UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

TEXT TO ACCOMPANY:

COAL RESOURCE OCCURRENCE

AND

COAL DEVELOPMENT POTENTIAL

MAPS

OF THE

SOMERVILLE FLATS EAST QUADRANGLE,

JOHNSON AND CAMPBELL COUNTIES, WYOMING

BY

INTRASEARCH INC.

ENGLEWOOD, COLORADO

OPEN FILE REPORT 79-173
1980

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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 Somerville Flats East Quadrangle, Johnson and Campbell Counties, Wyoming. This CRO and CDP map series includes 57 plates (U. S. Geological Survey Open-File Report 79-173). The project is compiled by IntraSearch Inc., 5351 South Roslyn Street, Englewood, Colorado, under KRCRA Eastern 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 (KRCRAs) in the western United States.

The Somerville Flats East Quadrangle is located in Johnson and Campbell Counties, in northeastern Wyoming. It encompasses all or parts of Townships 49, 50 and 51 North, Ranges 76 and 77 West, and covers the area: 44°15' to 44°22'30" north latitude; 106°00' to 106°07'30" west longitude.

Access to the Somerville Flats East Quadrangle is available by minor roads and trails from Interstate 90 which runs east-west about 3.5 miles (5.6 km) south of the quadrangle. Additional trails provide access to the more remote areas of the quadrangle. Unimproved roads and trails are on the tops of most of the divides. The closest railroal is the Burlington Northern trackage approximately 7 miles (11 km) to the northeast near Echeta, Wyoming.

Primary drainage is provided by the northward-flowing Powder River in the southwest part of the quadrangle. Additional drainage is provided by Barber Creek in the center one-third of the quadrangle, and by Turner Draw and Williams Draw in the northern and southern areas, respectively, of the study area. These intermittent streams flow westward and are part of the Powder River system. Minor streams supplement the drainage throughout the quadrangle. Elevations attain heights of 4,660 feet (1,420 m) above sea level in the northeast and southeast quarters of the quadrangle, where hills rise 650 to 700 feet (198 to 213 m) above the Powder River valley floor.

The 13 to 14 inches (33 to 36 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 Arvada, 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 Johnson and Campbell County Courthouses in Buffalo 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 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 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 parts of identified 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 down 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 8.3 billion tons (7.5 billion metric tons) of total, unleased federal coal-in-place resources in the Somerville Flats East Quadrangle.

The suite of maps that accompanies this report sets forth and portrays the coal resource 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 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 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 Somerville Flats East Quadrangle is located in an area where surface rocks are classified within the Wasatch 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 650 to 700 feet (198 to 213 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.

Gale and Wegemann (1910) assigned names to the Dry Creek coal bed and the Healy coal bed. The Felix coal bed was named by Stone and Lupton (1910). Taff (1909) named the Smith coal bed. The Anderson, Canyon and Wall coal beds were named by Baker (1929). The Cook coal bed was named by Bass (1932). Warren (1959) named the Pawnee coal bed, and the Cache coal bed. IntraSearch (1978b, 1979, 1978a) informally assigned names to the Wildcat, Moyer, and Oedekoven coal beds.

IntraSearch's correlation of the thick coal beds from the Spotted Horse coal field to Gillette points out that the Wyodak coal bed, named the "D" coal bed by Dobbin and Barnett (1927), is equivalent to the Anderson and Canyon coal beds, and all, or part, of the Cook and Wall coal beds to the north and west of Gillette, Wyoming. Due to problematic correlations outside of the Gillette area, the Wyodak has been informally used by previous authors to represent coal beds in the area surrounding the Wyodak coal mine. The Anderson, Canyon, and Cook coal beds, mapped separately in the Somerville Flats East Quadrangle, correlate with the Wyodak coal zone in the Laskie Draw Quadrangle to the south. The Wall coal zone in this study area correlates with the Lower

Wall coal bed to the south in Laskie Draw Quadrangle.

Local. The Somerville Flats East Quadrangle lies on the eastern flank of the Powder River Basin, where the strata dip gently westward. 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.

The Fort Union Formation directly underlies the Wasatch Formation, and is composed of very fine-grained sandstones, siltstones, claystones, shales, carbonaceous shales, and numerous coal beds.

Structure contours drawn on the top of the coal beds in the Somerville Flats East Quadrangle usually depict a northwest-trending syncline. Minor flexures occur on the flanks of the main structural feature.

III. Data Sources

Areal geology of the coal outcrops is derived from the Barber coal field report (Wegemann, 1913). The coal bed outcrops are adjusted to fit the current topographic maps of the area. The Dry Creek and Healy coal beds crop out above the Felix coal bed, and are not mapped due to insufficient thickness and limited areal extent.

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 Somerville Flats East Quadrangle is published by the U. S. Geological Survey, compilation date 1972. 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 Wasatch Formation and Fort Union Formation coal beds that are present in all or part of the Somerville Flats East Quadrangle include, in descending stratigraphic order: the Healy, Dry Creek, Upper Felix, Lower Felix, Local, Smith, Local, Anderson, Canyon, Cook, Wall, Pawnee, Cache, Wildcat, Moyer, Oedekoven, Local '1' and Local '2' coal beds. The Smith coal beds, Anderson coal beds, and Pawnee 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 Upper Felix and Lower Felix coal beds. The Oedekoven-Local 1-Local 2 coal beds are mapped as a coal bed composite.

No physical or chemical analyses are known to have been published regarding coal bed samples taken from the Somerville Flats East Quadrangle. For Campbell County and northeastern Johnson 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							
			ASH %	FIXED CARBON %	MOISTURE %	VOLATILES %	SULFUR %	BTU/LB	MOIST, M-M-F BTU/LB	COAL RANK
Felix	(U)	Hole 7335	7.4	33.8	26.2	32.7	0.80	8538	9322	Subbtm. C
Smith	(U)	Hole 7340	3.5	38.0	30.0	28.5	0.31	8371	8700	Subbtm. C
Anderson	(U)	Hole 7334	5.4	34.6	29.2	30.8	0.46	8049	8551	Subbtm. C
Canyon-Cook	(U)	Hole 7334	5.1	34.9	29.4	30.5	0.28	8329	8814	Subbtm. C
Wall	(U)	Hole 7426	9.5	29.3	32.2	29.0	0.50	7279	8112	Lignite A
Pawnee	(U)	Hole 7424	7.9	31.0	31.9	29.2	0.39	7344	8025	Lignite A
Cache	(U)	Hole 741	9.5	30.5	31.4	28.6	0.49	7271	8097	Lignite A
Wildcat	(**)	Lab.No. 11447	4.3	29.4	27.8	29.4	0.27	8410	8818	Subbtm. C

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

** Winchester (1912).

(U) U. S. Geological Survey and Montana Bureau of Mines and Geology (1974 and 1976).

The proximate analyses presented above are from core hole or outcrop locations in excess of 20 miles (32 km) from this quadrangle. In order to simplify tonnage computations, all coal beds in the Somerville Flats East Quadrangle are tentatively classified as subbituminous C rank.

The Coal Data sheets, plates 3A, B, and C, show the down-hole identification of coal beds within the quadrangle as interpreted from U. S. Geological Survey and Montana Bureau of Mines and Geology drill holes and 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 Canyon coal bed underlies the entire quadrangle, it is designated as datum for the correlation diagram. The Anderson, Canyon, Wall, and Pawnee coal beds show the thickest coal bed occurrences throughout the study area. The Upper Felix, Lower Felix, Smith Coal Zone, Cook, Cache, Wildcat-Moyer, Oedekoven, Local 1, and Local 2 coal beds are relatively thin throughout the Somerville Flats East Quadrangle.

Approximately 15 percent of the Upper Felix coal bed is eroded or pinched out along the western edge of the study area. The Upper Felix coal bed ranges in thickness from 0 feet (0 m) in the southwest corner to 14 feet (4 m) in the southeast quarter of the quadrangle. Structure contours drawn on the Upper Felix coal bed top depict a series of north-trending, narrow, closed synclines and anticlines in the southern half, and gentle, northwest dip in the northern half of the quadrangle. The Upper Felix coal bed lies approximately 0 to 700 feet (0 to 213 m) beneath the surface.

The Lower Felix coal bed is separated from the overlying Upper Felix coal bed by 75 to 180 feet (23 to 55 m) of clastic sediments.

Coal thicknesses range from 0 to 7 feet (0 to 2.1 m) with the coal absent in the western one-third of the quadrangle and in the southeast corner. Structure contours drawn on the top of the Lower Felix coal bed indicate a syncline trending northeast located in the southeast corner. A closed anticline parallels the syncline to the north. A northwest-plunging syncline is present in the northwest quadrant. The Lower Felix coal bed lies from less than 200 feet (61 m) to greater than 800 feet (244 m) beneath the surface.

The Smith coal zone lies 285 to 510 (87 to 155 m) beneath the Lower Felix coal bed and 540 to 685 feet (165 to 209 m) beneath the Upper Felix coal bed where the Lower Felix coal bed is absent. The Smith coal zone ranges in thickness from 8 to 44 feet (2.4 to 13 m) with maximum thicknesses occurring in the northwest quarter of the quadrangle. The Smith coal zone is composed of as many as 5 separate coal beds with non-coal intervals ranging to 200 feet (61 m). Structure contours drawn on the top of the Smith coal zone indicate a broad, bifurcated, northwest-trending syncline dominating the structure map of the study area. Small structural highs are present in the east-central portion of the quadrangle and along the south-central edge of the quadrangle. The Smith coal zone occurs from less than 600 feet (183 m) to more than 1,250 feet (381 m) beneath the surface.

The Anderson coal zone occurs approximately 55 to 330 feet (17 to 101 m) beneath the Smith coal zone. Coal thicknesses range from 20 to 160 feet (6 to 49 m) with maximum thicknesses occurring in the west-central portion of the quadrangle. The Anderson coal zone separates into as many as 4 coal beds locally with a non-coal interval of 5 to 330 feet (1.5 to 101 m). Structure contours drawn on the top of the Anderson coal zone depict a closed syncline in the western one-half of the quadrangle, and in the southeastern corner. A bifurcated, west and southwest-trending anticline is present in the northeast quarter of the study area. Closed synclines are located in the west-central area and in the southeastern corner. The Anderson coal zone lies from less than 850 feet (259 m) to greater than 1,600 feet (488 m) beneath the surface.

The Canyon coal bed occurs 0 to 400 feet (0 to 122 m) beneath the Anderson coal zone and ranges in thickness from 24 to 58 feet (7 to 18 m). A maximum thickness is attained in the central-northern portion of the quadrangle, with gradual thinning in all directions. A broad, north-plunging syncline meanders through the central region of the quadrangle. A smaller, west-plunging anticline is present in the southwest quarter of the quadrangle. The Canyon coal bed lies from less than 1,150 feet (351 m) to greater than 2,000 feet (610 m) beneath the surface.

The Cook coal bed occurs from 0 to 300 feet (0 to 91 m) beneath the Canyon coal bed. Coal thicknesses range from 0 to 48 feet (0 to 15 m) with maximum thicknesses along the southern boundary. The coal bed is absent from the east-central edge of the map. The dominant structural configuration is a broad, north-plunging syncline in the center of the quadrangle. A narrow, northeast-trending anticline is located in the southeast corner of the study area. The Cook coal bed lies less than 1,250 feet (381 m) and greater than 2,100 feet (640 m) beneath the surface.

The Wall coal bed lies 7 to 220 feet (2.1 to 67 m) beneath the Cook coal bed and approximately 200 to 275 feet (61 to 84 m) beneath the Canyon coal bed where the Cook coal bed is absent. The Wall coal bed ranges in thickness from 10 to 100 feet (3 to 30 m). A maximum thickness is attained in the south-central portion of the quadrangle, with rapid thinning in all directions. Localized non-coal partings occur throughout the quadrangle ranging from 5 to 30 feet (1.5 to 9 m) thick. Structure contours drawn on top of the Wall coal bed indicate a broad, north-plunging syncline in the northwest quarter of the quadrangle, and gentle, northeast dip in the southern half of the quadrangle, with minor flexures. The Wall coal bed lies from less than 1,450 feet (442 m) to greater than 2,200 feet (671 m) beneath the surface.

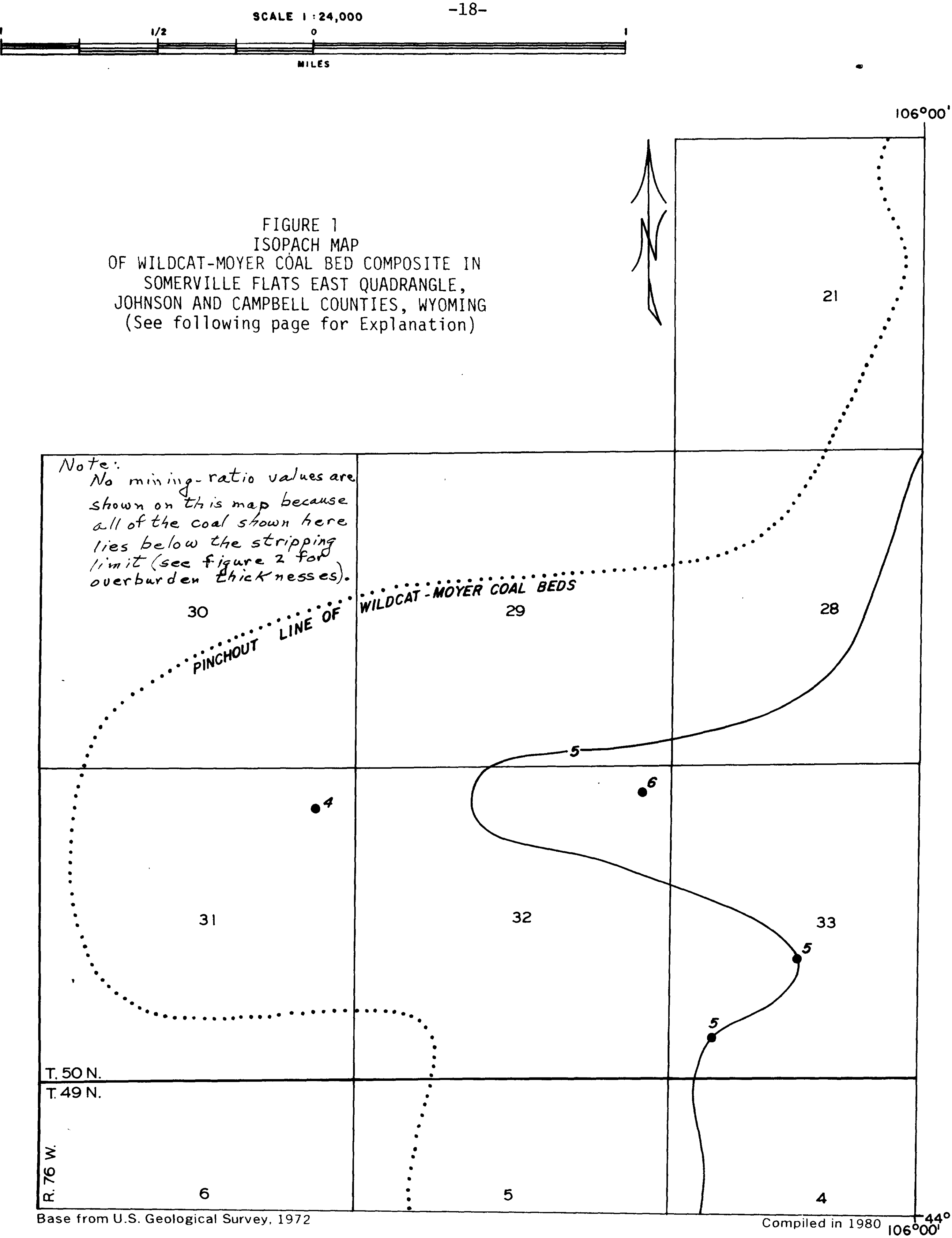
The Pawnee coal zone occurs approximately 10 to 275 feet (3 to 84 m) below the Wall coal bed. The total coal zone thickness ranges from 18 to 110 feet (5 to 34 m) with maximum coal thicknesses in the southeast corner. The total clastic interval separating the coal beds composing the coal zone ranges from 0 to 301 feet (0 to 92 m). The dominant structural configuration on this coal zone is a broad, northwest-plunging syncline through the central portion of the study area. A small anticline is present in the southwest quarter of the quadrangle. The Pawnee coal zone lies from less than 1,750 feet (533 m) to greater than 2,500 feet (762 m) beneath the surface.

The Cache coal bed lies approximately 60 to 180 feet (18 to 55 m) beneath the Pawnee coal zone and is composed of a thin, lenticular coal bed ranging in thickness from 0 to 7 feet (0 to 2.1 m). The Cache coal bed is absent from 60 percent of the Somerville Flats East Quadrangle, being present in the southeast quarter and along the extreme northern edge of the quadrangle. Structure contours drawn on the top of the Cache coal bed depict a gentle, westward dip with minor flexures. The Cache coal bed lies from less than 2,100 feet (640 m) to greater than 2,700 feet (823 m) beneath the surface.

The Wildcat-Moyer coal beds lie approximately 50 to 200 feet (15 to 61 m) beneath the Cache coal bed where present. The Wildcat-Moyer coal bed is composed of two, thin lenticular coal beds with a non-coal interval of approximately 40 to 110 feet (12 to 34 m). These coal beds are absent from 80 percent of the quadrangle. The Wildcat-Moyer coal beds are present only in the southeast corner of the quadrangle, and range in thickness from 0 to 6 feet (0 to 1.8 m) thick. Structure contours drawn on top of the Wildcat coal bed depict a gentle, westward dip. The Wildcat-Moyer coal beds lie from less than 2,350 feet (716 m) to greater than 2,700 feet (823 m) beneath the surface.

The Oedekoven-Local 1-Local 2 coal bed composite occurs approximately 40 to 150 feet (12 to 46 m) beneath the Wildcat-Moyer coal beds, and 200 to 420 feet (61 to 128 m) beneath the Cache coal bed where the Wildcat-Moyer coal beds are absent. In the area where the Wildcat-Moyer coal beds and the Cache coal bed is absent, a non-coal interval from 360 to 575 feet (110 to 175 m) separates the Oedekoven-Local 1-Local 2 coal bed composite from the Pawnee coal zone. This coal bed composite ranges in thickness from 10 to 41 feet (3 to 13 m) with maximum thicknesses in the northwest corner. Structure contours drawn on the top of the Oedekoven coal bed depict a west-plunging anticline in the

FIGURE 1
ISOPACH MAP
OF WILDCAT-MOYER COAL BED COMPOSITE IN
SOMERVILLE FLATS EAST QUADRANGLE,
JOHNSON AND CAMPBELL COUNTIES, WYOMING
(See following page for Explanation)



Base from U.S. Geological Survey, 1972

Compiled in 1980

EXPLANATION FOR FIGURE 1

● 6 — DRILL HOLE-Showing coal thickness in feet.

——— 5 ——— — ISOPACHS OF COAL BED-Showing thickness, in feet, isopach interval 5 feet.

To convert feet to meters, multiply feet by 0.3048.

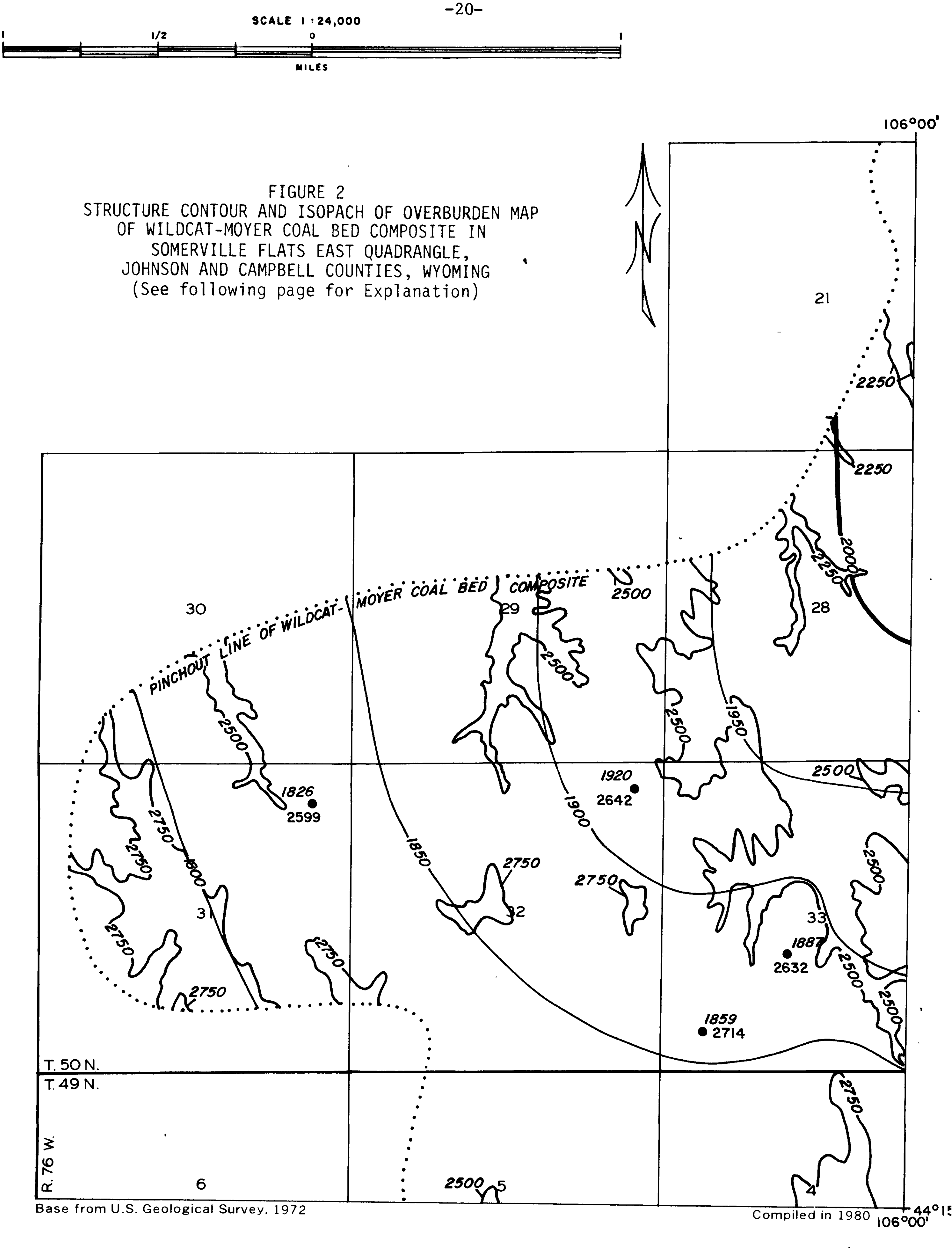


FIGURE 2
STRUCTURE CONTOUR AND ISOPACH OF OVERBURDEN MAP
OF WILDCAT-MOYER COAL BED COMPOSITE IN
SOMERVILLE FLATS EAST QUADRANGLE,
JOHNSON AND CAMPBELL COUNTIES, WYOMING
(See following page for Explanation)

Base from U.S. Geological Survey, 1972

Compiled in 1980

EXPLANATION FOR FIGURE 2

1920 2642 ●	DRILL HOLE-Slanted number showing elevation at top of coal bed; vertical number showing thickness of overburden from the surface to the top of the coal bed. Measurements in feet.
——*1950*—— ——*2000*——	STRUCTURE CONTOURS-Drawn on top of coal bed. Contour interval 50 feet. Datum is mean sea level.
——*2250*——	OVERBURDEN ISOPACH-Showing thickness of overburden, in feet, from the surface to the top of the coal bed. Isopach interval 250 feet.

To convert feet to meters, multiply feet by 0.3048.

northern end of the study area and a west-plunging syncline in the central portion. In the east-central portion, the Oedekoven coal bed is absent, and the structure contours are drawn on the top of the Local 1 coal bed, which correlates to the Local coal bed to the east in the Carr Draw Quadrangle. Structure contours drawn on top of the Local 1 coal bed depict a gentle, westward dip. The Oedekoven-Local 1-Local 2 coal bed composite lies from less than 2,250 feet (686 m) to greater than 2,750 feet (838 m) beneath the surface.

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 Somerville Flats East Quadrangle 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 coal isopach contours do not honor surface measured sections, the surface thicknesses are thought to be attenuated by oxidation and/or erosion: hence, they are not reflective of total coal thickness. Isopach lines extend to the coal bed outcrops, the projections of coal bed outcrops, and the contact between porcellanite (clinker) and unoxidized coal in place. Attenuation of total coal bed thickness is known to take place near these lines of definition; however, the overestimation of coal bed tonnages that results from this projection of total coal thickness is insignificant to the Coal Development Potential 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 Insufficient Data Line 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 tonnages (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. 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 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 54) 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 25 percent of the quadrangle. The surface-mining development potential area exists mainly in the northwest corner and south-central portion of the quadrangle, due to high overburden-to-coal thickness ratios for the Upper Felix and Lower Felix coal beds. The older coal beds occur greater than 500 feet (152 m) beneath the surface. Approximately 5 percent of Somerville Flats East Quadrangle is high development potential and approximately 5 percent is moderate development potential. The high and moderate development potential occurs in areas where the Upper Felix coal bed is less than 250 feet (76 m) beneath the surface. Approximately 15 percent of the quadrangle is rated as no development potential for surface mining due to the coals occurring greater than 500 feet (152 m) beneath the surface, or less than 5 feet (1.5 m) thick. The remaining 50 percent is classified as non-federal coal land and is not evaluated in this study. 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 Somerville Flats East Quadrangle is considered low. Inasmuch as recovery factors have not been established for the underground development of coal beds in this quadrangle, the recoverable 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 (plate 55) on the Somerville Flats East Quadrangle is high over approximately 40 percent of the quadrangle, and is caused by the thick Canyon and Cook coal beds, the Anderson coal zone, Wall coal zone, and Pawnee coal zone greater than 1,000 feet (305 m) beneath the surface. The high development potential rating occurs primarily in the western half of the quadrangle. Approximately 10 percent of the study area is rated as moderate development potential, and occurs in the extreme western edge of the quadrangle where the Anderson coal zone is less than 1,000 feet (305 m) deep, but the Canyon and Cook coal beds and the Wall and Pawnee coal zones are greater than 1,000 feet (305 m) deep. The remaining 50 percent of the quadrangle is classified as non-federal coal land. The coal resource tonnage totals for in-situ gasification are shown on table 3.

Table 1.--Strippable Coal Reserve Base Data (in short tons) for Federal Coal Lands in the Somerville Flats East Quadrangle, Johnson 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 Resources				
Upper Felix	7,659,547	6,759,944	110,190,509	124,610,000
Lower Felix	-	-	7,780,000	7,780,000
Total	7,659,547	6,759,944	117,970,509	132,390,000

Table 2.--Coal Reserve Base and Hypothetical Resource Data (in short tons) for Underground Mining Methods for Federal Coal Lands in the Somerville Flats East Quadrangle, Johnson and Campbell Counties, Wyoming.

Coal Bed Name	High Development Potential	Moderate Development Potential	Low Development Potential	Total
Reserve Base Resources				
Upper Felix	-	-	5,040,000	5,040,000
Lower Felix	-	-	1,040,000	
Smith	-	-	926,210,000	926,210,000
Anderson	-	-	2,816,930,000	2,816,930,000
Canyon	-	-	1,116,050,000	1,116,050,000
Cook	-	-	388,010,000	388,010,000
Wall	-	-	1,011,570,000	1,011,570,000
Pawnee	-	-	964,270,000	964,270,000
Cache	-	-	9,130,000	9,130,000
Oedekoven-Local 1-Local 2	-	-	887,360,000	887,360,000
Total	-	-	8,125,610,000	8,125,610,000
Hypothetical Resources				
Smith	-	-	3,770,000	3,770,000
Anderson	-	-	4,070,000	4,070,000
Canyon	-	-	3,770,000	3,770,000
Cook	-	-	1,630,000	1,630,000
Wall	-	-	930,000	930,000
Pawnee	-	-	3,560,000	3,560,000
Oedekoven-Local 1-Local 2	-	-	2,240,000	2,240,000
Total	-	-	19,970,000	19,970,000
GRAND TOTAL	-	-	8,145,580,000	8,145,580,000

for In-Situ Gasification

Table 3.--Coal Reserve Base and Hypothetical Resource Data (in short tons) for Federal Coal Lands in the Somerville Flats East Quadrangle, Johnson and Campbell Counties, Wyoming.

Coal Bed Name	High Development Potential	Moderate Development Potential	Low Development Potential	Total
Reserve Base Resources	6,216,784,718	684,698,085	1,224,127,197	8,125,610,000
Hypothetical Resources	-	-	19,970,000	19,970,000
Total	6,216,784,718	684,698,085	1,244,097,197	8,145,580,000

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