

CHAPTER II

DESCRIPTION OF THE EXISTING ENVIRONMENT

Air Quality

The Carter coal property is located in the Wyoming Intrastate Air Quality Control Region (Figure 2, Chapter IV, Part I).

Wind direction, inversion occurrences, monitoring information, and present ambient air quality are described for the region in Part I, Chapter IV. Present air quality in the area, typical of that described for the region, is estimated to be good.

Topography

The North Rawhide mine of the Carter Oil Company is near the western edge of the northern Great Plains and on the northern end of a broad plateau extending from Gillette to the Cheyenne River. Streams of this broad plateau drain northward into the Little Powder River.

The terrain in the vicinity of the coal lease is characterized by irregular ridges and isolated knobs separated by narrow to moderately wide valleys (Figure 1). Most of the topographic highs surrounding the mining area are related to erosion-resistant clinker or to sandstone channel deposits; these resistant rock at the burnline result in hummocky topography. Small intermittent lakes dot the flat plateau surface.

Major streams meander through alluviated valleys, the floors of which range in width from 500 to 3,000 feet. The predominant direction of drainage is northward. North Rawhide Creek bisects the lease in this direction.

Elevation ranges from a minimum of 4,060 feet in North Rawhide Creek at the north margin of the lease to a maximum of 4,434 feet on a knoll in the southeastern part. The area has over 200 feet of relief between the valley floor and the crests of adjacent ridges. Side slopes are less than 10 percent but locally steepen to over 30 percent.

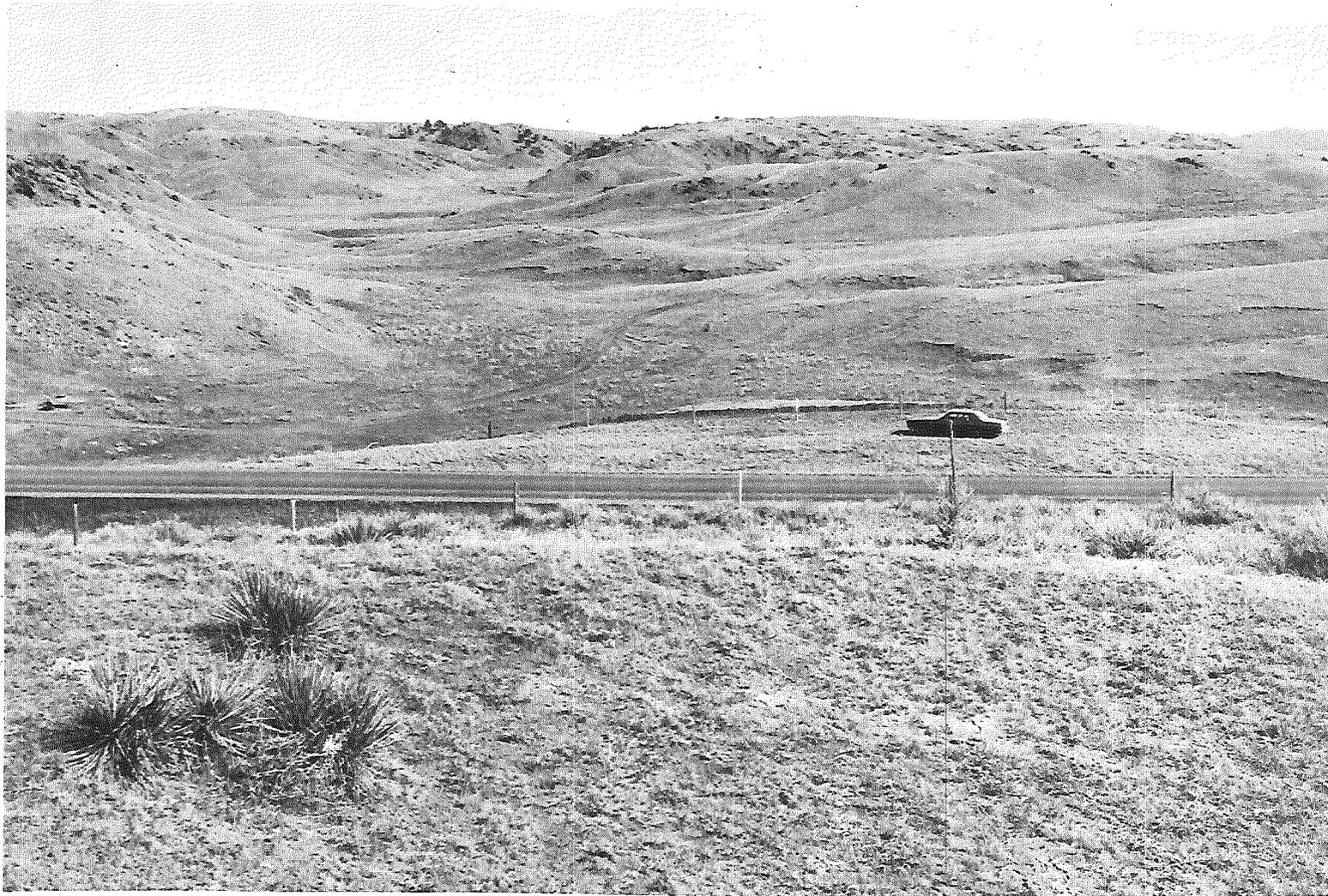


Figure 1

Existing Topography at the Facilities Site and Initial Mining Area of
the Proposed North Rawhide Mine

Soils

The Soil Conservation Service completed the field work for a general reconnaissance soil survey of Campbell County in 1939 and published the report in 1955. Although the report identified various soil series, it must be noted that each delineation included several other associated soil series. Therefore, specific interpretations for the identified soil series cannot be applied to the entire delineation shown on the map. The SCS has informed us that many of the soil series identified in 1955 are subject to change as more detailed data is collected. The 1955 report is adequate for general planning only. The University of Wyoming is conducting soil studies for the Carter Oil Company. Additional detailed soil inventories must be conducted upon the mining area to evaluate each soil taxonomic unit.

Based upon the 1955 reconnaissance soils report, ten major soil mapping units occur on the mining lease area. An estimate of their suitabilities and limitations is included in Table 1, Soil Interpretation Summary. Tables 10 through 28, Appendix C, give a description of each soil series and list their physical, chemical, and management characteristics. A general soils map, illustrated in Figure 2, locates the soils occurring within the mining plan area. A brief summary and acreages for the ten major soil types follows.

The Arvada soil types occur on approximately 200 acres. These soils occur on sloping terraces and alluvial fans. They are shallow (20"), strongly alkaline, and very high in exchangeable sodium. Productivity is very low and present erosion is high. These soils are unsuitable for agricultural use, road fill, building construction, and other uses.

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SOIL UNIT	EROSION HAZARD POTENTIAL**		REVEGETATION POTENTIAL	SUITABILITY FOR SPRINKLER IRRIGATION	SUITABILITY FOR FINAL COVER FOR MINED LAND	SUITABILITY FOR TRANSPORTATION ROUTES	SUITABILITY FOR ROADFILL	SUITABILITY FOR SEPTIC-TANK ABSORPTION FIELDS	SUITABILITY FOR SEWAGE LAGOONS	SUITABILITY FOR SANITARY FACILITIES (TRENCH)	SUITABILITY FOR SMALL COMMERCIAL BLDGS.
Symbol	%Slope	Water	Wind		Suita- In, Available	bility					
Ab	0-5	M	M	L	L	0	L	L	L	L	L
	5-10	H	M	L	L	0	L	L	M	L	L
Ac	0-5	M	M	L	L	0	L	L	H	L	L
	0-5	M	M	M	L	6	M	L	L	L	L
Ra-Rb	0-5	M	M	M	L	6	M	L	L	L	L
	5-10	H	M	M	L	6	M	L	L	L	L
Rc	10-20	H	L	M	L	6	M	L	L	L	L
	20-30	H	L	M	L	6	M	L	L	L	L
	30-40	H	L	M	L	6	M	L	L	L	L
	30-40	H	L	M	L	6	M	L	L	L	L
Rd	0-5	M	M	M	M	8	H	L	L	L	L
	5-15	H	M	M	M	8	H	L	L	L	L
Re	10-20	H	L	M	M	8	H	L	L	L	L
	20-30	H	L	M	L	8	H	L	L	L	L
	30-40	H	L	M	L	8	H	L	L	L	L
Rf-Rg	20-30	H	L	L	L	0	L	L	M	L	L
	30-40	H	L	L	L	0	L	L	L	L	L
	40-50	H	L	L	L	0	L	L	L	L	L
Rh	20-30	H	L	L	L	0	L	L	M	L	L
	30-40	H	L	L	L	0	L	L	L	L	L
	40-50	H	L	L	L	0	L	L	L	L	L
Ua	0-5	M	M	L	L	6	M	L	L	L	M
Ub	5-10	H	M	L	L	6	M	L	L	L	M
Uc	0-5	M	M	M	M	16	M	M	M	L	M
	5-10	H	M	M	M	16	M	M	L	L	M
Ud-Ue	0-5	M	M	M	M	16	H	M	L	L	M
	5-10	H	M	M	M	16	H	M	L	L	M
	5-10	H	L	L	L	8	L	M	H	L	H
Wa	10-20	H	L	L	L	8	L	L	H	L	M
	20-30	H	L	L	L	8	L	L	M	L	L

* - 3 Classes - L - Low, M - Moderate, H - High.

** - Estimated on-site erosion, bare soil conditions, L - 3%/ac, M- 3-8 T./ac., H - 8T./ac.

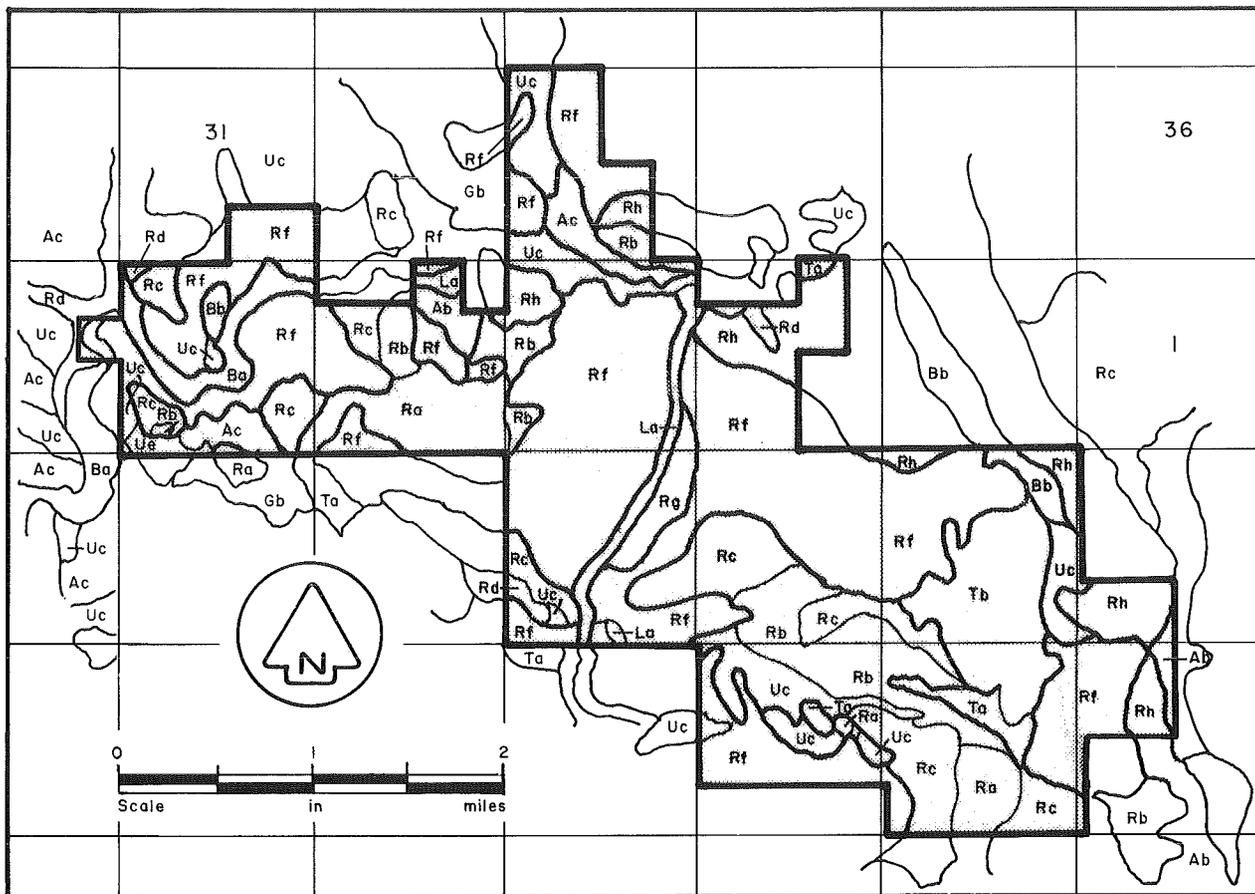
Source of interpretations: 1. Descriptions from Campbell County. 2. Soil Conservation Service soil profile descriptions. 3. S.C.S. Form 5, Interpretation sheet. 4. Region 2, F.S. Guidelines for Soil Interpretations. 5. S.C.S. Guide for Interpreting Eng. Uses of soils.

Table 1
Carter
Soil Interpretation Summary *

R 72 W

T 52 N

T 51 N



LEGEND

<u>SYMBOL</u>	<u>SERIES</u>	<u>SYMBOL</u>	<u>SERIES</u>
Ab	Arvada Clayloam	Rc	Renohill rolling phase
Ac	Arvada loam	Rd	Renohill loam
Ba	Bankard fine sandy loam	Re	Renohill loam rolling phase
Bb	Satanta very fine sandy loam	Rf-Rg-Rh	Rough Broken Land
Gb	Unnamed	Ta-Tb	Terry sandy loam
La	Haverson clay loam	Ua-Ub	Ulm clay loam
Ra	Renohill clay	Uc-Ud-Ue	Ulm loam
Rb	Renohill clay loam	Wa	Wilboux-Searing complex

Source: USDA, Soil Conservation Service, Soil Survey, Campbell County, Wyoming July 1955, Soil Map, Sheet No. 384

Fig. 2
General Soils Map (Carter Coal Property)

The Renohill soil types occupy nearly 1,800 acres on gently sloping to rolling uplands underlain by weathered shale at depths of 20 to 40 inches. Soil reaction is moderately alkaline at 6 to 20 inches. Internal drainage is slow due to the clay subsoil. Productivity for native vegetation is medium, ranging from 750 to 1,800 pounds per acre dry weight. Agricultural use is limited due to shallow depth to bedrock and alkalinity. Present erosion condition is high. Erosion hazard increases to very severe if vegetation or protective cover is removed.

A miscellaneous land type, known as Rough Broken Lands, occupies nearly 2,500 acres. These lands are steep, eroded, and strongly dissected along escarpments and steep-walled drainage channels. Fragments and blocks of red shale, scoria land material, and clinker are scattered on the surface. They are highly eroded, not suitable for agriculture, and productivity is low for native vegetation.

The Terry soil type occupies nearly 600 acres and occurs on moderately sloping to steep sidehill slopes. Depth to bedrock is 20 to 30 inches. Present erosion condition is high. Erosion hazard is high due to the steep slopes and fine sandy loam textures. Productivity for native vegetation is medium, yielding about 1,000 to 1,500 pounds per acre total dry matter.

The Ulm soil types occupy nearly 500 acres situated on rolling to steeply sloping uplands that are strongly dissected by gullies. Depth to bedrock ranges from 10 to 20 inches. Productivity is fair, yielding approximately 500 to 1,500 pounds per acre total dry vegetative matter. Present erosion is high.

The Satanta soil type occupies approximately 120 acres on nearly level to undulating sloping uplands and high terraces. These soils formed

from eolian materials reworked by wind action. Wind erosion hazard is high. Productivity is high, ranging from 1,800 to 2,500 pounds per acre total dry weight. Soil reaction is neutral to alkaline.

The remaining 80 acres are occupied by other soils with few acres as identified in Figure 2.

Summarily, the soils occurring within the Carter lease area are moderately to highly susceptible to wind and water erosion if the vegetation is removed and topsoil disturbed. The revegetation capabilities are poor due to high alkaline or sodium concentrations. Although present native vegetation is sparse, it is tolerant to the salt concentrations and able to provide a protective plant cover against wind and water erosion. As these soils are derived from shale parent materials, they have a moderate to high shrinkswell potential and are highly susceptible to compaction. These two factors, coupled with low infiltration and permeability rates, increase the hazards for erosion, revegetation, water runoff, and flooding, and limit their suitability for reservoirs, road fill material, and other construction uses.

Mineral Resources

Stratigraphic and structural relations

The Carter Oil Company's North Rawhide federal coal lease in parts of T51 and 52N, R72 and 73W, is on the gently dipping east flank of the Powder River Basin in Wyoming. This broad regional downwarp, or asymmetric structural basin, contains almost flat-lying rocks of Tertiary age in the center surrounded by Cretaceous and progressively older rocks that are upturned on the flanks of the bordering Precambrian-cored mountains--the Black Hills to the east, the Bighorns to the west, and the Laramie Range to the south; northward the basin blends indistinctly with the Great Plains (Figure 8, Chapter IV, Part I). The lease is in the Powder River coal field that was mapped by Stone and Lupton (U.S. Geological Survey 1908). The following descriptions of the geology and coal resources on the lease block have been summarized from their report, from the reports cited in Part I, Chapter IV, and from the information in the mining and reclamation plans proposed by the Carter Oil Company. The poorly exposed surface bedrock is assigned to two Tertiary formations--the Fort Union Formation of Paleocene age and the overlying Wasatch Formation of Eocene age (Figure 9, Chapter IV, Part I). For all practical purposes the top of the Wyodak (Roland) coalbed defines the top of the Fort Union Formation. The contact is rarely exposed because the coal is masked almost everywhere by alluvium or by the red baked and fused rock, commonly called clinker, scoria, or porcellanite, that formed from the overlying shales and sandstone when the coalbed burned sometime during the past. The Fort Union Formation is underlain in turn by the Upper Cretaceous Lance Formation and Fox Hills Sandstone. The base of the Fox Hills, top of the Pierre Shale, is at a depth of almost 4,000 feet below the lease area. Succeedingly older sedimentary formations representing Mesozoic and Paleozoic ages occur between the base of the Fox

Hills Sandstone and the top of the Precambrian igneous and metamorphic rock complex located as much as 15,000 feet below the surface.

The uppermost part of the Fort Union Formation is partially exposed along the northeast edge of the lease block (Figure 2, Chapter I). The Wyodak coalbed and its associated shale parting form the upper 70 to 150 feet of the formation. The company uses the terminology of Stone and Lupton (U.S. Geological Survey 1908) in referring to these as the Roland and Smith coalbeds and an intervening shale. The formation below the coalbeds at the top is composed predominantly of drab-gray and brownish- and bluish-gray carbonaceous clay shale with lenticular beds of yellowish-gray siltstone and fine-grained friable sandstone and a few thin coalbeds. Only coalbeds less than 10 feet thick have been found in holes drilled to 200 feet below the Wyodak bed in the lease area. Brownish-red, highly ferruginous, thin resistant lenticular sandstone beds and hard ferruginous concretions distinctively mark the formation.

The surface over most of the lease block is underlain by the Wasatch Formation, the overburden to be stripped at the North Rawhide mine. It ranges in thickness from zero feet along the coal crop line on the northeast edge of the lease block to as much as 240 feet in several areas near the center and western parts of the lease (Figure 8, Chapter I). The formation is characterized by fluvial sedimentary beds consisting of light-yellowish-gray, fine-grained, poorly consolidated sandstone, drab-gray soft clay shale, brownish-gray carbonaceous siltstone, and thin coalbeds. In general, the Wasatch Formation in the lease block is composed of about 50 percent argillaceous and silty sandstone, 25 percent clay shale, and 25 percent siltstone. The Wasatch Formation is generally basic, pH values 7.4 to 8.7, and nontoxic as indicated by the analyses of 11 core samples reported in Table 1, Chapter I.

The Wyoming Highway Department encountered no difficult engineering or construction problems in cuts for an interstate highway through the Fort Union and Wasatch Formations in Campbell County; however, all rocks were near surface and weathered and, thus, were rippable with standard road-building equipment, and blasting was not required (Sherman 1974). Unweathered bedrock commonly is found at depths less than 25 feet and has a bearing strength of 3 to 7 tons per square foot. Unweathered bedrock in surface mines probably will have to be blasted before removal. Landslides or other slope stability problems occur only locally in oversteepened cuts. Shale from the Fort Union and Wasatch Formations used in fills breaks down and deteriorates in less than one year. Consolidation and differential settling of the fill ranges from 10 to 20 percent; shale is unstable in slopes greater than 2:1; some clay is compressible, but no problems were encountered unless slope ratios exceeded 2:1 (Sherman 1974).

Quaternary alluvium consisting of as much as 25 feet of silty and sandy clay occurs throughout the lease block in valleys along most of the intermittent streams.

Areas of clinker almost surround the proposed mine area on the North Rawhide lease block (Figure 3). Clinker is a red gravelly-textured rock that formed when the strata overlying the coalbeds were baked and fused during combustion of the coal; it is used extensively for road metal and ballast.

The strata on the North Rawhide lease block dip imperceptibly from one to two degrees to the west conformable to the regional structure.

Major faults are not known to offset the rocks in the lease area; faults with small displacement may be present, similar to those described by Osterwald and Dean (U.S. Geological Survey 1961, pl. 28). Detailed studies have not been made of the attitude and spacing of joints or fractures in rocks on the lease area; the joint system probably will be the same as regionally developed in the Great Plains; that is, two prominent sets, one striking northwest and the other northeast (U.S. Geological Survey 1961, pl. 28).

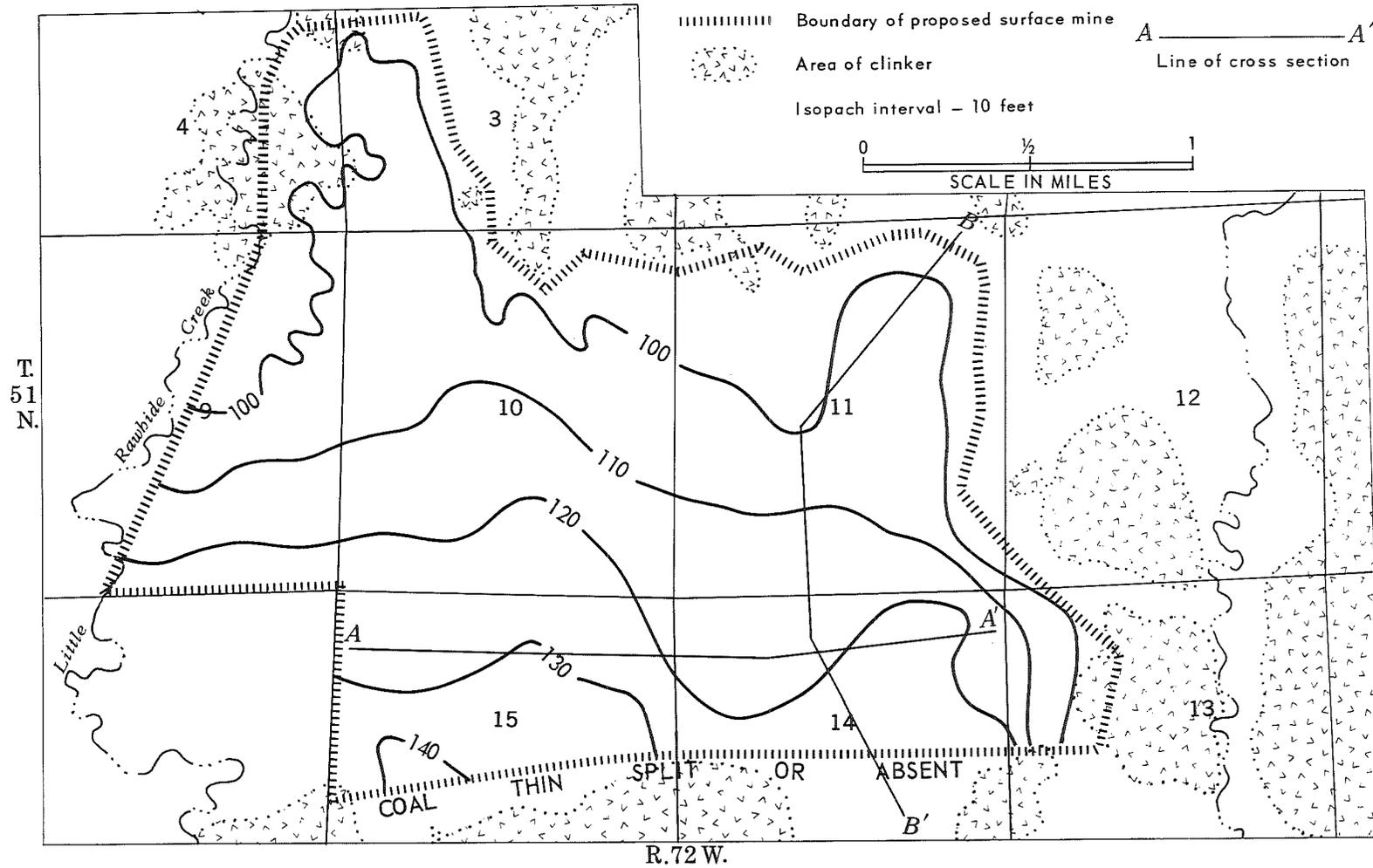
Coal

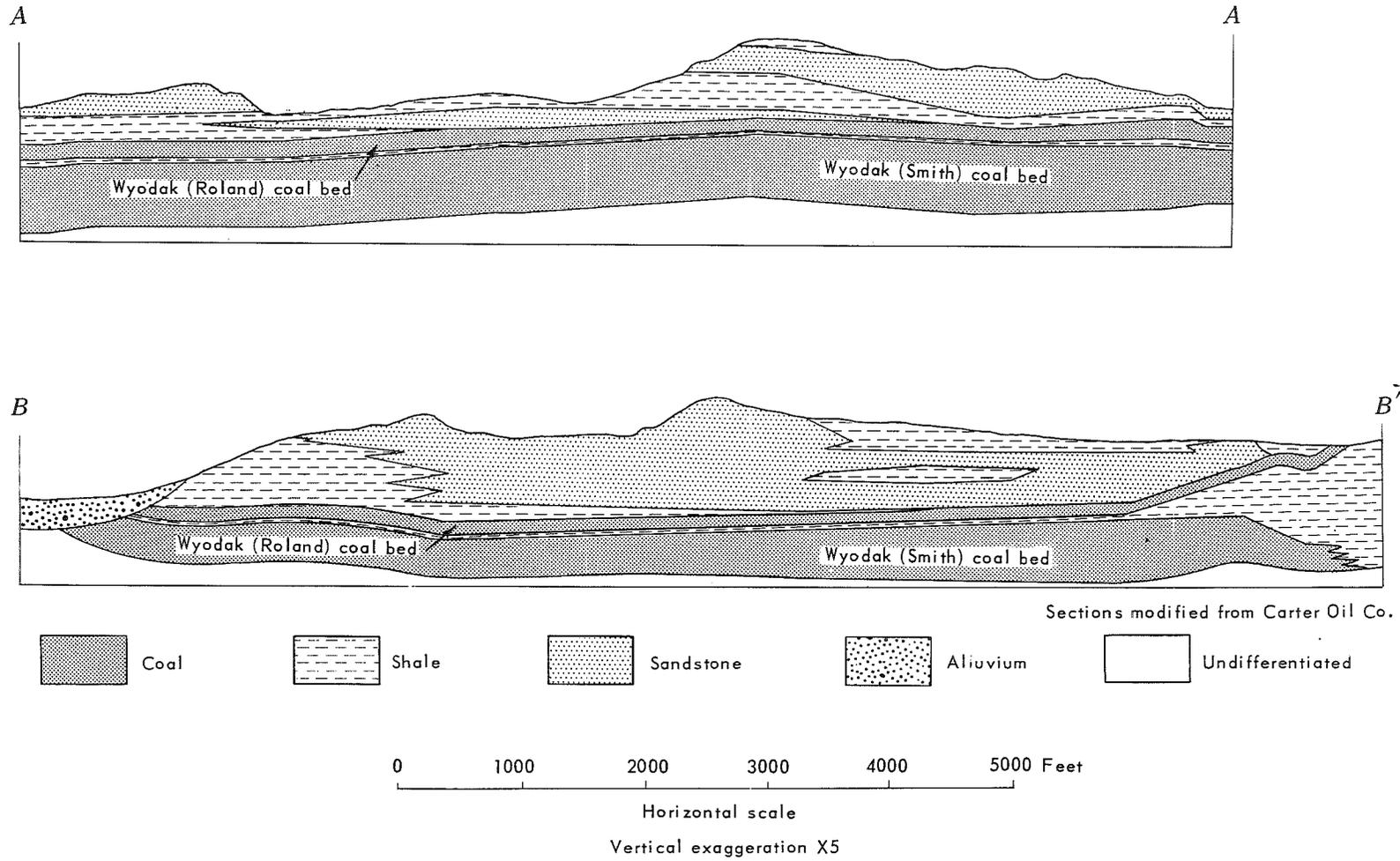
The Wyodak coal to be mined at the North Rawhide mine occurs in two beds separated by carbonaceous clay shale that ranges in thickness from 2 to 10 feet and averages about 6 feet. At the south boundary of the lease area, this shale increases to more than 100 feet thick (Figure 4). The upper coalbed (Roland) ranges from 20 to 35 feet in thickness except in a zone about 500 to 1,000 feet wide along the eastern and southern crop lines where, because it has been eroded and burned, it ranges from zero to 35 feet in thickness. In general, this upper coalbed thickens in a northerly direction across the proposed mine area (Figure 4). The lower coalbed (Smith) averages about 82 feet thick; it ranges from 50 to 120 feet in thickness except for the zone along the crop line where it is eroded. This lower coalbed generally thickens to the south-southwest, but the bed thins abruptly and lenses-out completely within several hundred feet of the southern boundary of the lease block (Figures 3 and 4). The upper coalbed is continuous through this area of abrupt facies change but is separated from the lower bed by more than 100 feet of

Figure 3

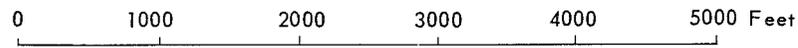
Thickness of the Coalbeds at the Proposed North Rawhide
Mine, Carter Oil Company, Campbell County, Wyoming

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Sections modified from Carter Oil Co.



Horizontal scale
Vertical exaggeration X5

Figure 4

Sections Showing the Relationship of Coalbeds at the Proposed North Rawhide Mine,
T51N, R72W, Carter Oil Company, Campbell County, Wyoming.

(Lines of sections shown on Figure 3.)

shale (Figure 4). An ancient erosion channel subsequently filled with sediments has been suggested as an explanation for the abrupt termination of the coalbed in this area (U.S. Geological Survey 1973).

The thickness lines shown on Figure 3 are for the combined Wyodak coalbed excluding the interbedded shale. The thickest coal is along the south edge of the proposed mine area adjacent to the abrupt thinning and facies change in the coalbed.

Quality of the coal

The analyses supplied by Carter Oil Company show that the coal to be produced at the North Rawhide mine is subbituminous C in rank. The proximate and ultimate analyses of coal, the fusion temperature of the ash, and the oxide analysis of the ash shown in Table 2 are the averages of coal samples from 35 core holes drilled in the area of the proposed mine in the eastern part of the lease block. The number of samples taken to date in the western part of the lease block are insufficient to adequately characterize the quality of coal there but do indicate the Btu and sulfur content of the coal are slightly higher than in coal in the proposed mine area. The distribution of sulfur content, ash content, and Btu values in the proposed North Rawhide mine area are shown respectively on Figures 5, 6, and 7. The actual range in sulfur content is 0.28 to 0.52 percent. The mining plan will be fitted to the natural distribution patterns of the sulfur, ash, and Btu so that coal will be produced which will consistently meet the Environmental Protection Agency's requirements and standards. Trace amounts of the toxic elements are significant in the evaluation of potential impact on the environment by coal burned in power plants. Results of analyses for selected trace elements in coal samples from five core holes

Table 2

Average Analysis of 35 Coal Samples from the
Proposed North Rawhide Mine,
Campbell County, Wyoming
(All values except Btu and Fusion temperature are
in percent. Analyses by Commercial Testing and
Engineering Company.)

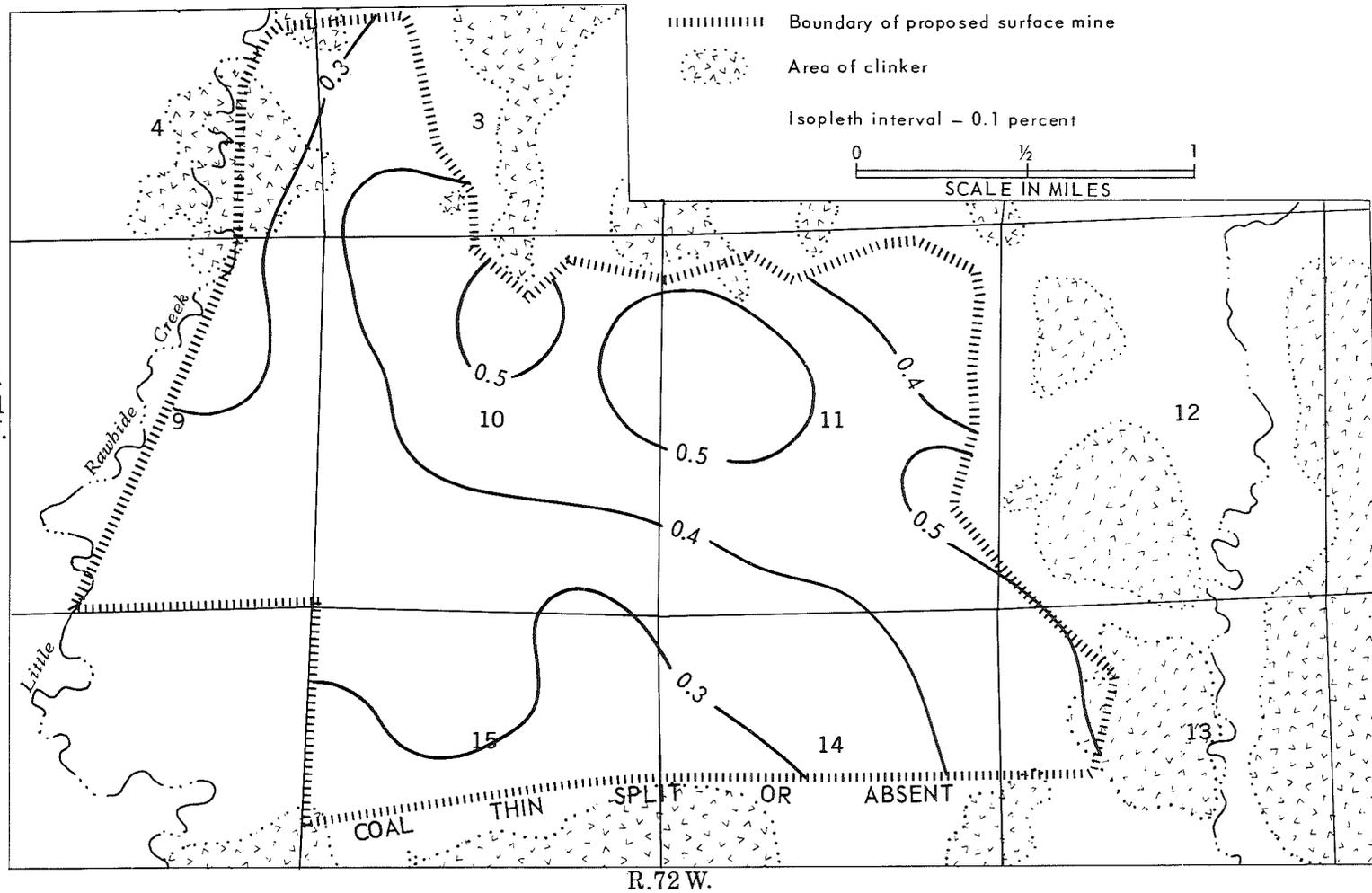
	Proximate Analysis		Ultimate Analysis	
	As Received	Moisture Free	As Received	Moisture Free
Moisture	31.00	--	Moisture	31.00
Ash	5.96	8.64	Carbon	46.81
Volatile Matter	30.05	43.55	Hydrogen	3.25
Fixed carbon	32.78	47.51	Nitrogen	0.66
Btu	8063	11686	Chlorine	--
Sulfur	0.38	0.55	Sulfur	0.38
Alkalies as Na ₂ O	0.13	0.19	Ash	5.96
			Oxygen	11.94
				17.30

Fusion Temp. of Ash °F Oxide Analysis of Ash

	<u>Reducing</u>	<u>Oxidizing</u>		
Initial				
Deformation	2147	2212	Phos pentoxide P ₂ O ₅	0.52
Softening (H=W)	2178	2234	Silica Si O ₂	34.93
Softening (H= $\frac{1}{2}$ W)	2192	2249	Ferric oxide Fe ₂ O ₃	6.02
Fluid Temp.	2215	2279	Alumina Al ₂ O ₃	16.64
			Titanium TiO ₂	1.02
			Lime CaO	20.68
			Magnesia MgO	4.62
			Sulfur trioxide SO ₃	14.65
			Potassium oxide K ₂ O	0.51
			Sodium oxide Na ₂ O	1.11

Figure 5

Distribution of Sulfur Content of Coalbeds at the Proposed North Rawhide Mine,
T51N, R72W, Carter Oil Company, Campbell County, Wyoming



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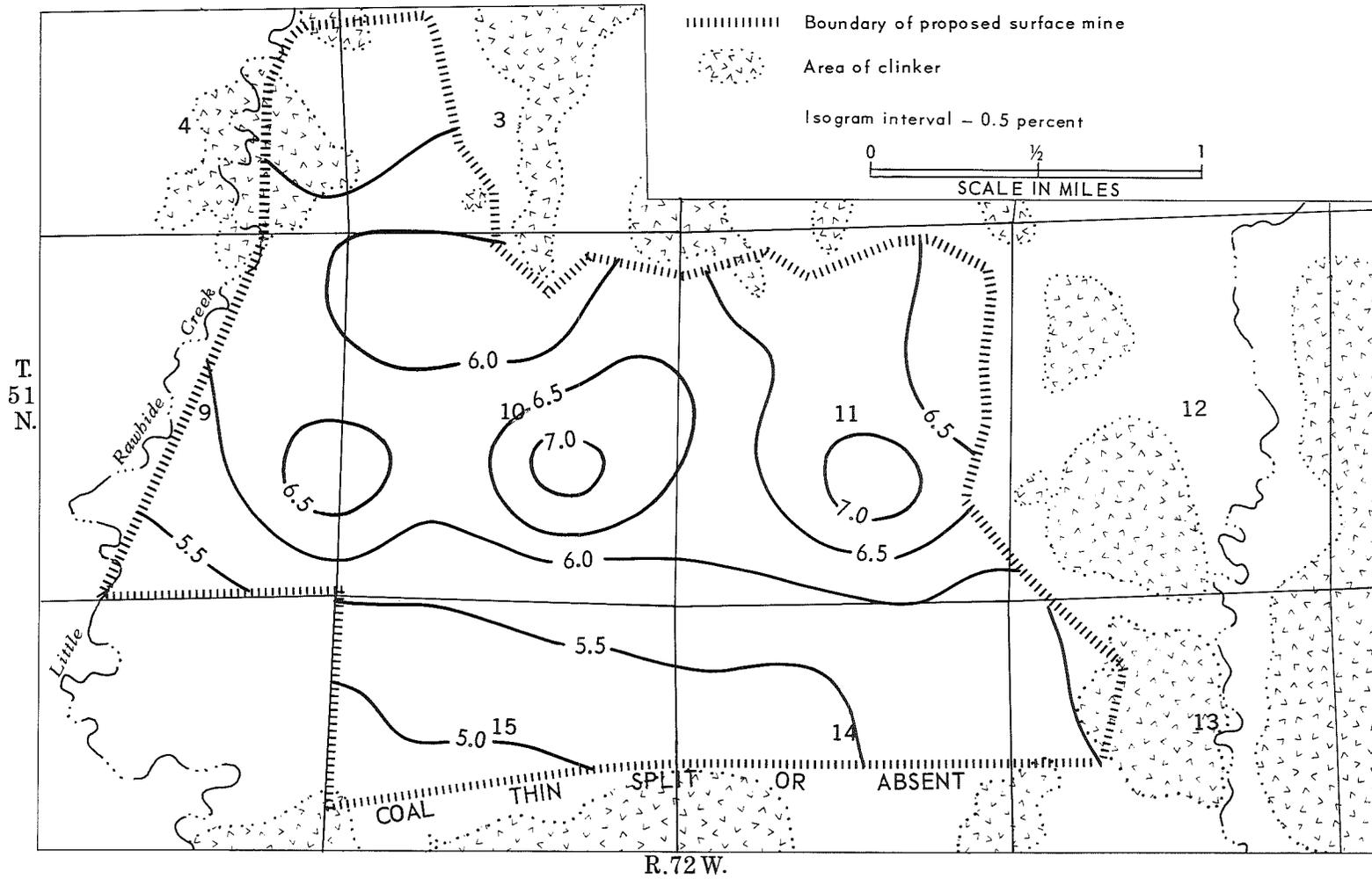


Figure 6

Distribution of the Ash Content of Coalbeds at the Proposed North Rawhide Mine,
Carter Oil Company, Campbell County, Wyoming

drilled in the initial mining area are shown in Table 3. The concentrations appear to be normal for values as compared to other western coals.

Quantity of the coal

The general estimates of the amount of coal in the North Rawhide lease block are given in Table 4. Coal in the Wyodak bed within the lease area totals about 752.5 million tons; the basal three feet of the bed will not be mined and so has been excluded from the estimates. The mine block area contains about 393.5 million tons of coal of which about 354 million tons can be produced, assuming 90 percent recoverability of coal in the ground. About 76 percent of the coal in the mine block is contained in the lower (Smith) bed and 24 percent in the upper (Roland) bed. The estimated reserves appear to be adequate to meet the proposed schedule of production. The low stripping ratios of overburden per ton of coal shown in Table 4 make the coal amenable to surface mining.

Other minerals

Occurrences of minerals other than coal are not known on the lease block.

Clinker is abundantly distributed in the lease area and should be adequate to provide road metal and ballast (Figure 8, Chapter I and Figure 3, this chapter). Sand and gravel occur locally as lenses in alluvium on the intermittent streams.

Oil and gas

The Carter Oil Company's federal coal lease in T51 and 52N, R72W presently contains three plugged and abandoned oil and gas test holes. No other wells are known within the lease area; other oil and gas tests to any

Table 3

Analyses for Selected Trace Elements in Composite Samples of the Wyodak Coal in Drill Cores from the Proposed North Rawhide Mine, Campbell County, Wyoming (Value in Parts per Million. Spark Source Mass Spectrographic Analyses by Commercial Testing and Engineering Company. Data supplied by the Carter Oil Company)

ELEMENT	Sample Number							
	NRH 58 ^{1/}	NRH 62 ^{1/}	NRH 76 ^{1/}	D-279 ^{1/}	D-281 ^{2/}	D-281 ^{3/}	D-286 ^{2/}	D-286 ^{3/}
Arsenic	1.8	<0.33	1.1	1.5	0.65	< 0.20	2.9	0.29
Boron	29.	3.6	32.	25.	2.8	3.2	25.	28.
Fluorine	200.	2.6	131.	170.	5.0	1.5	7.5	150.
Lead	1.9	0.51	0.93	1.6	0.54	0.41	1.6	0.54
Mercury	< 0.007	< 0.006	0.28	0.006	< 0.005	< 0.005	0.28	0.23
Selenium	0.18	0.06	0.14	0.15	0.10	0.04	0.31	0.06
Uranium	1.3	0.7	1.5	1.1	1.1	0.48	1.1	1.4
Vanadium	19.	8.3	13.5	16.0	13.0	5.8	13.	11.

1) Composite coal sample of upper (Roland) and lower (Smith) beds.

2 Composite coal sample of upper (Roland) bed.

3 Composite coal sample of lower (Smith) bed.

Table 4

Available Coal, in Thousands of Short Tons, in the Wyodak Bed
at the North Rawhide Mine, Campbell County, Wyoming

Location	Lower (Smith) Bed ^{1/}		Upper (Roland) Bed		Total Coal in Place ^{2/}	Recoverable Coal ^{3/}	Stripping Ratio ^{4/}
	Acres	Coal in Place	Acres	Coal in Place			
MINE BLOCK AREA							
T. 51 N., R. 72 W.							
Section 3	115	12,280	91	5,445	17,725	15,952	0.62
Section 4	29	3,388	29	1,443	4,831	4,348	0.50
Section 9	272	37,812	272	12,600	50,412	45,371	0.92
Section 10	570	75,214	535	28,707	103,921	93,529	1.34
Section 11	540	67,303	518	23,762	91,065	81,959	1.29
Section 12	20	1,115	0	0	1,115	1,004	0.97
Section 13	63	8,054	51	1,726	9,780	8,802	0.78
Section 14	240	40,627	240	8,974	49,601	44,640	0.78
Section 15	<u>288</u>	<u>52,551</u>	<u>288</u>	<u>12,453</u>	<u>65,004</u>	<u>58,504</u>	<u>0.52</u>
Sub-total	2,137	298,344	2,024	95,110	393,454	354,109	1.01 ^{5/}
REMAINDER OF LEASE AREA							
T. 51 N., R. 72 W.							
Section 4	361	34,822	343	21,485	56,307	50,676	1.14
Section 5	430	45,124	309	24,564	69,688	62,719	1.19
Section 6	449	50,376	597	36,493	86,869	78,182	1.46
Section 9	381	47,075	381	22,408	69,483	62,535	1.23
Section 14	0	0	121	4,590	4,590	4,131	2.29
Section 15	0	0	121	7,713	7,713	6,942	1.38
T. 52 N., R. 72 W.							
Section 31	81	9,607	81	7,167	16,774	15,096	1.36
Section 33	<u>295</u>	<u>30,581</u>	<u>243</u>	<u>17,076</u>	<u>47,657</u>	<u>42,891</u>	<u>0.87</u>
Sub-total	1,997	217,585	2,196	141,496	359,081	323,172	1.24 ^{5/}
GRAND TOTAL	4,134	515,929	4,220	236,606	752,535	677,281	1.12 ^{5/}

^{1/} Basal 3 feet of bed, which will not be mined, are excluded from estimates.

^{2/} Assuming 1,770 short tons of coal per acre foot.

^{3/} Assuming 90 percent recovery of coal in place.

^{4/} Cubic yards of overburden per ton of recoverable coal.

^{5/} Weighted average.

Source: Carter Oil Company

formation within the area could be applied for at any time. Data on the abandoned wells in the lease area follow:

1) During December 1955 through February 1956 a well was drilled and abandoned 662 feet from south line and 661 feet from west line (C SW 1/4 SW 1/4) sec. 4, T51N, R72W on public oil and gas lease W-012699; ground elevation is 4,285 feet; 10 3/4-inch surface casing was set at 930 feet; total depth is 9,840 feet in the Minnelusa Formation.

2) During October 1968 a well was drilled and abandoned 660 feet from north line and 3,437 feet from east line (on Lot 3 or NE 1/4 NW 1/4) sec. 6, T51N, R72W, on a private oil and gas lease; ground elevation is 4,208 feet; 9 5/8-inch surface casing was set at 834 feet; total depth is 8,376 feet in the Morrison Formation.

3) During December 1971 a well was drilled and abandoned 2,110 feet from north line and 1,840 feet from west line (SW 1/4 SE 1/4 NW 1/4) sec. 10, T51N, R72W, on public oil and gas lease W-18362; ground elevation is 4,336 feet; 8 5/8-inch surface casing was set at 339 feet; total depth is 8,000 feet in the Lower Cretaceous Skull Creek Shale.

Water Resources

Ground water

Formations exposed on the Carter coal lease, above the two coal seams to be mined, are the Wasatch Formation comprising the uplands of the area and the alluvium in the valley of Rawhide Creek. Thickness of alluvium at the Carter coal lease is not known but probably is 40 to 50 feet thick based on a thickness of as much as 60 feet about three miles downstream. Thickness and character of the alluvium were determined downstream by a line of test holes drilled in 1967 by the U.S. Geological Survey across the valley of Little Powder River below the junction of Rawhide Creek. Water level in the test holes augered was about 10 feet below land surface.

Movement of water in the alluvium is downstream as underflow. Movement of water in the Wasatch Formation that forms the coal overburden is northward in most of the lease area with a strong component toward Rawhide Creek in most of the lease area. In the eastern part of the lease area, water movement is northeast toward the valley of Little Powder River.

Surface water

The surface of the lease area is drained by tributaries of the Little Powder River. Two of these tributaries, Rawhide Creek and Little Rawhide Creek, originate outside the lease area and flow through it. Rawhide Creek is an intermittent stream that originates from the west and flows mainly in an easterly direction across the northern part of the leased area. About 4.5 miles of Rawhide Creek's channel lies within the leased area. The leased area also has about 35.3 miles of minor ephemeral tributaries, most of which drain into Rawhide Creek or Little Rawhide Creek.

The drainage pattern within the area is dendritic, indicating an absence of lithologic effects. Streamflow occurs mainly from runoff or rainfall. The major portion of annual runoff occurs as a result of convective storms. Long-time residents of the general area say that the highest flows occur when rain is preceded by hail which beats the grass cover and soil so there is less retention of runoff when the rain begins.

Rawhide Creek has a drainage area of 60.5 square miles upstream from its intersection with the lease boundary. Based upon its basin characteristics and channel geometry, it is estimated to have a mean annual flow of 2 cubic feet per second (cfs) (1,450 acre-feet per year) and a mean annual flood peak of 900 cfs.

Little Rawhide Creek has a drainage area of 29.4 square miles upstream from its intersection with the boundary of the lease area. Its mean annual flow is estimated to be one cfs (724 acre-feet per year) and its mean annual flood peak is 600 cfs.

Nearby gauged streams show there is a high variation in year-to-year runoff values; thus annual runoff and flood peaks can be expected to vary widely.

The average slopes of the streambeds of Rawhide Creek and Little Rawhide Creek are 15.6 feet per mile and 20.6 feet per mile, respectively. Minor tributaries have average slopes of as high as 250 feet per mile; however, there is very little head or downcutting of channels within the lease area. The streambeds are generally grassed and have a stable appearance.

The hydrologic characteristics of Rawhide Creek and Little Rawhide Creek have been significantly altered during the past five years due to the associated activities of oil-field developments in their basins. Numerous areas have been cleared and leveled for oil drilling activities.

The main use of surface waters in the area is for watering of domestic and wild animals. Some irrigation of hay meadows is done along downstream reaches of the Little Powder River.

Erosion and sedimentation

Erosion of the leased area appears to be low in relation to other parts of the Eastern Powder River Coal Basin due to better grass cover.

Water quality

Water samples taken from the Little Powder River near Weston and near the Wyoming-Montana state line had dissolved solids concentrations ranging from 17 to 55 parts per million. Sodium and sulfate were the major ions with lesser concentration of calcium, magnesium, and bicarbonate. These samples should be representative of water quality upstream in the lease area.

Vegetation

Vegetation on and adjacent to the Carter coal property is made up mostly of short grasses intermixed with big sagebrush. Plant communities on and surrounding the property are in an intermediate state of plant succession because of domestic livestock grazing for many years. With continued livestock grazing, little successional change would be expected.

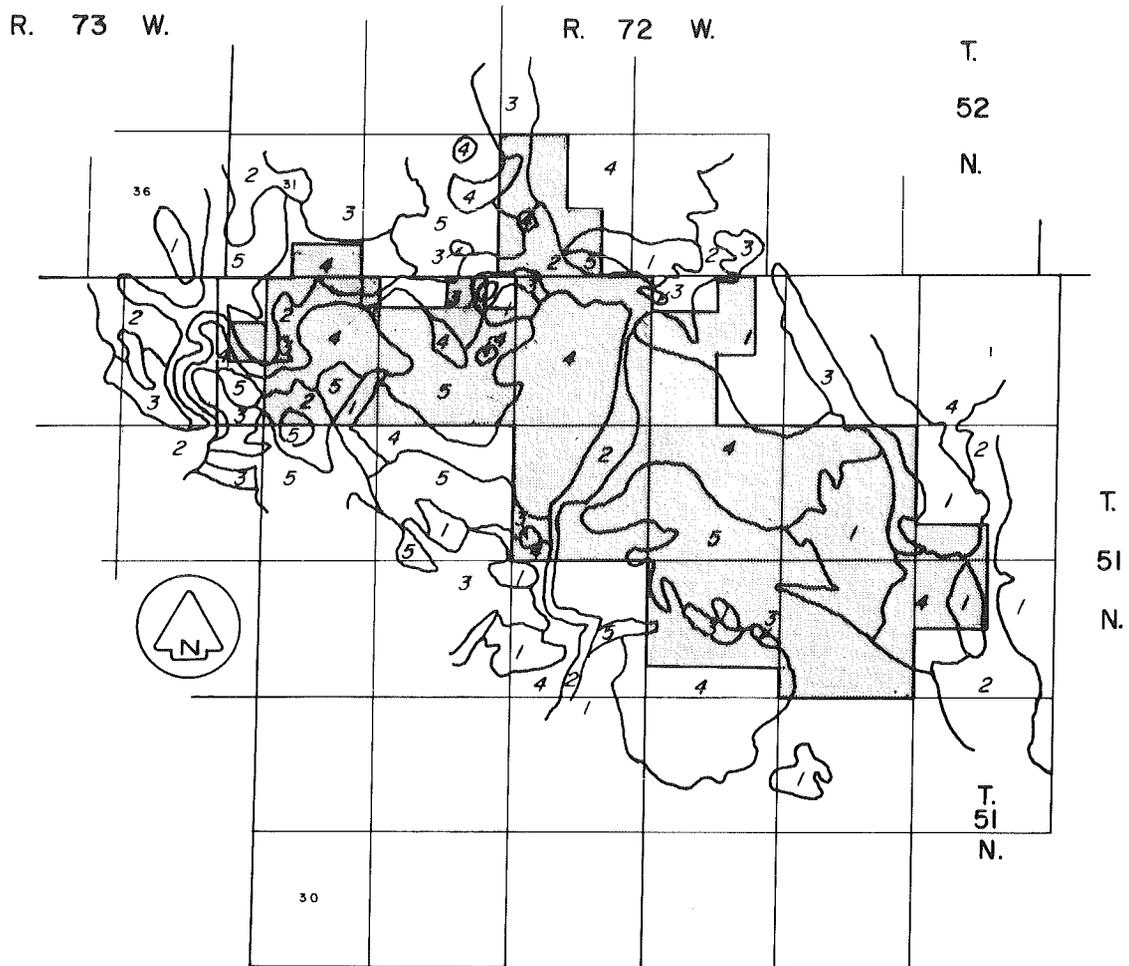
Plant communities have not been completely mapped for the entire area. (Vegetation is being mapped by the University of Wyoming for Carter, but is not yet complete.) In absence of a detailed vegetation map for the entire coal property, some broad vegetation communities have been delineated on Figure 8. These are described below and are keyed to Figure 8 with legend numbers. A list of the common plants occurring on the Carter mine site is in Table 6.

Approximately 43 percent of the area (about 2,500 acres of a total of 5,800 acres) is occupied by a big sagebrush-western wheatgrass-blue grama community which is found on the steep rough broken areas throughout the property.

The second largest community is a big sagebrush-blue grama type (#5) and it occupies approximately 1,460 acres. This community is found on clay to loamy soils of gently rolling to rolling uplands.

A bluebunch wheatgrass community (#1) occupies about 900 acres within the area, and it is found on the shallow and stony soils of rolling to hilly scoria land. About 660 acres of an inland saltgrass-western wheatgrass community (#2) are found in the stream bottoms and swales on clay to loamy soils.

A few scattered areas of a big sagebrush-needleandthread-blue grama community (#3) make up about 280 acres on the rolling to gently rolling uplands with loamy to clay loam soils.



LEGEND

- ① Bluebunch Wheatgrass
- ② Inland Saltgrass-Western Wheatgrass
- ③ Big Sagebrush/NeedleandThread-Blue Grama
- ④ Big Sagebrush/Western Wheatgrass-Blue Grama
- ⑤ Big Sagebrush/Blue Grama
- ▬ Boundary of Carter Coal Property

Source: After Soils Data, USDA, SCS, Soil Survey of Campbell County, Wyoming, July, 1955, Soil Map Sheet No. 3 and 4 .

Fig. 8
Vegetation Community Boundaries (Carter Coal Property)

Table 6

Some of the more common plants found on the Carter Mine Area:

<u>Symbol</u>	<u>Common Name</u>	<u>Scientific Name</u>
Agsm	western wheatgrass	<u>Agropyron smithii</u>
Agsp	bluebunch wheatgrass	<u>Agropyron spicatum</u>
Ansc	little bluestem	<u>Andropogon scoparius</u>
Bogr	blue grama	<u>Bouteloua gracilis</u>
Cafi	threadleaf sedge	<u>Carex filifolia</u>
Calo	prairie sand reedgrass	<u>Calamovilfa longifolia</u>
Dist	inland saltgrass	<u>Distichlis stricta</u>
Hoju	foxtail barley	<u>Hordeum jubatum</u>
JUNC	rushes	<u>Juncus</u> spp.
Kocr	prairie junegrass	<u>Koeleria cristata</u>
Orhy	Indian ricegrass	<u>Oryzopsis hymenoides</u>
Popr	Kentucky bluegrass	<u>Poa pratensis</u>
Pose	Sandberg bluegrass	<u>Poa sandbergii</u>
Stco	needleandthread	<u>Stipa comata</u>
ASTR	milkvetches	<u>Astragalus</u> spp.
LUPI	lupine	<u>Lupinus</u> spp.
LYGO	skeleton plant	<u>Lygodesmia</u> spp.
PHLO	phlox	<u>Phlox</u> spp.
PSOR	scurfpea	<u>Psoralea</u> spp.
Arca	silver sagebrush	<u>Artemisia cana</u>
Arfr	fringed sagebrush	<u>Artemisia frigida</u>
Artr	big sagebrush	<u>Artemisia tridentata</u>
Oppo	plains prickly pear	<u>Opuntia polyacantha</u>
Save	greasewood	<u>Sarcobatus vermiculatus</u>

Vegetation on and adjacent to the property is considered to be in fair to good range condition for all communities. Estimated live vegetation ground cover (percent of ground covered with live vegetation) ranges from 10 to 35 percent. Such a sparse cover reflects the short growing season and semiarid climate which has an average annual precipitation of about 14 inches.

Aquatic vegetation in the area is not significant since there is limited water available. Two intermittent streams cross the property, Little Rawhide and Rawhide Creeks, and a small amount of aquatic and riparian vegetation exists in and along the shorelines of year-long pools or pockets of water.

Archeological and Paleontological Values

Dr. May's inventory report indicated prehistoric values exist in the area of the Carter lease (Morton May 1974). Water resources are usually indicators of probable human use. Moyers Springs, southeast of the lease area, is a prominent site and was used in historic times by Indians (Dr. May 1974). In the nearby area teepee rings are in good condition. Rawhide Creek and Little Powder River are excellent areas to look for Indian remains. Dr. May lists sites along the water courses and the ridges above the streams which fit a normal, logical pattern of use in prehistoric days. He also lists teepee ring sites, which he describes as minor and in poor condition. These teepee rings could be of great value because of their age. Man probably lived in this area many, many years ago. It is thought that today's resources existed eleven to twelve thousand years ago--water, game, and, in the area of the Carter lease, shelter. The Carter lease and the surrounding areas have been covered by air and water borne sediments for thousands of years. If man has been in the area for this long, evidence of his existence lies buried within the sediments.

The Paleo-Indian period extends back as much as twelve thousand years to the altithermal period--a time of dryness that followed the last glacial period. No information on what man was doing during the altithermal period is available.

Historical Values

A literature review and site examination was made of the Carter lease by a professional historian and resident of the Powder River Basin. Research indicates the westbound party of John Jacob Astor's American Fur Company, under the leadership of Wilson Price Hunt, crossed north of the Carter site in the summer of 1811.

Over the next few decades, trappers and traders became reasonably well acquainted with the region, but their major trails did not cross near the lease. These traders tended to concentrate their main operations within the territory of the more hospitable Crow Indians in the western part of the region.

This area was equally uninviting to surveyors, explorers, and immigrants interested in developing routes to the far west. Most of this historic activity passed well to the south and southwest.

No historic events have occurred on the Carter site and no historic sites or structures were found there.

Aesthetics

The landform on the Carter lease is typical of the northern section of the study area; that is, it has sharper ridges, steeper slopes, and straighter, more narrow valley bottoms. The southeastern portion of the lease has a gently sloping valley bottom. This valley bottom is surrounded on the south, east, and north by several high, flat-topped cones. The central portion of the lease is fairly rough with steep gullies, sharper ridges, and exposed soil. The extreme western edge of the lease is more gentle with irrigated farmland. Rawhide and Little Rawhide Creeks are wide meandering streams cutting through the lease block.

Texture on the lease area varies from a generally uniform texture of grass and sagebrush in the valley on the eastern edge of the lease to the more spotty, rugged textures of deeply incised gullies in the central portion of the lease. In the western portion, textures are a combination of uniform sagebrush with well defined patterns of irrigated farmland.

Colors reflected in the area are generally soft, gray-green muted colors of sage and grass in combination with the gray-browns and yellow earth tones of eroded soils. The red clinker material prevalent in both the southern and extreme northern portions of the lease are absent throughout the middle and western sections of the Carter lease. Red scoria does show through on ridge tops and exposed slopes. Scale is well defined because of high, evenly spaced cones which extend to the south and east of the lease.

The proposed railroad spur follows gently rolling terrain except where it leaves the mainline. Here, the Donkey Creek valley has well defined bluffs and texture is a fairly even distribution of grass and sage. Color is soft gray-green of summer vegetation turning to light brown in the fall and winter.

Most of the lease area is presently undisturbed with only a few intrusions. A few roads traverse the area, and there are two small ranches with weathered outbuildings located in the northwestern portion of the lease. Outside the lease, particularly to the south and closer to Gillette, are cultivated fields. There is one abandoned oil site in the northeast half of the lease and a nearby soil blow out. There are two major highways that cross the lease--U.S. Highway 14 and 16 on the western edge and State Highway 59 on the eastern edge.

Compared to the Bighorn Mountains and the Black Hills, the quality of the scenery in the lease area is relatively poor. Relief provided by the cones, color of the clinker area, and roughness of the badlands give the lease some of the more scenic land north of Gillette.

Most of the lease area is hidden from view by the surrounding hills. Even where the two highways cross the area, the view of mining will be limited by topography. Only the railroad spur and loading silos will be exposed to view from Highway 59.

Wildlife and Fish

Big game

A more extensive description of the existing wildlife resources in the regional study area is found in Chapter IV, Part I. Aspects with broad applicability in the study area will generally be discussed in Chapter IV, Part I. Common and Latin names of vertebrate wildlife species known or suspected to occur in the Eastern Powder River Basin (and the lease area) are found in Tables 29 to 32, Appendix C.

Pronghorn antelope

Pronghorn antelope are the most common big game animals on this lease area which falls primarily in the Gillette Antelope Hunt area (17) established by the Wyoming Game and Fish Department. An average of six antelope per section, or 50 antelope, is supported by the lease area on a yearlong basis. About 100 acres of the area falls in crucial antelope winter range. Seasonal concentrations of antelope well in excess of six antelope per square mile may occur. An estimated 15 antelope are harvested here each year.

A sagebrush-rabbitbrush-forb combination is preferred habitat while skunkbush sumac also provides important antelope forage. Water is adequately available in the lease area with major sources being the Little Powder River and the Dry Fork of Rawhide Creek.

Mule deer

The lease area falls in the Wyoming Game and Fish Department's Campbell Deer Management Area (18) and supports an estimated average of three deer per section or about 30 animals on a yearly basis. The Campbell Management Area is considered to be an excellent deer producing area. The lease area proper is probably occupied at or near the habitat's capacity to support deer.

On the lease area sagebrush must be considered the staple food item. Skunkbush sumac is also important. Grasses are utilized primarily during the spring months at which time succulent new growth is attractive. Forbs reach their peak of deer use during the summer months, but new growth by shrubs also becomes significant. In the lease area lack of moisture sometimes reduces the summer value of shrubs and some grasses due to curing and low succulence. The usual transition by deer to shrubby vegetation occurs during the fall. Crucial winter range generally falls outside of the subject lands. For those who do winter in the lease area, restricted food availability intensifies the importance of shrubby species such as sagebrush, rabbitbrush and sumac.

Availability of cover may represent the most significant limiting factor to deer on the lease area. Where sagebrush range intermingles with rougher breaks and draws, quality cover requirements are met.

Other mammals

The presence of streamside habitats in addition to the rolling hillsides and draws complicates the mammalian picture in the area. Many species from adjacent life zones are involved and 42 species of mammals are known or suspected to occur in the area with the possibility of nine species of bats being added at a later date (Carter Oil Company 1973a).

Predators

Representative species which may be in the lease area include coyote, bobcat, red fox, badger, and raccoon. Coyote, bobcat, and red fox inhabit the entire lease at least seasonally but are not abundant although the red fox may be increasing. The badger is a yearlong resident. Raccoons are closely tied to waterways providing reliable water and are found along the Little Powder River and Dry Fork of Rawhide Creek.

Rabbits and hares

The vast majority of cottontails present are the desert variety although the mountain cottontail may also be present. Cottontails are most numerous along drainage courses such as Rawhide and Little Rawhide Creek. Rocks, broken topography in association with shrubs, forbs, and grasses fulfill habitat requirements for food, water, and cover. Population densities of cottontails are an estimated 148 per square mile.

The white-tailed jackrabbit is cyclically abundant while the black-tailed variety is far less common. Habitat requirements are met in open grasslands interspersed with shrubs. Estimated densities are 100 per square mile. Sport or commercial harvest of rabbits and hares is a minor impact at present.

Rodents

A variety of rodents occurs on the lease area. Occurrence of the least chipmunk, thirteen-lined ground squirrel, northern pocket gopher, western harvest mouse, Wyoming pocket mouse, deer mouse, northern grasshopper mouse, and meadow vole has been confirmed. Ord's kangaroo rat, the porcupine, and bushy-tailed wood rat can also be expected to occur here.

Results of small mammal trapping studies on the lease area indicate that there was greater abundance of individuals and variety of species trapped in the shrub-grass vegetative type as compared to the grassland type. Exceptions are that thirteen-lined ground squirrels and grasshopper mice were more abundant in the grassland type. A brief summary of results follows:

Catch per 100 Trap Nights

Species	Shrub-Grass Type	Grassland Type
Deer mice	6.2	1.0
Harvest mice	1.5	.5
13-lined ground squirrel	.5	.8
Grasshopper mice	.07	.35
Least chipmunk	.09	none
Pocket mice	.06	none
Others	.05	none

Furbearers

The badger, beaver, and muskrat are believed to occur on the lease area. Beaver and muskrat are directly dependent upon reliable water and riparian vegetation. Badger's prey consists primarily of ground squirrels, pocket gophers, prairie dogs, rabbits, and mice along with occasional insects, lizards, and grouse.

Upland game birds

Sage grouse

The dependency of sage grouse upon sagebrush in the lease area varies with the season, becoming most critical during the winter. Wintering birds tend to gather in large flocks and concentrate in sagebrush areas. An estimated five to eight grouse per section make seasonal or yearlong use of the lease area. Sport harvest is minimal. Specific strutting grounds have not been documented.

Sharp-tailed grouse

These grouse are found especially along Little Powder River, Rawhide Creek, and Little Rawhide Creek. Thickets, sagebrush land, and limited treed areas provide escape cover. Food items are varied but foliage, buds, seeds, and fruits comprise the bulk of the diet. Dancing (mating) grounds are not specifically documented although they surely exist.

Hungarian (gray) partridge

This exotic is reasonably well established in the lease area. Cover requirements involve the availability of brushy draws and semigrassland habitats. Small amounts of animal food used include insects and other invertebrates found on low vegetation in open places. The Hungarian feeds primarily on seeds which are readily available in the lease area.

Mourning dove

The dove is a wide-ranging seasonal resident primarily present during the spring, summer, and early fall months. They are a migratory species moving out of the lease area and Wyoming to winter in the southern states.

Waterfowl and shorebirds

Waterfowl and shorebird habitat is limited to previously mentioned streams and numerous area stockwater ponds. The major value of this habitat results from the nesting, resting, and feeding opportunities provided. Most common species include the mallard, gadwall, and green-wing teal ducks, eared grebe, Wilson's phalarope, American avocet, killdeer, and mountain plover. Other probable species are listed in Appendix C.

Other birds

Raptors

The most common raptors on this lease area are the red-tailed hawk, Swainson's hawk, rough-legged hawk, and the American Kestrel. All of these species nest on or near the lease area and do at least part of their foraging there. During winter months, significant numbers of rough-legged hawks, bald eagles, and golden eagles move into the general area from the north where winters are more severe. Other raptors occurring include the ferruginous hawk, marsh hawk, prairie falcon, great-horned owl, and short-eared owl.

These raptors prey primarily on various rodents, cottontails, and jackrabbits. Small birds are occasionally taken. Significant numbers of grasshoppers and other large insects are readily utilized by raptors during periods of availability.

Song birds

The number of species of song birds present on this lease area at various times of the year may exceed 100. Most common species are the western meadowlark, lark bunting, and the horned lark. Common nighthawks, black-billed magpies, and red-winged blackbirds have been observed on the lease area as well. Food and nesting habits, territorial behavior, and vegetative characteristics vary enough that a considerable diversity of birds in this group can utilize the lease area.

Fish

Fish habitat within the lease area is limited to a few deep pools which retain water throughout the year such as in the otherwise intermittent flows of portions of Little Powder River and Dry Fork of Rawhide Creek. From 13 to 15 species, including rough fish, may be found in ponds and streams of

the lease area (Carter Oil Co. 1973a, p.9). Species include goldeye, western white suckers, mountain suckers, northern redhorse, plains flathead chubs, sturgeon chubs, plains longnose dace, brassy minnows, northern plains minnows, northern flathead minnows, channel catfish, northern bullheads, and stonecats.

Reptiles and amphibians

Thirteen species of reptiles and six species of amphibians have been recorded on the lease area (Carter Oil Co. 1973a, p.8). Populations are sparse. Included are turtles, lizards, snakes, frogs, toads, and salamanders. Examples are the eastern short-horned lizard, plains hognose snake, prairie rattlesnake, pale milk snake, leopard frog, plains spadefoot toad, Great Plains toad, and the tiger salamander. Amphibians are tied to aquatic environments for at least portions of their life cycles.

Invertebrates

Information concerning invertebrate populations found on this lease area is sparse. Common insect groups include an abundance of grasshoppers, beetles, ants, wasps, bees, butterflies, and moths. A variety of spiders is also present. These groups and others present include plant eaters, scavengers, parasites, and predators. Many species of plants depend on insects for pollination.

Threatened species

Black-footed ferret

While this rare mammal has not been sighted on this lease area, its presence is possible. Ferrets have been reported in the Powder River Basin in recent years. No prairie dog colonies, principal habitat of ferrets, were discovered during a field examination of this lease area. Where prairie dogs or

other small mammals are known or suspected to occur in numbers, the possible presence of the black-footed ferret cannot be discounted.

Peregrine falcon

The extremely rare peregrine falcon is believed to occur in the lease area during periods of migration.

Prairie falcon

The prairie falcon, not in the USDI "Red Book," is nevertheless rare in Wyoming and known to exist in the Powder River Basin. The periodic presence of this falcon in the lease area is highly likely.

Recreation

The primary recreational value of the Carter lease is for hunting mule deer and antelope. Good habitat exists because of the sheltering nature of the ridges and trees on the northern edge of the block, cultivated lands, and some perennial pools along Little Powder River and Rawhide Creek.

An average (1971, 72, 73) 2,562 antelope hunter days and 6,190 deer hunter days were annually recorded within the management units northwest and northeast of Gillette which cover the Carter lease (Wyoming Game and Fish Department 1972a, 1973, forthcoming). However, less than one percent of the management areas listed here are occupied by the Carter lease with rather insignificant annual hunter days (100) expected on the lease.

Upland game and small game could also be hunted on the lease; however, there are no recorded spot hunting records. No outstanding or unusual off-road vehicle use was observed on the Carter lease. Some off-road vehicle use does occur; however, much of this can be attributed to hunting or driving for pleasure.

Local groups contacted indicate no significant concentrations of collectable gemstones. Some petrified wood is known to exist on the lease site. Some artifact collecting may occur, but it is not considered a legitimate recreation resource use. Petrified wood and dried vegetation may be found on the lease, attracting some collecting.

Some perennial pools along intermittent stream beds support non-recreational fish. Without some larger impoundment, this lease would not be fished.

Some minor erosional features on sandstone caprock and red clinker heads provide interesting contrasting colors at different periods of the day.

These may be seen from State Highway 59. The maximum relief, however, is no more than 200 feet from valley floor to the crest of ridges.

Frequent opportunities to view antelope exist both from on and off State Highway 59, a situation common to the region. No rare or endangered species or wild horses are known to be indigenous to the site, but with rock outcrops, trees, and ridges, there are some opportunities to view birds of prey and other wildlife.

Agriculture

Livestock

Five ranching operations currently make use of the surface resources included in the Carter Oil Company North Rawhide Unit coal lease. The ranching uses include livestock grazing and associated cropping. Of the 5,800 acres included in the Carter unit, 5,760 acres were owned by six private individuals and 40 acres are federally owned and are administered by the Bureau of Land Management. Carter Oil has purchased the lands of four of the private owners to be most affected by the mining and is negotiating surface arrangements with the other private surface owners. The purchased lands have been leased back to the former owners and/or operators for ranching use until mining operations commence.

Ranch operation A

The Carter coal lease underlies approximately 80 acres of the ranch that is west of State Highway 16-18. This is native range land and makes up less than one percent of a large ranch. The Missouri River Basin Range Survey rates the carrying capacity at two acres per animal unit month (AUM) which indicates a highly productive site. No range improvements, other than the highway right-of-way fence, are located on the site. Rawhide Creek traverses the northern half of this acreage and does furnish livestock water during part of the year.

Ranch operation B

The Carter coal lease underlies about 360 acres of this ranch that is based mainly east of Wyoming Highway 59. This land is rated at a carrying capacity of four acres per AUM by the Missouri River Basin Range Survey and

makes up about six percent of this operation. The only range improvement on this land is the highway right-of-way fence. No sources of water are located on this land but the Dry Fork of the Little Powder River and a well are located one-half mile east in the same pasture.

Ranch operation C

This total operation is based on 6,260 acres of range and cropland; 1,120 acres are included in the Carter lease: 1,080 acres of range and 40 acres of cropland. The rangeland is used to summer 70 cows and calves out of a herd of 170 cows. The rangeland is rated at approximately four acres per AUM. The highway right-of-way fence and two division fences are used for livestock management. A water well on the coal lease area furnishes water for one pasture and is the only source. The 40 acres of cropland are alternately summer fallowed and cropped. Barley yields approximately 50 bushels per acre and wheat yields about 35 bushels per acre. Some of the grain is pelleted and used to supplement winter feed.

Ranch operation D

This entire ranch operation contains 3,040 acres: 2,000 acres of summer range and 1,040 of winter range and cropland. The summer range is located about five miles northwest of the Carter coal lease. Of the 1,040 acres in the Carter lease area, 800 acres are over the coal lease, and of that amount, approximately 250 acres are cropped. The rancher runs primarily a yearling operation. About 75 calves are bought between October and March and are kept until they are two years old and sold as grass-fat steers. The operation supports 150 steers and some sheep. Four hundred sheep are wintered in partnership with a neighboring ranch operation. This ranch provides about 30 percent of the range, or enough to winter about 120 sheep.

The ranching operation also produces a cash crop of barley or wheat from 250 acres of cropland. The wheat yields about 50 bushels per acre and the barley, 35 bushels per acre.

Little Rawhide Creek runs along the southeastern edge of this property, and there is a good water well located at headquarters. There is also another water well located in approximately the center of the property. This unit is fenced more or less on the ownership boundary.

Ranch operation E

This operation is made up of 6,000 acres of deeded land and 4,000 acres of leased lands. The Carter lease is under 3,280 acres of the deeded land and 240 acres of the leased land. This ranch is operated in conjunction with another ranch located south of Gillette and is used primarily for winter range. The native range land is rated at a carrying capacity average of four acres per animal unit month by the Missouri River Basin Range Survey.

Approximately 1,100 heifers and yearling steers are wintered on this ranch. Four hundred sheep are also run on this ranch unit in conjunction with a neighboring ranch. This ranch provides 70 percent of the winter range for 280 head of sheep. Of this ranch operation, 35.2 percent is within the Carter lease.

About 400 acres of land are share cropped. All the grain is sold and none is retained for use for livestock supplemental feed. Several small hay meadows provide hay during critical winter periods. Hay production is limited, averaging less than one ton per acre. About 65 acres of the hayland and none of the cropland is over the Carter lease.

Rawhide Creek and Little Rawhide Creek are intermittent streams on the land and are both on and off the lease area. The one known well is located at the headquarters on the coal lease.

Farming

Farming operations on the area included in the Carter Oil Company North Rawhide Unit coal lease are not of major significance. The area is generally not known for its farming due to low rainfall.

Of the five farming-ranching operations involved in the Carter lease area, three have some acreage involved that is used for farming. Of the 5,800 acres in the lease area less than three percent (approximately 160 acres) is used for farming.

Small grain yields are economical if summer fallow and cropping are rotated. Barley yields about 50 bushels per acre and wheat yields 35 bushels per acre. Since there are no reliable sources of stream water for irrigation, all of the crops are nonirrigated. The hay crop yield is approximately one ton per acre.

Of the 710 acres of farm land enumerated by three operators, 22.5 percent, or 160 acres, is on land included in the Carter coal lease.

Transportation Networks

The site of the Carter coal lease is located approximately six miles north of Gillette and overlaps both U.S. Highway 14 and 16 and State Highway 59. Both of these routes are lightly used, individually carrying less than 800 vehicles per day (Wyoming State Highway Commission 1972). Most of this traffic is due to daily commuting by workers in the oil fields north of Gillette.

There are approximately six unimproved and graded dirt roads across the lease area that provide access to ranches and other operations. These roads, if maintained, are done so privately. Traffic flow figures on these roads are not available, but it can accurately be described as extremely light. No known county maintained roads lie within the lease area.

The lease boundaries include within them two of the pipelines shown on Figure 82, Chapter IV, Part I. Major electric transmission lines in the area are shown on Figure 83, Chapter IV, Part I.

The proposed railroad spur runs approximately 12 miles from the east end of the Carter lease area in a southeasterly direction tying into the existing Burlington Northern line approximately nine miles east of Gillette. This route crosses 8 to 10 unimproved or graded dirt roads at least two of which are county maintained. All receive a very light amount of traffic. At least one pipeline right-of-way will be crossed.

Socio-Economic Conditions

The existing conditions of the study area, which includes this proposed development, are described in Chapter IV, Part I.