GROUND WATER IN OSCEOLA COUNTY, FLORIDA

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Prepared by the
U.S. GEOLOGICAL SURVEY
in cooperation with
OSCEOLA BOARD OF COUNTY COMMISSIONERS
and
SOUTH FLORIDA WATER MANAGEMENT DISTRICT

INTRODUCTION

Rapid population growth and increasing industrial development in central Florida in recent years have created a need for information about the water resources. Planning, management, and development of the water resources of any area are facilitated by an assessment of existing hydrologic conditions. This report describes the ground-water resources of Osceola County, Florida, with emphasis on the (1) location of the principal aquifers, (2) location of areas of ground-water recharge and discharge, (3) chemical quality of ground-water and (4) quantities of ground water available. This investigation was conducted by the U.S. Geological Survey in cooperation with the Osceola Board of County Commissioners and the South Florida Water Management District. The investigation included an inventory of 365 wells, test drilling in unconsolidated materials overlying the Floridan aquifer, water-level measurements, and water-quality sampling and analysis.

The population and industry of Osceola County are concentrated in the northwest part of the county where the Floridan aquifer contains an ample supply of freshwater. In 1970, about 90 percent of all ground water used in the county was from the highly productive Floridan aquifer. This aquifer supplies about 75 percent of ground water used in ranching, about 90 percent of that used by citrus groves and processing plants, and about 90 percent of that used by tourist-related facilities. The two major municipal water-supply systems, Kissimmee and St. Cloud, and all industrial and other large users tap the Floridan aquifer. The remaining ground-water supply is obtained from the surficial aquifer that overlies the Floridan aquifer.

An understanding of the terminology used in this report is necessary to obtain maximum use of the illustrations. The following definitions are for the most part taken verbatim from Lohman and others (1972). An *aquifer* is a formation, or group of formations, or part of a formation that contains sufficient saturated permeable material to yield a significant quantity of water to wells and springs. A *confining bed* is a body of relatively impermeable material stratigraphically adjacent to one or more aquifers. *Confined* ground water is under pressure significantly greater than atmospheric throughout and its upper limit is the bottom of a confining bed overlying the material in which the confined water occurs. *Artesian* water and *artesian* water body are equivalent respectively to confined ground water and confined water body. An artesian well is a well deriving its water from an artesian or confined water body. If the water level in an artesian well stands above the land surface, the well is a flowing artesian well (assuming the well is open to the atmosphere and land surface). *Unconfined ground water* is water in an aquifer that has a water table. A *water table* is that surface in an unconfined water body at which the pressure is atmospheric; it is generally accepted as being the top of the saturated zone. The *potentiometric surface* is a surface that represents the static head or pressure of water in the aquifer; it is defined by the levels to which water will rise in tightly cased wells penetrating the aquifer. The water table is a particular potentiometric surface.

Water moves downward from an unconfined aquifer to an underlying confined aquifer if the water table is above the potentiometric surface of the confined aquifer. The confined aquifer is said to be recharged. The rate of recharge varies with the head difference and the thickness and permeability of the confining bed. Discharge of water from a confined aquifer occurs when the potentiometric surface of the confined aquifer is above land surface or above the water table of the overlying unconfined aquifer. The rate of discharge varies with the head difference and the thickness and permeability of the confining bed. Areas where the potentiometric surface of a confined aquifer is above land surface are commonly called areas of artesian flow. Recharge and discharge areas of the Floridan aquifer are shown in figure 1.

An unconfined aquifer is recharged directly by rainfall. An unconfined aquifer discharges water laterally to streams, lakes, swamps, and to valley lowlands generally, vertically downward to an underlying confined quarter, and, in areas where the water table is relatively close to land surface, vertically upward by evapotranspiration.

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For those readers who may prefer to use metric units (SI) rather than inch–pound units, the conversion factors for the terms used in this report are listed below:

Multiply inch–pound unit	*By*	*To obtain metric (SI) unit*
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
gallons per minute (gal/min)	3.785	liters per minute (L/min)

HYDROGEOLOGY

Osceola County is underlain by a series of unconsolidated deposits (surficial aquifer) that overlie the Hawthorn Formation (confining bed) and limestones of the Ocala and Avon Park formations (Floridan aquifer) (fig. 2). The unconsolidated deposits consist of sand, shell material, limey sand, silt, and clay. These deposits vary in thickness throughout the county, but generally thicken to the east and south. Several zones in these unconsolidated deposits yield sufficient water to wells for water supply in parts of the county (fig. 3).

Throughout most of Osceola County, the Hawthorn Formation directly overlies and confines water in the limestones which comprise the Floridan aquifer. The Hawthorn is composed largely of greenish clays; shell; but the lower part is composed of weathered, impure limestones which are hydraulically connected to the Floridan aquifer. The basal, weathered limestones occur mainly in the southern half of the county. Drillers often have difficulty seating well casing in these weathered beds.

Floridan Aquifer

The Floridan aquifer underlies all of Osceola County and is the primary source of water for domestic, industrial, and agricultural uses. It is composed of more than 1,000 feet of porous to dense limestone and dolomitic limestone and includes the Avon Park and overlying Ocala formations. The Avon Park Limestone comprises the uppermost part of the Floridan aquifer in the northwest part of the county (fig. 2). In this area, the Ocala Limestone, which is present in the southern and eastern parts of the county, has been removed by weathering. The altitude of the top of the Floridan aquifer ranges from slightly above sea level in northwest Osceola County to more than 350 feet below sea level in the southwest and in a trough in the northeast (fig. 3). The two hydrogeologic sections in figure 2 show the general altitude of the formations that comprise the Floridan aquifer.

Most of the recharge to the Floridan aquifer in Osceola County occurs in Polk County and moves eastward. Some recharge to the Floridan aquifer occurs in Osceola County in areas where the confining beds above the Floridan are absent or are sufficiently permeable to transmit water downward. This downward movement of water occurs only in places where the water table in the surficial aquifer is higher than the potentiometric surface of the Floridan. The most effective recharge areas in Osceola County are in the extreme northwest where the surficial deposits are relatively thin and permeable and the Hawthorn formation is absent (figs. 1 and 2, section A-A′). Moderately effective recharge areas in central Osceola County also provide recharge through the unconsolidated sand and shell; however, some of the potential recharge in both areas is intercepted by pumpage from the surficial aquifer. Minimal recharge occurs in those areas shown as poor recharge areas because of the predominance of clayey sediments in the deposits that overlie the Floridan aquifer. There is virtually no potential for recharge in the discharge areas, which are areas of artesian flow from the Floridan.

Ground water moves from recharge areas toward discharge areas, in the direction of decreasing head as reflected in the slope of the potentiometric surface. The potentiometric surface of the Floridan rises with recharge and declines with discharge, either natural or artificial. Under natural conditions, the potentiometric surface fluctuates seasonally and annually in response to the amount and distribution of rainfall. The seasonal variation is shown in figure 4 for the period January 1973 to April 1974 for a well in a recharge area and for May 1973 to May 1974 for a well in a discharge area.

The yields to wells tapping the Floridan aquifer in Osceola County vary depending mainly on the thickness of aquifer penetrated and the permeability of the aquifer. Movement of water through the limestone of the Floridan aquifer has created extensive networks of solution cavities which store and readily transmit large quantities of water. Wells intercepting these solution cavities may produce as much as 1,000 gal/min in Osceola County. Yields to wells are less where sand and clay materials have filled the large cavities in the Floridan aquifer.

The quality of water in the Floridan aquifer varies with depth and location within the county. Generally, ground water contains less dissolved solids in recharge areas where downward percolation of rainfall directly influences the quality of water. Lowest concentrations of dissolved solids and chloride occur in water in the upper part of the Floridan aquifer in northwest and central Osceola County (figs. 5 and 6). The dissolved solids concentration of water increases from areas of recharge toward areas of discharge due to the percolation of water and solution of aquifer materials. The thickest section of freshwater in the Floridan aquifer in Osceola County is in the recharge area in the northwest part of the county where the total thickness of freshwater is estimated to be 1,500 to 1,800 feet.

Analyses of water from the Floridan aquifer in northeast Osceola County indicate that dissolved solids and chloride concentrations exceed the limits recommended by the U.S. Environmental Protection Agency (1977) of 500 mg/L (milligrams per liter) for dissolved solids and 250 mg/L for chloride. Records since 1960 indicate that chloride concentrations have remained fairly constant.

Objectionable concentrations of iron and hydrogen sulfide occur in water from some wells in the county. In the southern part of the county, casings are corroded in some wells finished in the upper part of the Floridan aquifer where the water contains sulfate in concentrations as high as 110 mg/L.

SURFICIAL AQUIFER

The surficial aquifer is composed of unconsolidated deposits which overlie either the Floridan aquifer or the Hawthorn Formation. The deposits consisting primarily of fine- to coarse-grained sand, shell, silt, and clay, differ from place to place in overall thickness and in the proportion in which the various components occur. Although the surficial aquifer yields only about 10 percent of the ground water used in the county, approximately 10 percent of the domestic and municipal water supplies and 10 to 25 percent of the ranching and the irrigation water supplies, respectively, in Osceola County are obtained from it. Analysis of well inventory and test drilling data indicate that wells tapping the surficial aquifer yield appreciable quantities of water in at least five distinct areas in Osceola County (fig. 3). Well points with screens are used to develop water from the surficial aquifer; the water occurs under unconfined to semiconfined conditions. The surficial aquifer may be the most economic source of water where only small quantities of water are required, or where water quality in the underlying Floridan aquifer is poorer than desired. Present data indicate that the surficial aquifer in southeast Osceola yields as much as 300 gal/min to individual wells. Yields from the surficial aquifer in other parts of the county are generally less than 30 gal/min.

The surficial aquifer in northwest Osceola County is in the area of most effective recharge to the Floridan aquifer. In the extreme northwest, medium to coarse-grained white to yellowish sands predominate, and water can be developed at most depths above the Floridan aquifer. Yields of as much as 20 gal/min are obtained from small diameter wells that vary in depth from 10 to 100 feet. West of Reedy Creek (fig. 1) in the northwest corner of the county, horizontal wells are used to tap sands that underlie ridges. Water quality in the medium to coarse-grained sand zone is excellent, with chloride concentration in water from most wells less than 10 mg/L and dissolved solids less than 100 mg/L.

The surficial aquifer also yields appreciable water to wells in a small area about 3 miles west of Lake Tohopekaliga. Here a coarse-grained white sand about 40 to 50 feet thick occurs at depths of from 45 to 94 feet below land surface. East of this small area the coarse-grained sand is semiconfined between gray and green clay beds. Well yields of as much as 15 gal/min are reported from small diameter wells finished in the coarse-grained sand. The quality of water from the surficial aquifer in this area is generally excellent; the concentrations of dissolved solids and chloride in water are generally low. However, iron concentrations as high as 1.1 mg/L may occur in some wells, causing treatment problems and staining of plumbing fixtures.

In north-central Osceola County, near East Lake Tohopekaliga, small supplies irrigation and domestic water are obtained from the surficial aquifer. In this area the surficial aquifer is composed of white to brown medium-grained sand which occurs at land surface to 50 feet below land surface and averages about 30 feet in thickness. The water is unconfined. Yields of 15 to 20 gal/min are obtained from small diameter wells and the water quality is generally good except for local occurrences of iron in excess of 0.8 mg/L. Well owners report the yield of shallow wells in this area to be dependable, even during dryer months.

In a relatively large area of south-central and southeast Osceola County the surficial aquifer consists of gray medium-grained sand with some interbedded shell materials. The top of this semiconfined water-bearing sand ranges from about 30 to 40 feet below land surface in the south-central part of the county to about 100 feet below land surface at the southwest corner of the county. The thickness of the sand ranges from about 25 feet near its northern and western limits to about 60 to 70 feet in the southeast. Water is obtained from the gray medium-grained sand primarily in the vicinity of Yeehaw Junction, where most wells are screened at depths of about 110 feet below land surface. The gray medium-grained sand in this area is highly productive, and is used extensively for irrigation and domestic supply. Yields of as much as 300 gal/min from 4-inch diameter wells have been reported. Available data indicate that this water-bearing sand thickens and becomes more permeable southward in Okeechobee County. Reconnaissance studies indicate this layer of medium grained sand is also present in the central part of the county, although it is tapped for water very little because yields to wells in the underlying Floridan aquifer are greater and the water of acceptable quality. The gray medium-grained sand is also generally thinner and finer grained in the central part of the county and is thus considered as an aquifer of marginal potential.

The lowest concentration of chlorides and dissolved solids in water of the surficial aquifer in south-central and southeast Osceola County occur in the semiconfined medium-grained sand near Kenansville and Yeehaw Junction; chloride concentrations average less than 10 mg/L and dissolved solids about 70 mg/L.

USE OF THE ILLUSTRATIONS

The illustrations present general information of use to those interested in the availability of ground water in Osceola County. However, the map portrayals represent interpretations of data from existing wells based on the assumption that the geologic and hydrologic conditions change somewhat uniformly between wells. This assumption may not hold true in all instances because the wells are far apart in some areas of the county and conditions commonly change somewhat abruptly over relatively short distances. Consequently, for more exact detail at any particular point in the county, site-specific information should be obtained.

To illustrate use of the maps, suppose that a ground-water supply from the Floridan aquifer is needed at a site within the county. The land-surface altitude of the site should first be determined; the approximate length of casing needed to seal off overlying sands and clays may then be obtained by reference to the contours of figure 3 that show altitude of the top of the Floridan aquifer. The static water level in the well may then be approximated by reference to the potentiometric contours of figure 1, which were compiled from data collected during May 1974, a period of generally low potentiometric levels. The chloride and dissolved-solids concentrations of the water in the Floridan aquifer may be approximately determined by reference to figures 5 and 6. The yield of an individual well in relation to its depth of aquifer penetration cannot be estimated from the illustrations. The yield of a well is proportional to the drawdown (lowering of water level during pumping), which varies with the permeability of the section of the aquifer from which water is obtained. In general, the yields of large diameter wells (6-inch or more) in Osceola County that produce water from the upper 200 feet of the Floridan aquifer range from 150 to 200 gal/min per foot of drawdown.

Wells tapping the surficial aquifer are less definite as to depth of well and expected yield. The water level, permeability of the sands, the occurrence of zones of shell or of confining layers of clay, marl, or other fine material, and the length and size of well points or screens all influence the yield of a well in the surficial aquifer. In general, however, well yields of 20 gal/min are common from the surficial aquifer; higher yields can be expected from the gray medium-grained sand in southeast Osceola County.

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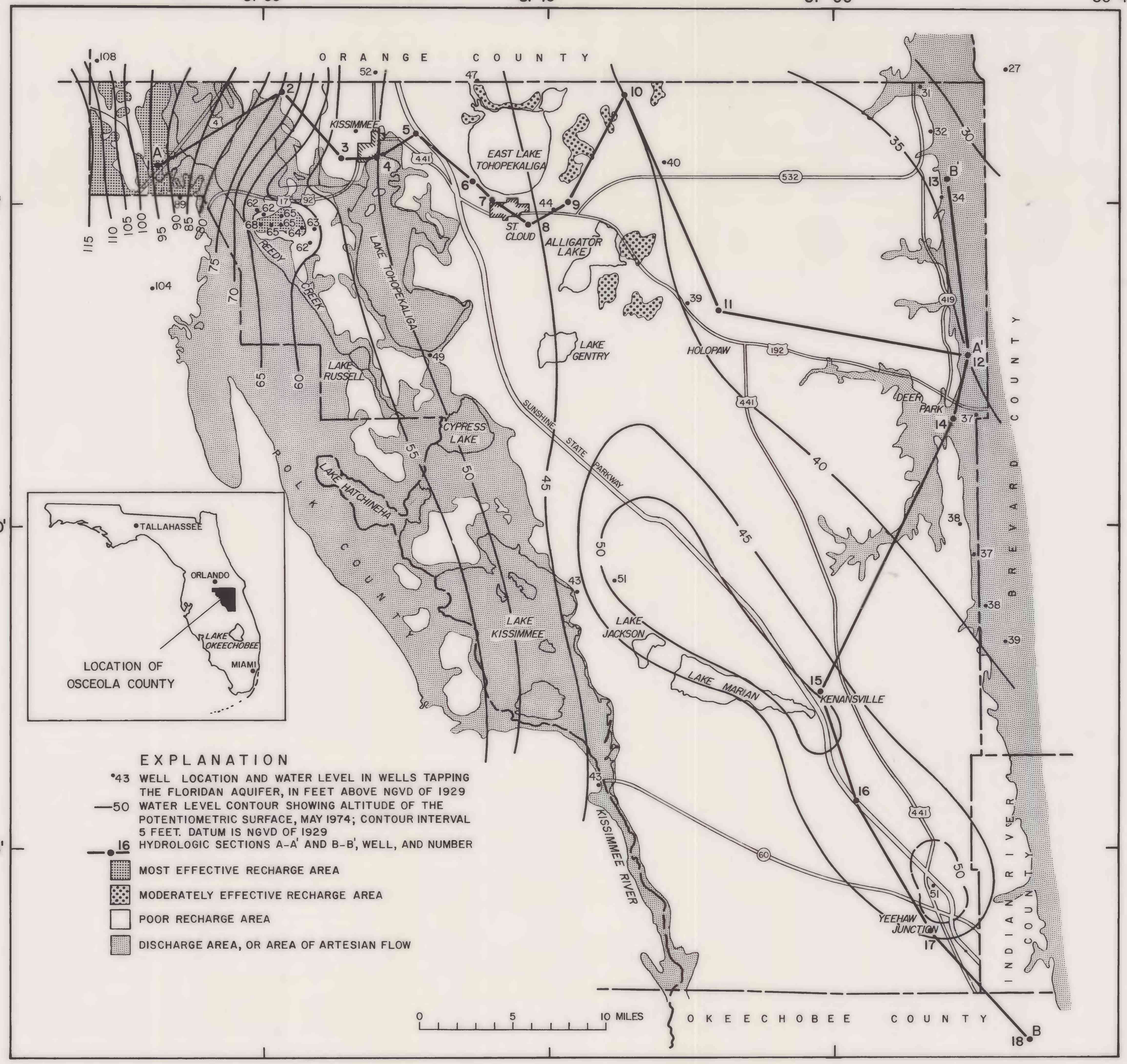

Figure 1.—Recharge areas, discharge areas, and the potentiometric surface of the Floridan aquifer.

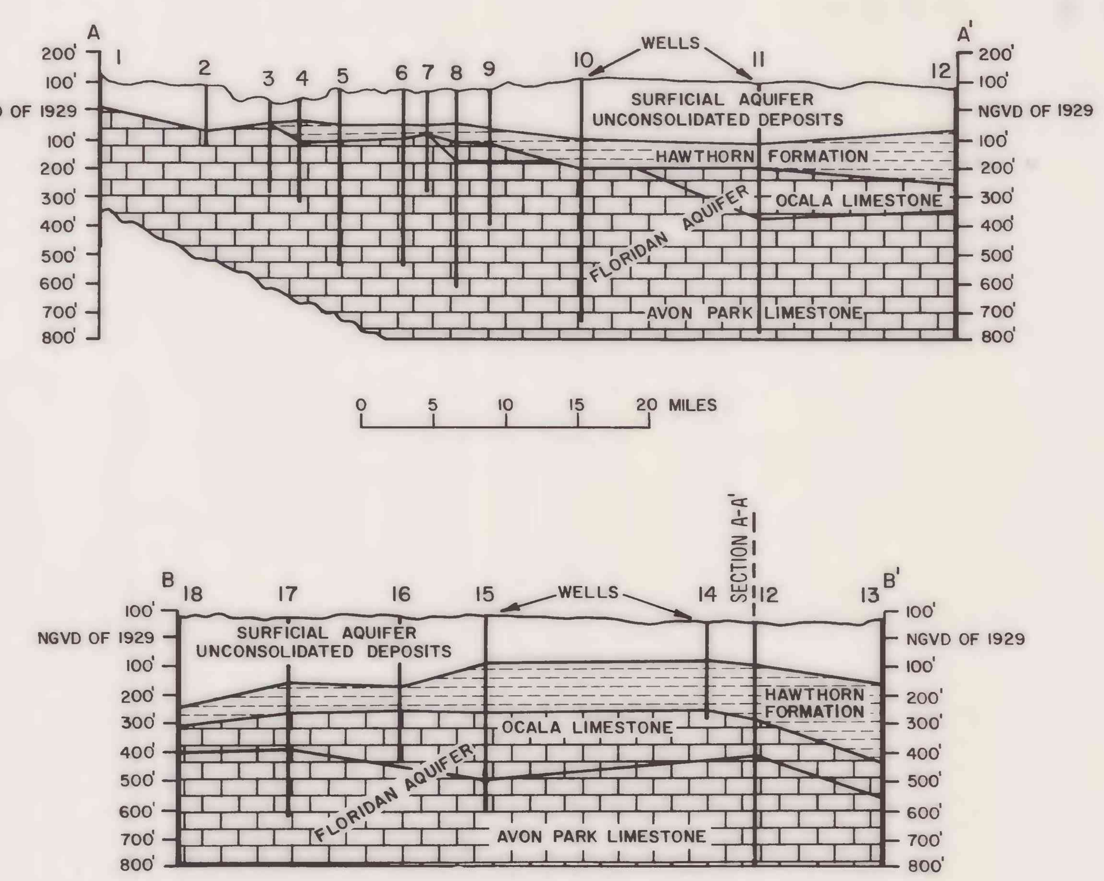

Figure 2.—Hydrogeologic sections.

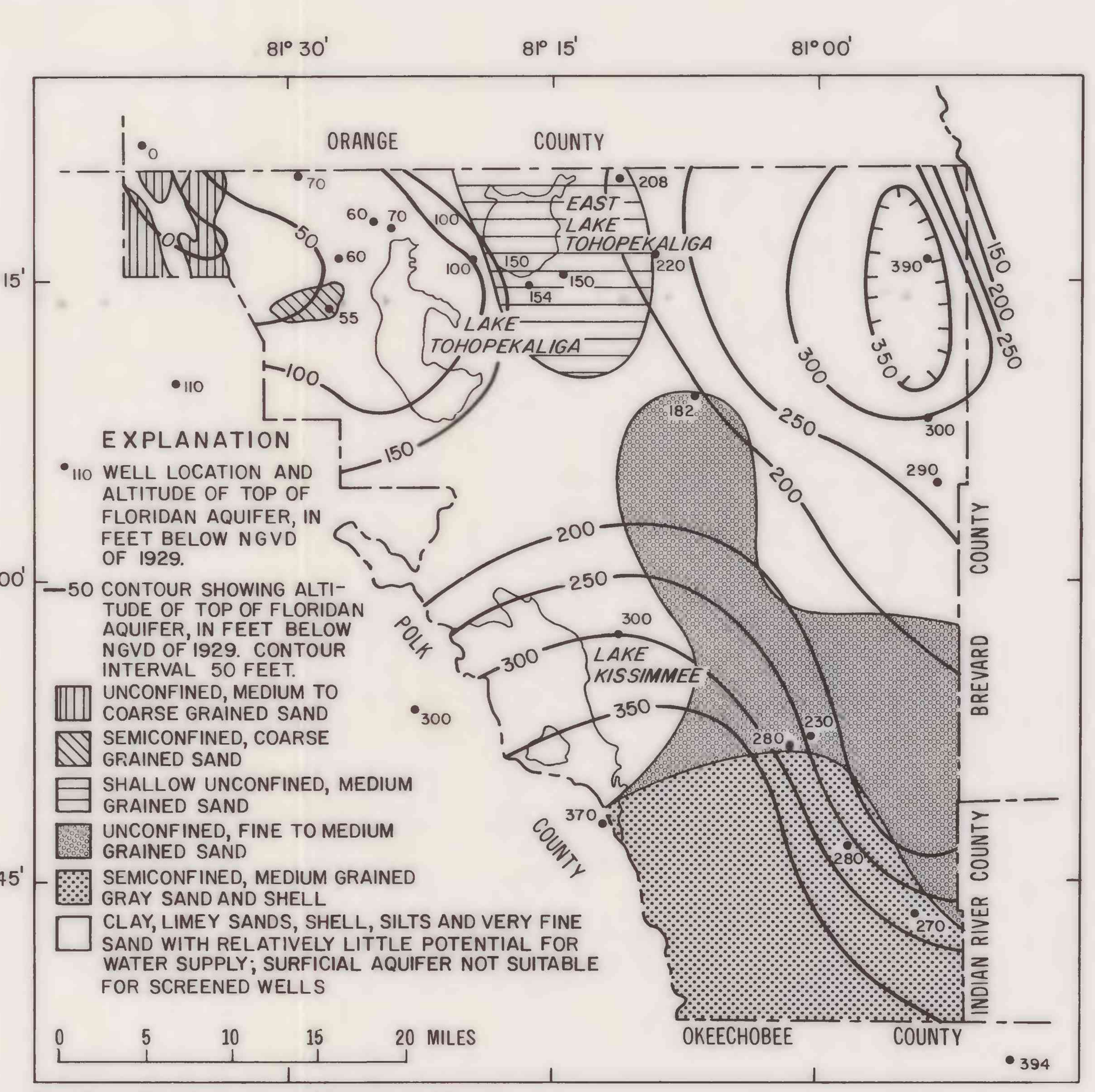

Figure 3.—Areal distribution of unconsolidated deposits of the surficial aquifer and altitude of top of Floridan aquifer (modified from Lichtler, 1972).

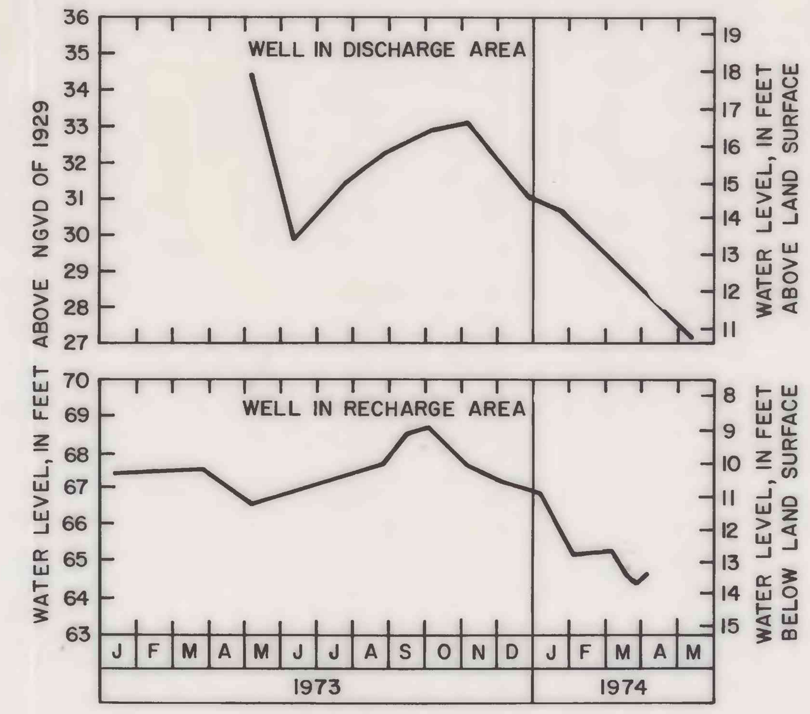

Figure 4.—Hydrographs of water level in a recharge area and in a discharge area.

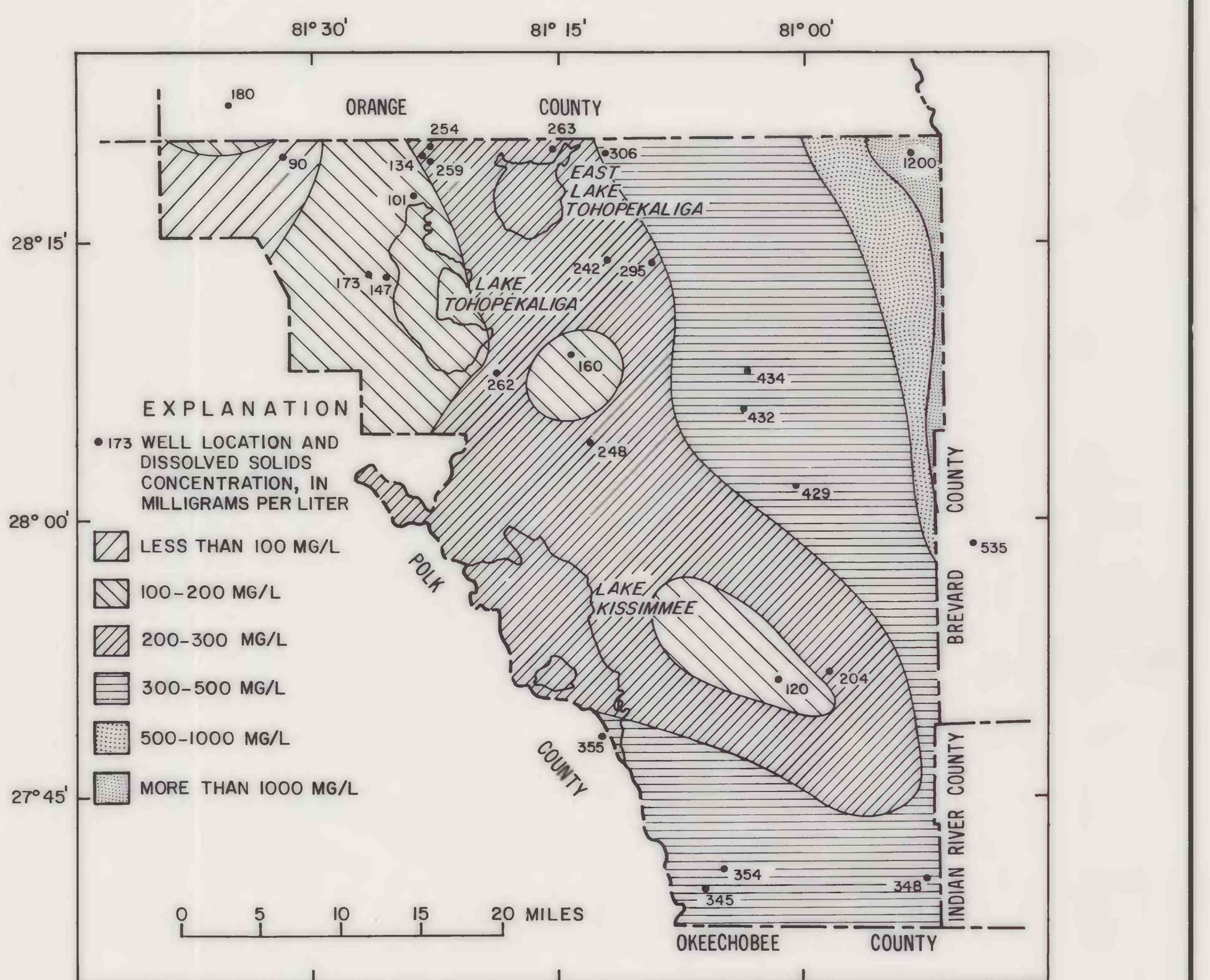

Figure 5.—Dissolved solids concentration in wells tapping the upper part Floridan aquifer.

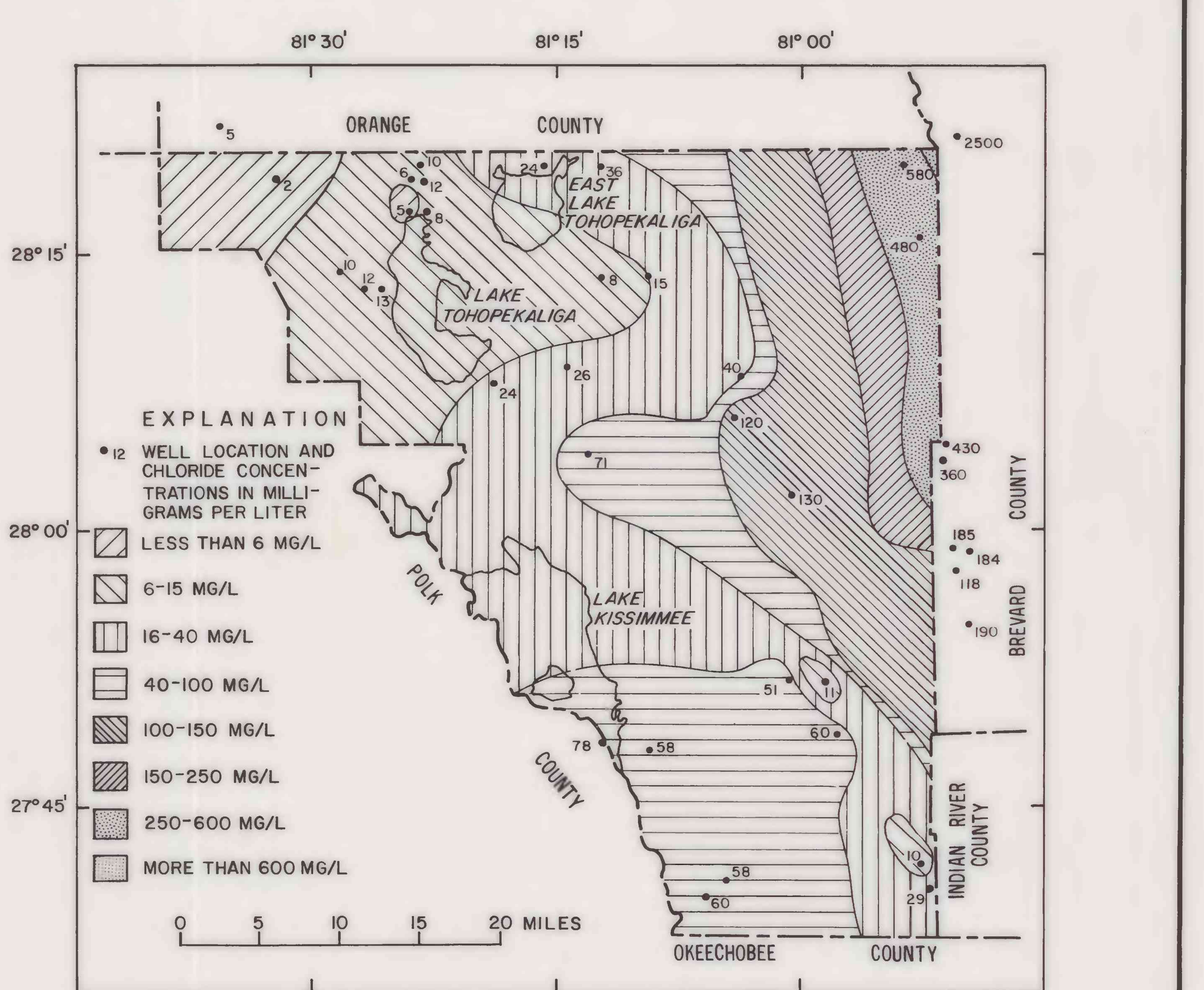

Figure 6.—Chloride concentrations in wells tapping the upper part Floridan aquifer.

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