UNITED STATES

DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

REGIONAL GEOHYDROLOGY OF THE NORTHERN LOUISIANA SALT-DOME BASIN, PART III, POTENTIOMETRIC LEVELS OF THE WILCOX-CARRIZO AND SPARTA AQUIFERS

By Gary N. Ryals

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations 83-4131

Prepared in cooperation with the

U.S. DEPARTMENT OF ENERGY

Baton Rouge, Louisiana

1983

UNITED STATES DEPARTMENT OF THE INTERIOR

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FACTORS FOR CONVERTING INCH-POUND UNITS TO INTERNATIONAL SYSTEM (SI) OF UNITS

Multiply	By	To obtain
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
square mile (mi^2)	2.590	square kilometer (km^2)

REGIONAL GEOHYDROLOGY OF THE NORTHERN LOUISIANA SALT-DOME BASIN, PART III, POTENTIOMETRIC LEVELS OF THE WILCOX-CARRIZO AND SPARTA AQUIFERS

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ABSTRACT

This report is the third in a series of reports describing the regional geohydrology of the northern Louisiana salt-dome basin. The Wilcox-Carrizo and Sparta aquifers are the principal Tertiary aquifers of regional extent in the basin. The Wilcox-Carrizo aquifer is not affected by regional water-level declines, as no large pumping centers have been developed. Water-level fluctuations in wells are mostly seasonal. As shown by the hydrographs of seven wells, the seasonal fluctuations are generally less than 10 feet annually. Therefore, the potentiometric surface of the Wilcox-Carrizo aquifer in northwestern Louisiana is shown by contours using data collected from 1960-80.

Intensive pumping of the Sparta aquifer throughout northern Louisiana and southern Arkansas has caused a regional lowering of water levels. Hydrographs of six wells show that the regional water-level decline is 1 to 3 feet per year, depending on the location of a well with respect to pumping centers. The potentiometric surface of the Sparta aquifer in northern Louisiana and southern Arkansas is shown by contours using data collected spring 1980.

INTRODUCTION

The U.S. Department of Energy (DOE) in 1976 began an expanded waste-management program for both defense and commercially produced radioactive waste. The National Waste Terminal Storage (NWTS) program is an effort by DOE to locate and develop sites in various parts of the country for disposal or storage of commercially produced radionuclides in deeply buried geologic formations. As part of the program, the Vacherie salt dome in the northern Louisiana salt-dome basin (fig. 1) is being studied to determine the dome's suitability as a repository. In Louisiana, a major part of the U.S. Geological Survey's participation in the NWTS Program, in cooperation with DOE, has been to describe the regional geohydrology of the northern Louisiana salt-dome basin. A series of four reports have been prepared by the Geological Survey; each report focuses on a specific aspect of the regional geohydrology. Previous reports

Figure 1.--Location of northern Louisiana salt-dome basin.

presented (1) a conceptual ground-water flow model (Ryals, 1982) and (2) geohydrologic maps of the basin (Ryals, 1983). This report is the third in the series and presents potentiometric data for the Wilcox-Carrizo and Sparta aquifers.

The northern Louisiana salt-dome basin has an area of about 3,000 mi^2 and includes all or parts of 11 parishes in north-central and northwestern Louisiana. The area of interest for this report (fig. 1) is considerably larger than the northern Louisiana salt-dome basin, as most of the aquifers have regional extent, and ground-water flow within the basin follows regional patterns.

GEOHYDROLOGIC RELATIONS OF THE WILCOX-CARRIZO AND SPARTA AQUIFERS AND CONFINING BEDS

The Wilcox-Carrizo and Sparta aquifers are the principal Tertiary aquifers in the salt-dome basin; both aquifers are regional in extent. The Wilcox Group-Carrizo Sand and the Sparta Sand are composed of alternating sand and clay beds. Within each unit the sand beds are interconnected; therefore, each unit responds as a single aquifer. The Wilcox-Carrizo aquifer is comprised of the Wilcox Group of Paleocene-Eocene age and the Carrizo Sand of Eocene age (table 1). The Carrizo Sand was deposited over an eroded and irregular Wilcox surface. Because of nondeposition or erosion over some Wilcox highs, the Carrizo Sand is discontinuous. The Wilcox is hydraulically interconnected with the overlying Carrizo Sand; therefore, the Wilcox and Carrizo are considered to be a single hydrologic unit. The Wilcox-Carrizo is separated from underlying aquifers by confining beds consisting of the Midway Group (table 1) and other confining beds of Cretaceous age.

The Sparta aquifer is comprised of the Sparta Sand of Eocene age (table 1). A confining bed, the Cane River Formation, separates the Sparta and Wilcox-Carrizo aquifers. The Sparta aquifer is separated from the overlying Cockfield aquifer by the Cook Mountain Formation. The Cockfield aquifer is an important aquifer in much of northeastern Louisiana but occurs in only a relatively small area in the southern part of the salt-dome basin.

POTENTIOMETRIC LEVELS OF THE WILCOX-CARRIZO AND SPARTA AQUIFERS

Water in the Wilcox-Carrizo and the Sparta aquifers is confined under artesian pressure, except in the outcrop areas where water-table conditions prevail in shallow unconfined sand beds. The principal fluctuations of water levels in wells in the unconfined sand beds are seasonal. The fluctuations are caused by changes in the amount of water in storage as a result of cyclic recharge by precipitation, which occurs mainly in winter and spring, and discharge by lateral movement to streams. Typically, water levels in wells in the unconfined sand beds are usually within 50 ft of land surface and generally are not affected by pumpage.

Table 1.--Generalized post-Cretaceous stratigraphic column for the northern Louisiana salt-dome basin and vicinity

System	Series	Group	Formation	Hydrologic unit
Quaternary	Holocene and Pleistocene		Terrace and alluvial deposits	Terrace and alluvial aquifers
Tertiary	Eocene	Claiborne	Cockfield Formation	Cockfield aquifer
			Cook Mountain Formation	Confining layer
			Sparta Sand	Sparta aquifer
			Cane River Formation	Confining layer
			Carrizo Sand	Wilcox-Carrizo aquifer
		Wilcox	Undivided	
	Paleocene	Midway	Undivided	Confining layer[1/]

[1/]Confining layer below Wilcox-Carrizo aquifer also includes units of Cretaceous age.

Potentiometric levels in wells screened in the confined part of the Wilcox-Carrizo aquifer generally range from a few feet to about 200 ft below land surface. Flowing wells have been reported in parts of Natchitoches Parish where the potentiometric levels are above land surface. As shown by the hydrographs in figure 2, water-level fluctuations in wells are generally less than 10 ft annually. Water levels have stayed at or near their predevelopment levels. The aquifer is not affected by regional water-level declines because no large pumping centers have been developed. Therefore, a potentiometric-surface map of the Wilcox-Carrizo aquifer (fig. 3) was compiled using water-level data that spans several years. The water-level data, collected 1960-80, are in the files of the U.S. Geological Survey, Alexandria, La. A map of this type, although not a precise representation of the potentiometric surface for any one year, is useful for establishing general directions of groundwater flow and approximate potentiometric gradients.

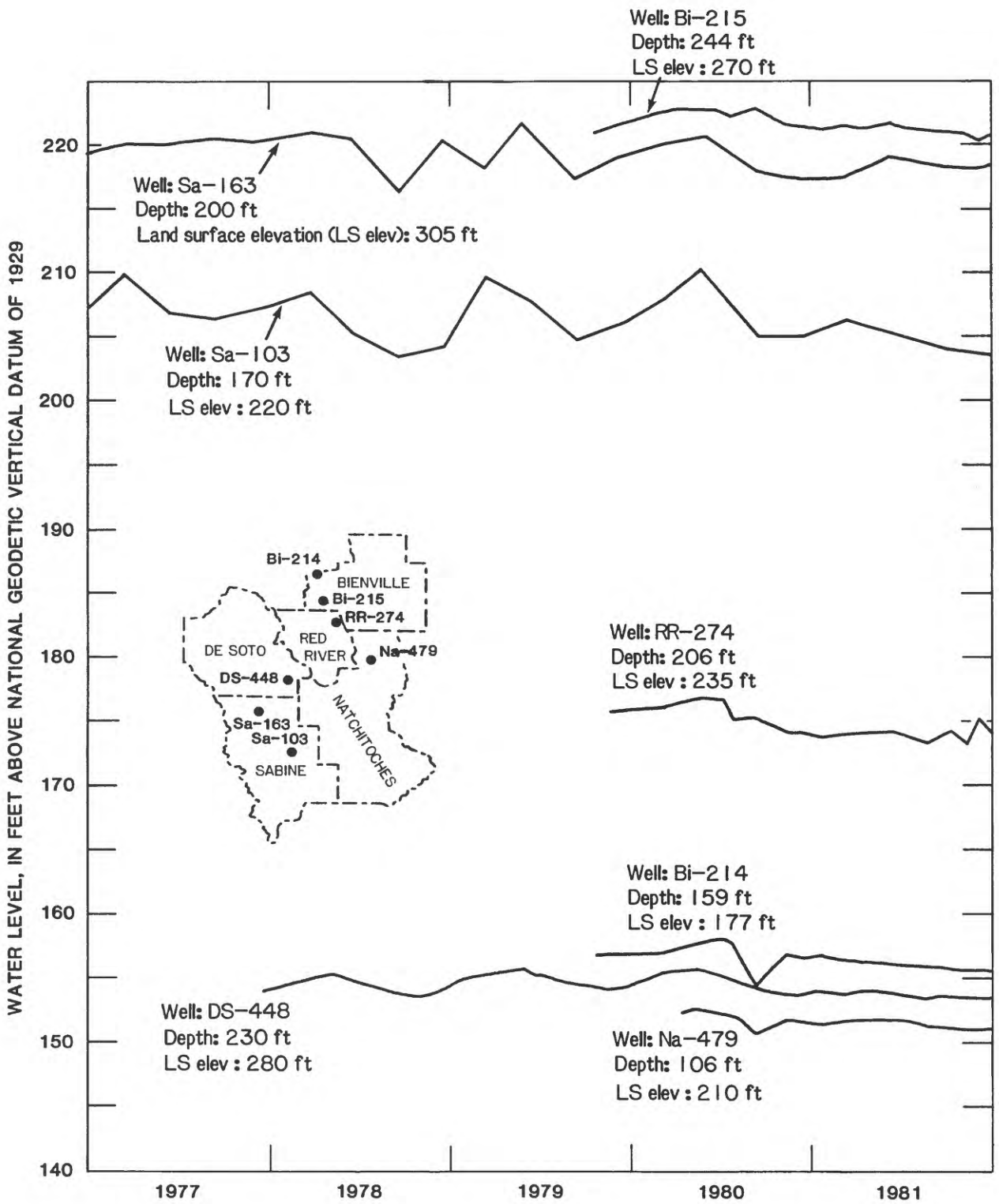
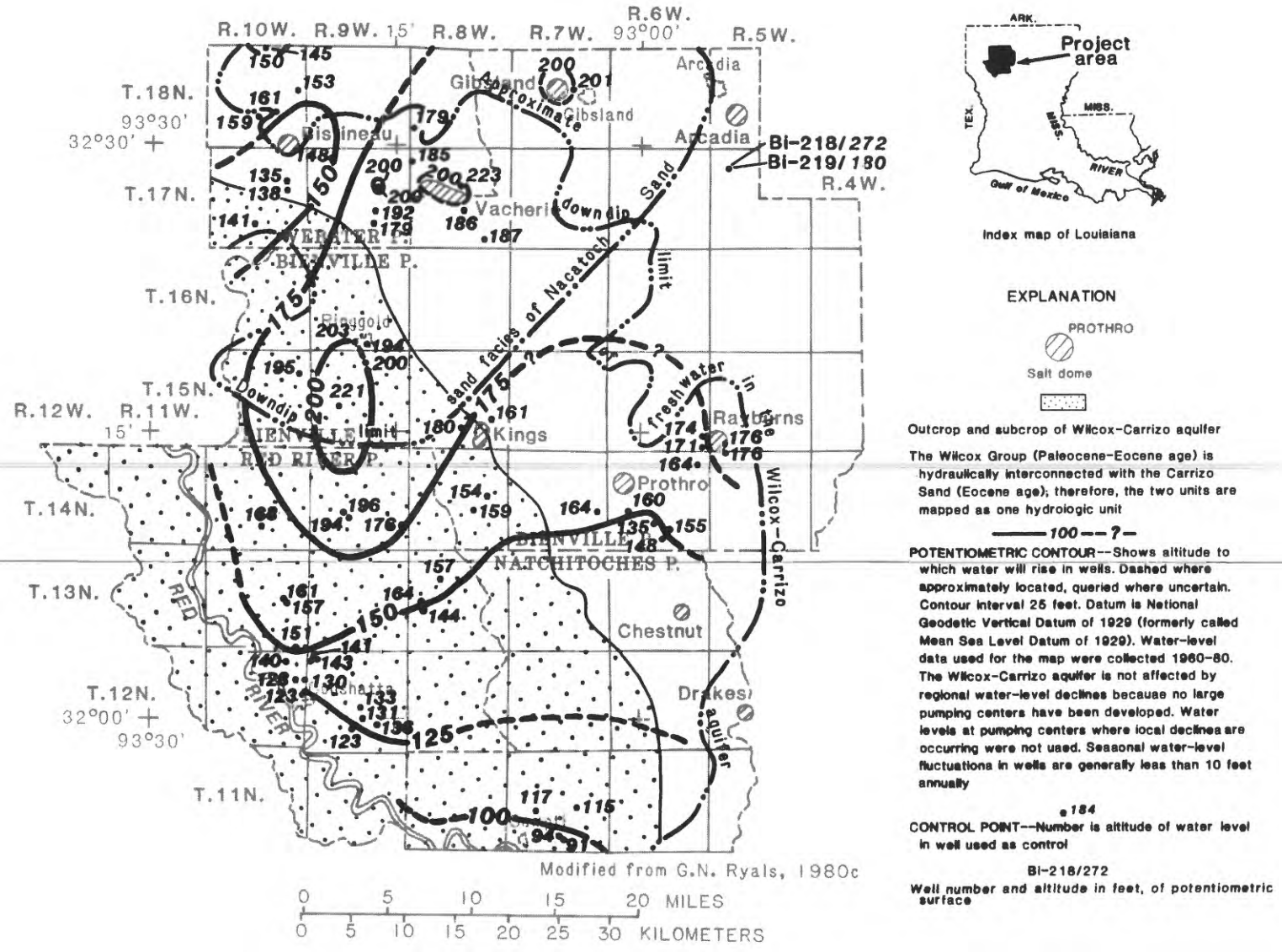


Figure 2.--Hydrographs of wells screened in the Wilcox-Carrizo aquifer.



Index map of Louisiana

EXPLANATION

PROTHRO
Salt dome

Outcrop and subcrop of Wilcox-Carrizo aquifer

The Wilcox Group (Paleocene-Eocene age) is hydraulically interconnected with the Carrizo Sand (Eocene age); therefore, the two units are mapped as one hydrologic unit

100 ? — POTENTIOMETRIC CONTOUR--Shows altitude to which water will rise in wells. Dashed where approximately located, queried where uncertain. Contour interval 25 feet. Datum is National Geodetic Vertical Datum of 1929 (formerly called Mean Sea Level Datum of 1929). Water-level data used for the map were collected 1960-80. The Wilcox-Carrizo aquifer is not affected by regional water-level declines because no large pumping centers have been developed. Water levels at pumping centers where local declines are occurring were not used. Seasonal water-level fluctuations in wells are generally less than 10 feet annually

•184 CONTROL POINT--Number is altitude of water level in well used as control

Bi-218/272
Well number and altitude in feet, of potentiometric surface

Figure 3.--Potentiometric surface of the Wilcox-Carrizo aquifer; Bienville, Red River, northern Natchitoches, and southern Webster Parishes, La.

The Sparta is the most important aquifer in northern Louisiana and southern Arkansas. Because of the extent and development of the aquifer, more potentiometric data are available for the Sparta than any other aquifer in the study area. Intensive pumping from the unit throughout north-central Louisiana and southern Arkansas has caused a regional lowering of potentiometric levels. A time-history distribution of potentiometric levels of the Sparta aquifer is presented in Ryals (1980b).

The regional water-level decline is being monitored by observation wells maintained by the U.S. Geological Survey. Hydrographs of six observation wells are shown in figure 4. Regionally, water-level declines range from less than a foot to about 3 ft/yr. In addition to the regional declines, water levels in wells in or near pumping centers respond to local variations in pumpage. For example, the hydrograph of well L-25 (fig. 4) shows the variations in pumpage at Ruston, La., as well as the regional decline.

The potentiometric surface (spring 1980) of the Sparta aquifer is shown in figure 5. Water-level measurements in Arkansas were made March 18-21, 1980, and in Louisiana, May 19-21, 1980. Most measurements were made in wells screened in the middle and lower parts of the Sparta.

Head relations between the Wilcox-Carrizo and Sparta aquifers, as well as heads in other aquifers in the northern Louisiana salt-dome basin and vicinity, are discussed by Ryals (1982). Conceptual ground-water flow of the northern Louisiana salt-dome basin is described in Hosman (1978) and Ryals (1982).

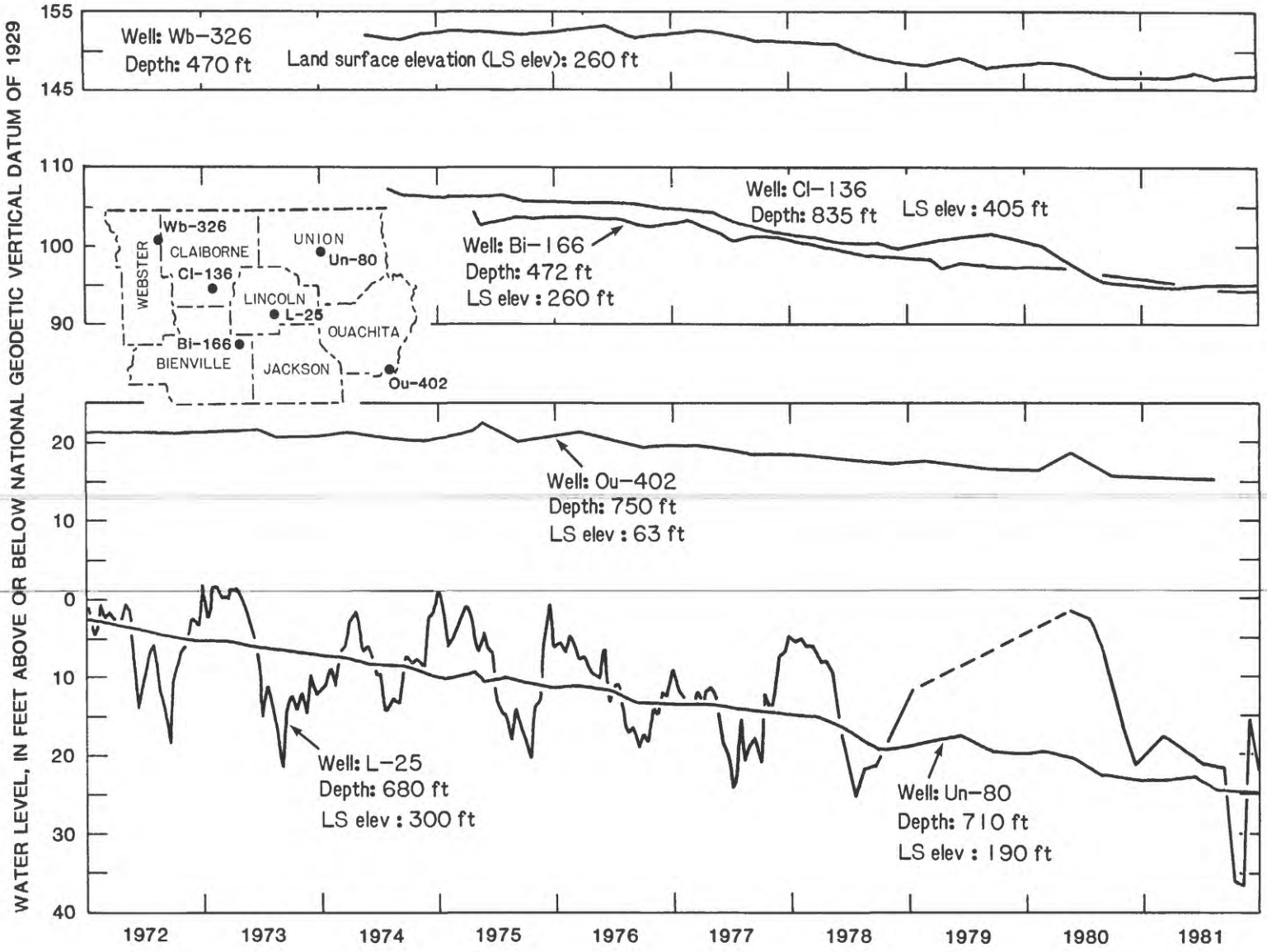


Figure 4.--Hydrographs of wells screened in the Sparta aquifer.

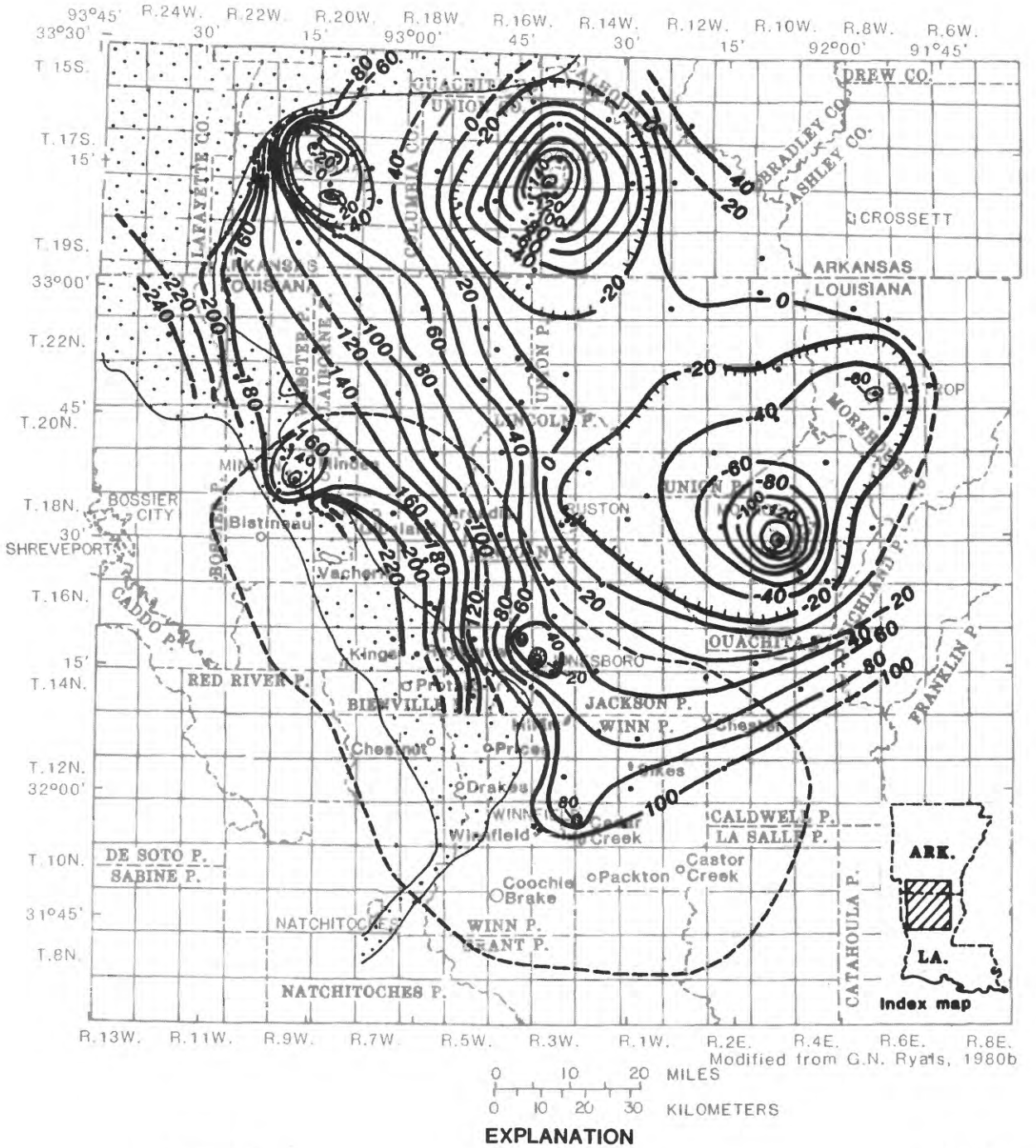


Figure 5.--Potentiometric surface of the Sparta aquifer, northern Louisian and southern Arkansas, spring 1980.

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