Water Resources of Lee County, Mississippi

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1899-B

Prepared in cooperation with the Tombigbee River Valley Water Management District

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By B. E. WASSON *and* F. H. THOMSON

CONTRIBUTIONS TO THE HYDROLOGY OF THE UNITED STATES

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GLOSSARY

Aquiclude. Rocks that will not transmit water fast enough to furnish an appreciable supply for a well or spring.

Aquifer. Rocks that contain and transmit water and thus will yield water to wells.

Artesian water. Ground water that is under sufficient pressure to rise above the level at which it is encountered by a well—does not necessarily rise to or above the surface of the ground.

Coefficient of permeability (field). The rate of flow of water, at the prevailing water temperature, in gallons per day, through a cross-sectional area of 1 square foot under a hydraulic gradient of 100 percent. Obtained by dividing coefficient of transmissibility by aquifer thickness.

Coefficient of storage (of an aquifer). The volume of water released from or taken into storage per unit surface area of the aquifer per unit change in water level (a dimensionless decimal fraction).

Coefficient of transmissibility. The rate of flow of water, at the prevailing water temperature, in gallons per day, through a vertical strip of the aquifer 1 foot wide extending the full saturated thickness of the aquifer under a hydraulic gradient of 100 percent.

Dip. The largest acute angle that a rock stratum makes with a horizontal plane. Its direction is at a right angle to the direction of strike of the bed.

Dissolved solids. The amount of residue on evaporation to dryness does not coincide completely with the amount of original material in solution, but the term "residue" is generally used synonymously with dissolved solids. Residue on evaporation includes organic matter and some water of crystallization. Few industrial processes can tolerate water containing more than 1,000 mg/l dissolved solids.

Drawdown. The lowering of the water table or artesian water level caused by pumping.

Evapotranspiration. The process which returns water as vapor to the air either through direct evaporation or through transpiration by vegetation; no attempt is made to distinguish between the two.

Fluoride (F). Most natural water contains a little fluoride. U.S. Public Health Service drinking water standards recommend that fluoride concentrations not exceed 1.0 mg/l in areas that have average maximum daily temperatures in the range experienced at Tupelo. Fluoride in large amounts may cause mottling of children's teeth; however, water having about 1 mg/l of fluoride may substantially reduce tooth decay in children who have used the water during calcification of their teeth.

Hardness. In the development of a water supply, hardness is one of the most important single factors to be considered. It is caused principally by the calcium and magnesium in solution and is generally reported as the calcium carbonate equivalent. Hardness is usually recognized in water by the increased quantity of soap required to make a permanent lather. Water having a hardness of 60 mg/l or less is soft; 61–120 mg/l is moderately hard; and more than 120 mg/l is hard.

Hydraulic gradient. The difference in elevation of the water level at two points divided by the distance between the points.

Hydrogen-ion concentration (pH). The pH is a measure of the activity of hydrogen ions in solution. A pH of 7.0 indicates a neutral solution. Values progressively lower than 7.0 denote increasing acidity, and those above 7.0 denote increasing alkalinity. As the pH increases, the corrosiveness of the water normally decreases, although excessively alkaline water may be corrosive to some metal surfaces. The pH has an important bearing on the utility of the water for many industrial purposes.

Hydrologic cycle. A convenient term to denote the circulation of water from the sea, through the atmosphere, to the land; and thence, with many delays and short circuits, back to the sea.

Infiltration. The movement of water through the soil surface into the ground.

Iron (Fe). Iron is dissolved from practically all rocks and soils, and nearly all natural water contains some iron. Water having a low pH tends to be corrosive and may dissolve iron in objectionable quantities from pipes. When iron-bearing water is exposed to air, iron precipitates and forms an insoluble hydrated oxide which causes reddish-brown stains on fixtures and on clothing washed in iron-bearing water. In large amounts, iron imparts a taste and makes water unsuitable for manufacture of food, paper, ice, and other products used in food processing. U.S. Public Health Service standards set a limit of 0.3 mg/l Fe and 0.05 mg]l Mn in water used for interstate carriers. Iron can be removed by aeration, precipitation, and filtration; by precipitation during removal of hardness; or by ion exchange.

Permeability. The ability of a rock or earth material to transmit water in response to head differences.

Piezometric surface. The surface that everywhere coincides with the level to which the water from a given artesian aquifer will rise in wells.

Recharge. The processes by which water is added to an aquifer.

Runoff (average annual, in inches). The depth to which the drainage area would be covered if all the runoff for an average year were uniformly distributed on it.

Specific capacity (of a well). The discharge expressed as rate of yield per unit of drawdown; in this report it means the gallons per minute per foot of drawdown at the end of one day of pumping. The specific capacity of a 100-percent efficient well can be calculated if the transmissibility and storage coefficient are known.

Specific conductance (micromhos at 25°C). Specific conductance is a measure of the ability of water to conduct an electric current, and it furnishes a rough measure of the mineral content of the water. It gives no indication of the relative quantities of the different constituents in solution, but is useful in estimating total mineral content of water. Dissolved-solids content of water in Lee County is usually 0.55–0.75 of the specific-conductance reading.

Strike. The direction of the line formed by the intersection of a rock surface with a horizontal plane.

Water table. The upper surface of the zone of saturation except where that surface is formed by an impermeable body.

CONTRIBUTIONS TO THE HYDROLOGY OF THE UNITED STATES

WATER RESOURCES OF LEE COUNTY MISSISSIPPI

By B. E. Wasson and F. H. Thomson

ABSTRACT

Lee County has sufficient water-supply potential to meet foreseeable needs. Many sites having favorable topographic and geologic conditions are available for surface reservoir construction. The mean annual runoff exceeds 1,000 acre-feet of water for each square mile of drainage area. Wisely managed, the water resources of the county can support further economic growth in the area.

Water use in the Tupelo area, near the center of the county, was about 7 mgd (million gallons per day) in 1967. This was supplied by withdrawals from the Eutaw and Gordo Formations, the area's two major aquifers. In recent years the increased use of water has caused water levels to decline 3–5 feet annually near the center of this heavy withdrawal area. Withdrawal of ground water in the Tupelo area could probably be doubled, but loss of artesian conditions would result.

There is limited potential for artificial recharge of aquifers in Lee County. In the northeastern part of the county, additional recharge to the Coffee Sand could be induced by constructing reservoirs in the outcrop area. Transfer of water from the Coffee Sand to the underlying Eutaw Formation is already occurring through the many open-hole wells in the area. The feasibility of constructing recharge wells in the Eutaw and Gordo aquifers in the vicinity of Tupelo should be further investigated.

The natural quality of the water in the streams and aquifers of Lee County is generally good, and the water is suitable for domestic, industrial, and agricultural uses.

INTRODUCTION

PURPOSE AND SCOPE

This report discusses the findings of a 2-year investigation of the water resources of Lee County, Miss., made by the U.S. Geological Survey in cooperation with the Tombigbee River Valley Water Management District. All sources of water supply in the county were appraised in order to provide water users and water managers with the information needed by them to make sound decisions concerning their water supplies and the water resources of the area. The study was undertaken because the community leaders recognized the need to locate and plan for the development of additional water supplies to meet the future needs of the area. Particular emphasis was given to analyzing the quantity of ground water available in the Tupelo area, where use by municipal and industrial systems is already high and where water-level declines have been greatest (fig. 1).

PREVIOUS INVESTIGATIONS

Several reports on the natural resources of Lee County and surrounding areas of northeastern Mississippi have been primarily concerned with geology. The geologic reports most applicable to Lee County are "The Upper Cretaceous Deposits" (Stephenson and Monroe, 1940); "General Geology of the Mississippi Embayment" (Cushing and others, 1964); "Prentiss County Geology" (Parks, 1960); and "Lee County Mineral Resources" (Vestal, 1946).

Reports in which ground-water hydrology in Lee County has received more than cursory treatment are "Ground Water Resources of Mississippi" (Stephenson and others, 1928); "Public and Industrial Water Supplies in a Part of Northern Mississippi" (Lang and Boswell, 1960); "Cretaceous Aquifers of Northeastern Mississippi" (Boswell, 1963); and "Cretaceous Aquifers in the Mississippi Embayment" (Boswell and others, 1965). In a report, "Available Water for Industry—Clay, Lowndes, Monroe, and Oktibbeha Counties, Mississippi" (Wasson and others, 1965), on the area south of Lee County, emphasis was placed on the quantity of water available. The most recent ground-water report, "Memorandum on the Ground-Water Resources of the Natchez Trace Parkway Headquarters Area, Lee County, Mississippi" (Thomson, 1967), describes in detail the aquifers available at that site.

Three reports contain information on Lee County surface water. These are "Low-Flow Measurements at Selected Sites on Streams in Mississippi" (Skelton, 1961), "Low-Flow Characteristics, Tombigbee River Basin, Mississippi" (Golden, 1962), and "Low-Flow Characteristics of Streams in the Mississippi Embayment in Mississippi and Alabama" (Speer and others, 1964). Records of stream-gaging stations in and near Lee County are included in the U.S. Geological Survey Water-Supply Paper series "Surface-Water Supply of the United States."

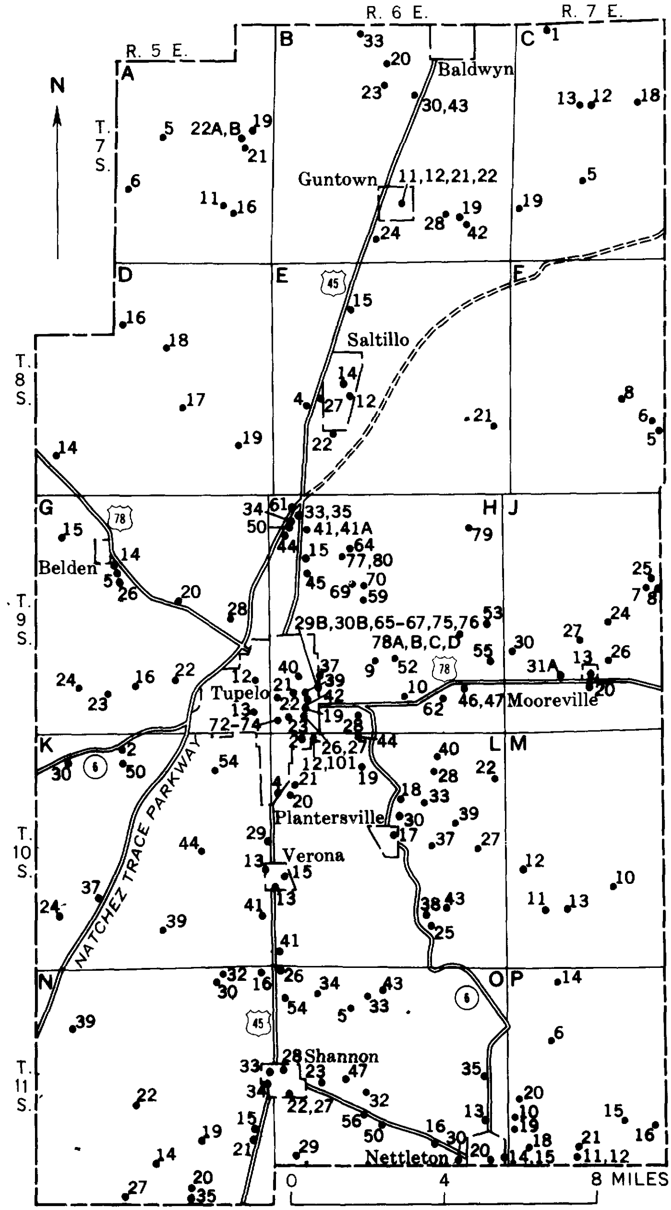

FIGURE 1.—Selected well locations in Lee County. (Wells are numbered independently within lettered grids.)

DESCRIPTION OF COUNTY

CULTURAL CHARACTER

The population of Lee County was 40,589 in 1960, and the population of Tupelo was 17,221. Tupelo (fig. 2) is the largest town in Lee County and bordering counties and has a large trade area. Practically all industry in Lee County—Lee is one of the most industrialized counties in the northern part of Mississippi—is located near Tupelo along two railroads which traverse the county north-south and northwest-southeast. Tupelo is the hub of both rail and highway transportation in the area.

Agriculture supplements the industrial economy of Lee County. A large acreage of row crops, principally cotton, soybeans, and corn, is grown mostly in the creek bottoms. Livestock raising is important throughout the county. Forest covers much of the eastern part of Lee County, but forestry contributes much less to the economy than either row crops or livestock.

DRAINAGE AND TOPOGRAPHY

Lee County is in the headwater area of the Mobile River basin. Approximately three-fourths of the county is drained through the West Fork of the Tombigbee River by tributary streams that include Town, Coonewah, and Chiwapa Creeks (fig. 2). The remainder of the county is drained by streams tributary to the Tombigbee River upstream from its junction with the West Fork Tombigbee River. These streams include Twentymile, Mantachie, and Boguegaba Creeks.

Streams in the county generally have broad flood plains, most of which have been cleared and are under cultivation. The stream channels have been straightened and widened to reduce flooding and to prevent stream meandering. Small streams in the sandy eastern part of the county have narrow, steep-sided wooded valleys.

Elevations in Lee County range from 200 feet along Town Creek at the southern boundary to slightly more than 500 feet on a few hilltops near the northeast corner of the county. Relief ranges from gentle to moderate. The greatest relief is in the sand hills in the northeast quarter of the county and along a ridge line that runs northwest from Shannon in the southern part of the county. Topographic maps of the county are available (fig. 2) with either 10-foot or 20-foot contour intervals.

CLIMATE

The county has a humid, subtropical climate. Precipitation is heaviest during winter and spring and lightest in autumn (fig. 3). Snow is not uncommon, but usually melts within a day or two. Droughts

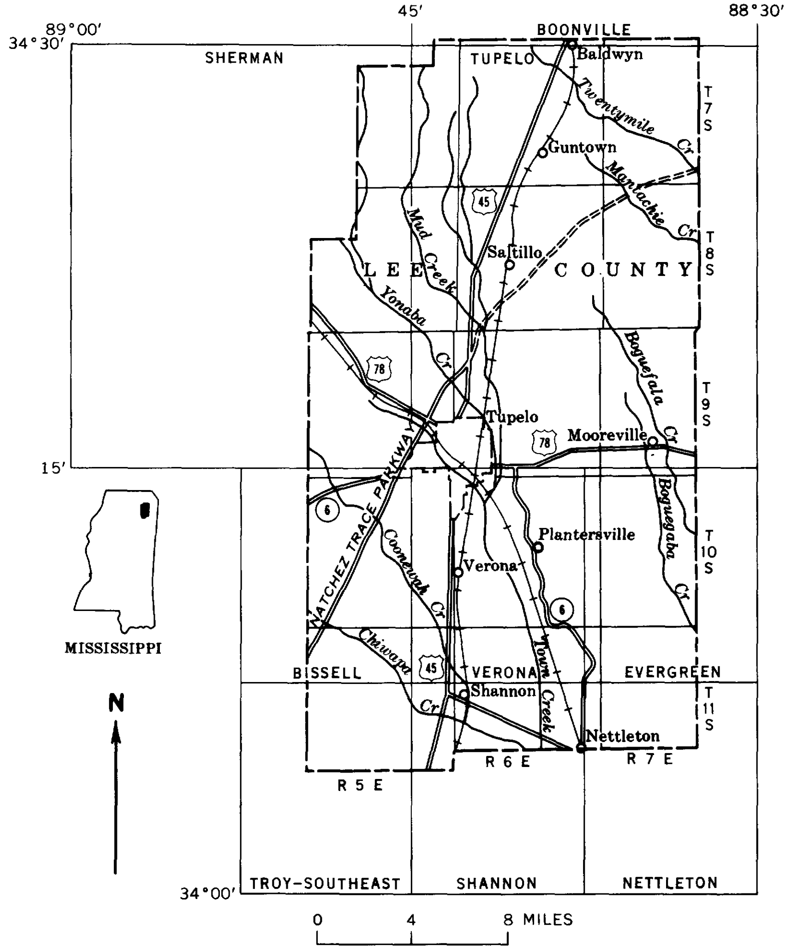

FIGURE 2.—Location, topographic-map coverage, and major drainage of Lee County.

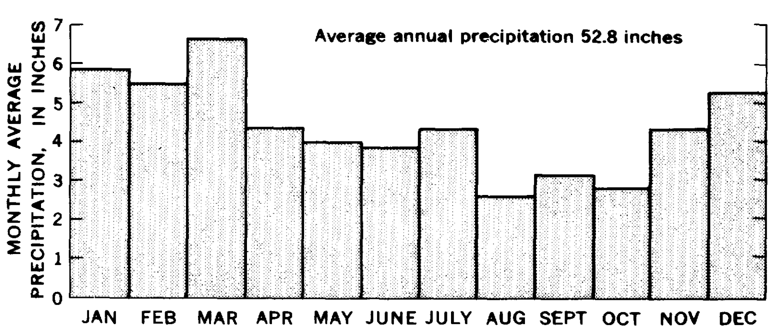

FIGURE 3.—Monthly average precipitation at Tupelo.

of 2-week duration often occur during late summer and autumn. Humidity frequently is above 85 percent.

The average annual air temperature is about 17°C (Celsius) (63°F), but temperatures during a normal year fluctuate between −11°C (12°F) and 38°C (100°F). Average monthly temperature (fig. 4) ranges from 6°C (44°F) to 28°C (82°F).

GEOLOGY

Unconsolidated and semiconsolidated beds of clay, shale, chalk, silt, sand, and gravel of Cretaceous age underlie the land surface of Lee County to depths of 400–1,100 feet. Underlying these strata are shale, sandstone, and limestone of Paleozoic age. The irregular contact between the beds of Cretaceous age and those of Paleozoic age dips 25–50 feet per mile to the southwest (figs. 5, 8). The Cretaceous beds dip 25–40 feet per mile to the west. The relative positions, depths, and characters of the sediments are shown in two geohydrologic sections of the county (figs. 6, 7). The principal aquifers are the Coffee Sand, Eutaw Formation, and Gordo Formation.

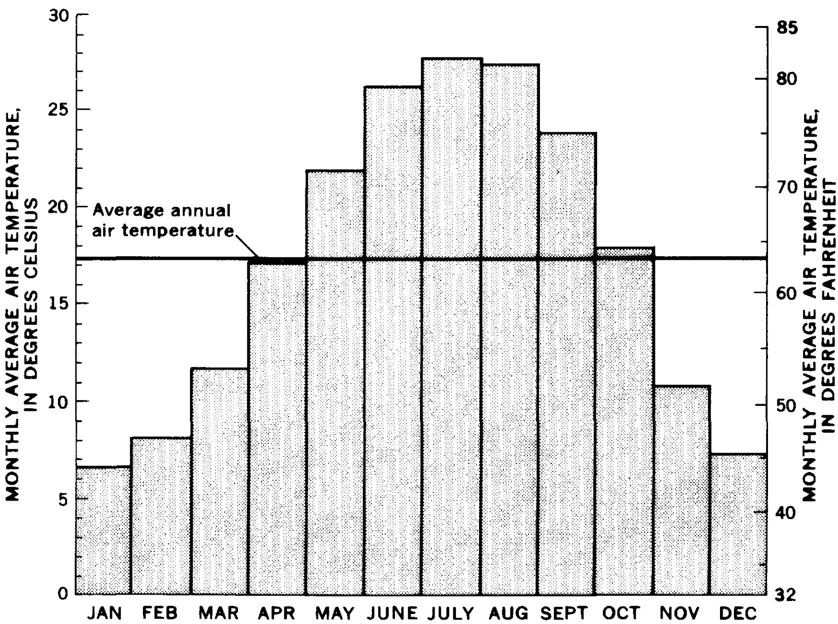

FIGURE 4.—Monthly average air temperature at Tupelo.

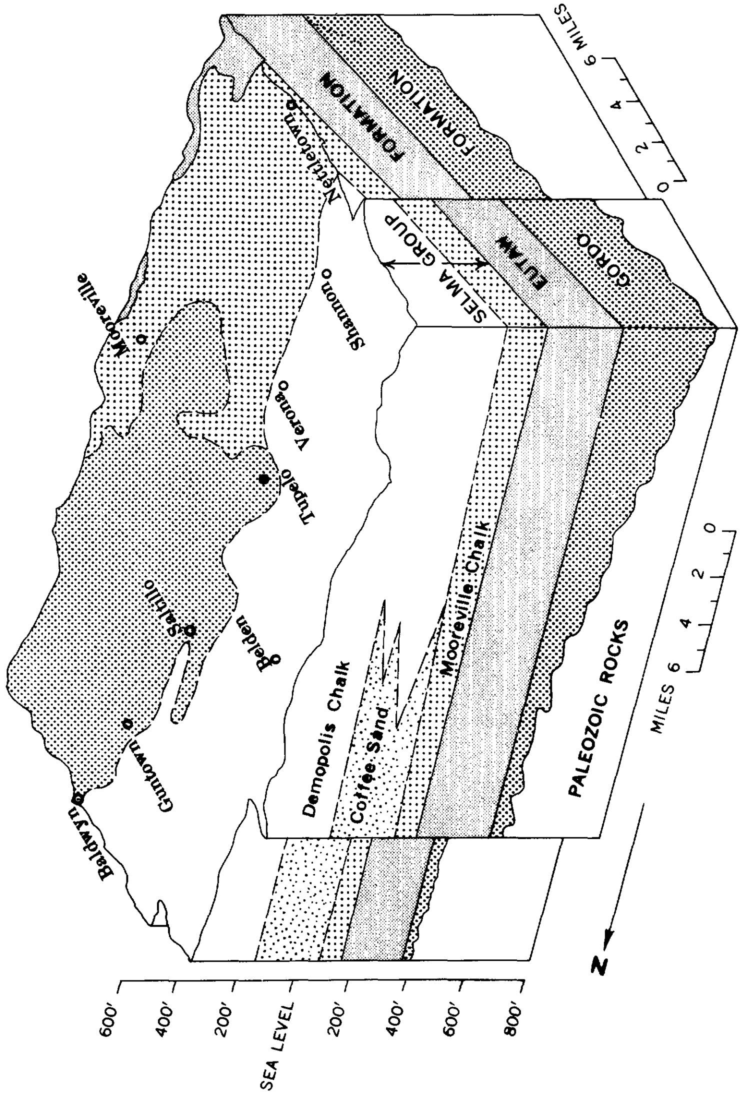

FIGURE 5.—Geologic block diagram of Lee County.

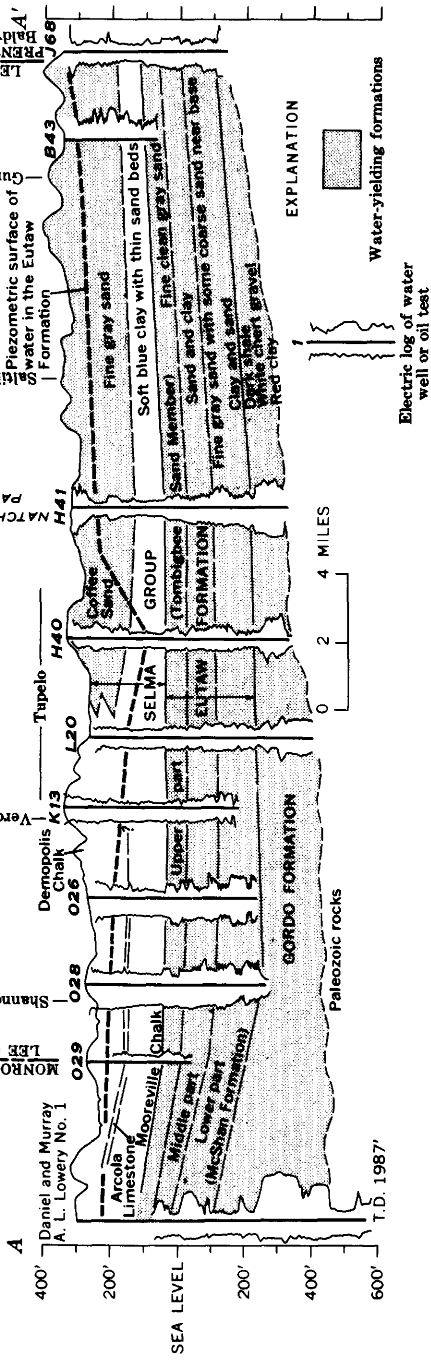

FIGURE 6.—Geohydrologic section A–A'—north-south through Tupelo

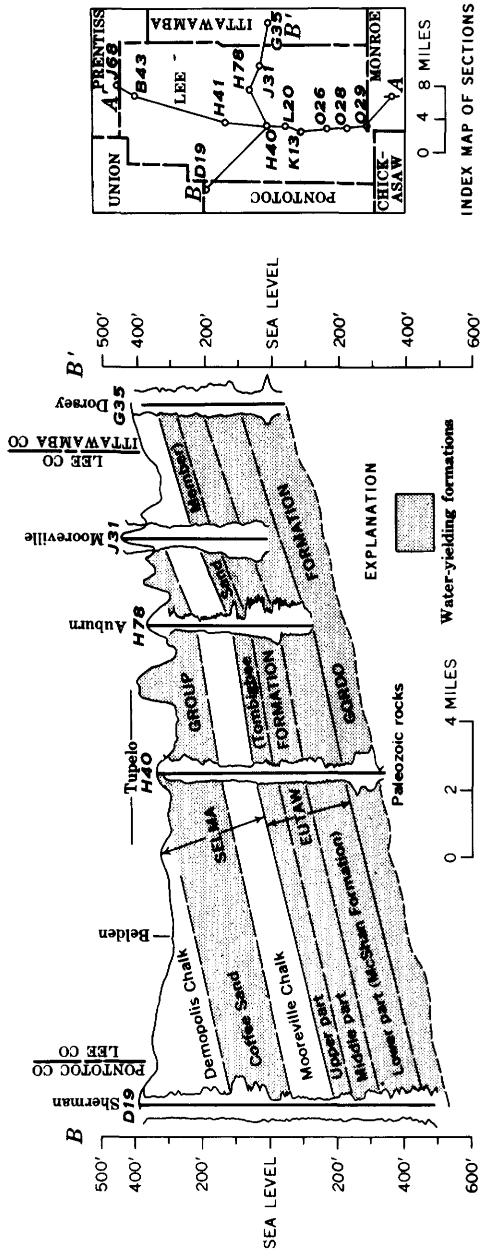

FIGURE 7.—Geohydrologic section B–B'—east-west through Tupelo.

WATER PROBLEMS

The principal water problems in Lee County are (1) decline of ground-water levels in the vicinity of Tupelo and (2) a general lack of dry-weather streamflow.

Ground-water levels have declined more than 150 feet at Tupelo since 1900. The rate of decline has increased in recent years because of increased pumping from the Eutaw and Gordo Formations, the only aquifers available at Tupelo.

Without storage, no stream in the county provides a year-round dependable water supply. All streams cease flowing during extreme droughts.

Flooding has been a problem in some areas in Lee County in the past, but recently-developed flood-control measures have greatly reduced this hazard.

Objectionable concentrations of iron in water from the Gordo Formation and fluoride in water from the Coffee Sand are problems in certain parts of the county. Water from many wells in the county is hard.

GROUND WATER

OCCURRENCE

All ground water pumped in Lee County is from beds of sand or gravel in the Coffee Sand, Eutaw Formation, or Gordo Formation. Ground water in Lee County occurs in the voids between grains of sand or gravel in the Cretaceous Formations and possibly in cracks in the weathered top of the hard Paleozoic rocks.

The Coffee Sand crops out in the eastern part of Lee County and dips gently to the west (fig. 8). It is slightly more than 200 feet thick in the northwestern part of the county. In the northern part of the county, beds of fine- to medium-grained sand constitute more than half of the Coffee Sand, but southward the unit contains progressively more silt, clay, shale, and chalk. South of Tupelo, the Coffee Sand loses its identity within the Selma Group (figs. 5, 6).

The Eutaw Formation is 250–290 feet thick in the central and southern parts of the county, but as thin as 200 feet in the northwestern part. Beds of fine- to medium-grained sand commonly account for more than half the thickness of the formation. The upper part of the Eutaw (Tombigbee Sand Member) usually consists of glauconitic fine-grained sand which includes layers of clay or shale in places. Sands in the middle part of the Eutaw generally are coarser and less glauconitic than those in the upper part. The lower part of the Eutaw (McShan Formation) commonly contains coarser sand than the upper units. Thin beds of pea-size gravel occur at the base of the Eutaw in many places.

The top of the Eutaw Formation is easily identified in most wells by drilling speed and drill cuttings; it is also easy to identify on electrical logs (figs. 6, 7). The Eutaw (fig. 8) dips about 30 feet per mile to the west. The Mooreville Chalk, an aquiclude, overlies the Eutaw. The basal sands of the Eutaw are, in places, in contact with sand and gravel of the underlying Gordo Formation.

The Gordo Formation is about 300 feet thick along the south edge of the county but thins rapidly to the north; at Tupelo, it is about 100 feet thick and in the northwestern part of the county it is only 20–40 feet thick. The top of the Gordo usually consists of tough pink clay, which is an aquiclude between the Eutaw and Gordo aquifers. The aquifers in the Gordo may consist of coarse white sand but more often are chert gravel and sand. Gravel beds in the Gordo commonly compose more than half of the formation.

Few test holes have been drilled into the Paleozoic rocks in Lee County. Data indicate that the Paleozoic rocks underlying Lee County will not yield large quantities of water. Present information indicates that water in the Paleozoic rocks is highly mineralized, except that from the weathered zone just beneath the Gordo Formation. Therefore, the top of the Paleozoic rocks may be considered the base of fresh water in Lee County (fig. 8).

Shallow alluvial deposits along some of the streams yield water by gravity drainage. These deposits contribute to base flow of streams, but they are too thin and narrow to be of importance as a source of water for wells.

QUANTITY

WATER USE

Total pumpage of ground water in Lee County is about 8 mgd (million gallons per day); all but about 1 mgd is used within 6 miles of Tupelo. Most early domestic water supplies in Lee County were from dug wells, springs, or cisterns. Ground-water levels in Lee County were generally unchanged until the first flowing wells were drilled about 1870. By 1920, several hundred flowing wells had been constructed along the streams. Flowing and pumping rates have been changing constantly since the first deep wells were drilled. Heavy pumpage was started at Tupelo by the city, the U.S. Fish Hatchery, and the Tupelo Oil and Ice Co. after 1900. Pumpage at Tupelo averaged about 1 mgd from 1900 to 1920, 2 mgd from 1920 to 1940, 3 mgd from 1940 to 1950, 4 mgd from 1950 to 1960, 5.5 mgd from 1960 to 1965, and 7 mgd in 1967. In 1967, the city of Tupelo pumped about 2 mgd from the Eutaw and 1 mgd from the Gordo. Industrial pumpage in Tupelo was 2.6 mgd from the Eutaw and 1.2 mgd from the Gordo (table 1).

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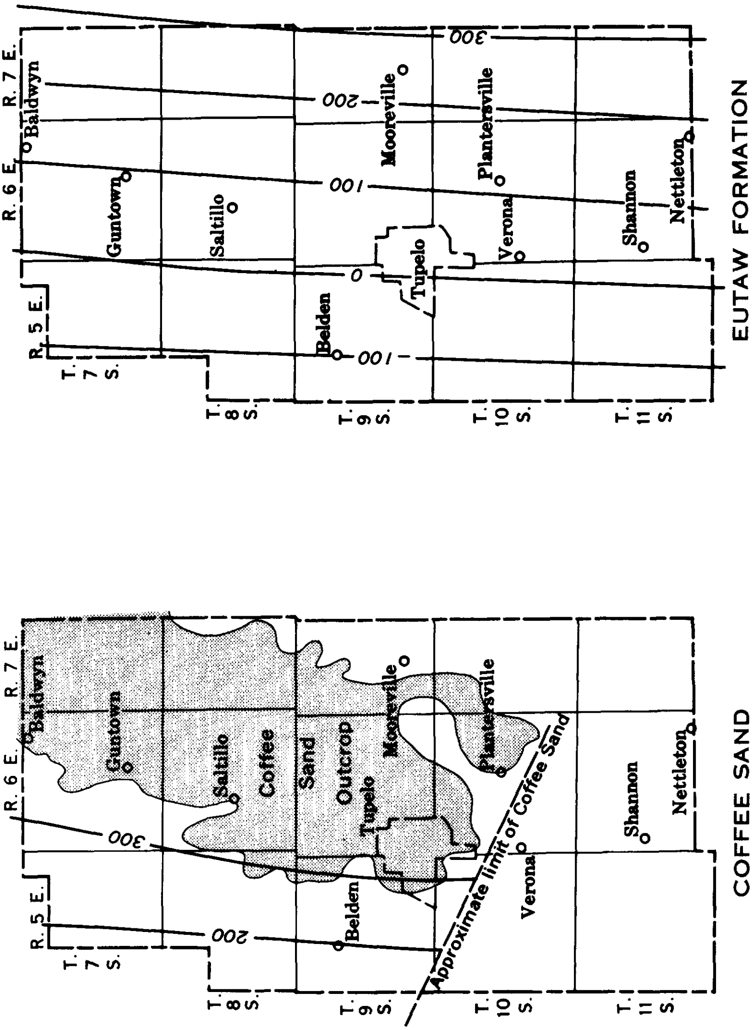
EUTAW FORMATION
R. 5 E.
R. 6 E.
R. 7 E.
T. 7 S.
T. 8 S.
T. 9 S.
T. 10 S.
T. 11 S.
Baldwyn
Guntown
Saltillo
Mooreville
Plantersville
Tupelo
Verona
Belden
Shannon
Nettleton
300
200
100
0
100
COFFEE SAND
Coffee Sand Outcrop
Approximate limit of Coffee Sand
300
200

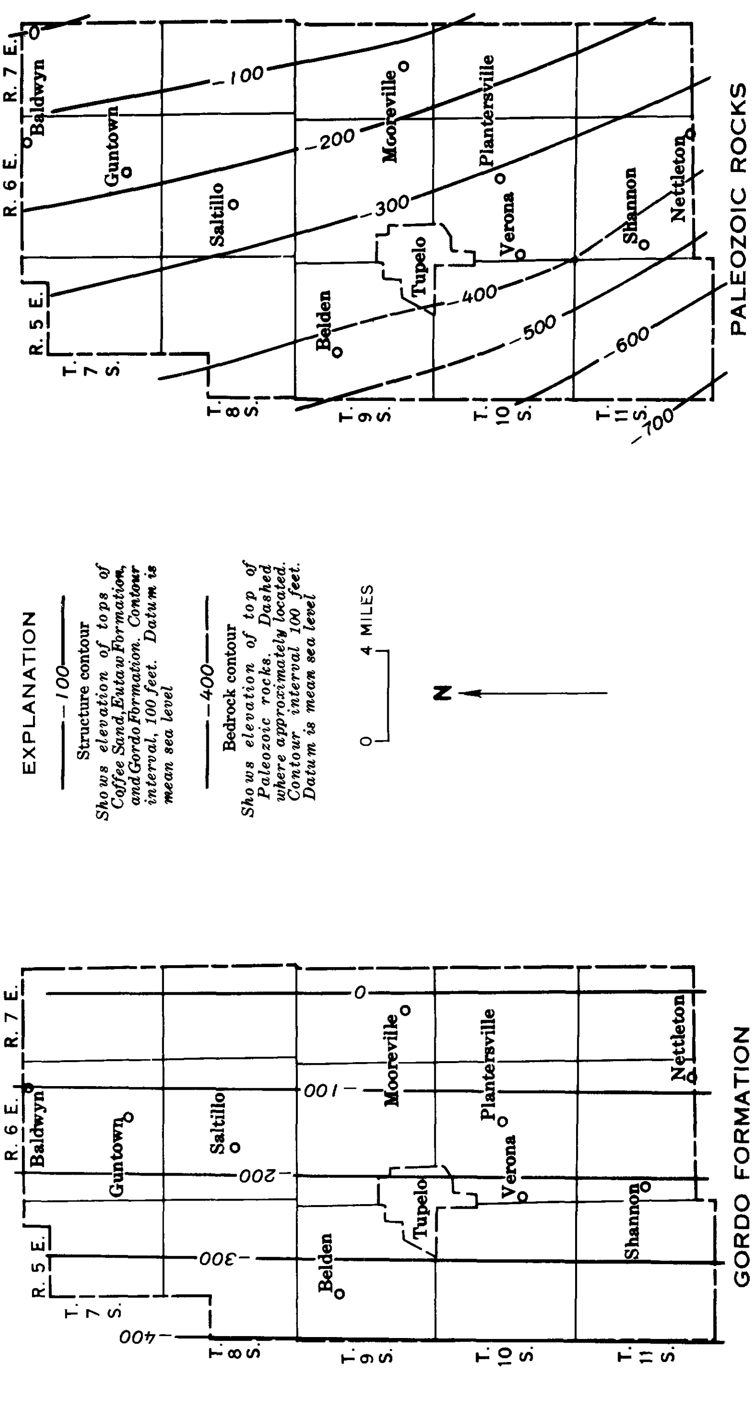

FIGURE 8.—Contours on the tops of the Coffee Sand, Eutaw Formation, Gordo Formation, and Paleozoic rocks

TABLE 1.—*Ground-water use, in millions of gallons per day, at Tupelo in 1967*

Owner and well	Pumpage by use		Pumpage by source		Total pumpage
	Municipal	Industrial (self-supplied)	Eutaw	Gordo	
City of Tupelo:					
G12 (Joyner Ave.)	0.5		0.5		0.5
G13 (West Main St.)					
H19 (Court St.)	.1		.1		.1
H28 (Lake St., East Tupelo)	.1		.1		.1
H39 (North Broadway)	.5		[1].3	[1]0.2	.5
H40 (North Church)	.5		.5		.5
H42 (Front St.)	.1			.1	.1
L2 (Elizabeth St.)	.2		.2		.2
L4 (Warrior Trail)	.5		[1].3	[1].2	.5
L19 (Eason Blvd.)	.5			.5	.5
Subtotal	3.0		2.0	1.0	3.0
Carnation Milk Co., H23		0.2	.2		.2
Tupelo Oil and Ice Co., H27		.2	.2		.2
Mid-South Packers, Inc., H29b, H-30b, H65–67		1.5	1.3	.2	1.5
Purnell's Pride, Inc., H72–74		.5	.5		.5
U.S. Fish Hatchery, L12, L101		.4	.4		.4
Pennsylvania Tire Co., L20, L21		1.0		1.0	1.0
Subtotal		3.8	2.6	1.2	3.8
Total	3.0	3.8	4.6	2.2	6.8

[1] Estimate.

The Tupelo-Lee Industrial Park south of Verona, which started operations in 1962, is the second largest water-using locality in Lee County, but in 1967 the average use was only 0.22 mgd. Three wells having a total pumping capacity of about 2 mgd are screened in the lower part of the Eutaw. During 1967, pumpage at the park nearly doubled that of 1966, and water use probably will continue to increase for several years.

There are several small public water supplies in and near Lee County (fig. 9). Baldwyn (0.16 mgd) and Nettleton (0.09 mgd) are the largest of these water users; combined water use of the remaining public and industrial water facilities is about 0.3 mgd. Most public water supplies outside Tupelo obtain water from the Eutaw Formation.

Rural water use, mostly for domestic purposes and livestock, is estimated to be 1 mgd and is obtained from the Eutaw Formation and the Coffee Sand. This use is rather uniformly distributed over the county. Several rural public water-supply systems are being built and will replace many of the domestic water wells. The new public water-supply systems will centralize pumping at fewer wells, but may not substantially increase pumpage.

AQUIFER CHARACTERISTICS

The coefficients of transmissibility and storage must be known to appraise the potential of an aquifer to yield water to a well, to a well field, or to a group of well fields. (See Glossary for definitions of technical terms.) Simply stated, transmissibility is a measure of the ease with which water moves through a vertical section of an aquifer, and the storage coefficient is a measure of the volume of water taken from or added to storage in a column of the aquifer in response to water-level changes. Coefficients of transmissibility and storage can be calculated from measurements of water-level changes accompanying pumping of wells. Aquifer coefficients calculated in this manner theoretically reflect the hydraulic conditions in a large sample of the aquifer. Hence, transmissibility divided by aquifer thickness normally gives a reliable appraisal of an aquifer's coefficient of permeability.

The coefficient of permeability of an aquifer can also be estimated from the coarseness of the sand in drill cuttings, the resistance on electrical logs, and the results of pumping tests of the aquifer at other places. If the thickness of the aquifer is known and the coefficient of permeability can be estimated, the coefficient of transmissibility can be approximated. Transmissibility can be used to predict the performance of wells and the capacity of an aquifer to transmit water from areas of recharge to areas of discharge.

Thirty pumping tests made in or near Lee County (table 2) and other tests made in the counties to the south (Wasson and others, 1965) permit an appraisal of the potential of the aquifers to transmit and store water. Transmissibility values were determined for each test, but coefficients of storage were determined at only a few sites where suitable observation wells were available. All the aquifers tested were artesian. Coefficients of storage for tests in the area average about 0.0002, which is indicative of artesian conditions. Coefficients of storage of water-table aquifers theoretically may be as high as 0.3.

For the 20 aquifer tests made in the Eutaw Formation, transmissibility values ranged from 1,500 to 17,000 gpd (gallons per day) per foot and averaged 8,000 gpd per foot. The coefficient of permeability for these tests ranged from 33 to 120 gpd per square foot and averaged 80 gpd per square foot. Average coefficient of permeability values for tests made in a five-county area south of Lee County was about 100 gpd per square foot for the Eutaw. Geologic correlations and aquifer testing indicate that the Eutaw is relatively uniform in thickness and composition in Lee County and surrounding areas. Only one of the 20 wells used in the Eutaw tests was screened throughout the full thickness of the water-bearing sand, and the aquifer test using this well gave the highest transmissibility value of any of the tests. Several of the wells were open (not cased or screened) through 40–60 feet of the water-bearing sands, and transmissibility in these beds of sand ranged from 1,500 to 6,000 gpd per foot. Transmissibility of the full thickness probably ranges from 8,000 to 20,000 and averages 15,000 gpd per foot.

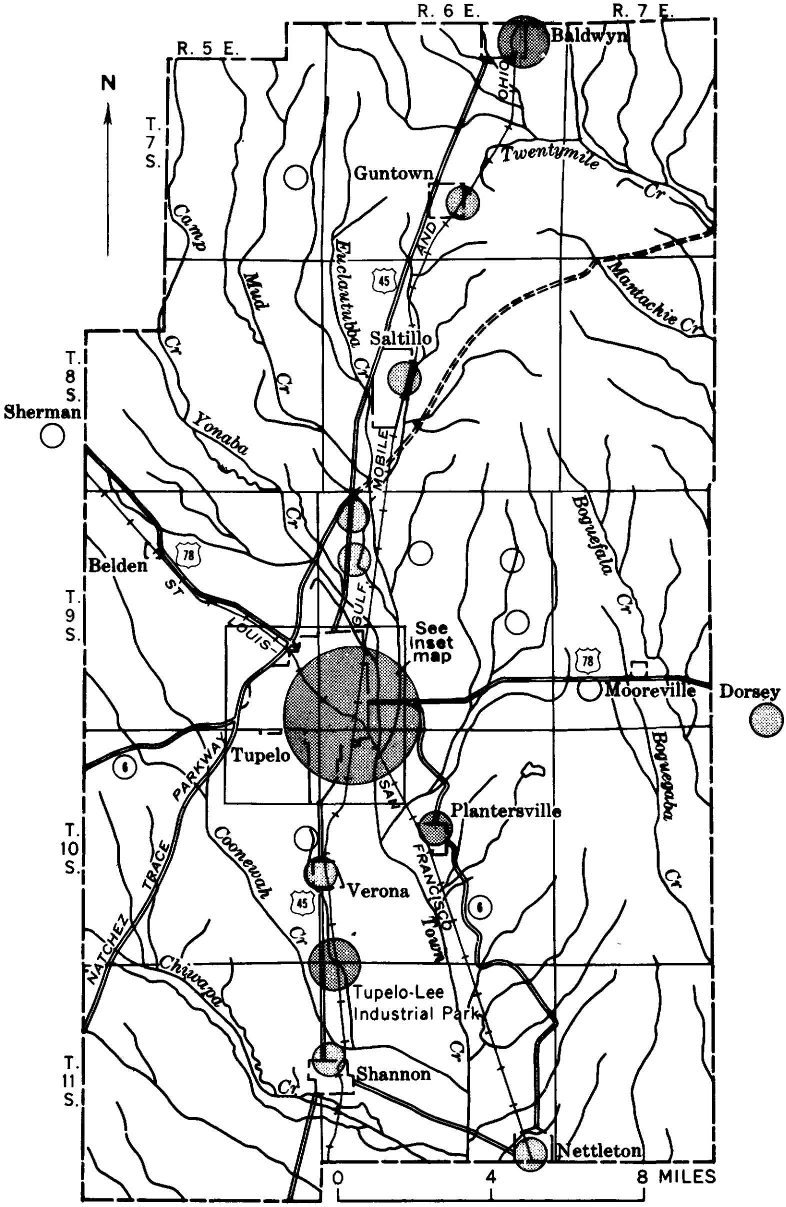

FIGURE 9.—Ground-water use.

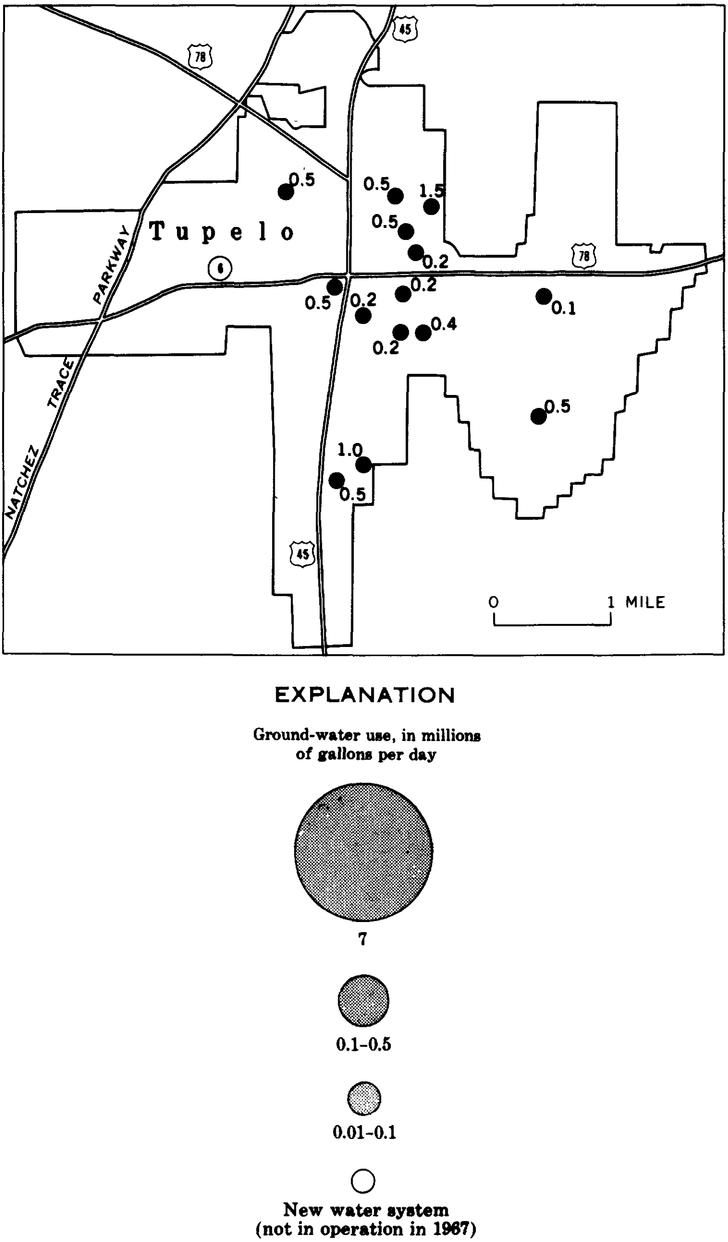

FIGURE 9.—Continued

TABLE 2.—*Aquifer tests in or near Lee County*

Well	Owner	Aquifer	Aquifer thickness (ft)	Production of well (gpm)	Specific capacity (gpm per ft at 24 hrs)	Transmissibility (gpd per ft)	Permeability (gpd per sq ft)	Coefficient of storage
Lee County								
A22a	Cedar Hill Water Association	Gordo	18	24	6	17,000	1,000	----------
A22b	do	Eutaw	40	18	.6	4,000	100	----------
B22	Town of Guntown	Gordo	70	225	5	7,000	100	----------
G12	City of Tupelo (Joyner Ave)	Eutaw	140	700	5.3	12,000	85	----------
H19	City of Tupelo (old water plant).	do	135	235	5	9,000	70	0.0004
H33	Natchez Trace Parkway	do	100	34	1.7	8,000	80	----------
H39	City of Tupelo (North Broadway).	Eutaw-Gordo.	140	500	6.2	16,000	110	----------
H41	Natchez Trace Parkway	Gordo	80	10	2.2	6,300	80	----------
H41a	do	Eutaw	100	100	2.4	8,000	80	----------
H42	City of Tupelo (at new reservoir).	Gordo	60	360	1.5	5,000	83	----------
H78a	Auburn Water Association	Eutaw	100	16	2.2	5,000	50	----------
H78b	do	do	44	13	.7	1,500	34	----------
H78c	do	Gordo	39	12	.5	1,000	26	----------
H79	Lake Piomingo	Eutaw	150	24	1.5	5,000	33	----------
H80	North Lee Water Association.	do	90	235	3.6	9,000	100	----------
L2	City of Tupelo (Elizabeth St.).	do	190	330	6.2	17,000	90	----------
L4	City of Tupelo (South Green St.)	Eutaw-Gordo.	158	630	17	35,000	220	----------
L18	Jim Williams	Eutaw	60	10	1.5	4,000	70	----------
L19	City of Tupelo (Eason St.)	Gordo	60	515	15	35,000	580	----------
L21	Pennsylvania Tire Co	do	40	726	5.1	19,000	500	.00003
L41	Tupelo-Lee Industrial Park (north well).	Eutaw	107	585	3.8	11,000	100	----------
N16	Tom Dupree	do	90	9	3	7,000	80	----------
O14	Town of Nettleton	Gordo	50+	83	18	180,000	3,600	----------
O15	do	Eutaw	75	253	2.3	6,000	80	----------
O28	Town of Shannon	do	120	150	2.9	8,000	65	----------
O54	Tupelo-Lee Industrial Park (south well).	do	100	585	4.4	11,000	110	----------
O56	Clinton Edge	do	40	9	.8	2,000	50	----------
Itawamba County								
G35	Dorsey Water Association	Eutaw	100	170	3.9	10,000	100	----------
Prentiss County								
J22	Town of Baldwyn	Eutaw	50	300	3	6,000	120	----------
J68	do	do	80	236	3.7	10,000	120	----------

The Gordo Formation has a much wider range of transmissibility and permeability than the Eutaw Formation. Seven tests of wells screened in the Gordo ranged in transmissibility from 1,000 to 180,000 gpd per foot. The 180,000 value was in the southern part of the county at Nettleton, where the formation is thickest. The other six tests were in the central and northern parts of the county and had an average transmissibility of 14,000 gpd per foot; the highest of these six transmissibilities was 35,000 gpd per foot. Transmissibility of the Gordo Formation probably ranges from 1,000 to 50,000 gpd per foot in the central and northern parts of Lee County and from 20,000 to 300,000 gpd per foot in the southern third of the county.

No aquifer tests were made in the alluvial deposits along the streams, in the Coffee Sand, or in the Paleozoic rocks. The alluvial sediments are rather permeable at places but are not thick enough to be of importance as aquifers. The upper part of the Paleozoic rocks may be sufficiently permeable because of weathering, fractures, or character of the sedimentary rocks to yield small quantities of water to wells. The Coffee Sand is extensively used for domestic water supplies, but no large-capacity wells tap this aquifer system in Lee County. In the northern part of the county, beds of sand in the Coffee Sand may have an aggregate thickness of 100 feet, and permeability probably is as high as 100 gpd per square foot in beds of coarser sand. Southward, the beds become thinner and the sand finer, and south of Tupelo the permeability is so low that it is not possible to construct a domestic well in the aquifer.

WELL YIELDS

RELATION OF WELL YIELDS TO AQUIFER CHARACTERISTICS

The coefficients of transmissibility and storage and the rate of discharge determine the water-level change caused by pumping a particular well. The effect of pumping is greatest in the pumped well, and the water-level decline is progressively less with increasing distance from it. Water-level decline increases with time, but at an ever-decreasing rate.

A graph that relates drawdown effects to time, distance, and discharge for selected aquifer characteristics (fig. 10) is useful in planning pumping rates and well spacing. This graph is applicable to aquifers in the area; however, it should be used with caution, because all the limiting conditions set out for the theoretical model are seldom met (Wenzel, 1942).

If the transmissibility value for an artesian aquifer is divided by 2,000, it provides an approximate value for the specific capacity to be expected of a fully efficient 12-inch-diameter well that penetrates the entire aquifer. Production of the well, in gallons per minute, divided by the theoretical specific capacity, in gallons per minute per foot of drawdown, gives the drawdown to be expected. The drawdown in a less than fully efficient well will be greater.

Based on aquifer transmissibility, the specific capacities of fully penetrating and properly-completed wells in the Eutaw would average about 7 gpm (gallons per minute) per foot of drawdown; specific capacities of wells in the Gordo would range from 0.5 to 25 in the central and northern parts of the county and would be as much as 150 gpm per foot of drawdown on the south edge of Lee County.

380-726 O—70——4

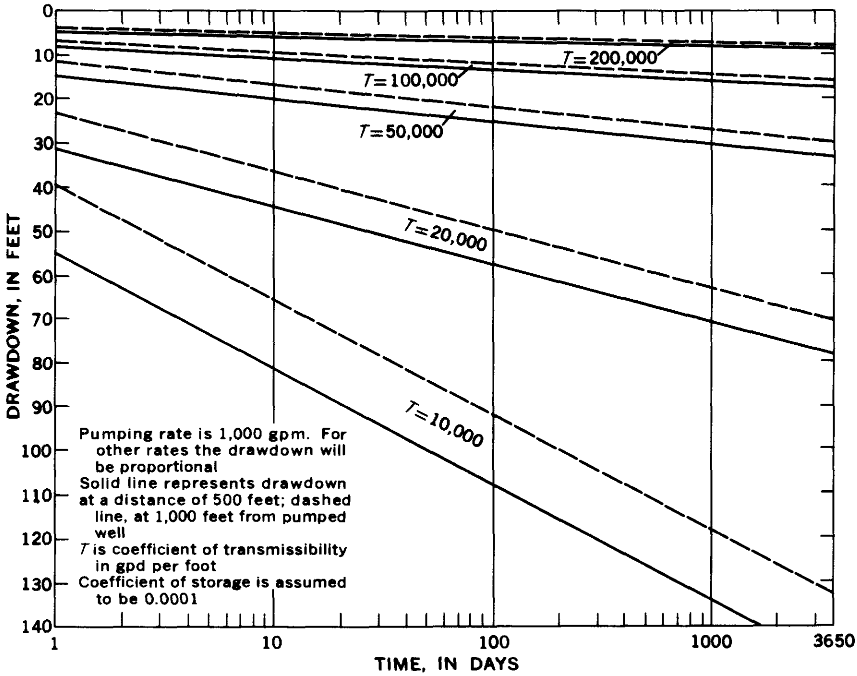

FIGURE 10.—Theoretical time-drawdown relation for aquifers.

RELATION OF WELL YIELDS TO WELL CONSTRUCTION

Construction factors which affect well yield are diameter, length, size of openings, and percentage of open area of screen; diameter and length of casing; pump and motor capacity; pumping head; and development (washing) of aquifer next to screen (table 3). In an efficient well, the water flows freely from the aquifer to the inside of the well screen with little pressure drop. The correct screen and proper development insure an efficient well. The larger the diameter of the screen and the higher the percentage of aquifer screened, the higher the specific capacity of the well. Measuring the specific capacity is a better way of judging a well than measuring yield only. Specific capacities of several typical wells in Lee County may be found in table 2, and theoretically possible specific capacities at several localities are given in table 9. Many wells in the county are fully efficient—observed specific capacities equal the theoretically possible specific capacities.

The open-hole domestic wells common in Lee County usually are efficient, because there is no screen entrance loss. These open-hole wells are inexpensive, but they have disadvantages. Sand is sometimes drawn into the pump if the pumping rate is high, and the open sections may collapse and block off deeper water-bearing sand.

TABLE 3.—*Well descriptions*

Well: See figure 1 for location of wells.
Elevation of land-surface datum: Altitude of land-surface datum at well, in feet above mean sea level, interpolated from topographic maps.
Well depth: All depths measured from land-surface datum—depth of most wells was reported by driller.
Well finish: O, open hole through aquifer; P, casing perforated; S screened.
Aquifer: CS, Coffee Sand; E, Eutaw Formation; Eu, upper part of Eutaw; Em, middle part of Eutaw; Ee, lower part of Eutaw; G, Gordo Formation; E-G, Eutaw and Gordo Formations.
Water use: D, domestic; P, public; S, stock; I, Industrial; U, unused.

U.S.G.S. Well No.	Owner	Drilled (yr)	Elevation of land surface	Well depth (ft)	Casing depth (ft)	Well finish	Casing diameter (in.)	Aquifer	Water level: Feet below land surface	Water level: Date	Yield (gpm)	Water use
A5	J. E. McGee	1948	410	739	335	O	6	E	60	9-56	3	U
A6	O. B. Cartwright	1916	380	400		O	8	E	62	9-56		D
									77	2-67		
A11	Gordon Robison	1949	360	525	280	O	4	E	45	-49		D
									70	2-67		
A16	do	1962	365	200	21	O	4	CS	60	11-62		S
A19	Hickey Randle	1936	400	650	400	O	4	E				D
A21	do		400	99	21	O	4	CS	80	9-67		D
A22a	Cedar Hill Water Association	1967	400	669	649	P	4	G	90	9-67	24	P
A22b	do	1967	400	572	552	P	4	E	91	10-67	19	P
B11	Town of Guntown	1909	400	400	60	O	4	E	50	7-14		P
B12	do	1945	400	500	250	O	4	Ee				P
B19	Sportsman Club	1961	410	420	390	S	4	Em	170	-61		D
B20	Mrs. Weatherford	1960	410	411	134	O	4	E	70	12-60		D
									85	2-67		
B21	Town of Guntown	1962	390	520	289	S	4	E	84	6-62		P
B22	do	1965	405	591	526	S	10	G	102	2-67	230	P
B23	Murl Murphy	1962	385	200	40	O	4	CS	60	4-62		D
									42	2-67		
B24	Milton Messines	1960	385	189	44	O	4	CS	60	9-60		D
									44	2-67		
B28	Sportsman Club	1967	445	420		S	4	E	118	3-67		D
B30	Mrs. L. J. Henry	1965	350	200		O	4	CS	39	2-67		D
B33	C. C. Seay	1961	420	460	197	O	4	E	90	4-61		D
									113	2-67		
B42	Hurley Malone	1962	455	429	212	O	4	E	126	2-62		D
B43	Mrs. Tom Mauldin	1967	348	278	42	O	4	CS	64	3-67		D
C1	V. M. Willie	1942	360	360		O	4	Ee	42	2-67		D
C5	F. W. Roper	1910	310	175		O	4	E	0	2-67		S
C12	Marcus Hassell	1957	340	240	52	O	7	E	18	-57		D
									24	2-67		
C13	Douglas Grissom	1953	330	247	22	O	4	E	8	2-67		D
C18	Zeke Childeus	1962	350	260	46	O	4	E	50	2-62		D
									48	2-67		

TABLE 3.—*Well descriptions*—Continued

U.S.G.S. Well No.	Owner	Drilled (yr)	Elevation of land surface	Well depth (ft)	Casing depth (ft)	Well finish	Casing diameter (in.)	Aquifer	Water level: Feet below land surface	Water level: Date	Yield (gpm)	Water use
C19	M. L. Williams	1965	465	440	181	O	4	E	170	10-65		D
									174	2-67		
D14	D. W. Bruce	1906	345	305	100	O	6	CS	50	9-56		D
D16	J. E. Montgomery	1963	342	240	22	O	4	CS	60	1-63		D
D17	Hermon Irvin	1963	335	200	30	O	4	CS	50	4-63		D
									43	2-67		
D18	J. B. Hankings	1963	360	520	40	O	5	E	80	7-63		D
									74	2-67		
D19	J. M. Long	1961	310	460	191	O	4	E	75	6-61		D
									63	2-67		
E4	Marley Long	1939	305	525		O	4	Ee	20	9-56		D
E12	L. Q. Conlee	1909	320	400	30	O	5	E	18	4-19		D
E14	Town of Saltillo	1963	320	543	472	S	10	G	55	7-63		P
									64	10-67		
E15	J. W. Spicer	1960	370	550	200	O	4	E	100	7-60		I
									85	2-67		
E21	V. C. Rogers	1963	485	440	147	O	4	E	180	19-63		D
									212	10-67		
E22	Charles Brazer	1963	305	380	202	O	4	E	60	10-63		D
									53	2-67		
E27	Bill Cherry	1961	325	460	208	O	4	E	75	9-61		D
F5	C. Thompson	1966	345	220	22	O	4	E	57	3-67		D
F6	Robert R. Posey	1967	345	216	21	O	4	E	57	3-67		D
F8	Tommy H. Rogers	1967	400	280	42	O	5	E	95	9-67		D
G5	N. J. Altom	1905	340	147	20	O	4	CS	60	9-10		D
G12	City of Tupelo	1954	310	556	450	S	12	Ee	120	7-55	525	P
									162	3-67		
G13	do	1949	270	543	453	S	12	Ee	100	7-55	770	P
G14	R. D. Brookshire	1909	340	159	20	O	4	Cs	70	9-19		D
G15	M. T. Adams	1902	390	310	30	S	4	E	100	9-19		D
G16	S. Sheffield	1960	340	580	560	S	4	E	130	7-60		D
G20	Alvin Vinson	1961	320	200	22	O	5	Cs	50	5-61		D
G22	Jack Warren	1962	330	550	235	O	4	Eu	120	5-62		D
									164	10-67		
G23	Gus Moran	1962	340	621	21	O	4	E	139	3-67		D
G24	Claude Duke	1959	345	620	30	O	4	E	133	12-59		D
G26	Red Scott	1962	345	200	20	O	4	CS	60	12-62		D
									60	2-67		
G28	Silas Cockran	1961	335	500	162	O	4	E	114	10-61		D
									141	2-67		
H9	Pierce Grocery	1947	280	335	59	O	4	E	35	-47		D
									112	2-68		

H10	Barber Milk Co.		300	386	284	S	6	Ee			I
H15	Blue Bell Manufacturing	1956	290	437	368	S	10	Ee	55	10-56	234 I
H19	City of Tupelo	1919	275	450	140	S	12	Ee	163	9-66	235 P
									165	10-67	
H21	do	1935	300	450	370	S	12	Ee	129	5-58	P
									191	10-67	
H22	do	1945	280	430	370	S	12	Ee	120	8-54	U
									163	10-67	
H23	Carnation Milk Co.	1927	265	385		S	8	Ee	33	-27	400 I
									146	4-67	
H26	Tupelo Oil & Ice Co.	1903	270	325	30	O	8	E	20	7-10	U
									176	3-68	
H27	do	1926	270	450	160	O	12	Ee	90	-58	200 I
H28	City of Tupelo	1939	270	380	317	S	6	Ee	32	3-39	P
H29b	Mid-South Packing Co.	1965	280	517	455	S	12	Ee	181	11-66	300 I
H30b	do	1966	275	654	614	S	12	G	167	11-66	200 I
H33	Natchez Trace Parkway	1956	315	492	450	S	8	Ee	62	6-56	34 P
									100	2-67	
H34	do	1935	330	400	20	O	4	Ee	69	4-58	U
									98	10-67	
H35	do		325	400	20	O	4	E	67	4-58	U
H37	International Minerals Co.	1959	275	478	418	S	8	Ee	111	-59	I
H39	City of Tupelo	1961	310	630	387	S	16	E-G	190	-62	500 P
H40	do	1963	340	655	433	S	12	Ee	280	10-63	510 P
H41	Natchez Trace Parkway	1966	325	580	560	S	6	G	74	7-66	10 U
H41a	do	1966	325	490	426	S	8	Ee	95	8-66	110 P
H42	City of Tupelo	1966	280	562	510	S	16	G	164	8-66	360 P
H44	WTWV T.V., Inc.	1962	330	450	80	O	4	Eu	85	1-62	D
									110	2-67	
H45	James Newcomb	1964	283	380	63	O	4	E	80	4-64	D
									76	2-67	
H46	Charles Leslie	1962	300	260	21	O	4	E	60	10-62	D
									75	3-67	
H47	Doug Buchanon	1960	300	260	21	O	4	E	80	3-67	D
H50	Tom Llewellyn	1935	320	325	20	O	4	CS			D
H52	Bill Watts	1963	415	460	253	O	4	E	180	7-63	D
									190	3-67	
H53	Walter Duncan	1965	350	300	42	O	4	Eu	90	10-65	D
									98	3-67	
H55	Charles Maxwell	1965	330	300	38	O	4	E	120	7-65	D
H59	W. W. Sparks	1962	282	360	64	O	4	E	60	9-62	D
									78	3-67	
H61	Glenn Farrar	1965	300	460	167	O	4	E	87	2-67	D
H62	Hurley Coff	1966	296	260	20	O	5	E	90	3-67	D
H64	Charles Mears	1962	306	350	42	O	4	Eu	82	3-67	D
H65	Mid-South Packing Co.	1959	275	510	105	P	12	E	206	11-66	175 I
H66	do	1962	275	520	220	P	12	E	126	3-62	250 I
									194	11-66	I
H67	do	1965	270	521	211	S	12	E			300
H69	F. L. Bobo	1961	280	420	90	O	4	E	90	12-61	S
H70	Howard Conway	1962	310	408	36	O	4	E	93	5-62	D
H72	Purnells Pride Co.	1959	270	500	200	P	12	E	154	4-67	225 I

TABLE 3.—*Well descriptions*—Continued

U.S.G.S. Well No.	Owner	Drilled (yr)	Elevation of land surface	Well depth (ft)	Casing depth (ft)	Well finish	Casing diameter (in.)	Aquifer	Water level: Feet below land surface	Water level: Date	Yield (gpm)	Water use
H73	Purnells Pride Co	1960	270	500	200	P	12	E	99	-60	225	I
H74	do	1963	270	504	200	P	12	E	151	-63	225	I
H75	Tupelo Reduction Co	1961	270	540	300	P	6	E	120	5-61	50	I
									165	4-67		
H76	do	1956	280	540	460	S	6	E	170	-66	50	I
H77	North Lee Water Association	1967	290	596	42	O	4	E-G	67	7-67		U
H78a	Auburn Community Water Association.	1967	370	398	42	O	4	E	139	6-67	16	P
H78b	do	1967	370	480	420	O	4	Ee	137	6-67	13	P
H78c	do	1967	370	526	500	P	4	G	148	6-67	12	P
H78d	do	1967	370	370	330	S	8	E	146		130	P
H79	Lake Piomingo	1967	410	400	168	O	6	E	167	8-67	24	P
H80	North Lee Water Association	1967	286	400	320	S	10	E	63	7-67	235	P
J7	A. V. White		420	160		O		Eu	18	9-56		U
J8	do	1953	420	262	28	O	6	E				D
J13	Mooreville School	1960	405	350	216	S	6	E				D
J20	J. E. Gray	1961	400	320	35	O	4	E	150	5-61		D
J24	Hoyle Estes	1967	370	304	23	O	4	E	110	3-67		D
J25	Lelua White	1966	410	320	22	O	4	E	139	3-67		D
J26	James M. Cosysou	1962	341	224	22	O	4	E	78	3-67		D
J27	Leo Keith	1967	422	320	33	O	5	E	151	1-67		D
									155	3-67		
J30a	Lawrence Edward	1967	375	332	42	O	5	E	142	5-67	5	D
J31a	Mooreville Water Association	1967	450	350	330	S	4	Eu			15	P
K2	Wages Brothers		312	605		O	4	E				D
K13	Town of Verona	1960	352	522	457	S	10	Ee				P
K24	T. E. Yancy	1945	294	400	40	O	4	Eu	80	9-56		D
									100	2-67		
K29	Barber Milk Co	1966	345	491	451	S	10	E	178	3-67		I
									189	10-67		
K30	H. L. Denton	1966	370	680	640	S	4	Ee	167	2-67	30	D
K37	Lamar Metcalf	1960	300	540	20	O	4	Eu	100	11-60		D
K39	Ray Purnell	1961	330	600	26	O	5	E	130	5-61		S
									139	3-67		
K41	D. L. Collum	1962	310	427	22	O	4	E	90	4-62		D
									129	3-67		
K44	Dennis Cayson	1962	305	480	243	O	4	E	120	9-62		D
									128	3-67		
K50	Wade Snipes	1965	305	600	29	O	5	E	110	4-65		D
									123	10-67		
K54	H. Davenport	1966	330	515	253	O	4	E	172	10-66		D
									182	10-67		

L2	City of Tupelo	1952	260	470	320	S	12	E	83	12-52	570	P
L4	do	1959	285	567	368	S	12	E-G	88	11-59	630	P
L12	U.S. Fish Hatchery	1959	260	406	326	S	6	Ee	128	7-59		D
L13	Town of Verona	1949	321	470	444	S	6	E	88	5-49	75	P
L15	R. S. Gibson	1910	310	425	30	O	4	E	65	9-19		D
L17	Town of Plantersville	1964	322	450	360	S	8	Ee	115	12-64	200	P
L18	Jim Williams	1966	340	375	42	O	4	Eu	148	12-66	9	D
L19	City of Tupelo	1966	276	541	461	S	16	G	84	5-66	500	P
									148	3-67		
L20	Pennsylvinia Tire Co	1966	267	669		S		G				I
L21	do	1967	263	643		S		G				I
L22	Tombigbee State Park	1965	390	420	380	S	5	Ee	160	2-67		D
L25	John Cody	1961	285	308	215	O	4	E	70	3-61		D
									81	3-67		
L27	Roy Partlow	1962	348	300	30	O	4	E	131	2-67		D
L28	A. B. Webb	1962	360	400	89	O	5	E	140	5-62		D
L30	Raymond Sampler	1963	315	360	42	O	5	E	90	8-63		U
									125	10-67		
L33	Z. B. Williams	1962	293	300	21	O	4	E	85	11-62		D
L37	Clyde Foster	1965	305	320	22	O	4	E	95	5-65		D
L38	Charles Paynn	1962	280	280	42	O	4	E	70	7-62		D
L39	P. P. Davis	1965	305	280	24	O	4	E	90	8-65		D
									93	2-67		
L40	Carl Kelly	1967	370	397	86	O	5	E	146	3-67	5	D
L41	Tupelo-Lee Industrial Park	1966	270	478	387	S	12	Ee	74	3-66	585	I
									86	10-67		
L43	Joe F. Bell	1967	325	326	37	O	4	E	115	10-67	10	D
L44	R. A. Kitchins	1944	295	200		O	3	E	145	10-67		U
L101	U.S. Fish Hatchery	1927	262	412	412	S	15	Ee	84	12-54		S
M10	Minnie Presley	1963	321	110		O	4	Eu	49	3-67		D
M11	H. R. Morgan	1965	351	380	32	O	5	Ee	112	2-67		D
M12	Stewart Young	1962	360	300	48	O	5	E	100	9-62		D
M13	M.R. Partlow	1966	345	240	33	O	4	E				D
N14	John Lyle	1896	305	500	20	O	4	E				D
N15	Jack Ivey	1966	280	414	42	O	4	E	84	12-66		D
N16	Tom Dupree	1967	257	420	22	O	5	E	68	3-67	9	D
N19	H. W. Thompson	1962	282	420	24	O	4	E	90	7-62		D
									79	3-67		
N20	Terry Helms	1962	320	460	22	O	4	E	100	3-67		D
N21	Russel Parker	1963	278	420	31	O	5	E	70	1-63		D
									77	3-67		
N22	Lynn McCrary	1963	300	500	23	O	5	E	100	2-63		D
									103	3-67		
N27	Leroy Sullivan	1961	325	515	22	O	4	Eu	130	1-61		D
N30	Mitchell Sisk	1961	335	480	23	O	4	E	100	4-61		D
N32	do	1966	272	440	18	O	4	E	75	4-66		D
N33	Jack Ethridge	1960	260	370	21	O	4	E	50	8-60		D
									58	3-67		
N34	Straw Harris	1961	260	360	23	O	4	E	60	8-61		D
N35	Billy Harper	1966	310	500	17	O	5	E	120	12-66		D
N39	Buddy Spencer	1967	350	458	40	O	5	E	158	10-67		D
O5	J. R. Johnson	1920	277	325	35	O	4	Eu	45	9-56		D
O13	John Dickerson	1954	265	200		O	4	E				D

TABLE 3.—*Well descriptions*—Continued

U.S.G.S. Well No.	Owner	Drilled (yr)	Elevation of land surface	Well depth (ft)	Casing depth (ft)	Well finish	Casing diameter (in.)	Aquifer	Water level: Feet below land surface	Water level: Date	Yield (gpm)	Water use
O14	Town of Nettleton		266	612	587	S	8	G	22	7-40		P
									42	3-68		
O15	do	1956	266	282		S	8	El	20	9-56	230	P
									52	3-68		
O16	B. G. Coggin	1938	225	200		O	4	E	2	8-56		D
									11	3-67		
O20	Town of Nettleton	1903	262	515	20	O	4	G	+1	6-14	1	P
O22	Town of Shannon	1955	253	485	340	S	6	El	35	7-57		P
O23	Lawrence Harmon	1958	272	325	23	O	4	E	54	6-58		D
O26	Tupelo-Lee Industrial Park	1962	272	502	416	S	12	El	67	7-62	500	I
O27	J. H. Homan Sr	1963	260	386	15	O	5	E	52	1-64		U
O28	Town of Shannon	1964	276	515	410	S	8	E	80	2-64	220	P
O29	Canary McMaster	1966	275	314		O	4	Eu				D
O30	Edd McDuffe	1962	222	160	20	O	4	E	40	10-62		D
									13	3-67		
O32	Richard Trice	1962	282	320	33	O	4	Eu	50	2-62		D
									73	3-67		
O33	Ralph Earrey	1962	265	340	21	O	4	Eu	70	11-62		D
									61	3-67		
O34	Frank Watts	1965	280	340	30	O	4	Eu	80	10-65		D
									89	10-67		
O35	E. C. Jackson	1963	298	240	36	O	4	Eu	80	11-63		D
									75	3-67		
O43	John L. Tate	1966	262	320	21	O	5	Eu	60	12-66		D
O47	R. Rutherford	1963	295	320	25	O	4	Eu	45	3-63		D
O50	J. E. Cauthen	1962	265	300	25	O	5	E	40	6-62	9	D
O54	Tupelo-Lee Industrial Park	1966	257	446	364	S	12	Ee	56	3-67	585	I
O56	Clinton Edge	1967	272	320	23	O	5	E	64	3-67		D
P6	T. W. Dabbs	1953	325	210	21	O	4	E	81	-53		D
P10	Edd P. Burgess	1956	286	280	20	O	4	E				D
P11	Porter Sullivan	1950	256	140		O	4	Eu	25	2-67		D
P12	do		258	16		O	36	Eu	3	2-67		D
P14	Houston Edwards	1961	355	220	24	O	4	Eu	80	8-61		D
P15	Billy Capps	1962	300	206	65	O	4	Eu	45	2-62		D
P16	Doyle Young	1962	318	140	38	O	4	Ee	50	4-62		D
									62	2-67		
P18	Bobby G. Estes	1962	275	180	42	O	4	Eu	70	10-62		D
P19	G. H. Waycaster	1963	270	180	26	O	4	Eu	4	9-63		D
P20	Edd Burgess	1965	300	200	24	O	4	Eu	70	12-65		D
P21	Eugene Sullivan	1966	275	200	36	O	4	Eu	40	5-66		D
									21	2-67		

RELATION OF WELL YIELDS TO STATIC WATER LEVEL

Although aquifer characteristics, well construction, and well development determine the specific capacity of a well, the available drawdown limits the pumping rate. Available drawdown is the distance between the static, or nonpumping, water level and the pump setting. In 1967, water levels in the Eutaw and Gordo Formations were sufficiently high that in no well was the water level drawn down to the top of the aquifer. Available drawdown limits the pumping rate of a well in as much as specific capacity multiplied by drawdown equals yield.

WATER LEVELS AND MOVEMENT

Artesian water levels in Lee County have been dropping since the first flowing artesian wells were drilled about 1870 (fig.11). In the southern half of Lee County, original water levels in the Gordo Formation were probably slightly higher than water levels in the Eutaw Formation. In the northern half of the county, water levels in the two formations were probably about the same. The piezometric surfaces of the Eutaw and the Gordo originally stood slightly above the flood plains of the principal streams. In 1900, before heavy pumping began, water levels in the Eutaw and the Gordo declined from northeast to southwest (fig. 12), and therefore water movement was in that direction. The southward movement of water in these formations was caused by the decrease in elevation of the outcrop (recharge area) to the south. Elevations of streams in the Eutaw outcrop are more than 100 feet higher northeast of Lee County than southeast of the county. In the past, the Eutaw Formation discharged water to the West Fork Tombigbee River, which is incised into the Eutaw outcrop southeast of Nettleton.

The higher elevation of the Coffee Sand outcrop in the north also resulted in ground-water movement from north to south (fig. 12). The outcrop of the Coffee Sand immediately north and west of Tupelo discharges water to streams, rather than being recharged (figs. 12, 13). Comparison of water levels for 1900 and for 1967 (figs. 12, 13) shows that the greatest water-level decline has been in the Tupelo area where pumpage has been the heaviest. During recent years, water levels in Tupelo have declined at the rate of 3–5 feet annually. Water levels in both the Eutaw and Gordo Formations have declined about 150 feet below original levels. In downtown Tupelo, the water levels are 150–170 feet below land surface (60–80 feet above the top of the Eutaw Formation, fig. 6).

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Water levels in the Eutaw and Gordo Formations slope toward Tupelo from all points in the county (fig. 13); therefore, water is moving toward Tupelo from all points except possibly the southwest corner of the county where the piezometric surface is nearly flat. Water levels and water quality in the Gordo Formation southwest of Tupelo are poorly defined, owing to lack of data.

In the northern and central parts of the county, Eutaw and Gordo water levels are at about the same elevation, which suggests that the two aquifer systems are hydraulically connected or that they have similar recharge and pumpage histories, or both. The aquiclude separating the two formations may not be continuous, and leakage between them may occur as long as water levels differ. The steepest hydraulic gradients (Glossary) in both the Eutaw and Gordo are between the recharge area north and east of Tupelo and the discharge area at Tupelo.

In Lee County water levels are higher in the Coffee Sand than in the Eutaw Formation; this fact and water-quality data indicate that water from the Coffee Sand is moving downward to the Eutaw Formation through the open-hole wells. This differential may also cause downward vertical leakage through the relatively thin aquicludes in the northern part of the county. Leakage from the Coffee Sand to the Eutaw continues south as far as the Coffee Sand is sufficiently permeable to yield water to the many open-hole wells.

The Eutaw and Gordo Formations are separated by an aquiclude that is thicker and more continuous in the southern part than in the northern part of Lee County. Leakage from shallow to deeper sands in the Eutaw, through open-holes and otherwise, is probably significant in the southeastern part of Lee County but insignificant in the southwestern part.

In the southern part of Lee County (fig. 13), hydraulic gradients are much lower in the Gordo than in the Eutaw. The lower gradients are a result of much higher transmissibility of the Gordo in that area. If equal amounts of water were pumped from the Gordo at Nettleton and at Tupelo, the hydraulic gradient around Nettleton would be much less than that at Tupelo because of the higher transmissibility.

QUALITY

Practically all ground water in Lee County meets the chemical quality needs of most water users, with little or no treatment; however, the chemical quality of water in the various aquifers is different (table 4).

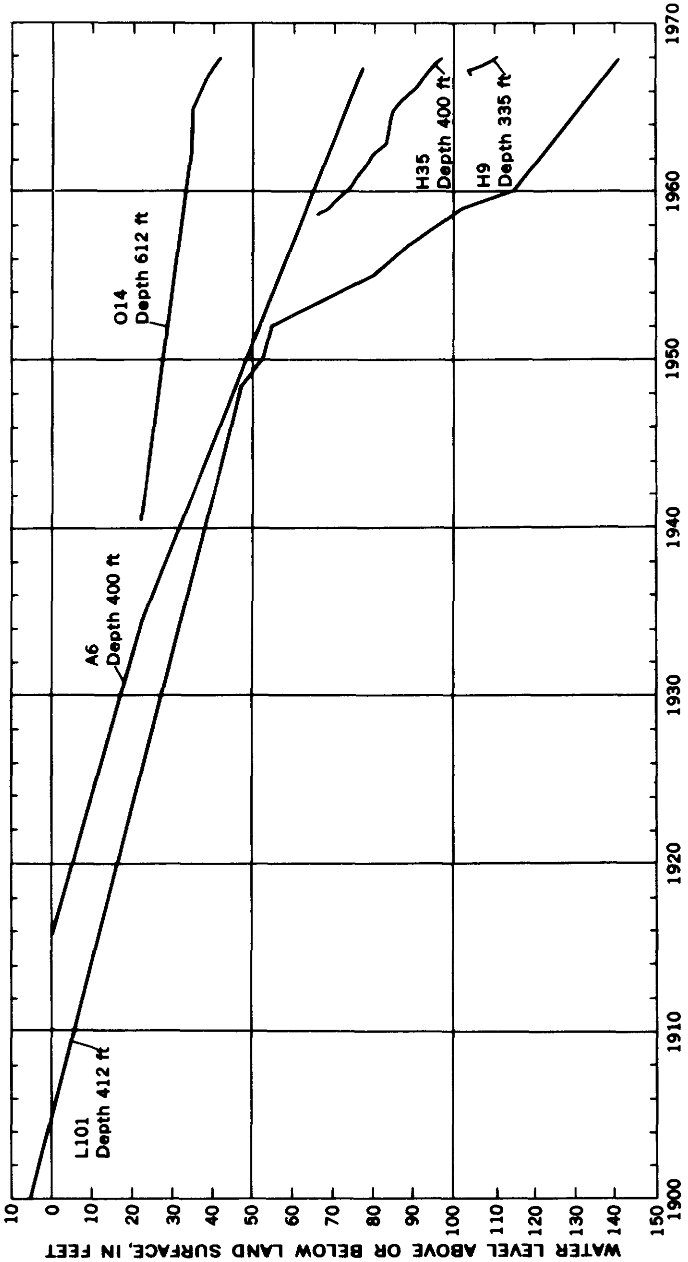
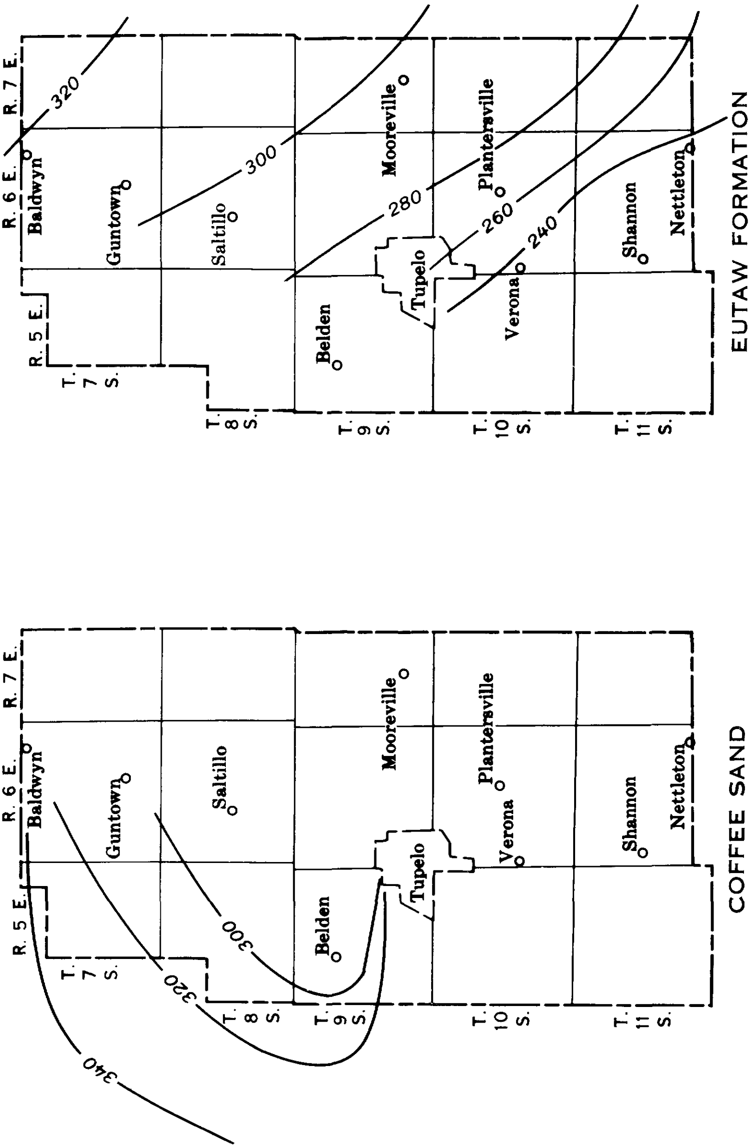


FIGURE 11.—Water-level declines in selected wells.


EUTAW FORMATION
COFFEE SAND
R. 5 E.
R. 6 E.
R. 7 E.
T. 7 S.
T. 8 S.
T. 9 S.
T. 10 S.
T. 11 S.
Baldwyn
Guntown
Saltillo
Mooreville
Plantersville
Tupelo
Belden
Verona
Shannon
Nettleton
320
300
280
260
240
340

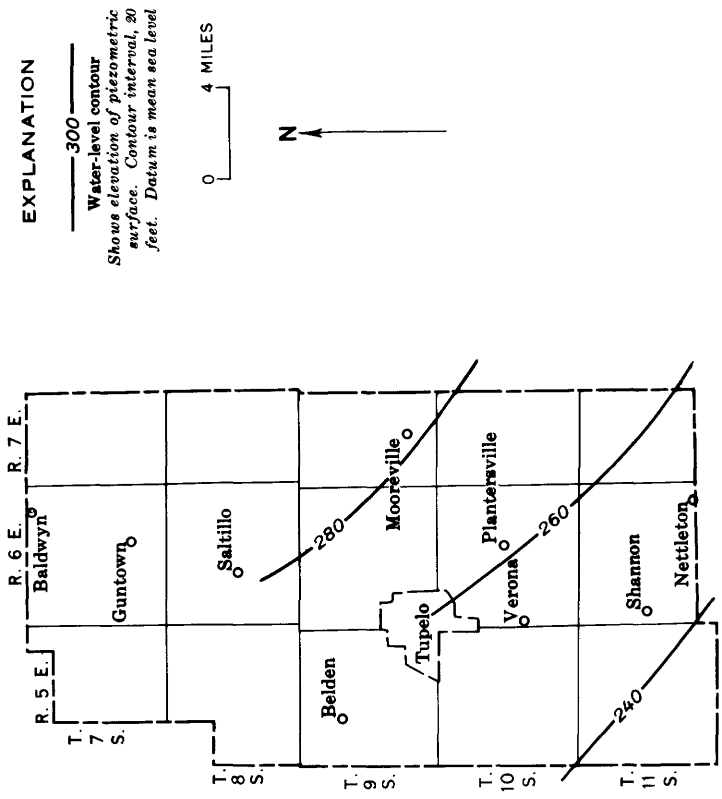
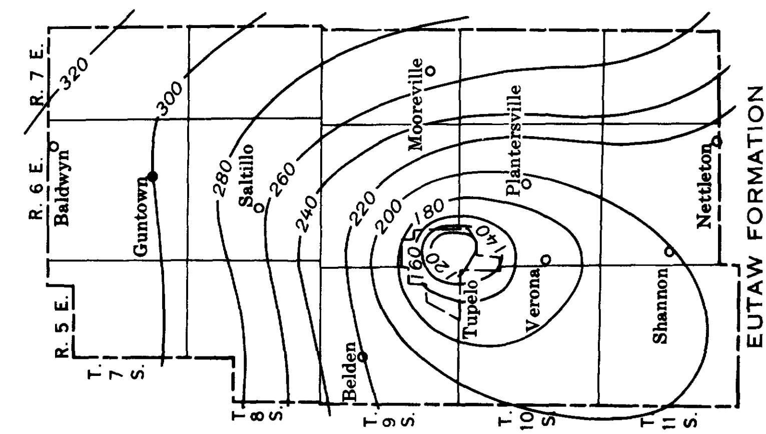
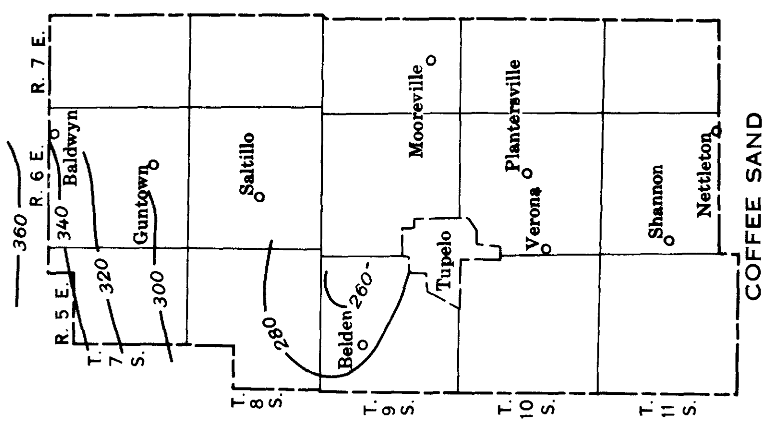


FIGURE 12.—Water-level contours for the Coffee Sand, Eutaw Formation, and the Gordo Formation in 1900.


EUTAW FORMATION
R. 5 E.
R. 6 E.
R. 7 E.
T. 7 S.
T. 8 S.
T. 9 S.
T. 10 S.
T. 11 S.
Baldwyn
Guntown
Saltillo
Mooreville
Plantersville
Nettleton
Belden
Tupelo
Verona
Shannon
320
300
280
260
240
220
200
180
160
140
120


COFFEE SAND
R. 5 E.
R. 6 E.
R. 7 E.
T. 7 S.
T. 8 S.
T. 9 S.
T. 10 S.
T. 11 S.
Baldwyn
Guntown
Saltillo
Mooreville
Plantersville
Nettleton
Belden
Tupelo
Verona
Shannon
360
340
320
300
280
260

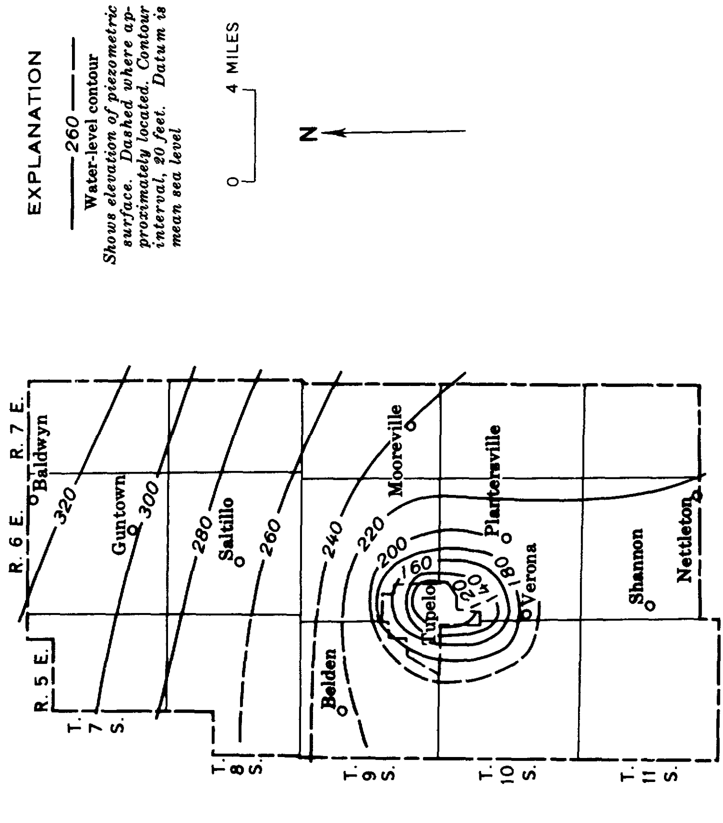


FIGURE 13.—Water-level contours for the Coffee Sand, Eutaw Formation, and the Gordo Formation in 1967.

TABLE 4.—*Chemical analyses*

[Analyses by U.S. Geological Survey.

USGS well	Well depth (ft)	Date of collection	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)
A5	739	3- 3-60	--------	0.15	--------	--------	--------	--------	--------	156	0
A6	400	2-16-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
A11	525	3- 3-60	--------	.15	--------	--------	--------	--------	--------	142	0
		2-16-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
A16	200	2-16-67	12	.47	--------	51	12	62	5.5	108	0
A22a	669	9-18-67	10	.38	--------	42	8.5	25	2.9	141	0
B11	400	7- 8-14	22	2.6	--------	51	11	--------	--------	254	0
B12	500	11-24-58	4.9	.11	--------	27	5.4	28	4.3	164	0
B19	420	4-12-62	12	.17	0.1	30	4.8	20	3.2	138	0
B20	411	2-14-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
B21	520	2-15-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
B22	591	2-15-67	13	.14	--------	37	7.7	18	3.7	134	0
B23	200	2-14-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
B24	189	2-15-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
B33	460	2-14-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
B33	460	2-16-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
B42	429	3- 1-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
C1	360	2-14-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
C5	175	3- 2-60	--------	.7	--------	--------	--------	--------	--------	128	0
C12	240	2-14-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
C13	247	2-14-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
C18	260	2-16-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
C19	440	2-16-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
D14	305	2-17-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
D16	240	2-16-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
D17	200	2-16-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
D18	520	2-16-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
D19	460	2-16-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
E4	525	2-14-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
E12	400	4-23-14	15	.85	--------	20	2.9	--------	--------	116	0
		3- 1-60	--------	.7	--------	--------	--------	--------	--------	114	0
E14	543	2-14-67	12	.16	--------	34	8.5	35	4.4	131	0
E15	550	2-15-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
E22	380	2-14-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
E27	460	2-14-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
F5	220	3- 2-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
G5	147	9- 5-19	25	.23	--------	9.4	5.6	--------	--------	202	25
G12	556	4- 3-67	14	.33	--------	36	6.8	44	5.0	123	0
G14	159	9-22-19	17	.5	--------	16	5.6	--------	--------	243	0
G15	310	9-22-19	24	.6	--------	11	3.8	--------	--------	243	9
G16	580	3- 1-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
G20	200	2-17-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
G22	550	3- 1-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
G23	621	3- 1-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
G24	620	3- 1-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
G26	200	2-17-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
G28	500	2-17-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
H10	386	2-21-67	12	.21	--------	14	1.2	27	3.2	89	0
H15	437	7-19-60	5.5	.18	--------	35	7.4	36	3.9	128	0
H19	450	4- 1-20	30	.4	--------	30	4.8	--------	--------	121	0
		5-21-51	17	.3	.1	29	5.6	46	4.6	122	0
		5-21-51	16	.6	.1	33	5.2	45	7.0	104	0
		2-17-67	12	.25	--------	30	4.6	40	4.4	123	0
		3-29-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
H23	385	4- 4-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
H26	325	9-23-19	27	.5	--------	30	4.8	--------	--------	107	7
H27	450	3-28-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
H28	380	3-28-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
H30b	654	3-29-67	10	.32	--------	38	8.5	75	5.8	130	0
H33	492	10-20-65	11	.23	--------	39	7.7	41	3.8	132	0
H39	630	3-27-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
H40	655	3-29-67	12	.54	--------	32	6.1	47	4.8	126	0
H41	580	7-22-66	10	1.5	--------	40	9.3	83	5.3	146	0
H41a	490	8-16-66	12	.9	--------	36	8.0	134	3.4	137	0
H42	562	3-27-67	11	.37	--------	37	6.7	86	5.8	119	0
H44	450	2-13-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
H45	380	2-14-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
H46	260	3- 1-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
H47	260	3- 1-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
H50	325	2-13-67	12	.37	--------	10	1.2	40	3.2	104	0
H52	460	3-23-67	--------	--------	--------	--------	--------	--------	--------	--------	--------

of water from wells

Constituents are in mg/l]

Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids		Hardness as $CaCO_3$		Sodium adsorption ratio	Specific conductance (micromhos at 25° C)	pH	Temperature (° F)
					Residue at 180° C	Calculated	Calcium, magnesium	Noncarbonate				
-------	21	0.6	-------	-------	235	-------	48	-------	-------	424	8.2	-------
-------	25	1.2	-------	-------	-------	-------	62	-------	-------	439	8.1	-------
-------	35	.4	-------	-------	249	-------	81	-------	-------	363	8.2	61
-------	38	.3	-------	-------	-------	-------	82	-------	-------	388	8.0	-------
162	42	.4	0.8	-------	412	401	176	87	-------	650	7.0	-------
6.2	54	.1	.0	-------	229	218	140	24	-------	414	7.8	-------
19	6.0	-------	.8	-------	272	265	-------	-------	-------	-------	-------	-------
10	7.5	.3	1.8	-------	185	170	90	0	-------	281	7.8	62
.4	17	.0	.0	0.6	162	155	95	0	0.9	294	7.2	-------
-------	18	.3	-------	-------	-------	-------	74	-------	-------	316	8.2	-------
-------	32	.0	-------	-------	-------	-------	82	-------	-------	263	7.8	-------
8.0	36	.1	.1	-------	192	190	124	14	-------	348	7.3	-------
-------	4.2	.2	-------	-------	-------	-------	93	-------	-------	255	7.5	-------
-------	3.6	.3	-------	-------	-------	-------	83	-------	-------	2,227	3.0	-------
-------	8.8	.4	-------	-------	-------	-------	64	-------	-------	308	8.2	-------
-------	16	.4	-------	-------	-------	-------	75	-------	-------	289	7.8	-------
-------	20	.1	-------	-------	-------	-------	82	-------	-------	276	8.1	-------
-------	.0	.2	-------	-------	-------	-------	125	-------	-------	278	7.6	-------
-------	55	.1	-------	-------	220	-------	97	-------	-------	243	8.2	61
-------	20	.1	-------	-------	-------	-------	104	-------	-------	278	8.0	-------
-------	25	.1	-------	-------	-------	-------	114	-------	-------	313	7.9	-------
-------	18	.1	-------	-------	-------	-------	118	-------	-------	300	7.8	-------
-------	12	.1	-------	-------	-------	-------	85	-------	-------	263	8.0	-------
-------	8.4	1.7	-------	-------	-------	-------	30	0	-------	358	8.2	-------
-------	15	1.3	-------	-------	-------	-------	50	-------	-------	333	8.2	-------
-------	34	.7	-------	-------	-------	-------	130	-------	-------	628	7.8	-------
-------	44	.7	-------	-------	-------	-------	60	-------	-------	480	8.2	-------
-------	27	.5	-------	-------	-------	-------	66	-------	-------	321	8.2	-------
-------	50	.3	-------	-------	-------	-------	103	-------	-------	381	8.0	-------
8.9	19	-------	-------	-------	153	156	-------	-------	-------	-------	-------	-------
-------	15	.3	-------	-------	161	-------	64	-------	-------	240	7.9	61
6.6	60	.2	.1	-------	236	226	120	13	-------	423	7.3	-------
-------	20	.1	-------	-------	-------	-------	64	-------	-------	260	7.6	-------
-------	22	.1	-------	-------	-------	-------	58	-------	-------	258	8.3	-------
-------	35	.1	-------	-------	-------	-------	84	-------	-------	326	8.1	-------
-------	9.4	.1	-------	-------	-------	-------	98	-------	-------	251	7.8	-------
38	13	-------	.9	-------	324	-------	-------	-------	-------	-------	-------	-------
6.6	76	1.4	.1	-------	253	251	118	17	-------	467	7.2	-------
39	13	-------	1.2	-------	297	302	-------	-------	-------	-------	-------	-------
19	11	-------	1.0	-------	280	294	-------	-------	-------	-------	-------	-------
-------	38	.2	-------	-------	-------	-------	39	-------	-------	337	8.3	-------
-------	22	2.4	-------	-------	-------	-------	60	-------	-------	508	8.1	-------
-------	51	.3	-------	-------	-------	-------	50	-------	-------	378	7.9	-------
-------	71	.4	-------	-------	-------	-------	100	-------	-------	482	7.8	-------
-------	82	.3	-------	-------	-------	-------	80	-------	-------	501	8.0	-------
-------	14	2.8	-------	-------	-------	-------	53	-------	-------	503	8.2	-------
-------	33	.3	-------	-------	-------	-------	42	-------	-------	312	8.4	-------
5.6	19	.2	.6	-------	123	127	40	0	-------	221	7.1	-------
7.8	62	.0	.8	-------	247	221	105	13	1.4	436	7.5	65
6.7	61	-------	.2	-------	240	238	-------	-------	-------	-------	-------	-------
8.1	65	.0	1.2	-------	230	238	95	0	-------	405	7.6	66
16	71	.0	.5	-------	240	246	104	19	-------	429	7.7	-------
4.8	61	.2	.1	-------	221	218	94	0	-------	415	7.5	-------
-------	64	.1	-------	-------	-------	-------	100	-------	-------	421	7.9	-------
-------	74	.1	-------	-------	-------	-------	99	-------	-------	448	7.9	-------
6.7	60	-------	.3	-------	243	233	-------	-------	-------	-------	-------	-------
-------	72	.1	-------	-------	-------	-------	105	-------	-------	446	8.0	-------
-------	50	.1	-------	-------	-------	-------	101	-------	-------	379	7.8	-------
.2	137	.4	.5	-------	344	339	130	23	-------	657	7.2	68
5.8	79	.0	.0	-------	271	252	129	21	-------	492	7.1	-------
-------	119	.2	-------	-------	-------	-------	125	-------	-------	600	7.9	-------
4.6	75	.2	1.5	-------	246	245	105	2	-------	457	7.3	-------
4.2	149	.3	.1	-------	388	373	138	-------	-------	707	7.0	69
7.2	63	.0	.1	-------	234	231	123	11	-------	435	7.6	64
.0	151	.3	.2	-------	364	357	120	22	-------	686	7.1	-------
-------	16	.3	-------	-------	-------	-------	79	-------	-------	270	8.2	-------
-------	12	.9	-------	-------	-------	-------	40	-------	-------	222	7.9	-------
-------	20	.1	-------	-------	-------	-------	48	-------	-------	232	8.3	-------
-------	19	.1	-------	-------	-------	-------	55	-------	-------	250	7.4	-------
8.0	13	2.4	1.6	-------	140	142	30	0	-------	233	7.2	-------
-------	52	.2	-------	-------	-------	-------	68	-------	-------	299	8.0	-------

TABLE 4.—*Chemical analyses of*

[Analyses by U.S. Geological Survey.

USGS well	Well depth (ft)	Date of collection	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)
H53	300	3-23-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
H55	300	3-26-70	-------	-------	-------	-------	-------	-------	-------	-------	-------
H59	360	3- 2-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
H61	460	2-13-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
H62	260	3- 1-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
H64	350	3- 2-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
H65	510	3-29-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
H67	521	3-29-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
H69	420	3- 2-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
H70	408	3- 2-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
H72	500	4- 3-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
H73	500	4- 3-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
H74	504	4- 3-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
H78a	398	6-15-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
H78b	480	6-26-67	12	.54	-------	35	6.0	48	3.8	131	0
H78c	526	6-20-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
J7	160	9-13-56	-------	.0	-------	32	4.6	2.5	4.6	123	0
J8	262	3-22-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
J13	350	2-15-67	15	.8	-------	29	3.8	28	4.8	126	0
J20	320	2-15-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
J25	320	3-22-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
J26	224	3-22-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
J27	320	3-22-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
J31a	350	12-13-67	14	.44	-------	28	2.4	31	3.0	124	0
K2	605	2-21-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
K13	522	6-10-60	5.8	.46	-------	33	5.6	54	6.4	126	0
K24	400	3-22-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
K29	491	12- 5-67	12	.9	-------	30	5.4	50	3.3	124	0
K30	680	3-21-67	12	.81	-------	32	5.4	59	4.6	124	0
K37	540	3-22-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
K39	600	3-22-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
K41	427	3- 3-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
K44	480	3- 2-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
K50	600	2-21-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
K54	515	3- 2-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
L4	567	3-28-67	11	.36	-------	30	4.9	70	5.4	123	0
L12	406	3- 2-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
L13	470	7-22-58	4.1	.0	-------	37	7.7	52	5.3	130	0
L15	425	9- 5-19	35	.55	-------	11	2.3	-------	-------	69	41
L17	450	2-17-67	13	.22	-------	21	3.1	34	3.4	121	0
L18	375	2-17-67	14	.6	-------	17	1.8	34	3.1	103	0
L19	541	3-29-67	9.5	.23	-------	38	7.1	76	5.8	130	0
L21	643	12- 7-67	9.8	.26	-------	30	5.6	63	3.6	119	0
L22	420	2-21-67	14	.13	-------	29	3.8	134	4.2	121	0
L25	308	3- 2-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
L27	300	2-28-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
L28	400	2-21-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
L33	300	2-21-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
L37	320	2-28-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
L38	280	3- 2-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
L39	280	2-28-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
L41	478	4-18-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
L101	412	7-19-61	11	1.90	.1	36	4.5	44	3.9	132	0
M10	110	2-23-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
M11	380	2-28-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
M12	300	2-28-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
M13	240	2-28-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
N14	500	9-15-56	-------	.10	-------	5.1	2.8	73	3.8	120	0
N15	414	3-20-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
N16	420	3- 3-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
N19	420	3-21-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
N20	460	3-20-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
N21	420	3-20-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
N22	500	3-21-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
N27	515	3-20-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
N30	480	3-21-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
N32	440	3- 3-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
N34	360	3-21-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
N35	500	3-20-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
O5	325	9-11-56	-------	.1	-------	9.4	2.2	45	3.6	106	0
O13	200	3-21-67	-------	-------	-------	-------	-------	-------	-------	-------	-------
O14	612	12- 2-54	7.0	10	-------	14	3.4	5.2	3.8	62	0

water from wells—Continued

Constituents are in mg/l]

Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids: Residue at 180° C	Dissolved solids: Calculated	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Sodium adsorption ratio	Specific conductance (micromhos at 25° C)	pH	Temperature (° F)
--	19	.1	--	--	--	--	52	--	--	228	7.9	--
--	18	.1	--	--	--	--	68	--	--	281	7.9	--
--	29	.3	--	--	--	--	78	--	--	329	8.2	--
--	34	.6	--	--	--	--	80	--	--	322	8.0	--
--	21	.1	--	--	--	--	50	--	--	249	8.1	--
--	20	.7	--	--	--	--	54	--	--	248	8.0	--
--	72	.1	--	--	--	--	108	--	--	446	7.9	--
--	74	.2	--	--	--	--	100	--	--	425	8.0	--
--	25	.3	--	--	--	--	63	--	--	275	8.1	--
--	8.0	1.0	--	--	--	--	38	--	--	205	8.1	--
--	70	.1	--	--	--	--	102	--	--	442	7.9	--
--	40	.2	--	--	--	--	66	--	--	328	7.9	--
--	65	.2	--	--	--	--	86	--	--	406	7.9	--
--	24	.0	--	--	--	--	68	--	--	282	--	--
.8	86	.1	.1	--	253	257	112	--	--	492	7.5	65
--	142	.1	--	--	--	--	127	--	--	652	--	--
36	10	.3	.7	--	187	174	99	0	--	290	8.2	--
	9.4	.1	--	--	--	--	93	--	--	324	7.8	--
5.4	35	.2	.2	--	177	183	88	0	--	328	7.3	--
--	21	.1	--	--	--	--	76	--	--	299	8.1	--
--	9.2	.1	--	--	--	--	112	--	--	297	7.7	--
--	25	.1	--	--	--	--	96	--	--	311	7.6	--
--	24	.3	--	--	--	--	70	--	--	260	7.9	--
6.4	33	.0	.0	--	182	179	80	0	--	321	7.5	17
--	39	.1	--	--	--	--	40	--	--	348	8.0	--
4.2	85	.0	.4	--	267	256	104	2	2.3	474	7.9	67
--	47	.3	--	--	--	--	31	--	--	373	8.3	--
2.8	80	.1	.1	--	252	245	97	0	--	474	7.2	18
.0	96	.2	.1	--	275	270	102	0	--	522	7.4	--
--	41	.1	--	--	--	--	28	--	--	350	8.4	--
--	52	.2	--	--	--	--	56	--	--	405	8.3	--
--	67	.1	--	--	--	--	62	--	--	418	7.3	--
--	33	.2	--	--	--	--	26	--	--	313	8.6	--
--	33	.2	--	--	--	--	40	--	--	353	8.6	--
--	29	.3	--	--	--	--	27	--	--	296	8.6	--
.2	102	.2	.1	--	348	285	95	0	--	536	7.4	--
--	56	.2	--	--	--	--	100	--	--	391	8.0	--
3.8	92	.3	.1	--	291	266	106	18	--	487	8.0	67
7.6	35	--	.9	--	249	234	--	--	--	--	--	--
5.4	28	.2	.1	--	160	168	165	0	--	300	7.1	--
6.2	23	.2	.4	--	146	151	50	0	--	253	7.0	--
.6	128	.3	.1	--	323	329	124	18	--	634	7.4	--
.0	105	.1	.0	--	285	276	98	0	--	545	7.3	19
5.2	42	.2	.6	--	182	193	88	0	--	344	7.8	--
--	10	.2	--	--	--	--	64	--	--	297	8.3	--
--	30	.2	--	--	--	--	64	--	--	291	7.2	--
--	31	.2	--	--	--	--	74	--	--	312	7.2	--
--	35	.2	--	--	--	--	60	--	--	309	8.2	--
--	36	.4	--	--	--	--	144	--	--	502	7.7	--
--	33	.2	--	--	--	--	63	--	--	286	8.0	--
--	30	.1	--	--	--	--	59	--	--	305	8.3	--
--	87	.2	--	--	--	--	107	--	--	500	7.7	--
.4	70	.1	.1	.3	235	235	109	1	1.8	447	7.2	65
--	16	.3	--	--	--	--	115	--	--	270	6.9	--
--	7.0	.1	--	--	--	--	134	--	--	343	7.8	--
--	73	.1	--	--	--	--	156	--	--	518	7.7	--
--	18	.0	--	--	--	--	110	--	--	338	7.8	--
5.0	58	.6	1.4	--	229	209	24	0	--	384	8.2	--
--	66	.7	--	--	--	--	54	--	--	487	8.0	--
--	35	.2	--	--	--	--	35	--	--	311	8.5	--
--	56	.1	--	--	--	--	40	--	--	399	8.2	--
--	56	.3	--	--	--	--	32	--	--	398	8.5	--
--	63	.1	--	--	--	--	52	--	--	417	8.3	--
--	51	.2	--	--	--	--	37	--	--	396	8.4	--
--	60	.3	--	--	--	--	25	--	--	414	7.3	--
--	47	.2	--	--	--	--	50	--	--	370	8.4	--
--	47	.3	--	--	--	--	37	--	--	379	7.7	--
--	62	.2	--	--	--	--	57	--	--	411	8.3	--
--	57	.2	--	--	--	--	38	--	--	421	8.5	--
5.8	28	.3	1.1	--	160	147	32	0	--	270	7.9	--
--	35	.1	--	--	--	--	145	--	--	440	8.0	--
8.8	5.0	.3	1.1	--	86	8[illegible]	49	0	--	136	6.5	64

TABLE 4.—*Chemical analyses of*

[Analyses by U.S. Geological Survey.

USGS well	Well depth (ft)	Date of collection	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)
O15	282	6-18-58	20	.11	.10	50	6.8	13	6.0	176	0
O20	515	6-26-14	18	.97	--------	27	4.2	--------	--------	124	0
O22	485	7-25-57	--------	.4	--------	23	4.6	58	5.3	116	0
O23	325	3-21-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
O26	502	4-18-67	11	.87	--------	28	5.8	65	3.8	121	0
O28	515	3-21-67	12	.10	--------	27	5.5	62	5.4	120	0
O29	314	3-20-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
O32	320	3-21-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
O33	340	3- 2-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
O34	340	3- 2-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
O35	240	3-21-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
O43	320	3- 2-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
O47	320	3-21-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
O50	300	3-21-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
		5- 7-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
O54	446	4-19-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
O56	320	5- 9-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
P6	210	9-12-56	--------	16	--------	48	9.2	16	6.1	137	0
P10	280	2-28-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
P12	16	2-28-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
P14	220	2-28-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
P15	206	2-28-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
P16	140	2-28-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
P18	180	2-28-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
P19	180	2-28-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
		12- 5-67	14	.45	--------	259	31	96	4.2	234	0
P20	200	2-28-67	--------	--------	--------	--------	--------	--------	--------	--------	--------
P21	200	2-28-67	--------	--------	--------	--------	--------	--------	--------	--------	--------

Two principles control the chemical quality of water in the coastal-plain aquifers of Mississippi. The first is that, as water moves down the dip within any aquifer, its quality gradually changes: mineralization, pH, and temperature increase, and hardness decreases. At shallow depths, water in Lee County usually is a calcium bicarbonate type, has a low dissolved-solids content of 20–100 mg/l (milligrams per liter), is soft to moderately hard (5–100 mg/l), has a low pH (5–7), and has a temperature about the same as the average annual air temperature (17°C). Down the dip, the type changes to sodium bicarbonate, pH increases to nearly 9, the dissolved solids increase to as much as 300 mg/l (fig. 14), hardness decreases to less than 25 mg/l as $CaCO_3$, and temperature increases about 1°C for each 100 feet of depth.

The second principle concerning quality of water in coastal-plain aquifers of Mississippi is that with increasing depth (of wells at a locality) the water is more mineralized, has a higher pH, is softer, and is warmer. In the Tupelo area and in the part of the county northeast of Tupelo, water in successively deeper aquifers is more mineralized. Data indicate that water in the Paleozoic rocks is highly mineralized; the top of these rocks (fig. 8) is considered to be the base of fresh water (1,000 mg/l of dissolved solids) in Lee County. However, the mineral-

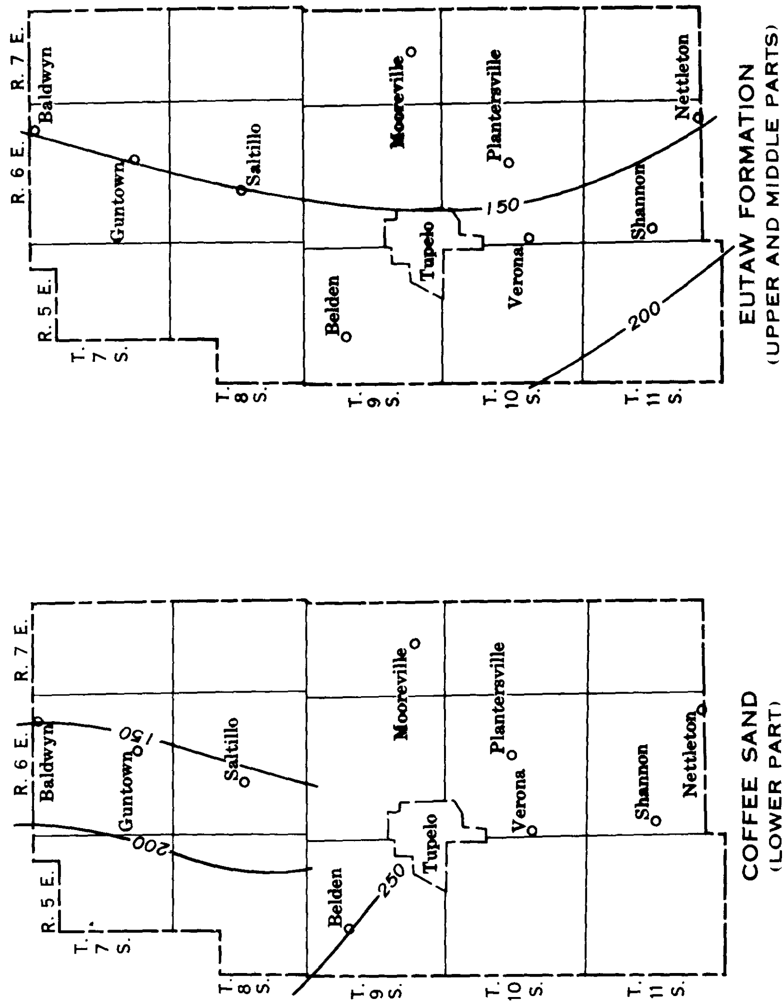
water from wells—Continued

Constituents are in mg/l]

Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids		Hardness as $CaCO_3$		Sodium adsorption ratio	Specific conductance (micromhos at 25° C)	pH	Temperature (° F)
					Residue at 180° C	Calculated	Calcium, magnesium	Noncarbonate				
34	4.0	.0	.0	------	217	221	153	8	------	362	7.4	64
8.5	10	------	.0	------	149	153	------	------	------	------	------	------
4.2	74	.7	.9	------	228	227	76	0	------	441	8.0	------
------	33	.2	------	------	------	------	45	------	------	310	8.0	------
.0	104	.2	.2	------	273	278	94	0	------	539	7.3	66
4.2	88	.2	.1	------	257	263	90	0	------	490	7.2	------
------	46	.6	------	------	------	------	42	------	------	352	8.3	------
------	32	.1	------	------	------	------	34	------	------	289	8.4	------
------	27	.1	------	------	------	------	50	------	------	291	8.2	------
------	41	.4	------	------	------	------	38	------	------	325	8.5	------
------	5.8	.1	------	------	------	------	93	------	------	280	8.0	------
------	28	.2	------	------	------	------	50	------	------	295	8.3	------
------	35	.1	------	------	------	------	32	------	------	279	9.0	------
------	31	.2	------	------	------	------	40	------	------	308	7.4	------
------	29	.1	------	------	------	------	42	------	------	309	8.2	------
------	73	.2	------	------	------	------	95	------	------	553	7.7	------
------	31	.2	------	------	------	------	44	------	------	304	8.2	------
72	7.5	.1	.9	------	258	227	113	45	------	382	7.6	------
------	9.4	.1	------	------	------	------	134	------	------	345	7.7	------
------	30	.1	------	------	------	------	99	------	------	289	5.5	------
------	19	.0	------	------	------	------	198	------	------	491	7.8	------
------	6.2	.2	------	------	------	------	100	------	------	226	7.2	------
------	5.8	.3	------	------	------	------	123	------	------	257	7.2	------
------	11	.1	------	------	------	------	140	------	------	400	7.5	------
------	79	.0	------	------	------	------	1,225	------	------	2,550	7.0	------
724	45	.1	.1	------	------	1,290	776	584	------	1,720	7.3	------
------	11	.1	------	------	------	------	129	------	------	379	8.0	------
------	15	4	------	------	------	------	75	------	------	216	7.1	------

ization part of the second principle does not hold among all aquifers in other parts of the county. In the northwestern part of the county, the water in the upper part of the Coffee Sand is more mineralized than that in the lower part of the Coffee Sand or that in the underlying Eutaw and Gordo Formations. In the southern part, the Eutaw is more mineralized than the Gordo. From north to south in eastern Lee County, the dissolved-solids content of water in the lower part of the Eutaw Formation is about 150 mg/l; however, dissolved solids in the Gordo decrease from about 150 mg/l in the north to about 50 mg/l in the south (fig. 14).

Several factors may contribute to this change in quality-of-water relation between aquifers. In the northeastern part of the county, water may move from the Eutaw into the Gordo. The higher mineralization of water in the Gordo at Tupelo may be the result of leakage from underlying Paleozoic rock. Thickness and permeability of the Gordo increase to the south; water thus moves through the formation more easily, and this flushing action has resulted in less-mineralized water in the southern part of the aquifer (fig. 14).


EUTAW FORMATION
(UPPER AND MIDDLE PARTS)
R. 5 E.
R. 6 E.
R. 7 E.
T. 7 S.
T. 8 S.
T. 9 S.
T. 10 S.
T. 11 S.
Baldwyn
Guntown
Saltillo
Mooreville
Plantersville
Nettleton
Shannon
Tupelo
Verona
Belden
150
200
COFFEE SAND
(LOWER PART)
R. 5 E.
R. 6 E.
R. 7 E.
T. 7 S.
T. 8 S.
T. 9 S.
T. 10 S.
T. 11 S.
Baldwyn
Guntown
Saltillo
Mooreville
Plantersville
Nettleton
Shannon
Verona
Tupelo
Belden
150
200
250

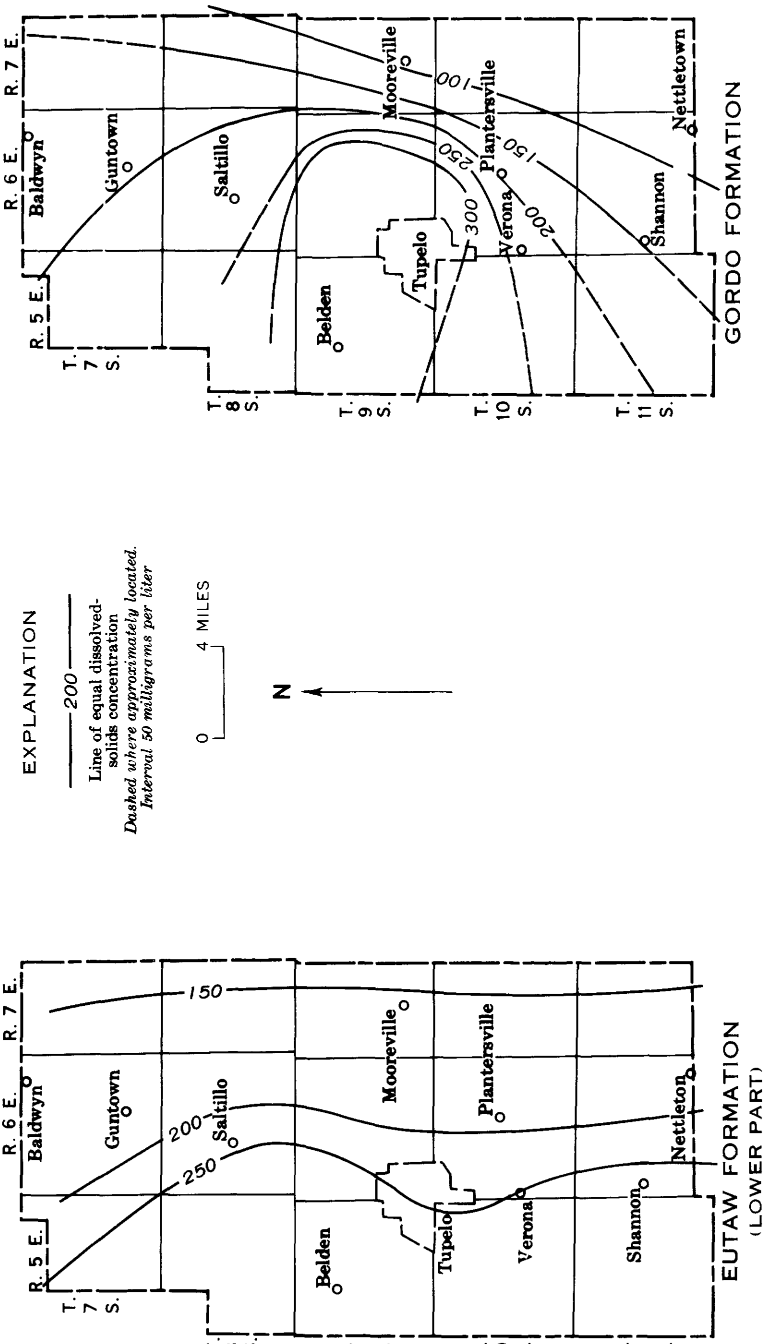


FIGURE 14.—Dissolved-solids content of water in the Coffee Sand, Eutaw Formation, and Gordo Formation.

The principal water quality problems in the county are hardness, excessive iron and fluoride, and low pH. Hardness is as much as 100 mg/l in many parts of the aquifers, but is as low as 25 mg/l in other parts. Iron is not a problem in the Coffee Sand or the Eutaw Formation, except in the outcrop areas; there the pH is usually low and the water may be corrosive to metals. Water in the Gordo, however, usually has objectionable concentrations of iron and a lower pH than water in the Eutaw at the same site. Excessive concentrations (as high as 2.8 mg/l) of fluoride (Glossary) occur in the upper part of the Coffee Sand.

It is difficult to determine which aquifer (or aquifers) yields water to most of the domestic wells in Lee County, because the wells generally are open holes that penetrate two or more aquifers. This difficulty also applies to the wells that are screened opposite two or more aquifers. Some open-hole wells are partially filled with sand and are shallower than the reported depth. In most wells, the differences in water levels between aquifers probably cause water to flow from one aquifer to another when the well is not being pumped; hence, when the well is pumped, the water may be a mixture which varies with time.

POTENTIAL OF AQUIFERS

The history of water-level declines and ground-water pumpage at Tupelo can be used to predict future water levels in response to specified pumping. Present water-level trends indicate that it will be 10–20 years before the water level in the Eutaw Formation (fig. 6) will be drawn down into the aquifer, except within a few hundred feet of pumping wells. This projection allows for a gradual increase of 2 or 3 mgd of pumpage during the period. However, if pumpage from the Eutaw should be increased by a lump sum of 3 mgd, it would probably be less than 5 years until water levels would be drawn down into the aquifer in the areas of heaviest pumpage.

Dewatering of the upper part of the Eutaw will not be the end point of aquifer development. Wells screened in the lower part of the Eutaw will operate efficiently and will still draw water levels down far below the top of the Eutaw Formation. Dewatering of the aquifer will result in a change from artesian to water-table conditions. This change will result in a greatly increased coefficient of storage. The larger coefficient of storage will increase the specific capacity of wells; however, this will be partly offset by lower transmissibilities, which will result from less saturated thickness of the aquifer.

The above predictions assume that pumpage outside the Tupelo area will remain stable. Significant increases in pumpage, however, probably will occur in other areas of the county; these will lower water levels at Tupelo.

Future water-supply needs probably will be heaviest along the two railroads that cross the county. To simplify reference to this heavy-use area, we will think of it as a line running north and south across the county through Tupelo. The potential sustained yield of the Eutaw Formation along this line is about 9 mgd, assuming certain conditions. The conditions are (1) the average transmissibility of the Eutaw Formation is 15,000 gpd ped foot, (2) static water levels will be lowered to the top of the Eutaw Formation in the heavy-use belt, (3) no water is used on either side of this line, (4) the recharge area is 15 miles to the east, (5) static water levels in the pumping area are 300 feet lower than in the recharge area, and (6) no leakage occurs between the Eutaw and the aquifers above or below.

Obviously, the condition that all pumpage be restricted to a narrow belt is not practical. However, the 9-mgd potential for the Eutaw would remain generally applicable if part of the pumpage were distributed over the county. The assumption that no leakage occurs between the Eutaw and other formations is known to be untrue, but the amount of leakage is not known. Leakage and the resulting potential for recharge are greater in the northern part of the county; in this area the potential sustained yield of the aquifer is greater than indicated by the 9-mgd yield calculated for the county.

Uniform distribution of the 9-mgd potential of the Eutaw along a north-south line through the county would give 0.3 mgd (210 gpm) per mile. Wells yielding 500 gpm each on a sustained basis would need to be about 2½ miles apart along the north-south line. The 500-gpm pumping rates would cause the water levels in the pumped well to be about 70 feet lower than the water levels in the area between the pumped wells. More wells and lower pumping rates could yield the same quantity and would cause less difference between pumping levels and areal water levels.

In Tupelo and to the north, the Gordo probably will yield less water than the Eutaw, but southward from Tupelo the capacity of the Gordo to yield water increases. Along the south edge of Lee County, the Gordo may yield 10 times as much water as the Eutaw, with equal water-level drawdown. At Shannon and Nettleton, the Gordo probably can yield as much as 100 gpm per foot of drawdown to fully penetrating efficient wells. Well yields of more than 1,000 gpm and well-field yields of several million gallons per day should be possible in this area. In places where the aquifer is most productive in the Tupelo area, specific capacities of properly constructed wells should be as much as 20 gpm per foot of drawdown, and yields should be as much as 1,000 gpm. However, most wells in this area will have much lower yields.

The potential of the Coffee Sand may approach that of the Eutaw in the northwestern part of the county. None of the other geologic units have significant water-supply development potential.

With increasing pumping time and rate, the amount of dissolved solids in water in the Eutaw and Gordo Formations will probably decrease in the eastern part of the county, which is between the recharge area and the heavily pumped areas. West of the heavily pumped areas, the amount of dissolved solids will remain stable or increase. Depending on the quantity and source, leakage from the Coffee Sand and from the Gordo Formation will also affect the water quality in the Eutaw.

The dissolved-solids content of water in the Gordo Formation at Tupelo is higher than at other places in the county. Leakage from the Paleozoic rocks to the Gordo Formation probably is not great; therefore, mineralization is likely to decrease with pumping. However, if the higher mineralization is the result of leakage rather than incomplete flushing, it probably will increase with an increase in pumping.

SURFACE WATER

SOURCE OF STREAMFLOW

In Lee County, the greatest part of streamflow is the direct result of precipitation. Municipal and industrial waste water contribute to streamflow below Tupelo. Lee County streams are characterized by low base flow. As used in this report, base flow is the part of streamflow that is directly derived from ground-water sources.

The average annual precipitation in Lee County is approximately 53 inches (fig. 3). The portion contributed directly to streamflow is the total amount minus that lost to evapotranspiration, soil moisture, ground-water recharge, and animal growth. There is no simple way to determine the exact amount of streamflow derived directly from precipitation, but during a normal year more than 80 percent of all Lee County streamflow will be derived from this source.

The base flow of a stream is affected primarily by basin size, topography, and the hydraulic nature of the material in contact with the stream. Other things being equal, streams with larger drainage areas have larger base flows. Also, the greater the topographic relief within a basin, the greater the base flow.

Within Lee County, the nature of the material over which the streams flow is probably the most significant factor in explaining the pattern of base flow. Generally, two conditions must be met if a stream is to have a strong base flow. First, the material the stream cuts through must contain water, which it does in Lee County. Second, the material must be capable of yielding water to the stream. The sand and chalk at the surface in Lee County contain water; however, the sediments vary in the ease with which they release water.

The permeability of the chalk in western and southern Lee County (fig. 5) is low; therefore, little water is contributed to streams. Base flow in these areas is dependent upon the weathered soil above the chalk. The upper reaches of a few of the streams extend to sandy areas that support base flow. Chiwapa Creek extends the farthest into such an area and has the highest base flow of any Lee County stream.

Sand crops out in the northeast quarter of the county and along the east edge. Streams in these parts of the county have narrow valleys and generally small drainage areas. The sand hills support base flow in these streams, although at most places the dry-weather flow is small. Streams may cease flowing during extended dry periods owing primarily to the small drainage areas and the water demands of vegetation. All Lee County streams stop flowing during extended dry periods except where significant waste water is present to support flow.

To show how the nature of the surface material affects the flow of streams, flow-duration curves for continuous-record gaging stations in or near Lee County are presented in figure 15. The discharges have been divided by the drainage area in each case so that the effect of basin size is removed. This allows a direct comparison of flow characteristics of different streams. The locations of the gaging stations are shown in figure 16.

The sediments in the upstream basins of Euclautubba and Town Creeks are primarily chalk. Chiwapa Creek has its headwater area in sand hills, and the lower part of its basin is in chalk. West Fork Tombigbee River is formed by Town and Chiwapa Creeks. Upstream from Fulton, the Tombigbee River largely drains sand outcrop areas.

The flow-duration curve for the station on West Fork Tombigbee River near Nettleton shows a slight bend to the right at the lower end, indicating higher sustained dry-weather flow. This flow is not entirely the result of base flow. The station was the only one studied that was found to be influenced by waste-water disposal, and this influence probably caused the effect noted.

QUANTITY

DURATION AND FREQUENCY OF LOW FLOW

Unlike the ground-water-reservoir conditions, which reflect seasonal variations slowly, natural streamflow conditions may change rapidly. Most Lee County streams may be described as "flashy." The stage of these streams can rise tens of feet in a few hours as a result of a storm and, within hours after the rain ends, return to nearly the level it was prior to the storm. This characteristic is particularly true of streams that have much of their drainage area in chalk terrane.

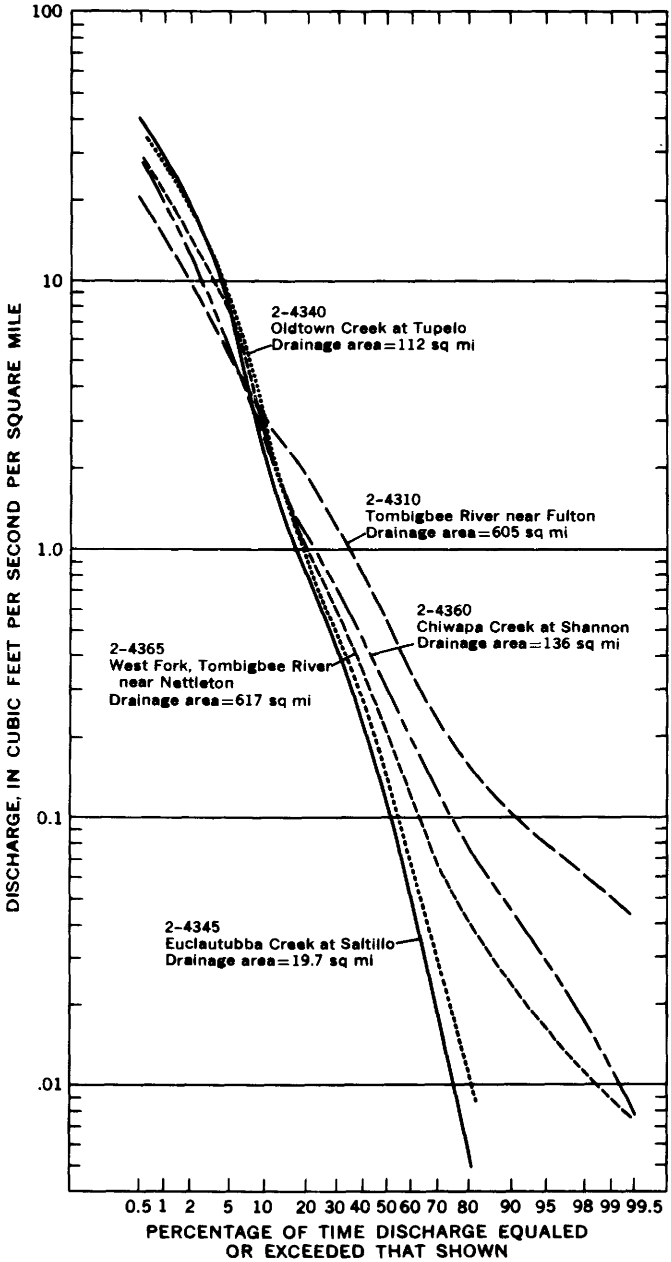


FIGURE 15.—Duration curves of daily flow for selected streams.

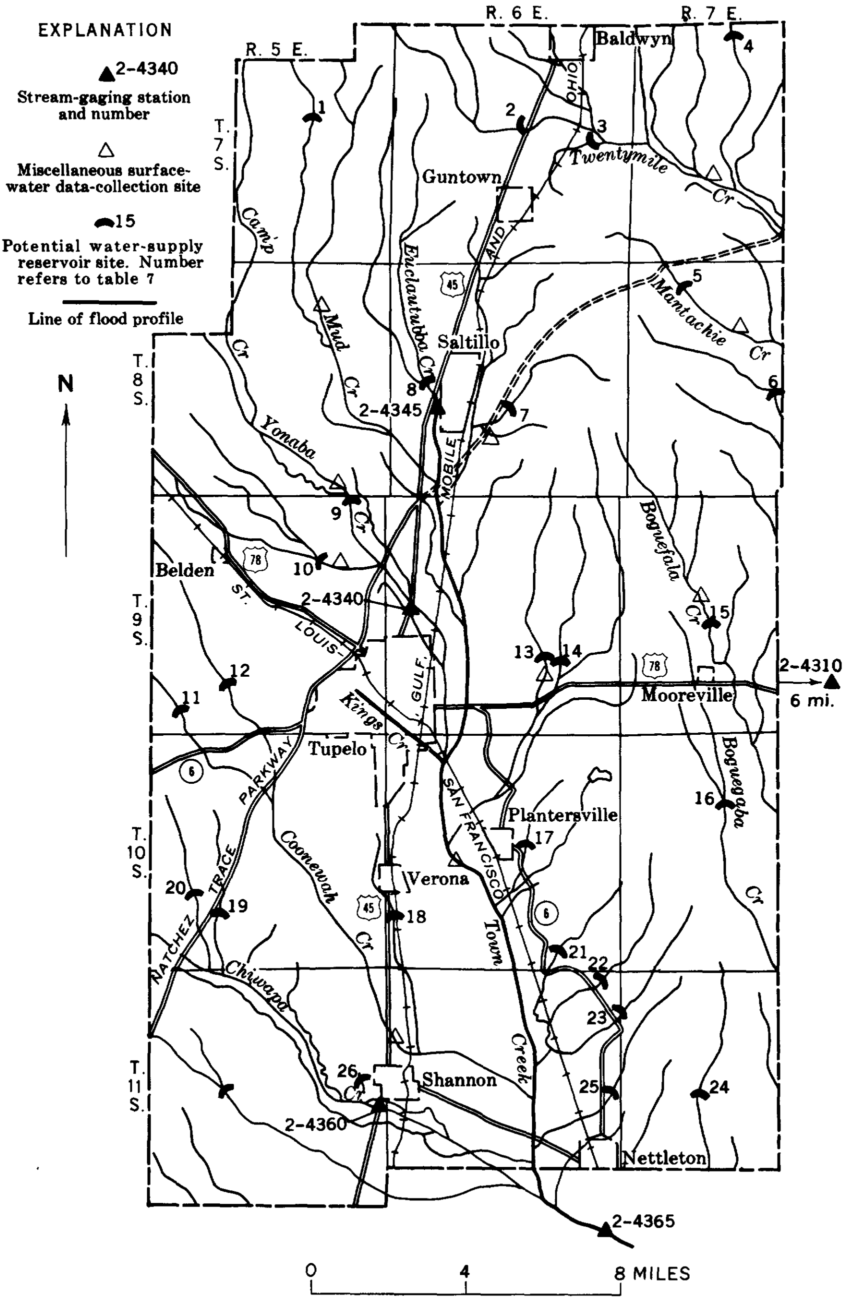


FIGURE 16.—Location of gaging stations, potential reservoir sites, and flood-profile sections.

Although it is impossible to say exactly when low-flow conditions will occur in an unregulated stream, it is possible to predict with reasonable accuracy the duration and probability of occurrence of a low-flow event. Three continuous record-gaging stations in Lee County and one just outside the county (fig. 16) have been operated for several years and the records from these stations have been statistically analyzed. Flow-duration and frequency data for each of these stations are presented in tables 5 and 6.

AVERAGE FLOW AND RESERVOIRS

With the exception of Chiwapa Creek, the mean annual runoff to Lee County streams is slightly more than 1,050 acre-feet of water for each square mile of drainage area. During very dry years the total runoff can be as little as 350 acre-feet per square mile, and during wet years more than 1,900 acre-feet can be expected for each square mile of drainage area.

Because the upper reaches of Chiwapa Creek are in an area of heavily wooded, sandy soil, the annual runoff for this stream is slightly less than that for other Lee County streams. The mean annual runoff in Chiwapa Creek is approximately 950 acre-feet per square mile of drainage area. The total runoff figures to be expected during dry and wet years for this stream are 300 and 1,750 acre-feet per square mile, respectively.

A reservoir loses water through evaporation, seepage, and plant growth. The total amount of water that may be withdrawn for use is therefore less than the total amount of water that the reservoir collects. If all water losses could be eliminated, the total amount of water that could be withdrawn from a reservoir would approach the mean annual runoff from the drainage basin (assuming that all runoff is stored in the reservoir, that the reservoir is filled prior to any withdrawal, and that the reservoir has sufficient capacity to carry its operation through dry years.) Since water losses cannot be completely eliminated, the true maximum yield of any reservoir is less than the mean annual runoff.

There are 27 potential water-supply reservoir sites in Lee County which merit further study (fig.16). The total amount of water that would be available at each of these sites is given in table 7.

Most of the sites shown are in areas where the relief is favorable to reservoir construction. Many sites are at points where tributary streams first enter the valleys of the larger streams into which they flow. These are sites which could be developed to provide irrigation water to crops grown on the relatively flat flood plains of the larger streams. A few of the sites have potential not only for water-supply development, but also for limited recreational development.

TABLE 5.—*Duration of flow at daily-record gaging stations in or near Lee County*

[Data are adjusted to period 1941–66 on basis of relation to data at station 2–4365]

Station No.	Station name	Drainage area (sq mi)	Flow, in cubic feet per second, which was equaled or exceeded for indicated percentage of time																
			99.5	99	98	95	90	80	70	60	50	40	30	20	10	5	2	1	0.5
2–4340	Town Creek at Tupelo	112	0	0	0	0	0.3	1.4	3.9	8.2	16	30	59	114	390	980	1,920	2,900	4,150
2–4345	Euclautubba Creek at Saltillo	19.7	0	0	0	0	0	.1	.4	1.0	2.4	4.7	9.2	17	52	160	382	605	900
2–4360	Chiwapa Creek at Shannon	136	.5	.8	1.5	3.3	5.8	11	18	29	44	66	106	163	360	740	1,650	2,780	4,040
2–4365	West Fork Tombigbee River near Nettleton	617	3.2	4.1	5.5	8.8	14	26	47	82	139	231	408	700	2,000	4,700	8,850	13,000	18,200

TABLE 6.—*Magnitude and frequency of annual low flow at daily-record gaging stations in or near Lee County*

[Data are adjusted to period April 1929–March 1958 on basis of relation to data at other gaging stations]

Station No.	Station name	Drainage area (sq mi)	Period (consecutive days)	Annual low flow, in cubic feet per second, for indicated recurrence interval, in years: 2	10
2-4340	Town Creek at Tupelo	112	7	0.1	0
			15	.1	0
			30	.7	.1
			60	1.4	.2
			120	5.4	.5
			183	14	1.3
2-4345	Euclautubba Creek at Saltillo	19.7	7	0	0
			15	0	0
			30	0	0
			60	.3	0
			120	1.2	0
			183	3.4	.2
2-4360	Chiwapa Creek at Shannon	136	7	3.3	.1
			15	4.6	.2
			30	6.1	.7
			60	10	2.2
			120	22	5.2
			183	37	9.8
2-4365	West Fork Tombigbee River near Nettleton.	617	7	8.7	3.2
			15	11	3.8
			30	14	4.8
			60	24	7.0
			120	60	12
			183	126	23

TABLE 7.—*Available water at potential reservoir sites, Lee County*

Site No. (see fig. 16)	Stream	Drainage area (square miles)	Water available in thousands of acre-feet per year: Normal year	Dry year	Wet year
[1] 1	Little Dry Creek	5.8	6.1	2.1	11.0
2	Campbelltown Creek	10.3	10.8	3.9	19.6
3	Campbelltown Creek Tributary	5.1	5.4	1.9	9.7
4	Dugger Creek	4.7	4.9	1.8	8.9
5	Mantachie Creek	7.8	8.2	3.0	14.8
6	Puncheon Creek	6.0	6.3	2.2	11.4
7	Sand Creek Tributary	7.3	7.7	2.8	13.9
[1] 8	Euclautubba Creek	18.6	19.5	7.1	35.3
9	Yonaba Creek	[2] 78.0	81.9	30.0	148.0
[1] 10	Town Creek	78.1	29.5	10.7	53.4
11	Coonewah Creek	22.4	23.5	8.5	42.6
[1] 12	Little Coonewah Creek	6.1	6.4	2.3	11.6
[1] 13	West Tulip Creek	5.5	5.8	2.1	10.4
[1] 14	Tulip Creek	10.2	10.7	3.9	19.4
15	Boguefolo Creek	8.1	8.5	3.1	15.4
16	Bognegaba Creek	7.9	8.3	3.0	15.0
17	Little Garrett Creek	4.2	4.4	1.6	8.0
18	Louisa Creek	1.3	1.4	.5	2.5
19	Gormans Branch	3.0	3.1	1.1	5.7
20	Reeds Branch	3.5	3.7	1.3	6.6
21	Smith Creek	5.7	6.0	2.1	10.8
22	Carmichael Creek	4.7	4.9	1.8	8.9
23	Leeper Creek	4.3	4.5	1.6	8.2
24	Cowpenna Creek	5.3	5.6	2.0	10.0
25	Smith Creek	3.6	3.8	1.3	6.8
26	Chinopo Creek Tributary	1.6	1.7	.6	3.0
27	Tubbalubba Creek	6.5	6.8	2.5	12.3

[1] Site coincides with proposed Town Creek watershed reservoir site.
[2] Approximate.

FLOOD HAZARD

Wherever man utilizes land along natural stream channels, he faces the possibility of periodic flooding. Little can be done to prevent major floods, but flood damage can be reduced by recognizing the danger and by establishing an appropriate flood-control program. Commonly accepted measures for reducing flood damage include:

1. Evacuation of threatened area prior to flooding.
2. Construction of flood walls or enlargement of levees to confine floodflow to a predetermined channel.
3. Use of diversion channels or floodways to reduce floodflow past developed areas.
4. Construction of reservoirs to hold back portions of flood water and reduce peak flow.
5. Channel improvements to increase velocity of flow and thus reduce peak stage.

Most flood-control projects involve a combination of one or more of these measures with a land-management program designed to reduce storm runoff.

Before a flood-control project can be designed to provide adequate protection for an area, it is necessary to know what the flood danger is. By studying past flood events, it is possible to estimate, within reasonable limits, the stage and discharge of future floods. Such an estimate ordinarily is based on the assumption that conditions such as climate, degree of urbanization, and type of land use will not vary in the future from what they have been in the past; however, by studying the effects that changing conditions have had in other areas, it may be possible to adjust the estimates of flood danger to allow for anticipated changes in the area for which the flood-control project is being considered.

In past years, floods on Lee County streams have caused extensive property damage and have been a threat to public health and safety. On the night of April 10–11, 1962, more than 7 inches of rain fell at Tupelo during an 8-hour period and produced a record-breaking flood on Kings Creek. The greatest flood of record on Town Creek occurred in March 1955. Profiles of the March 1955 flood along Town Creek and the April 1962 flood along Kings Creek have been developed for the Tupelo area (figs. 17, 18).

Additional flood information for Lee County streams is available in earlier U.S. Geological Survey reports (Neely, 1964, p. 78–89; Neely, 1967, p. 3 and 5; Wilson, 1964, p. 93). Flood-frequency curves may be used to estimate the magnitude and frequency of future floods at a few sites in Lee County (Wilson and Trotter, 1961). Estimates may not be reliable for regulated streams; very small drainage areas;

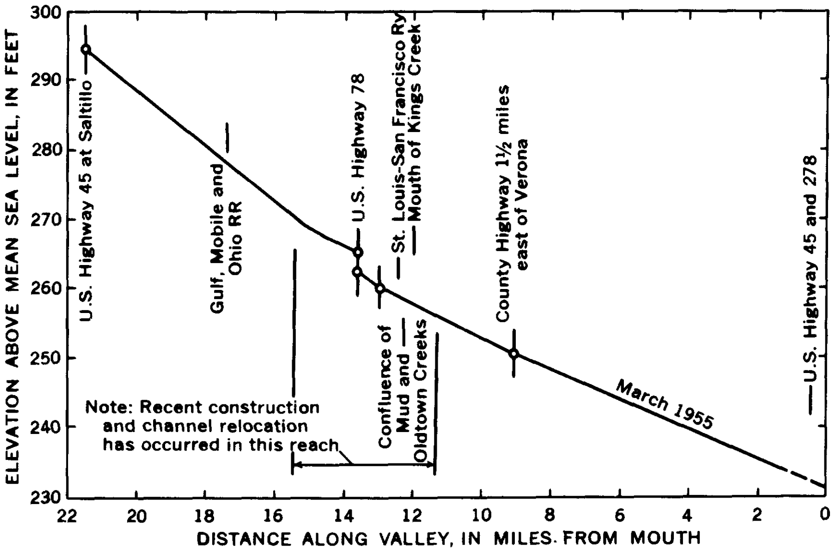


Figure 17.—Flood profile along Mud and Town Creeks.

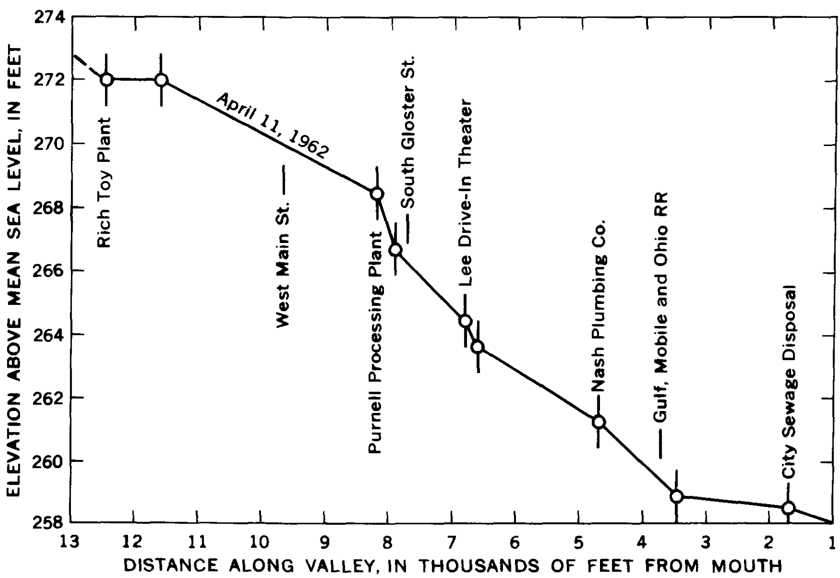


Figure 18.—Flood profile along Kings Creek.

or sites near mouths of streams draining into larger streams where variable backwater effects may occur.

As it pertains to flood hazard, urban development is a "two-headed monster." As areas become urbanized, more and more targets for flood damage are erected. Lowlands, which may have been avoided because of flood danger during the early stages of urban growth, become too valuable to be left idle. More and more business places, homes, churches, and public and industrial works are constructed in locations where they may be within the reach of floodwaters. At the same time, roof, pavings, and changes in land use tend to increase the magnitude of floods, making additional areas susceptible to flood damage.

In recent years, growth in the Tupelo area has proceeded at an increasing rate. New industries have moved into the industrial areas along the railroads north and south of town. New roads have been constructed across and along the valley of Town, Mud, and Kings Creeks. The urban area has expanded farther into the upstream drainage basins of the major water courses. Many areas have been protected by constructing ring dikes and levees. All these activities have the potential to increase the flood hazard.

On the other hand, channel improvements have been made in the vicinity of Tupelo. Additional channel work and the construction of several flood-retention reservoirs are included in work plans developed by the Soil Conservation Service of the U.S. Department of Agriculture (1963). When these plans are fully implemented, the lower flood peak stages should result in a substantial reduction in flood hazards at Tupelo.

QUALITY

CHEMICAL

The chemical quality of water in Lee County streams varies with location and with stream discharge. If it were not for the industrial and municipal waste which enters some streams, all water in Lee County streams could be classified chemically as good (table 8).

Figure 19 shows the specific conductance of stream water under low-flow conditions. Generally the streams that drain sandy areas have lower specific conductance values than streams that drain chalk outcrop areas.

When surface water is stored, some change in its quality is to be expected. Odor, taste, and color will be affected by any organic material left in the reservoir area; temperature extremes will be less variable; mineralization of the stored water will be more constant than that of the natural streamflow. These and other changes are discussed in recent references (Fair and Geyer, 1965; U.S. Public Health Service, 1965).

TABLE 8.—*Chemical analyses of water from streams*

[*Results in mg/l except as indicated*]

Date of collection	Discharge (cfs)	Silica (SiO_2)	Iron [1] (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Specific conductance in micromhos at 25° C	pH (hydrogen ion concentration)	Color [2]
2-4339. Yonaba Creek near Saltillo																		
11-16-66	1.9	5.0	0.00	35	2.6	6.5	5.7	108	19	6.0	0.3	0.3	138	98	9	232	7.0	20
2-4339.96. Town Creek near Tupelo																		
11-16-66	0.1	8.4	0.00	63	7.9	11	4.7	218	25	6.9	0.4	0.3	243	190	11	409	7.5	20
2-4340. Oldtown Creek at Tupelo																		
12- 6-67	11	7.5	0.02	47	1.9	4.8	3.0	126	28	6.8	0.1	0.0	162	125	22	284	7.0	10
2-4342.5. Tishomingo Creek near Saltillo																		
11-12-59	0.30	1.1	0.06	56	2.6	2.6	4.8	100	70	5.5	0.2	0.6	204	150	68	301	7.2	11
5-31-60	.57	1.5	.00	46	2.6	5.3	1.9	102	40	9.0	.1	.4	172	126	42	267	7.2	10
2-4345. Euclautubba Creek at Saltillo																		
12- 6-67	3.9	10	0.00	53	1.8	5.7	3.3	144	24	7.2	0.1	0.1	179	140	22	316	7.1	5
2-4355. Oldtown Creek near Verona																		
11-16-66	13.7	12	0.01	45	6.7	67	9.1	138	34	105	1.6	6.1	357	140	27	636	6.8	20

2-4365. West Fork Tombigbee River near Nettleton

10-20-58	70	3.0	0.14	54	4.7	15	0.8	172	17	16	0.1	2.0	220	154	13	339	7.3	15
3- 4-59	260	1.0	.00	44	2.6	7.8	1.2	120	25	9.2	.3	1.3	168	120	22	260	7.2	7
6-24-59	152	2.0	.00	54	4.1	12	2.1	162	21	12	.4	4.1	200	152	18	329	7.4	10
9- 4-62	22	4.7	.02	41	1.6	7.6	3.2	116	14	13	.3	1.9	167	109	14	276	6.8	5
2- 5-63	244	1.1	.06	41	2.3	7.8	1.8	106	27	9.5	.3	1.3	151	112	25	264	7.1	30
9-18-63	32	8.4	.01	54	3.7	26	3.5	152	29	36	.5	4.8	243	150	25	419	7.7	5
10-16-63	16	7.3	.02	51	4.5	43	3.0	165	14	55	.6	6.2	305	146	11	504	7.3	10
12-13-63	1,750	20	.02	28	1.2	4.4	2.3	82	13	4.7	.2	2.0	124	75	8	163	6.8	30
10-16-64	31	6.8	.01	44	3.2	29	3.6	132	17	37	1.6	4.3	219	123	15	375	7.0	15
3-11-65	397	7.3	.02	49	1.8	5.8	.8	131	23	8.0	.5	.1	179	130	23	285	6.8	5
8-13-65	12	7.7	.01	47	3.1	32	4.1	119	22	51	2.2	3.0	256	130	32	454	6.4	15
12- 5-67	429	8.4	.02	49	2.1	6.0	3.9	135	18	11	.1	.1	175	131	20	306	6.8	10

[1] Iron in solution at time of analysis.
[2] Color data were obtained by comparing color of water sample to the platinum-cobalt scale.

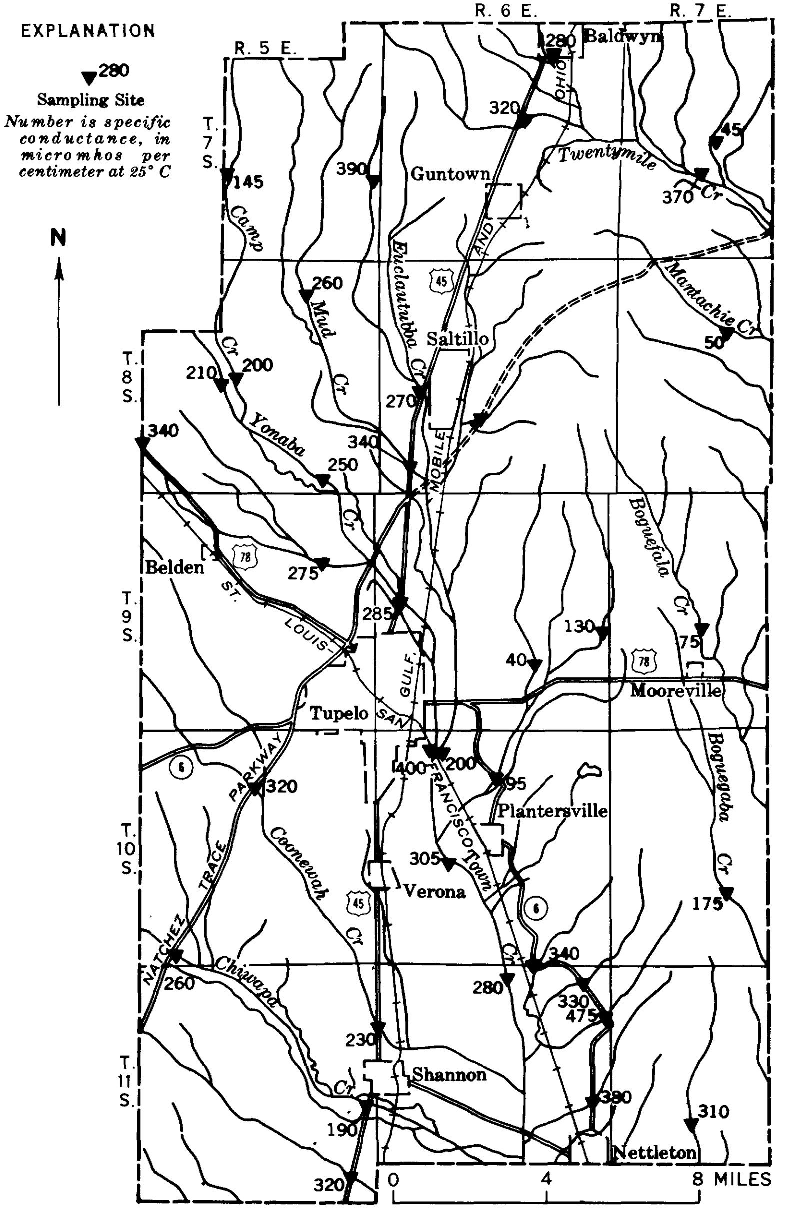


Figure 19.—Specific conductance of streams under low-flow conditions, June 4, 1968.

SEDIMENT

Every stream carries some suspended sediment; the amount transported by Lee County streams is relatively small. The average annual sediment discharge for streams draining the chalk outcrop area ranges from about 0.23 to nearly 0.75 acre-foot per square mile of drainage area. Areas under cultivation and areas having great relief have large sediment yields; pastureland and wooded areas have small yields.

The sediment yield of the sand hills of northeastern and eastern Lee County is not known. These hills, however, are generally wooded and probably produce less than 0.25 acre-foot of sediment annually per square mile of drainage area.

The largest part of the sediment load is transported as the streams rise in reponse to storm runoff. The peak sediment concentration is reached 3–5 hours ahead of the flood crest for all but the smallest streams. Virtually no suspended sediment is transported by flow which does not exceed the 50 percent flow-duration discharge.

WATER MANAGEMENT CONSIDERATIONS

Lee County has sufficient fresh water to meet future needs if it is efficiently managed; however, if the present trends in usage are continued, this valuable resource may soon be in short supply in some parts of the county. Ground-water pumpage is so concentrated in the Tupelo area that water levels are declining at the rate of several feet per year, while nearby surface-water sources go unused. A large part of the industrial water pumpage is used once for cooling and then discharged as waste. Pollution of some streams makes the water unfit for use at points downstream.

A water-management program for Lee County must consider social and economic factors as well as hydrology. Many of the hydrologic-data requirements for the development of a water-management plan have been presented here, but more detailed information is required at specific locations.

In the course of the water-resources investigation in Lee County, some observations made were not important in appraising the water resources, but they may benefit city and county planners and others who may be concerned with the development of water supplies. Elaborations on some of these observations follow.

USE OF MULTIPLE AQUIFERS

Use of all aquifers available at a site should be considered in a water-management plan. Each aquifer should be evaluated by using such criteria as depth of aquifer, well yields, quality of water, water levels, and cost of well installation. These are some of the principal factors affecting the cost of delivering water of good quality. In some cases, one of these factors may outweigh all other considerations.

If the most suitable aquifer does not yield sufficient water for all needs, then less desirable aquifers must also be used. At Tupelo, water from the Eutaw Formation needs no treatment, but the Eutaw does not yield as much water as desired without excessive drawdown; therefore, the Gordo Formation is also tapped, even though water in the Gordo usually contains objectionable concentrations (more than 0.3mg/l) of iron. Often a mixture of water from two or more sources provides adequate quantities and acceptable quality.

ARTIFICIAL RECHARGE OF AQUIFERS

No attempt at artificial recharge of aquifers has been made in or near Lee County; however, there is evidence that water is moving from one aquifer to another through the many uncased wells in the northeastern part of the county. Additional recharge may be feasible in this area through a system of small surface reservoirs designed to hold overland flow until it can be induced to enter the ground-water system by means of natural seepage and (or) a system of wells.

It may be feasible to partially recharge the Eutaw and Gordo aquifers in the vicinity of Tupelo with water that would otherwise be wasted. A large volume of the industrial water demand is for cooling, and in present practice this water is used once and discharged to the streams. If additional use cannot be found for this water, it might be returned to the aquifers through recharge wells.

Several methods of artificial recharge have been employed in various parts of the nation, and a great amount of literature is available on the subject (Todd, 1959). Determination of the best method for use in Lee County would require detailed study and field tests of local conditions.

USE OF RESERVOIRS

Surface-water reservoir sites are not a renewable resource. Within any area there exists a finite number of locations suitable for reservoir construction. The needs of the community should be carefully considered before any site is utilized, since the misuse of even one reservoir site could adversely affect the future water-resources development for a large area.

Reservoirs can be constructed to serve any one need or a combination of several varied needs. The potential uses for reservoirs in Lee County are for industrial, municipal, and irrigational water supply; recreation; low-flow augmentation; and flood control.

The use of a reservoir dictates the design and operation of the reservoir-control structure. A flood-control reservoir should be empty prior to a storm so that the full capacity is available to reduce floodflow. By contrast, a water-supply reservoir should be full as much of the time as possible so that its entire capacity is available to meet any water demand.

In the operation of a recreation reservoir, it is desirable to maintain a nearly constant pool elevation as much of the time as possible. Little flood water is retained in such a reservoir, and little water is released during rainless periods.

Irrigation and low-flow augmentation are seasonal needs. Reservoirs designed to meet these needs may be full or empty during a large part of the year without affecting the usefulness of the structure so long as water is available during the time of need.

Despite the contradictions of design and operation, reservoirs may be built to meet more than one need. The usual design and pattern of operation of these reservoirs reflects a compromise between the various needs.

Both single-purpose and multiple-purpose reservoirs can claim certain advantages to their use. A single-purpose structure can more fully satisfy the needs of its designed use than can a multiple-purpose structure. The initial cost of such structures is also less. Multiple-purpose reservoirs are usually more adaptable to future water-development needs than single-purpose reservoirs.

CHANNEL LOSSES BELOW RESERVOIRS

A water-supply reservoir cannot always be constructed at the place where the water will be used. In this situation, some means of transporting the water to the user must be provided. If a reservoir is upstream from the point of use, it is often possible to use the natural stream channel to transport the water.

During extended dry periods, most Lee County streams cease flowing. The primary reason for this is the demand for water exerted by vegetal growth near the water course. This interception of the ground water before it reaches the stream reduces the base flow. Vegetation growing at the edge of a stream probably also obtains some water from the stream itself.

If a natural channel is used to transport water from a water-supply reservoir to a downstream user, vegetal growth near the channel should be controlled to minimize water losses. Evaporation from the surface of the stream will occur, but it is a minor loss.

Lee County streams do not lose water to the ground-water system under normal conditions. The chalk areas are impermeable, and therefore significant seepage from the streams does not occur. In the sandy areas, the water table is higher than the stream surfaces, so water movement is toward and into the streams except during periods of flooding.

SUMMARY AND CONCLUSIONS

All water supplies in Lee County are obtained from wells. Groundwater levels have declined 3–5 feet per year in the Tupelo area for many years and probably will continue to decline if the water use continues to increase as expected in the future. Water use in and near Tupelo in 1967 was about 7 mgd; about 4.5 mgd was pumped from the Eutaw Formation, and almost 2.5 mgd from the Gordo Formation. About 1 mgd was pumped in Lee County outside the Tupelo area, mostly from the Eutaw Formation. The quality of the water is best in the Eutaw Formation, but water in the Gordo Formation and Coffee Sand meets the needs of most users, with little or no treatment.

Full development of the aquifers in Tupelo might yield double the 1967 withdrawal if no significant increases occur at other places in Lee County; however, water levels would decline into the aquifers and necessitate replacement or reworking of wells and pumping equipment.

Full ground-water development along a north-south line through Tupelo would produce a total of about 10 mgd in Tupelo. The northern segment of this line, Saltillo to Baldwyn, also would yield about 10 mgd. Between Verona and Nettleton, the Eutaw Formation would yield 3 or 4 mgd and the Gordo Formation might yield more than 20 mgd. Pumpage equal to the present use at Tupelo could be centered any place in Lee County, if there were no other withdrawals.

Surface reservoirs could be constructed at many sites in the county and may become important future sources of water in areas where water use is high. Although all streams in Lee County have been observed dry at some time, reservoirs on these streams could supply continuously much more water than could be obtained from the ground (table 9).

Artificial recharge of the aquifers should be considered in any long-range water management plan for Lee County.

TABLE 9.—*Summary of water resources at selected locations*

Location	Elevation (ft)	Ground water: Formations containing aquifers: Formation	Depth to top (ft)	Depth to bottom (ft)	Selected wells (data for wells may be found in tables 2, 3, 5)	Theoretical wells; probable maximum specific capacity (gpm per ft)	Water level below land surface 1967 (ft)	Water quality: Selected analyses (table 4)	Water quality: Dissolved-solids concentration (mg/l)	Surface water: Nearest reservoir sites (numbers refer to fig. 16)	Water normally available: Thousands of acre-ft annually	Water normally available: Mgd
Baldwyn	400	Coffee Sand	0	200	B43	3?	60	B30	150	2	10.8	9.7
		Eutaw	300	500	C1	5	80	C1	160	3	5.4	4.8
		Gordo	500	540		5	70		,170	4	4.9	4.3
Belden	340	Coffee Sand	140	340	G26	2?	60	G26	250	10	29.5	26.3
		Eutaw	440	680	G23	7	120	G23	180–270			
		Gordo	680	790		10	120		300?			
Guntown	400	Coffee Sand	0	200	B24	3?	40	B24	150	2	10.8	9.7
		Eutaw	300	530	B11, B12, B19	7	100	B12, B19	150–200	3	5.4	4.8
		Gordo	530	580	B22	7	100	B22	200			
Mooreville	400	Eutaw	150	420	J13, J31a	5	140	J13, J31a	100–150	15	8.5	7.5
		Gordo	420	550		10	160		100			
Nettleton	260	Eutaw	80	350	O15, P18	7	40	O15, P18	150–200	24	5.6	5.0
		Gordo	350	610	O14, O20	80	40	O14	50–100	25	3.8	3.3
Plantersville	325	Eutaw	225	465	L17, L18	7	125	L17, L18	120–200	17	4.4	3.9
		Gordo	465	635		10	115		200			
Saltillo	320	Coffee Sand	0	160		2?	40		150	7	7.7	6.8
		Eutaw	260	500	E22, E27	7	60	E22, E27	150–250	8	19.5	17.4
		Gordo	500	570	E14	5	60	E14	250			
Shannon	325	Eutaw	285	535	O22, O28	8	125	O22, O28	150–250	26	1.7	1.5
		Gordo	535	800		40?	115		150			
Tupelo	270	Eutaw	230	470	G12, H19, H28, L2	7	150	G12, H19, H28	150–250	9	81.9	73.1
		Gordo	470	620	H30b, H42, L19, L20	10	150	H30b, H42 L19, L21	300	10	29.5	26.3
Verona	300	Eutaw	280	520	K13, K29, L41, O26	8	120	K13, K29, O26	150–250	18	1.4	1.2
		Gordo	520	750		20?	100		250			

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