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DIVISION OF THE STATE GEOLOGICAL SURVEY M. M. LEIGHTON, Chief URBANA

REPORT OF INVESTIGATIONS-NO. 153

# SUBSURFACE GEOLOGY AND COAL RESOURCES OF THE PENNSYLVANIAN SYSTEM IN WHITE COUNTY, ILLINOIS

BY

JOHN A. HARRISON



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URBANA, ILLINOIS

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1951

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# SUBSURFACE GEOLOGY AND COAL RESOURCES OF THE PENNSYLVANIAN SYSTEM IN WHITE COUNTY, ILLINOIS

ΒY

JOHN A. HARRISON

### INTRODUCTION

HITE COUNTY, with an area of 507 square miles, lies in the southeastern part of Illinois within the Illinois basin, but south of its deepest part (fig. 1).

Before 1938, data on which to base Pennsvlvanian subsurface structure came from only five diamond-drill holes in the southernmost tier of townships, one diamonddrill hole in T. 3 S., R. 14 W., and a coal mine at Norris City. Records of six churn-drill oil test holes in the county were unreliable as sources of information about the occurrence of coal beds. Since that date additional information for 19 rotary test holes, fairly evenly spaced throughout the county, have been obtained by members of the Illinois Geological Survey (fig. 2). The wells were carefully logged, drill cuttings were collected and studied, and the interpretation was aided by use of electric logs. In addition about 3000 electric logs have been examined and the position of coal beds in these holes determined upon the basis of information supplied by records of nearby diamond-drill holes, by records of the so-called "control" test holes (logged in detail by members of the Survey staff), and by the record of the depth of the No. 6 coal bed in the mine shaft at Norris City.

It was not possible to plot all the closely drilled test holes for which electric logs were available. Therefore only about onethird of the total number have been shown (pl. 1 and fig. 3). Only those thicknesses are recorded in the tabulation or used in calculating coal resources which were reported in logs of core-drill holes or recorded in logging the 19 control wells, because thickness cannot be determined satisfactorily from electric logs.

This report on White County is one of a series of county reports on subsurface



FIG. 1.—Outline of Illinois structural basin and White County.

studies of Herrin (No. 6) and other coal beds mainly in the Illinois basin. Data for this and other county reports have been compiled for several years by members of the Survey.

Tabulated data accompanying this report appear in an abbreviated form showing location, county numbers, type of hole, surface altitude and how determined, and the altitude of the beds above or below sea level. A plus sign by the county number refers to



FIG. 2.—Distribution of diamond-drill and control rotary-drill holes in White County and surrounding counties, and the mine at Norris City. (See also figures 7 and 14.)

table 2 which gives detailed geological information where available. Complete tabulation, similar to those accompanying previous reports of this series, is available at a slight charge for printing.

This report has been prepared under the supervision of G. H. Cady, Head of the Coal Division of the State Geological Survey. The author is indebted for advice and suggestions in this study to his colleagues on the Survey staff.

#### KEY BEDS

In the interpretation of the stratigraphy and structure of the Pennsylvanian strata in White County, it was desirable to use for reference as many Pennsylvanian strata or groups of strata as can be satisfactorily identified and also a few of the upper Mississippian formations, because the latter aid in determining the position and amount of faulting. The sources of information mainly relied upon for the subsurface geologic succession were records of diamond and rotary drill holes.

A diamond-drill hole located near New Haven in sec. 18, T. 7 S., R. 10 E., penetrated 1,757 feet of Pennsylvanian beds and 476 feet of Mississippian strata to a depth



FIG. 3—Oil pools in White County.

of 2,232 feet (pl. 2). The core was described in detail by geologists of the Survey and reproduced graphically in an earlier report.<sup>1</sup> The greatest thickness of the Mc-Leansboro group penetrated in any of the five diamond-drill holes was in sec. 5, T. 7 S., R. 9 E. (County No. 5), where 780 feet of McLeansboro strata were found above No. 6 coal bed, 237 feet of these strata lying above the New Haven (Shoal Creek) limestone.

It is possible to identify a fairly large number of distinctive beds in the logs of the diamond-drill holes, although these are only driller's logs, but for most of the county dependence must be placed upon rotary drill holes. Some of these rotary holes were carefully logged from cuttings, and drilling time was recorded by members of the Survey staff, but the drilling was usually too fast to permit fine lithologic discrimination, so that only a few of the most distinctive beds are recognizable in electric logs. These provide useful key or reference beds in the construction of structure and isopach (thickness) maps.

Ten such Pennsylvanian key beds have been selected (fig. 4):1) New Haven limestone; 2) West Franklin limestone; 3) "No. 7" coal bed; 4) Herrin (No. 6) coal bed; 5) Harrisburg (No. 5) coal bed; 6) "No. 4" coal bed; 7) "No. 2A" coal bed; 6) "No. 2" coal bed; 9) Palzo sandstone; and 10) Stonefort limestone. These are not equally useful as key beds for not all could be used effectively to prepare structure maps. However, key beds commonly help to reveal location and amount of fault movement.

<sup>&</sup>lt;sup>1</sup> Cady, Gilbert H., Coal resources of District V: Illinois Geol. Survey Coop. Mining Series Bull. 19, Pl. 2, 1919.

PENNSYLVANIAN SYSTEM IN WHITE COUNTY



FIG. 4.—Key beds in McLeansboro, Carbondale, and upper part of Tradewater group, based on diamond drilling in White and northern Gallatin counties.

The three Mississippian formations used as key or reference beds in the interpretation of structure are: 1) Lower Kinkaid limestone; 2) massive Glen Dean limestone; and 3) Barlow limestone.

The possibility of correlating the stratigraphic or lithologic units with the pattern of potential and resistivity curves of electric logs is illustrated by comparison of a graphic log based on drill cuttings with the pattern of the electric log of a control well (fig. 5).

The ten Pennsylvanian key beds as observed in cores and cuttings and their characteristic patterns in electric logs (pl. 2) are described below, including discussion of their relative usefulness as datum planes for delineation of structure.

#### NEW HAVEN LIMESTONE

The New Haven limestone, the uppermost key member of the McLeansboro group, was named by A. H. Worthen<sup>2</sup> from exposures at New Haven in the extreme northeastern portion of Gallatin County where it is 4 feet thick. It is believed by Wanless<sup>3</sup> to be the equivalent of the Shoal Creek limestone.

In drill holes in White County, the New Haven limestone ranges in depth from 144 to 694 feet, lies 370 to 480 feet above Herrin (No. 6) coal, and has an average thickness of 6 feet. Cuttings of this limestone are white to buff, finely crystalline, and sparsely fossiliferous. It is commonly underlain by a black shale; coal is rarely found beneath the shale.

The New Haven limestone is recorded in 58 percent of the drill records examined. This percentage figure does not agree with the apparent general persistence of this limestone, in spite of the fact that it is believed to be cut out here and there by sandstone. The reason may be that the New Haven limestone has probably been used as the solid footing for casing in many wells, hence it is not recorded in the electric logs. This is especially true in the southern portion of

SELE-POTENTIAL DECICTIVITY SHORT NORMAL LONG NORMAL NEW HAVEN LS 400 WEST FRANKLIN IS. ő ₫-"NO.7" COAL -HERRIN LS. NO.6 COAL NO.5 COAL 80 "NO.4" COAL NO.2A" COAL POSITION OF DEKOVEN COAL ĩ DAVIS COAL STONEFORT LS. 200

FIG. 5.—Resistivity pattern of key beds. Jarvis Bros. and Marcell-L. C. Cleveland 1, Sec. 1, T. 5 S., R. 10 E.

Worthen, A. H., Geological Survey of Illinois, Vol. VI, p. 67, 875.
 Wanless, H. R., Pennsylvanian correlation in the East-

<sup>&</sup>lt;sup>3</sup> Wanless, H. R., Pennsylvanian correlation in the Eastern Interior and Appalachian coal fields: Geological Society of America, Special Paper No. 17, p. 13, 1939.

the county where the depth of the limestone is moderate. The New Haven limestone is probably more persistent throughout the county than is indicated by the percentage of holes in which its presence is reported.

#### West Franklin Limestone

The West Franklin limestone was named by J. Collett<sup>4</sup> from an exposure along the bluff of the Ohio River near the town of West Franklin in Posey County, Indiana. The limestone in White County here designated the West Franklin is so called on the basis of its general position and lithology and because it has been similarly correlated in earlier reports of this series.5

One, two, or three benches of limestone may be present at this position, and between two of them a thin coal bed or black shale is found in some wells. Near West Franklin, Indiana, and in the control well in sec. 21, T. 4 S., R. 14 W., a coal bed is present; in the diamond-drill core in sec. 18, T. 7 S., R. 10 E., near New Haven and in another control well in White County black shale was found.

When only one or two benches of the limestone are present, it is commonly impossible to determine which bench is represented. The variegated shale found between the two lower benches at West Franklin may or may not be restricted to this position, hence it is not a convincing criterion unless there is supporting evidence.

The West Franklin limestone with an average thickness of 12 feet has been identified in 95 percent of the records studied. The subsurface contour map of the West Franklin limestone shows this distribution (pl. 2). The interval between the New Haven and the West Franklin limestones ranges from 150 to 200 feet, and the interval between the West Franklin limestone and the No. 6 coal generally ranges from 220 to 280 feet. This large interval between West Franklin and No. 6 coal prevails except in T. 3 S., R. 8 E. in the northern part of the county where the interval is 150 to 200 feet. Resistivity patterns on the electric logs at this locality are characterized by proportionate diminutions of the various units recognized where the interval is more normal. Studies of cuttings, however, show that the unit corelated as West Franklin limestone is a very calcareous sandstone, hence the correlation is somewhat in doubt.

The West Franklin limestone, like the New Haven limestone, produces a characteristic and relatively conspicuous resistivity pattern in the electric log (fig. 5) compared with the pattern for 100 feet above and below. It is generally present and so provides a suitable bed to use for delineation of structure.

## "No. 7" Coal

A thin persistent coal bed lies from 150 to 200 feet below the West Franklin limestone (except in T. 3 S., R. 8 E., where the interval is 80 to 120 feet) and from 70 to 80 feet above the No. 6 coal. This coal bed is shown in 96 percent of the drill records studied. Its average thickness as determined in 18 control wells is 2 feet 4 inches. It is generally the first coal bed above the Herrin (No. 6) coal bed in the control drill holes studied; however, in two of the control tests, sec. 13, T. 4 S., R. 8 E., and sec. 28, T. 6 S., R. 10 E., two coal beds are present at this general position, the upper being regarded as "No. 7." The coal bed called "No. 7" in this and companion reports, is tentatively and somewhat uncertainly correlated with the Danville (No. 7) bed. On the basis of its relative position, the "No. 7" coal bed may equally well be the equivalent of the Cutler<sup>6</sup> coal bed of southern Illinois, the exact position of which with reference to Danville (No. 7) coal bed is also uncertain. In drill cuttings, the "No. 7" coal is bright, flaky, and pyritic. The bed is overlain by black shale and underlain by an underclay.

 <sup>&</sup>lt;sup>4</sup> Collett, J., Indiana Department of Geology and Natural History, 13th Annual Report, pp. 61-62, 1884.
 <sup>5</sup> Pullen, M. William, Jr., Structure, key beds, and coal resources of Pennsylvanian strata of Gallatin County north of the Shawneetown Fault, with brief considera-tion of application of data on further oil and gas exploration: Illinois Geol. Survey. Unpub. ms.

<sup>&</sup>lt;sup>6</sup> Bell, Alfred H., Ball, Clayton, and McCabe, Louis, Geol-ogy of the Pinckneyville and Jamestown areas, Perry County, Illinois: Illinois Geol. Survey, Illinois Petro-leum 19, p. 3, 1931.



FIG. 6.—North-south cross section (A-A'), west side of White County, showing relative position of the top of six Pennsylvanian key beds and the Barlow limestone; also the base of the Lower Kinkaid and massive bed of the Glen Dean limestone member of the Chester group. (See plate 3 for location of wells.)

The resistivity peak at "No. 7" coal in the electric log is moderately prominent below a fairly long shale pattern of little relief, rarely exceeding 30 ohm-meters. In comparison the resistivity peak for limestones generally exceeds 100 ohm-meters. A reverse or negative peak of the third curve frequently accompanies the normal peak of the "No. 7" coal bed. That is, the normal resistivity curve shows a higher resistivity and the third curve a lower resistivity than the adjacent shales. This negative peak generally occurs when the thickness of the coal bed is equal to or less than that of the electrode spacing.

A thin coal bed found between "No. 7" and No. 6 coals in the two control test holes mentioned above, may be the equivalent of the Jamestown<sup>7</sup> coal bed of southern Illinois.

#### HERRIN (NO. 6) COAL BED

The Herrin (No. 6) coal bed ranges in position from 52 feet below sea level in the southern portion of the county to 606 feet below sea level in the northern portion of the county. This is not the extreme range in the county (pl. 3), such as results from faulting; irregularities produced by either normal or reverse faulting distort the picture of regional northward deepening of the coal basin toward the trough of the Illinois basin. This structural trend is shared by all Pennsylvanian beds as they are essentially parallel (fig. 6). No. 6 coal bed is locally cut out by a sandstone.

The pattern produced in electric logs by strata near and at the position of the No. 6 coal bed characteristically consists of one or two distinct peaks<sup>8</sup> (fig. 5). The

<sup>7</sup> Op. cit., Geology of the Pinckneyville and Jamestown areas.

<sup>&</sup>lt;sup>8</sup> Taylor, E. F., Pullen, M. W., Jr., Sims, P. K., and Payne, J. N., Methods of subsurface study of the Pennsylvanian strata encountered in rotary-drill holes: Illinois Geol. Survey Rept. Inv. 93, p. 18, 1944.



FIG. 7.-Distribution of thickness of the interval between No. 5 and No. 6 coal beds.

upper peak is believed generally to represent the limestone caprock and the lower one the coal bed. Where the limestone and coal bed are in close contact, both beds may be recorded by a single peak. The effect of the underclay or the cavity caused by the undercutting of the underclay is uncertain. The erratic pattern of the electric logs at the position of coal beds makes them practically useless for determining the thickness of this or any other coal bed.

#### HARRISBURG (No. 5) COAL BED

The Harrisburg (No. 5) coal bed lies from 60 to 120 feet below No. 6 coal bed and seems to be present everywhere. It is more widespread than No. 6 coal, mainly because there was no Pennsylvanian erosion of the bed (fig. 7). It has an average thickness of 3.6 feet, so far as can be estimated from the logs of six diamond-drill holes and 19 control wells.

The No. 5 coal bed is overlain by black shale and lies upon underclay. Only a few drill holes record a caprock, the St. David limestone, overlying the black shale. In electric logs (fig. 5) the resistivity peak is not strong, but it is readily recognizable at an appropriate interval below the Herrin coal and above "No. 4" coal bed.

#### "No. 4" Coal Bed

The "No. 4" coal bed lies from 80 to 105 feet below the No. 5 coal. Control wells

indicate some variability in associated beds. Black shale is persistent in the coal zone with the coal bed generally present in the lower part. A thin limestone is locally present at or near the top of the black shale. In some control wells the coal appears to be absent, only limestone and black shale marking the zone. A thickness of 1 foot 10 inches is given for this coal in the New Haven core record.

The electric log pattern is generally characterized by two relatively weak, but closely spaced, resistivity peaks whose cause is undetermined. The position of this double peak in the electric logs is a useful structure datum because it can be identified in 98 percent of the available electric logs in the county.

#### COAL BEDS BETWEEN "NO. 4" AND "NO. 2"

"No. 2A" coal bed. In two diamonddrill records in sec. 32, T. 7 S., R. 8 E. in Gallatin County and in sec. 18, T. 7 S., R. 10 E. in White County, two thin coal beds, each ranging from 4 to 8 inches thick and both called the "No. 2A" bed, are reported between the "No. 4" and the "No. 2" coal bed. The interval between the "No. 4" coal bed and the upper bed is 15 feet and 20 feet respectively in the two holes; between the upper and lower bench the interval is 8 and 16 feet; and between the lower bench and "No. 2" coal bed it is 45 and 50 feet. In the first log a dark gray argillaceous sandstone, and in the other a dark gray shale, is reported above the upper bench; a dark gray shale is reported above the lower bench in both records. In the control tests and electric logs of the wells only one coal bed could be discerned.

The position of one or the other, or both coal beds, is only indistinctly indicated in about 70 percent of the electric log records in White County. However the "No. 2A" coal is always a poor key zone because it has a vague pattern in the electric log, it is uncertain whether or not there are two benches, the interval between the two benches is variable, and the coal is apparently absent in about 30 percent of the electric logs.

#### "No. 2" Coal Bed

A prominent and persistent reverse peak in the normal resistivity curve of the electric log commonly marks the position of a coal bed lying 60 to 80 feet below "No. 4" coal bed, 160 to 185 feet below No. 5 coal bed. This reverse peak may be an effect produced at the position of the underclay rather than by the coal bed, because coal as a rule is marked by high resistivity on the electric logs. Diamond-drill records and the logs of control wells reveal the presence of a coal bed which is tentatively called "No. 2."

A coal bed found in drill holes in Franklin County at what seems to be an approximately similar position giving a similar pattern in electric logs has been correlated by the use of spores9 with the La Salle (No. 2) coal bed of northern Illinois. It may eventually be possible, by using spores obtained from drill cuttings from beds in White County, to establish more definitely the stratigraphic position of the "No. 2" coal bed and its relation to the La Salle (No. 2) and Indiana IIIA coal beds. Regardless of the uncertain correlation, this reverse peak is found in 94 percent of the electric logs of White County wells and can be used as a key marker.

#### PALZO SANDSTONE

The Palzo sandstone where present is the basal member of the Carbondale group. The New Haven records, for example, show a sandstone below the "No. 2" coal in the position of the Palzo sandstone. Definite identification of the Palzo sandstone throughout the county is impossible at present because the electric log exhibits no characteristic pattern at the position of the sandstone; therefore, it is not a satisfactory key bed.

#### STONEFORT LIMESTONE

The lower Pennsylvanian Stonefort limestone in the Tradewater group, lying between 290 and 360 feet below No. 5 coal bed, may not be widespread, for it

<sup>9</sup> Kosanke R. M., Pennsylvanian spores of Illinois and their use in correlation: Illinois Geol. Survey Bull. 74, p. 70, 1950.



FIG. 8.—East-west cross section (B-B') near south line of White County, showing relative position of top of seven Pennsylvanian key beds and Barlow limestone; also bottom of Lower Kinkaid and the massive bed of Glen Dean limestone member of the Chester group. (See plate 3 for location of wells.)

can be identified in only 57 percent of the drill records in the county. Drill cuttings from this limestone are light brown, crystalline, and fossiliferous. The limestone in many places is associated with a thin coal bed. Its position is not marked by a characteristic pattern in the electric log, hence it is not a good key bed.

#### MISSISSIPPIAN DATUM BEDS

Three Mississippian limestones were used in determining the fault pattern: the Lower Kinkaid, the massive Glen Dean, and the Barlow. All three are generally present and their positions on the electric logs are characteristically indicated.

#### STRUCTURE

The structure of the Pennsylvanian system in White County is characterized by a prevailing northwestward dip and by conspicuous northeast-southwest trending faults. The major faults, the Ridgeway, the Herald-Phillipstown, and the Maunie, cross the county, whereas two other faults, the Pitcher Lake fault and the Mink Island fault, cross only the easternmost townships.

The cross sections (figs. 8 and 9) show graphically the structural relationships produced by this faulting. The Herald-Phillipstown fault and the Maunie fault bound an intervening graben, which appears on both cross sections. The Maunie fault and the Pitcher Lake fault bound a horst, but the Pitcher Lake fault and the Mink Island fault bound another graben.

The faults are in general single normal gravity faults. However, repeated faulting exists along the fault zone in sec. 31, T. 3 S., R. 14 W. (fig. 10), where the wells cross at least two faults. The western fault has a throw of 175 feet and the eastern



FIG. 9.—Cross section (C-C') running northwest across the northeastern part of White County. (See plate 3 for location of wells.)

fault has a throw of 40 feet, and the two appear to be parallel normal faults. Similar parallel faulting is also indicated in sec. 18, T. 6 S., R. 9 E., where wells cross more than one fault with different amounts of displacement.

The strike for all faults is generally northeast-southwest; however, local variations occur, as in sections 19 and 30 in T. 4 S., R. 14 W. In sec. 31, T. 3 S., R. 14 W., the Herald-Phillipstown fault strikes N. 23° E. and dips 82° SE. as determined from a simple three-point analysis. The dip may not be uniform along the faults, but all faults are at a high angle. The throw along the faults ranges from 32 feet in sec. 27, T. 3 S., R. 10 E., along the Ridgeway fault, to 444 feet in sec. 31, T. 4 S., R. 11 E., along the Herald-Phillipstown fault.

The local fault pattern can usually be worked out by analysis of the stratigraphy. The well on the left side in figure 11 shows the standard succession but in the well on the right side, which crossed the Herald-Phillipstown fault, coal beds are missing because they were lost by faulting. The throw at this point is 230 feet. Records of other pairs of test holes in the fault zone would reveal similar relationships.

The throw of the faults is the same in both the Pennsylvanian and the Mississippian systems, as far as can be determined.



FIG. 10.—Section across Herald-Phillipstown fault showing interpretation based on faulting of strata in five electric logs.

STRUCTURE



FIG. 11.—Graphic diagram of electric logs of two adjacent drill holes, one of which crosses a fault with the loss of three coal beds.

Few wells have penetrated the Barlow limestone on the downthrow side of the faults in the Mississippian system, but where this has happened, the off-set is as great as in the Pennsylvanian system.

The beds are approximately parallel and except in the fault blocks they show the general regional northwestward dip (fig. 6).

The effect of the uplift of the Omaha dome in Gallatin County extends northward into White County as far as T. 7 S., R. 8 E. Another structural high is located in the Mill Shoals area in T. 3 S., R. 8 E.

#### COAL RESOURCES

In estimating coal resources, the U. S. Geological Survey many years ago set a depth of 3,000 feet as the limit of minable coal.<sup>10</sup> However, legal requirements for plugging oil test holes in Illinois have in effect reduced this depth to 1,000 feet, at least wherever drilling is closely spaced. The Oil and Gas Division of the Department of Mines and Minerals has ruled that coal beds 30 inches or more thick must be protected to a depth of 1,000 feet.

Only one mine in the state, that at Assumption, has worked coal at or slightly below 1,000 feet. In the Illinois basin, however, most of the coal resources lie below this depth, and hazards of mining in areas penetrated by numerous unplugged holes may well be the main factor in indefinitely delaving development of the coal resources of such areas. A minimum thickness of 28 inches for minable coal has been established in the plan for estimating coal reserves by the National Bituminous Coal Advisory Council to the Secretary of the Interior. Coal beds of this thickness are mined on a commercial scale at some places in the United States, but operations in Illinois, except for a few local mines, are in thicker beds.

The commercial possibilities of the coals in White County are determined by the quantity of coal in the different beds as based on their thickness, extent, physical character and quality of the coal, and on roof and floor conditions.

The coal resources of White County were estimated on the following basis: proved resources consist of coal beds where mining and diamond drilling has established the presence and thickness of the coal bed. The proved coal (Class IA) extends half a mile from the drill hole or mine. Probable resources (Class IB) surround or lie adjacent to proved areas, extending not more than one mile from the mine or drill Strongly indicated coal resources hole. (Class IIA) are found in areas where Survey control wells establish the presence and probable thickness of the coal beds extending not more than four miles from mine or drill hole. Special conditions indicating lenticular or irregular distribution of a coal bed may considerably decrease the estimated area of indicated coal resources. Weakly indicated coal resources (Class IIB) are determined on the basis of data supplied by electric logs of rotary drill holes, weakly substantiated diamond-drill hole evidence and geological probability. The extent of the mined-out area at Norris City was obtained from a mine map of Norris City Coal Corporation operation on file in the Department of Mines and Minerals at Springfield, Illinois.

In calculating tonnage from a map, planimeter measurement of the area in square inches was converted to square miles by multiplication by the factor 0.972, the scale of the map being slightly greater than 1 mile to the inch (U. S. Geol. Survey stand-



FIG. 12.—Graphic representation of beds associated with coal beds having a thickness of 28 inches or more in the Tradewater and Caseyville groups.

<sup>&</sup>lt;sup>10</sup> Cady, Gilbert H., Coal resources of District V, Illinois Geol. Survey Coop. Mining Series Bull. 19, p. 3, 1919.



FIG. 13.-Thickness of No. 5 coal bed, position of faults and location of closely drilled areas.

ard scale 1:62,500). Resources were calculated on the basis of 1,800 tons per acre foot or 1,152,000 tons per square mile foot (table 1).

The initial total coal resources in the county of all four classes and subclasses are estimated to have been 9,243,713,344 tons of which 32,486,393 tons are regarded as proved and lying less than 1,000 feet in depth. To date 3,493,647 tons have been mined or rendered unrecoverable by mining and 1,698,251,476 tons are in areas of closely drilled oil test holes.

### Caseyville and Tradewater Proved Coal Resources

Little information is available for map-

ping coal beds below Herrin (No. 6) coal bed in White County. Only one of the six diamond-drill holes in the county completely penetrated the Tradewater group. Three of the records are skeleton logs and three are complete logs. The record of the New Haven core shows three coal beds 28 inches or more thick in the Casevville and Tradewater groups. The lowest coal lies 35 feet below the Battery Rock sandstone at a depth of 1,667 feet. The other two coals are near the top of the Tradewater group. The lower or Davis coal is 3 feet thick and the upper or Dekoven coal is 3 feet 4 inches thick. The beds are separated by an interval of 26 feet. The Dekoven coal is described as pyritic and bony. Figure 12 shows graph-

			Unava	Available				
CLASSIFICATION	Cut out	Mined out and lost by mining		Oil p dr	ools or other closely illed areas	Classes I and II		
	<sup>z</sup> q. Mi.	Sq. Mi.	Tons	Sq. Mi.	Tons	Sq. Mi.	• Tons	
Coal No. 6 IA IB IIA. IIB	12.95	0.66	*3,493,647 None None None	0.50 1.18 80.39 1.29	2,966,400 6,998,400 481,795,200 7,430,400	3.42 11.81 359.24 30.21	19,249,920 66,349,440 1,877,978,880 156,096,000	
No. 5 IA IB IIA IIB			None None None None	0.46 0.87 86.02 1.03	2,249,027 4,346,414 425,389,743 5,071,668	2.39 3.73 384.10 26.21	12,957,346 22,227,993 1,802,781,221 119,590,284	
"No. 7" IA IB IIA IIB			None None None None	$\begin{array}{c} 0.57 \\ 0.74 \\ 69.21 \\ 18.00 \end{array}$	$1,510,272 \\ 1,960,704 \\ 239,189,760 \\ 47,692,800$	$\begin{array}{c} 0.21 \\ 1.48 \\ 171.76 \\ 245.03 \end{array}$	556,416 3,921,408 593,602,560 649,231,488	
Dekoven IA IB IIA IIB			None None None None	0.57 0.74 87.21	2,166,912 2,813,184 **None 231,071,616	0.21 1.48 416.79	798,336 5,626,368 **None 1,104,326,784	
Davis IA IB IIA IIB			None None None None	0.57 0.74 87.21	1,969,920 2,557,440 **None 231,071,616	0.21 1.48 416.79	725,760 5,114,880 **None 1,104,326,784	
Total			3,493,647		1,698,251,476		7,545,461,868	

TABLE 1.-COAL RESOURCES OF WHITE COUNTY

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Summary: Total cut out: 12.95 sq. mi.

Mined out and lost by mining	Tons 3,493,647	Tons
Oil pools or other closely drilled areas Available I and II		1,698,251,476
Total Class IA		
IB	103,240,089	
IIA	$\dots 4, 274, 362, 661$	
IIB	3,133,571,340	
	7,545,461,868	7,545,461,868
Total coal present	9,243,713,344	

\* 1,681,741 tons == total production from this mine as obtained from Coal Reports. The figure in the column includes all coal originally in the area of the mine. (Recovery factor = 48%.)
\*\* Dekoven and Davis coals are considered as IIB because of their depth, except in vicinity of diamond-drill holes.



FIG. 14.—Fault lines, variation in thickness of No. 6 coal bed, areas where control wells did not encounter this coal bed, and position and extent of the mined-out area at Norris City.

ically the nature of the strata associated with these coal beds as found in the New Haven drill hole.

Little is known about roof or floor conditions except at the Norris City mine. The beds above and below the coal beds are described in table 2. The bases for these descriptions are diamond drilling, Norris City mine, and Survey control wells. Distinction between these is made in the table. These beds have been mined at one locality near Harrisburg in Saline County and more widely near Stonefort in Williamson and Saline counties.

#### COAL BEDS OF THE CARBONDALE GROUP

The two important coal beds of White County as well as of the state are found in the Carbondale group, that is, Harrisburg (No. 5) and Herrin (No. 6) coal beds, but coal has been produced in White County from only the Herrin (No. 6) bed. Coal beds "No. 2" and "No. 4" have not been mined and are unimportant in southern Illinois.

The limited amount of information as to the character, thickness, and roof and floor conditions of coal beds "No. 2" and "No. 4" does not justify any estimate of their

	<b>a</b> (		DATUM S	ea Level				
County No.	Surface elevation (instru- mental) feet	Coal No.	Depth to top coal bed in feet	Elevation top coal bed in feet	Thickness above coal bed in feet (from control well records)	Coal ft.	bed in.	Below coal bed (thickness in ft.)
†421	424	"7" 6 5	703 754 833	$-279 \\ -330 \\ -409$	Gray shale 92 Limestone 7; black shale 1 Gray shale 13; black shale 1	4 4 4	0 0 0	Underclay 1; siltstone 27 Underclay 3; gray shale 3 Underclay 1; limestone 2
†422	385	"7" 6 5 "4" "2" Dk Dav.	765 826 937 1014 1091 1132 1189		Gray shale 16. Gray shale 6; black shale 2. Gray shale 12; black shale 2. Sandstone 23; black shale 1. Gray shale 11; black shale 1. Gray shale 5; black shale 2. Sandstone 28; black shale 1.	2 3 5 3 2 4 4	0 0 0 6 0 0	Underclay 1; siltstone 4 Underclay 3; sand and shale 9 Underclay 2; sandstone 29 Sandstone 23 Gray shale 6; sandstone 22 Underclay 1; sandy shale 8 Sandstone 34
†423	380	"7" 6	718 784	$-338 \\ -404$	Gray shale 16; black shale 1 Siltstone 18; black shale 1	2 4	0 0	Underclay 2; gray shale 3; sandstone 16 Underclay 1; sandstone 8
†424	431	"7" 5	744 882	$-313 \\ -451$	Siltstone 14; black shale 8 Limestone 4; black shale 2	$\frac{1}{3}$	0 0	Underclay 1; gray shale 16 Underclay 1; siltstone 28
†425	440	"7" 6 5	1018 1064 1138	$     -578 \\     -624 \\     -698   $	Gray shale 22; black shale 1 Limestone 7; black shale 1 Gray shale 6; black shale 1	$1\\3\\2$	0 0 0	Underclay 1; gray shale 18 Underclay 1; sandstone 20 Gray shale 4; sandstone 23
†553	378	"7" 6	762 804	-384 - 426	Gray shale 44; black shale 3 Limestone 5; black shale 1	3 8	0 0	Gray shale 2; shale and coal 6 Underclay 2; gray shale 6
†427	435	"7" 6 5	817 883 984	$-382 \\ -448 \\ -549$	Gray shale 3; black shale 1 Gray shale 6; limestone 4 Limestone 1; gray shale 6	1 5 3	0 0 6	Gray shale 3; sandstone 31 Underclay 2; gray shale 3 Underclay 1; gray shale 14
†428 ·	401	"7" 6 5 "4" Dk. Dav.	713 792 860 940 1072 1108	$ \begin{array}{r} -312 \\ -391 \\ -459 \\ -539 \\ -671 \\ -707 \\ \end{array} $	Gray shale 9; black shale 2 Limestone 5; gray shale 2; black shale 2. Gray shale 33; black shale 2 Gray shale 64; black shale 1 Siltstone 32; black shale 1 Siltstone 30; black shale 1	2 2 2 3 3	0 0 6 0 0	Underclay 1; gray shale 6 Underclay 3; shale and siltstone 14 Underclay 2; sandstone 12 Underclay 1; gray shale 4 Underclay 1; siltstone 30 Underclay 1; gray shale 8

#### TABLE 2.-DATA ON COAL BEDS FROM CONTROL WELL RECORDS AND DIAMOND-DRILL RECORDS

†176	392	"7" 6 5 "4" Dk. Dav.	884 970 1051 1138 1264 1302	$ \begin{array}{c} -492 \\ -578 \\ -659 \\ -746 \\ -872 \\ -910 \end{array} $	Gray shale 86 Limestone 2; gray shale 2; black shale 2. Gray shale 4; limestone 1; black shale 2. Gray shale 64; black shale 1. Sandstone and shale 24 Gray shale and sandstone 24; black shale 4	1 4 2 4 2	0 0 0 0 0	Underclay 1; gray shale 6 Underclay 1; sandstone 4; limestone 6 Underclay 1; gray shale 64 Sandstone 2; gray shale 16 Sandstone and shale 30 Gray shale 6; limestone 4
†429	371	"7" 6 5 "4" Dav.	682 750 823 926 1098	$ \begin{array}{r} -311 \\ -379 \\ -452 \\ -555 \\ -727 \end{array} $	Gray shale 8; black shale 1 Limestone 6; black shale 1 Siltstone and sandstone 6; black shale 1 Gray shale 28; black shale 6 Sandstone 42	1 3 4 2 5	0 6 0 0 0	Gray shale 2; sandstone 12 Underclay 1; sandstone 18 Underclay 3; limestone 6 Underclay 2; siltstone 7 Underclay 1; siltstone 8
†430	393	"7" 6 5	568 626 704	-175 -233 -311	Gray shale 30; black shale 2 Shale and limestone 14; limestone 4 Shale 15; black shale 2	2 6 6	0 0 0	Gray shale 10; limestone 4 Underclay 1; siltstone 6 Underclay 4; sandstone 10
†431	443	"7" 6 5	770 834 924	-327 - 391 - 481	Gray shale 59; black shale 1 Limestone 2; black shale 1 Gray shale 45; black shale 2	3 4 4	0 0 6	Underclay 1; sandstone 24 Underclay 2; siltstone 24 Underclay 2; sandstone 5
†737	366	5	864	-498	Siltstone 10; black shale 1	5	0	Underclay 2; gray shale 6
†433	348	"7" 6 5	430 484 580	-82 -136 -232	Gray shale 29; black shale 1 Limestone 5; black shale 1 Gray shale 43; limestone 1; black shale 2.	2 5 4	0 0 0	Sandstone 20; limestone 4 Underclay 1; sandstone 22 Sandy shale 18
†606	350	"7" 6 5 "4" Dav.?	367 425 530 598 799	$ \begin{array}{r} - 17 \\ - 75 \\ - 180 \\ - 248 \\ - 449 \end{array} $	Gray shale 26; black shale 1 Gray shale 5; limestone 5 Gray shale 32; black shale 1 Gray shale 64 Gray shale 6	4 5 5 2 4	6 0 0 6 0	Underclay 2; gray shale 5 Gray shale 1; sandstone 10 Underclay 1; gray shale 64 Gray shale 2; limestone 2 Underclay 1; limestone 4
‡1110	504	"7" 6 5 Dk. Dav.	798 845 932 1148 1176	$ \begin{array}{r} -294 \\ -341 \\ -428 \\ -644 \\ -672 \\ \end{array} $	Gray shale 80; black shale 1 Limestone 4; black shale 2 Gray shale 9; black and gray shale 7 Gray shale 24; black shale 2 Gray shale 9; black shale 1	2 5 2 2 3	6 0 0 0 0	Underclay 2; gray shale 6 Clay shale 2; sandstone 11 Gray shale 6; sandstone 6 Gray shale 2; sandstone 12 Gray shale 2; siltstone 4
‡ <b>4</b> 37	446	"7" 6 5 "4"? "2" Dk.? Dav.?	826 870 944 1031 1106 1176 1194	$ \begin{array}{r} -380 \\ -424 \\ -498 \\ -585 \\ -660 \\ -730 \\ -748 \end{array} $	Gray shale 24; black shale 1 Limestone 5; gray shale 2; black shale 1 Gray shale 23; black shale 1 Sandstone 19; black shale 1 Sandstone 8; gray shale 3; black shale 1 Sandstone 18; black shale 1 Gray shale 5; black shale 1	2 4 3 1 1 2	0 0 0 0 0 0 0	Gray shale 8 Underclay 4; sandstone 16 Underclay 1; gray shale 22 Gray shale 4; sandstone 2; gray shale 20 Underclay 1; shale and sandstone 16 Underclay 1; gray shale 8 Underclay 1; gray shale 3

			DATUM S	Sea Level				
County No.	Surface elevation (instru- mental) feet	Coal No.	Depth to top coal bed in feet	Elevation top coal bed in feet	Thickness above coal bed in feet (from control well records)	Coa ft.	l bed in.	Below coal bed (thickness in ft.)
‡793	382	"7" 6 5 "4" "2" Dk.	850 909 1018 1120 1192 1272	$ \begin{array}{r} -468 \\ -527 \\ -636 \\ -738 \\ -810 \\ -890 \\ \end{array} $	Gray shale 45; black shale 1 Limestone 6; black shale 1 Gray shale 44 Limestone 2; black shale 4 Gray shale 25; black shale 1 Sandstone 21; gray shale 6	2 5 5 2 3 1	0 0 0 0 0 0	Underclay 3; sandstone 6; siltstone 6 Underclay 2; sandstone 10 Shale and sandstone 72 Gray shale 12; siltstone 2 Underclay 3; siltstone and sandstone 21 Underclay 2; sandstone 24
‡75 <b>4</b>	372	"7" 6 5 "4" Dk. Dav.	640 693 770 860 991 1025	$ \begin{array}{r} -268 \\ -321 \\ -398 \\ -488 \\ -619 \\ -653 \\ \end{array} $	Black shale 2. Limestone 3; black shale 3. Gray shale 14; black shale 4. Gray shale 5; black shale 1. Sandstone 44; black shale 2. Sandstone 31.	2 6 4 1 1	0 0 6 0 6	Underclay 2; gray shale 7 Sandstone 10; siltstone 5 Underclay 2; limestone 2 Underclay 1; gray shale 10 Siltstone 1; sandstone 31 Underclay 2; gray shale 36
‡ 4	347	"7" 6 5 "4" Dk. Dav.	574'8" 616'8" 718 812 891'3" 936'2" 967'6"	-22'8" -269'8" -371 -465 -544'3" -589'2" -620'6"	Taken from diamond drill records Gray shale 154 Limestone 5; black shale 4" Sandstone 18'; gray and black shale 15'2" Gray shale 30'2"; limestone 6"; black shale 3'10" Sandstone 16'9"; gray shale 6'3" Sandstone 18'; gray shale 15'2" Gray shale and coal streak 8'6"	2 5 4 1 0 3 3	4 0 0 10 3 4 0	Black to dark shale 9'8"; sandstone 9"; limestone 5'3" Gray clay shale 3'9"; sandstone 3' Gray shale 3'; sandstone 10' Sandstone 18'10" Gray shale 1'; sandstone 10'6" Sandstone 19'6" Sandstone 8'4"; shale 6'9"
‡*5	416'6"	"7" 6	730'2" 779'9"	-313'6'' -363'3''	Dark shale 137'2" Shale, dark and variegated 2': black	2	0	Gray shale 1'4"; dark shale 2'7"
‡*7 	376'6"	5 "7" 6 5	868'8" 394'9" 476 575'3"	-452'2'' + 1'9'' - 99'6'' - 198'9''	shale 1'9" Shale, blue and gray 8'6"; black shale 6' Dark shale 91 Limestone 3'7"; dark shale 1'5" Limestone 2'. dark shale 2'6"	4 4 2 5 5	$     \begin{array}{c}       11 \\       0 \\       0 \\       0 \\       9     \end{array} $	Fireclay 1'4"; gray shale 14' Fireclay 4'4"; sandy shale 1 Light shale 6'3" Gray shale 3'10"; sandstone 5'2" Gray shale 4'1014"

<b>‡*</b> 8	414	6	635	-221	Blue limestone 6'; black shale 1	5	$3\frac{1}{2}$	No record
‡**Mine	419	6 6	640 640	$-221 \\ -221$	Limestone 4'6"; slate $2'6"$ Limestone $4'\pm$	4 5	$8\frac{1}{2}$ $2\frac{1}{4}$	Fireclay Fireclay

1

\* Drillers logs only. \*\* Mine at Norris City—taken from column samples in mine. † Changed from data in "Subsurface Studies of the Pennsylvanian System in the Illinois Basin," by G. H. Cady et al., Illinois Geol. Survey Rept. Inv. 93. ‡ Additional to data in "Subsurface Studies of the Pennsylvanian System in the Illinois Basin." by G. H. Cady et al., Illinois Geol. Survey Rept. Inv. 93.

TABLE 3.—THREE PROFILES OF NO. 6 COAL BED FROM NORRIS CITY MINE

No. 1 Face of the Mai	n North Inches	
Limestone roof Draw slate	0	
Coal, mostly glance		
Coal	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	
Coal Blue band (gray shale)	$     \begin{array}{ccccccccccccccccccccccccccccccccc$	
Coal		
Laboratory No. BM80594	Tape 59 1/2"	

No. 2	Main East Face	Inches
Black slate		12
Coal-glance		7 1/2
Pyrite lens		1/8
Coal		11
Pyrite lens		1
Coal		$14 \ 1/2$
Charcoal and co	al	_ 1/2
Coal		7
Blue band-gra	y shale	$\frac{2}{2}$ 1/4
Coal		7
Pyrite lens		1
Coal		$10 \ 1/2$
-		$\overline{62 \ 3/8}$
HIOOT-CIAT		

No. 3	6th Southwest	Inches
Limestone		
Gray shale		7
Coal		8 1/4
Pyrite		1/4
Coal		$17 \ 3/4$
Charcoal		3/8
Coal		14
Blue band shale		2
Coal		$4 \ 1/2$
Charcoal		1/4
Coal		$13 \ 1/2$
		60 7/8
Floor—clay Laboratory No. B	M80596 Tape 59 3/4"	

economic value. Their general occurrence and probable thickness are inferred from the records of two diamond-drill holes and 19 control wells. Study of electric logs indicates that "No. 2" coal bed is present in at least 94 percent and "No. 4" coal bed is present in 98 percent of drill records studied.

Harrisburg (No. 5) coal bed is mined in the southern part of the Illinois coal field in Saline, Gallatin, and Williamson counties, but not in White County. The average thickness in White County is 3.6 feet, based on records of diamond-drill holes and Survey control well records. Planimeter measurements of the isopach map (fig. 13) suggest that No. 5 coal bed, 5 feet or more thick, underlies 120.18 square miles or 23.59 percent of the county, and that coal 2.5 to 5 feet thick underlies 389.23 square miles or 76.41 percent of the county; however, only 2.85 square miles or 0.57 percent is regarded as proved. The remaining resources are regarded as probable and strongly or weakly indicated (table 1).

The Herrin (No. 6) coal bed has been worked in White County only at the mine at Norris City now abandoned. The average thickness of No. 6 coal bed in White County according to present information is 4.5 feet. The pattern of thickness variation is shown on the isopach map (fig. 14). No. 6 coal bed, 5 feet or more thick, underlies 222.17 square miles or 43.78 percent of the county, and where 2.5 to 5 feet thick it underlies 279.34 square miles or 55.05 percent of the county.

Only 3.92 miles or 0.77 percent is proved, the remainder being probable, strongly inferred, or weakly indicated.

No. 6 coal bed is locally cut out (pl. 3) by sandstone in 1.17 percent of the county or 12.95 square miles.

Three descriptions of face profiles of the No. 6 coal bed from the Norris City mine are available. These measurements and mine locations, made in 1921 by Netzeband, are given in table 3.

These profiles reveal the benched structure of the No. 6 coal bed with pyrite and shale commonly marking the parting between benches. The blue band is the only widespread parting but it provides a characteristic profile feature. An underclay underlies the coal at all three positions.

#### Coal Beds of the McLeansboro Group

Several thin coal beds are present in the McLeansboro group, "No. 7" coal bed being the most persistent and thickest. This



FIG. 15.-Coal resources in White County in No. 5 and No. 6 coal beds undifferentiated as to probable and inferred resources; also positions of faults, areas where No. 6 coal bed is absent, areas where the depth of No. 6 and the depth of No. 5 or both beds exceeds 1000 feet, and areas where close spacing of rotary drill holes will render mining especially hazardous.

coal bed can be identified in 96 percent of the records studied and has an average thickness of 2.5 feet. It lies 70 to 80 feet above No. 6 coal bed but has not been mined in White County. The area and estimate of resources appear in the accompanying table (table 1).

Figure 15, coal resource map of White County, shows the areas of closely drilled oil tests, cut-out areas, mined-out area, and the area where coal is below 1,000 feet.

Three analyses are available of the No. 6 coal from the mine at Norris City representing samples described in table 3. These are shown in table 4.11

#### RANK OF COAL

The rank of the No. 6 coal sampled in the mine at Norris City is indicated by the rank index 13312 as compared with 131 in Franklin County, 137 for No. 5 coal in Saline County, and 133 for No. 6 in Williamson County. Lower coal beds may have a somewhat higher rank than No. 6.

Cady, Gilbert H., Classification and selection of Illinois coals: Illinois Geol. Survey Bull. 62, 1935.
 *Op. cit.* Classification and selection.

Laboratory Number	Mine Index Number	Date	Condition*	Moisture	Volatile Matter	Fixed Carbon	Ash	Sulfur	CO2	B.t.u.
BM80594	227	1921	1 2 3 4	8.20	34.68 37.78 41.55	48.79 53.15 58.45	8.33 9.07	2.93 3.19 3.51	.73 .80 .88	12,079 13,158 14.471
BM80595	227	1921	1 2 3 4	7.86	36.01 39.08 44.11	45.62 49.51 55.89	10.51 11.41	2.75 2.98 3.36	.96 1.04 1.17	14,696 11,701 12,699 14,335
BM80596	227	1921	1 2 3 4	9.22	35.05 38.61 42.27	47.88 52.74 57.73	7.85 8.65 —	2.89 3.18 3.48	.23 .25 .27	14,387 11,991 13,209 14,460 14,678

TABLE 4.—ANALYSES OF NO. 6 COAL FROM NORRIS CITY MINE

\* Explanation of numbers in this column:
1. Sample as received at laboratory.
2. Moisture free.
3. Moisture and ash free.
4. Dry mineral matter free (unit coal).

# APPENDIX

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## APPENDIX

### TABULATED DATA

EXPLANATION OF ABBREVIATIONS USED IN TABULATED DRILL RECORD DATA

Location: The location of the drill holes and mine is shown by Township, Range, section, and location within section. The Township and Range is given by T. and R. No. as follows:

T. and R. No. 1 = T. 3 S. - R. 8 E.

2 = -	9	E.
3 ===	10	Ε.
4 ====	11	E.
5 ===	14	W.
6 ==	T. 4 S R. 8	E.
7 ===	9	Ē.
8==	10	Ē
9 ====	11	Ē.
10 ==	14	w
10	11	•••
11 ==	T. 5 S. – R. 8	Е.
12 ==	9	E.
13 ==	10	E.
14 ===	11	E.
15 ===	14	W.
16 ===	T. 6 S R. 8	Е.
17 ===	9	E.
18 ===	10	E.
19 ==	11	E.
20 ===	T. 7 S R. 8	E.
21 =	9	E.
22 =	10	E.
23 ==	11	E.
75 ===	Posev County,	Ind.,
т	5 S _ R 14	\$37

Note: Drill hole number 1200, on page 35, is erroneously marked as Township and Range No. 9; it should be in T. 4 S., R. 13 W.



The wells are located in the section as accurately as records permit. Where the location is known to the nearest 10 acres (quarter-quarter-quarter section), the position of the drill hole is indicated by the letters A through H and the numbers 1 through 8, starting from the southeast corner of the section.

								н
					_			G
								F
							[-]	Ε
								D
								с
	-		_					В
								Α
8	7	6	5	4	3	2	<u> </u>	

Examples: SE-SE-SE == A1 NW-NE-SE == D2

*County number*: The county number is an identification number assigned to each drill hole or mine within the county. It is also recorded on the structure contour map next to the symbol of the hole or mine.

All county numbers refer to rotary drill holes unless otherwise indicated by a symbol following the county number. Symbols indicate the drill holes logged by the Coal Division as control wells, an abandoned shaft mine, and diamond-drill holes.

Surface elevation: The surface elevation is given to the nearest foot. The method for determining the elevation of the top of hole, shaft, etc., is indicated as follows:

B = Barometer

C = Company information

D == Company, derrick floor

- H = Hand level
- P = Plane table

G = Ground (estimated from instrumentally determined data, recorded depths modified accordingly.)

*Elevation of datum beds:* Elevation of the datum bed is given in feet below sea level. An asterisk (\*) following this figure indicates the elevation is *above* sea level; \*0 in the elevation column indicates that the datum bed is eroded or is absent at its horizon for some other reason. Where no data are given the information is unreliable or the hole did not reach the datum bed.

[33]

						ELEVATION								ELEVATION	
T. and R. No.	Section	Spot	County Number	Surface Elevation How determined	No. 6 Coal	No. 5 Coal	W. F. Ls.	T. and R. No.	Section	Spdt	County Number	Surface Elevation How determined	No. 6 Coal	No. 5 Coal	W. F. Ls.
1	19 19 19 19 20	A 3 C 5 D 3 D 8 B 8	439 936 937 448 447	378D 377G 380D 376C 380C	532 536 551 556 536	617 635 637 644 620	*0 336 361 359 328	 3	277 277 277 28	83 82 82 87 87 87	1161 1144 1164 208 1095	3740 3840 3790 3746 3840	380 412 411 423 428	*0 512 519 531 524	* 0 * 0 * 0 * 0 1 3 9 *
	20 20 20 20 20 20 21	D7 E8 F6 B3	938 164 939 463 464	377C 383C 458D 427D 435C	549 560 548 561 540	635 645 637 645 610	370 359 340 350 335		32 33 33 35	A 2 B 5 B 7 H 8	478 1025 210 1163	380D 379D 377G 387D	451 457 455 385	*0 548 565 *0	173 177 180 *0
	21 25 28 29	H 1 H 6 F 7 F 5	465 1149 1157 1158 445	4710 4220 3950 3990 3790	544 576 559 547 539	621 668 661 629 619	322 321 309 291 327	4	19 30 30 30	G 6 A 4 B 6	948 949 951 950	4110 3980 4300 4130	434 422 417 407	524 502 496 472	169 145 *0 *0
	29 30 30 30 30	F7 85 03 07 E3	201 202 206 451 453	3 8 0 C 3 7 9 D 3 7 5 C 3 7 6 C 3 7 3 D	532 514 518 524 514	610 591 595 606 592	310 271 287 284 289		31 31 31	С 6 F 5 G 4 H 7	159 952 953 954	4350 4310 4240 4370	387 397 417	472 475 491 495	*0 *0 143
	30 30 30 30 30	E 5 F 6 G 8 G 8	454 450 449 441 443	375C 376D 378C 374C 377D	518 511 519 526 516	599 591 602 610 596	287 290 297 306 *0	5	19 19 20 20	A 1 C 1 A 5 A 7	559 560 220 561	3950 3970 4290 4180	412 417 551 386	499 501 627 461	142 140 301
	31 31 31 31 31	A 5 87 67 67 67	940 466 442 438 444	381C 381C 379G 381C 385C	519 519 515 519 523	602 609 598 594 601	244 239 248 284 281		200220	B 6 C 3 C 4 D 2 F 3	222 562 226 1092 563	471D 453D 448G 429D	397 517 3*8 547 386	477 *0 480 623 479	127 282 130 281 121
	31 32 33 35 36	67 08 01 E5 E3	446 941 942 943 205	3850 3790 3800 3920 3880	520 532 576 567 582	599 614 658 654 785	283 283 329 332 362		21 28 28 28 28 28 28 28 28 28 28 28 28 28	C 6 B 4 B 6 D 4 H 4	583 480 214 481 882	4 6 2 D 3 6 4 D 3 9 5 C 3 8 6 D 3 7 2 D 3 7 2 C	493 420 431 426 440	596 492 503 500 530	229 160 185 168 184 238
2	20 21 21 21 21 21	H 5 A 3 B 6 C 3 G 7	944 945 467 468 946	420 <u>0</u> 3920 3920 3890 3890 3920	526 522 526 519 521	626 632 624 617 619	2 4 2 2 4 4 2 5 1 2 4 3 2 4 3 2 4 8		29 29 29 30 30	E 7 H 6 H 7 B 1 D 3	767 1096 1130 1155 1154	405D 405D 4000 415D 412D	615 381 398 368 402	689 473 472 459 496	*0 145 120 99 130
	21 27 28 28 28	H 2 H 8 A 5 C 8 E 5	1093 1129 161 469 162	3910 3930 4810 4350 4230	503 533 484 512 491	599 643 619 632 609	233 257 239 252 230		30 31 31 31 31 31	F 7 A 2 B 3 B 3 B 5	158 462 955 421¤ 1007	4 2 2 D 4 3 3 D 4 3 8 C 4 2 4 C 4 6 9 D	418 637 625 330 341	505 713 702 409 423	158 367 356 58 77
	2 2	F 4 F 6 G 2 B 1 B 3	471 472 947 211 473	3970 4100 4020 4490 4490 4430	507 514 514 509 507	613 626 629 623 625	235 243 244 253 256		31 31 31 31 31	C 3 D 2 D 8 E 2 E 2	956 957 958 959 1287	4 4 3 D 4 2 3 C 4 0 0 D 4 0 1 C 3 0 8 D	343 *0 380 598 637	421 *0 460 677 *0	74 317 *0 363 422
	29 29 29 29 29 29 31	01 D3 E1 F8 H4	474 475 212 476 1159	426C 419C 418C 417C 423D	516 511 522 535 552	634 619 632 635 655	254 259 260 282 297		31 31 31 31 31	E 3 E 4 F 2 F 8 H 1	1288 1289 960 961 962	445C 409C 421C 404D 401C	359 371 359 394 *0	437 447 444 476 \$0	87 101 *0 126 379
3	32 19 20	H7 H5 B2	1094 1024 209	455D 383D 381C	525 517 476	619 611 564	271 225 182		3 2 3 2 3 2 3 2 3 2 3 2 3 3 3 3	83 E3 F8 G1 A8	482 217 1290 963 484	3900 3850 3850 3850 3870 3880	486 495 624 456 428	556 570 704 533 507	220 233 354 208 192
	NNN NN NNN NI	83 D4 E2 E4	477 1006 479 160	446D 404D 406D 404D	419 410 407 406	504 519 528 521	*0 *0 *0		33 33 33 33	C 7 D 8 E 6 E 7	485 225 486 488	383C 382D 388C 441D	444 450 427 437	510 525 502 512	179 192 177 181
	23425	£4 A1 A5 A5	1160 876 877 207	470D 423D 462D 453D	368 395 428 445	*0 487 538 537	106 151 153 165	6	6	F 8 G 8 H 7	456 278 455	4010 380C 381C	532 521 524	618 608 606	254 262 246 246
	22222	G 3 G 5 H 6 H 7	878 880 1165 1162	462D 482D 390D 387D	*0 *0 388 403	524 *0 506 513	162 155 114 127		13 18 32	Н 2 F 7 Н 8	793)X 487 1000	3820 4116 4010	527 606 546	636 696 675	242 298 231

\* Elev. above sea level; \*0 Datum bed absent; "Control well.

## APPENDIX

						ELEVATION								ELEVATION	l.
T. and R. No.	Section	Spot	County Number	Surface Elevation How determined	No. 6 Coal	No. 5 Coal	W. F. Ls.	T. and R. No.	Section	Spot	County Number	Surface Elevation How determined	No. 6 Coal	No. 5 Coal	W. F. Ls.
7	2 2 7 11 13	E 3 G 2 H 4 E 4 E 5	457 280 1131 458 168	440C 469C 397D 417G 410C	432 441 535 418 410	527 531 643 515	167 183 279 155 111	8	25 25 27 27	H 1 H 5 D 1 C 1 H 2	424 505 826 886 887	4 3 1 D 4 1 3 D 4 0 9 D 4 0 1 D 3 9 6 D	*0 404 415 423 457	4 5 1 4 8 7 4 9 5 5 0 3 5 <b>3 4</b>	87 129 139 153 185
	14 15 17 18 22	A 2 C 7 A 2 D 4	861 1166 282 862 863	3960 387C 386C 383D 3810	445 454 464 527 468	559 587 *0 665 569	148 174 192 235 176		88345 223345	D 4 1 3 2 1	506 1036 1209 1210 298	391G 381C 394D 404D 406D	481 484 474 429 390	566 565 551 508 478	218 217 208 164 112
	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	С 8 G 4 B 6 G 3 H 8	283 459 864 1168 284	381C 387D 387D 369D 369C	473 410 425 396 420	569 499 518 481 510	171 118 129 109 124		36 36 36 36 36	A 1 A 8 B 1 E 4 F 1	507 888 300 932 301	4 1 0 C 4 0 4 C 4 1 0 C 4 1 6 C 4 0 5 C	390 389 391 374 391	454 479 452 461 465	100 113 98 96 103
	26 26 28 8 9	43 C5 E8 F1 C6	931 460 865 1170 1169	3890 3850 3880 3780 3910	453 443 468 467 483	547 543 608 572 585	153 145 164 169 188	9	36 6 7	H 1 C 3 A 4	302 1211 999 1150	405C 437D 411D	380 374 347 367	465 453 419 445	99 *0
	30 34 34 35 35	E 3 B 5 C 6 B 6 B 6	285 1026 461 286 1167	396C 454C 445D 422D 450D	524 471 469 472 478	630 576 580 582 578	226 160 160 168 172		18 18 18 18	▲5 86 D4 E7	535 508 537 536	4790 4790 4590 4776 4610	363 375 340 359	433 445 415 434	*0 *0 81 *0
	35 35	С 8 Н 4	287 866	447C 408D	463 463	563 572	$161 \\ 157$		18 19 19	H 4 A 4 A 6	509 510 511	4 3 8 D 4 5 6 D 4 4 5 C	350 *0 315	424 436 430	*0 82 75
8	1 5 5 7	F 3 E 3 H 1 E 6 A 2	867 1204 288 422X 289	4 6 5 D 3 7 4 D 3 8 0 G 3 8 5 C 3 8 0 C	394 471 492 441 412	489 566 592 552 524	133 188 196 142 112		19 19 19 19 19	А7 С7 F 8 G 5 H 6	512 513 514 539 1001	4 2 7 D 4 3 6 D 4 4 3 D 4 6 4 D 4 5 8 C	347 *0 366 376	4 4 3 4 3 7 4 6 3 4 3 9 4 5 2	87 82 110 108 *0
	7 7 7 7 7	A 3 A 5 A 7 C 3 C 5	489 491 490 167 290	368D 3810 398D 378D 378D 374C	407 407 405 420 422	509 515 505 522 522	107 113 105 118 123		30 30 30 30 31	86 C5 F6 H8 ≸5	1005 1004 1002 1003 517	4 2 6 D 4 3 7 D 4 2 9 D 4 2 2 D 4 2 2 D 4 2 2 D	*0 *0 367 *0 678	4 4 9 4 4 4 4 2 8 4 4 0 7 5 7	91 92 81 82 411
	7 7 7 8	C 7 E 25 F 15	492 493 494 495 291	4 4 6 C 3 7 9 C 3 8 7 C 3 6 9 D 3 8 3 G	417 421 421 427 521	5 2 9 5 2 3 5 3 3 5 2 5 6 2 4	119 125 123 125 237		31 31 31 31 31	A 7 B 4 C 5 D 5 D 8	518 1009 277 303 165	4 2 8 C 4 0 9 C 4 3 8 C 4 2 5 C 4 0 8 C	362 684 706 548 387	442 765 742 651 447	81 411 419 320 92
	8 8 10 10	A 8 C 8 E 3 G 5	496 497 292 1206 1205	3810 3800 3750 3830 4110	407 413 428 457 483	511 516 538 547 569	113 123 128 203 222		31 31 31 31	E 4 E 5 E 7 G 5	1008 519 520 521	4 2 3 D 4 1 8 C 4 1 9 C 4 2 5 C	*0 374 374 382	447 442 441 448	301 80 84 79
	11 14 14 15 17	87 D3 H7 G 1 G 8	1207 1097 1208 1027 498	4100 4190 4230 3940 3790	443 441 443 470 557	535 525 531 556 665	181 *0 184 206 259	9	19	нв	1200	3680	249	3,29	38*
	18 18 18 18 18	A 7 D 8 E 3 F 3 G 3	499 166 294 500 502	385D 390D 381D 383D 365D	417 415 399 430 405	519 515 487 525 497	114 114 103 133 103	10	4 4 4 4 4	A 5 A 8 B 4 D 5 D 8	31 27 534 227 228	377G 376G 379G 384D 386C	460 451 451 436 409	520 507 508 516 476	177 171 173 156 148
	18 18 18 20 22	G 7 H 2 H 5 H 5 H 4	501 503 423) 870 504	4070 3810 3800 4320 4250	401 408 404 526 461	501 496 516 610 549	103 113 106 248 203		4 4 4 5	E 5 F 5 H 8 H 8	34 1010 23 25 38	377C 380D 381C 384D 380C	418 410 409 423 440	488 485 484 500 514	156 144 150 160 179
	234 24 24 24 24 24	A 7 A 1 B 5 C 5 D 4	871 872 874 873 875	407D 441D 425D 436D 4620	443 *0 383 369 *0	529 455 463 454 458	174 89 119 111 96		55555	46 C4 C5 E1 H1	1011 19 48 43 45	4 0 3 C 4 0 7 G 4 1 7 C 3 B 3 C 3 B 4 D	492 457 485 407 426	544 530 556 481 501	232 199 218 149 168
	44555 222255	E 4 G 7 A 5 D 1 D 5	881 296 297 885 883	4560 413C 409C 4150 4130	363 412 381 323 390	456 495 456 443 474	100 147 111 100 118		5 6 6 6	H 7 B 5 B 6 C 6 D 2	20 1201 529 1014 1015	390G 435D 441D 438D 452C	561 671 355 342 626	637 749 431 420 658	302 405 85 76 368

\* Elev. above sea level; \*0 Datum bed absent;  $\alpha$  Control well.

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						ELEVATION								ELEVATION	
T. and R. No.	Section	Spot	County Number	Surface Elevation How determined	No. 6 Coal	No. 5 Coal	W. F. Ls.	T. and R. No.	Section	Spot	County Number	Surface Elevation How determined	No. 6 Coal	No. 5 Coal	W. F. Ls.
10	6 6 6 6 6 6	D 4 E 4 F 3 G 2 G 3	1013 530 531 425¤ 1012	4410 4530 4250 4400 4200	659 *0 629 624 *0	735 *0 709 698 *0	393 403 367 360 370	10	2 2 2 2 2 2 2 2 2 3 2 2 3 3 2 3 3 3 3 3	С 5 D 1 H 5 В 7 С 6	255 557 558 564 258	384C 384D 375C 374D 3730	406 393 405 372 387	483 474 485 451 455	138 136 130 126 127
	6 7 7 7	G 6 H 2 B 7 C 6 C 7	532 533 540 1018 1016	459D 434D 439D 441D 444D	337 642 706 689 714	419 716 783 767 804	71 368 431 417 444		8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	С 8 Е 6 С 8 С 8 С 8	565 566 257 567 568	374D 375D 376D 376D 376D 374D	380 381 396 *0 403	457 460 474 486 482	121 123 132 128 126
	7 7 8 8	D 7 G 7 H 5 A 2 B 5	1017 541 1202 93 51	4410 4350 4210 3740 3740	705 569 665 436 470	785 *0 744 503 544	439 401 397 176 214		2 2 2 2 7 7 7 7	A 1 E 4 E 8 A 4 A 6	1031 569 570 572 573	3730 3736 -3740 3730 3770	*0 *0 381 372 369	316 533 460 447 445	59* 164 111 105 101
	8 8 8 9	01 65 61 82	121 71 68 88 1019	377C 377C 378C 379C 379C 377D	436 471 442 475 435	507 543 517 550 507	175 212 179 215 171		27 27 27 27 27 27 27	A 7 C 5 C 8 E 5 G 2	262 574 575 576 577	3760 3790 3740 3770 3770 3730	370 377 386 385 373	444 455 461 455 451	104 107 117 111 97
	9999999	88 D4 F3 F6 H3	140 126 526 112 528	3780 3830 3786 3800 3800 3820	425 419 425 442 426	494 499 504 514 503	$162 \\ 157 \\ 165 \\ 170 \\ 163 \\ 170 \\ 163 \\ 163 \\ 163 \\ 163 \\ 163 \\ 100 $		27 28 28 28 28 28 28	G 8 A 1 A 3 A 6 C 7	264 578 579 266 581	3760 3630 3700 3670 3670 3690	404 386 390 403 418	4 8 0 4 5 7 4 6 3 4 7 3 4 9 3	138 *0 *0 130 151
	10 14 14 14 14	A 7 A 6 A 8 C 8 D 6	151 152 524 153 525	3830 3760 3740 3770 3770 3780	407 392 396 398 417	4 8 2 4 7 4 4 7 9 4 7 6 4 9 2	137 130 126 123 141		2 8 2 8 8 8 8 9 9	D 4 F 5 G 2 H 7 A 1	366 582 265 267 584	3720 3740 3720 3740 3740 3750	414 433 425 422 425	482 495 493 497 505	144 168 153 164 155
	15 15 15 15 16	A 8 C 1 C 6 F 8 B 1	$1021 \\ 1020 \\ 230 \\ 1022 \\ 522 $	379D 378C 378D 369G 377D	421 397 408 421 425	501 475 489 500 499	149 126 138 140 153		29 30 30 30	D 1 A 6 A 7 A 8 C 8	585 1212 1213 1032 1033	3690 4730 4600 4500 4420	438 *0 366 *0	514 805 440 440 442	178 427 *0 82 78
	1616161616	87 08 F8 F8	523 232 231 1023 156	378C 373C 369G 378D 374G	457 460 461 440 439	522 510 519 511 515	182 177 187 164 176		30 30 31 31	E 4 E 7 G 1 B 8 D 8	$1217 \\ 587 \\ 1216 \\ 588 \\ 588 \\ 589 $	470D 462D 395G 419D 439D	676 *0 617 675 691	759 442 677 765 743	422 89 347 410 403
	1617171717	H 5 A 6 B 3 B 7 C 4	1037 238 233 240 235	372G 383G 377C 373G 372C	442 494 450 491 472	515 547 523 547 521	163 229 198 234 202		31 31 32 32 32	E 8 F 7 G 8 E 1 E 1	1034 590 591 592 270	4 4 1 D 4 4 1 D 4 5 4 D 3 8 0 C 3 6 9 D	675 *0 *0 440 431	751 773 433 509 501	397 408 55 154 151
	1717 17 17 18	Ë 3 F 1 G 6 H 1 A 8	542 239 234 236 544	373C 375C 371G 368G 485D	458 437 466 424 *0	509 508 538 502 *0	182 177 207 173 322		282 282 282 282 282 282 282 282 282 282	G 1 G 3 A 5 A 7 B 7	$269 \\ 1187 \\ 593 \\ 1132 \\ 594$	3770 3700 3730 3720 3720 3690	429 478 374 382 393	503 556 445 451 460	163 212 109 116 114
	18 18 18 18	D 5 D 8 E 8 G 8 H 4	545 546 437¤ 547 1028	4 3 9 N 4 5 4 N 4 4 6 D 4 4 0 D 3 9 4 D	617 332 424 580 610	690 402 498 642 680	361 108 *0 324 344		33 33 33 33 33 33 33	C 1 E 2 E 4 E 6 G 1	595 596 169 597 600	367D 370C 373D 369D 367D	363 368 391 395 373	4 2 9 4 3 7 4 5 1 4 6 7 4 4 4	103 96 113 121 *0
	19 19 20 20 20	86 68 81 62 62	548 549 550 1029 243	4 7 2 D 5 2 4 D 3 7 4 C 3 7 7 D 3 7 7 C	414 515 448 437 443	488 584 524 507 518	156 *0 211 183		33 33 34 34 34	G 5 G 7 A 8 C 7 D 3	598 599 601 602 603	3700 3710 3720 3700 3700 3720	395 401 346 340 350	463 475 417 411 421	113 126 *0 106 96
	20 20 21 21 21	H 4 H 6 H 7 A 3 A 8	245 552 1030 251 250	383D 482D 472C 378D 374C	460 487 525 419 436	531 556 575 494 510	205 233 253 158 185		34 34 34 34	U 6 F 7 G 5 G 5	276 274 604 605	3750 3760 3730 3730 3730	343 351 362 358	409 419 434 431	*0 91 97 99
	21 21 21 21 21 21	85 01 05 62	246 247 252 248 553X	3 7 3 C 3 7 7 C 3 7 4 D 3 6 4 G 3 7 8 D	425 421 432 433 426	500 493 506 507 506	$168 \\ 165 \\ 180 \\ 207 \\ 168 $	11	1 4 5 1 2 1 3	E 5 8 8 6 6 8 6 8 6	768 850 1188 851 934	4060 4060 3930 4030 3960	500 520 511 496 472	606 607 587 609 567	194 199 209 193 182
	2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2	G 6 A 1 A 3 B 6 B 8	249 555 555 253 556	375C 378D 376D 381C 370C	445 379 384 407 405	518 457 464 479 479	206 107 109 127 133		14 18 19 24 24	H 4 A 4 C 1 C 6 H 1	769 304 852 305 853	4 0 5 G 4 7 8 C 4 7 5 D 4 0 1 C 3 9 6 D	474 467 447 445 454	562 548 515 521 544	187 159 137 149 176

\* Elev. above sea level; \*0 Datum bed absent; Control well.

## APPENDIX

		1				ELEVATION	·····								ELEVATION	
T. and R. No.	Section	Spot	County Number	Surface Elevation How determined	No. 6 Coal	No. 5 Coql	W. F. Ls.	~	T. and R. No.	Section	Spot	County Number	Surface Elevation How determined	No. 6 Coal	No. 5 Coal	W. F. Ls.
11	25 28 32 35 36	H 4 H 1 D 5 E 5 A 1	854 306 855 178 1110¤	4110 4210 4270 4850 5040	422 434 393 412 341	499 519 478 505 428	129 149 113 123 43		13	9 10 10 10 11	E 8 C 3 H 1 H 6 E 5	321 781 322 929 821	3821) 3780 3730 3880 3880	471 449 454 454 476	558 534 549 532 550	195 158 164 160 186
	36 36 36 36 36 36 36	A 2 8 3 8 5 0 1 E 5	859 857 858 856 860	5 0 0 D 4 7 8 D 4 7 6 D 4 7 6 D 4 7 3 D 4 4 0 D	343 -352 358 359 373	429 431 438 423 441	47 59 66 59 80			12 12 13 14 15	A 1 H 7 D 7 G 2	323 822 823 176¤ 1195	3690 3700 3730 3730 3920 3850	561 409 537 578 455	633 462 605 659 523	281 120 64 286 147
12	2 2 2 3	D 8 F 7 C 4 C 8	1190 1189 770 307	4 6 3 D 4 4 3 D 4 7 9 G 4 3 8 G	609 607 484 473	701 715 580 547	307 302 188 163			15 19 21 22 24	H 8 D 1 H 4 F 5 B 5	1194 1134 782 1196 1105	3930 3830 3890 3970 3660	497 431 439 655 422	567 513 511 711 500	187 152 126 353 149
	3 4456	D 7 C 2 E 2 H 4 A 4	1191 309 308 771 831	428D 430G 420G 391C 386D	455 459 462 496 504	536 543 544 599 599	155 150 153 199 202			2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	E 4 B 7 D 5 F 3 F 5	783 824 324 785 786	3640 3660 3760 3690 3750	444 442 441 428 416	522 494 484 487 489	*0 152 141 143 131
	6 7 7 9 9	A 3 E 4 A 8 G 4	1192 1098 964 4270 772	3850 4050 3900 4320 4540	496 471 488 448 445	577 581 588 549 523	193 183 190 155 156			2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	F 7 H 2 3 B 5 C 0	825 325 1107 1106 1108	3730 3700 4010 3940 3990	435 420 613 424 617	497 494 677 <b>*</b> 0 683	148 150 313 136 321
	15 16 16 17	67 05 68 C8	311 832 833 1099	4 4 7 G 4 7 0 G 4 5 3 D 4 2 8 D	638 419 438 458	728 512 541 562	377 117 135 106			28 28 29 31	E 3 H 1 G 7 A 6 B 1	828 175 787 829 327	3920 3950 3950 3860 4390	374 370 414 403	426 441 488 486	58 148 126 106
	18 18 18 19	A 4 85 E 4 A 7	836 835 834 177 935	4130 4050 4070 4220	465 457 471 422	554 550 568 510	156* 156* 161 163 122			312222	G 4 A 6 B 2 C 7	328 330 1198 788	4 2 9 C 4 O 3 D 4 O 3 D 4 O 9 C	391 369 347 388	471 445 423 443	101 71 51 72
	19 19 21 21 21	г ~ Н 4 Н 5 Д 7 Е 6	838 837 1193 1133 1101	419D 4210 4280 436D 467D	466 453 602 416 427	555 543 688 512 515	135 143 151 294 112 119			3225335	E 5 G 1 A 4 G 3 D 8	329 1197 933 830	4 2 2 C 3 9 9 D 3 7 2 D 3 7 3 D 3 7 2 D	400 356 459 446 428	455 429 534 522 508	81 55 178 161
	223222222222222222222222222222222222222	C 1 B 1 D 1 D 3 F 7	312 773 314 313 774	3950 3850 3900 3850 4000	560 531 545 552 556	645 611 627 635 639	287 247 258 268 276			36 36	F 4 F 6	332 1199	371G 370D	424 402	486 482	136 135
	24 26 29 29 31	C 1 B 3 E 2 A 2	315 316 840 839 843	374C 374C 4550 4350 4080	462 481 345 370 338	546 560 427 453 386	186 210 60 62 17		14	6 6 6 6 6 6	D 7 E 7 E 8 F 6 G 8	818 790 791 792 173	3810 3760 3790 4000 4290	631 388 389 638 378	699 451 461 709 449	379 *0 129 390 93
	31 31 31 31 32	A 6 E 4 F 1 G 8 A 4	842 844 845 841 846	4240 4750 4550 4790 3960	341 323 321 358 321	407 403 405 436 404	33 36 34 65 23			6 19 19	н 6 В 8 G 5	1161 819 1114	4380 3660 3720	*0 439 470	544 518 548	240 171 200
	3 2 2 2 3 3 3 2 2 3 3 3 3 3 3 3 3 3 3 3	А 8 В 6 F 8 H 6 H 8	849 848 847 1102 1103	4 1 1 D 4 1 5 D 4 4 6 D 4 5 4 D 4 2 0 D	327 323 324 330 348	395 409 402 418 442	15 20 33 44 66		15	3 4 4 4 4	H 8 B 8 D 1 F 3	799 798 4290 797 795	371D 367D 371D 371D 370D	338 *0 379 379 352	424 435 452 439 432	80 88 109 100 94
	36 36	01 E5	1104 317	397D 441C	*0 419	499 494	127 139			4 5 5 5 5 5	H 1 C 5 E 5 F 5	796 800 803 802 804	3720 3660 3830 3820 3860	344 *0 *0 *0	421 471 519 489 507	89 114 168 137 169
13	1 1 1 1	C 1 U 3 F 1 F 3 G 3	775 776 777 778 820	3800 3830 4140 3970 4070	444 385 376 401 407	513 461 452 458 455	184 107 100 103 105			5 7 7 8	G 1 F 1 G 1 H 1 F 4	801 805 806 337 817	378C 370C 376D 376D 376D 374D	393 *0 484 `*0 *0	452 571 569 576 503	107 216 214 224 134
	1 12 6 7	H 2 H 8 H 1 H 5 C 5	428¤ 318 319 320 780	4 0 1 C 4 0 9 C 4 1 6 C 4 2 6 G 3 8 2 C	391 394 388 571 522	459 476 471 671 608	101 116 112 288 246			8 9 9 1 4	H 4 G 5 H 8 B	868 928 809 810 1115	3640 3730 3620 3660 3580	393 *0 *0 356 *0	483 511 476 461 *0	126 149 108 95 156

\* Elev. above sea level; \*0 Datum bed absent; Control well.

	[	Γ				ELEVATION								ELEVATION	a a manfanin karalah a """
T. and R. No.	Section	Spot	County Number	Surface Elevation How determined	No. 6 Coal	No. 5 Coal	W. F. Ls.	T. and R. No.	Section	Spot	County Number	Surface Elevation How determined	No. 6 Coal	No. 5 Coal	W. F. Ls.
15	14 15 15 18 19	C 8 A 1 E 8 H 2 G 5	816 815 338 1112 1111	3650 3580 3630 3670 3700	*0 *0 \$0 503 454	555 546 458 580 530	221 233* 89 222 190	16	26 26 28 28 32	E 4 F 5 C 4 E 6 E 6	692 361 363 120 1176	4 1 1 C 4 2 2 C 4 1 3 C 4 1 4 B 3 7 9 D	227 225 172 168 194	303 294 262 293	63* 62* 86* 79*
	20 21 21 22 22 22 22	G 4 8 1 F 8 E 3	171 1117 340 339 930	3660 3700 3700 3700 3670 3700	447 326 412 445 476	528 412 495 550 550	181 54 134 168 168		33 334 356 36	C 5 G 5 H 3 A 8	693 694 1113 364 365	426D 425D 401D 494D 498C	137 157 187 168 164	232 247 279 232 232	130* 112* 78* 126* 130*
	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	E 5 H 7 E 8 D 1 D 2	1215 811 341 813 344	3 6 2 D 3 6 7 D 3 6 3 C 3 6 6 D 3 6 3 D	*0 *0 327 322 335	634 451 404 400 419	251 74 58 109		36	G 5	894	4660	186	265	93*
	2 2 2 2 2 2 2 2 2 0 0 0 2 2 0 0 0 0	E 3 G 2 G 5 D 8 H 8	343 812 342 170 814	3670 3596 3666 368P 3610	407 415 447 437 *0	499 504 528 502 515	147 148 176 168 180	17	1 1 1 1	83 85 05 64	1048 1044 1046 1047 1045	4 1 5 0 4 1 6 0 4 1 2 0 4 6 5 0 4 3 2 0	408 400 420 438	4 8 5 4 8 6 4 6 4 4 8 7 4 8 4	95 114 94 119 120
16	1	▲ 8 B 4	899 895	484D 448D	388 352	448 426	72 49		Q 5555 555	D 1 C 2 C 7 D 4 D 6	965 1179 1049 911 914	391D 377D 410D 381D 384D	437 331 298 323 311	523 401 384 395 342	143 35 4 24 14
	1 1 3	E 4 G 4 H 1 D 4 E 3	898 896 897 900	4910 4730 5060 4990	383 361 353 381	434 435 419 433	57 53 40 69		55566	E 7 G 5 H 2 G 4 G 4	913 912 910 917 918	3890 4040 3930 4310 4230	311 340 331 288 327	393 397 405 369 393	11 20 27 9* 21
	11 11 12 12	G 1 H 1 A 3 C 1	902 903 678 345	457D 472D 394C 395C	388 387 301 287	459 466 381 372	09 77 78 4* 14*		6 6 6 6 7	G 7 H 1 H 6 H 8 A 1	920 916 919 915 695	453D 400D 4330 497D 3900	349 318 333 337 246	401 390 399 417 324	32 13 27 36 65 <b>*</b>
	122122	С 3 D 5 F 4 H 6 H 8	189 906 907 905 922	410C 413D 424D 461D	305 333 321 345 382	386 417 410 424 448	10* 27 20 45		7 7 7 8	A 3 C 1 E 5 G 4 A 4	369 696 697 921 923	405C 402D 416D 429C 423D	245 248 259 277 255	327 324 343 353 337	53* 50* 36* 27* 45*
	13 13 13 14 20	C 6 G 1 H 8 A 2 G 3	908 346 909 347 679	4080 3900 4110 4276 3950	270 27.5 329 307	340 353 403 370	43* 33* 23 10*		88889	★ 8 F 5 H 4 H 5	187 925 924 926 927	4000 4390 4030 4140 4120	240 268 294 289 494	319 353 377 370 577	63* 26* 5* 9* 204
	21 22 23 23	D 1 E 6 C 8 A 5	889 8 <b>%</b> 14 351	458C 414H 462H 464C	208 221 205 238	294 311 316	41 * 49 * 52 *		11 11 11 11	A 2 C 1 D 4 F 4	698 699 700 701	4 0 0 C 38 7 G 39 3 C 4 0 3 G	366 390 404 429	470 467 479 498	98 95 107 125
	22222	81 C5 D1 D4	681 682 683 890	459G 459D 477C 465D 488C	255 236 270 259 268	311 345 337 354	50* 61* 35* 44* 28*		11 12 12 12	G 4 A 8 D 1 D 7	186 703 1050 704	398C 395C 395C 378D 386C	438 369 377 424	502 453 452 474	134 83 74 99
	2333 2233 224 224	E 2 E 3 E 7 H 1 A 2	548 684 350 685 352	4971) 5380 4850 4540 4540	264 271 286 291 220	347 355 369 360 299	35* 24* 8* 29* 96*		13 14 14 14	F 1 H 8 A 8 C 3 D 5	1135 705 707 371 708	3940 3740 3750 3850	363 372 375 387	409 448 454 459 465	41 74 76 75 87
	44445 88888 8888 8888 8888 8888 8888 88	A 7 C 1 C 4 E 7 E 3	891 353 354 359 686	478D 470C 442C 461D 478C	214 207 204 244 200	302 285 285 324 282	70* 95* 97* 58* 103*		14 14 14 14	Е В G 4 G 5 G 7 H 2	709 710 706 368 1035	370C 3890 3860 385C 396C	418 396 399 412 391	492 481 482 492 464	114 105 108 119 94
	8 5 5 5 5 5 8 8 8 8 8 8	G 1 G 4 G 6 H 2 H 2	893 687 688 689 358	4890 4760 4400 4750 4640	335 190 207 314 214	398 269 287 *0 294	34 109* 95* 22 96*		15 15 17 17 17	82 G4 88 08 F8	711 372 373 712 430¤	373C 369C 379C 378D 393C	398 455 323 260 233	481 537 399 *0 311	97 155 15 24* 71*
	88888 899966	H 3 H 5 H 7 D 2 E 2	690 691 892 362 360	474C 458C 463N 408C 417N	204 206 221 236 228	284 286 292 300 298	98* 100* 75* 59* 69*		18 18 18 18 18	A 1 A 3 A 5 D 1 E 1 G 5	374 714 715 716 717 718	3960 3980 4360 3860 3800 3800 3830	340 226 224 220 222 222 217	412 300 300 298 300 293	32 77* 86* 87* 81* 81*

Elev. above sea level; \*0 Datum bed absent; 🛱 Control well; 🋠 Shaft mine, abd.; • Diamond drill hole.

## APPENDIX

	_					ELEVATION								ELEVATION	
T. and R. No.	Section	Spot	County Number	Surface Elevation How determined	No. 6 Coal	No. 5 Coal	W. F. Ls.	T. and 8. No.	Section	Spot	County Number	Surface Elevation How determined	No. 6 Coal	No. 5 .Coal	W. F. Ls.
17	18 19 19 19 19	H 1 E 5 F 6 G 5 G 5	719 720 721 722 723	395C 460D 426D 434D 424D	229 380 236 392 258	311 454 317 466 323	71* 73 71* 84 45*	16	13 13 13 13 13	85 D7 F4 G5 H5	740 741 388 1076 389	3720 3700 3650 3640 3640	224 396 241 386 243	318 454 332 472 322	60* 120 29* 156 62*
	N NN N N N NN N O	H 8 A 7 D 1 F 4 G 3	724 1038 378 376 725	4 4 3 C 4 2 5 D 3 7 3 C 3 6 4 C 3 6 6 C	411 380 358 384 384	4 9 1 4 6 7 4 2 2 4 6 0 4 4 8	103 79 51 79 77		15 15 16 18	С 8 Н 4 С 2 G 8	1077 1078 1079 1080 1137	3750 3730 3696 3710 3850	395 407 362 386 357	461 473 432 463 407	105 109 86 101 39
	8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	G 5 A 7 B 1 F 6 F 6	726 379 1178 727 1039	3560 3860 3700 3630 3660	396 324 300 351 373	481 408 380 412 431	102 24 4 31 52		18 21 21 21 21	H 6 A 2 G 5 H 1	390 742 1081 1082 1083	3890 3700 3710 3690 3710 3710	679 316 339 361 373	738 390 399 433 437	361 31 43 71 81
	2 2	D 1 F 1 H 2 H 4 A 4	1182 1181 1180 184 1040	364D 365T 365D 371C 419D	618 503 307 342 561	700 583 387 392 644	328 175 15 24 33		2 2 2 2 4 4 2 2 2 2 4 4 2 2 2 2 2	87 G4 G8 A1 A5	743 1086 1085 744 745	3690 3690 3690 4410 4180	*0 370 366 196 202	409 450 426 294 294	43 80 71* 87* 81*
	25 25 26 7 27	C6 E5 F4 B1 A1	1203 1139 1041 1138 1042	403D 407G 400D 403D 415D	297 256 *0 245 293	375 338 *0 331 381	18 38* 200 37* 5*		24 244 224 28 28	D 6 H 2 H 5 H 7 B 7	748 751 752 392 1087	370C 442C 367C 362D 368D	224 218 230 245 337	329 301 327 333 404	51 * 69* 55* 43* 36
	27 27 27 27 28	C 2 D 2 G 8 D 2 H 5	728 381 1043 4310 1052	4390 4950 4110 4430 4510	303 348 328 391 381	4 0 3 4 3 0 4 0 8 4 8 1 4 7 2	8 37 27 84 84		2 8 8 2 8 8 2 8 2 8 8 8 8 8 8 8 8 8 8 8	E 4 F 2 G 5 G 8 H 1	754 <b>¤</b> 755 756 1088 757	3720 3740 3710 3740 3740 3690	321 329 324 356 328	398 392 382 420 391	33 43 44 35
	28 29 30 30 31	H 1 F 1 H 8 D 8	1051 1053 1054 382 1055	4 0 6 C 4 4 0 D 4 3 9 D 4 7 5 C 5 1 6 D	404 414 431 349 328	489 493 511 430 405	92 116 141 43 29		29 29 29 32 32 32 32 32	83 E1 H1 C5 E5	1089 1090 1091 1177 758	364G 374D 370D 357C 368D	330 *0 *0 *0	439 416 426 445 449	36 48 45 45 48
	2888 2988 2988 2988 2988 2988 2988 2988	D 1 E 6 H 8 A 1 E 1	383 1184 384 1056 1057	467.C 444D 438D 521D 510D	387 394 424 311 313	477 476 506 402 402	89 100 129 15 14		33 33 33 33 34	81 07 83 05	759 395 760 394 396	3669 3710 3730 3730 3680	292 315 297 322 310	366 403 383 407 395	8 25 17 33 15
	34 34 34 35	88 F 2 G 7 H 5	1058 730 1059 1060 386	4990 4090 4960 4290 4290 4410	311 277 330 295 224	399 365 420 385 312	11 23* 24 4* 65*		35 35 35 36	А 6 F 1 H 7 D 3	1136 762 397 398	3670 3690 3630 3670 3670	177 173 184 148	269 268 279 243	113* 112* 106* 129*
	35 35 35 35 36	83 F7 G8 87	1061 731 385 732 1062	4 1 9 0 4 5 6 0 4 3 3 0 3 9 7 0 4 5 4 0	235 260 257 273 534	318 348 322 361 616	59* 34* 50* 23* 238	19	6 7 18 19	A 2 A 8 D 7 G 8 A 3	763 764 765 766 399	361D 364D 366C 366D 454G	299 *0 *0 *0 193	381 312 328 328 293	11 56* 42* 43* 90*
	36 36	Н 5 Н 6	1063 1064	4010 4020	561 *0	645 384	273 92		19 29 30	D 8 С7 Н 8	180 1186 179	4 4 9 D 3 6 0 D 4 5 3 C	199 134 202	291 226 297	78* 148* 83*
18	2 2 4 5 6	D 7 G 1 D 1 H 7 A 8	733 734 183 387 1065	3700 3740 3750 4020 3910	*0 438 *0 388 391	508 516 563 456 461	142 158 200 82 91	20	1 1 1 1	A 5 B 6 C 5 C 8 D 4	634 635 636 637 402	4 3 0 N 4 7 4 D 4 6 6 C 4 5 5 D 4 5 6 D	129 128 124 124 124	218 218 213 215 234	131* 133* 141* 145* 122*
	6 6 7 8	D 8 E 4 H 5 A 4	1066 1067 1068 1069 735	3970 4140 3850 3880 4000	394 372 378 *0 *0	467 451 455 450 586	91 70 75 72 220		1 1 1 2 2	E 6 E 8 G 5 C 3	400 638 401 407 639	461C 479D 497D 433D 4540	139 142 159 117 110	218 215 223 209 196	133* 143* 131* 153* 158*
	10 10 10 12	C 6 D 5 E 3 F 4 A 3	1070 1071 1072 1073 736	3700 3780 3720 3770 3770 3670	412 415 430 430 293	488 493 508 511 336	122 127 134 138 24*		2 2 2 2 2 2 2 3	D 2 E 3 F 7 H 4 8 4	640 641 631 966 1118	4840 4800 4480 4540 4150	119 136 145 *0 127	208 212 231 230 223	152* 145* 131* 132* 132*
	12 12 12 13 13	A 5 B 5 B 6 A 7 B 2	1075 1074 737¤ 738 739	365D 367C 366C 368C 372C	375 *0 *0 244 221	467 491 498 332 310	135 125 126 38* 60*		4 6 7 8 8	U 8 A 2 A 3 E 3 F 7	642 967 643 644 409	3921 4211 4731 3690 4081	122 143 89 125 101	204 253 187 227 198	116* 133* 121* 91* 118*

\* Elev. above sea level; \*0 Datum bed absent; |Control well.

## PENNSYLVANIAN SYSTEM IN WHITE COUNTY

					ELEVATION							ELEVATION			
T. and R. No.	Section	Spot	County Number	Surface Elevation How determined	No. 6 Coai	No. 5 Coal	W. F. Ls.	T. and R. No.	Section	Spot	County Number	Surface Elevation How determined	No. 6 Coal	No. 5 Coal	W. F. Ls.
20	9 9 10 10 11	E 3 F 6 A 1 A 7 A 2	968 7 410 645 646	4320 377P 4130 4790 4180	104 99 87 95 109	204 198 182 193 208	120* 125* 140* 135* 123*	21	11 11 11 11 11	D 4 D 8 E 6 H 4 H 5	1122 978 979 627 1121	4 2 4 0 4 3 0 0 4 4 2 0 4 7 6 C 4 8 2 0	* 0 * 0 * 0 * 0	494 307 326 316 320	116 66* 57* *0 62*
	11 11 11 11 11	A 6 A 8 C 4 E 7 E 7	413 647 648 649 650	393C 405D 398C 427D 410C	89 *0 102 99 100	182 184 196 193 198	131* 140* 133* 154* 145*		12 13 13 13 13	A 5 A 3 A 5 B 5 C 5	426 1140 1124 1141 1123	4 1 7 C 3 9 4 D 3 9 5 D 3 9 3 D 4 0 0 D	363 280 298 307 320	448 372 393 401 408	91 28 39 46
	11 11 11 11 12	F 1 F 5 G 7 H 2 A 1	651 652 653 197 654	4 2 5 C 4 2 2 D 4 2 0 C 4 5 2 D 4 5 1 C	*0 114 110 106 272	189 212 205 196 *0	161* 145* 150* 155* 26		13 13 14 14 14	C 5 C 7 B 7 D 1 E 7	1145 1142 982 1143 981	4 0 1 D 4 0 3 D 3 9 2 G 3 9 3 G 4 1 9 G	320 357 *0 364 *0	409 433 482 465 326	41 73 127 96 110
	12 12 12 12 12	A 7 C 4 C 6 D 2	415 655 656 657 633	4 1 9 0 4 3 2 C 4 4 1 D 4 3 1 D 4 5 5 D	105 123 114 111 154	201 218 209 207 237	125* 119* 128* 135* 102*	5 5	14 14 15 15	E 7 F 8 G 7 A 1 E 1	983 980 984 985 986	4 2 3 G 4 0 4 D 4 3 2 D 4 4 5 D 4 0 2 D	* 0 * 0 * 0 * 0	*0 311 305 325 316	1.08 69* *0 42* 50*
	12 12 12 12 13	E 8 F 6 G 8 A 6	658 659 416 660 661	4350 4230 4350 4470 4460	*0 123 117 *0 117	189 213 209 187 212	155* 132* 137* 161* 71*		15 15 17 17	E 8 H 5 D 4 G 4 C 2	632 628 987 194 1156	4 0 0 D 4 0 7 C 4 1 6 D 4 3 6 C 4 1 8 C	262 253 344 341 321	350 343 436 428 412	3* 17* 120 102 104
	13 13 13 13 14	F 4 F 8 H 6 H 8 A 2	418 662 663 417 664	424C 4090 415C 414C 4320	126 121 108 125 88	219 216 199 221 182	92 * 87 * 122 * 109 * 122 *		2 2 2 3 3 3	F 5 A 4 A 5 C 2	1237 990 989 988	3660 3650 3650 3650 3630	169 187 361 189	259 281 439 277	120* *0 67 105*
	14 14 14 14 14	85 G8 H4 H5 H7	419 665 656 667 668	424G 3950 4100 3950 3910	65 81 98 89 89	164 184 193 185 159	145* 149* 122* 125* 128*		4 4 4 5	C 4 D 5 E 4 G 5 E 3	1125 993 1126 994 991	368D 368D 367D 371C 371D	270 278 275 283 302	362 365 365 372 392	16* 8* 7* 16
	15 15 15 15	88 02 06 7	669 1146 1151 670 671	4080 4070 4070 4190 4330	56 59 71 62 77	156 157 169 161 175	161* 153* 148* 160* 146*		6 7 8 8	C 3 C 2 C 8 C 8 E 2	1173 992 629 630 193	3560 3710 3730 3530 3580	376 272 290 271 255	464 361 385 363 339	80 3* 11 6* 32*
	15 15 15 15	F 1 G 4 G 5 H 7 B 1	672 673 674 420 675	4 2 2 0 4 3 4 0 4 4 6 0 4 7 1 0 4 2 0 0	81 84 90 89 52	180 186 189 191 150	126* 142* 140* 135* 160*		8 9 10 10 10	E 8 D 7 F 4 G 5	995 996 1153 1127 997	3550 3570 3540 3670 3650	295 242 352 183 367	386 306 422 277 485	13 57* 55 99* 81
	16 16 17 17	C1 C4 E3 C2	676 196 677 970 959	4340 4390 4300 3990 4260	64 71 75 127 73	162 166 170 228 172	148* 147* 138* 87* 135*		14 15 15 16 18	A 4 A 1 F 4 A 5 E 7	1174 433¤ 998 192 1128	346,0 3480 3520 3560 3910	130 136 186 154 260	224 232 271 247 379	154* 135* 108* 129* 10
21	12222	C 8 A 3 C 2 D 6 F 8	$616 \\ 1119 \\ 617 \\ 618 \\ 195$	4970 4810 4840 5030 5100	466 *0 468 239 235	573 383 560 323 322	188 13 218 29* 55*		21 23	F 1 E 2	1175 1147	343D 352D	193 114	287 210	9 81* 169*
	8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	G 2 G 5 A 2 5 C 2 C 2 C 2 C 2 C 2 C 2 C 2 C 2 C 2 C 2	$1171 \\ 619 \\ 620 \\ 621 \\ 622$	4830 4480 4770 4700 4720	241 233 239 264 250	325 322 323 353 353 337	49* 56* 22* 47*	83	19 19 19 19 19	A 4 C 4 C 5 C 6 D 4	606¤ 607 608 609 611	3500 3520 3500 3510 3500	75 61 76 115 63	180 165 172 221 164	208* 228* 224* 181*
•	33 4 4 4	D 5 H 7 A 1 F 1 H 1	971 972 1152 974 973	493D 474D 4410 514D 528C	285 308 308 306 369	370 396 391 396 403	13* 6 17 16 19		19 19 19 19 19	D 5 D 6 E 3 E 4 E 5	612 613 614 1160 190	3500 3530 3516 3506 3506 3496	74 111 61 67 122	172 217 163 171 226	224 * 182 * 225 * 178 *
	5 7 8 10 10	A 7 E 8 C 1 A 4 B 5	5 • 6 2 3 9 7 5 6 2 4 6 2 5	4 1 7 P 4 6 6 C 4 7 0 D 4 1 7 C 4 1 1 G	363 310 327 *0 263	452 392 404 331 354	48 64 31 * 34 *		19 19 20	Е 6 G 1 Н 8	615 1148 432	3 5 3 C 3 5 6 C 3 6 0 D	113 52 56	2 1 1 1 5 4 1 5 4	185* 235*
	10 10 10 11	D 1 F 2 H 5 5 8	977 626 976 1120	4390 4380 4540 4190	*0 223 261 *0	303 310 349 319	69* 62* 26* 59*	75	14 23	4 2 F 6	2 1	466C 370C	144 161	251 251	128* 132*

\* Elev. above sea level; \*0 Datum bed absent; Control well; • Diamond drill hole.

ILLINOIS STATE GEOLOGICAL SURVEY

Report of Investigations No. 153