UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Text to accompany:

Open-File Report 79-1415

COAL RESOURCE OCCURRENCE AND COAL DEVELOPMENT POTENTIAL MAPS OF THE BANTY POINT QUADRANGLE RIO BLANCO COUNTY, COLORADO

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Prepared for the U.S. Geological Survey
under contract No. 14-08-0001-17457

1980

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Purpose

These maps were compiled to support the land-use planning work of the Bureau of Land Management and to provide a systematic coal resource inventory of Federal coal lands in the Lower White River Known Recoverable Coal Resource Area (KRCRA) in response to the land-use planning requirements of the Federal Coal Leasing Amendments Act of 1976.

Published and unpublished non-proprietary data sources were used for this study.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

Location

The Banty Point quadrangle is located in Rio Blanco County in northwestern Colorado. The city of Craig, the county seat of Moffat County, is 76 miles (122 km) northeast of the quadrangle. The city of Meeker, the county seat of Rio Blanco County, is approximately 50 miles (80 km) east of the quadrangle. The town of Rangely is 4 miles (6 km) east of the quadrangle and the Colorado-Utah State line is 2.5 miles (4 km) to the west. The Colorado-Wyoming state line is 61 miles (98 km) north of the quadrangle. The city of Vernal, Utah is 36 miles (58 km) northwest of the quadrangle.

Accessibility

Colorado State Highway 64 crosses the northeast corner of the quadrangle providing access to the town of Rangely and to U.S. Highway 40. Numerous light-duty roads in the northeast quarter of the quadrangle serve the Rangely oil field. Light-duty gravel roads run east-west on each side of the White River in the central part of the quadrangle. Several unimproved dirt roads and jeep trails provide access to the more rugged areas in the south half of the quadrangle. Roads are found in Cottonwood Creek, Shavetail Park, and in the area between Shavetail Wash and Big Trujillo Wash.

The nearest railhead is at Craig. This is the western terminus of a branch line of the Denver and Rio Grande Western Railroad; from Craig rail connections can be made to Denver, Colorado. An airport is maintained near the town of Rangely, and there is a landing strip in the northeast corner of the quadrangle in the Rangely oil field.

Physiography

The topography of the Banty Point quadrangle ranges from relatively flat lowland in the Coal Oil Basin around the Rangely oil field in the northeastern quarter of the quadrangle to a rather rugged and hilly topography in the rest of the quadrangle area. The relief in the quadrangle is approximately 1,335 ft (407 m). The high point is 6,430 ft (1,960 m) above sea level on a mountain at the south edge of the quadrangle. The low point is about 5,095 ft (1,553 m) where the White River leaves the west side of the quadrangle. The steepest topography within the quadrangle is the precipitous mountain face on the north side of the White River in the west central part of the quadrangle. In this area the cliffs are from 400 to 800 ft (122 to 244 m) high.

Part of the northeastern quarter of the quadrangle lies in the relatively flat lowland called the Coal Oil Basin. The southern half of the quadrangle has gently rolling hills and knolls dissected by Shavetail Wash and Big Trujillo Wash. The southwest corner of the quadrangle is mountainous. The White River forms the major drainage in the area and crosses the central part of the quadrangle in an east-west direction. The river meanders across its flood plain which is up to 0.5 mile (0.8 km) wide and flows westward to its confluence with the Green River in Utah.

Climate

The Banty Point quadrangle has a mid-latitude steppe climate and the normal annual precipitation ranges from 9 inches (23 cm) in the northern part of the quadrangle to 11 inches (28 cm) in the southern part (U.S. Department of Commerce, (1964)).

The nearest weather data recording station is at Rangely where a record high temperature of 104^{o} F (40^{o} C) and a record low temperature of -37^{o} F (-38^{o} C) were recorded (National Weather Service Forecast Office, personal communication). The mean annual temperature at Rangely is 45.6^{o} F (7.6^{o} C). The temperatures in the Banty Point quadrangle are expected to be a few degrees cooler than at Rangely (elevation, 5,240 ft (1,597 m)) because of the higher altitudes in the quadrangle area. A flood hazard exists along the flood plain of the White River.

Land Status

The Banty Point quadrangle lies in the western part of the Lower White River Known Recoverable Coal Resource Area (KRCRA). The KRCRA covers approximately 17,550 acres (7,102 ha) of the quadrangle. The areas of non-Federal land and the KRCRA boundary are shown on plate 2. There were no existing Federal coal leases or preference right lease applications in this quadrangle at the date of the land check for this report as shown on plate 2. A comparison of the areas of unleased Federal coal ownership and non-Federal land in the quadrangle area is shown in table 1.

Table 1.--Comparison of Federal and non-Federal land areas in the Banty Point quadrangle, Rio Blanco County, Colorado.

Category	Approximate Area (Acres)[1]	Percent of Quadrangle Area (%)
Non-Federal land	7,070	19
Unleased Federal coal ownership	29,590[2]	81
Total	36,660	100

[1]To convert acres to hectares, multiply acres by 0.4047.
[2]Coal is known to be present in only part of this area.

Previous Work

Gale (1910) described the coal fields of northwestern Colorado and northeastern Utah including the Lower White River field. Cullins (1968) mapped the geology and coal exposures of the Banty Point quadrangle. Sub-surface data was obtained from an oil test hole drilled cooperatively by Chevron, Pan American, and Amerada oil companies.

GENERAL GEOLOGY

Stratigraphy

Sedimentary rocks exposed in the Banty Point quadrangle are Late Cretaceous and Tertiary in age. The important coal beds in the area occur in rocks of the Mesaverde Formation of Late Cretaceous age. This formation has been divided, in ascending order, into the Sego Sandstone Member, minor coal memeber, main coal member, and barren member by Cullins (1968). The Wasatch Formation of Paleocene and Eocene age overlies the Mesaverde Formation.

The oldest formation exposed in the quadrangle is the Mancos Shale which crops out in the northeast quarter of the quadrangle. The Mancos consists of brownish-gray, noncalcareous marine shale. It is over 3,600 ft (1,097 m) thick but only 1,900 ft (597 m) are exposed in the quadrangle (Cullins, 1968). The tongue of Castlegate Sandstone, 50 to 70 ft (15 to 21 m) thick, separates the Buck Tongue of the Mancos Shale from the main body of the Mancos Shale. The tongue of Castlegate Sandstone is composed of very light-gray, very fine-grained resistant sandstone. The Buck Tongue of the Mancos Shale is approximately 250 feet (76 m) thick and is similar to the main body of the Mancos. It contains orange-weathering dolomite concretions that contain *Baculites*. Abundant gypsum occurs in the upper 85 ft (26 m) of the Buck Tongue.

The Sego Sandstone overlies the Buck Tongue of the Mancos Shale and consists of very light-gray, fine- to very fine- grained sandstone. The Anchor Mine Tongue of the Mancos Shale occurs in the middle of the Sego Sandstone and consists of brownish-gray, sandy shale. The total thickness of the Sego Sandstone is approximately 200 ft (61 m) including the Anchor Mine Tongue of the Mancos Shale which is approximately 110 ft (34 m) thick.

The minor coal member of the Mesaverde Formation is approximately 750 ft (229 m) thick and consists of light-brown, yellowish-gray, and very light-gray, fine- to very fine-grained, limy sandstone interbedded with gray to light brownish-gray shale and brown carbonaceous shale. A few thin coal beds occur in this member.

The main coal member of the Mesaverde Formation is approximately 500 ft (152 m) to 600 ft (183 m) thick and consists of yellowish-gray to dirty orange, very fine- to fine-grained limy sandstone interbedded with gray and brown carbonaceous shale, and coal.

The barren member of the Mesaverde Formation consists of brown to yellowish-gray, fine- to very fine-grained, massive, lenticular, limy sandstone interbedded with yellow-gray shale. Thin coal beds are locally present in the upper part of this member. The barren member is approximately 1,100 ft (335 m) thick.

The Wasatch Formation consists of green, grayish-green, purple, and red claystone and shale; and white to ash-gray, fine- to medium-grained, slightly resistant to nonresistant sandstone. Dark chert grains are commonly found in the sandstones. The Wasatch is approximately 120 ft (37 m) to 325 ft (99 m) thick.

The Green River Formation of Eocene age overlies the Wasatch Formation and consists of marlstone, shale, limestone, sandstone, and oil shale. The formation is approximately 2,515 ft (767 m) thick in the quadrangle area.

Approximately 360 ft (110 m) of the lower part of the Uinta Formation is exposed in the northwest corner of the quadrangle. The Uinta Formation overlies the Green River Formation and consists of brown and light-brownish gray, medium- to coarse-grained lenticular sandstone interbedded with gray-olive and brown calcareous shale.

Structure

The axial trace of the Rangely anticline crosses the northeast corner of the quadrangle in a northwest-southeast direction. The coal outcrop trace shown on plate 1 lies on the southwest flank of the anticline where the rocks dip from 20^{o} to 40^{o} southwestward. The dips decrease southward toward the synclinal axis which crosses the central part of the quadrangle in a northwest-southeast direction (Cullins, 1968).

Minor faulting occurs in the non coal-bearing area in the northeast part of the quadrangle. Several larger faults offset the coal-bearing strata in the east-central and southeast parts of the quadrangle (pl. 1). The amounts of displacement on these northeast-southwest trending faults are only approximately known.

COAL GEOLOGY

The important coal beds in the Banty Point quadrangle occur in the main coal member of the Mesaverde Formation (pl. 3). Most of the coal beds in this formation are highly lenticular and cannot be correlated any great distance. The datum on plate 3 is the top of a coal bed which occurs at the base of the main coal member. Because of the lenticular nature of the coal beds and the uncertainty of correlation, the correlation lines shown between some of the columns on plate 3 are dashed. Also, the vertical positions of isolated coal beds shown on plate 3 are only relative. The spatial relationships of the coal beds shown on that plate are plotted using the best information available but may not be accurate.

In this quadrangle the lenticular coal beds of very limited lateral extent are called "local" coal beds. These beds are designated by the letter "L" on plates 1 and 3. Two beds have been correlated over small areas and have been called the Local 1 (L1) and Local 2 (L2) beds.

Local 1 Coal Bed

Local 1 coal bed, referred to as the L1 coal bed on plates 1 and 3, is Reserve Base thickness (5 ft (1.5 m) or more) in the northeast quarter of the quadrangle. The L1 coal bed ranges from 10.0 to 12.2 ft (3.0 to 3.7 m) in thickness along the northwest-southeast trending coal outcrop trace in the northeast part of the quadrangle. Lack of data behind the outcrop makes it difficult to project coal thicknesses in that direction. Therefore, an insufficient data line was drawn approximately one-quarter mile from the outcrop trace on the coal isopach and the areal distribution and identified resources maps (pl. 4 and 5).

The L1 coal bed dips over 15° to the southwest except in the east central part of the quadrangle (pl. 4) where the dips are less than 15°.

Isolated Data Points

In instances where isolated measurements of coal beds greater than 5 ft (1.5 m) thick are encountered, the standard criteria for construction of isopach, structure contour, mining ratio, and overburden isopach maps are not available. The lack of data concerning these beds limits the extent to which they can be reasonably projected in any direction and usually precludes correlation with other coal beds. For this reason, isolated data point maps are included on a separate sheet (in U.S. Geological Survey files) for non-isopachable coal beds. Resource data for these isolated data points were calculated for areas within ¼ mile (0.4 km) of the points of measurement and are given in table 2 and are shown by asterisks on plate 2.

PROXIMATE ANALYSES OF THE COAL

No proximate analyses of coal from the Banty Point quadrangle are available. However, analyses of coal samples taken from an 11.9-ft (3.6 m) thick coal bed in the abandoned J. W. Rector mine in the adjoining Rangely quadrangle were reported by Cullins (1971) and are shown in table 3.

Table 2.--Isolated data points in the Banty Point quadrangle, Rio Blanco County, Colorado

Index Number (pl. 1,3)	Location	Coal Bed Name	Outcrop or Drill Hole	Coal Thickness (ft)[1]	Measured Area (ac)[2]	Resource Tonnage (s.t.)[3]
12	SW¼NE¼ sec. 7 T. 1 N., R. 102 W.	Local	Outcrop	6.5	73 (62)[4]	900,000
15	SW¼SW¼ sec. 5 T. 1 N., R. 103 W.	Local	Drill Hole	6.0	129	1,400,000
				Total Resource tonnage		2,300,000

[1]To convert feet to meters, multiply feet by 0.3048
[2]To convert acres to hectares, multiply acres by 0.4047
[3]To convert short tons to metric tons, multiply short tons by 0.9072
[4]Horizontal plane area is 62 acres; true bedding plane area is 73 acres based on a dip of 32°.

Table 3. Analyses of coal samples from the J. W. Rector Mine, NW¼,SE¼ section 14, T. 1 N., R. 102 W., Rangely quadrangle, Rio Blanco County, Colorado (Cullins, 1971)

Laboratory No.	5519	5520
Air drying loss of sample received	3.1 percent	4.8 percent
Chemical analysis, air-dried basis		
Moisture	8.55 percent	9.77 percent
Volatile Matter	33.40 Do.	33.43 Do.
Fixed Carbon	49.99 Do.	51.27 Do.
Ash	8.06 Do.	5.53 Do.
Sulfur	0.46 Do.	0.40 Do.
Heating Value	11,080 Btu/lb[1]	11,490 Btu/lb[1]

[1] To convert Btu/lb to Kj/kg multiply by 2.326

On the basis of these analyses, the coal bed sampled in the J. W. Rector mine is ranked as high-volatile C bituminous coal (American Society for Testing and Materials, 1977) and it is assumed that the coal in the Banty Point quadrangle is of similar rank.

MINING OPERATIONS

Available information indicates that no coal mining has taken place in the Banty Point quadrangle. There are two abandoned, unnamed coal mines in the adjoining Rangely NE quadrangle. One, located in the SE¼NE¼ sec. 16, T. 3 N., R. 102 W., apparently mined a local coal bed. The other is located in the SW¼SE¼ sec. 10, T. 3 N., R. 102 W. The coal bed in that mine is not correlatable with any coal bed in the Banty Point quadrangle. The periods of operation for both these mines are unknown and no production figures are available.

The abandoned J. W. Rector mine referred to above, is located in the NW¼SE¼ section 14, T. 1 N., R. 102 W. in the adjoining Rangely quadrangle. The coal bed in this mine was 11.9 ft (3.6 m) thick (Cullins, 1971). The mine was opened in 1898 and produced at least 100 short tons (91 metric tons) of coal. The total production figure for the mine is unknown.

COAL RESOURCES

The principal source of data used in the construction of the coal isopach, structure contour, and coal-data maps was Cullins (1968). The geophysical logs of the Chevron-Pan American-Amerada oil test well No. 1 Federal 14-15 were available. All of the measured sections shown on plate 1 (index numbers 1-14) were taken from Cullins' (1968) geologic map of the Banty Point quadrangle.

The coal isopach map was constructed using a point-data net derived from coal-thickness measurements of an individual bed obtained from surface exposures within the quadrangle boundary and within a 3-mile (4.8-km)-wide border extending beyond the quadrangle boundary. Measured coal thickness values were used directly in the point-data net. The principle of uniform variation in thickness between data points was used to establish the position of the isopach lines.

A structure contour map was constructed using a point-data net derived from surface exposures. Elevations for the top of the contoured coal bed are based on surface altitude referenced to mean sea level.

The overburden isopach map was based on a point-data net derived from stratigraphic-interval thicknesses measured from the ground surface to the top of the isopached coal bed. A secondary set of data-net points was generated by laying a structure contour map over a topographic contour map, in registration, and then calculating apparent overburden thickness values at the intersections of structure contour lines and surface topographic contour lines.

Coal thickness data was obtained from the coal isopach maps (pl. 4) for resource calculations. The coal-bed acreage (measured by planimeter) multiplied by the average isopach thickness of the coal bed multiplied by a conversion factor of 1,800 short tons of coal per acre-foot (13,238 metric tons of coal per hectare-meter) for bituminous coal yeilds coal resources in short tons. Reserve Base and Reserve values for the Local 1 (L1) coal bed are shown on plate 5 and are rounded to the nearest tenth of a million short tons. Reserve tonnages were not calculated for areas beyond the stripping limit where the dip of the beds is greater than 15°. For areas of surface mining the Reserves are based on a recoverability factor of 85 percent (specified by the U.S. Geological Survey, unpublished data, 1979). Resource tonnages for isolated data points are shown only in table 2 and with asterisks on plate 2. In areas where the dip of a coal bed is greater than 25 degrees, the Reserve Base tonnage has been adjusted for dip by multiplying the apparent bedding-plane area by the secant of the dip of the bed to obtain the true bedding-plane area.

The following criteria for coal resource determinations are given in U.S. Geological Survey Bulletin 1450-B: "Measured.--Resources are computed from dimensions revealed in outcrops, trenches, mine working, and drill holes. The points of observation and measurement are so closely spaced and the thickness and extent of coals are so well defined that the tonnage is judged to be accurate within 20 percent of true tonnage. Although the spacing of the points of observation necessary to demonstrate continuity of the coal differs from region to region according to the character of the coal beds, the points of observation are no greater than ½ mile (0.8 km) apart. Measured coal is projected to extend as a ¼ mile (0.4 km) wide belt from the outcrop or points of observation or measurement.

"Indicated.--Resources are computed partly from specified measurements and partly from projection of visible data for a reasonable distance on the basis of geologic evidence. The points of observation are ½ (0.8 km) to 1½ miles (2.4 km) apart. Indicated coal is projected to extend as a ½ mile (0.8 km) wide belt that lies more than ¼ mile (0.4 km) from the outcrop or points of observation or measurement.

"Inferred.--Quantitative estimates are based largely on broad knowledge of the geologic character of the bed or region and where few measurements of bed thickness are available. The estimates are based primarily on an assumed continuation from Demonstrated coal [a collective term for the sum of coal in both Measured and Indicated Resources and Reserves] for which there is geologic evidence. The points of observation are 1½ (2.4 km) to 6 miles (9.5 km) apart. Inferred coal is projected to extend as a 2¼-mile (3.6 km) wide belt that lies more than 3/4 mile (1.2 km) from the outcrop or points of observation or measurement." (U.S. Bureau of Mines and U.S. Geological Survey, 1976, p. B6 and B7).

Coal resource tonnages were calculated for measured, indicated, and inferred categories in the unleased areas of Federal coal land where the coal is 5 ft (1.5 m) or more thick and lies within 3,000 ft (914 m) of the surface. The criteria cited above were used in calculating Reserve Base and Reserve data in this report and differ from those stated in U.S. Geological Survey Bulletin 1450-B, which calls for a minimum thickness of 28 in (70 cm) for bituminous coal and a maximum depth of 1,000 ft (300 m).

In this study, coal of Reserve Base thickness lying between the ground surface and a depth of 200 ft (61 m) is considered amenable to surface mining methods; coal of Reserve Base thickness lying between 200 ft (61 m) and 3,000 ft (914 m) below ground level in beds having dips of less than 15° is considered minable by conventional subsurface methods. Coal of Reserve Base thickness lying between 200 ft (61 m) and 3,000 ft (914 m)

Table 4.--Coal Reserve Base data for surface mining methods for Federal coal lands in the Banty Point quadrangle, Rio Blanco County, Colorado

(In short tons)[1]

Coal Bed Name	High development potential (0-10 mining ratio)	Moderate development potential (10-15 mining ratio)	Low development potential (>15 mining ratio)	Total
Local 1	5,100,000	100,000	-0-	5,200,000

[1]To convert short tons to metric tons, multiply by 0.9072

below ground level with dips greater than 15^{0} is assumed to be suitable for in situ coal gasification methods.

Reserve Base tonnages of Federal coal per section for all isopached coal beds are shown on plate 2 and total approximately 17.2 million short tons (15.6 million metric tons) for the unleased Federal coal lands within the quadrangle. Reserve Base (in short tons) in the various development potential categories for surface mining methods are shown in table 4. The Reserve Base tonnage for in situ coal gasification mining methods for this quadrangle is approximately 12.0 million short tons (10.9 million metric tons) and is classified as having a low-development-potential. The coal resource tonnage for the nonisopached coal beds at isolated data points is 2.3 million short tons (2.1 million metric tons) (table 2).

AAA Engineering and Drafting, Inc. has not made any determination of economic recovery for any of the coal beds described in this report.

COAL DEVELOPMENT POTENTIAL

Coal development potential areas are drawn (pl. 6 and 7) so as to coincide with the boundaries of the smallest legal land subdivisions shown on plate 2. In sections or parts of sections where no land subdivisions have been surveyed by the BLM (U.S. Bureau of Land Management), approximate 40-acre (16-ha) parcels have been used to show the limits of high-, moderate-, or low-development-potential areas.

The designation of a coal-development-potential classification is based on the occurrence of the highest rated coal-bearing area that may occur within any fractional part of a 40-acre (16-ha) BLM land-grid area, lot, or tract of unleased Federal coal land. For example, a certain 40-acre

(16-ha) parcel is totally underlain by a coal bed of moderate-development potential. If a small corner of the same 40-acre (16-ha) area is also underlain by another coal bed of high-development-potential, the entire 40-acre (16-ha) area is given a high-development-potential rating even though most of the area is rated "moderate".

Development Potential Using Surface Mining Methods

Areas where the coal beds 5 ft (1.5 m) or more in thickness are overlain by 200 ft (61 m) or less of overburden are considered to have a surface mining potential and were assigned a high-, moderate-, or low-development-potential on the basis of the mining ratio (cubic yards of overburden per ton of recoverable coal). The following formula is used to calculate mining ratios:

$$MR = \frac{t_o(0.896)}{t_c\ (rf)}$$

Where MR = mining ratio (cubic yards of overburden per ton of recoverable coal)

t_o = thickness of overburden (in feet)

t_c = thickness of coal (in feet)

rf = recovery factor

0.896 = factor for bituminous coal.

To convert mining ratio to cubic meters of overburden per metric ton of recoverable coal, multiply MR by 0.8428.

Areas of high-, moderate-, and low-development-potential for surface mining methods are here defined as areas underlain by coal beds having respective mining-ratio values of 0 to 10, 10 to 15, and greater than 15.

These mining-ratio values for each development-potential category are based on economic and technological criteria and were provided by the U.S. Geological Survey (1979, unpublished data).

The coal development potential using surface mining methods is shown on plate 6. Approximately 4 percent of the unleased Federal land area in this quadrangle is classified as having a high-development-potential and less than 1 percent has a moderate-development-potential using surface mining methods. The remaining Federal land in the quadrangle is classified as having an unknown surface mining development potential or no development potential.

Unknown development potential has been assigned to those areas for which coal data are absent or extremely limited including the areas containing only isolated data points. Even though these areas may contain coal beds thicker than 5 ft (1.5 m) within 200 ft (61.0 m) of the surface, limited knowledge of the areal distribution of the coal prevents accurate evaluation of development potential. Resources included in the unknown potential category for areas having isolated data points total 2,300,000 short tons (2,100,000 metric tons) (table 2). Lands where it is known that no coal beds occur within 200 ft (61.0 m) of the surface have no surface mining development potential.

Development Potential Using Subsurface Mining and In Situ Coal Gasification

The coal development potential for areas in which subsurface development of coal is assumed possible is shown on plate 7. Areas where coal beds dip 15° or less, are 5 ft (1.5 m) or more thick and are overlain by 200 to 1,000 ft (61 to 305 m) of overburden are considered to have a high-development-potential for conventional subsurface mining methods. Areas where such beds are overlain by 1,000-2,000 ft (305-610 m) and 2,000-3,000 ft (610-914 m) of overburden are rated as having moderate- and low development-potentials, respectively. Areas that contain no known coal beds 5 ft (1.5 m) or more thick but do contain coal-bearing units at depths between 200 to 3,000 ft (61-914 m) are classified as areas of unknown subsurface coal development potential. Areas where it is known that no coal beds occur or where coal beds are present at depths greater than 3,000 ft (914 m) have no coal-development potential.

Reserve Base tonnages have been calculated for all areas where the coal beds are known to be 5 ft (1.5 m) or more thick. Reserves are based on a recoverability factor of 50 percent (specified by the U.S. Geological Survey, unpublished data, 1979) and have been calculated for only that part of the Reserve Base considered to be suitable for conventional subsurface mining methods. An arbitrary dip limit of 15^{0} is assumed to be the maximum dip suitable for conventional subsurface mining methods, and Reserves have not been calculated for those areas where the dip of the coal beds exceeds 15^{0}. Areas that contain Reserve Base coal beds overlain by 200 to 3,000 ft (61 to 914 m) of overburden and having dips in excess of 15^{0} are considered to have potential for development only by in situ coal gasification methods.

Inasmuch as no known areas in the Banty Point quadrangle contain coal beds of Reserve Base thickness that dip less than 15 degrees, no areas in the quadrangle are known to be amenable to conventional subsurface mining methods. Areas within the quadrangle where coal beds dip more than 15 degrees, are 5 ft (1.5 m) or more thick, and are overlain by more than 200 ft (61 m) and less than 3,000 ft (914 m) of overburden are considered to have a low development potential for in situ coal gasification methods. Areas of low coal development potential for in situ coal gasification are shown on plate 7 and include approximately 5 percent of the unleased Federal coal land in the quadrangle. In areas where nonisopached coal beds occur (at isolated data points), the development potential is rated as unknown.

Table 5.--Sources of data used on plate 1.

Source	Plate 1 Index No.	Drill hole or Measured section
Cullins, 1968	1	No number used
Do.	2	Do.
Do.	3	Do.
Do.	4	Do.
Do.	5	Do.
Do.	6	Do.
Do.	7	Do.
Do.	8	Do.
Do.	9	Do.
Do.	10	MS 14
Do.	11	No number used
Do.	12	MS 17
Do.	13	No number used
Do.	14	Do.
Chevron-Pan American-Amerada	15	Federal 14-15

REFERENCES

American Society for Testing and Materials, 1977, Standard specifications for classification of coals by rank, in Gaseous fuels, coal, and coke; atmospheric analysis: ASTM Publication D 388-77.

Cullins, H. L., 1968, Geologic map of the Banty Point quadrangle, Rio Blanco County, Colorado: U.S. Geol. Survey Geologic Quadrangle Map GQ-703.

Cullins, H. L., 1971, Geologic map of the Rangely quadrangle, Rio Blanco County, Colorado: U.S. Geol. Survey Geologic Quadrangle Map GQ-903.

Gale, H. S., 1910, Coal fields of northwestern Colorado and northeastern Utah: U.S. Geol. Survey Bull. 415.

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.

U.S. Department of Commerce, (1964), Normal annual precipitation, 1931-1960, Colorado: Environmental Science Services Admin., Weather Bureau.