UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

TEXT TO ACCOMPANY:

COAL RESOURCE OCCURRENCE AND COAL DEVELOPMENT POTENTIAL MAPS OF THE NORTHEAST QUARTER OF ROSS 15' QUADRANGLE, CONVERSE AND CAMPBELL COUNTIES, WYOMING

BY

INTRASEARCH INC.

ENGLEWOOD, COLORADO

OPEN-FILE REPORT 79-181

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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.

TABLE OF CONTENTS

TABLE OF CONTENTS

MAPS		PLATES

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/ metric ton
acre-feet	0.12335	hectare-meters
British thermal units/pound (Btu/lb)	2.326	kilojoules/kilogram (kj/kg)
British thermal units/pound (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 Northeast Quarter of Ross 15' Quadrangle, Converse and Campbell Counties, Wyoming. This CRO and CDP map series includes 24 plates (U. S. Geological Survey Open-File Report 79-181). The project is compiled by IntraSearch Inc., 5351 South Roslyn Street, Englewood, Colorado, under KRCRA Eastern Powder River Basin, Wyoming, 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 (KRCRAs) in the western United States.

The Northeast Quarter of Ross 15' Quadrangle is located in Converse and Campbell Counties, in northeastern Wyoming. It encompasses all or parts of Townships 39, 40, and 41 North, Ranges 74 and 75 West, and covers the area: 43°21'30" to 43°30' north latitude; 105°45' to 105°52'30" west longitude.

Primary access to the Northeast Quarter of Ross 15' Quadrangle is provided by Ross Road, a maintained gravel road that crosses the area in a southeastward direction from the west central border. Ross Road intersects with U. S. Highway 387, at a point some 15 miles (24 km) north-northwest of the quadrangle and 10 miles (16 km) southwest of Pine Tree, Wyoming. Minor roads and trails branching from Ross Road provide access to the more remote areas. The closest railroad is the Burlington Northern trackage (under construction, 1979), 22 miles (35 km) to the east.

Primary drainage for the quadrangle is provided by Antelope Creek which flows eastward into the Cheyenne River system. Numerous intermittent streams provide additional drainage. Elevations in excess of 5440 feet (1658 m) above sea level, 450 feet (137 m) above the valley floors, contribute to the moderate-to-rugged terrain present in the area.

The 10 to 12 inches (25 to 30 cm) of annual precipitation falling in this semi-arid region accrue principally in the springtime. Summer and fall precipitation usually originates from thunderstorms, and infrequent snowfalls of 6 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 Douglas, Wyoming, average wintertime minimums and summertime maximums range from +5° to +15°F (-15° to -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 and Campbell County Courthouses in Douglas and Gillette, Wyoming, respectively. 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 nonfederal 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 the delineation of lignite, subbituminous coal, bituminous coal, and anthracite at the surface, and in the subsurface. In addition, the program identifies total tons of coal in place (resources), as well as recoverable tons (reserves). These coal tonnages are then categorized in measured, indicated, and inferred identified reserves and resources, and hypothetical resources. Finally, recommendations are made 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 to 3,000 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.

Surface and subsurface geological and engineering extrapolations drawn from the current data base suggest the occurrence of approximately 2.1 billion tons (1.9 billion metric tons) of total, unleased federal coal-in-place in the Northeast Quarter of Ross 15' Quadrangle.

The suite of maps that accompanies this report sets forth and portrays the coal resources and reserve occurrence in considerable detail. For the most part, this report supplements the cartographically displayed information with minimum verbal duplication of the CRO-CDP map 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 3,000 feet (914 m) of the Fort Union Formation, including 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 the 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. The Lebo Member is east of the principal coal outcrops and associated clinkers (McKay, 1974), and it 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 are trying to develop criteria for subsurface recognition of the Lebo-Tullock and Tongue River-Lebo contacts through use of subsurface data from geophysical logs, 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 tropical to subtropical depositional environment included broad, inland flood basins with extensive swamps, marshes, freshwater lakes, and a sluggish, but active, northeastward-discharging drainage system. These features were superimposed on an emerging sea floor, near base level. Much of the vast area 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 character, 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 it 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 2 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 delicate balance between subsidence of the earth's crust and and in-filling of these areas 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 of 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 servicing this lowland 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. It is considered to descend disconformably 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 for this 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, brown-to-black carbonaceous shales, and coal beds. These sediments are noticably to imperceptibly coarser than the underlying Fort Union clastics.

The Northeast Quarter of Ross 15' Quadrangle is located in an area where surface rocks are classified within the Watsatch Formation.

Although the Wasatch Formation is reportedly up to 1,800 feet (549 m) thick (Denson and Horn, 1975), Olive (1957) mapped 700 to 800 feet (213 to 244 m). Only 450 to 550 feet (137 to 168 m) of Wasatch Formation are exposed in the quadrangle. Olive (1957) correlated coal beds in the Spotted Horse coal field with coal beds in the northward extension of the Sheridan coal field, Montana (Baker, 1929), and Gillette coal field, Wyoming (Dobbin and Barnett, 1927), 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 Smith coal bed was named by Taff (1909), and Baker (1929) assigned names to the Anderson and Canyon coal beds. The Wildcat coal bed was informally named by IntraSearch (1978). Regional correlations by IntraSearch throughout the area indicate that the Smith coal bed of Taff correlates with the Badger coal bed of Baker (1929). Moreover, the Anderson coal bed of Baker is possibly equivalent to the School coal bed. The School coal bed was informally named by previous workers.

Local. The Northeast Quarter of Ross 15' Quadrangle is located near to the axis of the Powder River Basin, where the strata dip gently northward. The Wasatch Formation crops out over the entire quadrangle and is composed 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.

III. Data Sources

Geophysical logs from oil and gas test bores and producing wells compose the source of subsurface control. 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 80 percent of the logs include resistivity, conductivity, and self-potential curves. Occasionally, the suite of geophysical logs includes gamma, density, and sonic curves. These logs are available from several commercial sources.

All geophysical logs available in the quadrangle and its 3-mile perimeter area were scanned to select those with data applicable to Coal Resource Occurrence mapping. Paper copies of the logs were obtained and interpreted, and coal intervals were annotated. Maximum accuracy of coal bed identification was accomplished where gamma, density and resistivity curves were available. Coal bed tops and bottoms were identified on the logs at the midpoint between the minimum and maximum curve deflections. The correlation of coal beds within and between quadrangles was achieved utilizing a fence diagram to associate local correlations with regional coal occurrences.

The reliability of correlations, set forth by IntraSearch in this report, varies depending on: the density and quality of lithologic and geophysical logs; the details, thoroughness, and accuracy of published and unpublished surface geological maps, and interpretative proficiency. There is no intent on the part of IntraSearch to refute nomenclature established in the literature or used locally by workers in the area. IntraSearch's nomenclature focuses upon the suggestion of regional coal bed names applicable throughout the eastern Powder River Basin. It is expected and entirely reasonable that some differences of opinion regarding correlations, as suggested by IntraSearch, exist. Additional drilling for coal, oil, gas, water, and uranium, coupled with expanded mapping of coal bed outcrops and associated clinkers will broaden the data base for coal bed correlations and allow continued improvement in the understanding of coal bed occurrences in the eastern Powder River Basin.

The topographic map of the Ross 15' Quadrangle is published by the U. S. Geological Survey, compilation date 1960. The Northeast Quarter of the Ross 15' Quadrangle was enlarged to a scale of 1:24,000 for CRO/CDP mapping purposes. 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

Wasatch and Fort Union Formation coal beds that are present in all or part of the Northeast Quarter of the Ross 15' Quadrangle include, in descending stratigraphic order: the Smith (Badger), Upper and Lower Anderson (School), Upper and Lower Canyon, and Middle and Lower Wildcat. The Upper and Lower Anderson coal beds, the Upper and Lower Canyon coal beds, and the Middle and Lower Wildcat coal beds are mapped as coal zones. A suite of maps composed of: coal isopach and mining ratio, where appropriate; structure; overburden isopach; areal distribution of identified resources; identified resources and hypothetical resources, where applicable, is prepared for each of these coal beds or coal zones. Mining ratios are presented on the isopach maps of the Smith and Upper and Lower Anderson Coal Beds.

Additional subsurface control has become available in this area since the CRO/CDP maps in adjacent quadrangles were open-filed. The new control is utilized in the Northeast Quarter of the Ross 15' Quadrangle mapping program. Inasmuch as the previously open-filed quadrangle mapping does not conform to the new control, minor contouring irregularities will be existent between the current and older map compilations.

No physical or chemical analyses are known to have been published regarding the coal beds in the Northeast Quarter of the Ross 15' Quadrangle. For Converse County coal beds, the "as received" proximate analysis; the Btu value computed on a moist, mineral-matter-free basis;* and the coal rank are as follows:

COAL BED NAME		DATA SOURCE IDENTIFICATION	AS RECEIVED BASIS						MOIST, M-M-F BTU/LB	COAL RANK
			ASH %	FIXED CARBON %	MOISTURE %	VOLATILES %	SULFUR %	BTU/LB		
Smith (Badger)	(1)	Lab.No. 74-35	8.5	28.5	29.0	34.0	0.41	7606	8371	Subbtm. C
Anderson (School)	(1)	Lab.No. 74-37	9.7	29.5	26.4	34.4	0.52	7830	8743	Subbtm. C
Canyon	(U)	Hole 757	6.0	32.8	29.9	34.2	0.34	8366	8948	Subbtm. C
"Wildcat"	(**)	Hole 11447	4.3	38.5	27.8	29.4	0.27	8410	8819	Subbtm. C

* The moist, mineral-matter-free Btu values are calculated in the manner stipulated in the publications by American Society for Testing and Materials (1971).

** Winchester (1912).

(1) Glass (1975a).

(U) U. S. Geological Survey and Montana Bureau of Mines and Geology (1976).

The proximate analyses presented above are from core hole or outcrop locations in excess of 20 miles (32 km) from this quadrangle. For the simplification of tonnage computations, all coal bed in the Northeast Quarter of the Ross 15' Quadrangle are tentatively classified as subbituminous C rank.

The Coal Data Sheet, plate 3, shows the down-hole identification of coal beds within the quadrangle as interpreted from geophysical logs from oil and gas test bores and from producing sites. This portrayal is schematic by design; hence, no structural or coal thickness implications are suggested by the dashed correlation lines projected through No Record (NR) intervals. Inasmuch as the Smith (Badger) coal bed underlies the entire quadrangle, it is designated as datum for the correlation diagram. The Middle-Lower Wildcat coal beds show the thickest coal bed occurrence throughout the study area. The Smith (Badger), Upper and Lower Anderson (School), and Upper and Lower Canyon coal beds are relatively thin throughout the Northeast Quarter of Ross 15' Quadrangle.

The Smith (Badger) coal bed thickness ranges from less than 5 feet (1.5 m) to greater than 15 feet (5 m) with the thickest coal occurrence located in the southwest corner of the quadrangle. It thins toward the northwest corner. The Smith (Badger) coal bed dips gently northward with a broad, north-plunging anticline and syncline mapped in the northern two-thirds of the area. The coal bed is present throughout the quadrangle at depths from less than 200 feet (61 m) to greater than 700 feet (213 m).

The Upper and Lower Anderson (School) coal beds lie approximately 147 to 236 feet (45 to 72 m) below the Smith (Badger) coal bed and are absent from approximately two percent of the quadrangle in the northeastern quadrant. The Anderson (School) coal bed has an upper and lower member separated by approximately 30 to 74 feet (9 to 23 m) with the Upper

Anderson (School) coal bed absent in the west-central part of the area. The composite thickness of the Anderson (School) coal beds varies from 0 to over 50 feet (15 m) with the thickest coal in the northwest corner of the area. Structure contours drawn on the top of the Anderson (School) coal beds indicate gentle northward dip with local tight folding in the northeast part of the quadrangle. The Anderson (School) coal beds occur within 500 feet (152 m) of the surface over approximately five percent of the area principally along the eastern border, and attain a depth of over 1,000 feet (305 m) beneath the surface.

The Upper and Lower Canyon coal beds, absent from all but the eastern one-third of the quadrangle, lie approximately 120 to 157 feet (37 to 48 m) below the Lower Anderson coal bed and consist of an upper and lower member. The interburden between the Canyon coal bed members is less than 10 feet (3 m). The composite thickness of the Canyon coal beds ranges from 0 to over 10 feet (0 to 3 m) with the maximum thickness in the northeast quadrant and near the southeast boundary. Gentle dip to the north is shown by structure contours drawn on the top of the Upper Canyon coal bed. The Canyon coal beds are between 600 and 900 feet (183 and 274 m) beneath the surface.

The Middle and Lower Wildcat coal beds also consist of two members and are approximately 1,069 to 1,150 feet (326 to 351 m) below the Lower Canyon coal bed. The total non-coal interval between the members ranges from 25 to 68 feet (8 to 21 m) with local minor parting in the Lower Wildcat coal bed. The Lower Wildcat coal bed is absent from the western half of the quadrangle. The composite coal isopach thickness of the Wildcat coal beds varies from less than 5 feet (1.5 m) to 37 feet (11 m) and exhibits rather uniform thinning from east to west from the maximum thickness that occurs along the eastern edge of the area. Structure contours drawn on top of the Middle Wildcat coal bed show gentle dip to the north. A prominent, broad, north-plunging anticline is present along the extreme north-central border of the area. Total overburden to the top of the Middle Wildcat coal bed ranges from less than 1,750 to greater than 2,000 feet (533 to 610 m) in thickness.

V. Geological and Engineering Mapping Parameters

The correct horizontal location and elevation of drill holes utilized in subsurface mapping are critical to map accuracy. IntraSearch plots the horizontal location of the drill hole as described on the geophysical log heading. Occasionally this location is superimposed on or near to a drillsite shown on the topographic map, and the topographic map horizontal location is utilized. If the ground elevation on the geophysical log does not agree with the topographic elevation of the drillsite, the geophysical log ground elevation is adjusted to conformance. If there is no indication of a drillsite on the topographic map, the "quarter, quarter, quarter" heading location is shifted within a small area until the ground elevation on the heading agrees with the topographic map elevation. If no elevation agreement can be reached, the well heading or data sheet is rechecked for footage measurements and ground elevation accuracy. Inquiries to the companies who provided the oil and gas geophysical logs frequently reveal that corrections have been made in the original survey. If all horizontal location data sources have been checked and the information accepted as the best available data, the drillsite elevation on the geophysical log is modified to agree with the topographic map elevation. IntraSearch considers this agreement mandatory for the proper construction of most subsurface maps, but in particular, the overburden isopach, the mining ratio, and Coal Development Potential maps.

Subsurface mapping is based on geologic data within, and adjacent to, the Northeast Quarter of the Ross 15' Quadrangle area. Data from geophysical logs are used to correlate coal beds and control contour lines for the coal thickness, structure, and overburden maps. Structure contour maps are constructed on the tops of the main coal beds. Where subsurface data are 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 above a particular coal bed under study. Mining ratio maps for this quadrangle are constructed utilizing a 95 percent recovery factor. Contours of 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, or where federal coal leases, preference-right lease applications, and coal prospecting permits exist.

Coal tonnage calculations involve the planimetering of areas of measured, indicated, and inferred parts of identified resources and hypothetical resources to determine their areal extent in acres. An <u>Insufficient Data Line</u> is drawn to delineate areas where surface and subsurface data are too sparse for CRO map construction. Various categories of resources are calculated in the unmapped areas by utilizing coal bed thicknesses mapped in the geologically controlled area adjacent to the insufficient data line. Acres are multiplied by the average coal bed thickness and 1,750, or 1,770--the number of tons of lignite A or subbituminous C coal per acre-foot, respectively (12,874 or 13,018 metric tons per hectare-meter, respectively)--to determine total tons in place. Recoverable tonnage (reserves) are calculated at 95 percent of the total tons in place. 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 2 to 3 percent, plus or minus, accuracy.

VI. <u>Coal Development Potential</u>

<u>Strippable Coal Development Potential</u>. 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 for subbituminous coal is as follows:

$$MR = \frac{to\ (0.911)^*}{tc\ (rf)}$$

where MR = mining ratio
to = thickness of overburden
tc = thickness of coal
rf = recovery factor
0.911 = conversion factor (cu. yds./ton)

*A conversion factor of 0.922 is used for lignite.

A surface mining development potential map (plate 24) was prepared utilizing the following mining ratio criteria for coal beds 5 feet to 40 feet (1.5 to 12 m) thick:

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 following mining ratio criteria are utilized for coal beds greater than 40 feet (12 m) thick:

1. Low development potential = 7:1 and greater ratio.
2. Moderate development potential = 5:1 to 7:1 ratio.
3. High development potential = 0 to 5:1 ratio.

The surface mining development potential is low for approximately 50 percent of the quadrangle. This low development potential is concentrated in the southern two-thirds of the area. The relative thinness of the Smith (Badger) and Anderson (School) coal beds and their deep burial depths contribute to the low potential classification. The remainder of the quadrangle either has no potential of is non-federal coal. Table 1 sets forth the estimated strippable reserve base tonnages per coal bed for this quadrangle.

Underground Mining Coal Development Potential. Subsurface coal mining development potential throughout the Northeast Quarter of the Ross 15' Quadrangle is considered low. Inasmuch as recovery factors have not been established for the underground development of coal beds in this quadrangle, reserves are not calculated for coal beds that occur more than 500 feet (152 m) beneath the surface. 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 development potential relates to the occurrence of coal beds more than 5 feet (1.5 m) thick buried from 500 to 3,000 feet (152 to 914 m) beneath the surface. This categorization is as follows:

1. Low development potential relates to: 1) a total coal section less than 100 feet (30 m) thick that lies 1,000 feet (305 m) to 3,000 feet (914 m) beneath the surface, or 2) a coal bed or coal zone 5 feet (1.5 m) or more in thickness that lies 500 feet (152 m) to 1,000 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 buried from 1,000 to 3,000 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 1,000 to 3,000 feet (305 to 914 m).

The coal development potential for in-situ gasification within the Northeast Quarter of the Ross 15' Quadrangle is low throughout the quadrangle; therefore, no in-situ mining development potential map is generated for this map series. The coal resource tonnage for in-situ gasification with low development potential totals approximately 1.7 billion tons (1.5 billion metric tons) (table 3).

Table 1.--Strippable Coal Reserve Base and Hypothetical Resource Data (in short tons) for Federal Coal Lands in the Northeast Quarter of Ross 15' Quadrangle, Converse and Campbell Counties, 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
Reserve Base				
Smith	-	-	371,960,000	371,960,000
Anderson	-	-	18,980,000	18,980,000
Total	-	-	390,940,000	390,940,000
Hypothetical Resource				
Smith	-	-	5,070,000	5,070,000
Total	-	-	5,070,000	5,070,000
GRAND TOTAL	-	-	396,010,000	396,010,000

Table 2.--Coal Reserve Base and Hypothetical Resource Data (in short tons) for Underground Mining Methods for Federal Coal Lands in the Northeast Quarter of Ross 15' Quadrangle, Converse and Campbell Counties, Wyoming.

Coal Bed Name	High Development Potential	Moderate Development Potential	Low Development Potential	Total
Reserve Base				
Smith	-	-	120,430,000	120,430,000
Anderson	-	-	772,710,000	772,710,000
Canyon	-	-	82,780,000	82,780,000
Wildcat	-	-	699,140,000	699,140,000
Total	-	-	1,675,060,000	1,675,060,000
Hypothetical Resource				
Anderson	-	-	6,120,000	6,120,000
Total	-	-	6,120,000	6,120,000
GRAND TOTAL	-	-	1,681,180,000	1,681,180,000

Table 3.--Coal Reserve Base and Hypothetical Resource Date (in short tons) for In-Situ Gasification for Federal Coal Lands in the Northeast Quarter of Ross 15' Quadrangle, Converse and Campbell Counties, Wyoming.

Coal Bed Name	High Development Potential	Moderate Development Potential	Low Development Potential	Total
Reserve Base				
Smith	-	-	120,430,000	120,430,000
Anderson	-	-	772,710,000	772,710,000
Canyon	-	-	82,780,000	82,780,000
Wildcat	-	-	699,140,000	699,140,000
Total	-	-	1,675,060,000	1,675,060,000
Hypothetical Resource				
Anderson	-	-	6,120,000	6,120,000
Total	-	-	6,120,000	6,120,000
GRAND TOTAL	-	-	1,681,180,000	1,681,180,000

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