CHAPTER 2

DESCRIPTION OF THE ENVIRONMENT

INTRODUCTION

This chapter consists of two parts: existing environment and future environment. It describes the physical, biological, and cultural factors which constitute the environment at the proposed Buckskin Mine site. The description of the existing environment emphasizes those environmental factors most likely to be affected by the proposed action. The description of the future environment focuses on the same environmental factors as they would exist in 1980, 1985, and 1990, and at the end of mine life without approval of the proposed action. These descriptions provide a base for the analysis in Chapter 3, "Environmental Impacts of the Proposed Action,"since alteration of these environmental factors would result if approval were to be granted.

CLIMATE

The climate of Campbell and Converse counties is characterized by dry air masses, which are modified Pacific air masses that move eastward over the Rocky Mountains. The Big Horn Mountains, part of the Rocky Mountain chain, lie about 60 miles west of the proposed Buckskin Mine site. Most of the region's precipitation falls from these air masses, but some precipitation results from incursions of moist air from the Gulf of Mexico. In the summer, most of the precipitation in the region is provided by thunderstorms. The prevailing winds are south-southeasterly and south-southwesterly. Northerly winds are also common.

The proposed Buckskin Mine site, about 10 miles north of Gillette, is located in an area of gently rolling hills. Temperatures at the site average 44°F annually with an average of 22°F in January and 72°F in July. Maximum temperatures of 90°F or above occur in July, while January is the coldest month with a frequent daily mininum temperature of 0°F or below. The average growing season (32°F or above) at the site is estimated to be 129 days. The area receives about 14 inches of precipitation annually (National Oceanic and Atmospheric Administration 1974).

Theoretical calculations indicate that at any point in the Eastern Powder River Basin the mean recurrence interval for a rainfall rate of 1.7 inches in a 30-minute period is 100 years. Similarly, 24-hour rainfalls of 4 inches can be expected once every 100 years (Hershfield 1961). It may be assumed that these occurrences have the same probability at the Buckskin Mine site.

Statistical analysis of long-term data for Douglas, Gillette, and Dull Center indicates that 1-year drought periods occur once every 7 years; 2-year drought periods occur once every 25 years; and 3-year drought periods occur once every 143 years. For further details, refer to Chapter 2, Climate, in the regional analysis.

Wind speeds are out of the south for much of the year and average about 9 miles per hour. Figure BU2-1, a wind rose for Moorcroft, Wyoming, is considered representative of wind patterns on the Buckskin site. Stable atmospheric conditions prevail about 60% of the time because of the cool temperatures and moderately strong winds (Hosler 1961). Surface-based inversions occur on 75% of the mornings, being most frequent in summer (84%) and least in winter (60%). They occur only 18% of the time in the afternoon, being most frequent in winter (41%) and least in spring (5%). The mean annual lake evaporation is about 36 to 42 inches.

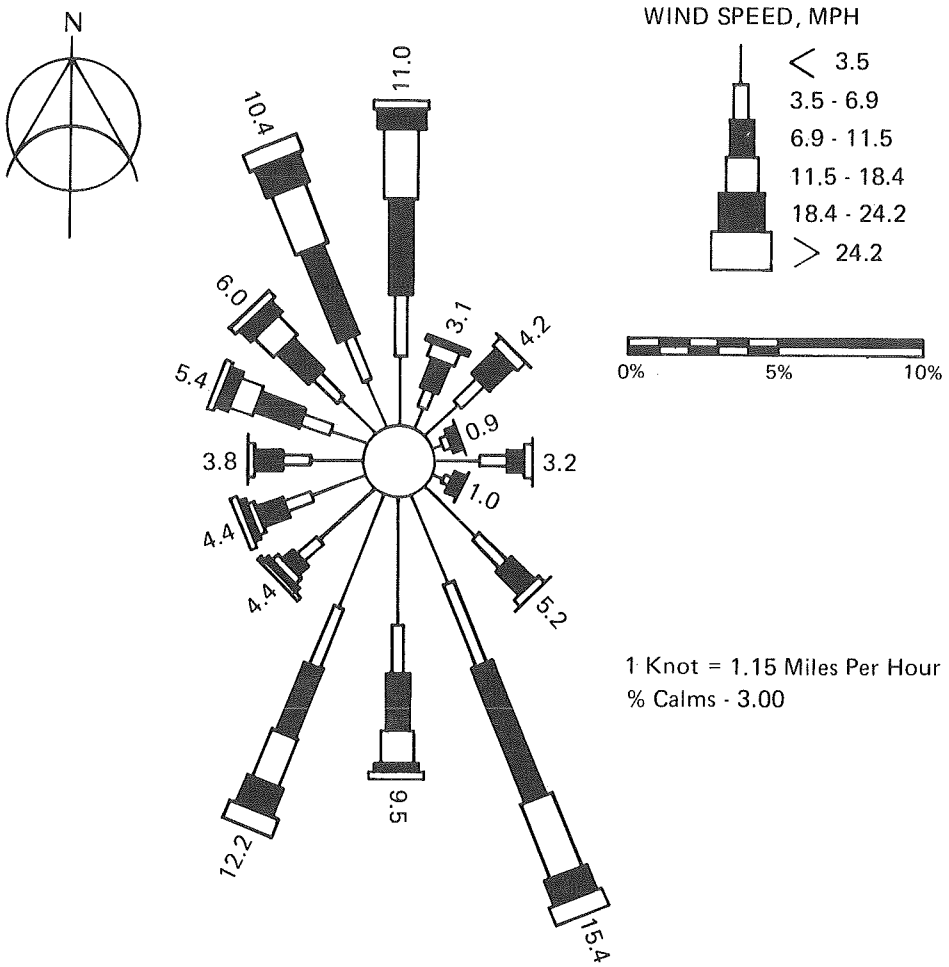
AIR QUALITY

Particulate air quality in undeveloped areas of Campbell and Converse counties ranges from 11 to 31 micrograms per cubic meter ($\mu g/m^3$) annual geometric mean as recorded at 17 state and privately operated particulate sampling sites. The median concentration at the 17 samplers is 19 $\mu g/m^3$.

The available particulate sampling data which best represent existing particulate air quality at the proposed mine site are from two high-volume samplers which were located onsite. The annual geometric mean concentrations recorded at the sampling sites were 11 and 12 $\mu g/m^3$, with maximum 24-hour concentrations of 44 and 47 $\mu g/m^3$. These values are all less than 20% of the corresponding Wyoming state ambient air quality standard.

Concentrations of sulfur dioxide (SO_2) and nitrogen dioxide (NO_2) were sampled at a site 7 miles south of Gillette. The annual arithmetic means recorded in 1976 for SO_2 and NO_2 were 13 $\mu g/m^3$ and 19 $\mu g/m^3$ respectively (Wyoming Department of Environmental Quality 1977), both of which are far below the Wyoming state standards. No measurements of carbon monoxide or hydrocarbons were taken.

Visibility at the site ranges from less than 1 mile to greater than 60 miles throughout the year. The primary causes of low visibility are fogs, haze, dust, and blowing snow. Average monthly visibility ranges from about 26 to 47 miles, with greatest visibility occurring during spring and summer months.



SOURCE: NATIONAL CLIMATIC CENTER, 1950-1952, 1968

Figure BU2-1
ANNUAL WIND ROSE FOR THE PROPOSED BUCKSKIN MINE SITE

DESCRIPTION OF THE ENVIRONMENT

TOPOGRAPHY

The proposed mine site lies within the Upper Missouri Basin of the Northern Great Plains physiographic province (Fenneman 1931); it is characterized by low, rolling hills dissected by intermittent drainages. In the northern part of the site, the land slopes gently southward, and in the southern part gently northward into Rawhide Creek, the main drainage. Rawhide Creek is an intermittent stream which flows from west to east across the southern part of the site. Spring Draw, the main tributary of Rawhide Creek in the lease area, is also intermittent. It flows from northwest to southeast and joins Rawhide Creek along the southeast edge of the lease. Two intermittent internal drainage systems which terminate in playas are present along the western boundary of the lease, and two more are present within the 1,000-foot perimeter (Figure BU2-2). The highest point of elevation on the lease is about 4,260 feet in the northeast corner, and the lowest point, 4,110 feet, is on the southeast boundary where Rawhide Creek exits the property. A physiographic diagram illustrating generalized topography of the lease is shown in Figure BU2-3. Figure BU2-2 is a detailed topographic map of the mine site.

GEOLOGY

The proposed mine site is located on the gently (generally less than 2°) southwest dipping east flank of the Powder River Basin.

Geologic formations that are exposed in the lease area are the Paleocene Fort Union Formation, the Eocene Wasatch Formation, and Quaternary alluvium. (See regional analysis, Figure R2-7, for rock and geologic time sequences.)

There is some disagreement as to the exact location of the Fort Union-Wasatch boundary, but for purposes of this statement, it is considered to be at the top of the coal. The Fort Union Formation, below the coal, consists of brown and dark gray to black carbonaceous shale and siltstone interbedded with light gray, fine-grained, friable sandstone and thin coal beds. The Anderson-Canyon (Wyodak) coal bed, which is to be mined, is at the top of the Fort Union Formation and averages 104 feet in thickness in the lease area. The Wasatch Formation above the coal consists of shale, sandy shale, and soft lenticular sandstone. It varies from 20 to 215 feet in thickness.

Quaternary deposits consist of colluvium (weathered bedrock) and unconsolidated clay, silt, sand, and gravel alluvium along streams. Some of the quaternary units are wholly or partially within the definition of alluvial valley floors (Surface Mining Control and Reclamation Act (SMCRA)) as shown on the geologic map (Figure BU2-4). (Quaternary units not within the SMCRA definition are not shown.) Scoria (clinker) is present in many places in the permit area; scoria is the result of baking and collapse of the enclosing rock when portions of the coal seam burned, probably during early Quaternary (Pleistocene) time. Scoria, colluvium, and alluvium generally mask the outcrop of the coal seam, but the approximate edge of the coal is shown on Figure BU2-4. The line showing the top of the coal in Figure BU2-4 was formed by joining the ends of structure contours on top of the Wyodak Seam (Shell Oil 1977, Figure 2.1-3). The line showing the base of the coal is equivalent to the 0 (zero) thickness line on the coal isopach map (Carter Mining Company 1977, Figure 7, Sheet 2).

According to the environmental analysis provided by the applicant, the area is geologically stable with no faulting or extensive folding, and there is no evidence of landsliding or stratigraphic instability. Geological stability is a regional characteristic.

Paleontology

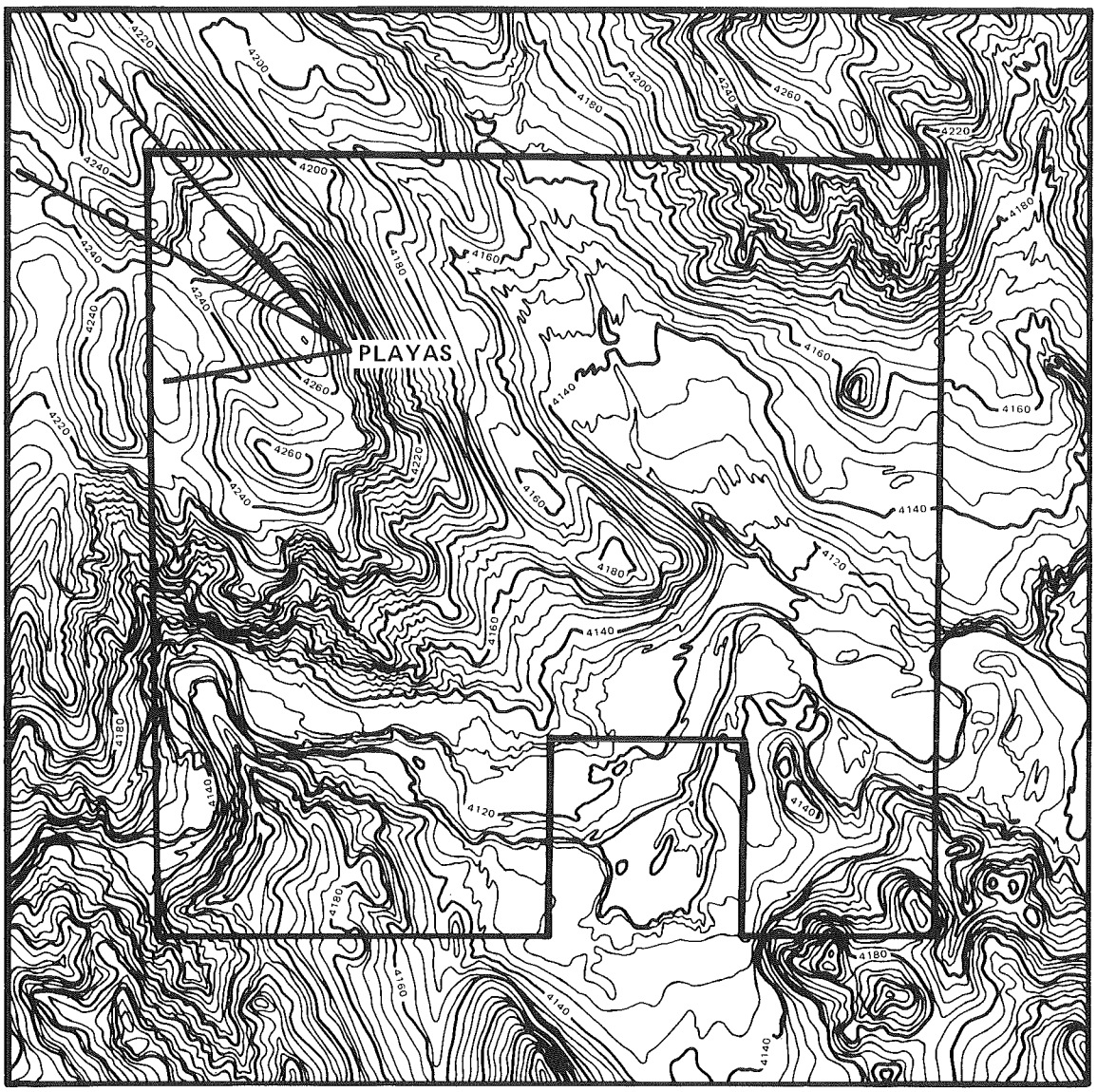
The proposed Buckskin site was surveyed for paleontological resources and assessed for its potential by Paul O. McGrew, Department of Geology, University of Wyoming, in 1976. He reported the following results (personal communication 1977). No fossil localities are known from the lease area. Fossil leaves and invertebrates which occur fairly abundantly throughout the Fort Union and Wasatch Formations likely would be encountered at the Buckskin site. No significant vertebrate fossils have ever been found in the Fort Union Formation of the Powder River Basin, and vertebrate fossils from the Wasatch Formation are quite rare and known from only a few isolated localities. Some of these forms could be encountered at the Buckskin site. McGrew assessed the possibilities of encountering fossil mammals in the lease area as remote for the Fort Union Formation and very low for the Wasatch Formation.

SOILS

Eight soil series and one land type, rough broken land, have been identified on the Buckskin lease by the Soil Conservation Service (SCS) in their 1955 Soil Survey of Campbell County, Wyoming. These were correlated with the most recent soil survey of the area by Mine Reclamation Consultants of Laramie, Wyoming in 1976 (Shell Oil Company 1977). The soil map (Figure BU2-5) shows the location and extent of different kinds of soil located on the Buckskin lease. The proposed mine site is being remapped by SCS; information given on Figure BU2-5 and below may change as a result of the remapping.

The following are brief descriptions of the soils on the lease area. A technical soil profile description of each soil series is shown in the Appendix. More interpretive information on each soil series below is in Table RB-1, Appendix B of the regional analysis.

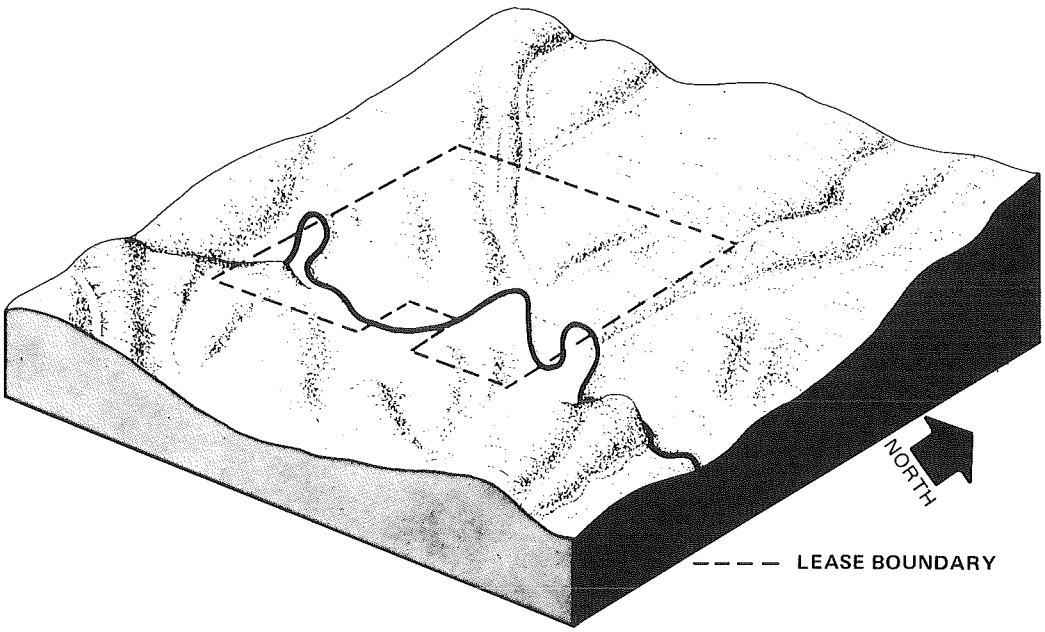
Arvada Series: The Arvada series consists of deep, well-drained, fine-textured, alkaline-rich soils forming on level to undulating alluvial fans and topslopes. Topsoil potential is poor because of high clay content and high alkaline content.



MODIFIED FROM SHELL OIL COMPANY 1977

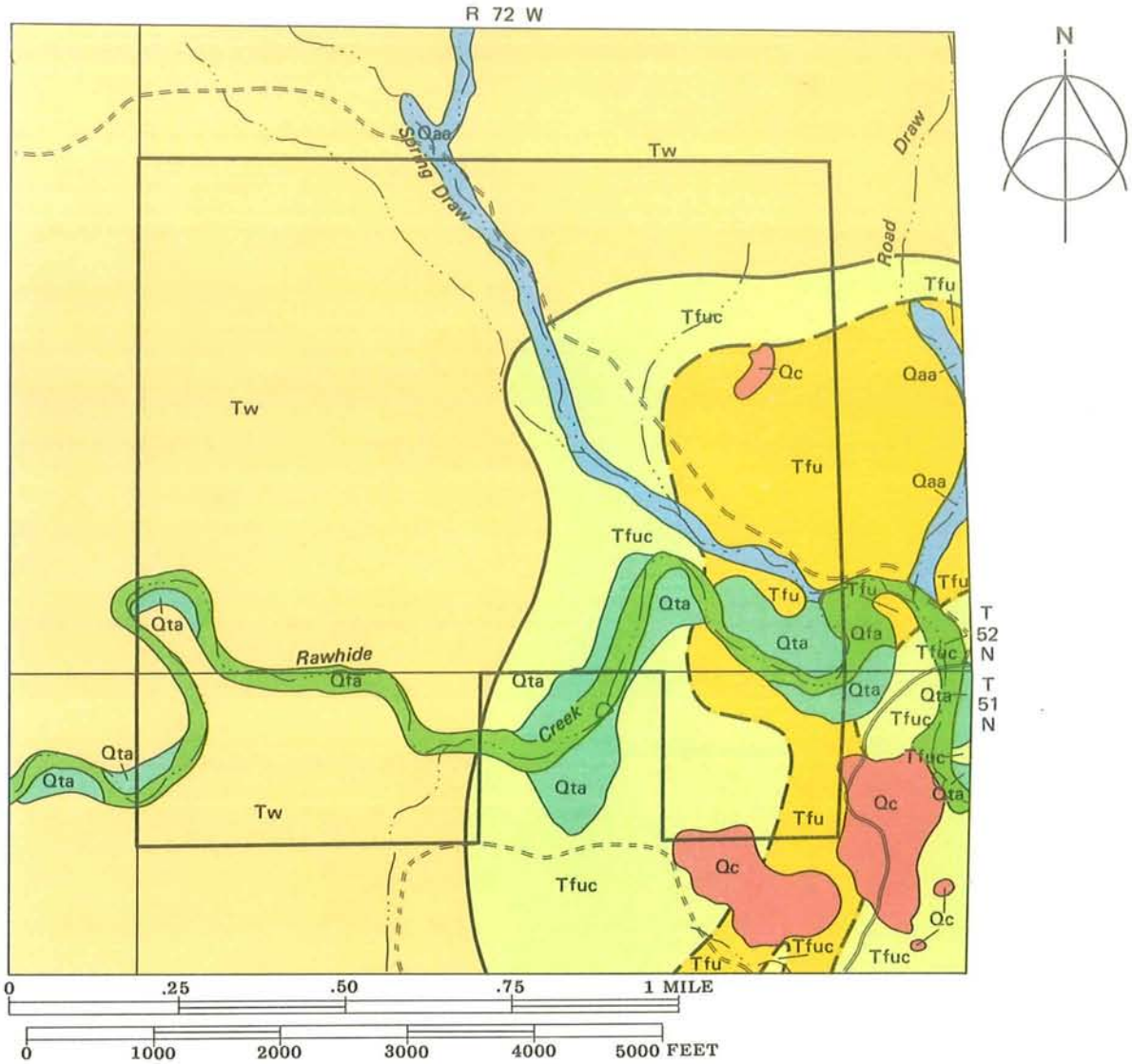
Figure BU2-2

TOPOGRAPHIC MAP OF THE BUCKSKIN MINE AREA



SOURCE: ECOLOGY CONSULTANTS 1977

Figure BU2-3
GENERALIZED TOPOGRAPHY OF THE PROPOSED BUCKSKIN MINE AREA



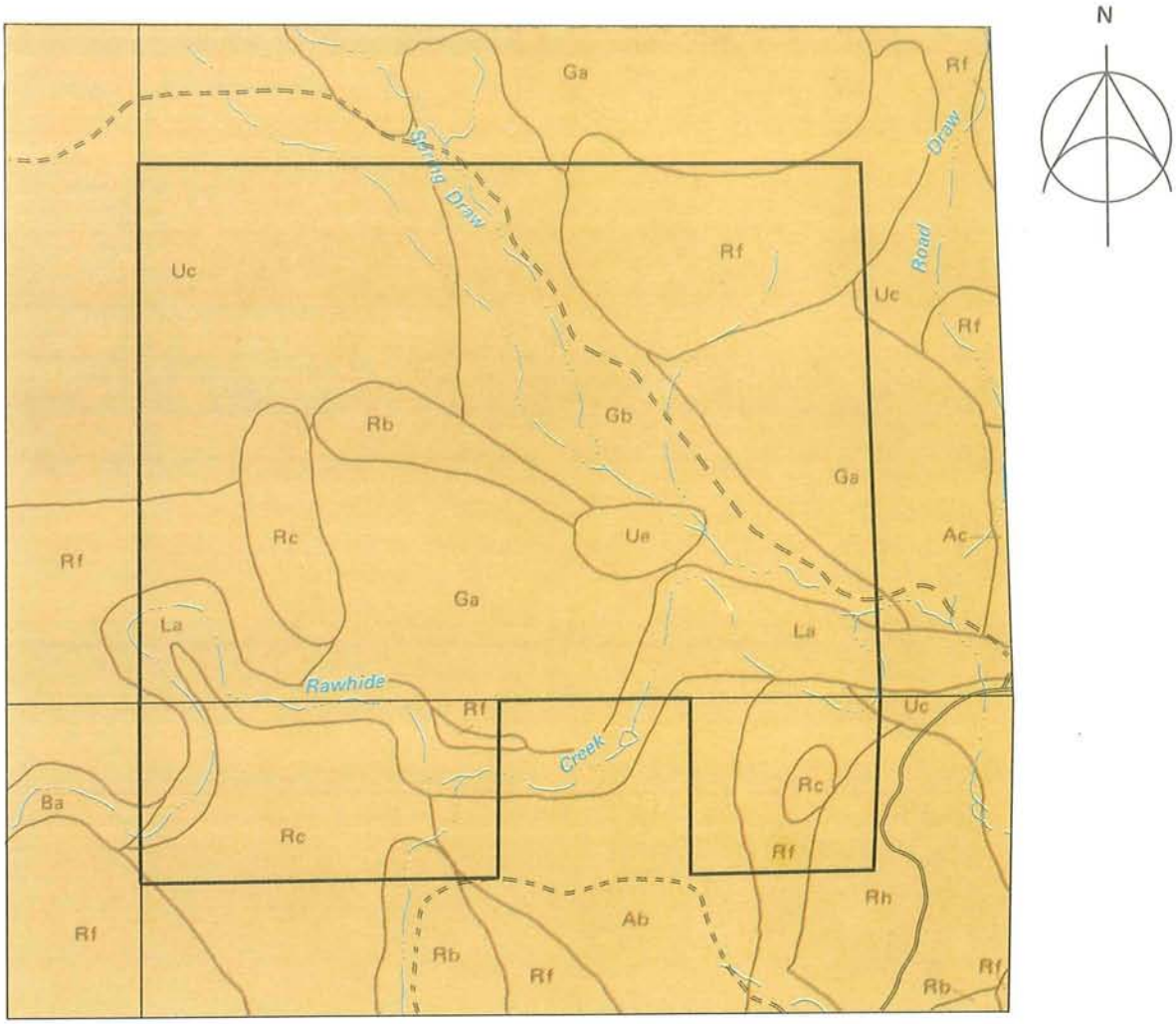
LEGEND

Qfa	FLOODPLAIN ALLUVIUM
Qta	LOW TERRACE ALLUVIUM
Qaa	FLOODPLAIN AND TERRACE ALLUVIUM OF MINOR STREAMS
Qc	SCORIA (BAKED WASATCH FORMATION)
Tw	WASATCH FORMATION
Tfuc	FORT UNION COAL (WYODAK SEAM)
Tfu	FORT UNION FORMATION
———	APPROXIMATE TOP OF COAL
- — -	BASE OF COAL

NOTE: Qfa is within the definition of alluvial valley floors according to the Surface Mining Control and Reclamation Act of 1977 (SMCRA). Qta and Qaa are included, but must be studied in greater detail to determine how much of their area falls within the SMCRA definition. Figure is modified from Williams, 1978.

Figure BU2-4

SIMPLIFIED GEOLOGIC MAP OF BUCKSKIN MINE SITE



LEGEND

Ab Ac	ARVADA SERIES
Ba	BANKARD SERIES
Uc,Ue	BOWBAC SERIES
La	HAVERSON SERIES
Ga,Gb	OLNEY SERIES
Rb,Rc	RENOHILL SERIES
Rh,Rf	SAMSIL - SHINGLE - ROCK OUTCROP

SOURCE: Soil Survey of Campbell, County, Wyoming, July, 1955 with modifications from Shell Oil Company, 1977.

Figure BU2-5
SOILS MAP OF BUCKSKIN MINE SITE

Bankard Series: The Bankard series consists of deep, well-drained, coarse-textured soils forming on alluvial valley floors on low terraces adjacent to streams. Topsoil potential is poor because of sandy textures and gravelly horizons.

Bowbac Series: The Bowbac series consists of moderately deep, well-drained, medium-textured soils forming on gently rolling to moderately steep uplands. Topsoil potential is only fair because of sandy horizons present in the soil profile and shallow depth to bedrock.

Haverson Series: The Haverson series consists of deep, well-drained, medium-textured soils forming on alluvial valley floors on low terraces adjacent to streams. Topsoil potential is good to fair because of gravelly horizons present in the soil profile.

Olney Series: The Olney series consists of deep, well-drained, medium-textured soils forming on gently rolling to moderately steep uplands. Topsoil potential is good to fair because of sandy horizons present in the soil profile.

Renohill Series: The Renohill series consists of moderately deep, well-drained, fine-textured soils forming on gently undulating to rolling uplands. Topsoil potential is poor because of high clay content.

Samsil Series: The Samsil series consists of shallow, well-drained, fine-textured soils forming on ridges and hill slopes. Topsoil potential is poor because of high clay content and shallow depth to bedrock.

Shingle Series: The Shingle series consists of shallow, well-drained, medium-textured soils forming on ridges and hill slopes. Topsoil potential is poor because of shallow depth to bedrock.

Rough Broken Land: This mapping unit is mainly derived from mixed sandstone, siltstone, and shale. Included are escarpments between benches formed by erosion, badly dissected areas, and rock-outcrops. Small, shallow stony areas and deep soils are intermingled with the areas of rock outcrop. Topsoil potential is poor because of the variable materials.

Land capability classification refers to a grouping of kinds of soils into special units according to their capability for intensive use and the treatments required for sustained use. This classification system has been prepared by the SCS (1973), which recognizes eight classes of land according to the risk of land damage or the difficulty of land use. Four of these classes are present on the proposed Buckskin Mine site:

Class IV: Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both. Generally the last soil grouping considered suitable for cultivated crops; requires major treatment.

Class VI: Soils that have severe limitations that make them generally unsuited for cultivation and limit their use largely to pasture, or range, woodland, or wildlife food and cover.

Class VII: Soils that have very severe limitations that make them unsuitable to cultivation and that restrict their use largely to grazing, woodland, or wildlife food and cover.

Class VIII: Soils and landforms that preclude their use for commercial plant production and restrict their use to recreation, wildlife, water supply, or aesthetic purposes. Generally, Class VIII soils do not respond to management treatment within agricultural purposes.

Land capability classification has been in use by the SCS for a number of years to assist landowners with their farm and ranch planning. Soil surveys are interpreted into capability groups and range sites (a range site is a distinctive kind of rangeland that differs from other kinds of rangeland in its potential to produce native plants) according to production potential and conservation treatment needs. A complete description of the land capability system is in the regional analysis, Chapter 2, Soils, and the range sites are described in detail in Appendix B of the regional analysis.

Table BU2-1 shows land capability units and range sites for the proposed Buckskin Mine site.

WATER RESOURCES

Groundwater

The groundwater that would be affected if the Buckskin Mine is approved is that in the overburden and coal. It is assumed that part of the water for mine usage would come from aquifers below the coal, and these aquifers would also be affected.

Groundwater occurs in the overburden in the alluvium, which is as much as 20 feet thick, and in sandstone lenses in the Wasatch Formation. Movement of water in the alluvium is in a downstream direction and natural discharge is into the surface water system and by evapotranspiration. Flow of water in the Wasatch, in the area that would be affected by mining, is toward Rawhide Creek. The contours of the water levels in the Wasatch that were furnished by the applicant are essentially the same as the water level contour in the coal. (See Figure BU2-6.) Natural discharge is by springs, evapotranspiration, and into the alluvium.

The applicant, in summarizing the aquifer properties, stated the alluvium could transmit an average of about 8,000 gallons per day through each foot of aquifer width when the hydraulic gradient is 1:1 (gpd/ft.), and the sandstone could transmit about 5,000 gpd/ft. The storage coefficient, which is the volume of water released from, or taken into, storage per unit decline in head per unit surface area of the aquifer, is about 0.05 for the alluvium and in the order of 0.05 for the sandstone.

The contour map of water levels in the coal (Figure BU2-6) indicates the mine site is in an area where water is being discharged from the coal toward Rawhide Creek where it is discharged into the alluvium. The applicant states the coal will transmit an average of about 2,000 gpd/ft. of water and that the storage coefficient is about 0.0006.

The chemical quality of the water from the alluvium, overburden, and coal at the leasehold is similar to that elsewhere in the region. One set of analyses furnished by the applicant is given in the Appendix. The locations of the sampling sites are shown in Figure BU2-7.

TABLE BU2-1

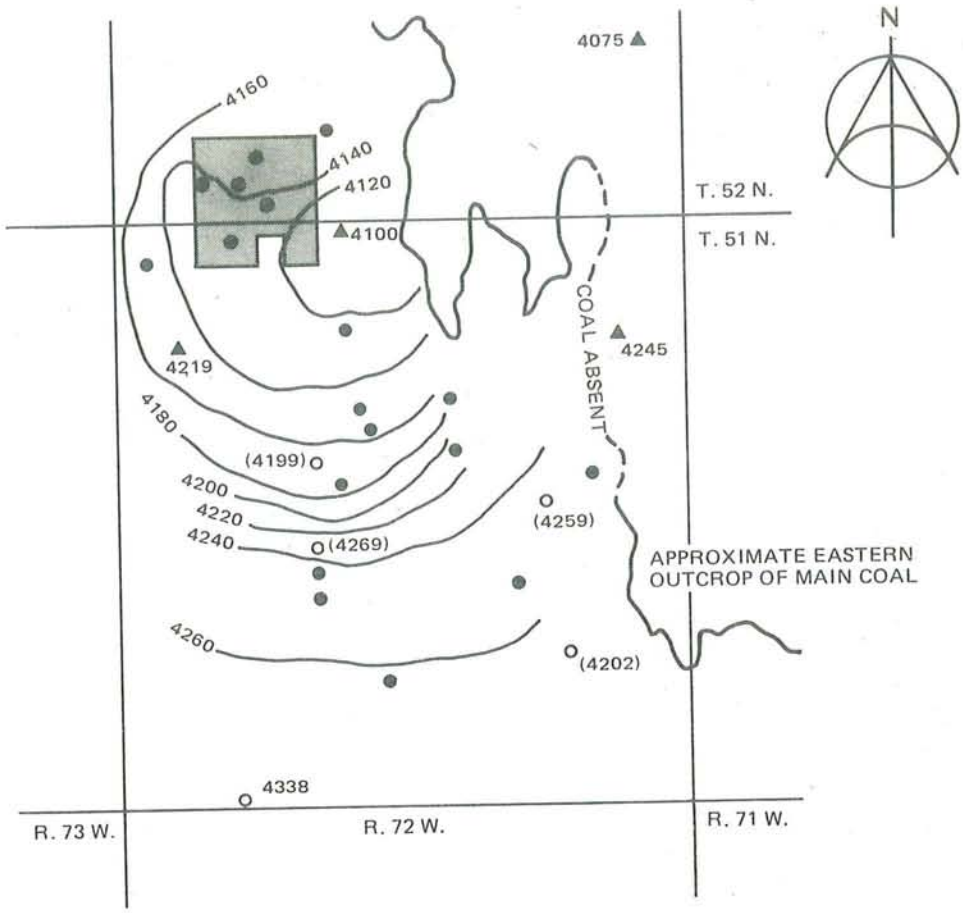
SOILS, LAND CAPABILITY UNITS, AND RANGE SITES AT PROPOSED BUCKSKIN MINE SITE

Soils	Land Capability	Range Site
Arvada	VIs	Saline lowland
Bankard	IVe	Lowland
Bowbac	VIe	Sandy
Haverson	IVe	Lowland
Olney	VIe	Sandy
Renohill	VIe	Clayey
Rough Broken Land	2/3 VIIe 1/3 VIIIs	1/3 Shallow loamy 1/3 Shallow clayey 1/3 Rock outcrop
Samsil	VIIe	Shallow clayey
Shingle	VIIe	Shallow loamy

Subclasses are groups of capability units which have the same major conservation problem.

s - special soil characteristic such as root-zone limitations or excess salts

e - erosion and runoff



▲ Approximate Elevation of Land Surface

● Control Point

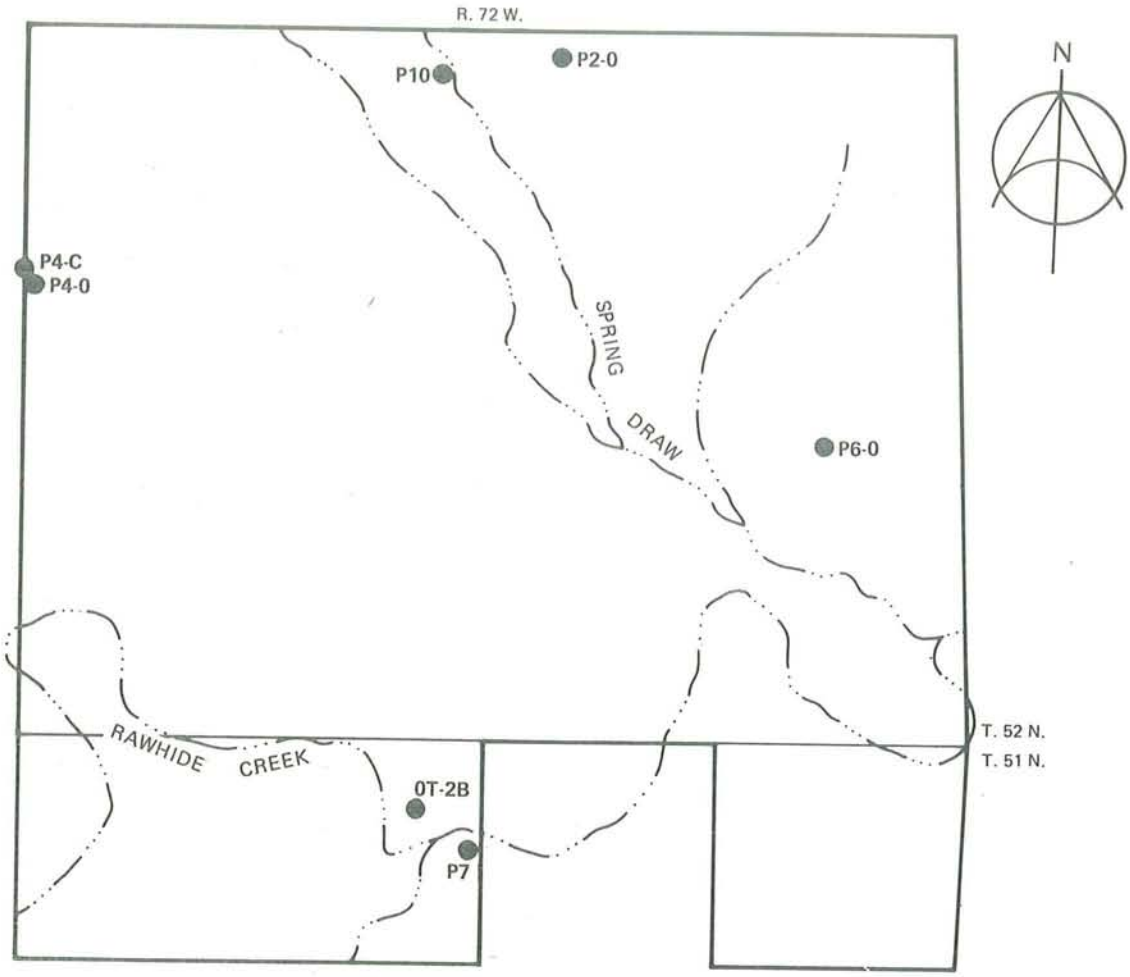
o Control Point Not Used in Drawing Contours (Elevation of Water Surface in Parentheses)

Buckskin Mine Site

WATER LEVEL DATA DERIVED FROM SHELL OIL COMPANY, 1977; CARTER OIL COMPANY, 1977; AMAX COAL COMPANY, 1977. EASTERN OUTCROP OF COAL ADAPTED FROM DENSON AND KEEFER, 1974

Figure BU2-6

CONTOUR MAP OF WATER LEVELS IN THE COAL



SOURCE: MODIFIED FROM SHELL OIL COMPANY 1977

P2-C MONITOR WELL AND IDENTIFIER

C WELL IN COAL

0 WELL IN OVERBURDEN

Figure BU2-7

LOCATIONS OF WELLS ON THE BUCKSKIN LEASE FOR WHICH CHEMICAL ANALYSES ARE GIVEN IN APPENDIX

Hydrologic information provided by Shell Oil and given above correlates with other data collected in the region.

Excluding wells drilled by the applicant, there are 6 wells inside or within one-half mile of the lease. There are 46 wells outside ½ mile but within 3 miles of the lease. Twenty of these wells are observation wells at adjoining mines. Other wells were drilled for stock or domestic supplies.

The Surface Mining Control and Reclamation Act of 1977 (SMCRA) defines "alluvial valley floors"for the purposes of the act as "the unconsolidated stream-laid deposits holding streams where water availability is sufficient for subirrigation or flood irrigation agricultural activities but does not include upland areas which are generally overlain by a thin veneer of colluvial deposits composed chiefly of debris from sheet erosion, deposits by unconcentrated runoff or slope wash, together with talus, other mass movement accumulation and windblown deposits" The presence of unconsolidated stream-laid deposits containing groundwater indicates hydrologic conditions within the definition of "alluvial valley floors"are present. Strip mining of the floors would have to comply with the standards established by SMCRA.

Surface Water

Ephemeral streams (flow as a result of precipitation) entering the proposed mine area are both intermittent and interrupted (flow for parts of most years and for short distances at points in the streams). Rawhide Creek enters the area from the west draining about 69.1 square miles, and Spring Draw enters from the northwest draining about 2.13 square miles. (See regional analysis, Chapter 2, for more detailed description of streams and drainage.) Average valley slopes are about 0.3% for Rawhide Creek and 1.2% for Spring Draw. Maximum land surface slopes vary from about 70% to about 100% (1:1).

Surface water flow originating from the approximately 1 square mile of the proposed mining area should amount to about 0.031 cubic feet per second (cfs) or 0.031 cubic feet per second per square mile (cfsm). Streamflow entering the area from the Rawhide Creek drainage should average about 0.80 cfs or 0.012 cfsm, and that from the Spring Draw drainage should average about 0.045 cfs or 0.021 cfsm. Peak streamflows with return periods of 10 years and 25 years (10% chance and 4% chance, respectively, of occurring in any given year) should be about 1,400 cfs and 2,300 cfs respectively for Rawhide Creek and about 400 cfs and 600 cfs respectively for Spring Draw. (Peak flow data was derived from U.S. Department of the Interior 1977, Hodson et al. 1973, and Lowham 1976). Stream slopes are about 0.2% for Rawhide Creek and about 1.1% for Spring Draw; the sinuosities (as measured by the ratio of stream length to valley length) for the two streams are about 1.3 and 1.1 respectively. Flood velocities should vary from about 3 feet per second (fps) to about 5 fps in Rawhide Creek and from about 4 fps to about 7 fps in Spring Draw.

There is only about ½ mile of main channel in the proposed lease area, which could possibly contain point sources of intermittent flow. Reconnaissance on September 30, 1977, indicated water in 0.2 to 0.3 miles of channel. There are about 6 wells and 5 reservoirs, irrigation diversion ditches, and spreader dams in the area (data furnished by the applicant).

Erosion and sedimentation depend upon the energy of the rainfall and water flow, erodibility of the soil, and the protective influence of vegetation. Water-borne sediment originates from sheet erosion and from gulley and channel formation. Shown and others (report in preparation) found that the sediment rate in the vicinity of the mine (based on data from about 20 ranch ponds in Campbell County) varied between about 0.01 to about 0.25 acre-feet per square mile per year. Sediment concentrations from adjoining streams, Little Missouri River near Alzada, Montana and Belle Fourche River below Moorcroft, Wyoming, varied from about 2,000 parts per million (ppm) to about 4,000 ppm in 1949 and 1950 (from annual streamflow data reports of the Geological Survey).

Water quality investigations from several wells and from Rawhide Creek indicate that the water in the lease area is typical of water found in the Gillette area, i.e., highly mineralized, and it exceeds the recommended maximum concentration for domestic or municipal use for one or more constituents. Several well samples showed some trace elements above the U.S. Public Health Service's suggested limits for drinking water. Surface water samples showed that streamflow had a dissolved oxygen content lower than expected; that it was high in dissolved solids; and that it could be characterized as magnesium/sodium/ sulfate type water. (Water quality information was derived from Shell Oil's mining and reclamation plan, which is on file at the Bureau of Land Management's Casper District Office. See water quality tables in appendices of regional and site-specific analyses).

Water is presently used on the proposed mine site for stock and wildlife watering and for sub and flood irrigation of hay.

VEGETATION

The Buckskin Mine site is considered to be in a vegetative transition zone between the northern desert shrub type and the shortgrass plains type. The transition zone is frequently dominated in appearance by sagebrush, but contains numerous grass and forb species common to the shortgrass communities of the Great Plains. The proposed Buckskin Mine site, in particular, is more representative of true shortgrass plains than the surrounding areas. This condition is likely a result of past management practices which prevented serious overgrazing of the property.

Terrestrial Vegetation

As shown in Chapter 1, the Buckskin permit area consists of a main mining area, a railroad route, and access roads. The acreages of all these areas are included in the following discussion. The vegetation map, however, is confined to the main mining area (lease plus 1,000-foot perimeter).

The following information was derived from the applicant's mining and reclamation plan. Five primary vegetation types exist on the Buckskin mine permit area: playa grassland, sandhills grassland, big sagebrush, silver sagebrush, and riparian. In addition to these types, there is some scattered cultivated land on the mining area.

The vegetative types within the proposed mining area have been delineated in Figure BU2-8; they are described in the following paragraphs, and are keyed to the map.

Playa Grassland Type (map symbol 1A) 5 acres

This vegetation type covers the smallest portion of the total permit area. Vegetation of the playa type is dominated by grasses and grasslike species. Important species found here are western wheatgrass *(Agropyron smithii)*, Kentucky bluegrass *(Poa pratensis)*, rush *(Juncus* spp.) and sedges *(Carex* spp.). Common dandelion *(Taraxacum officinale)* and Louisiana sagewort *(Artemisia ludoviciana)* are also found in this vegetation type.

Sandhills Grassland Type (map symbol 1C) 298 acres

Grasses and forbs predominate in this vegetation type, comprising approximately 81% of the vegetative cover. Prairie sandreed *(Calamovilfa longifolia)*, needle-and-thread *(Stipa comata)*, blue grama *(Bouteloua gracilis)*, and prairie junegrass *(Koeleria cristata)* are the common grasses. Forbs and shrubs include silverleaf scurfpea *(Psoralea agrophylla)*, hairy goldenaster *(Heterotheca villosa)*, fringed sage *(Artemisia frigida)*, and silver sagebrush *(Artemisia cana)*.

Big Sagebrush Type (map symbol 4) 662 acres

This vegetation type is the most extensive on the Buckskin permit area and is characterized by the presence of big sagebrush *(Artemisia tridentata)* as the predominant shrub. Grass and grasslike species of primary importance include western wheatgrass, blue grama, needle-and-thread, prairie junegrass, and threadleaf sedge *(Carex filifolia)*. Other common species are Hood's phlox *(Phlox hoodii)*, milkvetch *(Astragalus* spp.), broom snakeweed *(Gutierrezia sarothrae)*, fringed sage, and silver sagebrush.

Silver Sagebrush Type (map symbol 4A) 478 acres

A predominance of grasses interspersed with clumps of silver sagebrush characterizes this vegetation type on the permit area. The most important grass and grasslike species are needle-and-thread, blue grama, western wheatgrass, and threadleaf sedge. Important forbs and shrubs are scarlet globemallow *(Sphaeralcea coccinea)*, and fringed sage. Plains pricklypear cactus *(Opuntia polycantha)* is found infrequently in sandy depressions.

Riparian-Bottomland Type (map symbol 10) 148 acres

Total vegetative cover is highest in this vegetation type (62.6%), with grasses making up 57% of the total. Important grasses are Kentucky bluegrass, prairie cordgrass *(Spartina pectinata)*, and inland saltgrass *(Distichlis spicata)*. Other common species include sedges, baltic rush *(Juncus balticus)*, and yellow sweetclover *(Melilotus officinalis)*. The vegetation of Rawhide Creek is indicative of an alluvial valley floor, and is mapped as such by Williams (1978) (Figure BU2-4).

Cultivated Lands (map symbol 19) 169 acres

The scattered cultivated lands comprise approximately 10% of the total lease and perimeter area. These lands include several areas that have been seeded only to native or introduced grasses as a range improvement or for hay production. The primary species occurring in this area is intermediate wheatgrass *(Agropyron intermedium)*. This area is generally harvested for hay each summer. Some barley and wheat are also grown. (See Chapter 2, Agriculture.)

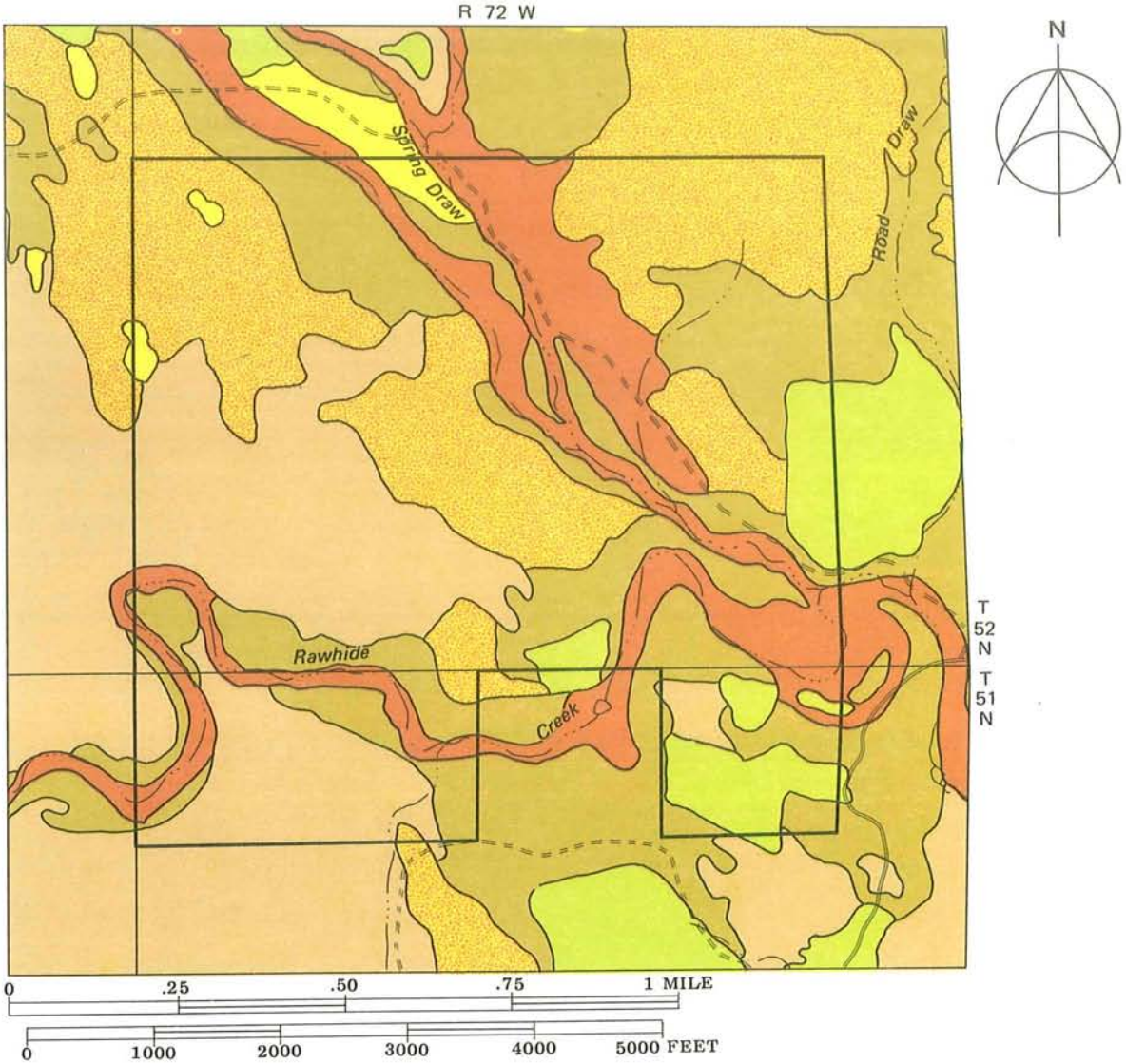
Aquatic Vegetation

Rawhide Creek flows during periods of snowmelt in the spring and after summer thunderstorms. During the remainder of the year, surface water in Rawhide Creek consists of isolated pools of perhaps 100 square feet or less with depths of 2 to 6 inches. Aquatic vegetation is limited to species which require wet ground, but which can exist for long periods without standing water, if other moisture is available from subirrigated alluvium, subsurface springs, or overflowing water tanks. Main species observed in Rawhide Creek include bulrush *(Scirpus* spp.), common cattail *(Typha latifolia)*, sedges, watercrowfoot *(Ranunculus aquatilis)*, and filamentous green algae. The predominant species observed was watercrowfoot which completely filled the pools.

Temporary surface water exists in the playas near the west lease boundary. Each playa drains less than 40 acres. Semiaquatic vegetation in the playas consists primarily of sedges. Aquatic flora is probably limited to a few species of algae.

Endangered and/or Threatened Species

No plants which have been identified as threatened or endangered, or are proposed for such designation, have been found on the proposed mining area (Shell Oil Company 1977). A plant specialist from the Wyoming De-



LEGEND

- PLAYA GRASSLAND
- SANDHILLS GRASSLAND
- BIG SAGEBRUSH
- SILVER SAGEBRUSH
- RIPARIAN - BOTTOMLAND
- CULTIVATED

MODIFIED FROM SHELL OIL COMPANY, 1977

Figure BU2-8
GENERAL VEGETATION MAP OF BUCKSKIN MINE SITE

partment of Environmental Quality has conducted a survey, at the request of the Bureau of Land Management, and has verified the applicant's conclusion (personal communication 1978).

FISH AND WILDLIFE

Habitat Types

The six habitat types found on the proposed mine site and the wildlife species normally associated with each type are listed below. Acreages shown in parentheses are those that would actually be disturbed by mining.

Sagebrush-Grass (Big Sagebrush) (447 acres). Horned lark, lark bunting, vesper sparrow, Brewer's sparrow, deer mouse, northern grasshopper mouse, least chipmunk, white-tailed jackrabbit, coyote, mule deer, pronghorn antelope.

Silver Sagebrush (278 acres). Brewer's sparrow, lark bunting, western meadowlark, vesper sparrow, deer mouse, desert cottontail, pronghorn antelope, mule deer.

Riparian (72 acres). Cliff swallow, red-winged blackbird, barn swallow, mourning dove, mallard, blue-winged teal, pintail, killdeer, Wilson's phalarope, meadow vole, deer mouse, muskrat, mule deer, snapping turtle, leopard frog, chorus frog.

Sandhills Grassland (149 acres). Vesper sparrow, horned lark, mourning dove, western harvest mouse, northern pocket gopher, desert cottontail, red fox, pronghorn antelope.

Playa Grassland (4 acres). Savannah sparrow, western meadowlark.

Cultivated Land (121 acres). Savannah sparrow, western meadowlark, mourning dove, western harvest mouse, northern pocket gopher, desert cottontail, white-tailed jackrabbit.

Fishery

Approximately 1½ miles of Rawhide Creek lie within the area that would be disturbed by the proposed Buckskin Mine. Rawhide Creek is an intermittent stream which contains standing pools of water yearlong. Field investigations by the Wyoming Game and Fish Department (1978) revealed the presence of fathead minnows in some of the pools in Rawhide Creek. A single green sunfish was also observed.

Wildlife

The wildlife observation data and density figures which follow were provided by Shell Oil Company (1977) and the Wyoming Game and Fish Department (1978), unless otherwise noted. These data are consistent with other information gathered in the region (see Chapter 2 of the regional analysis). See Table BU2-2.

Birds

Nongame. The primary nongame bird species observed on the proposed Buckskin site were vesper sparrow, Brewer's sparrow, grasshopper sparrow, lark bunting, western meadowlark, brown-headed cowbird, red-winged blackbird, and Brewer's blackbird. Shorebirds observed on the site included spotted sandpipers, killdeer, and Wilson's phalaropes. Density figures derived from field investigations conducted by the Wyoming Game and Fish Department (1978) are shown in Table BU2-2.

Raptors. Raptor species observed on the site were Swainson's hawk, American kestrel, marsh hawk, red-tailed hawk, ferruginous hawk, prairie falcon, golden eagle, and great horned owl. An active red-tailed hawk nest was found in 1978 by Wyoming Game and Fish Department investigators in an area that would be mined. Several other active nests were found within 2 miles of the proposed mine site. Raptor density on the site is estimated to be 4.8 per square mile.

Game. Mourning doves are the most common game bird on the site. Densities by habitat type for this species are shown in Table BU2-2. Sage grouse and sharp-tailed grouse have been observed on the site, but no density data were gathered. Investigators working for the applicant did not observe either of these birds in 1975 or 1976.

Waterfowl observed on the site included blue-winged teal, green-winged teal, pintail, shoveler, American widgeon, and mallard. Density estimates for waterfowl are 6.6 per square mile (Shell Oil 1977).

Sensitive Species. The burrowing owl is the only state-listed sensitive species known to occur in the general vicinity of the proposed mine area. None was observed on the area that would be disturbed.

Endangered and/or Threatened Species. Bald eagles are known to winter in the Eastern Powder River Basin, and peregrine falcon and whooping crane may migrate through the region (personal communication, Harry Harju, Wyoming Game and Fish Department 1978). No observations of endangered and/or threatened bird species on the proposed mine site have been reported. Based on their previous studies, the Wyoming Game and Fish Department is satisfied that no endangered and/or threatened birds exist on the mine site (ibid.).

Mammals

Nongame. The most common small mammal species observed on the proposed site were deer mouse, thirteen-lined ground squirrel, and northern grasshopper mouse. Density estimates for small nongame mammals are presented in Table BU2-2 by habitat type.

White-tailed jackrabbit density on the site is estimated to be 5 per square mile.

Furbearers/Predators. Predator species occurring on the site are coyote, raccoon, and red fox. Muskrat and badger have also been observed on the site. No density information is available for muskrats, coyotes, or rac-

TABLE BU2-2

TERRESTRIAL WILDLIFE DENSITIES ON THE BUCKSKIN MINE SITE
(Number per Acre)

	All Habitat	Sandhills Grasslands	Playa Grassland	Big Sagebrush	Silver Sagebrush	Riparian
Birds						
Nongame*		1.31		1.23	1.55	3.57
Raptors**	4.8/sq. mi.					
Game						
Mourning Dove*		.004		.01	.02	.08
Sage Grouse		No density data, but observed on the site.				
Sharp-tailed Grouse		No density data, but observed on the site.				
Gray Partridge		No density data, but observed on the site.				
Waterfowl**						6.6/sq. mi.
Mammals						
Nongame						
Small Mammals*		4.4		2.75	8.8	14.9
White-tailed Jackrabbits**	5.0/sq. mi.					
Furbearers/Predators						
Muskrat		No density data, but observed on the site.				
Badger**	1/sq. mi.					
Coyote		No density data, but observed on the site.				
Red Fox**	.4/sq. mi.					
Raccoon		No density data, but observed on the site.				
Small Game**						
Desert Cottontail	3.3/sq. mi.					
Big Game						
Pronghorn***	9.47/sq. mi.					
Mule Deer**	.5/sq. mi.					

* Wyoming Game and Fish Department 1978
** Shell Oil Company 1977
*** Average of summer density data collected by Shell Oil Company in 1975 and 1976, and data collected by the Wyoming Game and Fish Department in 1978.

coons on the site. Badger density is estimated at one per square mile.

Game. Cottontail rabbit density is estimated to be 3.3 per square mile.

The Buckskin Mine site is in an area classified by the Bureau of Land Management as winter-concentration-yearlong antelope range. Antelope density on the site is estimated at 9.3 per square mile during the summer. During the winters of 1977-78 and 1978-79, pronghorn gathered in large numbers just south of the mine site. Approximately 300 animals crossed the proposed mine and access road to reach their preferred wintering area.

Mule deer density on the proposed mine site is estimated at 1 per 2 square miles. Mule deer numbers should not be subject to seasonal fluctuation because the area is used as yearlong range.

Endangered and/or Threatened Species. The only endangered and/or threatened mammal which may occur in the region is the black-footed ferret. Prairie dog towns are considered primary ferret habitat. No prairie dog towns exist on the Buckskin site, and the Wyoming Game and Fish Department is satisfied that ferrets are not present (personal communication, Harry Harju 1978).

Amphibians and Reptiles

The two amphibians observed on the proposed mine site were the leopard frog and chorus frog. The applicant states one leopard frog was observed per 10 feet of stream channel, and one chorus frog was observed per 20 feet of stream.

A plains garter snake and a snapping turtle was the only reptiles observed on the site.

Endangered and/or Threatened Species. No known endangered or threatened amphibian or reptile species are known to occur in the region or, therefore, on the project area.

CULTURAL RESOURCES

No sites in the Buckskin permit area are currently listed on the Wyoming Historic Preservation Plan or on the National Register of Historic Places. Two sites are determined eligible for listing, however.

Prehistoric

The entire Buckskin permit area was surveyed by the University of Wyoming (Zeimens and Walker 1977 and Zeimens et al. 1978). Two sites (48 CA 16 and 48 CA 17) are within the area which would be mined; they contained stone flakes, projectile points, and fragments of bone and shell. Neither site is considered to be of National Register quality by the archeological survey crew (Zeimens et al. 1978).

Two prehistoric sites lie outside the area to be mined. One (48 CA 89) is an extensive group of stone circles with associated Late Prehistoric Period (1700 to 300 years before the present) artifacts. The portion of the site lying within the proposed rail access line to the mine was tested and recorded. The other site (48 CA 130) is an arroyo trap bison kill which also lies partially within the proposed rail right-of-way. It too was extensively tested in areas where it was likely to be affected. Eligibility for protection under the historic preservation laws is established for 48 CA 89 and 48 CA 130 (Zeimens et al. 1978). Appropriate consultation among the State Historic Preservation Officer, the Bureau of Land Management, and the Advisory Council for Historic Preservation will take place regarding all sites present on the lease.

There is a possibility that buried archeological deposits exist along Rawhide Creek. Should such sites of potential National Register significance be indicated during overburden removal, appropriate mitigation would be conducted in consultation with the State Historic Preservation Officer and the Advisory Council as required in Section 106 of the Historic Preservation Act.

Historical

Recorded history began for the Buckskin Mine site in 1883 when section corners were set. The first application for a homestead was filed in 1902 and a second in 1903. The remaining acreage transferred to private ownership after 1916 and before 1925. The intensive cultural resource inventories conducted in the permit area did not reveal any physical evidence of these activities.

VISUAL RESOURCES

The characteristic landscape of the proposed Buckskin Mine site is open country with low rolling hills, scattered buttes, and occasional creek bottoms. There is little water or variation in vegetation, and there are no unique visual factors. Man-made intrusions into this setting are ranch buildings and equipment, roads, utility lines, and nearby coal mines. The western edge of the permit area and some of the high spots can be seen by people traveling south on U.S. Highway 14/16 for approximately 1½ miles at a distance of 1 mile.

A visual resource inventory was conducted using the Bureau of Land Management's visual resource inventory and evaluation procedures (see regional analysis, Appendix B). The area falls into scenery quality Class C, because it lacks variety in landform, color variation, and color contrast. The permit area is in the foreground-middleground view zone, and has been identified as having medium visual sensitivity. Based upon the visual evaluation, the entire permit area has been assigned a Class IV visual resource management designation. This means that if the land involved were public, the Bureau of Land Management would allow permanent changes which alter the original visual character, but which reflect only what could be natural occurrences.

RECREATION RESOURCES

Recreation participation is limited on the proposed Buckskin Mine site because the land surface is privately owned. Hunting for antelope, mule deer, small game, and upland game birds is probably the only recreation opportunity. At the present time, the owner (Shell Oil) leases its property for grazing, and permission to hunt on the land is at the discretion of the lessee.

AGRICULTURE

Livestock Grazing

The land within the Buckskin Mine permit area is currently used for livestock grazing on an intermittent basis.

At the present time cattle ranching operations are being conducted by two operators. Cattle graze the main mining area (lease and 1,000-foot perimeter) during spring and summer for a yearly use of 243 animal unit months (AUMs). All permit areas (main mining area, railroad, and access road) have an annual capacity of 320 AUMs.

Livestock water is provided by Rawhide Creek as well as a few ponds located on Spring Draw. Both quality and quantity of water appear adequate for present livestock use. Most of the riparian zone along Rawhide Creek in the southeast corner of Section 32 is grazed each year and also harvested for hay each summer.

Farming

Small scattered portions of the main mining area are being utilized on an intermittent basis for the production of hay and grain. Approximately 32 acres are utilized for the production of barley; they provide a yield of 25 to 40 bushels per acre. Two acres of wheat yield 25 to 30 bushels per acre. Hay production amounts to 1,000 to 2,000 pounds per acre on 87 acres, depending on climatic conditions. See Figure BU2-8 for the location of these scattered tracts.

Meadows and the acreages planted to introduced grasses are used for livestock grazing every year and are harvested for hay in years when precipitation is sufficient. No irrigation techniques are used on the area. Moisture is received from precipitation, flooding, and natural subirrigation.

Agricultural land must meet certain criteria (established by the Surface Mining Control and Reclamation Act (SMCRA)) to be classified as prime farmland. Because the Buckskin Mine site has no developed irrigation or dependable water supply system, and because annual precipitation is 14 inches or less, these criteria are not met. Therefore, prime farmland, as defined by SMCRA, does not exist on the site. The Soil Conservation Service, as well, has not made a determination that prime farmland exists on the site.

Approximately 18 acres of cultivated land are located within and adjacent to the alluvial valley of Rawhide Creek. Intermittent farming practices, particularly hay cutting, are carried out on this cultivated land.

MINERAL RESOURCES

The coal bed to be mined at Buckskin is the Anderson-Canyon (Wyodak) at the top of the Fort Union Formation. It ranges in thickness from 0 to 125 feet, and averages about 107 feet. This thickness includes 2 to 5 feet of shale parting just above the middle of the seam.

The coal reserve at Buckskin is estimated by the applicant to be 84 million tons, of which 80 million tons is recoverable by present mining methods. (Four million tons of coal would be either left in the lease boundary highwalls or mixed with overburden and partings.) The coal is subbituminous in rank and has a heat rating of 8,183 BTUs per pound. On an undiluted, as received basis, it contains .51% sulphur, 29.8% moisture, and 6.11% ash.

There is no other ongoing or potential mineral development on the Buckskin site.

TRANSPORTATION NETWORKS

Railroads

The Burlington Northern (BN) is the rail system which serves Campbell County. The railroad line that passes through Gillette begins in Huntley, Montana, at a connection to the BN east-west Spokane, Washington to Fargo, North Dakota main line (see Figure BU2-9). From this point, the route follows a generally southeasterly alignment passing through Sheridan and Gillette, the southwest corner of South Dakota, and most of Nebraska before reaching Lincoln, Nebraska. The main railroad system is discussed in detail in the regional analysis, Chapter 2.

Near Donkey Creek, a branch line leaves the main line in a northerly direction (see Figure BU2-9). This line has been established as far as the Carter Oil Company's Rawhide Mine. The Buckskin Mine would be served by a 6-mile spur line to be extended northwest from the end of the line serving the Rawhide Mine.

Highways

The major highway serving the immediate area of Buckskin Mine site is U.S. Highway 14/16, which runs north and south to the west of the lease. State Highway 59 runs north out of Gillette and passes east of the lease (Figure BU2-10). Several unimproved dirt roads which provide access for local traffic presently exist on or near the lease area.

Traffic flow in 1958 on four sections of U.S. Highway 14/16 near the mine site is compared to traffic flow in

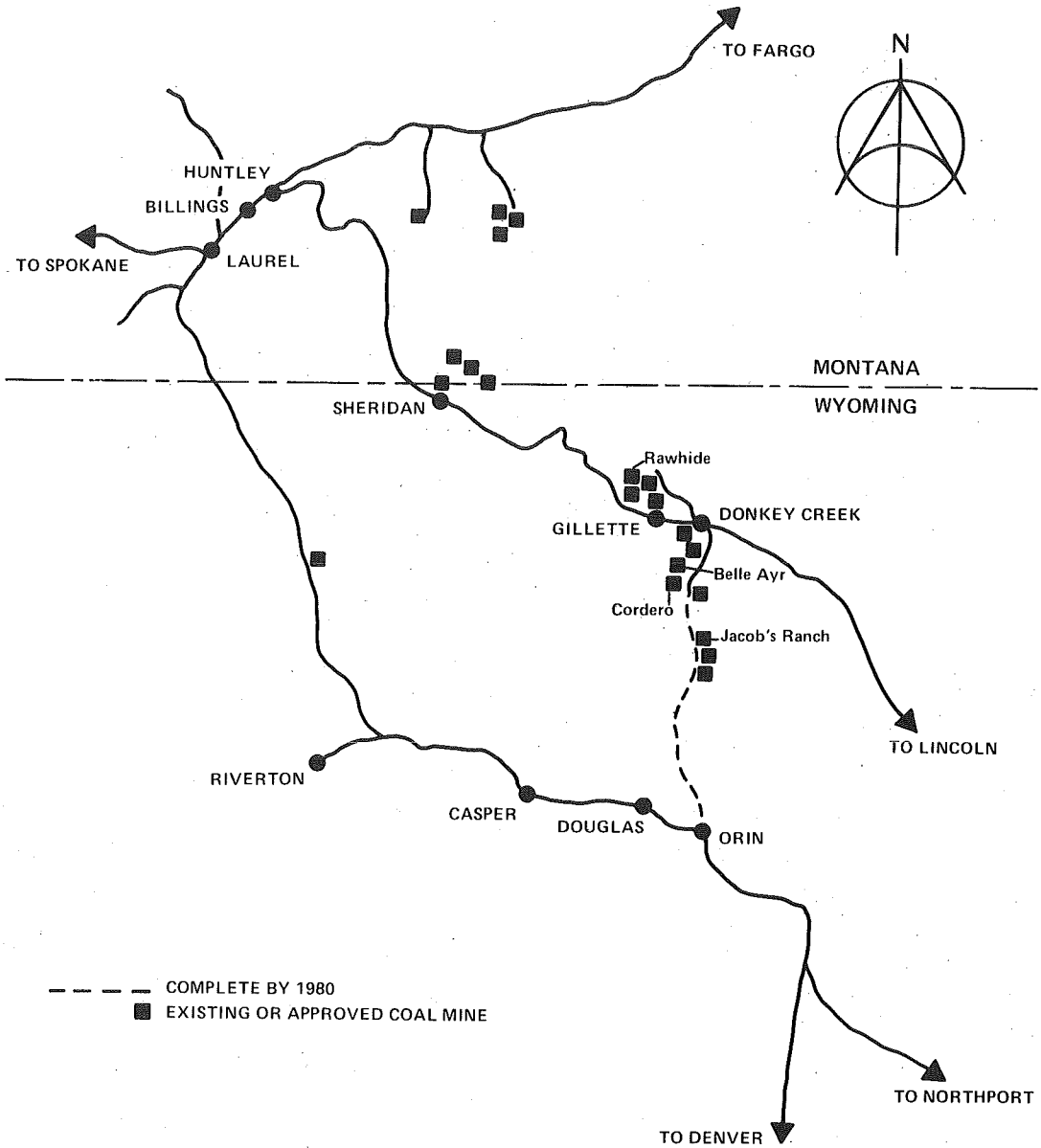
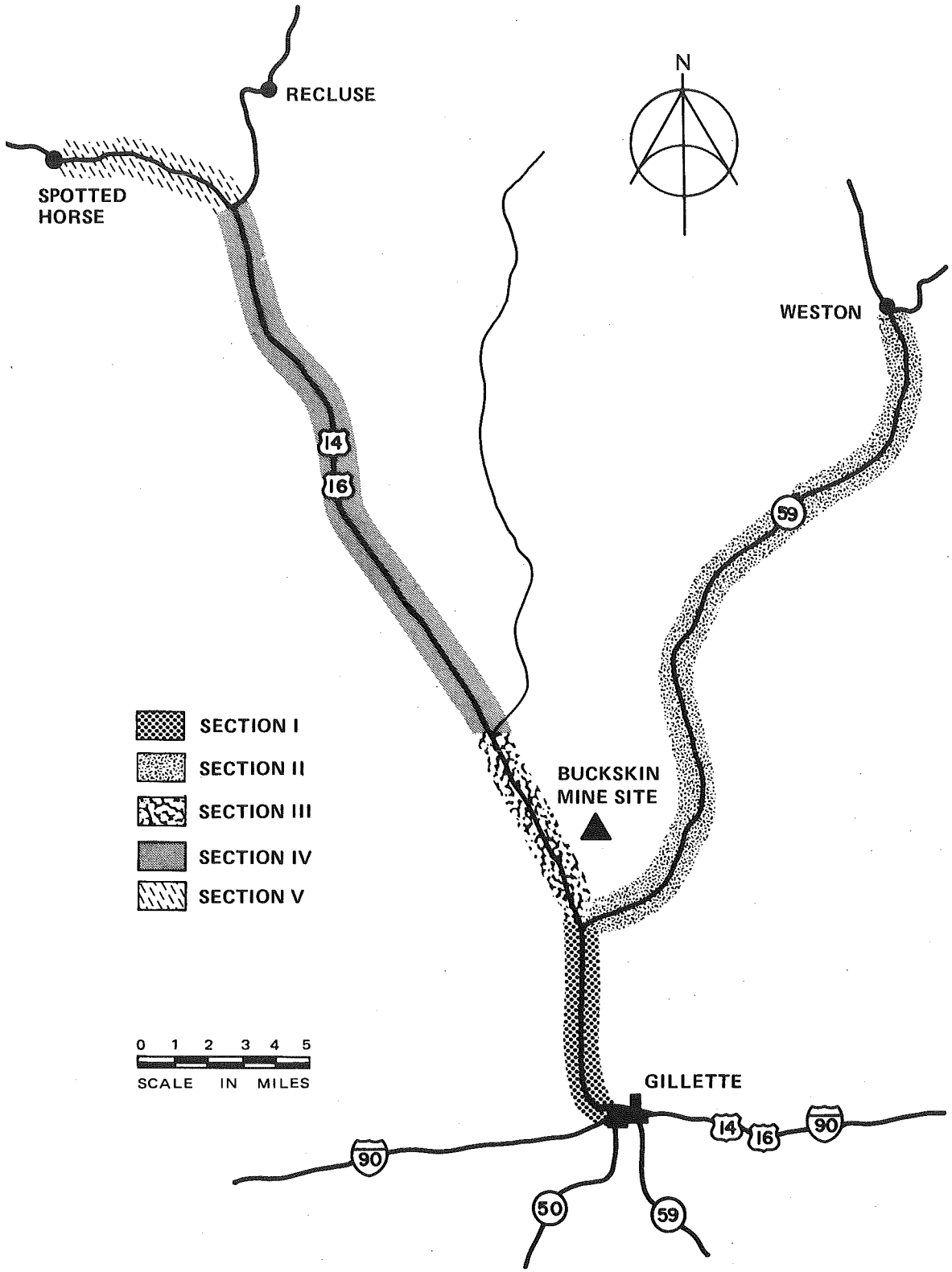


Figure BU2-9
BURLINGTON NORTHERN RAILROAD SYSTEM
POWDER RIVER BASIN



SOURCE: ECOLOGY CONSULTANTS 1977

Figure BU2-10

MAJOR HIGHWAYS IN THE VICINITY OF THE PROPOSED BUCKSKIN MINE

years 1970 through 1975 on Figure BU2-11. Traffic flow for these years on two portions of State Highway 59 is given on Figure BU2-12. In 1958, before Interstate 90 was completed, virtually all traffic past the proposed Buckskin Mine site was through traffic. More recent traffic figures (1970 through 1975) illustrate that vehicular traffic has shifted to local traffic. As shown on Figure BU2-11 and Figure BU2-12, traffic levels have remained nearly the same or increased near Gillette and the lease area, whereas traffic levels have decreased on sections of U.S. Highway 14/16 and State Highway 59 farther north of Gillette. The increase near Gillette is likely due to the expansion of the coal and oil industries which has occurred in recent years.

In Gillette itself, 97% of the residents feel there is a definite need for improved city streets (City of Gillette/ Campbell County Department of Planning and Development 1977 Citizens' Policy Survey).

Other

The Gillette-Campbell County Airport provides chartered and air taxi service. Almost 80% of Campbell County residents responding to the 1977 Citizens' Policy Survey agreed that the airport needs improved facilities. Total air operations at the Gillette-Campbell County Airport for 1976 were 53,578 (personal communication, Sam Stafford 1977).

Bus service is provided to Gillette from Casper, Wyoming and Billings, Montana by Continental Trailways. Telephone service is supplied for the Gillette area by Mountain Bell.

SOCIOECONOMIC CONDITIONS

Introduction

A description of existing socioeconomic conditions in the eight northeastern counties of Wyoming can be found in the regional analysis, Chapter 2. This site-specific analysis concentrates on socioeconomic conditions in Campbell County and Gillette, where the effects of population increase due to the proposed Buckskin Mine would be felt.

Sociocultural Profile

It is possible to distinguish some of the differences and similarities between newcomers and old-timers in Gillette by analyzing data collected by the Wyoming Services Project of the University of Wyoming in 1976 *(Campbell County Parks and Recreation Department Citizens' Survey)*. The study indicates that newcomers tend to be younger, better educated, less rural (based only on their latest place of employment), and that they have a lower unemployment rate than their old-timer counterparts in Gillette. Newcomers depend more on mobile homes for their dwellings than do old-timers. The two groups have similarities in terms of their basic geographic backgrounds, and in their racial and religious homogeneity. Both groups have similar family sizes, work about the same number of hours per week, have high average incomes relative to the rest of the state, and depend heavily on mineral development-related work for their incomes.

The boom-town conditions in Gillette are such that one area psychologist, Dr. E. L. Dean Kohrs, has coined the phrase "the Gillette syndrome"to characterize its conditions (1975). He has described the Gillette syndrome as a "social system of higher rewards and greater pains"that accompanies a boom-town growth situation. He feels it "... includes the three A's— alcohol, accidents, and absenteeism, as well as the three D's--divorce, delinquency, and depression"

Economic Profile

Local Demography

Table BU2-3 shows population figures from 1950 to the present.

Campbell County experienced a 121% population increase between 1960 and 1970, owing primarily to an oil boom. Many new residents during this period settled in Gillette, causing the city to grow at an average annual rate of 5.6% per year.

During the past 8 years, the development of coal resources in the county has been primarily responsible for an 50% increase in the population, from 12,957 in 1970, to an estimated 26,080 in 1978. Gillette's population increased 62% from 7,763 to an estimated 20,450 during the same period, making it the fifth largest city in the state in 1978.

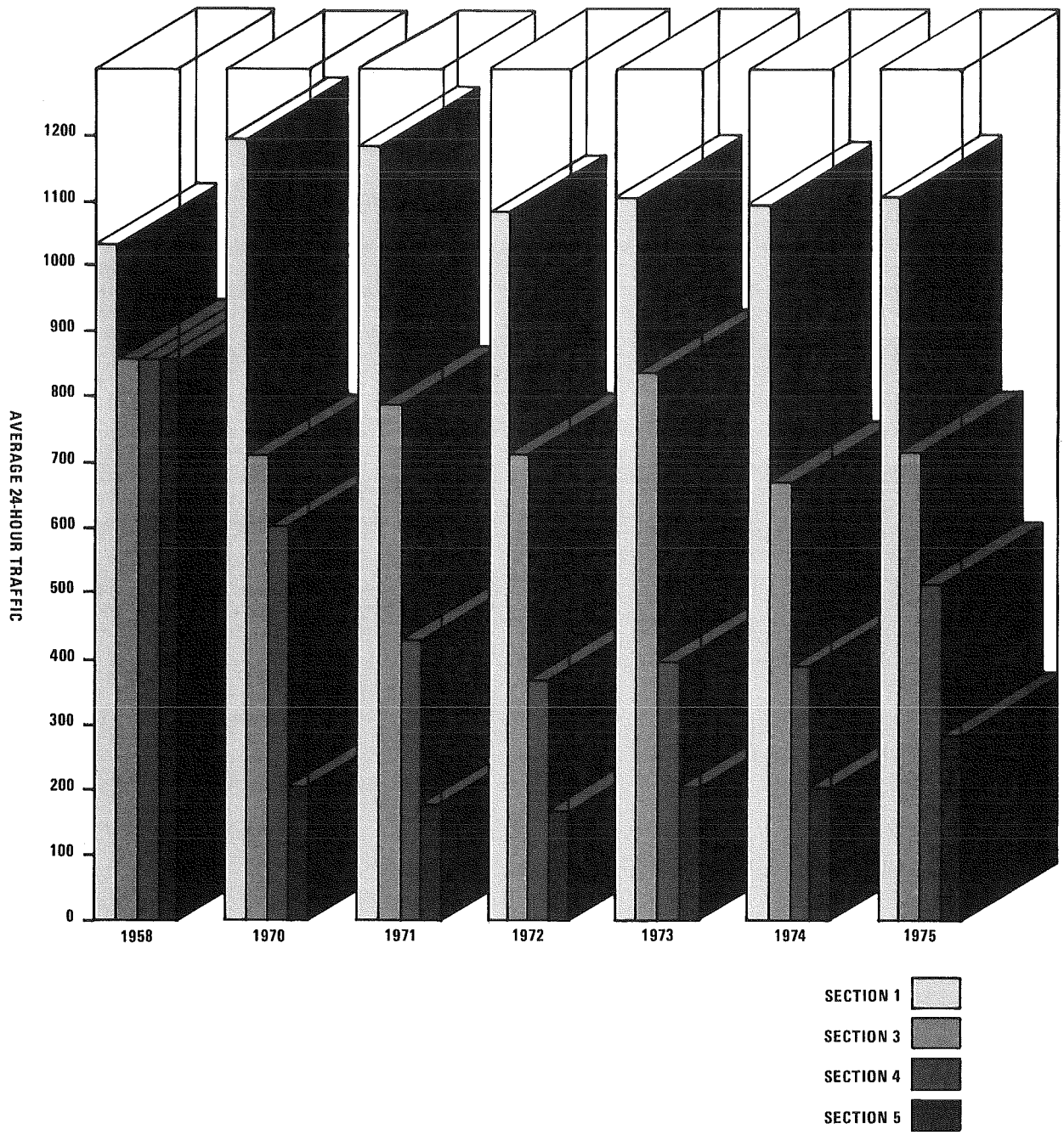
Employment and Income

Recent data show a marked increase since 1970 in employment levels and income values. The change is due to inflation and the rapid population increase, most of which consists of skilled construction and mine workers. Between 1970 and 1975, the number of wage and salary employees in Campbell County rose by 1,710—an average annual increase of 6.4%.

Table BU2-4 shows the distribution of total employment by sector in Campbell County in 1970 and 1975. The table demonstrates the change, or evolution, in employment.

During the last 5 years, unemployment in Wyoming has varied between 3% and 5%. Unemployment in Campbell County during September, 1977, was 2.2%, lower than the state and national averages of 2.8% and 6.9% (seasonally adjusted) respectively.

It is interesting to note that although relative sectoral employment remained fairly stable over the period between 1970 and 1975, the distribution of personal income



SOURCE: ECOLOGY CONSULTANTS 1977

Figure BU2-11
TRAFFIC FLOW ON U.S. HIGHWAYS 14/16 IN VICINITY OF BUCKSKIN MINE SITE

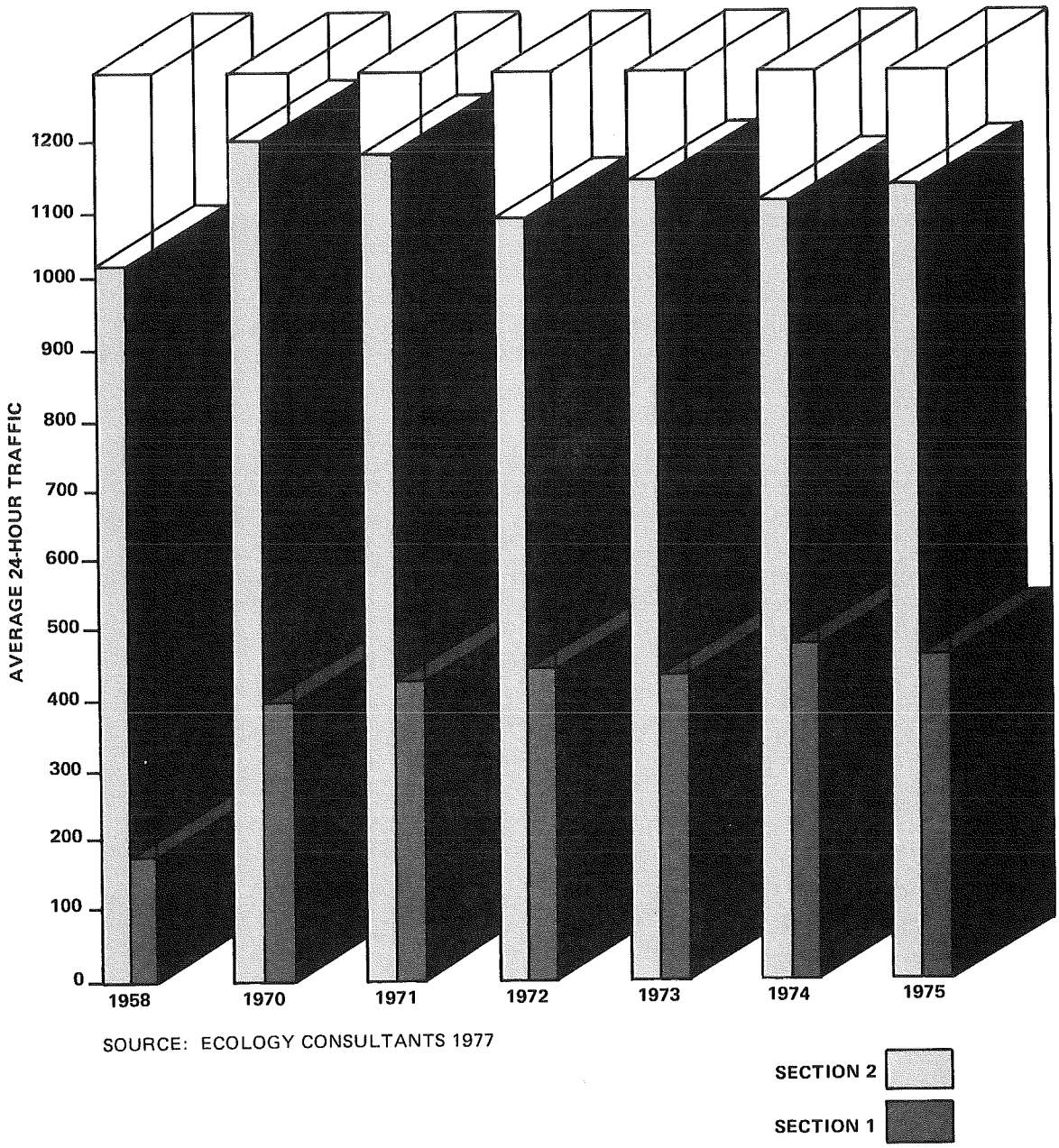


Figure BU2-12

TRAFFIC FLOW ON STATE HIGHWAY 59 IN VICINITY OF BUCKSKIN MINE SITE

TABLE BU2-3

POPULATION OF CAMPBELL COUNTY AND THE CITY OF GILLETTE (1950-1976), AND PROJECTED POPULATION OF CAMPBELL COUNTY (1977-1990)

	CAMPBELL COUNTY		CITY OF GILLETTE		CAMPBELL COUNTY EXCLUSIVE OF CITY OF GILLETTE	
Year	Population	Annual rate of change in percent*	Population	Annual rate of change in percent*	Population	Annual rate of change in percent*
1950	4,839	---	2,191	---	2,648	---
1960	5,861	+2	3,580	+5	2,281	-1
1970	12,957	+8	7,763	+8	5,194	+9
1973	12,283	-2	7,801	**	4,482	-5
1975	13,090	+3	8,215	+3	4,875	+4
1978	26,080	+4	20,450	---	5,630	---

Source: U.S. Department of Commerce, Bureau of the Census, November 1970, April 1977, July 1977.

* Average rate of change compounded annually.
** Less than 1%.

TABLE BU2-4

WAGE AND SALARY EMPLOYMENT FOR CAMPBELL COUNTY
1970-1975

	1970	Percent of Total	1975	Percent of Total
Agriculture	157	(3.3)	188	(2.9)
Minerals	1,109	(23.6)	1,402	(21.9)
Construction	473	(10.1)	1,031	(16.1)
Manufacturing	27	(0.6)	84	(1.3)
Business and Consumer Services	2,157	(46.0)	2,733	(42.7)
Government and Education	767	(16.3)	962	(15.0)
Military	5	(0.1)	4	(0.1)
Total Wage and Salary Employment	4,694		6,404	

Source: U.S. Department of Commerce, Bureau of Economic Analysis (BEA) 1977.

Note: Table includes full- and part-time workers. BEA data on which this table is based deleted sector employment data where necessary to preserve confidentiality. In preparing this table, estimates were made of deleted items.

changed dramatically. For example, farm income accounted for 13.9% of personal income in 1970 but only accounted for 0.6% of the personal income in 1975 (see Table BU2-5). Over the same time frame, manufacturing, mining, and construction were all experiencing an increase, both relatively and absolutely, in personal income. In fact, personal income from mining increased by $15.1 million or 139%, construction increased by nearly $10 million or 199%, and manufacturing revealed a 622% increase which amounted to slightly less than $1.1 million. The total increase in personal income amounted to a little over $36 million, which translates into a 92% increase over the 5-year period between 1970 and 1975.

Cost of Living

The boom-town atmosphere created in Campbell County by the impact of current and anticipated coal mining has directly affected local residents. Gillette ranked as the most expensive place in Wyoming to live in the third quarter of 1977 for the seventh consecutive quarter, according to the Wyoming Department of Labor and Statistics (November 9, 1977). The Wyoming cost of living index for Gillette was 107.61 (100 is the average cost in Wyoming). Housing is the expense that affects local residents the most. The cost index for the third quarter was 123.43, by far the highest above average in the six categories used to compute the cost of living index. The second highest expense was medical care with a cost index of 110.72.

The Public Sector

Introduction

Boom-town conditions such as exist in Gillette affect local services and finances. Annual population growth rates in excess of 10% strain the capacity of local facilities and services supplied by both the public and private sectors of the local economy. Although both sectors often face critical constraints on capital, labor, and time, impacts are apt to be acute in the public sector, because local government is subject to more stringent procedural and financial constraints and is highly visible to local residents.

Existing development of energy resources in Campbell County has not only strained local facilities and services, such as streets, water supply, sewers, and police and fire protection; development has also laid stress on local government itself and its planning function.

Land Use Patterns

The urban sprawl developing around Gillette is a symptom of rapid and often poorly controlled growth. The total acreage of the city in 1977 tripled from the 1965 amount (Table BU2-6). Residential acreage alone increased 33% during 1977. Land demand forecasts made for the Gillette urban area through 1990 estimate that 1,120 to 1,820 acres of private land will be developed (Table BU2-7). During the period 1972 through 1976, total building permit valuations issued by the City of Gillette/Campbell County Building Department jumped tenfold.

The Gillette urban area contains many areas of mixed land use. This pattern is most obvious in the original part of Gillette where the central business district is expanding into areas that have been primarily residential. The development along State Highway 59 has randomly mixed areas of residential, commercial, recreational, and industrial land use. This pattern of development also tends to occur outside the city limits.

Patchwork or "leapfrog"development results in enclaves of undeveloped land left within the urban area as development spreads outward from the city. Land speculation and the higher costs of development in the city have accelerated this tendency. Numerous mobile home subdivisions have recently developed in Campbell County outside of the Gillette urban area. Leapfrog development and the mobile home subdivisions complicate services such as mass transit, and police and fire protection.

The 1977 Citizens' Policy Survey (City of Gillette/Campbell County Department of Planning and Development) reflects local concerns about zoning and building codes and their enforcement. Of those surveyed, 75% either "agreed"or "strongly agreed"with the statement, "Zoning ordinances should be strictly and consistently enforced" Similarly, 79% felt that, "Zoning can protect property values and properly guide community development if enforced" Concerning building codes, 71% "agreed"or "strongly agreed"with the statement; "Uniform building codes should be adopted and enforced in platted subdivisions in unincorporated areas of Campbell County" Thus, local citizens appear to be aware of the implications of the land use patterns and construction practices that are occurring, and they feel that zoning and building codes should be used to shape future growth. While Gillette has both zoning and building codes, Campbell County has no zoning requirements and has only a plumbing code. The adequacy of zoning and building code enforcement is unknown.

Planning

The Gillette Planning Commission was formed in 1963, and a city master plan was adopted in that year. In 1968, a joint City of Gillette/Campbell County Planning Department was formed. The city's master plan was updated in 1973. The planning department has developed a land use plan for the Gillette urban area—the 6 mile by 5 mile area defined by the Gillette zoning ordinance. Planning for the impact of new coal mining has had high priority in the city administration since January 1975.

The final draft of the comprehensive plan for Campbell County, as required in part by the 1975 Wyoming Land Use Planning Act, was completed by the City of Gillette/Campbell County Department of Planning and Development in June 1978. It was subsequently ap-

TABLE BU2-5

EARNINGS BY SECTOR FOR CAMPBELL COUNTY 1970-1975
(THOUSANDS OF CURRENT DOLLARS AND AS A PERCENT OF TOTAL EARNINGS)

	1970	Percent	1975	Percent
Farm	5,482	(13.9)	462	(0.6)
Manufacturing	172	(0.4)	1,242	(1.6)
Mining	10,909	(27.6)	26,057	(34.4)
Construction	4,985	(12.6)	14,883	(19.6)
Business and Consumer Services	15,594	(39.4)	29,404	(38.8)
Government and Education	2,160	(5.5)	3,430	(4.5)
Military	254	(0.6)	375	(0.5)
Total Income	39,556		75,853	

Source: U.S. Department of Commerce, Bureau of Economic Analysis 1977.

Note: Where the source contained deleted items, figures were estimated.

TABLE BU2-6

LAND USE - CITY OF GILLETTE

Land use Types	1965 Total Acres	1965 % of Developed Acres	1976 Total Acres	1976 % of Developed Acres	1977 Total Acres	1977 % of Developed Acres
Residential	176.8	33.6%	480	32%	642	33%
Commercial	41.9	8%	115	7%	13.1	7%
Industrial	75.6	14.4%	160	11%	160	10%
Utility			50	3%	50	3%
Public-Semipublic	86.7	17%	120	7%	120	7%
Recreational	5.4	1%	150	10%	150	9%
Sreets & Alleys	136.3	26%*	405	27%*	450.85	29%*
Developed Areas	525.7	100%	1,480	100%	1,705	100%
Undeveloped Areas	523.9		1,090		1,342	
Interstate Right-of-way			280		280	
Total Acres	1,049.6		2,850		3,327	

Source: City of Gillette/Campbell County Department of Planning and Development 1978.

* This figure includes major streets. Within single-family developments, 20% is a desirable figure.

TABLE BU2-7

LAND DEMAND FORECASTS FOR THE GILLETTE URBAN AREA 1976-1990

General Land Use Category	Low Range Forecast	High Range Forcast
Residential	1,120 acres	1,820 acres
Retail	29 acres	80 acres
Commercial Office, Institutional & Related	9 acres	17 acres
Industrial	48 acres	90 acres
Total	1,206 acres	2,007 acres

Source: City of Gillette/Campbell County Department of Planning and Development 1978.

proved by the city, the county, and the State of Wyoming. The comprehensive plan is: (1) the official statement of policy regarding the future development of the county, (2) a summary of a broad range of available information, and (3) a long-range planning program. See Chapter 3 of the regional analysis for further information.

There is as yet no publicly stated federal policy for future development of federally owned coal in Campbell County. Of those surveyed in the 1977 Citizens' Policy Survey, 57% felt that local citizens had no real opportunity to participate in the decisions made at the federal level regarding energy development, while 22% felt they did.

Local Government

In 1968, Gillette's annual budget was $812,000. The 1977-1978 budget is $7,348,000, more than nine times the size of the 1968 budget. The current city budget is 28% greater than the previous year's budget. A city administrator was hired during 1977 to help the mayor govern the city. The city government, in conjunction with the town of Moorcroft, Wyoming, recently obtained a $50,000 management program grant, funded by the Federal Energy Administration and the state government, to improve the city's administrative ability. Increased demand for county services caused the Campbell County government to increase its 1977-78 budget to $4,430,000, up 44% from the previous fiscal year.

Fire Protection

Fire protection is provided by the City of Gillette/Campbell County Fire Department under direction of a fire board and a county fire warden. The department consists of a full-time fire chief and 4 firemen, supplemented by approximately 19 active volunteer firemen. The city and county each fund the department through a one-half mill levy on personal property. The 1977-78 budget is $178,000. Of those responding to the 1977 Citizens' Policy Survey, 39% felt fire protection was adequate, while 32% felt that it needed improvement.

Police Protection

Police protection is provided in Gillette by a 26-person force. The sheriff's department provides protection for the entire county, including the city. The 1977-78 budget for the Gillette Police Department is $614,000; that of the sheriff's department is $404,000, up by 23% from the previous year's budget. Of those responding to the 1977 Citizens' Policy Survey, 70% of county residents residing outside of Gillette felt that county police protection needed improvement, and 79% of city residents felt that traffic control needed to be improved.

In 1973, the Gillette Police Department had 2.22 policemen per 1,000 city residents. The 1977 figure was 0.75 per 1,000, while the national average was 1.9 per 1,000, emphasizing the lag between rapid population growth and expanded city services. In addition, the turnover rate at the Gillette Police Department is very high, and is partially attributable to the cost of living in Gillette.

Water Supply

Gillette obtains its water supply from local wells tapping the Wasatch or Fort Union Formation. Surface water is not readily available in Campbell County, and it is not used as a domestic water source. Historically, the city's water supply has been inadequate for summer needs, and the water has been of poor quality, either being very hard, or soft with the smell of hydrogen sulfide. Of those residents of Gillette responding to the 1977 Citizens' Policy Survey, 80% felt that the water supply needed improvement, and 95% felt that the quality of the water needed improvement.

In order to reduce the impact of new subdivision approvals on the city's water supply system, Gillette began requiring that all new subdivisions provide well sites. In addition, in order to assure adequate financing to provide sufficient water in each new subdivision, the city increased tap fees from $250 plus costs to $950 plus costs.

During 1977, Gillette markedly improved its water supply system by (1) renovating its pretreatment water plant, (2) drilling two new soft water wells (costing $163,000) and renovating several abandoned water wells, and (3) tripling the city's water storage capacity for summer needs to 6 million gallons (costing $1.5 million). The city's water now undergoes lime softening, and degasifying before it is supplied to city residents. The 1978 Wyoming Legislature provided loans for the construction of pipelines to bring water to Gillette from wells drilled into the Madison Formation.

Waste Disposal

Gillette constructed a $4.19-million sewage treatment plant in 1974 that has a capacity of 1.4 million gallons of sewage per day. Funding was supplied by the Environmental Protection Agency (EPA) and distributed by the State of Wyoming. The Wyoming Department of Environmental Quality (DEQ) granted the city a discharge permit for the new plant in April 1974.

The plant is currently processing an average of 0.76 million gallons per day with peak loads approaching 1.4 million gallons per day. The city government has stated that the plant has been operating at capacity since 1975. During the summer of 1976, the city increased its sewer tap fee to $1,081 per residential tap in order to increase revenues.

Raw sewage, some of which presumably comes from outside of the city limits, can currently be disposed of at the city's sewage treatment plant, further impacting the plant's limited capacity. The city is considering drastically increasing the rates charged for disposal of the raw sewage in order to increase revenue and discourage use of the disposal service.

Of those residents of Gillette responding to the 1977 Citizens' Policy Survey, 63% felt that the city's sewage treatment needed improvement; however, 40% of the residents of mobile home parks and residential subdivisions in Campbell County felt that there was a critical need for improvement of sewage treatment facilities. Campbell County has experienced periodic health problems arising from the operation of marginally adequate sewage treatment facilities serving housing subdivisions in the unincorporated areas around Gillette, and the county administration is apparently developing countywide regulations to govern sanitation practices.

Solid waste from Gillette is placed in an 80-acre sanitary landfill project that is located on the southwestern edge of the city. The site can be utilized for another 5 or 6 years. The city has been unable to secure a future landfill site that meets federal and state regulations.

Industrial oil is apparently being illegally dumped into the city's sewer system, adversely affecting the biological treatment system used at the sewage treatment plant. Neither the city nor the county currently provides facilities for disposal of industrial oil.

Medical Facilities

The Campbell County Memorial Hospital, with a capacity of approximately 30 beds and newly improved emergency room facilities, is located in Gillette. The Northeast Wyoming Regional Medical Center and the Medical Center of Campbell County are also located in Gillette. Medical service in Campbell County is provided by nine doctors; there are thus 1,778 patients for every practicing physician.

Of those Campbell County residents responding to the 1977 Citizens' Policy Survey, only 6% indicated that local medical service is adequate while 60% felt that there was a critical need for improved service. Until recently, local medical service was critically understaffed. Some overworked doctors left the county, and service was often difficult to obtain. Many dissatisfied residents apparently obtained medical service outside the county. The Campbell County Hospital Board successfully recruited five doctors during the fall and winter of 1977, reducing the doctor shortage. The goal of the hospital board is to eventually have one doctor per 1,000 residents.

The residents of Campbell County passed an $8.5 million bond issue June 23, 1976 for construction of a new county hospital. Construction of the 55-bed facility began during the fall of 1977, but completion of the facility will not occur for several years.

Although existing medical facilities and service have been impacted by rapid population growth, improvement of both the facilities and service did occur during 1977.

Education

Classroom space and number of teachers are currently adequate in Gillette.

The Private Sector

Introduction

Boom-town conditions also affect the private sector of the local economy. Services, such as motels, restaurants, and retail stores, are often overwhelmed by local population growth. Local lending institutions are often hard pressed to finance local private sector expansion. Uncertainty about future developments causes investors to be wary.

Housing

Normally, increases in economic activity and population growth are signs of opportunity to the housing industry. Increased housing demand is expected to stimulate increased housing production in roughly the quantity of units, the mix of unit types, and the price ranges demanded. However, in Gillette increased housing demand has come in difficult-to-predict waves to a geographically isolated community, which did not have a well-developed housing industry to begin with. The result has been a series of mutually reinforcing problems.

Single-Family Homes. A recent opinion poll in Campbell County found that 85% of all respondents desired to live in single-family homes (1977 City of Gillette/Campbell County Citizens' Policy Survey). There is evidence that as the mining work force in Campbell County shifts from construction workers to permanent workers, and as more construction workers view their stay in Gillette as long term, this preference for single-family homes can be expected to increase.

The local housing situation is not able to satisfy these preferences. Table BU2-8 describes the existing housing stock in the county. About 30% of the available dwellings are single-family units. The majority of these units are several years old, and located within the city of Gillette. Fifty-four percent of the housing stock is mobile homes, mostly recent additions located just outside the city limits. Table BU2-9 shows the changes in the housing stock since 1970. Only 30% of the new housing in Gillette is single family.

The overall cost of housing in Gillette is presently estimated to be 17% higher than in nearby Sheridan, 19% higher than in Wyoming communities in general, and 23% higher than the Denver metropolitan area, which serves as the regional financial center (Wyoming Department of Labor and Statistics 1977). This, however, may be understating the difference in price for new dwellings of common size and quality of construction. Developers who market similar houses in both Gillette and the Denver metropolitan area indicate that costs of production are 30% higher in Gillette than in Denver. New single-family units in Gillette, whether modular or conventionally constructed, are seldom priced at less than $46 per square foot. For most builders, the "bottom of the line"is a 1,100-square-foot home for roughly $51,000.

The reason for this price differential is found in the developer's costs. As a result of land speculation, finished

TABLE BU2-8

EXISTING HOUSING STOCK IN CAMPBELL COUNTY, JULY 1977

Type of Dwelling Unit	City of Gillette		Remainder of Campbell County		Totals	
	Number	Percent	Number	Percent	Number	Percent
Single-Family	1,623	42.3	515	15.9	2,138	30.1
Rural Dwellings	0	0	396	12.2	396	5.5
Duplexes (no. of units)	181	4.7	8	0.2	189	2.6
Multi-Family (no. of units)	499	13.0	28	0.9	527	7.4
Mobile Homes (in parks)	1,154	30.0	1,805	55.6	2,959	41.8
Mobile Homes (outside parks)	378	9.8	494	15.2	872	12.3
Total	3,835		3,246		7,081	

Source: City of Gillette/Campbell County Department of Planning and Development 1978; U.S. Department of Commerce, Bureau of the Census 1972.

TABLE BU2-9

CHANGES IN THE HOUSING STOCK, 1970-1977

	Total Units 1970	Total Units 1977	Net Change 1970-1977	Percent of the Increase of New Housing Stock 1970-1977
Gillette				
Single-Family	1,139	1,623	484	30
Duplexes (no. of units)	165	181	16	Less than 1
Multi-Family (no. of units)	279	499	220	14
Mobile Homes	645	1,532	887	55
Total	2,228	3,835	1,607	
Campbell County (including Gillette)				
Single-Family	1,782	2,138	356	19
Duplexes (no. of units)	172	189	17	Less than 1
Multi-Family (no. of units)	318	527	209	11
Mobile Homes	1,644	2,959	1,315	69
Total	3,916	5,813	1,897	

Source: U.S. Department of Commerce 1972, City of Gillette/Campbell County Department of Planning and Development 1978, Denver Research Institute 1977.

lots may cost $7,500 to $14,000 before tap fees (25% to 40% higher than in the Denver area). Facing financial difficulties of its own, the City of Gillette is charging approximately $2,100 for water and sewer tap fees (considerably higher than in the Denver area). Plumbing subcontracts may cost $2,000, or more, per unit (50% to 100% higher than in the Denver area). Carpentry labor may cost $7.00 to $12.00 an hour (8% to 85% more than in the Denver area where the union wage is $6.50 an hour).

Thus far, with single-family units comprising such a small portion of the available housing stock, it has been a sellers' market. Houses priced below $60,000 are usually sold before construction is completed.

Inflated housing production costs have placed the goal of a single-family dwelling beyond the reach of many newcomers. At prevailing conventional mortgage terms, a household would require almost $7,000 in cash and a $22,000 annual income in order to purchase a $55,000 home. (The most common terms are 9¼% to 9½% (including ¼% for private mortgage insurance) for 30 years, with a 10% down payment. In addition to the down payment, closing costs average $1,300. Most lending institutions require that principal and interest payments not exceed 25% of a household's gross monthly income, or that its total debt liabilities not exceed 30%. Using a 9½% interest rate and the 25% rule, for a $55,000 home; the annual income requirement would be $21,780.) By regional standards, wages in Campbell County are excellent. Mining wages average $19,700 per year; all other occupations combined average $14,400 per year (personal communication, Wolford, Employment Security Commission of Wyoming 1977). Nevertheless, most households are unable to afford a single-family house unless they have more than one full-time wage earner.

Mobile Homes. As Tables BU2-8 and BU2-9 indicate, mobile homes are the most prevalent and the fastest growing housing alternative in Campbell County. Sixty percent of the increase in housing since 1970 has been in mobile homes. Presently, 67% of the housing in the county outside Gillette is mobile homes.

Mobile homes, including campers, are the most common alternative for those who would have preferred single-family dwellings. While they are by no means inexpensive, mobile homes are priced at a level within the reach of most local households. The typical purchase requires $1,800 in down payment and an annual income of $7,200. Typical principal and interest payments are $150 per month. Many households presently living in mobile homes hope to use them as "starter homes,"to sell their mobile homes and use the equity to purchase single-family dwellings.

Thus far, mobile homes have worked well as starter homes. Rapid increases in housing demand and inflation in the cost of new mobile homes have resulted in high resale value for existing units. Units have tended to appreciate in value, which is contrary to the national pattern. However, planners are concerned that over the next decade, large numbers of mobile homes will deteriorate in physical condition, since their life span is much shorter than that of traditionally constructed dwelling units.

Conditions have changed since the initial phase of Gillette's housing boom when mobile home parks were an attractive investment. While banks and private mortgage companies have been successful in packaging and selling home mortgages to the secondary mortgage market, there is still an acute shortage of local commercial credit. As a consequence, local loans for all but the most favorable new business ventures, which presently excludes new mobile home parks, are difficult to obtain.

There is already a shortage of mobile home spaces in and around Gillette. Barring further housing development initiatives by the coal companies, it is likely to get worse. Anti-mobile home sentiment already exists among bankers and community leaders; consequently, their support of plans to increase the number of mobile home lots will probably be minimal.

Multi-Family Units. As Table BU2-9 indicates, less than 10% of the new dwelling units in the county have been duplexes or multi-family units. For the most part, these have been rental units. There is a great need for more rental units. The Gillette Chamber of Commerce has recently begun a rental referral service to assist newcomers in finding apartments. It has far more requests for referrals to rental units than it can fill.

As with mobile home parks, the main reasons for this shortage are the relatively high level of risk associated with new apartment developments and the shortage of local commercial credit. The risks to commercial lenders for apartments are seen as particularly high since initial capital investment is high and apartment vacancy rates are dependent on such a large number of variables. Actions by coal companies to improve housing conditions, such as subsidies of single-family units, could have the side effect of decreasing the demand for apartments.

Partially because of increased business activity and partially because of the shortage of long-term rental units, there is also a shortage of transient quarters. Many newcomers find themselves forced to live in motel rooms for long periods of time while searching for other housing alternatives. Unfortunately, motel space is also in extremely short supply.

FUTURE ENVIRONMENT

If the proposed mining does not take place, and if Shell Oil does not sell or use the land surface for a purpose other than coal mining, the project area would continue to exist in its present condition, subject to modification by natural processes, or the continuation of existing uses, including approved coal mines in the vicinity. The project area may be subject to increased casual use by hunters, off-road vehicle users, and collectors due to increased regional population; since the land is privately owned, such use would be restricted. Local transportation improvements would continue as planned without approval of the Buckskin Mine (see regional analysis, Chapter 8, Low-Level Scenario, Transportation Networks). Socioeconomic impacts of the same type and virtually the same magnitude would occur in the region with or without the proposed mine. See regional analysis, Chapter 4, Socioeconomic Conditions, for a complete discussion of regional and local effects of mineral development.