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COAL RESOURCES OF THE WALKER FLAT QUADRANGLE SEVIER COUNTY, UTAH

By

AAA Engineering and Drafting, Inc.

CONTENTS

ILLUSTRATIONS

TABLES

INTRODUCTION

Purpose

This report was compiled to support the land planning work of the Bureau of Land Management and to provide a systematic coal resource inventory of Federal coal lands in Known Recoverable Coal Resource Areas (KRCRA's) in the Western United States. It supplements the land planning requirements of the Federal Coal Leasing Amendments Act of 1976 (Public Law 94-377) sec. (3)(B) which states, in part, that "Each land-use plan prepared by the Secretary [of the Interior] (or in the case of lands within the National Forest System, the Secretary of Agriculture pursuant to subparagraph (A) (i)) shall include an assessment of the amount of coal deposits in such land, identifying the amount of such coal which is recoverable by deep mining operations and the amount of such coal which is recoverable by surface mining operations."

Published and unpublished public information were used as data sources for this study. No new drilling or field mapping was done to supplement this study. No confidential or proprietary data were used.

Location

The Walker Flat 7½ minute quadrangle is located on the east side of the southern part of the Wasatch Plateau coal field in south central Utah. The quadrangle lies in Sevier and Emery Counties and is approximately 39 miles (63 km) east of the city of Richfield, the county seat of Sevier County. The town of Castle Dale is the county seat of Emery County and is 27 miles (43 km) northeast of the quadrangle. The city of Salina is 6 miles (10 km) north and 26 miles (42 km) west of the quadrangle, and the town of Emery is 3 miles (5 km) north.

Accessibility

Utah Highway 10 runs northeast from its junction with U.S. Interstate Highway 70 in the southwest corner of the quadrangle. Numerous unimproved dirt roads and jeep trails cross the lowland area east of Utah Highway 10. No roads exist in the steep rocky canyons in the northwest corner of the quadrangle which is generally inaccessible to vehicular traffic.

The nearest railhead is at Salina, approximately 6 miles (10 km) north and 26 miles (42 km) west of the quadrangle. A branch line of the Denver and Rio Grande Western Railroad runs north and south from Salina along the western side of the Wasatch Plateau in Sanpete Valley. The railroad makes connections to Salt Lake City, Utah and Denver, Colorado.

Physiography

The eastern margin of the Wasatch Plateau is approximately 80 miles (129 km) long and consists of sparsely vegetated sandstone cliffs and steep shale slopes cut by numerous steep-walled canyons. The rocks are gently dipping, generally less than 10 degrees. The cliff line which marks the eastern edge of the plateau crosses the northwest corner of the Walker Flat quadrangle.

The lowland area below the cliffs is characterized by low hills and shallow washes. The lowest point in the quadrangle is 5,780 ft (1,762 m) above sea level where Ivie Creek leaves the east side of the quadrangle. The highest point is 8,663 ft (2,640 m) above the cliffs in the northwest corner of the quadrangle.

Most of the quadrangle area drains into Ivie Creek which flows eastward across the central part of the quadrangle. Ivie Creek drains into Muddy Creek approximately 3 miles (5 km) east of the quadrangle. Quitchupah Creek crosses the northeast corner of the quadrangle and then flows into Ivie Creek. The area is in the Colorado River drainage system.

Climate

The Wasatch Plateau is in the mid-latitude steppe climate with semi-arid conditions prevailing at the lower elevations. The normal annual precipitation in the Walker Flat quadrangle ranges from 7 inches (18 cm) along the east side to approximately 13 inches (33 cm) in the high mountainous area in the northwest corner of the quadrangle. (U.S. Department of Commerce, (1964)).

Temperatures on the high plateau are generally cool in the summer and cold in winter. Summertime temperatures may reach a high of 85 degrees F (29 degrees C) and a low of -30 degrees F (-34 degrees C) in winter. The temperatures at the lower elevations below the steep mountain front range approximately between 100 degrees F (38 degrees C) and -20 degrees F (-29 degrees C).

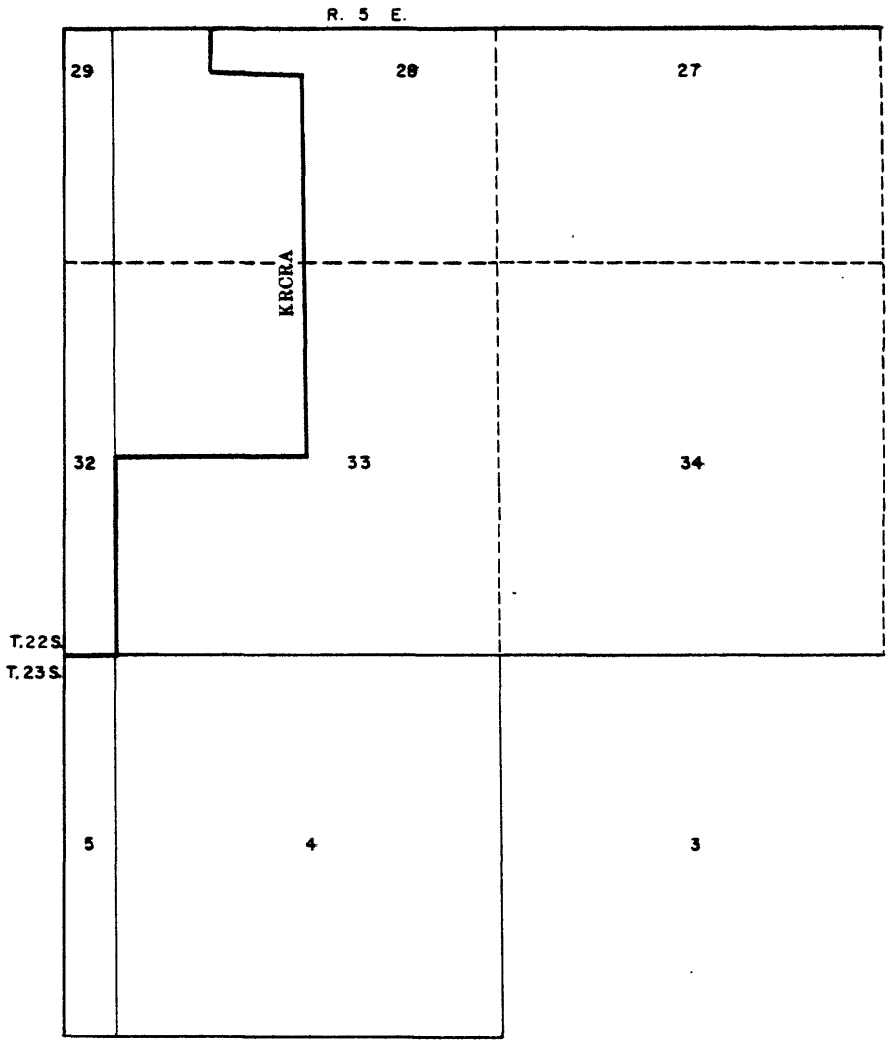
Land Status

The Walker Flat quadrangle lies on the east side of the southern part of the Wasatch Plateau Known Recoverable Resource Area (KRCRA) and approximately 500 acres (202 ha) in the northwest corner of the quadrangle lie within the KRCRA. This area consists entirely of unleased Federal coal land (1979) (see figure 1).

GENERAL GEOLOGY

Previous Work

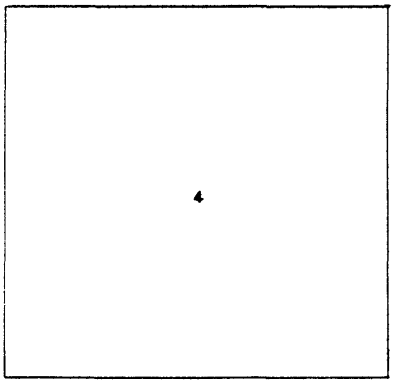
Spieker (1931) mapped and described the geology and coal occurrences of the Wasatch Plateau. The stratigraphy of the area was described by Spieker and Reeside (1925), Spieker (1949), Katich (1954), and Hayes and others (1977). Doelling (1972) compiled the geology and available coal data for the coal field.



EXPLANATION

KRCRA

KNOWN RECOVERABLE COAL RESOURCES AREA BOUNDARY – Label within KRCRA boundary.



SECTION OF LAND

NOTE: BLM Coal Ownership Data current as of September 22, 1977.

REFERENCE

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, 7p.

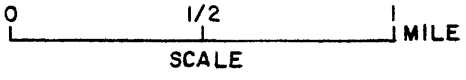
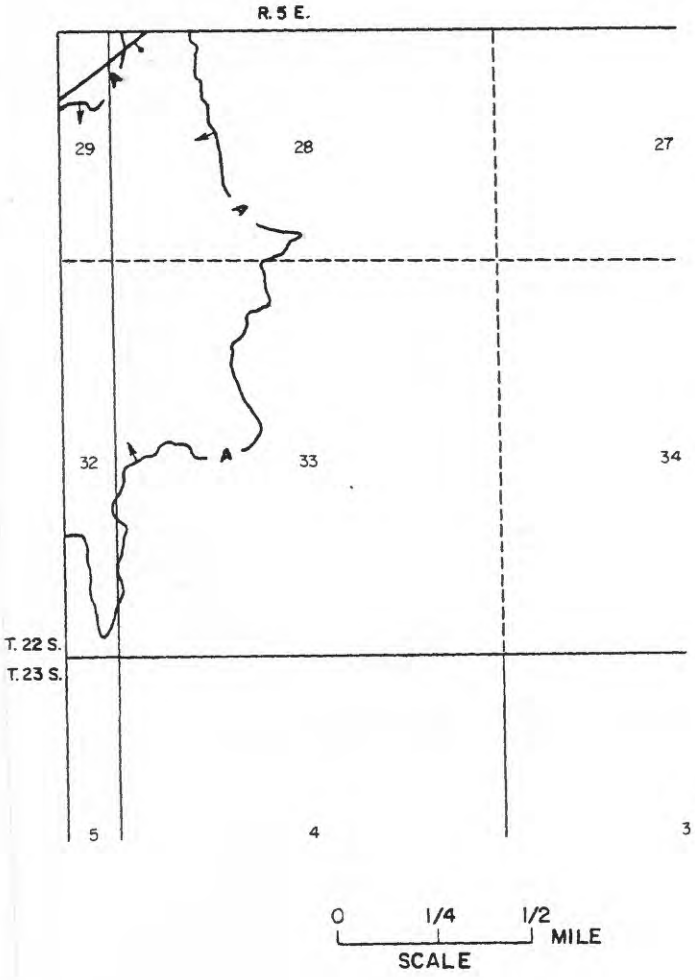


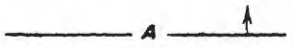
FIGURE 1. Boundary map, Walker Flat Quadrangle, Sevier and Emery counties, Utah.



EXPLANATION

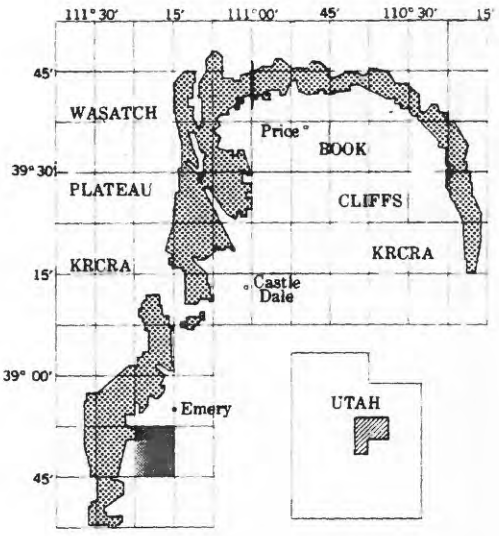
A – "A" bed (formerly Hiawatha of Spieker, 1931)

COAL BED SYMBOL AND NAME



TRACE OF COAL BED OUTCROP – Letter designate the name of the coal bed as listed above. Arrow points toward the coal bearing area.

FAULT – Dashed where approximately located: bar and ball on downthrown side



MAP SHOWING LOCATION OF THE WALKER FLAT QUADRANGLE (SHADED) AND THE BOOK CLIFFS AND WASATCH PLATEAU KNOWN RECOVERABLE COAL RESOURCE AREAS (STIPPLED), UTAH.

FIGURE 2. Coal data map, Walker Flat Quadrangle, Sevier and Emery counties, Utah.

The Emery West quadrangle which joins the north side of the Walker Flat quadrangle was recently mapped by Hayes and Sanchez (1977). Detailed measurements and descriptions of closely spaced stratigraphic sections of the upper part of the Star Point Sandstone and the lower part of the Blackhawk Formation in those two quadrangles were made by Marley and Flores (1977). Marley, Flores, and Carovac (1978) presented in preliminary form a discussion of depositional environments and origin of rocks within the Blackhawk Formation and the Star Point Sandstone in the Wasatch Plateau. A detailed description of the lithostratigraphy of portions of these two formations was made by Marley (1978).

AAA Engineering and Drafting, Inc. (1979a, 1979b, and 1979c) prepared coal resource occurrence and coal development potential maps for the adjoining Acord Lakes, Emery West, and Old Woman Plateau quadrangles.

Stratigraphy

The coal beds of economic importance in the Wasatch Plateau coal field are Upper Cretaceous in age and are confined to the Blackhawk Formation of the Mesaverde Group. This group includes, in ascending order: Star Point Sandstone, Blackhawk Formation, Castlegate Sandstone, and Price River Formation (see figure 3). The Upper Cretaceous Mancos Shale underlies the Star Point Sandstone and includes the following members in ascending order: Tununk Shale, Ferron Sandstone, Blue Gate Shale, Emery Sandstone, and Masuk Shale.

The oldest unit exposed in the quadrangle is the Tununk Shale Member of the Mancos Shale which crops out in the southeast corner of the quadrangle and consists of gray marine mudstone and minor thin sandy layers.

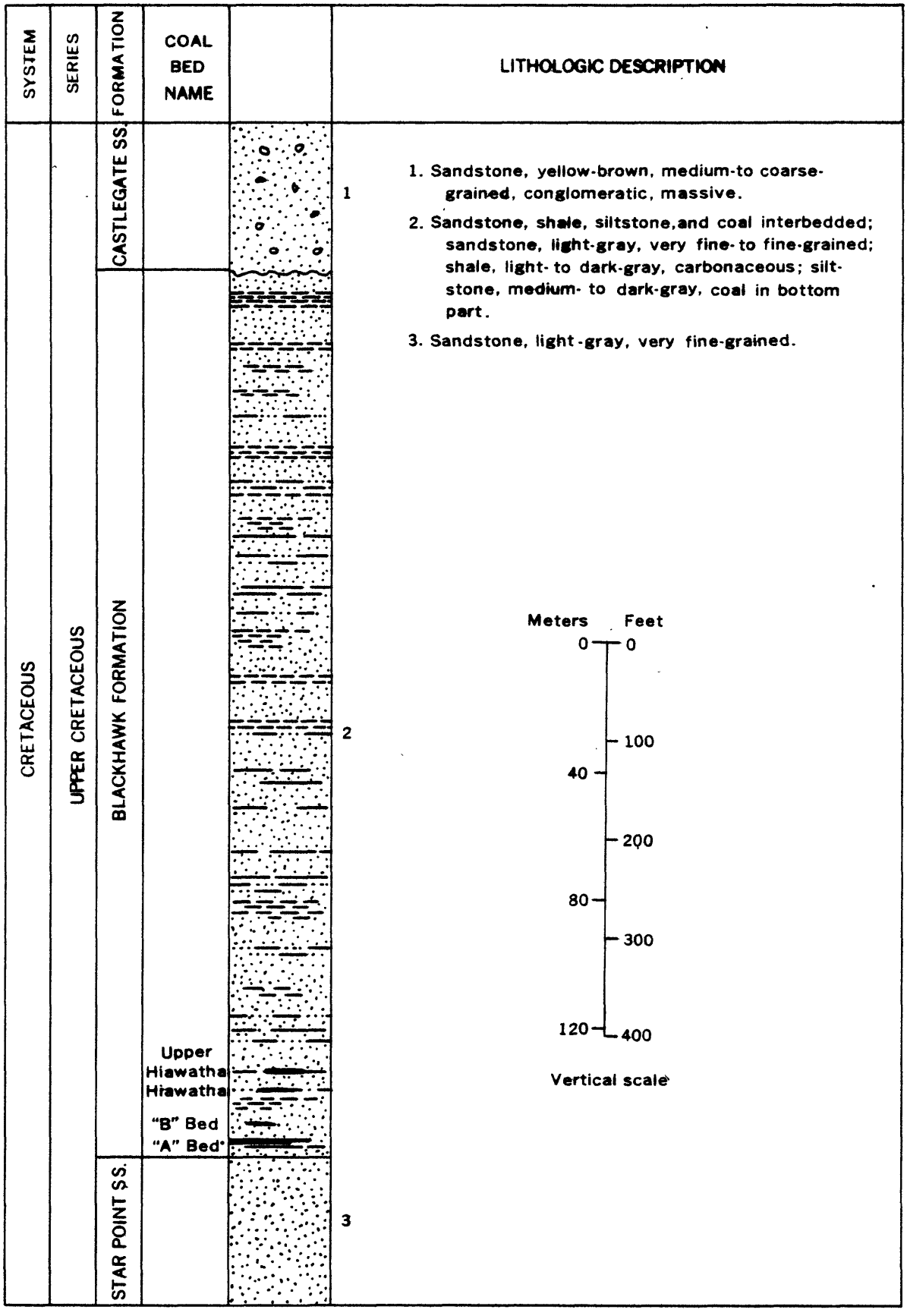


FIGURE 3. Composite columnar section, Walker Flat Quadrangle, Sevier and Emery Counties, Utah.

The Ferron Sandstone Member is exposed in the eastern third of the quadrangle and is composed of interbedded sandstone, gray shale, carbonaceous shale, shaly sandstone, and coal. The Ferron Sandstone is approximately 450 ft (137 m) thick. The Blue Gate Shale Member is similar to the Tununk Shale except lighter in color. The nodular and earthy-weathering gray shales have a yellowish cast in some areas where the sand content is increased. The Blue Gate weathers into rounded hills with finely fluted drainage lines. Doelling (1972) estimates that this member is about 1,600 ft (488 m) thick. The Blue Gate crops out or is overlain by a veneer of Quaternary gravel in a wide north-south trending band running through the central part of the quadrangle. The Blue Gate Shale is overlain by the Emery Sandstone Member which is 800 ft (244 m) thick. It consists of massive sandstone alternating with much thinner beds of gray shale and shaly sandstone. The Emery is overlain by the Masuk Shale which consists of approximately 700 ft (213 m) of bluish-gray sandy shale (Doelling, 1972).

The Star Point Sandstone overlies the Masuk Shale and crops out as a cliff along the eastern margin of the Wasatch Plateau. The Star Point is from 300 to 450 ft (91 to 137 m) thick (Doelling, 1972) and is composed of an upper massive white sandstone unit which is underlain by an interbedded sandstone and shale unit. It is exposed in the Wasatch Plateau cliffs in the northwest corner of the quadrangle.

Doelling (1972) reports that the Blackhawk Formation is approximately 750 ft (229 m) thick in the adjoining quadrangle to the west and 850 ft (259 m) thick in the adjoining quadrangle to the north. The formation consists of interbedded sandstone, shale, siltstone and coal beds. Marley and Flores (1977, p. ii and iii) report that "the Blackhawk Formation

interfingers laterally with and locally unconformably overlies the Star Point Sandstone. . . The characteristics of the rock types of the Blackhawk Formation suggest that they represent delta-plain deposits, which grade (seaward) into the underlying delta-front and prodelta deposits of the Star Point Sandstone."

The youngest consolidated formation exposed in the quadrangle is the Castlegate Sandstone. It is a massive, cliff-forming, yellow to gray sandstone unit 90 to 200 ft (27 to 61 m) thick and caps the mountain in the northwest corner of the quadrangle.

Structure

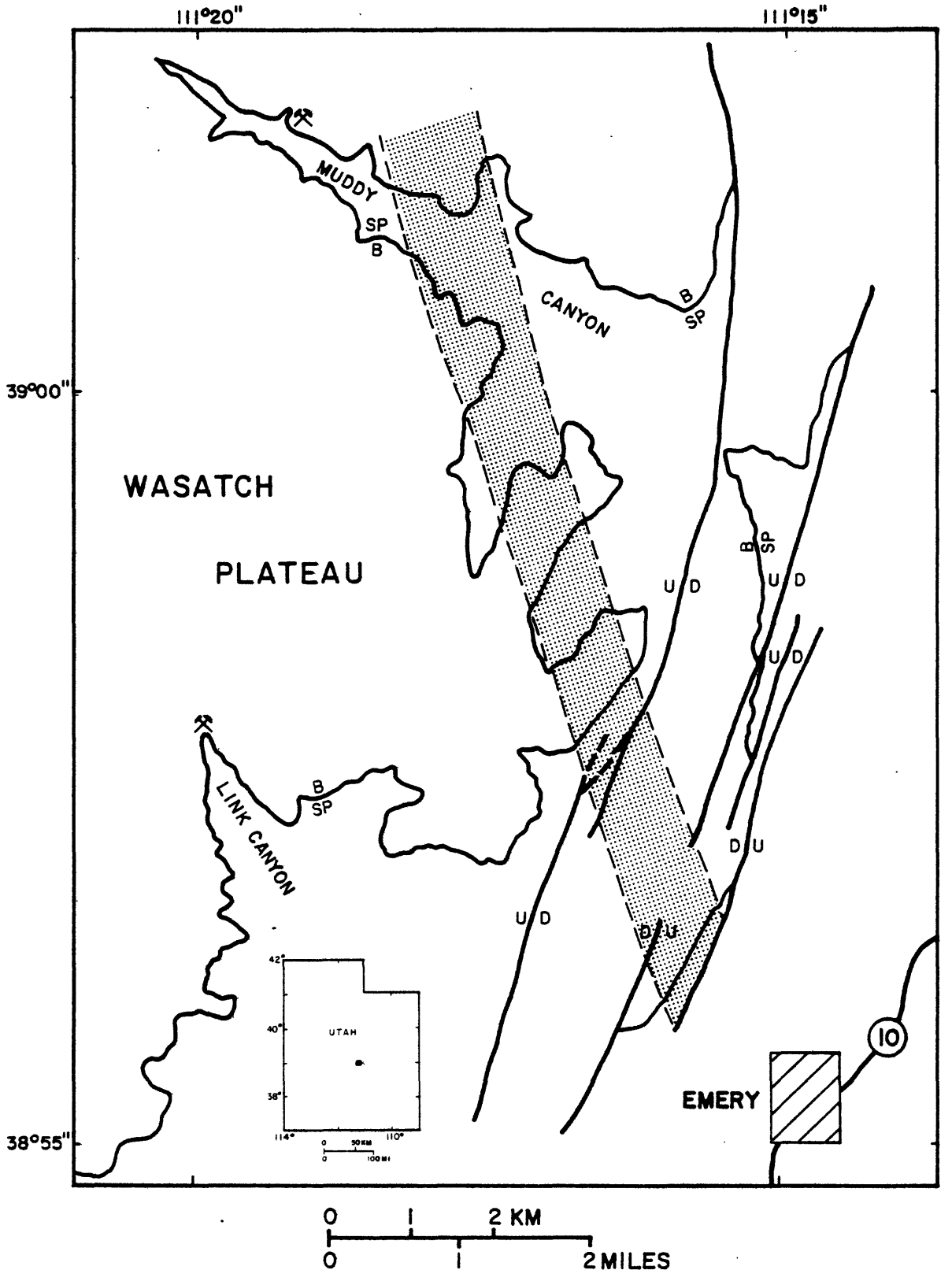
North-south trending faults of the Joes Valley-Paradise fault zone occur in the western half of the quadrangle but do not involve the coal beds in the quadrangle KRCRA. An insignificant normal fault with small displacement cuts across the northwest corner of the quadrangle (see figure 2). The rocks in the northwest corner of the quadrangle dip less than 3 degrees westward based on a structure contour map of the Hiawatha coal bed for the adjoining quadrangle on the west (AAA Engineering and Drafting, Inc., 1979c).

COAL GEOLOGY

Major coal beds in the Wasatch Plateau coal field occur in the lower part of the Blackhawk Formation. In the adjoining quadrangle to the west Spieker (1931) and Doelling (1972) list the following coal beds in ascending order: the Hiawatha, Upper Hiawatha, Ivie, Upper Ivie, Saleratus, and thin local beds. For the adjoining quadrangle to the north (Emery West) these authors list the following coal beds in ascending order: the Hiawatha, Upper Hiawatha, Muddy No. 2, Upper Ivie, and upper local beds.

Sanchez and Hayes (1977) mapped the geology of the Flagstaff Peak quadrangle and the geology of the Emery West quadrangle (Hayes and Sanchez, 1977). Marley and Flores (1977) made detailed measurements and descriptions of closely-spaced stratigraphic sections of the upper part of the Star Point Sandstone and the lower part of the Blackhawk Formation. A zone of intertonguing between these two formations was observed at several localities within a 6 mile (10 km) long and 0.6 mile (1 km) wide belt extending south-southeastward from the north wall of Muddy Creek Canyon in the Flagstaff Peak quadrangle to a point near the town of Emery in the Emery West quadrangle (see figure 4). "As a result of this intertonguing, the contact between the two formations is about (20 m) higher to the east than it is to the west and the coal-bed correlations of Spieker (1931) must be modified." (Flores and others, 1978).

As a consequence of the recognition of the intertonguing, a revision of the correlations of the lower Blackhawk Formation coal beds on the two sides of the zone of intertonguing was suggested by Flores and others (1978). They pointed out, for example, that "the upper bed in the abandoned mine of Muddy Canyon and referred to as Muddy No. 2 coal bed by Spieker (1931) is apparently the Hiawatha coal bed. . .", and that, "The coal bed mined in the abandoned Link Canyon mine. . .and identified by Doelling (1972) as the Upper Hiawatha coal bed merges laterally eastward into the Star Point Sandstone and must be about 20 m below the stratigraphic position of the Upper Hiawatha coal bed of areas to the east of the zone of intertonguing" (Flores and others, 1978). Generalized cross sections through the zone of intertonguing are shown in figure 5.



EXPLANATION

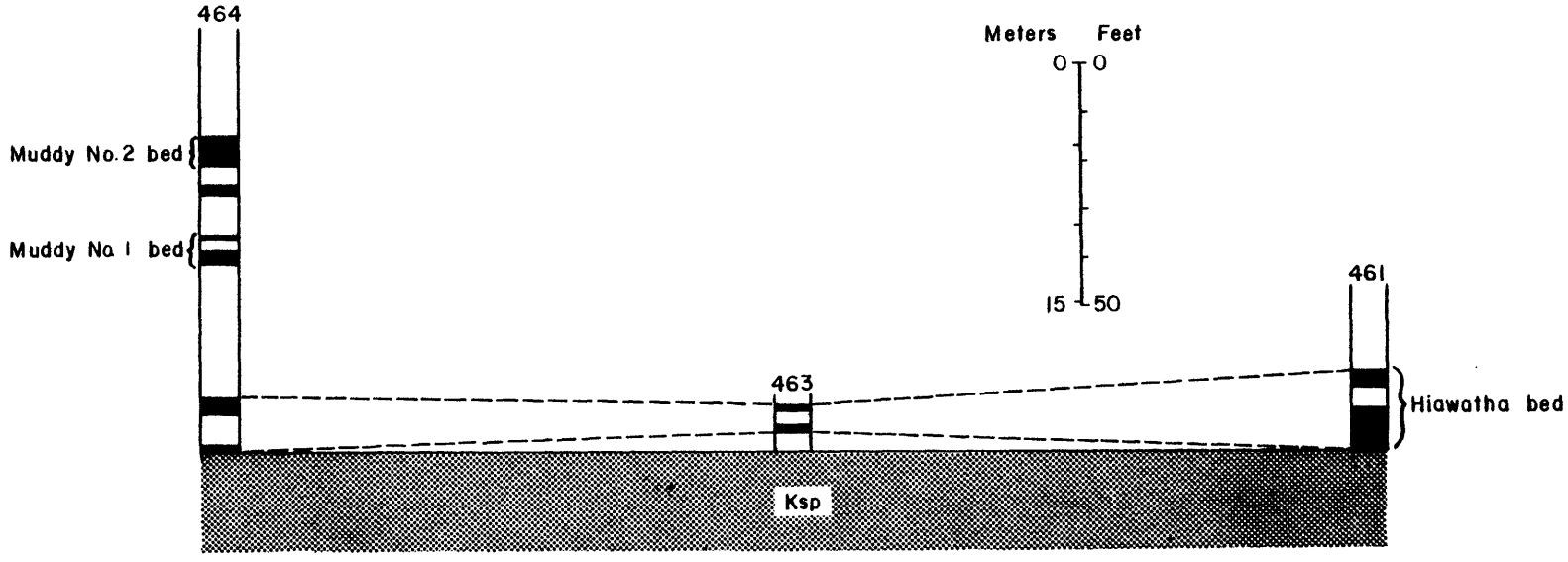
ZONE OF INTERTONGUING

COAL MINE

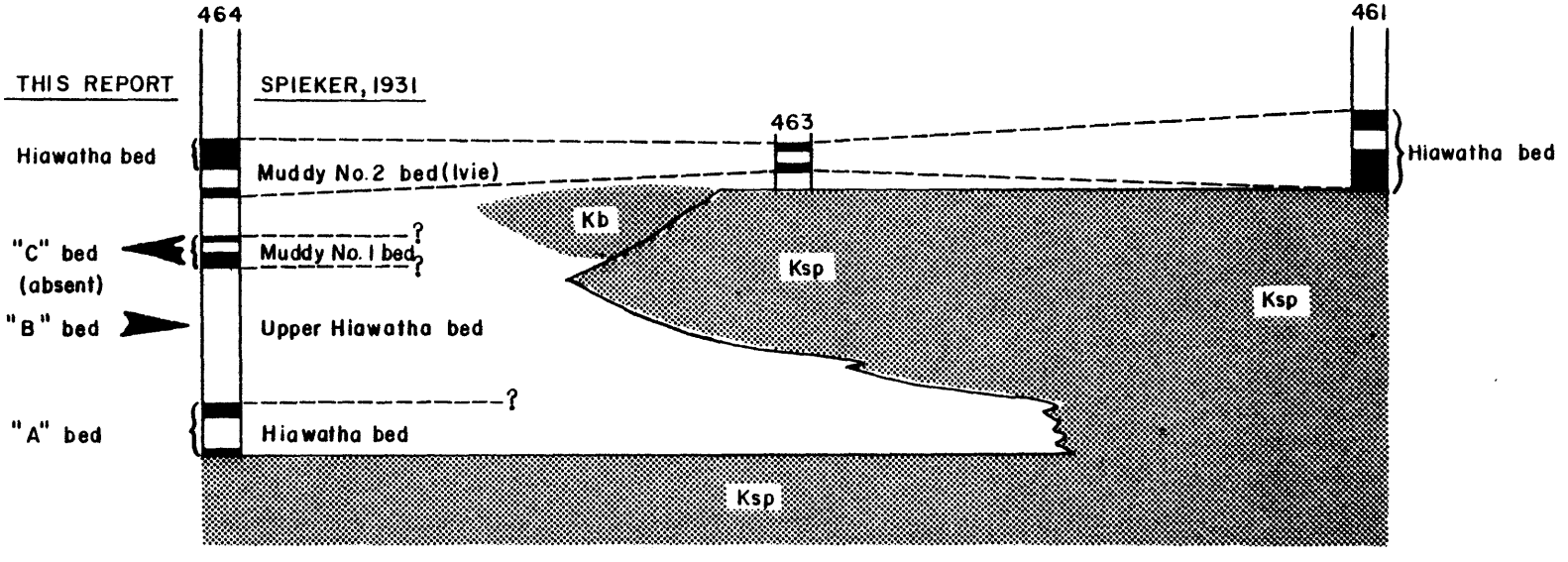
B / SP — CONTACT BETWEEN BLACKHAWK FORMATION (B) AND STAR POINT SANDSTONE (SP)

U / D — FAULT - DASHED WHERE FAULT IS INFERRED U. UPTHROWN SIDE, D. DOWNTHROWN SIDE

FIGURE 4. Map showing zone of intertonguing (after Flores and others, 1978).



Correlations of Spieker (1931)



Revised correlations

FIGURE 5. Generalized cross sections showing former and revised coal-bed correlations (after Flores and others, 1978).

The KRCRA in the Walker Flat quadrangle lies approximately 7 miles (11 km) southwest of the zone of intertonguing and the coal-bed names used here reflect the stratigraphic correlations suggested by Flores and others (1978) in the Emery West and Flagstaff Peak quadrangles. The names "A" bed and "B" bed, are substituted for the Hiawatha and Upper Hiawatha beds of Spieker (1931). Table 1 shows the coal bed correlations used on the west side of the zone of intertonguing in this report and in the Emery West and Old Woman Plateau quadrangles.

Table 1. Correlations of coal beds on the east and west side of the zone of intertonguing, Old Woman Plateau and Emery West quadrangles, Sevier and Emery Counties, Utah.

West Side of Zone of Intertonguing			East Side of Zone of Intertonguing
New Correlations This report and Old Woman Plateau Quadrangle	New Correlations Emery West Quadrangle	Spieker (1931) and Doelling (1972)	Spieker (1931) and Doelling (1972)
Upper Hiawatha Hiawatha (absent) "B" Bed "A" Bed	Upper Hiawatha Hiawatha "C" Bed "B" Bed "A" Bed	Upper Ivie Muddy No. 2 (Ivie) Muddy No. 1 Upper Hiawatha Hiawatha	Upper Ivie Muddy No. 2 Muddy No. 1 Upper Hiawatha Hiawatha

"A" Coal Bed

The "A" coal bed occurs on the west side of the zone of intertonguing. The bed in this area is the one formerly called the "Hiawatha" coal bed by Spieker (1931) and Doelling (1972). Based on work by Flores and others

(1978) the bed merges laterally into the Star Point Sandstone in the zone of intertonguing and is approximately 65 ft (20 m) stratigraphically below the Hiawatha coal bed on the east side of the zone.

In the adjoining Old Woman Plateau quadrangle the "A" bed is lenticular and ranges up to 3.0 ft (0.9 m) in thickness. The nearest measured section to the Walker Flat quadrangle KRCRA is about 0.5 mile (0.8 km) west of the quadrangle where the "A" bed is split into an upper 2.0-ft (0.6-m) bed and a lower 2.1-ft (0.6-m) bed by 7.7 ft (2.3 m) of rock. The bed reaches a thickness of 9.6 ft (2.9 m) approximately 4.4 miles (7.1 km) north of the Walker Flat quadrangle (AAA Engineering and Drafting, Inc., 1979b). The trace of the "A" bed on figure 2 is the trace of the former Hiawatha bed of Spieker (1931). No measured sections nor drill-hole data were available for the KRCRA in the Walker Flat quadrangle.

"B" Coal Bed

The "B" coal bed occurs on the west side of the zone of intertonguing and was formerly called the Upper Hiawatha coal bed by Spieker (1931), Doelling (1972), and others. This bed is missing in much of the Old Woman Plateau quadrangle. It is lenticular and thin, but reaches a thickness of 4.0 ft (1.2 m) approximately 0.5 mile (0.8 km) west of the Walker Flat quadrangle KRCRA. The bed thickens northward and northwestward where it reaches over 15.0 ft (4.6 m) thick 3.5 miles (5.6 km) north in the Emery West quadrangle and 18.0 ft (5.5 m) thick in the Acord Lakes quadrangle.

"C" Coal Bed

The "C" coal bed, formerly called the Muddy No. 1 by Spieker (1931) on the west side of the zone of intertonguing, occurs in the Emery West quadrangle but is apparently absent in the Old Woman Plateau and Acord Lakes quadrangles.

Hiawatha Coal Bed

Based on field work by Flores and others (1978) the Hiawatha coal bed on the east side of the zone of intertonguing correlates with the coal bed formerly called the Muddy No. 2 coal bed on the west side of the zone by Spieker (1931) and Doelling (1972). In the Ivie Creek area Spieker (1931, p. 180) suggests the equivalency of the Muddy No. 2 and the Ivie coal beds. In the Old Woman Plateau quadrangle, the coal bed called "Hiawatha" is the one formerly called the Ivie coal bed by Spieker (1931) and in the Emery West quadrangle the Hiawatha bed is the one formerly called the Muddy No. 2 by Spieker (1931) on the west side of the zone of intertonguing. The nearest point of measurement for this coal bed is in the Old Woman Plateau quadrangle about 0.5 mile (0.8 km) west of the Walker Flat quadrangle KRCRA. At that point the Hiawatha bed is split into an upper bed 0.5 ft (0.2 m) and a lower bed 1.3 ft thick by a rock interval 3.4 ft (1.0 m) thick (AAA Engineering and Drafting, Inc., 1979c). Southwestward from that point, however, the bed thickens to 11.7 ft (3.6 m). The bed thickens northward and is 7.0 ft (m) thick in the central part of the Emery West quadrangle.

Upper Hiawatha Coal Bed

The coal bed called the Upper Hiawatha was formely called the Upper Ivie coal bed by Spieker (1931) on the west side of the zone of intertonguing. The bed is generally thin and somewhat lenticular in the Old Woman Plateau quadrangle but reaches a thickness of 10.3 ft (3.1 m) 1.5 miles (2.4 km) west of the Walker Flat quadrangle KRCRA. From that point the bed thins eastward toward the Walker Flat quadrangle.

Local Coal Beds

Several thin non-correlatable coal beds occur at various positions in the measured sections and drill holes in the adjoining quadrangles. Most of these local coal beds are lenticular and less than 5.0 ft (1.5 m) thick.

Chemical Analyses of the Coal

No chemical analyses of coal from the Walker Flat quadrangle are available. However, analyses of the Upper Hiawatha coal bed (formerly the Upper Ivie bed of Spieker, 1931) from the adjoining Acord Lakes quadrangle (Doelling, 1972) on the northwest indicate this coal ranges in rank from high volatile C bituminous to high volatile B bituminous (American Society for Testing and Materials, 1977). The following table shows the range and average proximate analyses of coal samples from the Acord Lakes quadrangle.

Table 2. Average proximate analysis of coal from the Upper Hiawatha coal bed (formerly Upper Ivie bed of Spieker, 1931), Acord Lakes quadrangle, Sevier County, Utah.*

	No. Analyses	As-received (percent) Average	Range
Moisture	12	8.7	5.6-10.4
Volatile matter	11	38.3	36.2-40.6
Fixed carbon	11	46.6	43.3-50.4
Ash	12	6.5	5.9- 7.1
Sulfur	12	0.46	0.3- 0.6
Btu/lb**	11	11,770	11,390-12,260

*Doelling, 1972, p. 141
**To convert Btu/lb to Kj/kg multiply by 2.326

Doelling (1972) lists 7 coal analyses of the "B" coal bed (formerly the Upper Hiawatha bed of Spieker, 1931) from the Link Canyon mine in the Emery West quadrangle. The proximate analyses of these samples are summarized in the following table.

Table 3. Average proximate analysis of coal from the "B" coal bed (formerly the Upper Hiawatha bed of Spieker, 1931), Emery West quadrangle, Sevier and Emery Counties, Utah.*

	No. Analyses	As-received (percent) Average	Range
Moisture	7	8.3	7.0-12.9
Volatile matter	5	38.1	37.5-38.6
Fixed carbon	5	46.0	45.3-46.4
Ash	7	8.0	5.4-10.0
Sulfur	7	0.42	0.4- 0.5
Btu/lb**	5	11,674	11,570-11,770

*Doelling, 1972, p. 133
**To convert Btu/lb to Kj/kg multiply by 2.326

Based on the ASTM system of classification, coal with the average analysis shown in table 3 is ranked as high volatile C bituminous (American Society for Testing and Materials, 1977).

Mining Operations

There are no known coal mines or prospects in the Walker Flat quadrangle KRCRA. However, mining operations have occurred in the adjoining quadrangles. In the Emery West quadrangle the Link Canyon mine produced about 164,000 short tons (148,780 metric tons) of coal from the "B" bed (formerly the Upper Hiawatha of Spieker, 1931) during a period of operation from 1940 to 1952. At this writing (1979) the mine was inactive.

The only active mine in the Old Woman Plateau quadrangle (1979), the Knight mine, is located in Ivie Creek Canyon in Section 34, T. 23 S., R. 4 E. This mine is producing from the Hiawatha bed (formerly the Ivie bed of Spieker, 1931). It was opened in 1923 and has been intermittently active with a 20-year period of inactivity preceding its reactivation in 1977.

Two known coal mines occur in the Acord Lakes quadrangle. The Queatchappel or Queatch-up-pah Creek mine in Quitchpah Canyon operated intermittently from 1901-1920 and produced about 6,600 short tons (5,988 metric tons) (Doelling 1972). The mine was abandoned at this writing (1979). The Southern Utah Fuel mine in East Spring Canyon, a tributary of Convulsion Canyon, became active in 1941 and is presently operating (1979). Doelling (1972) reports that it produced a total of 1.1 million short tons (1.0 million metric tons) by 1969. The mine is producing from the Upper Hiawatha bed (formerly the Upper Ivie bed of Spieker, 1931).

COAL RESOURCES AND COAL DEVELOPMENT POTENTIAL

Inasmuch as there are no coal bed measurements in the Walker Flat quadrangle KRCRA and no coal beds of Reserve Base thickness have been projected into the area from adjoining quadrangles, no coal resources are shown.

Development Potential for Surface Mining Methods

No development potential for surface mining methods exists in the KRCRA of this quadrangle because of the rugged topography, steep-sided canyons, extreme relief, and thick overburden. There may be very small areas where some contour mining could be done, but in general the area is not conducive to surface mining methods.

Development Potential for Subsurface Mining and In Situ Coal Gasification Methods

The coal development potential for subsurface mining of coal is based on coal thickness and thickness of overburden for beds dipping less than 15 degrees. Areas where coal beds 5 ft (1.5 m) or more in thickness

are overlain by less than 1,000 ft (305 m) of overburden are classified as having a high development potential for subsurface mining. Areas where such beds are overlain by 1,000 to 2,000 ft (305 to 610 m) and 2,000 to 3,000 ft (610 to 914 m) of overburden are rated as having a moderate and a low development potential, respectively. Areas that contain no known coal in beds 5 ft (1.5 m) or more thick, but coal-bearing units are present at depths of less than 3,000 ft (914 m) are classified as areas of unknown coal development potential. Areas where no coal beds are known to occur or where coal beds are present at depths greater than 3,000 ft (914 m) have no coal development potential.

There are no known coal bed measurements in the Walker Flat quadrangle KRCRA. Projections of coal bed thicknesses into the quadrangle from adjoining quadrangles indicate that several coal beds occur in the lower part of the Blackhawk Formation in the northwest corner of the quadrangle and that these beds are less than 5 ft (1.5 m) in thickness. These coal beds are overlain by less than 1,000 ft (348 m) of overburden. Therefore, the entire KRCRA area in the Walker Flat quadrangle is classified as having an unknown development potential.

Classification of development potential for in situ coal gasification was not done because dips are less than 15 degrees within the KRCRA in the Walker Flat quadrangle. The criteria for selection of areas suitable for in situ coal gasification are a minimum coal thickness of 5 ft (1.5 m), dips of 15 to 90 degrees, and overburden greater than 200 ft (61 m) and less than 3,000 ft (914 m).

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