Text to Accompany:

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FEDERAL COAL RESOURCE OCCURRENCE AND FEDERAL COAL DEVELOPMENT POTENTIAL MAPS OF THE STIGLER EAST QUADRANGLE, MUSKOGEE AND HASKELL COUNTIES, OKLAHOMA

[Report includes 9 plates]

Prepared for

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

By

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INTRODUCTION

Purpose

This text is to be used in conjunction with the Federal Coal Resource Occurrence (FCRO) and Federal Coal Development Potential (FCDP) Maps of the Stigler East 7.5-minute quadrangle, Muskogee and Haskell Counties, Oklahoma.

This report was compiled to support the land-planning work of the Bureau of land Management (BLM). The work was undertaken by Geological Services of Tulsa, Inc., Tulsa, Oklahoma, at the request of the United States Geological Survey under contract number 14-08-0001-17989. The resource information gathered for this report is in response to the Federal Coal Leasing Amendments Act of 1976 (Public Law 94-377). Published and unpublished publicly available information was used as the data base for this study. No new drilling or field mapping was done to supplement this study, nor was any confidential or proprietary data used.

Location

The Stigler East 7.5-minute quadrangle is located to the north of the Howe-Wilburton district and to the east of the Quinton-Scipio mining district of the southeastern Oklahoma coal field. All but the extreme northwestern tip of the quadrangle is in Haskell County, and the northwestern part is in Muskogee County. The city of McAlester is about 40 miles (64 km) southwest of the quadrangle, and the city of Tulsa is approximately 75 miles (120 km) northeast of the quadrangle.

Accessibility

The town of Stigler, the largest in the quadrangle, is in the extreme southwest corner of the quadrangle. Routes 9 and 82 intersect in Stigler. Route 82 runs south from here out of the quadrangle, and Route 9 runs east-west across the southern part of the quadrangle.

Many improved and unimproved roads provide access to almost every section in the quadrangle. The Midland Valley Railroad cuts across the southeastern corner of the quadrangle. The Canadian River also flows through the neighboring Stigler West quadrangle, from southwest to northeast, and joins the Arkansas River Navigation Channel north of the area.

Physiography

The Stigler East quadrangle is in the Arkoma Basin north of the Ouachita Mountains in the Arkansas Valley physiographic province of Fenneman (1931). In general, the topography can be characterized as that of erosional valleys interrupted by low, elongate ridges of more resistant rocks. Buttes are present in some of the synclinal areas (Oakes and Knechtel, 1948). Local relief across the area is about 350 feet (107 m), from about 500 feet (153 m) in some valleys to over 850 feet (259 m) on Morgan Mountain.

Many small lakes and ponds exist within the Stigler East quadrangle, and small creeks and intermittent streams are plentiful.

Climate and Vegetation

The climate in southeastern Oklahoma is for the most part fairly moderate. Winters are short, and extremely cold weather is rare. Summers, however, are generally long and hot. The mean annual temperature is about 62°F (17°C), and ranges from a daily average of about 41°F (5°C) in January to about 82°F (28°C) in July though it is not unusual to have occasional periods of very hot days (Hendricks, 1939). Annual precipitation in the area averages approximately 41 in. (105 cm), with rains generally abundant in the spring, early summer, fall and winter (Hendricks, 1939).

Southeastern Oklahoma supports a wide variety of vegetation, with oaks, blackjacks, hickories, elms and hackberries being most common. On the higher mountains and ridges pines can also be found. In parts of the valleys that have not been cleared for farming, thick stands of water oaks, willows oaks, hickories, cottonwoods, willows and wild plums may be present (Hendricks, 1939).

Land Status

The Stigler East quadrangle includes part of the Morgan Mountain Known Recoverable Coal Resource Area (KRCRA).

About 1,600 acres (647 hectares) of the total 4,706 acres (1,905 hectares) belonging to the KRCRA lie in this quadrangle, or about 34%. The Federal Government holds title to the coal mineral rights for an additional 11,240 acres (4,549 hectares), or about 30% of the entire quadrangle. As of October 19, 1979, about 1,800 acres (728 hectares) of this Federal land was under lease.

GENERAL GEOLOGY

Previous Work

Much work has been done on the southeastern Oklahoma coal field. The first geologic study of the region was published by Chance (1890) and included a map showing the outcrops of the most important coal beds in the area. In 1897, Drake published the results of his study on the coal fields of the Indian Territory, which consisted of a map and text of the principal coal beds, general stratigraphy and structural features.

From 1899 to 1910, Taff and his associates published several reports on the Oklahoma coal lands. These included a number of investigations carried out for the United States Geological Survey on the extent and general character of local stratigraphy, including coal beds. Much of his work was a part of Senate Document 390 (1910), which represented a compilation of material collected for the purpose of determining the value and extent of coal deposits in and under the segregated coal lands of the Choctaw and Chickasaw Nations in Oklahoma.

The Oklahoma Geological Survey published a bulletin by Snider in 1914 on the geology of east-central Oklahoma, emphasizing the geologic structure and oil and gas possibilities of the area. Further studies on the southern Oklahoma coal lands were carried out by Shannon et al (1926), Moose and Searle (1929), and Hendricks (1939). These, along with later works by Knechtel and Oakes in the 1940's added greatly to the body of knowledge on Oklahoma coals, particularly in terms of their quality, chemical compositions and extent.

A number of estimates as to original and remaining coal reserves have been published, among them are figures published in papers by Trumbull (1957) and Friedman (1974). Non-proprietary results of coal test holes drilled in various years in the Stigler (East) quadrangle were obtained from USGS files.

In recent years a number of masters theses have been completed for various sections of the southeastern Oklahoma coal field. Karvelot (1972) carried out a study of the Stigler coal in an area of southeastern Oklahoma that included the Stigler East quadrangle, and some of his work has been incorporated into this report.

Stratigraphy

The Arkoma Basin, once part of the larger Ouachita geosyncline, formed as a result of subsidence beginning in Mississippian time and continuing through Early and Middle Pennsylvanian. Strata in the basin are thought to have been deposited in a deltaic environment with sediment coming primarily from eroding highlands to the northeast, north, and northwest (Branan, 1968). Evidence that the basin was becoming full is provided by coal seams in the upper Atoka and lower Desmoinesian section. Sedimentation continued until late Pennsylvanian time, when the Arbuckle Orgeny of southern Oklahoma took place (Branan, 1968). In early Permian time, Ouachita moutain building to the south of the basin compressed Arkoma Basin strata into a series of long, narrow, east-west anticlinal and synclinal folds (see section on Structure below).

All of the rock units cropping out in the Stigler East quadrangle are of Pennsylvanian age, and include the Atoka Formation, as well as the Hartshorne, McAlester, Savanna and Boggy formations of the Lower Desmoinesian Krebs Group. The Hartshorne, McAlester and Boggy formations are coal-bearing in this quadrangle.

The Atoka Formation was named by Taff and Adams (1900). It is the oldest exposed formation in the quadrangle, and crops out only in the extreme northwest corner of the quadrangle (Oakes and Knechtel, 1948). The formation consists mostly of black to dark-gray sandy shale interbedded with ridge-forming brown or light gray locally calcareous sandstone units. The sandstone is highly variable in character, both from bed to bed and within a single bed. In most exposures it is fine-grained, silty and irregularly bedded; however, locally it may be coarse-grained, clean, and massive to thick-bedded. Information on the thickness of the Atoka Formation is spotty, but in a well log north of the quadrangle in Sec. 23 of T. 11 N., R. 21 E, the unit measures approximately 1,850 feet (555 m) (Oakes and Knechtel, 1948).

The Hartshorne Formation which forms the basal unit of the Desmoinesian Series, is not exposed in the Stigler East quadrangle (Oakes and Knechtel, 1948). It is most probably conformable with the underlying Atoka Formation (Dane, et al, 1938; Hendricks, 1937; Oakes and Knechtel, 1948). However, a sharp and irregular contact between the Hartshorne and Atoka formations in areas east of the McAlester mining district has lead some observers to conclude that a minor unconformity separates them, at least locally (Hendricks, 1939; Dane, et al, 1938; Branson, 1962). The contact between the Hartshorne Formation and the overlying McAlester Formation is conformable (Hendricks, 1937, 1939).

The boundaries of the Hartshorne Formation have been modified several times since the unit was first mapped by H. M. Chance in 1890. Then called the "Tobucksy" sandstone, the formation was renamed the Hartshorne sandstone by Taff in 1899. Early workers limited the formation to the massive sandstones and the Hartshorne (Lower Hartshorne) coal; the Upper Hartshorne coal and underlying shale were included in the overlying McAlester Formation.

However, Oakes and Knechtel (1948) recognized a convergence of the Upper and Lower Hartshorne coals in northern Le Flore and eastern Haskell counties, and redefined the Hartshorne formation to include both coals. The Hartshorne coal, undivided to the north, splits into Upper and Lower Hartshorne coals along a northeast-southwest trending line. This split line is located quite a bit south of the Stigler East quadrangle. The presently-used definition of the Hartshorne Formation is one proposed by McDaniel (1961), which supports the boundaries suggested by Oakes and Knechtel (1948), but formally divides the formation into Upper and Lower members where applicable (based on the above mentioned coal "split line").

The Hartshorne Formation is highly variable in character and thickness in the Stigler area, and may be anywhere from 50 to 100 feet (15 to 30 m) or more thick. In general it is a greenish-gray, fine- to medium-grained sandstone, with small scale cross-bedding (Oakes, 1977).

The McAlester Formation consists primarily of clayey shale and silty shale, with prominent sandstone beds at widely spaced intervals that give rise to conspicuous escarpments (Oakes, 1977). In the Stigler area the McAlester Formation varies in thickness from 400 to 800 feet (120 to 240 m), and it thins northward. It crops out quite extensively across the area (Oakes, 1977 and Oakes and Knechtel, 1948) and lies conformably on the Hartshorne Formation. The McAlester Formation includes various unnamed shale members, as well as several sandstone members and local coals. In ascending order, the McAlester Formation includes the McCurtain Shale Member and the Warner, Lequire, Cameron, Tamaha and Keota Sandstones Members. Between each of these sandstones, and above the Keota sandstone member, is an unnamed shale unit. The thickness given in the text below for each individual member has been estimated from well logs in the area.

The lower most unit of the McAlester Formation is the McCurtain Shale Member. The lower half of this shale is dark gray to black, slabby and silty, with numerous siderite concretions and plant material. The upper half is more argillaceous, buff to greenish, and concretions are generally less abundant (Wilson and Newell, 1937).

The most persistent sandstone of the McAlester Formation is the Warner Sandstone Member, a buff, calcareous, fine-grained, massive to thin-bedded argillaceous unit which forms the first prominent escarpment stratigraphically above the Hartshorne Formation (Wilson and Newell, 1937). This member forms the upper boundary of the McCurtain shale. It is highly variable in thickness (Oakes and Knechtel, 1948), and has a locally persistent coal associated with it. The Warner thins southward through Muskogee County, and in Secs. 17-20, T. 10 N., R. 20 E. it virtually pinches out (Oakes, 1977). Above the Warner is an unnamed shale unit which is dark to greenish-gray, silty and fissile, and varies from almost nothing up to 60 feet (18 m) thick (Oakes, 1977). Where this shale thins dramatically the Warner and overlying Lequire Sandstone are mapped as one unit (Oakes, 1977 and Oakes and Knechtel, 1948). Two thin, lenticular sandstones can be found within this shale, and siderite concretions are common (Oakes, 1977).

The Lequire Sandstone Member includes variable sandstone lenses interbedded with siltstones and shales, and can include a thin local coal. Because of its proximity to the Cameron Sandstone, and considering the Cameron's discontinuous nature in this area, Oakes (1977) has mapped the Cameron-Lequire as a single unit in Muskogee County. They are mapped as separate units in Haskell County by Oakes and Knechtel (1948).

The shale units separating the above mentioned sandstone members are in general greenish to blue-gray, silty and fissile.

Above the Cameron, or Cameron-Lequire Sandstone, is the Stigler coal, the only coal to crop out in the Stigler East quadrangle. The Stigler coal is entirely within a shale sequence that thins northward across the area, and normally has a well-developed underclay between 1 and 2 feet (0.3 to 0.6 m) thick (Karvelot, 1968).

The Tamaha Sandstone Member is the next sandstone above the Stigler coal. It is absent over much of Haskell and Muskogee counties and has its best development northeast of the study area, where it is 25 feet (8 m) thick. Where it occurs, the Tamaha is micaceous, fine-grained and well sorted (Karvelot, 1968). A gray shale separates the Tamaha from the Keota Sandstone.

In the Stigler East quadrangle area, the Keota Sandstone Member is composed of a sequence of sandstone lenses in sandy shale. These lenses thin to the north, and become fewer in number and finer grained (Oakes, 1977). The Keota varies quite a bit in thickness, but averages about 30 feet (9 m) thick in the Stigler East quadrangle. A sandy shale occurs above the uppermost Keota Sandstone lens, and continues up to the basal member of the overlying Savanna Formation.

The Savanna Formation crops out around Morgan Mountain (Oakes and Knechtel, 1948). It consists mostly of sandstones and shales. The sandstones are quite variable in both character and thickness from place to place and bed to bed (Oakes, 1977), but in general are gray, hard and fine-grained. The Savanna Formation in the Arkoma Basin contains a few thin disconnected limestone beds and several thin coal seams, including the Rowe, or lower Boggy (Oakes, 1977). As with other Pennsylvanian formations mentioned here, the Savanna Formation thins northward (Oakes, 1977).

The Boggy Formation crops out on Morgan Mountain in the northwest quarter of the Stigler East guadrangle. This is the upper unit of the Krebs Group in the Desmoinesian Series, and the youngest formation exposed in the quadrangle. It lies conformably on the Savanna Formation, and includes the Secor coal (though this coal is not present in the Stigler East quadrangle). The Boggy Formation consists of alternating shale and sandstone units, and its lower boundary is defined as the Bluejacket Sandstone (Russell, 1960), which crops out on the top of Morgan Mountain (Oakes and Knechtel, 1948).

Deposits of Quaternary alluvium and terrace deposits are quite extensive throughout the quadrangle.

Structure

The Stigler East quadrangle lies within a zone of folded Pennsylvanian rocks characterized by broad, shallow synclines and narrow anticlines (Russell 1960). The axes of these structures are commonly an echelon, and in general run parallel to the frontal margin of the adjacent Ouachita salient, marked by the Choctaw Fault. The princiapl surface structures in the Stigler East quadrangle are shown on Plate 1. These include the Mudlark fault, the Garland fault, the Stigler syncline, the Lone Star anticline, the Chickasaw Flats anticline, the Saylor Bottom syncline, the Quinine Flats anticline, the Antioch anticline, and the Kamina syncline.

The Mudlark fault runs across the northwest corner of the Stigler East quadrangle (Oakes and Knechtel, 1948). Roughly paralleling this structure is the Lone Star anticline. This is an asymmetrical structure, with its steeper limb on the southeast side (Oakes and Knechtel, 1948). The Lone

Star anticline probably extends westward into Muskogee County, but is hidden by alluvium starting in Sec. 27 of T. 10 N., R. 20 E. (Oakes and Knechtel, 1948).

The Stigler syncline is a long asymmetrical structure, with steep dips on the northwest limb, and a broad southeast limb formed of strata dipping gently northwestward (Oakes and Knechtel, 1948). It is offset by a branch of the Mudlark Fault in Sec. 2 of T. 10 N., R. 21 E.

The Garland fault trends northeastward across the north part of Sec. 27, T. 10 N., R. 21 E., cutting outcrops of the Tamaha, Keota and Cameron sandstone, including the Stigler coal outcrop (Oakes and Knechtel, 1948) and offsetting them eastward.

The Saylor Bottom syncline extends northeasterly from Sec. 7, T. 10 N., R. 22 .. in the Stigler East quadrangle. Its axis is gently undulatory, with the highest points between sections 7 and 8, North of this syncline, and roughly parallel to it, is the Chickasaw Flats anticline, a low anticline with gently dipping beds.

The Antioch anticline, in the southeast portion of the quadrangle, exposes rocks of the Warner and Lequire Sandstone members. Strata dip at relatively low angles along the structure, and northwest limb of the anticline is partically continuous with the Qunine Flats anticline. The axes of these two anticlines are separated by two normal faults. The Quinine Flats anticline is a low, northeastward plunging structure expressed by outcrops of the Tamaha sandstone (Oakes and Knechtel, 1948).

The Kamina syncline is a basin-like structural depression centered in an area of Tamaha sandstone in Sec. 7 and 8 of T. 9 N., R. 22 E., and is reflected in a wide arc of outcrops of the Warner-Lequire Sandstone members in the southeast corner of the Stigler East quadrangle.

COAL GEOLOGY

The only coal which crops out in the Stigler East quadrangle, and the only coal mapped and studied in detail for this report, is the Stigler (Lower McAlester) coal seam. In addition, there was one measurement of the Hartshorne coal estimated from a well log to be 3 feet (0.9 m) thick and one measurement of an unnamed local coal that exceeded Reserve Base thickness of 1 foot (0.3 m). These occurrences have been treated as isolated data points and were mapped separately.

Stigler (Lower McAlester) Coal Bed

The Stigler coal is the only coal found at the surface in the Stigler East quadrangle. It crops out in three different parts of the quadrangle (Plate 1). The structure of the Stigler coal is shown on Plate 5, and reflects the influence of the Stigler syncline, with beds dipping gently toward the axis of the syncline.

The Stigler coal varies in thickness from 0.2 feet (0.06 m) to estimates of 4 feet (1.2 m) from a well log in the northwestern part of the study area. The coal has undergone extensive mining in the quadrangle.

Chemical Analyses of Coal

A summary of the chemical analyses currently available for the Stigler coal bed is presented in Table 1. Average analyses are given, as is the range for all samples used to calculate each average value.

High rank coals are classified according to fixed carbon, as determined on a dry, mineral-matter-free (mmf) basis. Lower rank coals are classified according to calorific value on the moist basis. The "as received" fixed carbon (FC) shown on Table 1 were converted to dry mmf Btu/lb according to the following formula:

$$\text{Dry mmf FC} = \frac{\text{As rec'd FC} - 0.15\text{ S}}{[100 - (\text{M} + 1.08\text{A} + 0.55\text{ S}]} \times 100$$

where M = moisture, A = ash, S = sulfur

Based on the average fixed carbon shown in Table 1, the Stigler coal is classified as medium volatile bituminous coal, with an average 72.5% dry mmf fixed carbon.

Isolated Data Points

In instances where single or isolated measurements of coal beds thicker than 1.0 foot (0.3 m) are encountered within 3,000 feet (914 m) of the surface, 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 their correlation with other, better known beds. For this reason, isolated data points have been mapped on separate figures for non-isopached coal beds. These figures are not included in this report, but are kept on file at the USGS office in Denver. However, coal resources from these isolated data points are included in tables 2 and 3, and in the Reserve Base tonnages shown on Plate 2.

Table 1.--Average chemical analyses of coal in the Stilger east quadrangle, Muskogee and Haskell Counties, Oklahoma. Data in this table is from Oakes and Knechtel (1948) and from non-prietary information in USGS files.

	STIGLER COAL BED (Lower McAlester)			
% ANALYSES	FORM OF ANALYSIS	# OF SAMPLES	AVERAGE	RANGE
PROXIMATE				
Moisture	A	11	2.5	1.5- 3.6
Volatile Matter	A	11	25.8	24.2-27.6
	C	13	26.8	25.2-30.0
Fixed Carbon	A	11	67.4	66.2-68.9
	C	13	68.0	65.0-70.1
Ash	A	11	4.1	2.5- 6.2
	C	13	4.8	3.1- 8.4
ULTIMATE				
Sulfur	A	11	0.7	0.4- 1.0
	C	13	1.0	0.5- 2.6
Hydrogen	A	2	5.1	5.0- 5.2
	C	2	5.0	4.9- 5.0
Carbon	A	2	82.2	81.2-83.1
	C	2	84.3	82.2-86.4
Nitrogen	A	2	1.9	1.8- 1.9
	C	2	1.9	1.8- 2.0
Oxygen	A	2	6.1	5.4- 6.7
	C	2	3.8	3.3- 4.3
HEATING VALUE				
Calories	A	6	8,077	7,972- 8,172
	C	4	8,330	8,228- 8,450
Btu/lb	A	11	14,532	14,260-14,710
	C	9	14,832	14,440-15,030

Form of Analyses: A = as received, C = moisture-free.

To convert Btu/lb to kj/kg, multiple by 2.324

The only isolated data points in the Stigler East quadrangle include a measurement of the Hartshorne coal (estimated from a well log) in data point 38 and of an unnamed local coal in data point 18 (see Plate 1 for locations).

COAL RESOURCES

Data from drill holes, mined measured sections, outcrops, well logs and mine maps were used to construct outcrop, isopach, and structure contour maps of the various coal beds in the Stigler East quadrangle (see below). The source of each indexed data point shown on Plate 1 is listed in Appendix I at the end of this report.

A system for classifying coal resources has been published by the U.S. Bureau of Mines and the U.S. Geological Survey, and published in U.S. Geological Survey Bulletin 1450-B (1976). Under this system, resources are classified as either Identified or Undiscovered. Identified Resources are "specific bodies of coal whose location, rank, quality and quantity are known from geologic evidence supported by specific measurements", while Undiscovered Resources are bodies of coal which are thought to exist, based on broad geologic knowledge and theory (U.S.G.S. 1976).

Identified Resources may be subdivided into three categories of reliability of occurrence, according to their distance from a known point of coal-bed measurement. In order of decreasing reliability, these categories are: measured, indicated and inferred. Measured coal is that which is located within 0.25 mile (0.4 km) from a measurement point, indicated coal extends 0.5 mile (0.8 km) beyond measured coal to a distance of 0.75 mile (1.2 km) from the measurement point, and inferred coal extends 2.25 miles beyond indicated coal, or a maximum distance of 3 miles (4.8 km) from the measurement point.

Undiscovered Resources may be either hypothetical or speculative. Hypothetical resources are those undiscovered coal resources that may reasonably be expected to exist in known coal fields under known geologic conditions. They are located beyond the outer boundary of inferred resources (see above) in areas where the coal-bed continuity is assumed, based on geologic evidence. Hypothetical resources are those more than 3 miles (4.8 km) from the nearest measurement point.

Speculative resources are Undiscovered Resources that may occur in favorable areas where no discoveries have yet been made. Speculative resources have not been estimated in this report.

Coal resources for the Stigler (Lower McAlester) coal were calculated using data obtained from the coal isopach map (Plate 4). The coal-bed acreage (measured by planimeter and calculated using the trapezoidal method [modified from Hollo and Fifadara, 1980]) multiplied by the average thickness of the coal bed, and by a conversion factor of 1800 short tons of coal per acre-foot (13,238 metric tons per hectare-meter) for bituminous coal yields the coal resources in short tons. Coal resource tonnages were calculated for Identified Resources in measured, indicated, and inferred categories, and Undiscovered Resources in the hypothetical category, for unleased Federal coal lands. All coal beds thicker than 1 foot (0.305 m) that lie less than 3,000 feet (914 m) below the ground surface are included in these calculations. These criteria differ from those stated in U.S. Geological Survey Bulletin 1450-B, which calls for a minimum thickness of 28 inches (70 cm) and a maximum depth of 1,000 feet (305 m) for bituminous coal. Narrow strips between mines where undisturbed coal is less than 246 feet (75 m) from the nearest mine are considered to have no reserves and are included within mined-out areas.

Mine boundaries are only approximately located (as stated in the legend of Plate 1) and therefore these narrow areas may in reality not even exist. For this reason they are considered to have no reserves, and have not been planimetered.

Reserve Base and Reserve tonnages for the above mentioned coal beds are shown on Plate 7, and have been rounded to the nearest 10,000 short tons (9,072 metric tons). In this report, Reserve Base coal is the gross amount of Identified Resources that occurs in beds 1 foot (0.3 m) or more thick and under less than 3,000 feet (914 m) of overburden. Reserves are the recoverable part of the Reserve Base coal. In the southeastern Oklahoma coal field, a recovery factor of 80 percent is applied toward surface-minable coal, and a recovery factor of 50 percent is applied toward subsurface-minable coal. No recovery factor is applicable for in-situ coal gasification methods.

The total tonnage per section for both Reserve Base coal, including both surface and subsurface-minable coal, is shown in the northwest corner of the Federal coal land in each section on Plate 2. All values shown on Plate 2 are rounded to the nearest 10,000 short tons (9,072 metric tons), and total approximately 31.66 million short tons (28,72 million metric tons) for the entire quadrangle, including tonnages for the isolated data points. Reserve Base tonnages from the various development potential categories for surface and subsurface mining and in-situ coal gasification methods are shown in tables 2 and 3.

Geological Services of Tulsa has not made any determination of economic recoverability for any of the coal beds described in this report.

COAL DEVELOPMENT POTENTIAL

Coal development potential areas are drawn 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, approximate 40-acre (16-hectare) parcels have been used to show to limits of the high, moderate, or low development potentials. A constraint imposed by the BLM specifies that the highest development potential affecting any part of a 40-acre (16-hectare) lot, tract, or parcel be applied to that entire lot, tract, or parcel. For example, if 5 acres (2 hectares) within a parcel meet the criteria for a high development potential; 25 acres (10 hectares), a moderate development potential; and 10 acres (4 hectares), a low development potential; then the entire 40 acres (16 hectares) are assigned a high development potential. For purposes of this report, any lot or tract assigned a coal development potential contains coal in beds with a nominal minimum areal extent of 1 acre (0.4 hectare).

Development Potential for Surface Mining Methods

Areas where the coal beds of Reserve Base thickness are overlain by 150 feet (46 m) or less of overburden are considred to have potential for surface mining and are assigned a high, moderate, or low development potential based on their mining ratios (cubic yards of overburden per ton of recoverable coal). The formula used to calculate mining ratios for surface mining of coal is as follows:

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

where MR = mining ratio

t_o = thickness of overburden in feet

t_c = thickness of coal in feet

rf = recovery factor (80 percent for this quadrangle)

cf = conversion factor to yield MR value in terms of cubic yards of overburden per short ton of recoverable coal:

0.896 for bituminous coal

Note: 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 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.

Areas where the coal data is absent or extremely limited between the 150-foot (46 m) overburden line and the coal outcrop are assigned unknown development potential for surface mining methods. This applies to areas where coal beds 1.0 foot (0.305 m) or more thick are not known but may occur, and to those areas influenced by isolated data points. Limited knowledge pertaining to the areal distribution, thickness, depth and attitude of the coals in these areas prevents accurate evaluation of development potential in the high, moderate, or low categories. The areas influenced by isolated data points in this quadrangle contain approximately 0.14 million short tons (0.13 million metric tons) of coal available for surface mining.

The coal development potential for surface mining methods is shown on Plate 8. A summary of all tonnage values is presented in Table 2. Of Federal coal land not subject to currently outstanding coal lease, permit, license of preference right lease application having a known development potential for surface mining, 3 percent is rated high, 1 percent is rated moderate, and 22 percent is rated low. The remaining Federal land (74 percent) is classified as having unknown or no development potential for surface mining methods.

Table 2.--Coal Reserve Base data for surface mining methods for Federal coal land (in short tons) in the Stigler East quadrangle, Muskogee and Haskell counties, Oklahoma.

Coal Bed	High Development Potential	Moderate Development Potential	Low Development Potential	Unknown Development Potential	Total
Stigler	100,000	50,000	5,620,000	---	5,770,000
Isolated Data Points	---	---	---	140,000	140,000
Total	100,000	50,000	5,620,000	140,000	5,910,000

Development Potential for
Subsurface Mining and In-Situ Coal Gasification Methods

Areas considered to have a development potential for conventional subsurface mining methods are those areas where the coal beds of Reserve Base thickness are between 150 and 3,000 feet (46 to 914 m) below the ground surface and have dips of 15° or less. Unfaulted coal beds lying between 150 and 3,000 feet (46 and 914 m) below the ground surface, dipping greater than 15°, are considered to have a development potential for in-situ coal gasification methods.

Areas of high, moderate, and low development potential for conventional subsurface mining methods are defined as areas underlain by coal beds at depths ranging from 150 to 1,000 feet (46 to 305 m), 1,000 to 2,000 feet (305 to 610 m), and 2,000 and 3,000 feet (610 to 914 m), respectively.

Areas where the coal data is absent or extremely limited between 150 and 3,000 feet (46 to 914 m) below the ground surface are assigned unknown development potentials. This applies to areas where coal beds of Reserve Base thickness are not known, but may occur, and to those areas influenced by isolated data points. The areas influenced by isolated data points in this quadrangle contain approximately 0.70 million short tons (0.63 million metric tons) of coal available for conventional subsurface mining.

The coal development potential for conventional subsurface mining and in-situ gasification methods is shown on Plate 9. A summary of all tonnage values is presented in table 3. Of Federal coal land areas having a known development potential for these mining methods, 82 percent is rated high, none is rated moderate, and none is rated low. The remaining Federal land in the quadrangle (18 percent) is classifiied as having unknown or no development potential for either conventional subsurface mining or in-situ gasification methods.

Based on criteria provided by the U.S. Geological Survey coal beds of Reserve Base thickness dipping between 15° and 35°, regardless of tonnage, have a low development potential for in-situ coal gasification methods. Beds dipping from 35° to 90°, with a minimum of 50 million tons of coal in a single unfaulted bed or multiple, closely spaced, approximately parallel beds have a moderate development potential for in-situ coal gasification methods. Coal lying between the 150-foot (46 m) overburden isopach and the outcrop is not included in total coal tonnages available because it is needed for cover and containment in the in-situ process. There is no development potential for in-situ coal gasification in the Stigler East quadrangle.

Table 3.--Coal Reserve Base data for subsurface mining and in-situ gasification methods for Federal coal land (in short tons) in the Stigler East quadrangle, Muskogee and Haskell counties, Oklahoma.

Coal Bed	High Subsurface Development Potential	Moderate Subsurface Development Potential	Low Subsurface Development Potential	Low In-Situ Development Potential	Unknown Development Potential	Total
Stigler	24,490,000	560,000	---	---	---	25,050,000
Isolated Data Points	---	---	---	---	700,000	700,000
TOTAL	24,490,000	560,000	---	---	700,000	25,750,000

Table 4.--SOURCE AND RELIABILITY OF DATA USED ON PLATE 1

Listed below is a point by point accounting as to the source and reliability of all information shown on Plate 1. Also presented are any notes or comments pertaining to individual data points.

DATE POINT #	LOCATION	INCREASING RELIABILITY →	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	NE NW	Location				x		Oakes & Knechtel, 1948,	
	Section 5	Overburden		x				p. 101, Bore Hole #2.	
1	T 10 N | R 22 E	Coal Thickness			x				
	SW NW	Location				x		Oakes & Knechtel, 1948,	
	Section 5	Overburden		x				p. 101, Bore Hole #3.	
2	T 10 N | R 22 E	Coal Thickness			x				
	SW NW	Location				x		Oakes & Knechtel, 1948,	
	Section 5	Overburden		x				p. 101, Bore Hole #4	
3	T 10 N | R 22 E	Coal Thickness			x				
	NE SE	Location				x		Oakes & Knechtel, 1948,	
	Section 6	Overburden		x				p. 101, Bore Hole #5.	
4	T 10 N | R 22 E	Coal Thickness			x				
	C N/2 SE	Location				x		Oakes & Knechtel, 1948,	
	Section 6	Overburden		x				p. 101, Bore Hole #6.	
5	T 10 N | R 22 E	Coal Thickness			x				
	SW SE	Location				x		Oakes & Knechtel, 1948,	
	Section 6	Overburden		x				p. 101, Bore Hole #7.	
6	T 10 N | R 22 E	Coal Thickness			x				
	SW SE	Location				x		USGS files, Bore Hole S-1,	
	Section 7	Overburden				x		1954.	
7	T 10 N | R 21 E	Coal Thickness				x			
	SW SW	Location					x	USGS file, Bore Hole M-2,	
	Section 8	Overburden				x		1954.	
8	T 10 N | R 21 E	Coal Thickness				x			
	SE SW	Location				x		USGS, Bore Hole M-1, 1954.	
	Section 8	Overburden				x			
9	T 10 N | R 21 E	Coal Thickness				x			
	SE SW	Location					x	BLM Emria Project, 1979,	IEL, D-GR, caliper logs.
	Section 8	Overburden					x	Bore Hole DH-AB-5.	
10	T 10 N | R 21 E	Coal Thickness					x		
	C N/2 S/2	Location				x		USGS files, Bore Hole G-1,	
	Section 9	Overburden				x		1954.	
11	T 10 N | R 21 E	Coal Thickness				x			

DATA POINT #	LOCATION	INCREASING RELIABILITY →	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	NE SE	Location				x		USGS files, Bore Hole W-1,	
	Section 9	Overburden				x		1954	
12	T 10 N | R 21 E	Coal Thickness			x				
	NE SE	Location					x	BLM Emria Project, 1979,	IEL, D-GR, caliper logs.
	Section 9	Overburden	-	-	-	-	-	Bore Hole DH-AB-4.2	
13	T 10 N | R 21 E	Coal Thickness	-	-	-	-	-		
	SE SE	Location					x	BLM Emria Project, 1979,	IEL, D-GR, caliper logs.
	Section 9	Overburden					x	Bore Hole DH-AB-4	
14	T 10 N | R 21 E	Coal Thickness					x		
	NW NE	Location					x	USGS files Bore Hole R -1,	1750' W, 800's of NE corner
	Section 10	Overburden				x		1954	located by KRCRA map.
15	T 10 N | R 21 E	Coal Thickness				x			
	NE NE	Location				x		USGS files, Bore Hole #2,	
	Section 10	Overburden				x		1954	
16	T 10 N | R 21 E	Coal Thickness				x			
	NE NE	Location				x		USGS files, Bore Hole HO-1	
	Section 10	Overburden				x		1954	
17	T 10 N | R 21 E	Coal Thickness				x			
	SE NE	Location					x	USGS files, Bore Hole	1.3' coal is estimated to
	Section 10	Overburden				x		GY-4A, 1967	be 40% ash.
18	T 10 N | R 21 E	Coal Thickness				x			
	SE NE	Location					x	USGS files, Bore Hole #23,	
	Section 11	Overburden				x		1960	
19	T 10 N | R 21 E	Coal Thickness				x			
	SE SE	Location					x	USGS files, Bore Hole #25,	
	Section 11	Overburden				x		1960	
20	T 10 N | R 21 E	Coal Thickness				x			
	SE NW	Location				x		Oakes & Knechtel, 1948,	
	Section 7	Overburden		x				p. 101, Bore Hole #8	
21	T 10 N | R 22 E	Coal Thickness			x				
	SW NE	Location				x		Oakes & Knechtel, 1948,	
	Section 7	Overburden		x				p. 101, Bore Hole #9	
22	T 10 N | R 22 E	Coal Thickness			x				
	NW SE	Location				x		Oakes & Knechtel, 1948,	
	Section 7	Overburden		x				p. 101, Bore Hole #10	
23	T 10 N | R 22 E	Coal Thickness			x				
	SE SE	Location				x		Oakes & Knechtel, 1948,	
	Section 7	Overburden			x			p. 101, Bore Hole #11	
24	T 10 N | R 22 E	Coal Thickness			x				

DATE POINT #	LOCATION	INCREASING RELIABILITY	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	SW SE	Location				x		Oakes & Knechtel, 1948,	
	Section 7	Overburden			x			p. 101, Bore Hole #12	
25	T 10 N | R 22 E	Coal Thickness			x				
	NW NE	Location				x		Oakes & Knechtel, 1948,	
	Section 18	Overburden			x			p. 102, Bore Hole #20	
26	T 10 N | R 22 E	Coal Thickness			x				
	SE NW	Location				x		Oakes & Knechtel, 1948,	
	Section 18	Overburden			x			p. 102, Bore Hole #21	
27	T 10 N | R 22 E	Coal Thickness			x				
	SE NW	Location				x		Oakes & Knechtel, 1948,	
	Section 18	Overburden				x		p. 102, Bore Hole #22	
28	T 10 N | R 22 E	Coal Thickness			x				
	SW NW	Location				x		Oakes & Knechtel, 1948,	
	Section 18	Overburden			x			p. 102, Bore Hole #23	
29	T 10 N | R 22 E	Coal Thickness			x				
	SE NE	Location				x		Oakes & Knechtel, 1948,	
	Section 13	Overburden			x			p. 100, Bore Hole #1	
30	T 10 N | R 21 E	Coal Thickness			x				
	SW NE	Location				x		Oakes & Knechtel, 1948,	
	Section 13	Overburden			x			p. 100, Bore Hole #2	
31	T 10 N | R 21 E	Coal Thickness			x				
	NW SE	Location				x		Oakes & Knechtel, 1948,	
	Section 13	Overburden			x			p. 100, Bore Hole #3	
32	T 10 N | R 21 E	Coal Thickness			x				
	SE SW	Location				x		Oakes & Knechtel, 1948,	
	Section 13	Overburden			x			p. 100, Bore Hole #4	
33	T 10 N | R 21 E	Coal Thickness			x				
	SE SW	Location				x		Oakes & Knechtel, 1948,	
	Section 13	Overburden			x			p. 100, Bore Hole #5	
34	T 10 N | R 21 E	Coal Thickness			x				
	SE SW	Location				x		Oakes & Knechtel, 1948,	
	Section 13	Overburden			x			p. 100, Bore Hole #6	
35	T 10 N | R 21 E	Coal Thickness			x				
	SW SW	Location				x		Oakes & Knechtel, 1948,	
	Section 13	Overburden			x			p. 100, Bore Hole #7	
36	T 10 N | R 21 E	Coal Thickness			x				
	SE SE	Location				x		USGS file, Bore Hole K-11,	
	Section 16	Overburden				x		1968	
37	T 10 N | R 21 E	Coal Thickness				x			

DATA POINT #	LOCATION	INCREASING RELIABILITY →	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	E/2 W/2 NE	Location					x	Snee & Eberly, Reading	KB is 8' above GL. IES,
	Section 18	Overburden			x			#1-18, 1975	RXO/RT, G, Porosity logs.
38	T 10 N | R 21 E	Coal Thickness		x					
	NW SW	Location				x		USGS file, Bore Hole 2-SR,	
	Section 21	Overburden				x		1964	
39	T 10 N | R 21 E	Coal Thickness				x			
	NE SE	Location				x		Oakes & Knechtel, 1948,	
	Section 22	Overburden	-	-	-	-	-	p. 100, Measured Section	
40	T 10 N | R 21 E	Coal Thickness			x			#9	
	NW NE	Location				x		Oakes & Knechtel, 1948,	
	Section 23	Overburden			x			p. 100, Bore Hole #10	
41	T 10 N | R 21 E	Coal Thickness			x				
	NW NE	Location				x		Oakes & Knechtel, 1948,	
	Section 23	Overburden			x			p. 100, Bore Hole #11	
42	T 10 N | R 21 E	Coal Thickness			x				
	NE NE	Location				x		Oakes & Knechtel, 1948,	
	Section 23	Overburden			x			p. 100, Bore Hole #12	
43	T 10 N | R 21 E	Coal Thickness			x				
	SE SW	Location				x		Oakes & Knechtel, 1948,	
	Section 26	Overburden			-			p. 100, Measured Section	
44	T 10 N | R 21 E	Coal Thickness			x			#14	
	SW NW	Location				x		Oakes & Knechtel, 1948,	
	Section 26	Overburden	-	-	-	-	-	p. 100, Measured Section	
45	T 10 N | R 21 E	Coal Thickness			x			#13	
	SE NE	Location				x		Oakes & Knechtel, 1948,	
	Section 27	Overburden			x			p. 100, Bore Hole #20	
46	T 10 N | R 21 E	Coal Thickness			x				
	NW NE	Location				x		Oakes & Knechtel, 1948,	
	Section 27	Overburden	x					p. 100, Bore Hole #15	
47	T 10 N | R 21 E	Coal Thickness			x				
	SW NE	Location				x		Oakes & Knechtel, 1948,	
	Section 27	Overburden			x			p. 100, Bore Hole #16	
48	T 10 N | R 21 E	Coal Thickness			x				
	NW SE	Location				x		Oakes & Knechtel, 1948,	
	Section 27	Overburden			x			p. 100, Bore Hole #19	
49	T 10 N | R 21 E	Coal Thickness			x				
	NW SE	Location				x		Oakes & Knechtel, 1948,	
	Section 27	Overburden			x			p. 100, Bore Hole #18	
50	T 10 N | R 21 E	Coal Thickness			x				

DATA POINT #	LOCATION	INCREASING RELIABILITY	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	C S/2 S/2 N/2	Location				x		Oakes & Knechtel, 1948,	
	Section 27	Overburden			x			p. 100, Bore Hole #17	
51	T 10 N | R 21 E	Coal Thickness			x				
	NE NE	Location				x		USGS files, Bore Hole #7,	
	Section 28	Overburden				x		1961	
52	T 10 N | R 21 E	Coal Thickness			x				
	SE SW	Location				x		USGS files, Bore Hole #1SR	
	Section 28	Overburden				x		1964	
53	T 10 N | R 21 E	Coal Thickness				x			
	SW NW	Location				x		USGS files, Bore Hole #6,	
	Section 28	Overburden				x		1961	
54	T 10 N | R 21 E	Coal Thickness			x				
	C NW SE	Location					x	Natol Petroleum Corp.,	KB is 13.5' above GL.
	Section 30	Overburden			x			Chastain #1, 1969	IG-log.
55	T 10 N | R 21 E	Coal Thickness	-	-	-	-	-		
	NE NE	Location				x		USGS, Bore Hole #10, 1968	
	Section 32	Overburden				x			
56	T 10 N | R 21 E	Coal Thickness				x			
	SE SW	Location					x	Oakes & Knechtel, 1948,	
	Section 33	Overburden		x				p. 101, Bore Hole #21	
57	T 10 N | R 21 E	Coal Thickness			x				
	NW NE	Location				x		USGS files, Bore Hole #9,	
	Section 33	Overburden				x		1961	
58	T 10 N | R 21 E	Coal Thickness			x				
	NW NE	Location				x		USGS files, Bore Hole #11,	
	Section 33	Overburden				x		1961	
59	T 10 N | R 21 E	Coal Thickness			x				
	SE NW	Location					x	Oakes & Knechtel, 1948,	
	Section 34	Overburden	-	-	-	-	-	p. 101, Measured Section	
60	T 10 N | R 21 E	Coal Thickness		x				#22	
	C NE	Location			x			Oakes & Knechtel, 1948,	
	Section 4	Overburden	-	-	-	-	-	p. 98, Measured Section #2	
61	T 9 N | R 21 E	Coal Thickness			x				
	NE NW	Location			x			Oakes & Knechtel, 1948,	
	Section 4	Overburden			x			p. 98, Bore Hole #1	
62	T 9 N | R 21 E	Coal Thickness			x				
	C E/2 W/2	Location			x			Oakes & Knechtel, 1948,	
	Section 4	Overburden			x			p. 98, Bore Hole #3	
63	T 9 N | R 21 E	Coal Thickness			x				

DATA POINT #	LOCATION		INCREASING RELIABILITY →	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
64	NE SW		Location			x			Oakes & Knechtel, 1948,	
	Section 4		Overburden			x			p. 98, Bore Hole #4	
	T 9 N	R 21 E	Coal Thickness			x				
65	NW SW		Location			x			Oakes & Knechtel, 1948,	
	Section 4		Overburden			x			p. 98, Bore Hole #5	
	T 9 N	R 21 E	Coal Thickness			x				
66	SW SW		Location			x			Oakes & Knechtel, 1948,	
	Section 4		Overburden			x			p. 98, Bore Hole #6	
	T 9 N	R 21 E	Coal Thickness			x				
67	NE SE		Location					x	USGS files, Bore Hole	
	Section 5		Overburden				x		#Sn-4, 1959	
	T 9 N	R 21 E	Coal Thickness		x					
68	SE SE		Location					x	USGS file, Bore Hole #Sn-3	
	Section 5		Overburden				x		1959	
	T 9 N	R 21 E	Coal Thickness		x					
69	SE SE		Location			x			Oakes & Knechtel, 1948,	
	Section 5		Overburden			x			p. 98, Bore Hole #7	
	T 9 N	R 21 E	Coal Thickness			x				
70	SE SE		Location					x	USGS files, Bore Hole	
	Section 5		Overburden				x		#Sn-2, 1959	
	T 9 N	R 21 E	Coal Thickness		x					
71	SE SE		Location					x	USGS files, Bore Hole	
	Section 5		Overburden				x		#Sn-1, 1959	
	T 9 N	R 21 E	Coal Thickness			x				
72	SW SE		Location			x			Oakes & Knechtel, 1948,	
	Section 5		Overburden			x			p. 98, Bore Hole #8	
	T 9 N	R 21 E	Coal Thickness			x				
73	NE NW		Location				x		USGS files, Bore Hole #7,	Correlated with strip logs.
	Section 6		Overburden				x		1968	
	T 9 N	R 21 E	Coal Thickness			x				
74	NW NW		Location				x		Oakes & Knechtel, 1948,	
	Section 8		Overburden			x			p. 98, Bore Hole, #10	
	T 9 N	R 21 E	Coal Thickness			x				
75	NW NW		Location				x		Oakes & Knechtel, 1948,	
	Section 8		Overburden			x			p. 98, Bore Hole, #11	
	T 9 N	R 21 E	Coal Thickness			x				
76	NW NE		Location				x		Oakes & Knechtel, 1948,	
	Section 8		Overburden			x			p. 98, Bore Hole, #9	
	T 9 N	R 21 E	Coal Thickness			x				

DATE POINT #	LOCATION	INCREASING RELIABILITY	1	2	3	4	5	REFERENCE	NOTES/COMMENTS
	NE NE	Location			x			Oakes & Knechtel, 1948,	
	Section 7	Overburden	-	-	-	-	-	p. 98, Measured Section #3	
77	T 9 N | R 22 E	Coal Thickness			x				
	NE NW	Location			x			Oakes & Knechtel, 1948,	
	Section 8	Overburden	-	-	-	-	-	p. 98, Measured Section #4	
78	T 9 N | R 22 E	Coal Thickness			x				
	C NW/4	Location				x		Oakes & Knechtel, 1948,	
	Section 17	Overburden	-	-	-	-	-	p. 98, Measured Section #5	
79	T 9 N | R 22 E	Coal Thickness			x				

Table 5.--TABLES OF OIL AND GAS TEST HOLES

Note: "Top Log Int." refers to the measured depth to the top of the interval logged by the particular sonde. Driller log total depth, referenced to K.B. or D.F., has been abbreviated to T.D. (Note: This may vary from T.D. referenced to G.L.). The measured depth at which coal is reported on the scout card appears in the column titled "Scout Card Coal". The column titled "Harts./Drill./Scout" contains the measured depths drilled to the top of the Hartshorne Sandstone, as reported by the driller logs and the scout cards.

* Logged interval stratigraphically below Hartshorne Coals.

Sec-Tn-Rg	Operator/Farm Location	Driller Logs Coal Reported Thickness & Depth	Scout Card Coal	Harts. Drill. Scout	Top Log Int. Gamma Elec.	Top Log Int. Dens. Sonic	T.D. Year
2-9-21	Funk/#1 Nichols			NR			4970
	CSW	NR	NR	NR			1979
2-9-21	Southern Union/#1 Walkup			NR		4000	4875
	CSE	NR	NR	NR	561		1974
7-9-21	E. L. Johnson/#1 Bird			NR			4656
	260 FSL 910 FWL of SE/4	NR	NR	NR			1976
8-9-21	Royer & D/#1 Lossiter						4376
	CSW		NR	NR			1977
9-9-21	Medders/#1 Suggs						4538
	NW NW SE		NR	NR			1961
10-9-21	Snee & Eberly/#1 Killian			NR			4923
	NE NE SW	50' zone @ 415	NR	NR			1964
11-9-21	Funk/#1 Stephens			NR			5130
	C S/2 NW	NR	NR	NR			1979
15-9-21	Taylor/#1 Flanagan			NR			4950
	C N/2 SW	NR	NR	NR			1977
17-9-21	So. Union Prod./#1 Brooks-Few			NR			4219
	760 FSL 600 FWL	NR	NR	NR			1975
3-10-21	ITIO/Blake			NR			3007
	SW SW NW	NR	NR	NR			1930
18-10-21	Snee & Eberly/#1-18 Reading			NR		165	2349
	1320 FSL 1120 FWL of NE/4	60' zone @ 690	NR	NR			1976
20-10-21	Texas O & G/#1 Ward "C"			NR			5400
	C W/2 NW	NR	NR	NR			1979
23-10-21	Texas O & G/#1 Storment			NR			5123
	C W/2 SW	NR	NR	NR			1979

Sec-Tn-Rg	Operator/Farm Location	Driller Logs Coal Reported Thickness & Depth	Scout Card Coal	Harts. Drill. Scout	Top Log Int. Gamma Elec.	 Dens. Sonic	T.D. Year
29-10-21	Lone Star/#1 J. P. Ward			NR			4942
	CSW NW	NR	NR	NR			1968
30-10-21	Natol/#1 Chastain			NR			4327
	CNW SE	NR	NR	NR			1969
33-10-21	Service Drilling/#1-33 Honeycutt			NR			5130
	2010 FSL 1030 FWL of SE/4	970	NR	NR			1979

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