mine includes 160 acres of state lands. Counties have authority to effect a wide variety of controls in matters not specifically reserved to the state. The authority applies only to those portions of the county that are unincorporated. A county may regulate and restrict location and use of buildings and structures and use, condition of use, or occupancy of lands for residency, recreation, agriculture, industry, commerce, public use, and other purposes that are reasonably necessary to protect the public good of its citizens. All of the respective jurisdictions (federal, state, and county) have sufficient authority to impose effective land and resource use controls.

TRANSPORTATION NETWORKS

Highways

Interstate 80 crosses just north of the Black Butte project area. This four-lane highway is used extensively by truck freight, recreationists passing through, and local residents. A county road follows Bitter Creek providing access through the central part of the mining area. There are numerous two-track roads throughout the area. In 1976, 31,700 vehicle license tabs were sold in Sweetwater County.

Railroads

The main east-west line of the Union Pacific Railroad passes through the center of the area from the northwest to the southeast. This railroad line connects the east and west portions of the country as it services southwest Wyoming. Table BB2-14A depicts the estimated capacities and current use which passes through Wyoming.

SOCIOECONOMIC CONDITIONS

The social and economic environments that would be affected most significantly by the proposed Black Butte Mine include that portion of Sweetwater County within the ES region and two major communities—Rock Springs, the county's largest city, and Green River, the county seat.

Table BB2-13A

ESTIMATED RECOVERABLE RESERVES

	Measured	Indicated	Inferred	Total
Federal	45,726,000	4,140,000	1,623,000	51,489,000
Private	52,872,000	11,024,000	4,104,000	68,000,000
Total	98,598,000	15,164,000	5,727,000	119,489,000

Table BB2-13B

ESTIMATED RECOVERABLE RESERVES COMPUTED WITH 90% RECOVERY FACTOR

Stripping Depth	Federal	UPRR	Black Butte	Fee	Total
To 150 feet	33,398,000	46,250,000	4,158,000	1,156,000	84,962,000
To 175 feet	41,170,000	57,013,000	5,323,000	1,425,000	104,931,000
To 200 feet	48,549,000	67,232,000	6,277,000	1,680,000	123,738,000

Table BB2-13C

CHANDLER AND ASSOCIATES PRODUCING WELLS

Kind	Location	Mine	Date Mining Would Reach
Gas	Sec. 2, T. 19 N., R. 100 W.	H	1987
Gas	Sec. 10, T. 19 N., R. 100 W.	A	1991
Oil	Sec. 16, T. 19 N., R. 100 W.	M	1994
Oil	Sec. 16, T. 19 N., R. 100 W.	L	1998

Source: Black Butte Coal Company 1977.

Table BB2-14A

ESTIMATED CAPACITIES OF IDENTIFIED LINE SEGMENTS

Segment	Number of Tracks	Signaling	Length (Miles)	Estimated Capacity (trains per day)	Current Traffic (Trains per day)	Estimated % Capacity
Kansas City to Topeka	2	ABS	68	55- 60	44	73%
Topeka to	1	CTC	203	25- 30		73%
Gibbon	2	CTC	17	70- 80	22	28%
Council Bluffs to Gibbon	2	ABS	176	55- 60	34	57%
Gibbon to	2	ABS	100	55- 60		88%
North Platte	2	CTC	8	70- 80	53	66%
North Platte to	2	ABS	182	55- 60		78%
Cheyenne	2	CTC	43	70- 80	47	•59%
Cheyenne to	3	CTC	35	100-115		44%
Hanna	2	CTC	108	70- 80	51	64%
Hanna to Rawlins	2	CTC	40	70- 80	45	56%
Rawlins to	2	ABS	101	55- 60		73%
Green River	2	CTC	33	70- 80	44	55%
Green River to Granger	2	CTC	30	70- 80	40	50%
Granger to Kemmerer	1	CTC	40	25- 30	13	43%
Kemmerer to McCammon	1	CTC	174	25- 30	13	43%
McCammon to Pocatello	1	CTC	174	25- 30	13	43%

Table BB2-14A

ESTIMATED CAPACITIES OF IDENTIFIED LINE SEGMENTS
(Continued)

Segment	Number of Tracks	Signaling	Length (Miles)	Estimated Capacity (trains per day)	Current Traffic (trains per day)	Estimated % Capacity
Granger to	2	ABS	126	55- 60		53%
Ogden	2	CTC	19	70- 80	32	40%

Source: Union Pacific Railroad Company, 1978.

ABS = Automatic Block Signalization
CTC = Centralized Traffic Control

Population

The estimated 1977 population of that portion of Sweetwater County within the ES region was 41,263 persons. The populations of Rock Springs and Green River were 25,996 and 12,502, respectively. The remaining 7% (2,765) of the county's population is spread out among 11 much smaller towns and in rural areas (Abt Associates 1978).

The county has recently experienced a period of rapid growth with "boom town"proportions (Gilmore 1974). Its population has increased 124% (22,872) over the 1970 census figure of 18,391 (U.S. Department of Commerce, Bureau of the Census 1970a). Rock Springs and Green River have had increases of 123% (14,339) and 198% (8,306), respectively, in the same period. The "boom"-conditions were primarily the result of the construction of the Jim Bridger Power Plant and the expansion of trona mining activities in the area.

Employment

Total employment in the county in 1977 was estimated at 19,653 jobs (Table BB2-15A). Employment in Rock Springs accounts for approximately 60% of county employment (Dempsey, John and Associates 1975). Approximately 49% (9,633 jobs) of 1977 total employment was in the mining and construction sectors.

The unemployment rate in the county was 3.8% (618) in 1977 (Wyoming Employment Security Commission 1977); however, Sweetwater County has consistently maintained a low rate in recent years. The ratio of the local service to basic employment jobs in 1977 was 0.75 or 6,700 local service jobs to 15,633 basic employment jobs (THK Associates 1977).

Income

Personal earned income in the county was estimated at $258.4 million in 1977, while per capita income was $6,263 (Abt Associates 1978). The median family income in 1977 was $16,200—an increase of 27% ($3,408) over the 1970 figure of $12,792. This rapid increase in income was a result of the increase in the activities mentioned above.

Infrastructure

Private Sector

Rock Springs is the leading commercial center in the county. While most data predates the high growth years of 1973-1974, studies show that it captures 77% of retail revenues, 51% of service revenues, and 94% of wholesale revenues in the county (U.S. Department of Commerce, Bureau of Census 1972a). Green River captures approximately 18% of retail revenues. County monthly retail sales in 1977 were estimated at $110.2 million, while wholesale sales were estimated at $39.9 million (Abt Associates 1978).

Public Finance

The rapid growth of the county has increased demands on both public operating and capital expenditures in recent years. The county's response has been to increase bonded indebtedness substantially and reduce the mill levy on significantly increased valuation. Assessed valuation was $469.9 million in 1977 (Abt Associates 1978).

Housing

It is estimated that there were 10,367 dwelling units in the county in 1977 (Table BB2-15B). Rock Springs had 5,197, and Green River had 3,312 (Abt Associates 1978). In spite of recent construction, the demands for housing are still greater than what is available. Many residents are forced to turn to mobile homes in lieu of more permanent housing.

Education

There are two school districts in the county—district 01 serves Rock Springs and district 02 serves Green River. Table BB2-15C provides data on teachers and expenditures in the district. In 1977 enrollment was 4,903 in district 01 and 3,052 in district 02. Both have current and planned excess capacity (Dempsey, John and Associates 1975, Parker and Associates 1975a).

Health and Social Services

The recent population expansion has put severe strains on these services. The health services profile for the county for 1977 is shown on Table BB2-15D. The county is served by a new 100-bed hospital. Mental health services are provided by the Southwest Counseling Service in Rock Springs. Other services are offered through the Sweetwater County Welfare Office.

Police and Fire Protection

The County Sheriff's Department has 25 officers. It has modern offices and a new jail that are currently adequate. The Rock Springs Police Department has a total force of 33. It is considered adequate, although recruitment problems exist because wages are below most larger, competing cities. The Green River Police Department has 21 officers. Its facilities are in need of expansion to support recent increases in manpower (Abt Associates 1977 and 1978).

Fire protection is provided to Rock Springs by 23 paid and 3 volunteer firemen. Outlying areas within a 6-mile radius are also served by the force. The city has a fire insurance rating of 7 (Abt Associates 1978). The town of

Table BB2-15A

EMPLOYMENT: SWEETWATER COUNTY

	1977 Estimated Employment
Total employment	19,653
Proprietors	1,081
Farm	116
Nonfarm	965
Wage and salary	18,572
Farm	243
Nonfarm	18,329
Government	1,821
Private	16,508
Manufacturing	358
Mining	4,897
Construction	4,736
Transportation	1,167
Trade	2,930
Finance, insurance and real estate	217
Services	2,169
Other	34

Source: Abt Associates 1978.

Table BB2-15B

HOUSING CHARACTERISTICS: SWEETWATER COUNTY

County Community	Total Units	Single-Family	Multi-Family	Mobile Homes
Sweetwater County[1]	10,367	5,555	1,171	3,641
Rock Springs[1]	5,197	3,199	622	1,376
Green River[2]	3,312	1,783	467	1,062
Balance of county[2]	1,858	573	82	1,203

[1]Abt Associates 1978.
[2]THK Associates 1976.

Table BB2-15C

EDUCATIONAL SYSTEM CHARACTERISTICS: SWEETWATER COUNTY

	Rock Springs SD#1	Green River SD#2
1977 fall enrollment	4,903	3,052
(Number of classroom teachers Full-time equivalent)[1]	259.5	145.0
Student/teacher ratios[1,3]	18.9	21.0
Total annual expenditures ($-millions)[1]	11.08	5.3
Average daily membership (ADM)[1]	4,557	2,875
Expenditures per ADM[2,4] ($)	2,429	1,857
Assessed valuation ($-millions)[1]	313	134.5
Assessed valuation per ADM[2,5] ($)	68,686	46,783
Number of classrooms	222	139

[1]Wyoming Department of Education, Division of Planning, Evaluation and Information Services 1977.
[2]Derived from Wyoming State Department of Education data.
[3]Fall 1977 statewide average for classroom teachers 18.4 (Wyoming Department of Education, Division of Planning, Evaluation and Information).
[4]1976-1977 statewide average expenditures per ADM - $1,721 (Wyoming Department of Education, Division of Planning, Evaluation and Information).
[5]1976-1977 statewide average assessed value per ADM - $31,143 (Wyoming Department of Education, Division of Planning, Evaluation and Information).

Table BB2-15D

HEALTH AND SOCIAL SERVICES: SWEETWATER COUNTY

Personnel Facilities	Number	Ratio Per Population Increment	State Standard Ratio Per Population Increment
Physicians	14	1:2,947	1:1,000
Nurses (employed)			
Registered nurses	92	1:449	1:285
Licensed practical nurses	24	1:1,719	1:769
Public health nurses	8	1:5,158	1:7,660
Total	124		
Dentists	13	1:3,174	1:1,600
Optometrists	5	1:8,253	1:7,000
Hospitals	1	1:41,263	1:19,944
Hospital beds	97	1:425	1:179
Ambulances	9	1:4,585	1:3,740
Emergency rooms	1	1:41,263	1:13,296
Mental health centers	1	1:41,263	1:12,297

Source: Wyoming Division of Health and Medical Services 1977.

Green River has a 31-man volunteer fire department. Outlying areas with a 6-mile radius are also served. The town has a fire insurance rating of 7 (Abt Associates 1978).

Water and Sewer Systems

Both Rock Springs and Green River receive water from the Pacific Power and Light Company. The water supply comes from the Green River and receives treatment via a micro floc filter system. The plant has a capacity of 12 million gallons per day (mgd) which is expected to be adequate until 1982 or 1983 (Abt Associates 1977).

Green River currently has a sewage lagoon and privately owned sewage treatment plant. The town has recently expanded its system; it has a capacity of 1.5 mgd. It should be adequate through 1990. Rock Springs' sewage system has a 2.0 mgd capacity with a 1.6 mgd average 1977 daily flow (Abt Associates 1978).

Utilities

Electric power is supplied to both Rock Springs and Green River by the Pacific Power and Light Company. With the construction of the Jim Bridger Plant, the company has the potential of producing over 3,000 megawatts (two other facilities are also used). Electric power supply should not be a problem in the foreseeable future (Abt Associates 1977).

Natural gas service for both communities is supplied by the Mountain Fuel and Supply Company. It has a capacity of over 11 million cubic feet per hour coming into the area. No supply problems are anticipated at present (Abt Associates 1977).

Attitudes and Expectations

The attitudes and expectations of county residents are dependent upon the benefits that they expect to receive from recent growth and the local government's ability to cope with the pressures resulting from it. In 1970, the county was basically rural in nature. Coal mining and the railroad were the primary industries before trona mining began to expand in response to a need for a nonpolluting source of soda ash and construction of the Jim Bridger plant began. Since then, the county has seen a rapid expansion of employment opportunities and, consequently, a rapid increase in population and income.

Those involved in the mining and construction sectors generally have a favorable outlook financially. They make high salaries and enjoy the benefits that accompany above average incomes. Residents employed in local services with their lower incomes find it difficult to compete for goods and services with the inflated prices arising under rapid growth conditions. Items such as adequate housing, especially the purchasing of a new home, become very difficult to obtain.

Nearly all residents, however, are concerned about the shortages in services that exist in most areas. The huge increase in population has put great demands on social services (hospitals, dentists, etc.), recreation facilities, public facilities (roads, sewage systems, etc.), and consumer services. It has also led to unplanned growth that has resulted in scattered mobile home parks, traffic congestion, and other problems associated with overcrowding. These difficulties have made many residents unhappy with life in the area. Unable to get needed services and find recreational or cultural outlets, many leave causing high turnover rates in housing and jobs. Crime, drinking, and family problems have all risen.

On the other hand, the local governments have made significant efforts to remedy the situation. Rock Springs now has a city planner as does Sweetwater County. Comprehensive plans have been or are being prepared to control future growth. The increased population and new industry have brought in new funds to support additional services and facilities to help cope with demands. Rock Springs, especially, is beginning to "catch up"with its "boom,"and residents' outlooks are on the upswing (Gilmore 1974 and Abt Associates 1977).

Life Styles

There are two basic components to life styles in Sweetwater County. The older and more permanent style is a reflection of preboom years when the area was primarily rural in nature. Communities had a small-town atmosphere with life centering on outdoor activities, hard work, church, and family. The recent industrial growth has threatened this way of life. Many older residents resent it, even though they have benefited from it in terms of expanded services and higher incomes in many cases. There is also concern about maintaining the wide-open spaces associated with this area. Mining and other new industrial activities would disturb the land both physically and visually.

Economic growth and increased industrialism has, however, changed much of the rural atmosphere of the area. Laborers from other communities, including large cities, have entered the county. They are used to more city-centered activities and have found the transition to a smaller town difficult. The increase in population has also brought many of the problems associated with larger towns (traffic, crime, noise, etc.) as well as the benefits (more services and expanded facilities). The newer population has in effect brought with it a faster pace of life, a turn towards greater industrialism, and a trend of urbanization (Gilmore 1974 and Abt Associates 1977).

FUTURE ENVIRONMENT

The portion of Sweetwater County within the ES region will grow at an estimated annual rate of 3% through 1985 and 1.5% after 1985 and through 1990. The county's population will increase from an estimated

41,263 persons in 1977 to 45,320 in 1980, 52,951 in 1985, and 57,286 in 1990. About 63% of the new growth by 1990 (10,094 persons) will occur in Rock Springs and 30% (4,856 persons) in Green River. County employment will increase from an estimated 19,653 jobs in 1977 to 21,571 in 1980, 25,453 in 1985, and 27,446 in 1990. The mining sector will nearly double in size between 1977 and 1990 (4,897 to 9,002 jobs). Personal and per capita income will reach an estimated $502.3 million (a 94% increase) and an estimated $8,768 (a 40% increase), respectively. The expected population increases will put significant additional pressures on public and private services and facilities, housing, and utilities. The governments of Sweetwater County, Rock Springs, and Green River will need to substantially increase expenditures.

The upward trend in the county's population will result in increased vehicular use of roads and highways. It is estimated that annual vehicle license tab sales will increase from 31,700 in 1976 to 34,800 in 1978 through 1979 and from 40,700 in 1980 through 1984 to 44,000 in 1985 through 1990.

Table BB2F-14A presents estimated increased railroad traffic data through 1990.

Estimated changes in recreational visitor use in Sweetwater County through 1990 are shown in Table BB2F-11A.

The expanded Jim Bridger Power Plant will have a local effect on air quality (see Maps R2-2A and R2-2B).

Adverse and beneficial impacts to cultural and paleontological resources will show correlation with developmental and population trends.

The air quality, climate, geology, topography, soils, water, vegetation, fish and wildlife, visual, and mineral resources of the lands comprising the Black Butte project area will not change appreciably through 1990 without the proposed mining.

Table BB2F-14A

ESTIMATED FUTURE RAILROAD TRAFFIC WITHOUT COAL MINING IN SOUTHWEST WYOMING

Segment	Estimated Capacity[1] (trains per day)	Current Traffic[1,2] (trians per day)	1980 Traffic[3,4] (trains per day)	1980 % Capacity	1985 Traffic[3,4] (trains per day)	1985 % Capacity	1990 Traffic[3,4] (trains per day)	1990 % Capacity
Kansas City to Topeka	70-80	44	48	60	56	70	65	81
Topeka to Gibbon	70-80	22	24	30	28	35	32	40
Council Bluffs to Gibbon	55-60	34	37	62	43	72	50	83
Gibbon to North Platte	70-80	53	58	73	67	84	78	98
North Platte to Cheyenne	70-80	47	51	64	60	75	69	86
Cheyenne to Hanna	70-80	51	56	70	65	81	75	94
Hanna to Rawlins	70-80	45	49	61	57	71	66	83
Rawlins to Green River	70-80	44	48	60	56	70	65	81
Green River to Granger	70-80	40	44	55	51	64	59	74
Granger to Kemmerer	25-30	13	14	47	16	53	19	63
Kemmerer to McCammon	25-30	13	14	47	16	53	19	63
McCammon to Pocatello	25-30	13	14	47	16	53	19	63

Table BB2F-14A

ESTIMATED FUTURE RAILROAD TRAFFIC WITHOUT COAL MINING IN WOUTHWEST WYOMING
(Continued)

	Estimated	Current	1980		1985		1990	
Segment	Capacity[1] (trains per day)	Traffic[1,2] (trains per day)	Traffic[3,4] (trains per day)	% Capacity	Traffic[3,4] (trains per day)	% Capacity	Traffic[3,4] (trains per day)	% Capacity
Granger to Ogden	55-60	32	35	58	41	68	47	78

[1]Union Pacific Railroad Company 1978.
[2]Through freight only.
[3]Abt Associates 1978.
[4]Estimates by ES team.

Table BB2F-11A

ESTIMATED RESIDENT VISITOR USE DEMAND BY ACTIVITY
FOR YEARS 1980, 1985, AND 1990

Activity	Visitor Days 1980	Visitor Days 1985	Visitor Days 1990
Fishing	192,700	229,400	250,700
General[1]	188,900	229,100	253,500
Hunting	59,400	69,100	74,300
Off-road vehicle[2]	7,400	8,700	9,400
Sightseeing	58,200	69,900	76,700
Urban	123,300	157,600	178,800
Water sports	90,600	112,500	126,200
Winter sports	25,400	33,800	38,800

[1]General includes camping, picnicking, etc.
[2]Estimate by ES Team Outdoor Recreation Planner.

CHAPTER 3

THE ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

This chapter discusses the impacts that would result from implementation of the proposed Black Butte Mine. Impacts are linked to specific aspects of the mining and reclamation plan and are quantified to show magnitude, intensity, duration, and incidence.

This chapter also provides the bases for assessing unavoidable adverse impacts in Chapter 5.

ASSUMPTIONS AND ANALYSIS GUIDELINES

An analysis of impacts requires establishing assumptions and guidelines for coal-related development.

Assumptions

1. Labor and equipment shortages would not significantly distort the projected levels of development.
2. No extensive delays would be encountered in obtaining required clearances and permits.
3. The reclamation of mined areas would require an estimated 9 years. This would include 4 years for backfilling, spoil shaping, seedbed preparation, planting, and replanting and 5 years for plant establishment (during which time livestock and extensive big game use would be prevented).
4. Areas not disturbed by mining excavation (such as rights-of-way, etc.) would not require extensive backfilling and shaping and would be reclaimed in an estimated 8 years.
5. It is assumed that irrigation would be employed if necessary to avoid extensive delays in reclamation.

Guidelines

1. Impacts are analyzed at four time points (1980, 1985, 1990, and 2004 (end of mine life)).
2. Impacts remaining after post mining reclamation are considered long term.
3. Table R1-6 in the Regional ES presents projected acreages used to determine facility disturbance not given in the mining and reclamation plan.
4. Mining plant site analyses include mine, mine facilities, and all ancillary development (i.e., roads, power lines, railroad spur tracks, and ponds).
5. The proposed revegetation seeding mixture would be subject to revision based on research results at the proposed mining area and, when applicable, at other locations.
6. Successful reclamation would require the establishment of a diverse, effective, and permanent vegetative cover of native and (or) acceptable introduced species capable of supporting post mining land uses. The living plant ground cover on revegetated areas would have to equal the ground cover of living plants on approved reference areas for a minimum of two growing seasons.
7. Post mining land uses would primarily involve livestock grazing, wildlife habitat, and outdoor recreation (Bureau of Land Management (BLM) Salt Wells Management Framework Plan 1977c).
8. The BLM would design and implement appropriate grazing management systems to prevent overgrazing of reclaimed areas.

AIR QUALITY

Emissions from the Proposed Mine

The specific emission sources of the Black Butte Mine are presented in Table BB3-2A. From this table, it is obvious the fugitive dust emissions are included in this analysis (43 CFR 118 Regulations are not applied) and, therefore, represent a conservative (upper bound) assessment of the impact of the proposed mine. However, based on state-of-the-art emission calculations and modeling techniques, this analysis reflects as accurately as possible the impacts of the mining and reclamation plan which was on file with the U.S. Geological Survey (USGS) at the time of the modeling effort.

For the contribution of wind erosion from unreclaimed and partially reclaimed land, the most probable situation would be represented by mulching and furrowing in the spring, followed by fall planting. Note that the projected emissions (Table BB3-2A) were based on the assumption that mulching and planting would be performed in the fall in a one-step operation. Surface roughness impediments to erosion (furrowing), moreover, were neglected in that analysis. If these control measures were included in the analysis, the total emissions load would be reduced by 26%, 36%, 37%, and 17% for the years 1980, 1985, 1990, and end of mine life, respectively.

As shown in the preceding paragraph, best management practices were not necessarily included in the air quality impact analysis. Only those mitigating measures discussed in the Black Butte mining and reclamation plan

Table BB3-2A

BLACK BUTTE PARTICULATE EMISSIONS

	Total Suspended Particulates in Tons Per Year			
	1980	1985	1990	End of Mine Life
Overburden removal	1,121	1,435	960	4,800
Ore loading	270	330	315	165
Truck dumping	54	66	63	33
Train loading	5	7	6	3
Conveying	27	33	32	16
Coal storage	2	2	2	1
Crushing (primary)	3	3	3	2
Crushing (secondary)	9	11	10	5
Employee access roads	43	37	37	37
Haul roads (coal)	357	437	417	219
Haul roads (overburden)	0	0	0	0
Haul road repair	56	56	56	56
Dozers (overburden dumps)	224	224	224	224
Wind erosion	1,020	2,111	1,861	1,467
Totals	3,191	4,752	3,986	7,028

Source: Environmental Research and Technology (ERT) 1978b.

on file with the USGS at the start of this rewrite were included in the modeling. In any event, the worst case mine situation is discussed, and best management practices will produce fewer and less intense impacts. It was not possible to include best management practices in Chapter 3 because the suggestions came in too late for modeling to be done and, if included now, would negate the continuity of the present analysis. Chapter 8 contains an air quality alternative which discusses the best management practice impacts.

Impact on Air Quality

Figures BB3-2A through BB3-2D show the mine-related suspended particulates (SP) concentrations for worst-case annual and 24-hour averages predicted by the model. Concentrations are shown to decrease rapidly with distance. Annual 24-hour mine-related concentrations decrease to 10% of maximum values at 3 to 4.5 miles and 1.5 to 2 miles downwind of the mine, respectively.

When annual average background particulate values of 17 micrograms per cubic meter ($\mu g/m^3$) for 1980 and 18 $\mu g/m^3$ for all other years (ERT, 1978a), are added to projected mine-related contributions, total levels greater than the annual 75 $\mu g/m^3$ National Ambient Air Quality Standards (NAAQS) are predicted within 1.5, 2, 2, and 2.5 miles of the mine; and total TSP concentrations greater than the Wyoming 60 $\mu g/m^3$ standard are predicted within 2, 2.5, 2.5, and 3 miles of the mine for the years 1980, 1985, 1990, and end of mine life, respectively. Background concentrations are projected to contribute 70% to total TSP levels at 5.5 to 9 miles and 18 to about 25 miles from the mine for annual and 24-hour averaging periods, respectively.

If projected mine-related 24-hour SP values and background concentrations of 35 $\mu g/m^3$ are combined, concentrations greater than the 24-hour primary NAAQS of 260 $\mu g/m^3$ are predicted within 3, 4, 3.5, and 5 miles; and concentrations greater than the Wyoming standard of 150 $\mu g/m^3$ are predicted within 4.5, 6, 5, and 8 miles of the mine for the years 1980, 1985, 1990, and end of mine life, respectively.

A comparison of the worst-case mine impact with prevention of signficant deterioration (PSD) regulations is shown in Table BB3-2B. The distances from the mining area within which predicted concentrations are higher than the specified regulations are listed for annual and 24-hour averages according to PSD area classification. Concentrations greater than the Class II annual PSD increment are predicted to occur within 3 to 6 miles and the 24-hour increment within 11 to 20 miles of the mine. In addition, when the coal is mined near Interstate Highway 80 (I-80), the PSD increments and air quality standards may be exceeded near the highway.

Note that under the new PSD regulations (43 CFR 118), the violations discussed above would not occur. In fact, the surface mines would be within the applicable NAAQS and PSD regulations.

The impact of blasting and coal fires is difficult to assess, although the maximum air quality degradation would occur on a local scale. The cloud of dust produced by blasting would be short-lived, at least compared to the averaging times of the TSP standards (24 hours or greater), so that little contribution to 24-hour levels would be measured outside the mine site. The dust produced would also be initially dispersed to a great degree by the force of the blast. Blasting would generally take place during the day, when meteorological characteristics are most favorable for dispersing ground-level pollutants. Any fire on the site could significantly contaminate the air and cause a safety hazard. However, due to the high degree of fire control technologies, potential fire impacts would probably be minimal.

Gaseous Pollutants

Vehicle emissions would be the only source of gaseous air pollutants from the proposed mine. Federal and state regulations include limitations on ambient air concentrations of the vehicle-related pollutants CO, HC, NO_2, and SO_2.

Maximum predicted concentrations of CO ranged between 0.02% and 0.44% of the standard. Maximum predicted HC concentrations ranged between 0.88% and 3.44% of the standard. Maximum predicted NO_2 concentrations ranged between 0.60% and 3.0% of the standards. Maximum predicted concentrations of SO_2 ranged between 0.02% and 0.33% of the standards. The values represent predictions at less than one-half mile from the mines. Predictions were significantly less at further distances from the mines. Assuming similar vehicle activity for all western coal mines, the impact of vehicle emissions on ambient concentrations of gaseous pollutants would be minimal and insignificant compared to their respective standards.

Visibility

Using the technique discussed in the Chapter 4, Regional Technical Report (ERT 1978a), visibilities have been computed downwind from the source. Results for worst-case 24-hour SP concentrations for the years 1980, 1985, 1990, and end of mine life are shown in Table BB3-2C. Also given are the mass fractions of the total TSP for coal and soil for each year which were used in calculating the visibilities shown in Table BB3-2C. For 1980 the visibility of an observer at 1 mile downwind would be approximately 38.4 miles assuming a background visibility of 40 miles. In general, visibility would increase with downwind distance from the mine. At 5 miles downwind the visibility would be 39.4 miles and at 10 miles it would reach 39.5 miles. The corresponding values, assuming a background visibility of 7 miles, are 6.7 miles, 6.9 miles, and 6.9 miles, respectively. Additional analysis years are given in the table.

The visibility impact from mining along I-80 could be significant visually on high wind speed days, but is not

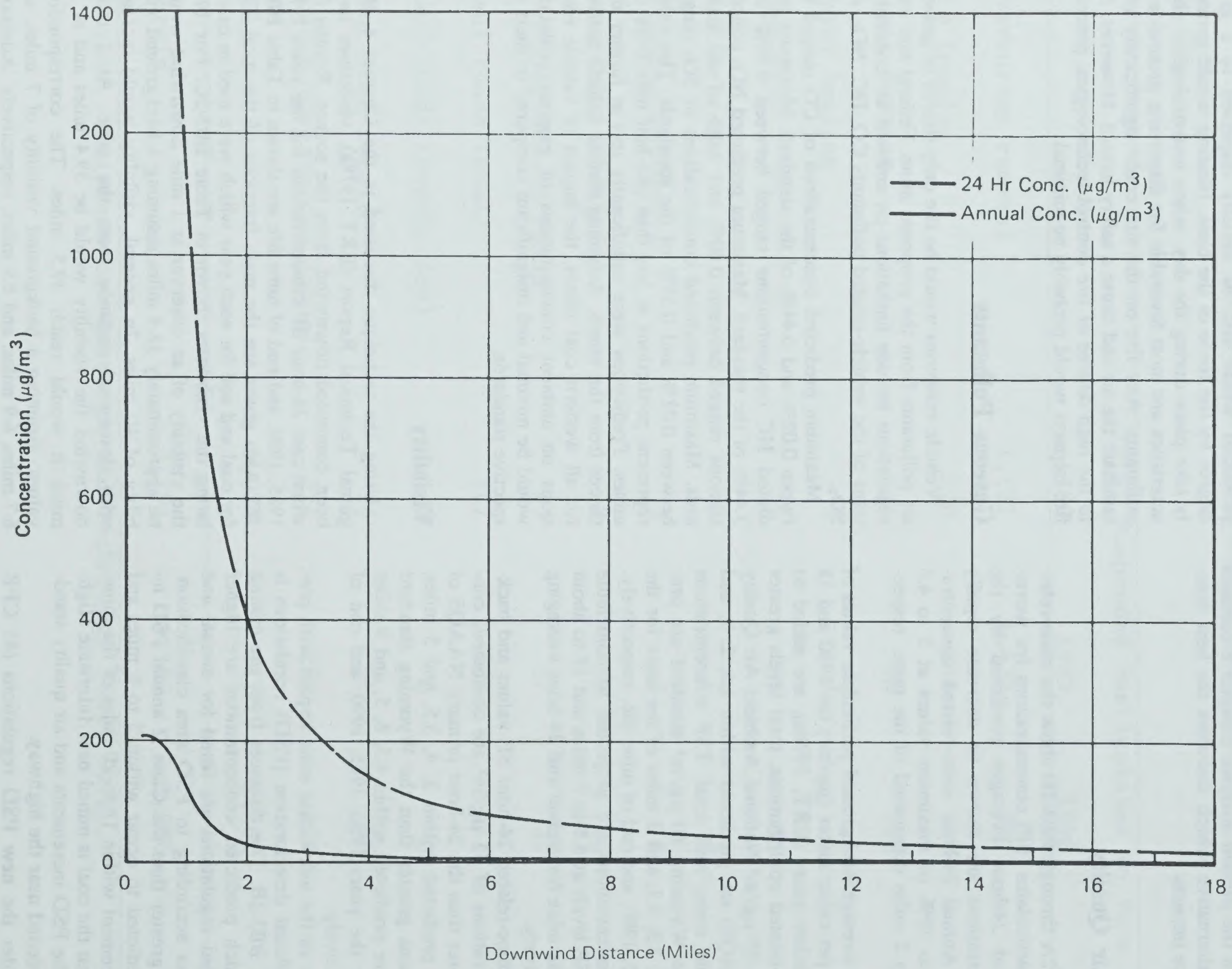


Figure BB3-2A

1980 BLACK BUTTE SP CONCENTRATIONS

Source: 1978a

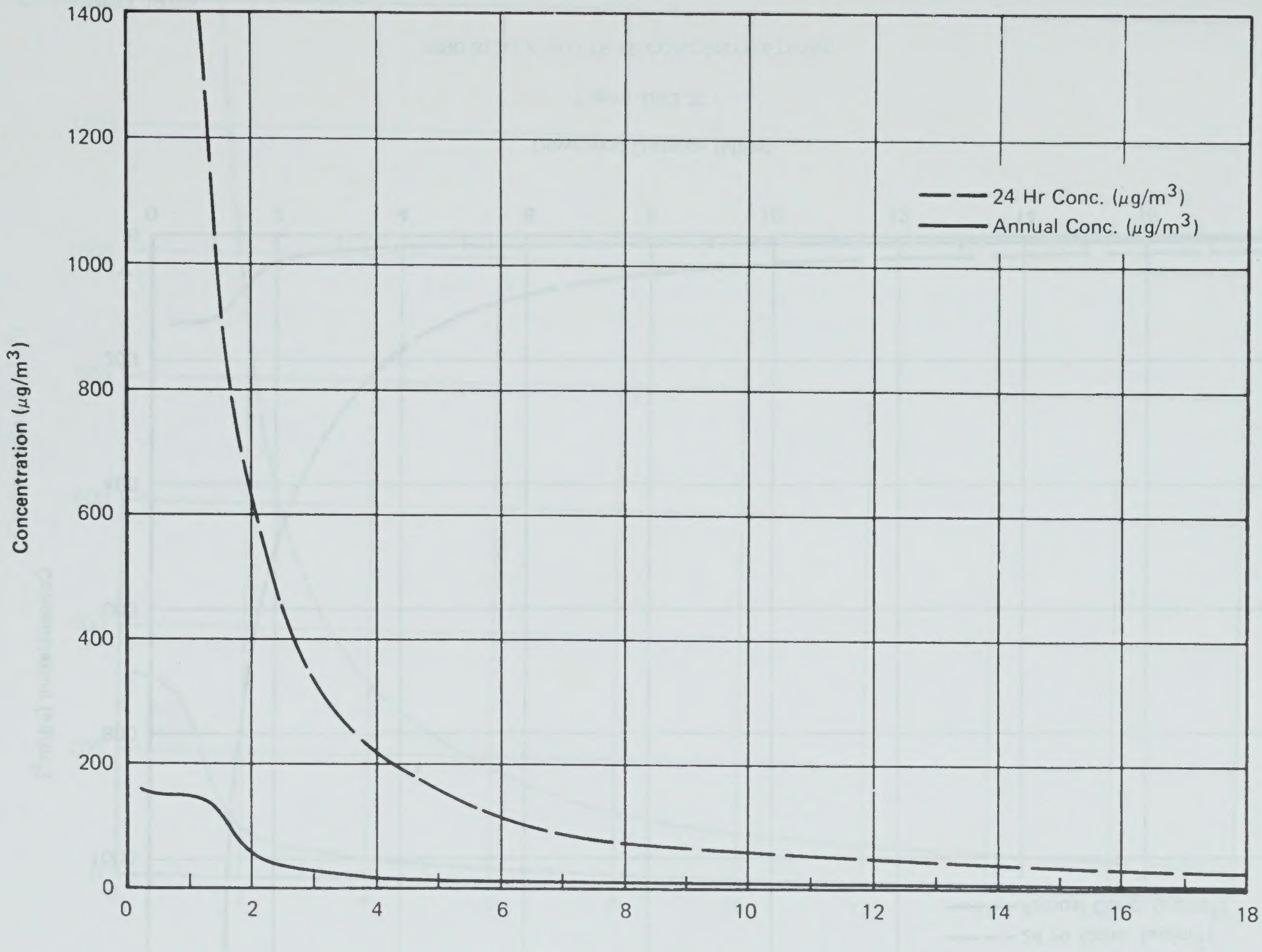


Figure BB3-2B

1985 BLACK BUTTE SP CONCENTRATIONS

Source: 1978a

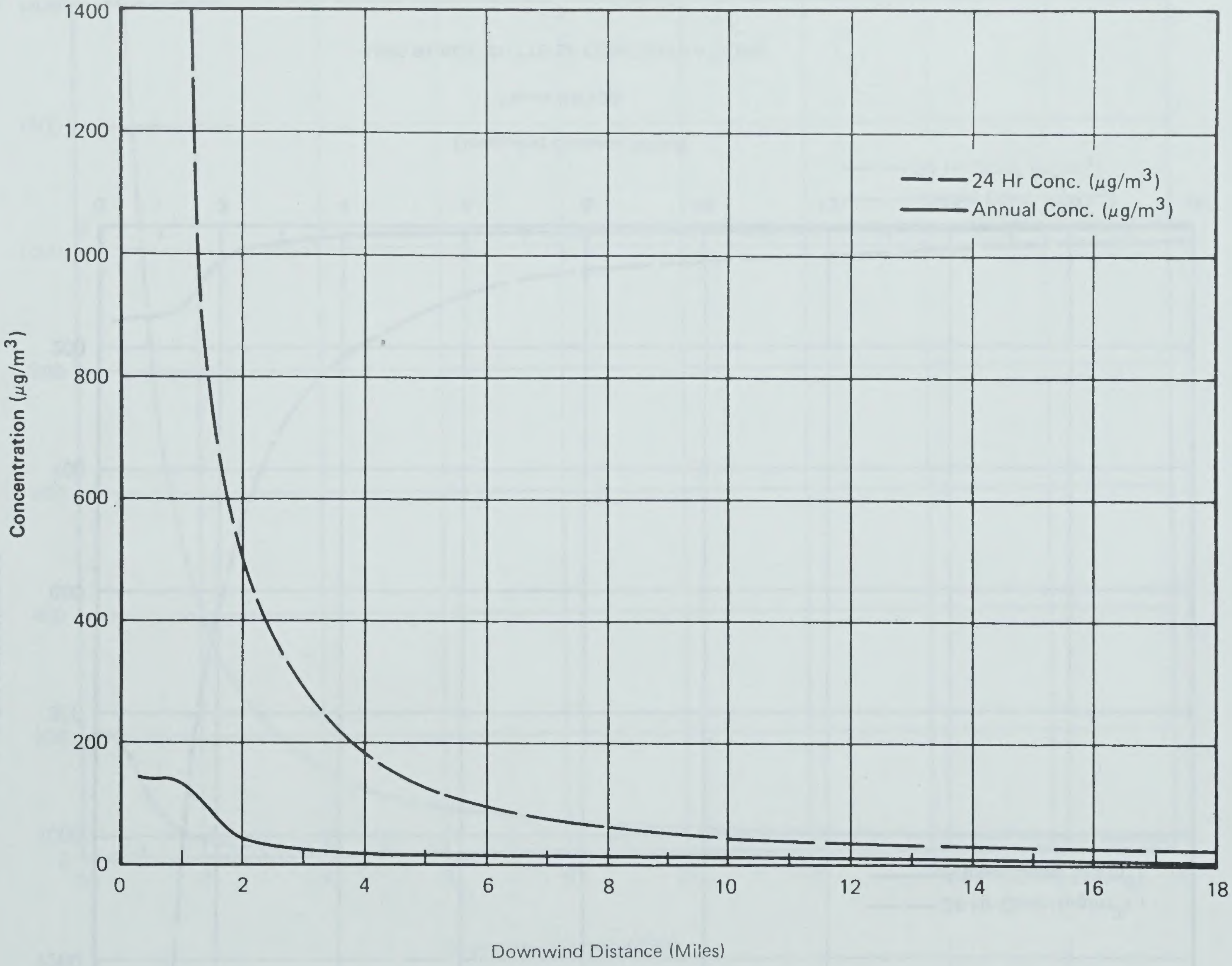


Figure BB3-2C

1990 BLACK BUTTE SP CONCENTRATIONS

Source: ERT 1978a

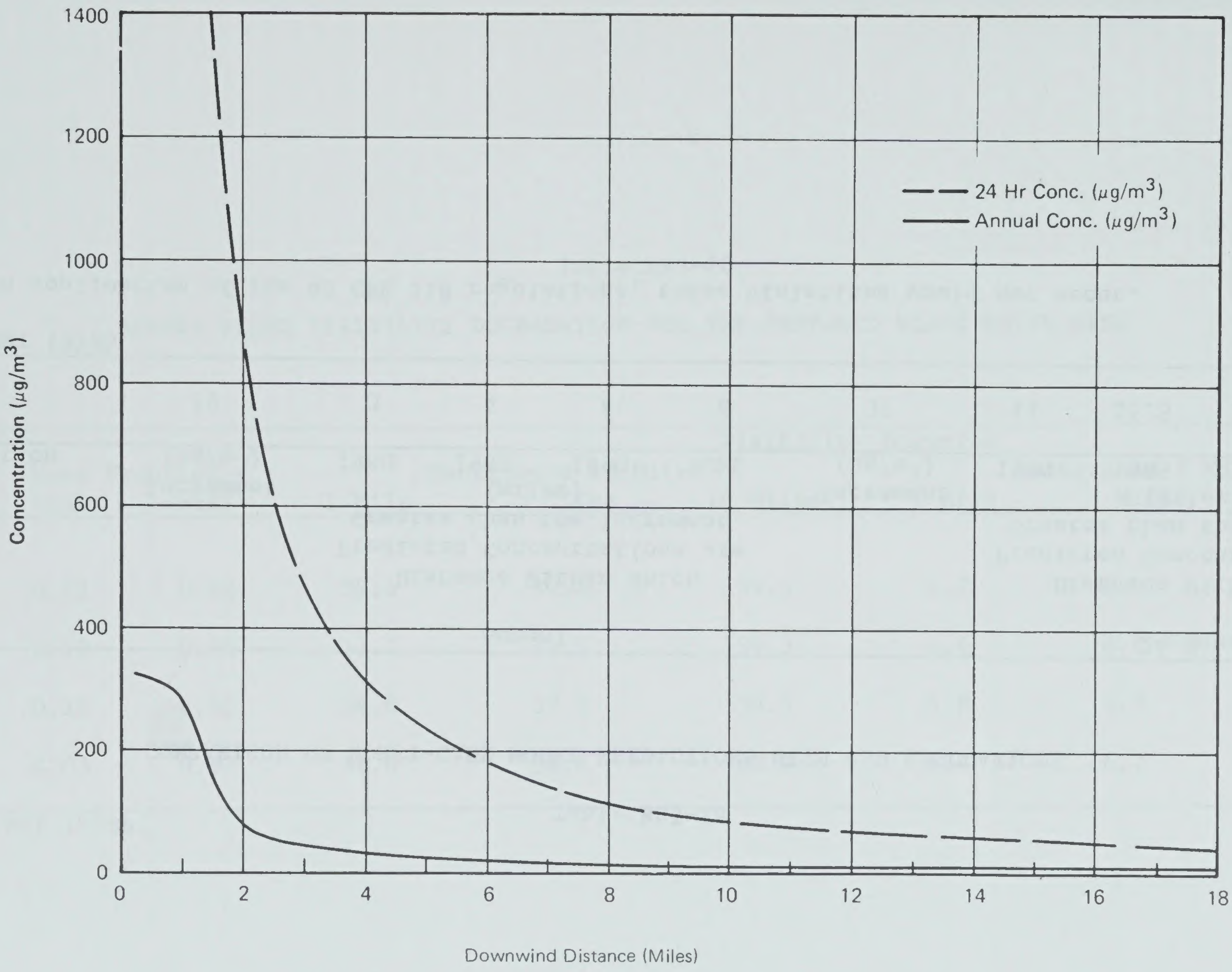


Figure BB3-2D

END OF MINE LIFE BLACK BUTTE SP CONCENTRATIONS

Source: ERT 1978a

Table BB3-2B

COMPARISON OF WORST-CASE MODEL PREDICTIONS WITH PSD REGULATIONS

	Annual					24-Hour				
		Distance Within Which Predicted Concentrations are Greater than the Increment (miles)					Distance Within Which Predicted Concentrations are Greater than the Increment (miles)			
Area Classification	Increment ($\mu g/m^3$)	1980	1985	1990	EOML	Increment ($\mu g/m^3$)	1980	1985	1990	EOML
II	19	3	4	4	6	37	11	15.5	12.5	20

Source: ERT 1978b.

Note: With application of the 43 CFR 118 regulations, these violations would not occur.

Table BB3-2C

ACROSS PLUME VISIBILITY DEGRADATION FOR THE PROPOSED BLACK BUTTE MINE

			Visibility Downwind					
	Mass Fraction		Background 40 Miles			Background 7 Miles		
Year	Coal	Soil	1 Mile	5 Miles	10 Miles	1 Mile	5 Miles	10 Miles
1980	0.12	0.88	38.4	39.4	39.5	6.7	6.9	6.9
1985	0.10	0.90	37.7	39.0	39.3	6.6	6.8	6.9
1990	0.12	0.88	38.8	39.2	39.4	6.8	6.9	6.9
EOML	0.03	0.97	36.6	38.6	38.9	6.4	6.7	6.8

Source: ERT 1978b.

expected even then to cause a serious safety hazard. Table BB3-2C indicates how small an impact TSP would be expected to have on visibility.

GEOLOGY

Paleontology

Impacts to paleontological resources would consist of losses of plant, invertebrate, and vertebrate fossil materials for scientific research, public education (interpretative programs), and to other values. Losses would result from destruction, disturbance, or removal of fossil materials as a result of coal mining activities, unauthorized collection, and vandalism.

A beneficial impact of development would be the exposure of fossil materials for scientific examination and collection which otherwise may never occur except as a result of overburden clearance, exposure of rock strata, and mineral excavation.

Fossil materials of Paleocene and Cretaceous age in the Almond, Fort Union, and Lance Formations would be impacted to variable degrees.

All exposed fossilferous formations could also be affected by increased unauthorized fossil collecting and vandalism as a result of increased population. The extent of this impact cannot be presently assessed due to a general lack of specific data on such activities.

Due to the present lack of data and accepted evaluatory criteria for determination of significance, no meaningful assessment can be presently made as to the extent and nature of the loss of these paleontological values to science or education, or hence to the significance of potential impacts on the fossil record.

Geologic Hazards

Because the dip of the rock strata is not steep, and the strata commonly dip into the slopes, the landslide potential of the proposed mining area is thought to be minimal, even though the landslide susceptibility of the rock and earth material is estimated to be high (Radbruch-Hall et al. 1976). If slopes were undercut or oversteepened, however, some caving or sliding could occur during periods of thawing or heavy rain. Where the coal seams are exposed by mining, zones of burning coal could occur. The lands are in an area of very low seismic activity so the probability of damage resulting from earthquake activity is slight.

TOPOGRAPHY

In much of the area that would be affected by the supporting operations related to mining, the topography would not be greatly disturbed. The construction of roads (135 acres) and railroads (95 acres) might lead to an unquantifiable amount of gullying through the consequent channelization of drainage water. Also, the burial of utility lines (205 acres) and relocation of the existing pipeline and power line (298 acres) might lead to an unquantifiable amount of gullying as a result of the disturbance and loosening of surface material. Ponds would cover 109 acres and their construction would, of course, involve the formation of undrained depressions. These would be relatively shallow in comparison to the relief of the proposed project area. Mine facilities would cover 255 acres but would not constitute significant impact upon the topography. All support facilities would be in place by 1980 and would remain through the lifetime of the mining operation.

The major impact upon the topography would be from the mining and the dumping of spoil piles. This disturbance would cover 721 acres by 1980, 3,834 acres by 1985, 7,399 acres by 1990, and 13,103 acres through the lifetime of the mining operation.

In the mine and spoil pile areas the resulting land surface would, in places, be as much as 220 feet higher than the original surface. In other places it would be as much as 165 feet lower. The reclaimed surface would be significantly different from the original topography in that all but the most major topographic expression would be obliterated.

Many of the larger watercourses would be moved, straightened, rerouted, or otherwise modified. Some that presently flow off the site would flow into ponds.

All the lesser watercourses and all tributaries to the larger watercourses would be obliterated.

The effects of topographic changes on the drainage of the project area are discussed more fully in the Water Resources section.

SOILS

Mining would result in the disturbance and mixing of soils on areas proposed for mine pits and spoil storage sites (13,103 acres). (Table BB2-9A presents soils that would be affected.) The removal, transporting, and stockpiling of topsoil would destroy natural soil structure and would result in a mixing of the various soil textures. The removal of soil too deep in some areas by scrapers would result in mixing topsoil with underlying subsoil high in soluble salts. This would result in topsoil contamination. The stockpiling process would eliminate a majority of the soil biota population in the soil stockpiled. This loss in soil biota would result from the scraping process and from the lack of sufficient oxygen supply when they become buried too deep in the stockpile to live (Brock 1966). The cumulative result of the above would be a short-term reduction in soil productivity when the topsoil is used for preparation of a seedbed.

Approximately 1.35 billion cubic yards of overburden, including lower soil horizons, would be removed and disturbed during the 26-year life of the mine. This would result in destruction of long established subsoil horizon/parent material relationships. An average of 509 acres of soil surface would be disturbed yearly during the life of the mine. An accelerated rate of water erosion would occur on these disturbed areas; however, designed drainageways and settling ponds should hold the generated sediment on the project area during normal rainfall years.

An accelerated rate of wind erosion would occur on areas disturbed and being reclaimed (vegetative cover removed and not reestablished). The amount of soil lost yearly (entering atmosphere) over the average area disturbed and being reclaimed would be 764.2 tons per year, which would be an increase of 584 tons per year over that of the area prior to mining.

After reshaping the land surface during reclamation, the newly formed soil would be exposed to water action at an accelerated rate until a vegetative cover could be reestablished. The rate of water erosion on the areas with recent respread topsoil would be approximately 7.5 tons per acre per year (calculated using Musgrave's Equation, BLM Manual 7317.22A). This is an increase of 2.5 tons per acre per year over the area as it exists prior to mining. A portion of this soil would be lost for the production of vegetation during reclamation. Also, some of this eroded soil would end up in the eight permanent water impoundments that would remain after mining. The amount of soil erosion would decrease as vegetation became established. With reclamation activity (machinery traffic) some soil compaction would occur resulting in less water infiltration and, therefore, a decrease in soil productivity on compacted areas undergoing reclamation.

During reclamation, topsoil would be evenly spread over the disturbed areas prior to revegetation. Thus areas deficient in topsoil prior to mining would gain topsoil from sources with a surplus. The result would be some increase in soil productivity in these deficient areas. However, the increase in productivity in these localized areas would not be significant in relation to the reduction of soil productivity on the major portion of disturbed acreage.

The construction of the plant office area, roads, rail spurs, and topsoil storage would require approximately 530 acres of soil surface. The soil required for the above construction would be removed from vegetative production for the life of the mine. Therefore, soil productivity of these areas would be temporarily lost until the end of mining. At the conclusion of mining these areas would undergo reclamation, and since soil disturbance would be minor, original productivity should be readily attained. Population increase as a result of mining would result in the removal of about 300 acres of soil surface from production as a result of the construction of housing and support facilities.

The overall result of the mining action would be a short-term lowering of soil productivity on approximately 13,103 acres associated with mine pits and spoil storage sites. Soil productivity would be lowered on 721 acres by 1980, 3,834 acres by 1985, and 7,399 acres by 1990 due to compaction, soil loss, topsoil contamination, destruction of soil structure, and a loss of soil biota. The temporary lowering of soil productivity would affect reclamation of mined lands (see Vegetation section).

WATER RESOURCES

Ground Water

Ground water occurs within the alluvium and the Fort Union, Lance, Almond, and Ericson Formations. It is possible that mining the Almond coal beds would drain the coal aquifer to its base, thus drawing down water levels in wells that tap the aquifer in the surrounding area. A well in the SW¼SW¼, Section 30, T. 20 N., R. 100 W., reportedly drilled to a depth of 1,400 feet, is known to tap the Almond and underlying Ericson Formations. Depth to water in this well was reported to be 17 feet below land surface, thus indicating that it tapped an artesian aquifer. Water levels in this and other nearby wells could be lowered. However, after reclamation the water levels in these wells would recover.

Black Butte Coal Company proposed construction of eight water impoundments as part of their final reclamation plan. The construction of these is contingent upon an evaluation of a test pond to be constructed in an area in the SW¼NW¼, Section 33, T. 19 N., R. 100 W. At the sites of the eight ponds the predevelopment ground water levels are above the planned level at four ponds; two are at or near the planned pond levels; and two are below the planned pond levels. It is assumed that water levels would recover during post development times to a position at or near the predevelopment position. Thus, it can be reasoned that six of these ponds may become discharge points for ground water by means of evaporation. If this is so, then the water table near these ponds would tend to be redirected toward the ponds as water is evaporated from them. There would be a total of 62.88 acres exposed to potential ground water evaporation if the ponds reach design levels. At an average annual estimated evaporation rate of 3 feet per year, about 188 acre-feet per year of pond water would be evaporated, almost all of which could come from ground water in dry years. Most of the ground water movement in the area at predevelopment time is toward the valley of Bitter Creek, and the amount of ground water evaporated by the ponds could lessen this underflow toward the Bitter Creek Valley. The total underflow toward Bitter Creek is not quantifiable, thus the possible impact of pond evaporation cannot be quantified.

Table BB3-6A shows the approximate area from which aquifers would be completely removed by coal mining.

Although spoil replaced in the mined-out cuts as part of the reclamation process would be more permeable at first, it would, with time, compact and become less permeable. The mining process would thoroughly mix the sandstones, siltstones, and shales of the original overburden, creating a poorly sorted heterogenous mixture. Data shown by Van Voast (1976) indicates that at Colstrip Mine in Montana, 11 tests on mine spoils showed a mean hydraulic conductivity about twice as great as that of in-sites coal. The maximum and minimum were less than the maximum and minimum of the hydraulic conductivity of the coal. Artesian pressures in the Ericson Forma-

Table BB3-6A

AQUIFERS REMOVED BY COAL MINING

Aquifer	Affected Area in Square Miles
Fort Union	9.58
Lance	7.92
Wasatch	5.37
Almond	3.03

tion may cause upward movement of ground water if overburden and coal were removed from the Almond Formation. These pressures also could result in heaving and cracking in the Almond Formation as well as movement of water from the Ericson into the excavation. This would result in a lowering of artesian pressures in the Ericson and a decline in water levels in any wells that tapped that formation.

Changes in quality of ground water may be caused by replacement of overburden in the mined out pits where part or all of the overburden would be below the water table. Van Voast (1976) says:

"Rahn (April 1975 p. 351, 352), reported that his preliminary data from northeastern Wyoming and southeastern Montana indicate no significant differences between mined-area waters and waters from nearby undisturbed aquifers. Van Voast and Headges (December 1975 p. 18, 19) described ground water (sic) from Decker mines spoils that contained much higher concentrations of dissolved solids than in waters from the coal-bed aquifer being mined"

Van Voast further states that at the Rosebud Mine, where the oldest spoils are 45 years old, "ground (water) has not yet circulated enough to create chemical trends or consistencies"

If replaced spoils would cause an increase in total dissolved solids in ground water, it may be a long-term effect.

Surface Water

Failure of the holding ponds which are planned to be constructed in compacted fill material would result in excess sediment discharging from the project area to Bitter Creek. Added sediment load can change the channel characteristics of Bitter Creek, thus changing the flood flow characteristic. It is unlikely that reclamation practices can completely restore the original topography and drainage. Consequently, new channels would be formed by natural or artificial means so that flow characteristics would not duplicate the original characteristics. Spoil stabilization, reclamation, and revegetation would take time to be effective. Sediment discharge from the project area would increase during and after the mining reclamation, thus increasing the sediment load in Bitter Creek. Data are not sufficient to estimate the change in sediment discharge resulting from mining operations. According to 30 CFR 715.17(j)(2) "Surface coal mining operations located west of the 100th meridian west longitude shall not interrupt, discontinue, or preclude farming on alluvial valley floors and shall not materially damage the quantity or quality of surface or ground water that supplies these valley floors . . ." The Bitter Creek drainage might quality as an alluvial valley floor.

Eight permanent ponds for cattle and wildlife are planned to be left on the site as part of the reclamation plan. The ponds are planned to occupy 109 acres and would effectively isolate 19,624 acres of drainage area from the Bitter Creek system. Their planned capacity is 2,218 acre-feet. Approximately 330 acre-feet per year would be kept from entering Bitter Creek drainage and would not be available to those holding water rights below the Black Butte project area.

Three samples of surface water which may be representative of that which would be retained in the ponds have been collected and analyzed for trace elements, total dissolved solids, sulfate, and chloride. The results are tabulated in Table BB3-6B and compared with Land Quality Guideline No. 4 of the Wyoming Department of Environmental Quality.

These data probably adequately represent the quality of surface runoff in the area and fall within the guidelines set by the Wyoming Department of Environmental Quality, Land Quality Guideline No. 4. Where these ponds are constructed so that they are below the level of the water table in the adjacent aquifers, a lowering of the water table would occur and regional ground water movement would be diverted toward the ponds. Some of the ground water would enter the ponds and mix with any collected surface runoff, thus changing the chemical quality in proportion to the amount of ground water entering.

Water Uses

By 1990, Black Butte Coal Company plans call for production of 6.3 million tons of coal per year. Assuming 50.4 acre-feet of water for all purposes (e.g., sanitation, dust control) needed per million tons of coal produced, Black Butte Mine would require about 318 acre-feet of water per year.

VEGETATION

Terrestrial

The proposed Black Butte mining operation would remove native vegetation from about 14,245 acres. Sagebrush, saltbush, and greasewood vegetation types would comprise about 65% (9,259 acres), 32% (4,559 acres), and 3% (427 acres) of areas disturbed, respectively.

Vegetation would be temporarily lost on approximately 14,136 acres. Long-term loss of vegetation would occur on about 109 acres, on which eight ponds would be constructed to provide water for livestock and wildlife.

About 1,419, 4,545, 8,420, and 14,245 acres would be disturbed at the benchmark dates of 1980, 1985, 1990, and 2004 (end of mine life), respectively. Acreages reclaimed to the stage of initial seeding at the same benchmark dates would be approximately 341, 2,624, 6,623, and 14,136, respectively. An average of about 509 acres would be disturbed annually. Disturbed areas would range in size from about 3,119 acres to 435 acres (see Map BB1-2).

Some changes in drainages would occur as the result of mining. Overall changes in plant species composition

Table BB3-6B

TRACE ELEMENT ANALYSES OF WATER FROM TWO STOCK PONDS AND BITTER CREEK COMPARED WITH GUIDELINES OF THE WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY

	Sec. 36, T. 20 N., R. 100 W. 10-Mile 4-15-77	Sec. 18, T. 188 N., R. 101 W. Brooks Ranch 4-20-77	Bitter Creek Brooks Ranch 5-02-77	Bitter Creek Median Site B	DEQ Guideline Max. Conc.
pH units	7.81	8.39	9.32	7.2 - 8.6	6.0 - 9.0
Total dissolved solids	250	712	782	1,500	5,000
Aluminum	0.1	0.1	0.1	1.2	5.0
Arsenic	0.05	0.05	0.01	.007	0.2
Boron	0.09	0.16	0.79	.2	5.0
Cadmium	0.01	0.01	0.01	.01	0.05
Chromium	0.01	0.1	0.1	.1	1.0
Copper	0.01	0.01	0.01	.01	0.5
Fluoride	0.10	0.33	0.17	1.2	2.0
Lead	0.1	0.1	0.1	.1	0.1
Mercury	0.002	0.001	0.001		0.01
Selenium	0.001	0.001	0.001	.001	0.05
Zinc	0.02	0.03	0.02	.02	25.0
Sulfate	67.9	255	332	700	3,000
Chloride	12.6	38.6	51.7	110	2,000

Note: Constituents in milligrams per liter unless otherwise indicated. Data from the Black Butte mining plan (Black Butte Coal Company 1977).

and production would probably be minimal due to the intermittent nature of affected drainages.

Population increases as the result of mining would result in a loss of vegetative production on an estimated 200 to 300 acres for housing and support facilities, primarily adjoining existing municipalities. Increased numbers of people in the area would result in additional disturbance of native vegetation, particularly by off-road vehicle use (see Recreational Resources section).

The revegetation of disturbed areas would be difficult due to many factors. Climatic conditions are severe with extremely low and high temperatures; strong winds; and low, erratic precipitation. Moisture would probably be the most limiting factor (May 1975 and Cook, Hyde, and Sims 1974), with average annual precipitation of the area estimated to be about 8 to 9 inches (see Climate section). Other factors which could hinder revegetation are less than ideal soil properties (see Soils section), competition for moisture and nutrients from undesirable weedy plant species (May 1975), steep slopes, and the loss of seeds and destruction of seedlings by small mammals (Thames ed. 1977).

Despite such problems, successful reclamation appears to have been achieved in the ES region along highway rights-of-way and on areas disturbed by oil and gas activities. Published reclamation research concerning these sites, however, is apparently not available. Natural plant succession is also in evidence on many of these sites, with the rate and extent of succession depending on site characteristics. Hodder (Thames ed. 1977), in discussing highway and mined land reclamation, considered the problems in reclaiming these types of disturbance similar in many respects and dissimilar in others. One major difference expressed was that mined spoils may be manipulated (i.e., farmed, etc.), while roadside problem materials must be accepted as they exist.

Revegetation research in the arid southwestern United States indicates that the reclamation of coal and copper mined lands is possible under extremely harsh environmental conditions (Aldon 1978, Bengson 1977, Aldon and Springfield and DeRemer and Bach (Thames ed. 1977)).

Reclamation activities are being conducted at two active surface coal mines in the region. Seeding operations began in 1972 at the Kemmerer Coal Mine, located about 4 miles southwest of Kemmerer, Wyoming. Only 46 acres of 376 acres seeded through 1977 have received topsoil treatment (Kemmerer Coal Company 1977). This situation exists because early mining reclamation laws did not require topsoiling of mine spoils. May et al. (1971) found spoil materials at the Kemmerer Mine to be extremely variable in some properties. Values of pH ranged from 2.2 to 7.3. Some spots were high in aluminum content and extremely low in pH. The most common soil textures found were clay loams and clays. Clay soils are difficult to work into a proper seedbed and are known for poor water infiltration properties (Cook, Hyde, and Sims 1974).

The initial seeding of disturbed lands at the Jim Bridger Mine, located about 35 miles northeast of Rock Springs, Wyoming, was in 1975 (personal communication, Harley Meuret, Jim Bridger Coal Company 1978). Topsoil has been applied to all lands being reclaimed as required by current state and federal laws. About 246 acres have been graded, topsoiled and seeded through 1977 (Bridger Coal Company 1978).

Supplemental irrigation is being experimented with at both mines. This practice is considered essential, or probably essential, by some reclamation authorities for reclaiming mined lands in areas having low and erratic precipitation (DeRemer and Bach and Aldon and Springfield (Thames ed. 1977)). Both mining companies have in recent years adopted the use of rangeland drills for seeding operations. Drilled seeding is generally considered superior to broadcast seeding, particularly on areas where a good seedbed can be prepared (Vories ed. 1976 and Thames ed. 1977). The use of topsoil, with some reservations, is also recognized as a beneficial treatment in achieving revegetation (Vories ed. 1976 and Thames ed. 1977). In view of the topsoiling deficiencies at the Kemmerer Mine, the early seeding methods employed at both mines, and the short time lapse between the present time and the initial seeding conducted at the Jim Bridger Mine, it is understandable that large scale reclamation has not been achieved at either mine.

A review of current mined-land reclamation literature and analysis of resources available for reclamation indicate that the methods and procedures proposed in the Black Butte mining and reclamation plan (subject to compliance with SMCRA) would result in the successful reclamation of disturbed lands. However, since conclusive site-specific reclamation success data are unavailable and since reclamation success is dependent on site-specific conditions and the solving of problems either identified or yet to be identified, a reclamation alternative is presented in Chapter 8. This alternative identifies a procedure to prove the feasibility of on-site reclamation. An estimated 9 years would be required to reclaim mined areas and 8 years for other disturbed sites. The reclamation time estimates are based on revegetation results on semiarid to arid mined lands (Aldon et al. 1976, Bengson 1977, Aldon and Springfield and DeRemer and Bach (Thames ed. 1977)) and on the recommended need for plants to be protected from extensive grazing during establishment (Cook, Hyde, and Sims 1974). It is assumed that supplemental irrigation would be employed when necessary to achieve seed germination and seedling establishment. Without irrigation, reclamation would be delayed during years when soil moisture is inadequate.

The achievement of reclamation earlier or later than estimated would lessen or increase impacts to living organisms and their nonliving environment due to the loss of vegetative cover and production (see Air Quality, Soils, Fish and Wildlife, Agriculture, and Water Resources sections).

Based on the proposed Black Butte seeding mixture, reclaimed areas would have a general appearance of grassland. Grasses would be the most common forage class, with shrubs and forbs being reduced in density and cover as compared to premined conditions.

Natural plant succession would occur on reclaimed lands and could restore approximate premined plant cover and composition values in an estimated 30 to 50 years, as suggested by Cook (Vories ed. 1976).

Aquatic

Sufficient information is not available to determine if there would be any impact to the few species of algae and other aquatic vegetation present in seasonal drainages.

Endangered and (or) Threatened

A survey of the project area by BLM and Black Butte Coal Company personnel revealed no plants proposed for endangered and (or) threatened status (Dorn 1977). The process for requesting formal consultation under Section 7 of the Endangered Species Act of 1973 was initiated with the U.S. Fish and Wildlife Service on 2 March 1978.

The U.S. Fish and Wildlife Service responded by letter dated 7 March 1978 that formal consultation cannot be conducted for unlisted species. It also varified the fact that no Wyoming plant species are presently on the endangered and (or) threatened list.

FISH AND WILDLIFE

General Information

Impacts of the proposed action upon fish and wildlife resources are summarized in Tables BB3-8A, BB3-8B, and BB3-8C. Impacts can be categorized into three general types: (1) loss of fish and wildlife habitat, (2) loss of the carrying capacity of that habitat to sustain fish and wildlife populations, and (3) loss of the fish and wildlife population and their progeny (offspring) over the period of mining and reclamation.

The proposed mining operation would remove native vegetation from about 14,245 acres. Disturbance to the sagebrush, saltbush, and greasewood habitat types would be 9,259 acres, 4,559 acres, and 427 acres, respectively. There would be no disturbance to the juniper type.

Habitat Losses

The proposed mining operation would result in both direct and indirect losses to wildlife habitat. Direct losses would include that habitat physically disturbed by mining and related activities. Indirect losses would be that area (area of influence) that would be indirectly lost or affected. This "area of influence"would be indirectly lost or affected because of the fact that all living organisms to some degree exhibit a home range or territory and daily or seasonal migration. Hence, if an organism is impacted upon part of that home range or territory, the remaining part of that home range or territory is also impacted to a certain degree. This degree of impact can range from a slight impact to 10% to 20% or to a total impact of 100%, depending upon the individual organisms or species involved. This area of indirect loss or adversely affected fish and wildlife habitat would range in size from an area equal to the direct habitat loss for such species as a leopard frog to four or five times the area directly affected for such species as the golden eagle. Anticipated acreage loss in this area of influence is summarized in Table BB3-8B. Habitat losses for specific seasonal ranges for the major game species are summarized in Table BB3-8D.

Reclamation would have varying degrees of effectiveness to wildlife depending on the wildlife species involved, the plant species used, and the success of revegetation. Reclamation, however, would be difficult in southwestern Wyoming because of soil and climatic conditions (see Black Butte and Regional Vegetation sections and Regional Wildlife discussion of reclamation). Since quantification of the effectiveness of reclamation to wildlife is not possible with current available information, the numbers representing habitat and population losses do not reflect any post-reclamation return of either one.

Carrying Capacity Losses

As a result of the loss of the fish and wildlife habitat (vegetation and living space), there would exist a loss of that area's ability to support fish and wildlife population. This ability to support fish and wildlife population is known as its "carrying capacity" The loss of this carrying capacity would occur on 1,419 acres (area directly affected) by 1980 and on 64,103 acres (area of influence) by the end of mine life. The acreages on which carrying capacity loss would occur are summarized in Table BB3-8B.

Fish and Wildlife Population Loss

Introduction

There would be a loss of wildlife populations within the area to be disturbed. For example, if there are five animals per acre in a given area, and 1,000 acres of that area are disturbed, loss to that population would be 5,000 individuals. In addition, there would be a loss of the populations progeny (offspring) over the period of disturbance. See Fish and Wildlife Population Loss, Chapter 4, Regional, for an explanation of the method used to calculate total population losses.

When estimating losses to the wildlife resource, it was assumed that all habitat would be at carrying capacity for the particular species being discussed. This would not

Table BB3-8A

SUMMARY OF IMPACTS ON FISH AND WILDLIFE RESOURCES
BY THE PROPOSED BLACK BUTTE MINE

Classification of Impacts	Anticipated Impact of Proposed Mine: None	Minor	Major
Fish and wildlife habitat			x
Carrying capacity for fish and wildlife			x
Fish and wildlife populations			
Fishery			
Nongame	x		
Game	x		
Endangered and (or) threatened species	x		
Wildlife			
Birds			
Nongame			x
Game			x
Endangered and (or) threatened species	x		
Mammals			
Nongame			x
Game			x
Endangered and (or) threatened species	x		
Reptiles and amphibians			
General			x
Endangered and (or) threatened species	x		

Table BB3-8B

SUMMARY OF FISH AND WILDLIFE AREA IMPACTED BY THE PROPOSED BLACK BUTTE MINE

	Direct Loss (Acres)[1]	Indirect Loss or Adversely Affected Area (Acres)[2]
Fish and wildlife habitat		
1980	1,419	6,386
1985	4,545	20,453
1990	8,420	37,890
End of mine life	14,245	64,103
Area of fish and wildlife carrying capacity affected		
1980	1,419	6,386
1985	4,545	20,453
1990	8,420	37,890
End of mine life	14,245	64,103
Area in which fish and wildlife populations would be affected		
1980	1,419	6,386
1985	4,545	20,453
1990	8,420	37,890
End of mine life	14,245	64,103

[1]Totally (100%) affected.
[2]Data are insufficient at this time to determine the degree to which these areas (areas of influence) would be affected. It may be only slightly (10%-20%) or totally (100%), depending upon the individual species involved.

Table BB3-8C

SUMMARY OF ESTIMATED WILDLIFE POPULATION LOSSES

	Estimated Number of Individuals Directly Lost to Proposed Action				
	1980	1985	1990	Mine Life	% of Population[2]
Wildlife					
Birds					
Nongame[1]	4.88T	39T	74.2T	343T	<1%
Raptors	---	---	---	2.2T	<1%
Game	15	130	340	680	.1%
Mammals					
Nongame	274T	2.4M	6.3M	20M	<1%
Game					
Antelope	63	430	955	3.65T	3%
Reptiles and Amphibians	6T	30T	56T	570T	<1%

Note: All estimates are for the total population, including the progeny that would have been produced.

[1]All nongame birds except raptors.
[2]These percent figures represent the amount of regional or herd/management unit populations that will be lost by end of mine life. Percent figures that are underline are based on herd or management unit populations.

T = Thousands
M = Millions

Table BB3-8D

WILDLIFE HABITAT DISTURBANCE

Species and Habitat	Acres Impacted by Time Periods 1980	1985	1990	End of Mine Life	% of Available Range
Sage grouse					
Yearlong	1,419	4,545	8,420	14,245	0.9%
Crucial nesting	0	350	700	1,050	0.1%
Pronghorn antelope					
Summer	972	2,913	4,724	8,143	2%
Winter/yearlong	447	1,632	3,696	6,102	2%
Mule deer					
Winter/yearlong	1,419	4,545	8,420	13,725	3%

Note: The percent figures represent the amount of range the disturbance would remove by the end of mine life from the total range now available. In some cases, it was more practical to calculate percentages based on herd or management units rather than on a regional basis. These figures are underlined.

necessarily be the case and it is realized that possibly not all the wildlife occupying an area to be disturbed would be lost. However, definitive data concerning habitat condition and trend in and around proposed project areas were not available; therefore, projections as to the survival of displaced animals were not made.

Fishery

Nongame. No loss to nongame fish is anticipated.

Game. No loss to game fish is anticipated.

Endangered and (or) Threatened. It is not anticipated that there would be any adverse impacts to endangered and (or) threatened fish species.

Wildlife

Birds.

Nongame. The primary small nongame bird species impacted would be horned lark, blackbilled magpie, sage thrasher, Brewer's blackbird, vesper sparrow, sage sparrow, and Brewer's sparrow.

Based upon breeding bird surveys conducted by the Wyoming Game and Fish Department, the best density estimate is about 27 birds per square mile. Using this assumption and the formula for biotic potential, the proposed mine would account for the loss of an estimated 4,880, 39,000, 72,400, and 343,000 birds by 1980, 1985, 1990, and end of mine life, respectively. These figures represent a minute percentage of the total population of small nongame birds in the region.

There may be a loss of 29 raptor nests. Of the 29 nests, 11 are golden eagle nests. None of the eagle nests would be physically eliminated, but nesting may not take place because of their close proximity to disturbance areas. Of the remaining 18 raptor nests, 5 would be physically eliminated, and 13 are close enough to the proposed mining operation that nesting may not take place. The 29 nests would have the potential to produce an estimated 88 birds in a given year. Over the life of the mine (26 years), these nests would have produced an estimated 2,200 birds.

Game. Sage grouse would be the only game bird significantly impacted by the proposed mine. There would be a loss of 1,419, 4,545, 8,420, and 14,245 acres of sage grouse yearlong range and 0, 350, 700, and 1,050 acres of crucial nesting habitat lost by 1980, 1985, 1990, and end of mine life, respectively. The end of mine life figure of 14,245 acres represents about 0.9% of the total yearlong habitat available in bird management section 014 of the Flaming Gorge Management Unit. Using the assumption of an average of 4 birds per square mile, an estimate of the losses would be 15, 130, 340, and 680 birds by 1980, 1985, 1990, and end of mine life, respectively. Actual losses would probably be greater since crucial nesting habitat would be disturbed; however, no population information is available for this habitat.

The end of mine life figure represents about 0.1% of the production of the total production within the bird management section by that time. These losses include the progeny which would have been produced had mining not taken place.

Endangered and (or) Threatened. At this time and with current information, it is not anticipated that there would occur any adverse impact to any endangered and (or) threatened bird species. However, in accordance with Section 7 of the Endangered Species Act of 1973, the BLM has officially requested formal consultation with the U.S. Fish and Wildlife Service by letter dated 2 March 1978. The only endangered bird species for which consultation is presently being conducted is the American perigrine falcon. Under Section 7 of the Endangered Species Act of 1973, the Secretary of the Interior will grant no approval which would jeopardize the continued existence of any endangered and (or) threatened species or result in the destruction or modification of their critical habitat.

Mammals.

Nongame. The primary small nongame mammal species affected would be whitetail prairie dog, Richardson ground squirrel, least chipmunk, and deer mouse. The best population density estimates available indicate about 5 individuals per square mile in the sagebrush type, about 0.5 per acre in the saltbush type, and about 1.5 per acre in the greasewood type (Maxell 1973). Using the formula for biotic potential, the proposed mine would account for the loss of an estimated 274,000, 2,384,000, 6,338,000, and over 20 million animals by 1980, 1985, 1990, and end of mine life, respectively. Although these figures seem large, they are only a minute percentage of the total production of small nongame mammal populations within the region. In addition, it is realized that small nongame mammal populations do fluctuate greatly and that losses would vary accordingly. However, habitat disturbance would remove the areas' ability to produce that peak population until reclamation is successful.

Game. Pronghorn antelope would be the only big game species to be significantly impacted. The proposed mine would eliminate about 972, 2,913, 4,724, 8,143 acres of antelope summer range and 447, 1,632, 3,696, and 6,102 acres of antelope winter/yearlong range by 1980, 1985, 1990, and end of mine life, respectively.

The end of mine life losses represent about 2% of the total summer range available and about 2% of the total winter/yearlong range available in the Black Butte-Kenney Rim Herd Unit.

Assuming an average density of 50 antelope per square mile on the winter/ yearlong range within the project area, population losses to antelope including progeny would be about 55, 385, 855, and 3,350 antelope by 1980, 1985, 1990, and end of mine life, respectively. The average density on the summer range is estimated to be 3 individuals per square mile; therefore, losses would be about 8, 45, 100, and 300 antelope, including progeny, by 1980, 1985, 1990, and end of mine life, respectively. The combined population loss, including progeny, would be 63, 430, 955, and 3,650 antelope by 1980, 1985, 1990, and end of mine life, respectively. The end of mine life figure would represent about 3% of the production of the total population in the herd unit by that time. Probably not all of these animals would be lost, but the areas ability to support that maximum observed population would be removed.

The proposed mine would eliminate about 1,419, 4,545, 8,420, and 13,725 acres of mule deer winter/yearlong range by 1980, 1985, 1990 and end of mine life, respectively. The end of mine life figure represents about 3% of the total winter/yearlong range available in the Black Butte Herd Unit. This loss of range would not affect mule deer at their present population level in the project area but would inhibit any future population increase.

Endangered and (or) Threatened. At this time and with current information, it is not anticipated that there would occur any adverse impact to any endangered and (or) threatened mammal species. However, in accordance with Section 7 of the Endangered Species Act of 1973, the BLM has officially requested formal consultation with the U.S. Fish and Wildlife Service by letter dated 2 March 1978. The only endangered mammal species for which consultation is presently being conducted is the black-footed ferret *(mustala nigripes)*. Under Section 7 of the Endangered Species Act of 1973, the Secretary of the Interior will grant no approval which would jeopardize the continued existence of any endangered and (or) threatened species or result in the destruction or modification of their critical habitat.

In June of 1978, an intensive black-footed ferret survey was undertaken by the U.S. Fish and Wildlife Service, Denver Research Center, in the area of the proposed Black Butte Mine. The results of this survey are anticipated by October 1978.

Reptiles and Amphibians

General. The primary reptile and amphibian species that would be impacted are northern shorthorned lizard, northern plateau lizard, northern cliff lizard, wandering garter snake, and Great Basin gopher snake.

The best density estimates currently available are an average of 2.5 individuals per acre on sagebrush, saltbush, and greasewood habitat types (personal communication, Dr. George Baxter, January 1978). Using this assumption, it is estimated that 6,000, 30,000, 56,000, and 570,000 individuals would be lost by 1980, 1985, 1990, and end of mine life, respectively. These figures include the progeny which would have been produced had mining not taken place.

Endangered and (or) Threatened. No adverse impact is anticipated to any endangered and (or) threatened reptile or amphibian species.

Wild Horses

No impacts to wild horses are anticipated.

CULTURAL RESOURCES

Impacts to cultural resources would include: (1) destruction or alteration of all or part of a property; (2) isolation from or alteration of its surrounding environment; and (3) introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting (36 Code of Federal Regulations 800.9). These impacts may take place to both archeological and historical sites in the region.

The loss to cultural resource sites and the data contained therein would be a direct result of their physical destruction through land modification required in mining and associated surface facilities, access roads, rail spurs, and power lines. Site destruction could also occur through development of related events such as increased population, which could lead to increase in pothunting and vandalism and increased vehicular use of the land resulting in some unintentional destruction of cultural resources.

Because cultural resources are nonrenewable, the physical destruction of any cultural data or artifacts could eventually have a potentially significant impact on efforts to reconstruct the prehistory and history of the region.

Archeological

A total of 18,914 acres or 52% of the 36,600 acres within the project area were intensively inventoried.

Potential disturbances in the surveyed area include 13 sites by 1980, 40 sites by 1985, 81 sites by 1990, and an estimated 133 sites by the end of mine life. An estimated 125 sites remain unsurveyed within the mine permit boundary. Seventy-one sites lie in proximity to the proposed mining area, but are not threatened directly by mining activities. They are, however, threatened with possible physical destruction due to their proximity to surface disturbing activities within the project area and related rights-of-way.

The potential for buried archeological sites exists within the project area and associated rights-of-way. Early period and Altithermal sites would have been buried by Quaternary deposits through time and, because of their scarcity, would be of particular importance. These sites are not and would not be evident before actual disturbance uncovered them. This action could partially or completely destroy them, and a site may go unnoticed.

The increase in pothunting, arrowhead collecting, and vandalism that would result from an increase in population would affect all known and unknown resources within the region. The significance of this impact is potentially great, since the kind of data removed by these activities, arrowheads and tools, are the major resources for dating and analyzing prehistoric activity.

It is impossible to evaluate the significance of uninventoried or buried sites. Known Early period, Altithermal, and multicomponent sites are quite rare, and, therefore, would be highly significant if found in the region. Their loss would represent a significant impact to the prehistory of the Northwest Plains and Great Basin areas.

Historical

Major impacts to historic resources in the proposed Black Butte Mine area would be to the old Black Butte Mine, Hallville, Gibraltar Mine, Black Buttes Stage Station, and the Overland Trail corridor, although visible ruts no longer exist in the area. All are on the Wyoming Historic Preservation Plan.

All of these sites are in proximity to areas of proposed surface disturbance. Disturbances from construction of access roads, power lines, and mine facilities could disturb these sites by altering their environment and introducing foreign visual, audible or atmospheric elements.

Some of these impacts would be reduced by the Black Butte Coal Company in their efforts to preserve and protect cultural resources. If ownership is gained of areas where important resources such as the Black Butte Stage Station, Black Butte Mine, and Overland Trail are located, the company would endeavor to stabilize and protect these resources from physical disturbance in accordance with comments made by the State Historic Preservation Officer and Advisory Council.

Increased population would increase antiquities collection and increase off-road vehicle disturbances to the resource.

VISUAL RESOURCES

Visual resource contrast ratings were derived for the Black Butte project area using viewpoints along Interstate 80 and the Union Pacific Railroad (UPRR) line as critical viewpoints (see Map BB2-10A). These contrast ratings, summarized in Table BB3-10A, are available for review at the Rock Springs District Office of the BLM. Further explanation of the Visual Resource Contrast Rating System (BLM Manual 6320) is available in the library of the Rock Springs District Office of the BLM.

Contrast ratings are assessed in terms of how the proposed action would affect the basic elements (form, line, color, and texture) of the existing landscape features, i.e., landform, vegetative patterns, and structures (e.g., power lines and buildings). Resultant contrast ratings are then compared to the maximum acceptable impact limit for the visual resource management (VRM) class as seen from a viewpoint. If two VRM classes are seen from a particular viewpoint, the class with the more stringent limit is used. Two time periods (during active mining and post reclamation) were used for the Black Butte Mine contrast ratings.

Summary of Visual Contrast Ratings (Table BB3-10A)

Viewpoint from A to B

The contrast ratings indicate that the proposed coal mining would create strong contrasts to line, form, color, and texture. Spoil piles, pit headwalls, coal storage, and topsoil piles would be visible along this stretch of Interstate 80. Transmission lines, pipelines, and roads close to the interstate would be moved. These mining activities would change the visual resource management class from a Class III to a Class V. After reclamation the strong contrasts and visual changes would be evident even though the area would be rehabilitated to meet BLM objectives for VRM Class IV. This would not meet BLM management's objectives to maintain the visual quality of the area.

Viewpoint C

From viewpoint C, along the UPRR line, a small portion of the Class III area is visible. Mining activities and structures in the Class III area would create strong contrasts to all the basic elements. The contrast rating would change to a Class V. After reclamation, the area would still reflect the change in landscape due to the mining and, therefore, only return to a VRM Class IV. This also would not meet BLM management's objectives to maintain the visual quality of the area.

Viewpoint from C to D

All mining activities and structures related to the Black Butte Mine would be visible from this stretch of the UPRR line. The activities and structures would create strong contrasts to all the basic landscape elements changing the area from a VRM Class IV to a Class V. After reclamation the area would still be characterized as an area that had been surface mined, but it would meet the BLM management objectives for and return to a Class IV.

RECREATIONAL RESOURCES

Visitor Use Data

Table BB3-11A depicts estimated change in resident recreation visitor use demand by activity due to coal mining in years 1980, 1985, and 1990. The changes are those which occur in the region and result from increased population in Sweetwater County due to the proposed Black Butte Mine. Data used to calculate use are available in the files at the Rock Springs District Office of the BLM.

Hunting

Adverse impacts to hunting would result when restricted access or displacement of deer, antelope, rabbits, rodents, and coyotes result as construction and mining destroys wildlife habitat (see Fish and Wildlife section). With an increased number of people in the region, some ranchers would restrict access across private lands. The impact of the displacement of animals would be a loss of hunter days. Increased human population would induce a

Table BB3-10A

SUMMARY OF VISUAL CONTRAST RATINGS

Views from Critical Viewpoints	Visual Management Class	During Active Mining	Post Reclamation of Mining	During Active Mining	Post Reclamation of Mining	During Active Mining	Post Reclamation of Mining	Active Structures	Post Reclamation of Structures	Active Structures	Post Reclamation of Structures	Active Structures	Post Reclamation of Structures
		FEATURES BEING EVALUATED											
		Land	Land	Veg.	Veg.	Stru.	Stru.	Land	Land	Veg.	Veg.	Stru.	Stru.
A - B	III	3/29*	3/17	3/30	3/22	**	**	3/29	3/17	3/20	3/22	3/26	3/21
C	III	3/20	2/17	3/30	2/15	**	**	3/30	2/17	3/30	2/15	3/30	1/10
C - D	IV	3/30	2/17	3/30	2/15	**	**	3/30	2/17	3/30	2/15	3/30	1/10

Visual Management Class	Maximum Acceptable Impact
Class II	2/10
Class III	2/16
Class IV	-/20

$* \frac{3}{29}$ 3 = Highest element score; 29 = Total score for feature

**Feature not affected

Table BB3-11A

ESTIMATED RESIDENT VISITOR DAYS DEMAND DUE TO POPULATION CHANGE FOR YEARS 1980, 1985, AND 1990

		1980 Population: 1,342[1]				1985 Population: 1,876[1]				1990 Population: 1,882[1]			
Activity	1977	Without Proposed Action	Increase Due to Proposed Action	Total Projection	% of Projection Due to Proposed Action	Without Proposed Action	Increase Due to Proposed Action	Total Projection	% of Projection Due to Proposed Action	Without Proposed Action	Increase Due to Proposed Action	Total Projection	% of Projection Due to Proposed Action
Fishing	172,400	192,700	5,710	198,410	2.9	229,400	8,130	237,530	3.4	250,700	8,240	258,940	3.2
General[2]	168,500	188,900	5,600	194,500	2.9	229,100	8,110	237,210	3.4	253,500	8,330	261,830	3.2
Hunting	54,500	59,400	1,760	61,160	2.9	69,100	2,450	71,550	3.4	74,300	2,440	76,740	3.2
Off-Road Vehicles[3]	6,700	7,400	220	7,620	2.9	8,700	310	9,010	3.4	9,400	310	9,710	3.2
Sightseeing	52,900	58,200	1,720	59,920	2.9	69,900	2,480	72,380	3.4	76,700	2,520	79,220	3.2
Urban Recreation	106,400	123,300	3,650	126,950	2.9	157,600	5,580	163,180	3.4	178,800	5,880	184,680	3.2
Water Sports	79,600	90,600	2,680	93,280	2.9	112,500	3,990	116,490	3.4	126,200	4,150	130,350	3.2
Winter Sports	21,500	25,400	750	26,150	2.9	33,800	1,200	35,000	3.4	38,800	1,280	40,080	3.2

[1] Population change due to project (from Socioeconomic section).
[2] General includes camping, picnicking, etc.
[3] Estimate by ES team Outdoor Recreation Planner.

greater demand for hunting and decrease the quality of the hunting experience in the region.

Sightseeing

The construction and mining would cause adverse impacts to existing recreational sightseeing values owing to restricted access in the area. There would be adverse impacts to zoological sightseeing due to the displacement of wildlife species. There would be beneficial impacts for geological and industrial interpretation as the mining operations draw persons to view the area.

Off-Road Vehicles

Offroad vehicle use by four-wheel drive enthusiasts would be restricted from the area of active mining. However, more people would get out in the region to recreate as populations increase.

General

With an increased visitor use due to increased population in Sweetwater County, there would be a general lowering of the "primitive"quality of the outdoor recreation experience in the region surrounding the Black Butte project area. There would also be increased use in urban recreation areas in the city of Rock Springs and the town of Green River.

AGRICULTURE

Livestock Grazing

It is estimated that mining would cause cumulative losses of 153, 790, 1,952, and 4,896 animal unit months (AUMs) by 1980, 1985, 1990, and 2013 (end of reclamation), respectively. Federal grazing licenses would be reduced by the appropriate number of AUMs lost on public lands as the result of mining. Restoration of grazing privileges would be made upon reclamation, as it is believed that reclaimed lands would be capable of supporting premining livestock stocking rates.

Eight ponds, proposed for construction in mined areas, would provide water for livestock and wildlife. The water developments would improve livestock distribution and forage utilization (see Regional, Chapter 3, Water Impoundments, for a discussion of requirements for pond establishments).

The Black Butte and Long Canyon mining projects are both within the Rock Springs Grazing Allotment which provides about 193,140 AUMs annually. The Black Butte mining project would cause an estimated average annual loss of 144 AUMs for 34 years. This loss combined with the loss of AUMs from the proposed Long Canyon mining project (an average of 36 AUMs for 41 years) would represent but a small percentage ($<1\%$) of the grazing allotment AUMs annually available without mining. The loss of AUMs from the proposed mining would not result in severe hardship to any of the livestock operators of the Rock Springs Grazing Allotment.

The reclaimed lands, however, would require more intensive grazing management than would be needed for undisturbed rangeland (Lang, Berg, Hodder (Vories ed. 1976)).

Prime Farmland

Consultation with personnel of the U.S. Department of Agriculture, Soil Conservation Service, Rock Springs, Wyoming, revealed that prime farmland is not present in areas proposed for disturbance (see Regional ES, Chapter 9, Consultation and Coordination).

MINERAL RESOURCES

During the 26-year life of the mine an estimated 146 million tons of coal would be removed. An estimated 9.5 million tons would be removed by 1980, 41 million tons by 1985, and 72.5 million tons by 1990. The surface mining of the coal beds would result in the recovery of close to 90% of the coal reserves within the Black Butte project area. An unknown quantity of coal in the overburden and (or) interburden would be lost. This coal would be in seams too thin or of too low a quality to be of economic interest.

TRANSPORTATION NETWORKS

Impacts to transportation networks in the Black Butte project area would result from: (1) mining activities requiring destruction and relocation of roads, power lines, and gas lines; (2) transportation of coal out of and supplies into the area; and (3) increased employment and population with its increased vehicles and miles traveled.

There are several light-use two-track roads passing through the area which would be destroyed by the proposed mining. Destruction of these roads would limit recreational access.

Black Butte Coal Company proposes haul roads, railroad spurs, and power lines to pass through the Black Butte project area. The company also proposes to relocate along Interstate 80 those existing power lines and pipelines which pass through the northern portion of the area.

Transportation of coal out of the region would be by railroad. The Black Butte Mine would add 330 loaded trains per year east and 300 loaded trains per year west to the railroad traffic. Table BB3-14A depicts the increased use on segments of track.

The increase in employment and population would put additional vehicles on the highways and streets around Rock Springs and Green River. It is estimated the vehicle license tab sales in Sweetwater County due to the

Table BB3-14A

ESTIMATED TRAIN VOLUME INCREASES ON TRACK SEGMENTS OF THE UNION PACIFIC RAILROAD IN AVERAGE TRAINS PER DAY

Segment	Estimated[1] Capacity	Current[1,2] Traffic	1980				1985				1990			
			Projected[4] Volume w/o Coal	Total[1] Number Coal Training	Coal Trains[4] due to P.A.	Total Volume	Projected[4] Volume w/o Coal	Total[1] Number Coal Training	Coal Trains[4] due to P.A.	Total Volume	Projected[4] Volume w/o Coal	Total[1] Number Coal Training	Coal Trains[4] due to P.A.	Total Volume
Kansas City to Topeka	70-80	44	48	2.6	0	48	56	1.8	0	56	65	1.6	0	65
Topeka to Gibben	70-80	22	24	5.0	0	24	28	7.6	0	28	32	7.0	0	32
Council Bluffs to Gibben	55-60	34	37	10.8	1.8	38.8	43	11.0	1.8	44.8	50	10.2	1.8	51.8
Gibben to North Platte	70-80	53	58	16.0	1.8	59.8	67	18.4	1.8	68.8	78	17.6	1.8	79.8
North Platte to Cheyenne	70-80	47	51	12.8	1.8	52.8	60	12.2	1.8	61.8	69	11.4	1.8	70.8
Cheyenne to Hanna	70-80	51	56	13.4	1.8	57.8	65	12.8	1.8	66.8	75	11.4	1.8	76.8
Hanna to Rawlins	70-80	45	49	6.2	1.8	50.8	57	5.2	1.8	58.8	66	5.8	1.8	67.8
Rawlins to Rock Springs	70-80	44	48	6.2	1.8	49.8	56	6.2	1.8	57.8	65	6.8	1.8	66.8
Rock Springs to Green River	70-80	44	48	1.4	1.6	49.8	56	2.6	1.6	57.8	65	3.4	1.6	66.8
Green River to Granger	70-80	40	44	1.8	1.6	45.6	51	3.0	1.6	52.6	59	3.8	1.6	60.6

Table BB3-14A

ESTIMATED TRAIN VOLUME INCREASES ON TRACK SEGMENTS OF THE UNION PACIFIC RAILROAD IN AVERAGE TRAINS PER DAY
(Continued)

Segment	Estimated[1] Capacity	Current[1,2] Traffic	1980 Projected[4] Volume w/o Coal	1980 Total[1] Number Coal Training	1980 Coal Trains[4] due to P.A.	1980 Total Volume	1985 Projected[4] Volume w/o Coal	1985 Total[1] Number Coal Training	1985 Coal Trains[4] due to P.A.	1985 Total Volume	1990 Projected[4] Volume w/o Coal	1990 Total[1] Number Coal Training	1990 Coal Trains[4] due to P.A.	1990 Total Volume
Granger to Kemmerer	25-30	13	14	2.6	1.6	15.6	16	4.6	1.6	17.6	19	6.8	1.6	20.6
Kemmerer to McCammon	25-30	13	14	1.4	1.6	15.6	16	2.8	1.6	17.6	19	4.0	1.6	20.6
McCammon to Pocatello	25-30	15	16	2.8	1.6	17.6	19	5.8	1.6	20.6	22	9.4	1.6	23.6

1 Union Pacific Railroad Company 1978.
2 Through freight only.
3 Abt Associates 1978.
4 Estimates by ES team.

Black Butte Mine would increase by 1,000 between 1978 and 1980 and by 1,400 between 1980 and the end of mine life (Table BB3-14B) over the estimated future situation without the proposed action. Increased use of private roads in the region which cross ranches would induce many ranchers to close their private roads.

SOCIOECONOMIC CONDITIONS

The primary socioeconomic impacts of the Black Butte Mine would be associated with increases in population, employment, and income.

Population

The populations of Sweetwater County (that portion in the ES region), Rock Springs, and Green River would increase because of the new jobs made available by the construction and operation of this mine and the induced employment that would result. As shown on Table BB3-15A, the total population of the county would reach 59,168 by 1990; 1,882 of this total would be caused by the Black Butte Mine. The mine would cause only slight increases in the annual rates of growth of the various components of the county except during the 1978 to 1980 period. Even though the impacts of the mine on rates of growth would be small (1.5% per year or less), the cumulative impact would raise the rates into a range (4% or more) that would create temporary over-population impacts on both the public and private sectors of the county.

With the closing of the Black Butte Mine, 320 mining jobs would be lost to Sweetwater County. If other employment opportunities were not available, outmigration would occur. This would result in reduced basic employment, population, and the demand for local goods and services. These impacts should not be significant since the closing of the mine would probably be phased over a period of time, and the effects would be only temporary.

Employment

Approval of this mine would impact Sweetwater County by providing approximately 220 jobs by the end of 1978. An additional 55 jobs would open in 1979; the number would eventually stabilize at approximately 320 in 1981 (Black Butte Coal Company 1977). An additional 595 jobs should also become available as induced employment to support the population increase caused by the mine (Abt Associates 1978). This would be a significant increase in job opportunities.

These employment increases would, as mentioned earlier, result in a higher population with additional indirect impacts. These would include an increase in local income (see Income section) and reduced unemployment. There would also be minor negative impacts if laborers were pulled out of other employment sectors. The high wages offered by the mining industry could cause temporary shortages in these other areas (Abt Associates 1977).

Income

Population and employment increases would cause total personal earned income in the county to rise significantly. It would increase from an estimated $258.4 million in 1977 to $321.7 million in 1980, $429.8 million in 1985, and $519.0 million in 1990. The Black Butte Mine would be responsible for 6.4% ($16.7 million) of the projected new income in 1990. Per capita income would not be significantly impacted by the mine.

Several temporary indirect income impacts could occur. Most of the benefits of the higher income would go to those in the mining and construction sectors; those in the local service sector, on fixed incomes, and the poor could be placed in an even less favorable financial position. This would occur if prices continue to inflate causing even more difficulties for these groups to compete for goods and services. However, increased income would cause increased consumer spending and provide benefits to the community as retail revenues and taxes to local governments increased (Abt Associates 1977 and Gilmore 1974).

Infrastructure

Private Sector

Rock Springs would continue to be the leading commercial center in the county, but Green River could be expected to gain an increased share of sales revenues as its population and services expanded. County retail sales would be significantly impacted by the projected larger population and increased personal income. They are projected to reach $146.1 million in 1980, $224.8 million in 1985, and $316.5 million in 1990 from an estimated $110.2 million in 1977 (Abt Associates 1977). The mine would be responsible for the following portions of these projections: 2.9% ($4.2 million) in 1980, 3.4% ($7.7 million) in 1985, and 3.2% ($10.0 million) in 1990.
Wholesale revenues would increase from an estimated $39.9 million in 1977 to $52.9 million in 1980, $81.4 million in 1985, and $114.5 million in 1990. The Black Butte Mine would cause $3.6 million (3.1%) of the 1990 total.

Public Finance

Two moderate impacts to local governments are likely to occur. Government expenditures could be expected to continue to increase to provide more and improved services and facilities to residents, and increased revenues (through higher property valuations and more tax income) could accrue to local governments. These impacts would begin to subside after 1980.

Table BB3-14B

ESTIMATED VEHICLE LICENSE TAB SALES

	1976	1978-1980	1980-1985	1985-2004
Sales Without Proposed Action	31,700	34,600	40,700	44,000
Sales Due to Proposed Action	N/A	1,000	1,400	1,400
Sales With Proposed Action	N/A	35,600	42,100	45,400

N/A - Not Applicable

Table BB3-15A

(1) PROJECTED POPULATION: SWEETWATER COUNTY

	1977	1980				1985				1990			
		Population Projection				Population Projection				Population Projection			
	Estimated Population	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action	Without Proposed Action	With Proposed Action	Cumulative Impact	Impact of Proposed Action
Sweetwater County[1]	41,263	45,320	46,662	5,399	1,342	52,951	54,827	13,564	1,876	57,286	59,168	17,905	1,882
Rock Springs	25,996	28,552	29,514	3,518	962	33,359	34,704	8,708	1,345	36,090	37,439	11,443	1,349
Green River	12,502	13,732	13,983	1,481	251	16,044	16,395	3,893	351	17,358	17,710	5,208	352
Balance of county	2,765	3,036	3,165	400	129	3,548	3,728	963	180	3,838	4,019	1,254	181

(2) PROJECTED POPULATION ANNUAL RATES OF GROWTH: SWEETWATER COUNTY

		1978 - 1980				1981 - 1985				1986 - 1990			
Sweetwater County[1]	N/A	3.3%	4.4%	N/A	1.1%	3.4%	3.5%	N/A	0.1%	1.6%	1.6%	N/A	0
Rock Springs	N/A	3.3%	4.5%	N/A	1.2%	3.4%	3.5%	N/A	0.1%	1.6%	1.6%	N/A	0
Green River	N/A	3.3%	3.9%	N/A	0.6%	3.4%	3.4%	N/A	0	1.6%	1.6%	N/A	0
Balance of county	N/A	3.3%	4.8%	N/A	1.5%	3.4%	3.6%	N/A	0.2%	1.6%	1.6%	N/A	0

Source: Abt Associates 1978.

Note: Cumulative Impact = projection "with" the proposed action - 1977 estimate.
Impact of the proposed action = projection "with" the proposed action - projection "without" the proposed action.

[1]That portion of the county within the ES region.

NA = Not Applicable

Housing

The increased population caused by this mine would put significant additional demands upon the housing industry in the county. Table BB3-15B shows the additional housing that would be required with approval and operation of it. Rock Springs would require 72% (603 homes) of the new housing requirements caused by the mine. If the housing industry does not keep pace with the population growth, housing impacts could become even more significant as the current housing shortage became even more aggravated.

Education

A larger school-age population would occur because of this mine; however, the increases caused by it would be less than 5% of total enrollment. Pupil expenditures, classroom demands, and pressures on student/teacher ratios would probably all moderately expand. They would not cause excessive adjustments since both county school districts have current and planned excess capacity (Abt Associates 1977).

Social Services and Facilities

The effects of this one mine are difficult to assess, because it is not known how the local governments would respond to the demands of an additional 1,882 people over other projected growth spread over 13 years. Many services and facilities are already being expanded or are in the planning stages. Some of these improvements may cover the effects of the mine. In any case, the mine would put additional pressures on current services and facilities. Some additional doctors, nurses, fire and police personnel and facilities, and water and sewer facilities would be required (Abt Associates 1977).

Attitudes and Expectations

Residents opposed to continued growth and disturbance of the wide-open spaces would view the mine as a further aggravation of their position. In spite of the benefits (employment and income increases), they would resent the increased population and urbanization that would occur, even though it would be slight from this one mine (see Population section). Those persons who would benefit from the mine directly (e.g., mine employees and local merchants) would welcome the employment opportunities and higher wages they could expect to receive. Their positions would advance financially, and they would see the mine as a chance to improve the quality of their lives. Those in the lower income brackets and unable to improve their positions because of the mine could see it as further depressing their situation. They could see it as detrimental, because it would continue to inflate prices, make it harder to compete for goods and services, and widen the gap between their incomes and those in the mining sector (Abt Associates 1977 and Gilmore 1974).

Life Styles

This one mine should not cause significant impacts to the life styles that currently exist in the county. The trend towards urbanization would continue, but as discussed in the Population section, it would not cause the annual rates of growth of the county, Rock Springs, or Green River to rise more than 1.5%. Some would still feel, however, that it was aggravating the situation by inducing unwanted new growth and possibly hampering the county's recovery from the "boom"years of 1973-1974 (Abt Associates 1977).

Table BB3-15B

PROJECTED HOUSING DEMAND: SWEETWATER COUNTY

	1977 Housing	1980 Housing Projection Without Proposed Action	1980 Housing Projection With Proposed Action	1980 Cumulative Impact	1980 Impact of Proposed Action	1985 Housing Projection Without Proposed Action	1985 Housing Projection With Proposed Action	1985 Cumulative Impact	1985 Impact of Proposed Action	1990 Housing Projection Without Proposed Action	1990 Housing Projection With Proposed Action	1990 Cumulative Impact	1990 Impact of Proposed Action
Sweetwater County	10,367	12,062	12,640	2,273	578	15,381	16,202	5,835	821	17,245	18,086	7,719	841
Rock Springs	5,197	6,265	6,679	1,482	414	8,356	8,944	3,747	588	9,530	10,133	4,936	603
Single family	3,199	3,840	4,047	848	207	5,094	5,388	2,189	294	5,799	6,100	2,901	301
Multi family	622	782	844	222	62	1,096	1,184	562	88	1,272	1,363	741	91
Mobile homes	1,376	1,643	1,788	412	145	2,166	2,372	996	206	2,459	2,670	1,294	211
Green River	3,312	3,826	3,934	622	108	4,881	4,985	1,673	154	5,396	5,553	2,241	157
Single family	1,783	2,117	2,171	388	54	2,771	2,848	1,065	77	3,138	3,216	1,433	78
Multi family	467	529	545	78	16	649	672	205	23	717	741		24
Mobile homes	1,062	1,180	1,218	156	38	1,411	1,465	403	54	1,541	1,596	[illegible]	55
Balance of county	1,858	1,971	2,027	169	56	2,194	2,273	415	79	2,319	2,400	542	
Single family	573	635	660	87	25	758	794	221	36	827	863	290	36
Multi family	82	88	91	9	3	99	103	21	4	105	109	27	4
Mobile homes	1,203	1,248	1,276	73	28	1,337	1,376	173	39	1,387	1,428	225	41

Source: Abt Associates 1978.

Note: Cumulative Impact = projection "with" the proposed action - 1977 housing.
Impact of the Proposed Action = projection "with" the proposed action - projection "without" the proposed action.

CHAPTER 4

MITIGATION MEASURES NOT INCLUDED IN THE PROPOSED ACTION

MEASURES

Mining and Reclamation Plan

U.S. Geological Survey (USGS)

Before approval of the mining and reclamation plan, the Bureau of Land Management (BLM) will prepare Section 106 compliance case reports on existing or potential National Register sites within the mine area.

Black Butte Mitigating Measure 1. To avoid adverse effects to the properties eligible for the National Register (Hallville Townsite and Mine, Gibraltar Townsite and Mine, and Blck Buttes Stage Station) from mining and other related surface disturbing activities, a stipulation preventing occupancy, travel through, or any disturbance to the property will be placed in the mining and reclamation plan. Periodic monitoring, four times a year of Hallville Townsite and Mine, Gibraltar Townsite and Mine, and Black Buttes State Station Complex by professional cultural resource personnel will be conducted. If physical or other adverse impacts are occurring to the property, the BLM will develop suitable mitigation for these impacts in consultation with the State Historic Preservation Officer and Advisory Council.

Black Butte Mitigating Measure 2. To reduce losses of subsurface archeological sites caused by mining and other surface disturbing activities, a qualified archeologist acceptable to the BLM will be contracted by the lessee to be present during the initial surface disturbance of all of those zones or areas of alluvium which were determined to be sensitive by inventory. The lessee may opt to conduct trenching and (or) test bore holes of identified sensitive areas prior to mining or surface disturbances using an archeologist and methodology acceptable to the BLM and State Historic Preservation Officer (SHPO). If National Register quality sites are found during this additional work, Section 106 compliance procedures will be conducted by BLM and appropriate mitigation will be conducted in consultation with the SHPO and Advisory Council. Salvaging or testing of non-National Register sites will be conducted pending the professional judgment of the archeologist. Periodic monitoring of sensitive areas and particularly those adjacent to areas of proposed surface disturbances, whether in or outside the project area, will also be required using an archeologist acceptable to BLM.

Periodic monitoring of known National Register sites by qualified professional cultural resource personnel would be conducted to ensure site integrity. If additional mitigative work is needed because of potential damage or adverse effects to the site(s), it will be carried out in consultation with the SHPO and Advisory Council.

Black Butte Mitigating Measure 3. The BLM and USGS are currently developing a Memorandum of Understanding relating to the protection of paleontological resources on public lands. Those agencies are also developing technical guidelines to define the resource, provide evaluatory criteria, and provide measures for protection.

When finalized, the provisions of these documents will serve as a basis for management of paleontological resources and appropriate protective programs.

Wyoming Department of Environmental Quality

To reduce the potential degradation of surface and ground waters from leaching of salts and (or) trace metals, Black Butte mitigating measures 3 and 4 will be implemented.

Black Butte Mitigating Measure 4. Ground water samples will be analyzed for chemical content including analysis for trace metals. These samples will be taken at wells penetrating the mined formation, the next adjacent formations, and should be located down the ground water hydraulic gradient from the mined areas.

Black Butte Mitigating Measure 5. The Black Butte Coal Company will sample water at regular intervals both upstream and downstream from points of possible inflow of runoff waters from mined areas to the main stem of Bitter Creek. These samples will be analyzed to determine biological, chemical, and sediment content of runoff. Periodic analysis for trace metals will be made of both the dissolved constituents and the sediment load. Samples of water from ponds remaining on the site after reclamation of a particular mined area should be analyzed annually. The analyses should include analysis for trace metals as well as a standard chemical analysis.

Black Butte Mitigating Measure 6. The applicant will submit data required under 30 CFR 715.17(3)(i)(A through E) pertaining to alluvial valley floors. These data will provide information needed to establish standards for which compliance with the Surface Mining Reclamation and Enforcement Act may be evaluated.

Black Butte Mitigating Measure 7. Several types of air quality control measures are possible to help prevent the generation of fugitive dust. The application of water to unpaved roadways is the most common method for dust control and has already been included as a design control measure in the analysis of the proposed action. Several other control measures are available, some of which have a definite quantitative efficiency and others which are common sense measures and cannot be assessed quantitatively.

In general, fugitive dust can be controlled by watering at transfer points, such as conveyor ends or loading stations. The efficiency of this measure is dependent on the frequency of water application, an excess of which could create the obvious safety hazards of mud on nonlevel surfaces. Hoods, connected to a ventilation and dust collection system, over sources such as crushers or sorters, limit emissions from mechanical handling of coal. General cleanliness and the prevention of spills also help to reduce the amount of fugitive dust. The emissions from the above sources, however, do not contribute to ambient concentrations of total suspended particulates (TSP) as significantly as emissions from overburden removal, travel on unpaved roads, and wind erosion.

Control of fugitive dust emissions from overburden removal is not feasible due to the continuous exposure of dry subsurface material. Control of fugitive dust emissions from travel on unpaved roads is possible with several measures. Watering, with an approximate efficiency of 50%, has already been included in the design plans. Paving, or treatment with chemical stabilizers which approximate paving, could reduce fugitive dust emissions from these sources by 85%. This will result in a significant reduction in cumulative regional concentrations of TSP.

Travel on unpaved roads accounts for 69% of the predicted total fugitive dust emissions from proposed mining in 1980, 59% in 1985, and 58% in 1990. Paving and chemical stabilization of unpaved access and haul roads, therefore, could reduce mine-related TSP impact on a regional basis by approximately 48% in 1980, 41% in 1985, and 40% in 1990. In lieu of paving or chemical stabilization, control of vehicular speeds can also reduce fugitive dust emissions from travel on unpaved roads. Limiting vehicular speed to 15 mph will reduce emissions by 44%, and a limit of 10 mph will reduce emissions by as much as 75%.

As shown in the preceding paragraphs, best management practices were not necessarily included in the air quality impact analysis. Only those mitigating measures discussed in the mining and reclamation plan on file with the USGS at the start of this rewrite were included in the modeling. In any event, the worst case mine situation is discussed, and best management practices will produce fewer and less intense impacts. It was not possible to include best management practices in Chapter 3, because the suggestions came in too late for modeling to be done and, if included now, would negate the continuity of the present analysis. Chapter 8 contains an air quality alternative which discusses the best management practice impacts.

Bureau of Land Management

Black Butte Mitigating Measure 8. In order to reduce the visual impacts resulting from the construction of roads, railroad, and other rights-of-way when strong contrasts are created to the basic elements of form, line, color, and texture, Black Butte mitigating measure 6 will be implemented. The lessee will follow natural contours insofar as practicable to reduce the number and magnitude of cuts and fills.

Black Butte Mitigating Measure 9. The Black Butte proposed seeding mixtures may not be optimal for all areas. The seed mixtures would be subject to revision based on research results at the proposed Black Butte Mine and, when applicable, from other locations. In addition, if establishment of shrub species from seed proves infeasible, planting of seedlings, tublings, and (or) plant transplanting would be required.

ANALYSIS OF EFFECTIVENESS

Mining and associated surface disturbing activities may adversely effect Hallville Townsite and Mine, Gibraltar Townsite and Mine, and the Black Buttes Stage Stagion Comples. (Mitigating measure: Black Butte number 1.) The measure will avoid adverse effects of mining and associated surface disturbing activity.

Subsurface archeological sites would be destroyed by mining and associated surface disturbing activities. (Mitigating measure: Black Butte number 2.) The measure will reduce the loss of subsurface sites and sites in sensitive areas.

Paleontological losses would occur from the destruction, disturbance, or removal of fossil materials as a result of coal mining activities, unauthorized collection, and vandalism. This measure will reduce the loss of paleontological resources by an undetermined amount. (Mitigating measure: Black Butte number 3.)

Soil mixing and leaching of salts or trace metals into potential surface and ground water sources may impact reclamation efforts and degrade water quality. (Mitigating measures: Black Butte numbers 4 and 5.) The measures will identify possible toxic and (or) marginal material to aid in reducing reclamation losses from salts or trace metals.

The proposed mining could degrade the Bitter Creek drainage, which might be an alluvial valley floor. (Mitigating Measure: Black Butte 6.) This measure will ensure adequate data gathering needed to develop standards that would protect the Bitter Creek drainage.

Fugitive dust generated from unpaved roads would degrade air quality. (Mitigating measure: Black Butte number 7.) There will be a reduction of TSP impact of from 40% to 48%.

Visual impacts would result from construction of roads, railroad, and other rights-of-way due to strong contrasts in the basic elements of form, line, color, and texture. (Mitigating measure: Black Butte number 8.) Contrasts will be reduced from strong to weak.

Black Butte Mitigating Measure 9. This measure would enhance the return of premine habitat values and wildlife species, however, data are not available which would allow quantification of effectiveness.

MONITORING, RESEARCH, AND STUDY PROGRAMS

In order to develop a base for future mine impact analysis, the operators will be required to provide a monitoring program both upstream and downstream for measuring any runoff as to chemical quality, trace metals, and sediment yield in Bitter Creek to determine effects of the mining.

Mining would disrupt livestock distribution and affect forage utilization by livestock on adjoining rangeland. This situation will be monitored by the BLM annually.

As reclamation is accomplished, the compliance officers (state and federal) will conduct periodic inspections of mining areas to assure that reclamation is accomplished in accordance with an approved reclamation plan.

Reclaimed areas will be inspected by federal and state agency representatives for compliance with approved plans. Corrective measures will be agreed upon by representatives and the operator for areas not meeting acceptable reclamation standards.

Table BB4-1

SUMMARY TABLE

Impact	Mitigating Measure	Residual Impact
Adverse effects to National Register eligible properties	Black Butte number 1	This measure would avoid or mitigate all adverse effects to eligible properties
Loss of unknown archeological information and sites from subsurface disturbing activities	Black Butte number 2	An unknown number of the subsurface sites could be lost
Loss of paleontological resources and information from destruction of fossils and from authorized surface and subsurface destruction, disturbance, and removal	Black Butte number 3	Loss of subsurface fossils
Soil mixing and leaching of salts or trace metals into potential surface and ground water sources	Black Butte numbers 4 & 5	Potential decrease of water quality and reclamation efforts
Potential degradation of the Bitter Creek drainage	Black Butte number 6	This measure could be 90% to 100% effective.
Degradation of air quality from fugitive dust	Black Butte number 7	There will be a reduction to TSP impact of from 40% to 48%
Construction of roads, railroads, and other rights-of-way create sharp contrasts in the basic elements of form, line, color, and texture	Black Butte number 8	Strong contrasts will be reduced to weak. This action will not cause a change in the VRM class.
Loss of wildlife habitat and wildlife populations	Black Butte number 9	Reduction in time of wildlife habitat loss and wildlife population loss.

CHAPTER 5

ANY ADVERSE IMPACTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED

This chapter presents a summary of the residual adverse impacts that would remain after considering the mitigating measures discussed in Chapter 4.

AIR QUALITY

Impacts on Air Quality

When annual average background particulate values of 17 micrograms per cubic meter ($\mu g/m^3$) for 1980 and 18 $\mu g/m^3$ for all other years are added to projected mine-related contributions, the annual primary National Ambient Air Quality Standard (NAAQS) of 75 $\mu g/m^3$ is predicted to be exceeded (in the worst case) within 1.5, 2, 2, and 2.5 miles of the active site; and the annual Wyoming standard of 60 $\mu g/m^3$ is predicted to be exceeded within 2, 2.5, 2.5, and 3 miles of the active site for the years 1980, 1985, 1990, and end of mine life, respectively.

If projected mine-related 24-hour suspended particulate values and background concentrations of 35 $\mu g/m^3$ are combined, the 24-hour primary NAAQS of 260 $\mu g/m^3$ is predicted to be exceeded within 3, 4, 3.5, and 5 miles of the active site; and the Wyoming standard of 150 $\mu g/m^3$ is predicted to be exceeded within 4.5, 6, 5, and 8 miles of the active site for the years 1980, 1985, 1990, and end of mine life, respectively.

A comparison of the worst-case mine impact with Prevention of Significant Deterioration regulations indicates the annual standard would be exceeded within 3, 4, 4, and 6 miles; and the 24-hour standard would be exceeded within 11, 15.5, 12.5, and 20 miles of the active site for the years 1980, 1985, 1990, and end of mine life, respectively.

With the application of the 43 CFR 118 regulations, the violations of the Class II increment will not occur.

Two other potential sources of significant particulate emissions are associated with the Black Butte Mine: blasting and coal fires. The cloud of dust produced by blasting would be short-lived, at least compared to the averaging times of the total suspended particulate standards (24 hours or greater), so that little contribution to 24-hour levels would be measured outside the mine site. Coal fires could occur in spite of mitigating measures taken to prevent them. Any fire on the site could significantly contaminate the air and cause a safety hazard. However, due to a high degree of fire control technologies, potential fire impacts would probably be minimal.

If reclamation fails because of a natural catastrophe and the area disturbed by mining operations is not revegetated, particulate emissions could be increased over all predicted emission levels presented in this environmental statement (ES), although the magnitude of this increase is unknown.

Gaseous Pollutants

Mine-related nitrogen dioxide (NO_2) and sulfur dioxide (SO_2) emissions are expected to be insigificant, as discussed in Chapter 4 of the Regional Statement Component (Environmental Research and Technology 1978a); therefore, ambient pollutant concentrations have not been predicted.

Recent studies (U.S. Department of the Interior 1976) of the impact of vehicle emissions associated with western coal mines were reviewed to estimate the probable range of impact. Maximum predicted concentrations of carbon monoxide ranged between 0.02% and 0.44% of the standard. Maximum predicted hydrocarbon concentrations ranged between 0.88% and 3.44% of the standards. Maximum predicted NO_2 concentrations ranged between 0.60% and 3.0% of the standards. Maximum predicted concentrations of SO_2 ranged between 0.02% and 0.33% of the standards. The values represent predictions at less than one-half mile from the mines. Predictions were significantly less at further distances from the mines.

Visibility

For 1980, the visibility of an observer at 1 mile downwind would be approximately 38.4 miles, assuming a background visibility of 40 miles. In general, visibility would increase with downwind distance from the mine. At 5 miles downwind the visibility would be 39.4 miles, and at 10 miles it would reach 39.5 miles. The corresponding values, assuming a background visibility of 7 miles, are 6.7 miles, 6.9 miles, and 6.9 miles, respectively. Similar reductions in visibility would result in 1985, 1990, and end of mine life.

GEOLOGY

A nonquantifiable number of coal fires may be ignited in spite of routine measures taken to prevent them. The emission of combustion products to the atmosphere from accidental coal fires occurring during mining operations is discussed in the Air Quality sections of this ES.

Paleontology

Unavoidable destruction, disturbance, and removal of paleontological resources, both exposed and unexposed, would occur. The significance of this impact cannot be presently meaningfully assessed due to the lack of data and evaluatory criteria.

SOILS

The disturbance of soils on 13,103 acres proposed for mining and spoil storage is unavoidable. The removal, transporting, and mixing of topsoil would result in the loss of soil structure and the loss of soil biota. The removal of topsoil too deep in some areas would contaminate the topsoil with salts. The above would result in a decrease in productivity when the topsoil is used in reclamation.

Soil erosion, with the associated soil loss resulting from soil moving off the area being reclaimed, would occur. The increased rate of soil erosion would be approximately 2.5 tons per acre per year over that of the existing environment. Also, an accelerated rate of wind erosion would occur over areas disturbed by mining and areas being reclaimed prior to the reestablishment of a vegetative cover. The increase in soil loss (in suspension) by wind erosion over the current rate would be approximately 584 tons per year. Some soil compaction would occur with machinery traffic during reclamation. This would result in a decrease in soil productivity. Approximately 300 acres of soil surface would be lost for vegetative production as a result of the construction of housing and support facilities associated with the increase in population created by mining.

Overall soil productivity of the disturbed areas (13,103 acres) when used in revegetation would decrease temporarily as a result of the mining action. This short-term decrease in soil productivity is unavoidable.

If a 10-, 25-, 50-, or 100-year flood were to occur when areas are in the process of being reclaimed, an accelerated rate of erosion would occur over the amount that would occur normally. This would result in large amounts of soil loss, and the occurrence of one of these floods during reclamation could considerably lengthen the time required for vegetation reestablishment.

WATER RESOURCES

Ground Water

Water levels in wells tapping water-bearing formations would be lowered during mining.

Surface Water

If the detention and sedimentation ponds are designed to retain runoff from a 100-year flood and the life of the mine is 26 years, there is a 77.8% chance that a 100-year flood would not be exceeded and a 22.2% chance that it would be exceeded. If the capacity of the holding ponds is exceeded, sediment laden water would be discharged to Bitter Creek drainage.

VEGETATION

Changes in plant species composition, cover, and density would be unavoidable if mining is approved. Mining would require the short-term loss of vegetation on approximately 13,555 acres and the long-term loss on 690 acres (mining and support facilities 581 acres and livestock ponds 109 acres). Short- and long-term losses of vegetation would affect numerous living organisms and their nonliving environment. Affected components are discussed in other sections of this chapter.

Population increases due to mining would result in the long-term loss of vegetation on an estimated 300 acres for housing and support facilities, primarily adjoining existing municipalities. Increased numbers of people in the area would result in additional disturbance of native vegetation, particularly by off-road vehicle use (see Recreational Resources section).

Revegetated areas would have a general appearance of grassland. Grasses would be the most common forage class, with shrubs and forbs being reduced in density and cover as compared to premining conditions.

Natural plant succession would occur on reclaimed lands and could restore approximate premining plant cover and composition values in an estimated 30 to 50 years, as suggested by Cook (Vories ed. 1976).

The temporary and permanent losses of vegetative cover and production on disturbed areas would affect numerous living organisms and their nonliving environment (see Air Quality, Soils, Fish and Wildlife, Visual Resources, Recreational Resources, and Agriculture sections in this chapter).

FISH AND WILDLIFE

Wildlife habitat, carrying capacity, and populations would be lost on 1,419, 4,545, 8,420, and 14,245 acres by 1980, 1985, 1990, and end of mine life, respectively, as a direct result of mining. Wildlife habitat would be adversely affected (area of influence) on 6,386, 20,453, 37,890, and 64,103 acres by 1980, 1985, 1990, and end of mine life, respectively.

Specific habitat losses by the end of mine life would be 14,245 acres of sage grouse yearlong range, 1,050 acres of crucial sage grouse nesting habitat, 8,143 acres of antelope summer range, 6,102 acres of antelope winter/yearlong range, and 13,725 acres of mule deer winter/yearlong range.

These acreages represent 0.9%, 2%, 2%, and 3% of the total available sage grouse yearlong range, antelope summer range, antelope winter/yearlong range, and mule deer winter/yearlong range, respectively, within their particular management or herd unit.

Loss of wildlife population would be estimated at 4,880, 39,000, 72,400, and 343,000 small nongame birds; 15, 130, 340, and 680 sage grouse; 0.274 million, 2.4 million, 6.3 million, and over 20 million small nongame mammals; 63, 430, 955, and 3,650 antelope; and 6,000, 30,000, 56,000, and 570,000 reptiles and amphibians by 1980, 1985, 1990, and end of mine life, respectively.

End of mine life population losses for sage grouse and antelope represent an estimated 0.1% and 3%, respectively, of the production of their total populations within their respective management units by that time.

Reclamation, if successful, would mitigate some of the above losses. Quantification of such mitigation, however, is not possible with current knowledge and available information (see discussion of reclamation in Regional Wildlife and Vegetation sections).

The habitat and population losses would be of major significance to localized populations, but, when compared to total habitat and populations within the region or herd/management unit, they would be of minor significance when based upon percentages alone.

Although it may appear that losses are of minor significance, the projected losses of populations and habitat could, in some instances, be of critical importance to wildlife. Current data are insufficient to thoroughly analyze the effects of each individual habitat or population loss.

Raptor losses could not be calculated for each benchmark date. By the end of mine life, losses would be estimated at 2,200 raptors including their progeny.

All the above estimates include the progeny which would have been produced had mining not occurred.

CULTURAL RESOURCES

All cultural resources within the project area would be affected by increased pothunting and vandalism regardless of mitigation measures applied. This would reduce the amount of information which might be obtained from historical sites for interpretive purposes. The collecting and pothunting of archeological sites could potentially remove important surface indications of significant buried sites. The chances of such sites being discovered and contributing important information to the prehistory of the region and perhaps North America would be reduced

Archeological

The destruction of buried archeological sites by mining and related surface disturbing activities would probably be only partially mitigated. Mitigation success would depend on such factors as successfully predicting areas of likely buried sites and the amount of destruction occurring to a site as a result of not being recognized. The destruction of buried sites could have a significant impact, because if they exist they could be important to the prehistory of the region or the nation.

Historical

The visual impact to historical sites from nearby mining activities would also destroy their integrity. This impact is a temporary effect, however, and would exist only through mine life.

VISUAL RESOURCES

The proposed coal mining would lower the scenic quality of the landscape character of the Black Butte project area. During mining the area would be lowered from Visual Resource Management (VRM) Classes III and IV to Class V. Spoil piles, pit headwalls, coal storage, and topsoil piles would permanently alter the landscape character. Roads, power lines, phone lines, conveyor system, load out, crusher facilities, and other structures would remain until removed and the site is revegetated. The changes to line, form, color, and texture would be obviously visible until vegetation is successfully reestablished. Changes in the landscape character would remain after revegetation and the highest visual class objective achievable after mining would be VRM Class IV. BLM management objectives to maintain the quality of the VRM Class III areas would not be met.

RECREATIONAL RESOURCES

Recreational access would be restricted during mining in the Black Butte project area. As the mine developed, people would come to the area to view the mining activities. Those activities which would be affected by the access restrictions on site would be hunting, sightseeing, and off-road vehicle travel.

Increased population would result in increased recreational use throughout the southwestern Wyoming region. This increased use would result in lowering the quality of the existing "primitive"type of recreational experience. Also, due to increased use, ranchers in Sweetwater County would restrict access across their private lands. The urban recreation facilities in Rock Springs and Green River would experience increased use.

Visitor Use Data

The estimated resident recreation use demand change due to the proposed action would account for approximately 2.9%, 3.4%, and 3.2% of the total recreation use demand in Sweetwater County by 1980, 1985, and 1990, respectively.

AGRICULTURE

Mining would cause a loss of animal unit months (AUMs) within the Rock Springs Grazing Allotment. Estimated cumulative losses would be 153, 790, 1,952, and 4,896 AUMs by 1980, 1985, 1990, and 2,013 (end of reclamation), respectively. An average of 144 AUMs would be lost annually. This loss would represent but a small percentage (<1%) of the total AUMs available annually and would not significantly affect livestock grazing in the allotment.

MINERAL RESOURCES

The proposed mining activity would have an unavoidable adverse impact on coal resources since deposits of a nonrenewable mineral commodity would be depleted. Based on company plans, an estimated 146 million tons of coal would have been mined by 2004. This comprises approximately 10% of the estimated economically recoverable strippable coal reserves identified in Sweetwater, Lincoln, and Uinta Counties, Wyoming. Loss of 10% or 14 million tons of coal in mining, loading, and transportation operations is unavoidable. An unknown quantity of coal in the overburden and (or) interburden would be lost. This coal would be in seams too thin or of too low a quality to be of economic interest.

TRANSPORTATION NETWORKS

There would be increased use of highways and other transportation facilities in the area owing to increased population and mining activities. There would be an estimated increase in license registrations due to increased population. This increase would be 3% from 1978 through the end of mine life. The increased use may not change the traffic accident rate, but there would be an increase in the number of accidents due to the increased numbers of miles traveled.

Certain roads and trails would be obliterated by coal mining. This could lead to other roads being used more heavily. Some private roads would be closed by ranchers limiting access across their land. The increased highway use would lead to the need for more maintenance as the heavy use breaks down the roadbed.

SOCIOECONOMIC CONDITIONS

Population

There would be an unavoidable increase in the population of Sweetwater County and its two major communities (Rock Springs and Green River) if the Black Butte Mine is approved, constructed, and goes into production. Table BB5-15A shows the population increases that would result because of the mine. While population increase may not necessarily be adverse, it would change the size of communities, reduce small-town atmospheres, and continue the trend towards greater urbanization.

Social Conditions

The increase in population could, however, have a number of adverse indirect impacts on Sweetwater County. The most evident of these would be additional pressures on public services and facilities. More crowded conditions would require more police and fire protection; construction of additional access routes; improved or expanded sewer and water systems; and expanded medical, social, and mental services.

Table BB5-15A

PROJECTED POPULATION INCREASES CAUSED BY THE BLACK BUTTE MINE
(SWEETWATER COUNTY)

	1980	1985	1990
Sweetwater County	1,342	1,876	1,882
Rock Springs	962	1,345	1,349
Green River	251	351	352
Balance of county	129	181	181

Source: Abt Associates 1978.

CHAPTER 6

THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The mining of 146 million tons of coal would result in short-term (a period beginning with on-site construction and ending with post-mining reclamation) and long-term (a period beginning after post-mining reclamation) losses or alterations of natural resources and the human environment.

In the short term there would be:

1. a reduction in air quality and visibility by fugitive dust and, to a much lesser extent, vehicular emissions;
2. increased soil erosion and lowered soil productivity on 13,103 acres;
3. the loss of an estimated 4,896 animal unit months (AUMs) due to the removal of native vegetation on approximately 14,245 acres (does not include 300 acres of housing for which AUM data are unavailable);
4. wildlife habitat, carrying capacity, and populations lost on 1,419, 4,545, 8,420, and 14,245 acres and adversely affected (area of influence) on 6,386, 20,452, 37,890, and 64,103 acres by 1980, 1985, 1990, and end of mine life, respectively;
5. There would be a loss of wildlife populations estimated at 7,500, 52,000, 98,000, and 800,000 small nongame birds, 40, 200, 400, and 1,130 sage grouse, 0.25 million, 1.3 million, 2.4 million, and 110 million small nongame mammals, and 6,000, 30,000, 56,000, and 570,000 reptiles and amphibians by 1980, 1985, 1990, and end of mine life, respectively. Raptors and antelope losses could not be calculated for each benchmark date. By the end of mine life, losses would be estimated at 2,200 raptors and 7,000 antelope. All the above estimates include the progeny which would have been produced had mining not occurred.
6. There would be destruction of an unquantifiable number of nonrenewable cultural resources;
7. a reduction from Visual Resource Management Classes III and IV to Class V;
8. a lowering in the "primitive"quality of recreational experiences due to increased population;
9. impeded traffic movement due to increased numbers of trains and vehicles;
10. a disruption of social order due to rapid population growth and subsequent changes in community structure;
11. a possible lowering of the ground water levels in the mining area; and
12. an increase in employment opportunities and total earned income within Sweetwater County.

The residual effects of mining on long-term productivity would be:

1. loss of soil and vegetative productivity on about 409 acres for permanent livestock/wildlife ponds and housing;
2. the permanent loss of 4 raptor nesting sites (potential offspring loss of 14 birds per year);
3. the loss of 139 known fossil vertebrate localities and impacts to an undetermined number of uninventoried exposed and unexposed fossil localities;
4. a gain in knowledge of paleontological resources due to surveys and exposure of resources which might never have been found without excavation;
5. the destruction of an unquantifiable number of nonrenewable cultural resources;
6. the degradation of Visual Resource Management Class III areas to Class IV; and
7. a lowering in the "primitive"quality of recreational experiences due to increased population.

CHAPTER 6

THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The mining of 140 million tons of coal would result in short-term (a period beginning with on-site construction and ending with post-mining reclamation) and long-term (a period beginning after post-mining reclamation) losses or alterations of natural resources and the human environment.

In the short term there would be:

1. a reduction in air quality and visibility by fugitive dust and, to a much lesser extent, vehicular emissions;

2. increased soil erosion and lowered soil productivity on 15,101 acres;

3. the loss of an estimated 4,000 animal unit months (AUMs) due to the removal of native vegetation on approximately 14,183 acres (does not include 920 acres of leasing for which AUM data are unavailable);

4. wildlife habitat, carrying capacity, and populations lost on 1,415, 6,565, 4,071, and 14,183 acres and adversely affected areas of influence on 6,215, 26,665, 17,003, and 44,101 acres by 1985, 1990, 1995, and end of mine life, respectively;

5. There would be a loss of wildlife populations estimated at 7,500, 32,050, 58,861, and 105,948 small nongame birds, 46, 201, 400, and 1,530 sage grouse, 0.25 million, 1.2 million, 2.9 million and 159 million small nongame mammals, and 4,963, 22,061, 35,979, and 179,000 reptiles and amphibians by 1985, 1990, 1995, and end of mine life, respectively. Predators and big game losses could not be calculated for each time-frame; however, by the end of mine life, losses would be estimated at 2,228 raptors and 7,950 antelope. All the above estimates assume the progeny which would have been produced had mining not occurred.

6. There would be destruction of an unknown number of unrecoverable cultural resources.

7. a reduction from Visual Resource Management Classes III and IV to Class V;

8. a lessening in the "primitive" quality of recreational experiences due to increased population;

9. impeded traffic movement due to increased numbers of trains and vehicles;

10. a disruption of social order due to rapid population growth and subsequent changes in community structure;

11. a possible lowering of the ground water levels in the mining area; and

12. an increase in employment opportunities and total earned income within Sweetwater County.

The residual effects of mining on long-term productivity would be:

1. loss of soil and vegetative productivity on about 470 acres for permanent livestock/wildlife ponds and facilities;

2. the permanent loss of 4 raptor nesting sites (potential offspring loss of 14 birds per year);

3. the loss of 119 known fossil vertebrate localities and exposure to an undetermined number of paleontological sites and unexposed fossil locations;

4. a gain in knowledge of paleontological resources due to surveys and recovery of resources which might never have been found without excavation;

5. the destruction of an unquantifiable number of nonrecoverable cultural resources;

6. the degradation of Visual Resource Management Class III areas to Class IV; and

7. a lessening in the "primitive" quality of recreational experiences due to increased population.

CHAPTER 7

ANY IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED

Approximately 145 million tons of coal would be produced by the Black Butte Mine. About 14.4 million additional tons of coal would be lost and unrecoverable due to current mining methods. An unknown quantity in the overburden and (or) interburden would be lost. This coal would be in seams too thin or of too low a quality to be of economic interest.

Energy, in the forms of petroleum products and electricity, would be expended to obtain the coal. Some materials used in manufacturing mining machinery and buildings would not be recycled and thus would be lost.

Most air quality impacts associated with the Black Butte Mine would be reversed when the land is reclaimed and returned to an equivalent of the preexisting vegetative cover and general contours. The only long-term air quality impacts anticipated are those resulting from continued use of unpaved access roads after the project has been completed or halted. Since use of these roads could be stopped by blocking access or reclaiming roadbeds, no irreversible air quality impacts are predicted.

Irretrievable air quality impacts would occur. The loss of good air quality for the period of the project cannot be retrieved. During the life of the project, total suspended particulate standards may be exceeded and visibility reduced in the immediate vicinity of the project.

Forage (about 4,896 AUMs) for livestock and wildlife consumption would be lost.

Wildlife habitat, carrying capacity, and populations would be lost on 1,419, 4,545, 8,420 and 14,245 acres by 1980, 1985, 1990, and end of mine life, respectively, as a direct result of mining. Wildlife habitat, carrying capacity, and populations would be adversely affected (area of influence) on 6,386, 20,452, 37,890, and 64,103 acres by 1980, 1985, 1990, and end of mine life, respectively.

Loss of wildlife populations would be estimated at 4,880, 39,000, 72,400, and 343,000 small nongame birds; 15, 130, 340, and 680 sage grouse; 0.274 million, 2.4 million, 6.3 million, and 20 million small nongame mammals; and 6,000, 30,000, 56,000, and 570,000 reptiles and amphibians by 1980, 1985, 1990, and end of mine life, respectively. Raptors and antelope losses could not be calculated for each benchmark date. By the end of mine life, losses would be estimated at 2,200 raptors and 7,000 antelope. All the above estimates include the progeny which would have been produced had mining not occurred.

Cultural resources would be inadvertantly destroyed. Knowledge would be lost due to resources being investigated at the present rather than in the future—when improved techniques would be available.

Visual resource values would be altered; Class IV would be the highest attainable visual resource management class after reclamation.

Loss would include the destruction or disturbance of 139 known fossil vertebrate localities and impacts to an undetermined number of uninventoried exposed and unexposed fossil localities.

CHAPTER 8

ALTERNATIVES TO THE PROPOSED ACTION

The USGS has accepted the Black Butte mining and reclamation plan as adequate for environmental review and subsequent approval under 30 CFR 211 of May 1976. The Secretary's actions may be approval as proposed, rejection on various environmental or other grounds, approval in part and rejection in part, or approval subject to such additional conditions and requirements or modifications as he may impose under existing laws and regulations. He may also defer decision pending submittal of additional data, compilation of required studies, or for other specific reasons.

Even after a mining and reclamation plan is approved, the regulations and lease terms require that all subsequently proposed departures and deviations therefrom be approved in advance by the Secretary. The regulations (30 CFR 211 and 700) permit the Secretary to direct that changes be made in previously approved operations. For example, changes could be ordered to accommodate new, improved, or revised administrative requirements, technological improvements, environmental concerns or requirements, or revisions of prior evaluations thereof in the light of experience or previously unknown factors.

NO ACTION

The no-action alternative includes analysis of impacts that will occur if the mining and reclamation plan and associated rights-of-way are not approved. Without mining and reclamation plan approval, there will not be any environmental impacts from mining on the leased land.

Coal from the proposed Black Butte Mine is presently committed to supply 3.3 million tons per year to a market in Illinois and 3 million tons per year to a market in Idaho. Without the Black Butte Mine, other coal will have to be acquired to supply these markets. Such a substitution could create a shortage for other coal markets. If the alternate coal source were of a higher sulfur content, lower air quality from the power generation plants in these areas would be expected.

Both adverse and beneficial impacts will occur to paleontological resources in approximate proportion to the level of regional development and the area disturbed.

Under the no-action alternative, increased recreational activity will still occur in the area due to population increases associated with other expected development (Table BB8-1). The increased activity will basically lower the "primitive"quality of the recreational experience which is common around the Black Butte project area. As a result of increased activity, there will be increased recreation maintenance and cleanup costs. There will also be conflicts between local ranchers and recreationists which could result in the ranchers restricting access across their private lands.

The population of Sweetwater County will increase to 45,320 in 1980, 52,951 in 1985, and 57,286 in 1990. County employment will increase to 21,571 jobs in 1980, 25,453 in 1985, and 27,446 in 1990. Personal earned income in the county will increase to $310.6 million in 1980, $414.9 million in 1985, and $502.3 million in 1990. Rock Springs and Green River will absorb most of these increases.

AIR QUALITY

Best Management Practices

Impact Alternative

This alternative contains recommendations which, if implemented, would reduce some of the major impacts described in Chapters 3 through 7. Best management practices could include the following:

1. Mulching and furrowing in the spring followed by fall planting differs significantly from the one-step fall planting process analyzed in Chapter 3. This measure along could reduce total emissions from the mine by 17% to 37% depending on the year (Table BB8-2).
2. Chemical stabilization of the haul roads could reduce haul road impacts by an additional 25% over that of watering the roads.
3. Paving or an equivalent stabilization of all access roads could reduce access road impacts by 85% over that of unpaved access roads.
4. Use of negative pressure bag houses or an equivalent method at all coal dump locations (truck to crusher and silo to railroad car) could reduce these impacts by 95% if properly engineered.
5. The use of conveyor and transfer point coverings and, where necessary, water sprays could reduce these emissions by 75%.

Table BB8-2 is a comparison of the Chapter 3 total TSP emissions with those of best management practice emissions. About a 19% to 43% reduction in total TSP emissions is possible; however, between 17% and 37% of the reduction results from more effective management of disturbed soil during the dry summer months (mulching

Table BB8-1

COMPARISION OF IMPACTS OF PROPOSED ACTION AND NO-ACTION ALTERNATIVE

Elements and Components (Visitor Use Days)[1]	1977	1980 No Action	1980 Total Projection With Proposal	1985 No Action	1985 Total Projection With Proposal	1990 No Action	1990 Total Projection With Proposal
Fishing	172,400	192,700	198,410	229,400	237,530	250,700	258,940
General[2]	168,500	188,900	194,500	229,100	237,210	253,500	261,830
Hunting	54,500	59,400	61,160	69,100	71,550	74,300	76,740
Off-road vehicle[3]	6,700	7,400	7,620	8,700	9,010	9,400	9,710
Sightseeing	52,900	58,200	59,920	69,900	72,380	76,700	79,220
Urban	106,400	123,300	126,950	157,600	163,180	178,800	184,680
Water sports	79,600	90,600	93,280	112,500	116,490	126,200	130,350
Winter sports	21,500	25,400	26,150	38,800	35,000	38,800	40,080

[1]Visitor day = 12 hours.
[2]General includes camping, picnicking, etc.
[3]Estimate by ES team Outdoor Recreation Planner.

Table BB8-2

COMPARISON OF CHAPTER 3 TOTAL TSP EMISSION IMPACTS
TO THOSE OF THE BEST MANAGEMENT PRACTICE ALTERNATIVE
TOTAL TSP EMISSION IMPACTS

Year	Total TSP Chapter 3 Emissions (tons/yr)	Total TSP Best Management Practice Emissions (tons/yr)	Reduction in Emissions (%)	Reduction due only to mulching and furrowing in the spring and planting in the fall (%)
1980	3191	2133	33	26
1985	4752	2779	42	36
1990	3986	2259	43	37
End of Mine Life	7028	5679	19	17

and furrowing). The other recommendations reduce total emissions by only 2% to 7%, depending on the year analyzed.

Fish and Wildlife Mitigation Alternative

This alternative lists recommendations which, if implemented, would greatly reduce or totally eliminate the major impacts to existing fish and wildlife resources described in Chapters 3 and 5 through 7 by enhancement of the wildlife habitat and carrying capacities of those lands adjacent to the proposed mining operations or on nearby off-site locations.

1. That all mining areas be reclaimed to wildlife habitat (Table BB8-3) as soon as possible or feasible. Reclamation would be in conformance to the post-mining land use set out in BLM's land use plans for the area. Vegetative planting and reclamation should be accomplished in consultation with the Wyoming Game and Fish Department, the Wyoming Department of Environmental Quality, and the U.S. Fish and Wildlife Service. The goal of reclamation should be to achieve the highest possible wildlife carrying capacity at the earliest possible date, regardless of cost. All possible tools to achieve this goal should be implemented as needed.

2. That approximately 11,200 acres of pub ic land lying in immediate association with the proposed Black Butte mining area or on nearby off-site locations be set aside as a mitigation area and managed intensively for fish and wildlife resources (Table R8-12). Selection of this mitigation area should be accomplished in consultation with the Wyoming Game and Fish Department and the U.S. Fish and Wildlife Service.

3. That the mitigation area be managed to increase its wildlife carrying capacity by at least 50%. Management tools such as water development, fertilization, vegetative manipulation, spraying, transplanting, seeding, protection of wildlife cover, and management of livestock grazing to enhance wildlife habitat should be implemented as necessary. The habitat of this mitigation area should be managed by the BLM and the wildlife by the Wyoming Game and Fish Department.

4. That the mine permit will not be granted on land critical to the bald and golden eagle's ecological requirements. A qualified team of biologists from the Fish and Wildlife Service, Wyoming Game and Fish Department, and the Bureau of Land Management will judge and recommend the areas to be excluded from mining. Mine permits may be granted for these areas if regulations are adopted that provide for planning substitute mining practices, buffer zones, prey base, and alternate nest sites.

If this alternative is successfully implemented it is estimated that 80% to 90% of the fish and wildlife resource impacts described in Chapters 3 and 5 through 7 could be mitigated. Impacts to other resources would be the same as the proposed action.

UNDERGROUND MINING ALTERNATIVE

This alternative was not considered feasible for reasons of economy and technology.

Underground mining would not be possible as the Black Butte mining plan proposes to mine coal from beneath 0 to 200 feet of overburden. This would not provide sufficient structural strength to support the roof of underground mine works.

BLACK BUTTE RECLAMATION ALTERNATIVE

The mining and reclamation plan would be conditionally approved for a period of 10 years during which time a specific testing and monitoring program for the purpose of measuring revegetation success would be implemented by the coal mining company. In this alternative a plan describing the testing and monitoring program would be prepared by the Black Butte Coal Company for approval by the regulatory authorities prior to its implementation.

If it cannot be demonstrated that revegetation can be successful commensurate with Public Law 95-87 (SMCRA) at the conclusion of the 10-year program, the Department of the Interior will revoke its approval for mining on public lands.

Although current reclamation research indicates that successful reclamation can be achieved on semiarid coal mined lands, it is recognized that answers to reclamation problems are needed on a site-specific basis in order to ensure success.

Table BB8-3

RECOMMENDED VEGETATION FOR RECLAMATION OF BLACK BUTTE MINE

Forbs	Shrubs[1]	Grasses or Grasslikes
1. Wallflower (Erysimum spp.)	1. Big sagebrush (Artemisia tridentata)	1. Thickspike wheatgrass (Agropyron dasytachyum)
2. Phlox (Phlox spp.)	2. Fourwing saltbush (Atriplex canescens)	2. Bluegrass (Poa spp.)
3. Wildbuckwheat (Eriogonum spp.)	3. Shadscale saltbush (Atriplex confertifolia)	3. Basin ryegrass (Elymus cinereus)
4. Fleabane (Erigeron spp.)	4. Nuttall saltbush (Atriplex nutallii)	4. Indian ricegrass (Oryzopsis hymenoides)
5. Sandwort (Arenaria spp.)	5. Black greasewood (Sarcobatus vermiculatus)	5. Bluebunch wheatgrass (Agropyron spicatum)
	6. Common winterfat (Eurotia lanata)	6. Needlegrass (Stipa spp.)
		7. Idaho festuca (Festuca idahoensis)

Note: Common and scientific plant names are according to Beetle (1970).

[1]At least 20% of the annual forage production should be browse.

This alternative, if implemented, would result in the gathering of data to show that lands proposed for mining are reclaimable within a reasonable period of time.

The Black Butte Coal Company would be required, under the direction of state and federal reclamation regulatory and surface ownership agencies, to establish a suitable number of demonstration plots to provide evidence of revegetation success.

The demonstration plots would be established as soon as practicable following the authorization of the Department of the Interior to commence mining operations.

Impacts which would occur if revegetation could not be accomplished would be as follows:

1. The mining company would be forced to shut down its operation on public land.

2. A shut down of the mine would cause economic loss to the mining company from the sale of coal, loss of employment for most of the employees, and partial loss of investment in equipment and material needed to open and operate the mine for the 10-year period.

3. Areas disturbed (about 6,060 acres) during the 10-year period of mining would be unreclaimed or at best only partially reclaimed.

4. The consumer of coal from the mine would need to obtain coal from another source.

5. The reduction in labor force would cause socioeconomic impacts to the region.

6. In the event that mining would still occur on non-public lands, the above impacts would be lessened but would still be significant.

RECLAMATION METHODOLOGY ALTERNATIVE

This alternative lists recommendations which, if implemented, would reduce impacts on surface water quality (erosion) and air quality.

1. Backfilled slopes would be designed low and the length of slopes short.

2. All suitable topsoil and suitable overburden would be conserved for subsequent placement on disturbed areas.

3. Appropriate soil amendments would be used to improve soil structure.

4. Fertilization of topsoil would be done based on soil analyses.

5. All topsoiled areas would be mulched and additional organic matter added.

6. Supplemental irrigation would be employed for the first two growing seasons. Application rates would be based on soil moisture monitoring.

This alternative, if implemented, would result in the use of methodology that would enhance rapid establishment of vegetation. The vegetation would decrease soil erosion from water action and decrease the emission of dust from treated areas.

The grading of all disturbed areas to less than moderate slopes would enhance revegetation but would result in such areas having less topographical diversity. Moderate and steeper slopes provide seasonal and (or) year-round habitat for wildlife and provide protection from storms for livestock and wildlife.

Care would need to be taken to avoid creating conditions unfavorable to native plant species proposed in seeding mixtures. Many of these species are adapted to soils with low to moderate productivity.

DEFER ACTION ALTERNATIVE

For proper cause, the Secretary may defer final action on this proposed mining and reclamation plan. This could include, but is not limited to, the need and time required for:

1. Modification of the proposal to correct specific administrative or technological deficiencies. (No need for additional changes or alternatives was identified during the public review beyond those which are already presented.)

2. Redesign to reduce or avoid specific environmental impact. (No need for additional changes or alternatives was identified during the public review beyond those which are already presented.)

3. Acquisition of additional data to provide an improved basis for technical or environmental evaluation.

In the public review, several comments were received concerning the probability of successful reclamation. As a result the following alternative is presented: Approval of the mining and reclamation plan would be deferred pending the Black Butte Coal Company demonstrating on site that lands proposed for mining or other disturbances would be reclaimable within a reasonable period of time. The principal effects of deferring action on the proposed mining and reclamation plan would be (a) a short-term delay, (b) presumably some reduction or avoidance of certain significant adverse impacts, (c) a better data base and subsequent analysis of specific adverse impacts, (d) economic loss to Black Butte Coal Company from delay of approval, (e) the market for which Black Butte Coal Company has proposed to deliver coal would need to find another source of coal, and (f) possible reduction in the Black Butte Coal Company labor force.

4. Further evaluation of the proposal and (or) alternatives. (No need for additional changes or alternatives was identified during the public review beyond those which are already identified.)

PREVENT (FURTHER) DEVELOPMENT ON THE LEASE ALTERNATIVE

The Secretary may reject any individual proposed activity that does not meet the requirements of applicable laws and regulations under his authority, including the potential for environmental impact that could be reduced or avoided by adoption of a significantly different disigned course of action by the lessee (operator). This may be accomplished by suspension of operations (if ongoing), cancellation of the lease (if environmentally acceptable development is not possible), federal acquisition of the lease, or rejection of the mining and reclamation plan. (No need for additional changes or alternatives was identified during public review beyond those which are already presented.)

RESTRICT DEVELOPMENT ON THE LEASE ALTERNATIVE

This alternative could be applied to all or a portion of the lease, as appropriate. The subject lease conveys the right to develop, produce, and market the federal coal resource if all other terms and conditions are met by the lessee. Various measures that may tend to restrict development may be taken by the Secretary at any time in the interest of conservation of the resources or in the protection of various specific environmental values in accordance with existing laws and regulations; for example, the National Historic Preservation Act of 1966, the Endangered Species Act of 1973, the Surface Mining Control and Reclamation Act of 1977, etc. (No need for additional changes or alternatives was identified during public review beyond those which are already presented.)

ALLOW DEVELOPMENT OF SELECTED AREAS NOW UNDER LEASE ALTERNATIVE

This alternative would permit only selective exploration and development of existing leaseholds based on anticipated adverse environmental consequences. The decision maker has the authority and responsibility to evaluate the coal resources and impacts of mining on these leases prior to acting on the proposals. Exploration and development could be allowed only on those leaseholds, or portions thereof, that would have the lowest anticipated adverse environmental consequences. Weighing the tradeoffs of mining or precluding mining on selected tracts is part of the evaluation and decision process. Adoption of this alternative would reduce adverse effects by reducing the area in which the impacting activities could take place. (No need for additional changes or alternatives was identified during public review beyond those which are already presented.)

CHAPTER 9

CONSULTATION AND COORDINATION

See the Regional Environmental Statement (ES) for a description of the consultation and coordination efforts involved in the preparation of the ES.

BLACK BUTTE SITE-SPECIFIC ES APPENDIX

SOIL ASSOCIATION MAPPING UNIT DESCRIPTIONS

A description of each soil association mapping unit within the Black Butte project area follows. These descriptions and Table BB-A1 are intended for use with the Black Butte soils map found in Chapter 2.

101—Rock Outcrop

This unit consists of steep to vertical rocky escarpment (80%) and associated very shallow soils (20%). The rock escarpments are made up of sandstone and shale. The soils in the unit are very shallow fine sandy loams. Slopes of the unit range from 3% to 30%. Annual precipitation is from 7 to 9 inches.

113—Vegetated Playas

These are soils of vegetated playa areas (alluvial flats) in the 7- to 9-inch precipitation zone. They are calcareous and highly saline with textures of silt loam with vegetation consisting of greasewood and saltbush. Deep cracks occur on some of these soils when dry, indicating high rates of shrink-swell. All of these soils have developed on water-transported sediments.

115—Alluvial Fans, Fine-Loamy Soils

These deep, well drained soils occur on level to nearly level alluvial fans and bottomlands. They are fine-textured (silt loam to clay loam) soils with deep profiles. The soils are calcareous and strongly alkaline and occur in the 7- to 9-inch precipitation zone. Vegetation is mostly saltbush, greasewood, and sparse grasses.

117—Alluvial Fans, Sandy Saline Soils

These are fine sandy loams (calcareous) of nearly level to gently sloping alluvial fans. They are deep, well drained, moderately alkaline and saline soils formed in alluvium. Slopes range from 1% to 8% and annual precipitation is from 7 to 9 inches.

123—Residual Uplands, Moderately Deep Soils, Gently Sloping to Sloping

These soils have formed on plateaus and upland mesas in the 7- to 9-inch precipitation zone. They are shallow to moderately deep with sandy loam to fine sandy loam textures. Most soils (80%) in this association are calcareous, with the remaining component being deep soil associated with snow drifting (developed by melt water). Vegetation varies widely, with sagebrush and mixed grasses dominating.

124—Residual Uplands, Shallow Soils, Nearly Level to Sloping

These are shallow soils formed on plateaus and upland mesas in the 7- to 9-inch precipitation zone. They are nearly all less than 20 inches deep with poorly developed profiles. All are calcareous throughout and have developed over sandstone. Rock outcrop occupies about 5% of this association. Vegetation is mostly low sagebrush and sparse grasses.

225—Residual Uplands, Shallow Soils, Hilly

These are soils of sloping to steep and hilly areas that have developed over calcareous sedimentary rocks. Soil textures within this unit vary from sandy loam to silty clay. These soils are well drained and occur in the 7- to 9-inch precipitation zone. Slopes range from 6% to 30%. Rock outcrop occupies about 15% of this association.

127—Slickspots, Playas, and Dunes

These are nearly level alluvial soils. The majority (80%) of the unit are slickspots which are deep, poorly drained, strongly sodic and (or) very strongly saline, silty clay loam soils formed from alluvium. The rest (20%) are deep, well drained, strongly or very strongly alkaline, wind deposited loamy sands. Very little to no vegetation grows on the slickspots. Annual precipitation is from 7 to 9 inches.

Table BB-A1

SOIL ASSOCIATION CHARACTERISTICS

Map Unit No.	Map Unit Name[1]	% of Map Unit	Subgroup	Family	Effective Root Depth	Soil Reaction (pH)	Natural Soil Drainage	Potential Runoff	Permea-bility	Available Water Capacity
101	Rock Outcrop	80	Rock Outcrop (Sandstone and Shale)		---	---	---	High	---	---
		20	Inclusions of very shallow fine sandy loam soils							
113	Playas, vegetated	95	Typic Torriorthents	Fine montmorillonitic (calcareous), frigid	60+	8.6-9.6	Playa-Floods	Low	Very Slow	Very Low
		5	Inclusions are deep loamy sands, loamy and fine sandy loam soils							
115	Alluvial Fans, fine-loamy soils	80	Typic Torriorthents	Fine-loamy, mixed (calcareous), frigid	60+	8.5-9.0	Well Drained	Mod.-High	Moderate	Low
		20	Typic Torrifluvents	Fine-loamy, mixed (calcareous), frigid	60+	8.4-9.4	Well Drained	Moderate	Moderate	Low
117	Alluvial Fans, sandy saline soils	100	Typic Torriorthents	Coarse-loamy, mixed (calcareous), frigid	60+	8.0-8.8	Intermittent Drainage-Floods	Moderate	Mod.-Rapid	Low
123	Residual Uplands, moderately deep soils, gently sloping to sloping	50	Typic Calciorthids	Coarse-loamy, mixed, frigid	20-40	8.0-9.4	Well Drained	Moderate	Mod.-Rapid	Low
		15	Typic Torriorthents	Coarse-loamy, mixed (calcareous), frigid	20-40	8.4-8.8	Well Drained	Moderate	Moderate	Low
		15	Typic Torriorthents	Loamy, mixed (calcareous), frigid, shallow	10-20	8.0-8.4	Excessive	High	Mod.-Rapid	Very Low
		20	Inclusions are deep sandy loams, deep fine sands, and moderately deep loams							
124	Residual Uplands, shallow soils, nearly level to sloping	40	Typic Torriorthents	Loamy, mixed (calcareous), shallow, frigid	10-20	8.0-8.4	Excessive	High	Mod.-Rapid	Very Low
		20	Lithic Torriorthents	Loamy, mixed (calcareous), frigid	<10	8.2-8.4	Excessive	High	Mod.-Rapid	Very Low
		20	Typic Calciorthids	Coarse-loamy, mixed, frigid	20-40	8.0-9.4	Well Drained	High	Mod.-Rapid	Low
		10	Lithic Torriorthents	Loamy, mixed (calcareous), frigid	10-20	7.4-8.4	Excessive	High	Mod.-Rapid	Very Low
		10	Inclusions are deep fine sandy loams, deep loamy sands, moderately deep fine sandy loams, shallow and very shallow loamy soils, and Rock Outcrop							

Table BB-A1

SOIL ASSOCIATION CHARACTERISTICS
(Continued)

Map Unit No.	Map Unit Name[1]	% of Map Unit	Subgroup	Family	Effective Root Depth	Soil Reaction (pH)	Natural Soil Drainage	Potential Runoff	Permea-bility	Available Water Capacity
125	Residual Uplands, shallow soils, hilly	40	Typic Torriorthents	Loamy, mixed (calcareous), shallow, frigid	10-20	8.0-8.4	Excessive	High	Moderate	Very Low
		20	Typic Torriorthents	Loamy-skeletal, mixed (calcareous), frigid	10-20	8.5-9.2	Excessive	High	Rapid	Very Low
		15	Rock Outcrop (Sandstone)							
		10	Lithic Torriorthents	Loamy, mixed (calcareous), frigid	<10	8.2-8.4	Excessive	High	Mod.-Rapid	Very Low
		10	Typic Torriorthents	Loamy, mixed (calcareous), shallow, frigid	<10	8.0-9.0	Excessive	High	Moderate	Very Low
		5	Inclusions are deep fine sandy loams, deep loamy sands, and moderately deep loams							
127	Slickspots, Playas and Dunes	80	Slickspots		0	8.4-9.4	Intermittent Drainage	Moderate	Very Slow	Low
		20	Typic Torripsamment	Mixed (calcareous), frigid	60+	8.0-8.4	Excessive	Low	Rapid	Low
131	Residual Uplands, shallow fine-loamy soils, gently sloping and sloping	50	Typic Torriorthents	Loamy, mixed (calcareous), shallow, frigid	<10	8.5-9.2	Excessive	High	Moderate	Very Low
		30	Typic Torriorthents	Loamy, mixed (calcareous), shallow, frigid	10-20	8.5-9.2	Excessive	High	Moderate	Very Low
		20	Inclusions are shallow and very shallow sandy loams, moderately deep and shallow loamy soils, and Rock Outcrop							
135	Residual Uplands, shallow sandy soils, hilly	40	Typic Torriorthents	Loamy, mixed (calcareous) shallow, frigid	10-20	8.0-8.4	Excessive	High	Moderate	Very Low
		20	Typic Torriorthents	Coarse-loamy, mixed (calcareous), frigid	20-40	8.4-8.8	Well Drained	Moderate	Mod.-Rapid	Low
		20	Rock Outcrop (Sandstone)							
		10	Typic Torriorthents	Coarse-loamy, mixed (calcareous), frigid	40+	8.2-8.5	Well Drained	Moderate	Mod.-Rapid	Moderate
		10	Inclusions are deep loamy sands and shallow and very shallow channery sandy loams							

Table BB-A1

SOIL ASSOCIATION CHARACTERISTICS
(Continued)

Map Unit No.	Map Unit Name[1]	% of Map Unit	Subgroup	Family	Effective Root Depth	Soil Reaction (pH)	Natural Soil Drainage	Potential Runoff	Permeability	Available Water Capacity
143	Stabilized Dunes and Residual Uplands	40	Typic Torripsamments	Mixed (calcareous), frigid	40+	8.0-8.4	Excessive	Low	Rapid	Low
		20	Typic Torriorthents	Loamy, mixed (calcareous), shallow, frigid	10-20	8.0-8.4	Excessive	High	Mod.-Rapid	Very Low
		20	Typic Calciorthids	Coarse-loamy, mixed, frigid	20-40	8.0-8.4	Well Drained	Moderate	Mod.-Rapid	Low
		20	Inclusions are deep fine sandy loams, very shallow channery sandy loams and Rock Outcrop							
181	Alluvial Fans, fine	60	Typic Torriorthents	Fine, montmorillonitic (calcareous), frigid	60+	8.2-9.0	Bitter Creek Drainageway	High	Very Slow	Low
		35	Typic Torriorthents	Fine-silty, mixed (calcareous), frigid	60+	8.3-9.4	Intermittent	High	Moderate	Low
		5	Inclusions are deep fine sandy loams							
182	Alluvial Fans, sodic	70	Typic Natrargids	Fine-loamy, mixed (calcareous), frigid	60+	8.4-9.4	Intermittent Drainageway-Floods	High	Mod.-Slow	Low
		30	Typic Torriorthents	Coarse-loamy, mixed (calcareous), frigid	60+	8.4-9.4	Intermittent Drainageway-Floods	Moderate	Mod.-Rapid	Low
246	Rocky, Sandy Ridge Tops, Ustic Zone	20	Rock Outcrop (Grey Sandstone)							
		40	Lithic Torripsamments	Mixed, frigid	<10	7.0-7.6	Excessive	High	Rapid	Very Low
		10	Ustic Torripsamments	Mixed, frigid	40+	7.0-7.6	Well Drained	Moderate	Rapid	Low
		30	Inclusions are shallow and moderately deep loamy fine sands and shallow fine sandy loams							

Note: Table derived from information obtained from contract with U.S. Department of Agriculture, Soil Conservation Service, 1977.

[1]Unit names were derived from geomorphic setting of the soil.

Permeability

In/Hour	Class
0.06	Very Slow
0.06 - 0.2	Slow
0.2 - 0.6	Mod. Slow
0.6 - 2.0	Moderate
2.0 - 6.0	Mod. Rapid
6.0 -20	Rapid
20+	Very Rapid

Available Water Capacity

In/60" Profile*	Class
0 - 3	Very Low
3 - 6	Low
6 - 9	Moderate
9 -12	High
12+	Very High

*or to limiting layer

Note: Classes derived from "Supplement to Guide to Authors of Published Survey," TSC Transm. Sheet L1-1, U.S. Department of Agriculture, Soil Conservation Service. 1971.

131—Residual Uplands, Shallow Fine-Loamy Soils, Gently Sloping and Sloping

These are shallow, well drained, strongly alkaline, loamy soils that have formed from shale. Slopes are from 1% to 8% for most of the area, but also included are short, steep rocky ravines and escarpments. Annual precipitation is from 7 to 9 inches.

135—Residual Uplands, Shallow Sandy Soils, Hilly

These are primarily shallow, well drained, fine sandy to sandy loam formed from sedimentary rocks. These soils are calcareous and are in the 7- to 9-inch precipitation zone. Slope ranges from 6% to 30%. About 20% is sandstone rock outcrop.

143—Stabilized Dunes and Residual Uplands

This unit consists of undulating to hilly residual uplands with intermittent sand dunes. The uplands are shallow to moderately deep, well drained, sandy loams formed from sedimentary rocks. The dunes are excessively drained, wind deposited, loamy and fine sands over sedimentary rocks. Annual precipitation ranges from 7 to 9 inches.

181—Alluvial Fans, Fine and Fine-Silty Soils

These level and nearly level soils occur on alluvial fans and bottomlands of Bitter Creek. They are deep, well drained, strongly alkaline and saline, silt loam, silty clay loams, and clayey soils. Annual precipitation ranges from 7 to 9 inches.

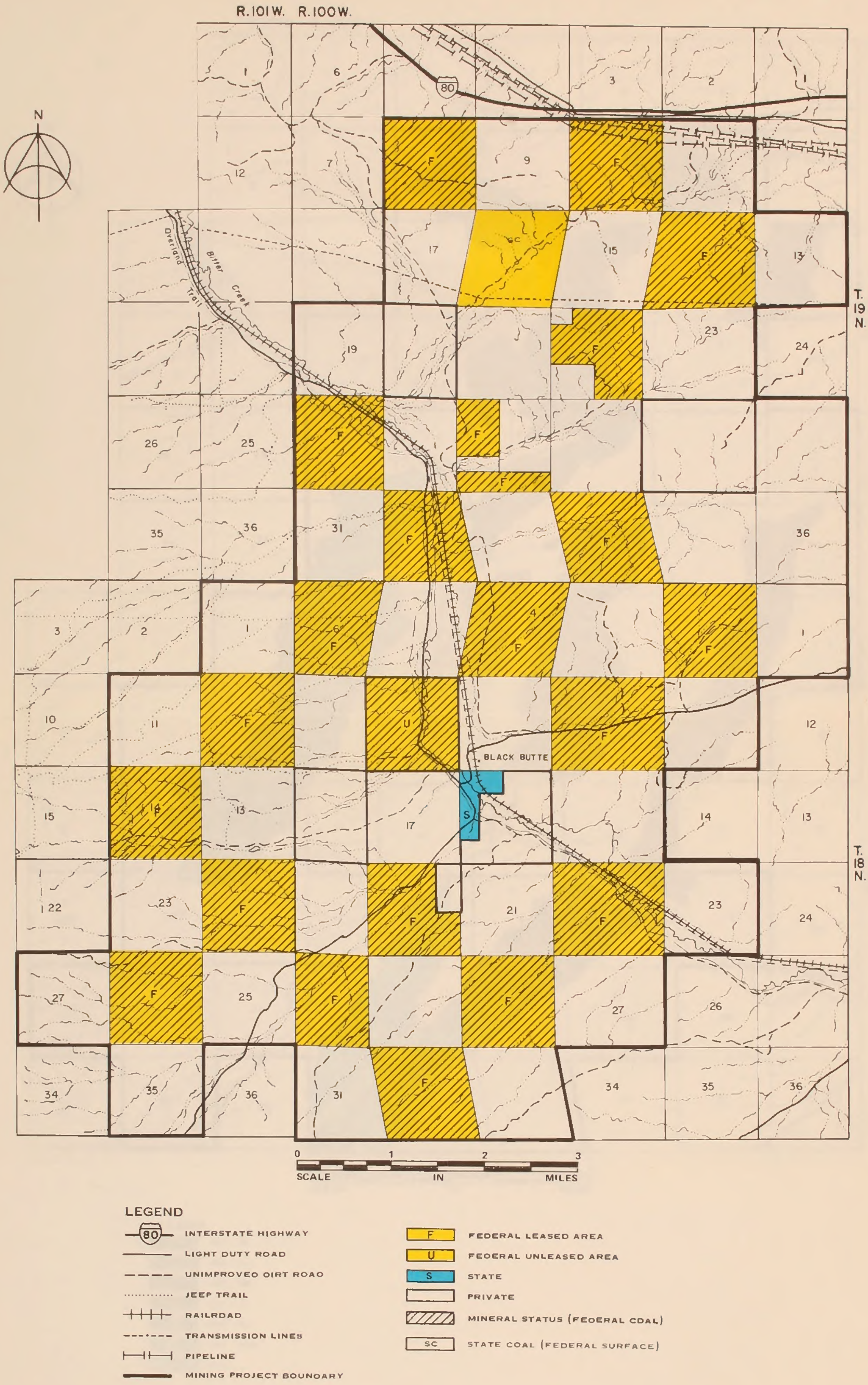
182—Alluvial Fans, Sodic Soils

These are nearly level soils on alluvial fans and bottomlands, slopes are 0% to 3%. They (70%) are deep, well drained, loam soils formed in alluvium from marine shales and sandstones. The remaining (30%) are deep, well drained, strongly alkaline and saline, fine sandy loams developed from alluvium. Annual precipitation ranges from 7 to 9 inches.

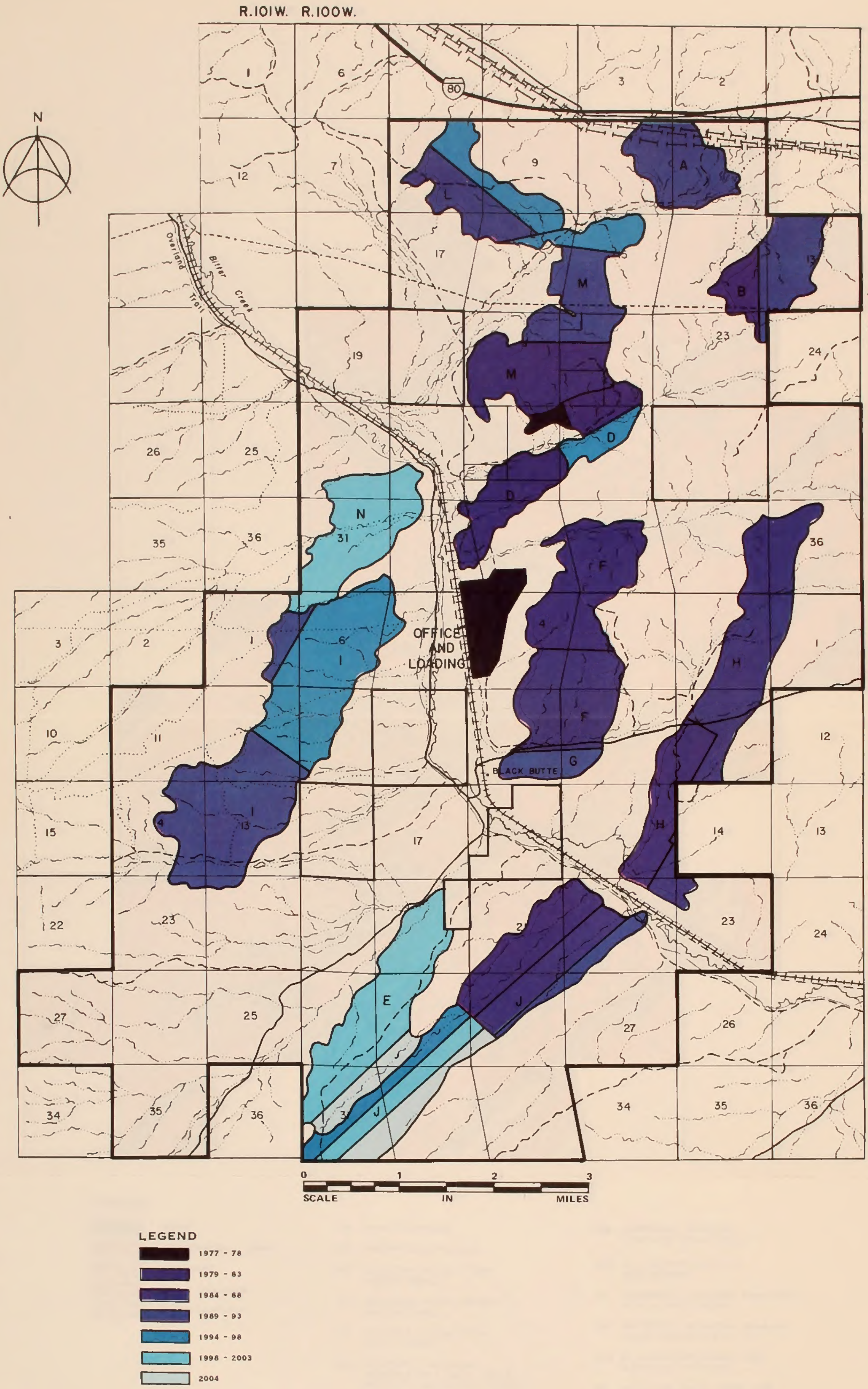
246—Rocky, Sandy Ridge Tops, Ustic Zone

These are sloping to steep soils on residual uplands. They are very shallow to moderately deep, excessively drained, noncalcareous loamy sands formed in residuum of sedimentary rock; also are associated soils that have developed over wind-deposited sands. This unit contains 20% rock outcrop. Annual precipitation ranges from 10 to 14 inches.

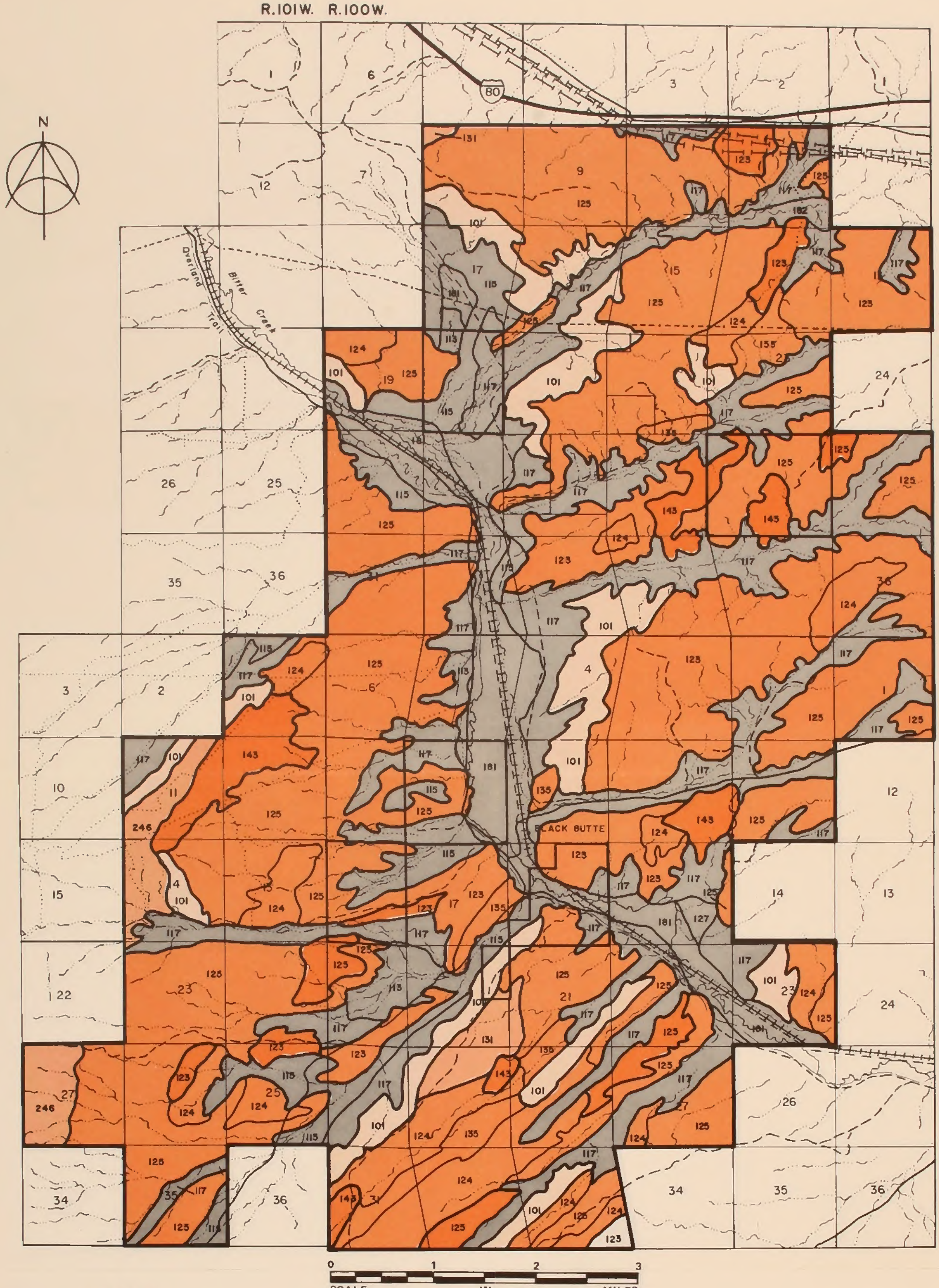
☆U.S. Government Printing Office: 1978-778-644



Map BB1 - 1
SURFACE AND MINERAL STATUS
BLACK BUTTE



Map BB1 - 2
LAYOUT AND MINING SEQUENCE
BLACK BUTTE



LEGEND

- DEEP
- MODERATELY DEEP
- SHALLOW
- VERY SHALLOW
- ROCK OUTCROP

101 ROCK OUTCROP

113 VEGETATED PLAYAS

115 ALLUVIAL FANS, FINE-LOAMY SOILS

117 ALLUVIAL FANS, SANDY SALINE SOILS

118 ALLUVIAL FANS, FINE-SILTY SOILS

125 RESIDUAL UPLANDS, MODERATELY DEEP SOILS, GENTLY SLOPING TO SLOPING

124 RESIDUAL UPLANDS, SHALLOW SOILS, NEARLY LEVEL TO SLOPING

123 RESIDUAL UPLANDS, SHALLOW SOILS, HILLY

127 SLICKSPOTS, PLAYAS, AND DUNES

131 RESIDUAL UPLANDS, SHALLOW-FINE LOAMY SOILS

135 RESIDUAL UPLANDS, SHALLOW SANDY SOILS, HILLY

143 STABLILIZED DUNES AND RESIDUAL UPLANDS

181 ALLUVIAL FANS, FINE AND FINE-SILTY SOILS

182 ALLUVIAL FANS, SODIC SOILS

246 ROCKY, SANDY RIDGE TOPS, USTIC ZONE

Map BB2 - 5A

SOILS

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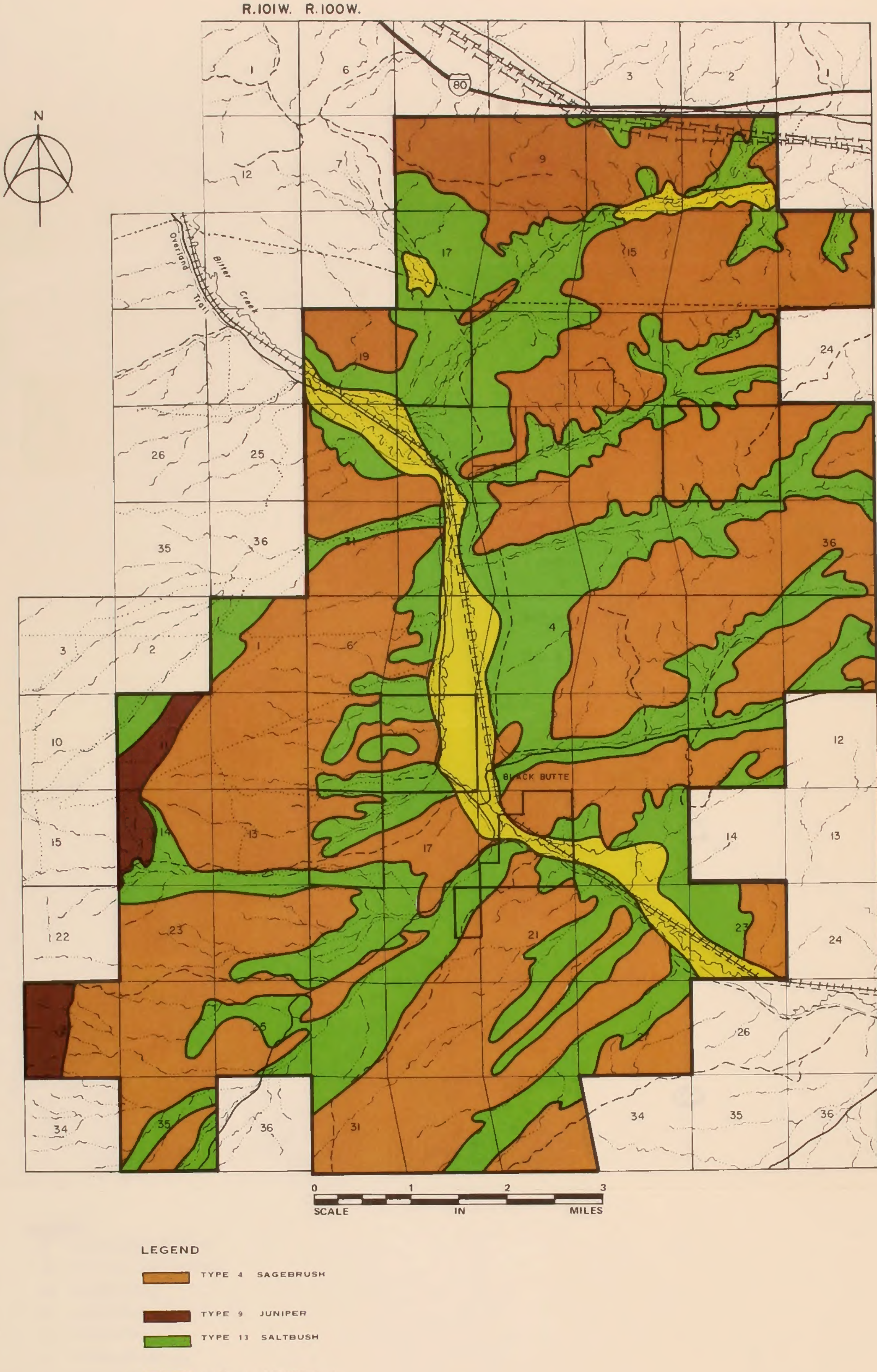

Map BB2 - 7A

VEGETATIVE TYPES

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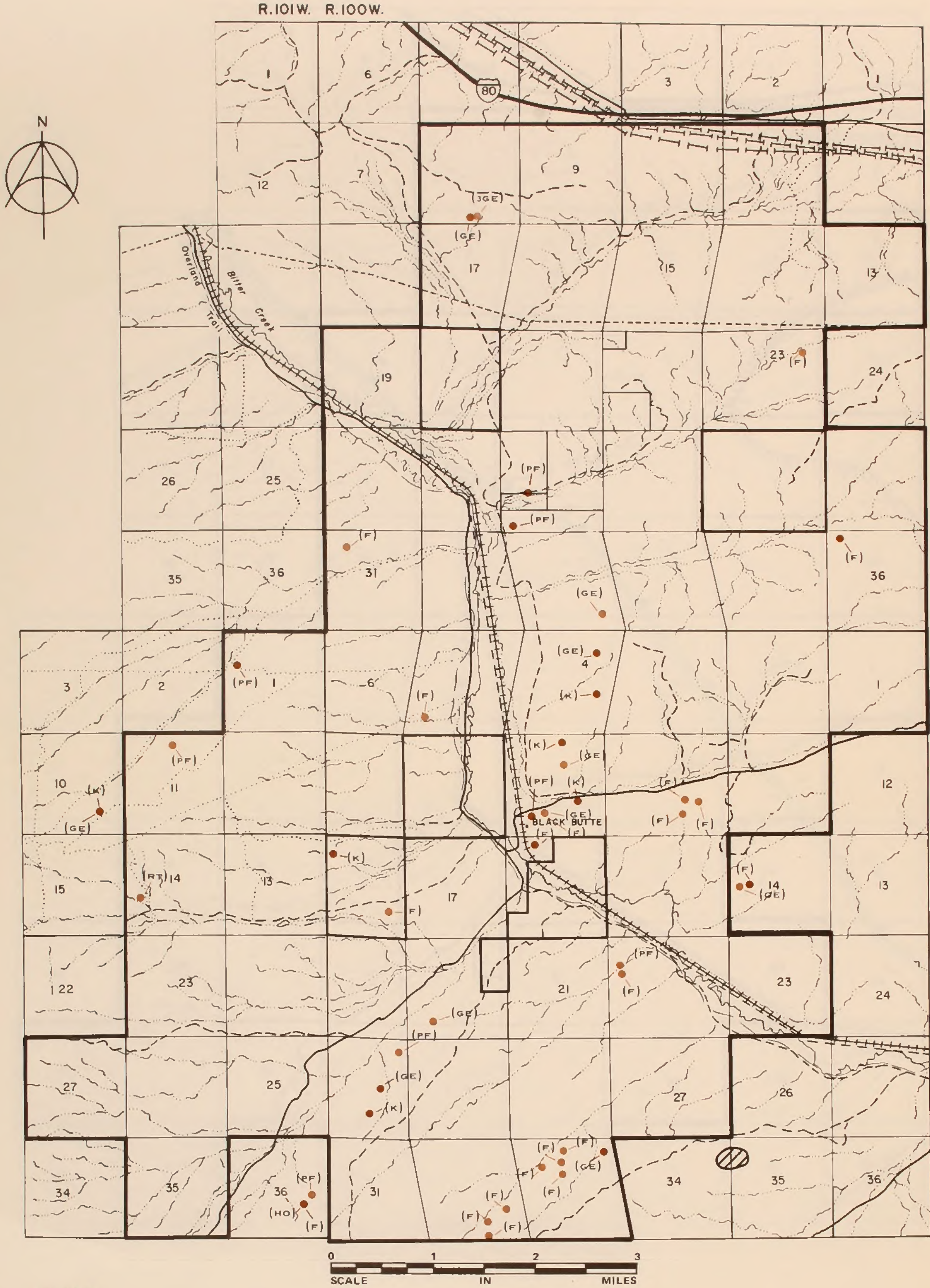

LEGEND

- ● ACTIVE NEST LOCATION
- ● INACTIVE NEST LOCATION
- GE GOLOEN EAGLE
- F FERRUGINOUS HAWK
- PF PRAIRIE FALCON
- K AMERICAN KESTREL
- RT REO TAILEO HAWK
- HO GREAT HORNEO OWL
- SAGE GROUSE STRUTTING GROUNO

ENTIRE AREA IS SAGEGROUSE YEARLONG RANGE.

A NUMBER PRECEOING THE SPECIES SYMBOL INOICATES NUMBER OF NESTS FOUNO AT THAT LOCATION.

Map BB2 - 8A

ANIMAL DISTRIBUTION
(Small Animals)
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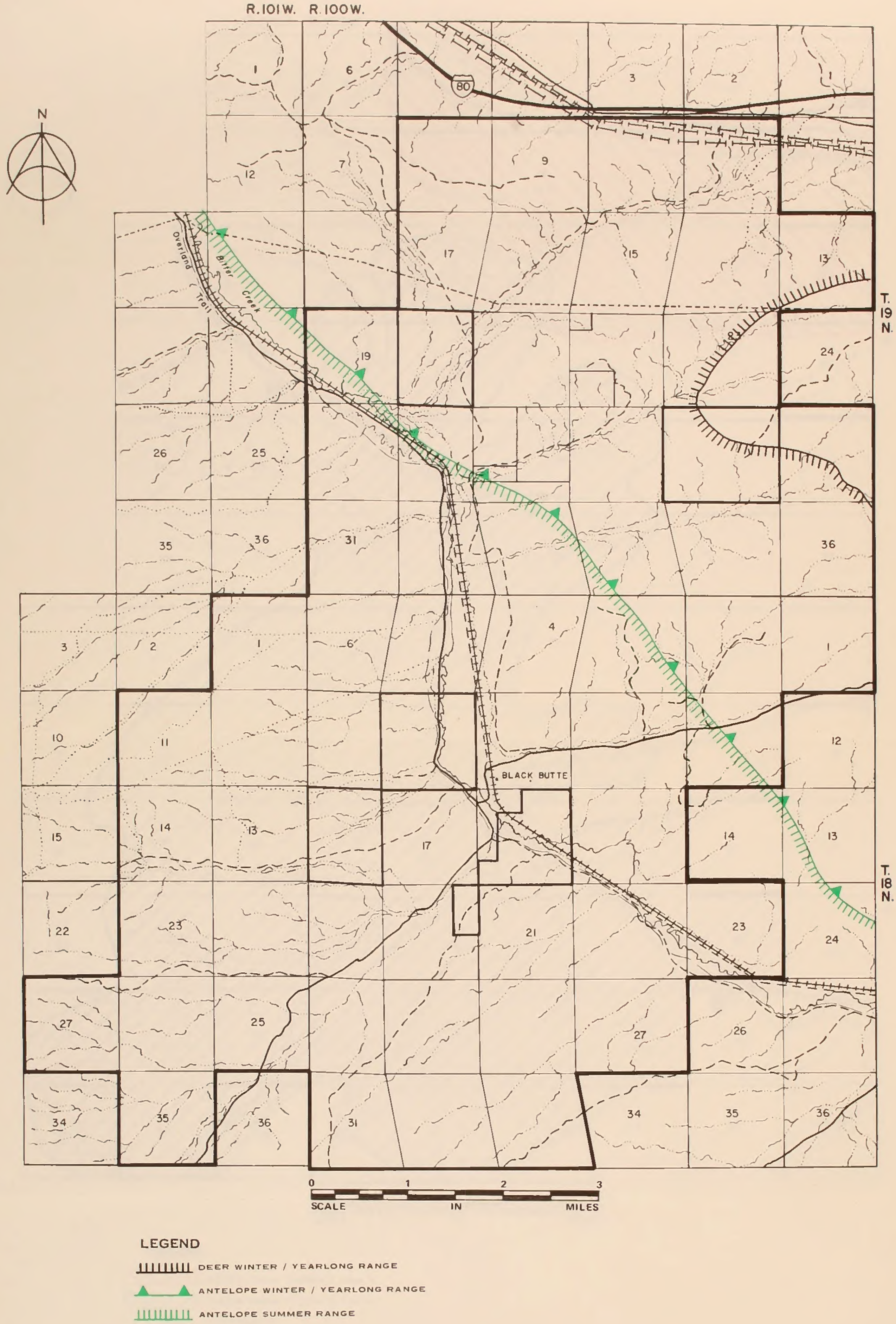
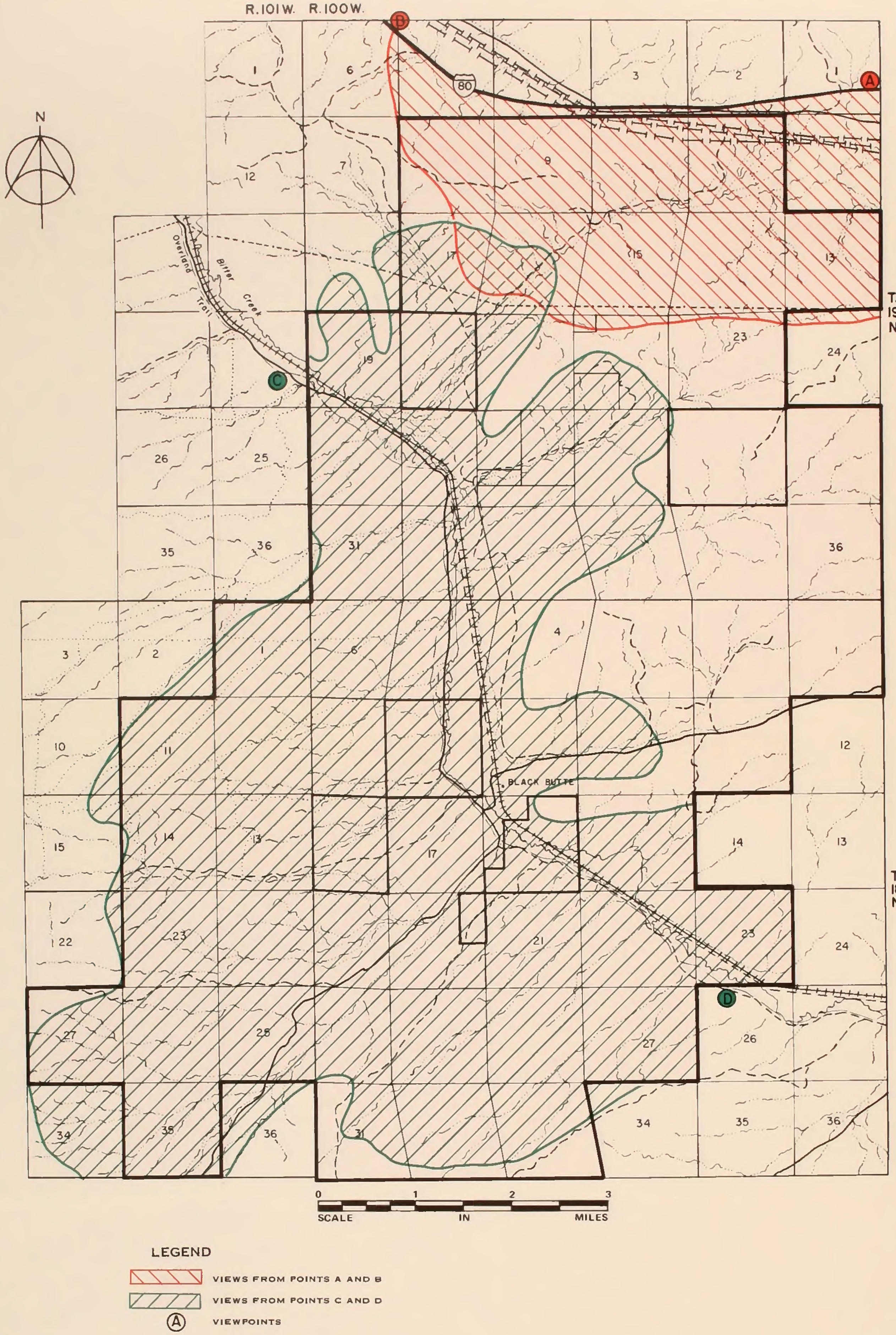


Map BB2 - 8B

ANIMAL DISTRIBUTION
(Large Animals)
BLACK BUTTE



Map BB2 - 10A

VIEWPOINTS AND VIEWS
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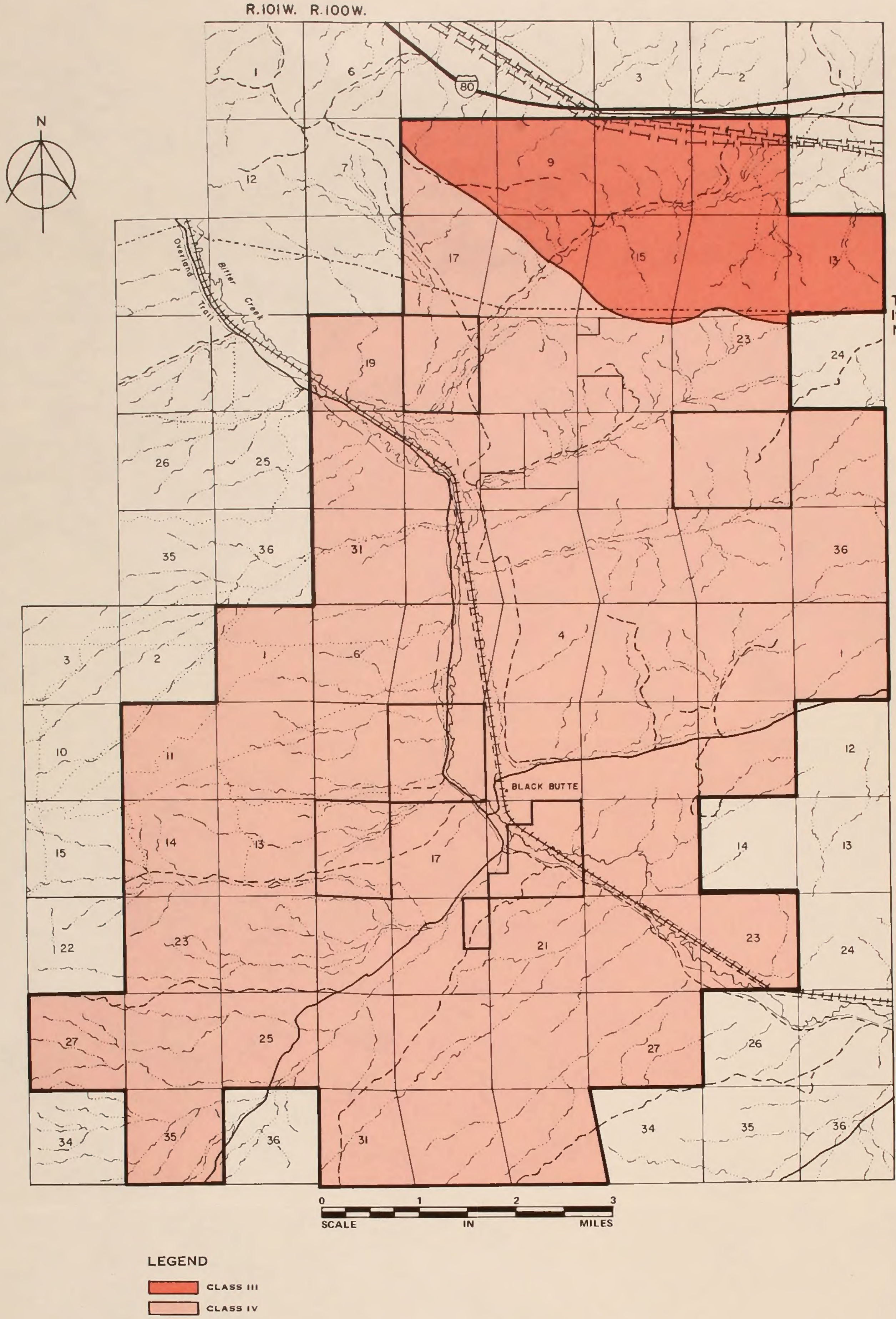

Map BB2 - 10B

VISUAL MANAGEMENT CLASSES

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