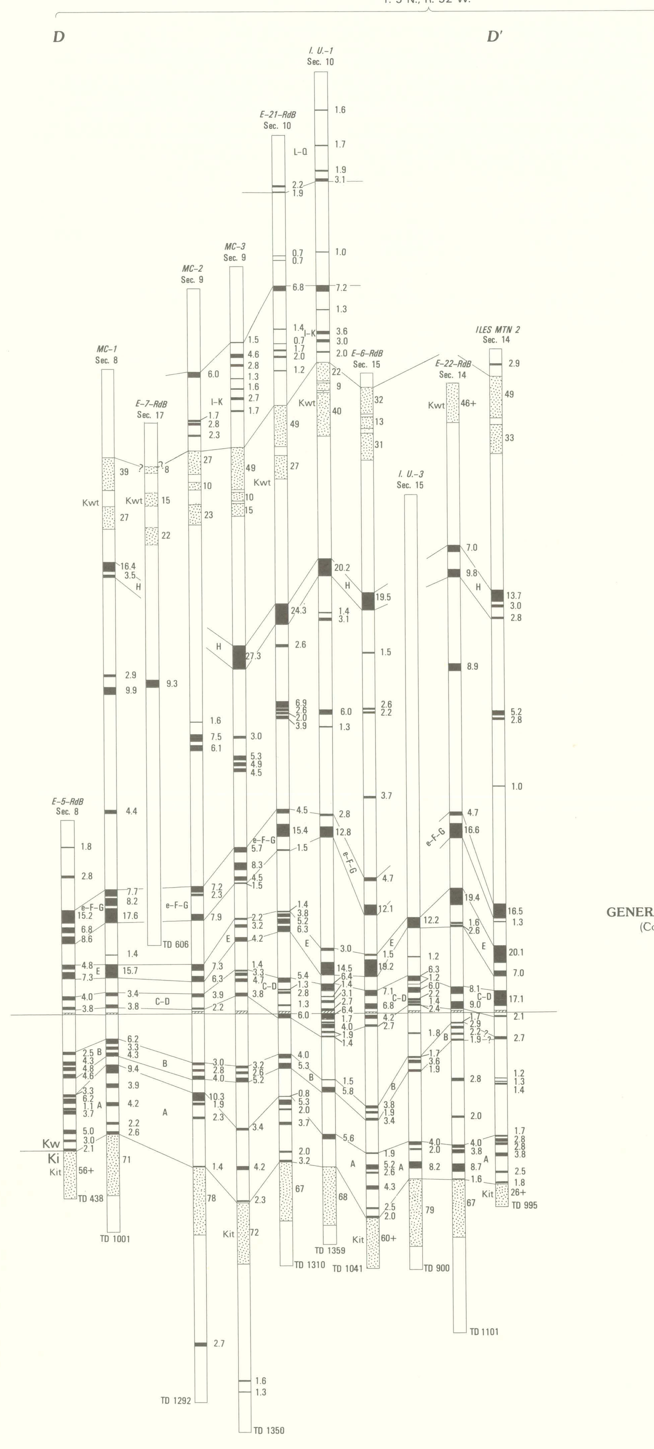
T. 5 N., R. 92 W. T. 6 N., R. 92 W. T. 5 N., R. 91 W.



EXPLANATION

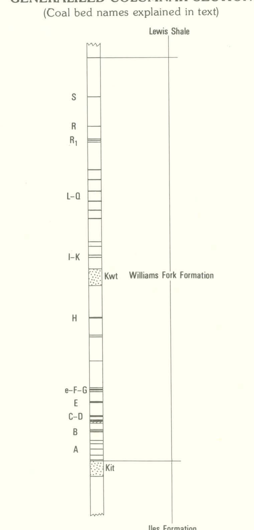
- COAL—Thickness shown in feet
- NOT DESCRIBED
- CONTACT
- SANDSTONE—Thickness shown in feet
- CONTACT—Dashed where uncertain
- CLAYSTONE
- INTERVAL OMITTED—Thickness shown in feet
- TOTAL DEPTH LOGGED—Shown in feet

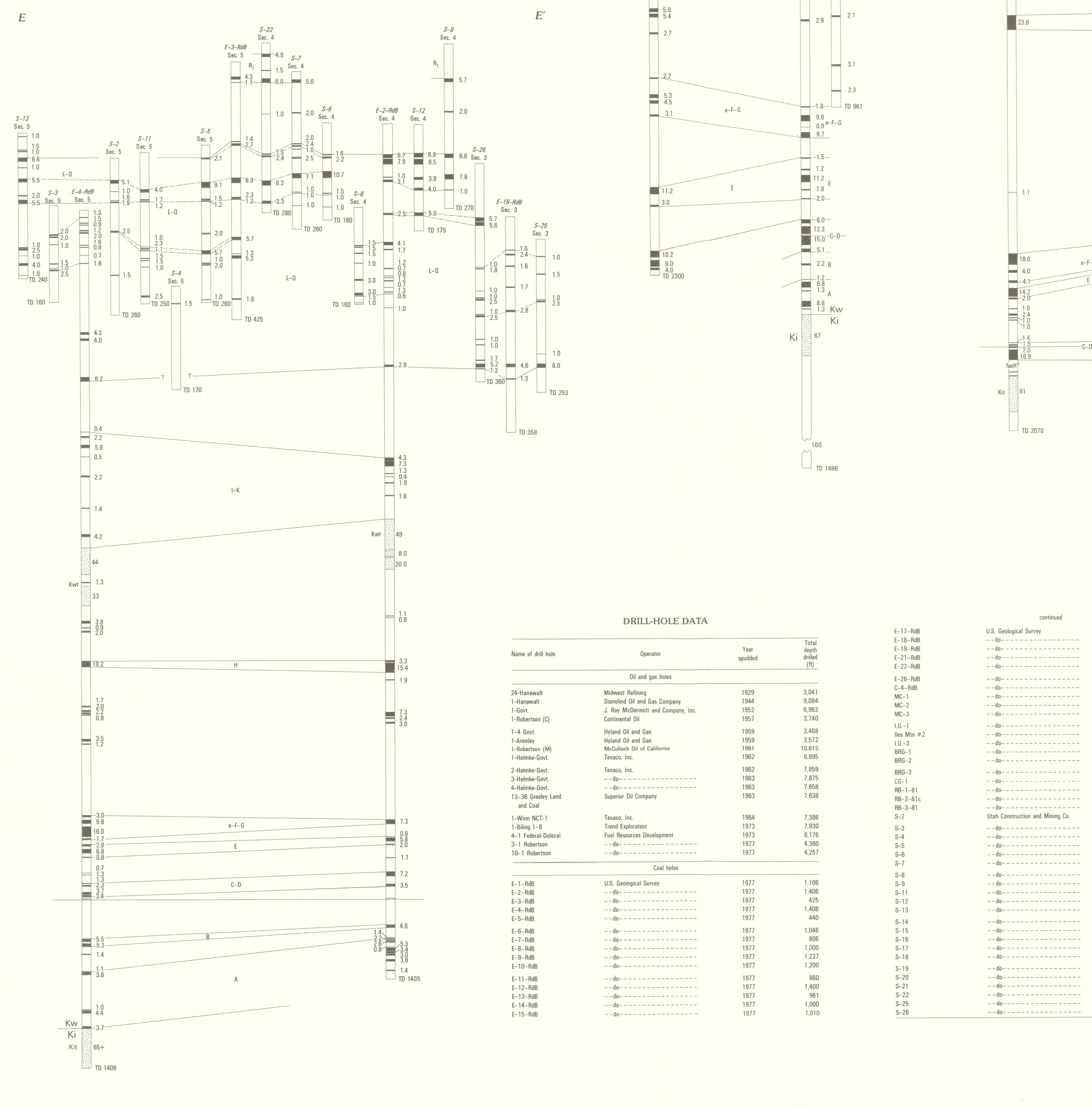
- Kls — LEWIS SHALE
- Kw — WILLIAMS FORK FORMATION
- Kwt — Twentymile Sandstone Member
- Ki — ILES FORMATION
- Kit — Trout Creek Sandstone Member
- E — COAL BED OR ZONE NOMENCLATURE USED BY EMPIRE ENERGY CORP.
- —?— CORRELATION LINE—Queried where uncertain; dashed where local

VERTICAL SCALE: FEET 0, 50, 100, 150, 200, 250; METERS 0, 25, 50, 75

NOTES:
Where possible, sections are hung on base of a claystone that can be correlated regionally
Depths and thicknesses of units are approximate. For more accurate measurements refer to open-file reports of geophysical logs
Coal beds burned and missing in upper parts of some holes
Reliability and exact location of holes labelled S, drilled by Utah International Inc., could not be verified

GENERALIZED COLUMNAR SECTION
(Coal bed names explained in text)



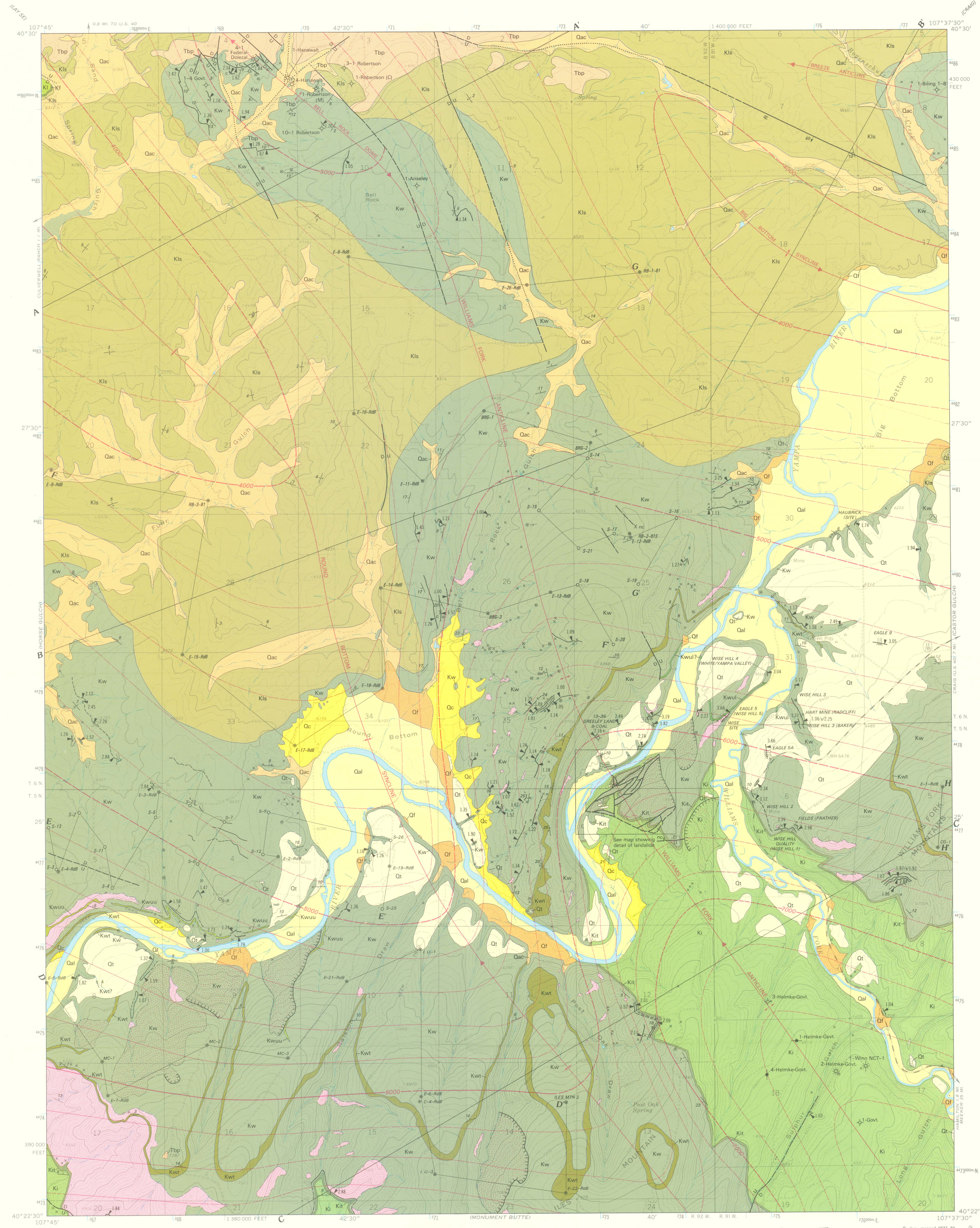


DRILL-HOLE DATA

Name of drill hole	Operator	Year spudded	Total depth drilled (ft)
	Oil and gas holes		
24-Hanawalt	Midwest Refining	1929	3,041
1-Hanawalt	Stanolind Oil and Gas Company	1944	9,084
1-Govt.	J. Ray McDermott and Company, Inc.	1952	6,962
1-Robertson (C)	Continental Oil	1957	3,740
1-4 Govt.	Hyland Oil and Gas	1959	3,468
1-Anseley	Hyland Oil and Gas	1959	3,572
1-Robertson (M)	McCulloch Oil of California	1961	10,615
1-Helmke-Govt.	Texaco, Inc.	1962	6,895
2-Helmke-Govt.	Texaco, Inc.	1962	7,859
3-Helmke-Govt.	--do--	1963	7,875
4-Helmke-Govt.	--do--	1963	7,658
13-36 Greeley Land and Coal	Superior Oil Company	1963	7,638
1-Winn NCT-1	Texaco, Inc.	1964	7,386
1-Biling 1-8	Trend Exploration	1973	7,930
4-1 Federal-Dolezal	Fuel Resources Development	1973	8,176
3-1 Robertson	--do--	1977	4,360
10-1 Robertson	--do--	1977	4,257
	Coal holes		
E-1-RdB	U.S. Geological Survey	1977	1,106
E-2-RdB	--do--	1977	1,406
E-3-RdB	--do--	1977	425
E-4-RdB	--do--	1977	1,406
E-5-RdB	--do--	1977	440
E-6-RdB	--do--	1977	1,046
E-7-RdB	--do--	1977	806
E-8-RdB	--do--	1977	1,000
E-9-RdB	--do--	1977	1,227
E-10-RdB	--do--	1977	1,200
E-11-RdB	--do--	1977	860
E-12-RdB	--do--	1977	1,400
E-13-RdB	--do--	1977	961
E-14-RdB	--do--	1977	1,000
E-15-RdB	--do--	1977	1,010

continued

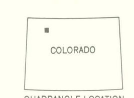
Name of drill hole	Operator	Year spudded	Total depth drilled (ft)
E-17-RdB	U.S. Geological Survey	1977	580
E-18-RdB	--do--	1977	840
E-19-RdB	--do--	1978	360
E-21-RdB	--do--	1978	1,311
E-22-RdB	--do--	1978	1,101
E-26-RdB	--do--	1978	941
C-4-RdB	--do--	1978	294
MC-1	--do--	1980	1,002
MC-2	--do--	1980	1,300
MC-3	--do--	1980	1,380
I.U.-1	--do--	1980	1,360
Iles Mtn #2	--do--	1980	995
I.U.-3	--do--	1980	900
BRG-1	--do--	1980	1,763
BRG-2	--do--	1980	1,840
BRG-3	--do--	1980	1,500
CG-1	--do--	1980	1,105
RB-1-81	--do--	1981	2,070
RB-2-81c	--do--	1981	1,485
RB-3-81	--do--	1981	2,318
S-2	Utah Construction and Mining Co.	1961	260
S-3	--do--	1961	160
S-4	--do--	1961	170
S-5	--do--	1961	260
S-6	--do--	1961	160
S-7	--do--	1961	260
S-8	--do--	1961	160
S-9	--do--	1961	270
S-11	--do--	1961	250
S-12	--do--	1961	175
S-13	--do--	1961	240
S-14	--do--	1961	355
S-15	--do--	1961	350
S-16	--do--	1961	370
S-17	--do--	1961	268
S-18	--do--	1961	200
S-19	--do--	1961	170
S-20	--do--	1961	240
S-21	--do--	1961	100
S-22	--do--	1961	280
S-25	--do--	1961	253
S-26	--do--	1961	360



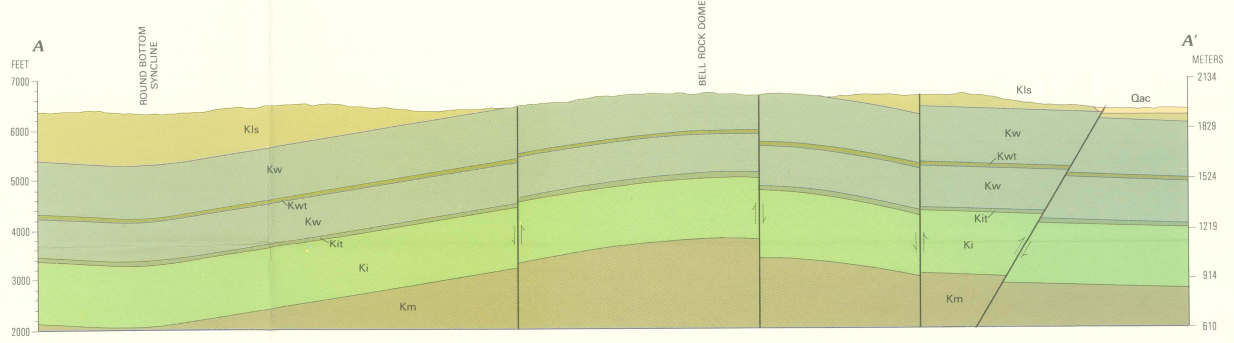
Base from U.S. Geological Survey, 1966
10,000-foot grid based on Colorado coordinate system, north zone
1000-meter Universal Transverse Mercator grid ticks, zone 13, shown in blue

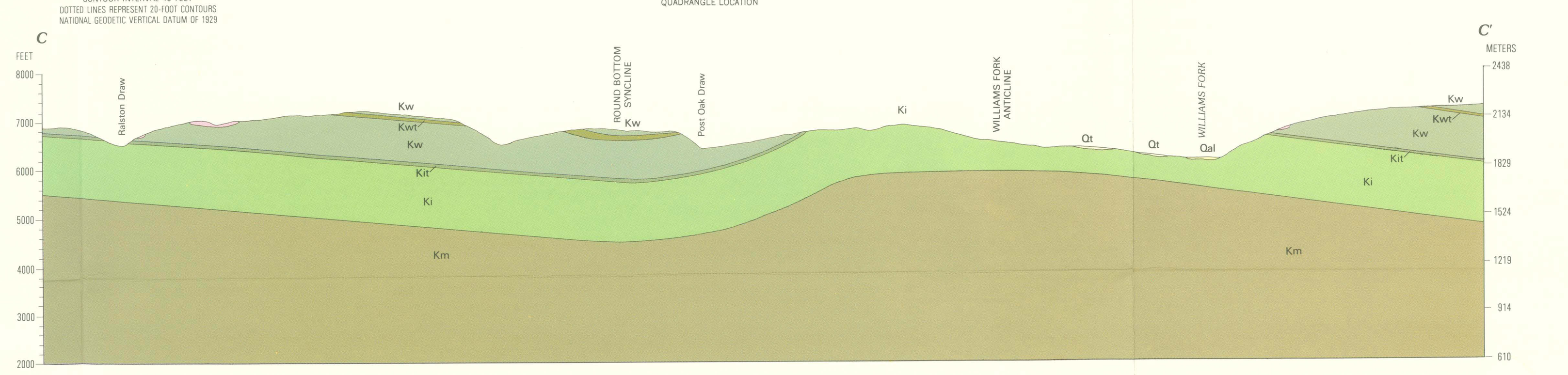
APPROXIMATE MEAN DECLINATION, 1987

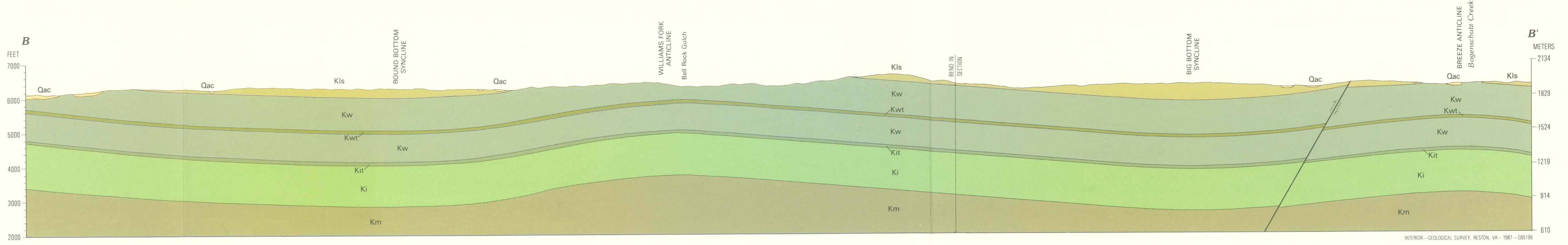
SCALE 1:24 000
CONTOUR INTERVAL 40 FEET
DOTTED LINES REPRESENT 20-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929



Geology mapped 1977–81







INTERIOR—GEOLOGICAL SURVEY, RESTON, VA—1987—G85199

LIST OF MAP UNITS

Unit	Epoch	System
Qal, Qf, Qc, Qac	Holocene	QUATERNARY
Qt	Pleistocene(?)	QUATERNARY
Tbp	Miocene	TERTIARY
Kl, Kf, Kls, Kw, Kwuu, Kwt, Kwul, Ki, Kit (Kwuu–Kit: Mesaverde Group)	Upper Cretaceous	CRETACEOUS
Km	Lower Cretaceous	CRETACEOUS

DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS (HOLOCENE)

Qal Alluvium—Well-sorted clay, silt, sand, and well-rounded granule- to cobble-sized gravel associated with present Yampa and Williams Fork Rivers

Qf Alluvial-fan deposits—Poorly sorted clay, silt, sand, and subangular granule- to boulder-sized gravel

Qc Colluvium—Poorly sorted clay, silt, sand, subangular granule- to boulder-sized gravel in talus sheets and slope-wash deposits

Qac Alluvium and colluvium—Undifferentiated

SURFICIAL DEPOSITS (PLEISTOCENE?)

Qt Terrace deposits—Well- to poorly sorted sand and well-rounded granule- to cobble-sized gravel composed mainly of quartzite, felsic instrusive rock, gneiss, and mafic extrusive rock. Basal part of unit locally cemented by calcite. Deposits cap beveled bedrock at several levels above and adjacent to modern Yampa and Williams Fork Rivers

Tbp BROWNS PARK FORMATION (MIOCENE)—Light-gray to chalky-white, fine- to medium-grained tuffaceous quartz sandstone, generally cross-stratified. Persistent basal conglomeratic sandstone rests unconformably on older units and contains subrounded to subangular pebbles of mafic and felsic igneous and metamorphic rocks, red and white quartzite, varicolored chert, and milky quartz. Exposures limited to western part of northern boundary area of quadrangle, where at least 18.3 m (60 ft) present. Some exposures shown on the map represent only the basal conglomeratic material and may actually be lag deposits. Many similar areas too obscure to map also occur in extreme northern part of area. The only exposure in the remainder of quadrangle is small area situated atop hill 7284, stradling sections 16 and 17 in T. 5 N., R. 92 W.

Kl LANCE FORMATION (UPPER CRETACEOUS)—Light-gray to yellowish-brown, very fine to fine-grained sandstone interbedded with muddy sandstone, siltstone, and gray shale. Known to contain carbonaceous shale and thin coal beds in some areas. Only a small outcrop present in quadrangle, veneering a dip slope in southwest corner of sec. 5, T. 6 N., R. 92 W.

Kf FOX HILLS SANDSTONE (UPPER CRETACEOUS)—Light-gray, very fine to medium-grained, massive sandstone. Occurs only in southwest corner of sec. 5, T. 6 N., R. 92 W., forming a northwest-facing dip slope. Thickness probably less than 21.4 m (70 ft)

Kls LEWIS SHALE (UPPER CRETACEOUS)—Dark-gray, soft, calcareous, marine shale with minor thin ridge-forming calcareous sandstone exposed in north-central part of quadrangle in axial areas of Round Bottom and Big Bottom synclines. Thickness in quadrangle not determined, but known to exceed 610 m (2,000 ft) in adjacent areas

Kw WILLIAMS FORK FORMATION (UPPER CRETACEOUS)—Nearly equal amounts of brown to gray, very fine to fine-grained lenticular sandstone and darker, siltstone, mudstone, and carbonaceous shale. Thick to thin, lenticular coal beds widely distributed throughout unit. In some areas coal has burned, giving area a distinctive reddish tone when viewed from a distance. Thickness approximately 573.4 m (1,880 ft)

Kwuu Unnamed upper sandstone member—Light-gray, very fine to fine-grained, massive sandstone approximately 61 m (200 ft) above Twentymile Sandstone Member. Unit mainly exposed in cliffs north of Yampa River, west of Round Bottom. Discontinuous in this quadrangle, the member becomes regionally significant to the west in Horse Gulch quadrangle and where well exposed at mouth of Fuhr Gulch, unit is 11.9 m (39 ft) thick

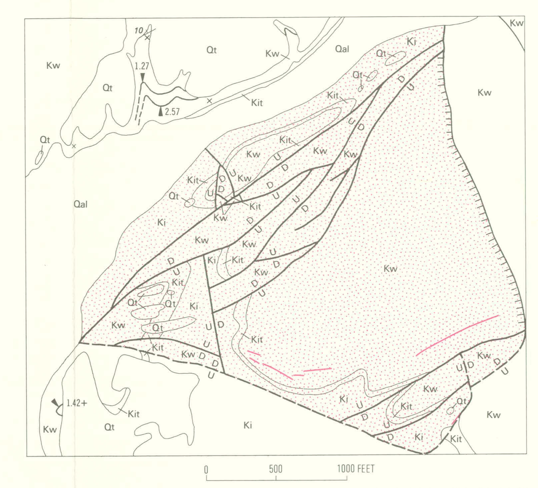
Kwt Twentymile Sandstone Member—Light-gray, very fine to fine-grained, massive sandstone ocurring in from one to three thick units, each separated by finer grained and thinner bedded materials. Base averages 247.5 m (812 ft) above Iles Formation and usually rests on small amount of marine(?) shale that is not included in the Twentymile unit. Well exposed across southern half of quadrangle, but becomes indistinct near western boundary. Average thickness in drill holes is 25.3 m (83 ft)

Kwul Unnamed lower sandstone member—Light-gray, very fine to fine-grained, massive sandstone. Base averages 115.8 m (380 ft) above Iles Formation. Best exposed west of Williams Fork River in cliff above Eagle 5 mine, where it is double ledged and referred to as the "middle sandstone" by Empire Energy Corp. Discontinuous within quadrangle. Average thickness in drill holes is 14.6 m (48 ft). Often difficult to identify

Ki ILES FORMATION (UPPER CRETACEOUS)—Brown to gray, very fine to fine-grained, resistant sandstone, siltstone, mudstone, and minor amounts of gray shale, carbonaceous shale, and thin coal beds. Lacks reddish appearance of overlying formation. Resistant nature of sandstone causes it to develop into persistent ledges that are found throughout formation. Base of formation not exposed within the quadrangle, but total thickness known to be approximately 396.5 m (1,300 ft)

Kit Trout Creek Sandstone Member—Light-gray, very fine to fine-grained sandstone; weathers white. Located at top of Iles Formation and rests on approximately 27.5 m (90 ft) of marine shale. Well exposed on flanks of Williams Fork anticline. Thickness in drill holes ranges from 20.4 to 24.1 m (67 to 79 ft)

Km MANCOS SHALE (UPPER AND LOWER CRETACEOUS)—Dark-gray, soft, marine shale with minor lenticular sandstone in upper and lower parts. Known to exceed 1,525 m (5,000 ft) in adjacent areas. Shown in cross section only



MAP SHOWING DETAIL OF LANDSLIDE LOCATED IN SEC. 36, T. 6 N., R. 92 W. AND SEC. 1, T. 5 N., R. 92 W.

- COAL BED—Equal to or greater than 1 m thick. Dashed where inferred. Thickness, in meters, measured at triangle
- COAL BED—Less than 1 meter thick. Circled where thickness equal to or greater than 80 cm
- CLINKER—Associated with burned coal beds. Boundaries approximately located
- CONTACT—Approximately located; dashed where inferred
- LANDSLIDE
  - Approximately located boundary and affected area—May define a resulting change in topography
  - Location of significant scarp. Hachured on down side
  - Open fracture—Tension crack in landslide
- FAULT—Approximately located; dashed where inferred, dotted where covered. U, upthrown side; D, downthrown side; R on upthrown side indicates reverse movement; arrow shows dip of fault plane
- ANTICLINE—Showing troughline and direction of plunge. Approximately located
- SYNCLINE—Showing crestline and direction of plunge. Approximately located
- STRIKE AND DIP OF BEDS—Dot indicates measurements computer generated from aerial photographic model
- STRUCTURE CONTOUR—Drawn on top of Trout Creek Sandstone Member of Iles Formation, using surface and drill-hole data. Dashed where approximately located; short dashed where projected over land surface. Contour interval 200 ft (61 m)
- ADIT
  - Coal mine entry, showing name where available. Previous or other name in parentheses
  - Inaccessible; caved
- PROSPECT PITS
  - Coal
  - Noncoal
- U.S. GEOLOGICAL SURVEY COAL DRILL HOLE—Showing hole number
- COAL PROSPECTING PERMIT (EXPIRED) COAL DRILL HOLE—U.S. Geological Survey permit nos. C-066620, C-066621, or C-066623
- HOLES DRILLED FOR OIL AND GAS—Showing well name
  - Dry hole
  - Gas well
  - Shut-in oil well
  - Shut-in gas well
  - Abandoned oil well
  - Abandoned gas well

ECONOMIC GEOLOGY

The Round Bottom quadrangle was mapped as a part of the U.S. Geological Survey's program to classify and evaluate mineral lands in the public domain. The primary economic resource within the quadrangle is subbituminous B to high-volatile C bituminous coal; oil and gas is of secondary importance. Sand and gravel, uranium, and gold may be of potential economic importance.

COAL

The Round Bottom quadrangle contains numerous coal beds, ranging from several centimeters to 8.2 m (26.9 ft) in thickness. Several active mines and many abandoned wagon mines and prospect pits exist in the area. Much of the coal geology has been described previously by Fenneman and Gale (1906), Gale (1910), and Hancock (1925). A large part of the quadrangle is within the Yampa Known Recoverable Coal Resource Area (KRCRA), and several active State and Federal coal leases have been issued for areas within the quadrangle.

The coal exposed in this quadrangle is part of the Upper Cretaceous (Campanian) Mesaverde Group, which is composed of the Iles Formation and the overlying Williams Fork Formation. Traditionally in this region, coal in these two formations has been divided into three groups. The coal above the Twentymile Sandstone Member of the Williams Fork Formation is designated the upper group, coal between the Trout Creek Sandstone Member of the Iles Formation and the Twentymile Sandstone Member is designated the middle group, and the lower group contains all the coal in the Iles Formation. The coal in this part of the Yampa coal field is widely distributed vertically throughout the Mesaverde Group in numerous thin to thick beds. In addition, individual beds commonly split into several smaller seams. These irregularities, coupled with poor exposures and extensive areas of clinker, make the tracing of individual beds in the surface nearly impossible over any significant distance and the correlation of subsurface units difficult. In mapping this quadrangle, every observed outcrop of coal was dug out by hand and measured, but because of the many occurrences, only those beds equal to or greater than 1 m (3.3 ft) were recorded and traced.

Coal beds of the lower group, in the Iles Formation, are rare and thin in the mapped area. However, just east of the southeast boundary, Hancock (1925) measured several lower-group beds greater than 1.7 m (5.5 ft) thick, in the Castor Gulch quadrangle.

All economic coal in the Round Bottom quadrangle occurs in the middle and upper groups, in the Williams Fork Formation. Unfortunately, the two major coal companies in the area have different systems for naming the coal beds. As shown in the coal sections of this report, a modified version of Empire Energy Corp.'s letter designation has been used for this report. In all instances, the letters can represent both individual beds or their equivalent zones.

The middle group contains the thickest and most persistent coal beds in the Yampa coal field. In the area of this map, the group is divided by a barren zone, with or without a thick sandstone bed, informally designated the "middle sandstone," which separates the group into two parts. Below this interval, in ascending order, are the A, B, C, D, E, e, F, and G coal beds; above this interval, only the H bed is significant. Within the mapped area the thickest beds in the middle group are the H, F, and E beds. U.S. Geological Survey coal test hole MC–3 in the SE1/4SE1/4 sec. 9, T. 5 N., R. 92 W., encountered an 8.2-m-(26.9-ft-) thick H bed at 165 m (541 ft) in depth.

The only mine in the mapped area presently taking coal from the middle group is located in the east-central part of the quadrangle and is operated by Empire Energy Corp. The Eagle no. 5 mine (formerly the Wise Hill no. 5) was opened in 1969 as an underground mine in the F coal bed.

Empire Energy Corp. reports approximate as-received heating values of 10,500 Btu/lb, 0.4 percent sulfur, and 8 percent ash for the F coal bed from the mine. An as-received analysis of the H coal bed from U.S. Geological Survey core hole C–4–RdB in the NE1/4 NE1/4 sec. 15, T. 5 N., R. 92 W. showed a heating value of 10,432 Btu/lb, 0.4 sulfur, and 4.1 percent ash.

The upper group of coal beds is typically thinner and more difficult to correlate than the underlying middle group. In ascending order, these coal beds are designated I, J, K, L, M, Mu, N, P, Q, R_1, R, and S. The I–K and L–Q coal beds are easily grouped together. Empire Energy Corp. opened an underground mine, the Eagle no. 9, in 1978 in the P bed near the east-central boundary of the quadrangle. In the Castor Gulch quadrangle to the east, at the Trapper Mine, Trapper Mining, Inc. strip mines several coal beds that can be correlated with the upper-group beds in the Round Bottom quadrangle. Trapper Mining, Inc. reports average as-received values of 10,000 Btu/lb, 0.46 percent sulfur, and 7 percent ash for coal produced from their mine.

Although coal is known to occur in the Lance Formation, none was observed in the small exposure of this formation in the northwest corner of the quadrangle.

OIL AND GAS

A major plunging anticline trends to the north-northwest across the entire Round Bottom quadrangle and provides closure for two oil and gas fields. This Laramide structure is known as the Williams Fork anticline in the southeast part of the mapped area where its southwest limb is considerably steeper than its northeast limb. In the northwest part of the quadrangle the plunge of this structure is interrupted and a local structural high, known as the Bell Rock Dome, has developed.

The Williams Fork oil and gas field, located athwart Sulphur Gulch in the southeast corner of the quadrangle, was first drilled in 1952, but the 1-Govt. hole, drilled by J. Ray McDermott, was abandoned as a dry hole. In 1962 the 1-Helmke-Govt. hole, drilled by Texaco, discovered oil in the Cretaceous Dakota Sandstone and the Williams Fork Formation Known Geological Structure (KGS) was established the next year. Since that time, Texaco has drilled four additional holes, testing sandstones from the upper part of the Mancos Shale down to the Pennsylvanian and Permian Weber Sandstone, with marginal success. Currently, the discovery well is shut in and the only producing well is the 2-Helmke-Govt. drilled in 1962, which is presently taking gas from the Jurassic Morrison Formation.

Bell Rock Dome was first drilled in 1929 by Midwest Refining Co. 24-Hanawalt was abandoned at 3,041 ft with junk in the hole, but not before discovering gas in the so-called "rim rock" at the base of the Iles Formation. Eleven years later, the Bell Rock KGS was established. Since that time, eight wells have been drilled by several companies testing sandstones as low in the section as the Weber Sandstone. To date, only the "rim rock" has produced significantly and the only potential producer in the field is 4–1 Federal-Dolezal, drilled in 1973 by Fuel Resources Development and completed as a gas well.

In the northeast corner of the mapped area, 1-Biling 1–8 was drilled in 1973 by Trend Exploration Limited, but was abandoned as a dry hole. This well was the westernmost test on an east-west-trending structure known as the Breeze anticline. East of the quadrangle boundary, more successful wells have been drilled in this same structure in the Craig gas field.

SAND AND GRAVEL, URANIUM, AND GOLD

Sand and gravel have been mined for many years from the alluvial-valley floor along the Yampa River in Big Bottom. Excavation was particularly heavy during the construction of the railroad along the Yampa River in 1979. Numerous uranium prospect pits exist in the Tertiary Browns Park Formation, and small amounts of placer gold have been taken from various alluvial deposits along the Yampa River.

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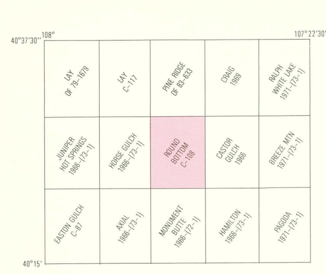

INDEX SHOWING LOCATION OF ROUND BOTTOM QUADRANGLE, AVAILABLE 7½-MINUTE TOPOGRAPHIC QUADRANGLE MAPS, AND RECENTLY PUBLISHED U.S. GEOLOGIC SURVEY GEOLOGIC MAPS

CONVERSION TABLE

To convert METRIC UNITS	Multiply by	To obtain ENGLISH UNITS
Meters	3.281	Feet
Kilometers	.6214	Miles

GEOLOGIC MAP AND COAL SECTIONS OF THE ROUND BOTTOM QUADRANGLE, MOFFAT COUNTY, COLORADO

By
E. A. Johnson
1987

For sale by U.S. Geological Survey, Map Distribution, Box 25286, Federal Center, Denver, CO 80225