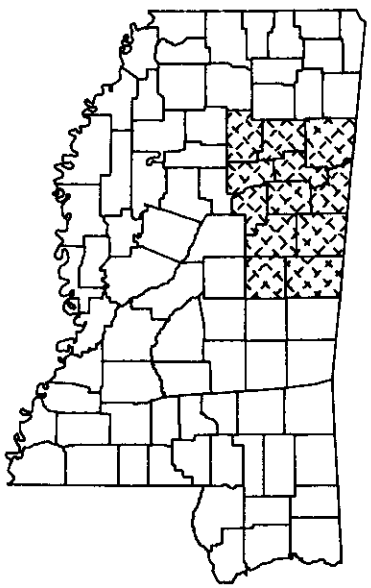
POTENTIOMETRIC MAP OF THE COKER AND MASSIVE SAND AQUIFERS IN NORTHEASTERN MISSISSIPPI FALL AND WINTER, 1992

by

David L. Hardin and Jo F. Everett

OLWR HYDROLOGIC MAP 93-5



MISSISSIPPI DEPARTMENT OF ENVIRONMENTAL QUALITY

OFFICE OF LAND AND WATER RESOURCES

Charles T. Branch

Office Head

Jackson, Mississippi

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Suggested cataloging data

Hardin, David L.
Potentiometric map of the Coker and massive sand aquifer in northeastern Mississippi, fall and winter, 1992 / David L. Hardin and Jo F. Everett. -- Jackson, MS: Mississippi Department of Environmental Quality, Office of Land and Water Resources, c1994.
7 p. : ill., charts, maps: 28 cm.--(OLWR Hydrologic Map: 93-5).

1. Aquifers--Mississippi. 2. Water, Underground--Mississippi. 3. Mississippi--Water Supply. 4. Mississippi--Maps, Potentiometric. I. Hardin, David L. II. Everett, Jo F. III. Mississippi Department of Environmental Quality. Office of Land and Water Resources. OLWR Hydrologic Map: 93-5. IV. Series: OLWR Hydrologic Map (Mississippi Office of Land and Water Resources): 93-5.

GB 1025

STATE OF MISSISSIPPI
DEPARTMENT OF ENVIRONMENTAL QUALITY
JAMES I. PALMER, JR.
EXECUTIVE DIRECTOR

LETTER OF TRANSMITTAL

Commission on Environmental Quality
of the State of Mississippi

To the Citizens of the State of Mississippi:

The Department of Environmental Quality, Office of Land and Water Resources, is pleased to transmit to you OLWR Map 93-5, entitled "Potentiometric Maps of the Coker and Massive Sand Aquifers in Northeastern Mississippi, Fall and Winter, 1992" by David L. Hardin and Jo F. Everett.

The wise use of the ground-water resources of Mississippi is dependent upon the collection of water-level data. This report presents data and interpretations pertinent to that effort.

It is hoped that water-management agencies, municipalities, water associations, and the water development industry can utilize data from this report to the benefit of the citizens of the State of Mississippi.

Respectfully submitted,

R. B. (Dick) Flowers
Chairman

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POTENTIOMETRIC MAPS OF THE COKER AND MASSIVE SAND AQUIFERS IN NORTHEASTERN MISSISSIPPI, FALL AND WINTER, 1992

INTRODUCTION

These potentiometric maps of the Coker and "massive sand" aquifers are part of a new series of maps prepared by the Mississippi Department of Environmental Quality, Office of Land and Water Resources (OLWR) that delineate the potentiometric surfaces of the major fresh-water aquifers in Mississippi. Made for the purpose of documenting changes in water levels, these maps are based on water-level measurements made in 19 massive sand wells and 14 Coker wells during fall and winter, 1992. At the present time there are only 20 wells screened in the Coker aquifer and 25 wells screened in the massive sand aquifer, with 15 and 19 wells respectively, being used for ground-water withdrawals. For the Coker aquifer a pre-1970 potentiometric map was constructed and is included as a reference for changes in the potentiometric surface. It should be noted that water levels may be highly variable seasonally or even daily and therefore only long-term and regional trends should be interpreted from the data presented herein.

Records of water wells screened in the Coker and massive sand aquifers were evaluated to select wells from which previous water-level measurements were obtained by this office and the U.S. Geological Survey. In areas where there were no wells that had been previously measured, additional wells were located and measured to fill in these voids. The locations of all the wells used in this study were plotted on U. S. Geological Survey 7.5 minute series topographic maps. Locations and altitudes of wells were checked and corrected in the field. The height and location of the measuring point of each well were noted. Information for each site was entered into a GIS database that was used to generate base maps for the study. Water levels were measured using either a steel tape or an electric tape. At least one additional measurement was made to verify the validity of the first measurement.

ACKNOWLEDGEMENTS

In the course of the field investigations, S. W. Bryant, L. A. May, P. A. Phillips, L. Stewart and A. J. Warner were of great assistance in the collection of water-level data used in the study. P. A. Phillips rendered great service in preparation of all the data for presentation in its final format through the use of a GIS data base. E. H. Boswell and J.H. Hoffmann made many helpful suggestions and reviewed the report.

HYDROGEOLOGY

The Coker Formation is a part of the Upper Cretaceous age Tuscaloosa Group, which also includes the Gordo Formation. The Coker is overlapped by the Gordo Formation and is underlain by Paleozoic rocks to the north and by lower Cretaceous age rocks to the south (Boswell, 1978). Sediments of the Coker Formation are not found at the surface in Mississippi, but crop out east of the state line in western Alabama. The northern limit of subsurface occurrence of the Coker Formation is approximately

the northern edge of Calhoun, Chickasaw, and Monroe Counties. From its northern limit the Coker thickens to the south and southwest to a thickness in Kemper County of approximately 400 feet. The Coker consists of an upper unnamed member and the Eoline Member. The unnamed member is composed of gray shale and lenticular beds of sand of near-shore marine origin. The Eoline Member is composed of shale and sand similar to the overlying unnamed member, and includes at its base the massive sand (Boswell, 1963).

The massive sand is present in the subsurface in Mississippi from Calhoun, Chickasaw, and Monroe Counties southward. It attains a maximum thickness of about 350 feet in Kemper and Noxubee Counties and thins northward until it pinches out. Boswell (1963) considered the massive sand to include all sediments of predominantly nonmarine origin that underlie the Eoline Member of the Coker Formation and overlie Paleozoic rocks in its northern area of occurrence and Lower Cretaceous rocks in the southern part. The unit is mainly composed of medium to coarse-grained sand and some interbedded shale. Gravel may also occur, particularly in the lower part.

AQUIFER DEVELOPMENT AND GROUND-WATER USE

The Coker and massive sand aquifers are a source of freshwater for some public water supplies and industries in several counties in northeastern Mississippi (see Figure 1).

Due to abundant, good quality freshwater available in the shallower Eutaw-McShan and Gordo aquifers, the Coker and massive sand aquifers have not been developed extensively. In recent years there have been greater demands for water because of population growth and increased industrial requirements, leading to more wells being drilled to these aquifers.

Large wells developed in the Coker produce 1,500 to 1,800 gpm. Wells located at low altitudes flow. A well drilled about 1960 flowed at a reported rate of 2,300 gpm and a 1977 well at Columbus flowed at approximately 1000 gpm (Boswell, 1978). All of the wells completed in the Coker aquifer that are withdrawing ground water are larger than 6 inches in diameter and have been permitted by the Office of Land and Water Resources. The total permitted volume for the Coker is 7.2 mgd with the following breakdown for the permitted volume: Public Supply - 19 per cent, Industrial - 81 per cent, Irrigation - <0.5 per cent.

Large wells developed in the massive sand produce up to 2,300 gpm. As with the Coker, massive sand wells located at low altitudes will flow. Only one massive sand well withdrawing ground-water is less than 6 inches in diameter and all the remaining wells have been permitted by the Office of Land and Water Resources. The total permitted volume for the massive sand is 18.2 mgd., broken down as follows: Public Supply - 44 per cent, Industrial - 55 per cent, Irrigation -1 per cent.

Although the volumes noted above are for permitted volumes, they are believed to be representative of the total amount of ground water presently being withdrawn from the two aquifers.

POTENTIOMETRIC MAPS

During the preliminary stages of planning for measuring water levels and mapping the potentiometric surfaces of the Coker and massive sand aquifers, it was assumed that the two aquifers had

sufficient hydraulic connection that one potentiometric map could be constructed. After all the water-level measurements were completed and plotted on a map, it became evident that the two aquifers were almost totally independent of each other. Apparently the confining bed overlying the massive sand is continuous enough to isolate the two aquifers, except for possibly in the north near the limit of subsurface occurrence of the sands. Although no water wells have been completed in the northern area of occurrence of the aquifers, logs from oil tests indicate that no confining bed is present.

The pre-1970 Coker potentiometric map can be considered a pseudo-predevelopment map, because very little groundwater withdrawal had occurred prior to this time. The map shows increasing water levels to the west, with a bend in the south toward an area of regional discharge in western Alabama. Water levels for the 1992 potentiometric map show considerable declines in the western section. Interpretation of these declines is based on the fact that relatively small withdrawals have occurred in the western section and the declines in water levels are probably very localized. The total permitted pumpage from Oktibbeha and Webster Counties is 1.2 mgd. This volume is probably not sufficient to create regional declines, but results in local declines around the pumping wells.

The 1992 potentiometric map of the massive sand shows increasing water levels to the east and, like the Coker, has a bend in the south toward an area of regional discharge. The major withdrawals from the massive sand occur in Lowndes County and are reflected in a small cone of depression in the southern part of the county.

This interpretation reasonably represents the potentiometric surfaces of both aquifers; however, it must be understood that at present a very limited number of data points are available. As more wells are completed in these deeper aquifers, a better comprehension of these aquifers will be attained.

WATER LEVELS

Recharge, primarily by precipitation, to the Coker and massive sand aquifers is on the outcrop where permeable units are exposed. In Alabama, some recharge may be received from the overlying Gordo Formation in areas where it is thin and the Coker or massive sand subcrops beneath it. In the Coker aquifer, water levels in the eastern part of the study area have shown less long-term change than water levels in the western part (see Figure 1). In the massive sand aquifer, not enough long-term water levels are available to detect any trends.

SELECTED REFERENCES

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_____, E. H., 1978, The Tuscaloosa aquifer system in Mississippi: U. S. Geological Survey Water-Resources Investigations 78-98, 3 sheets.

_____, E. H., Moore, G. K., MacCary, L. M., and others, 1965, Cretaceous aquifers in the Mississippi embayment with a discussion of quality of the water by H. G. Jeffery: U. S. Geological Survey Professional Paper 448-C, 37p.

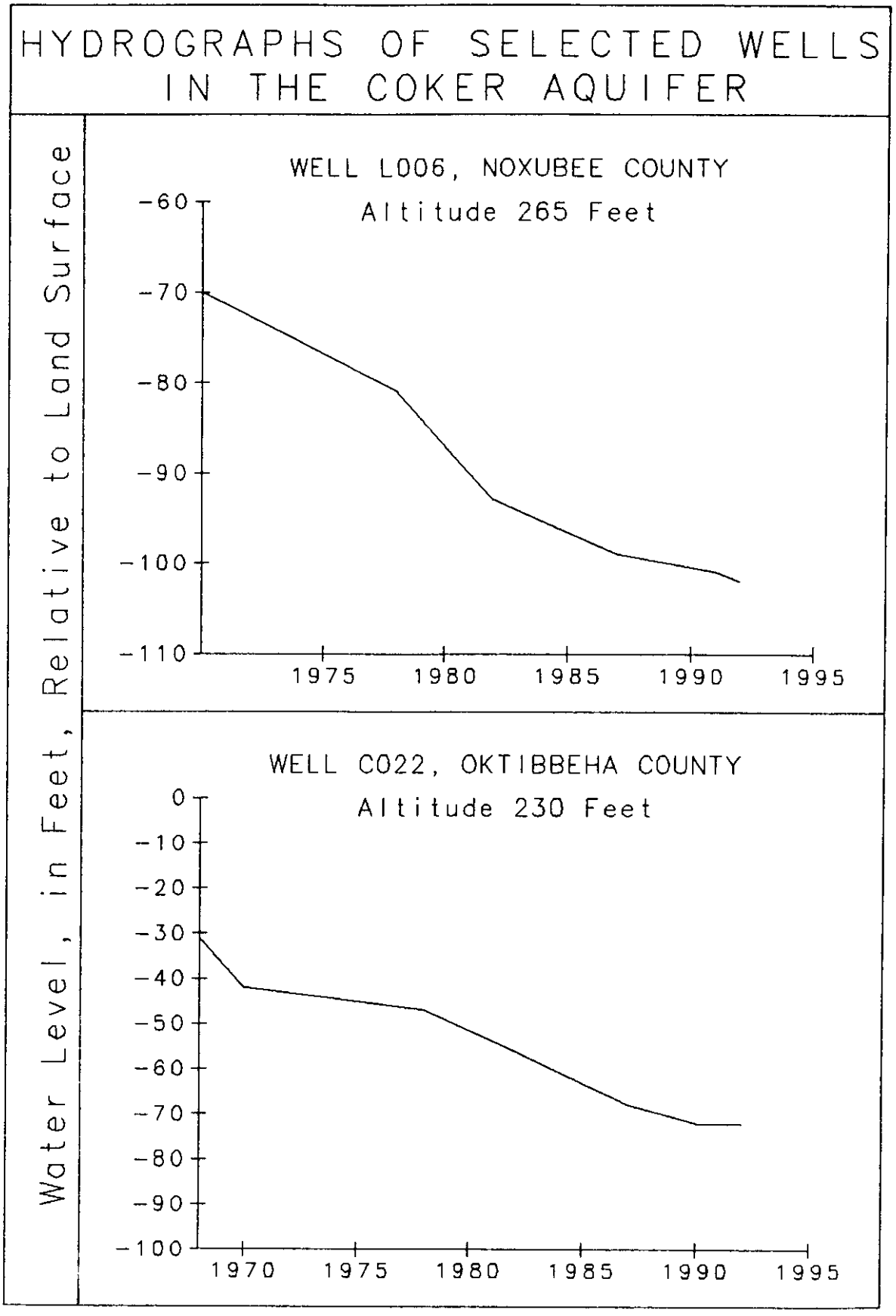
HYDROGRAPHS OF SELECTED WELLS IN THE COKER AQUIFER
Water Level, in Feet, Relative to Land Surface
WELL L006, NOXUBEE COUNTY
Altitude 265 Feet
-60
-70
-80
-90
-100
-110
1975
1980
1985
1990
1995
WELL C022, OKTIBBEHA COUNTY
Altitude 230 Feet
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
1970
1975
1980
1985
1990
1995

FIGURE 1

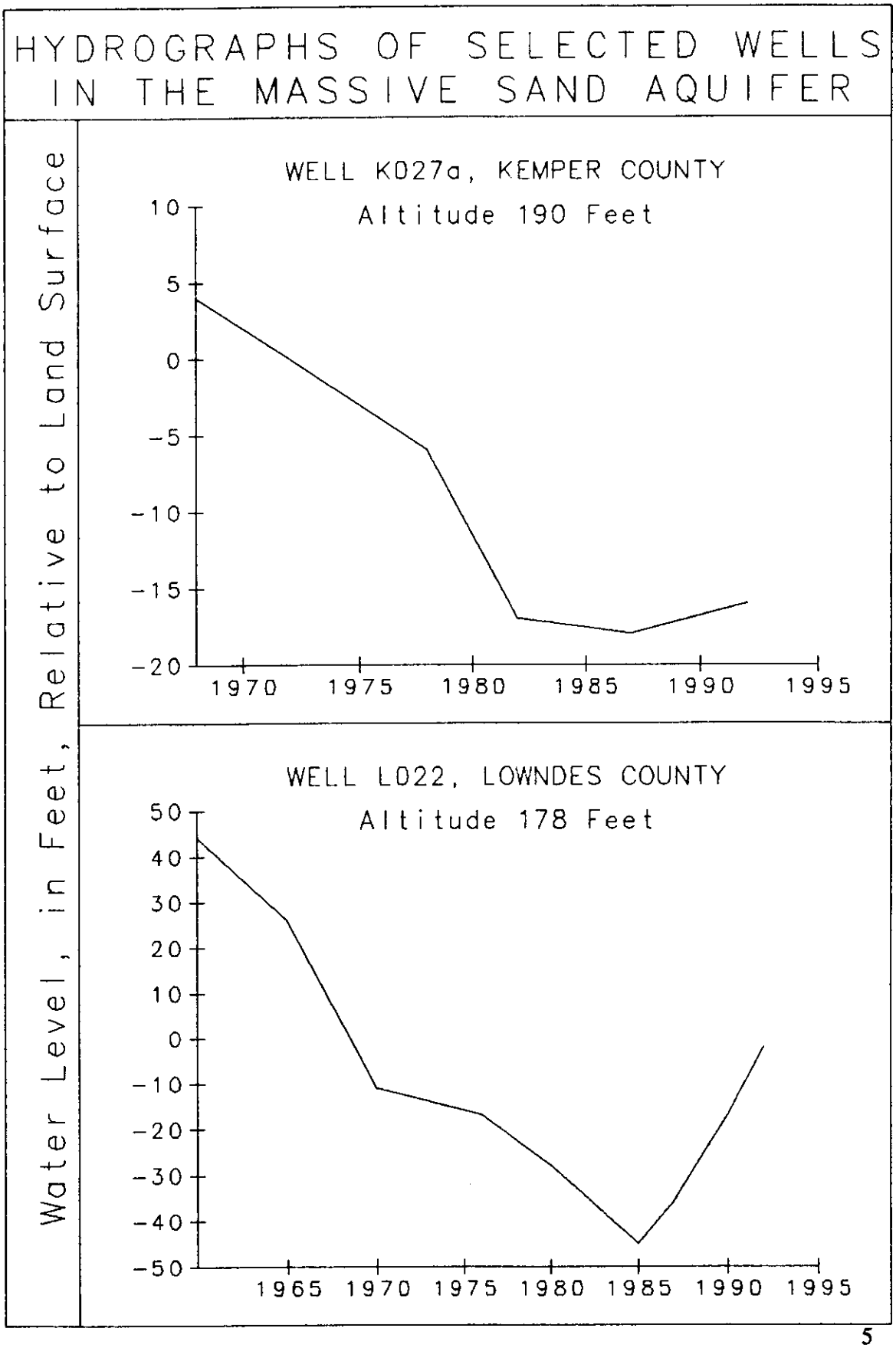
HYDROGRAPHS OF SELECTED WELLS IN THE MASSIVE SAND AQUIFER
Water Level, in Feet, Relative to Land Surface
WELL K027a, KEMPER COUNTY
Altitude 190 Feet
10
5
0
-5
-10
-15
-20
1970
1975
1980
1985
1990
1995
WELL L022, LOWNDES COUNTY
Altitude 178 Feet
50
40
30
20
10
0
-10
-20
-30
-40
-50
1965
1970
1975
1980
1985
1990
1995

FIGURE 2

TABLE 1: WATER LEVEL RECORDS OF WELLS SCREENED IN THE MASSIVE SAND AQUIFER

COUNTY	U.S.G.S. WELL NUMBER	ALTITUDE IN FEET RELATIVE TO MSL	1992 HEAD VALUES IN FEET RELATIVE TO MSL	1992 WATER LEVELS IN FEET RELATIVE TO LAND SURFACE	PREVIOUS WATER LEVELS IN FEET RELATIVE TO LAND SURFACE	AVERAGE CHANGE IN WATER LEVEL RISE (+) OR DECLINE (-) IN FEET PER YEAR
KEMPER	K021	227	171.22	55.78	35.00 (1978)	- 1.48
	K022	210	178.03	31.97	33.50 (1990)	+ 0.77
	K023	230	171.91	58.09	54.00 (1985)	- 0.58
	K027	190	173.95	16.05	6.49 (1978)	- 0.68
LOWNDES	G182	178	181.00	+ 3.00	16.25 (1991)	+ 19.25
	G185	178	181.00	+ 3.00	2.90 (1980)	+ 0.49
	K032	262	170.78	91.22	102.25 (1987)	+ 2.21
	K037	240	168.75	71.25	74.50 (1982)	+ 0.33
	L022	178	175.52	2.48	+ 25.90 (1965)	- 1.05
	O033	222	152.05	69.95	---------.---------	-----.-----
	P019	215	156.87	58.13	85.84 (1984)	+ 3.46
	P020	222	159.86	62.14	50.00 (1981)	- 1.10
NOXUBEE	C040	258	167.49	90.51	79.00 (1980)	- 0.96
	H016	210	166.39	43.61	19.00 (1970)	- 1.12
	H038	215	170.23	44.77	23.00 (1970)	- 0.99
	H055	225	169.95	55.05	55.70 (1991)	+ 0.65
	J018	205	174.68	30.32	33.00 (1983)	+ 0.30
	S024	235	170.09	64.91	34.00 (1969)	- 1.34
	Q018	480	167.87	312.13	310.00 (1985)	- 0.30

TABLE 2: WATER LEVEL RECORDS OF WELLS SCREENED IN THE COKER AQUIFER

COUNTY	U.S.G.S. WELL NUMBER	ALTITUDE IN FEET RELATIVE TO MSL	1992 HEAD VALUES IN FEET RELATIVE TO MSL	1992 WATER LEVELS IN FEET RELATIVE TO LAND SURFACE	PREVIOUS WATER LEVELS IN FEET RELATIVE TO LAND SURFACE	AVERAGE CHANGE IN WATER LEVEL RISE (+) OR DECLINE (-) IN FEET PER YEAR
LOWNDES	L031	175	166.66	8.34	8.95 (1991)	+ 0.61
	L033	175	169.65	5.35	6.27 (1991)	+ 0.92
	L036	179	172.20	6.80	--------.--------	-----.-----
MONROE	L102	218	184.96	33.04	30.67 (1991)	- 2.37
	P079	222	199.73	22.27	19.71 (1991)	- 2.56
NOXUBEE	C018	287	150.76	136.24	110.00 (1966)	- 1.01
	C041	249	150.72	98.28	97.00 (1983)	- 0.14
	L006	265	162.55	102.45	81.00 (1978)	- 1.53
OKTIBBEHA	C021	380	151.44	228.56	172.00 (1965)	- 2.09
	C022	230	158.03	71.97	42.00 (1970)	- 1.36
	J010	325	164.28	160.72	137.60 (1978)	- 1.65
WEBSTER	E009	343	168.55	174.45	158.90 (1978)	- 1.11
	J004	415	167.76	247.24	228.10 (1978)	- 1.37
	J009	420	163.03	256.97	245.00 (1981)	- 1.09

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POTENTIOMETRIC MAP OF THE COKER AQUIFER IN NORTHEASTERN MISSISSIPPI PRE-1970

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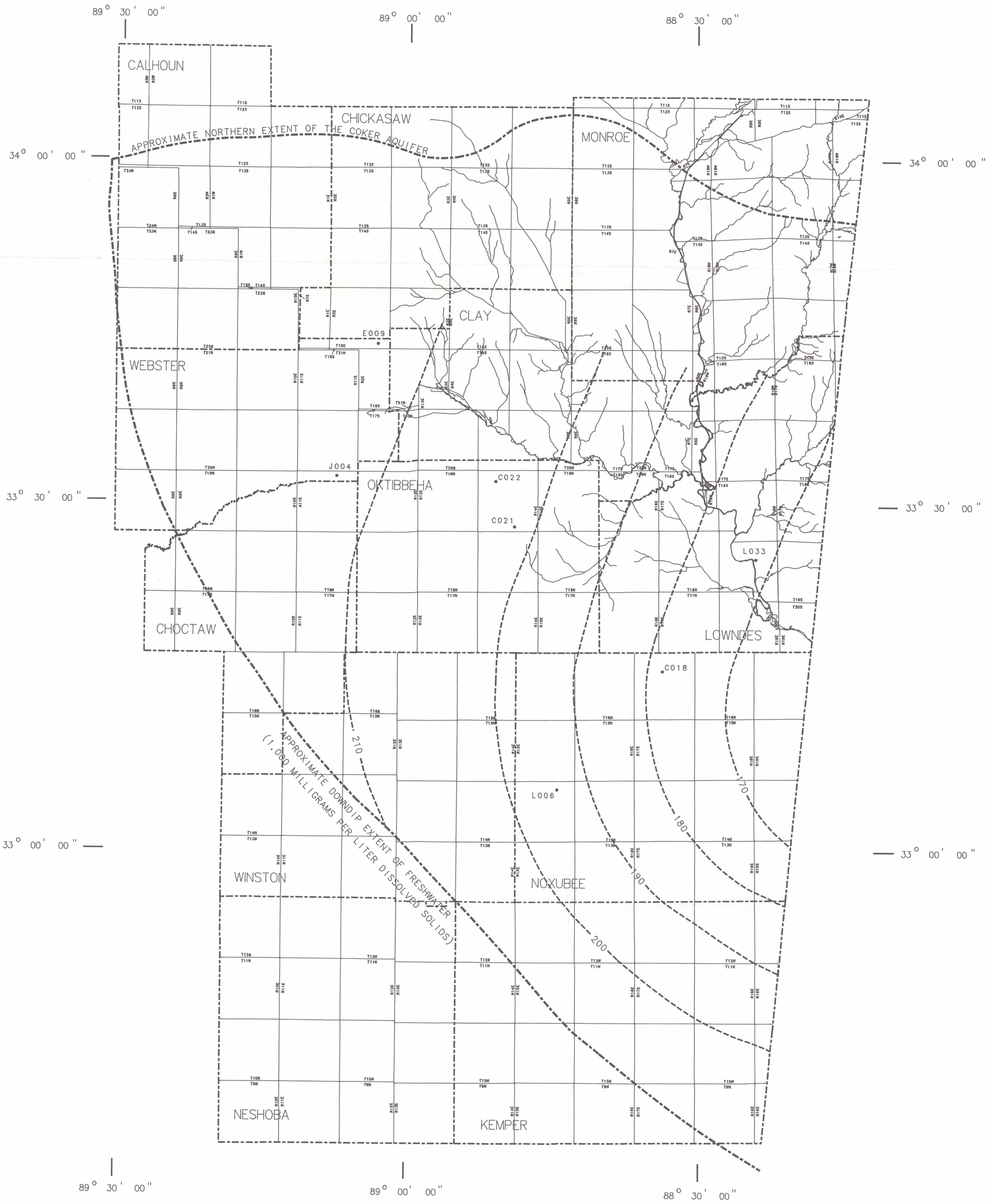

EXPLANATION

— 260 — POTENTIOMETRIC CONTOUR
Contour interval 10 feet, dashed where approximate
Datum is sea level.

THE COKER DOES NOT CROP OUT IN MISSISSIPPI

A046 ● OBSERVATION WELL AND NUMBER

SCALE 1:400000

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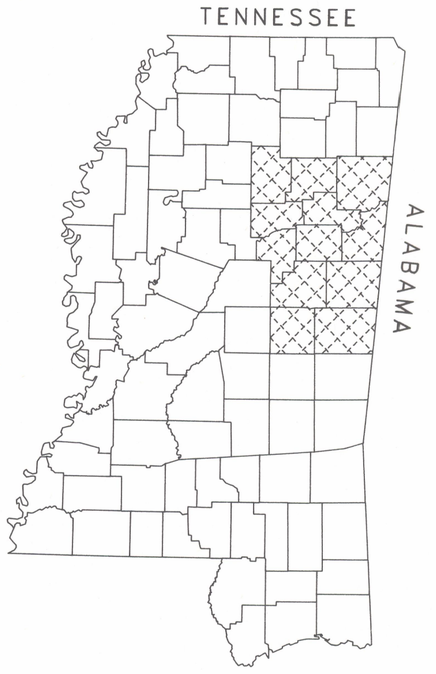
MILES



Location of Study Area

POTENTIOMETRIC MAP OF THE COKER AQUIFER IN NORTHEASTERN MISSISSIPPI FALL AND WINTER, 1992

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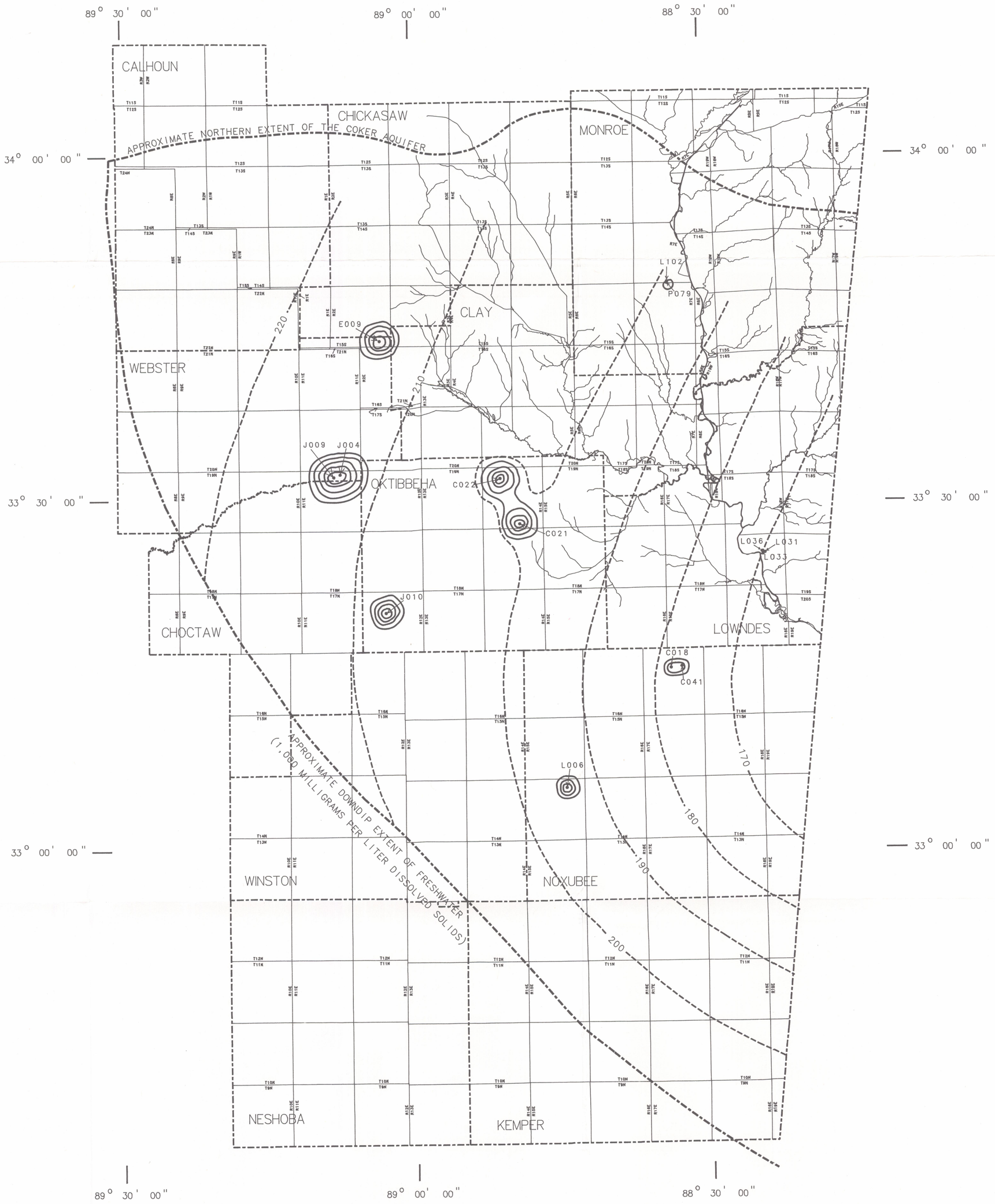

EXPLANATION

260 — POTENTIOMETRIC CONTOUR
Contour interval 10 feet, dashed where approximate
Datum is sea level.

THE COKER DOES NOT CROP OUT IN MISSISSIPPI

A046 — OBSERVATION WELL AND NUMBER

SCALE 1:400000

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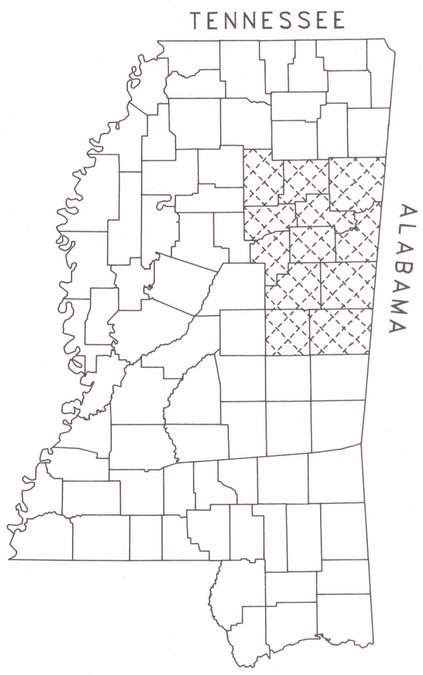
MILES



Location of Study Area

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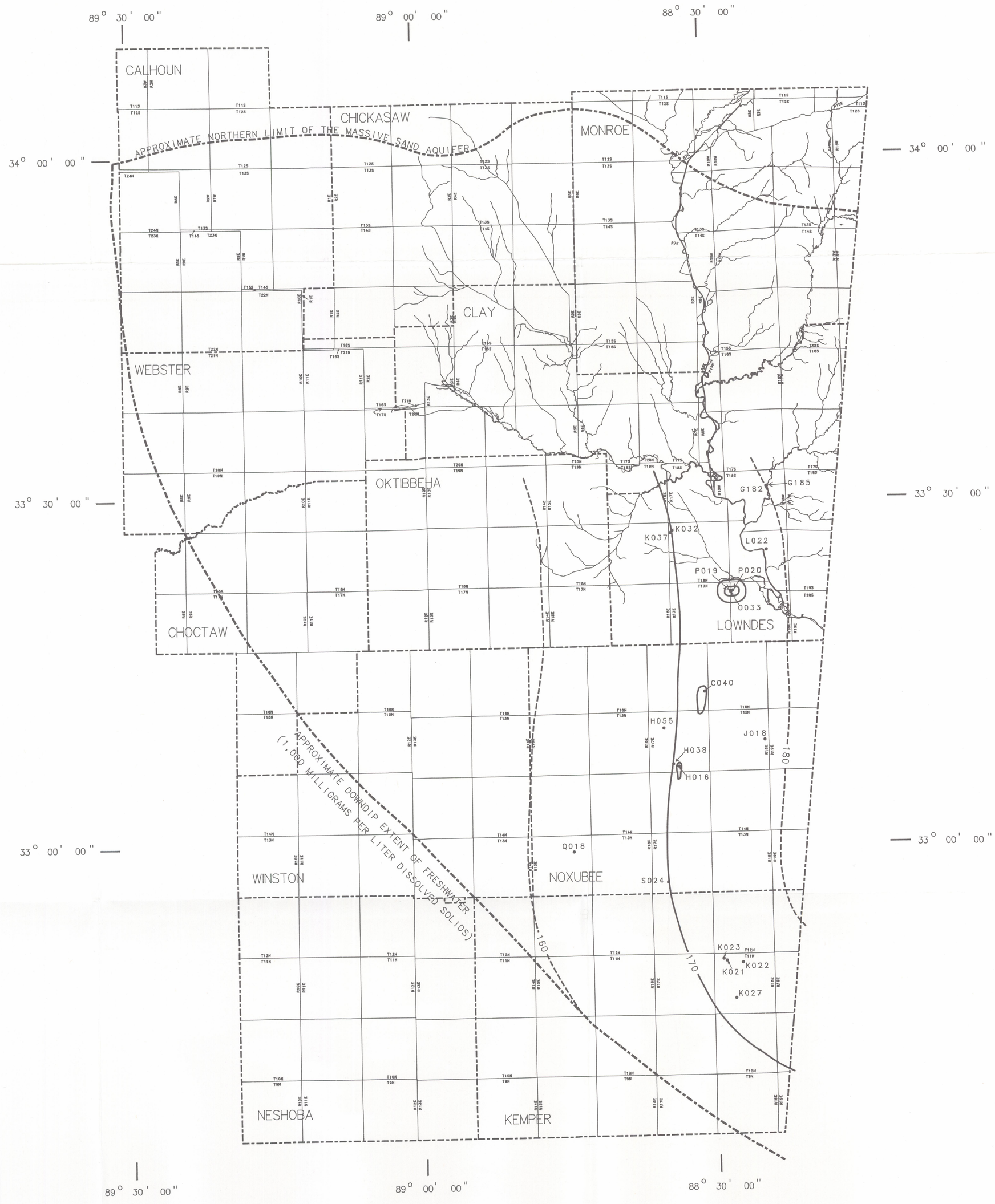


EXPLANATION

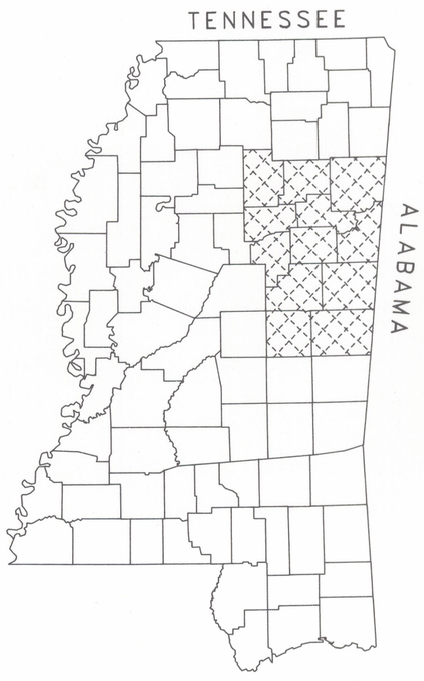
— 260 — POTENTIOMETRIC CONTOUR
Contour interval 10 feet, dashed where approximate
Datum is sea level.

THE MASSIVE SAND DOES NOT CROP OUT IN MISSISSIPPI

A046 ● OBSERVATION WELL AND NUMBER

SCALE 1:400000

5 0 5 10 15 20
MILES



Location of Study Area