UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

COAL RESOURCE OCCURRENCE

AND

COAL DEVELOPMENT POTENTIAL

MAPS

OF THE

WHITE TAIL BUTTE QUADRANGLE

CAMPBELL COUNTY, WYOMING

BY

INTRASEARCH INC.

DENVER, COLORADO

OPEN-FILE REPORT 79-021
1979

TABLE OF CONTENTS

TABLE OF CONTENTS(continued)

TABLE OF CONTENTS(continued)

CONVERSION TABLE

To Convert	Multiply By	To Obtain
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

The report and accompanying maps set forth the Coal Resource Occurrence (CRO) and Coal Development Potential (CDP) of coal beds within the White Tail Butte Quadrangle, Campbell County, Wyoming. This CRO and CDP map series includes 39 plates (U.S. Geological Survey Open-File Report 79-021). 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 federal coal in Known Recoverable Coal Resource Areas (KRCRA) in the western United States.

The White Tail Butte Quadrangle is located in Campbell County in northeastern Wyoming. It encompasses all or parts of Townships 55,56, and 57 North, Ranges 72 and 73 West, in Wyoming, and covers the area: 44°45' to 44°52'30" north latitude; 105°30' to 105°37'30" west longitude.

Five maintained gravel roads provide access to the White Tail Butte Quadrangle. The Elk Creek Road extends east and west throughout the area, and the other main gravel road angles south through the quadrangle. This road extends further southwest where it joins U.S. Highway 14-16 2.5 miles (4 km) north of Wildcat, Wyoming. Two minor gravel roads provide access from the southeastern corner of the quadrangle to the Elk Creek Road and to the other major maintained road. The remaining minor road angles northeast from the western edge of the

quadrangle and becomes an unimproved road. Minor roads and trails that branch from all of the aforementioned roads constitute an avenue of access to much of the study area. The closest railroad is the Burlington Northern trackage, 22 miles (35 km) to the southwest at Croton, Wyoming.

White Tail Creek, Elk Creek, and the North Fork of Elk Creek flow intermittently southeastward into the Little Powder River. The floor of Elk Creek has an elevation of 3820 feet (1164 m) above sea level, and drains fairly rugged terrain that attains elevations of 4340 feet (1323 m) above sea level. The somber grays, yellows, and browns of outcropping shales and siltstones contrast strikingly with the brilliant reds, oranges, and purples of "clinker", and deep greens of the juniper and pine tree growth.

The thirteen to fourteen inches (33 to 36 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 Arvada, Wyoming, average wintertime minimums and summertime maximums approach +5° to +15°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 CountyCourthouse in Gillette, 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 focuses upon: 1) the delineation of lignite, subbituminous, bituminous, and anthracite coal 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, and hypothetical resources; and 4) recommendations regarding the potential for surface mining, subsurface mining and in-situ gasification of the coal beds. This report evaluates the coal resources of all coal beds in the quadrangle which are five feet (1.5 m) or greater in thickness and occur at a depth down to 3000 feet (914 m).

Surface and subsurface geological and engineering extrapolations drawn from the current data base suggest the occurrence of approximately 5.3 billion tons (4.8 billion metric tons) of total coal-in-place in the White Tail Butte Quadrangle.

The suite of maps that accompany this report set forth and portray the coal resource and reserve occurrence in considerable detail. For the most part, this report intends to augment the cartographically displayed information with minimum word duplication of said data.

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 in 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 presumably 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 within the ancient stream channel system servicing 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

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, in northwestern Campbell County, Wyoming, the contact is positioned near the top of the Roland coal bed as mapped by Olive (1957) 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 increased 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, and brown to black carbonaceous shales. These sediments are noticeably to imperceptibly coarser than the underlying Fort Union clastics.

The White Tail Butte Quadrangle is located in an area where surface rocks are classified into the Tongue River Member of the Fort Union Formation and the Wasatch Formation. Although the Tongue River Member is reportedly 1200 to 1300 feet (366 to 396 m) thick (Olive, 1957), only 500 to 600 feet (152 to 183 m) are exposed in this area. 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. Baker (1929) assigned names to the Anderson, Canyon, and Wall coal beds. The Cook coal bed was named by Bass (1932), and the Pawnee and Cache coal beds were named by Warren (1959). The Oedekoven coal bed was informally named by IntraSearch (1978).

Local. The White Tail Butte Quadrangle lies on the eastern flank of the Powder River Basin, where the strata dip gently westward. The Tongue River Member of the Fort Union Formation crops out over most of the quadrangle and the Wasatch Formation covers the remaining area. The Fort Union Formation is composed of very fine-grained sandstone, siltstone, claystone, shale, carbonaceous shale, and numerous coal beds.

Two major southeast-trending faults with 10 to 15 feet (3 to 5 m) of vertical displacement occur in the northeast corner of the quadrangle.

Two faults diverge from the northeasternmost fault mentioned above, and another smaller southeast trending fault with 5 to 10 feet (1.5 to 3 m) of displacement occurs between the two major faults.

III. Data Sources

Areal geology of the coal outcrops and associated clinker is derived from the preliminary geologic map of the Croton 1 SE (White Tail Butte) Quadrangle (Landis and Hayes, 1973). The Dietz and Canyon coal beds mapped by Landis and Hayes (1973) are referred to by IntraSearch in this report as the Canyon and Cook coal beds, respectively. This nomenclature facilitates correlation by IntraSearch with adjacent quadrangles. Color aerial photography, scale 1:24,000, is utilized by IntraSearch to delineate the faults in the northern half of the quadrangle. This photography is also used to refine the published Anderson and Canyon coal bed outcrop configurations. In the northwestern corner of the quadrangle, the Dietz coal bed mapped by Landis and Hayes (1973) is identified in this report as the Lower Canyon coal bed in order to establish correlation by IntraSearch with adjacent quadrangles.

The major source of subsurface control, particularly on deep coal beds, is the geophysical logs from oil and gas test bores and producing wells. A number of shallow exploratory drill holes are located near the White Tail Butte Quadrangle. These drill holes, drilled by the U.S. Geological Survey and Montana Bureau of Mines and Geology, provide subsurface information on

the coal beds near the surface. In some parts of the Powder River Basin, additional subsurface control is available from U.S. Geological Survey open-file reports that include geophysical logs of oil and gas test holes and producing wells, and geophysical and lithologic logs of shallow holes drilled specifically for coal exploration. A sparse scattering of subsurface data points are shown on unpublished CRO-CDP maps compiled by the U.S. Geological Survey, and where these data are utilized, the rock-coal intervals are shown on the Coal Data Map (plate 1). Inasmuch as these drillholes have no identifier headings, they are not set forth on the Coal Data Sheets (plate 3). IntraSearch cannot obtain the geophysical logs to ascertain the accuracy of location, topographic elevation, and coal bed data.

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 annotated. Maximum accuracy of coal bed identification is accomplished where gamma, density, and resistivity curves are available. Coal bed tops and bottoms are picked on the logs at the midpoint between

the minimum and maximum curve deflections. The correlation of coal beds within and between quadrangles is achieved utilizing a fence diagram to associate local correlations with regional coal occurrences.

The topographic map of the White Tail Butte Quadrangle is published by the U.S. Geological Survey, compilation date, 1971. Land ownership data is compiled from land plats obtained from the U.S. Bureau of Land Management in Cheyenne, Wyoming. This information is current to October 13, 1977.

IV. Coal Bed Occurrence

Fort Union Formation coal beds that are present in all or part of the White Tail Butte Quadrangle include, in descending stratigraphic order, the Anderson, Canyon, Cook, Wall, Pawnee, Cache, and Oedekoven. A complete suite of maps (structure, isopach, mining ratio, overburden/interburden, identified resources and areal distribution of identified resources is prepared for each of these coal beds.

U.S. Geological Survey and Montana Bureau of Mines and Geology drill hole number 7418 is located in Section 24, T. 56 N., R. 73 W. The general "as received" basis proximate analysis for northern Campbell County, Wyoming coal beds are as follows:

COAL BED NAME		ASH	FIXED CARBON	MOISTURE	VOLATILES	SULPHUR	BTU/LB
Smith (P)		6.440	31.390	35.370	26.800	0.450	7125
Anderson (U)	Hole 7418	6.384	29.577	33.974	30.064	0.399	7235
Canyon (P)		4.290	32.852	35.100	27.758	0.307	7298
Cook (P)		4.620	34.410	33.640	27.330	0.250	7766
Wall (U)	Hole 7426	9.542	29.322	32.150	28.985	0.500	7279
Pawnee (U)	Hole 7424	7.880	31.029	31.910	29.183	0.386	7344
Cache (U)	Hole 741	9.481	30.517	31.420	28.582	0.488	7271

(P) - Proprietary Data
(U) - U.S. Geological Survey & Montana Bureau of Mines & Geology - 1974

The Coal Data Sheets, Plates 3A, 3B, 3C, and 3D show the downhole identification of coal beds within the quadrangle as interpreted from geophysical logs from oil and gas test bores and producing sites. Inasmuch as the Canyon coal bed underlies the entire quadrangle, it is designated as datum for the correlation diagram. The Anderson, Canyon, and Pawnee coal beds show the thickest single bed occurrences throughout the quadrangle. Structure contours on the top of most of the coal beds define a small synclinal feature in the southwest corner of the quadrangle.

The Anderson coal bed is eroded from approximately sixty percent of the quadrangle. Where this coal bed is present, considerable burning is apparent along the outcrop. The Anderson coal bed averages approximately 30 feet (9 m) thick, and ranges from 5 to 44 feet (1.5 to 13 m) in thickness throughout the quadrangle. A structural low coincides with thickening of the Anderson coal bed about one mile (1.6 km) east of White Tail Butte in Section 32, T. 56 N., R. 72 W.

The Canyon coal bed lies 3 to 183 feet (0.9 to 56 m) beneath the Anderson coal bed, and varies in thickness from 18 to 49 feet (5 to 15 m). The Canyon coal bed is eroded or burned from approximately thirty percent of the quadrangle. As a result of extensive burning of the Upper Canyon coal bed in the northeastern portion of the quadrangle, the Lower Canyon coal bed is utilized for mapping purposes. The

shift in datum, for structural mapping procedures, from Upper to Lower Canyon across to the major fault in the north-central part of the quadrangle creates an exaggerated fault displacement on the accompanying structural map (plate 10). Due to the absence of subsurface data in the northeastern sector of the study area, supplemental structural elevation points, interpolated from outcrop configurations on the topographic map are utilized for structural contour control.

The Cook coal bed is separated from the overlying Canyon coal bed by 20 to 187 feet (6 to 57 m) of interburden. The Cook coal bed thickness averages 11 feet (3 m), and varies in thickness from 3 to 20 feet (0.9 to 6 m). In the western half of the quadrangle, the Cook coal bed thins to less than 5 feet (1.5 m) in three areas. Subsurface data suggests the existence of a thin channel sand through the Cook coal bed in Sections 14 and 23, T. 56 N., R. 73 W. The restricted nature of channel sand data precludes its display on the isopach map of the Cook coal bed. A structural high is present in Section 33, T. 56 N., R. 72 W., approximately one mile (1.6 km) east of White Tail Butte.

The Wall coal bed occurs 9 to 212 feet (2.7 to 65 m) beneath the Cook coal bed, and averages 11 feet (3 m) thick. The Wall coal bed pinches out in Section 15, T. 56 N., R. 72 W., and attains a thickness of 25 feet (8 m) in Section 4, T. 56 N., R 72 W. The Wall coal bed

does not crop out within the White Tail Butte Quadrangle, and occurs in excess of 500 feet (152 m) beneath the surface in the western half of the study area.

Five to 193 feet (1.5 to 59 m) separate the overlying Wall coal bed from the Pawnee coal bed. The Pawnee coal bed varies from 11 to 30 feet (3 to 9 m) in thickness, and averages 22 feet (7 m) thick. The structure contour map portrays a fairly uniform dip of 1° to 2°to the west, and defines a structural low on the western edge of the quadrangle. The Pawnee coal bed does not crop out within the quadrangle and is 500 feet (152 m)or more beneath the surface over most of the area.

The Cache coal bed lies 15 to 128 feet (5 to 39 m) beneath the Pawnee coal bed, and averages 12 feet (4 m) in thickness. It ranges from 0 to 21 feet (0 to 6 m) thick, and is absent in the northeastern part of the quadrangle. The maximum thickness of 21 feet (6 m) occurs along the western edge of the study area. Folding of the Pawnee coal bed defines two structural highs in the southern half of the quadrangle, and these anticlines relate to positive structural features present in the overlying coal beds. The Cache coal bed is more than 500 feet (152 m) beneath the surface throughout most of the White Tail Butte Quadrangle.

The Oedekoven coal bed is separated from the overlying Cache coal bed by 315 to 516 feet (96 to 157 m) of clastic sediments. The Oedekoven

coal bed varies from 0 to 11 feet (0 to 3 m) in thickness, and averages 7 feet (2.1 m) thick. The maximum thickness of 11 feet (3 m) occurs on the western edge of the quadrangle. In the northwest and northeast corners, the coal bed grades into a carbonaceous shale. The Oedekoven structure contour map portrays two structural lows along the western edge of the quadrangle. These synclines correspond to structures present in the overlying coal beds. The Oedekoven coal bed is over 500 feet (152 m) beneath the surface throughout the White Tail Butte Quadrangle.

V. Geological and Engineering Mapping Parameters

Subsurface mapping is based on geologic data within and adjacent to the White Tail Butte area. Data from geophysical logs are used to correlate coal beds and control contour lines for the coal thickness, structure, and overburden maps. Isopach lines are also drawn to honor selected measured sections where there is sparse subsurface control. Where isopach contours do not honor surface measured sections, the surface thicknesses are thought to be attenuated by oxidation and/or erosion, hence not reflective of total coal thickness. Structure contour maps are constructed on the tops of the main coal beds. Where subsurface data is scarce, supplemental structural control points are selected from the topographic map along coal outcrops.

In preparing overburden isopach maps. no attempt is made to identify coal beds that occur in the overburden to a particular coal bed under study. Mining ratio maps for this quadrangle are constructed

utilizing a 95% recovery factor. Contours on these maps identify the ratio of cubic yards of overburden to tons of recoverable coal. Where ratio control points are sparse, interpolated points are computed using coal structure, coal isopach, and topographic control. On the Areal Distribution of Identified Resources Map (ADIR), coal bed reserves are not calculated where the coal is less than 5 feet (1.5 m) thick, where the coal occurs at a depth greater than 500 feet (152 m), and where non-federal coal exists.

Coal tonnage calculations involve the planimetering of areas of measured, indicated, inferred reserves and resources, and hypothetical resources to determine their areal extent in acres. Acres are multiplied by the average coal bed thickness and 1750 (the number of tons of lignite A per acre-foot; 12,874 metric tons per hectare-meter) to determine total tons in place. Recoverable tonnage is calculated at 95% of the total tons in place. North of the White Tail Butte Quadrangle, in the Montana portion of the Powder River Basin, a recovery factor of 85 percent is utilized because of the general northward thinning of economic coal beds. Where tonnages are computed for the CRO-CDP map series, resources and reserves are expressed in millions of tons. Frequently the planimetering of coal resources on a sectionized basis involves complexly curvilinear lines (coal bed outcrop and 500-foot stripping limit designations) in relationship with linear section boundaries and circular resource category boundaries. Where these relationships occur, generalizations of complex curvilinear lines are discretely utilized, and resources and/or reserves are calculated within an estimated two to three percent plus or minus accuracy.

VI. Coal Development Potential

Strippable Coal Development Potential. Areas where coal beds are 5 feet (1.5 m) or more in thickness and are overlain by 500 feet (152 m) or less of overburden are considered to have potential for surface mining and are assigned a high, moderate, or low development potential based on the mining ratio (cubic yards of overburden per ton of recoverable coal). The formula used to calculate mining ratios is as follows:

$$MR = \frac{t_o \ (0.922)}{t_c \ (rf)}$$

where MR = mining ratio
t_o = thickness of overburden
t_c = thickness of coal
rf = recovery factor
0.922 = conversion factor (cu.yds/ton)

A surface mining potential map was prepared utilizing the following mining ratio criteria:

1. Low development potential = 15:1 and greater ratio.
2. Moderate development potential = 10:1 to 15:1 ratio.
3. High development potential = 0 to 10:1 ratio.

The surface mining potential is high for most of the White Tail Butte Quadrangle. The valleys of the North Fork of Elk Creek, Elk Creek, and White Tail Creek are carved into the Tongue River Member of the Fort Union Formation, and in various parts of these valleys, the Anderson, Canyon, Cook, and Wall coal beds underlie the surface at shallow depths. The relationship between these thick coal beds and thin overburden produce low overburden-to-coal ratios which account for much of the

high development potential for surface mining. Furthermore, the Anderson, Canyon, and Cook coal beds underlie most of the terrain on the White Tail Butte Quadrangle at depths of less than 500 feet (152 m). This situation establishes additional high development potential for surface mining. Table 1 sets forth the estimated strippable reserve base tonnages per coal bed for the quadrangle.

Underground Mining Coal Development Potential. Subsurface coal mining potential throughout the White Tail Butte Quadrangle is considered low. Table 2 sets forth the estimated coal resources in tons per coal bed.

In-Situ Gasification Coal Development Potential. The evaluation of subsurface coal deposits for in-situ gasification potential relates to the occurrence of coal beds more than 5 feet thick buried from 500 to 3000 feet (152 to 914 m) beneath the surface. This categorization is as follows:

1. Low development potential relates to a total coal section less than 100 feet (30 m) thick, or coal beds that lie 500 feet (152 m) to 1000 feet (305 m) beneath the surface.
2. Moderate development potential is assigned to a total coal section from 100 to 200 feet (30 to 61 m) thick, and from 1000 to 3000 feet (305 to 914 m) beneath the surface.
3. High development potential involves 200 feet (61 m) or more of total coal thickness buried from 1000 to 3000 feet (305 to 914 m).

The coal development potential for in-situ gasification on the White Tail Butte Quadrangle is low, hence no CDP map is generated for this map series. The resource tonnage for in-situ gasification with low development potential totals approximately 1.8 billion tons (1.6 billion metric tons) (Table 3). None of the coal beds in the White Tail Butte Quadrangle qualify for a moderate or high development potential rating.

Table 1.--Strippable Coal Reserve Base Data (in short tons) for Federal Coal Lands in the White Tail Butte Quadrangle, Campbell County, Wyoming.

(Development potentials are based on mining ratios (cubic yards of overburden/ton of recoverable coal).

Coal Bed	High Development Potential (0-10:1 Mining Ratio)	Moderate Development Potential (10:1-15:1 Mining Ratio)	Low Development Potential (>15:1 Mining Ratio)	Total
Anderson	565,540,000	-	-	565,540,000
Canyon	1,264,670,000	87,660,000	4,600,000	1,356,930,000
Cook	58,180,000	34,580,000	422,900,000	515,660,000
Wall	31,820,000	51,300,000	296,250,000	379,370,000
Pawnee	76,170,000	84,770,000	317,180,000	478,120,000
Cache	-	1,810,000	116,630,000	118,440,000
Oedekoven	-	-	-	-
TOTAL	1,996,380,000	260,120,000	1,157,560,000	3,414,060,000

Table 2.--Coal Resource Base Data (in short tons) for Underground Mining Methods for Federal Coal Lands in the White Tail Butte Quadrangle, Campbell County, Wyoming.

Coal bed name	High development potential	Moderate development potential	Low development potential	Total
Anderson	-	-	-	-
Canyon	-	-	-	-
Cook	-	-	-	-
Wall	-	-	219,670,000	219,670,000
Pawnee	-	-	735,040,000	735,040,000
Cache	-	-	521,680,000	521,680,000
Oedekoven	-	-	288,090,000	288,090,000
Total	-	-	1,764,480,000	1,764,480,000

Table 3.--Coal Resource Base Data (in short tons) for In-Situ Gasification for Federal Coal Lands in the White Tail Butte Quadrangle, Campbell County, Wyoming.

Coal bed name	High development potential	Moderate development potential	Low development potential	Total
Anderson	-	-	-	-
Canyon	-	-	-	-
Cook	-	-	-	-
Wall	-	-	219,670,000	219,670,000
Pawnee	-	-	735,040,000	735,040,000
Cache	-	-	521,680,000	521,680,000
Oedekoven	-	-	288,090,000	288,090,000
Total	-	-	1,764,480,000	1,764,480,000

Baker, A. A., 1929, The northward extension of the Sheridan coal field, Big Horn and Rosebud Counties, Montana: U. S. Geol. Survey Bull. 806-B, p. 15-67.

Bass, N. W., 1932, The Ashland coal field, Rosebud, Powder River, and Custer Counties, Montana: U. S. Geol. Survey Bull. 831-B, p. 19-105.

Brown, R. W., 1958, Fort Union Formation in the Powder River Basin, Wyoming: Wyo. Geol. Soc. Guidebook, Thirteenth Annual Field Conf., p. 111-113.

Dobbin, C. E., and Barnett, V. H., 1927, The Gillette coal field, northeastern Wyoming with a chapter on the Minturn district and northwestern part of the Gillette field by W. T. Thom, Jr.: U. S. Geol. Survey Bull. 796-A, p. 1-50.

Glass, G. B., 1975, Review of Wyoming coal fields, 1975: Wyoming Geol. Survey Public Information circ. 4, p. 10.

IntraSearch Inc., 1978, Coal resource occurrence and coal development potential of the Cabin Creek Northeast Quadrangle, Sheridan and Campbell Counties, Wyoming and Powder River County, Montana: U. S. Geol. Survey Open-File Report 78-064, 21 p.

Jacob, A. F., 1973, Depositional Environments of Paleocene Tongue River Formation: Am. Assoc. of Petroleum Geologists Bull., vol. 56, no. 6, p. 1038-1052.

Landis, E.R., and Hayes, P.T., 1973, Preliminary geologic map of the Croton 1 SE (White Tail Butte) Quadrangle, Campbell County, Wyoming: U.S. Geol. Survey Open File Report, scale 1:24,000.

McKay, E.J., 1973, Preliminary geologic map of the Croton 1 NE (Homestead Draw) Quadrangle, Campbell County, Wyoming: U.S. Geol. Survey Open-File Report, scale 1:24,000.

McKay, E.J., 1974, Preliminary geologic map of the Bertha 2 NW (Rocky Butte) Quadrangle, Campbell County, Wyoming: U.S. Geol. Survey Open-File Report 74-173, scale 1:24,000.

Olive, W W., 1957, The Spotted Horse coal field, Sheridan and Campbell Counties, Wyoming: U.S. Geol. Survey Bull. 1050, 83 p.

Schell, E.M., and Mowat, G.D., 1972, Reconnaissance map showing some coal and clinker beds in the Fort Union and Wasatch Formations in the eastern Powder River Basin, Campbell and Converse Counties, Wyoming: U.S. Geol. Survey Open-File Report, scale 1:63,360.

Taff, J.A., 1909, The Sheridan coal field, Wyoming, in Coal Fields of Wyoming: U.S. Geol. Survey Bull. 341-B, p. 123-150.

U.S. Bureau of Mines and U.S. Geological Survey, 1976, Coal resource classification system of the U.S. Bureau of Mines and U.S. Geological Survey: U.S. Geol. Survey Bull. 1450-B, 7 p.

U.S. Geological Survey and Montana Bureau of Mines and Geology, 1974, Preliminary report of coal drill-hole data and chemical analyses of coal beds in Campbell County, Wyoming: U.S. Geol. Survey Open-File Report 74-97, 241 p.

Warren, W.C., 1959, Reconnaissance geology of the Birney-Broadus coal field, Rosebud and Powder River Counties, Montana: U.S. Geol. Survey Bull. 1072-J, p. 561-585.

Weimar, R.J., 1977, Stratigraphy and tectonics of western coals, in Geology of Rocky Mountain Coal, A Symposium, 1976: Colorado Geol. Survey Resource Series 1, p. 9-27.