

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

TEXT TO ACCOMPANY:
COAL RESOURCE OCCURRENCE
AND
COAL DEVELOPMENT POTENTIAL
MAPS
OF THE
BILL 4 SOUTHWEST QUADRANGLE,
CONVERSE COUNTY, WYOMING

BY
INTRASEARCH INC.
DENVER, COLORADO

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This report is preliminary, and has not been edited or reviewed for conformity with United States Geological Survey standards or stratigraphic nomenclature.

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CONVERSION TABLE

<u>TO CONVERT</u>	<u>MULTIPLY BY</u>	<u>TO OBTAIN</u>
inches	2.54	centimeters (cm)
feet	0.3048	meters (m)
miles	1.609	kilometers (km)
acres	0.40469	hectares (ha)
tons (short)	0.9072	metric tons (t)
cubic yards/ton	0.8428	cubic meters per metric ton
acre feet	0.12335	hectare-meters
Btu/lb	2.326	kilojoules/kilogram (kJ/kg)
Btu/lb	0.55556	kilocalories/kilogram (kcal/kg)
Fahrenheit	$5/9 (F-32)$	Celsius

I. Introduction

This report and accompanying maps set forth the Coal Resource Occurrence (CRO) and Coal Development Potential (CDP) of coal beds within the Bill 4 Southwest Quadrangle, Converse County, Wyoming. This CRO and CDP map series includes 3 plates (U. S. Geological Survey Open-File Report 79-467). The project is compiled by IntraSearch Inc., 1600 Ogden Street, Denver, Colorado, under KRCRA Northeastern Powder River Basin, Wyoming Contract Number 14-08-0001-17180. This contract is a part of a program to provide an inventory of unleased federal coal in Known Recoverable Coal Resource Areas (KRCRA) in the western United States.

The Bill 4 Southwest Quadrangle is located in Converse County, in eastern Wyoming. It encompasses parts of Townships 35 and 36 North, Ranges 69 and 70 West, and covers the area: 43° 00' to 43° 07' 30" north latitude; 105° 07' 30" to 105° 15' west longitude.

Several unimproved roads provide access to the Bill 4 Southwest Quadrangle. A maintained gravel road extends west from the west-central portion of the study area and joins Wyoming State Highway 59, 0.8 miles (1.3 km) west of the quadrangle boundary. Minor roads and trails that branch from the aforementioned roads provide additional access to the study area. The closest railroad is the Chicago North Western trackage approximately 20 miles (32 km) to the south near Shawnee, Wyoming. The proposed Burlington Northern railroad will be located along the western portion of the Bill 4 Southwest Quadrangle.

Northeastward-flowing Lightning Creek provides the major drainage for the quadrangle. Box Creek flows eastward through the northern portion of the study area at an elevation approximately 4650 feet (1417 m) above sea level. A maximum elevation of 5040 feet (1536 m) above sea level is

located in the southwest portion of the Bill 4 Southwest Quadrangle.

Minimum elevations of 4560 feet (1390 m) above sea level occur in the valley floor of Box Creek at the eastern quadrangle boundary. The somber grays, yellows, and browns of outcropping shales and siltstones contrast strikingly with the deep greens of the juniper and pine tree growth.

The ten to twelve inches (25 to 30 cm) of annual precipitation that falls in this semi-arid region accrues principally in the springtime. Summer and fall precipitation usually originates from thunderstorms, and infrequent snowfalls of six inches (15 cm) or less generally characterize winter precipitation. Although temperatures ranging from less than -25°F (-32°C) to more than 100°F (38°C) have been recorded near Gillette, Wyoming, average wintertime minimums and summertime maximums approach $+5^{\circ}$ to $+15^{\circ}\text{F}$ (-15° and -9°C) and 75° to 90°F (24° to 32°C), respectively.

Surface ownership is divided among fee, state, and federal categories with the state and federal surface generally leased to ranchers for grazing purposes. Details of surface ownership are available at the Converse County Courthouse in Douglas, Wyoming. Details of mineral ownership on federal lands are available from the U. S. Bureau of Land Management in Cheyenne, Wyoming. Federal coal ownership is shown on Plate 2 of the Coal Resource Occurrence maps. The non-federal coal ownership comprises both fee and state coal resources.

The Coal Resource Occurrence and Coal Development Potential program pertains to unleased federal coal and focuses upon: 1) the delineation of lignite, subbituminous coal, bituminous coal and anthracite at the surface and in the subsurface on federal land; 2) the identification of total tons in place as well as recoverable tons; 3) categorization of these tonnages into measured, indicated, and inferred reserves and resources,

hypothetical resources, and and 4) recommendations regarding the potential for surface mining, underground mining, and in-situ gasification of the coal beds. This report evaluates the coal resources of all unleased federal coal beds in the quadrangle which are 5 feet (1.5 m) or greater in thickness and occur at depths down to 3000 feet (914 m). No resources or reserves are computed for leased federal coal, state coal, fee coal, or lands encompassed by coal prospecting permits and preference right lease applications.

II. Geology

Regional. The thick, economic coal deposits of the Powder River Basin in northeastern Wyoming occur mostly in the Tongue River Member of the Fort Union Formation, and in the lower part of the Wasatch Formation. Approximately 3000 feet (914 m) of the Fort Union Formation, that includes the Tongue River, Lebo, and Tullock Members of Paleocene age, are unconformably overlain by approximately 700 feet (213 m) of the Wasatch Formation of Eocene age. These Tertiary formations lie on a structural basin flanked on the east by the Black Hills uplift, on the south by the Hartville and Casper Mountain uplifts, and on the west by the Casper Arch and the Big Horn Mountain uplift. The structural configuration of the Powder River Basin originated in Late Cretaceous time, with episodic uplift thereafter. The Cretaceous Cordillera was the dominant positive land form throughout the Rocky Mountain area at the close of Mesozoic time.

Outcrops of the Wasatch Formation and the Tongue River Member of the Fort Union Formation cover most of the areas of major coal resource occurrence in the Powder River Basin. The Lebo Member of the Fort Union Formation is mapped at the surface northeast of Recluse, Wyoming, east of the principal coal outcrops and associated clinkers (McKay, 1974), and pre-

sumably projects into the subsurface beneath much of the basin. One of the principal characteristics for separating the Lebo and Tullock Members (collectively referred to as the Ludlow Member east of Miles City, Montana) from the overlying Tongue River Member is the color differential between the lighter-colored upper portion and the somewhat darker lower portion (Brown, 1958). Although geologists working with subsurface data, principally geophysical logs, in the basin are trying to develop criteria for subsurface recognition of the Lebo-Tullock and Tongue River-Lebo contacts, no definitive guidelines are known to have been published. Hence, for subsurface mapping purposes, the Fort Union Formation is not divided into its member subdivisions for this study.

During the Paleocene epoch, the Powder River Basin tropic to subtropic depositional environment included broad, inland flood basins with extensive swamps, marshes, freshwater lakes, and a sluggish but active northeastward discharging drainage system, superimposed on a near base level, emerging sea floor. Much of the vast areas where organic debris collected was within a reducing depositional environment. Localized uplifts began to disturb the near sea level terrain of northeastern Wyoming, following retreat of the Cretaceous seas. However, the extremely fine-grained characteristics of the Tongue River Member clastics suggest that areas of recurring uplift peripheral to the Powder River Basin were subdued during major coal deposit formation.

The uplift of areas surrounding the Powder River Basin created a structural basin of asymmetric characteristic, with the steep west flank located on the eastern edge of the Big Horn Mountains. The axis of the Powder River Basin is difficult to specifically define, but is thought to be located in the western part of the Basin, and to display a north-south

configuration some 15 to 20 miles (24 to 32 km) east of Sheridan, Wyoming. Thus, the sedimentary section described in this report lies on the east flank of the Powder River Basin, with gentle dips of two degrees or less disrupted by surface structure thought to relate to tectonic adjustment and differential compaction.

Some coal beds in the Powder River Basin exceed 200 feet (61 m) in thickness. Deposition of these thick, in-situ coal beds requires a discrete balance between subsidence of the earth's crust and in-filling by tremendous volumes of organic debris. These conditions in concert with a favorable ground water table, non-oxidizing clear water, and a climate amenable to the luxuriant growth of vegetation produce a stabilized swamp critical to the deposition of coal beds.

Deposition of the unusually thick coal beds of the Powder River Basin may be partially attributable to short distance water transportation of organic detritus into areas of crustal subsidence. Variations in coal bed thickness throughout the basin relate to changes in the depositional environment. Drill hole data that indicate either the complete absence or extreme attenuation of a thick coal bed probably relate to location of the drill holes within the ancient stream channel system draining this low land area in Early Cenozoic time. Where thick coal beds thin rapidly from the depocenter of a favorable depositional environment, it is not unusual to encounter a synclinal structure over the maximum coal thickness due to the differential compaction between organic debris in the coal depocenter and fine-grained clastics in the adjacent areas.

The Wasatch Formation of Eocene age crops out over most of the central part of the Powder River Basin and exhibits a disconformable contact

with the underlying Fort Union Formation. The contact has been placed at various horizons by different workers; however, for the purpose of this report the contact is positioned near the top of the Roland coal bed as mapped by Olive (1957) in northwestern Campbell County, Wyoming, and is considered to disconformably descend in the stratigraphic column to the top of the Wyodak-Anderson coal bed (Roland coal bed of Taff, 1909) along the eastern boundary of the coal measures. No attempt is made to differentiate the Wasatch and Fort Union Formations on geophysical logs or in the subsurface mapping program that is a part of this CRO-CDP project.

Although Wasatch and Fort Union lithologies are too similar to allow differentiation in some areas, most of the thicker coal beds occur in the Fort Union section on the east Flank of the Powder River Basin. Furthermore, orogenic movements peripheral to the basin apparently increase in magnitude during Wasatch time causing the deposition of friable, coarse-grained, to gritty arkosic sandstones, fine-to very fine-grained sandstones, siltstones, mudstones, claystones, brown-to-black carbonaceous shales and coal beds. These sediments are noticeably to imperceptibly coarser than the underlying Fort Union clastics.

North and west of the Bill 4 Southwest Quadrangle the top of the Wyodak-Anderson coal bed is considered the contact between the Wasatch Formation and the underlying Fort Union Formation. Subsurface data indicate that this coal bed pinches out northwest of the Bill 4 Southwest Quadrangle; hence, identification of the formation boundary on the basis of coal bed occurrence, is not possible in the subsurface. The thin local coal beds that occur in this quadrangle probably are positioned in that part of the Fort Union Formation where the Moyer and Wildcat coal beds are identified in quadrangles to the north and west. Therefore, some of the surface rocks in the Bill 4

Southwest Quadrangle probably should be classified into the Fort Union Formation; however, Wasatch age outcrops may cover most of the quadrangle (Denson and Horn, 1975; Love and others, 1977).

A major part of the 400 to 500 feet (122 to 152 m) of sedimentary rocks exposed in this area are probably Wasatch in age. Olive (1957) correlated coal beds in the Spotted Horse coal field with coal beds in the Sheridan coal field (Baker, 1929) and Gillette coal field (Dobbin and Barnett, 1927), Wyoming, and with coal beds in the Ashland coal field (Bass, 1932) in southeastern Montana. This report utilizes, where possible, the coal bed nomenclature used in previous reports. The Wildcat and Moyer coal beds were informally named by IntraSearch (1978 and 1979).

III. Data Sources

Areal geology of the coal outcrops and associated clinker is derived from the Lost Spring coal field report (Winchester, 1912). Two coal bed outcrops less than 5 feet (1.5 m) thick are present in the northeastern portion of the Bill 4 Southwest Quadrangle, but cannot be definitely correlated with the local coal beds identified in the subsurface.

The major source of subsurface control is the geophysical logs from oil and gas test bores and producing wells. Some geophysical logs are not applicable to this study, for the logs relate only to the deep potentially productive oil and gas zones. More than eighty percent of the logs include resistivity, conductivity, and self-potential curves. Occasionally the logs include gamma, density, and sonic curves. These logs are available from several commercial sources.

All geophysical logs available in the quadrangle are scanned to select those with data applicable to Coal Resource Occurrence mapping. Paper

copies of the logs are obtained, interpreted, and coal intervals identified where they exist.

The topographic map of the Bill 4 Southwest Quadrangle is published by the U. S. Geological Survey, compilation date, 1970. Land network and mineral ownership data are compiled from land plats available from the U. S. Bureau of Land Management in Cheyenne, Wyoming. This information is current to October 13, 1977.

IV. Coal Bed Occurrence

The Bill 4 Southwest Quadrangle is located south of the principal coal deposits of the Powder River Basin. Two thin coal bed outcrops, less than 5 feet (1.5 m) thick, are present in this area.

The Coal Data Sheet, Plate 3, shows by columnar sections the interpretations of geophysical well logs. The coal beds identified in the subsurface are thin and have limited lateral extent. Because of these characteristics, coal bed resource estimates are not made for this quadrangle. Inasmuch as the ^{most persistent} local coal bed in the stratigraphic column underlies most of the quadrangle, it is designated as datum for the correlation diagram (Plate 3).

V. Coal Development Potential

The current data base indicates that within the parameters of this CRO/CDP program, there are no significant coal resources within the Bill 4 Southwest Quadrangle. The entire quadrangle is considered to have no coal development potential. As a result, no coal development potential maps were prepared.

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