Base from U.S. Geological Survey, 1960
10,000-foot grid based on North Dakota coordinate system, south zone
1000-meter Universal Transverse Mercator grid, zone 13

APPROXIMATE MEAN DECLINATION, 1975

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL

Interior—Geological Survey, Reston, Va.—1975

Geology mapped in 1965 and 1966

NORTH DAKOTA
QUADRANGLE LOCATION

GEOLOGIC MAP AND COAL RESOURCES OF THE WHITE BUTTE NE QUADRANGLE, STARK AND HETTINGER COUNTIES, NORTH DAKOTA

By
K. S. Soward

1975

CORRELATION OF MAP UNITS

DESCRIPTION OF MAP UNITS

Qa — ALLUVIUM (HOLOCENE) – Silt, sand and clay and a small amount of pebble gravel

Qt — LANDSLIDE DEPOSITS (HOLOCENE AND PLEISTOCENE)

TERRACE DEPOSITS – Silt and sand and a small amount of gravel

Qt_1 — About 30–75 feet[1] above the Heart River (HOLOCENE AND PLEISTOCENE)

Qt_2 — About 80–140 feet above the Heart River, 60–90 feet above Plum Creek, and 30–75 feet above Beaver Creek (PLEISTOCENE–EARLY OR PRE-WISCONSIN)

Qt_3 — About 175–220 feet above the Heart River (PLEISTOCENE–PRE-WISCONSIN)

Unconformity

Tc — CHADRON FORMATION (OLIGOCENE) – Upper part, interbedded calcareous claystone and limestone beds, 15–40 feet thick; middle part light-gray to light-olive-gray sandy claystone, 3–15 feet thick; lower part, grayish-yellow bentonitic and conglomeratic sandstone, 4–23 feet thick. Fluvial and lacustrine deposits

Unconformity

Tg — GOLDEN VALLEY FORMATION (EOCENE AND PALEOCENE) – Siltstone and claystone, light-grayish-orange, grayish-yellow, and grayish-pink to paler-red; some beds are weathered to pale olive and shades of green; 0–10 feet thick. Siltstone and sandstone, light-gray to white, kaolinitic, clayey; orange stain along joints and a few beds, 12–20 feet thick. Fluvial, lacustrine, and paludal deposits

FORT UNION FORMATION (PALEOCENE) – Fluvial, lacustrine, and paludal deposits

Tfs — Sentinel Butte Member – Upper unit: sandstone, yellowish-gray, very fine grained to medium-grained, massive, friable, crossbedded, clean; 0–120 feet thick. Middle unit: sandstone, yellowish-gray, very fine grained to fine-grained, interbedded with thin beds of dark-greenish-gray to medium-dark-gray siltstone and claystone, silicified siltstone and sandstone, and lignite; 185–210 feet thick. Lower unit: dark-gray clayey siltstone interbedded with light-olive-gray and dark-yellowish-orange silty claystone, brown carbonaceous claystone and siltstone, yellowish-gray sandstone, bentonite, and lignite; contains silicified wood and in places silicified lignite; 25–50 feet thick

Tft — Tongue River Member – Siltstone and claystone, medium- to light-gray and light-olive-gray; contains a few beds of yellowish-gray sandstone, brown carbonaceous siltstone and claystone, and lignite; 0–95 feet exposed

EXPLANATION OF LINE SYMBOLS

3 — 2.7 HQ — COAL BED – Dashed where approximately located; short dashed where inferred. Letters denote coal bed named in the generalized stratigraphic section. Circled number refers to plotted coal section measured at triangle. Equivalent thickness of coal, in feet, measured at triangle, calculated by method of Bass, Smith, and Horn (1970, p. 6)

CONTACT – Dashed where approximately located; short dashed where indefinite or inferred

GLACIAL ERRATICS – Ice rafted; in NE¼ sec. 30, T. 138 N., R. 92 W., NE¼ sec. 26, T. 138 N., R. 93 W., and NE¼ sec. 3, T. 137 N., R. 92 W.

Texaco, Inc.–1 Schank (DO) 10,425 — OIL WELL – Showing name, total depth, in feet, and production from bottom hole formation (Red River Formation of Ordovician age)

Texaco, Inc.–2 Schank (DO) 10,429 — DRY HOLE – Showing name, total depth, in feet, and bottom hole formation (Red River Formation of Ordovician age)

3547 (1100) R 4 — TEST HOLE – Drilled by North Dakota State Water Commission and U.S. Geological Survey. Showing number of hole, depth, in feet in parentheses, and reported thickness, in feet, of designated coal bed

P27 (95) H 3 — POWER AUGER HOLE – Drilled by U.S. Geological Survey. Showing number of hole, depth, in feet in parentheses, and reported thickness, in feet, of designated coal bed

A 1.7 — HAND AUGER HOLE – Showing thickness of coal bed, in feet

W (200) H 2 — WATER WELL – Showing depth, in feet in parentheses, and reported thickness, in feet, of designated coal bed

D 4464 — FOSSIL LOCALITY – U.S. Geological Survey Paleobotany collection number (Denver catalogue)

GRAVEL PIT

ABANDONED COAL MINE

[1] To convert feet to meters, multiply by 0.3048.

COAL SECTIONS

ECONOMIC GEOLOGY

The White Butte NE, NW, East, and West quadrangles were mapped as part of the U.S. Geological Survey program of classifying Federal lands and to make a systematic study and evaluation of the coal resources. Economic resources in the White Butte quadrangles consist of coal, oil and gas, sodium chloride, limestone, rubble, and sand and gravel.

COAL

Coal resources in the map area are in the nonmarine members of the Fort Union Formation of Paleocene age. The approximate stratigraphic relationships of the coal beds are shown in the generalized sections. The lowest exposed coal bed in the quadrangles is the Many Springs bed about 95 feet (29 meters) below the top of the Tongue River Member. The highest exposed coal bed is the Discovery bed about 225 feet (69 meters) above the base of the Sentinel Butte Member. The Spring Valley and Heart Butte beds are the thickest and most extensive of the exposed beds and range in thickness from 0 to 10 feet (0 to 3.0 meters) and 0 to 7 feet (0 to 2.1 meters), respectively. The Hummel, Schank, and Shell coal beds are the thickest and most extensive in the subsurface. Driller's logs of water wells north of the quadrangles indicate that (1) the Hummel bed is as much as 9.5 feet (2.9 meters) thick in sec. 19, T. 138 N., R. 92 W.; (2) the Schank bed is 6.0 feet (1.8 meters) thick in sec. 15, T. 137 N., R. 92 W.; and (3) the Shell bed may be as much as 6.5 feet (2.0 meters) thick in secs. 28 and 33, T. 136 N., R. 92 W. The Schank and Hummel beds may be benches of the same coal.

Correlations of coal beds in the White Butte quadrangles with the coal beds in the Clark Butte NW and SW quadrangles are seemingly reliable, and the same names are used generally for coal beds at the same stratigraphic position.

A ground-water survey of Stark and Hettinger Counties was made in 1966 by the Water Resources Division, U.S. Geological Survey, in cooperation with the North Dakota State Water Commission. Henry Trapp, Jr., U.S. Geological Survey, hydrologist-in-charge, made available the logs of many water wells, test holes, and auger holes drilled in and near the White Butte quadrangles. The thicknesses of coal beds in many of the water wells and test holes are those reported by Gerald Moe of Mott, N. Dak., an experienced water-well driller who supplied many water-well records. These records aided greatly in correlation of coal beds, in construction of the structure contour map, and in calculation of resources.

Some areas in the White Butte quadrangles do not have any known coal beds as thick as 2.5 feet (0.76 meters). Although definitive data are not available, the thick section of coal-bearing sediments and sparse drill-hole data indicate that future exploration will prove that these areas are underlain by coal beds 2.5 feet (0.76 meters) or more in thickness.

Small abandoned open-pit mines were worked by local residents to produce coal for their own use. These cuts, which now have slumped sides and in most places no exposed coal beds, are shown on the geologic maps. The largest mine opened was in the W½ sec. 13, and the NE¼ sec. 14, T. 135 N., R. 94 W., White Butte West quadrangle, where 10-12 acres (4.0–4.9 hectares) of the 4–5-foot (1.2–1.5 meters) thick Heart Butte bed was strip mined between 1906 and 1944.

PHYSICAL AND CHEMICAL PROPERTIES

No coal analyses are available from the White Butte quadrangles but the results of analyses on six samples from drill holes in the Clark Butte quadrangles are given in table 1 (Smith, 1970, p. 4–17).

The lignite is hard and brittle and generally slacks in air. It is mainly attrital and contains a small amount of previtrain lenses and some fusain. Jarosite, pyrite, gypsum, and partings of claystone, siltstone, and silicified coal occur in some beds. Laterally the coal may vary considerably in thickness within short distances or may change in part or entirely to brown carbonaceous siltstone or claystone.

TABLE 1. – *Analyses of coal from the Clark Butte quadrangles*
[Results in percent except as indicated]

Source of sample and depth (feet)[1]	Bureau of Mines Lab. No. and sampling date	Method of analysis[2]	Moisture	Volatile matter	Fixed carbon	Ash	Sulfur	Heating value (Btu)[3]
Drill hole 1: NE¼NE¼SE¼ sec. 6, T. 135 N., R. 90 W. Many Springs bed, 165.65–168.70	1-42093 1966	A	37.9	26.5	28.1	7.5	1.0	6,720
		B	17.2	35.4	37.4	10.0	1.4	8,960
		C		42.7	45.2	12.1	1.6	10,810
		D		48.6	51.4		1.9	12,300
Drill hole 2: SW¼SW¼SE¼ sec. 8, T. 135 N., R. 91 W. Heart Butte bed, 37.8–40.8 and 41.6–45.55	1-42081 1966	A	40.5	26.1	26.0	7.4	1.0	6,280
		B	17.8	36.0	35.9	10.3	1.4	8,690
		C		43.8	43.7	12.5	1.7	10,570
		D		50.1	49.9		1.9	12,070
Drill hole 3: SE¼SW¼ sec. 28, T. 136 N., R. 92 W. Many Springs bed, 234.5–237.8	1-42089 1966	A	38.9	26.9	26.9	7.3	0.6	6,600
		B	18.0	36.1	36.0	9.9	0.8	8,870
		C		44.0	44.0	12.0	1.0	10,810
		D		50.0	50.0		1.1	12,280
Drill hole 4: NE¼NE¼NE¼ sec. 12, T. 136 N., R. 92 W. Many Springs bed, 178.25–179.38 and 179.83–181.75	1-42092 1966	A	35.9	24.0	24.1	16.0	2.0	5,790
		B	15.0	31.8	31.9	21.3	2.7	7,680
		C		37.4	37.6	25.0	3.1	9,030
		D		49.8	50.2		4.2	12,030
Drill hole 4: Shell bed, 258.4–266.8	1-42090 1966	A	36.6	24.9	25.9	12.6	1.0	6,220
		B	15.8	33.1	34.3	16.8	1.3	8,260
		C		39.2	40.9	19.9	1.5	9,810
		D		49.0	51.0		1.9	12,270
Drill hole 9: SW¼SW¼SE¼ sec. 22, T. 138 N., R. 90 W., Spring Valley bed, 107.8–114.2	1-42086 1966	A	34.8	23.5	22.0	19.7	3.8	5,510
		B	14.6	30.8	28.8	23.8	5.0	7,220
		C		36.1	33.7	30.2	5.8	8,450
		D		51.7	48.3		8.3	12,100
Average		A	37.4	25.3	25.5	11.8	1.6	6,187
		B	16.4	33.9	34.1	15.7	2.0	8,280
		C		40.5	40.9	18.6	2.5	9,911
		D		49.9	50.1		3.2	12,172

[1] To convert feet to meters, multiply by 0.3048.
[2] A, as received; B, air-dried; C, moisture free; D, moisture- and ash-free.
[3] To convert Btu's to joules, multiply by 1.0550×10^3.

COAL RESOURCES

The resources are reported in three separate classes—measured, indicated, and inferred, based on the relative abundance of reliable information. Measured resources are within one-fourth mile (402 meters) of an outcrop or drill-hole measurement. The computed tonnage is expected to be within 20 percent of the true value. Where beds have a relatively uniform thickness and a high degree of continuity, a half-mile (805 meters) width from outcrops is used. Indicated resources are generally within half a mile of an outcrop or drill-hole measurement and outside the area of measured reserves, but a band as much as 2 miles (3,219 meters) from outcrops was used in areas of uniform, widespread beds. Inferred resources are computed from less data, are outside the area of indicated reserves, and lie farther from measured points. These parameters are based on a broad general knowledge of the geology and the coal beds.

Using outcrop measurements and drill-hole information, an estimate was made on all beds on which data were available. Coal thicknesses used are equivalent thicknesses (Bass and others, 1970, p. 6). The area underlain by each class was measured by a planimeter, the volume in acre-feet was determined for each class, and tonnages were calculated using a factor of 1,750 tons per acre-foot (12,870 metric tons per hectare meter or 1,287 kilograms per cubic meter) of coal.

Coal resources in the White Butte quadrangles are estimated to be 1,052,500,000 tons (955×10^6 metric tons) in beds 2.5–10 feet (0.76–3.05 meters) thick within 1,000 feet (305 meters) of the surface. About 53 percent of the coal resources are in 7 beds that do not crop out. Four of these beds contain 47 percent of the total resources, and they are 180–710 feet (55–216 meters) below the top of the Tongue River Member or from 100 to 1,000 feet (30 to 305 meters) below the ground surface. Of the 11 beds that do crop out, two beds, Heart Butte and Spring Valley, contain 24 percent of the coal resources. Although the total coal resources in the four quadrangles are large, the widespread occurrences of the beds, over an area of 205 square miles (531 square kilometers) and throughout as much as 1,000 feet (305 meters) of stratigraphic section, reduce the importance of the resources to the extent that exploitation is many years in the future. Distribution of the resources by bed and by class for each township or fractional part of a township is shown in table 2. The estimated coal resources by beds in the White Butte quadrangles are given in table 3.

None of the lignite deposits in these quadrangles are considered as potentially strippable. The near-surface beds rarely reach the minimum thickness of 5 feet (1.5 meters) that is generally considered to be necessary for economical strip mining, and the deeper, thicker beds have a strip ratio of more than 10 to 1 that is sometimes mentioned as the maximum for a profitable operation (Kepferle and Culbertson, 1955, p. 148–149).

EXPLANATION

Coal

Brown carbonaceous siltstone or claystone

Sandstone

Siltstone

Claystone

Bentonite

Silicified layer or stump in lignite bed

Interval omitted

3 — Locality number of measured surface coal section

Oil well — Dry hole
Oil and gas test wells

3547 — Test hole *Drilled by North Dakota State Water Commission and U.S. Geological Survey*

W — Water well

P 27 — Power auger hole

283 — Depth, in feet, to top of coal from ground surface

(All stratigraphic measurements shown in feet. For metric equivalent, multiply by 0.3048.)

GENERALIZED SECTION SHOWING STRATIGRAPHIC RELATIONSHIP OF THE COAL BEDS

TABLE 2. – *Estimated coal resources, by township and coal bed, in the White Butte quadrangles, North Dakota*

Lignite bed	Resources (millions of short tons)[1] Measured (ft)[2] 2.5–5	5–10	Indicated (ft)[2] 2.5–5	5–10	Inferred (ft)[2] 2.5–5	5–10	Totals
T. 135 N., R. 92 W. (fractional)							
Kit Fox	0.5	------	1.0	------	1.0	------	2.5
Spring Valley	1.1	1.2	4.4	1.6	1.8	------	10.1
Local; 37 ft above base of Sentinel Butte	.3	------	.8	------	------	------	1.1
Red Dog	------	------	------	------	1.9	------	1.9
Many Springs	.5	------	1.1	------	------	------	1.6
Shell	------	------	------	------	16.6	22.5	39.1
Hummel	------	------	------	------	4.2	------	4.2
Totals	2.4	1.2	7.3	1.6	25.5	22.5	60.5
T. 135 N., R. 93 W. (fractional)							
Heart Butte	------	------	------	------	4.7	------	4.7
Kit Fox	0.8	------	1.1	------	3.7	------	5.6
Spring Valley	------	------	2.9	------	5.1	------	8.0
Local	.3	------	.8	------	1.8	------	2.9
Red Dog	.9	------	1.8	------	31.0	------	33.7
Shell	.7	.6	2.0	1.8	12.4	2.6	20.1
Hummel	.7	.4	2.5	.8	23.3	2.2	29.9
Totals	3.4	1.0	11.1	2.6	82.0	4.8	104.9
T. 135 N., R. 94 W. (fractional)							
Discovery	------	------	------	------	0.5	0.5	1.0
Heart Butte	1.7	------	4.3	------	28.8	------	34.8
Kit Fox	------	------	------	------	16.0	------	16.0
Spring Valley	------	------	------	------	25.0	------	25.0
Totals	1.7	------	4.3	------	70.3	.5	76.8
T. 136 N., R. 92 W. (fractional)							
Spring Valley	1.2	.2	2.2	------	4.1	------	7.7
Local (HT1)	------	1.2	------	3.3	------	7.9	12.4
Red Dog	.5	------	1.1	------	3.9	------	5.5
Shell	------	------	------	------	19.1	33.6	52.7
Totals	1.7	1.4	3.3	3.3	27.1	41.5	78.3
T. 136 N., R. 93 W.							
Heart Butte	1.9	1.1	9.9	------	22.5	------	35.4
Kit Fox	1.2	------	1.3	------	------	------	2.5
Spring Valley	------	1.9	3.0	0.9	1.7	------	7.5
Local	1.0	------	2.4	------	16.7	------	20.1
Red Dog	.4	------	1.4	------	2.7	------	4.5
Shell	.3	.2	.7	.9	24.9	------	27.0
Totals	4.8	3.2	18.7	1.8	68.5	------	97.0
T. 136 N., R. 94 W. (fractional)							
Discovery	0.7	------	1.6	------	1.0	------	3.3
WD (local)	.9	------	2.0	------	13.5	------	16.4
Heart Butte	.8	------	2.3	------	37.0	------	40.1
Kit Fox	1.0	------	4.0	------	6.6	------	11.6
Totals	3.4	------	9.9	------	58.1	------	71.4
T. 137 N., R. 92 W. (fractional)							
Heart Butte	2.6	------	------	------	------	------	2.6
Spring Valley	1.3	------	------	------	------	------	1.3
Red Dog	1.3	------	2.4	------	------	------	3.7
Many Springs	.4	------	.9	------	3.0	------	4.3
Koehler	.3	------	.4	------	5.0	------	5.7
Schank or Hummel[3]	------	------	------	------	33.0	------	33.0
Schank	2.2	------	5.9	------	49.7	------	57.8
Hummel	.5	------	1.6	------	16.6	------	18.7
Gunsch	1.8	------	------	------	12.9	12.3	27.0
Totals	10.4	------	11.2	------	120.2	12.3	154.1
T. 137 N., R. 93 W.							
Discovery	------	------	------	------	0.5	------	0.5
HQ	7.4	------	4.6	------	------	------	12.0
Heart Butte	10.6	------	8.0	------	3.2	------	21.8
Kit Fox	2.2	------	------	------	------	------	2.2
Spring Valley	------	------	2.3	------	9.2	------	11.5
HT Butte	.9	------	1.2	------	1.5	------	3.6
Shell	------	------	------	------	67.2	------	67.2
Schank and (or) Hummel	------	------	------	------	33.6	------	33.6
Totals	21.1	------	16.1	------	115.2	------	152.4
T. 137 N., R. 94 W. (fractional)							
Discovery	0.8	------	2.4	------	------	------	3.2
HQ	.3	1.3	2.0	------	4.7	------	8.3
Spring Valley	1.0	------	2.0	------	11.4	------	14.4
HT Butte	.5	------	2.2	------	------	------	2.7
Totals	2.6	1.3	8.6	------	16.1	------	28.6
T. 138 N., R. 92 W. (fractional)							
Spring Valley	------	------	------	------	6.6	------	6.6
HT Butte	4.4	------	------	------	------	------	4.4
Beaver Creek	1.0	------	------	------	------	------	1.0
Red Dog	.5	------	3.3	------	------	------	3.8
Many Springs	4.5	------	2.6	------	1.4	------	8.5
Koehler	.6	------	4.1	------	15.0	------	19.7
Schank	------	------	------	------	14.2	------	14.2
Hummel	------	.8	.3	2.1	10.5	28.7	42.4
Totals	11.0	.8	10.3	2.1	47.7	28.7	100.6
T. 138 N., R. 93 W. (fractional)							
Discovery	1.4	------	------	------	------	------	1.4
HQ	11.2	------	------	------	------	------	11.2
Heart Butte	5.4	------	------	------	------	------	5.4
Spring Valley	------	------	------	------	3.8	------	3.8
HT Butte	------	------	------	------	4.0	------	4.0
Beaver Creek	------	1.1	1.4	1.3	11.5	4.9	20.2
Local; 155 ft below Sentinel Butte-Tongue River contact	------	------	------	------	8.3	------	8.3
Local; about 215 ft below Tongue River-Sentinel Butte contact	.1	------	1.5	------	10.0	------	11.6
Hummel	------	------	------	------	6.5	------	6.5
Totals	18.1	1.1	4.0	1.3	21.2	3.0	24.2
T. 138 N., R. 94 W. (fractional)							
Spring Valley	------	------	------	------	10.5	------	10.5
Red Dog	------	------	------	------	4.4	1.4	5.8
Local; 155 ft below Tongue River-Sentinel Butte contact	------	------	------	------	7.4	------	7.4
Local; about 215 ft below Tongue River-Sentinel Butte contact	------	------	------	------	7.6	------	7.6
Totals	------	------	------	------	29.9	1.4	31.3
Grand Totals	80.6	10.0	104.8	12.7	724.8	119.6	1,052.5

[1] To convert short tons to metric tons, multiply short tons by 0.9072.
[2] To convert feet to meters, multiply by 0.3048.
[3] These beds are known in test holes at some distance from this township, and it is inferred that either one or the other underlies the western and southwestern parts of T. 137 N., R. 92 W.

TABLE 3. – *Estimated coal resources in the White Butte quadrangles*
[In millions of short tons]

Coal bed	Measured (ft)[2] 2.5–5	5–10	Total	Indicated (ft)[2] 2.5–5	5–10	Total	Inferred (ft)[2] 2.5–5	5–10	Total	Total
Discovery	2.9	------	2.9	4.0	------	4.0	2.0	0.5	2.5	9.4
WD	9	------	9	2.0	------	2.0	13.5	------	13.5	16.4
HQ	19.9	19.9	39.8	6.9	6.9	4.7	4.7	------	4.7	51.5
Heart Butte	23.0	1.1	24.1	24.5	------	24.5	96.2	------	96.2	144.8
Kit Fox	5.7	------	5.7	7.4	------	7.4	27.3	------	27.3	40.4
Spring Valley	4.6	3.3	7.9	16.8	2.5	19.3	79.2	------	79.2	106.4
Local	1.6	------	1.6	4.0	------	4.0	18.5	------	18.5	24.1
HT Butte	5.8	1.2	7.0	4.5	3.3	7.8	4.4	7.9	12.3	27.1
Beaver Creek	1.0	------	1.0	------	------	------	------	------	------	1.0
Red Dog	3.6	1.1	4.7	11.4	1.3	12.7	55.4	6.3	61.7	79.1
Many Springs	5.4	------	5.4	4.6	------	4.6	4.4	------	4.4	14.4
Koehler	.9	------	.9	4.5	------	4.5	28.3	------	28.3	33.7
Local	.1	------	.1	1.5	------	1.5	17.4	------	17.4	19.0
Shell	1.0	.8	1.8	2.7	2.7	5.4	140.2	58.7	198.9	206.1
Local	------	------	------	------	------	------	14.1	------	14.1	14.1
Schank	2.2	------	2.2	5.9	------	5.9	130.5	------	130.5	138.6
Hummel	1.2	1.2	2.4	5.2	2.1	7.3	75.8	33.9	109.7	119.4
Gunsch	1.8	------	1.8	------	------	------	12.9	12.3	25.2	27.0
Total	81.6	8.7	90.3	105.9	11.9	117.8	724.8	119.6	844.4	1,052.5

[1] To convert short tons to metric tons, multiply short tons by 0.9072.
[2] To convert feet to meters, multiply by 0.3048.

OIL AND GAS

Five test holes for oil and gas in these quadrangles have resulted in the discovery of the one-well Buffalo Creek field. The field was discovered November 9, 1966, with the completion of the Texaco, Inc., 1 Schank well, C NW¼SE¼ sec. 15, T. 137 N., R. 92 W. As of July 1, 1972, it had produced a total of 237,321 barrels (37.7×10^6 liters) of oil, 108,294 barrels (17.2×10^6 liters) of water, and an estimated 219,729 thousand cubic feet (62.2×10^6 liters) of gas (North Dakota Geological Survey, 1973, p. 44). Oil and gas tests drilled in the White Butte quadrangles are tabulated in table 4.

The 1 Schank well is located on a small structural bench south of a structural low in the northeast part of the White Butte NE quadrangle. Accumulation of the oil is probably not related to the small northward plunging nose shown by the structure contours on figure 1, because two nearby offsetting test holes were dry. Entrapment of the oil may be by other means than in structural highs—possibly production may be from fractures that are genetically related to the structural low. If so, the relationship of the 1 Schank well to the structural low should make the area south of the low in the White Butte NW quadrangle and the area south of another low that is two miles west of the low in the White Butte NE quadrangle (not shown by the 40-ft (12.2 m) contour interval in figure 1) interesting targets for further investigations.

TABLE 4. – *Wells drilled in the White Butte quadrangles, as of May 1, 1973*
[Compiled from U.S. Geological Survey records]

Operator	Well	Location Sec.	Tps. N	Rs. W	Year drilling ceased	Total depth (feet)[1]	Lowest formation reached	Remarks[2]
Texaco, Inc.	1 Schank	NW¼SE¼ 15	137	92	1966	10,425	Red River	Oil well; IP 265 BOPD; 30 BWPD.
Do.	1-A Schank	NE¼NW¼SE¼ 15	137	92	1967	5,000	Dakota or Lakota	Salt water disp. well.
Do.	2 Schank	SW¼ 23	137	92	1966	10,429	Red River	Abandoned
Bridger Petroleum Company.	1 Kilzer	NW¼SE¼NW¼ 9	137	92	1972	10,800	Red River	Do.
Amerada Petroleum Corporation.	1 Gross	NW¼NE¼ 35	136	93	1958	7,952	Madison Limestone.	Do.
Cannonball Oil Company.	1 Swindler	SW¼SE¼ 35	136	93	1959	7,502	Charles	Do.

[1] To convert feet to metres, multiply by 0.3048.
[2] Remarks: BOPD, barrels of oil per day; BWPD, barrels of water per day; IP, initial production. To convert barrels to liters, multiply by 158.97.

FIGURE 1 – Structure contour map drawn on base of the Sentinel Butte Member of the Fort Union Formation

SODIUM CHLORIDE

The quadrangles are underlain by three salt beds, Permian *A*, and Mississippian *D* and *F* beds (Anderson and Hansen, 1957, figs. 3, 7, and 9, pl. 11). The Permian *A* salt bed, at a depth of about 6,000 feet (1,829 meters) is 0–45 feet (0–14 meters) thick, and underlies the northern half of the White Butte NW quadrangle and the northwest corner of White Butte NE. The Mississippian *D* bed, at a depth of 7,070 feet (2,155 meters) at the 1 Schank well, has its zero edge about 1 mile (1.6 kilometers) northwest of the southeast corner of the White Butte East quadrangle and thickens to 23 feet (7.0 meters) in the northwest corner of White Butte NW. The Mississippian *F* bed, about 130 feet (40 meters) below the *D* bed, pinches out in the north half of the two southern quadrangles and is 28 feet (8.5 meters) thick in the northwest