STATE OF LOUISIANA
DEPARTMENT OF PUBLIC WORKS

Water Resources
TECHNICAL REPORT NO. 8

WATER RESOURCES
OF THE RUSTON AREA, LOUISIANA

Prepared by

UNITED STATES DEPARTMENT OF THE INTERIOR
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in cooperation with

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By

T. H. Sanford, Jr.
U.S. Geological Survey

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WATER RESOURCES OF THE RUSTON AREA, LOUISIANA

By T. H. Sanford, Jr.

ABSTRACT

Ground water, the present source of water supply in the Ruston area, is adequate to meet the present and projected needs through the year 2000, despite the proposed large increase in ground-water use at nearby Hodge. The principal aquifer, the Sparta Sand, is the only aquifer capable of yielding large quantities of fresh water in this area. The water level at Ruston has declined 175 feet since 1920; most of this decline is attributed to industrial pumpage at El Dorado, Ark., and at Monroe, Bastrop, and Hodge, La. Aquifer dewatering, which began in the mid-1960's, will increase the yield from storage manyfold, and thus the rate of water-level drawdown will decrease significantly.

The quality of water from the Sparta is generally good, but treatment is required for a "red water" problem believed to be caused by a combination of slightly corrosive water and iron bacteria in the water system.

As an alternative or complementary source, Bayou D'Arbonne Lake, 15 miles northeast of Ruston, can supply water of good quality. The lake has a capacity of 130,000 acre-feet (42.4 billion gallons) and can supply about 200 million gallons per day of water.

INTRODUCTION

Ruston gets its water supply from the most extensive and productive aquifer in northern Louisiana, the Sparta Sand. Water levels in the Sparta have been declining regionally for many years, principally because of large-scale industrial pumping from the aquifer in northern Louisiana and southern Arkansas. This study, which defines the geohydrology of the area and evaluates past and current effects of pumping, was made to predict future effects of pumping. Additional objectives of the study were to evaluate problems resulting from declining water levels and to investigate other sources of water supply.

Previous publications describe the regional hydrology of the Sparta Sand. The hydrologic significance of the lithofacies of the Sparta Sand in Arkansas, Louisiana, Mississippi, and Texas is described by Payne (1968).

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Hosman, Long, Lambert, and others (1968) describe the Tertiary aquifers, including the Sparta Sand, in the Mississippi embayment. Surface- and ground-water resources in the eastern part of the Ruston area are discussed by Gaydos, Rogers, and Smith (1973, in press).

The Ruston area, in north-central Louisiana (fig. 1 and pl. 1), comprises an area of 144 square miles in south-central Lincoln Parish and a small part of north-central Jackson Parish. The area is a dissected plateau characteristic of the upland topography of the West Gulf Coastal Plain. Ruston is on the drainage divide between Bayou D'Arbonne and the Dugdemona River (fig. 1). The streams that dissect the surface form steep-sided, flat-bottomed valleys. The 200 feet of relief in the Ruston area is between altitudes of 140 to 340 feet above mean sea level.

At Ruston, the municipally owned water system pumped an average of about 3 mgd (million gallons per day) in 1970, and the State-owned Louisiana Tech University system pumped an average of about 0.5 mgd. In addition, seven other public water systems supply the Ruston area. They are Grambling (0.10 mgd), Grambling College (0.37 mgd), Ruston State School (0.03 mgd), Mount Olive Water District (0.01 mgd), Greater Ward One Waterworks District (0.01 mgd), Water District No. 3 (0.01 mgd), and Riser Road Water District (0.01 mgd).

The population of Ruston has increased at a steady rate to 17,265 in 1970 and has more than doubled since 1940.

The climate of north-central Louisiana is mild and humid. The average annual temperature is 66°F (19°C), and the average annual precipitation is about 52 inches.

This study was made by the U.S. Geological Survey in cooperation with the Louisiana Department of Public Works. Mr. E. J. Taylor, Chief of the Water Resources Section, Louisiana Department of Public Works, provided data and advised in the study. The collection of basic data was facilitated by the full cooperation of the city of Ruston (through the office of Mr. Ben Clary) and Louisiana Tech University (through the office of Mr. Jack Potter). Larry D. Fayard, hydrologist, U.S. Geological Survey, made field determinations of pH and oxidation potentials of water at each well site and analyzed the chemical-quality data for the report. Richard A. Rohlf, hydrologist, U.S. Geological Survey, analyzed the surface-water records for the report. John Ferris, S. S. Papadopulos, and P. C. Trescott, research hydrologists, U.S. Geological Survey, furnished technical advice on aquifer modeling and on use of the Trescott iterative digital model for aquifer evaluation.
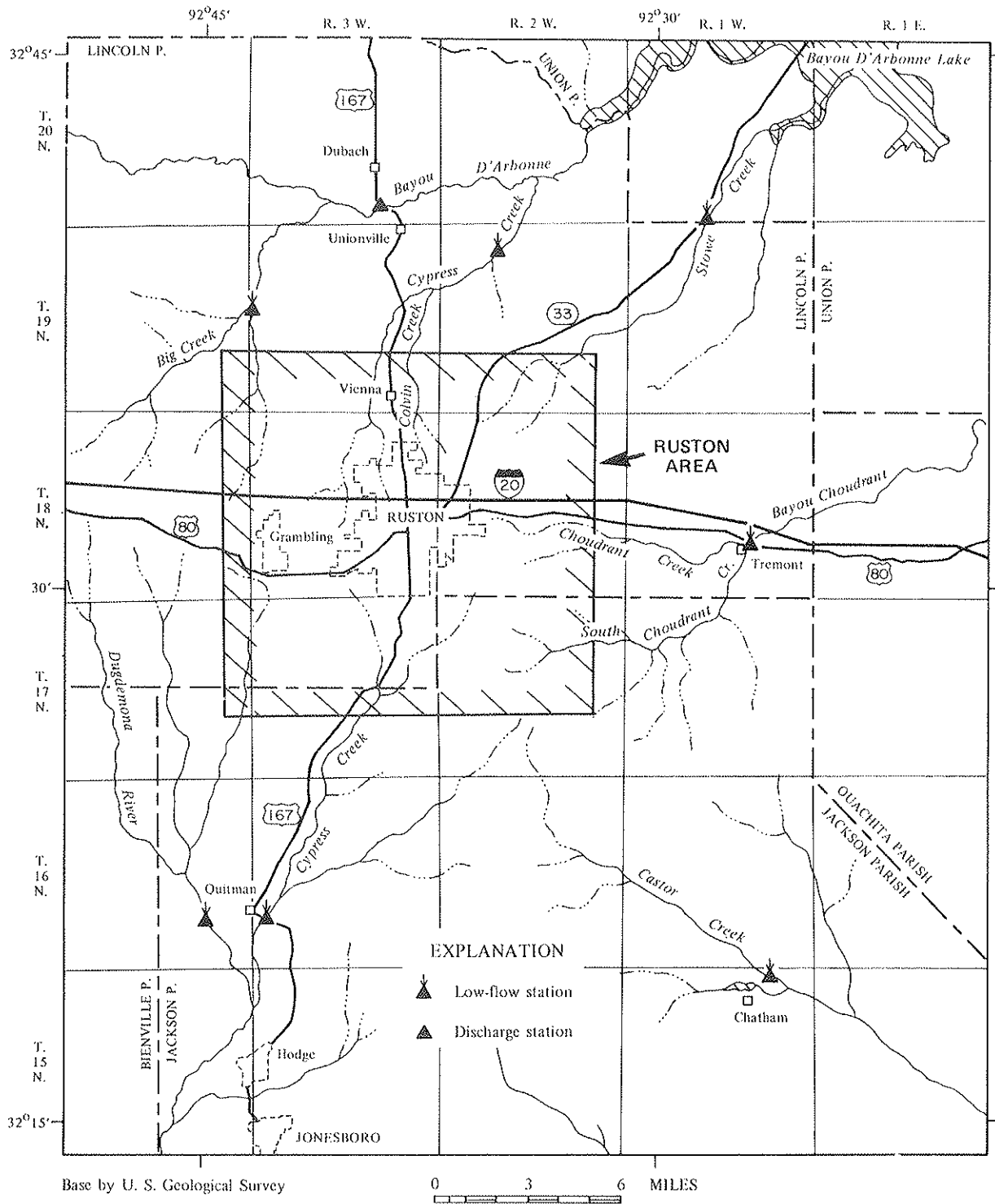
Figure 1.--Location of area, principal drainage, and surface-water-data stations in north-central Louisiana.

GENERAL GEOHYDROLOGIC FRAMEWORK

Ruston is on the west limb of the Mississippi structural trough, and regionally the geologic formations dip gently to the east. The formations in the fresh-water zone include (from youngest to oldest) the Cockfield Formation, the Cook Mountain Formation, and the Sparta Sand--all of the Claiborne Group of Eocene age (fig. 2). The base of fresh water, which is at or near the base of the Sparta, ranges from 650 to 900 feet below land surface in the Ruston area.

The lower Cockfield and upper Cook Mountain beds crop out in the Ruston area (fig. 2 and pl. 1). The Cockfield beds form and cap the rolling hills; the underlying Cook Mountain beds form the steep-sided, flat-bottomed stream valleys. The Sparta occurs in the subsurface in this area; it is overlain by the Cook Mountain and underlain by the Cane River Formation (fig. 2).

The Cockfield Formation generally is sand interbedded with silt, clay, and lignite. Erosion has removed the formation in part of the Ruston area; where present, it ranges from a few feet to about 140 feet in thickness. The base of the formation is at an altitude of between 200 and 260 feet above mean sea level.
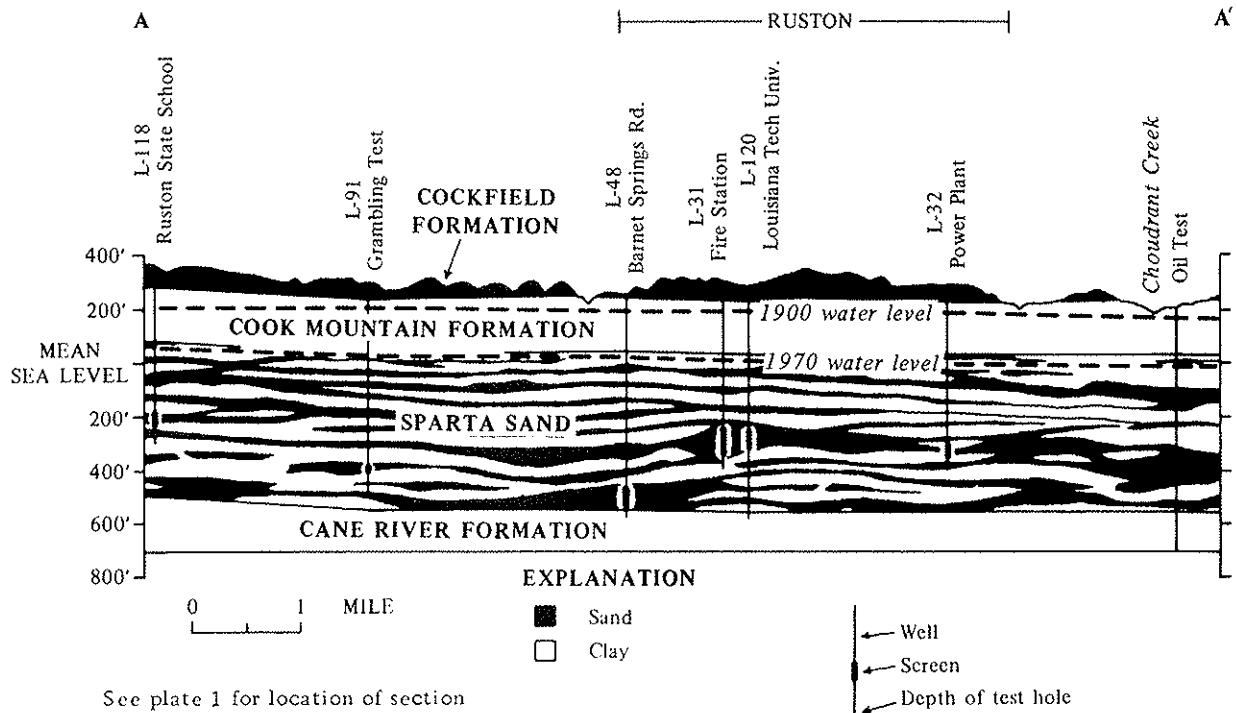
Figure 2.--East-west geohydrologic section.

Cockfield sand, generally fine grained and silty, occurs in beds up to 30 feet thick. Locally, the sand may be well sorted and fine to medium grained. The saturated beds yield water in amounts adequate for small domestic supplies but are neither thick enough nor extensive enough to yield large quantities.

The Cockfield and Sparta are separated by the relatively impermeable Cook Mountain Formation, which retards movement of water between the two formations. Before pumping began, water levels in the Sparta were already below the base of the Cockfield. Subsequent pumping of water from the Sparta has not noticeably affected the water level in the Cockfield at Ruston.

The Cook Mountain Formation is mostly clay but contains fine glauconitic sand and silt, fossils, and calcareous concretions. The thickness ranges from about 100 feet where erosion has removed the upper beds to 200 feet in the subsurface where the entire formation is present. The base of the formation in the Ruston area ranges from about sea level to nearly 100 feet above sea level. Fine-grained silty sands in the upper part of the Cook Mountain are as much as 30 feet thick and are adequate to supply small domestic wells.

A massive clay ranging from 100 to 140 feet in thickness occurs in the lower part of the formation and is continuous throughout the Ruston area. This relatively impermeable clay effectively retards the vertical movement of water and is the regional confining bed for sands in the basal Cook Mountain and for the underlying Sparta Sand. The altitude of the base of the confining clay in the Cook Mountain ranges from a low of 5 feet below mean sea level in the central part to nearly 100 feet above in the northwest corner of the area (pl. 1).

Pumping from the Sparta probably has not affected the water level in the upper Cook Mountain for the same reason the Cockfield water level has not been affected. However, pumping from the Sparta has had a measurable effect on the water level in the basal Cook Mountain sands, which are in direct hydraulic connection with the Sparta. An observation well (L-123) was screened in a Cook Mountain sand near the middle of the formation at the Ruston airport in 1970 and will be used to monitor the water-level changes above the massive clay.

The Sparta Sand crops out on both the west and east sides of the Mississippi embayment and dips toward the axis of the embayment and southward toward the gulf. The dip in the project area is to the east. Ruston is about 20-25 miles northeast and east of the nearest Sparta outcrop (fig. 3). Direct recharge to the aquifer occurs by precipitation on the outcrop area.

The Sparta Sand, as the formation name implies, is mostly sand with interbedded silt, clay, and lignite. Although the sand beds are discontinuous and individual sands cannot be traced for any distance, they are mostly interconnected and form thick sandy zones that are areally extensive. The formation is about 600 feet thick in the Ruston area, and the depth to the base ranges from about 720 to 940 feet below land surface.
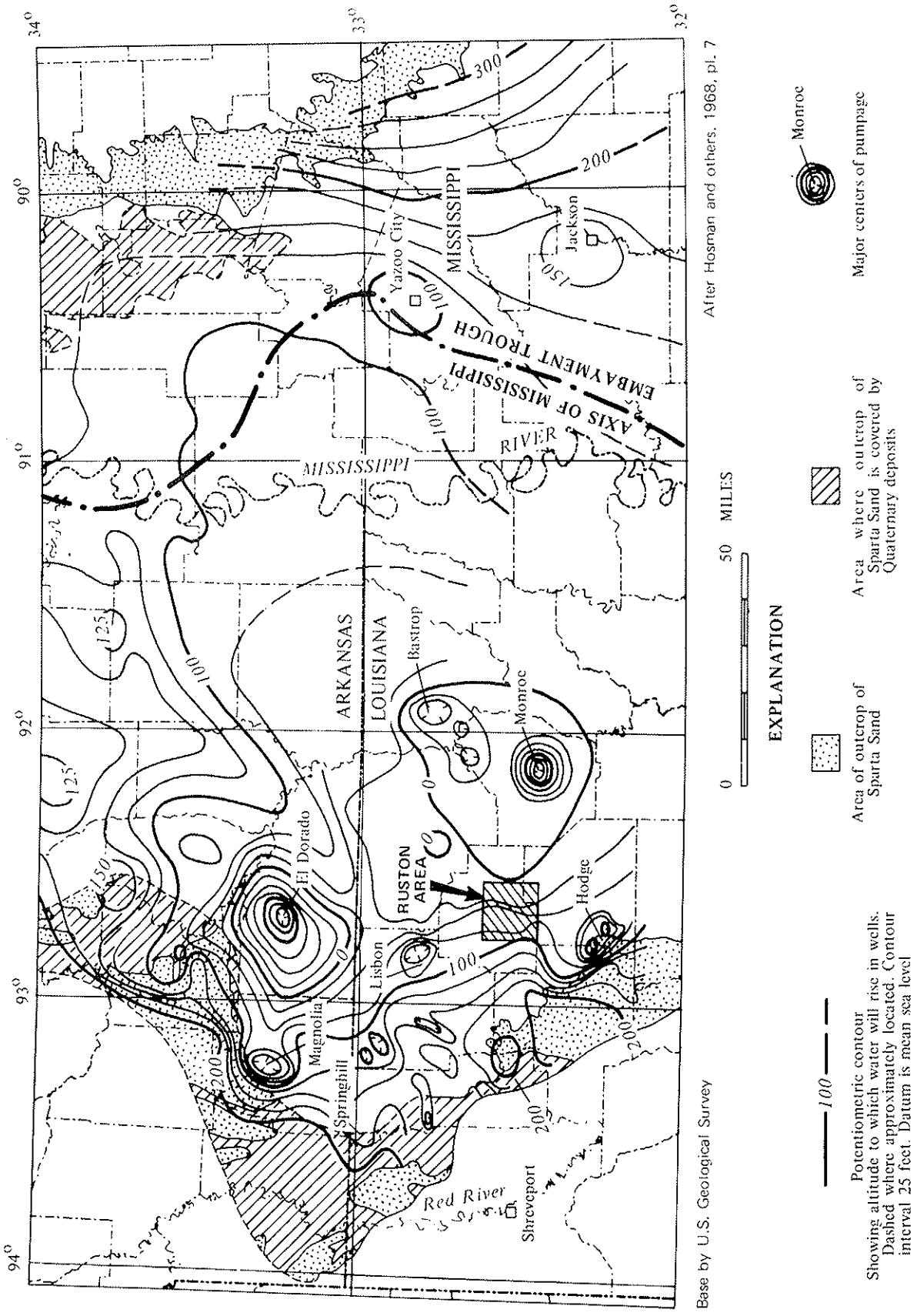
Figure 3.--Potentiometric surface (1965) and outcrop of the Sparta Sand.

Base by U.S. Geological Survey

After Hosman and others, 1968, pl. 7

EXPLANATION

—— 100 ——

Potentiometric contour
Showing altitude to which water will rise in wells.
Dashed where approximately located. Contour
interval 25 feet. Datum is mean sea level

Area of outcrop of
Sparta Sand

Area where outcrop of
Sparta Sand is covered by
Quaternary deposits

Major centers of pumpage

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Depressions in the potentiometric surface have formed at the major centers of pumping from the Sparta (fig. 3). The typical development pattern in the Sparta is to screen wells in single massive sands in the middle or lower part of the aquifer. Although some head difference between sands is created as a result of this type of development, the differences do not appear to be large. At some distance from pumping centers where the head differences can be readily measured, the water level of the upper part of the Sparta may be several feet higher than that of the middle or lower sands.

The water level in the Sparta at Ruston (1970) is about at sea level, ranging from 200 to 340 feet below land surface. Generalized contours on the potentiometric surface of the Sparta in the Ruston area (pl. 1) show a slope to the east. Although Hodge is the nearest major center of pumping to Ruston, the eastward slope indicates the dominating influence of the larger Bastrop-Monroe pumping cone on the Ruston area.

GROUND WATER IN THE SPARTA SAND

Description and Aquifer Characteristics

The Sparta Sand is the only aquifer in the Ruston area that alone is capable of supplying enough water for municipal use. The aquifer consists mostly of fine-grained sand. The grain size increases slightly with depth, both in the formation and in individual beds. Very fine or fine-grained sand may occur at any depth in the formation, but beds containing medium-grained sand occur only in the lower half of the formation. The sands are well sorted, having a uniformity coefficient[1] generally less than 2 and an effective size[1] that averages about 0.005 inch.

At Ruston the Sparta consists of 25 to 75 percent sand and probably averages 50 percent. Individual sands range from a few feet to 250 feet in thickness. Sands 100 feet thick are common and may occur at any depth in the formation but generally are in the middle or lower part. The thickest individual sand at any one site in Ruston is no less than 50 feet and, locally, as much as 250 feet. (See tables 2 and 3.)

The average permeability[1] of sands in the Sparta is about 300 gpd per sq ft (gallons per day per square foot). Although no test information is available in the upper third of the formation, the permeability of the fine-grained silty sands is relatively low. The permeability generally increases with the increase in grain size with depth. The permeability of sands in the lower two-thirds of the formation ranges from about 200 to 900 gpd per sq ft. More hydrologic data are available for sands in the middle third of the formation at Ruston because most wells are developed in sands in that interval. The permeability of sands in the middle third of the formation averages about 300 to 400 gpd per sq ft and ranges as high as 800 gpd per sq ft. Sands in the lower third of the formation have permeabilities as high as 900 gpd per sq ft and probably average 400 gpd per sq ft or more.

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[1]/See "Glossary."

The transmissibility of individual sands in the Sparta at Ruston ranges from about 10,000 to 110,000 gpd per foot and averages about 50,000 gpd per foot. The average transmissibility for the entire thickness of the Sparta in northern Louisiana is estimated to be 90,000[2] gpd per foot. This value probably can be applied to the Sparta Sand in the Ruston area where the average total thickness of sand units in the aquifer is about 300 feet.

The regional storage coefficient[3] for the Sparta Sand is about 10^{-4} where the water is confined by the Cook Mountain clay (artesian conditions prevail). Where water in the Sparta is confined only locally by clay lenses within the formation, as in the outcrop area or where the water level is below the Cook Mountain clay, the apparent storage coefficient probably approximates the regional value (10^{-4}) for only short periods of time (hours, days, or even weeks). For longer periods of time (months or years) storage should approach the specific yield of the sediments (10^{-1}) in the cone of depression as water-table conditions develop.

The apparent storage coefficient at Ruston should be intermediate between values for artesian (10^{-4}) and water-table (10^{-1}) conditions because the potentiometric surface crosses the contact between the Cook Mountain clay and the Sparta Sand in the cone of influence produced by pumping at Ruston.

The Sparta Sand in northern Louisiana and southern Arkansas yielded more than 70 mgd in 1970 and has yielded an average near that amount during the past 20 years or more. Although pumping has increased at some pumping centers, it has decreased at others. The average withdrawals from major centers of pumping in 1970 were: Springhill, La., 6 mgd; Bastrop, La., 12 mgd; Monroe, La., 11 mgd (reduced from 16 mgd in 1960); Hodge, La., 13 mgd; Magnolia, Ark., 6 mgd; and El Dorado, Ark., 19 mgd. The Sparta yields as much as 2,000 gpm (gallons per minute) to individual wells and can yield even move at some places in northern Louisiana.

In the Ruston area at either the airport well (L-30) site or the Barnet Springs Road well (L-48) site, the Sparta has the capacity to yield all the city's present needs (including the peak-day demand of 7 mgd). The airport well (L-30, table 4), screened in the middle sand, yields 600 gpm with a specific capacity of 32 gpm per foot of drawdown; the Barnet Springs Road well (L-48), screened in the lower sand, yields 800 gpm with a specific capacity of 33 gpm per foot of drawdown. At either site, a single well 24 inches in diameter screened opposite the full thickness of the sand unit (110 feet at well L-30 and 155 feet at well L-48) and developed to the same efficiency (near 100 percent) as the existing well on that site could yield 7 mgd. Theoretically, pumping continuously at 7 mgd (more than twice the present average pumping rate at Ruston) for 10 years would lower the water

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2/Although the transmissibility of the Sparta will be reduced somewhat as dewatering occurs, the actual change from dewatering of the upper third of the formation will be negligible because sands in this section are thin and have very low permeability. (See p. 15.)

3/See "Glossary."

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level in the well about 145 feet. The available drawdown (1970) to the top
of the sand screened is 180 feet at the airport well (L-30) and 400 feet at
the Barnet Springs Road well (L-48).

The lithologic and hydrologic characteristics of the formation indicate
that the Sparta probably can yield a million gallons per day from a single
well almost anywhere in Ruston. For example, a 50-foot sand in the lower
half of the formation (available drawdown at least 300 feet) having an aver-
age permeability of 300 gpd per sq ft will have a transmissibility of about
15,000 gpd per foot. A well finished in this sand with an effective radius
of 12 inches will have a theoretical specific capacity of 7 gpm per foot of
drawdown after pumping continuously for 1 day. Under these conditions a
well only 50 percent efficient[4] pumping 700 gpm (1 mgd) would have a draw-
down of 200 feet.

Water-Level Decline

The water level in the Sparta at Ruston has declined about 175 feet
during the last 45 years (figs. 2, 4). There was probably little or no de-
cline before the early 1920's in northern Louisiana and southern Arkansas.
The rate of decline at Ruston increased continually from 1925 to about 1948
(fig. 4) owing to the continued increase in regional pumpage. Since 1950,
the rate of decline at Ruston has been fairly steady at about 3½ feet per
year and, with the reduction of pumping at Monroe, probably would have been
decreasing except for the increasing pumpage at Ruston.
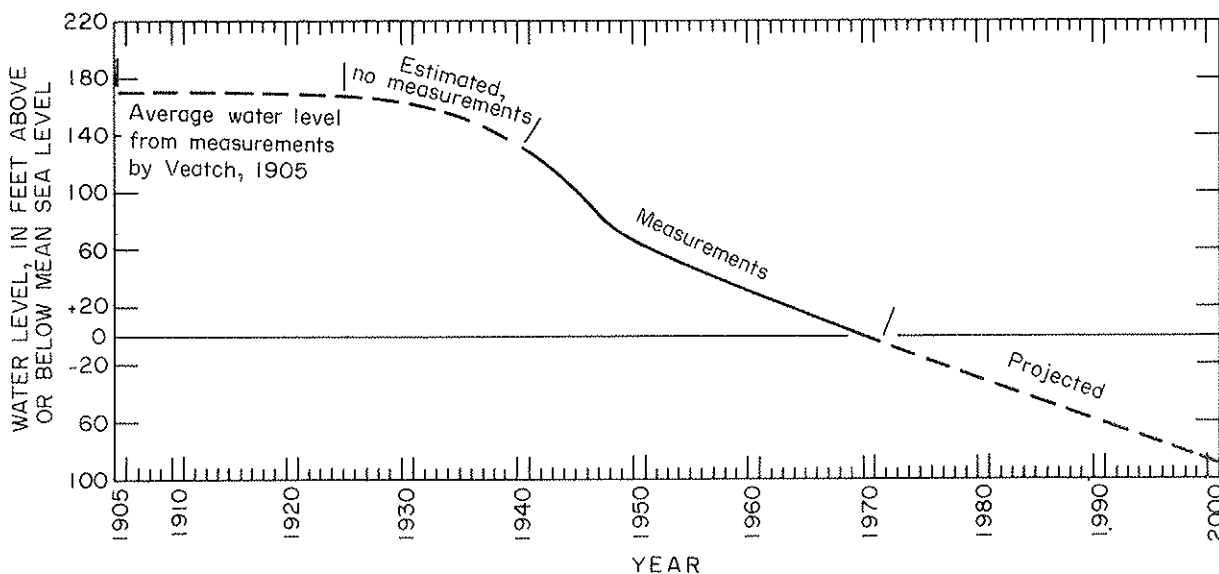
Figure 4.--Estimated decline in water level at Ruston.

[4]/Typical wells that yield 1 mgd or more are about 75 percent efficient.

As previously mentioned, the major centers of pumping from the Sparta have created depressions on the potentiometric surface (fig. 3). Some of the depressions are caused by rather large but short-term pumping. An example is the depression near Lisbon, at the northwest corner of Lincoln Parish, caused by large water use for petroleum production and refining. This depression has dissipated with the decline in water use at this site since 1965. Relatively minor centers of pumping, including Ruston, do not show up as closed depressions on the potentiometric map because the decline caused by these centers is less than one contour interval. The potentiometric map of the Ruston area (pl. 1) shows only a trough (valley) on the potential surface in response to pumping at Ruston. The average water-level decline at Ruston caused by pumpage at Ruston is about 20 feet, or approximately one contour interval. A smaller contour interval was not used because the seasonal range in water level at Ruston exceeded 20 feet (fig. 7).

Calculations by the Theis (1935) nonequilibrium method indicate that only 10 to 15 percent of the water-level decline[5] at Ruston has been caused by pumping at Ruston. Five major pumping centers in northern Louisiana and southern Arkansas are responsible for most of the decline at Ruston. The complex problem of determining the individual effect of five overlapping drawdown cones, further complicated by the proximity of the outcrop (recharge) area of the aquifer, can be solved most efficiently by digital computer simulation of the aquifer.

The iterative digital model developed by Trescott (1973) was used to estimate the effect of these pumping centers on water levels at Ruston.

An area of about 46,500 square miles (fig. 6) was modeled using 1,833 nodes with a grid spacing ranging from 3 to 13½ miles. A constant transmissibility of 90,000 gpd per foot and storage coefficient of 0.0001 were used throughout the model. Although values of these parameters range widely in the Sparta, experience confirms that the values used are valid regionally, and generally valid at most of the pumping centers affecting Ruston. The outcrop (recharge) area was modeled by gradually decreasing the transmissibility from 90,000 to 3,000 gpd per foot to simulate decreasing thickness across the outcrop of the formation. Recharge was simulated by maintaining a constant head along the outcrop, making recharge dependent on drawdown. The north boundary of the model was made a discharge boundary to simulate the divide caused by the large pumping center northeast of El Dorado. A line of no drawdown (constant head) was placed far enough to the east and south to simulate water movement from outlying areas of the aquifer.

For verification of the model, past pumpage was averaged for each well field for 1925-65 (table 1) and imposed on the model as one continuous pumping period. The model was tested, after imposing this average historical pumpage on the system, by comparing (1) the shape and magnitude of the actual drawdown map (fig. 5) with the simulated drawdown map (fig. 6) obtained

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[5] This is the average areal decline as measured in nonpumping wells. Pumping wells at Ruston are dispersed, and there is no concentrated center of pumping.

from the model and (2) comparing the simulated drawdown with actual drawdown at the major pumping centers and at Ruston (table 1). The model results are in reasonable agreement with actual measurements except at Springhill, La., and Magnolia, Ark., where local hydrologic complexities cannot be modeled accurately.

Table 1.--Average pumping rates used in Sparta digital model and simulated and actual drawdown, 1925-65

Well field	Average pumpage (mgd)	Actual drawdown (ft)	Simulated drawdown (ft)
LOUISIANA			
Bastrop---	10	180	200
Hodge---	10	160	170
Monroe---	13	220	220
Ruston---	1.6	160	150
Springhill---	6.8	60	160
ARKANSAS			
El Dorado---	16	300	230
Magnolia---	3	220	130

It should be emphasized that this truncated form of the Trescott digital model was planned solely to estimate drawdown in the Ruston area. For more general use, a more sophisticated model utilizing the full potential of the computer program could be developed for the Sparta when the need justifies the additional work that will be required. Such a model could be used as a planning tool to solve management problems throughout the area. Although some of the data needed for a refined model is available in published reports (Payne, 1968; Hosman and others, 1968; and Reed, 1972), additional information on variations in transmissibility, storage, and leakage coefficients is needed, as well as more precise pumpage and recharge data. With this type of information available, major refinements could be made in the model to include (1) variable transmissibility of the aquifer, (2) leakage from the confining Cook Mountain clay, (3) conversion from artesian to water-table conditions in parts of the area, (4) multiple pumping periods for historical pumpage, and (5) extension of the model area to include all of the outcrop of the aquifer and a reasonable distance downdip. The refinements can be easily handled by the Trescott iterative digital model.
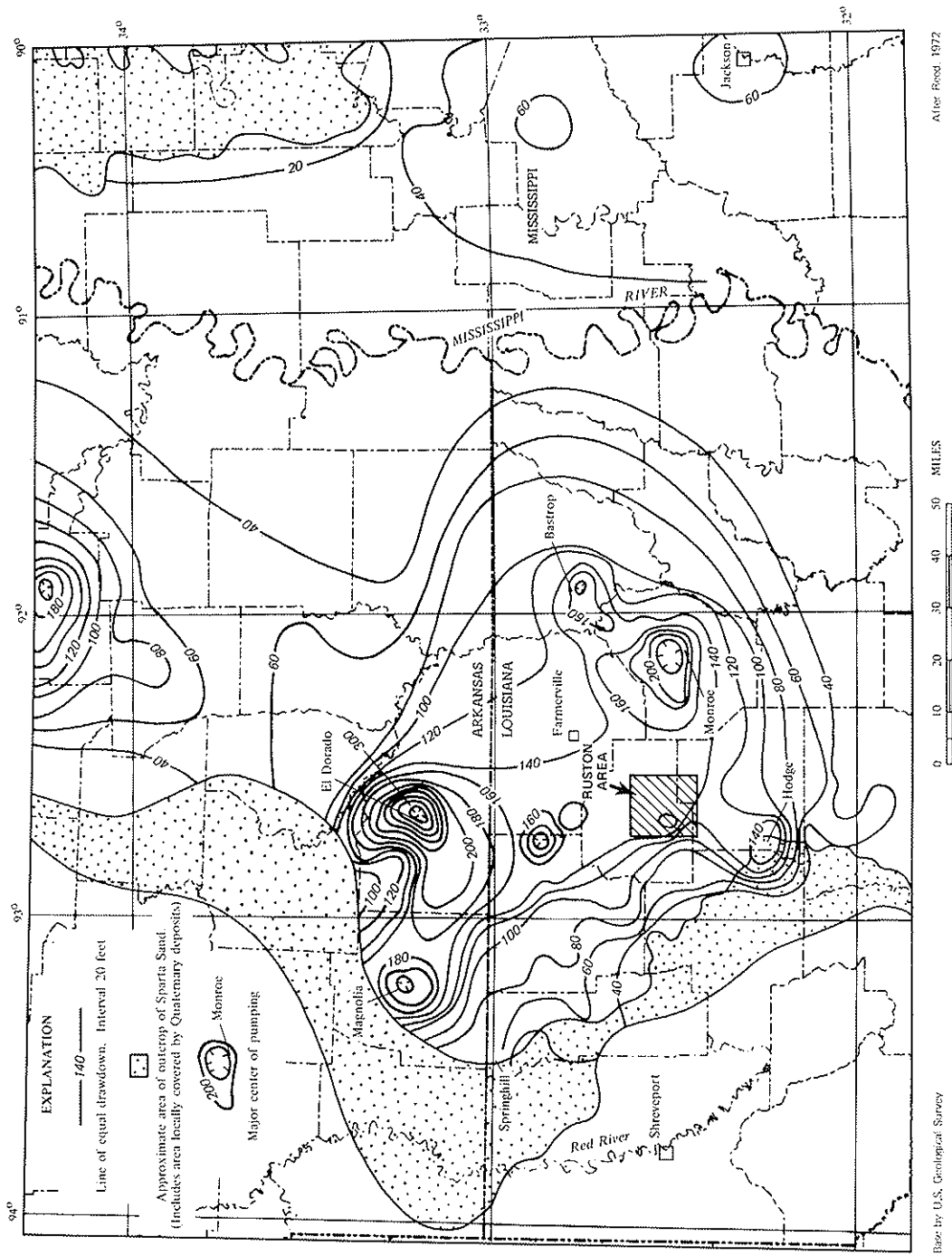
Figure 5.--Drawdown of water level in the Sparta Sand to 1965.

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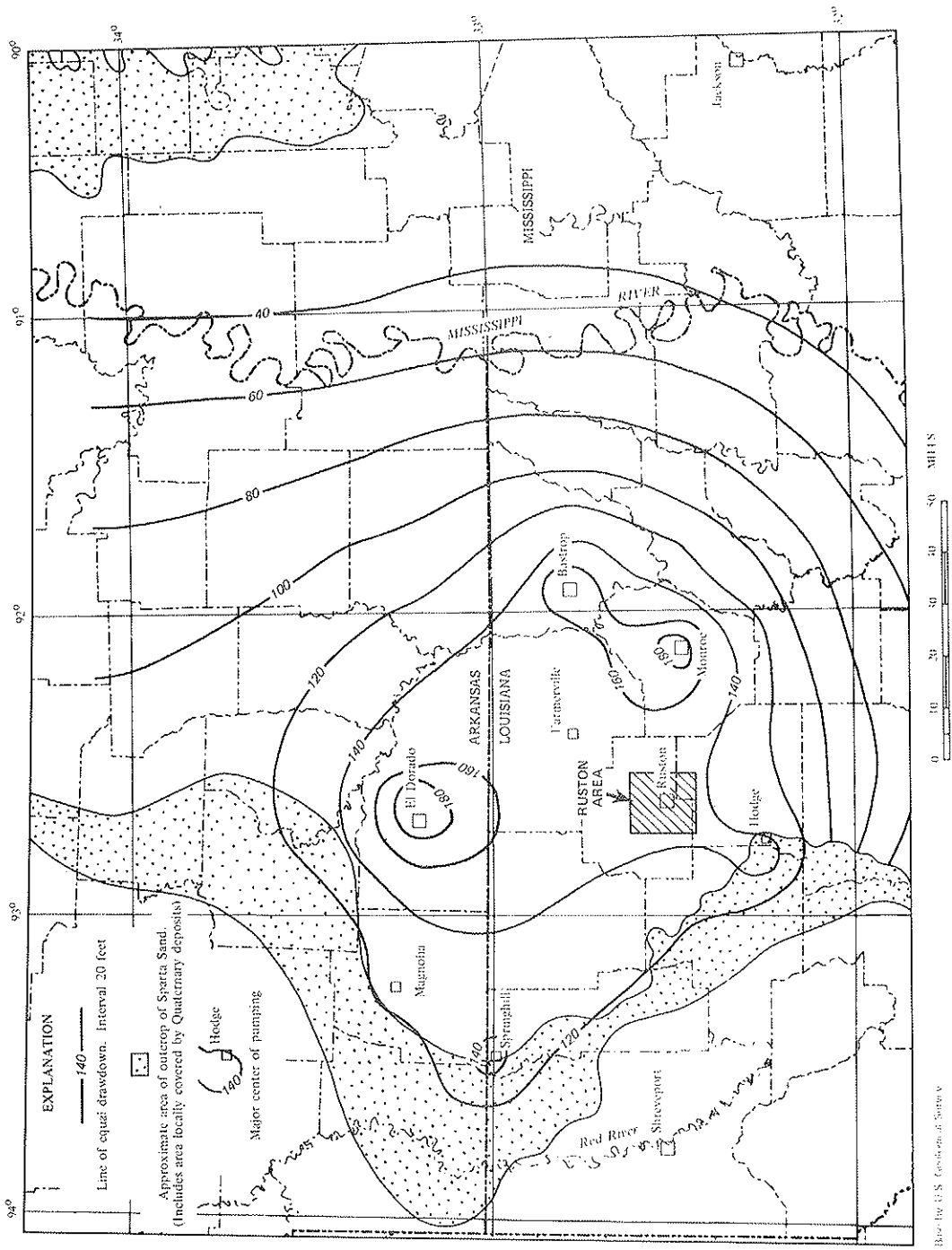
Figure 6.--Drawdown computed by the digital model for pumping, 1925-65.

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In addition to the effects of regional pumping, the water level at Ruston responds to local variations in pumpage, as shown by the short-term fluctuations in figure 7. The monthly pumpage at Ruston more than doubled from winter to summer in 1969 owing to a high demand caused by very low precipitation. This caused a seasonal decline of about 25 feet in the water level at well L-25 (pl. 1). However, the water level recovered in response to the reduction in pumping rate.

The average decline at well L-25 over the past 3½ years has been about 4 feet per year. Well L-25 is near the center of pumping in Ruston and is ideally situated to monitor future changes in water level.

A well completed in a middle Sparta Sand can be pumped simultaneously with a well completed in a lower Sparta Sand at some sites without appreciable drawdown interference. For example, well L-25, screened in the middle sand, shows no short-term drawdown in response to pumping 700 gpm from a nearby well screened in the lower sand. However, the static water level in the two wells is nearly the same, indicating that the two sands are reflecting the same regional hydrologic controls. Other sites where the two sands are separate and might be pumped with little or no drawdown interference are at wells L-108, L-122, and L-130 and oil-test sites in sec. 30, T. 19 N., R. 2 W.; sec. 21, T. 18 N., R. 2 W.; and sec. 7, T. 18 N., R. 3 W. (See table 3 and pl. 1.) Because the two sands coalesce locally, some sites may not be favorable for development of adjoining wells because of immediate drawdown response to one another.

Land subsidence caused by the decline of artesian head has occurred in several heavily pumped areas in the United States, including Baton Rouge, La., where maximum subsidence of nearly 1 foot is related to an average head decline of about 200 feet. Although the artesian head has declined about
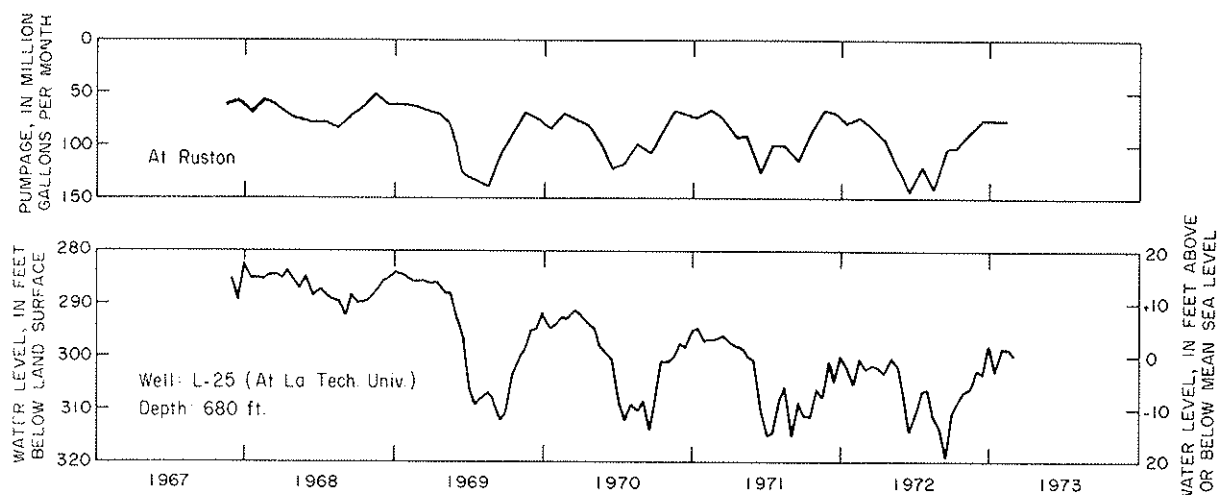
Figure 7.--Changes in water level in response to pumping at Ruston.

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175 feet at Ruston, subsidence is not likely to become a major problem in the near future. (A comparison of U.S. Coast and Geodetic Survey leveling data for 1958 and 1970 at Ruston indicate that little or no subsidence occurred during that period.) The relation of subsidence to head decline in the Sparta should be studied at heavily pumped areas such as Monroe or Bastrop. Should one of these major centers of pumping develop problems associated with subsidence, it would serve as a warning to areas such as Ruston.

Local Dewatering of Sands

At Ruston and in the area between Ruston and the Sparta outcrop (fig. 3), water levels in the middle and lower sands of the Sparta have been below the massive Cook Mountain clay since the mid-1960's. As the sands below the Cook Mountain clay are connected, dewatering of the lower sands of the Cook Mountain and the uppermost sands of the Sparta probably has begun.

For several years prior to the time the regional water level declined below the massive Cook Mountain clay, the pumping level in wells at Ruston was below the massive clay. Theoretically, during this period dewatering did not occur because no air could enter the formation, although water in the upper part of the formation near the well was under less than atmospheric pressure. As there was no dewatering, the storage coefficient remained about the same. When the water level declined below the massive clay between Ruston and the Sparta outcrop, allowing air to enter the system, dewatering began, and the storage coefficient began changing.

The Sparta water level (1971) at Ruston ranges from 10 to 60 feet below the Cook Mountain clay. Although drainage of the material being dewatered is now a contributing factor in the yield of the Sparta, it has not been evaluated quantitatively because of the uncertainty in estimating the actual specific yield of the deposits.

The transmissibility will decrease with decrease in the saturated thickness of the aquifer; however, even if as much as two-thirds of the aquifer is dewatered, the decrease in transmissibility probably will only amount to one-half or less because the lower part of the formation contains the bulk of the permeable sands. However, the storage coefficient will probably approach 1,000 times its initial value of the artesian range as the formation is dewatered.

Dewatering of the Sparta has a negligible effect on water levels in sands in the Cockfield and upper Cook Mountain because recharge by precipitation to the Cockfield is greater than loss by slow movement from the Cockfield to the Sparta through the Cook Mountain clay. The low flow of streams in the Ruston area is maintained by water discharged from sands in the Cockfield and the upper Cook Mountain; therefore, dewatering of the Sparta does not affect streams in the area except where the Sparta outcrops.

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Future Supply

Only a small part of the potential ground-water supply at the beginning
of the century had been developed by 1970 at Ruston; many times this amount
remains available. The amount of water pumped per foot of decline, so long
as the water level remains above the top of the Sparta and artesian condi-
tions prevail, is only a fraction of that potentially available per foot of
decline once the water level falls below the top of the Sparta and dewater-
ing begins.

Although the water level at Ruston has declined 175 feet, at least 200
feet of available drawdown remains (1970). The Sparta water level at Ruston
is about 200 feet above the top of the middle (upper producing) sand and 400
feet above the top of the lower producing sand. The pumping water level in
most of the public-supply wells at Ruston is at least 200 feet above the top
of the screen.

At the present rate of water-level decline (3½ feet per year) the water
level will not decline to the middle (upper producing) sand for nearly 60
years, and the water level will not decline to the lower producing sand for
nearly twice that long. The rate of water-level decline is not expected to
remain the same but will decrease as the apparent storage coefficient in-
creases in response to aquifer dewatering.

The projected gradual increase in water use at Ruston, from 3.5 mgd in
1970 to 5.5 mgd in 1980, is equivalent to an added volume of withdrawal rep-
resented by an average increase of 1 mgd for the 10-year period. This pro-
jected increase will cause a theoretical additional decline in water level
of about 10 feet at Ruston by 1980.

At present, the average pumpage at the city of Ruston is 3 mgd, and the
peak demand is about 6.5 mgd. The projected average municipal use by 1980
will be about 5 mgd, and the peak demand will be about 11 mgd. If a total
of 12 wells were developed at the average yield of the existing wells, they
would meet the peak demand of 11 mgd. If demand increases as predicted,
then five additional wells (similar to the existing wells) would be needed--
an average of one new well every 2 years. Of course, if new wells were de-
veloped to produce more than the average yield of existing ones, fewer wells
would be required.

The decreased production of individual wells, particularly of some of
the older wells, results from the increase in pumping head due to the de-
cline in water level at Ruston (not diminished capacity of the aquifer, as
had been suggested). In other communities having similar problems, the
yields of wells have been increased by using centrifugal booster pumps at
the surface to provide the external head and thus increase the discharge
capacity of the well pumps (E. J. Taylor, Louisiana Department of Public
Works, oral Commun., 1971).

The effect of increased pumping at Hodge on the Ruston water supply has
been a topic of concern at Ruston. Pumping from the Sparta at Hodge was

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originally expected to double early in the 1970's. However, based on additional tests in the new well field west of Hodge, apparently 8-9 mgd will be developed instead of the originally proposed 14 mgd. The estimated water-level decline at Ruston at the end of 20 years, caused by pumping an additional 9 mgd at Hodge, is about 30 feet, based on the digital-model solution.

If the water-level decline at Ruston continues at the present rate ($3\frac{1}{2}$ feet per year) for the next 20 years, water levels will be about 70 feet lower. An additional 30 feet of decline caused by the increased pumping at Hodge would mean about 100 feet of water-level decline at Ruston by 1990. The remaining available drawdown to the top of the middle Sparta Sand (the upper producing sand at Ruston) would be about 100 feet.

Although Ruston's ground-water supply appears more than adequate for the immediate future, major changes in pumpage could change the outlook. For example, if the proposed 9-mgd pumpage increase planned at Hodge were made the same distance (20 miles) from Ruston but northeast of Ruston at Farmerville, the resulting decline at Ruston after 20 years would also be about 30 feet. Should an additional 9 mgd be developed at Ruston, the additional decline there in 20 years would be about 85 feet. These hypothetical water-level declines are based on the digital model.

Water-Quality Problems

The water from the Sparta at Ruston is a soft, sodium bicarbonate type, having a hardness of less than 20 mg/l (milligrams per liter); low in dissolved solids, ranging from about 150 to 250 mg/l; and fairly high in silica content, ranging from about 15 to 50 mg/l. The water is well within the U.S. Public Health Service drinking-water standards (1962) with the possible exceptions of iron and manganese content (table 5) and corrosiveness. Earlier chemical analyses of water from the first city wells (wells L-1 and L-2, table 5) compared with recent chemical analyses from the same wells indicate little or no change in water quality. However, water from the middle Sparta sands is slightly different from that in lower sands. Water from the lower sand has less dissolved-solids content, lower pH, and higher silica content than water from the middle sand.

Although earlier analyses of water from several wells at Ruston indicated iron concentrations slightly in excess of the recommended limit (0.3 mg/l), no iron (red water) problem was experienced until recently. Analyses of water samples collected from the wells during this study indicate that concentrations of iron have not increased with time. The previously reported relatively high concentrations apparently resulted from sampling problems. Field measurement of oxidation potentials of water from the city wells indicates that the theoretical concentrations of iron agree approximately with the iron concentrations found by the latest analyses.

No comparison can be made between past and present corrosiveness of the water because no field determinations of pH were made prior to the late

1960's at Ruston. However, water from the lower sand was recently determined to be more corrosive than the water from the middle sand.

"Red water" was reported in the city system during 1970, first only in a few areas of the city but eventually throughout most of the system. Because the iron concentration of water in the aquifer is probably too low to be responsible for this problem, the high iron apparently is picked up from sources outside the aquifer. The combination of slightly corrosive water and iron bacteria may be the cause of the "red water" problem. Iron bacteria were observed in water samples from several points in the water system; and water from the wells is slightly corrosive, based on the Langelier corrosion index.

A possible reason for the "red water" problem could be the increase in pumping of corrosive water from the lower sand. Until late 1958 all city wells were completed in the middle sand; at that time, well L-33 (LW-6) was developed in the lower sand. The capacity of well L-33 (LW-6) represented only 20 percent of the system's potential capacity; but in late 1966, well L-48 (LW-7) was developed in the lower sand. Although the addition of well L-48 increased the potential from the lower sand to 35 percent with all wells pumping, the amount actually pumped from the lower sand was usually greater than 35 percent. The first wells to be cut off after periods of peak demand were usually those in the middle sand.

The city began treatment for the iron problem in early 1971 by injecting sodium hexametaphosphate and chlorine in the water at each well site. It may be too soon to appraise the long-range effect of the treatment in eliminating the "red water" problem, but to date the treatment appears to be successful.

Some changes in water quality may result from the dewatering of the Sparta. Because the sands being pumped at Ruston are still 200 feet below the water level in the Sparta, it may be a long time before such changes could alter the water quality appreciably. Any change will probably be gradual; and periodic analyses, including field determinations for pH and oxidation potentials, should be made so future problems may be anticipated.

Changes in water quality may also occur if water of a different quality moves in from an adjacent area. Electrical-log data indicate that the lower 100 feet of Sparta Sand contains salty water at Grambling. Well L-48 (LW-7), at the west edge of Ruston, is screened in the lower 100 feet of the Sparta. The estimated velocity of ground-water movement from Grambling to Ruston is a maximum of about 200 feet per year. The distance from well L-91 at Grambling, where salty water is believed to occur in the lower 100 feet of the Sparta, to well L-48 (LW-7) is 2.6 miles (14,000± feet); thus the minimum time for salty water to reach well L-48 would be about 70 years. However, the small pumping cone at Grambling and the discontinuity of the Sparta sands will tend to reduce this rate of movement.

SURFACE WATER

Bayou D'Arbonne Lake, with a capacity of 130,000 acre-feet (42.4 billion gallons), is 15 miles northeast of Ruston. The lake can provide a supply of about 200 mgd of water (Snider and others, 1972, p. 44). The water is generally of good quality, being soft and low in iron and dissolved solids. (See table 6.) However, during the summer months, water in the lake stratifies, causing significant changes in quality in the lower part (Shampine, 1971, p. 9).

As indicated in table 7, no stream closer to Ruston than Bayou D'Arbonne Lake can supply the amount of water needed by the town without construction of storage facilities. Records from three low-flow stations within 10 miles of Ruston (Cypress Creek near Unionville, Big Creek near Vienna, and Bayou Choudrant at Tremont) were correlated with the records for Bayou D'Arbonne near Dubach, and storage requirements for selected draft rates were computed. (See fig. 1 for station locations.)

About 2,500 acre-feet of water would be needed in storage along any of these streams at the sites analyzed to provide the average pumpage at Ruston (See table 8.) The maximum daily pumpage at Ruston is about twice the average daily pumpage; and because the maximum pumpage occurs during the low-flow period of the streams, the reservoir volume should be based on a draft rate equal to the maximum daily rate, or about 5,000 acre-feet. These storage requirements do not include evaporation or seepage, nor would this volume be adequate for year-round recreational or other uses. The minimum amount of water needed in storage along these streams to meet the city's present needs, assuming a uniform draft rate, is about 50 percent of the annual volume pumped.

The quality of water from these streams (table 6), like that from Bayou D'Arbonne Lake, is generally good. However, Colvin Creek, a tributary of Cypress Creek upstream from the station near Unionville, contains effluent from part of Ruston's sewage-disposal system.

Table 6.--Chemical analyses of surface water

Date of collection	Discharge, in cubic feet per second	Temperature (°F)	Temperature (°C)	Silica (SiO₂)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO₃)	Sulfate (SO₄)	Chloride (Cl)	Fluoride (F)	Nitrate (NO₃)	Dissolved solids (calculated)	Hardness as CaCO₃ Calcium, magnesium	Hardness as CaCO₃ Noncarbonate	Specific conductance (micromhos at 25°C)	pH	Color
BAYOU D'ARBONNE LAKE [Location: Lat 30°42'44", long 92°20'26". Drainage area: 1,585 sq mi. Surface area: 23.83 sq mi at elevation of 80 ft. Volume: 130,000 acre-ft. Use: Conservation and recreation]																				
6- 5-68	--------	--	--	8.0	0.06	7.0	1.3	11	0.3	12	3.2	25	0.1	0.1	83	23	13	114	---	40
4- 3-69	11,000	66	19	.9	0	6.9	.7	13	1.6	2	7.0	27	.1	2.7	61	20	18	129	5.7	10
7- 8-69	--------	97	36	6.1	.01	7.7	1.6	15	1.7	16	4.4	30	.1	2.6	77	26	13	140	6.3	15
CYPRESS CREEK NEAR UNIONVILLE [Location: Lat 32°39'35", long 92°35'15". Drainage area: 63.3 sq mi]																				
12- 8-70	12	50	10	18	0.11	6.7	1.8	23	4.0	58	8.4	14	0.10	0.40	105	24	0	177	7.2	10
BIG CREEK NEAR VIENNA [Location: Lat 32°37'50", long 92°43'25". Drainage area: 68.9 sq mi]																				
4- 4-69	128	75	24	12	0.01	2.5	1.4	3.1	1.0	10	6.4	3.5	0.0	0.2	35	12	0	43	6.3	5
7-10-69	.02	79	26	14	.02	11	2.8	5.4	2.1	52	1.4	4.5	.1	1.1	68	39	0	102	7.0	10
BAYOU CHOUDRANT AT TREMONT [Location: Lat 32°31'20", long 92°27'00". Drainage area: 87.5 sq mi]																				
3-10-69	--------	48	9	11	0.09	2.9	1.6	6.0	1.3	11	10	6.0	0.0	0.2	44	14	5	68	6.2	15
7- 7-69	--------	79	26	10	.03	3.0	.9	6.4	1.6	21	3.8	4.1	.1	.3	40	11	0	57	6.2	30

Milligrams per liter

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Table 7.--Summary of low-flow frequency and flow-duration data[1]/

Station name	Location			Drainage area, in square miles	Annual low flow, in cubic feet per second for 7 consecutive days and for indicated recurrence interval, in years		Flow, in cubic feet per second, which was equaled or exceeded for indicated percent of time			
	Sec.	T.	R.		2-year	5-year	60	80	90	95
Big Creek near Vienna, La------	18	19 N.	3 W.	68.9	0.2	0	10	0.7	0.1	0
Cypress Creek near Unionville, La---	7	19 N.	2 W.	63.3	.1	0	10	1.3	.2	0
Stowe Creek near Farmerville, La--	33	20 N.	1 W.	29.0	0	0	3.1	.1	0	0
Bayou Choudrant at Tremont, La ------	26	18 N.	1 W.	87.5	1.3	.6	9.7	2.9	1.7	1.1
Castor Creek at Chatham, La ------	2	15 N.	1 W.	60.0	.1	0	5.0	.6	.2	0
Dugdemona River near Quitman, La ----	26	16 N.	4 W.	117	1.2	.4	11	2.9	1.7	1.1
Cypress Bayou at Quitman, La ------	30	16 N.	3 W.	46.0	0	0	12	.3	0	0

[1]/Partial record and short-term gaging station in north-central Louisiana. Data adjusted to period 1929-57 on basis of relation to data of regular gaging station (Page, 1963, p. 107).

Table 8.--Storage required for selected draft rates for streams near Ruston
[Approximate average daily pumping rate at Ruston: 6 cubic feet per second; maximum average rate: 12 cubic feet per second]

Draft rate, in cubic feet per second	Storage required, in acre-feet					
	Cypress Creek near Unionville		Big Creek near Vienna		Bayou Choudrant at Tremont	
	10-percent chance deficiency	5-percent chance deficiency	10-percent chance deficiency	5-percent chance deficiency	10-percent chance deficiency	5-percent chance deficiency
6 (3.9 mgd)	2,120	2,200	2,210	2,410	2,060	2,230
12 (7.8 mgd)	4,760	5,000	4,795	5,250	4,540	4,930

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SUMMARY AND CONCLUSIONS

The Sparta Sand is the only aquifer at Ruston suitable for use as a public supply. The Sparta yields as much as 2,000 gpm to wells, and larger yields are possible. Although the water level has declined 175 feet since pumping began, only about 20 feet of the decline was caused by pumping at Ruston. Industrial pumping at El Dorado, Ark., and at Monroe, Bastrop, and Hodge, La., is responsible for about 90 percent of the water-level decline at Ruston.

Dewatering of the lower Cook Mountain and upper Sparta sands probably began in the mid-1960's; and as dewatering continues, there will be a decrease in rate of water-level decline, owing to an increase in the quantity removed from storage as water-table conditions are created. At least 200 feet of available drawdown remains at Ruston (1970), and at the present rate of decline the available drawdown will not be depleted for nearly 60 years. The decrease in water-level decline at the present rate of pumping, caused by dewatering, may partially compensate for the effect of increasing decline caused by increased pumpage at Hodge. The Sparta should adequately meet the present and future water-supply needs of the Ruston area at least through the year 2000. Periodic monitoring of water quality should be started to detect any changes in quality that may be caused by dewatering.

GLOSSARY

Available drawdown
>The height the water level in an artesian well stands above the top of the artesian water body it taps; in a water-table well it is the height the water level stands above the top of the screen.

Confining bed
>A body of relatively impermeable material stratigraphically adjacent to one or more aquifers.

Effective size
>The particle size where 10 percent of the sand is finer and 90 percent is coarser (Edward E. Johnson, Inc., 1966, p. 183).

Langelier corrosion index (Langelier pH saturation index)
>A representation of the degree of supersaturation or undersaturation with respect to calcium carbonate, used in evaluating the stability of water supplies after treatment.

Oxidation potential
>The relative intensity of oxidizing or reducing conditions in solutions.

Permeability, coefficient of (P)
>The rate of flow, in gallons per day, through a cross-sectional area of 1 square foot of aquifer material under a hydraulic gradient of 1 foot per foot at a temperature of 60°F (15.5°C). The field coefficient of

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permeability is the same except that it is measured at the prevailing temperature of the water.

In recent Geological Survey reports the term "hydraulic conductivity," expressed in consistent units of feet (or meters) per day, is generally used instead of permeability. The coefficient of permeability divided by 7.48 is equal to hydraulic conductivity.

Potentiometric surface
A surface which represents the static head. As related to an aquifer, the surface is defined by the levels to which water will rise in tightly cased wells. The water table is a particular potentiometric surface. (Replaces the term "piezometric surface.")

Specific yield
The specific yield of a rock or soil is the ratio of (1) the volume of water which, after being saturated, the rock or soil will yield by gravity to (2) the volume of the rock or soil. Specific yield is generally observed as the change in the amount of water in storage per unit area of unconfined aquifer that occurs as the result of a unit change in head.

Storage coefficient (S)
The volume of water an aquifer releases from or takes into storage per unit surface area of the aquifer per unit change in the component of head normal to that surface. (In confined aquifers containing appreciable silt and clay, part of the water is released from storage instantaneously; the remainder is released very slowly as the clay and silt compact. In unconfined aquifers, water is released slowly, mainly by gravity drainage; and only a very small part by elastic compression of the aquifer and expansion of the water. After long periods of drainage, as by pumping, the storage coefficient may equal to specific yield.)

Transmissibility, coefficient of (T)
The number of gallons of water that will move in 1 day through a vertical strip of the aquifer 1 foot wide having the full height of the aquifer, under a hydraulic gradient of 1 foot per foot, at the prevailing temperature of the water.

In recent Geological Survey reports the term "transmissivity," expressed in consistent units of square feet (or meters) per day, is generally used instead of transmissibility. The coefficient of transmissibility divided by 7.48 is equal to transmissivity.

Uniformity coefficient
An expression of the variety in the sizes of grains that constitute a granular material. It is defined as the quotient of the 40-percent size of the sand divided by the 90-percent size (Edward E. Johnson, Inc., 1966, p. 184).

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BASIC DATA

Tables 2-5

Table 2.—Summary of data for water-test holes in the Ruston area

[Data available: C, chemical analysis; D, driller's or geologist's log; E, electrical log; MA, mechanical analysis of sand samples; S, sand samples (location shown on pl. 1)]

Well No.	Location Sec.	T.	R.	Test hole depth (ft)	Well depth (ft)	Part of Sparta screened	Estimated water level, 1970, in feet below land surface datum	Best sands Thickness (ft)	Best sands Depth to base (ft)	Approximate available drawdown to 100 feet above base of sand	C	D	E	MA	S
L-36	13	18 N.	3 W.	839	601	Middle---	215	50	565	250	x	x	x	-	-
L-93	31	18 N.	3 W.	803	738	Lower----	290	100	625	235	-	x	x	x	x
L-94	17	18 N.	3 W.	804	710	Lower----	280	130	765	385	x	x	x	x	x
L-100	23	18 N.	3 W.	853	766 {---	Lower----	295	70	765	370	-	x	x	x	x
							295	70	650	255					
L-101	26	18 N.	3 W.	855	593	Middle---	285	125	620	235	-	x	x	x	x
L-103	8	18 N.	2 W.	780	510	Middle---	315	200	605	190	x	x	x	x	x
L-107	35	18 N.	3 W.	846	716	Lower----	275	70	765	390	x	x	x	x	x
L-108	22	18 N.	3 W.	850	764 {---	Lower----	275	80	805	430	x	x	x	x	x
						---------	275	100	505	130					
L-109	26	18 N.	3 W.	850	---	---------	300	240	675	275	-	x	x	x	x
L-111	22	18 N.	3 W.	788	---	---------	210	70	705	395	-	x	x	x	x
L-121	11	18 N.	3 W.	760	539	Middle---	265	90	585	220	x	x	x	x	x
L-122	15	18 N.	3 W.	732	---	---------	240	{100	735	395	-	x	x	x	x
								130	595	255					
L-124	30	18 N.	3 W.	791	---	---------	265	125	695	330	-	x	x	x	x
L-127	30	18 N.	2 W.	901	---	---------	310	60	660	250	-	x	x	-	x
L-128	18	18 N.	2 W.	880	587	Middle---	320	75	605	185	x	x	x	x	x
L-129	29	19 N.	2 W.	900	556	Middle---	280	60	565	185	x	x	x	x	x
L-130	34	19 N.	3 W.	744	629 {---	Lower----	135	40	635	450	x	x	x	x	x
						---------	135	70	585	400					

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Table 3.—Summary of data for oil and gas test holes in the Ruston area

[Location shown on pl. 1]

| Location | | | Test hole depth (ft) | Top of Sparta, in feet below land surface datum | Estimated water level, 1970, in feet below land surface datum | Best sands | | Approximate available drawdown to 100 feet above base of sand |
Sec.	T.	R.				Thickness (ft)	Depth to base (ft)	
30	19 N.	2 W.	9,092	180	200	{ 100 70	625 430	325 130
36	19 N.	3 W.	9,169	210	265	55	340	0
5	18 N.	2 W.	9,686	280	320	115	760	340
11	18 N.	2 W.	10,462	230	295	270	550	155
21	18 N.	2 W.	9,951	210	255	{ 150 75	635 410	280 55
7	18 N.	3 W.	10,304	235	260	{ 90 65	735 825	375 465
1	17 N.	4 W.	8,737	225	255	35	610	255

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Table 4.--Description of public-supply wells in the Ruston area

[Data available: C, chemical analysis; D, driller's or geologist's log; E, electrical log; MA, mechanical analysis of sand samples; PT, pumping test; S, sand samples (data available for well or nearby test hole). Status of well: D, well destroyed; O, observation well; P, production well]

U.S. Geological Survey Well No.	Owner	Sec.	T.	R.	Year drilled	Casing diameter (in)	Screen Diameter (in)	Screen Interval (ft)	Screen Opening (in)	Pump setting 1970	Pump setting Maximum possible [1]	Water level, 1970, in feet below land surface	Water level below land surface (ft)	Gallons per minute	Drawdown (ft)	Specific capacity (gpm per ft)	Year	C	D	E	MA	PT	S	Status of well
												RUSTON												
L-1	LW-2	24	18 N.	3 W.	1936	16	10	553-633	0.025	375	483	305	165	750	75	10	1936	x	x	-	-	-	-	P
L-2	LW-3	24	18 N.	3 W.	1936	12	10	567-646	.025	381	497	315	165	750	75	10	1936	x	x	-	-	-	-	P
L-3	LW-1	24	18 N.	3 W.	1926	16	5	{617-677 681-741}	{.017 .016}	--	--	--	251	680	--	--	1949	-	x	-	-	-	-	D
L-24	HW-1	24	18 N.	3 W.	1947	12	8	545-632	{.016 .020}	--	--	--	---	600	--	--	1947	-	-	x	-	-	-	D
L-30	LW-4	25	18 N.	3 W.	1955	12	8	570-648	.030	462	475	345	340	700	21	33	1970	x	x	x	-	x	-	P
L-31	CW-1	26	18 N.	3 W.	1953	16	8	531-636	-----	364	462	290	248	1,100	63	17	1953	x	x	x	-	-	-	P
L-32	LW-5	19	18 N.	2 W.	1958	16	10	592-652	.030	408	511	310	257	700	--	18	1962	x	x	x	-	-	-	P
L-33	LW-6	23	18 N.	3 W.	1958	16	--	{736-761 776-811}	.030	448	670	300	300	860	80	11	1970	x	x	x	-	x	-	P
L-48	LW-7	27	18 N.	3 W.	1966	16	10	698-728	.030	398	618	235	219	1,180	30	39	1968	x	x	x	-	x	-	P
												LOUISIANA TECH UNIVERSITY												
L-25	1	23	18 N.	3 W.	1948	12	--	-680	-----	--	--	300	250	600	--	--	1961	-	-	-	-	-	-	O
L-61	2	23	18 N.	3 W.	1964	12	6	544-598	0.015	390	502	253	243	420	70	6	1968	x	x	x	-	x	-	P
L-106	1	23	18 N.	3 W.	1967	12	10	701-766	.014	520	651	298	288	410	94	4	1967	x	x	x	x	x	x	P
L-120	3	26	18 N.	3 W.	1970	12	8	528-593	.016	420	498	290	290	400	29	14	1970	x	x	x	x	x	x	P

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GRAMBLING

Well		Sec.	Twp.	Rng.	Yr			Depth (1/)									Yr							Use
L-35	-----	30	18 N.	3 W.	1956	8	4	532-572	-----	304	---	---	239	140	27	5	1957	x	x	-	-	-	-	P
L-79	-----	30	18 N.	3 W.	1961	8	4 {4	470-490 / 558-598	0.010} / .010	---	---	---	250	-----	--	--	1961	-	x	-	-	-	-	D
L-92	-----	19	18 N.	3 W.	1961	8	4	415-475	.012	300	315	---	234	100	51	2	1962	x	x	x	x	-	-	P
L-102	-----	31	18 N.	3 W.	1967	10	6	545-601	.010	380	525	---	282	490	47	10	1967	x	x	x	x	x	-	P
L-125	-----	30	18 N.	3 W.	1971	10	6	671-746	.020	389	631	292	292	425	38	11	1970	-	-	x	-	-	-	P

GRAMBLING COLLEGE

Well		Sec.	Twp.	Rng.	Yr			Depth (1/)									Yr							Use
L-11	3	30	18 N.	3 W.	1937	6	--	-567	-----	---	---	---	-----	-----	--	--	-----	-	x	-	-	-	-	P
L-72	2	30	18 N.	3 W.	----	12	--	-590	-----	---	---	---	204	385	26	15	-----	-	-	-	-	-	-	P
L-126	-----	30	18 N.	3 W.	1971	8	6	670-721	0.015	---	---	---	275	205	26	8	1971	-	x	x	x	-	x	P

RUSTON STATE SCHOOL

Well		Sec.	Twp.	Rng.	Yr			Depth (1/)									Yr							Use
L-83	-----	24	18 N.	4 W.	1942	6	6	550-622	-----	---	---	---	302	-----	--	--	1968	-	x	-	-	-	-	P
L-98	-----	14	18 N.	4 W.	----	--	--	±600	-----	---	---	---	270	450	--	--	1965	-	-	-	-	-	-	P
L-118	-----	24	18 N.	4 W.	1970	10	8	548-586	0.015	486	518	306	306	100	--	--	1970	x	x	x	x	x	-	D
L-119	-----	24	18 N.	4 W.	1970	8	8	435-473	.015	415	420	317	317	145	30	5	1970	x	x	x	x	-	-	D

GREATER WARD ONE WATERWORKS DISTRICT

Well		Sec.	Twp.	Rng.	Yr			Depth (1/)									Yr							Use
L-66	-----	8	18 N.	2 W.	1967	7	--	485-515	0.020	370	433	300	300	-----	--	--	1967	-	x	x	-	-	x	P

MOUNT OLIVE WATER DISTRICT

Well		Sec.	Twp.	Rng.	Yr			Depth (1/)									Yr							Use
L-65	-----	17	18 N.	3 W.	1967	6	--	689-719	0.030	357	616	---	265	250	14	18	1967	x	x	x	-	-	x	P

WATER DISTRICT NO. 3

Well		Sec.	Twp.	Rng.	Yr			Depth (1/)									Yr							Use
L-63	1	31	18 N.	2 W.	1966	11	6	615-645	0.030	---	---	---	316	200	30	7	1966	x	-	x	-	-	-	P

RISER ROAD WATER DISTRICT

Well		Sec.	Twp.	Rng.	Yr			Depth (1/)									Yr							Use
Ja-136	1	7	17 N.	2 W.	1969	5	3	711-731	0.010	315	690	---	248	38	9	4	1969	x	x	x	-	-	-	P

1/Depth to top of lap pipe.

Table 5.--Chemical analyses of water from wells in the Ruston area (location of wells shown on pl. 1)

[Sand: U, upper Sparta; M, middle Sparta; L, lower Sparta; pH values measured in laboratory except values preceded by letter "f" measured in field]

Well No.	Location Sec.	T. (N.)	R. (W.)	Date of collection	Screened interval	Temp. (°F)	Temp. (°C)	Silica (SiO₂)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO₃)	Sulfate (SO₄)	Chloride (Cl)	Fluoride (F)	Nitrate (NO₃)	Dissolved solids (calculated)	Hardness as CaCO₃	Specific conductance (micromhos at 25°C)	pH	Color	Sand	Remarks
U.S. Public Health Service drinking-water standards									0.3	0.05						250	250	1.0	45	500				15		
L-1	24	18	3	4- 4-51	557-637	76	24.5	23	0.16	---	1.6	0.5	69	3.2	163	13	8.0	0.1	0.5	----	6	305	---	---	M	City No. LW-2.
L-1				3-23-55		75	24	25	.17	---	1.4	.3	72	1.0	168	13	8.0	.1	.8	210	5	316	7.8	10		
L-1				10- 7-70		---	---	25	.19	---	1.8	.6	75	1.6	173	12	7.1	.1	.0	209	7	311	7.9	15		
L-2	24	18	3	5-30-41	-637	---	---	31	.36	---	2.3	.8	67	2.0	156	14	13	.1	.5	211	9	313	7.4	---	M	City No. LW-3.
L-2				6-13-68		---	---	27	.48	---	1.9	.8	71	1.1	162	14	14	.2	.1	210	8	313	7.4	5		
L-24 [1]	25	18	3	1-24-48	545-632	---	---	--	.1	---	---	---	---	---	---	---	---	---	---	----	---	---	---	---	M	City No. HW-1.
L-25	23	18	3	10-16-61	-680	---	---	19	.13	0.01	1.3	.2	80	.8	180	15	10	.2	.0	265	5	339	7.9	5	M	Louisiana Tech.
L-30	25	18	3	10- 7-70	570-648	76	24.5	33	.05	.02	1.4	.1	62	1.3	146	2.2	12	.4	.0	218	4	289	8.0	10	M	City No. LW-4.
L-31	26	18	3	9- 1-60	531-636	76	24.5	37	.52	.01	1.9	.3	75	1.6	163	9.4	13	.1	.0	187	4	321	6.9	30	M	City No. CW-1.
L-31				10- 7-70				20	.31	.01	.1	.0	84	.8	180	15	19	.1	.0	224	1	341	7.9	15		
L-32	19	18	2	6-23-70	592-652	76	24.5	41	.11	.04	.0	.0	51	1.3	112	9.8	8.0	.2	.0	223	0	222	f8.6	5	M	City No. LW-5.
L-33	23	18	3	9- 1-60	736-811	78	25.5	50	.20	.01	.7	.1	58	1.3	118	8.4	13	.2	.0	167	1	236	6.7	20	L	City No. LW-6.
L-33				6-23-70		78	25.5																			
L-35 [2]	30	18	3	6- 7-60	532-572	---	---	37	.19	.01	1.3	.4	59	2.0	132	13	6.7	.2	.8	3/186	5	275	7.6	5	M	Grambling.
L-36 [2]	13	18	3	4- -68	591-601	---	---	24	.41	---	2.2	.8	65	---	159	6.3	9.0	---	---	232	9	254	8.1	5	M	Test well.
L-48	27	18	3	5-14-58	698-758	77	25	41	.15	---	1.1	.3	58	1.5	124	14	8.5	.5	.0	186	4	252	7.4	5	L	City No. LW-7.
L-61	23	18	3	5-16-68	543-602	74	23.5	22	.14	---	.5	.3	74	.9	166	14	6.8	.2	.0	201	4	307	8.1	15	M	Louisiana Tech.
L-62	1	17	4	1-18-68	-340	---	---	24	2.6	---	28	8.8	26	2.8	169	21	5.8	.2	.2	200	106	324	7.2	5	U	Grambling.
L-63	31	18	2	8- 5-68	615-645	---	---	12	.07	---	1.6	.0	100	.8	223	31	15	.3	.0	275	4	449	7.8	15	M	Water Dist. No. 3.
L-65	17	18	3	6-13-68	689-719	77	25	51	1.1	---	2.6	1.1	34	2.5	76	12	6.9	.1	.5	147	11	165	7.8	15	L	Mount Olive Water Dist.
L-94	17	18	3	4- 4-66	700-710	77	25	57	1.05	---	3.1	.5	130	2.7	78	9.8	7.6	.1	.0	151	10	165	6.7	15	L	Grambling.
L-102	31	18	3	5-19-67	545-601	76	24.5	34	.23	---	1.0	.5	65	1.6	132	28	5.8	.1	.5	201	3	262	6.7	10	M	Test well.
L-103	8	18	2	3- 3-67	480-510	74	23.5	30	1.2	---	1.0	.1	60	.7	141	6.4	6.3	.1	1.2	174	3	251	7.5	20	M	Test well.
L-104	8	18	3	4- 5-67	493-508	74	23.5	26	.03	---	.7	.1	63	.7	145	5.4	8.5	.1	1.0	176	2	250	8.0	10	M	Louisiana Tech.
L-106	23	18	2	12-27-67	701-766	77	25	24	.12	---	.7	.0	61	.3	136	11	7.7	.1	1.0	171	0	261	f8.1	20	M	Test well.
L-107	35	18	3	11-22-68	706-716	78	25.5	15	.18	---	2.4	.0	96	.9	182	14	16	.4	.0	243	6	387	8.7	10	M	Test well.
L-108	22	18	3	12-31-68	752-764	---	---	48	.48	---	.4	.2	47	1.6	110	10	8.8	.2	1.4	173	2	205	8.7	40	M	Test well.
L-119	24	18	4	4-15-70	435-473	---	---	16	.35	.03	2.6	.2	62	1.2	143	11	2.6	.2	.2	168	6	205	7.2	25	L	Ruston State School.
L-120	26	18	3	1-21-71	428-593	75	24	36	.62	.03	2.6	1.1	81	2.7	171	11	24	.2	.2	247	11	267	8.5	10	U	Test well.
L-121	11	18	3	6-26-70	527-539	74	23.5	53	.86	.07	6.1	1.2	48	2.7	128	8.4	6.9	.1	.1	189	20	372	8.3	10	M	Test well.
L-128A	18	18	2	6- 4-71	378-388	---	---	15	.82	.05	4.8	.5	74	1.3	173	26	4.9	.1	.1	213	14	211	6.8	10	M	Test well.
L-128B	18	18	2	5-28-71	577-587	---	---	24	.35	.03	.3	.1	69	1.7	159	4.4	12	.2	.1	190	1	335	7.9	25	U	Test well.
L-129	29	19	2	6-11-71	546-556	---	---	13	.39	.01	.0	.0	76	.4	184	6.4	3.1	.1	.2	190	0	281	7.8	15	M	Test well.
L-130	34	19	3	6-11-71	619-629	---	---	23	.14	.08	.0	.0	71	.3	164	4.2	10	.2	.1	190	0	302	7.8	30	M	Test well.

Milligrams per liter

1/ Analysis by Louisiana State Board of Health.
2/ Analysis by Curtis Laboratories.
3/ Residue at 105°C.

INDEX

EXPLANATION

— 60 — —

Structure contour
Showing altitude of base of Cook Mountain clay. Contour interval 20 feet. Dashed where approximate. Datum is mean sea level

═══ +20 ═══

Potentiometric contour
Showing altitude of water level. Contour interval 20 feet. Datum is mean sea level

• 2

Water well
Blue circle indicates water-level control point. Numeral is U. S. Geological Survey well number. See table 5 for chemical analysis

✦

Oil or gas test hole

☐

Cockfield Formation

▦

Cook Mountain Formation

A •———•———• A'

Geohydrologic section
(see figure 2)
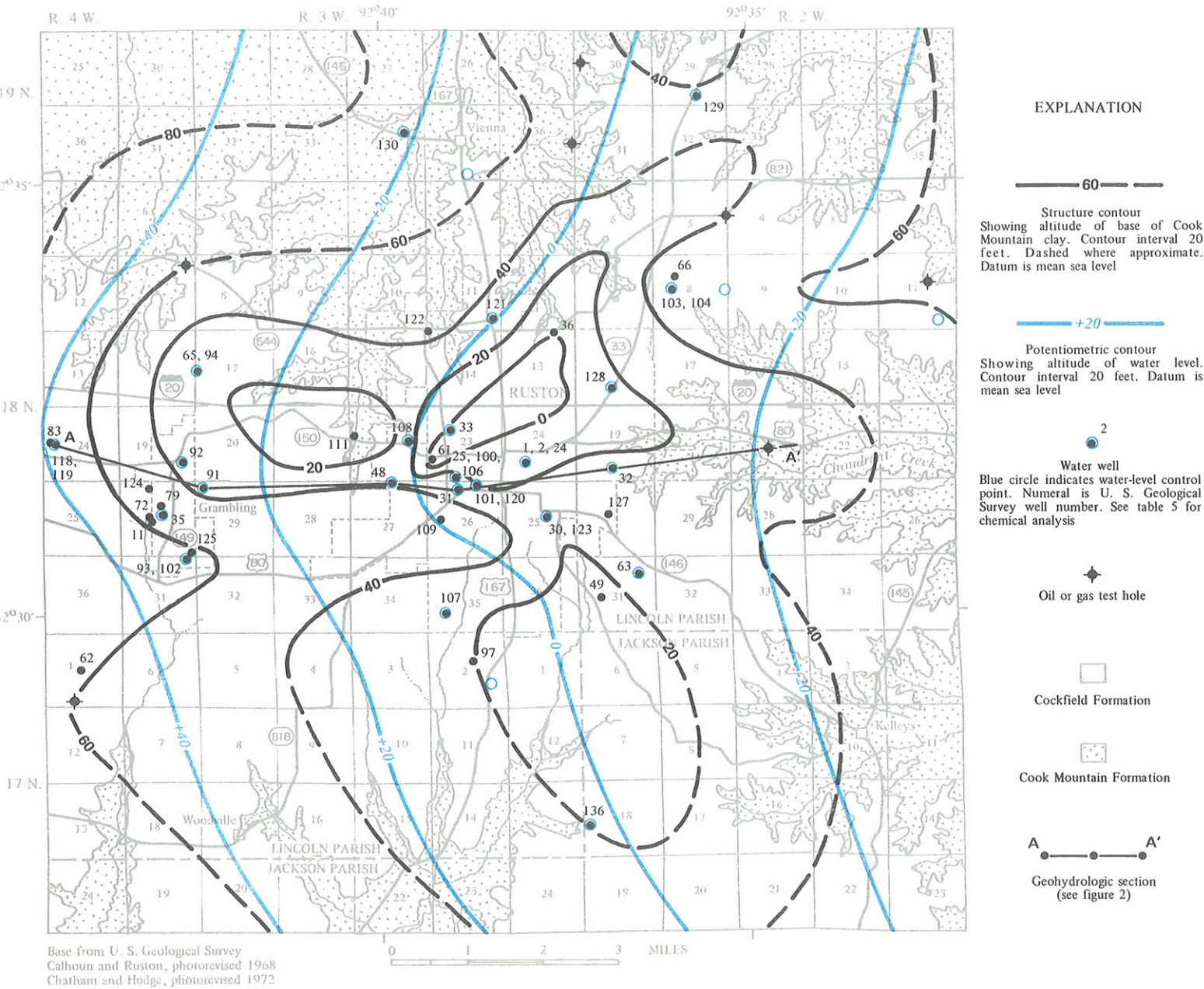
0   1   2   3   MILES

PLATE 1. MAP SHOWING GEOHYDROLOGIC FEATURES (1970) OF THE RUSTON AREA, LOUISIANA.