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WATER RESOURCES INVESTIGATIONS 46-75
SHEET 1 OF 3

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THE MIOCENE AQUIFER SYSTEM IN MISSISSIPPI

INTRODUCTION

A large amount of information is available on the aquifers of Mississippi. Reports resulting from various areal studies have described the ground-water resources of the areas concerned, but no reports dealing specifically with the statewide occurrence of individual aquifer systems have been prepared previously. A series of "aquifer atlases" was deemed the most effective way to point out the character, the potential, and the extent of development of the aquifers and thereby provide water managers with data needed for efficient utilization of available resources. This report on the Miocene aquifer system is the first in the series. Information on the aquifers was obtained in the cooperative programs of the U.S. Geological Survey with the Mississippi Board of Water Commissioners and other State and Federal agencies.

LOCATION AND THICKNESS

Most of the southern half of Mississippi is underlain by a series of irregular and locally lenticular sand and clay beds of Miocene age (fig. 1). Southwest of a line from Warren County on the west through Wayne County on the east, these sediments form a wedge that thickens gulfward and has its base about 5,500 ft (1,700 m) below sea level at the southern tip of Hancock County. The beds dip gulfward at 30 to 100 ft/mi (5.7-19 m/km), the rate of dip being least in the near-surface zone.

STRATIGRAPHIC RELATIONS

The Miocene sequence in southern Mississippi has been subdivided by some workers into the Pascagoula Formation, Hattiesburg Formation, and Catahoula Sandstone--from youngest to oldest--but these divisions cannot be reliably identified or traced in the subsurface. Likewise, a 400- to 900-ft-thick (120-270 m) unit at the top in the coastal counties has been identified as Pliocene in age on the basis of fossil evidence and assigned the name Graham Ferry Formation. Again, the unit cannot be distinguished from the next lower formation by lithological, geophysical, or hydrological means. Consequently, all the material between the Citronelle Formation, a blanket deposit of Pliocene age, and the limy Vicksburg Group of Oligocene age is herein considered to compose the Miocene aquifer system. A contour map shows the depth and configuration of the Miocene base.

Miocene beds crop out in more than half the region; elsewhere they are concealed by the Citronelle, which seldom exceeds 100 ft (30 m) in thickness and is highly dissected in many places; by scattered Pleistocene terrace deposits; or by a thin band of younger coastal deposits along the Mississippi Sound and the lower Pearl and Pascagoula Rivers.

WATER-SUPPLY DEVELOPMENT

Because of its thickness, areal extent, and permeability, the Miocene aquifer system is the largest potential source of ground-water supplies in the State. In the 17,000 mi^2 (44,000 km^2) area of its occurrence it is currently tapped for about 120 Mgal/d (5.3 m^3/s), slightly more than one-fourth of the ground water withdrawn in Mississippi for uses other than irrigation. Only the upper few hundred feet of the system have been significantly developed, and many thick aquifers remain untapped. Information on the systems using water from Miocene aquifers is given in table 1, and the map shows withdrawals from the Miocene aquifers in each county (fig. 2). Most of the individual wells used by the water systems were described by Callahan (1975).

FRESH-WATER OCCURRENCE

Fresh water is available from the Miocene aquifers wherever the system occurs, but not everywhere from the entire Miocene section. In the northern part of the outcrop area, the fresh water extends below the base of the Miocene into formations of Eocene age, namely the Cockfield Formation and the Sparta Sand (fig. 3). The base of the fresh-water section dips southward, but at a lower rate than the formational dip. As a result, the lower part of the Miocene Series contains saline water in much of southern Mississippi. Despite this, there is a fresh-water-bearing zone as thick as 3,000 ft (900 m) in places and averaging 1,500 ft (450 m). The map showing the configuration of the base of fresh water (fig. 4) and the geohydrologic cross sections (figs. 5-8) illustrate the thickness of the fresh-water section and its relation to the base of the Miocene series.

Although the Miocene sediments were deposited in a largely brackish-water environment, subsequent uplifts of the land and recessions of the sea permitted fresh water from the inland recharge areas to flush out the saline water to the great depths now recorded, even on the barrier islands and beyond. Fresh water is available to a 1,500-ft (450 m) depth on Horn Island, according to an oil-test electric log, and water wells as deep as 500 ft (150 m) on Ship Island supply excellent water with flowing head. Water-bearing sand has been logged to a depth of nearly 1,000 ft (300 m) on Cat Island. How much deeper the fresh-water section extends on Ship and Cat Islands is not known, but it is probably more than 2,500 ft (760 m).

WATER QUALITY

The quality of the water is generally good, the only substantial problem being excessive iron in places. In many--if not most--of the high-iron situations the acidic nature of the water probably is responsible for corrosion of iron fittings and the consequent inclusion of the iron in the water. The deeper the aquifer the less likely is the occurrence of acidic water. Table 2 shows maximum, minimum, and median values observed for the common chemical constituents and properties of the ground water. The water is almost exclusively a soft, sodium bicarbonate type and is markedly uniform areally and stratigraphically.

The temperature of ground water may be a consideration in its use. Since the Miocene contains deep aquifers, some rather high water temperatures can be expected. The thermal gradient is about 1 degree Fahrenheit for each 57 ft of depth increase (1°C for each 31 m). In near-surface aquifers the temperature is about 65°F (18°C), close to the average annual air temperature. The graph illustrates the thermal gradient (fig. 9).

WATER LEVELS AND RECHARGE

There are some places where ground-water development has been sufficiently intensive to create problems of excessive drawdown of water levels. At Laurel and Pascagoula, where 15-20 Mgal/d (0.7-0.9 m^3/s) are withdrawn in relatively small areas, certain aquifers have undergone severe drawdown. Even in these places, however, redistribution of pumpage areally and/or stratigraphically offers at least a partial remedy for the problem. Hydrographs of observation wells in the Miocene aquifers illustrate water-level trends in many areas (fig. 10). Water levels are declining regionally at the rate of 1-2 ft (0.3-0.6 m) per year, probably reflecting the aggregate withdrawal from the aquifers and the resulting interaquifer effects. Of course, near centers of heavy pumping the annual decline is much greater. (See hydrographs for Jackson and Jones Counties.)

The Miocene aquifers are recharged by rainfall directly on the outcrops, by infiltration from overlying surficial deposits (Citronelle Formation and younger sediments), and by interaquifer movement through the clay and silt beds that separate sand units. Water movement is gulfward, the direction of regional formation dip. The potentiometric surface slopes at a low rate, probably less than 5 ft/mi (1 m/km) except near pumping centers.

DISTRIBUTION OF AQUIFERS

To illustrate the occurrence of aquifers throughout southern Mississippi, selected electric logs--one for each county if available (fig. 11)--were analyzed and the sand intervals listed in table 3. Because of the lenticularity of the sand beds, it would not be reasonable to expect the sand intervals in the table to extend very far laterally; however, at any site several aquifers are likely to occur, and many of them are hydraulically connected. At any selected site the percentage of sand in the fresh-water section may range from 10 to 70 percent. Aggregate sand-bed thicknesses greater than 1,000 ft (300 m) have been recorded.

HYDRAULIC CHARACTER

The Miocene aquifers have greater water-transmitting capacity than the older formations of Mississippi. An average hydraulic conductivity of about 95 $(ft^3/d)/ft^2$, or 29 $(m^3/d)/m^2$, was indicated on 200 aquifer tests. With the substantial thickness that many of the sand beds have, it is common for the transmissivity to be near 13,000 $(ft^3/d)/ft$, or 1,200 $(m^3/d)/m$. Specific capacities of wells in current operation are generally less than 30 (gal/min)/ft, or 6.3 (l/s)/m, and few wells produce more than 1,000 gal/min, or 63 l/s; however, efficient wells constructed in some of the thicker aquifers of the region could produce several thousand gallons per minute each.

An important consideration in well-field design is the spacing of wells to minimize pumping interference. The graph relating water-level drawdown to time and distance, for various values of transmissivity and pumping rate, will provide a guide for well spacing and pump-capacity selection (fig. 12).

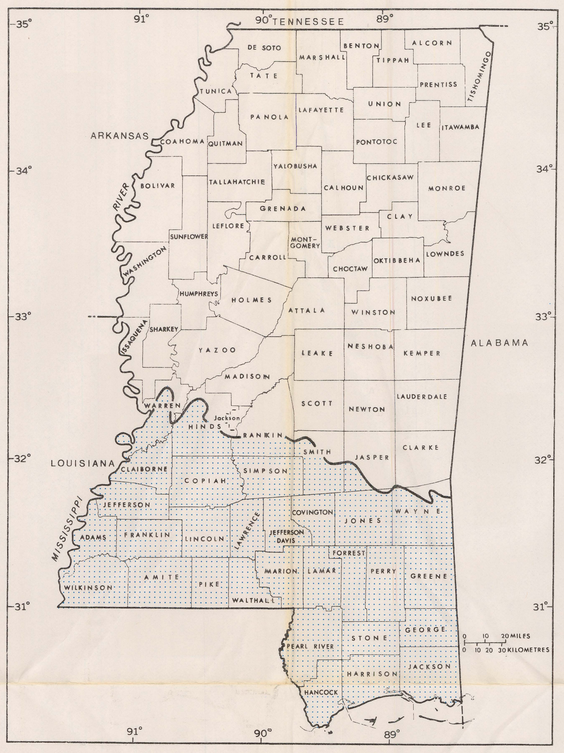

FIGURE 1.--AREA OF MIOCENE AQUIFER OCCURRENCE.

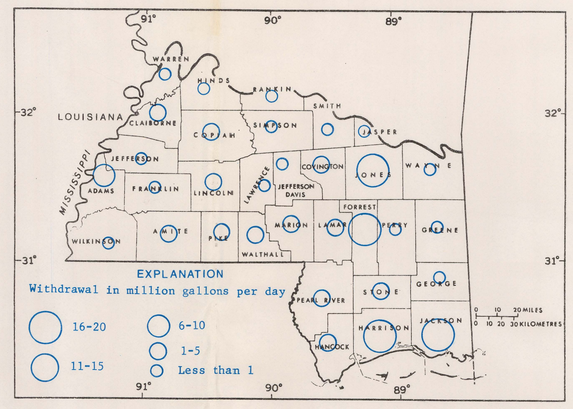

FIGURE 2.--GROUND-WATER WITHDRAWAL FROM THE MIOCENE AQUIFER SYSTEM.

TABLE 1. WATER SUPPLIES FROM MIOCENE AQUIFERS

COUNTY	WATER USER W A - WATER ASSOCIATION	DEPTH OF WELLS (FT)	PUMPING RATES OF WELLS (GAL/MIN)	DAILY WITHDRAWAL (THOUS. GAL)	TECHNICAL DATA AVAILABLE: CHEMICAL ANALYSIS	ELECTRIC LOG	PUMPING TEST
ADAMS	ADAMS COUNTY W A	265-570	400-500	715	X	X	X
	NATCHEZ	425-660	400-600	2,866	X	X	X
	OAKLAND WATER WORKS	135-165	65-365	82			
	SELF-SUPPLIED INDUSTRY	150-690	300-675	5,180	X	X	X
AMITE	CENTREVILLE	400	250	152	X		X
	GLOSTER	350-380	500-835	260	X	X	X
	LIBERTY	165-620	100-300	136	X		X
	SELF-SUPPLIED INDUSTRY	400	600	650		X	
CLAIBORNE	ALCORN STATE UNIVERSITY	180-200	100-300	400	X	X	
	CS&I W A	415	150	36		X	
	HERMANVILLE W A	480	180	64	X	X	
	PORT GIBSON	155-200	150-350	597	X		X
	SELF-SUPPLIED INDUSTRY	265	370	350	X		
COPIAH	BAYOU PIERRE W A	430-465	125-150	44	X	X	X
	COPIAH AND NEW ZION W A	130	25	11			
	CRYSTAL SPRINGS	320	220	[a]100	X	X	X
	GALLMAN	215	150	36	X	X	
	GEORGETOWN	760	100	60	X		
	HARMONY RIDGE W A	200	180	31	X	X	X
	HAZLEHURST	265-920	200-600	1,123	X	X	X
	NORTHEAST COPIAH W A	310	175	97	X	X	X
	REEDTOWN W A	250	160	70	X	X	
	WESSON	330-360	300	200	X	X	X
	SELF-SUPPLIED INDUSTRY	170-260	75-250	20		X	
COVINGTON	COLLINS	725-920	500	500		X	
	COLD SPRINGS W A	825	150	33	X	X	
	MT. OLIVE	210-390	165-600	68	X	X	X
	NORTH COVINGTON W A	290-700	375-565	114		X	
	SALEM W A	660	210	34		X	
	SANFORD	800	110	15	X	X	X
	SEMINARY	250-900	100-350	23	X	X	X
	SOUTHWEST COVINGTON W A	960	200	96		X	
	WILLOW GROVE W A	730	500	67		X	
	SELF-SUPPLIED INDUSTRY	165-740	30-1300	1,070	X	X	X
FORREST	BARRONTOWN W A	900	150-200	78	X	X	
	BROOKLYN W A	580	250	41	X	X	X
	CAMP SHELBY	400-550	500-550	930	X		X
	CARNES W A	820	150	22		X	X
	CENTRAL UTILITY ASSOC.	700	200-250	59	X	X	X
	DIXIE COMMUNITY W A	900	300	80		X	
	EASTABUCHIE W A	810	200	28		X	
	EAST FORREST UTILITY CO.	390	300	[a]175			
	GLENDALE W A	655	300	125	X	X	
	HATTIESBURG	200-700	300-1200	6,254	X	X	X
	MCLAURIN UTILITY ASSN.	630	100	17		X	
	PALMERS CROSSING UTILITY ASSN.	640	300	87		X	X
	RAWLS SPRINGS W A	700	200	150	X	X	
	SUNRISE UTILITY ASSN.	900	200	62	X	X	
	SELF-SUPPLIED INDUSTRY	160-740	25-1400	[a]8,700	X	X	
FRANKLIN	BUDE	250	230-500	80	X	X	X
	MEADVILLE	200-240	200-300	155	X	X	X
	PROVIDENCE W A	345	135	15	X		X
	ROXIE	335	200	75	X	X	
	SIX TOWN W A	250	100	22	X	X	
GEORGE	BEXELEY W A	600	200-300	43	X	X	
	LUCEDALE	1000	600	211	X	X	
	ROCKY CREEK W A	600-1050	200-300	50	X	X	
GREENE	BEAT THREE W A	500	300	56	X	X	
	LEAKESVILLE	125-240	100	105	X		X
	MCLAIN	180	175	40	X	X	
	NEELY UTILITY ASSOC.	300	150	13	X	X	
	STATE LINE	250	125	50	X	X	X
HANCOCK	BAY ST. LOUIS	840-1200	175-750	607	X	X	
	CLERMONT HARBOR	865-1250	100-250	36	X		
	DIAMOND HEAD UTILITY	325-930	20-1100	641	X	X	
	OAK HARBOR SUBDIVISION	2000	900	18		X	
	WAVELAND	1000	260	240		X	
	SELF-SUPPLIED INDUSTRY	700-1900	600-5000	2,125	X	X	X
HARRISON	ANCIENT OAKS	850	125	21			
	BILOXI	430-1200	80-1600	5,000	X	X	X
	COAST WATER WORKS	550-900	250-500	255		X	X
	COMMUNITY WATER SYSTEM	815	45	4			
	CRESTVIEW WATER WORKS	240-570	20	34	X		
	DEDEAUX UTILITY	740	250-350	94	X	X	
	FERNWOOD	650	50	6			
	FOREST COVE	370-1040	90-760	70			
	GULF HOMES WATER CORP.	780-1030	120-500	194		X	
	GULFPORT	650-1240	75-1100	4,896	X	X	X
	KEESLER AFB	500-875	300-1000	3,833	X	X	X
	LONG BEACH	850-950	400-800	740	X	X	
	MISSISSIPPI HOUSING	785	250	55	X		
	NORTH GULFPORT HOUSING	825	150	50		X	
	NORTH GULFPORT WATER WORKS	500-1400	20-60	223	X		
	OAKLEIGH UTILITY	510	165-200	33		X	
	ORANGE GROVE UTILITIES	700-765	300	322	X	X	
	PASS CHRISTIAN	900-1100	300-600	455	X		X
	PASS CHRISTIAN ISLE	800-920	225-500	68		X	
	PINE POINT SHORES AND PORTAGE ESTATES	810-840	150-350	10			
	SAUCIER W A	775	170	25	X	X	X
	SEASHORE UTILITY	800	100	27	X		
	TURN-KEY HOUSING	750-800	150	73		X	
	U.S. NAVAL BASE	750-1200	450-500	250	X		X
	V. A. HOSPITALS	1100	530	266	X		
	WOODLAND HEIGHTS	520	100	7	X		
	YUCCA VILLA	620	50	3			
	SELF-SUPPLIED INDUSTRY	250-1300	30-900	6,045	X	X	X
HINDS	UTICA	300	180	162	X		X
JACKSON	BAY WATER WORKS	600-860	130-350	205	X	X	
	BEACH BAYOU	875	70	20			
	CAMP MCCLELLAN WATER CO.	815	40	10			
	COAST WATER WORKS	500-875	80-500	157		X	X
	ESCATAWPA	250-400	200-250	236	X	X	
	GULF COAST JR. COLLEGE	870	130	43		X	
	GULF COAST RESEARCH LAB.	570-1200	25-185	154			
	GULF PARK ESTATES	520-1060	150-350	73	X	X	
	MARTIN BLUFF W A	730-850	100-500	137	X	X	
	MOSS POINT	800-890	300-700	1,694	X	X	
	NORTHWOOD UTILITY CO.	700	250	294	X	X	
	OCEAN SPRINGS	500-880	85-400	881	X	X	
	PASCAGOULA	300-800	200-840	4,500	X	X	
	PASCO UTILITY	775	300	32		X	
	POINT PORTEAUX	850	100	.2			
	SEASHORE UTILITY	760-840	100-300	275	X	X	
	ST. ANDREWS	630-710	350	34	X	X	
	SUBURBAN UTILITY	500-1200	400-500	125	X	X	
	TUCKER PARK	800	35	13			
	WESTGATE UTILITY	760	275	20		X	
	SELF-SUPPLIED INDUSTRY	230-950	50-1750	9,446	X	X	X
JEFFERSON	FAYETTE	265	350	304	X		
	LORMAN	275-375	125	37	X	X	
	UNION CHURCH W A	540	200	11	X	X	
	SELF-SUPPLIED INDUSTRY	550	55	26			
JEFFERSON DAVIS	BASSFIELD	400	100-200	32	X	X	
	CARSON	380	200	15	X	X	X
	DOUBLE POND W A	300	200	116	X	X	
	GOOD HOPE W A	400	250	72		X	
	LILY ROSE W A	800	200	22	X	X	
	LOWLAND W A	450	150	26	X	X	
	NORTHEAST JEFF DAVIS W A	340	500	116	X	X	
	PRENTISS	200-260	360-500	170	X	X	X
	SELF-SUPPLIED INDUSTRY	220	250	150	X	X	
JONES	CALHOUN W A	500	100	128	X	X	X
	ELLISVILLE	550	400-600	700	X	X	X
	ELLISVILLE STATE SCHOOL	550	300-400	280			
	ERRATA W A	300	175	26		X	
	GLADE W A	450-530	75-220	156	X	X	X
	GREATER LAUREL UTILITY	360	60-130	4		X	
	HATTEN W A	480	150	39		X	
	J & P W A	770	200-240	123		X	
	LAUREL	320-500	250-600	6,861	X	X	X
	MATTHEWS-MOSS W A	340-400	85-250	37	X		
	MOZELLE W A	720-750	150	74	X	X	
	MYRICK-MILL CREEK W A	350	165	96			X
	OAK GROVE W A	670	170	33		X	
	PLEASANT RIDGE COMMUNITY W A	400	250-300	165	X	X	
	POWERS W A	385	200-225	95			X
	SANDERSVILLE	130-180	110-250	70	X	X	X
	SHADY GROVE W A	370	160	77	X	X	X
	SHARON W A	230-250	175-200	85		X	
	SOSO COMMUNITY WATER SUPPLY, INC.	405-470	160-180	67	X		X
	SOUTHWEST JONES W A	900	220	131		X	
	UNIVERSITY UTILITIES	330	80-470	110		X	
	WATER ASSOCIATION OF PINE	675	125	29		X	X
	SELF-SUPPLIED INDUSTRY	175-1070	35-1600	9,646	X	X	X
LAMAR	ARNOLD LINE W A	780	150-250	89	X	X	X
	BASS MEMORIAL ACADEMY	200-500	40	53	X		
	BAXTERVILLE	200	180	10	X	X	
	LAMAR PARK W A	715	300	85		X	X
	LUMBERTON	875	460-750	161	X	X	X
	NORTH LAMAR W A	175	150-200	87		X	X
	NORTH LUMBERTON W A	650	215	34		X	
	PROGRESS COMMUNITY UTILITY	960	200	27		X	
	PURVIS	985	760	155	X	X	X
	SUMRALL	380	80-250	110	X	X	X
	WEST LAMAR W A	430	500	229		X	
	SELF-SUPPLIED INDUSTRY	900	260-800	3,144			
LAWRENCE	JAYESS-TOPEKA-TILTON W A	200	350	84		X	
	LAWRENCE COUNTY W A	865	150	49	X	X	
	MONTICELLO	900	150-400	221	X	X	X
	NEW HEBRON	360	185	47	X		X
	SILVER CREEK	800	115	32	X	X	X
	SONNTAG & WANILLA W A	840	200	32		X	X
	SELF-SUPPLIED INDUSTRY	260-930	250-300	290	X	X	X
LINCOLN	BOGUE CHITTO W A	640	225	30	X	X	X
	BROOKHAVEN	480-1200	250-570	[a]800	X	X	X
	LINCOLN COUNTY RURAL W A	410	500	237	X	X	X
	RUTH W A	420	150	16	X		
MARION	BUNKER HILL W A	540	150	34		X	X
	CEDAR GROVE - HARMONY W A	790	50	33	X	X	
	COLUMBIA	140	850-1000	700	X	X	X
	COLUMBIA TRAINING SCHOOL	430	150-265	127		X	
	COMMUNITY W A	1040	100	11	X	X	X
	FOXWORTH	715	110	47	X	X	X
	GOSS W A	160	150	22	X	X	
	HIGHWAY 98 EAST W A	960	150	24	X	X	
	HUB W A	1000	200	26	X	X	
	LAMPTON W A	195	300	60	X	X	
	MORGANTOWN W A	170	125	15	X		
	MT. GILEAD - IMPROVE W A	390	200	86			
	SELF-SUPPLIED INDUSTRY	210-540	100-700	409	X	X	
PEARL RIVER	CENTER W A	1140	350	37		X	X
	DERBY W A	1100	150	14		X	
	HIDE-AWAY LAKE	1000	250	7		X	
	PEARL RIVER CENTRAL W A	660-860	150-250	110		X	
	PICAYUNE	1050-1350	750-1000	862	X	X	X
	POPLARVILLE	550-1200	200-500	360	X	X	X
	SUNNY OAK W A	1000	150	50		X	
	SELF-SUPPLIED INDUSTRY	400-850	600-1000	1,458	X		
PERRY	BEAUMONT	575	75	170			
	NEW AUGUSTA	700-1100	50-200	40	X	X	X
	NORTHEAST PERRY COUNTY UTIL. ASSOC.	520	180	49		X	
	RICHTON	660-740	300-500	160	X	X	X
	SELF-SUPPLIED INDUSTRY	600-750	20-200	333	X		
PIKE	FRIENDSHIP W A	600	220	57	X	X	X
	HOMESTEAD W A	670-1300	180-200	75	X	X	X
	MAGNOLIA	700	1000	645	X	X	X
	MCCOMB	600	650-1000	2,193	X	X	X
	NORTH STREET W A	760	165	15	X	X	X
	OSYKA	170-230	200-250	102	X	X	X
	PERCY QUINN STATE PARK	230	120	[a]50			
	SUMMIT	560	530	[a]120	X		X
	SUNNYHILL W A	830	200	22	X	X	
	SELF-SUPPLIED INDUSTRY	300-700	150-350	278	X	X	
RANKIN	PINEY WOODS SCHOOL	300	100-150	50			
SIMPSON	BOGGAN RIDGE W A	260-630	120-400	92		X	
	D'LO	260	120	55	X	X	
	HARRISVILLE W A	320	150	28	X	X	
	HIGHWAY 28 W A	200	200-225	92	X	X	X
	MENDENHALL	350	300-400	172	X	X	X
	NEW HOPE W A	260	240	79	X	X	X
	POPLAR SPRINGS WATER DISTRICT	250-500	150-270	46	X	X	X
	TOUCHSTONE W A	425	155	32	X	X	X
	SELF-SUPPLIED INDUSTRY	400-540	135-350	130	X	X	
SMITH	MIZE	425	175	30	X	X	
	TAYLORSVILLE	250-350	75-500	698	X	X	
	SELF-SUPPLIED INDUSTRY	400	120	70			
STONE	BOND UTILITY CO.	900	300	32	X	X	
	MCHENRY UTILITY ASSOC.	900	300	26	X	X	X
	NEW ZION UTILITY W A	950	200	27	X	X	X
	PERKINSTON JUNIOR COLLEGE	950	400	500	X		
	WIGGINS	400-1300	300-1000	435	X	X	X
	SELF-SUPPLIED INDUSTRY	990	700	337	X	X	X
WALTHALL	DEXTER W A	420	110	14	X	X	
	IMPROVE W A	400	350	51	X	X	
	LEXIE W A	380	250	78		X	
	TYLERTOWN	350	100-700	200	X	X	X
	SELF-SUPPLIED INDUSTRY	160-570	30-500	1,104	X	X	X
WAYNE	CLARA W A	340	65	69	X	X	X
	WHISTLER W A	210	300	48		X	X
	SELF-SUPPLIED INDUSTRY	200-600	50-335	251	X		X
WILKINSON	BUFFALO W A	500	150	58	X	X	X
	CROSBY	650-830	300-400	156	X	X	X
	WOODVILLE	930-1600	200-600	235	X	X	X

[a] WITHDRAWAL FROM MIOCENE AQUIFERS ONLY; PART OF SUPPLY IS OBTAINED FROM OTHER AQUIFERS.

To convert English units to International System units

Multiply	By	To obtain
feet(ft)	0.3048	metres(m)
miles(mi)	1.609	kilometres(km)
square miles(mi^2)	2.590	square kilometres(km^2)
gallons per minute(gal/min)	.06309	litres per second(l/s)
million gallons per day (Mgal/d)	.044	cubic metres per second(m^3/s)
feet per mile(ft/mi)	.189	metres per kilometre(m/km)
gallons per minute per foot of drawdown[(gal/min)/ft]	.21	litres per second per metre [(l/s)/m]
cubic feet per day per square foot[$(ft^3/d)/ft^2$]	.305	cubic metres per day per square metre[$(m^3/d)/m^2$]
cubic feet per day per foot [$(ft^3/d)/ft$]	.093	cubic metres per day per metre [$(m^3/d)/m$]

THE MIOCENE AQUIFER SYSTEM IN MISSISSIPPI

Roy Newcome, Jr.

1975

JACKSON, MISSISSIPPI

Cartography by Frances M. Hester