WATER RESOURCES AND EFFECTS OF GROUND-WATER DEVELOPMENT IN PASCO COUNTY, FLORIDA

By J.D. Fretwell

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations Report 87-4188

Prepared in cooperation with

PASCO COUNTY, FLORIDA

Tallahassee, Florida

1988

DEPARTMENT OF THE INTERIOR

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CONVERSION FACTORS AND ABBREVIATIONS

For the convenience of readers who may prefer to use metric (International System) units rather than the inch-pound units used in this report, values may be converted by using the following factors:

Multiply inch-pound unit	By	To obtain metric unit
inch (in.)	25.4	millimeter (mm)
inch per year (in/yr)	25.4	millimeter per year (mm/yr)
foot (ft)	0.3048	meter (m)
foot per day (ft/d)	0.3048	meter per day (m/d)
mile (mi)	1.609	kilometer (km)
acre	0.4047	hectare (ha)
square foot per day (ft^2/d)	0.09294	square meter per day (m^2/d)
square mile (mi^2)	2.590	square kilometer (km^2)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
gallon (gal)	0.003785	cubic meter (m^3)
gallon per minute (gal/min)	0.00006309	cubic meter per second (m^3/s)
gallon per day (gal/d)	0.003785	cubic meter per day (m^3/d)
million gallons per day (Mgal/d)	0.04381	cubic meter per second (m^3/s)
million gallons per day per square mile [$(Mgal/d)/mi^2$]	0.01692	cubic meter per second per square kilometer [$(m^3/s)/km^2$]

Temperature in degrees Fahrenheit (°F) can be converted to degrees Celsius (°C) as follows:

$$°F = 1.8\ °C + 32$$

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Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called "Sea Level Datum of 1929."

ADDITIONAL ABBREVIATIONS

$CaCo_3$	calcium carbonate
$\mu g/L$	microgram per liter
mg/L	milligram per liter
$\mu S/cm$	microsiemens per centimeter
meq/L	milliequivalents per liter
pCi/L	picocuries per liter
Na	sodium
K	potassium
Ca	calcium
Mg	magnesium
Fe	iron
Cl	chloride
HCO_3	bicarbonate
So_4	sulfate
CO_3	carbonate

WATER RESOURCES AND EFFECTS OF GROUND-WATER DEVELOPMENT IN PASCO COUNTY, FLORIDA

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ABSTRACT

Pasco County, on the west-central coast of Florida, has a hill and valley terrain that ranges in altitude from sea level along the Gulf of Mexico to 300 feet above sea level in the ridge area near Hernando County. The principal perennial streams are the Withlacoochee and Hillsborough Rivers in the eastern part of the county and the Pithlachascotee and Anclote Rivers near the coast. The county is rural except for some intensive residential and commercial development along the coast; only 13 percent of the population is located in incorporated areas.

The Floridan aquifer system, the principal source of water in west-central Florida, is comprised of carbonate rock of Tertiary age. Only the upper part of the system (the Upper Floridan aquifer) is tapped for water supplies in Pasco County. Formations of the Upper Floridan aquifer in Pasco County consist of, in ascending order, the Avon Park Formation, the Ocala Limestone, the Suwannee Limestone, and the Tampa Limestone. These formations represent the freshwater part of the Floridan aquifer system in Pasco County. The aquifer is overlain by surficial deposits of sand and clay that range from zero to about 100 feet in thickness. In some parts of the county, the sand constitutes an unconfined surficial aquifer.

Water from the Upper Floridan aquifer accounted for 99 percent of the about 80 million gallons per day of water used for irrigation, industry, and rural and public supply in Pasco County in 1984. Thirty-one percent of this water was used for agricultural irrigation. Thirty-seven percent was used by the two major industries, rock mining (limestone) and food processing. Approximately 55.0 million gallons per day of water withdrawn from the aquifer was exported via pipeline to Pinellas County to the south and west. Of this, 1.5 million gallons per day were bought back by Pasco County.

The Upper Floridan aquifer is generally unconfined in the northwestern part of the county and semiconfined throughout the rest of the county. Its potentiometric surface changes slightly between wet and dry seasons. Ground water enters the Upper Floridan aquifer as infiltration from direct precipitation or as ground-water flow into the county from the east. Flow in the county is generally westward and southward toward the Gulf of Mexico and Tampa Bay, although some flow is northward out of the county. Reported transmissivity of the Upper Floridan aquifer in Pasco County ranges from approximately

$2.0x10^4$ to $4.8x10^5$ feet squared per day. Reported hydraulic conductivity of the surficial aquifer is low, ranging from 0.8 to 20 feet per day.

Chemical quality of water generally is suitable for most uses (concentrations of constituents are less than the maximum limits recommended by the Florida Department of Environmental Regulation for drinking water) except near the coast where concentrations of chloride generally exceed recommended limits due to the proximity of the Gulf of Mexico. A few wells yield water that has elevated concentrations (greater than 300 micrograms per liter) of iron. One well showed a high concentration of sodium and another had a sulfate concentration slightly above the recommended limit. Water from two sinkholes (Crews Lake Sink A and Hernasco Sink) contained high concentrations of lead under low water-level conditions in February 1985. One pond contained a high concentration of zinc. Iron concentrations exceeded the recommended limit at one location in the Withlacoochee River.

A ground-water flow model for Pasco County was calibrated and validated and used to estimate the potential effects of future ground-water withdrawals on Pasco County's water resources. Five model simulations were run to evaluate aquifer response to development plans for west Pasco County. Withdrawal rates ranged from 10 to 31.5 million gallons per day. Simulated drawdowns resulting from the increased demands ranged from 5 to 12 feet in the potentiometric surface of the Upper Floridan aquifer and 1 to 3 feet in the water table. The simulated radius of influence around well fields (drawdown of 1 foot or more) ranged from 4.75 to 7.25 miles in the Upper Floridan aquifer and from 1.2 to 5.4 miles in the surficial aquifer under the various development plans. The largest source of water for these increased withdrawals was reduction of ground-water evapotranspiration. Other sources were intercepted spring flow, reduced boundary outflow, and reduced streamflow. Drawdowns of about 1 to 2 feet occur near the saltwater-freshwater transition zone for all development plans.

In order to estimate the overall potential effects of ground-water development to meet all projected needs of both Pasco and Pinellas Counties and that part of Hillsborough County within the modeled area, additional simulations were made. These involved estimated total withdrawals for the year 2035 and a 10-percent reduction in recharge to the surficial aquifer. Simulations indicate a decline in the potentiometric surface (Upper Floridan aquifer) of 21 feet (below the 1976-77 level) in Cypress Creek well field and an increase of 8 feet in the St. Leo area because of reduced agricultural pumpage. Lowering of the potentiometric surface in the west increases the potential for contaminant infiltration in the Upper Floridan aquifer through thin surficial deposits, increased sinkhole development in sinkhole prone areas, and upconing and lateral intrusion of saltwater. Simulations also indicated lowering of the water table, possible dewatering of the surficial aquifer, lowering of lake levels, and reduced spring flows.

INTRODUCTION

Increasing demands are being made on the water resources of Pasco County (fig. 1) as a result of a rapidly increasing population in the county and in areas immediately south of the county. Demands for water for agricultural use in the eastern part of the county have leveled off, but demands are increasing for water for municipal use in the western part of the county and for export

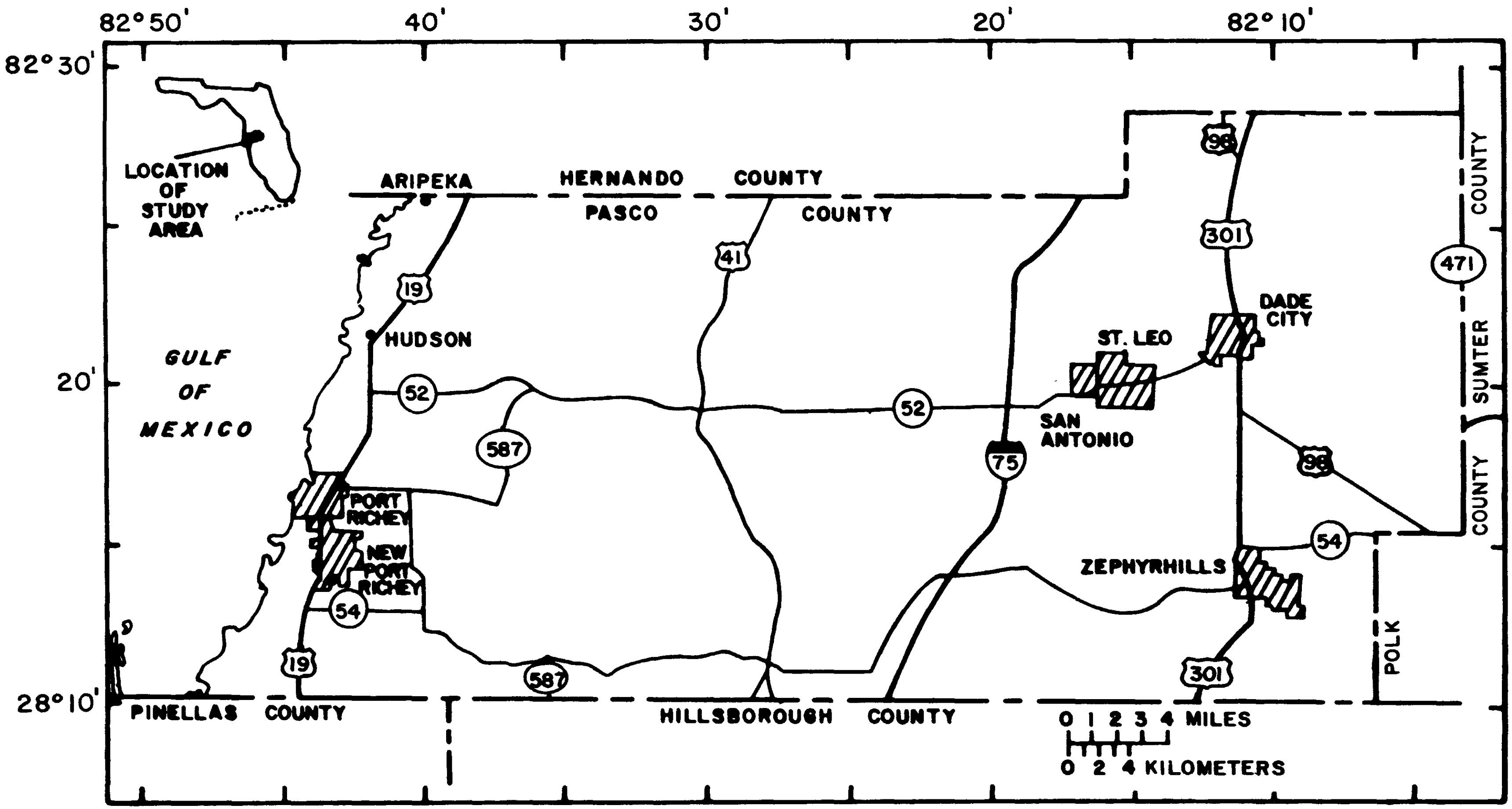


Figure 1.--Pasco County--the study area.

to Pinellas County to the south. Currently (1986), there are four major well fields in the county that supply more than 60 Mgal/d to municipal users in Pinellas and Pasco Counties. A fifth large well field (central Pasco) is being proposed for development in the near future. A sixth well field (Cypress Bridge) also is being considered. Additionally, many county-owned wells and small well fields have been developed to supply subdivisions and other local needs.

Current water-resource concerns of the county include the potential for (1) introduction of poor quality water into the Upper Floridan aquifer through sinkholes, by direct recharge where the confining unit is absent, by recharge from rivers, and by upwelling and lateral intrusion of saltwater along the coast; and (2) lowering of ground-water levels and lake levels as a result of ground-water withdrawals.

This project is the first comprehensive study of Pasco County's water resources by the U.S. Geological Survey since Wetterhall (1964). This study was undertaken in July 1983, in cooperation with Pasco County, to assist water managers in resource planning and management by assessing the county's water resources and by evaluating the potential effects of future ground-water development.

Purpose and Scope

The objectives of this report are to: (1) quantify the water resources of the county; (2) characterize the water quality; and (3) determine the potential effects of future ground-water development on the water resources, such as lowered lake and ground-water levels, and determine the potential intrusion of saltwater into the freshwater aquifer.

This report is intended to provide an understanding of the hydrology and water resources of Pasco County as a basis for management of the resources. The report includes descriptions of the geography, geology, water use, and surface-water and ground-water resources, including water quality and hydraulic properties of the surficial and the Upper Floridan aquifers. Possible effects from future ground-water development also are evaluated through model simulation. Information is based on data collected during the study (1983-85), historical data from the files of the U.S. Geological Survey and the Southwest Florida Water Management District, and from previously published reports.

Previous Studies

Descriptions of geology and hydrology are given in regional studies by Sellards (1908), Matson and Sanford (1913), Stringfield (1936), Cooke (1945), Carr and Alverson (1959), Pride and others (1966), Cherry and others (1970), and White (1970). More specific studies were conducted by the U.S. Geological Survey in and around the area of study. Wetterhall (1964) reported on a hydrogeologic reconnaissance that included Pasco County. Anderson and Laughlin (1982) reported on the Floridan aquifer system in the Withlacoochee River basin. Reports describing springs are presented by Wetterhall (1965) and Rosenau and others (1977). Henderson (1983) reported on the hydrology of lakes in the Lake Padgett area. Lopez and Hayes (1984) presented regional relations for estimating the magnitude and frequency of floods on lakes in west-central Florida. Causseaux and Fretwell (1982) mapped the saltwater-freshwater interface, including the area along the coast of Pasco County. Tibbals and others (1980) discussed the effects of pumping the Upper Floridan aquifer near Dade City in Pasco County.

Ryder (1985) described the regional ground-water hydrology of west-central Florida based on a three-dimensional model of the Upper Floridan and shallow aquifers. Models of well-field areas in and around Pasco County were described by Robertson and Mallory (1977), Hutchinson and others (1981), and Hutchinson (1984). Several reports are available for two well fields in Pasco County: Cypress Creek (Seaburn and Robertson, Inc., 1977; Ryder, 1978) and Cross Bar Ranch (Leggette, Brashears, and Graham, Inc., 1979; Hutchinson, 1985).

Methods of Investigation

The hydrogeology of the county was characterized on the basis of previously published reports and existing data in U.S. Geological Survey files. Thickness maps of the Floridan aquifer system and the surficial aquifer were prepared from previously published maps and drillers' completion reports. Several shallow wells were augured to provide information on thickness of sands and depth to the water table. Aquifer characteristics were determined from available data.

Past studies indicated only small changes with time in the chemical constituents of ground water except for wells tapping the transition zone between saltwater and freshwater. Much water-quality data are available for Pasco County. Additional water-quality sampling was done only where data were very old or lacking and in coastal areas where changes in chlorides are likely to occur. A complete analysis of major anions and cations was made at the U.S. Geological Survey laboratory in Ocala. Several wells along the coast that are open in the transition zone are currently sampled for chloride concentrations on a periodic basis. Results of these samplings were used to determine changes with time in chloride concentrations in wells within the transition zone.

Water-level measurements and water-quality analyses were used as indicators of the interconnection between surface water and ground water in various parts of the county. Water levels in the rivers and in wells located near the rivers were measured on a periodic basis and used to determine ground-water and surface-water relations. Water levels in wells and lakes were compared to determine potential ground-water flow direction. Water quality in sinkholes, lakes, and nearby wells was compared for additional evidence of interconnection.

Simulation of the effects of pumpage on reduction of flow to springs, lowering of lake levels, and lowering of the potentiometric surface was made by using the U.S. Geological Survey modular ground-water flow model. The model, which included all of Pasco County and major well-field areas to the south of Pasco County, was (1) calibrated by using data for the years 1976-77 to be consistent with a previous model of the area (Hutchinson, 1984), (2) validated with other predevelopment data (Ryder, 1982; 1985), and (3) then run with maximum projected pumpage and reduced rainfall for the year 2035. Projected pumpage was based on expected demands on Pasco County's water resources. In addition, five different development plans to accommodate projected increases in withdrawal from west Pasco County from 1985 to the year 2035 were used to show the different potential drawdowns resulting from each plan. The drawdowns resulting from the projected pumpage simulations were used to evaluate the potential effect of projected withdrawals on heads in the aquifer, reduction in spring flow, and on saltwater encroachment.

Data-Collection Sites

Data from 539 wells were used in this study (appendix A). Water samples collected from 64 wells during the study were analyzed for common inorganic constituents including calcium, magnesium, potassium, sodium, chloride, fluoride, silica, sulfate, iron, nitrite, and nitrate (appendices B and C). Also determined at the time of sampling at most wells were temperature, specific conductance, and pH. Potentiometric surfaces for May and September 1984 (Barr and Schiner, 1984; Barr, 1984) were mapped based on measurements in 123 wells in the Upper Floridan aquifer. Lithologic or water-table data were collected at 125 shallow wells. Selected wells from which water-level and water-quality data were collected prior to the study also have been included in appendices A, B, and C. The locations of wells from which ground-water data were collected are shown in figures 2, 3, and 4.

Data from 154 surface-water sites and sinkholes (fig. 5) were used in this study (appendix D). Water samples collected generally were analyzed for common inorganic constituents including calcium, magnesium, chloride, sulfate, potassium, sodium, and nutrients including nitrogen, phosphorus, and orthophosphate. Also determined at some sites were temperature, specific conductance, pH, color, and total organic carbon (appendix E). Discharge and stage were measured periodically at six sites during the study (appendix E). Water-level and water-quality data collected prior to the study from selected sites were also included in this study.

Acknowledgments

The author gratefully acknowledges the assistance provided by many organizations and individuals in conjunction with this investigation. Pasco County personnel were helpful in providing information and assistance. Special thanks to James G. Brewer, Manager of Hudson Water Works, who provided much information about Hudson's wells, and to Walter H. Nielsen, owner of Ironwood Golf Club in Aripeka, who took the time to show us around his property to point out seeps and wells. The Southwest Florida Water Management District personnel also provided valuable information. The author is grateful to the many well owners who permitted access to their land and allowed sampling of water and measuring of water levels in their wells.

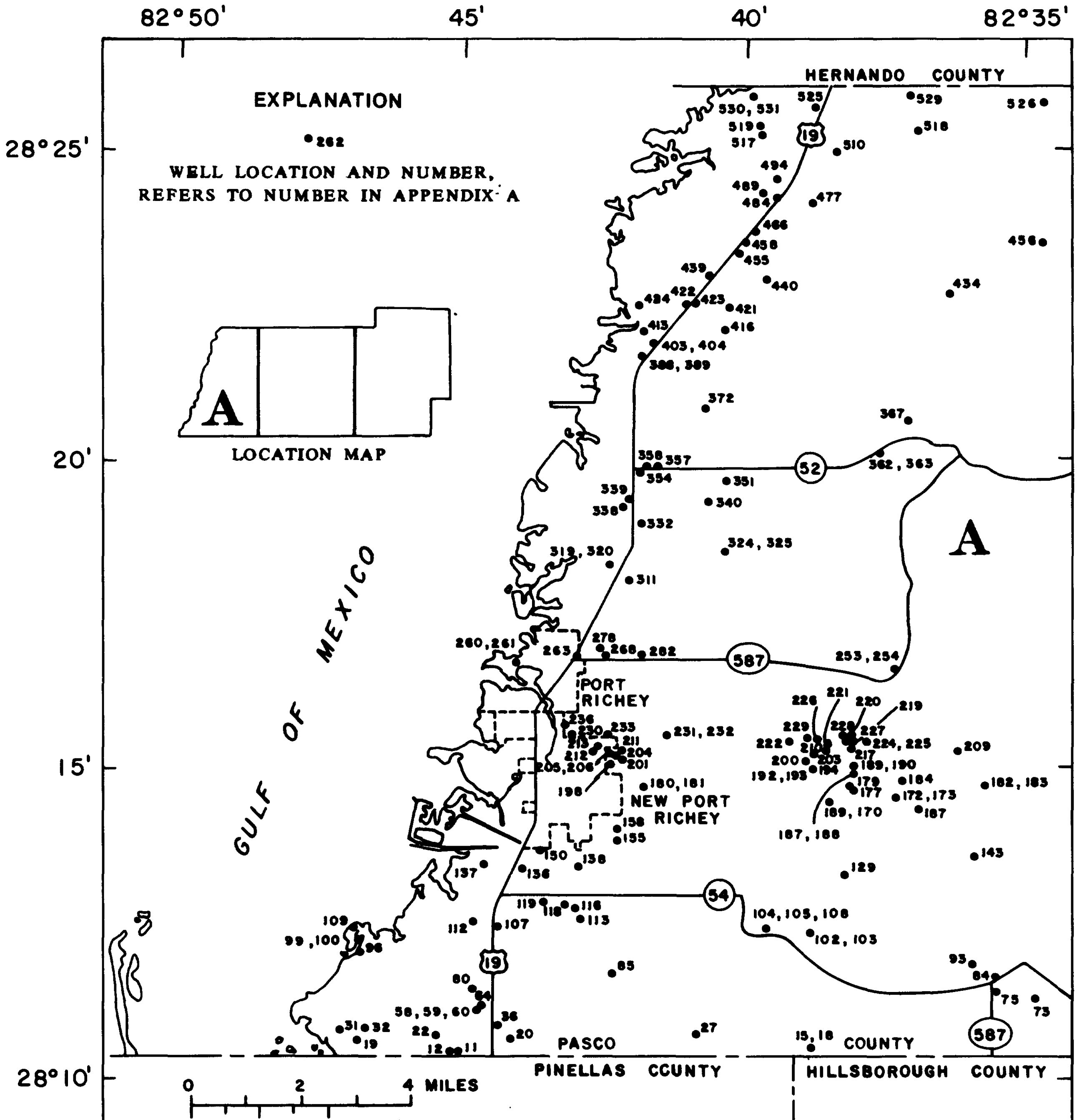


Figure 2.--Location of wells where ground-water data were collected in western (A) Pasco County.

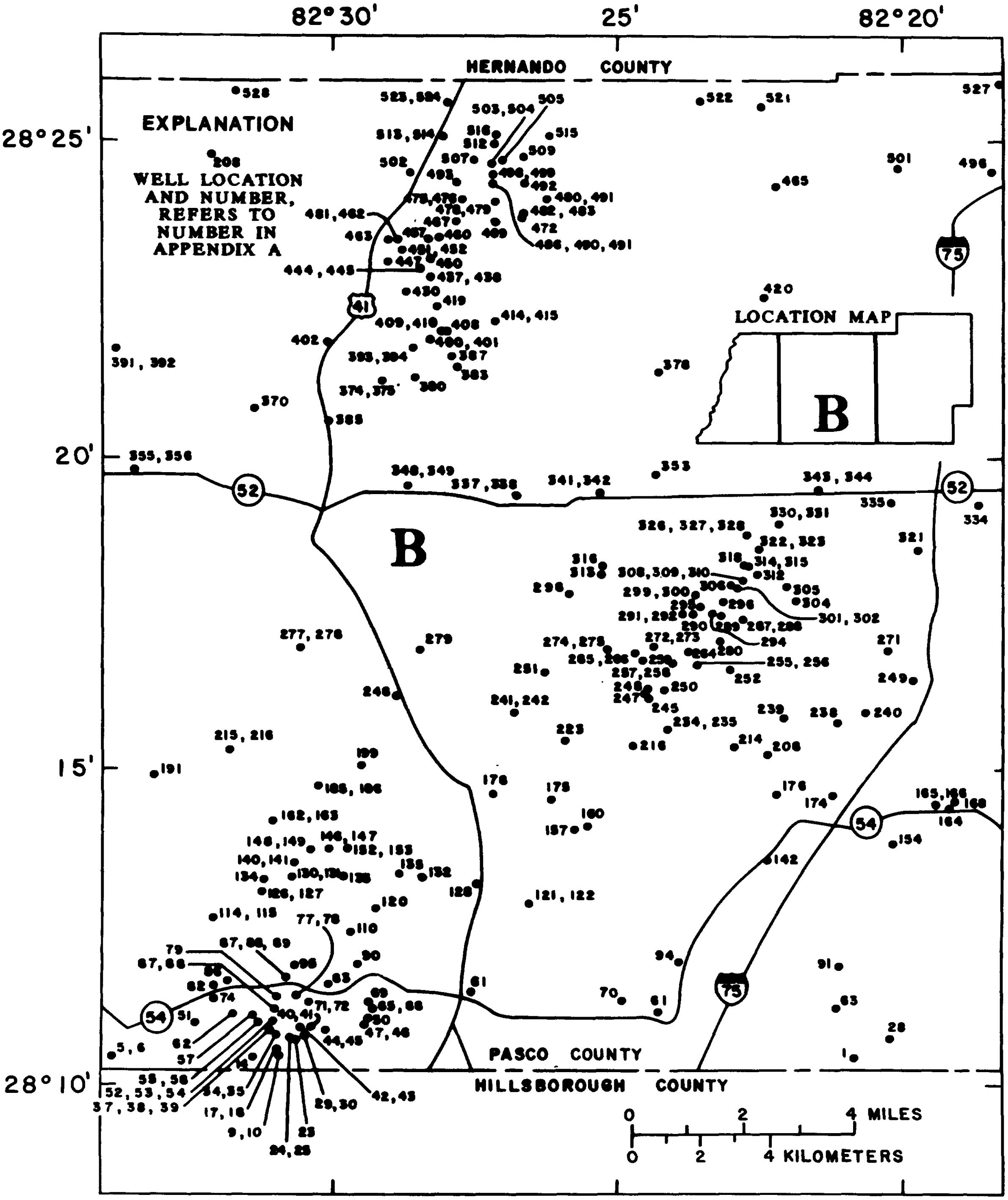


Figure 3.--Location of wells where ground-water data were collected in central (B) Pasco County.

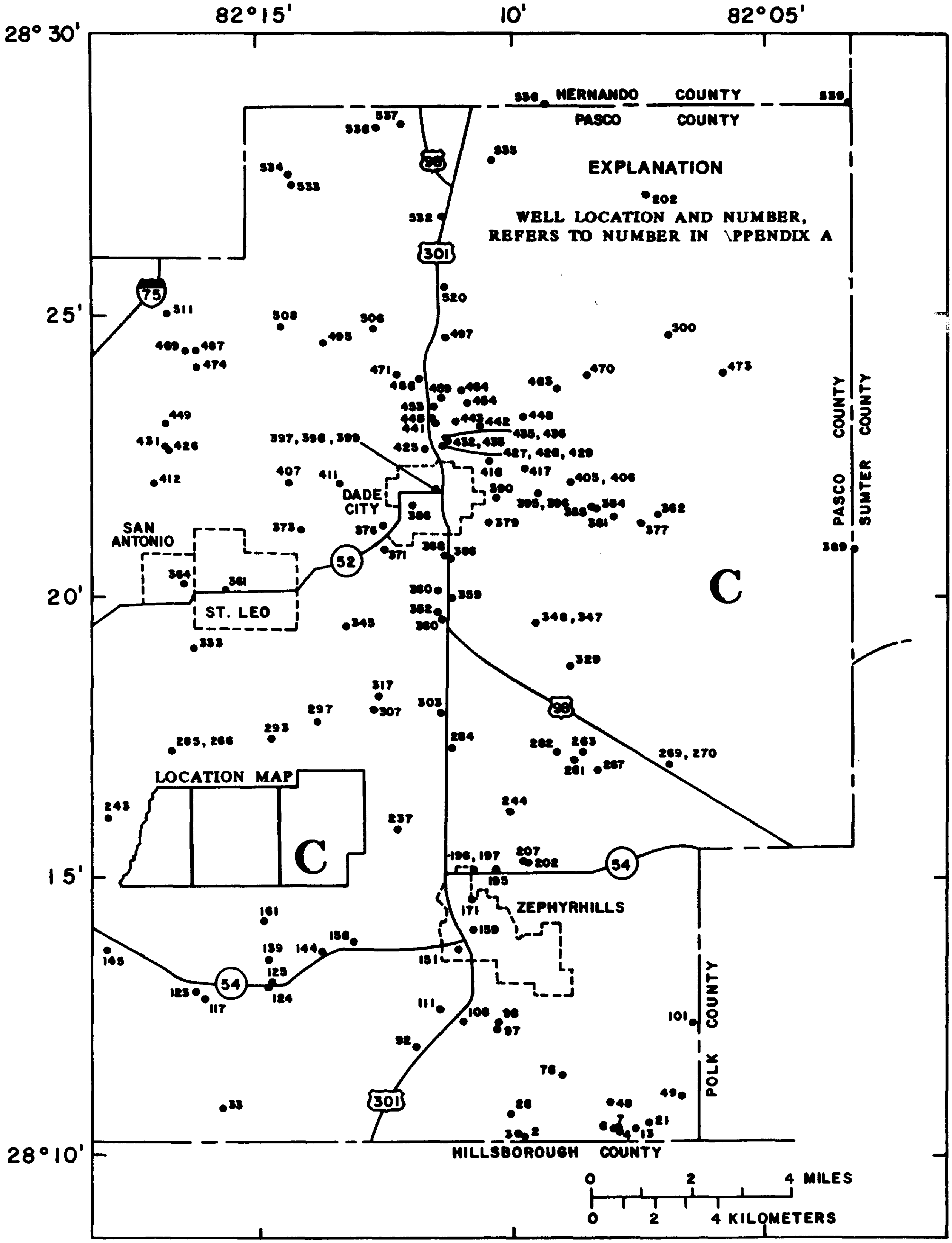
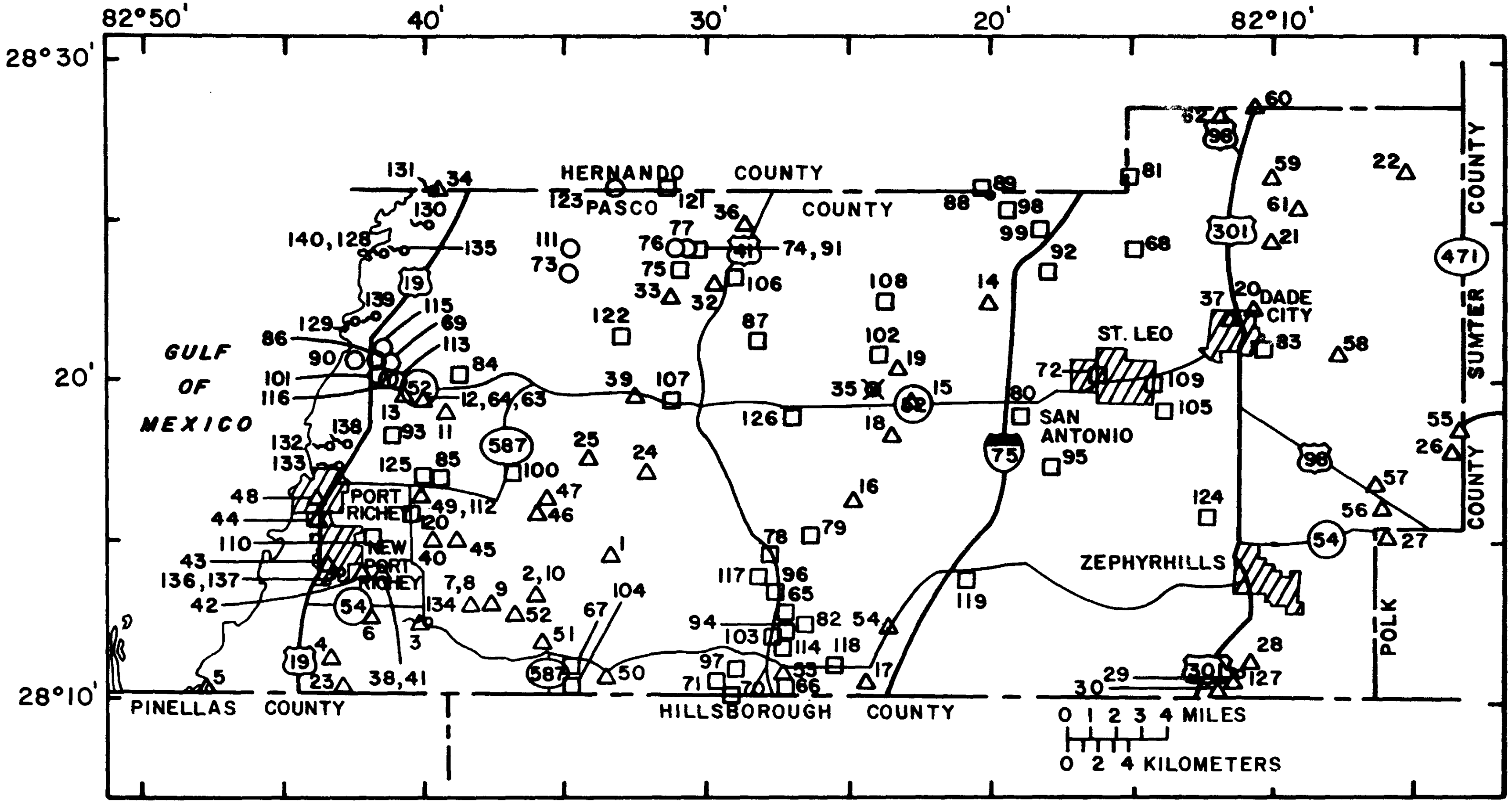


Figure 4.--Location of wells where ground-water data were collected in eastern (C) Pasco County.



EXPLANATION

25 △ STREAM LOCATION AND NUMBER

127 SPRING LOCATION AND NUMBER

83 □ LAKE LOCATION AND NUMBER

69 ○ SINKHOLE LOCATION AND NUMBER

35 MARSH LOCATION AND NUMBER

Figure 5.--Data-collection sites on streams, lakes, springs, and sinkholes. (Site identification and name are given in appendix D.)

FACTORS AFFECTING THE WATER RESOURCES

Geography, Topography, and Drainage

Pasco County, an area of about 750 mi^2, is on the coast of west-central Florida (fig. 1). Of these 750 mi^2, about 685 mi^2 is land and 65 mi^2 is inland water. The county is bounded on the west by the Gulf of Mexico, on the east by Polk and Sumter Counties, on the north by Hernando County, and on the south by Hillsborough and Pinellas Counties.

Land-surface altitudes range from sea level at the coast to about 300 feet above sea level in the Brooksville Ridge (fig. 6). The 100-foot contour generally denotes the northwest trending Brooksville Ridge. Topography is very irregular along the ridge with rolling hill and valley terrain. Northeast of the ridge, altitudes gradually decrease to about 75 feet above sea level.

Pasco County has partially developed surface drainage through four rivers and their tributaries: the Anclote and Pithlachascotee Rivers in the west and the Withlacoochee and Hillsborough Rivers in the east (fig. 7). The Anclote and Pithlachascotee Rivers flow from the interior of the county to the Gulf of Mexico. The Withlacoochee River enters the county from Polk County and traverses the eastern part of the county, flowing generally northwest. The Hillsborough River heads in the southeastern part of the county and flows southwest toward Hillsborough County. Cypress Creek heads in north-central Pasco County draining a large area of central Pasco County before discharging to the Hillsborough River in Hillsborough County.

Surface drainage in parts of Pasco County (especially in the north and northwest) is poorly developed and drainage is internal. Rainfall percolates through sand and clay to recharge the underlying Upper Floridan aquifer. After heavy rainfall, small intermittent streams flow to sinkholes where the water either percolates rapidly or ponds to form prairie lakes. During dry periods, these channels and lakes are usually dry. During wet periods, flooding may occur if the rate of rainfall exceeds the rate of runoff and percolation or if the potentiometric surface of the aquifer rises to or above land surface.

Much of the coastal area is characterized by saltwater marsh and swamp and is drained by many tide-affected creeks and channels. Freshwater swamps occur in the central and eastern parts of the county along either side of the Brooksville Ridge. Numerous lakes and ponds occur throughout the county.

Climate

The climate of Pasco County is subtropical, characterized by mild, moderately dry winters and warm, humid summers. Average monthly temperatures range from 60 °F in January to 82 °F in July and August (National Oceanic and Atmospheric Administration, 1932-85), and the average annual temperature is 72 °F.

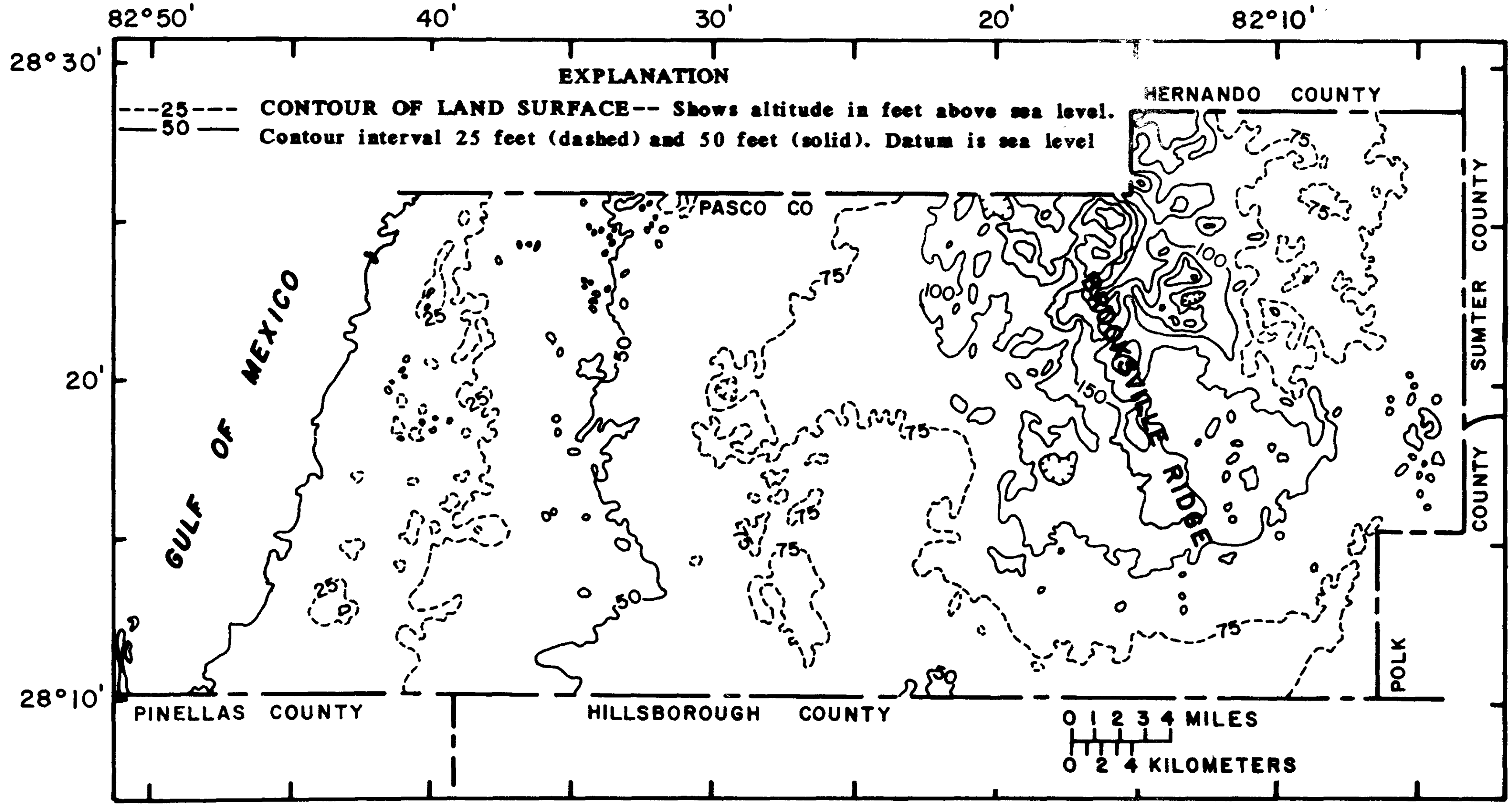


Figure 6.--General topography of Pasco County.

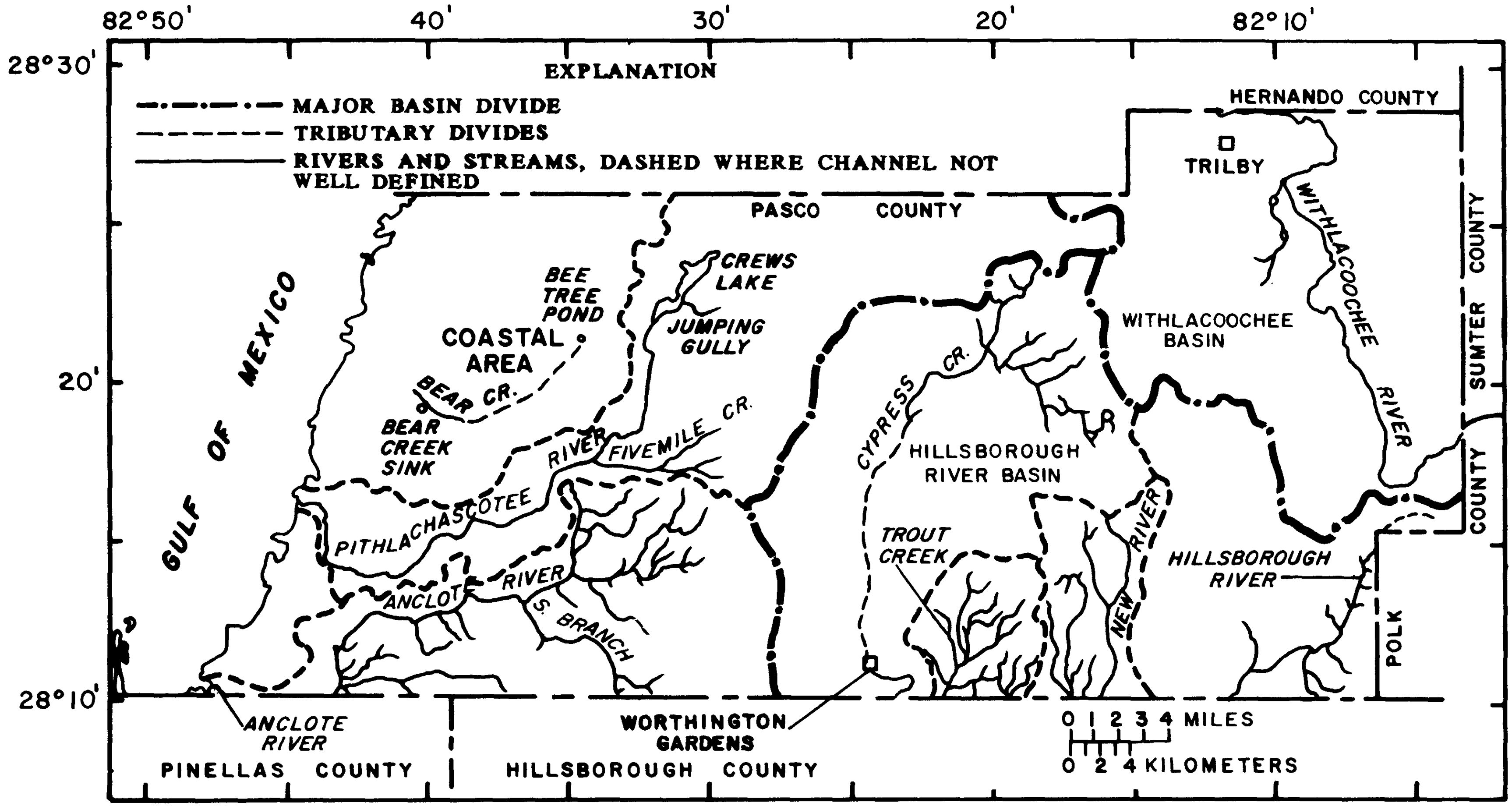


Figure 7.--Major drainage basins, tributary divides, and streams.

The average annual rainfall is about 55 inches at St. Leo (fig. 1), based on records for 1931-84 (National Oceanic and Atmospheric Administration, 1932-85). About 53 percent, or 29 inches of rainfall, occurs from June to September as thundershowers. Rainfall varies locally, as can be seen in figure 8. Differences in average rainfall between Tarpon Springs, along the coast just south of Pasco County, and St. Leo, in the Brooksville Ridge area of Pasco County, ranged between a fraction of an inch to almost 4 inches per month in 1984. Figure 9 shows annual variations in rainfall at St. Leo. During the study period (1983-85), wide variations from the normal occurred with extremely high rainfall in 1983 and below average rainfall in 1985.

Land Use

Seventy percent of Pasco County is agricultural and forest land of which much is used for growing citrus and as pastureland; much of this land is irrigated (fig. 10). Wetland areas, such as swamps, marshes, lakes, and streams, cover 17 percent of the county, especially along the coastal fringe and in the extreme eastern part of the county. A large part of the remaining county land is urban (10 percent). Only small amounts (2 percent) of unused (barren) land exist in the county. Industry occupies only a small part of the county (1 percent), and citrus processing and rock mining (limestone) account for most of the industrial land use.

The 1985 population of Pasco County is estimated at 233,000 (University of Florida, 1986). Of this, 13 percent reside in the incorporated areas of Dade City, New Port Richey, Port Richey, St. Leo, San Antonio, and Zephyrhills; however, much of the unincorporated area is heavily populated (fig. 11). In 1980, about 69 percent of the county's population resided in the western one-third of the county, concentrated along the gulf coast; about 22 percent resided in the eastern one-third of the county; and most of the remainder was concentrated near the unincorporated areas of Land O'Lakes and Quail Hollow in the south-central part of the county.

Population growth during the past 15 years (1970-85), as evidenced by census data reported by the University of Florida (1983), has been rapid (300-percent increase), as can be seen in figure 12. Population projections by the University of Florida indicate that this growth trend will continue. The influx of people has been accompanied by new and expanded industry. Currently (1986), growth in housing developments is occurring predominantly along the coast. The population of New Port Richey almost doubled between 1970 and 1980. This increase in population is putting an increased demand on the water resources of the county.

Water Use

Freshwater use for irrigation, industrial, public, and rural supplies in Pasco County in 1984 was 79.7 Mgal/d (Stieglitz, 1985). Of this, 99 percent was ground water and 1 percent was surface water (Stieglitz, 1985). Pumping varies from year to year and from season to season primarily as a function of the amount and distribution of rainfall. This is especially true of pumping for irrigation, which is greatest during the spring growing season when rainfall is low. As population continues to grow, pumping for public supply will increase.

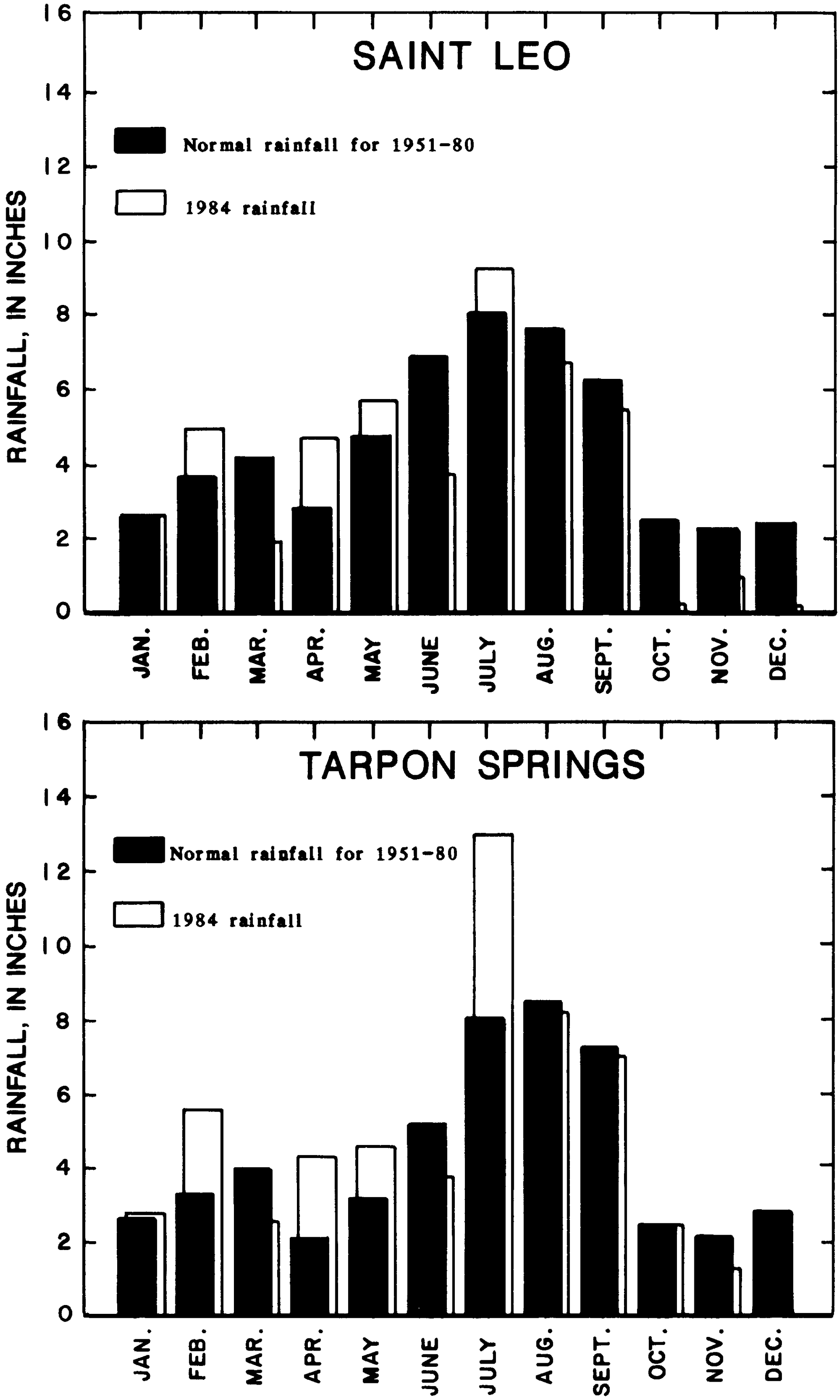


Figure 8.--Normal monthly and 1984 monthly rainfall at St. Leo and Tarpon Springs. (From National Oceanic and Atmospheric Administration, 1984.)

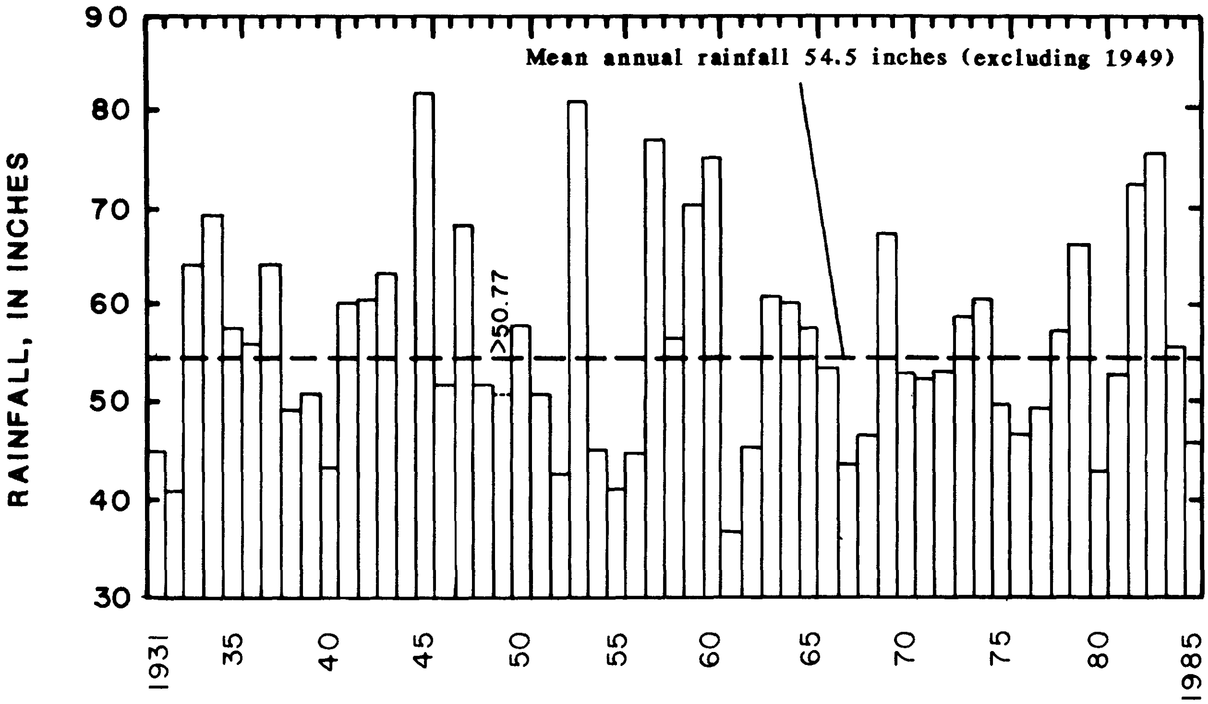


Figure 9.--Annual rainfall at St. Leo, 1931-85. (From National Oceanic and Atmospheric Administration, 1931-85.)

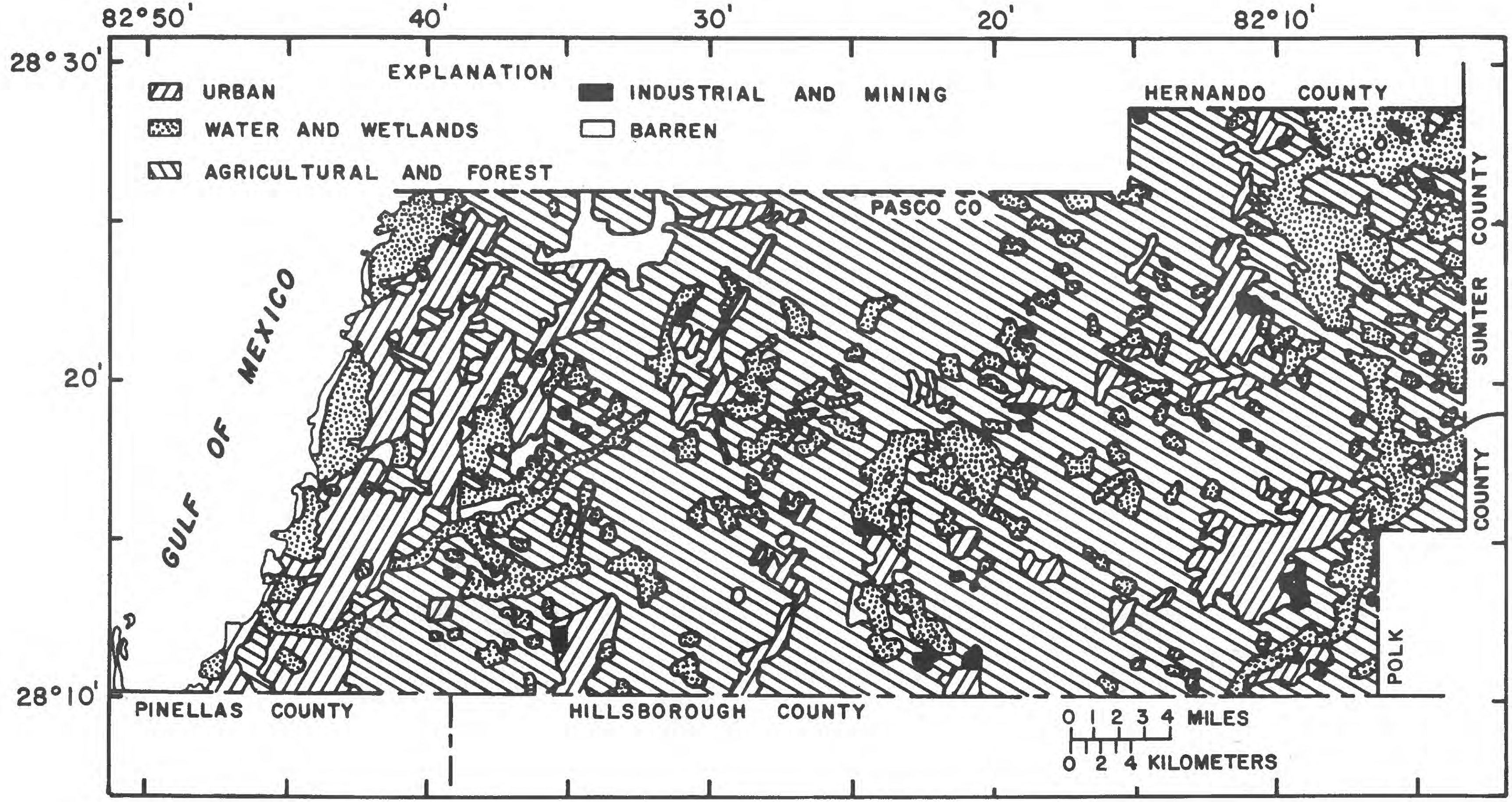


Figure 10.--Estimated land use in 1985. (Modified from Southwest Florida Water Management District, 1976.)

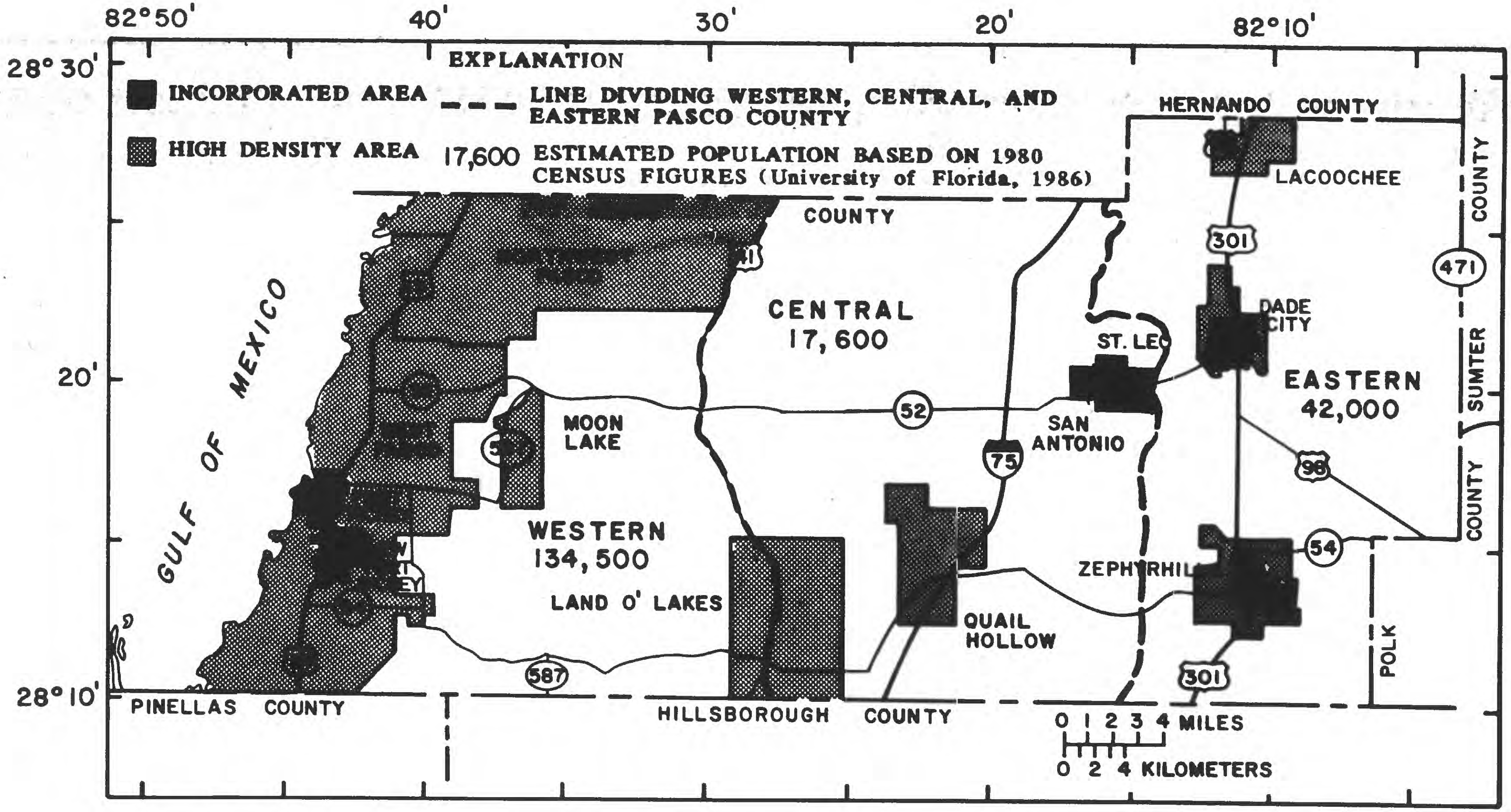


Figure 11.--Major population centers and estimated populations for 1980.

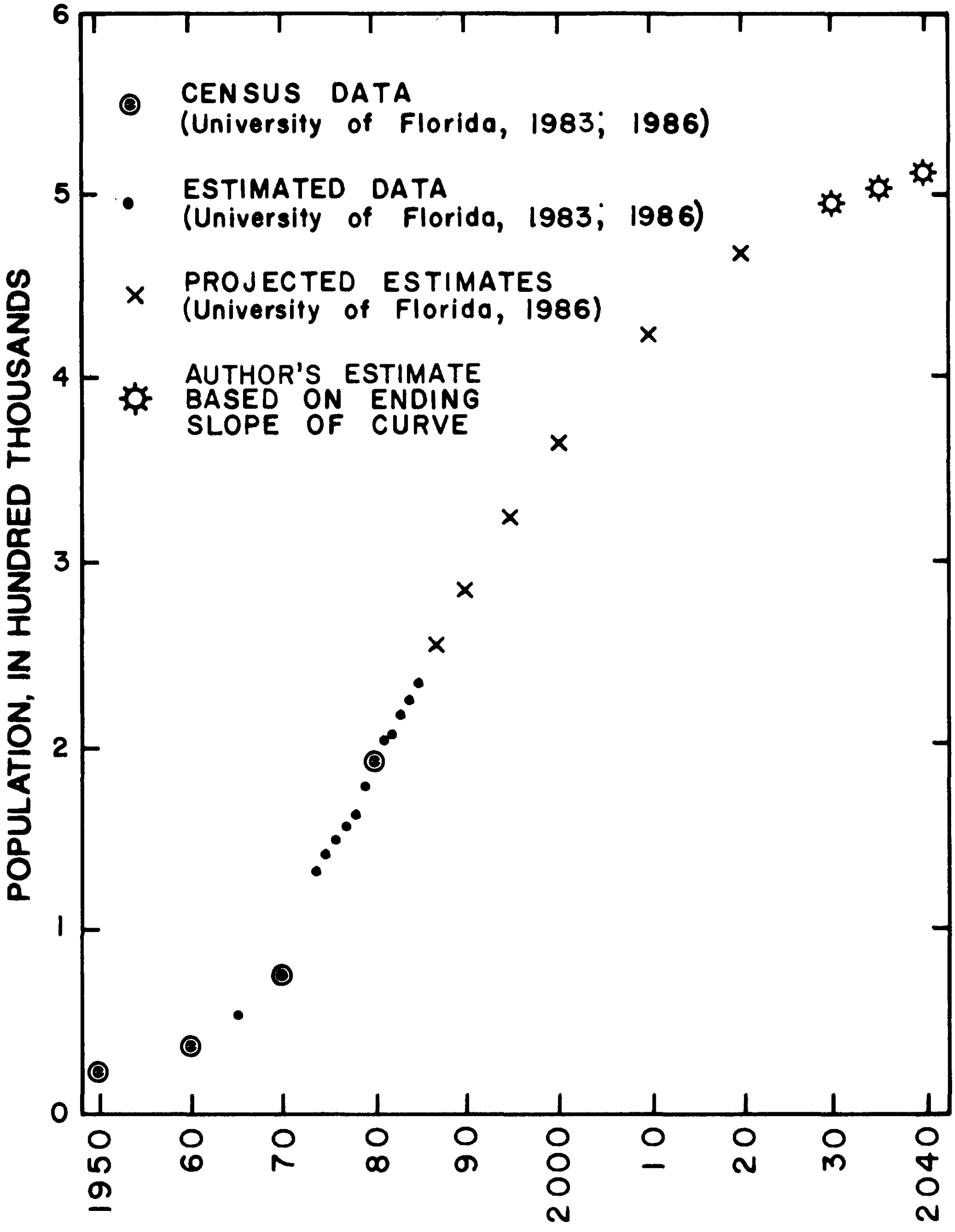


Figure 12.--Past and projected population of Pasco County.
(From University of Florida, 1983; 1986.)

In 1984, industry accounted for the largest amount of water used, 30.0 Mgal/d, or 37 percent (fig. 13). Of this amount, 22.4 Mgal/d was used for rock mining, and another 7.4 Mgal/d was used for citrus processing.

Irrigation is the second largest category of water use. In 1984, use for this purpose was 24.9 Mgal/d, or 31 percent (Stieglitz, 1985). About 96 percent of the water used for irrigation was from ground-water sources; 4 percent was from surface-water sources and constitutes nearly all surface-water use in Pasco County (Stieglitz, 1985). This category includes irrigation for citrus, turf, truck farming, other crops, and pastureland (fig. 14). These figures are based on consumptive use permitted by the Southwest Florida Water Management District and from data collected at selected sites by the U.S. Geological Survey. Water use for irrigation shows more seasonal variation than the other categories. The largest amount of water for irrigation is used in the dry spring months between March and June (fig. 15). Large amounts of water also are used from October through December for fall crops.

Public-supply water use includes all water pumped for the public-supply systems of Pasco County, Dade City, Hudson, Port Richey, San Antonio, Zephyrhills, and New Port Richey and for other suppliers that are permitted to pump more than 100,000 gal/d. All of the 19.9 Mgal/d of water used for public supply in 1984 was from ground-water sources. Public-supply use in 1984 was estimated at 111 gal/d per capita. Public-supply water use has increased from 3.00 Mgal/d in 1970 to 19.9 Mgal/d in 1984 (fig. 16).

Rural water use of 4.65 Mgal/d was the smallest water-use category in 1984. This category is comprised of self-supplied household water and water supplied by small public-supply systems pumping less than 100,000 gal/d. Rural water use is estimated based on an average per capita water use of 100 gal/d. The number of rural domestic users, for this report, is the difference between the total population and the number of people served by major public-supply systems. Rural water use has decreased from 13.60 Mgal/d in 1975 to 4.65 Mgal/d in 1984 (fig. 16).

Miscellaneous water use of 0.27 Mgal/d includes water used by educational facilities and other public institutions that do not fall into any of the other categories. This quantity is so small that it is not included in figure 13. Also not included in figure 13 is water withdrawn in Pasco County and exported to Pinellas and Hillsborough Counties. Water withdrawn for exportation is discussed in a later section.

Most public-supply systems are metered and, along with rural water use, are considered the most accurate of all water-use categories. With the expansion of towns and their public-supply systems, much of the rural population that supplied their own water in the past was added to these expanded systems by 1979. Because the total domestic population is either on public supply or supply their own water, the combined categories are a good estimate of total domestic water use. Combined public-supply and rural water use has increased from 18.2 Mgal/d in 1975 to 24.6 Mgal/d in 1984 (fig. 16).

Industrial water use has varied considerably since 1970 (fig. 16); however, it has averaged about 20 Mgal/d. This variability may be due in part to variability in mining operations.

Since 1979, accuracy of irrigation water-use estimates has increased due to new methods of obtaining data (such as the U.S. Geological Survey's

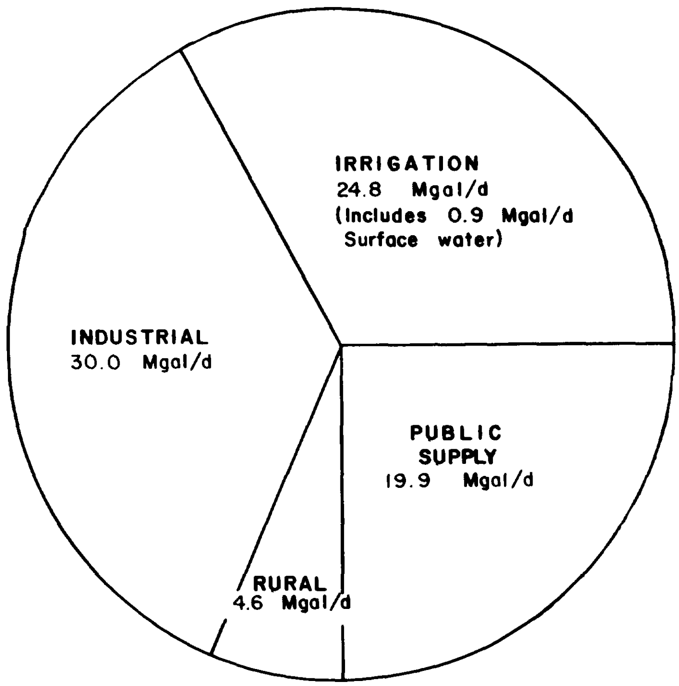


Figure 13.--Estimated freshwater use in 1984.

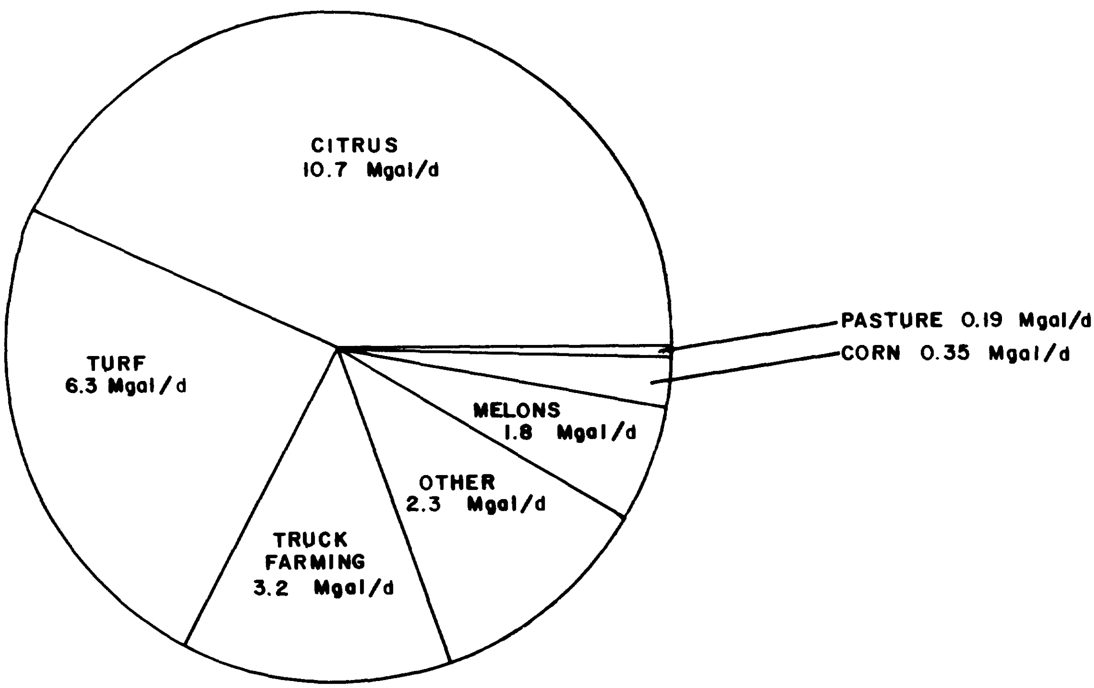


Figure 14.--Irrigation water use in 1984.
(From Stieglitz, 1985.)

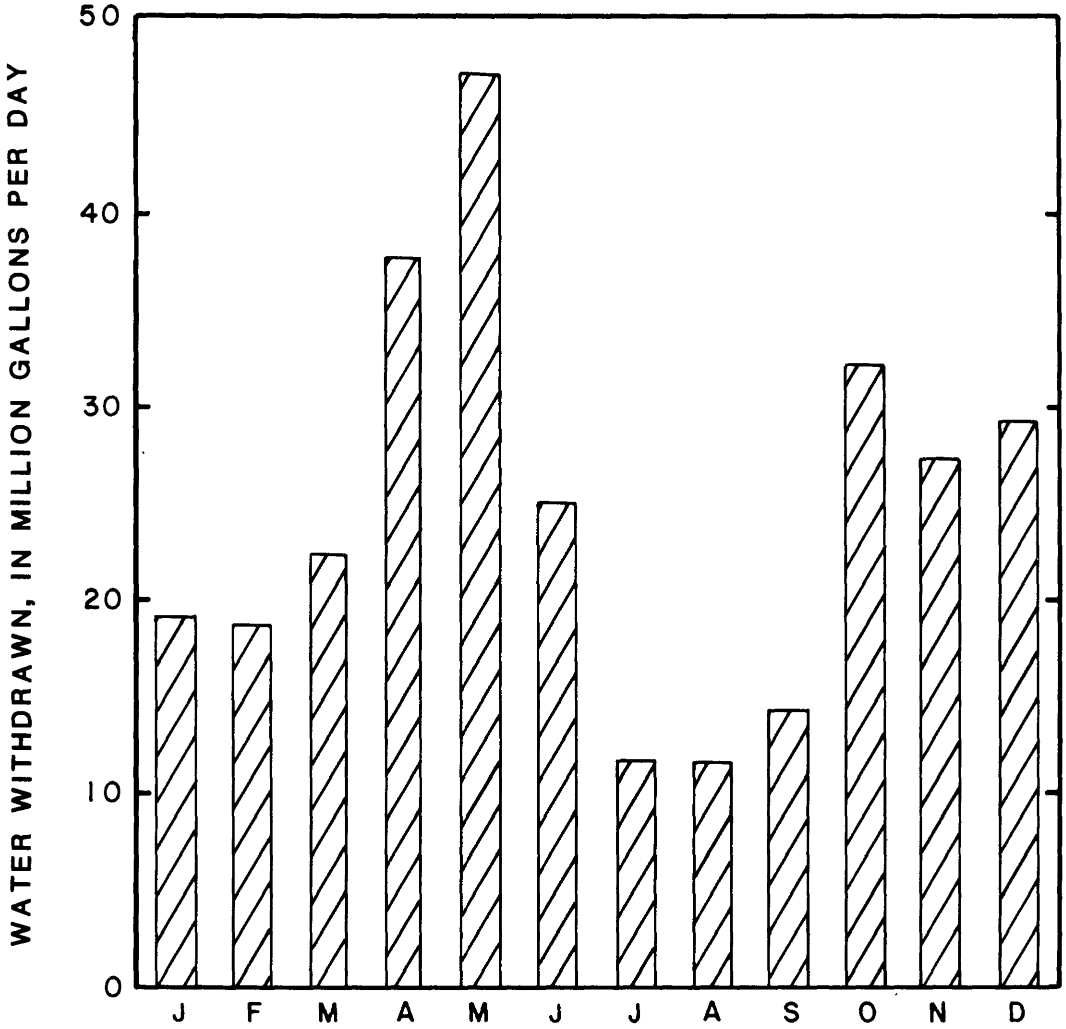


Figure 15.--Monthly irrigation in 1984.

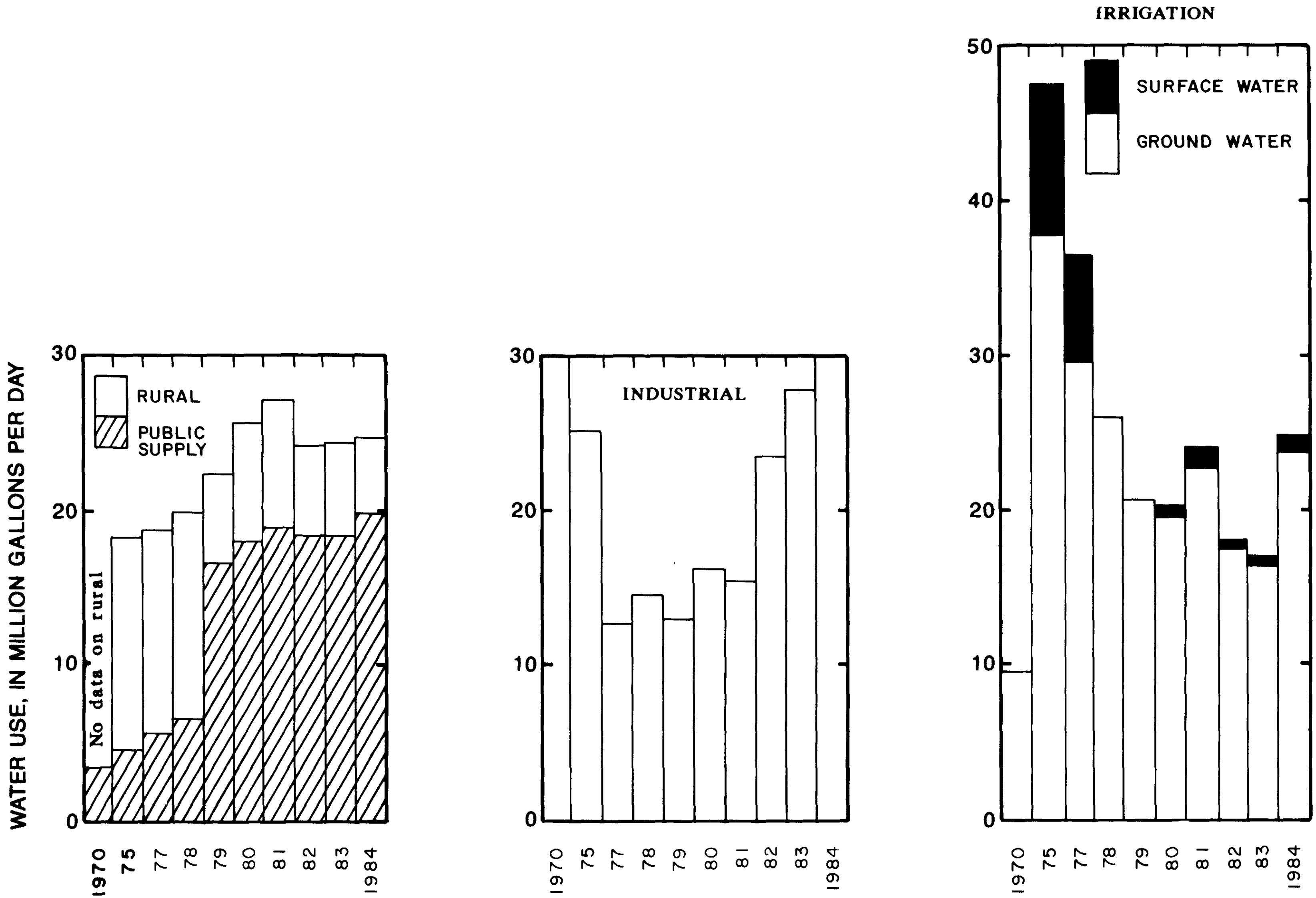


Figure 16.--Freshwater withdrawal by use category, 1970, 1975, and 1977-84. (Modified from Duerr and Sohm, 1983.)

benchmark farm program which meters the amount of water used per acre per crop at test sites), but it remains the least accurate estimate of all water-use categories. The small amount of irrigation reported in 1970 is possibly due to an extremely high rainfall in 1969. Irrigation water use generally decreased from 1975 through 1984, with increases only in 1981 and 1984 (fig. 16). Discussions with irrigators (Duerr and Sohm, 1983) indicated that increased pumping costs and reductions in the amount of pasture irrigation accounted for this general decline. Extended drought conditions accounted for the return to greater irrigation water use in 1981 and 1984.

Figures used in this report vary somewhat from those reported earlier by the U.S. Geological Survey and those reported by the Southwest Florida Water Management District. This has been done for consistency in an effort to more accurately depict changes with time. Public-supply figures were calculated based on a ratio determined by comparing the U.S. Geological Survey values (Duerr and Trommer, 1981) and the Southwest Florida Water Management District values for 1981 (Stieglitz, 1985). Rural water use was estimated at 100 gal/d per capita, although the Southwest Florida Water Management District increased this figure to 150 gal/d per capita in 1984. Industrial water-use figures were derived from data supplied by the Southwest Florida Water Management District and data on file with the U.S. Geological Survey.

Permitted Pumping Rates

Since 1975, the Southwest Florida Water Management District has required a permit to withdraw ground water from new wells that are 6 inches in diameter or larger, or produce more than 0.1 Mgal/d. The permit is for average and maximum daily pumping rates. The permit system was developed to protect the environment by preventing excessive depletion of ground water.

Locations of pumping centers and permitted average daily withdrawal rates, ranging from 0.1 to 20 Mgal/d, are shown in figure 17 (Southwest Florida Water Management District, written commun., 1983). The amounts shown do not reflect seasonal variations and do not include active irrigation wells that were installed prior to 1975 (before permitting was required). Although pumping rates are frequently less than permitted rates, the data in figure 17 serve to define pumping centers. At present, three of the major pumping centers are well fields, the fourth is near Dade City at a food-processing plant, and the fifth is on the Pasco-Polk County line in a rock-mining area northeast of Zephyrhills. In 1985, permitted pumpage had not changed significantly from that reported in 1983.

Well Fields

Four large well fields (Starkey, South Pasco, Cross Bar Ranch, and Cypress Creek) are located in Pasco County and two others (Central Pasco and Cypress Bridge) are currently proposed (fig. 18). Of these, only Starkey well field currently supplies water to Pasco County residents. The majority of water withdrawn is sold and distributed to Pinellas County for public supply. In 1984, monthly average pumpage from well fields within Pasco County ranged

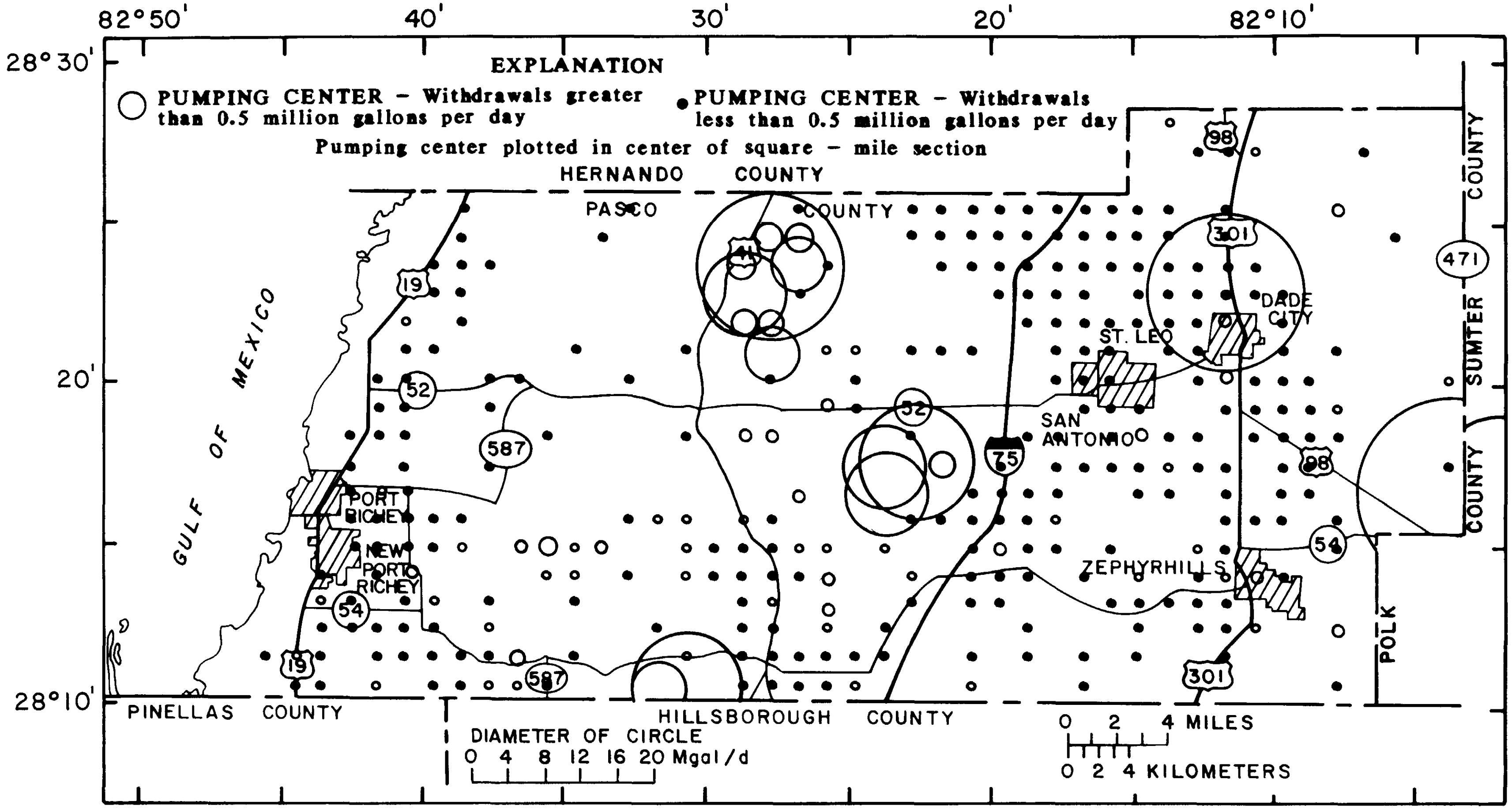


Figure 17.--Pumping centers and permitted average daily withdrawals of ground water, 1985.

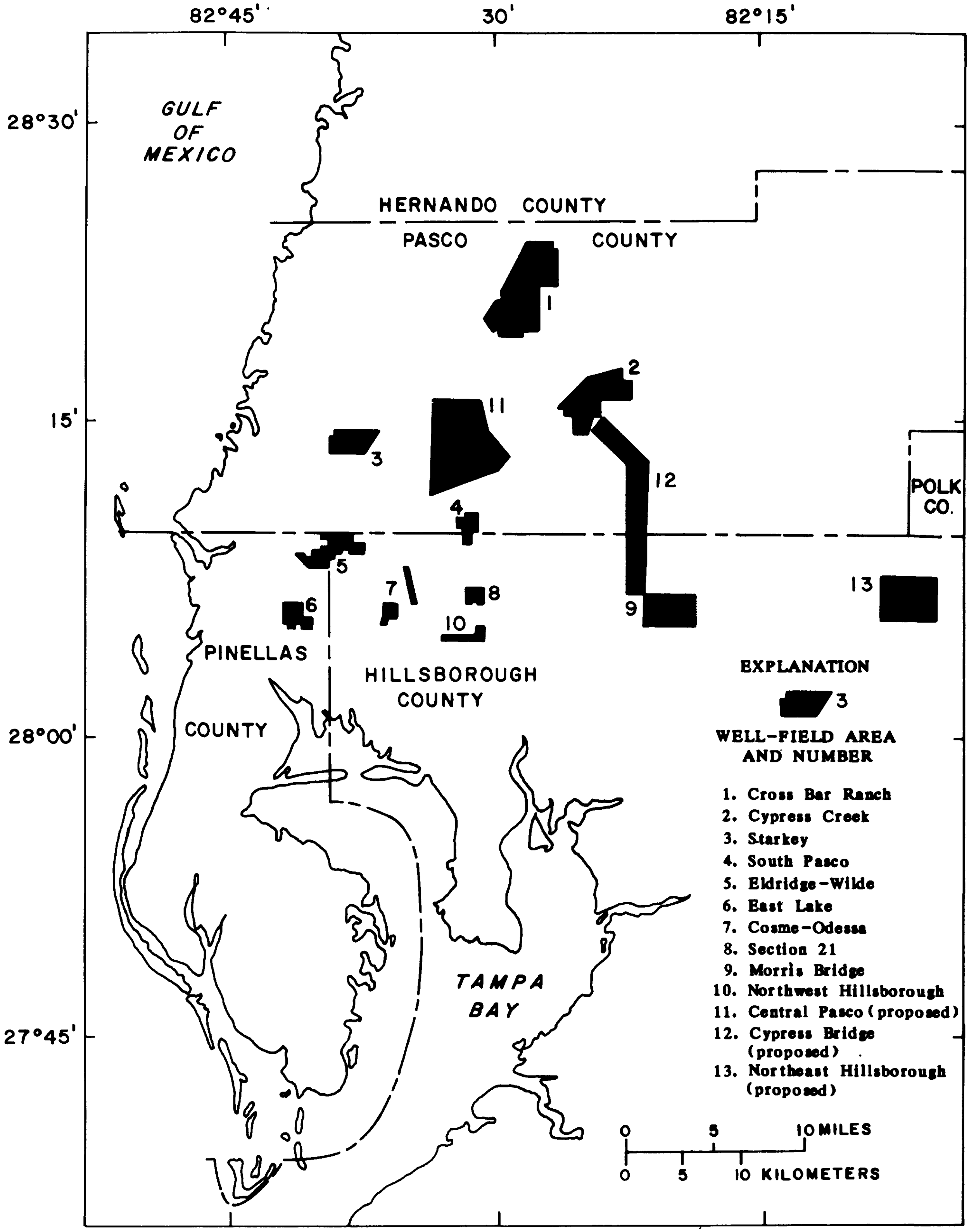


Figure 18.--Well-field areas in Pasco, Pinellas, and Hillsborough Counties. (Modified from Hutchinson, 1984.)

from 8.4 Mgal/d at Starkey well field to 30.1 Mgal/d at Cypress Creek well field (table 1). About 43 percent of the average permitted pumpage was actually withdrawn at Cross Bar Ranch well field, 71 percent at South Pasco, 105 percent at Starkey, and slightly greater than 100 percent at Cypress Creek. Well-field pumpage in Pasco County averaged 63.4 Mgal/d during 1984, of which only 9.9 Mgal/d was used in Pasco County. Of the 55 Mgal/d transmitted to Pinellas County, 1.5 Mgal/d was bought back by Pasco County. Table 2 shows the distribution of water withdrawn in Pasco County.

Eldridge-Wilde well field borders on Pasco, Pinellas, and Hillsborough Counties (fig. 18) and draws some of its water from Pasco County (Hutchinson, 1984, p. 42 and 44). Several other large public-supply well fields (Cosme-Odessa, Section 21, Morris Bridge, East Lake, and northwest Hillsborough) are located in Pinellas and Hillsborough Counties just south of Pasco County and may influence ground-water flow in Pasco County. These six well fields account for an additional 75.4 Mgal/d of water withdrawn from the Floridan aquifer system in 1984.

Projected Ground-Water Withdrawals

Projections indicate that the population of Pasco County will be about 510,000 by the year 2035 (fig. 12). Of this population, it is assumed for this study that 80 percent will be served by public-supply systems (approximately the same percentage as supplied in 1984). Rural supplies are expected to increase proportionately to the population, accounting for 20 percent of the population. Water-use rates of 130 gal/d per person (Camp, Dresser and McKee, Inc., written commun., 1984) for urban users and 100 gal/d per person for rural users were used in this study to estimate water demands. The increased per capita rate for public supply is related to changes in lifestyle. Total water use in public supply and rural use, therefore, is projected to be about 60 Mgal/d for 2035.

Water used for irrigation seems to have leveled off at about 20 Mgal/d, based on the decreasing trend shown in figure 16, due to agricultural areas diminishing in size and irrigation methods improving. During extremely dry spells, however, this number will be expected to increase as it did in 1981 and 1984. Industrial water use is difficult to predict and tends to fluctuate considerably. Over the past 10 years, however, industrial use has averaged about 20 Mgal/d. This value was used to project future ground-water withdrawals.

Total water use in Pasco County is predicted to increase from about 80 Mgal/d in 1984 to 100 Mgal/d in 2035. The greatest increase in projected water-use rates will be in coastal areas. Well-field withdrawals are expected to increase 31 percent between 1984 and 2035 to meet growing demands in Pinellas County to the south, as well as increased demands in Pasco County. By 2035, Pasco County anticipates exporting 70 Mgal/d to Pinellas County.

Projecting the location of water-withdrawal centers is conjectural. Current (1986) withdrawal sites are assumed to continue to be in use in 2035. The Central Pasco well field that is planned for future development is considered to be a source of water for the year 2035 under one of the five county-proposed development plans. Cypress Bridge well field, which stretches between Pasco and Hillsborough Counties, and the proposed northeast

Table 1.--Maximum and average permitted well-field pumpage and reported well-field pumpage for 1984

[All values are in million gallons per day]

Well field	Maximum permitted	Average permitted	Reported annual average, 1984
Cypress Creek[1]	40.0	30.0	30.1
Cross Bar[1]	45.0	30.0	12.9
Eldridge-Wilde	55.0	35.2	30.7
East Lake	5.0	3.0	.2
Section 21	22.0	13.0	9.8
Cosme-Odessa	22.0	13.0	10.9
South Pasco[1]	24.0	16.9	12.0
Morris Bridge	30.0	15.5	16.3
Starkey[1] (includes NPR #5)	15.0	8.0	8.4
Northwest Hillsborough	18.4	8.8	7.5

[1]Well field in Pasco County.

Table 2.--Distribution of ground water withdrawn in Pasco County in 1984

Withdrawal category	Amount, in million gallons per day
Total well-field withdrawals	63.4
Withdrawn from Starkey well field and used in Pasco County	8.4
Well-field water exported to Pinellas County	55.0
Well-field water bought back by Pasco County from Pinellas County	1.5
Total well-field water withdrawn in Pasco County and used in Pinellas County	53.5
Ground water withdrawn from sources other than well fields in Pasco County and used in Pasco County	78.8
Total ground-water withdrawn in Pasco County	142.2

Hillsborough well field also are considered a source of water for the year 2035.

Rural water-use centers are scattered throughout the county. Therefore, the amount of projected rural water use also is assumed to be scattered throughout areas that are not served by public-supply systems, excluding unused land. Locations of irrigation water-use centers are based on consumptive-use permits from the Southwest Florida Water Management District files and from land-use maps (Southwest Florida Water Management District, 1976). Industrial-use centers are assumed to remain constant through the year 2035.

Hydrogeologic Framework

A thick sequence of sedimentary rocks underlies Pasco County. Chemically precipitated deposits of limestone and dolomite that contain shells and shell fragments of marine origin were laid down throughout the Tertiary Period from Paleocene to early Miocene. Early in the Miocene Epoch, terrestrial deposits of sands, silt, and clay were brought in by rivers from the north and were intermixed with the upper Tertiary limestone deposits. By late Miocene time, the clastics were the dominant type of deposit.

The sequence of carbonate rocks that is hydrologically significant to this study ranges in age from Eocene to Miocene and comprises, in ascending order, the following formations: Avon Park Formation, Ocala Limestone, Suwannee Limestone, and Tampa Limestone. The formations constitute the Upper Floridan aquifer. The lithology and water-producing characteristics of the formations are summarized in table 3. Figure 19 shows the relative positions and thicknesses of the formations, and table 4 is an index to wells used to define the geologic sections. The top of the carbonate sequence ranges from near sea level at the coast to approximately 100 feet above sea level along the Brooksville Ridge. The average altitude of the top is about 50 feet above sea level. The formations generally dip from northeast to southwest.

The Avon Park Formation is the lowermost unit of the Upper Floridan aquifer. At its highest point in Pasco County, it lies about 100 feet below sea level. Thickness of the Avon Park Formation varies from 200 to 800 feet. This formation contains evaporites in the lower part, which restrict the flow of water, thus serving as the middle confining unit of the Floridan aquifer system. The Ocala Limestone is generally more than 70 and less than 250 feet thick. It underlies the Suwannee Limestone, the lowermost rock unit exposed at the surface in the county. Thickness of the Suwannee Limestone varies from zero to 250 feet. The Tampa Limestone of Miocene age generally overlies the Suwannee Limestone. Where present, the Tampa Limestone is only a few tens of feet thick.

The Hawthorn and Alachua Formations are part of a predominantly clay unit, herein called the upper confining unit, that contains some sand, limestone, phosphatic clay, marl, calcareous sandstone, and limestone residuum and that overlies the carbonate strata throughout most of the county and locally is exposed at the surface. The confining unit ranges from zero to more than 100 feet in thickness; it is generally thickest beneath the Brooksville Ridge (fig. 20).

Surficial deposits, comprised predominantly of sand with soil and clay and referred to in this report as the surficial sand unit, occur at land surface throughout most of the county. This unit ranges in thickness from zero to about 100 feet (fig. 21) and has an average thickness of about 25 feet. Where the saturated thickness of the surficial sand unit is thick enough to supply water to wells, it is called the surficial aquifer.

Table 3.--Geologic and hydrogeologic units in study area

Series	Stratographic unit	Hydrogeologic unit	Thickness of strato-graphic unit (feet)	Lithology	Water-producing characteristics
Holocene and Pleistocene	Undifferentiated surficial deposits	Surficial aquifer	0-100	Soil, sand, and clay of marine and estuarine terraces, alluvial, lake, and wind-blown deposits.	Wells generally yield less than 20 gal/min.
Pliocene and Miocene	Alachua and Hawthorn Formations	Upper confin-ing unit	0-100	Predominantly clay, some grayish-green, waxy, some interbedded sand and limestone, phosphatic clay, marl, calcareous sandstone, lime-stone residuum.	Generally not a source of water due to extremely low hydraulic conduc-tivity.
	Tampa Limestone	Upper Floridan aquifer	0- 60	Limestone, sandy, phosphatic, fos-siliferous, sand and clay in lower part in some areas.	Many domestic and irrigation wells produce water from the lower part.
Oligocene	Suwannee Limestone		0-250	Limestone, cream to tan colored, fine-grained, fossiliferous, thin bedded to massive, porous.	
Eocene	Ocala Limestone		70-250	Limestone, white to tan, fossili-ferous, massive, soft to hard, porous.	Yields large quan-tities of water from wells complet-ed above evaporites.
	Avon Park Formation	Middle con-fining unit	200-800	Limestone and dolomite. Limestone is light to dark brown, highly fos-siliferous, and porosity is variable in lower part. Dolomite is gray to dark brown, very fine to microcrys-talline and contains porous fossil molds, thin beds of carbonaceous material, and peat fragments. For-mation generally contains evapo-rites in lower part.	Generally not a source of water due to low permeability and poor water qual-ity.

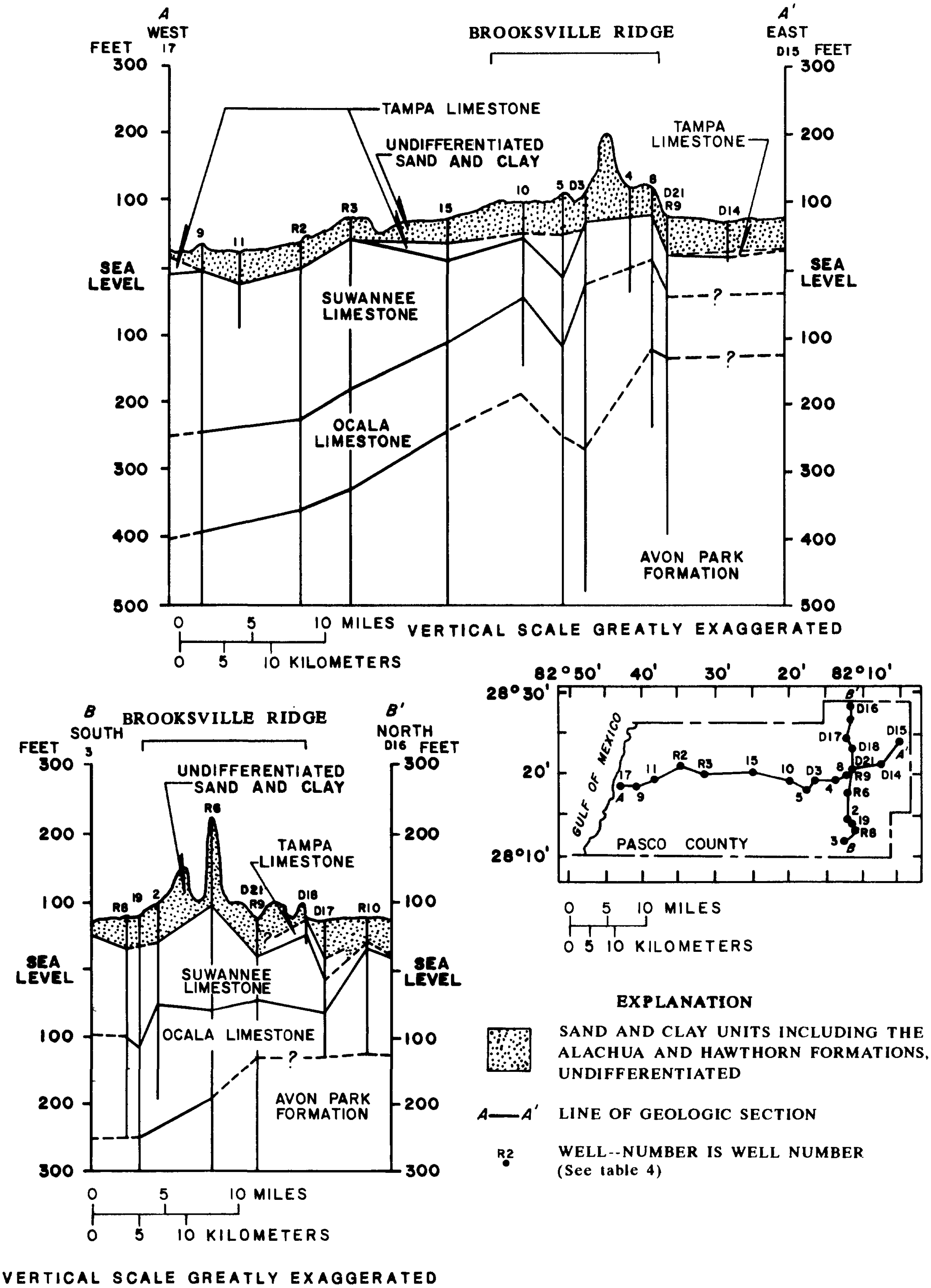


Figure 19.--Generalized geologic sections.

Table 4.--Index to wells used to define geologic sections

Well number	Florida Bureau of Geology well number	Report of Investigation 34[1]	Water-Resources Investigations 80-33[2]
17	W- 3570	816-242-1	
9	W-10891		
11	W-11588		
R2		821-234-1	
R3		819-231-1	
15	W-12831		
10	W-11563		
5	W- 5863		19
D3	W- 5865		20
4	W- 5282		17
8	W-10617		
R9 (D21)	W- 4468	820-211-1	22
D14		821-207-3	23
D15		824-206-1	40
3	W- 3512	811-211-1	
R8	W- 658	813-210-1	
19	W- 2972		2
2	W- 3284		6
R6	W- 2160	817-211-1	12
D18			34
D17			39
R10		826-211-1	
D16			46

[1]Wetterhall (1964).
[2]Tibbals and others (1980).

Figures 20 and 21 were delineated using the median thickness determined from several thousand drillers' logs of wells (Southwest Florida Water Management District, written commun., 1985). The maps are highly generalized, and local deviations from the thicknesses shown can be expected.

Solution Cavities and Sinkholes

A network of cavities in the carbonate rocks has developed under previous and present hydrologic conditions. Many of these cavities lie below the present water table and greatly facilitate ground-water flow. Collapse of the roofs over cavities forms sinkholes (Sinclair, 1978, p. 10), many of which are in evidence today as sinkholes and sinkhole depressions.

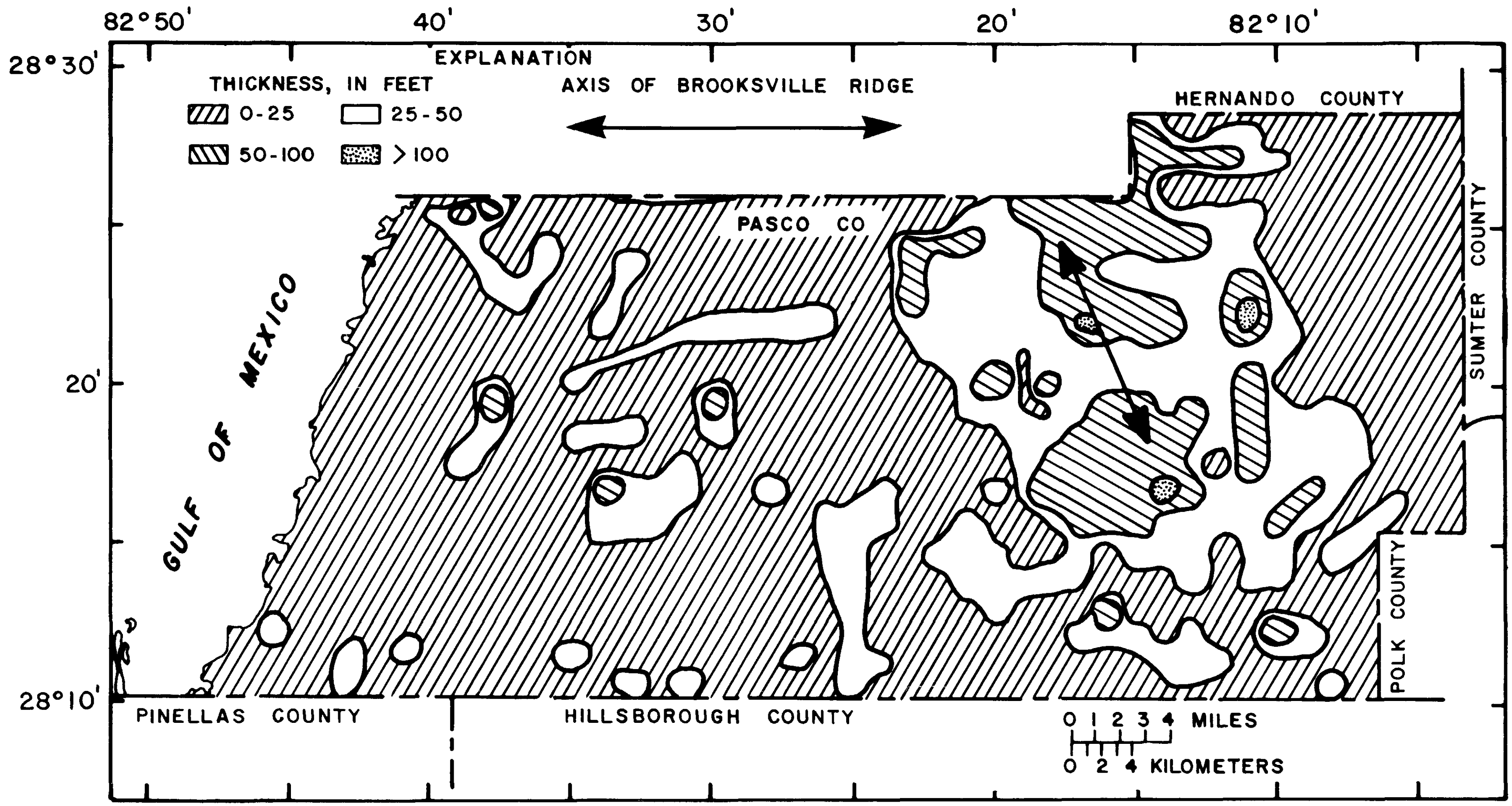


Figure 20.--Generalized thickness of the upper confining unit of the Upper Floridan aquifer.

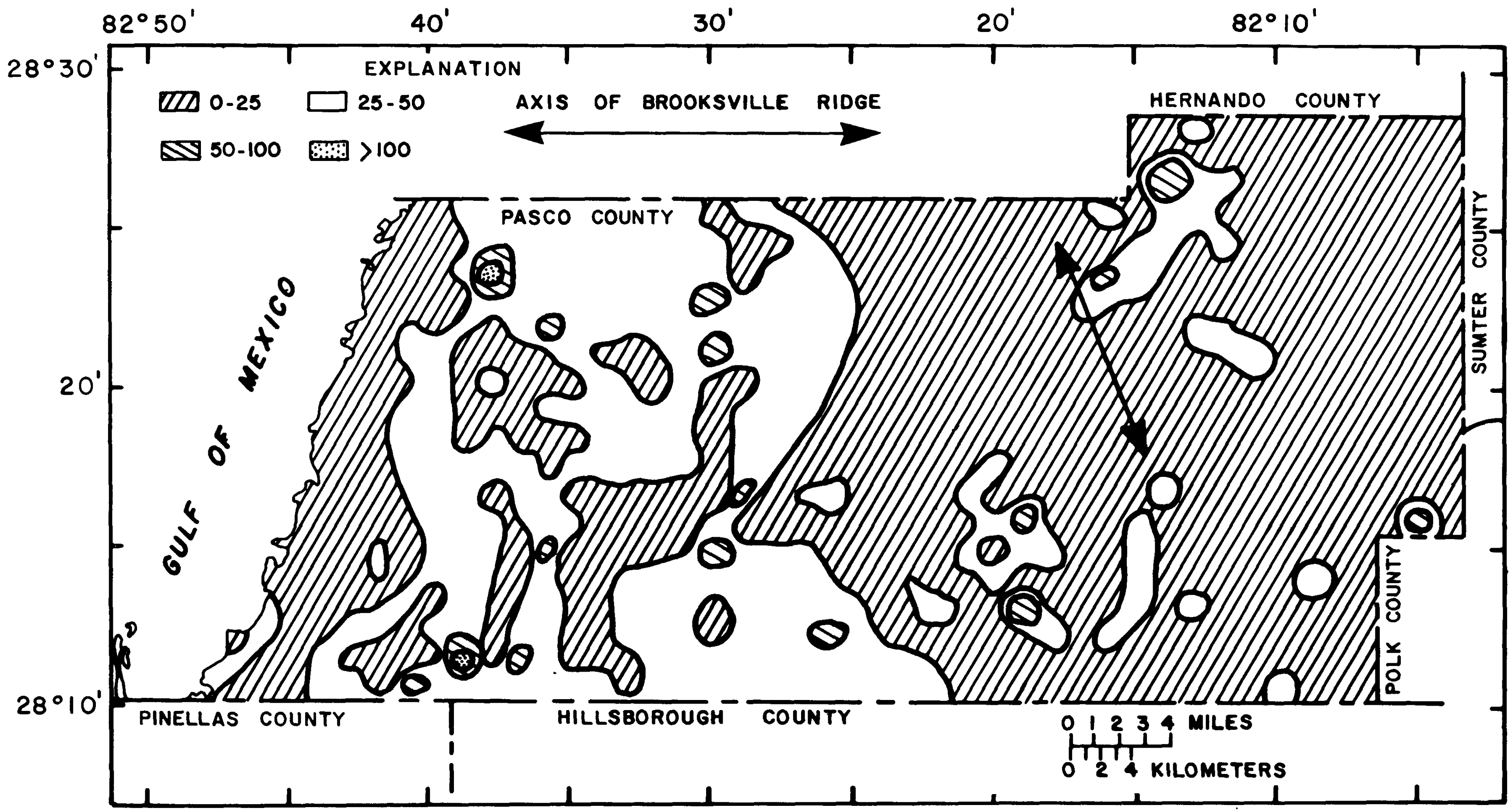


Figure 21.--Generalized thickness of surficial sand unit.

Surface drainage in parts of Pasco County is poorly developed, as is typical in a karst terrain. Much of the area is internally drained and closed depressions are common. Subsurface drainage to the ground-water system is adequate during periods of normal rainfall, but during very wet periods, the closed depressions become flooded and store large volumes of water. Most of this water eventually enters the ground-water system.

Several small streams in Pasco County terminate in sinkholes that provide recharge directly to the Upper Floridan aquifer. The largest of these streams is Bear Creek (fig. 7) that heads near Bee Tree Pond and ends, at normal flow, in Bear Sink about 7 miles to the west (fig. 22). According to Wetterhall (1964), at normal stage (about 3 feet above sea level), Bear Sink drains about 10 to 15 ft^3/s (6.4 to 9.7 Mgal/d). Trommer (1987) and Wetterhall (1964) found that during overflow conditions, Bear Sink drains about 40 ft^3/s (26 Mgal/d). At high stage, Bear Creek flows past Bear Sink, over a low divide, under a bridge at State Highway 52, and into Round Sink about 4,300 feet northwest of Bear Sink. Trommer (1987) recorded a 191-ft^3/s (123-Mgal/d) flow into Round Sink in September 1985 following the passage of Hurricane Elena.

Hernasco Sink, in Crews Lake in the headwaters of the Pithlachascotee River, drains about half (10 ft^3/s or 6.4 Mgal/d) the inflow to the lake (Cherry and others, 1970). At least two other sinks near Hernasco Sink (Crews Lake Sinks A and B) are suspected of being interconnected with the Upper Floridan aquifer (Trommer, 1987).

Several lakes in the surrounding area drain into Rocky Sink, 3.5 miles east of Port Richey, and many smaller sinkhole drains exist throughout the remainder of the county. Those sinkholes with known or suspected connection to the Upper Floridan aquifer are listed in appendix D and are shown in figure 22. The rapid disposal of surface water through sinkhole drains has precluded the general development of well-defined streams.

Figure 22 shows the general location of various sinkhole types (Sinclair and others, 1985) and larger sinkholes with known or suspected direct connection to the Upper Floridan aquifer (Trommer, 1987). Any direct connection to the Upper Floridan aquifer provides a channel for contamination of the aquifer from surface water. The highest density of closed depressions occurs in zone 4. Few depressions are found in zone 2. Although density is low in the ridge area (zone 5), the size (many covering 0.25 mi^2) and depth (as much as 60 feet) of the depressions are much greater than in the west (zone 4) where density is high and size (many less than 20 feet) is small. Depressions in the southern part of zone 4 have the least surface expression with depths less than 10 feet.

GROUND-WATER RESOURCES

In most of west-central Florida, including Pasco County, the Upper Floridan aquifer is the principal source of water for domestic, agricultural, and industrial supplies. In much of Pasco County, a surficial aquifer occurs in the sand overlying the Upper Floridan aquifer and is used primarily for lawn irrigation.

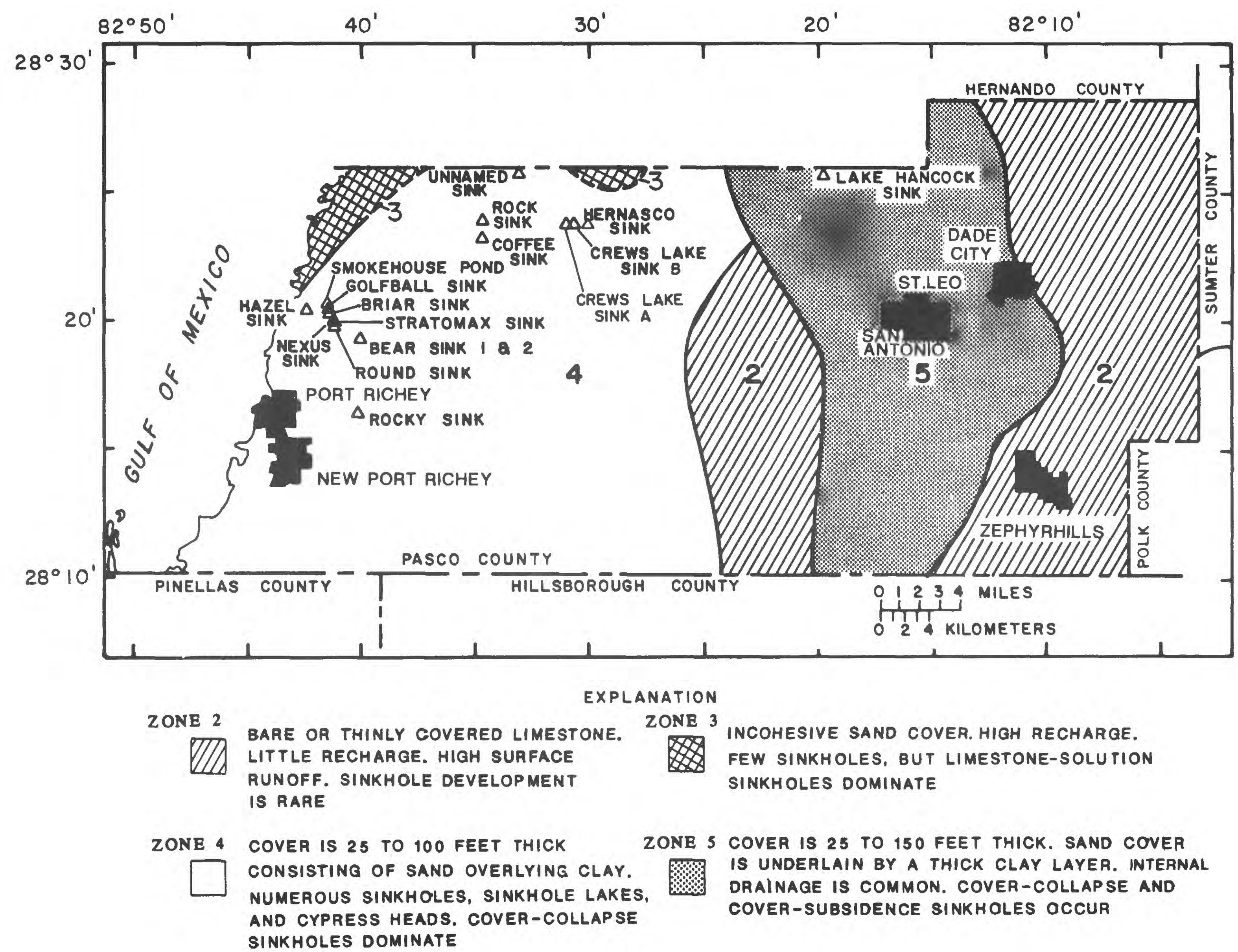


Figure 22.--Zones of different sinkhole types (modified from Sinclair and others, 1985) and larger sinkholes known or suspected to have connections to the Upper Floridan aquifer (modified from Trommer, 1987).

Surficial Aquifer

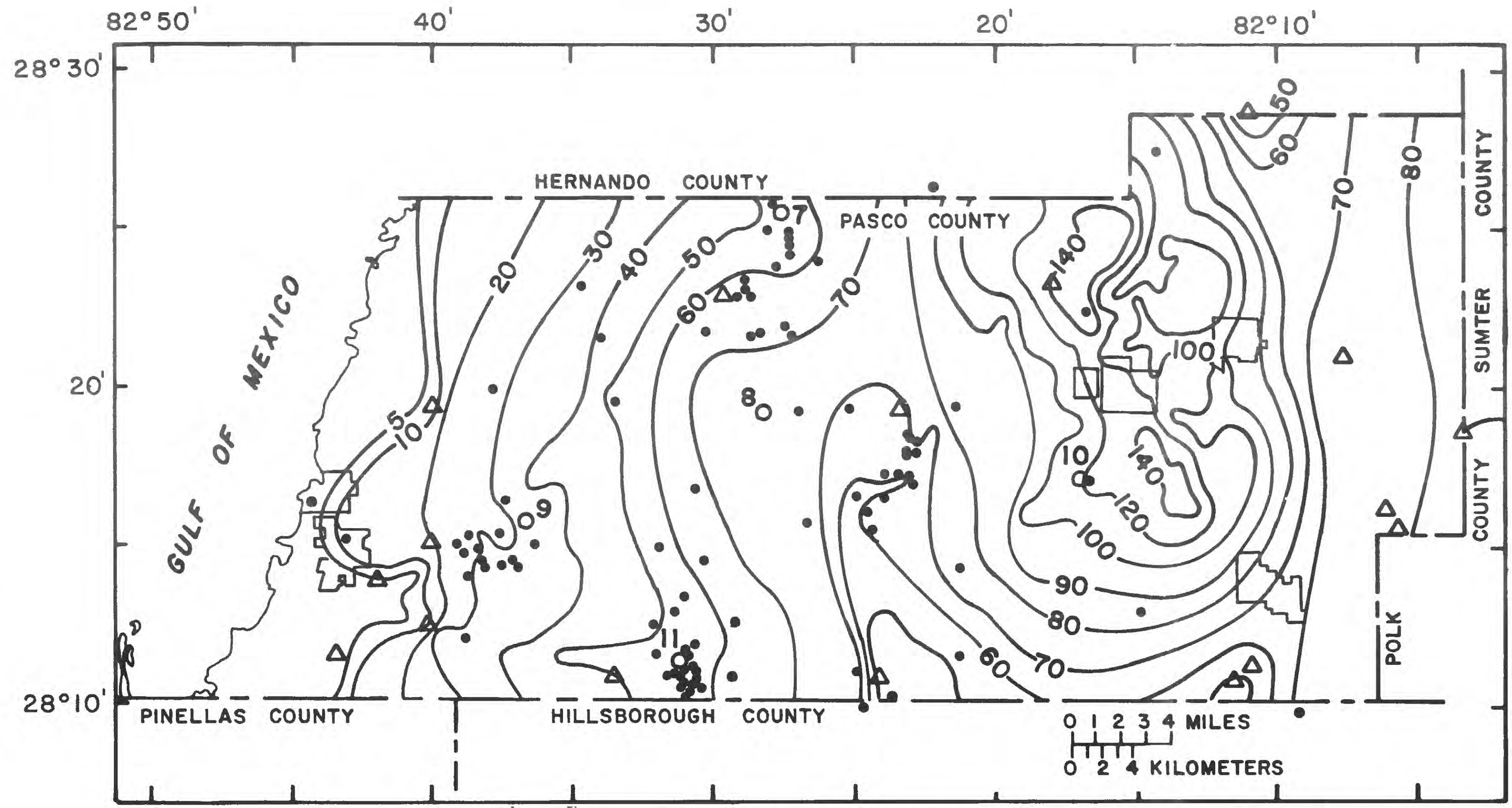
In Pasco County where limestone of the Upper Floridan aquifer is separated from the surficial sand by clay of very low permeability, the water table occurs in the surficial sand, and the sand constitutes the surficial aquifer. In some parts of the county, there are sufficient breaches in the clay layer to allow rapid percolation of water from the sand into the underlying limestone. Thus, the sand may not be saturated perennially. In areas where saturated sand lies directly above limestone (such as the northwestern coastal area and in the northeast where the Withlacoochee River borders Hernando County), water in the sand is hydraulically connected to the Upper Floridan aquifer and unconfined conditions occur in the Upper Floridan aquifer.

Cherry and others (1970) collected undisturbed samples of sediments from the surficial aquifer at five sites in Pasco County (fig. 23) at depths ranging from about 1 to 8 feet. These samples were analyzed for hydraulic conductivity, porosity, specific yield, and particle-size distribution by the Hydrologic Laboratory, U.S. Geological Survey, Water Resources Division, Denver, Colo. Table 5 shows the specific retention, porosity, specific yield, and hydraulic conductivity for the samples that were collected. This table indicates that hydraulic conductivity in the area is variable. The hydraulic conductivity ranged from 0.8 to 20 ft/d at sampling site 10 near St. Leo, decreasing with depth from about 3 to 6 feet. Samples 9 and 9a decreased from 12.3 to 8.8 ft/d in the depth interval of about 1 to 6 feet. Samples 7 through 7c, collected near the Hernando-Pasco County line, did not show any significant changes in hydraulic conductivity at depths of about 1 to 8 feet (Cherry and others, 1970). The average hydraulic conductivity for the sites that were sampled was 8.7 ft/d. The porosity ranged from 32.2 to 40.2 percent and averaged 35.7 percent. The specific yield averaged 0.317 percent. These values indicate that, although the shallow material has a relatively low hydraulic conductivity, the storage capacity is large, and the volume of water that will drain from the material, given enough time, is large (Cherry and others, 1970).

In some places, especially eastern Pasco County, the sand contains water only during the wet season (appendix F). Water levels in the sand change rapidly, which suggests hydraulic connection with the limestone and leakage through clay layers where present. The depth to water in the surficial aquifer is generally less than 5 feet below land surface (appendix F). Sand throughout much of the county yields insufficient quantities of water to wells to be of economic importance; however, water from the surficial aquifer is used for lawn irrigation in some areas and is a source of recharge to the underlying Upper Floridan aquifer.

A map of the estimated water table in Pasco County in September 1984 is presented in figure 23. This map is highly generalized and based on water levels measured in the indicated wells and stream stages at gaging stations. September represents a period of seasonal high water levels and a time when the water table is most likely to exist everywhere in the surficial aquifer.

The direction of movement of the water is downgradient and normal to the water-table contours. The water moves generally westward in the western part of the county and in all directions away from the high near St. Leo in the eastern part of the county. The slope of the water table is about the same as



EXPLANATION

——20—— **LINE OF EQUAL WATER-TABLE ELEVATION ABOVE SEA LEVEL IN SEPTEMBER 1984 CONTOUR INTERVAL 5 AND 10 FEET**

O 11 SEDIMENT SAMPLING SITE AND SITE NUMBER (table 5)

● **SURFICIAL AQUIFER WELL SITE**

△ **GAGING STATION FROM WHICH WATER LEVELS WERE DETERMINED**

Figure 23.--Locations from which sediment samples were collected and estimated elevation of the water table in Pasco County in September 1984.

Table 5.--Laboratory analysis of unconsolidated sediment samples

[From Cherry and others, 1970. ft/d, feet per day]

Sampling site	Depth (feet)	Specific retention (percent)	Total porosity (percent)	Specific yield	Hydraulic conductivity[1] (ft/d)
7	0.9-1.1	---	--	--	5.2
7a	3.1-3.3	---	--	--	7.5
7b	6.0-6.2	---	--	--	5.8
7c	8.0-8.2	3.7	36.0	0.32	5.9
8	2.5-2.7	3.4	40.2	.37	7.5
9	1.0-1.2	---	--	--	12.3
9a	6.0-6.2	2.8	34.7	.32	8.8
10	0.8-1.0	---	--	--	14.7
10a	3.0-3.2	---	--	--	20.0
10b	4.5-4.7	---	--	--	9.9
10c	6.0-6.2	7.7	35.6	.28	.8
11	3.0-3.2	2.5	32.2	.30	6.2

[1]Referred to as coefficient of permeability in Cherry and others (1970).

the slope of the stream channels in the area, and the configuration of the water table is similar to that of the land surface (fig. 6).

The water table in the surficial aquifer ranges from about 1 foot below to as much as 39 feet above the potentiometric surface of the Upper Floridan aquifer (fig. 24), as seen in the pairs of wells where water levels are recorded (figs. 25 and 26). Throughout most of the area, water moves downward from the surficial aquifer and recharges the Upper Floridan aquifer. Southeast of New Port Richey, however, the water table in the surficial aquifer is lower than the potentiometric surface of the Upper Floridan aquifer and water discharges upward to the surficial aquifer.

Floridan Aquifer System

The Floridan aquifer system is a thick sequence of carbonate rocks that in the past has been generally referred to as the Floridan aquifer. The aquifer system extends over all of Florida and parts of Georgia, Alabama, and South Carolina. Parker and others (1955) originally defined the Floridan aquifer as including, in ascending order, highly permeable rocks of all or parts of the Lake City (of former usage), Avon Park, Ocala, Suwannee, and Tampa Limestones and highly permeable parts of the Hawthorn Formation that are in hydrologic contact with the rest of the aquifer. Based on regional lithologic, paleontologic, and hydraulic characteristics, the Floridan aquifer has been redefined by Miller (1986, p. B5) as the Floridan aquifer system that comprises:

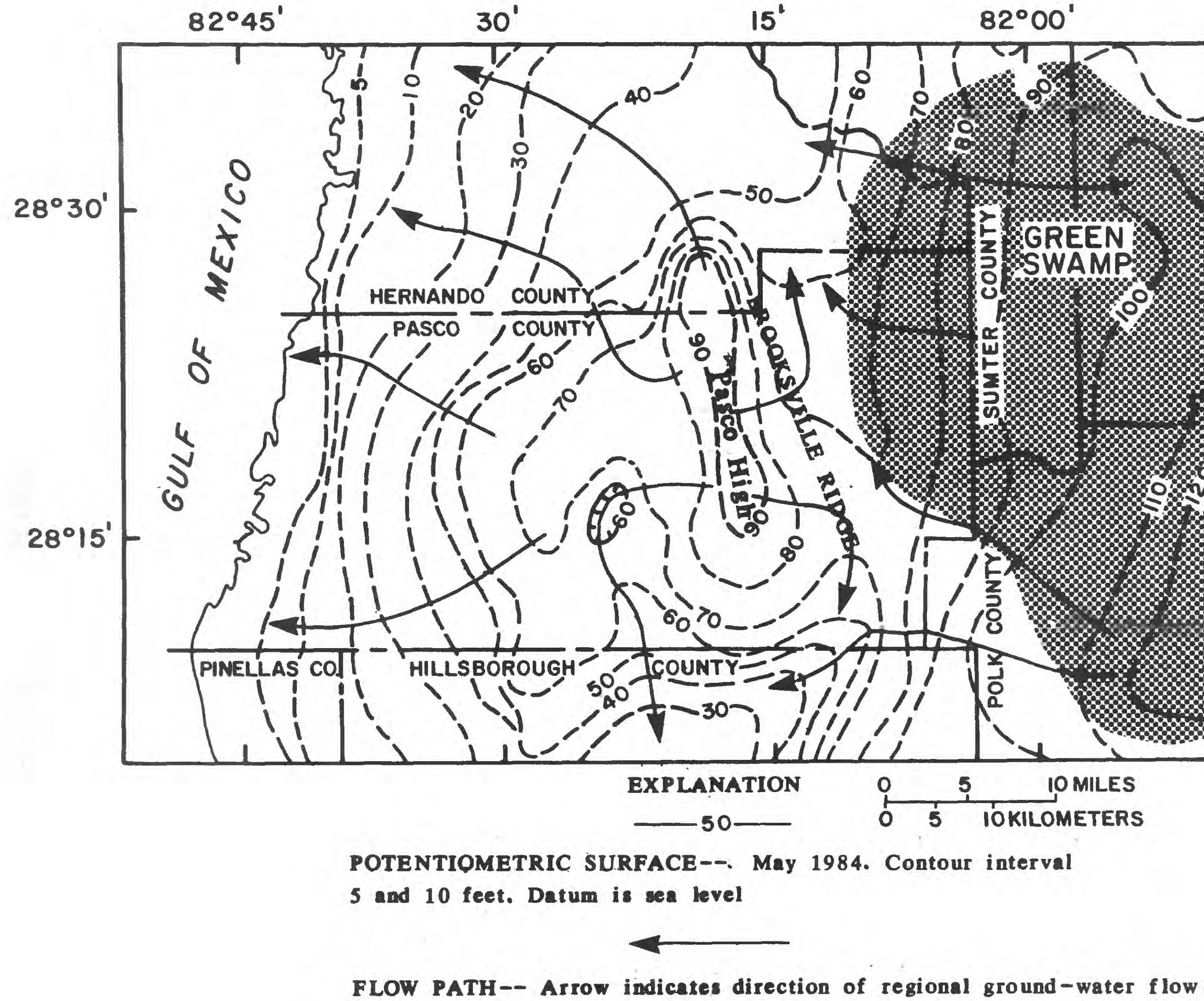


Figure 24.--Potentiometric surface of the Upper Floridan aquifer in the vicinity of Pasco County showing ground-water flow paths, May 1984. (From Barr, 1984.)

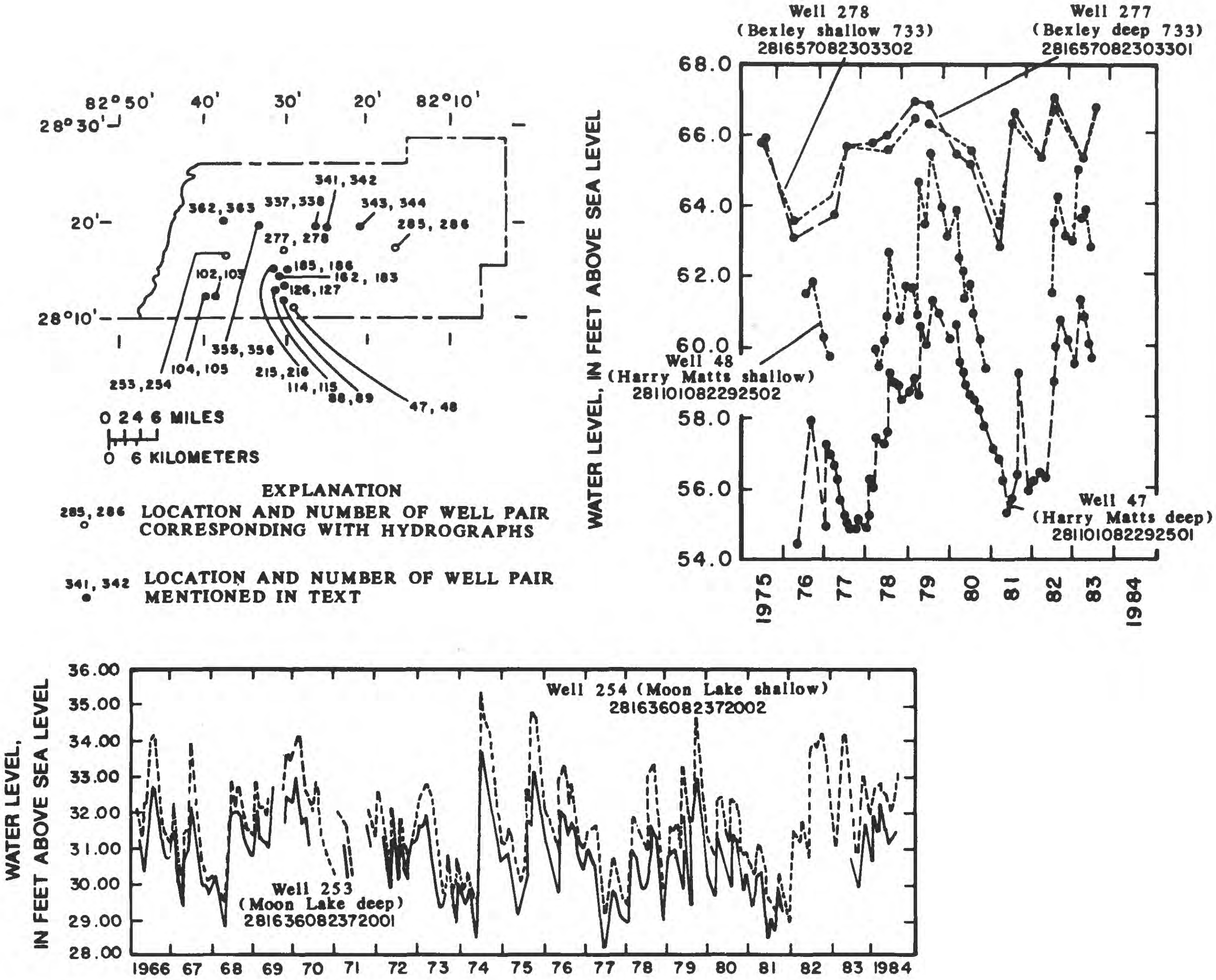


Figure 25.--Water levels in three pairs of wells in the surficial aquifer and Upper Floridan aquifer.

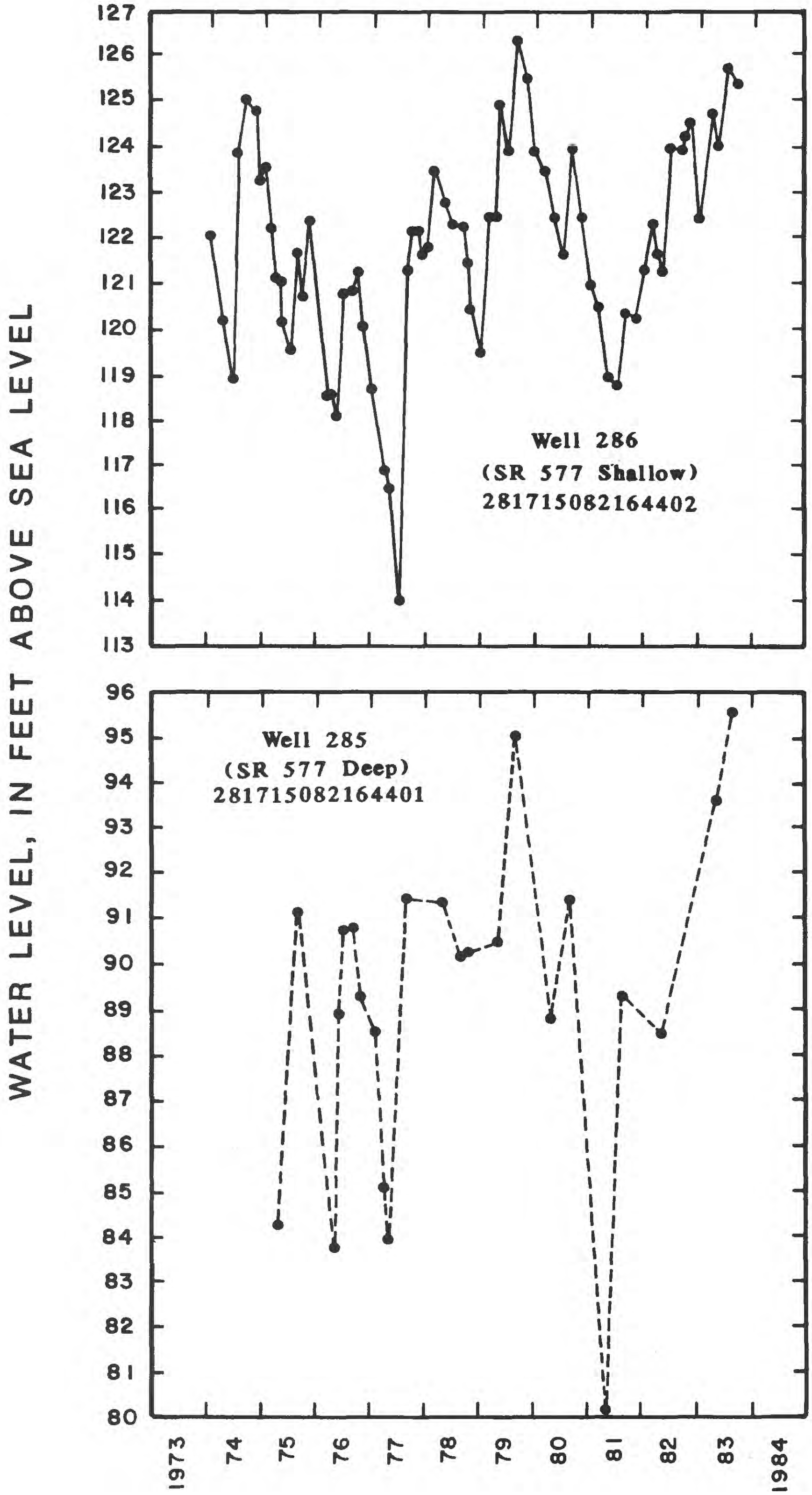


Figure 26.--Water levels in wells 285 (Upper Floridan aquifer) and 286 (surficial aquifer).

"a vertically continuous sequence of carbonate rocks of generally high permeability that are mostly of middle and late Tertiary age and hydraulically connected in varying degrees, and whose permeability is, in general, an order to several orders of magnitude greater than that of those rocks that bound the system above and below.

"* * * (in peninsular Florida), less-permeable carbonate units of subregional extent separate the system into two aquifers, herein called the Upper and Lower Floridan aquifer."

In Pasco County, the freshwater-bearing part of the Floridan aquifer system is the Upper Floridan aquifer that is comprised of the following formations, in ascending order: Avon Park Formation, Ocala Limestone, Suwannee Limestone, and Tampa Limestone (fig. 19, table 3). The lower part of the Avon Park Formation, formerly known as the Lake City Limestone, contains evaporites that consist of gypsum and anhydrite that reduce permeability of the rock and are considered to be the base of the Upper Floridan aquifer. The lower part of the Avon Park Formation and rocks below it contain brackish water; therefore, it is the lowermost unit studied here. The Upper Floridan aquifer is unconfined in the northwestern and eastern parts of Pasco County and is confined to varying degrees throughout the remainder of the county.

The top of the Upper Floridan aquifer is at land surface near the northern coast but is more than 100 feet below land surface in the Brooksville Ridge area (fig. 19). Thickness of the Upper Floridan aquifer (fig. 27) ranges from sightly less than 700 feet in the north-central part of the county to about 1,050 feet in the southwestern part of the county (Miller, 1986, plate 28).

Potentiometric Surface

The potentiometric surface of the Upper Floridan aquifer fluctuates in response to changes in the rates of recharge and discharge. Some factors in this process are rainfall, pumping, and near the coast, tidal fluctuations. The amount of rainfall, however, is the most important factor in determining the altitude of the potentiometric surface of the Upper Floridan aquifer. Figure 24 shows the potentiometric surface of the Upper Floridan aquifer for May 1984. May is normally the end of the dry season; September, the end of the wet season. The potentiometric surface in September has the same general pattern, but a slightly higher altitude. Generally, most stress is placed on the aquifer in May because seasonal rains have not yet begun and crop irrigation is heaviest. Also, tourism is at its peak in late winter and early spring and places additional demands on the freshwater supply at a time when rainfall is least.

Ground water moves from potentiometric-surface highs to areas where the surface is low, such as at the coast. One such high occurs in the Green Swamp area about 15 to 20 miles east of Pasco County (fig. 24). Here, the potentiometric surface was as much as 120 feet above sea level in May 1984 and as much as 130 feet in September 1984. Another potentiometric-surface high, known as the Pasco high, occurs in central Pasco County along the Brooksville Ridge where the potentiometric surface was about 90 feet above sea level in both May and September 1984. Ground water moves from the Pasco high in all directions:

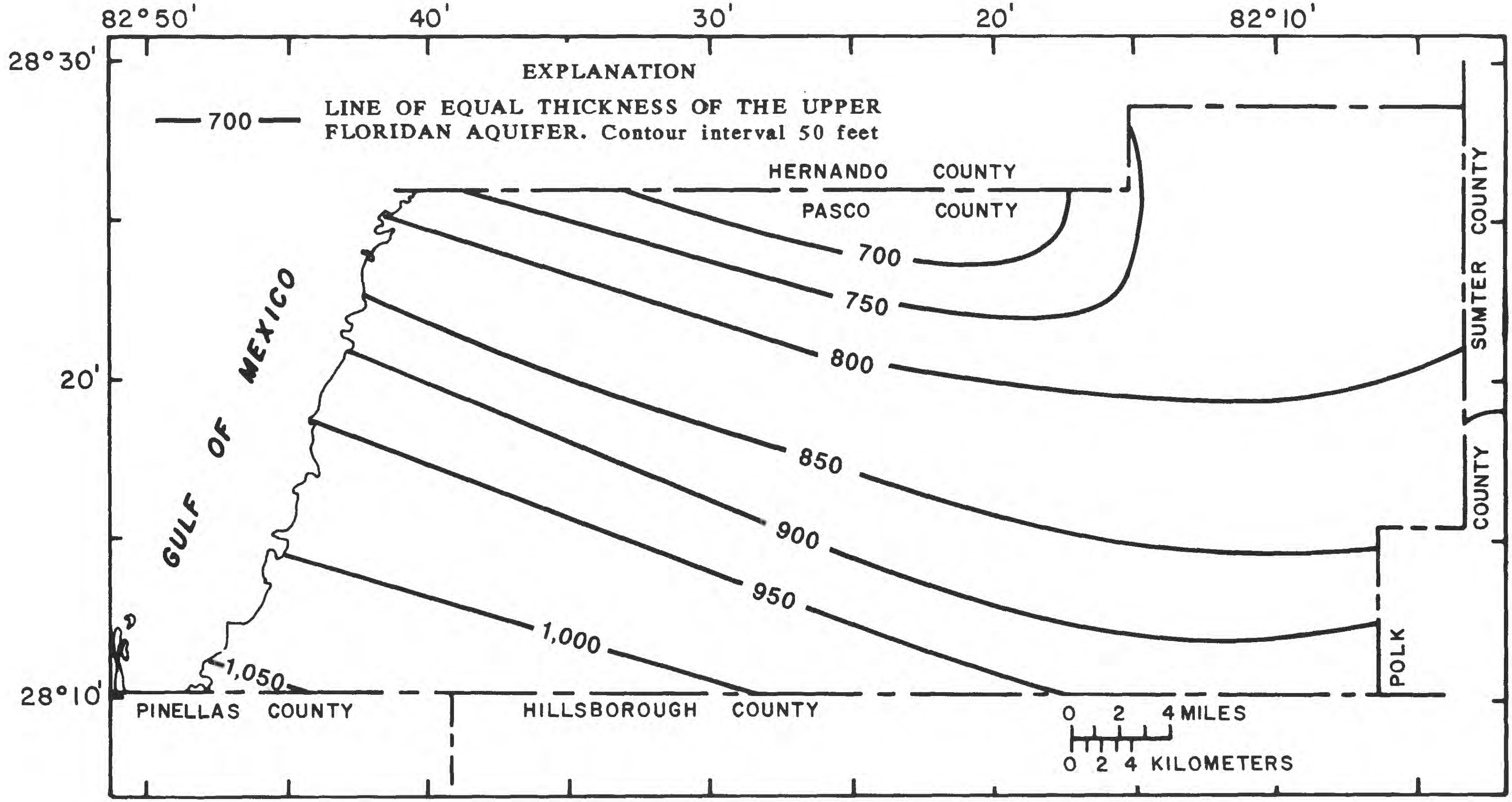


Figure 27.--Thickness of the Upper Floridan aquifer. (Modified from Miller, 1982; 1986.)

to the northeast into the Withlacoochee River basin where it is eventually carried to the Gulf of Mexico; to the south into the Hillsborough River basin where it eventually flows into Tampa Bay; and to the west and northwest where it flows toward the Gulf of Mexico. A trough exists east of the Pasco high along which water moves either north or south. Recharge to the aquifer occurs throughout most of Pasco County, generally through highly permeable surficial sand and sinkholes.

Hydrographs for wells open to the Upper Floridan ;uifer are shown in figures 25 and 26. The hydrographs show a normal seasonal trend with minimum water levels in late spring. Departures from a normal seasonal trend are illustrated by the peak that occurred in late 1979 and the almost steady decline until 1981. Water-level peaks in 1982 and 1983 corresponded with annual rainfall that exceeded the average by nearly 20 inches per year (fig. 9). Even though water levels fluctuated seasonally over the years, the hydrographs do not appear to indicate any long-term trend toward higher or lower levels. However, near well fields, the potentiometric surface declined between 10 and 20 feet from January 1964 to May 1980 (Yobbi, 1983).

Recharge and Discharge

Faulkner (1975) suggests a rate of recharge to the Upper Floridan aquifer in the Silver Springs and Rainbow Springs basins, east and north of Pasco County, of about 15 in/yr. Both the opportunity for recharge and the amount of rainfall available for recharge are probably as great in Pasco County as in these basins due to similar geology, rainfall, topography, and vegetation. Hutchinson (1984, p. 7) suggests the rate of recharge to the Upper Floridan aquifer ranges from 5 in/yr under nonpumping conditions to a maximum of 20 in/yr under pumping conditions. Cherry and others (1970) estimated evapotranspiration in the mid-Gulf area at 38.6 in/yr, which subtracted from 55.0 inches of rain gives 16.4 inches of recharge. At 5 inches, average daily recharge would be 178 Mgal; at 16.4 inches, 589 Mgal; and at 20 inches, 714 Mgal. In addition, several million gallons per day enter from Sumter and Polk Counties as lateral ground-water flow.

According to Hutchinson (1984), recharge rates are highest in areas of little or no surface runoff, such as the Brooksville Ridge area and northwestern Pasco County (fig. 28). Moderate recharge occurs in areas of moderate surface runoff where overlying deposits are generally thin or absent and where the potentiometric surface of the Upper Floridan aquifer and the water table are generally close to land surface.

Discharge from the Upper Floridan aquifer occurs in areas along the rivers and coast through springs and upward leakage in swamps and marshes. Hydrographs (figs. 25 and 26) indicate that flow is generally downward from the surficial to the Upper Floridan aquifer elsewhere in the county.

Other areas of discharge are around pumped wells. When a well is pumped, water levels in the well and in the aquifer are lowered and water is drawn laterally toward the well from all directions. The greatest drawdown is at the pumped well. The amount of drawdown decreases radially away from the well. The depressed water surface forms a cone known as "the cone of depression." The size and shape of a cone of depression is dependent on aquifer properties and proximity to areas of recharge or discharge.

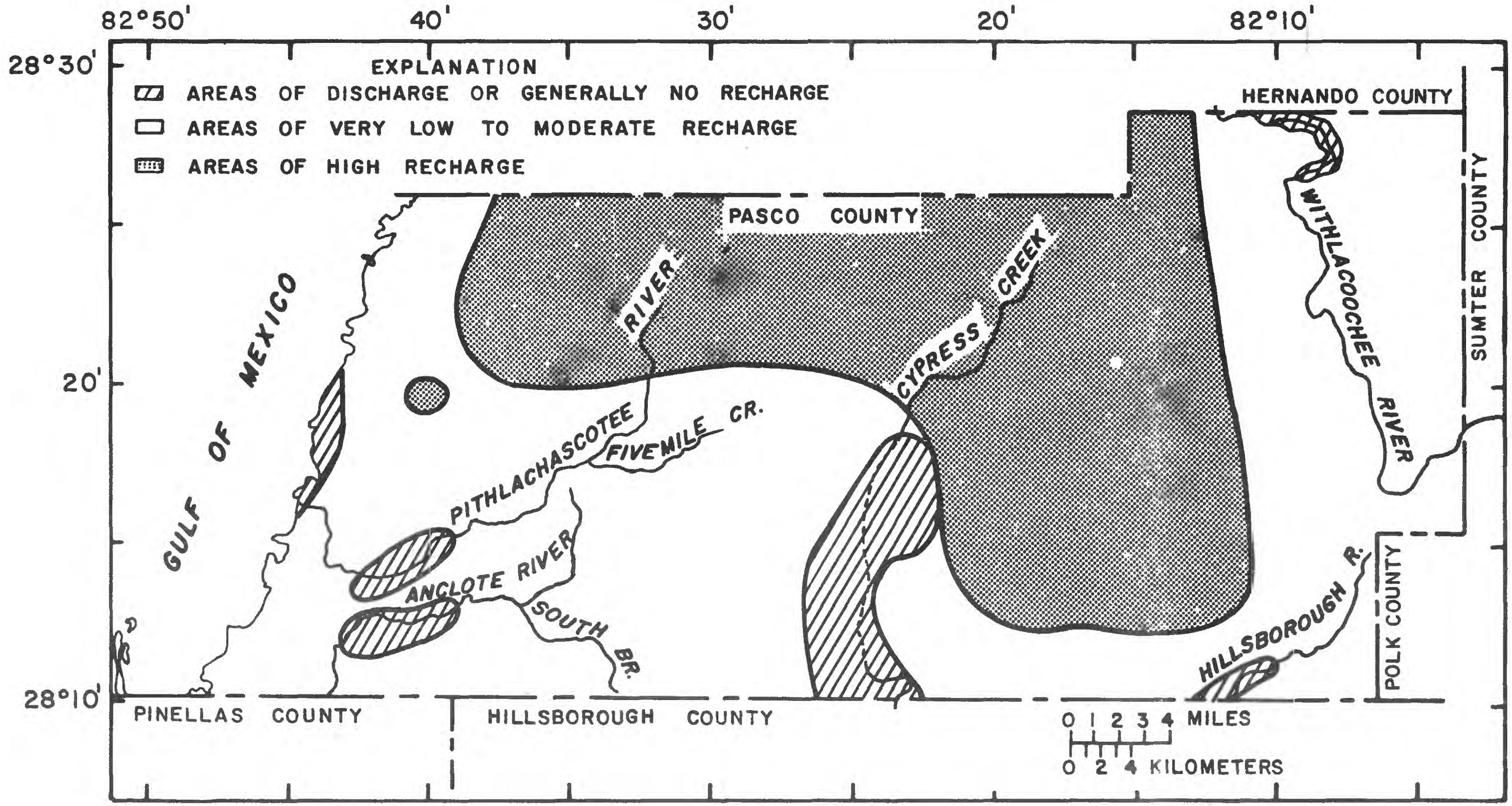


Figure 28.--Recharge and discharge areas of the Upper Floridan aquifer in Pasco County. (Modified from Stewart, 1980.)

Presently, cones of depression occur at most well fields in both the potentiometric surface of the Upper Floridan aquifer and the water table of the surficial aquifer. They are generally several feet deep. Another cone of depression occurs in the Dade City area around the citrus processing plants. Tibbals and others (1980, p. 48) believe that this cone is partly the result of a good interconnection of the Upper and Lower Floridan aquifers in the vicinity rather than being a direct result of pumping. Tibbals and others (1980, p. 48) describe another cone of depression 2 miles north of Zephyrhills. This too may be the result of a good interconnection between the Upper and Lower Floridan aquifers because there are no large ground-water withdrawal sites in the area (Tibbals and others, 1980, p. 48).

Aquifer Properties

Transmissivity is a measure of an aquifer's ability to transmit water. Figure 29 shows locations where transmissivity has been determined for the Upper Floridan aquifer in various studies, and table 6 lists these values of transmissivity and their sources. Transmissivity is generally highest in the northern part of the county where it ranges from 4.0×10^4 to 4.8×10^5 ft^2/d. Transmissivity of the Upper Floridan aquifer throughout the southern part of the county ranges between 2.0×10^4 to 2.4×10^5 ft^2/d.

Storage coefficient ranges from 0.002 to 0.007 (Cherry and others, 1970) in areas of the county where the Upper Floridan aquifer is confined. In northwestern and eastern Pasco County, the Upper Floridan aquifer is generally unconfined.

SURFACE-WATER RESOURCES

Streams

Streams in Pasco County receive water from direct runoff and from discharge from the Upper Floridan and surficial aquifers. Generally, the channels are poorly defined in the upper reaches but develop a well-defined, meandering pattern in the lower reaches. The area contributing water to a stream is usually bordered by a topographic divide, but because of the interconnection between ground and surface water in the study area, the ground-water divide probably better defines the area that contributes water to the stream than the topographic divide (Cherry and others, 1970, p. 18).

The principal streams draining Pasco County are the Withlacoochee, Hillsborough, Pithlachascotee, and Anclote Rivers and Cypress Creek. Other streams draining Pasco County are Trout Creek, Busy Branch, and New River, which discharge to the Hillsborough River south of the study area in Hillsborough County, and Bear Creek, which usually terminates at Bear Creek Sink (fig. 7).

The Withlacoochee River is the largest stream in Pasco County. It enters the county from the east where it forms the boundary between Polk and Sumter Counties (fig. 7). Mean flow as it enters Pasco County is 148 ft^3/s (96 Mgal/d) based on 18 years of record from 1968-85. The median flow for this

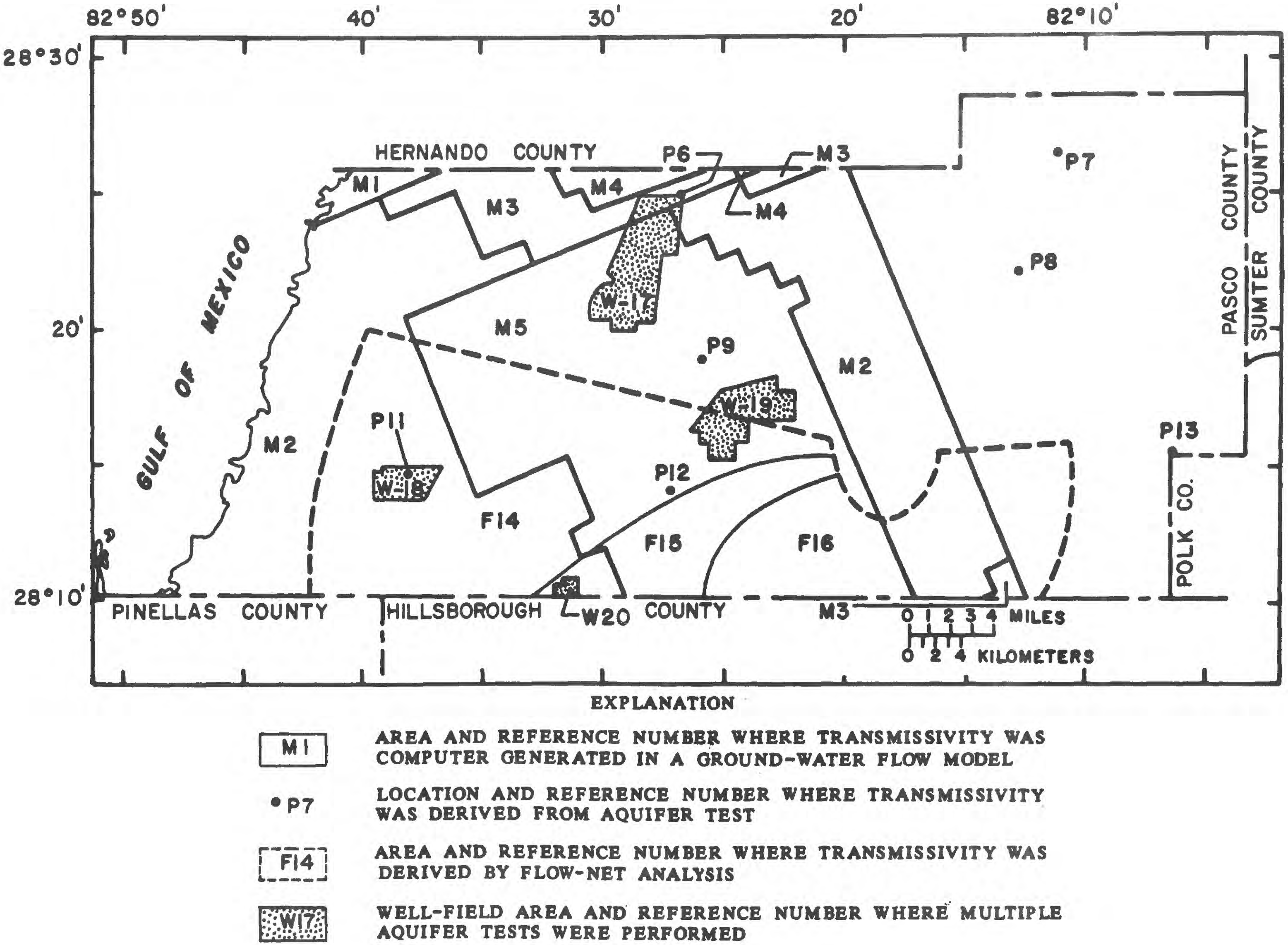


Figure 29.--Aquifer-test sites where transmissivity of the Upper Floridan aquifer was derived. (Values for transmissivity are given in table 6.)

Table 6.--Transmissivity of the Upper Floridan aquifer

[Locations of aquifer-test sites are shown in figure 30. ft^2/d, feet squared per day]

Site No.	Transmissivity (ft^2/d)	Reference
M1	4.6×10^4 to 1.0×10^5	D.K. Yobbi (U.S. Geological Survey, written commun., 1986)
M2	5.0×10^4 to 9.0×10^4	Hutchinson (1984, p. 17)
M3	1.0×10^5 to 2.4×10^5	Hutchinson (1984, p. 17)
M4	3.0×10^5 to 4.8×10^5	Hutchinson (1984, p. 17)
M5	2.0×10^4 to 4.0×10^4	Hutchinson (1984, p. 17)
P6	1.3×10^5	Ryder (1982, p. 13)
P7	4.0×10^4	Pride and others (1966)
P8	2.0×10^5 to 4.0×10^5	Tibbals and others (1980)
P9	3.74×10^4	Ryder (1982, p. 13)
P11	3.34×10^4	Ryder (1982, p. 13)
P12	2.81×10^4	Ryder (1982, p. 13)
P13	2.0×10^4	Pride and others (1966, p. 83)
F14	2.2×10^4	Cherry and others (1960, p. 75)
F15	5.3×10^4	Cherry and others (1970, p. 75)
F16	2.7×10^4	Cherry and others (1970, p. 75)
W17	4.7×10^4 to 1.15×10^5	Leggette, Brashears, and Graham, Inc. (1979)
W18	4.0×10^4	Robertson and Mallory (1977)
W19	3.15×10^4 to 5.36×10^4	Ryder (1978)
W20	5.3×10^4	Robertson and Mallory (1977)

same period is about 34 ft^3/s (22 Mgal/d). The river flows southwest for about 3 miles, turns and flows west for about 1.5 miles, and then turns north and flows generally north-northwest until it leaves the county to enter Hernando County near Trilby. At this point, the Withlacoochee River has a mean flow of 353 ft^3/s (228 Mgal/d) based on 55 years of record from 1931-85. The median flow for this same period (fig. 30) is about 157 ft^3/s (101 Mgal/d). The mean being much higher than the median signifies variable runoff with very large contributions of runoff for short periods of time during flood conditions. During a period of near median flow in the river, May 16, 1983, the potentiometric surface of the Upper Floridan aquifer was above the water surface in the river at sites 55, 56, 58, and 60 (fig. 5), suggesting that water from the Upper Floridan aquifer generally is discharging to the river, either directly or indirectly through the surficial aquifer. During a period of high water conditions in the river, May 16-17, 1979, Anderson and Laughlin

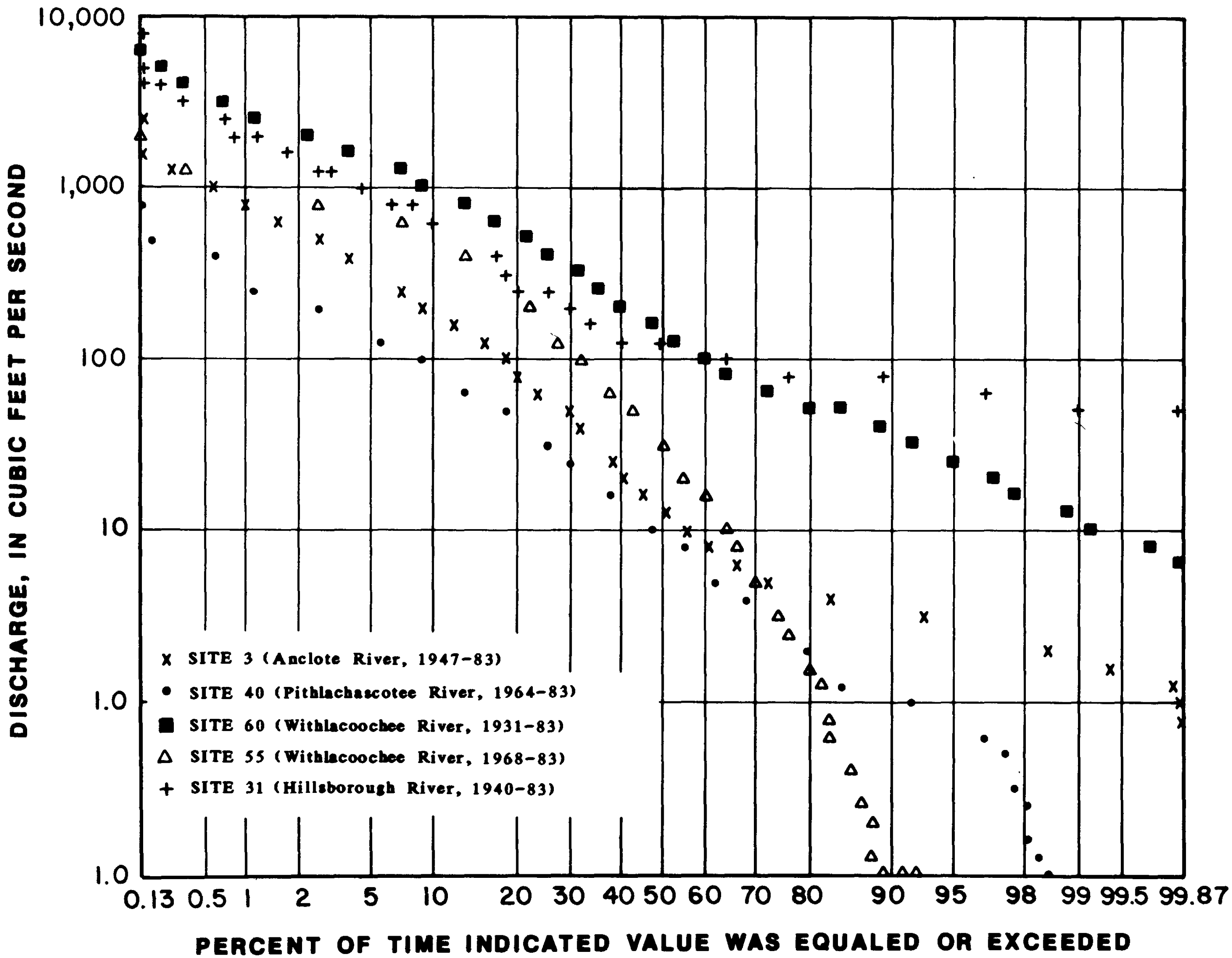


Figure 30.--Flow-duration curves for major rivers in Pasco County.

(1982) found the water surface of the Withlacoochee River to be above the potentiometric surface of the Upper Floridan aquifer in the southernmost reaches of the river. This suggests that, under high-flow conditions, water from the river recharges the aquifer.

The Hillsborough River heads in the southeastern part of Pasco County. Throughout most of the upper reaches of the Hillsborough River, Wolansky and Thompson (1987) found water to be discharging from the Upper Floridan aquifer into the river and surrounding swampy areas most of the time. In May 1985, the potentiometric surface of the Upper Floridan aquifer was above the river surface throughout Pasco County. Crystal Springs (site 127, fig. 5) contributes a large amount of water, averaging 58.6 ft^3/s, or 38 Mgal/d (U.S. Geological Survey, 1980-84), to the river just above the Hillsborough County line. Percentage of river flow contributed by the spring has ranged from 50 to 80 percent in the past 5 years (1980 through 1985). Mean discharge of the Hillsborough River near Zephyrhills below Crystal Springs is 257 ft^3/s (166 Mgal/d) for the 46-year period, 1940 through 1985. Flow is greater than 121 ft^3/s (77 Mgal/d) 50 percent of the time (fig. 30).

The Pithlachascotee River rises in south-central Hernando County, with no defined channel, and flows southwestward through Crews Lake and on through Pasco County to enter the Gulf of Mexico at New Port Richey (fig. 7). The major tributaries are Jumping Gully and Fivemile Creek. The upper reaches contain many lakes, sinks, and depressions. The middle and lower reaches are swampy and ill-defined. Flow is affected by tide near the mouth. Cherry and others (1970) estimated average flow at the mouth to be 55 ft^3/s (36 Mgal/d) during their 30-month study period from June 1964 to May 1966. Jumping Gully contributed about 25 ft^3/s (16 Mgal/d) to this flow, and Fivemile Creek contributed less than 5 ft^3/s (3 Mgal/d). The remainder, 25 ft^3/s (16 Mgal/d), is ground-water seepage through the channel bottom downstream from these tributaries (Cherry and others, 1970, p. 27). A flow-duration curve (fig. 30) indicates that, 50 percent of the time, flow of the Pithlachascotee River near New Port Richey is more than 10 ft^3/s (6 Mgal/d) for a 20-year period (1964 through 1985). Average flow for the same period is 31 ft^3/s (20 Mgal/d). In May 1983, the potentiometric surface of the Upper Floridan aquifer was slightly higher than the river surface throughout its reach.

The Anclote River rises in south-central Pasco County and flows westward to the Gulf of Mexico (fig. 7). Cherry and others (1970, p. 29) found the mean flow of the river near Elfers to be 95 ft^3/s (61 Mgal/d) during their 30-month study. Flow relations and chemical quality of water of the Anclote River and aquifers were used by Cherry and others (1970, p. 29) to estimate the contributions of the Upper Floridan aquifer to the stream. Indications were about 10 ft^3/s (6 Mgal/d) could be attributed to seepage from the aquifer to the stream. A flow-duration curve (fig. 30) of the river near Elfers indicates that, 50 percent of the time, flow exceeded 14 ft^3/s (9 Mgal/d) for a 39-year period of record (1947 through 1985). Mean discharge for this period is about 70 ft^3/s (46 Mgal/d). In May 1983, the river surface was above the potentiometric surface of the Upper Floridan aquifer in the upper reaches of the river. The potentiometric surface was above the river surface throughout the rest of the river reach.

Cypress Creek rises in northern Pasco County and flows southward to the Hillsborough River (fig. 7). The channel is not well-defined except in the middle reaches near Worthington Gardens where the banks are relatively steep. In the upper reaches, the creek emerges from low sand hills and sinkholes, and in the lower reaches south of Worthington Gardens, it flows through swampy lowlands to the Hillsborough River. During the study carried out by Cherry and others (1970, p. 34), seepage from the Upper Floridan aquifer to the creek averaged about 20 percent of the total flow of the creek near San Antonio. Computations also showed that, at high streamflow, discharge from the Upper Floridan aquifer is a negligible part of the total streamflow, but at low flow, the creek consists chiefly of water derived from the aquifer. Mean flow of Cypress Creek near San Antonio (site 15, fig. 7) is 22 ft^3/s based on the 22-year period of record from 1964-85. Mean flow of Cypress Creek at Worthington Gardens is about 54 ft^3/s based on an 11-year period of record, 1975-85.

Trout Creek heads just east of Interstate Highway 75 and south of State Highway 52 and flows southward to the Hillsborough River (fig. 7). Streamflow averaged about 70 ft^3/s (45 Mgal/d) for the period of study done by Cherry and others (1970, p. 34), as determined by correlating the streamflow of Trout Creek with that of Cypress Creek and New River. Busy Branch, east of Trout Creek and south of State Highway 52, flows generally southward to the Hillsborough River. Cherry and others (1970, p. 36) noted an average streamflow of about 5 ft^3/s (3 Mgal/d) during their study. New River begins south of San Antonio and flows southward into the Hillsborough River. The flow of the river averaged about 15 ft^3/s (10 Mgal/d) for the 30-month period June 1964 to May 1966. All of the streams discussed above had a larger quantity of water contributed to them during high-flow conditions, but during low flow, a higher percentage of the total flow was from the Upper Floridan aquifer.

Lakes

Pasco County has a large number of lakes. The largest lake in the county is Crews Lake (sites 74 and 75, fig. 5) that lies in the headwaters of the Pithlachascotee River. It has a surface area of 693 acres (Gant, 1985, p. 20). Hancock Lake, which lies partly in Hernando County (site 88, fig. 5), is the second largest lake and has a surface area of 519 acres (Gant, 1985, p. 21). Nine lakes in the county have surface areas of 200 acres or more.

The U.S. Geological Survey has collected long-term water levels on many lakes in Pasco County. Figures 31 through 33 are hydrographs of several of these lakes that show water-level changes with time. Both seasonal and annual changes in water levels can be seen. Over the periods of record, fluctuations in water levels ranged from 3.27 feet at Black Lake to 24.23 feet at Crews Lake (North). Most lake levels fluctuate less than 6 feet (table 7). Most of the low stages coincide with low water levels in the Upper Floridan and surficial aquifers (figs. 25 and 26).

The two lakes with the greatest range in observed water levels, Crews Lake (North) and Pasco Lake, lie within about 2 miles of each other in north-central Pasco County. Crews Lake (North) is known to contain a sinkhole that connects it with the Upper Floridan aquifer. The lake drains through this sinkhole during low stages of the lake. During high lake stages when the potentiometric surface of the Upper Floridan aquifer is about the same level as the lake, Crews Lake (North) and Crews Lake (South) become one lake. Pasco Lake may be reflecting mounding during high water levels at an overflow structure. This mounding disappears at low lake stages (Hutchinson, 1985,

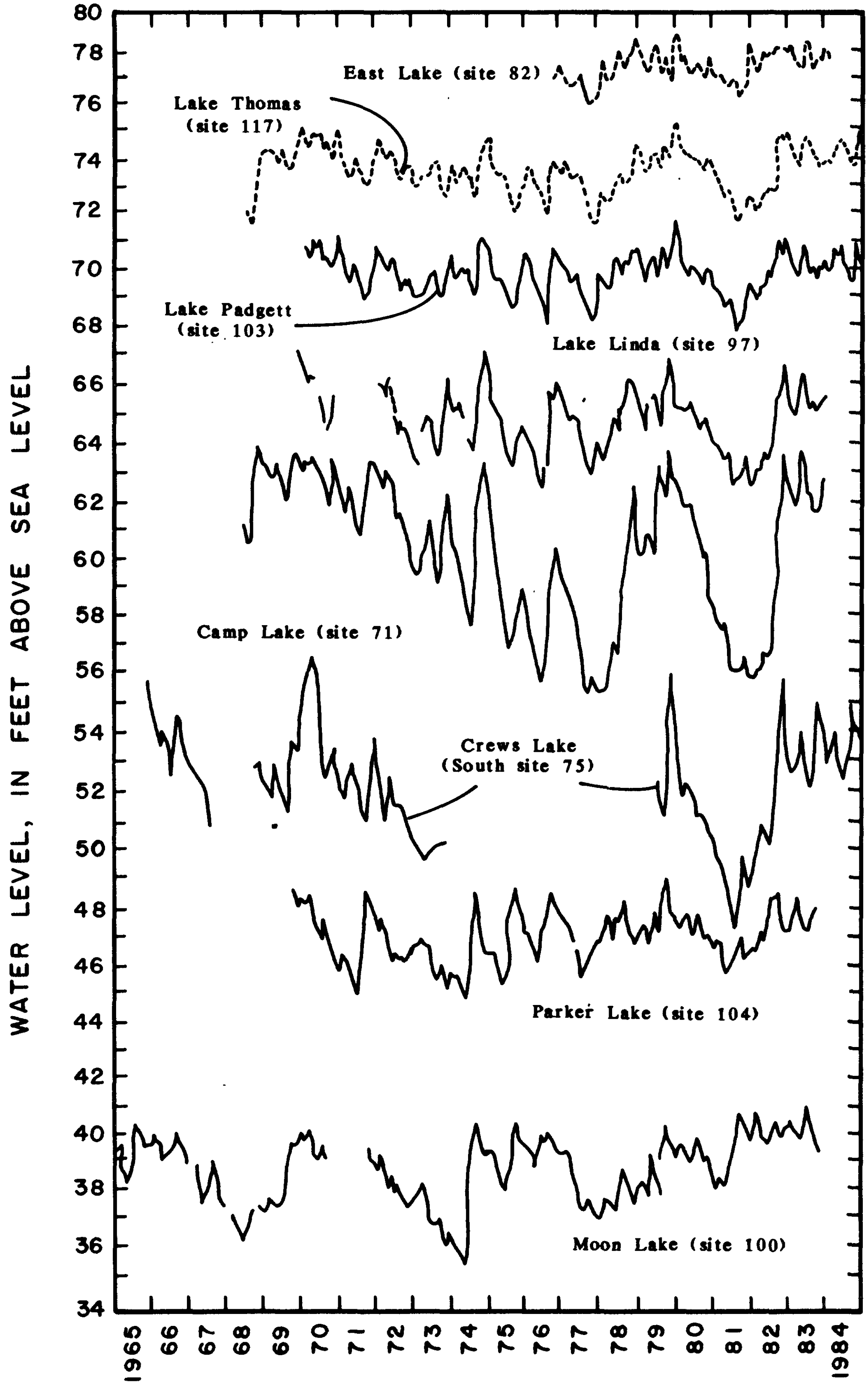


Figure 31.--Water levels in eight lakes in Pasco County.

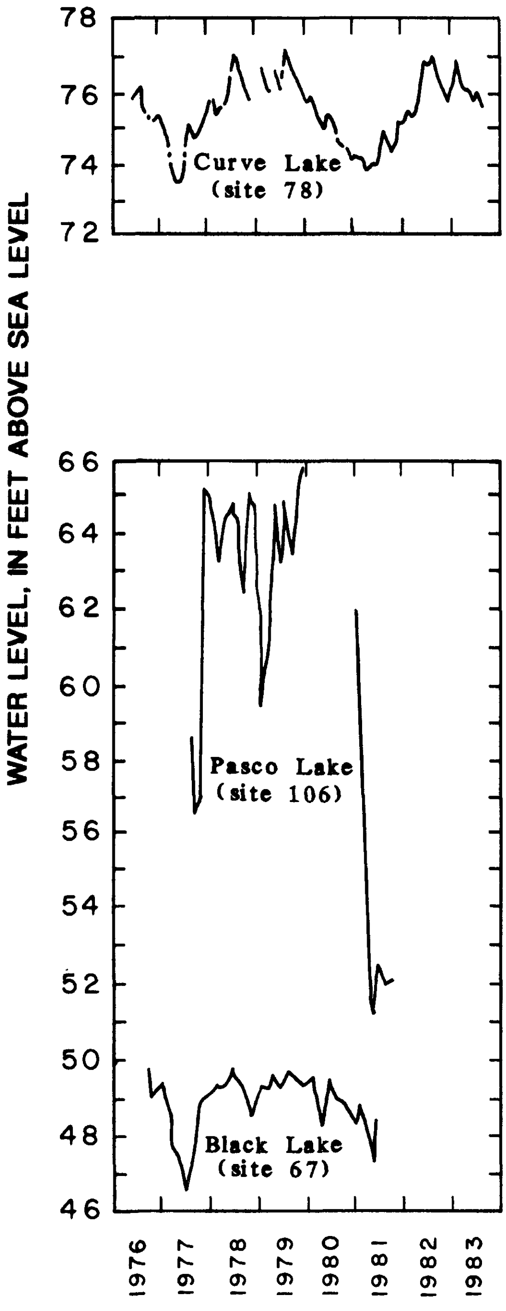


Figure 32.--Water levels in Curve Lake, Pasco Lake, and Black Lake.

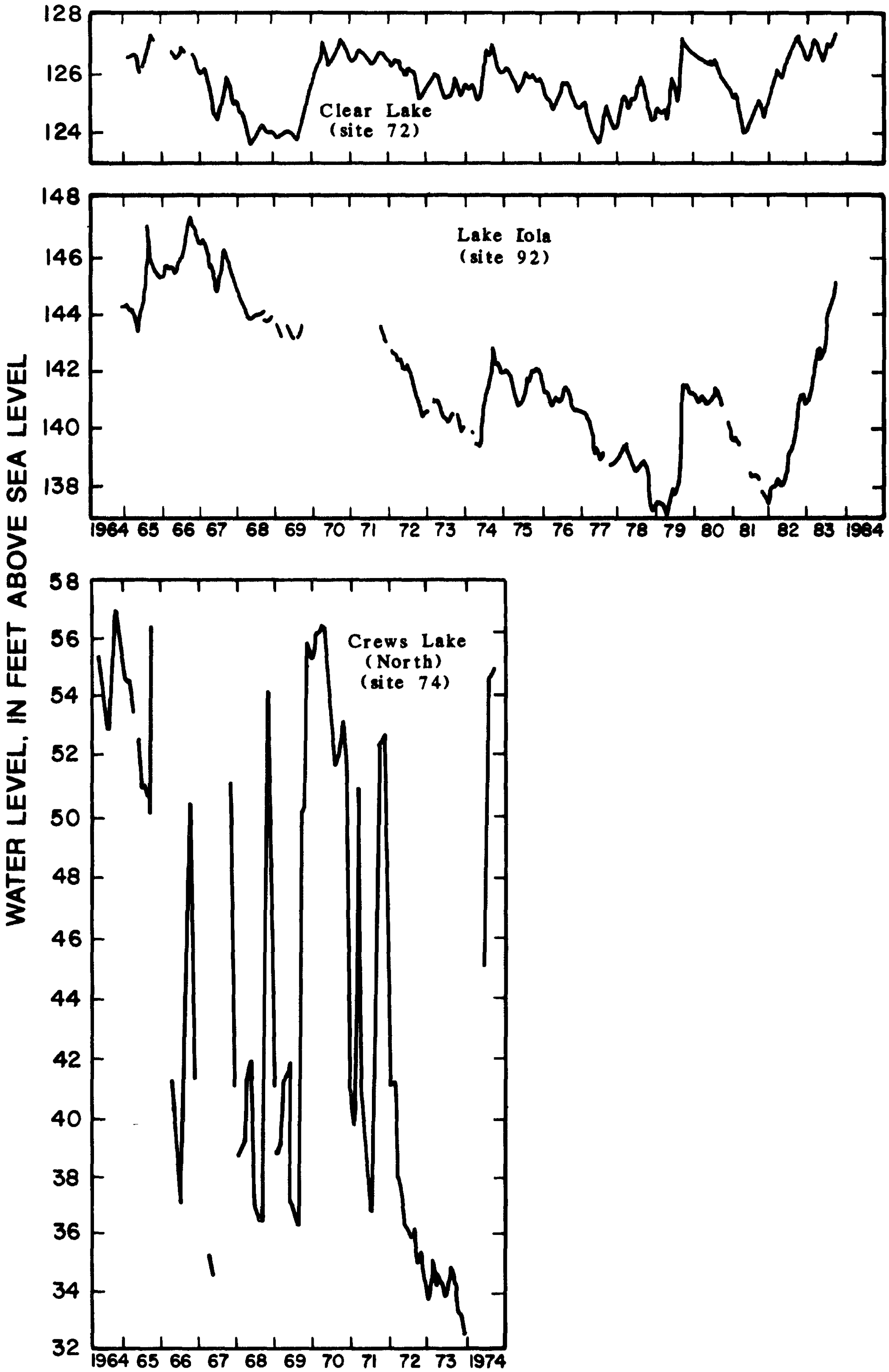


Figure 33.--Water levels in Clear Lake, Lake Iola, and Crews Lake (North).

Table 7.--Water-level extremes for lakes

[Locations of sites are shown in figure 5]

Site No.	Name	Identification No.	Altitude, in feet above sea level: Maximum observed	Altitude, in feet above sea level: Minimum observed	Range (feet)
67	Black Lake	02309869	49.73	46.46	3.27
70	Browns Lake	02306700	63.50	58.90	4.60
71	Camp Lake	02309814	64.00	54.94	9.06
72	Clear Lake	02311600	127.70	124.28	3.42
74	Crews Lake (North)	02310227	56.60	32.37	24.23
75	Crews Lake (South)	02310260	56.60	Below gage	>9.60
78	Curve Lake	02303416	77.71	73.15	4.56
79	Deane Lake	02303412	75.94	69.53	6.41
80	East Lake	02303450	79.10	75.70	3.40
92	Lake Iola	02310230	147.36	136.92	10.44
95	King Lake (near San Antonio)	02303379	104.72	101.40	3.32
96	King Lake (at Drexel)	02303438	73.92	69.84	4.08
97	Lake Linda	02309765	67.13	62.05	5.08
100	Moon Lake	02310290	40.60	34.96	5.64
103	Lake Padgett	02303440	71.84	67.62	4.22
104	Parker Lake	02309872	49.29	44.73	4.56
106	Pasco Lake	02310238	66.86	Below gage	>14.86
117	Lake Thomas	02309584	75.43	71.34	4.09

p. 26). In general, lakes respond to climatic changes in the same manner as the surficial and Upper Floridan aquifers respond, but the lakes tend to respond more quickly.

Springs

Three second magnitude springs (average discharge between 10 and 100 ft^3/s, Meinzer, 1927, p. 3) are located in Pasco County (fig. 5). Crystal Springs (site 127), the largest of the springs, discharges an average of 58.6 ft^3/s (38 Mgal/d), based on 358 measurements made between 1923 and 1984. The spring feeds into the upper reaches of the Hillsborough River near Zephyrhills. Average discharge for 1984 was 57 ft^3/s (37 Mgal/d), based on four measurements. The other second magnitude springs are (site 139) Unnamed Spring Number 3 (Rosenau and others, 1977) in Hudson and Salt Springs (site 133), 1.6 miles north of Port Richey (Rosenau and others, 1977). Unnamed Spring Number 3 flows from three openings uncovered by excavation. At least four third magnitude springs (average discharge between 1 and 10 ft^3/s) are known to exist in the county, all of which are in the coastal area. These include Horseshoe Spring (site 128), Isabella Spring (site 130), Magnolia Spring (site 131), and Salt Spring (site 132). Six smaller springs are documented by Rosenau and others (1977), four of which lie in the coastal area (Seven Springs, site 134; Hudson Spring, site 129; Unnamed Spring Number 2, site 138; and Unnamed Spring Number 5, site 140). The others, Unnamed Springs 1A (site 136) and 1B (site 137), are along the bank of the Pithlachascotee River in New Port Richey. Seven Springs (site 134) has not been known to flow since 1960 (Rosenau and others, 1977).

QUALITY OF WATER

Chemical characteristics of ground water and surface water are affected by many factors. Composition and solubility of soil and rocks over and through which water flows and the length of time water is in contact with these materials largely determine the degree of mineralization. Ions from atmospheric precipitation contribute to mineralization of these waters. The nature and extent of interconnection of sinkholes, ponds, lakes, rivers, and the gulf with the Upper Floridan aquifer affect the degree of mineralization of aquifer and surface water. Aquifer water will be diluted by surface water or vice versa depending on the nature of the interconnection. The mixing of freshwater and saltwater in coastal areas affects the quality of water in the Upper Floridan aquifer and the quality of water in channels along the gulf.

Chemical characteristics of water may influence its use. The Florida Department of Environmental Regulation (1982) has established primary drinking-water regulations. These regulations set minimum standards for the quality of drinking water distributed by public water systems for human consumption. Secondary drinking-water recommendations (Florida Department of Environmental Regulation, 1982; 1985) recommend limits on certain chemical constituents that are not directly related to health but rather to the aesthetic quality of water. Criteria have also been developed for evaluating the quality of water to be used for industrial and irrigation purposes (McKee and Wolf, 1963).

Chemical analyses of water samples from 65 selected wells, 19 lakes or ponds, 5 rivers and streams, 1 spring, and 5 sinkholes were made during this study. Results of these analyses and analyses of samples collected previously from these and other sites (figs. 2 through 5) are listed in appendices B, C, and E and table 8. Sampled wells range in depth from 5 to 957 feet and are distributed areally within the county. For constituents tested, water generally meets recommended limits of constituent concentrations set by the Florida Department of Environmental Regulation (1982; 1985), except along the coast where saltwater is present in the Upper Floridan aquifer and in tidal reaches of the rivers. However, concentrations of dissolved lead exceeded the recommended limit of 30 $\mu g/L$ at two sinkholes (Crews Lake Sink A and Hernasco Sink), as did concentrations of dissolved zinc at White Turkey Pond in 1968. Iron concentrations in surface water exceeded the recommended limit in the Withlacoochee River near Compressco. Areas where iron concentrations in Upper Floridan aquifer wells exceeded the recommended limit of 300 $\mu g/L$ are shown in figure 34, which was constructed using the most current available data. One well showed a high concentration of sodium and another had a sulfate concentration slightly above the recommended limit of 250 mg/L.

Table 8.--Summary of

[mg/L, milligrams per liter; µg/L, micrograms per liter; µS/cm,

Constituent or property	Florida Department of Environmental Regulation (1982 and 1985) standards Primary	Secondary
Alkalinity (mg/L)	NE	NE
Bicarbonate (mg/L)	NE	NE
Calcium (mg/L)	NE	NE
Chloride (mg/L)	NE	<250
Chromium (mg/L)	NE	<30
Dissolved solids (mg/L)	NE	NE
Fluoride (mg/L)	NE	[1]<1.6
Hardness, carbonate (mg/L)	NE	NE
Hardness, noncarbonate (mg/L)	NE	NE
Iron (µg/L)	NE	<300
Lead (µg/L)	[2]<50 [3]<30	NE
Magnesium (mg/L)	NE	NE
Nitrogen, ammonia (mg/L)	NE	NE
Nitrogen, nitrate and nitrite (mg/L)	NE NE	[4]<10 [5]NE
pH (units)	NE	[7]6.5
Phosphate, ortho (mg/L)	NE	NE
Phosphorus (mg/L)	NE	NE
Potassium (mg/L)	NE	NE
Silica (mg/L)	NE	NE
Sodium (mg/L)	<160	NE
Specific conductance (µS/cm)	NE	NE
Strontium (µg/L)	NE	NE
Sulfate (mg/L)	NE	<250
Temperature (degrees Celsius)	NE	NE
Zinc (mg/L)	NE	[2]<5 [3]<.03

[1]Based upon mean air temperature of 72 °F.
[2]For ground water.
[3]For surface water.
[4]As nitrate.

High iron concentrations are commonly associated with wells that have shallow casings; however, this association is not apparent in data collected for this study. Although high concentrations of iron were found in some shallow wells, such as wells 89 and 323, some deeply cased wells also showed high concentrations. Iron is commonly found as a product of a reducing water-quality data

microsiemens per centimeter at 25 degrees Celsius; NE, not established]

Range of concentrations			Median concentration		
Floridan aquifer wells	Surficial aquifer wells	Surface water	Floridan aquifer wells	Surficial aquifer wells	Surface water
<1-285	<1-103	0-151	93	34.5	36.5
196	---	7-176	196	--	87.5
28-130	1.0-36	6-65	59	26	14
4-50,000	8-64	3-43	201	9.9	13
---	---	1-10	--	--	1
66-715	24-128	31-259	189	67	152
0-0.6	0.1-0.3	<0.1-0.4	.1	.2	.2
50-1,230	4-100	16-153	175.5	35.5	60
0-170	0-23	---	9	5	--
9-920	50-850	0-490	90	50	20
---	---	0-300	--	--	5
1.0-75	0.4-3.3	1.0-8.0	6.7	.8	3.5
0.0	0.08-0.55	---	--	.19	--
[4]---	[4]---	[4]0-0.36	[4]--	[4]--	[4]1.95
[5]0-0.01	[5]0.0.02	[5]---	[5]0	[5]0	[5]--
[6]1.6			[6]1.6		
6.3-8.4	5.4-6.9	5.5-8.5	7.4	6.4	7.2
0-0.21	0-0.1	0-9.5	.08	.06	.01
---	<0.01-0.03	0.02-0.61	--	.02	.055
<0.1-6.6	0.1-0.2	0.1-26	2.2	.2	1.0
1.0-39	1.9-8.9	0-14	9.8	8.9	5.95
2.9-230	4.2-10	2.0-24	19	1.4	5.4
282-38,000	25-1,320	29-420	2,100	113.5	164
---	0-310	0-290	120	40	135
0-260	5.7-13	0.2-43	7	6.4	6.1
18-35	24-26	15-35	24.5	25.0	24.0
---	---	3-370	--	--	16

[5]As nitrite.
[6]Combined, nitrate plus nitrite.
[7]Minimum.

environment in swamps and marshes. Water from shallow sources such as these is easily drawn to shallow-cased wells. However, where casings are fairly deep, such as Cross Bar well field, the high iron concentration may be associated with swamps and marshes that were present at an earlier geologic time. High concentrations of dissolved solids in water are found only near

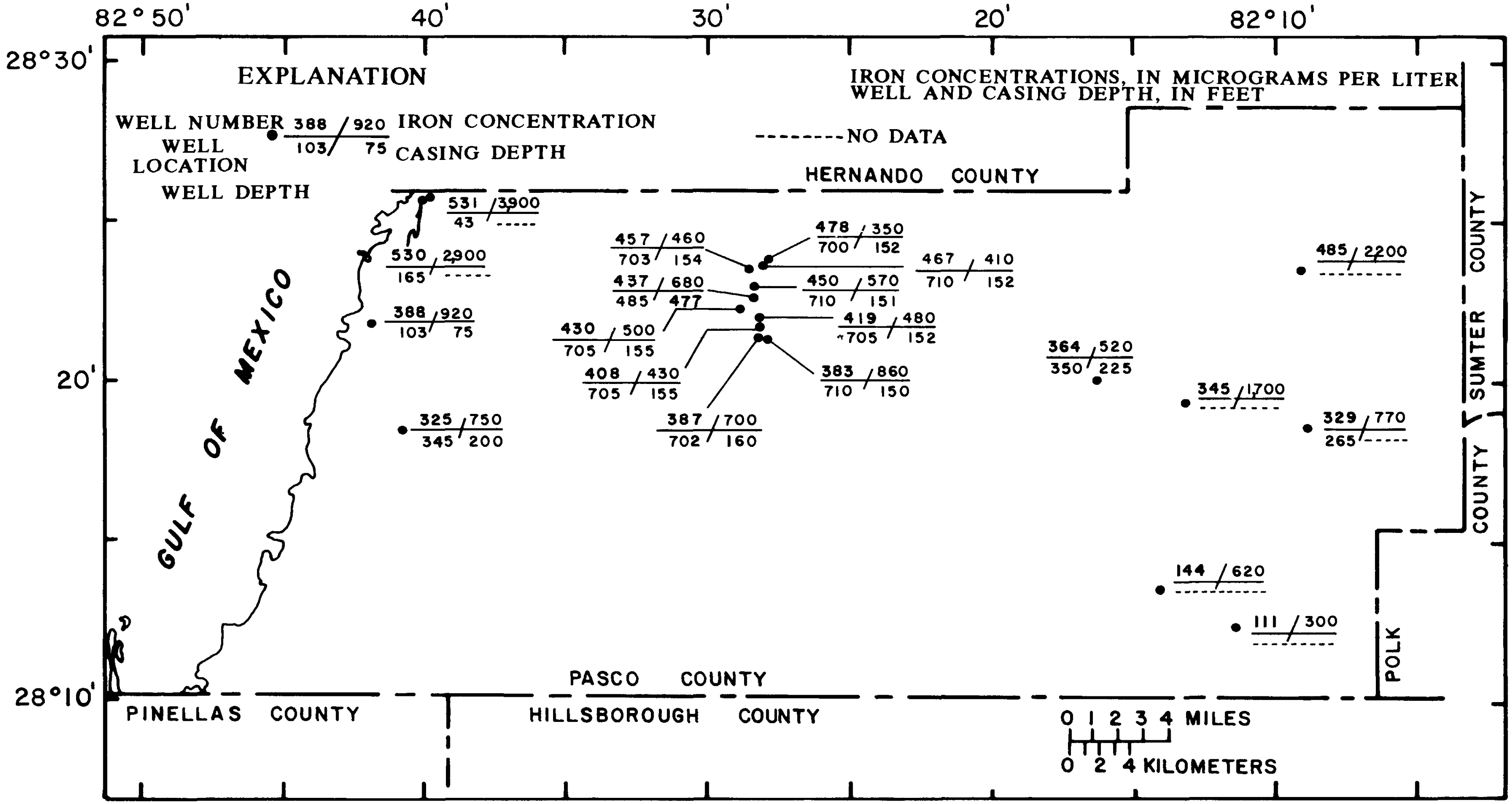


Figure 34.--Sites where concentrations of dissolved iron were greater than or equal to 300 micrograms per liter in water from the Upper Floridan aquifer.

the coast. Figure 35 shows the areal distribution of specific conductance in the Upper Floridan aquifer, indicating a saltwater wedge. Specific conductance is generally proportional to dissolved solids, and the highest values of conductance are found in the coastal area. The map (fig. 35) was constructed from the most recent data available (1960 to 1985).

Stiff diagrams depict the quality of water from representative wells (fig. 36). Inland wells in the Upper Floridan aquifer are of the calcium bicarbonate type. Well 530, typical of wells near the coast, has a significant amount of sodium and chloride due to the presence of seawater. Well 22 shows the transition from sodium chloride type to calcium bicarbonate type. Well 367 is more typical of a calcium bicarbonate type. In addition to areal variation, concentrations of calcium and bicarbonate generally increase with depth and distance from the Brooksville ridge. Surficial-aquifer wells are easily identifiable due to the very low concentrations of most chemical constituents in their water, such as wells 170 and 323. Concentrations of most constituents increase toward the coast and with depth. Silica concentrations are generally higher in inland areas and are probably related to percolation of water through sand and clay.

Concentrations of constituents were almost always higher for ground water than for surface water except near the coast (appendices B and E). Ground water generally is in contact with rocks and minerals for longer periods of time than surface water, which causes an increased mineral content.

Hardness generally reflects the time water has been in contact with rocks. Water from the Upper Floridan aquifer is generally hard to very hard (more than 120 mg/L of $CaCO_3$). Surficial aquifer and surface waters are generally soft (less than 60 mg/L of $CaCO_3$, with the exception of the Hillsborough River). Below Crystal Springs, the high concentration of $CaCo_3$ can be accounted for by spring inflow.

Increases in specific conductance or chloride concentrations may indicate areas of contamination by saltwater. A chloride concentration of 250 mg/L is the recommended maximum limit for drinking water (Florida Department of Environmental Regulation, 1982). Several wells along the coast have been monitored periodically for specific conductance and chloride concentration. Figures 37, 38, and 39 show the changes in chloride concentration with time in nine wells. Water from well 423 shows a scatter in chloride concentration that is probably related to tidal cycles and no long-term trend is evident. The more definite upward trend in chloride concentrations in water from wells 231 and 180 indicates saltwater contamination. The marked increase in chloride concentration in well 32 cannot be specifically accounted for due to missing data between 1974 and 1977, but it indicates saltwater contamination. The decline in chloride concentration in wells 31, 32, 11, 231, and 340 (fig. 2) in the early 1980's is probably related to the higher than normal rainfalls. Much of the scatter in chloride concentrations in all coastal wells is likely due to tide changes as related to time of sampling.

Saltwater encroachment threatens the quality of ground water along the coast where saltwater underlies freshwater in a wedge that diminishes in thickness in the landward direction (Cooper and others, 1964). A zone of mixing between saltwater and freshwater is referred to in this report as the transition zone. The transition zone contains water that ranges from saltwater (about 19,000 mg/L chloride) to freshwater (less than 25 mg/L chloride).

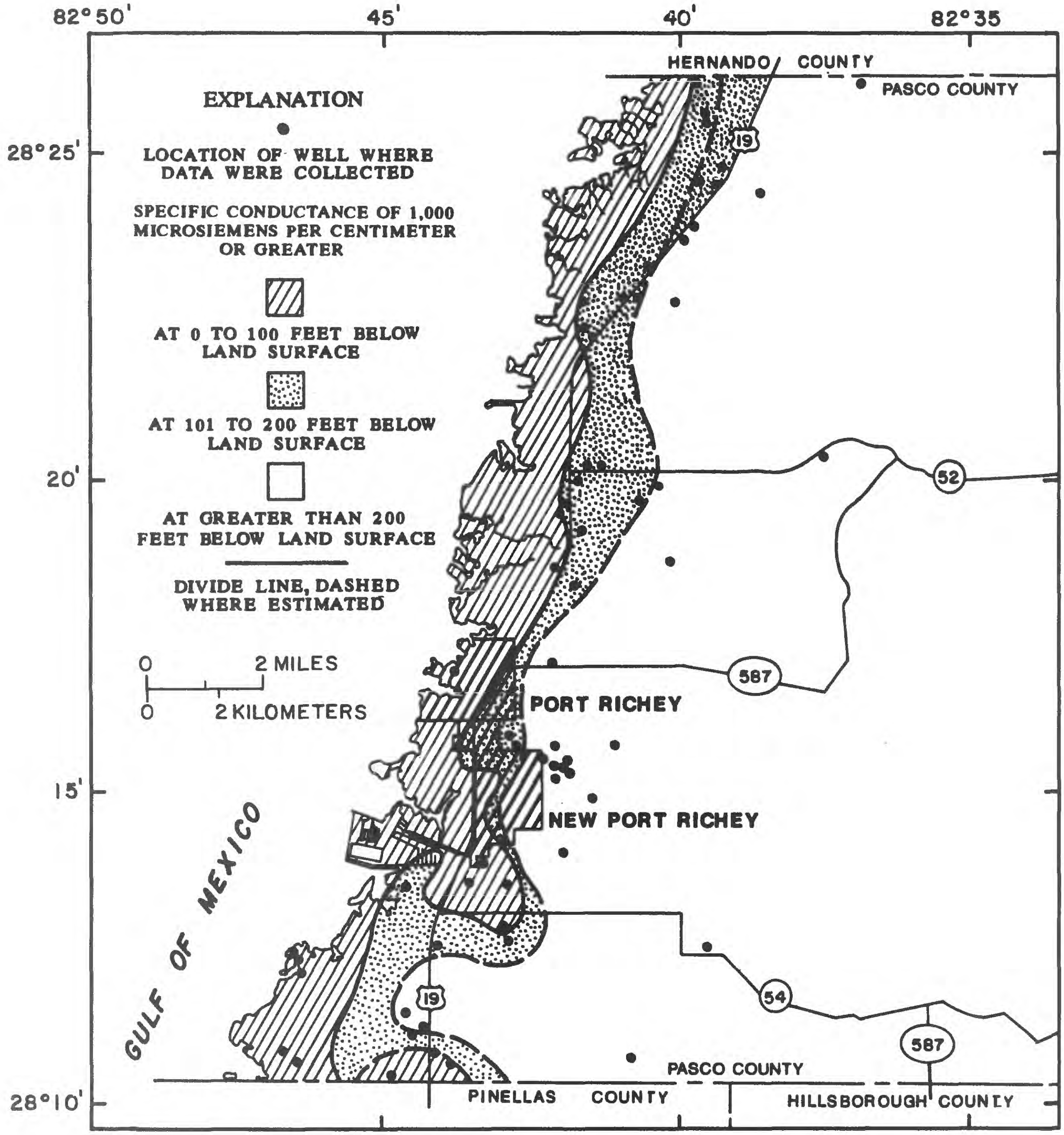
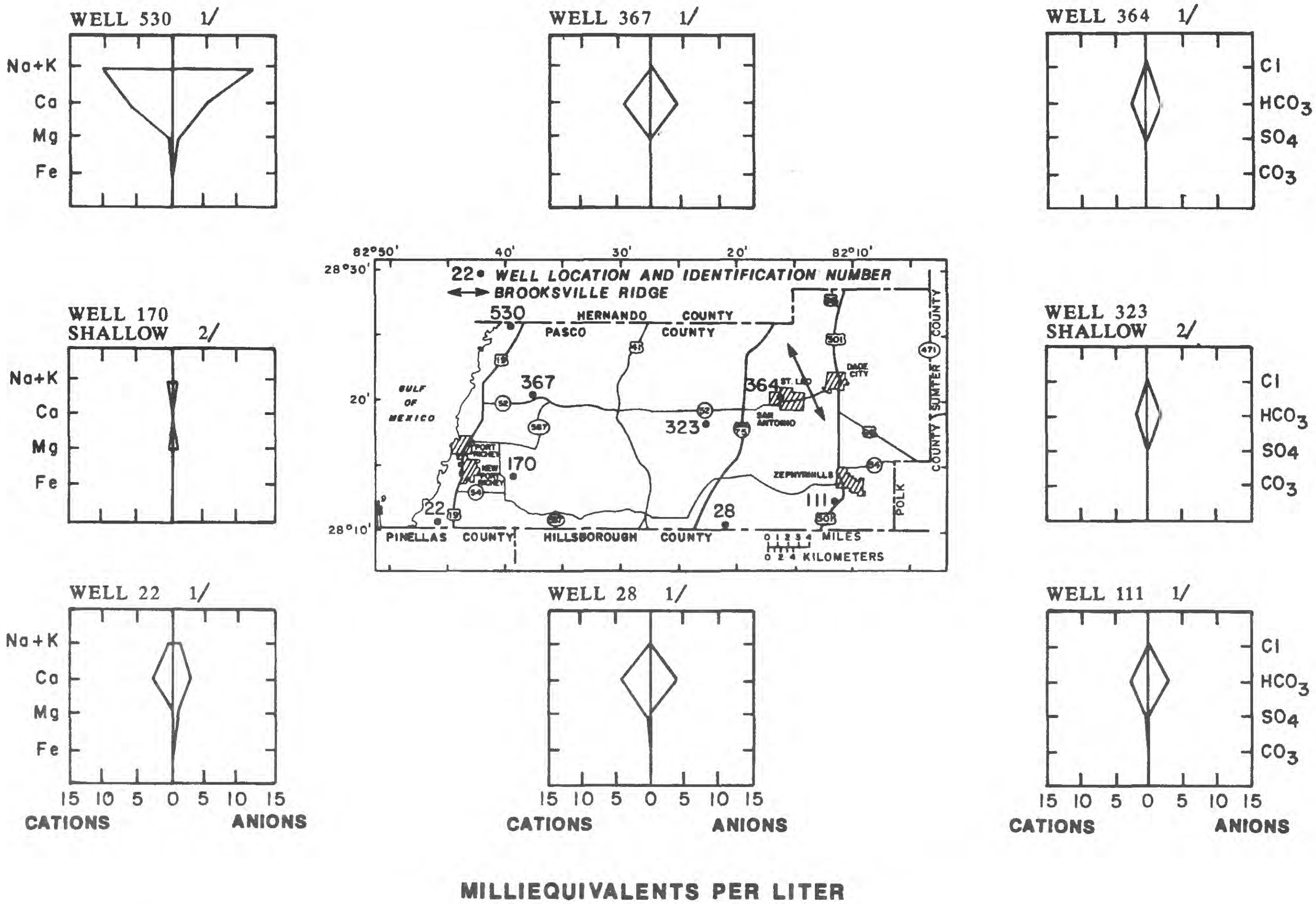


Figure 35.--Specific conductance of water in the Upper Floridan aquifer.



1/ Upper Floridan aquifer well

2/ Surficial aquifer well

Figure 36.--Concentrations of major constituents in water from selected wells.

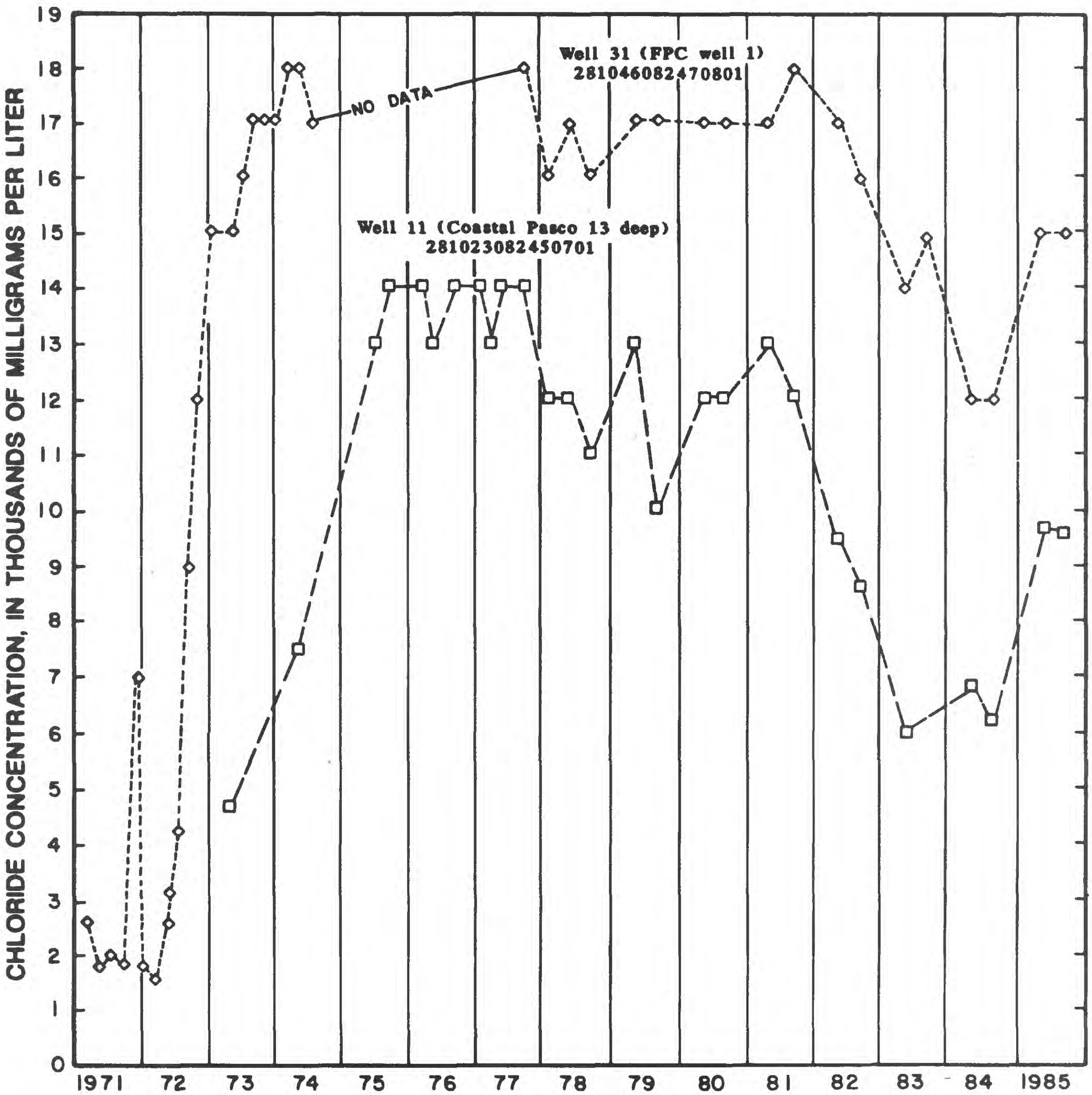


Figure 37.--Concentrations of chloride in water from wells 11 and 31 in the coastal area, 1971-85.

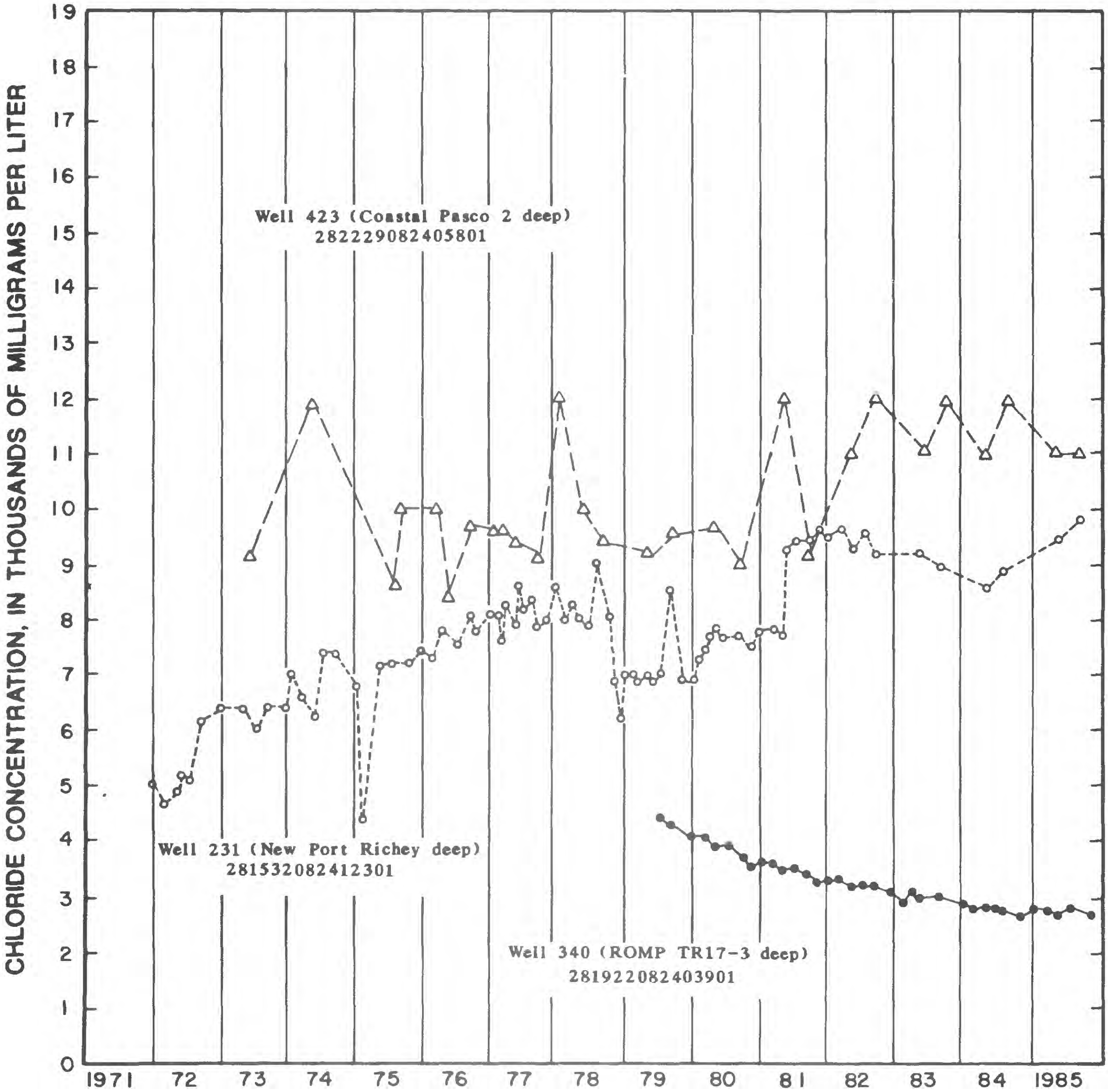


Figure 38.--Concentrations of chloride in water from wells 231, 340, and 423 in the coastal area, 1971-85.

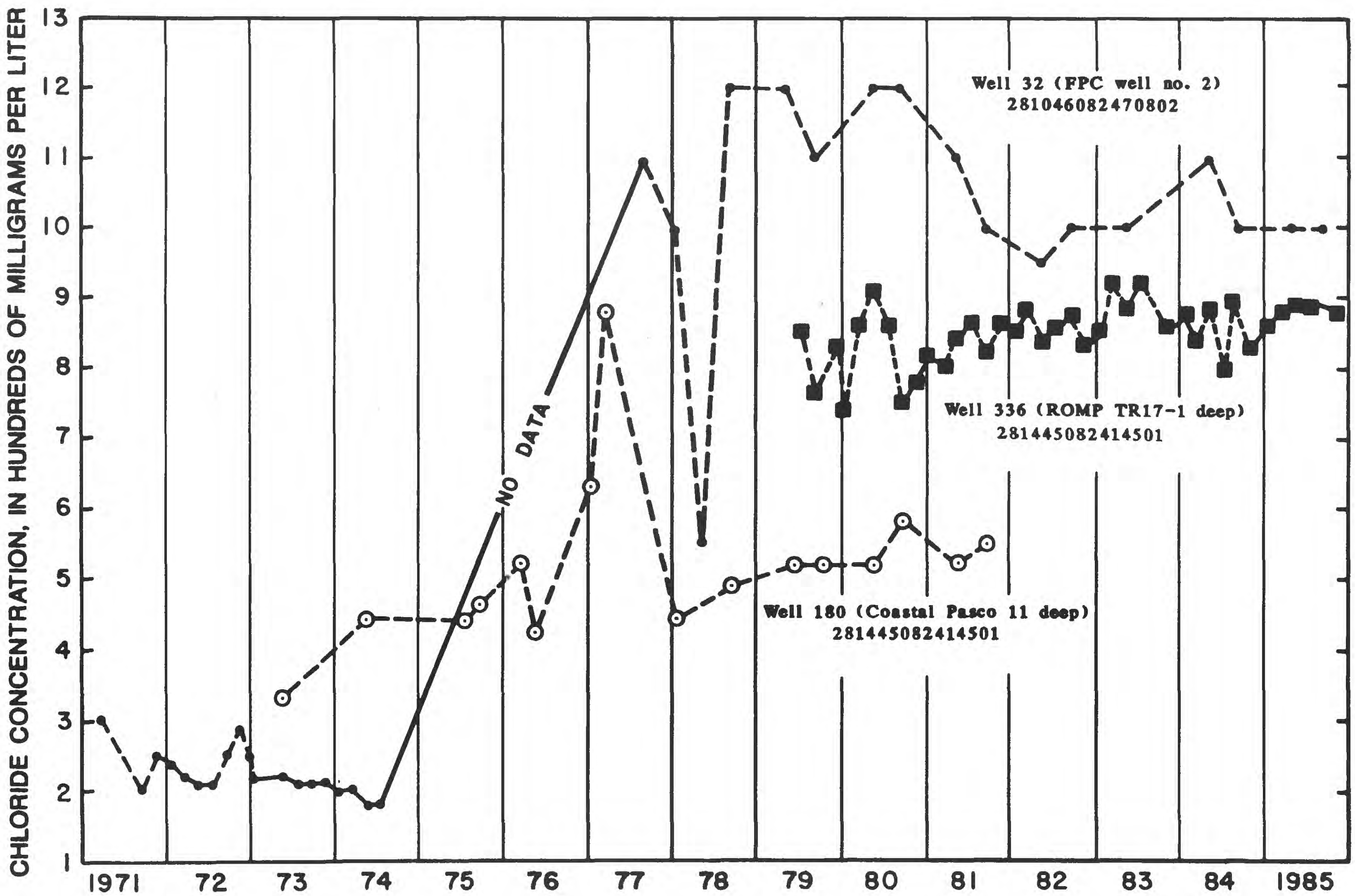


Figure 39.--Concentrations of chloride in water from wells 32, 180, and 336, 1971-85.

The zone is not static; it shifts with changes in recharge to and discharge from the Upper Floridan aquifer.

In the vicinity of the coast, the landward advance of saltwater is held in dynamic equilibrium as it is eroded by overriding freshwater moving seaward. The volume of seawater moving inland is balanced by the eroded seawater moving seaward in admixture with freshwater in the zone of transition (Cooper and others, 1964). The general shape of the transition zone at several sections along the coast is shown in figure 40. Each section was constructed using well data within a 2-mile-wide band. Most data were collected in 1985, but data collected as early as 1962 also were used. The transition zone is generally shallow about 2.5 miles inland from the coast and then drops sharply inland. At its steepest part, the zone drops about 250 feet in half a mile.

Encroachment of seawater results from a lowering of head in the Upper Floridan aquifer caused either by man or natural events, such as increased withdrawals from the aquifer or reduced rainfall and recharge. The rate and extent of landward movement of saltwater are determined primarily by the difference between the freshwater head and the saltwater head and the hydraulic characteristics of the aquifer.

Chloride concentrations in water from wells in or very near the transition zone will increase if the freshwater head is reduced by deficient rainfall or by pumping. If the natural balance of the system is not disturbed and mixing due to pumping does not occur at the wells, chloride concentrations may return to near their original concentrations after the return of normal rainfall. However, if mixing has occurred due to pumping of water from the transition zone, high concentrations of chloride may continue for long periods of time.

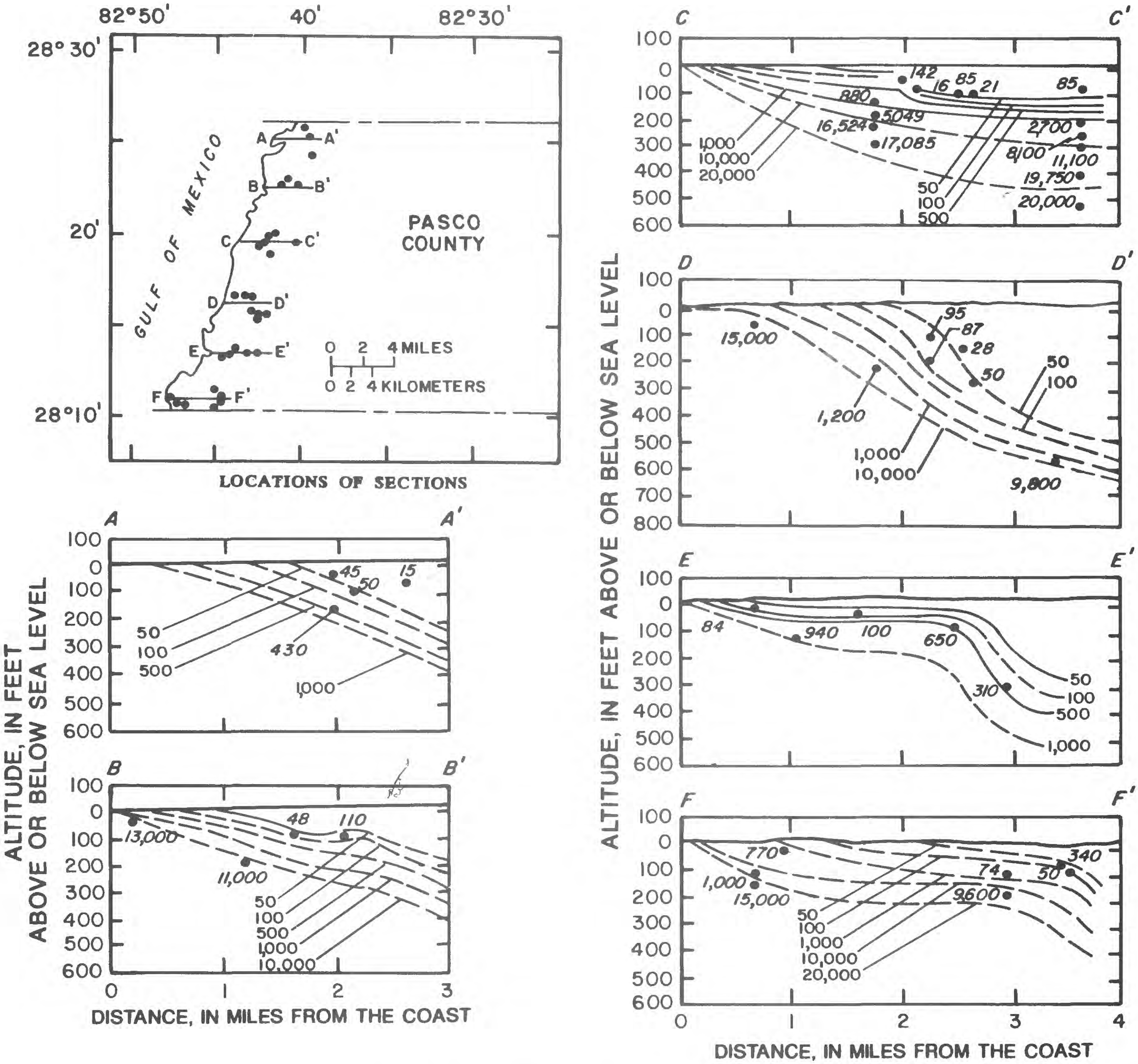
In coastal areas, chloride concentrations fluctuate in rivers and springs with tide. During rising tide, seawater flows up stream channels and often rises in springs that feed these streams. This causes increases in chloride concentrations in the lower reaches of streams and at some springs farther upstream until the tide again recedes.

EFFECTS OF GROUND-WATER DEVELOPMENT ON WATER RESOURCES

Ground-Water Flow Model

The U.S. Geological Survey modular ground-water flow model (McDonald and Harbaugh, 1984) was used in this study to estimate the effects of ground-water development. The model was configured in the quasi-three-dimensional mode as a sequence of two two-dimensional layers that are connected by vertical leakage through a semiconfining unit. The model uses a finite-difference method in which differential equations that describe the ground-water flow are solved numerically.

The modeled area is shown in figure 41. Its grid comprises an orthogonal matrix of 38 horizontal rows and 54 vertical columns with equidistant grid interval. Each grid block is 1 mi^2 and oriented to conform to a regional model of west-central Florida developed by Ryder (1985). Because of inactive blocks outside the area of study, the area of simulated ground-water flow is only 1,331 mi^2.



VERTICAL SCALE GREATLY EXAGGERATED

EXPLANATION

——————50——————

LINE OF EQUAL CHLORIDE CONCENTRATION, IN MILLIGRAMS PER LITER

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SAMPLE POINT CHLORIDE CONCENTRATION, IN MILLIGRAMS PER LITER

Figure 40.--Cross sections of the saltwater-freshwater transition zone in the Upper Floridan aquifer.

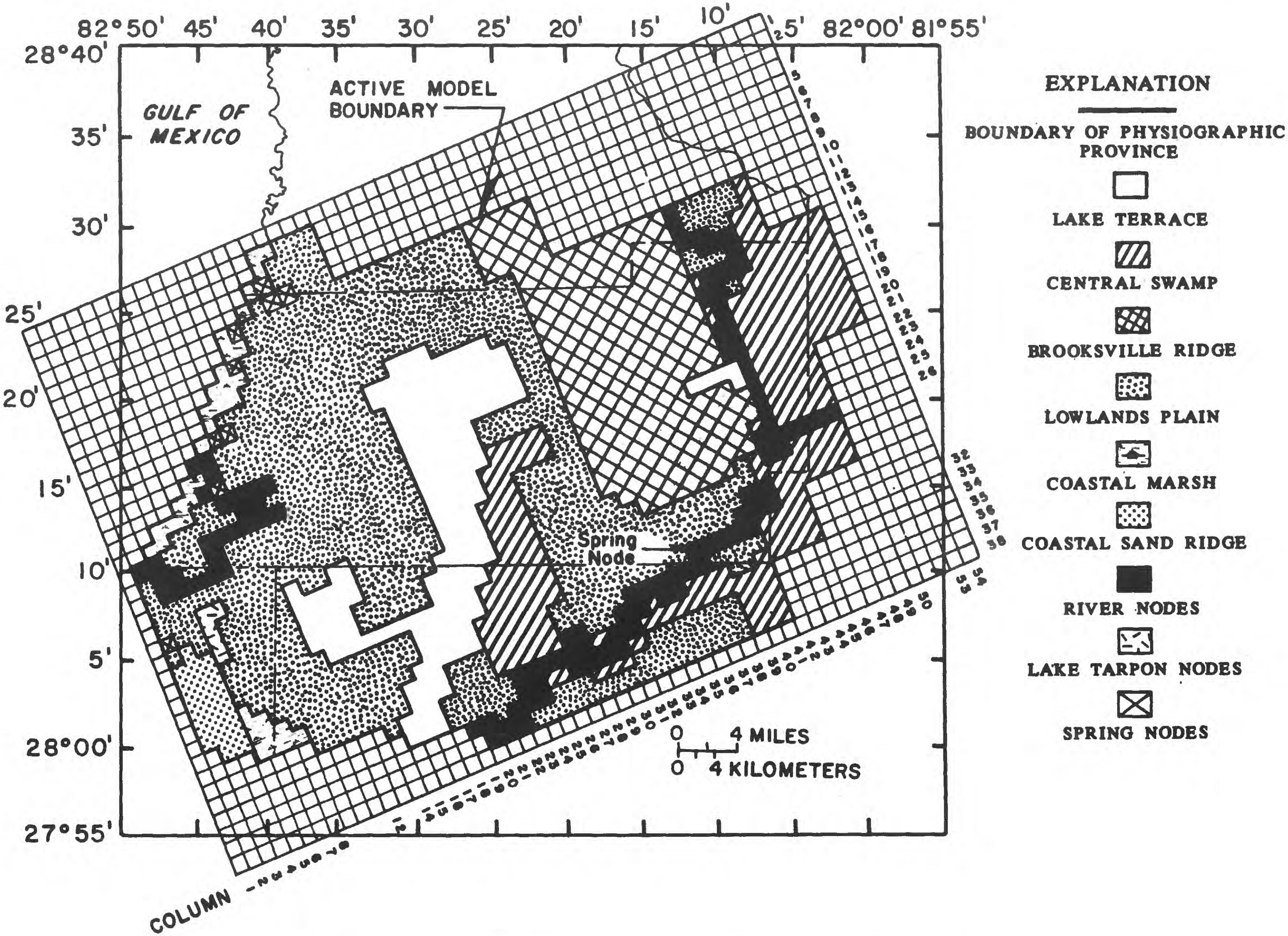


Figure 41.--Model grid and physiographic provinces.

For purposes of simulation, the Upper Floridan and surficial aquifers were treated as single layers with water moving in a horizontal plane. The surficial aquifer was modeled as though it existed throughout the modeled area; however, high leakance values were assigned where the surficial deposits were thought to be unsaturated. The modeling includes the following assumptions and limitations:

1. Ground-water movement in the surficial aquifer and the Upper Floridan aquifer is horizontal.
2. Water moves vertically into and out of the Upper Floridan aquifer through the overlying upper confining unit.
3. The upper confining unit has only vertical flow components.
4. Transmissivity of the Upper Floridan aquifer and leakance coefficient of the intermediate confining unit do not change with time.
5. Head changes in the surficial aquifer and the Upper Floridan aquifer caused by an imposed stress will eventually stabilize; that is, a condition of steady state will be reached.
6. Recharge is to and evapotranspiration is from the surficial aquifer.
7. The base of the Upper Floridan aquifer is that part of the rock column where gypsum or anhydrite consistently fills pores in the carbonate rocks and restricts flow of water. In the model, this base is treated as a no-flow boundary. No upward or downward leakage is allowed through the base of the aquifer. However, in the Dade City-Zephyrhills area, a higher value of transmissivity was used where the Upper and Lower Floridan aquifers are thought to be interconnected.
8. All lateral boundaries for the Upper Floridan aquifer are general head boundaries that assume an infinite source of water at some distance from the boundary. Ground-water flow to these boundaries is supplied at a rate proportional to the head difference between the source and the boundary cell (McDonald and Harbaugh, 1984, p. 343).
9. Constant-head conditions accurately represent the hydrologic conditions of the surficial aquifer at the model-grid boundary and Lake Tarpon.
10. Movement of the saltwater-freshwater interface has little or no effect on computed heads.

Local deviations from these assumptions can cause localized differences between model-calculated and observed ground-water heads, but the overall model analysis will not be adversely affected by these local deviations.

The Pasco County model was first calibrated by comparing computed heads with average heads for the September 1976 through May 1977 period. Next, it was tested against predevelopment data by removing pumpage and adding 10-percent recharge to account for normal rainfall. This predevelopment model was then used as the base from which both projected increased public-supply withdrawals for west Pasco County and projected withdrawals for the remainder of the county (including exported water) for 2035 were imposed to determine overall drawdowns. Five ground-water development plans for meeting the projected water needs of west Pasco County in 2035 were tested by the model and will be discussed in a later section of this report.

The model directly uses the values of many input parameters in ground-water flow equations. Others are used indirectly to compute values for parameters that vary with head, such as transmissivity of the surficial aquifer or evapotranspiration rate. Ranges in values for parameters in the calibrated model are presented in table 9.

Input data were adapted from Hutchinson (1984) where available. Data obtained from a coastal study by D.K. Yobbi (U.S. Geological Survey, written commun., 1985) have also been incorporated into the model. In remaining areas, Ryder's (1985) input was used and supplemented by new data where available. The modeling exercise done in conjunction with this study is an extension of the work done by Hutchinson (1984), including a larger area to the east and north. Rivers and springs not included in the earlier model have been included in this model.

Conceptual Model and Model Input

A schematic of the generalized conceptual model of the hydrologic system is shown in figure 42. The Upper Floridan aquifer (layer 2) is the principal source of ground-water supply; generally it is confined above by clay materials and below by less permeable limestone and dolomite and is overlain by an unconfined surficial aquifer (layer 1). Although clay confining materials may be locally absent, the Upper Floridan aquifer generally behaves like a leaky confined system and is treated as such for purposes of this model. The surficial aquifer is sometimes thin or unsaturated locally but, for purposes of this model, was assumed to be saturated and at least 10 feet thick everywhere due to model limitations. Nonetheless, the assumptions are probably valid when considering an average annual water table and average conditions within each square mile.

The Upper Floridan aquifer has a much higher hydraulic conductivity and is much thicker than the surficial aquifer. Hydrologic events outside the modeled area have a greater effect on the Upper Floridan aquifer than on the surficial aquifer. The model boundary is not a natural ground-water divide. Much water flows across this boundary through the Upper Floridan aquifer. Therefore, a general head boundary was selected for the Upper Floridan aquifer to allow for a source of water outside the modeled area. Water was supplied from outside the boundary to cells inside the modeled area at a rate proportional to the head difference between the source and the cell. Most water in the surficial aquifer is from local recharge. A constant head boundary was selected for the surficial aquifer by assuming little effect on the surficial aquifer from hydrologic events outside the modeled area.

Assuming all flow is vertical within confining units and horizontal within aquifers, a layer of nodes is not needed to represent the confining unit. A matrix of leakance values is read into the model directly. Leakance is similar to hydraulic conductivity in that it is a measure of the rate of flow between two vertically adjacent nodes. Initial values for this parameter, obtained from Hutchinson (1984) and Ryder (1985), were refined within realistic limits during modeling.

Maximum evapotranspiration occurs at land surface and is assumed to decrease linearly with depth below land surface to a depth at which evapotranspiration no longer occurs. This depth is known as the extinction depth and varies depending upon soil type, land cover, and climatological factors. The evapotranspiration rate and extinction depth may vary within the modeled area, but little data are available; therefore, the evapotranspiration rate

Table 9.--Values for hydrologic parameters of the calibrated steady-state model

[ft^2/d, feet squared per day; (ft/d)/ft, foot per day per foot; gal/d, gallons per day; in/yr, inches per year; Mgal/d, million gallons per day]

Parameter	Values used in calibrated model	Source of data used to determine realistic values
Potentiometric-surface altitude above sea level	0-91 feet	Ryder and Mills (1977a; 1977b).
Water-table altitude above sea level	0-164 feet	Ryder and Mills (1977a; 1977b); Tibbals and others (1980).
Transmissivity of Upper Floridan aquifer	25,920-645,000 ft^2/d	Published aquifer-test results (table 6).[1]
Transmissivity of surficial aquifer	100-351 ft^2/d	Model computed based on hydraulic conductivity measurements of Sinclair (1974).
Leakance coefficient of intermediate confining bed	0.00012-0.0008 (ft/d)/ft	Published aquifer-test results.
Hydraulic conductivity of surficial aquifer	10 ft/d	Sinclair (1974).
Altitude of the bottom of surficial aquifer	-14 to +155 feet	Wolansky and others (1979).
Saturated thickness of surficial aquifer	10-35 feet	Model computed based on difference between water table and estimated bottom of aquifer.
Elevation of river surfaces	0-88 feet	U.S. Geological Survey (1984).
Elevation of spring pools	1.5-52 feet	Published data, U.S. Geological Survey (1984); Wetterhall (1965); Rosenau and others (1977).
Elevation of river bottom	5-83 feet	Estimated.
Recharge rate to surficial aquifer	9-28 in/yr	Hutchinson (1984).

Table 9.--Values for hydrologic parameters of the calibrated steady-state model--Continued

Parameter	Values used in calibrated model	Source of data used to determine realistic values
Evapotranspiration rate from water table	0-38 in/yr	Model computed.
Evapotranspiration depth	10 feet	Hutchinson (1984).
Altitude of land surface	0-275 feet	U.S. Geological Survey topographic maps.
Pumping rate from Upper Floridan aquifer at individual nodes	0-9.86 Mgal/d	Southwest Florida Water Management District water-use permits, pumping reports, and irrigation requirements.
Total pumping rate from Upper Floridan aquifer (average 1976-77 conditions)	191.56 Mgal/d	-------

[1]Higher end of range is the result of assuming an interconnection between the Upper and Lower Floridan aquifers in the Dade City and Zephyrhills area.

and extinction depth were held constant for purposes of this model. Maximum evapotranspiration (38 inches) from the water table takes place when the water table is at land surface and decreases at a rate of 3.8 in/ft to zero at an extinction depth of 10 feet (Hutchinson, 1984, p. 9). Evapotranspiration from the water table averages about 15 inches and averages about 25 inches from plant surfaces, bare land, and the unsaturated zone.

Transmissivity values for the Upper Floridan aquifer were entered directly into the model. These values were initially selected from Hutchinson's (1984) and Ryder's (1985) values and were refined during calibration. An average uniform value of 1.2×10^{-4} ft^2/d (Hutchinson, 1984) for hydraulic conductivity for the surficial aquifer was input to the model. Little detailed data are available for this variable. A bottom elevation for the surficial aquifer also was input. Although, in reality, the surficial aquifer may be less than 10 feet thick, this minimum value for thickness was used in the model to prevent nodes from going dry. If nodes in the model go dry, errors in output will arise. The model uses the hydraulic conductivity and saturated thickness of the surficial aquifer to calculate transmissivity of the surficial aquifer.

Recharge to the surficial aquifer in internally drained areas could reach a maximum of about 28 inches. In swampy areas, recharge could be as low as 9 inches (Hutchinson, 1984, p. 14-15). Values used in the model ranged from 9 to 28 in/yr and averaged about 25 in/yr.

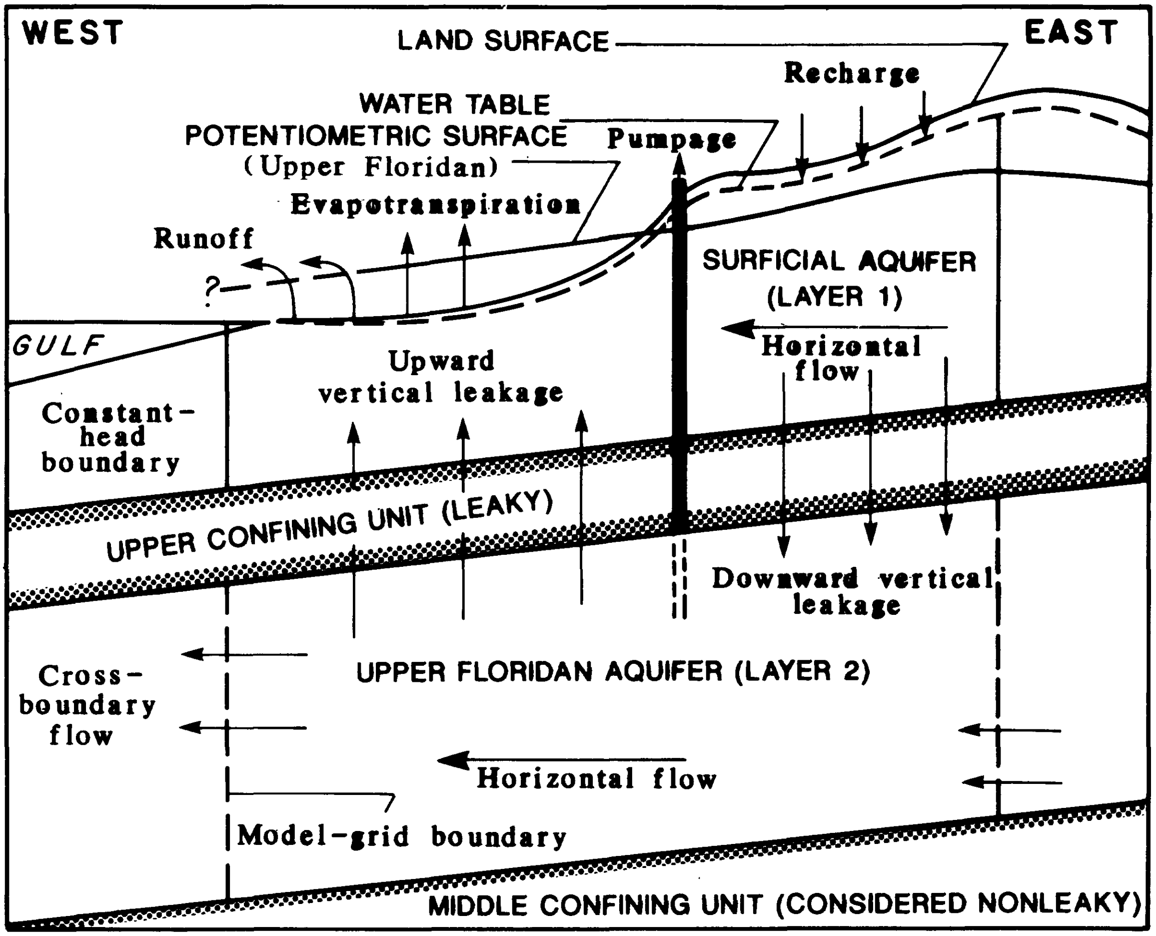


Figure 42.--Generalized conceptual model of the hydrogeologic system. (From Hutchinson, 1984.)

Except for Lake Tarpon, which is very large and in direct connection with the Upper Floridan aquifer, lakes were assumed to behave in the same way as the surficial aquifer. Therefore, they are not treated separately from the surficial aquifer.

Rivers were assumed to be hydraulically connected to the surficial and Upper Floridan aquifers because the surficial aquifer tends to be thin at rivers. For modeling purposes, each river was divided into reaches, each of which is contained in a single cell. Leakage between river and aquifer was defined for each river reach in the model cell that contains that reach. Water was assumed to have to pass through the riverbed to get from the river into the aquifer cell or visa versa. The rate at which the water moves through the riverbed is known as the conductance of the bed and is determined based on the area of the reach and head differences in the river and aquifer. The Withlacoochee and Hillsborough Rivers had higher conductances for the surficial aquifer, and the Anclote and Pithlachascotee Rivers had higher conductances for the Upper Floridan aquifer. Conductance values ranged from 0.07 to 0.4 ft^3/s. Stage for each river reach was estimated from topographic maps. A 5-foot water depth for the rivers was assumed, except on the Hillsborough River above the dam where an 18-foot depth was assumed.

Springs were treated as drains in the model. Spring head was input as elevation of the drain. Also input was hydraulic conductance of the interface between the drain and the aquifer. Hydraulic conductance was calculated as the flow rate of the spring divided by the difference in the elevation of the spring pool and the head in the aquifer.

Values of many hydrologic parameters were limited based on physiographic units (fig. 41). The following is from Hutchinson (1984, p. 9):

Physiographic unit	Recharge	Evapotranspiration	Leakage from surficial aquifer	Transmissivity of surficial aquifer
1. Coastal marsh	Low	High	Low	Low
2. Coastal sand ridge	Moderate	Low	High	High
3. Lowlands plain	Moderate	Moderate	Moderate	Moderate
4. Lakes terrace	High	Moderate	High	Moderate
5. Central swamp	Low	High	Low	Low
6. Brooksville ridge	Moderate	Low	High	High

Input for the model includes the following:

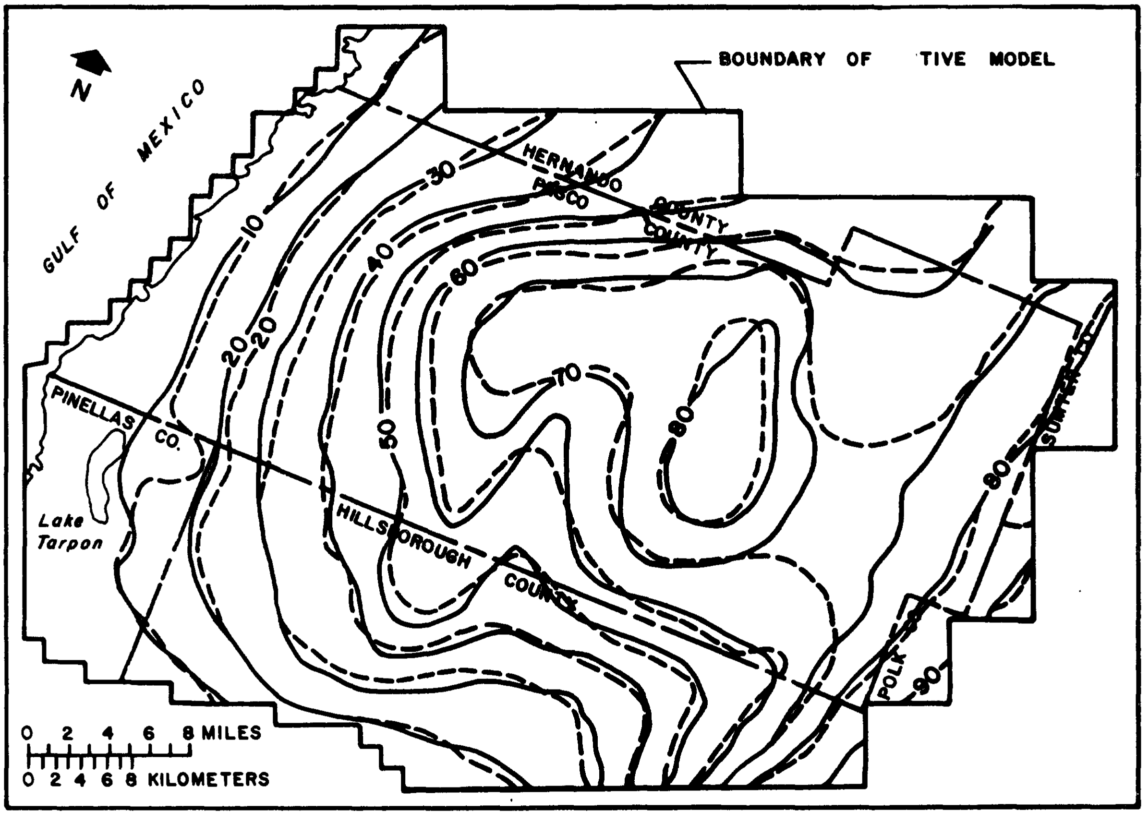
1. Altitude of the average potentiometric surface of the Upper Floridan aquifer, May 1976 through September 1977;
2. Altitude of the estimated average water table in the surficial aquifer, May 1976 through September 1977;
3. Transmissivity of the Upper Floridan aquifer;
4. Leakance coefficient (vertical hydraulic conductivity divided by thickness of the confining unit) of the upper confining unit;
5. Hydraulic conductivity of the surficial aquifer;
6. Altitude of the bottom of the surficial aquifer;
7. Recharge rate to the surficial aquifer;

8. Maximum evapotranspiration rate from the water table;
9. Maximum depth below land surface at which evapotranspiration occurs (10 feet was used for this model);
10. General head-boundary conductance (rate at which a source of water outside the modeled area supplies water to a cell in the modeled area, which is a rate proportional to the head difference between the source and the cell) for the Upper Floridan aquifer;
11. Altitude of land surface;
12. Model-grid spacing (1 x 1 mile);
13. Pumping rate for wells pumping from the Upper Floridan aquifer;
14. Altitude of the river surface in each river node;
15. Hydraulic conductance (hydraulic conductivity times length of river reach times width divided by thickness) of the river bottom;
16. Elevation of the river bottom;
17. Spring-pool elevations; and
18. Hydraulic conductance that describes the linear relation between head difference and flow rates at each spring.

Prior to calibration modeling, a test of boundary conditions was run using Ryder's (1982) model. Pumpage of 35 Mgal/d was input at each corner of Pasco County to estimate how far the effects of pumping would extend. A pumpage of 35 Mgal/d was selected because that is currently (1986) the maximum average permitted pumpage at any well field. If there was less than 2 feet of drawdown 8 miles out from the county line (a 2-node distance in Ryder's model), it was deemed acceptable to use a general head boundary for the Upper Floridan aquifer in the model. Initially, a 1-foot drawdown was considered, but only a few nodes southeast of the modeled area had drawdowns of greater than 1 foot, and the main area of interest is in western Pasco County. To prevent having to greatly expand the boundary of the model, a 2-foot drawdown was accepted. Pumping from the Upper Floridan aquifer is expected to have little effect on the water table at the edges of the model; therefore, a constant-head boundary was used for the surficial aquifer. Even if head changes in grid blocks adjacent to the boundary are large, changes in lateral boundary flow would be negligible because of a surficial-aquifer transmissivity of only about 300 ft^2/d (Hutchinson, 1984, p. 14-15).

Calibration

The model used for this study, the Pasco model, was calibrated by systematically adjusting input parameters within realistic limits until simulated heads in the surficial aquifer and the Upper Floridan aquifer matched average levels observed between September 1976 and May 1977 (figs. 43 and 44). This time period was selected for efficiency because the Hutchinson (1984) model was already calibrated for this time period; therefore, much of the input was readily available. Originally, the 1976-77 period was selected because conditions were approximately at steady-state (net change in storage in the regional flow system was negligible). Leakance of the upper confining unit, transmissivity of the Upper Floridan aquifer, recharge, evapotranspiration rate, and riverbed hydraulic conductance were adjusted within realistic limits during calibration of the model. In order to conceptualize recharge to, evapotranspiration and leakage from, and transmissivity of the surficial aquifer, six physiographic provinces were delineated (Hutchinson, 1984, p. 9) as shown in figure 41. Calibration changes were done node-by-node within these physiographic provinces; however, the range for parameter changes was limited by the province.



EXPLANATION

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OBSERVED POTENTIOMETRIC SURFACE-- Shows altitude, in feet, of September 1976-May 1977 average potentiometric surface of the Upper Floridan aquifer. Contour interval 10 feet. Datum is sea level

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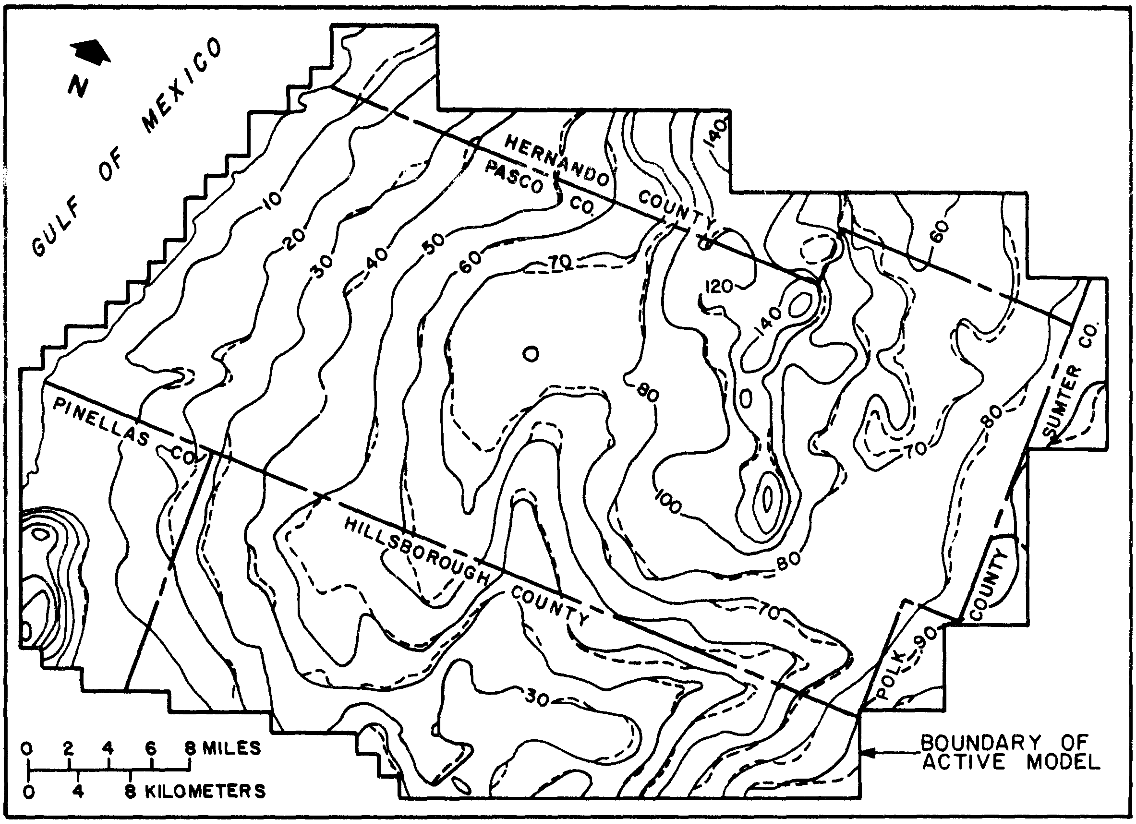
CALCULATED POTENTIOMETRIC SUFACE-- Shows altitude, in feet, of model-calculated potentiometric surface of the Upper Floridan aquifer. Contour interval 10 feet. Datum is sea level

Figure 43.--Comparison of average-observed potentiometric surface and model-calculated potentiometric surface, 1976-77, representing calibration.



EXPLANATION

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ESTIMATED WATER-TABLE CONTOUR-- Shows altitude in feet, of estimated average water table in the surficial aquifer, September 1976–May 1977. Contour interval 10 and 20 feet. Datum is sea level

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CALCULATED WATER-TABLE CONTOUR-- Shows altitude in feet, of model-calculated water table in the surficial aquifer. Contour interval 10 and 20 feet. Datum is sea level

Figure 44.--Comparison of average-estimated water table and model-calculated water table, 1976-77, representing calibration.

The model calibration was based on matching simulated heads with observed heads within 5 feet. The ±5-foot error limit is based on probable errors in averaging heads and aquifer properties over a grid block and constructing average water-level maps. For example, a well in a corner of a grid block may have a significantly different observed water level than is computed by the model at the center of the block. Add this error to map error, which is normally one-half the contour interval (in this case 2.5 feet), and ±5 feet is a reasonable error criterion.

The results of the calibration are assessed by comparing model-simulated and observed water levels in the 1,178 and 1,331 grid blocks that constitute the active surficial and Upper Floridan aquifer parts of the model, respectively. The surficial aquifer has fewer active nodes because boundary nodes and Lake Tarpon nodes are inactive. Average-observed and model-simulated water levels in both aquifers are compared statistically in table 10.

Table 10.--Statistics of model calibration

	1976-77 average versus model-simulated	
	Water table[1]	Potentiometric surface[2]
Number of active nodes	1,178	1,331
Maximum range of residuals[3] (feet)	4.4 to -5.3	5.2 to -4.5
Median residual (feet)	0.5	0.1
Mean residual (feet)	0.4	0.1
Mean of absolute value of residuals (feet)	1.3	1.5
Standard deviation of residuals (feet)	1.6	1.8
Correlation coefficient	0.9986	0.9975

[1]Surficial aquifer.
[2]Upper Floridan aquifer.
[3]Residuals were computed by subtracting model-simulated water levels from the average 1976-77 potentiometric surface and water table. A negative residual indicates that the model-simulated water level is higher than the 1976-77 average water level, and the reverse is indicated by a positive residual.

Residuals for the 1,178 grid blocks were nearly all within the ±5-foot limit. The standard deviation about the 0.4-foot mean of the residuals for the water table was 1.6 feet. That is, the model-simulated water table matched the average-observed water table within a range of 1.2 feet above to 2.0 feet below at about 68 percent of the nodes. Similarly, the model-simulated potentiometric surface matched the September 1976 to May 1977 average surface at 68 percent of the nodes within a range of 1.7 feet above to 1.9 feet below. This is based on a standard deviation of 1.8 feet about a residual mean of 0.1 foot below the average level. The correlation coefficients were near one, indicating near-perfect association between the average-observed and model-simulated water levels in both aquifers.

The statistics for the calibration are based on the assumption that the residuals between observed and computed water levels are normally distributed about the mean of the residuals (Arkin and Colton, 1965). The mean and median coincide, indicating a normal distribution of residuals for the water table and potentiometric surface, and there is a good match between observed and computed water levels (Arkin and Colton, 1965).

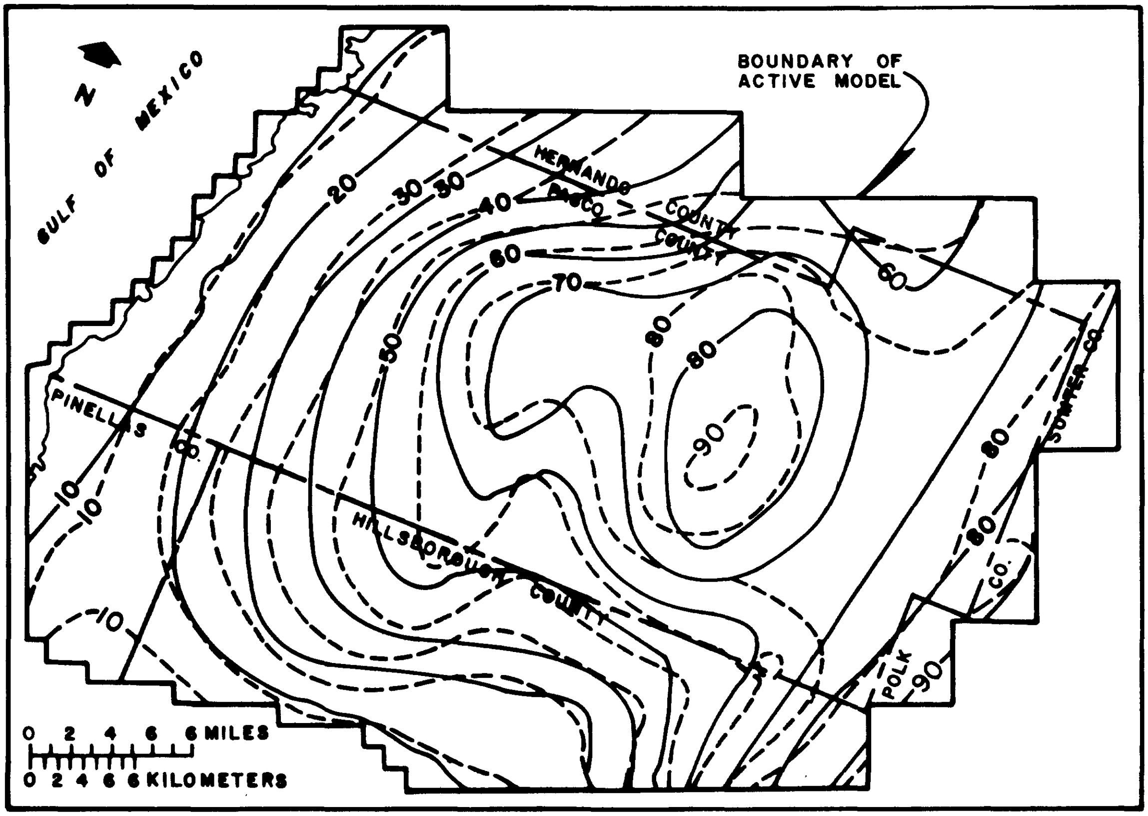
Validation

To test its usefulness in calculating effects of proposed pumpage, the Pasco County model was tested against a data set that represents hydrologic conditions different from those used for calibration. A map of estimated predevelopment water levels (derived from the earlier work of Stringfield, 1936) by Johnston and others (1980) was used to validate the Pasco County model. All pumpage was removed from the calibrated 1976-77 steady-state model, and recharge was increased by 10 percent because May 1976 through September 1977 rainfall was about 10 percent below normal.

The validation results were assessed by comparing the Johnston and others (1980) predevelopment water levels and the model-calculated water levels in the 1,331 grid blocks that comprise the model layer of the Upper Floridan aquifer (fig. 45). Statistics of comparison at the 1,331 grid blocks are listed in table 11. Over the 1,331 nodes within the model-grid boundary, the simulated potentiometric surface ranged from 10.6 feet above to 10.0 feet below the estimated level. The mean was 1.7 feet above the estimated level. The standard deviation about the mean of the residuals was 3.5 feet, which indicates the model-simulated potentiometric surface matched within a range of 5.2 feet above to 1.8 feet below the estimated level at about 68 percent of the nodes. A correlation coefficient of 0.9920 indicates a good correlation between the two surfaces. A moderate skewness in the distributions of residuals for the potentiometric surface is indicated. Although confidence in the statistics of the model validation is reduced somewhat because of skewness, overall, they strongly indicate that there is a reasonable match between Johnston and others (1980) predevelopment and model-simulated predevelopment water levels.

Sensitivity Analysis

Sensitivity of the model to changes in input parameter value can be tested by adjusting values of parameters one at a time within a realistic range, rerunning the model, and comparing changes in head caused by each parameter value change. Insight can be gained through this exercise in terms of the degree to which a change in any parameter value may affect results of the model simulation. Where model nodes are very sensitive to changes in a parameter value, small changes in the value can cause large changes in water levels; therefore, if the match is close, considerable confidence can be placed in the value of the parameter. Conversely, if a node is insensitive to changes in a parameter, little confidence can be gained by using the model to refine the parameter value. The confidence level in the value of a parameter also diminishes when a node is sensitive to more than one parameter, and the effects of one cannot be distinguished from the effects of the other.



EXPLANATION

——30——
PREDEVELOPMENT POTENTIOMETRIC CONTOUR--Shows estimated altitude, in feet, of predevelopment potentiometric surface of the Upper Floridan aquifer (Johnston and others, 1980). Contour interval 10 feet. Datum is sea level

– – –80– – –
SIMULATED PREDEVELOPMENT POTENTIOMETRIC CONTOUR--Shows model-calculated altitude, in feet, of predevelopment potentiometric surface of the Upper Floridan aquifer. Contour interval 10 feet. Datum is sea level

Figure 45.--Comparison of predevelopment potentiometric surface and model-simulated predevelopment potentiometric surface representing model validation.

Table 11.--Statistics of model validation, Upper Floridan aquifer

	Calculated predevelopment potentiometric surface versus estimated predevelopment potentiometric surface[1]
Number of active nodes	1,331
Maximum range of residuals[2] (feet)	10.0 to -10.6
Median of residuals (feet)	-1.9
Mean residual (feet)	-1.7
Standard deviation of residuals (feet)	3.5
Correlation coefficient	0.9920

[1]Johnston and others, 1980.

[2]Residuals were computed by subtracting calibrated predevelopment water levels from Johnston and others (1980) predevelopment potentiometric surface. A negative residual indicates that the calculated predevelopment water level is higher than the water level with which it is compared, and the reverse is indicated by a positive number.

One limitation to the modular model is that, if water-table nodes go dry or if water levels rise above land surface, errors can occur in the output. This did limit the range in values used to test leakance and recharge. Problems arose in surficial aquifer nodes in the Brooksville Ridge area when leakance was reduced by 20 percent or increased by 50 percent. In the same area when recharge was increased by 20 percent or decreased by 25 percent, problems again occurred in the surficial aquifer nodes. This suggests a possible error in the conceptual model in this area due to little information being available for the surficial aquifer in the Brooksville Ridge area. Also, averaging over a square mile could cause errors if large changes in parameters occur over short distances.

Model sensitivity was tested by varying maximum evapotranspiration rate and depth, recharge, hydraulic conductivity of the surficial aquifer, transmissivity of the Upper Floridan aquifer, and leakance of the upper confining unit. Table 12 shows ranges in water-level change in response to changes in parameter values. Figure 46 shows deviations along one row from the calibrated 1976-77 average water table and potentiometric surface due to changing maximum evapotranspiration depth by ±5 feet, recharge rate by ±15 percent, and maximum evapotranspiration rate by ±20 percent. Figure 47 shows deviations due to doubling and halving transmissivity and to changing transmissivity of the Upper Floridan aquifer by ±15 percent and leakance of the intermediate confining unit by ±15 percent and changing the hydraulic conductivity of the surficial aquifer by a factor of 2. The model could not accommodate a decrease in leakance of greater than 15 percent because surficial aquifer nodes would flood. This shows a great sensitivity of the model to changes in leakance. The cross sections in figures 46 and 47 depict model-simulated heads along row 24 of the model. Row 24 near the center of the model was selected because it intersects and thus depicts changes in five of the six physiographic units in the model. The cross sections were used in conjunction with maps of head changes to supply areal perspective to the sensitivity analysis.

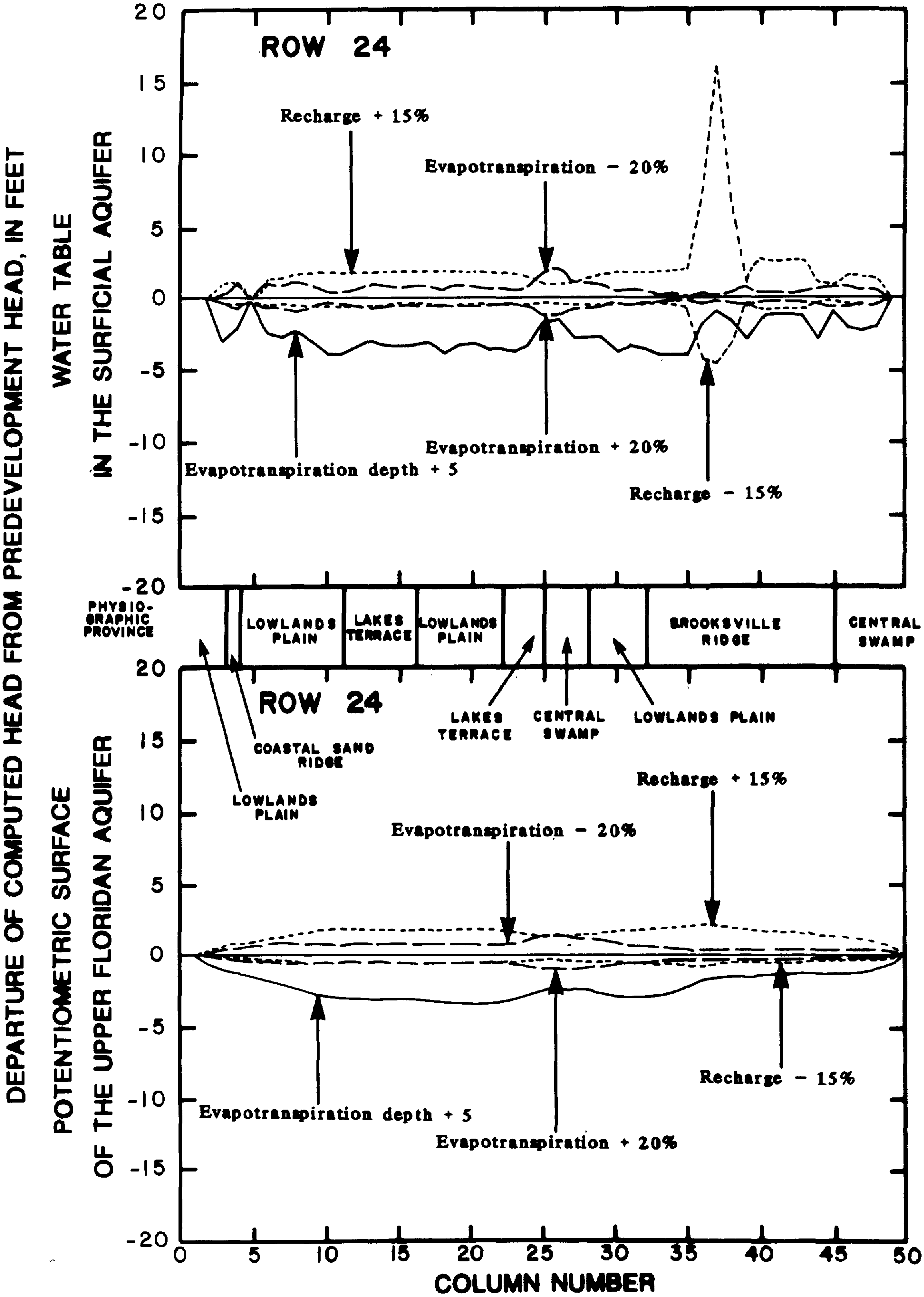


Figure 46.--Effects along row 24 of varying evapotranspiration and recharge parameters on the predevelopment model.

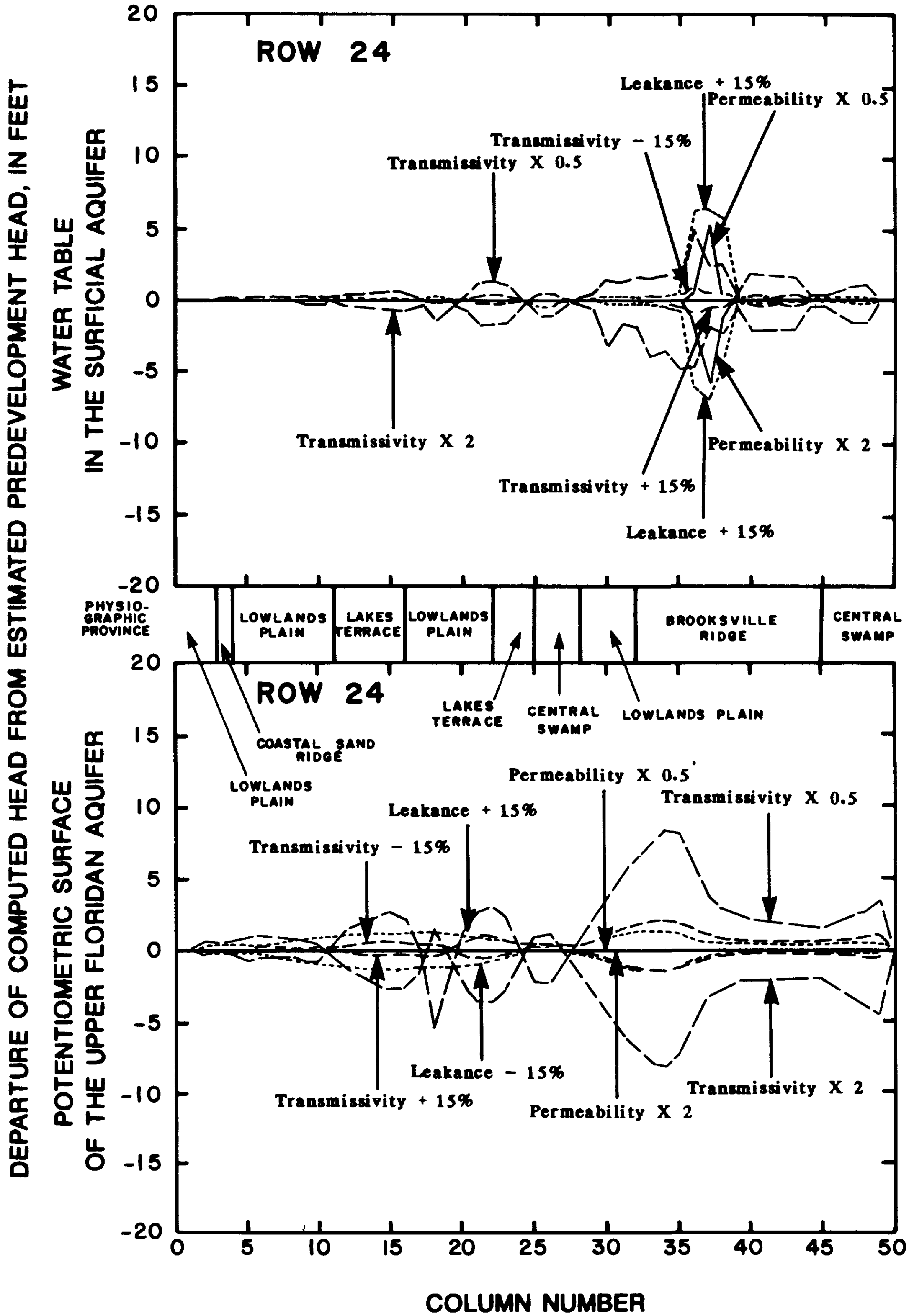


Figure 47.--Effects along row 24 of varying aquifer and confining bed hydraulic properties in the predevelopment model.

Table 12.--Range in head fluctuations resulting from model-sensitivity tests

Parameter and change	Range[1] of head fluctuation below (-) and above (+) that of the 1976-77 calibration simulation (feet)	
	Water table in surficial aquifer	Potentiometric surface of Upper Floridan aquifer
Hydraulic conductivity of surficial aquifer x 2	-6.2 to 2.3	-0.5 to 0.0
Hydraulic conductivity of surficial aquifer x 0.5	-0.7 to 7.7	0.0 to 0.2
Increase evapotranspiration rate by 20 percent	-1.2 to 0.0	-0.9 to -0.1
Decrease evapotranspiration rate by 20 percent	0.1 to 2.2	0.0 to 1.5
Increase evapotranspiration depth to 15 feet	-4.5 to -0.1	-3.4 to -0.1
Increase recharge rate by 15 percent	0.2 to 11.0	0.0 to 2.8
Decrease recharge rate by 15 percent	[2]-14.5 to -0.2	-3.6 to 0.0
Increase leakance by 15 percent	-7.6 to 0.4	-0.1 to 1.3
Decrease leakance by 15 percent	-0.5 to 8.9	-1.8 to 0.2
Change transmissivity of Upper Floridan aquifer x 2	-10.0 to 4.0	-9.8 to 5.1
Change transmissivity of Upper Floridan aquifer x 0.5	-9.8 to 12.6	-10.0 to 13.3
Increase transmissivity of Upper Floridan aquifer by 15 percent	-2.2 to 1.3	-2.2 to 1.3
Decrease transmissivity of Upper Floridan aquifer by 15 percent	-0.1 to 2.7	-1.8 to 2.8

[1]Represents range of model-computed residuals between the 1976-77 calibration and sensitivity simulations for 1,331 nodes.
[2]One node (14:39) went dry.

On the basis of six sensitivity tests, the model is most sensitive in the Brooksville Ridge area to changes in parameter values. The water table of the surficial aquifer in the ridge area shows the most sensitivity to change in recharge and leakance coefficient of the upper confining unit and increases in the hydraulic conductivity of the surficial aquifer. The potentiometric surface of the Upper Floridan aquifer also responds to changes in recharge and leakance coefficient in the Brooksville Ridge area, though not as significantly as the water table. The potentiometric surface shows a greater sensitivity to changes in transmissivity in the Brooksville Ridge area. The water table in the surficial aquifer responds very slightly to the same change. In the modeled area, the potentiometric surface of the Upper Floridan aquifer is very sensitive to changes in transmissivity compared to other areas of the Upper Floridan aquifer (Ryder, 1985). Both aquifers respond significantly to changes in maximum evapotranspiration rate in the central swamp province, and the greatest response is to decreases in the rate. Overall, the response of the water table to changes in transmissivity and leakance coefficient are very small compared to the responses of the potentiometric surface. The exception is to changes in the leakance coefficient in the Brooksville Ridge area. Both aquifers respond similarly to changes in recharge and maximum evapotranspiration rate except in the ridge area.

Varying the maximum evapotranspiration rate and recharge has a slightly greater effect on the water table than the potentiometric surface. One might expect to see a much larger effect on the water table because these changes directly apply to inflow to and outflow from the surficial aquifer. But due to the relatively high leakage rate from the surficial aquifer through the upper confining unit and the dampening effect on heads in this aquifer by the evapotranspiration function, head deviations from the calibrated model are nearly the same in each aquifer.

Other than in ridge areas, the effects of increasing or reducing recharge are dampened by increasing or reducing maximum evapotranspiration rate. In the swampy areas, evapotranspiration is high and changing it strongly influences the calibration, as can be seen in the central swamp area in figure 46. The ridge areas are more sensitive to recharge than other areas. In ridge areas where the water table generally is 10 feet or more below land surface, evapotranspiration from the water table and the potential for capturing runoff are nil, and small changes in the potentiometric surface sometimes result in large fluctuations in water-table levels.

Potential Effects of Future Development

Five model simulations were run to evaluate aquifer response to ground-water development plans for withdrawing the additional water that will be needed for public supply for projected population in west Pasco County by the year 2035. This is water over and above that already being withdrawn in western Pasco County. Each of these plans includes an average and maximum withdrawal rate ranging from 10 to 31.5 Mgal/d. Locations of well fields by model node and proposed withdrawal rates from the Upper Floridan aquifer are shown in table 13.

Plan 1 calls for initiating pumpage at central Pasco well field, increasing pumpage at Starkey well field, and supplementing with pumpage from local wells. Withdrawals would total a 20-Mgal/d average and a 31.50-Mgal/d maximum. Plan 2 calls for increasing pumpage at Starkey well field and adding additional local wells to supply a 10-Mgal/d average and an 18-Mgal/d maximum. Plans 3, 4, and 5 all propose an average pumpage of 17 Mgal/d and a maximum of 28 Mgal/d from various combinations of local wells and increased pumpage from Starkey well field. The pumpage data were entered into the predevelopment model, and the resultant drawdowns were determined in both the surficial and Upper Floridan aquifers. The model was run to steady-state.

The predevelopment model is the same as the 1976-77 model except that pumpage has been removed and rainfall increased by 10 percent to simulate normal climatic conditions. The predevelopment model was selected as the base from which to impose projected pumpage to show the relative effects of each pumping plan without the interference of other pumping. Figures 48 through 67 and table 14 show drawdowns resulting from each of the projected plans. Drawdowns in the potentiometric surface could be superimposed on potentiometric-surface maps for various times to determine the cummulative effect of the drawdowns due to these pumpage plans and other regional pumpage.

Drawdowns resulting from projected increases in public-supply demands ranged from 5 to 12 feet in the potentiometric surface and from 1 to 3 feet in the water table. The greatest drawdowns in the potentiometric surface and the water table occurred under plans 3, 4, and 5 with maximum pumpage conditions. The least drawdown occurred under plan 2, which proposes the lowest withdrawal rate of all plans. Although average pumpage proposed under plan 1 is three times as much as under plan 2, drawdown resulting from pumpage under plan 1 is only slightly greater. Pumpage under plan 1 is greater than under plans 3, 4, and 5 with considerably less maximum drawdown effect. One reason for this is that pumpage is spread over a larger area under plan 1 than under plans 3, 4, and 5. This wider distribution of pumpage also explains the greater radius of influence for plan 1 than plans 3 and 4.

For ease of depiction and comparison of relative influence of pumpage, a 1-foot drawdown has been used as the extent of the radius of pumpage influence in the following discussion. In actuality, the radius extends beyond the 1-foot drawdown to zero drawdown.

The radius of influence ranged from 4.75 to 7.25 miles in the Upper Floridan aquifer and from 1.2 to 5.4 miles in the surficial aquifer. Plan 2 shows a smaller radius of influence than any other plan; however, under plan 4 (average pumpage), 7 Mgal/d more is withdrawn with only a slightly larger radius of influence in the potentiometric surface. The radius of influence for the water table under average pumpage conditions for plan 4 is more than twice that of plan 2, and the radius of influence for plan 1 is three times that for plan 2. The radius of influence in the water table under maximum pumpage conditions is about 40 percent greater for plan 4 and about 200 percent greater for plan 1 than for plan 2.

The cone of depression resulting for plans 1 and 2 with average pumpage conditions does not approach the saltwater-freshwater interface; however, under plans 3, 4, and 5, the 1-foot contour line of the cone of depression almost reaches the saltwater-freshwater interface line (figs. 48 through 52). According to Hubbert (1940), a 1-foot drawdown in the potentiometric surface at the interface will theoretically cause seawater to rise about 40 feet from its present depth of about 200 feet below sea level to 160 feet below sea level along the 1979 interface line depicted by Causseaux and Fretwell (1982).

Table 13.--Various ground-water

[Pumpage in million gallons per day from the Upper Floridan aquifer; L, local;

Plan 1			Plan 2			Plan 3		
Location node (R:C)	Pumpage		Location node (R:C)	Pumpage		Location node (R:C)	Pumpage	
	Average	Maximum		Average	Maximum		Average	Maximum
13:17L	0.5	0.75	11:22L	0.22	0.33	13:18L	0.25	0.37
13:19L	.5	.75	12:21L	.22	.34	13:21L	.25	.38
14:15L	.5	.75	13:18L	.22	.33	14:19L	.25	.37
15:14L	.5	.75	13:19L	.23	.33	15:18L	.25	.38
16:13S	---	2.00	14:18L	.22	.33	15:21L	.25	.37
16:21P	1.0	1.35	14:21L	.22	.33	16:13S	2.14	3.57
17:13S	---	2.00	14:23L	.23	.34	16:23L	.25	.38
17:14S	---	2.00	15:22L	.22	.33	16:25L	.25	.37
17:15S	2.0	2.25	16:13L	--	2.00	17:13S	2.14	3.57
17:16S	2.0	2.25	16:17S	.22	.33	17:14S	2.14	3.57
17:20P	1.0	1.35	17:13S	--	2.00	17:15S	2.15	3.57
17:21P	1.0	1.35	17:14S	--	2.00	17:16S	2.14	3.57
18:15S	2.0	2.25	17:15S	2.00	2.25	17:17S	.25	.38
18:16S	2.0	2.25	17:16S	2.00	2.25	18:15S	2.15	3.57
18:20P	1.0	1.35	18:15S	2.00	2.25	18:16S	2.14	3.58
19:19P	1.0	1.35	18:16S	2.00	2.25			
19:20P	1.0	1.35						
20:19P	1.0	1.35						
20:20P	1.0	1.35						
21:18P	1.0	1.35						
21:19P	1.0	1.35						
Total	20.0	31.50	Total	10.00	18.00	Total	17.00	28.00

Wells open at depths greater than 160 feet below sea level could be contaminated by seawater. Under maximum pumpage conditions, the 1-foot contour line also almost reaches the saltwater-freshwater interface line under plans 1 and 2. Under plans 3, 4, and 5, the 2-foot drawdown contour is very close to the interface line. This drawdown could cause the interface to rise approximately 80 feet from its present location to about 120 feet below sea level. Wells near this 2-foot contour line and open to the aquifer below a depth of 120 feet below sea level could be contaminated by seawater.

Anywhere that drawdown occurs, flow of water toward the coast will be reduced or reversed because water will move toward cones of depression surrounding pumping wells. If a cone of depression occurs near the transition zone, saltwater could be drawn laterally toward the center of the cone. One must keep in mind that figures 48 through 67 depict only those drawdowns caused by the proposed increased pumpage. In order to determine actual drawdowns caused by total pumpage in the county, these drawdowns would have to be superimposed on those drawdowns caused by other pumpage.

development plans for Pasco County

P, Central Pasco well field; S; Starkey well field; R, row; C, column]

Plan 4			Plan 5		
Location node (R:C)	Pumpage		Location node (R:C)	Pumpage	
	Average	Maximum		Average	Maximum
7:18L	0.33	0.50	13:18L	0.33	0.50
8:20L	.33	.50	13:19L	.33	.50
9:22L	.34	.50	14:20L	.34	.50
9:24L	.33	.50	14:21L	.33	.50
10:25L	.33	.50	14:22L	.33	.50
11:23L	.34	.50	15:29L	.34	.50
16:13S	2.14	3.57	16:13S	2.14	3.57
17:13S	2.14	3.57	17:13S	2.14	3.57
17:14S	2.14	3.57	17:14S	2.14	3.57
17:15S	2.15	3.57	17:15S	2.14	3.57
17:16S	2.14	3.57	17:16S	2.14	3.57
18:15S	2.15	3.57	18:15S	2.15	3.57
18:16S	2.14	3.58	18:16S	2.15	3.58
Total	17.00	28.00	Total	17.00	28.00

A water balance was calculated for each of the five ground-water development plans (table 15). Decreased evapotranspiration accounts for nearly all of the water required for each development plan. Reduced springflow is the next largest source of water. Reduced boundary and river inflow are the remaining sources of water. The maximum reduction in ground-water leakage to the rivers is about 1 percent under plans 4 and 5 (maximum pumpage conditions). Most of this 1 ft^3/s is reduced leakage to the Pithlachascotee River, the remainder is to the Anclote River.

To evaluate the potential effects of overall pumpage in Pasco County in 2035, estimates of projected demands on the ground water for agricultural, industrial, rural, and public supply (both for use in Pasco County and for export to the south) were input into the predevelopment model and run to steady state. Estimates for 2035 demands for Pasco County were based on previous discussions of projected ground-water withdrawals. In addition, for modeling purposes, estimates were made of projected demands for water in those parts of Hillsborough, Pinellas, Hernando, and Polk Counties included in the

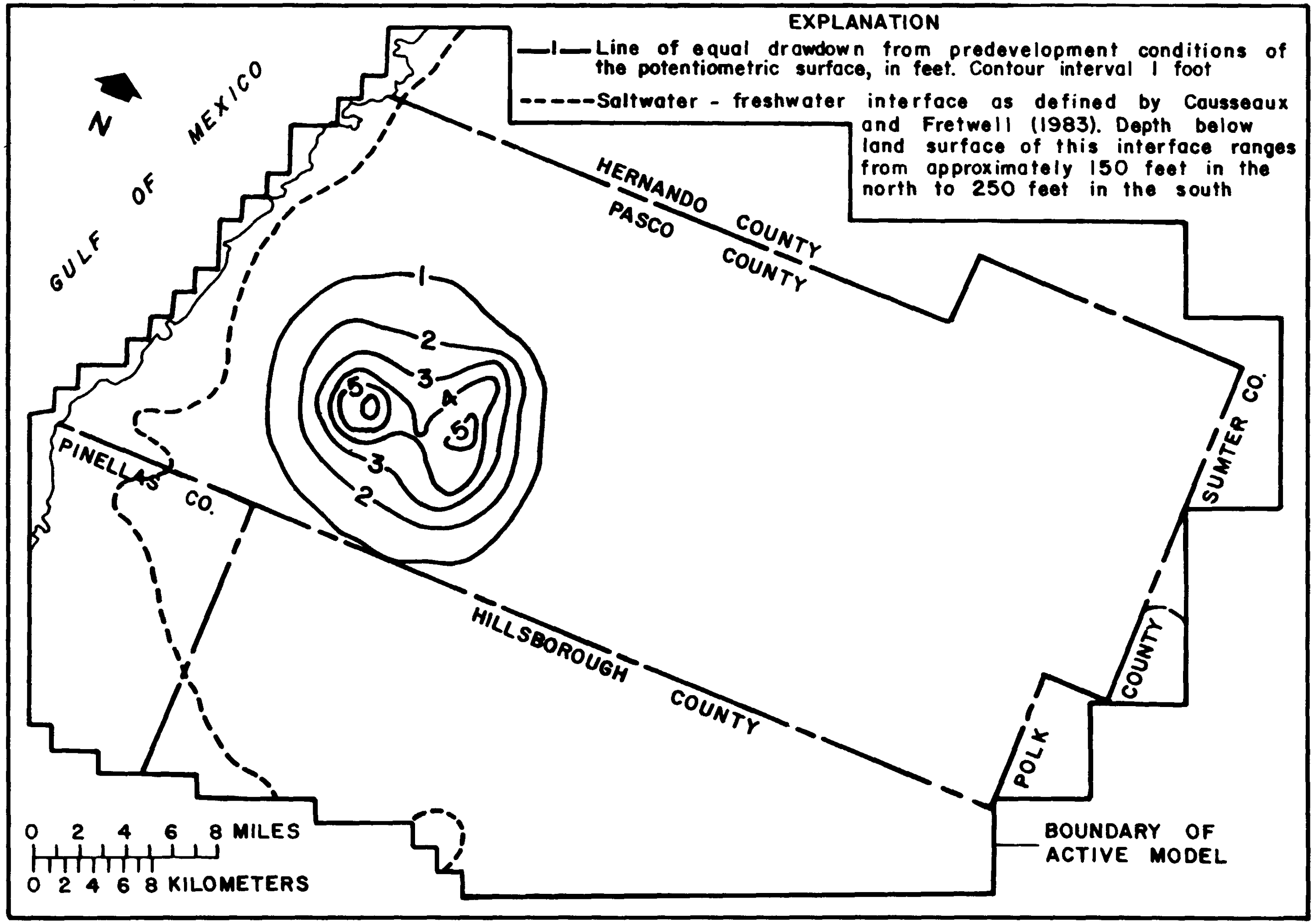


Figure 48.--Estimated drawdown in the potentiometric surface under plan 1 with an average pumping rate of 20 million gallons per day.

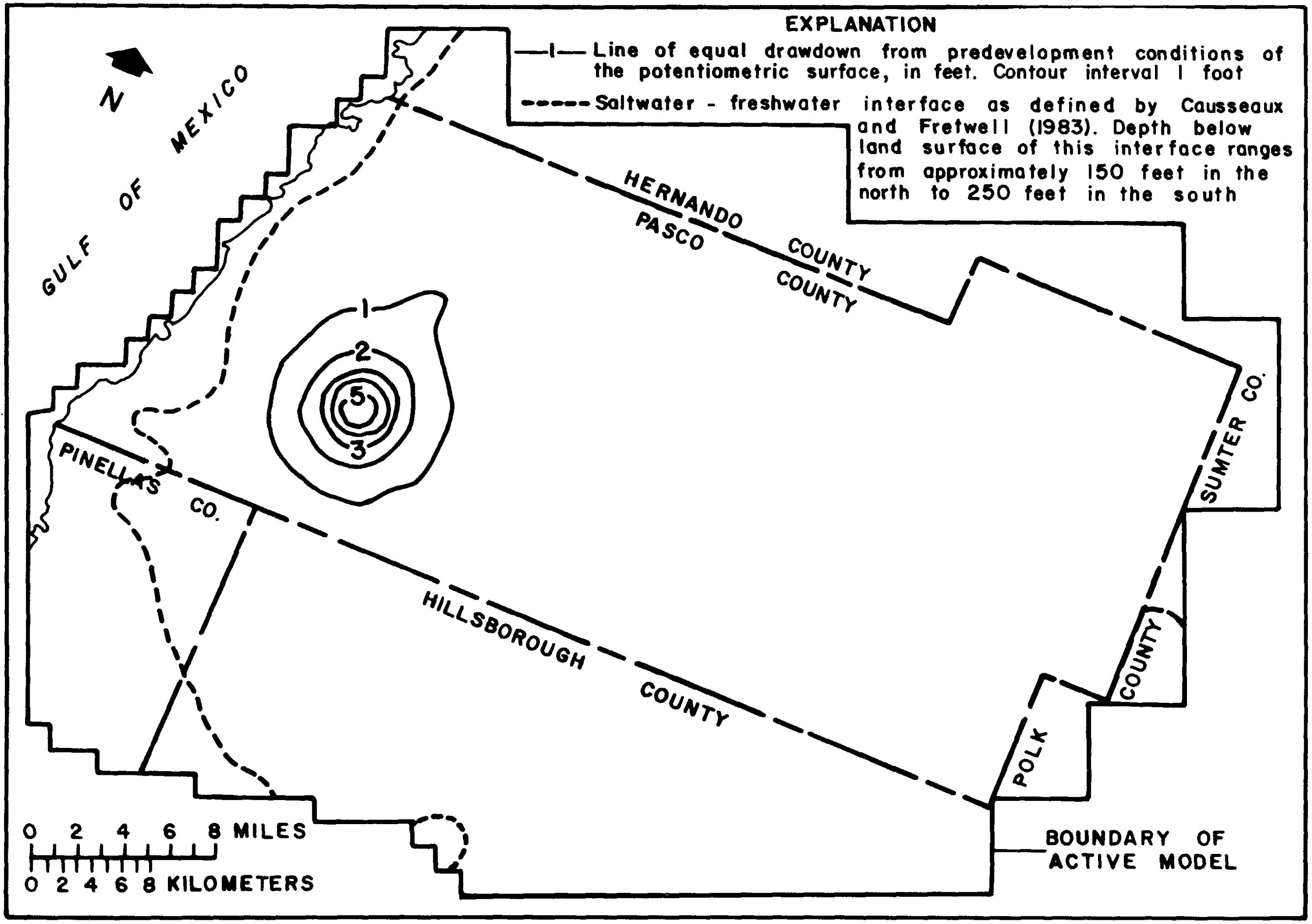


Figure 49.--Estimated drawdown in the potentiometric surface under plan 2 with an average pumping rate of 10 million gallons per day.

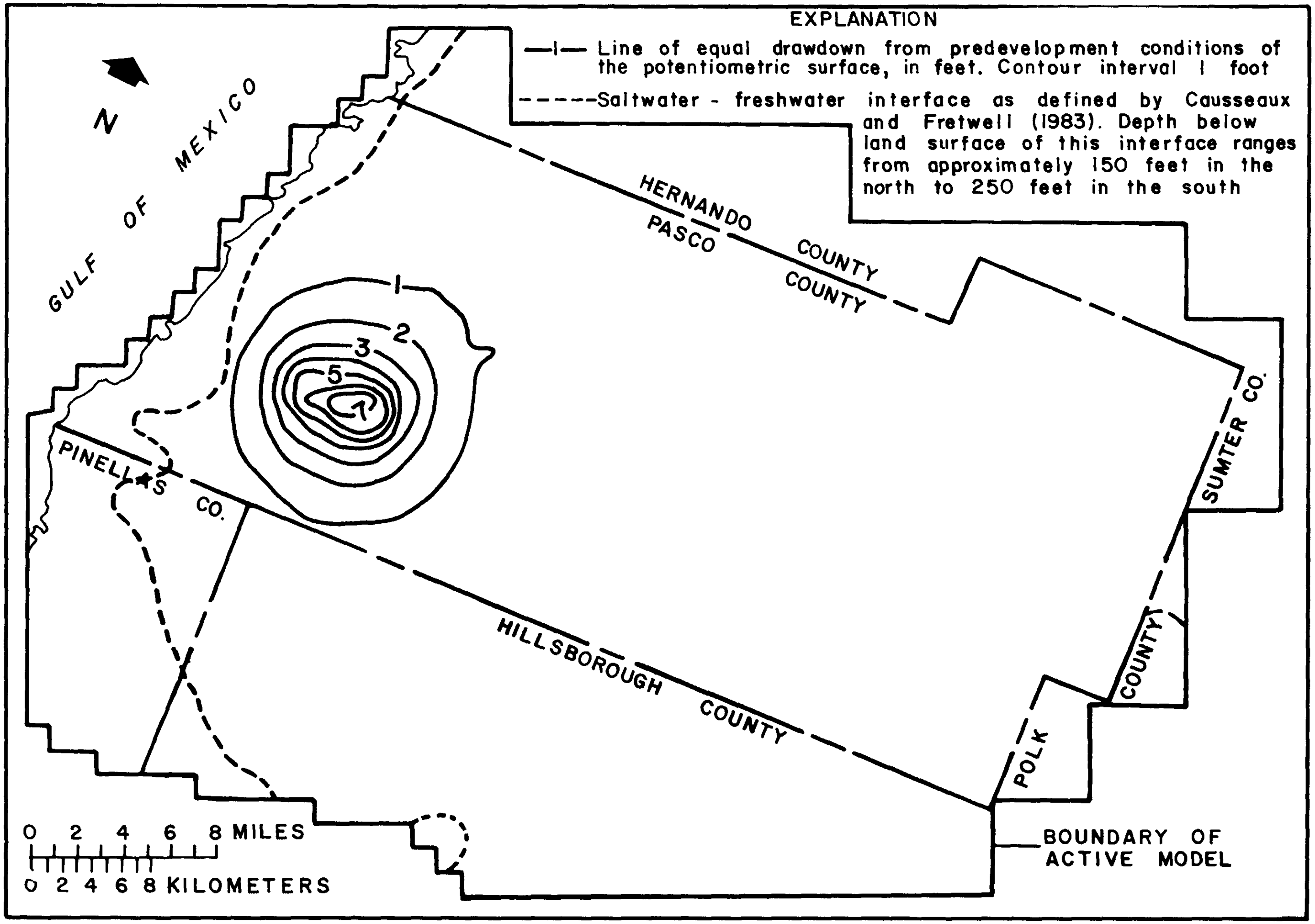


Figure 50.--Estimated drawdown in the potentiometric surface under plan 3 with an average pumping rate of 17 million gallons per day.

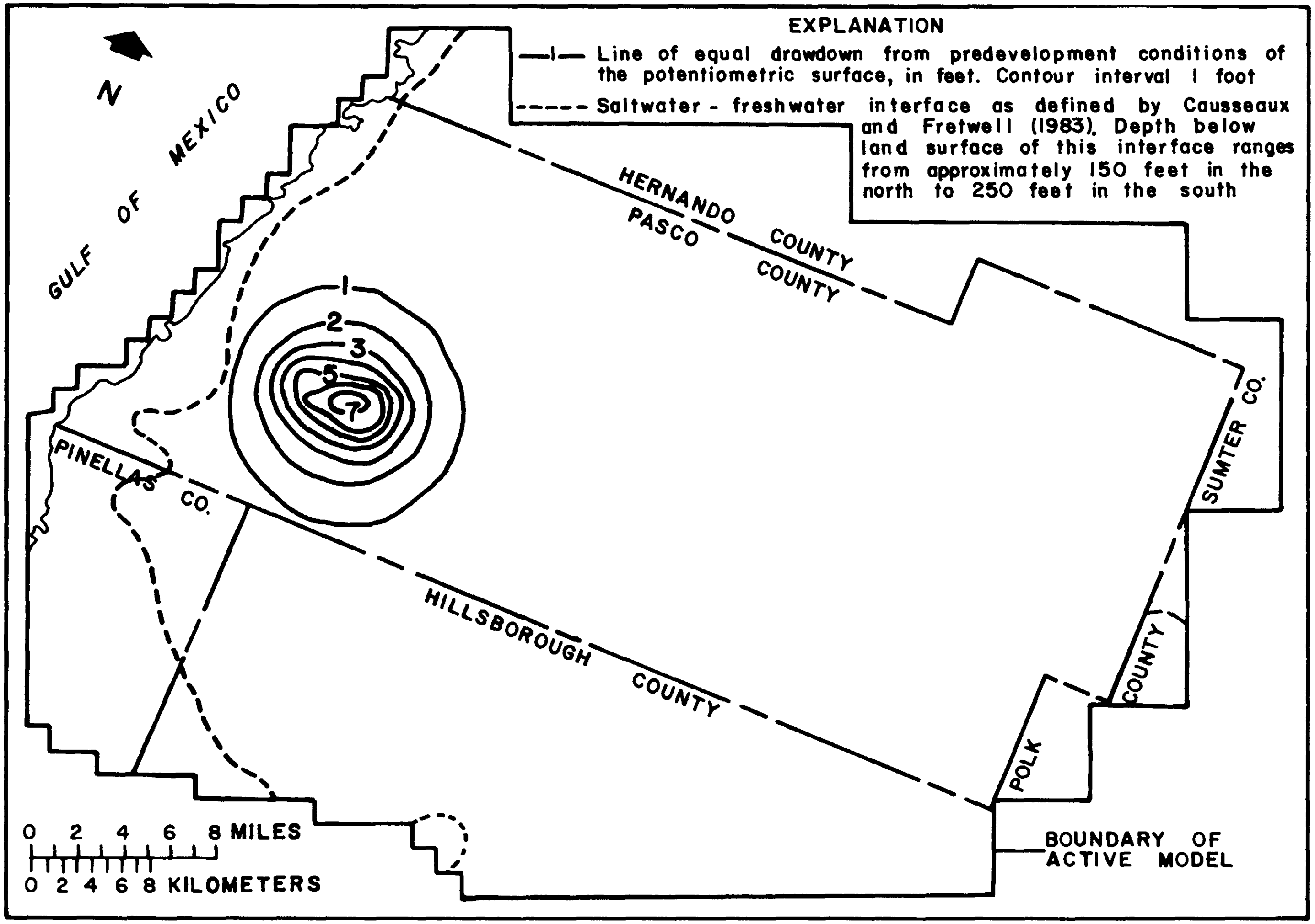


Figure 51.--Estimated drawdown in the potentiometric surface under plan 4 with an average pumping rate of 17 million gallons per day.

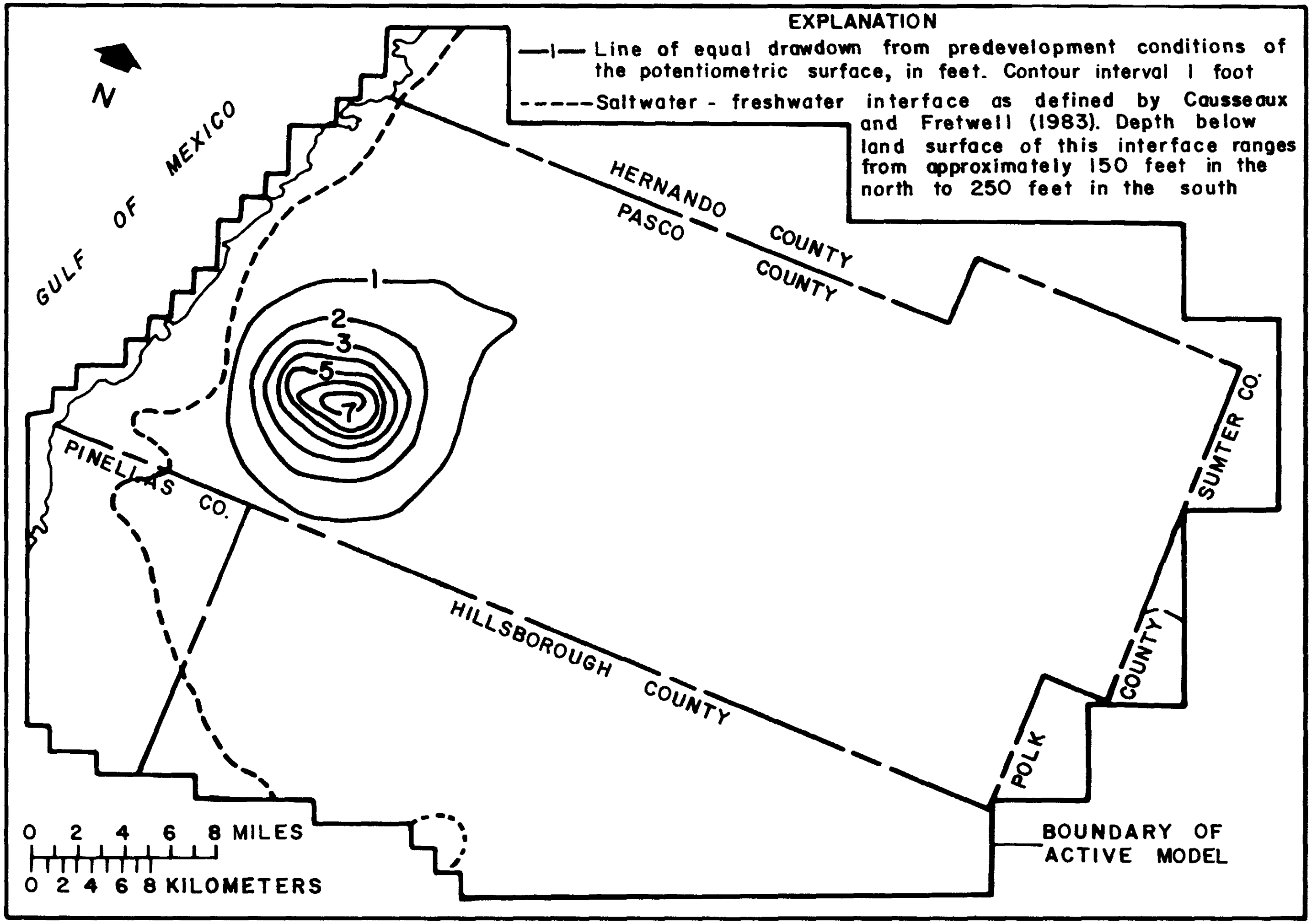


Figure 52.--Estimated drawdown in the potentiometric surface under plan 5 with an average pumping rate of 17 million gallons per day.

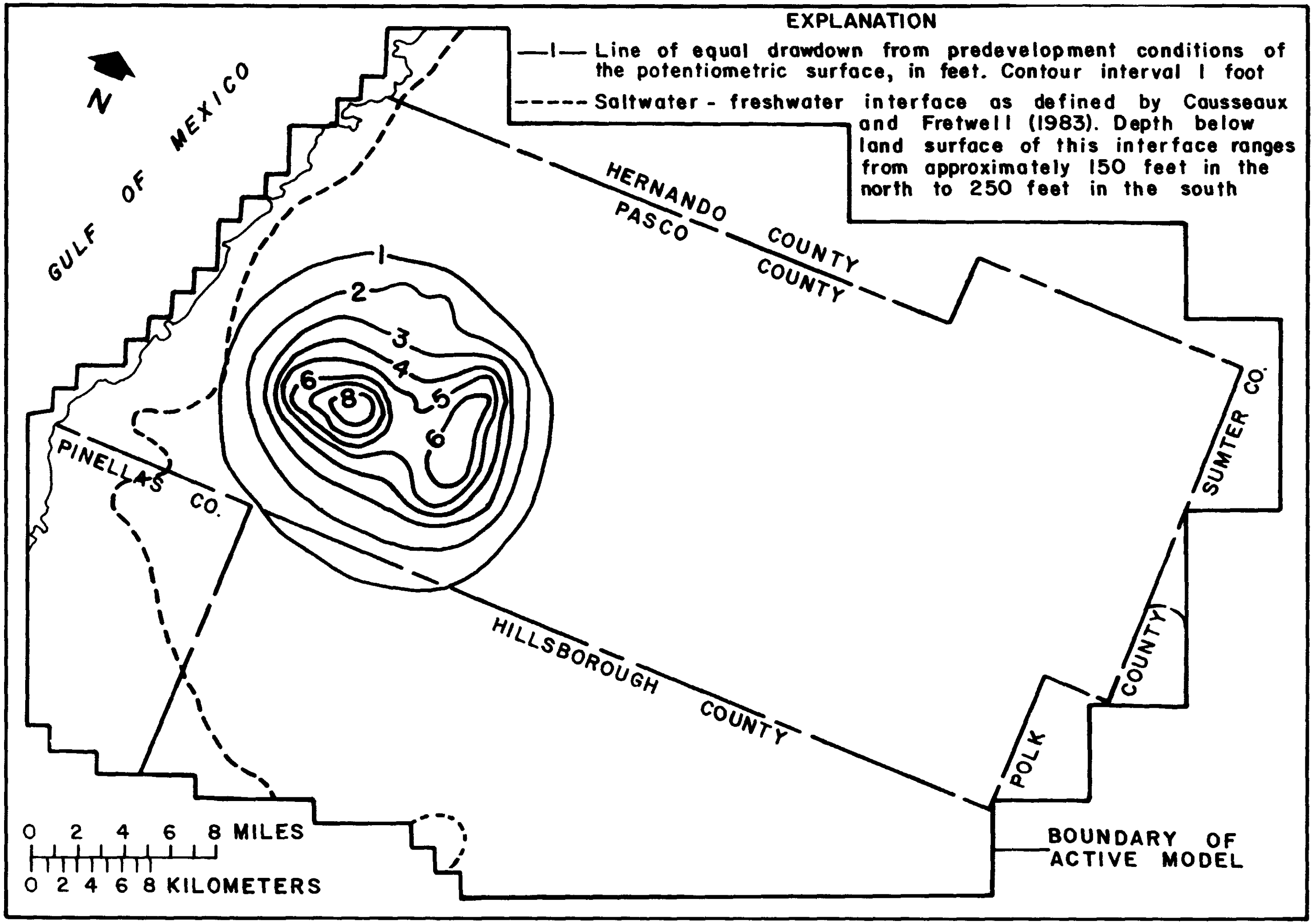


Figure 53.--Estimated drawdown in the potentiometric surface under plan 1 with a maximum pumping rate of 31.5 million gallons per day.

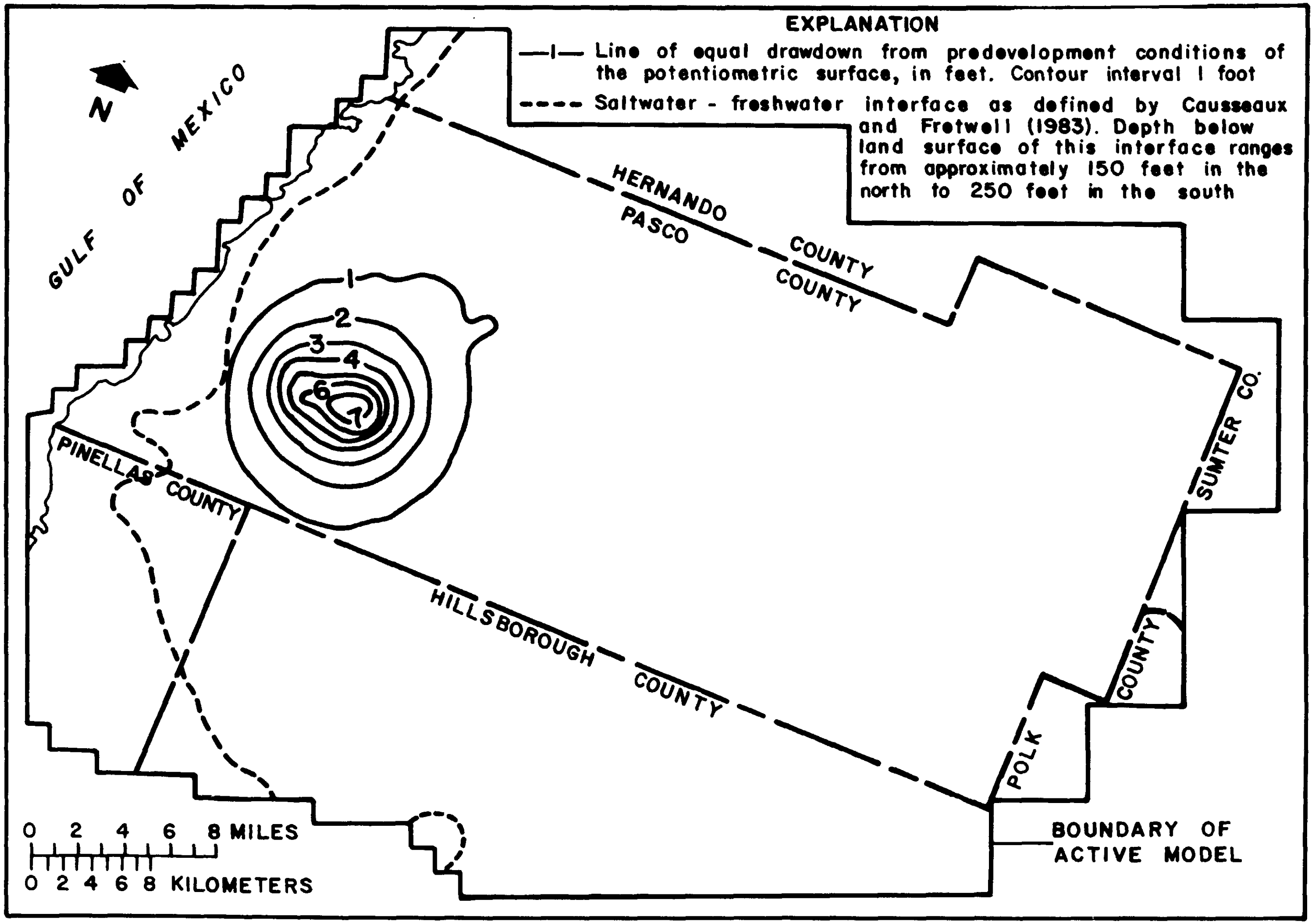


Figure 54.--Estimated drawdown in the potentiometric surface under plan 2 with a maximum pumping rate of 18 million gallons per day.

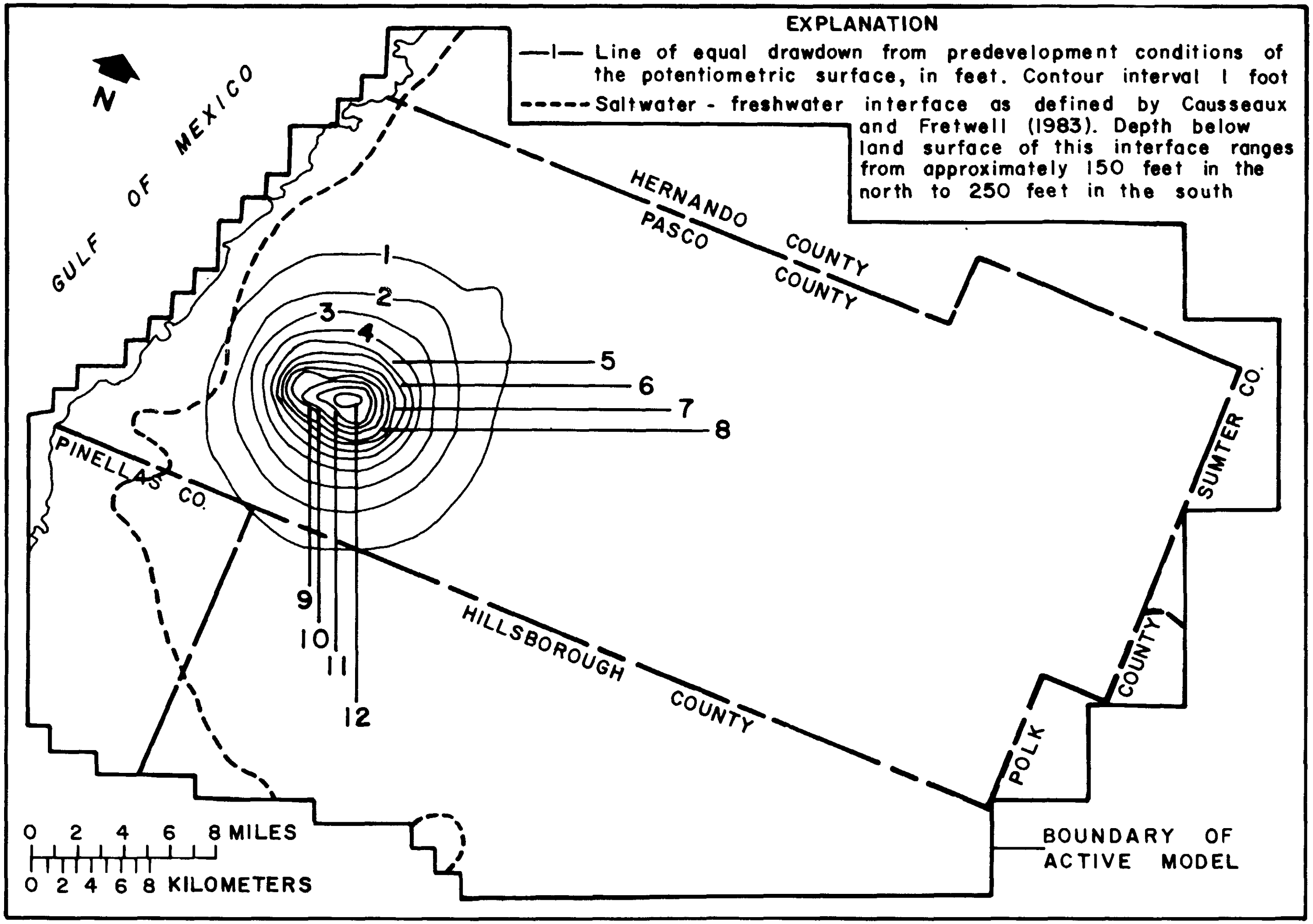


Figure 55.--Estimated drawdown in the potentiometric surface under plan 3 with a maximum pumping rate of 28 million gallons per day.

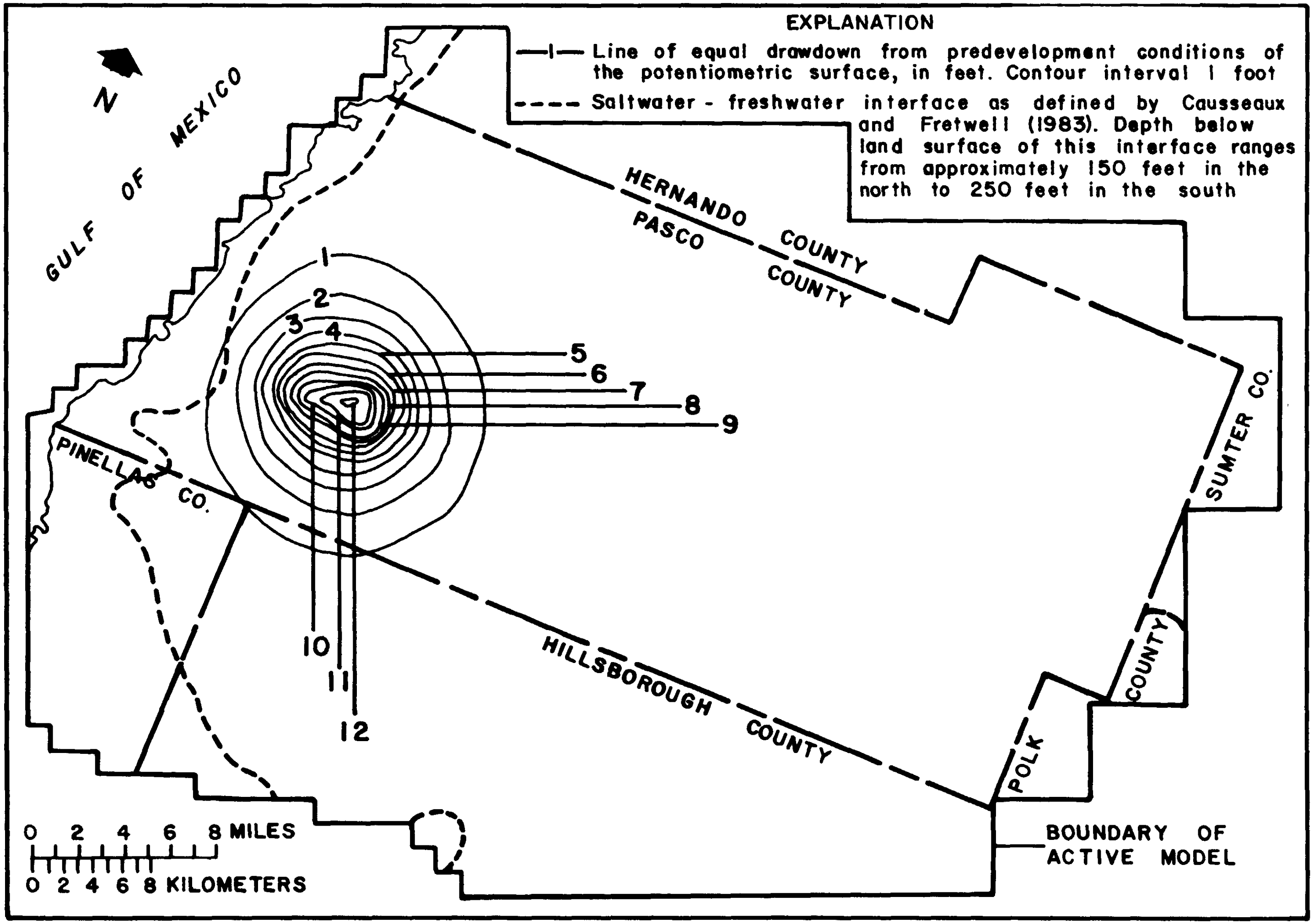


Figure 56.--Estimated drawdown in the potentiometric surface under plan 4 with a maximum pumping rate of 28 million gallons per day.

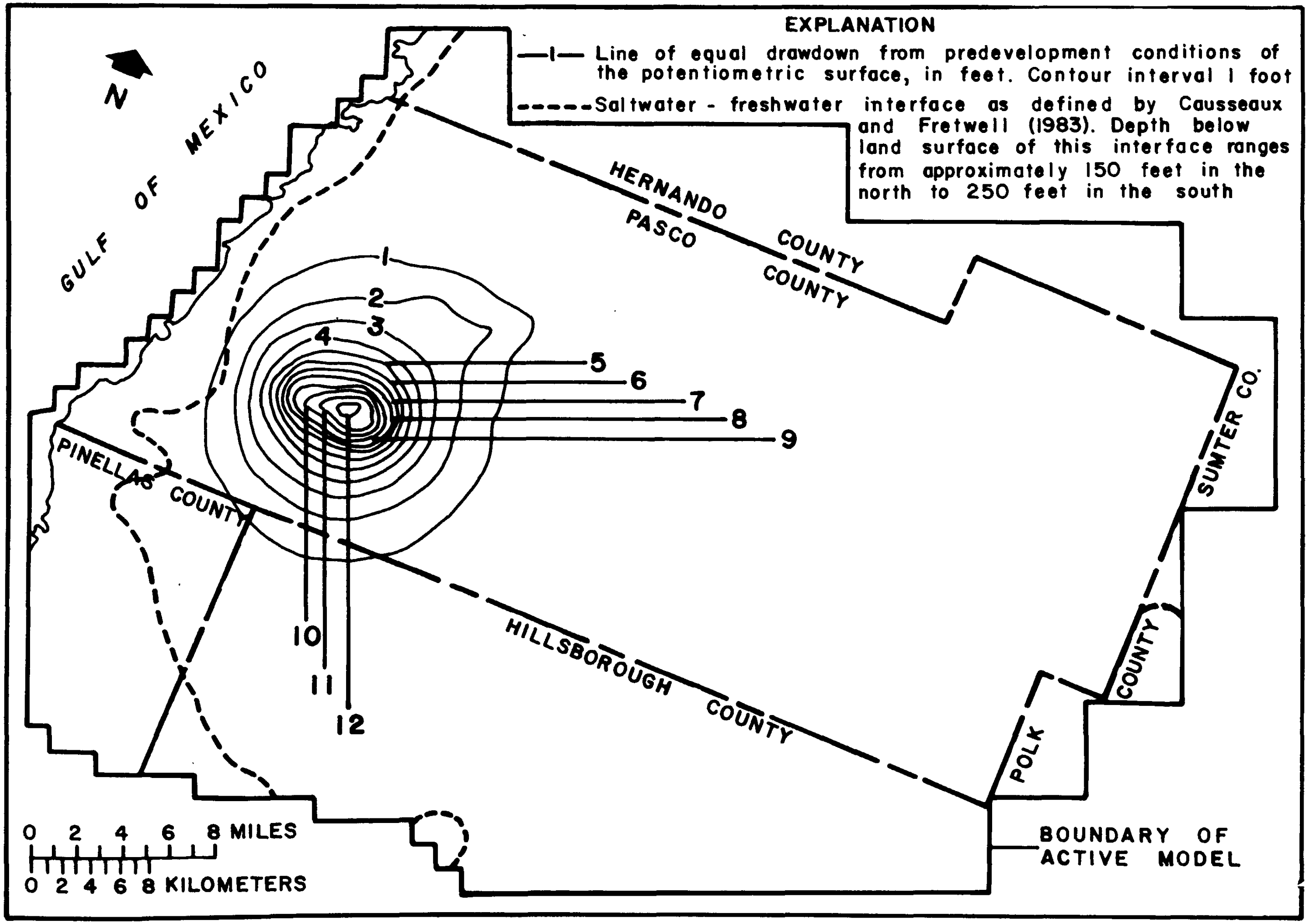


Figure 57.--Estimated drawdown in the potentiometric surface under plan 5 with a maximum pumping rate of 28 million gallons per day.

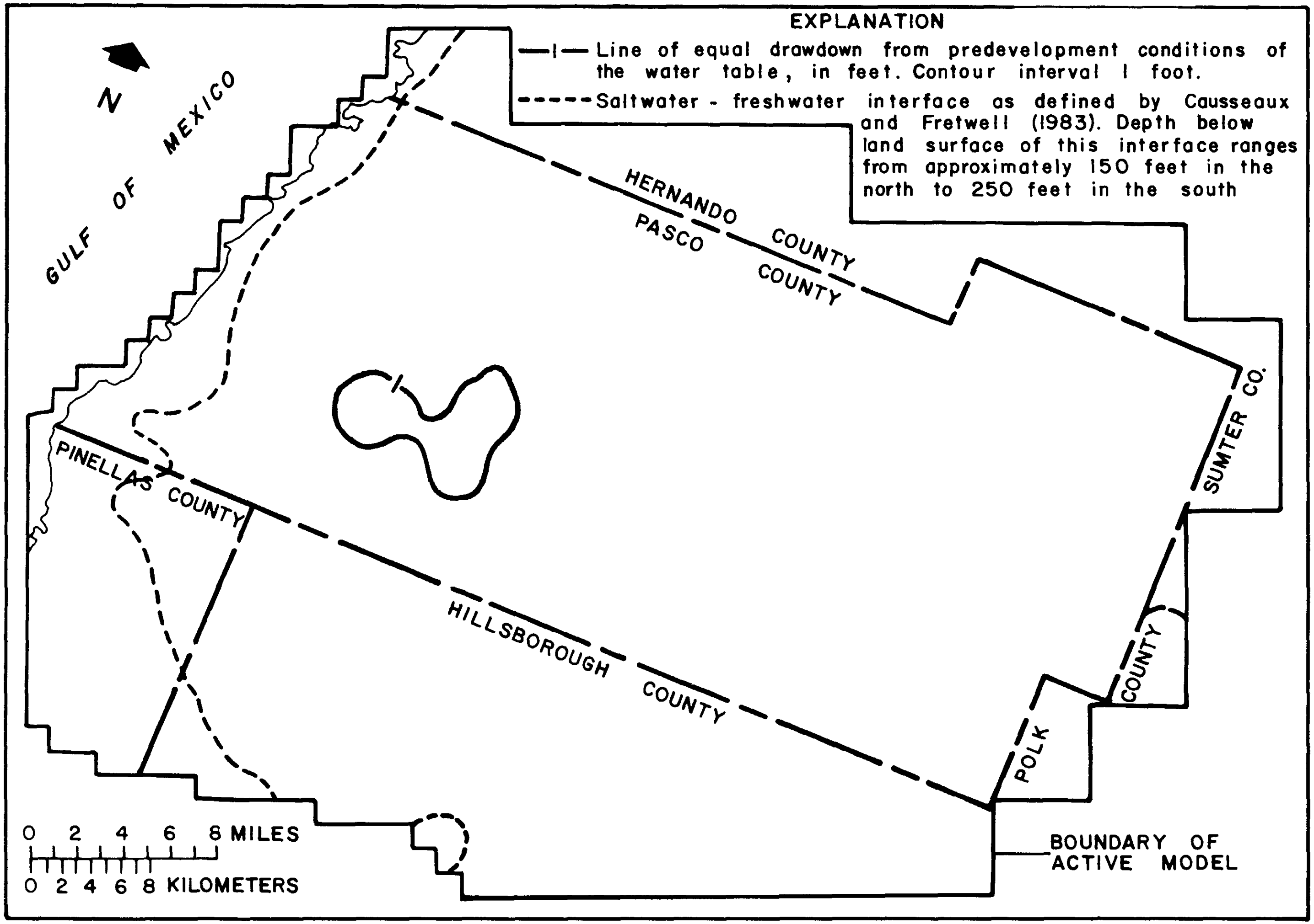


Figure 58.--Estimated drawdown in the water table under plan 1 with an average pumping rate of 20 million gallons per day.

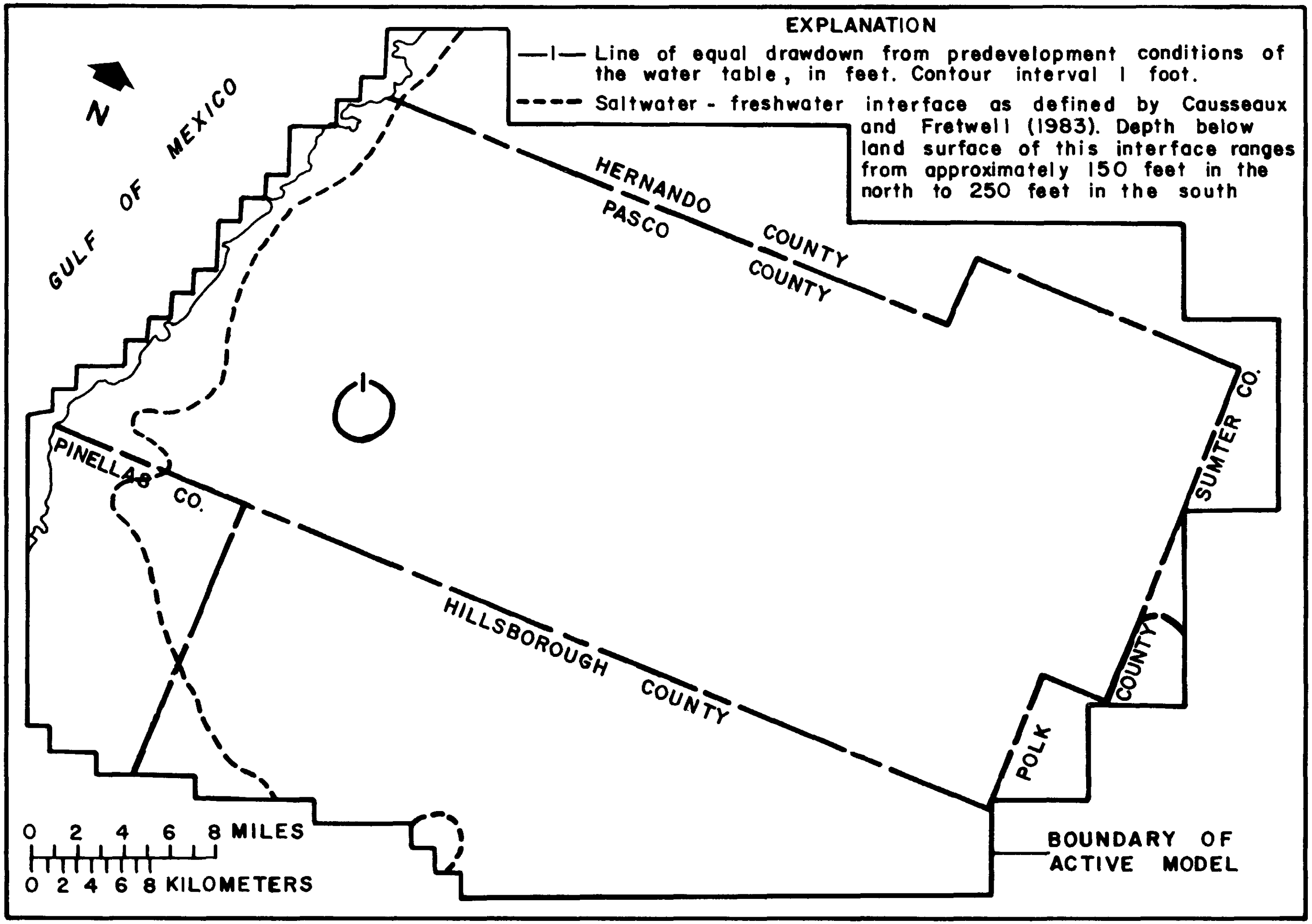


Figure 59.--Estimated drawdown in the water table under plan 2 with an average pumping rate of 10 million gallons per day.

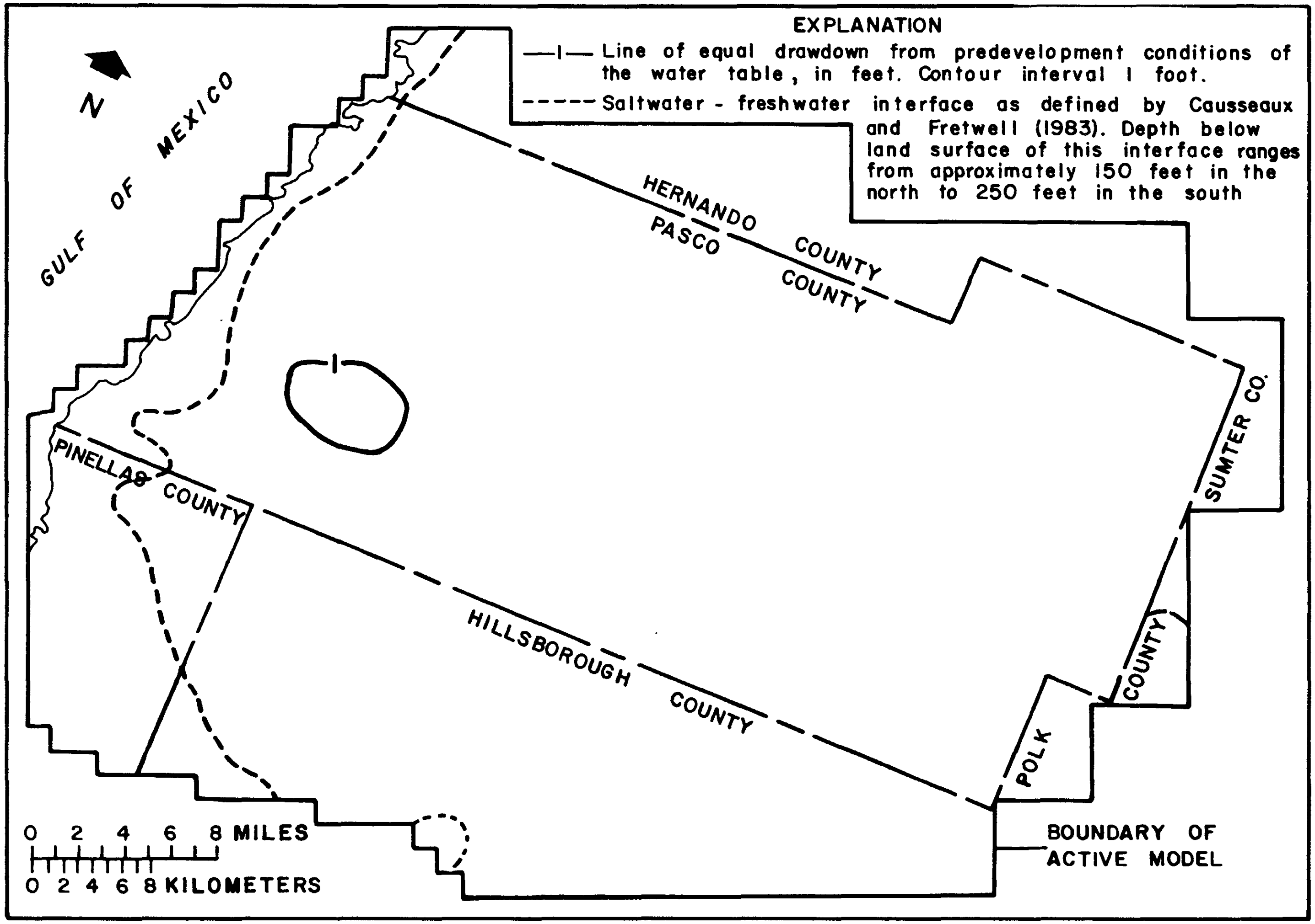


Figure 60.--Estimated drawdown in the water table under plan 3 with an average pumping rate of 17 million gallons per day.

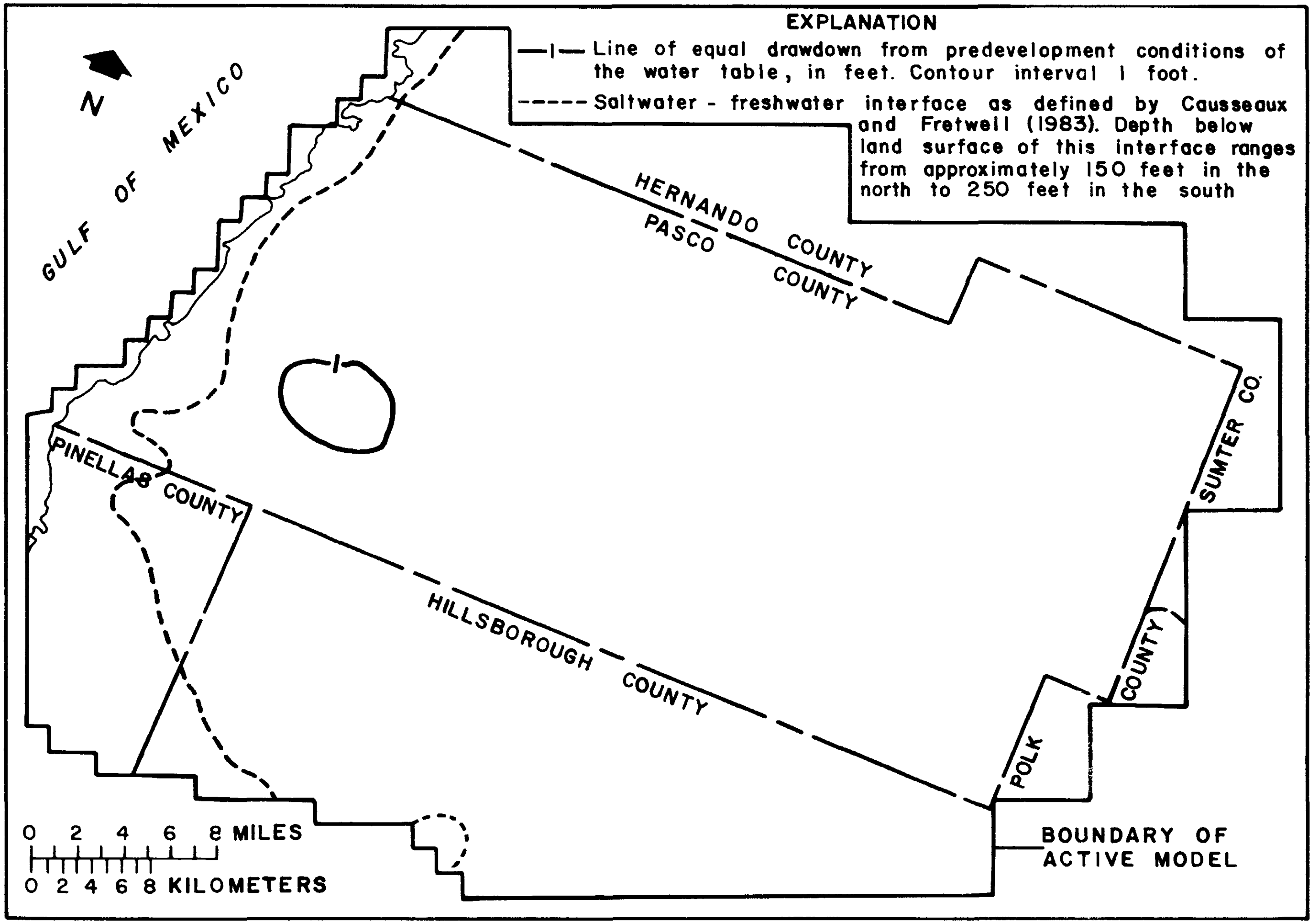


Figure 61.--Estimated drawdown in the water table under plan 4 with an average pumping rate of 17 million gallons per day.

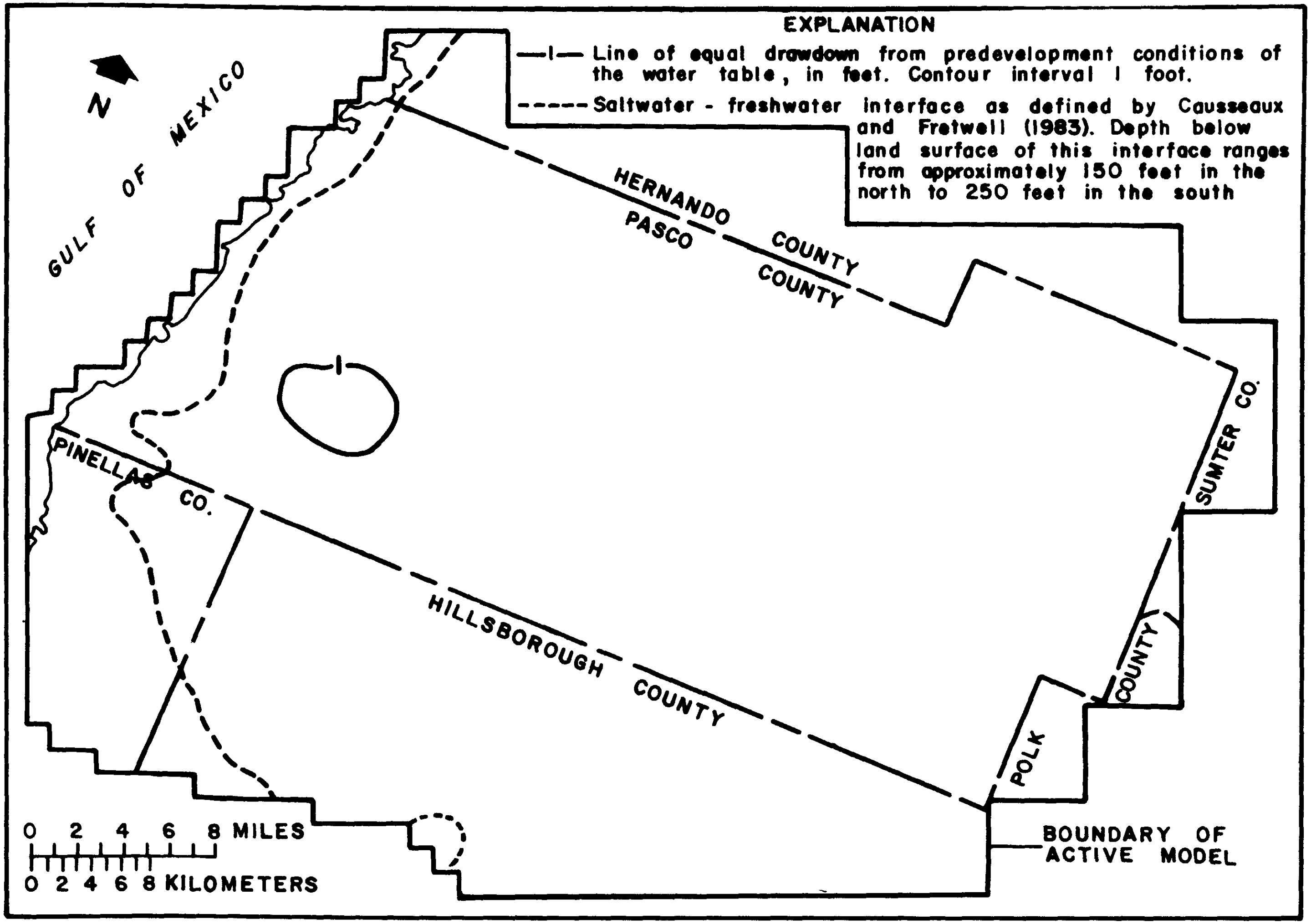


Figure 62.--Estimated drawdown in the water table under plan 5 with an average pumping rate of 17 million gallons per day.

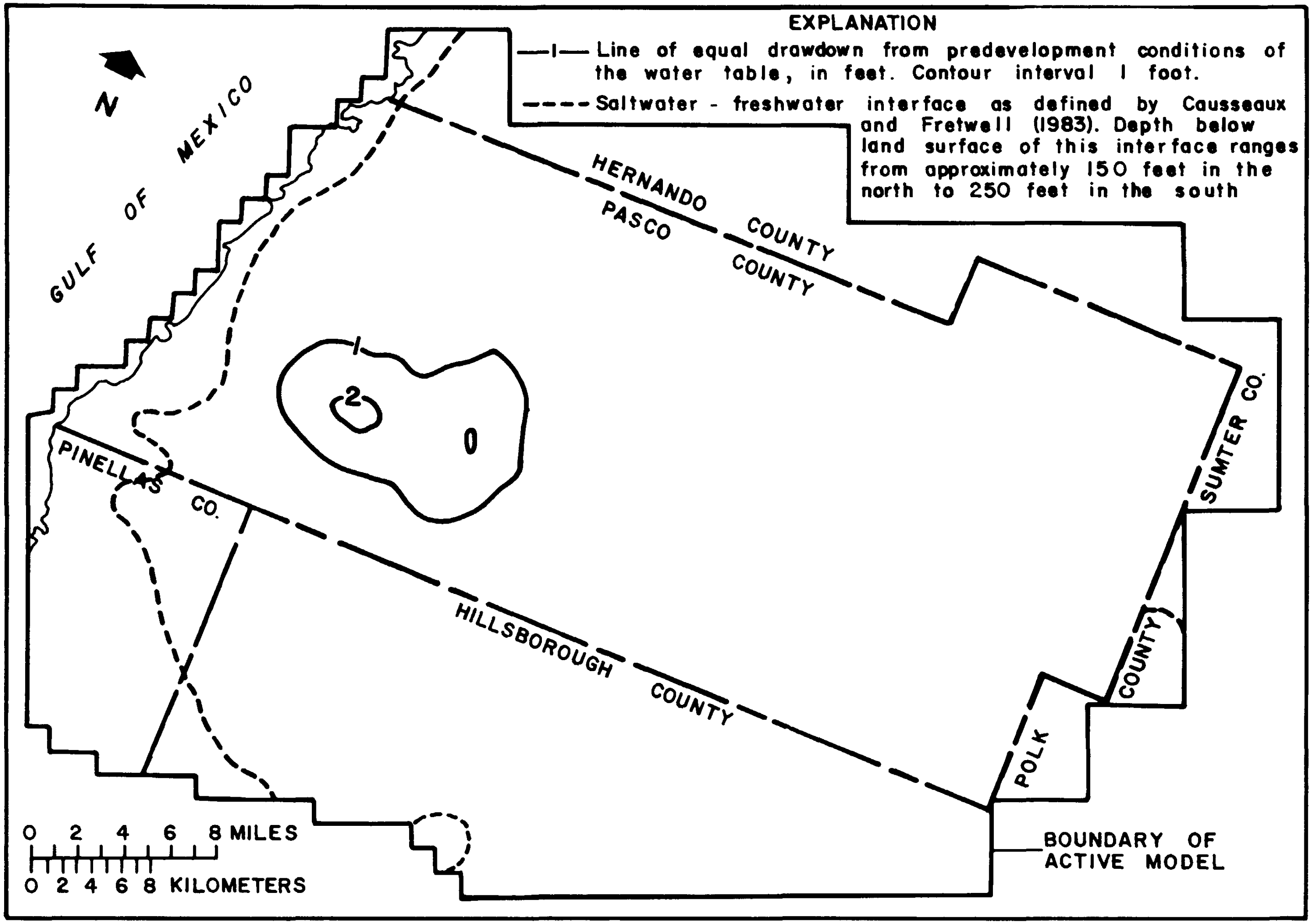


Figure 63.--Estimated drawdown in the water table under plan 1 with a maximum pumping rate of 31.5 million gallons per day.

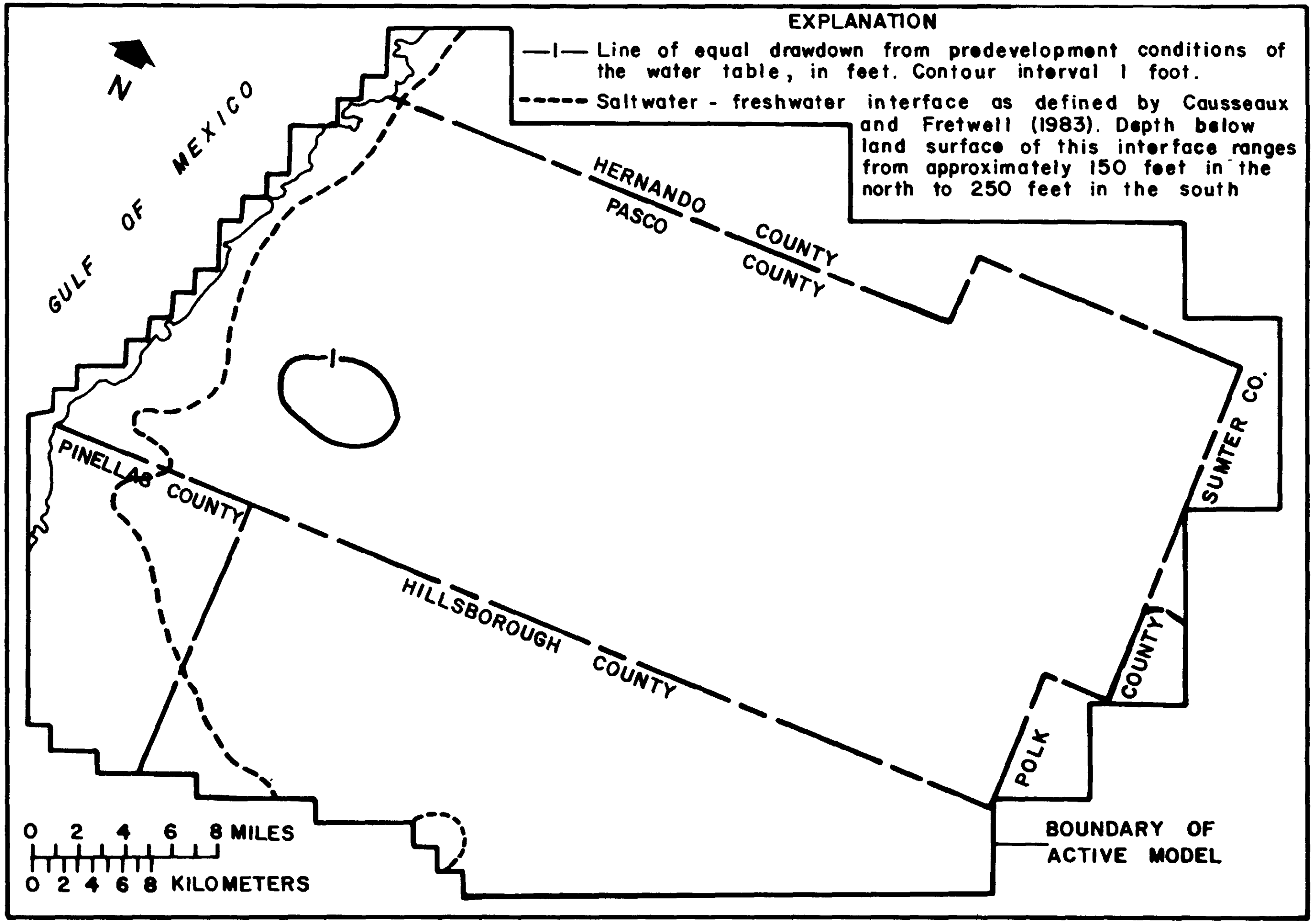


Figure 64.--Estimated drawdown in the water table under plan 2 with a maximum pumping rate of 18 million gallons per day.

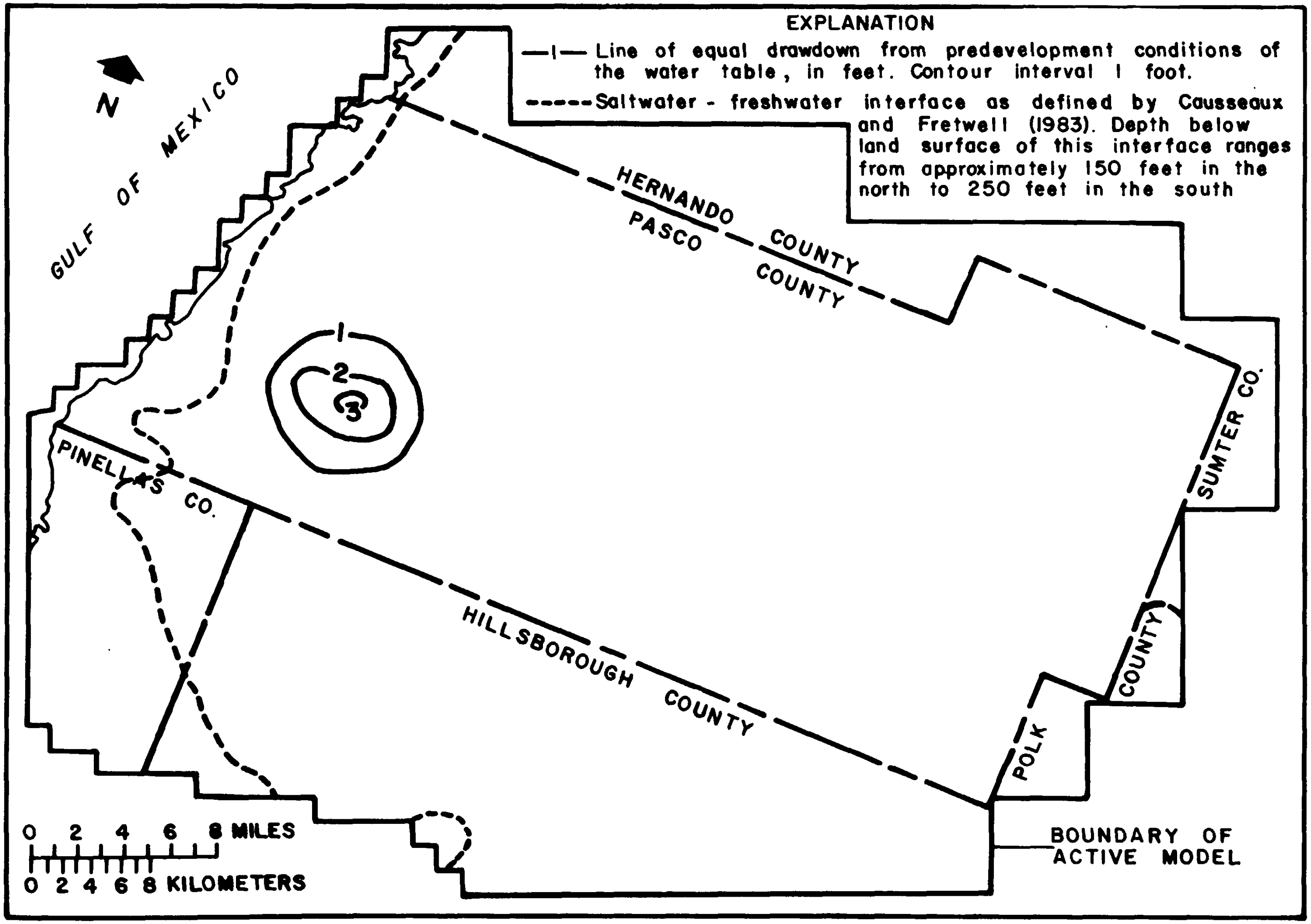


Figure 65.--Estimated drawdown in the water table under plan 3 with a maximum pumping rate of 28 million gallons per day.

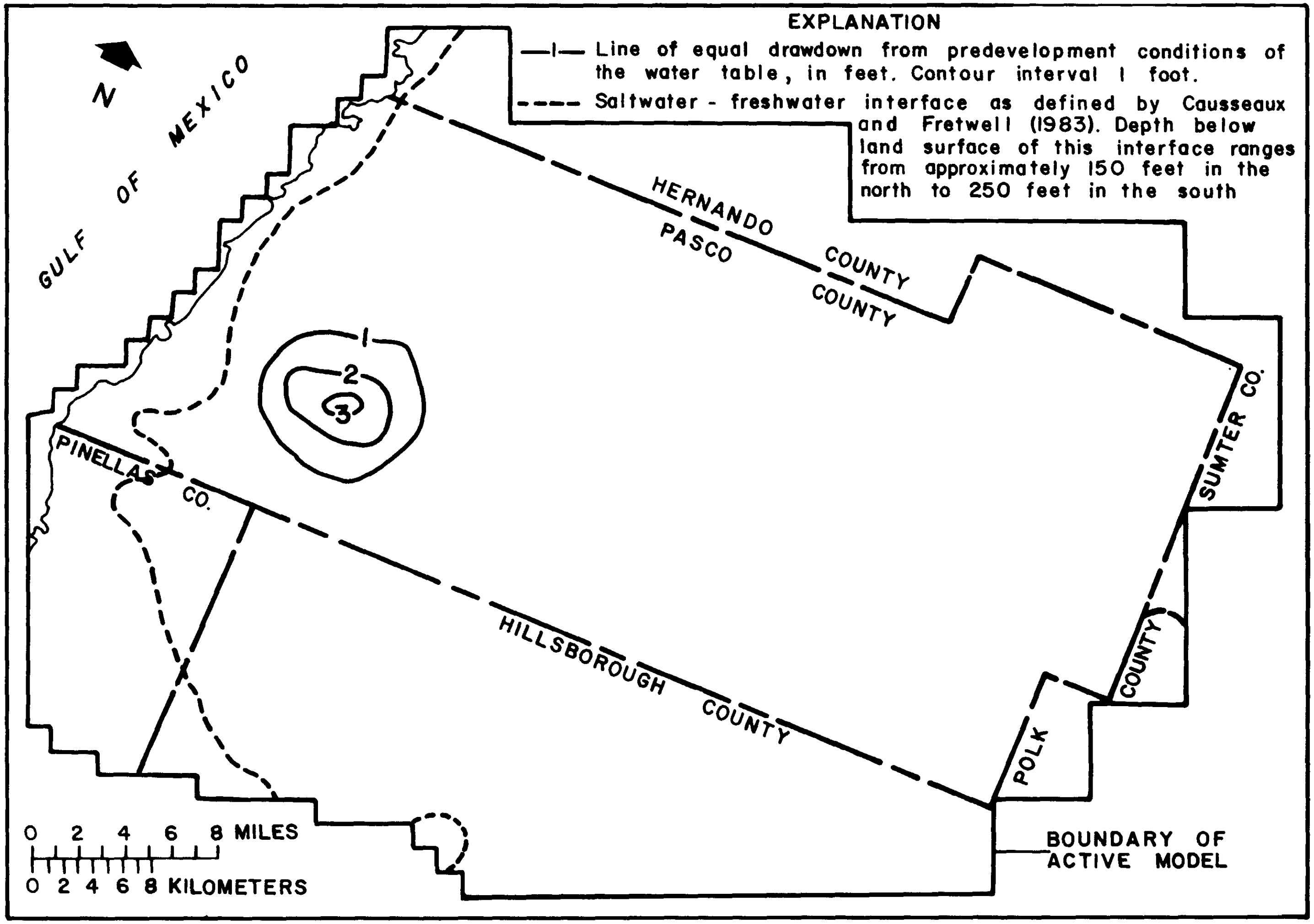


Figure 66.--Estimated drawdown in the water table under plan 4 with a maximum pumping rate of 28 million gallons per day.

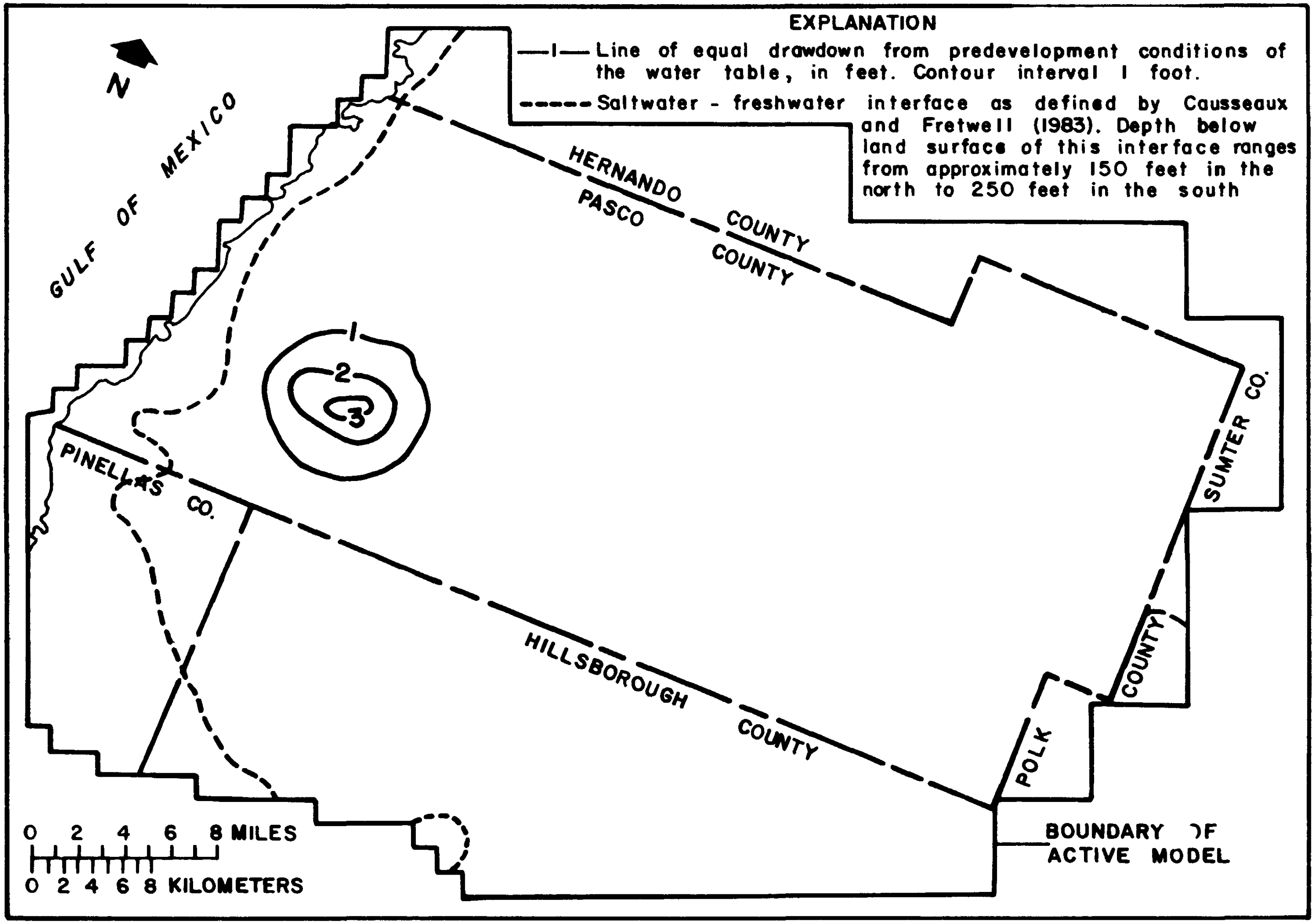


Figure 67.--Estimated drawdown in the water table under plan 5 with a maximum pumping rate of 28 million gallons per day.

Table 14.--Drawdown in the potentiometric surface and water table in response to pumping plans

[Mgal/d, million gallons per day]

Plan No.		Total pumpage (Mgal/d)	Potentiometric surface[1] Maximum drawdown[3] (feet)	Potentiometric surface[1] Radius of influence[4] (miles)	Water table[2] Maximum drawdown[3] (feet)	Water table[2] Radius of influence[4] (miles)
1	Average	20	6	6.40	1	3.60
1	Maximum	31.5	8	7.25	2	5.40
2	Average	10	5	4.75	1	1.20
2	Maximum	18	7	6.10	1	2.50
3	Average	17	7	5.70	1	2.60
3	Maximum	28	12	7.00	3	3.50
4	Average	17	7	5.00	1	2.50
4	Maximum	28	12	6.20	3	3.40
5	Average	17	7	6.50	1	2.51
5	Maximum	28	12	7.25	3	3.49

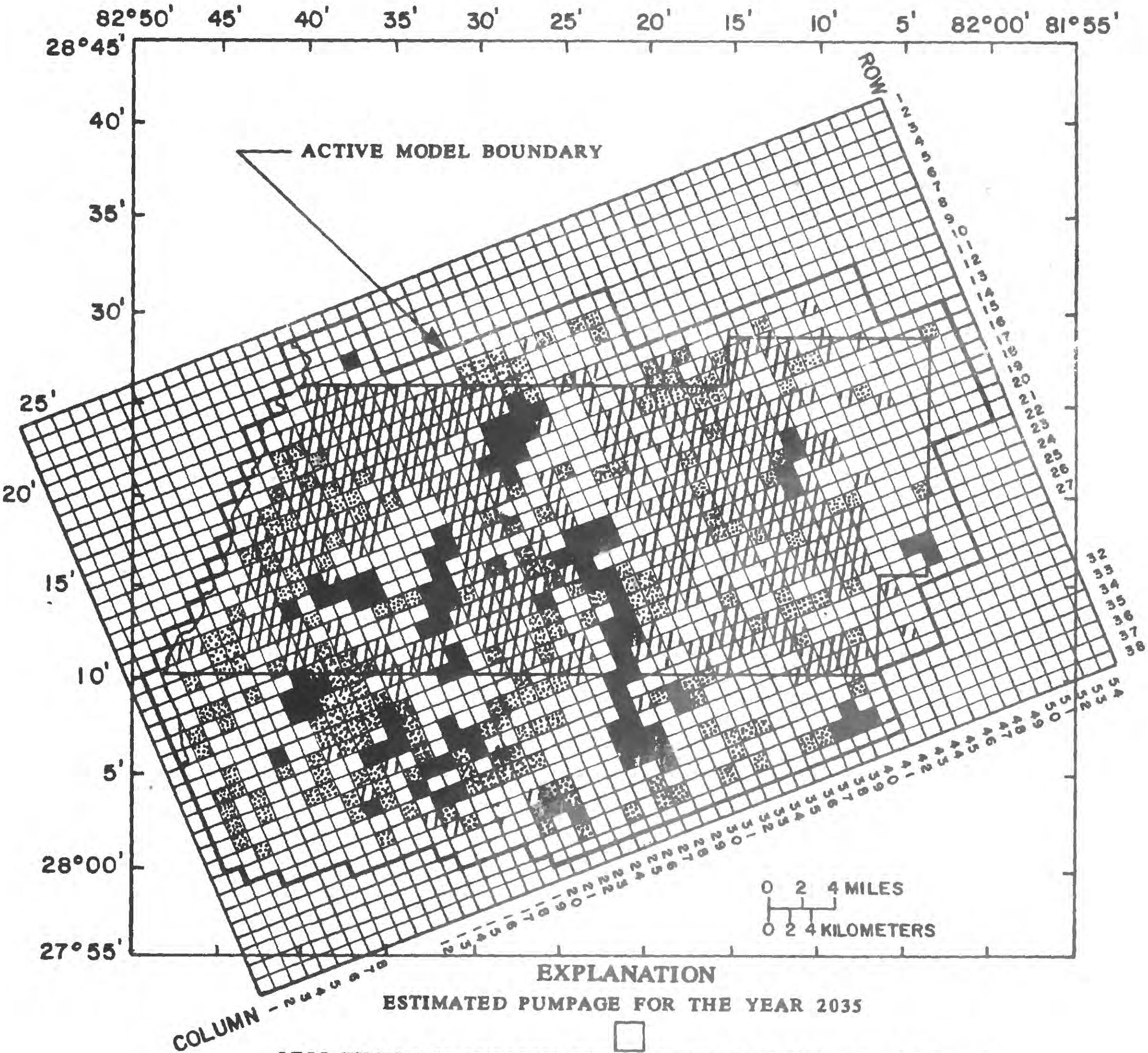
[1]Upper Floridan aquifer.
[2]Surficial aquifer.
[3]Average over 1 mi^2.
[4]Where drawdown is >1 foot.

model. Small areas of Sumter County that are within the model area have little withdrawal at the present time and little change is expected.

Almost all water withdrawn in Pinellas County is in the modeled area; therefore, the total amount of projected water to be withdrawn in Pinellas County is input into the model in Pinellas County. Much of the anticipated public-supply water needs for Pinellas County will be met by increased withdrawal from well fields in Pasco and Hillsborough Counties. It was assumed for purposes of this model that about 34 percent of the ground-water demands for Hillsborough County will be withdrawn from within the modeled part of the county. Additional water needed for Pinellas County from Hillsborough County was also withdrawn in the modeled part of Hillsborough County.

About 8 Mgal/d of water is estimated to be withdrawn from the Upper Floridan aquifer in that part of Hernando County within the modeled area. Withdrawals from the Upper Floridan aquifer in that part of Polk County within the modeled area are for mining and agriculture and are estimated to be about 3 Mgal/d. Table 16 is a list of anticipated ground-water needs for 2035 by county and simulated amounts withdrawn from each county to meet these needs.

The maximum rate for plan 1 was used in the overall predictive model to represent a part of the public-supply demand. A recharge of 10 percent below normal also was used to depict drier than average conditions. Figure 68 shows



EXPLANATION

ESTIMATED PUMPAGE FOR THE YEAR 2035

LESS THAN 0.01 MILLION GALLONS PER DAY PER SQUARE MILE

0.01 – 0.09 MILLION GALLONS PER DAY PER SQUARE MILE

0.10 – 0.99 MILLION GALLONS PER DAY PER SQUARE MILE

GREATER THAN 0.99 MILLION GALLONS PER DAY PER SQUARE MILE

Figure 68.--Areal projected withdrawal rates for 2035.

Table 15.--Summary of water balance simulated by

[ft^3/s, cubic feet per second; Mgal/d, million gallons per

	Inflow		
	Recharge (R) (ft^3/s)	Boundary inflow (BI) (ft^3/s)	Leakage from river (RO) (ft^3/s)
Average 1976-77 conditions -----------	1,871.8	258.41	28.60
Predevelopment conditions ------------	2,056.2	241.67	17.87
Projected pumpage for additional public supply to west Pasco County:			
Plan 1 - average ----------------	2,056.2	241.73	17.88
Plan 2 - average ----------------	2,056.2	241.74	17.87
Plan 3 - average ----------------	2,056.2	241.73	17.87
Plan 4 - average ----------------	2,056.2	241.88	17.87
Plan 5 - average ----------------	2,056.2	241.73	17.87
Plan 1 - maximum ----------------	2,056.2	241.76	17.88
Plan 2 - maximum ----------------	2,056.2	241.78	17.88
Plan 3 - maximum ----------------	2,056.2	241.76	17.88
Plan 4 - maximum ----------------	2,056.2	242.00	17.88
Plan 5 - maximum ----------------	2,056.2	241.77	17.88
Projected pumpage 2035 incorporating Plan 1 maximum pumpage and rainfall 10 percent below normal -------------	1,871.8	273.43	30.53

the distribution of estimated withdrawal rates for 2035 for each node of the flow model. The projected withdrawal for the modeled area is 381.5 Mgal/d, which represents an increase of 100 percent between 1977 and 2035.

Figure 69 shows the estimated differences in the potentiometric surface of the Upper Floridan aquifer between 1976-77 and 2035. Generally, the potentiometric surface has decreased in elevation in the west and increased in the east, which reflects an increase in well-field pumpage in the west and a slight decrease in agricultural pumpage in the east. The average 2035 potentiometric surface ranges from almost 8 feet higher (St. Leo area) to almost 21 feet lower (Cypress Creek well-field area) than the average 1976-77 potentiometric surface.

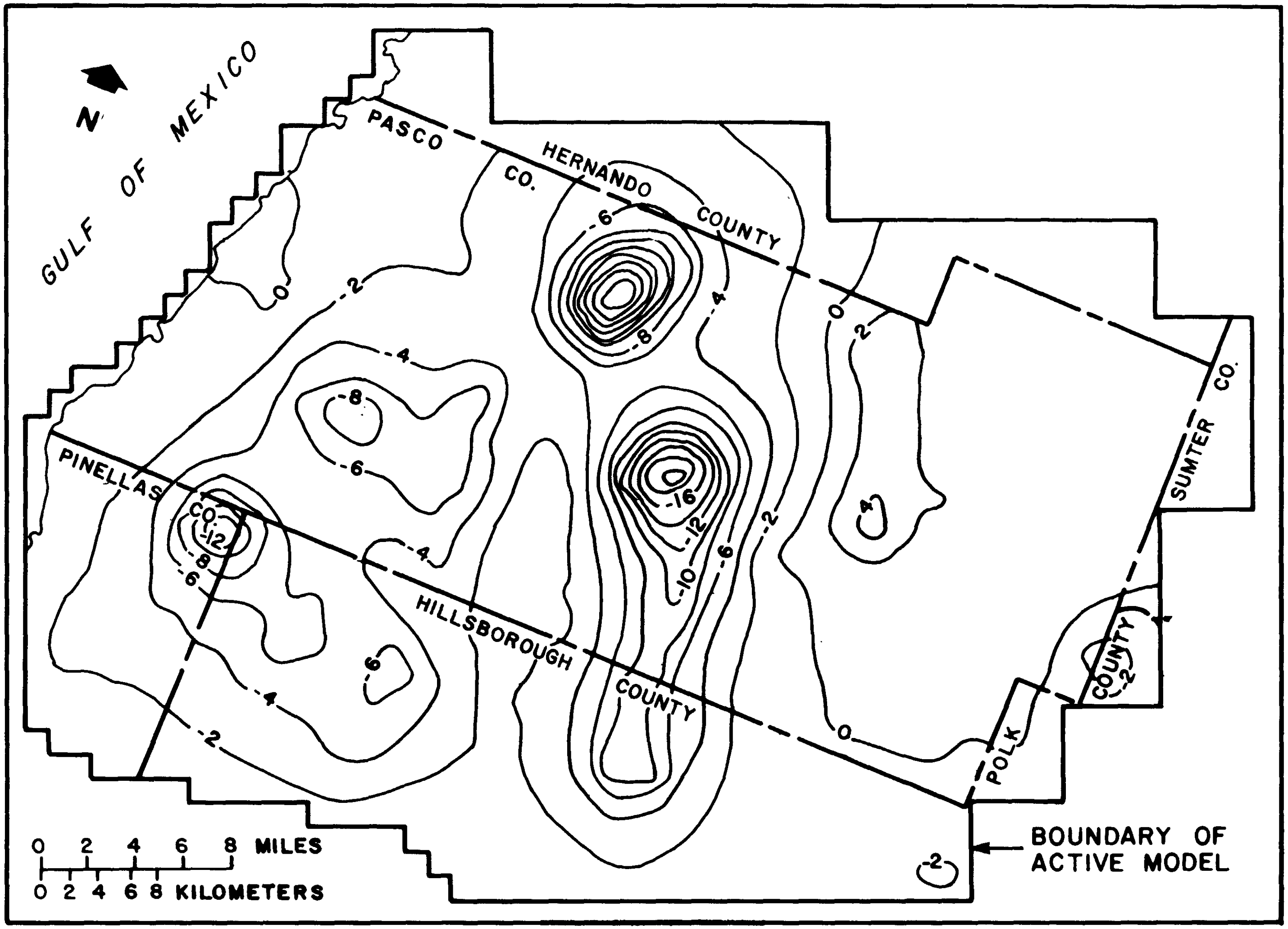
A decline in the potentiometric surface will potentially induce leakage from the surficial aquifer to the Upper Floridan aquifer in areas where the potentiometric surface is below the water table. This could be detrimental where little surficial material lies above the Upper Floridan aquifer to filter or impede the flow, and contaminants that might exist at the surface could be drawn into the Upper Floridan aquifer. This potential for the model under varying conditions of pumping

day; water balance: R + RO + BI = ET + RI + BO + S + W]

Outflow				
ET from water table (ET) (ft³/s)	Leakage to river (RI) (ft³/s)	Boundary outflow (BO) (ft³/s)	Spring outflow (S) (ft³/s)	Well discharge (W) (ft³/s)
1,166.9	131.20	495.33	68.92	296.37 (191.21 Mgal/d)
1,530.5	159.86	539.68	85.74	0.0
1,501.6	159.39	539.02	84.75	30.98
1,516.4	159.50	539.11	85.06	15.50
1,507.6	158.85	538.85	84.00	26.33
1,508.9	158.86	537.97	83.70	26.31
1,507.6	158.85	538.82	83.99	26.31
1,486.1	158.72	538.51	83.52	48.76
1,506.6	158.84	538.45	83.98	27.70
1,492.8	158.25	538.33	82.84	43.36
1,494.6	158.25	537.02	82.39	43.34
1,492.8	158.25	538.30	82.82	43.34
941.5	120.16	457.28	64.78	591.98 (381.83 Mgal/d)

contamination is higher at the Cypress Creek well field than at other well fields because of the thinner layer of surficial deposits. The possibility of new sinkholes developing in sinkhole-prone areas also increases when the potentiometric surface is lowered. The potential for sinkhole development is largest at the Cross Bar Ranch well field because it is in an area of likely sinkhole development (Sinclair and others, 1985). Another potential danger of a reduced potentiometric surface is the intrusion of saltwater either through upconing beneath pumped wells where drawdowns are excessive or by lateral intrusion as discussed previously. The potential for upconing seems greatest at the Cross Bar Ranch well field because of the large drawdowns and the fact that the Upper Floridan aquifer is thin there compared to other well field areas. The potential for lateral intrusion is greatest at the more coastal well fields (Starkey and Eldridge-Wilde).

Figure 70 shows the estimated differences in the water table in the surficial aquifer between 1976-77 and 2035. Large drawdowns occur in most of the well-field areas. The largest drawdowns are almost 18 feet in the Cross Bar Ranch well field and almost 14 feet in the Eldridge-Wilde well field. With slight changes in placement of pumpage in the well fields, nodes representing

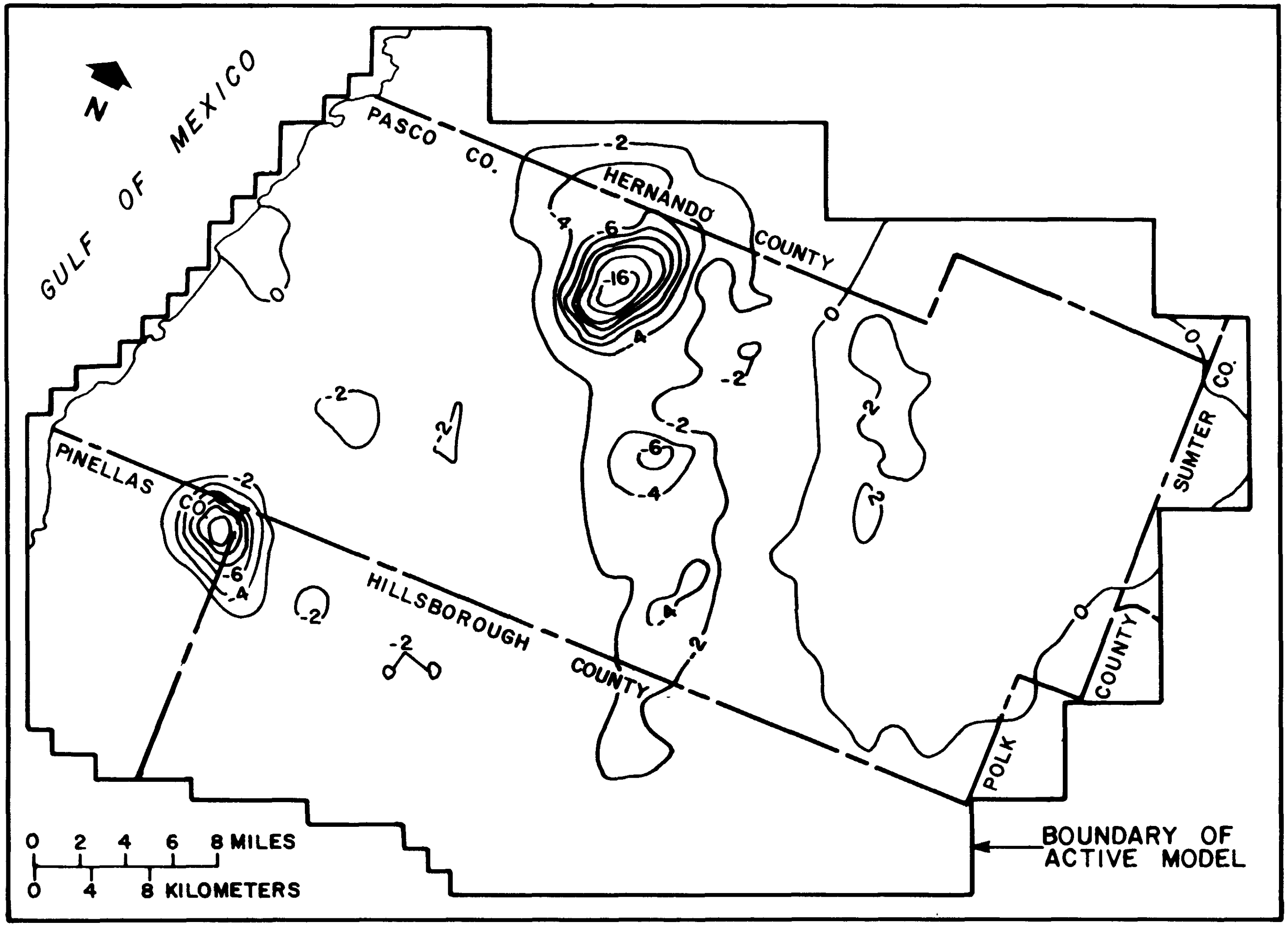


EXPLANATION

-10

LINE OF EQUAL CHANGE, IN FEET, OF THE POTENTIOMETRIC SURFACE FROM 1976-77 TO 2035. Contour interval 2 feet

Figure 69.--Estimated change in the potentiometric surface of the Upper Floridan aquifer between 1976-77 and 2035.



EXPLANATION

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LINE OF EQUAL CHANGE, IN FEET, IN THE WATER TABLE FROM 1976-77 TO 2035. Contour interval 2 feet

Figure 70.--Estimated changes in the water table of the surficial aquifer between 1976-77 and 2035.

Table 16.--Demands for and sources of water in the modeled area, 2035

[Mgal/d, million gallons per day; ft^3/s, cubic feet per second]

	Amount projected for use, in Mgal/d (ft^3/s)		Amount projected to be withdrawn in modeled area, in Mgal/d (ft^3/s)	
Pasco County				
Public supply at 130 gal/d per capita	53.00			
Rural at 100 gal/d per capita	10.20			
Agricultural	20.00			
Industrial	20.00			
Total	103.20	(159.96)	207.19	(321.15)
Pinellas County				
Public supply	167.31	(259.33)		
Rural	3.50	(5.42)		
Agricultural	11.00	(17.05)		
Industrial	.50	(0.78)		
Total	182.31	(282.58	49.19	(76.25)
Hillsborough County				
Public supply	133.12			
Rural	25.60			
Agricultural	71.00			
Industrial	20.00			
Total	249.72	(387.07)		
34 percent of total in modeled area	84.90	(131.60)	114.48	(177.45)
Hernando County				
Total in modeled area	8.15	(12.64)	8.15	(12.64)
Polk County				
Total in modeled area	2.91	(4.51)	2.91	(4.51)
Total	381.47	(591.29)	381.94	(592.00)

both the Cross Bar Ranch and Cypress Creek well fields would go dry, suggesting dewatering of the surficial aquifer in these areas. Water levels increased as much as 4 feet in the Brooksville Ridge area.

One result of a lowered water table (table 15) is the 19-percent reduction in evapotranspiration between 1976-77 and 2035. The lowered water table could be detrimental to current vegetation, and the potential for lowered lake levels exists. The degree to which lake levels will be affected depends largely upon the amount of confining material in the lake bottom. This information is not currently available for most lakes. If no confinement exists, lake levels would mimic the level of the water table.

Leakage to rivers from the aquifers was reduced by 8 percent between 1976-77 and 2035, and leakage from the rivers to the aquifers increased by about 2 percent, which means an overall stream loss of about 13 ft^3/s, representing a 13-percent reduction in average discharge of the rivers.

In 1976-77, more water moved from the aquifers into the Withlacoochee River (2 ft^3/s) than to the aquifers from the river; however, in 2035, about 3 ft^3/s will move to the aquifers from the river. The Hillsborough River showed the greatest change in leakage from the aquifers to the river from 90 to 60 ft^3/s (30 percent). There was a reduction of aquifer leakage of about 1 ft^3/s for each of the other rivers (Pithlachascotee and Anclote). Overall, spring flow was reduced by 6 percent between 1976-77 and 2035 in coastal springs. However, Crystal Springs showed a slight increase in flow. Springs 7 (Unnamed Number 2), 8 (Unnamed 1A and 1B), and 9 (Health Spring) ceased flowing. Springs 7 and 8 were not flowing during the 1976-77 period. Model-boundary inflow and outflow are the other water-balance components. Boundary inflow was reduced by 6 percent and boundary outflow was reduced by 8 percent.

Limitations of Model Application

The Pasco County model is a mathematical representation of the hydrologic system in and around Pasco County. It represents a conceptual model in which various parameters of the system were identified and then simplified to the extent necessary for representation in the digital model. The model offers approximate solutions to differential equations that define the system.

The scale of the model (1 mi^2) is a limiting factor in that it does not allow for the accurate depiction of small scale effects of pumpage within the 1-mi^2 blocks but rather an average effect of pumpage within the block. However, it is probably not possible to accurately simulate ground-water flow at a smaller scale than about 1 mi^2 in this karstic terrain. Sinclair and others (1985) described cavernous openings extending for 100's to 1,000's of feet in length in west-central Florida. The existence of such caverns causes large differences in transmissivity, greatly complicating the head distribution, and may cause turbulent flow near spring orifices. Thus, defining hydrologic parameters at a scale of less than 1 mi^2 is not realistic and simulation (with models that assume equivalent porous media flow such as McDonald-Harbaugh) is not feasible. Results of large amounts of pumpage near a model-grid block boundary also may not be depicted accurately because of averaging within the node. The same is true for springs, which may occur near a model-grid block boundary. The constant-head boundary around the perimeter of the surficial aquifer could lead to errors in heads near the boundary. The constant-head boundary tends to minimize the drawdown near the boundary.

The model does not take into account density differences in water that might occur in the transition zone between freshwater and saltwater along the coast, which could lead to some errors. The model only grossly accounts for changes in evapotranspiration, recharge, and runoff that result from changes in the water table. In the modular model, if nodes are allowed to go dry or flood (for example, water table above land surface, which is realistic), errors in calculation may occur. Values input into the model were based on the best available data; however, much data had to be estimated, which invariably lead to some errors in calculation. Because this model application uses a steady-state solution, it is not time dependent, and time required for heads to reach the computed levels is indeterminate. The model simulates a set of assumed future conditions, and variations from these conditions may occur (for example, development of other sources of water-supply, such as desalinization, rate of population growth different than projected, or rainfall much higher or lower than simulated).

Ideally, the model should represent all characteristics of the hydrologic system. Realistically, it represents a few of the more important characteristics of the system. The model can be used to compute a water balance and to depict regional water-level changes in response to various patterns of pumpage and conditions of recharge.

SUMMARY AND CONCLUSIONS

A hydrologic investigation of Pasco County was initiated in July 1983 (1) to quantify the water resources of the county, (2) to characterize water quality, and (3) to determine the potential effects of future ground-water development on the water resources and determine the potential intrusion of saltwater into the freshwater aquifer. Areas of concern were the effects of development on streamflow, ground-water levels, lake levels, and intrusion of saltwater into the Upper Floridan aquifer.

The Upper Floridan aquifer is the primary source of water in Pasco County for industrial, agricultural, and domestic use. The aquifer is composed of carbonate rock, 700 to 1,050 feet in thickness, that is found near land surface at the coast and as much as 100 feet below land surface in the Brooksville Ridge area of the county. Transmissivity of the Upper Floridan aquifer ranges from 2.0×10^4 ft^2/d in the Green Swamp to 4.8×10^5 ft^2/d in the north-central part of the county. In parts of the county, the Upper Floridan aquifer is overlain by a surficial aquifer of low permeability that is separated from the Upper Floridan aquifer by a clay confining unit. The surficial aquifer, though not a significant aquifer in its own right, is capable of storing large quantities of water for recharge to the Upper Floridan aquifer.

Ground water enters the county through subsurface flow from the Green Swamp area to the east and through local recharge in the potentiometric-surface high area near San Antonio. Water travels radially away from the potentiometric-surface high in all directions to be discharged eventually to the Gulf of Mexico to the west and Tampa Bay to the south. The water moving east off the high then travels north or south through the trough areas near Dade City and Zephyrhills.

As is typical in a karst terrain, surface drainage is poorly defined throughout much of the county; however, four rivers head in or near Pasco County. The Withlacoochee River averages a discharge of about 148 ft^3/s as it enters the county from the east and discharges an average of 353 ft^3/s into Hernando County to the north. The Hillsborough River heads in the southeastern part of Pasco County, and of the river's 257 ft^3/s average discharge that enters Hillsborough County to the south, an average of about 59 ft^3/s is contributed by Crystal Springs. Both the Pithlachascotee and the Anclote Rivers head in the central part of the county, flow toward the Gulf of Mexico, and discharge an average of 31 ft^3/s and 70 ft^3/s, respectively. Much of the flow in each of these rivers is discharge from the Upper Floridan aquifer.

Few water samples analyzed for this study had concentrations of chemical constituents greater than recommended limits for drinking water. High chloride concentrations and associated high specific-conductance values were found only near the coast in the saltwater-freshwater transition zone. The transition zone was generally near land surface between the coast and 2.5 miles inland and then dropped sharply.

Deep wells that contained high dissolved iron concentrations tended to be clustered in the Cross Bar well field and scattered throughout swampy areas, which suggests some association with either present or past reducing environments. Hardness of deep well water was generally greater than 120 mg/L and hardness of shallow well water was generally less than 60 mg/L. One well showed a high concentration of sodium and another a high concentration of sulfate. Concentrations of dissolved lead exceeded the Florida Department of Environmental Regulation's recommended limit of 50 μg/L at two sinkholes, as did concentrations of dissolved zinc at White Turkey Pond.

Overall, surface waters had low concentrations of most constituents. The Hillsborough River had hard water, which is due to a large percentage of the water being derived from the Upper Floridan aquifer. Iron concentrations exceeded the limit recommended by the Florida Department of Environmental Regulation in the Withlacoochee River near Compressco.

In the transition zone along the coast, saltwater is present in the Upper Floridan aquifer. Drawdown in the potentiometric surface around pumping wells can cause upwelling of saltwater, especially near the coast where the freshwater section is thinnest.

Although industrial and irrigation demands presently account for the largest percentage of water use in the county, future demands on water will be greatest for public supply. Projected increases in population in Pasco County, and in Pinellas County to the south, account for this expected increased demand for water. Five different water-development plans to meet projected increases in water demand in west Pasco County were evaluated by using a ground-water flow model. Each plan included average and maximum withdrawal rates that ranged from an average increased demand of 10 Mgal/d to a maximum increased demand of 31.5 Mgal/d. Each plan was analyzed by using a ground-water flow model to predict additional drawdowns that would occur in the potentiometric surface of the Upper Floridan aquifer and the water table of the surficial aquifer. Drawdowns ranged from 5 to 12 feet in the potentiometric surface and 1 to 3 feet in the water table. The radius of influence around well fields (drawdown of 1 foot or more) ranged from 4.75 to 7.25 miles in the Upper Floridan aquifer and from 1.2 to 5.4 miles in the surficial aquifer.

The largest source of water for these increased withdrawals was reduced evapotranspiration; the second largest source was reduced spring flow. Other sources were reduced boundary outflow and reduced streamflow. Drawdown occurred near the transition zone with average pumpage conditions for three of the five development plans, which indicates that saltwater intrusion is a potential hazard.

In order to evaluate results of projected ground-water development in Pasco County in 2035, the ground-water flow model was again run with estimates of ground-water withdrawals to meet the needs of all of Pasco and Pinellas Counties and 34 percent of Hillsborough County in 2035. The average potentiometric surface of the Upper Floridan aquifer for 2035 is predicted to range between 8 feet higher (St. Leo) to 21 feet lower (Cypress Creek well field) than the average 1976-77 potentiometric surface. Recovery of the surface occurs in the east where agricultural pumpage has decreased since 1976-77 and is expected to further decrease by 2035. Lowering of the potentiometric surface occurs in the west as a result of increased well-field pumpage. Where the potentiometric surface has declined, the potential for contamination of the Upper Floridan aquifer by increased leakage through the surficial materials is increased. This is most likely to occur at the Cypress Creek well field where surficial deposits are thin. The potential for sinkhole development will be increased in sinkhole-prone areas where large drawdowns in the potentiometric surface occur. Potential for this is greatest at the Cross Bar Ranch well field. The potential for saltwater contamination from both upconing and lateral intrusion also will be increased. Upconing is most likely at the Cross Bar Ranch well field where drawdown is large and the Upper Floridan aquifer is thinnest. The potential for lateral intrusion is greatest at the more coastal well fields (Starkey and Eldridge-Wilde).

Estimated changes in the water table of the surficial aquifer between 1976-77 and 2035 range from a 4-foot rise in the Brooksville Ridge area to about an 18-foot decline in the Cross Bar Ranch well field. A possibility of dewatering the surficial aquifer in both the Cross Bar Ranch and Cypress Creek well fields exists. Lowering of the water table caused a 19-percent reduction in evapotranspiration. This could prove detrimental to vegetation and also suggests the potential for lowered lake levels where lake bottoms are not effectively confined. Leakage between the aquifers and the rivers was reduced by 13 percent. The Withlacoochee River changed from a predominantly gaining stream to a losing stream. The greatest change was in the Hillsborough River, which showed a 30-percent reduction in aquifer discharge to the river. The Anclote and Pithlachascotee Rivers each had a reduction in inflow of about 1 percent. Spring flow was reduced by 6 percent, and several springs ceased flowing. Boundary inflow was reduced by 6 percent and outflow by 8 percent.

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APPENDIXES

APPENDIX A: Wells From Which Ground-Water Data Were Collected

[* denotes surficial aquifer well; x denotes Lower Floridan aquifer well]

Well No.	Identification No.	Well name	Well depth (feet)	Casing depth (feet)	Altitude of land surface (feet)
*1	281017082234701	S. 862 on I-75 at county line	22	--	57.50
2	281018082095201	Ernest Grant	57	53	75
3	281018082095801	Lois Carver	105	60	65
4	281022082075501	Weicht #1	500	240	90
5	281022082335101	Pasco 305	39	37	64.38
6	281022082335102		10	8	65
7	281023082075701	Weicht #2	100	60	90
8	281023082080801	Weicht #4	90	60	87
9	281023082305701	St. Petersburg #41 deep	707	72	59
*10	281023082305702	St. Petersburg #41 shallow	19	17	59
11	281023082450701	Coastal Pasco deep #13	188	172	11.87
12	281023082451301	Holiday Lake Estates #3	85	33	14
13	281024082073801	Weicht #3	60	40	90
14	281025082312401	Sierra Pines D. 218	90	--	59.85
15	281025082384601	Eldridge-Wilde Mitchell	608	42	36.42
16	281025082384602	Eldridge-Wilde Mitchell well 2	118	40	37
17	281035082305701	St. Petersburg #42 deep	398	70	59.11
*18	281035082305702	St. Petersburg #42 shallow	22	20	59
19	281035082464901	J. O'Dell	34	20	12
20	281036082440901	Pasco #14	121	112	16.65
21	281037082071801	J. Alston	55	47	94
22	281038082452801	Holiday Lakes Estates	--	--	12
23	281041082304101	Pasco WF D.E. of 43	474	62	59.57
24	281042082304601	Pasco WF production well 43	704	127	60.32
*25	281042082304602	St Petersburg #43 shallow	23	21	60
26	281043082100401	J. J. Childers	80	42	64
27	281043082443601	J. Dougherty	40	--	16
28	281045082201201	Williamsburg	--	--	60
29	281046082303101	St. Petersburg #44 deep	709	74	60.68
*30	281046082303102	St. Petersburg #44 shallow	22	20	61
31	281046082470801	FPC well #1	159	146	8.2
32	281046082470802	FPC well #2	112	104	8.12
33	281047082154401	Blanz	420	--	72.60
34	281050082305901	St. Petersburg #46	653	58	58
*35	281050082305902	St. Petersburg #46 shallow	22	20	59.27

Well No.	Identification No.	Well name	Well depth (feet)	Casing depth (feet)	Altitude of land surface (feet)
36	281051082442801	Ross Trailer Sales	70	69	8
x37	281053082310401	St. Petersburg E-105 deep	1,360	--	58.45
*38	281053082310402	St. Petersburg E-105 shallow	20	--	57.82
*39	281053082310403	St. Petersburg E-105 shallow	--	--	58
40	281055082302401	St. Petersburg #45	708	59	61.10
*41	281055082302402	St. Petersburg #45 shallow	20	18	61
42	281056082303301	Pasco WF #233 deep	--	--	58
*43	281056082303302	Pasco WF #233 shallow	--	--	58
44	281057082301301	Pasco WF #232 deep	52	--	61.60
*45	281057082301302	Pasco WF #232 shallow	--	--	58
46	281058082085201	Palm River Dairy	400	400	81
47	281101082292501	Harry Matts deep	60	59	69.03
*48	281101082292502	Harry Matts shallow	9	8	68
49	281102082064001	J. Alston	40	20	94.0
50	281103082292301	Harry Matts	62	45	65
51	281103082322601	Doyles Ranch deep	438	38	54
52	281104082310401	Pasco WF P-4 deep	410	88	60.50
53	281104082310501	St. Petersburg #47 deep	704	127	59.3
*54	281104082310502	St. Petersburg #47 shallow	21	19	59
55	281104082312001	St. Petersburg #48 deep	506	78	61
*56	281104082312002	St. Petersburg #48 shallow	16	14	61
*57	281106082312201	Pasco WF #230 shallow	--	--	59
58	281106082443901	Buena Vista TR #2	--	--	21
59	281106082443902	Buena Vista TR #3	150	--	21
60	281106082443903		30	--	21
*61	281109082241601	SR 54 shallow well 802	20	20	60
62	281109082314401	Boone #221 deep	--	--	63.50
63	281112082211301	Immer	256	--	56.91
64	281113082443801	Buena Vista #1 deep	90	--	18
65	281117082291501	Pasco #207 deep	173	72	68.90
66	281117082291601		90	--	63
67	281118082305901	Pasco WF production well #49	706	91	72
*68	281118082305902	St. Petersburg #49 shallow	22	20	60
69	281119082291601	G. L. Henley 2	58	40	65
*70	281120082245501	ROMP 80 shallow	19	--	80.55
71	281120082302701	Pasco WF #220 deep	47	45	59.90
*72	281120082302702	Pasco WF #220 shallow	15	14	59.70
73	281122082344601	W. L. Bott	96	60	53
*74	281124082320701	Doyle	15	--	52
75	281124082353001	Swains	365	63	50.69

Well No.	Identification No.	Well name	Well depth (feet)	Casing depth (feet)	Altitude of land surface (feet)
76	281125082090301	Dikes	105	45	65
77	281126082303801	St. Petersburg #50 deep	703	91	59.14
*78	281126082303802	St. Petersburg #50 shallow	19	17	59
*79	281126082305701	Pasco WF #231 shallow	--	--	60
80	281128082445501	Tahitian #3 deep	100	35	10
81	281129082273601	Woodward #214 deep	200	--	73
82	281132082323501	Blanco Dairy	124	22	55
83	281137082300601	Touchton	185	48	61
*84	281137082352801	USGS #302 shallow	10	8	54
85	281138082421701		175	--	15
*86	281139082315301	SR 54 #215 shallow	10	9	61
87	281143082304701	SR 54 top of limestone	69	52	59.53
88	281143082304702	SR 54 deep	345	178	59.04
*89	281143082304703	SR 54 shallow	5	5	60
90	281150082293201	Lutz #226	--	--	66
*91	281151082210901	SR 581 #801 shallow	10	8	57.50
92	281152082115701		176	56	70
93	281153082355201		--	--	49
94	281155082235401	King deep	550	--	70.90
*95	281157082304101	Pasco WF #227 shallow	--	--	59
96	281209082465202		69	--	3
*97	281214082101901	Himes-Bailey	17	--	63
98	281217082101901	W. M. Roland deep	180	130	70
99	281219082465101	Huber	35	--	5
100	281219082465102	Huber-A	43	--	5
101	281222082062301	J. O. Alston	41	--	85
102	281222082384301	Starkey Stock #700 deep	--	--	35
*103	281222082384302	Starkey #700 shallow	11	10	34
104	281222082393401	7 Springs deep	301	76	33.82
*105	281222082393402	7 Springs SR 54 shallow	5	3	36
*106	281222082393403	7 Springs shallow	11	9	35.04
107	281223082442301	Community Methodist Church deep	37	21	15
108	281224082110101	Rowland	55	42	74
109	281226082465301		--	--	4
*110	281228082294201	Pasco WF #223 shallow	10	8	64.8
111	281234082112701	Palm View Gardens	--	--	76
112	281234082444401	Beacon Square no. 2	--	--	25
113	281236082424901	O. J. Harvey	171	84	30
114	281244082320301	USGS #744 deep	31	29	57.70
*115	281244082320302	USGS #744 shallow	--	--	55

Well No.	Identification No.	Well name	Well depth (feet)	Casing depth (feet)	Altitude of land surface (feet)
116	281244082425501	Harvey	157	82	43
117	281248082160601	Williams New River	--	--	84
118	281248082431101	Colonial Hills	--	--	37
119	281250082433201	Elfers Grove #701 deep	--	--	40
*120	281254082291201	Bexley #224 shallow	12	8	68.5
121	281256082263601	Northrup 1	168	55	83
122	281257082263401	Northrup 2	69	55	83
123	281258082161301	Williams deep	305	--	86.48
124	281305082145101	Ralph Trailer Park	--	--	100
*125	281307082144802	Morris Bridge and 52 shallow	37	--	95
126	281309082311301	Bexley #743 deep	39	34	59.60
*127	281309082311302	Bexley #743 shallow	20	17	59.61
128	281314082272401	P. K. Cross	197	60	78
129	281314082380601	Starkey Picnic Area #745 deep	--	--	29.70
130	281318082303901	Bexley #742 deep	43	--	60
131	281318082303902	Bexley #742 shallow	--	--	--
132	281319082282401	Kinsman	100	68	75
133	281321082294201	Bexley #225 deep	--	--	67
*134	281322082311301	Bexley #741 shallow	10	7	57.56
135	281323082284601	Kinsman	730	70	75
136	281324082435601	Coastal Pasco 8	162	137	18.61
137	281324082443301	Mangold	32	--	6
138	281328082425501	Coastal Pasco 9 deep	102	90	28.06
139	281331082145301	Ryals Residence	400	--	90.30
140	281332082303801	Bexley #740 deep	--	--	61
*141	281332082303802	Bexley #740 shallow	11	9	63.15
142	281337082222501	Tampa Downs	--	--	70
143	281337082355301		--	--	40
144	281338082134501	Lake Bernadette	--	--	83
145	281342082175801	Brown deep	125	--	99.92
*146	281342082300601	Bexley #738 shallow	10	7	66.69
*147	281342082300702	USGS #737 shallow	9	6	66.56
*148	281342082302301	Bexley #739 shallow	17	7	63.85
149	281342082302302	Bexley #739 deep	--	--	64
150	281344082433601	New Port Richey	65	32	18.05
151	281348082110201	Zephyrhills #6	915	--	83.60
152	281348082294301	Bexley 1	564	36	70
*153	281348082294302	Bexley 1 shallow	9	7	68.49
154	281350082201001	Saddlebrook	--	--	75
155	281353082421301	Pasco #10	311	295	16.11

Well No.	Identification No.	Well name	Well depth (feet)	Casing depth (feet)	Altitude of land surface (feet)
156	281354082130701	Oak Royal	--	--	88
157	281403082254201	Covington	690	--	70.36
158	281403082421501		311	--	10
159	281404082105201	Zephyrhills #1	560	90	93
160	281408082253101		--	--	57
161	281414082145901	Ryals Ranch House	200	--	108.50
162	281414082310001	Bexley 3 #704 deep	712	92	63.50
*163	281414082310002	Bexley 3 #704 shallow	11	8	63
164	281419082190601	Wesley Chapel deep	414	78	105.77
165	281424082192701	ROMP 85 AP	505	--	107.94
166	281424082192702	ROMP 85 FLRD	300	--	108.09
*167	281424082365201	Starkey well field EMW7	14	--	36
168	281425082190801		15	8	100
169	281427082382801	Starkey #728 deep	67	62	35.77
*170	281427082382802	Starkey #728 shallow	18	16	35.20
171	281431082104701	City of Zephyrhills	964	984	105.80
172	281431082371801	Starkey #730 deep	82	77	36.60
*173	281431082371802	Starkey #730 shallow	17	14	36.4
*174	281432082211401	USGS #853 on I-75 shallow	--	--	85
175	281434082260801	Covington 2 #858 deep	697	112	72.80
176	281435082221301	Angus Valley 3 #860 deep	366	--	76.60
*177	281436082380101	Starkey well field EMW4	--	--	36
178	281437082271401	Nininger #857 deep	165	--	72.60
179	281441082380301	Starkey #705 deep	381	304	40.20
180	281445082414501	Coastal Pasco 11 deep	425	401	15.74
181	281445082414502	Coastal Pasco 11A	108	66	15.76
182	281446082354101	Starkey MW-1	--	--	50
*183	281446082354302	Starkey SM2 shallow	--	--	50
*184	281447082371002	Starkey #731 shallow	--	--	30
185	281448082301801	Bexley 2	743	44	67.43
*186	281448082301802	Bexley 2 shallow	--	--	70
187	281451082380701	Starkey 10 deep	392	153	41.16
*188	281451082380702	Starkey 20 shallow	22	--	41
189	281453082380301	Starkey #707 deep	408	135	38.50
*190	281453082380302	Starkey #707 shallow	22	20	38.37
191	281459082330201	Bexley #736 deep	--	--	52
192	281500082384501	Starkey #710 deep	345	--	42.60
*193	281500082384502	Starkey #710 shallow	30	20	42.7
*194	281501082380901	Starkey EMW3	--	--	31
195	281504082102101	Florida Trailer Estates	--	--	83

Well No.	Identification No.	Well name	Well depth (feet)	Casing depth (feet)	Altitude of land surface (feet)
196	281504082104801	ROMP 86 deep	438	--	87.20
*197	281504082104802	Old Wire Road and 52 shallow	17	17	87.00
198	281504082422801	New Port Richey #3	--	--	46.76
199	281505082292901	Bexley #709 deep	--	--	73
*200	281509082385401	Starkey W2S WT	--	--	21.20
201	281510082421001	New Port Richey #5	270	169	52
202	281512082094801	Hillside Mobile Home 3"	650	--	127
203	281512082384501	Starkey W2 production	550	--	30
204	281512082421701	NPR10	100	63	49.35
205	281512082422401	NPR	170	71	42.12
206	281512082423401	NPR	200	120	42
207	281513082094601	Hillside Mobile Home	550	--	130.10
208	281513082222201	Angus Valley 2 deep	365	--	71
*209	281516082361201	Starkey EMW6	--	--	37
210	281517082383301	Starkey WF SP1	14	--	25
211	281517082421101	City of New Port Richey #11	160	65	43.60
212	281517082424001	ROMP 16-2	--	--	40
213	281518082423901	NPR	228	200	37.52
214	281519082225501	Angus Valley 1 deep	397	--	68.10
215	281520082314501	Bexley #734 deep	73	68	60
*216	281520082314502	Bexley #734 shallow	11	8	60
*217	281521082380601	Starkey WF EMW5	12	--	32
218	281524082244501	U.S. Corps of Engineers levee	56	--	59
219	281524082380601	Starkey 4A FO	--	--	33
220	281525082381101	Starkey W4 production	--	--	31
*221	281525082383601	Starkey WF SH EMWJ	18	--	20
222	281525082391101	Starkey WF SW-WMD deep	--	--	24
223	281526082255701	Covington 4 #856	690	92	74.27
224	281526082374701	Starkey #729 deep	82	79	30.30
*225	281526082374702	Starkey #729 shallow	21	18	29.90
226	281528082383801	Starkey W1 production	--	--	25.50
227	281530082380101	Starkey WF W4B	300	--	31
*228	281530082381301	Starkey WF SP4	16	--	34
*229	281530082384801	Starkey SM-1SH	--	--	21
*230	281531082430301	Pasco 9	15	13	11
231	281532082412301	New Port Richey deep	582	572	17
232	281532082412302	New Port Richey shallow	120	53	17
233	281533082422401	New Port Richey #7A	93	46	29.2
234	281535082241301	Cypress Creek TMR-5 deep	--	--	68.66
*235	281535082241302	Cypress Creek TMR-5 shallow	--	--	64

Well No.	Identification No.	Well name	Well depth (feet)	Casing depth (feet)	Altitude of land surface (feet)
236	281543082421201	City of New Port Richey 8	200	120	20.15
237	281545082122001	Bridgham	228	--	91.40
238	281546082211101		--	--	76
239	281548082220601	Moehle	107	--	71.20
240	281549082204001	Murphy #852 deep	--	--	80
241	281558082264601	Pasco 13	49	43	79.93
*242	281558082264602	Pasco 13 shallow	--	--	80
243	281602082175801	Williams Double Branch	--	--	115
244	281606082100501	Cambridge Clark	--	--	100
245	281609082242901	Cypress Creek 1 deep	495	134	68.20
*246	281612082285201	Ehren #720 shallow	10	8	78
247	281613082242901	Cypress Creek 2 deep	311	71	68.67
*248	281615082242501	Cypress Creek 2 shallow	12	10	68.82
249	281622082195101	Williams Acres no. 4	--	--	110
250	281622082241301	Cypress Creek 3 deep	352	136	64.49
251	281631082261601	Catching's #849 deep	118	--	83.30
252	281636082230501	Springer #847 deep	103	--	71.40
253	281636082372001	Moon Lake deep	115	65	35.94
*254	281636082372002	Moon Lake shallow	25	22	38.69
255	281637082233501	Cypress Creek WF #829	52	49	73.60
*256	281637082233502	Cypress Creek WF #829 shallow	13	8	70
257	281641082240201	Cypress Creek WF C-10 deep	700	84	72.62
258	281641082240202	Cypress Creek WF C-10 supply	48	45	65.20
259	281641082243401		--	--	60
260	281642082440201	Coastal Pasco 4 deep	75	68	4.64
261	281642082440302	Fivay #713 shallow - Pasco 4A	25	20	4.5
262	281648082415001	Embassy Hills no. 1	--	--	37
263	281648082430201	Coastal Pasco 5 deep	235	223	10.87
264	281649082234501	Cypress Creek 9	--	--	75.34
265	281640082244501	Cypress Creek IMR-4 deep	--	--	63.84
*266	281650082244502	Cypress Creek TMR-4 shallow	--	--	63.84
267	281651082082202	Pine Breeze Court	--	--	85
268	281652082423301	Port Richey City deep	200	104	21.79
269	281654082065901	U.S. Highway 98 W	200	42	85.63
*270	281654082065902	U.S. Highway 98 shallow	--	--	85.00
271	281654082201601	Carr #846 deep	230	--	85
272	281655082242001	Cypress Creek TRM-4 deep	--	--	62
*273	281655082242002	Cypress Creek TRM-4 shallow	--	--	62
274	281656082251201	Cypress Creek WF #831 deep	57	54	60.10
*275	281656082251202	Cypress Creek WF #831 shallow	12	9	60.2

Well No.	Identification No.	Well name	Well depth (feet)	Casing depth (feet)	Altitude of land surface (feet)
276	281656082423301	Port Richey City	--	--	20
277	281657082303301	Bexley #733 deep	55	--	69.80
*278	281657082303302	Bexley #733 shallow	--	--	68
279	281659082282801	Conner deep	460	--	78.55
*280	281702082231401	Cypress Creek WF #828 shallow	--	--	67
281	281704082085201	Richland Baptist Church	247	--	135.70
282	281709082090801	Sunburst	--	--	140
283	281712082233901	Cypress Creek 8	--	--	73.11
284	281713082111501	Mobile Park Wire Road	600	--	113.67
285	281715082164401	SR 577 deep	150	57	130.01
*286	281715082164402	SR 577 shallow	21	18	130
287	281719082224801	Cypress Creek TMR-1 deep	535	--	70.04
*288	281719082224802	Cypress Creek TMR-1 shallow	--	--	70
*289	281723082231201	Cypress Creek #827 shallow	10	--	70.80
290	281723082234001	Cypress Creek 7	--	--	72.62
291	281723082234601	Cypress Creek WF #826 deep	37	--	69.04
*292	281723082234602	Cypress Creek WF #826 shallow	--	--	65
293	281725082144801	Oakley	447	--	177
*294	281728082232001	Cypress Creek WF #825 shallow	--	--	70
295	281733082233001	Cypress Creek 6	--	--	73.48
296	281742082231101	Cypress Creek 5	--	--	74.99
x297	281743082135101	Hilltop Irrigation	1,300	--	238
298	281745082255001	Starling #809 deep	678	139	77.50
299	281746082233701	Cypress Creek TMR-3 deep	625	--	65
*300	281746082233702	Cypress Creek TMR-3 shallow	11	--	65.41
301	281748082225301	Cypress Creek WF E-108 deep	700	90	72.64
*302	281748082225302	Cypress Creek WF E-108 shallow	--	--	69
303	281749082112701	I. A. Krusen	957	--	225
304	281749082215301	Cypress Creek 13	705	154	75.56
305	281749082220401	Cypress Creek 12	705	153	76
306	281754082230001	Cypress Creek 4	--	--	73
307	281755082124501	Bozeman	--	--	115.17
308	281801082225101	Cypress Creek E-107 deep	700	90	73.18
*309	281801082225102	Cypress Creek E-107 shallow	--	--	71
310	281802082225001	Cypress Creek 3	700	81	76.77
311	281803082420501	San Clemente deep	125	--	20
312	281804082223201	Cypress Creek 11	705	150	74.96
313	281807082251601	Cypress Creek 4 #812 deep	716	140	75.97
x314	281809082224401	Cypress Creek WF E-106 deep	1,290	1,010	74.10
*315	281809082224403	Cypress Creek WF E-106 shallow	--	--	72

Well No.	Identification No.	Well name	Well depth (feet)	Casing depth (feet)	Altitude of land surface (feet)
316	281809082251501	Cypress Creek 5 #813 deep	715	74	76.59
317	281812082123901	Pasadena Shores	--	--	98
318	281813082224201	Cypress Creek WF C-2 deep	750	116	78.59
319	281818082422501	J. T. Gause	77	--	25
320	281820082422501		--	--	22
*321	281827082194501	Cypress Creek #843S	--	--	85
322	281827082223501	Cypress Creek WF production C1	700	80	78.27
*323	281828082223201	Cypress Creek WF #824 shallow	12	--	74
324	281831082402301	Jasmine Development	517	195	25
325	281833082402001	Jasmine Lake	345	200	37.03
*326	281844082224101	Cypress Creek 822 shallow	--	--	75
327	281845082224001	Cypress Creek TMR-2 deep	625	--	78.33
*328	281845082224002	Cypress Creek TMR-2 shallow	--	--	78
329	281846082085501	Larkin	265	--	152.57
330	281850082221301	Cypress Creek WF #821 deep	37	32	79.77
*331	281850082221302	Cypress Creek WF #821 shallow	--	--	73
332	281858082415501	Palm Terrace deep	107	--	11
333	281906082161601	D. E. Cannon	640	240	120
334	281908082184001	St. Leo Abbey	170	--	110
335	281917082201201	R. E. McKendree	128	48	112.40
336	281917082420901	ROMP TR17-1 deep	139	--	10.27
337	281918082264601	SR 52 east of Gowers Corner deep	73	38	79.50
*338	281918082264602	SR 52 east of Gowers Corner shallow	7	7	79.50
339	281921082420201	R. Beede	30	--	12
340	281922082403901	ROMP TR17-3 deep	200	--	10
341	281923082252201	ROMP 93 deep	700	--	78
*342	281923082252202	ROMP 93 shallow	12	11	78
343	281926082212901	SR 52 and 581	113	83	89.47
*344	281926082212902	SR 52 and 581 shallow	12	12	85
345	281929082131301	Lake Pasadena	--	--	100.60
346	281930082093701	Lykes-Pasco Fertilizer	--	--	93.30
347	281930082093702	Lykes-Pasco Fertilizer 4"	167	--	93.55
348	281931082284101	SRW deep	700	146	76
*349	281931082284102	SRW shallow	13	9	76
350	281936082112201	Tom Oakley residence	472	--	145
351	281938082402101	Balicki deep	72	--	30
352	281942082113101	Floral Memory Gardens	--	--	132.72
353	281943082241801	Fort King Ranch 10"	560	--	80.15
354	281948082415301	Withlacoochee Electric 01	94	84	10
355	281949082332001	SR 52 west of Gowers Corner deep	73	60	55.89

Well No.	Identification No.	Well name	Well depth (feet)	Casing depth (feet)	Altitude of land surface (feet)
*356	281949082332002	SR 52 west of Gower Corner shallow	23	20	56.68
357	281954082413401	Ponderosa Development deep	100	42	18
358	281954082414401	USGS	14	14	15
359	281955082111701	Johnson	--	--	94.35
360	282005082112801	Stearns	565	--	83.20
361	282005082153501	Golf course	649	134	183.48
362	282009082373801	SR 52 deep	73	59	33
*363	282009082373802	SR 52 shallow	9	9	33
364	282011082162701	San Antonio production	350	225	168.40
365	282036082300801	H. L. and H. Nursery	109	--	75
366	282037082111601	Evans	525	--	82.01
367	282037082370301	Shadow Ridge no. 1	100	--	42
368	282038082112001	Evans Main Plant	475	--	78.51
*369	282044082031901	Pasco-Sumter shallow	5	0	97.00
370	282044082312401	H. Kent Grove	650	--	73
x371	282048082123301	Krissman	1,434	64	175.66
372	282052082404301	Beacon Woods no. 7	--	--	30
373	282106082140801	Parkview	--	--	145
374	282108082290401	Norris Cattle Company #840	100	--	80.59
375	282108082290501	Cross Bar WF N4S3 deep	100	--	80.24
376	282110082123201	Eldrid	--	--	100
377	282111082073101	Cummer Trailer	--	--	76.58
378	232113082241401	Fort King Ranch Grove	92	--	80
379	282114082103101	Quarters	49	--	75
380	282115082283701	Cross Bar WF N-16	--	--	88.97
*381	282119082075901	River Road shallow	12	0	76.00
382	282121082071101	Cummer Office	184	--	82.20
383	282123082274401	Cross Bar 1	710	150	79.80
384	282130082082401	Auton	--	--	78
385	282130082082901	Mac Brian	280	--	97.80
386	282132082115901	Boltin residence	--	--	116.40
387	282133082275301	Cross Bar 2	702	160	85.23
388	282138082414801	Melilli #1	103	75	11
389	282138082414802	Melilli #2	123	74	11
390	282141082101901	Collura #2	150	--	129
*391	282141082334901	Hays Road #751 shallow	--	--	46
*392	282141082335201	Hays Road #750 shallow	--	--	46
393	282142082283701	Cross Bar WF A deep CB 3	700	152	73.70
*394	282142082283702	Cross Bar WF A shallow	23	--	77
395	282143082093201	Thomas 6"	184	--	78.70

Well No.	Identification No.	Well name	Well depth (feet)	Casing depth (feet)	Altitude of land surface (feet)
396	282143082093301	Thomas 3"	150	--	78.10
397	282147082113001	Dade City #1	200	--	117
398	282147082113002	Dade City #2	200	--	117
399	282147082113004	Plant well #4 at Dade City	116	--	116.50
400	282148082281801	Cross Bar WF A-1 deep	700	--	74.40
*401	282148082281802	Cross Bar WF A-1 shallow	23	--	70
*402	282148082300701	Fivay 732 shallow	10	8	72
403	282152082413701	Ruland #1	27	--	9.89
404	282152082413801	Ruland #2	22	21	10
405	282153082085601	Parker	--	--	75.70
406	282153082085602	Parker #2	120	--	75.70
407	282154082142401	Haycraft	--	--	97.56
408	282154082280101	Cross Bar 4	705	155	78.13
409	282154082280401	Cross Bar WF A-2 deep	700	--	74
*410	282154082280402	Cross Bar WF A-2 shallow	23	--	74
411	282155082132601	Shuttler	--	--	155.24
412	282158082170801	Burger	699	205	200
413	282202082414901		72	--	4
414	282207082271101	Cross Bar WF A-3 deep	700	155	71.80
*415	282207082271102	Cross Bar WF A-3 shallow	21	18	71.80
416	282207082402401	Hudson #14	--	--	12
417	282212082094801	Lunceford	--	--	98.10
418	282221082103001	Collura	78	21	76
419	282222082280701	Cross Bar 5	705	152	78.13
420	282228082222701	Joe Gilmore	355	--	85
421	282228082402001	City of Hudson	100	46	26
422	282228082410301		--	--	12
423	282229082405801	Coastal Pasco # 2 at Hudson deep	178	156	11.57
424	282229082415701	USGS Pasco #1 near Hudson	30	27	3.66
425	282232082113901	Joyland	--	--	102
*426	282232082164401	577/578 shallow	12	12	232
427	282233082112201	Lykes-Pasco #8	69	55	88.37
428	282233082112202	Lykes-Pasco #9	69	--	88
429	282233082112203	Lykes-Pasco #12 PTBL	461	248	88.56
430	282233082283801	Cross Bar 6	705	155	73.47
431	282234082164401	Donald Nathe	365	--	231
432	282235082111901	Lykes-Pasco #13	466	--	84
433	282235082112301	Lykes-Pasco #1	462	--	89.21
434	282238082362101	Justice deep near Hudson	110	--	28
435	282240082112001	Lykes-Pasco #4	456	--	82.56

Well No.	Identification No.	Well name	Well depth (feet)	Casing depth (feet)	Altitude of land surface (feet)
436	282240082112002	Lykes-Pasco #5	115	--	82
437	282246082281601	Cross Bar WF 8 deep CB 7	485	477	73.90
*438	282246082281602	Cross Bar WF 8 shallow	21	--	76.76
439	282253082404001	Red Barn Bar deep	85	--	8
440	282256082394101		--	--	30
441	282258082113102	L-P 4" fire test well	178	61	77.43
442	282259082104101	Lykes-Pasco W.	36	--	73.81
443	282259082110901	Windmill #1	--	--	93.99
444	282259082282801	Cross Bar WF B-1 deep	701	143	72
*445	282259082282802	Cross Bar WF B-1 shallow	23	19	72
446	282302082113401	Rug Outlet	335	--	82
*447	282302082290301	Cross Bar WF S-1	21	--	71
448	282303082094901	Calvert	--	--	79
449	282304082164401	C. J. Petters and Sons	--	--	209
450	282310082281901	Cross Bar 8	710	151	78.48
451	282313082284301	Cross Bar WF B-2 deep	700	--	75.50
*452	282313082284302	Cross Bar WF B-2 shallow	23	--	72
453	282315082113601	Nursery	--	--	87
454	282319082105201	Lovett	--	--	124
*455	282321082401001	USGS	14	14	15
*456	282323082343301	Hays Road shallow	27	20	41.00
457	282324082281901	Cross Bar 9	703	154	71.88
458	282325082400601		--	--	19
459	282326082112001	W. Terrie	125	--	128.64
460	282326082280901	Cross Bar WF N4S2 deep	--	--	71.01
461	282326082285201	Cross Bar WF B-3 deep	642	153	68.30
*462	282326082285202	Cross Bar WF B-3 shallow	21	19	68.30
463	282330082290501	Rovan Farms 4" barn well	150	--	65
464	282332082110101	Boltin irrigation well	465	--	120.10
465	282336082091001	Ranch House well	--	--	87.90
466	282339082395801	Zazzy's deep	112	--	20
467	282342082274801	Cross Bar 10	710	152	74.23
468	282346082114901	Sapp	710	--	95
469	282346082271201	Cross Bar 11	702	155	74.15
470	282352082083501	Old Henley Place well	--	--	75.60
*471	282352082121601	Frazee Hill shallow	2	--	122
472	282352082263901	Cross Bar 12	710	120	73.35
473	282353082055301	Cummer Company housing	110	5	84
474	282404082161301	Pat Nathe old homestead	--	--	246
475	282408082274201	Cross Bar WF C-1 deep	700	--	68.60

Well No.	Identification No.	Well name	Well depth (feet)	Casing depth (feet)	Altitude of land surface (feet)
*476	282408082274202	Cross Bar WF C-1 shallow	21	--	72
477	282408082385001	A. J. Dunning deep	72	--	20
478	282410082271301	Cross Bar WF C deep CB 13	700	152	70.10
*479	282410082271302	Cross Bar WF C shallow	24	--	73.59
480	282411082261401	Cross Bar WF C-3 deep	700	146	73
*481	282411082261402	Cross Bar WF C-3 shallow	17	3	74
482	282413082263801	Cross Bar WF C-2 deep	500	--	68.90
*483	282413082263802	Cross Bar WF C-2 shallow	23	--	71
484	282413082392401	Concrete Co. deep	82	--	25
*485	282415082221401	Johnston Road shallow	5	0	105.00
486	282417082271001	Cross Bar WF N4S deep	--	--	71.49
487	282418082161301	Pat Nathe domestic well	470	--	253
488	282418082162001	Pat Nathe irrigation well	--	--	249.19
489	282418082393701	Grace Memorial Gardens deep	135	--	25
490	282419082271201	Cross Bar WF N-2 deep	480	--	70.32
*491	282419082271202	Cross Bar WF N-2 shallow	30	--	70.32
492	282422082263901	Cross Bar 14	710	120	75.89
493	282422082275101	Cross Bar 15	710	160	69.06
494	282427082392801		--	--	10
495	282428082134501	Lee well	738	200	170
496	282428082182801	Moody Lake well	--	--	196.95
497	282430082112101	Self well	--	--	130
498	282430082271201	Cross Bar WF N-1 deep	615	--	70.28
*499	282430082271202	Cross Bar WF N-1 shallow	35	--	70.28
500	282434082065801	Cumpressco Ranch	30	--	83.66
501	282434082200301	Airstream Trailer Park #833 deep	138	90	142.80
502	282434082283601	D. A. Sutyak	82	--	60
503	282441082271201	Cross Bar WF N-12 deep	625	--	67
*504	282441082271202	Cross Bar WF N-12 shallow	41	--	67
505	282441082270202	Hillcrest	--	--	69
506	282442082124401	Claypit well	--	--	113.20
507	282442082273201	Cross Bar 16A	630	118	61.92
508	282443082143201	Missing pump well	--	--	98.30
509	282443082263901	Cross Bar 17	710	117	75.59
510	282454082382301	Carter deep	300	--	22.13
511	282459082164301	George James well	290	--	218.70
512	282459082271301	Cross Bar WF N4N deep	--	--	64.73
513	282504082280301	NWO-2 deep	585	--	66
*514	282504082280302	NWO-2 shallow	32	--	66
515	282505082261301	Cross Bar WF NRW	706	--	67

Well No.	Identification No.	Well name	Well depth (feet)	Casing depth (feet)	Altitude of land surface (feet)
*516	282505082271102	NRW shallow	21	--	65
517	282512082394201		--	--	12
518	282516082365501	Lore deep	130	--	25.73
519	282519082394301	M. G. Scheer deep	111	--	11
520	282527082112301	Pasco County Utilities	225	126	103.73
521	282534082222801	Barthle Ranch #818 deep	126	52	118.50
522	282536082233101	Stagecoach Ranch	160	--	80.60
523	282540082275701	Masaryktown deep	82	29	65.71
*524	282540082275702	Masaryktown shallow	19	9	66
525	282540082384601	Briarwood	--	--	30
526	282545082344001	Keisel deep	117	--	37
527	282552082181201	Emmet Evans	850	150	209
528	282552082314201	Gooch deep	120	--	75.04
529	282553082370201	Brann well	100	--	30
530	282553082395301	Whiting well deep	165	--	5
531	282553082395302	Whiting well shallow	43	--	5
532	282641082112001	Overpass	227	49	80.17
533	282717082142001	Rossini	275	--	118.92
*534	282723082142301	575 west of Trilby shallow	14	0	118
535	282742082102401	Lacoochee	--	--	77
536	282816082123701		--	--	135
537	282821082121101	Trilby	--	--	100
*538	282842082091801	Pasco-Hernando at river shallow	14	0	75.00
*539	282845082031701	Bevell Place shallow	6	0	89.00

[mg/L, milligrams per liter; µg/L, micrograms per liter; µS/cm, microsiemens

Well No.	Identification No.	Date of sample	Well depth (feet)	Silica, dissolved (mg/L as SiO_2)	Iron, dissolved (µg/L as Fe)	Calcium, dissolved (mg/L as Ca)
2	281018082095201	2-15-66	57	--	--	--
		10-31-66		--	--	--
		5-16-67		--	--	--
		5-09-74		--	--	--
		9-13-74		--	--	--
		5-21-75		--	--	--
4	281022082075501	7-20-65	500	--	--	--
		2-15-66		--	--	--
		10-31-66		--	--	--
		5-16-67		--	--	--
7	281023082075701	7-20-65	100	--	--	--
		2-15-66		--	--	--
		10-31-66		--	--	--
8	281023082080801	7-20-65	90	--	--	--
		2-15-66		--	--	--
		10-31-66		--	--	--
[1]12	281023082451301	3-01-69	85	--	10	--
21	281037082071801	7-20-65	55	--	--	--
		2-15-66		--	--	--
		10-31-66		--	--	--
		5-16-67		--	--	--
22	281038082452801	7-24-84	--	6.8	30	62
26	281043082100401	7-20-65	80	--	--	--
		2-15-66		--	--	--
		10-31-66		--	--	--
28	281045082201201	7-26-84	--	16	140	80
34	281050082305901	3-19-73	653	--	--	80
*39	281053082310403	4-28-73	--	14	--	26
		4-24-74		15	9,800	13
40	281055082302401	6-21-71	708	11	--	82
46	281058082085201	7-20-65	400	--	--	--
		2-15-66		--	--	--
		10-31-66		--	--	--
		5-16-67		--	--	--
*48	281101082292502	8-19-71	9	4.6	--	3.5

Footnotes are at end of table.

Analyses of Water From Wells

per centimeter at 25 degrees Celsius; pCi/L, picocuries per liter]

Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Alkalinity (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)
--	--	--	--	--	18	0.1
--	--	--	--	--	15	.2
--	--	--	--	--	16	.1
--	--	--	--	--	--	--
--	--	--	--	--	--	--
--	--	--	--	--	--	--
--	--	--	--	--	8	.1
--	--	--	--	--	7	.1
--	--	--	--	--	5	.2
--	--	--	--	--	7	.1
--	--	--	--	--	--	--
--	--	--	--	--	--	--
--	--	--	--	--	--	--
--	--	--	--	--	11	.2
--	--	--	--	--	13	.2
--	--	--	--	--	14	.0
--	--	--	--	3	11	--
--	--	--	--	--	14	.2
--	--	--	--	--	11	.5
--	--	--	--	--	17	.4
--	--	--	--	--	16	.4
1.8	16	1.5	126	26	32	.2
--	--	--	--	--	10	.1
--	--	--	--	--	8	.1
--	--	--	--	--	5	.2
4.3	4.7	.5	206	<.1	7	.2
4.9	5.2	1.3	--	.8	--	<.1
4.4	9.0	.6	61	8.8	19	.2
2.1	10.0	.4	30	8	21	.1
4	4.8	.7	231	.4	8	.1
--	--	--	--	--	15	.2
--	--	--	--	--	15	.1
--	--	--	--	--	14	.2
--	--	--	--	--	14	.2
.8	1.4	.2	8	6.4	2.5	.3

Well No.	Identification No.	Date of sample	Well depth (feet)	Silica, dissolved (mg/L as SiO_2)	Iron, dissolved (µg/L as Fe)	Calcium, dissolved (mg/L as Ca)
49	281102082064001	5-16-67	40	--	--	--
50	281103082292301	8-19-71	62	--	--	--
*61	281109082241601	11-02-65	20	--	1,000	--
66	281117082291601	8-19-71	90	9.3	--	83
69	281119082291601	8-19-71	58	10	--	88
73	281122082344601	8-20-71	96	--	--	--
*74	281124082320701	8-23-71	15	15	--	78
76	281125082090301	7-20-65	105	--	--	--
		2-15-66		--	--	--
		10-31-66		--	--	--
		5-16-67		--	--	--
82	281132082323501	8-27-71	124	16	--	110
83	281137082300601	8-26-71	185	13	--	95
*84	281137082352801	11-03-65	10	--	50	--
87	281143082304701	8-26-71	69	12	--	78
88	281143082304702	10-24-64	345	16	--	61
		8-26-71		1.0	--	61
*89	281143082304703	11-02-65	5	--	4,000	--
92	281152082115701	7-19-65	176	--	--	--
		2-15-66		--	--	--
		10-31-66		--	--	--
		5-17-67		--	--	--
98	281217082101901	7-17-65	180	--	--	--
		2-14-66		--	--	--
		10-31-66		--	--	--
		5-17-67		--	--	--
101	281222082062301	2-16-66	41	--	--	--
		3-17-66		--	--	--
111	281234082112701	7-26-84	--	12	300	55
117	281248082160601	7-26-84	--	11	<10	61
118	281248082431101	7-24-84	--	12	40	80
121	281256082263601	8-26-71	168	5.5	--	59
122	281257082263401	8-26-71	69	14	--	76
124	281305082145101	7-26-84	--	13	30	70
128	281314082272401	8-27-71	197	--	--	--
132	281319082282401	8-27-71	100	10	--	50

Footnotes are at end of table.

Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Alkalinity (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)
--	--	--	--	--	17	.2
--	--	--	--	.4	5	--
--	--	--	--	--	7.8	--
1	3.3	.1	218	.4	6	.1
1.7	2.6	.4	226	.4	4	.1
--	--	--	--	0	10	--
3.5	9.2	.6	213	.4	10	.3
--	--	--	--	--	15	.2
--	--	--	--	--	15	.1
--	--	--	--	--	15	.2
--	--	--	--	--	13	.2
3.9	17	.4	285	0.0	33	.2
2.3	5.0	.5	236	.4	7	.1
--	--	--	--	--	--	--
3.6	6.4	.7	203	4	8	.1
54	4.2	1	--	3.2	8	0.0
3	6.2	.8	3	0.0	8	.3
--	--	--	--	--	48	--
--	--	--	--	--	6	.1
--	--	--	--	--	6	.1
--	--	--	--	--	5	.1
--	--	--	--	--	5	.1
--	--	--	--	--	4	.2
--	--	--	--	--	5	.1
--	--	--	--	--	8	.2
--	--	--	--	--	4	.1
--	--	--	--	--	22	.4
--	--	--	--	--	23	.2
6.6	4.7	.4	150	2.4	7	.3
1.3	5	.3	141	3.2	11	.2
14	54	3.4	131	70	100	.2
1.8	8.0	.7	--	6.4	2.5	.1
1.8	5.2	.4	197	.4	6	.2
5.3	4.7	.5	187	2.4	10	.2
--	--	--	--	1.6	8	--
1.2	4.6	.7	128	3.2	9	.2

Well No.	Identification No.	Date of sample	Well depth (feet)	Silica, dissolved (mg/L as SiO_2)	Iron, dissolved (µg/L as Fe)	Calcium, dissolved (mg/L as Ca)
135	281323082284601	8-27-71	730	--	--	--
144	281338082134501	7-26-84	--	15	620	86
150	281344082433601	3-15-62	65	--	150	--
156	281354082130701	7-26-84	--	10	30	54
159	281404082105201	3-16-62	560	9.2	--	47
160	281408082253101	12-15-76	--	12	--	60
161	281414082145901	7-28-77	200	12	--	62
162	281414082310001	3-11-71	712	--	--	73
*170	281427082382802	4-25-74	18	2.2	850	2.5
		4-23-75		1.9	820	1.0
171	281431082104701	3-16-62	964	--	--	52
192	281500082384501	6-05-75	345	8.4	20	57
		11-03-83		--	--	--
195	281504082102101	7-26-84	--	9.4	70	56
202	281512082094801	9-21-78	650	8.7	50	54
204	281512082421701	4-23-71	100	8.5	--	56
205	281512082422401	5-22-62	170	--	--	--
206	281512082423401	9-01-71	200	9.2	--	90
		9-01-71		9.2	--	90
		9-01-71		--	--	--
		9-01-71		--	--	--
207	281513082094601	7-28-77	550	9.8	--	53
211	281517082421101	8-02-71	160	12	--	69
213	281518082423901	5-22-62	228	--	--	--
236	281543082421201	11-21-61	200	--	--	--
237	281545082122001	7-29-77	228	13	--	52
		9-21-78		12	20	52
243	281602082175801	7-26-84	--	39	170	76
244	281606082100501	7-26-84	--	9.4	30	39
[1]245	281609082242901	1-09-73	495	--	--	--
249	281622082195101	7-26-84	--	16	<10	47
*256	281637082233502	12-15-76	13	--	--	8.7
257	281641082240201	12-13-76	700	14	--	100
[1]264	281649082234501	10-01-85	--	--	60	94
269	281654082065901	8-05-77	200	8.8	--	58

Footnotes are at end of table.

Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Alkalinity (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)
--	--	--	--	40	14	--
2.5	4.6	0.2	225	<.1	9	0.2
--	--	--	--	36	100	--
1.4	4.1	.1	131	<.1	7	.1
2.1	5.5	.1	--	3.6	9	0.0
2.3	4.3	--	--	<1	--	--
3.4	4.5	.8	169	.4	8.6	.1
4.1	5	.8	--	0.0	7	.2
.7	5.9	.1	4	5.7	9.9	.1
.4	5	.1	<1	7.7	6.5	<.1
6.4	4.6	.4	--	31	8	0.0
2.9	4.2	.4	144	6	5.6	.2
--	--	--	--	--	--	--
1.3	4.1	.1	134	7.2	5.4	.2
1.3	3.3	.1	130	1.8	5.3	.1
4.9	19	1.5	128	18	36	0.0
--	--	--	--	84	76	--
16	--	4	--	77	292	.2
16	--	4	--	77	292	--
--	--	--	116	--	--	--
--	--	--	116	--	--	.2
1.3	--	.3	134	.6	7.1	.1
4.9	15	.7	182	1.6	28	.1
--	--	--	--	46	172	--
--	--	--	--	10	27	--
2.8	4.4	.6	138	<1	11	.1
3	4.2	.5	130	1.4	8.2	.2
6.7	5	.9	216	<.1	8	.3
1.4	4.1	<.1	93	.4	5	.1
--	--	--	--	40	9	--
3.5	3.9	.3	111	3.2	8	.2
1.9	10	--	--	13	--	--
11	6.1	--	--	100	--	--
1.9	--	--	--	34	12.2	--
1	3.6	<.1	161	2.5	5.6	.2

Well No.	Identification No.	Date of sample	Well depth (feet)	Silica, dissolved (mg/L as SiO_2)	Iron, dissolved (µg/L as Fe)	Calcium, dissolved (mg/L as Ca)
281	281704082085201	7-28-77	247	8.8	--	45
		9-21-78		8.6	20	44
282	281709082090801	7-27-84	--	13	130	75
[1]283	281712082233901	10-01-85	--	--	60	94
284	281713082111501	7-28-77	600	10	--	46
		9-22-78		10	50	42
[1]290	281723082234001	10-01-85	--	--	30	88
293	281725082144801	7-28-77	447	14	--	72
[1]295	281733082233001	10-01-85	--	--	20	86
[1]296	281742082231101	10-01-85	--	--	10	90
[1]304	281739082215301	10-01-85	705	--	60	89
[1]305	281749082220401	10-01-85	705	--	70	85
[1]306	281754082230001	10-01-85	--	--	10	97
310	281802082225001	12-13-76	700	13	--	76
		10-01-85		--	40	91
[1]312	281804082223201	10-01-85	705	--	20	88
[1]318	281813082224201	10-01-85	750	--	20	86
322	281827082223501	10-01-85	700	--	120	83
*323	281828082223201	4-26-74	12	8.9	1,200	36
		4-23-75		7.6	1,000	42
324	281831082402301	7-14-60	517	--	30	--
325	281833082402001	5-15-62	345	--	750	--
329	281846082085501	7-28-77	265	12	--	41
		10-18-78		12	770	44
334	281908082184001	5-10-80	170	--	--	--
335	281917082201201	7-21-60	128	--	--	--
336	281917082420901	5-03-83	139	--	--	--
		5-01-84		--	--	--
		8-29-84		--	--	--
		5-02-85		--	--	--
340	281922082403901	8-01-83	200	--	--	--
		5-01-84		--	--	--
		8-29-84		--	--	--
		5-02-85		--	--	--
345	281929082131301	7-29-77	--	9.8	--	75
		9-21-78		9.5	1,700	74

Footnotes are at end of table.

Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Alkalinity (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)
1.3	4.5	0.3	121	<1	7.1	0.1
1.3	4.4	.3	110	1.4	6.3	.1
4.1	6.3	.3	201	<.1	9	.2
1.9	--	--	--	25	13.8	--
2.7	5.2	.4	118	.8	8.9	.1
2.6	4.8	.3	110	1.9	8.3	.1
1.9	--	--	208	14	13	--
2.4	5.7	.8	190	.2	12	.2
3.9	--	--	210	7	13	--
3.9	--	--	204	21	13	--
4.9	--	--	216	22	13	--
4.4	--	--	218	13	14	--
1	--	--	206	21	11	--
75	4.9	--	--	11	--	--
1	--	--	206	14	12.2	--
2.9	--	--	204	15	13	--
2.9	--	--	206	11	13	--
1.5	--	--	--	4	11.7	--
3.3	5	.2	103	1.8	9.2	.1
3.1	5	.2	114	1.9	9.3	.1
--	--	--	--	--	10	--
--	--	--	--	--	8.5	--
2.3	5.2	.6	102	5.9	10	.1
2.7	5.1	.5	97	6.1	9.7	.1
--	--	--	--	--	--	--
--	--	--	--	--	9	--
--	--	--	--	100	890	--
--	--	--	--	92	880	--
--	--	--	--	94	890	--
--	--	--	--	88	890	--
--	--	--	--	260	3,000	--
--	--	--	--	240	2,800	--
--	--	--	--	220	2,800	--
--	--	--	--	180	2,700	--
1.7	6.3	.5	194	.4	14	.1
1.9	5.8	.4	180	1.2	13	.1

Well No.	Identification No.	Date of sample	Well depth (feet)	Silica, dissolved (mg/L as SiO_2)	Iron, dissolved (μg/L as Fe)	Calcium, dissolved (mg/L as Ca)
346	281930082093701	7-28-77	--	8.2	--	45
		10-13-78		8.0	40	41
350	281936082112201	10-17-78	472	7.8	30	54
351	281938082402101	1-03-85	72	5.8	9	49
360	282005082112801	7-28-77	565	10	--	31
361	282005082153501	8-05-77	649	9.9	--	45
		8-21-78		10	80	45
364	282011082162701	10-12-78	350	9.6	520	48
367	282037082370301	7-24-84	100	7.9	100	79
368	282038082112001	7-28-77	475	9.8	--	49
		10-12-78		9.4	30	49
371	282048082123301	12-10-75	1,434	10	--	103
		12-16-75	--	--	--	--
		12-16-75	--	--	--	--
		12-16-75	--	--	--	--
		12-16-75	--	--	--	--
		12-16-75	--	--	--	--
		12-16-75	--	--	--	--
		12-16-75	--	--	--	--
		12-16-75	--	--	--	--
		12-16-75	--	--	--	--
		12-16-75	--	--	--	--
		12-17-75	--	--	--	--
		12-17-75	--	--	--	--
		12-17-75	--	--	--	--
		12-17-75	--	--	--	--
		12-17-75	--	--	--	--
372	282052082404301	7-24-84	--	6.1	30	82
373	282106082140801	7-27-84	--	9.4	30	53
376	282110082123201	7-27-84	--	10	30	56
382	282121082071101	7-29-77	184	6.8	--	67
		9-22-78		6.0	--	66
[1]383	282123082274401	12-01-85	710	--	860	74
[1]387	282133082275301	12-01-85	702	--	700	71
388	282138082414801	9-27-55	103	--	920	--

Footnotes are at end of table.

Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Alkalinity (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)
2.9	5.1	3.4	70	7.2	16	0.1
2.5	4.4	2.8	90	7.9	14	.1
3.3	6.8	.5	120	4.3	15	.1
1.9	11	.9	95	13	19	.1
5.2	4.2	.4	101	3.4	8.4	<.1
12	4.6	.4	<1	2	7.8	.3
13	4	.5	160	2.7	7.5	.2
2.2	4.4	.5	110	2.7	8	.1
2.3	4	.3	187	<.1	7	.1
5.1	5.2	.5	134	12	8.9	.1
5.5	5	.3	120	12	8	.1
1.4	--	--	--	140	9.2	--
--	--	--	--	--	--	--
--	--	--	--	--	19	--
--	--	--	--	--	--	--
--	--	--	--	--	--	--
--	--	--	--	--	--	--
--	--	--	--	--	19	--
--	--	--	--	--	--	--
--	--	--	--	--	--	--
--	--	--	--	--	--	--
--	--	--	--	--	--	--
--	--	--	--	--	14	--
--	--	--	--	--	--	--
--	--	--	--	--	--	--
--	--	--	--	--	--	--
--	--	--	--	--	19	--
8	51	2.2	183	18	85	.2
2.5	4.9	.1	134	.1	11	.1
3.5	5.7	.2	138	<.1	10	.1
1.2	4.1	.5	174	.3	9	<.1
1.3	3.9	.2	160	3.4	7.5	<.1
1.5	--	--	--	1	12.5	--
2.9	--	--	--	1	13	--
--	--	--	--	27	208	--

Well No.	Identification No.	Date of sample	Well depth (feet)	Silica, dissolved (mg/L as SiO_2)	Iron, dissolved (μg/L as Fe)	Calcium, dissolved (mg/L as Ca)
389	282138082414801	5-16-57	123	--	800	--
[1]393	282142082283701	12-01-85	700	--	140	73
395	282143082093201	7-29-77	184	14	--	53
397	282147082113001	8-11-71	200	9.0	--	44
		7-28-77		9.8	--	48
		10-13-78		9.5	<10	47
398	282147082113002	8-11-71	200	8.8	--	42
406	282153082085602	9-22-78	120	7.5	20	44
407	282154082142401	7-28-77	--	11	--	34
		9-21-78		11	<10	34
[1]408	282154082280101	12-01-85	705	--	430	74
411	282155082132601	10-13-78	--	11	200	44
416	282207082402401	7-25-84	--	6.3	30	56
417	282212082094801	9-23-78	--	1.9	50	46
418	282221082103001	7-29-77	78	8.8	--	51
[1]419	282222082280701	12-01-85	705	--	480	72
421	282228082402001	2-19-80	100	6.4	--	69
425	282232082113901	7-27-84	--	10	40	52
428	282233082112202	7-29-77	69	9.8	--	53
		10-17-78		9.2	70	50
429	282233082112203	7-29-77	461	9.6	--	50
[1]430	282233082283801	12-01-85	705	--	500	68
431	282234082164401	7-28-77	365	19	--	49
		9-21-78		17	30	49
432	282235082111901	7-29-77	466	9.8	--	53
		10-17-78		9.5	<10	54
433	282235082112301	7-29-77	462	9.6	--	54
435	282240082112001	8-05-77	456	9.2	--	54
436	282240082112002	8-05-77	115	9.2	--	54
[1]437	282246082281601	12-01-85	485	--	680	72
[1]450	282310082281901	12-01-85	710	--	570	73
*455	282321082401001	10-28-65	14	--	--	--
[1]457	282324082281901	12-01-85	703	--	460	68
459	282326082112001	7-28-77	125	10	--	53
464	282332082110101	8-05-77	465	10	--	53

Footnotes are at end of table.

Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Alkalinity (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)
--	--	--	--	38	203	--
1.5	--	--	--	1	12.5	--
1.8	12	0.7	149	.1	17	0.1
4.7	6	.4	118	14	8	0.0
4.8	5.1	.5	126	15	8.4	.1
5.1	4.7	.4	110	14	8	.1
4.6	6	.3	118	14	8	0.0
1.4	4.5	.3	90	3.3	8.4	.1
5.1	3.2	.6	108	.1	5.7	--
5.5	2.9	.4	98	3	5.1	.1
2.9	--	--	--	1	12.5	--
2.8	7	.3	80	1.3	14	.1
3.7	21	.7	128	13	41	.1
2.1	4	.1	110	5.1	6.7	.3
3.7	6.3	.5	106	15	15	.1
1.5	--	--	--	2	12.5	--
6.5	57	1.7	150	20	110	.1
5.2	6.9	.1	132	7.6	11	.1
6.3	6.3	.9	141	14	11	.2
5.1	5.7	.6	120	12	9.1	.1
6.3	5.3	.4	138	14	8.7	.3
--	--	--	--	--	--	--
7.1	4.3	.7	154	.6	6.6	.2
6.8	3.9	.6	160	1.1	5.8	.2
6.3	6	.6	148	13	9.7	.1
6.8	5.1	.5	140	16	8.5	.1
6.3	6.5	.5	144	14	12	.1
6.5	6.1	.5	<1	15	10	.2
6.1	6.3	.5	148	15	9	.2
--	--	--	--	--	--	--
--	--	--	--	--	--	--
--	--	--	--	--	--	--
--	--	--	--	--	--	--
3.4	5.4	.3	138	5.6	8.9	.1
2.6	5.6	.3	141	5.3	8.4	.1

Well No.	Identification No.	Date of sample	Well depth (feet)	Silica, dissolved (mg/L as SiO_2)	Iron, dissolved (µg/L as Fe)	Calcium, dissolved (mg/L as Ca)
465	282336082091001	7-29-77	--	9.5	--	59
		9-22-78		8.9	2,200	55
[1]467	282342082274801	12-01-85	710	--	410	68
468	282346082114901	7-28-77	710	9.8	--	38
		10-13-78		9.5	50	38
[1]469	282346082271201	12-01-85	702	--	110	67
[1]472	282352082263901	12-01-85	710	--	60	63
473	282353082055301	7-29-77	110	8.0	--	70
474	282404082161301	9-20-78	--	17	260	64
[1]478	282410082271301	12-01-85	700	--	350	70
487	282418082161301	9-20-78	470	17	260	64
488	282418082162001	8-05-77	--	14	--	88
[1]492	282422082263901	12-01-85	710	--	20	69
[1]493	282422082275101	12-01-85	710	--	40	72
496	282428082182801	7-29-77	--	36	--	29
		10-18-78		19	110	48
497	282430082112101	10-13-78	--	7.6	130	50
506	282442082124401	7-28-77	--	9.4	--	36
		9-21-78		9.2	<10	34
[1]507	282442082273201	12-01-85	630	--	160	67
[1]509	282443082263901	12-01-85	710	--	20	61
511	282459082164301	7-28-77	290	19	--	64
		9-20-78		19	170	63
520	282527082112301	7-28-77	225	9.5	--	42
523	282540082275701	1-12-83	82	8.9	--	75
*524	282540082275702	10-26-65	10	--	--	--
529	282553082370201	6-25-80	100	5.2	10	28
530	282553082395301	7-25-84	165	6.4	900	130
531	282553082395302	7-25-84	43	5.4	900	130
533	282717082142001	1-26-79	275	10	<10	38

*Shallow well.
[1]Private lab analysis.

Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Alkalinity (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)
1.2	5.8	0.5	154	4.3	11	--
1.4	5.9	.4	150	5.7	11	0.1
1.9	--	--	--	3	12.5	--
3.5	4.6	.6	103	5.4	8.2	--
3.7	4	.4	98	5	6.6	.1
2.4	--	--	--	1	11.5	--
1.5	--	--	--	1	10.5	--
1.9	6.1	2.2	171	4.4	13	.1
7.0	5.3	.5	190	1.2	8.6	.1
1.5	--	--	--	2	12.5	--
7	5.3	.5	190	1.2	8.6	.1
16	5.1	.6	184	100	8.8	.4
1.9	--	--	--	1	10.5	--
2.4	--	--	--	1	12.5	--
9.1	4.9	.6	116	.4	6.6	.6
5.1	4.3	.5	120	.5	8.2	.3
2.7	4.3	.3	120	5.7	7.2	.1
3.2	5.4	.4	92	4.4	9.2	.1
3.4	4.9	.2	90	4.1	8.4	.1
3.4	--	--	--	1	11	--
2.9	--	--	--	2	9.5	--
7	7	.6	194	.1	12	.1
7.4	7	.5	190	1.2	11	.2
4.8	5.8	.6	124	5.2	8.9	.1
1.2	5.7	.7	161	4	9	.3
--	--	--	--	--	--	--
1.1	3	.3	64	4.7	4.5	.1
5.8	230	6.6	241	36	430	.2
7.8	46	3.3	387	<.1	45	.3
5.4	3.9	.3	110	6.3	7.2	.1

Well No.	Nitrogen, $NO_2 + NO_3$, dissolved (mg/L as N)	Phos-phorus, dissolved (mg/L as P)	Solids, sum of constit-uents, dissolved (mg/L)	Hardness (mg/L as $CaCO_3$)	Hardness, noncarbo-nate (mg/L as $CaCO_3$)	Specific conduc-tance (µS/cm)
2	--	--	--	--	--	475
	--	--	--	--	--	330
	--	--	--	--	--	520
	--	--	--	--	--	--
	--	--	--	--	--	--
	--	--	--	--	--	--
4	--	--	--	--	--	395
	--	--	--	--	--	408
	--	--	--	--	--	349
	--	--	--	--	--	440
7	--	--	--	--	--	390
	--	--	--	--	--	425
	--	--	--	--	--	449
8	--	--	--	--	--	380
	--	--	--	--	--	372
	--	--	--	--	--	400
12	--	--	--	122	--	--
21	--	--	--	--	--	510
	--	--	--	--	--	282
	--	--	--	--	--	302
	--	--	--	--	--	375
22	--	--	--	--	--	398
26	--	--	--	--	--	460
	--	--	--	--	--	450
	--	--	--	--	--	485
28	--	--	--	--	--	409
34	--	--	--	--	--	--
39	--	--	122	83	23	210
	--	0.030	103	41	12	127
40	--	--	250	220	0	416
46	--	--	--	--	--	520
	--	--	--	--	--	372
	--	--	--	--	--	420
	--	--	--	--	--	540
48	--	--	26	12	4	39
49	--	--	--	--	--	168
50	--	--	--	158	--	271
61	--	--	--	--	--	99
66	--	--	234	210	0	389
69	--	--	245	230	0	426

pH (units)	Temperature (°C)	Strontium, dissolved (µg/L as Sr)	Bicarbonate, IT-lab (mg/L as HCO_3)	Nitrogen, ammonia, dissolved (mg/L as NH_4)	Phosphate, ortho, dissolved (mg/L as PO_4)	Nitrogen, nitrite, dissolved (mg/L as NO_2)
--	23.0	--	--	--	0.21	--
--	23.5	--	--	--	.02	--
--	--	--	--	--	.00	--
--	--	--	--	--	--	--
--	--	--	--	--	--	--
--	--	--	--	--	--	--
--	23.0	--	--	--	.25	--
--	24.0	--	--	--	.10	--
--	23.0	--	--	--	.10	--
--	--	--	--	--	.05	--
--	23.0	--	--	--	.21	--
--	19.0	--	--	--	.13	--
--	23.0	--	--	--	.06	--
--	23.0	--	--	--	.05	--
--	24.0	--	--	--	.08	--
--	24.0	--	--	--	.03	--
--	--	--	--	--	--	--
--	23.0	--	--	--	.21	--
--	22.0	--	--	--	.44	--
--	22.0	--	--	--	.06	--
--	--	--	--	--	.15	--
8.3	29.5	270	--	--	--	--
--	23.0	--	--	--	--	--
--	25.0	--	--	--	--	--
--	--	--	--	--	--	--
7.5	24.5	200	--	--	--	--
--	--	--	--	--	--	--
6.4	--	310	--	--	--	.02
5.4	--	40	--	0.55	.09	.00
7.1	24.5	2	--	--	--	.00
--	23.0	--	--	--	.17	--
--	--	--	--	--	.08	--
--	24.0	--	--	--	.00	--
--	--	--	--	--	.18	--
6.6	--	0	--	--	--	.00
--	--	--	--	--	.10	--
6.3	24.0	--	--	--	--	--
--	25.0	--	--	--	--	--
6.7	23.5	1	--	--	--	.00
6.5	23.0	1	--	--	--	.00

Well No.	Nitrogen, $NO_2 + NO_3$, dissolved (mg/L as N)	Phosphorus, dissolved (mg/L as P)	Solids, sum of constituents, dissolved (mg/L)	Hardness (mg/L as $CaCO_3$)	Hardness, noncarbonate (mg/L as $CaCO_3$)	Specific conductance (µS/cm)
73	--	--	--	205	--	400
74	--	--	246	210	0	412
76	--	--	--	--	--	510
	--	--	--	--	--	420
	--	--	--	--	--	520
	--	--	--	--	--	520
82	--	--	352	290	5	628
83	--	--	268	250	10	459
84	--	--	--	--	--	--
87	--	--	237	210	6	442
88	--	--	235	174	30	418
	--	--	66	50	0	132
89	--	--	--	--	--	1,320
92	--	--	--	--	--	320
	--	--	--	--	--	250
	--	--	--	--	--	295
	--	--	--	--	--	298
98	--	--	--	--	--	240
	--	--	--	--	--	246
	--	--	--	--	--	265
	--	--	--	--	--	250
101	--	--	--	--	--	560
	--	--	--	--	--	700
111	--	--	--	--	--	311
117	--	--	--	--	--	325
118	--	--	--	--	--	740
121	--	--	179	160	0	330
122	--	--	222	200	0	372
124	--	--	--	--	--	394
128	--	--	--	134	--	290
132	--	--	158	130	2	274
135	--	--	--	184	--	395
144	--	--	--	--	--	438
150	--	--	--	248	--	710
156	--	--	--	--	--	275
159	--	--	150	126	10	268
160	--	--	--	160	--	--
161	--	--	190	170	1	340
162	--	--	--	197	--	400
170	--	<0.010	31	9	5	52

pH (units)	Temperature (°C)	Strontium, dissolved (µg/L as Sr)	Bicarbonate, IT-lab (mg/L as HCO_3)	Nitrogen, ammonia, dissolved (mg/L as NH_4)	Phosphate, ortho, dissolved (mg/L as PO_4)	Nitrogen, nitrite, dissolved (mg/L as NO_2)
7.5	25.0	--	--	--	--	--
6.8	23.5	1	--	--	--	0.00
--	23.0	--	--	--	0.02	--
--	18.0	--	--	--	.21	--
--	--	--	--	--	.00	--
--	--	--	--	--	.05	--
6.6	24.0	2	--	--	--	.00
6.5	25.5	1	--	--	--	.00
--	25.0	--	--	--	--	--
7.7	23.5	1	--	--	--	.00
8.0	24.0	--	--	--	--	--
6.0	24.0	0	--	--	--	.00
--	24.0	--	--	--	--	--
--	23.0	--	--	--	.07	--
--	22.0	--	--	--	.13	--
--	24.0	--	--	--	.01	--
--	--	--	--	--	.05	--
--	23.0	--	--	--	.03	--
--	24.0	--	--	--	.21	--
--	24.0	--	--	--	.00	--
--	--	--	--	--	.15	--
--	23.0	--	--	--	.18	--
--	21.0	--	--	--	.13	--
7.4	24.5	1,000	--	--	--	--
7.4	23.5	190	--	--	--	--
7.6	24.5	290	--	--	--	--
7.0	22.5	1	--	--	--	.00
6.5	24.0	1	--	--	--	.00
7.4	23.5	220	--	--	--	--
--	23.0	--	--	--	--	--
6.3	23.5	0	--	--	--	.00
7.0	23.0	--	--	--	--	--
7.2	23.5	220	--	--	--	--
--	23.0	--	--	--	--	--
7.2	24.0	210	--	--	--	--
7.4	24.0	--	--	--	--	--
--	--	--	--	--	--	--
8.0	23.0	100	--	--	--	--
--	--	100	--	--	--	--
5.0	--	40	--	0.19	.00	.00

Well No.	Nitrogen, $NO_2 + NO_3$, dissolved (mg/L as N)	Phosphorus, dissolved (mg/L as P)	Solids, sum of constituents, dissolved (mg/L)	Hardness (mg/L as $CaCO_3$)	Hardness, noncarbonate (mg/L as $CaCO_3$)	Specific conductance (µS/cm)
170	--	--	24	4	4	55
171	--	--	183	156	40	315
192	--	--	172	150	10	309
	--	--	--	--	--	440
195	--	--	--	--	--	281
202	--	--	154	140	9	287
204	--	--	228	160	32	403
205	--	--	--	180	--	460
206	--	--	715	290	170	1,350
	--	--	--	--	--	1,350
	--	--	--	--	--	--
	--	--	--	--	--	--
207	--	--	160	140	1	285
211	--	--	242	190	10	430
213	--	--	--	200	--	705
236	--	--	--	116	--	297
237	--	--	170	140	2	300
	--	--	160	140	11	288
243	--	--	--	--	--	422
244	--	--	--	--	--	420
245	--	--	--	252	--	315
249	--	--	--	--	--	264
256	--	--	--	30	--	--
257	--	--	--	300	--	--
264	--	--	278	200	42	--
269	--	--	176	150	0	290
281	--	--	140	120	0	260
	--	--	131	120	9	255
282	--	--	--	--	--	396
283	--	--	279	204	40	--
284	--	--	150	130	12	275
	--	--	134	120	9	264
290	--	--	249	208	20	--
293	--	--	220	190	0	382
295	--	--	235	210	20	--
296	--	--	250	204	38	--
304	--	--	298	216	26	--
305	--	--	271	218	12	--
306	--	--	254	206	40	--
310	--	--	--	500	--	--

pH (units)	Temperature (°C)	Strontium, dissolved ($\mu g/L$ as Sr)	Bicarbonate, IT-lab (mg/L as HCO_3)	Nitrogen, ammonia, dissolved (mg/L as NH_4)	Phosphate, ortho, dissolved (mg/L as PO_4)	Nitrogen, nitrite, dissolved (mg/L as NO_2)
4.5	--	50	--	--	--	--
8.1	24.5	--	--	--	--	--
7.8	--	120	--	--	--	--
--	25.0	--	--	--	--	--
--	24.0	240	--	--	--	--
7.4	24.5	110	--	--	--	--
6.9	--	1	--	--	--	0.00
--	--	--	--	--	--	--
7.2	--	5	--	--	--	--
7.2	--	--	--	--	--	--
--	--	--	--	--	--	--
--	--	--	--	--	--	--
8.2	24.0	130	--	--	--	--
7.1	--	2	--	--	--	.00
--	24.0	--	--	--	--	--
--	--	--	--	--	--	--
7.9	--	90	--	--	--	--
7.2	26.0	90	--	--	--	--
7.4	23.5	220	--	--	--	--
7.4	23.5	210	--	--	--	--
--	--	--	--	--	--	--
7.4	23.5	180	--	--	--	--
--	--	--	--	--	--	--
--	--	--	--	--	--	--
7.4	--	--	--	--	--	--
--	23.0	80	--	--	--	--
8.3	23.0	90	--	--	--	--
7.3	24.5	80	--	--	--	--
7.1	23.5	450	--	--	--	--
7.4	--	--	--	--	--	--
8.3	23.0	120	--	--	--	--
7.1	24.5	100	--	--	--	--
7.4	--	--	--	--	--	--
7.9	23.5	110	--	--	--	--
7.4	--	--	--	--	--	--
7.4	--	--	--	--	--	--
7.6	--	--	--	--	--	--
7.5	--	--	--	--	--	--
7.4	--	--	--	--	--	--
--	--	--	--	--	--	--

Well No.	Nitrogen, $NO_2 + NO_3$, dissolved (mg/L as N)	Phos-phorus, dissolved (mg/L as P)	Solids, sum of constit-uents, dissolved (mg/L)	Hardness (mg/L as $CaCO_3$)	Hardness, noncarbo-nate (mg/L as $CaCO_3$)	Specific conduc-tance ($\mu S/cm$)
310	--	--	--	232	26	--
312	--	--	249	204	28	--
318	--	--	332	206	22	--
322	--	--	213	194	20	--
323	--	--	128	100	0	222
	--	--	139	120	4	248
324	--	--	--	--	--	--
325	--	--	--	202	--	396
329	--	--	140	110	8	258
	--	--	139	120	23	250
334	--	--	--	--	--	165
335	--	--	--	164	2	322
336	--	--	--	--	--	3,150
	--	--	--	--	--	3,250
	--	--	--	--	--	3,300
	--	--	--	--	--	3,450
340	--	--	--	--	--	10,500
	--	--	--	--	--	9,500
	--	--	--	--	--	9,400
	--	--	--	--	--	9,000
345	--	--	220	190	0	390
	--	--	216	190	12	400
346	--	--	130	120	50	310
	--	--	135	110	20	240
350	--	--	166	150	25	318
351	1.6	--	--	--	--	290
360	--	--	120	99	0	222
361	--	--	82	160	160	330
	--	--	177	170	10	343
364	--	--	145	130	14	252
367	--	--	--	--	--	--
368	--	--	170	140	6	305
	--	--	164	150	22	273
371	--	--	--	264	146	--
	--	--	--	520	--	960
	--	--	--	520	--	975
	--	--	--	500	--	975
	--	--	--	530	--	975
	--	--	--	540	--	980
	--	--	--	550	--	1,000

pH (units)	Temperature (°C)	Strontium, dissolved (µg/L as Sr)	Bicarbonate, IT-lab (mg/L as HCO_3)	Nitrogen, ammonia, dissolved (mg/L as NH_4)	Phosphate, ortho, dissolved (mg/L as PO_4)	Nitrogen, nitrite, dissolved (mg/L as NO_2)
7.4	--	--	--	--	--	--
7.4	--	--	--	--	--	--
7.4	--	--	--	--	--	--
7.5	--	--	--	--	--	--
6.9	--	110	--	0.08	0.03	0.00
7.1	--	40	--	--	--	--
--	--	--	--	--	--	--
--	24.0	--	--	--	--	--
8.2	23.0	230	--	--	--	--
7.8	24.0	260	--	--	--	--
7.4	23.0	--	--	--	--	--
7.3	--	--	--	--	--	--
--	24.5	--	--	--	--	--
--	24.5	--	--	--	--	--
--	25.0	--	--	--	--	--
--	25.0	--	--	--	--	--
--	24.0	--	--	--	--	--
--	24.5	--	--	--	--	--
--	24.5	--	--	--	--	--
--	24.5	--	--	--	--	--
8.3	--	80	--	--	--	--
6.9	24.0	90	--	--	--	--
8.1	23.0	120	--	--	--	--
7.6	24.0	120	--	--	--	--
7.5	24.0	70	--	--	--	--
7.3	24.0	86	--	--	--	.01
7.5	24.0	80	--	--	--	--
--	25.0	100	--	--	--	--
7.3	24.5	100	--	--	--	--
7.8	25.0	100	--	--	--	--
7.2	24.5	310	--	--	--	--
8.1	23.0	220	--	--	--	--
7.9	24.0	230	--	--	--	--
8.0	--	--	--	--	--	--
7.8	--	--	--	--	--	--
7.6	--	--	--	--	--	--
7.6	--	--	--	--	--	--
7.5	--	--	--	--	--	--
7.6	--	--	--	--	--	--
7.6	--	--	--	--	--	--

Well No.	Nitrogen, $NO_2 + NO_3$, dissolved (mg/L as N)	Phos-phorus, dissolved (mg/L as P)	Solids, sum of constit-uents, dissolved (mg/L)	Hardness (mg/L as $CaCO_3$)	Hardness, noncarbo-nate (mg/L as $CaCO_3$)	Specific conduc-tance (µS/cm)
371	--	--	--	570	--	1,030
	--	--	--	695	--	1,200
	--	--	--	930	--	1,550
	--	--	--	810	--	1,380
	--	--	--	525	--	960
	--	--	--	530	--	980
	--	--	--	820	--	1,380
	--	--	--	1,230	--	1,920
	--	--	--	545	--	1,025
372	--	--	--	--	--	--
373	--	--	--	--	--	290
376	--	--	--	--	--	320
382	--	--	--	170	0	345
	--	--	--	170	14	335
383	--	--	228	191	0	--
387	--	--	226	189	0	--
388	--	--	--	295	--	--
389	--	--	--	335	--	--
393	--	--	227	189	0	--
395	--	--	190	140	0	325
397	--	--	161	130	11	276
	--	--	170	140	14	295
	--	--	158	140	24	276
398	--	--	158	120	6	275
406	--	--	124	120	26	246
407	--	--	120	110	2	225
	--	--	121	110	9	221
408	--	--	221	197	0	--
411	--	--	129	120	42	254
416	--	--	--	--	--	409
417	--	--	131	120	17	255
418	--	--	206	140	36	320
419	--	--	213	185	0	--
421	--	--	361	200	49	679
425	--	--	--	--	--	317
428	--	--	190	160	19	340
	--	--	166	150	23	307
429	--	--	180	150	12	320
430	--	--	206	181	0	--
431	--	--	180	150	0	305

pH (units)	Temperature (°C)	Strontium, dissolved (µg/L as Sr)	Bicarbonate, IT-lab (mg/L as HCO_3)	Nitrogen, ammonia, dissolved (mg/L as NH_4)	Phosphate, ortho, dissolved (mg/L as PO_4)	Nitrogen, nitrite, dissolved (mg/L as NO_2)
7.6	--	--	--	--	--	--
7.5	--	--	--	--	--	--
7.4	--	--	--	--	--	--
7.5	--	--	--	--	--	--
8.1	--	--	--	--	--	--
7.6	--	--	--	--	--	--
7.5	--	--	--	--	--	--
7.4	--	--	--	--	--	--
7.6	--	--	--	--	--	--
7.2	24.0	340	--	--	--	--
7.3	23.5	160	--	--	--	--
7.2	23.5	170	--	--	--	--
7.6	--	--	--	--	--	--
6.7	23.5	--	--	--	--	--
7.4	--	--	--	--	--	--
7.3	--	--	--	--	--	--
--	23.0	--	--	--	--	--
--	23.0	--	--	--	--	--
7.4	--	--	--	--	--	--
8.1	--	60	--	--	--	--
7.1	23.5	2	--	--	--	--
8.0	23.0	270	--	--	--	0.00
7.9	24.0	290	--	--	--	--
7.0	23.5	2	--	--	--	.00
7.3	23.5	110	--	--	--	--
7.9	23.0	70	--	--	--	--
7.0	25.0	70	--	--	--	--
7.4	--	--	--	--	--	--
7.5	24.0	80	--	--	--	--
7.4	23.0	330	--	--	--	--
7.4	24.0	180	--	--	--	--
8.2	--	200	--	--	--	--
7.3	--	--	--	--	--	--
6.7	23.0	250	--	--	--	--
7.2	23.5	310	--	--	--	--
7.7	23.0	280	--	--	--	--
7.6	24.0	210	--	--	--	--
7.8	23.5	310	--	--	--	--
7.4	--	--	--	--	--	--
8.4	23.0	120	--	--	--	--

Well No.	Nitrogen, $NO_2 + NO_3$, dissolved (mg/L as N)	Phos-phorus, dissolved (mg/L as P)	Solids, sum of constit-uents, dissolved (mg/L)	Hardness (mg/L as $CaCO_3$)	Hardness, noncarbo-nate (mg/L as $CaCO_3$)	Specific conduc-tance (μS/cm)
431	--	--	178	150	0	310
432	--	--	190	160	12	335
	--	--	185	160	24	332
433	--	--	190	160	16	340
435	--	--	102	160	160	334
436	--	--	190	160	12	335
437	--	--	228	187	0	--
450	--	--	222	185	0	--
455	--	--	--	--	--	75
457	--	--	211	177	0	--
459	--	--	170	150	12	310
464	--	--	170	140	2	288
465	--	--	180	150	0	322
	--	--	179	140	0	313
467	--	--	213	177	0	--
468	--	--	130	110	7	240
	--	--	127	110	12	221
469	--	--	205	177	0	--
472	--	--	188	163	0	--
473	--	--	210	180	9	372
474	--	--	218	190	0	376
478	--	--	195	181	0	--
487	--	--	218	190	0	376
488	--	--	345	290	100	396
492	--	--	199	181	0	--
493	--	--	205	189	0	--
496	--	--	160	110	0	240
	--	--	160	140	18	276
497	--	--	152	140	13	353
506	--	--	120	100	7	240
	--	--	119	99	9	238
507	--	--	196	181	0	--
509	--	--	181	165	0	--
511	--	--	230	190	0	385
	--	--	223	190	0	385
520	--	--	150	120	0	270
523	--	--	240	190	--	372
524	--	--	--	--	--	25
529	--	--	90	75	11	184
530	--	--	--	--	--	1,900
531	--	--	--	--	--	848
533	--	--	135	120	11	260

pH (units)	Temperature (°C)	Strontium, dissolved (μg/L as Sr)	Bicarbonate, IT-lab (mg/L as HCO_3)	Nitrogen, ammonia, dissolved (mg/L as NH_4)	Phosphate, ortho, dissolved (mg/L as PO_4)	Nitrogen, nitrite, dissolved (mg/L as NO_2)
7.2	25.0	120	--	--	--	--
7.9	24.0	300	--	--	--	--
7.6	24.0	310	--	--	--	--
8.0	23.5	300	--	--	--	--
--	24.5	300	--	--	--	--
--	23.5	280	--	--	--	--
7.4	--	--	--	--	--	--
7.4	--	--	--	--	--	--
--	24.0	--	--	--	--	--
7.4	--	--	--	--	--	--
7.5	23.0	180	--	--	--	--
--	23.0	180	--	--	--	--
7.7	--	80	--	--	--	--
7.2	23.5	90	--	--	--	--
7.4	--	--	--	--	--	--
8.1	--	200	--	--	--	--
8.0	24.0	220	--	--	--	--
7.5	--	--	--	--	--	--
7.5	--	--	--	--	--	--
8.0	--	110	--	--	--	--
6.8	25.5	160	--	--	--	--
7.4	--	--	--	--	--	--
6.8	25.5	160	--	--	--	--
--	--	1,900	--	--	--	--
7.6	--	--	--	--	--	--
7.7	--	--	--	--	--	--
8.4	23.5	100	--	--	--	--
7.8	23.5	120	--	--	--	--
7.2	24.0	170	--	--	--	--
7.2	23.0	140	--	--	--	--
7.6	24.0	140	--	--	--	--
7.6	--	--	--	--	--	--
7.7	--	--	--	--	--	--
8.0	23.5	120	--	--	--	--
7.2	24.0	130	--	--	--	--
8.0	23.0	170	--	--	--	--
7.4	24.5	110	196	--	--	--
--	26.0	--	--	--	--	--
7.0	26.5	60	--	--	--	--
7.1	23.5	1,300	--	--	--	--
7.1	26.0	350	--	--	--	--
7.2	23.5	110	--	--	--	--

APPENDIX C: Concentrations of Chloride, Specific Conductance, and Temperature for Selected Wells

[mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 °C]

Well No.	Identification No.	Date	Depth (feet)	Chloride (mg/L as Cl)	Specific conductance (µS/cm)	Temperature (°C)
11	281023082450701	9-16-75	188	14,000	36,500	26.0
		1-07-77		14,000	37,200	25.5
		5-10-77		14,000	37,000	26.0
		9-20-77		14,000	38,000	25.5
		1-24-78		12,000	31,000	25.5
		5-18-78		12,000	33,000	26.0
		9-27-78		11,000	29,000	25.5
		5-17-84		6,800	20,600	25.5
		9-12-84		6,200	18,400	--
		5-15-85		9,600	26,900	25.5
		9-11-85		9,600	25,600	25.0
19	281035082464901	9-20-77	34	900	3,280	25.5
		1-24-78		880	3,090	25.0
		5-18-78		870	3,200	24.0
		9-27-78		770	2,950	24.5
20	281036082440901	9-17-69	121	575	2,280	--
27	281043082443601	5-03-66	40	18	320	--
31	281046082470801	3-12-71	159	2,600	8,800	--
		5-24-71		1,800	6,600	--
		7-01-71		2,000	7,100	--
		9-01-71		1,900	6,900	--
		11-01-71		6,900	--	--
		1-03-72		1,800	7,000	--
		3-01-72		1,600	7,000	--
		5-09-72		2,600	7,900	--
		7-03-72		4,200	16,600	--
		9-06-72		9,000	26,300	--
		11-06-72		12,000	36,400	--
		1-08-73		50,000	40,700	--
		5-14-73		15,000	39,900	--
		7-09-73		16,000	42,400	--
		9-04-73		17,000	44,000	--
		11-06-73		17,000	45,500	--
		1-02-74		17,000	43,900	--
		3-04-74		18,000	46,000	--
		5-21-74		18,000	46,500	--
		7-10-74		17,000	46,800	--
		9-26-77		18,000	45,800	--
		1-24-78		16,000	39,000	25.0
		5-18-78		17,000	46,000	25.0

Well No.	Identification No.	Date	Depth (feet)	Chloride (mg/L as Cl)	Specific conductance (μS/cm)	Temperature (°C)
31	281046082470801	9-27-78	159	16,000	42,000	25.0
		5-16-79		17,000	35,000	24.0
		9-19-79		17,000	44,000	25.5
		5-13-80		17,000	42,000	26.0
		9-18-80		17,000	43,000	24.5
		5-29-81		17,000	45,000	--
		9-22-81		18,000	40,000	24.0
		5-12-82		17,000	45,000	24.5
		9-15-82		18,000	42,000	24.5
		5-17-83		14,000	36,300	25.0
		5-17-84		12,000	33,700	25.0
		9-12-84		12,000	32,600	24.5
		5-15-85		15,000	39,900	24.5
		9-11-85		15,000	33,900	24.5
32	281046082470802	3-15-71	112	300	1,350	--
		9-01-71		200	1,220	--
		11-01-71		250	1,210	--
		1-03-72		240	1,210	--
		3-01-72		220	1,200	--
		5-09-72		210	1,160	--
		7-03-72		210	1,190	--
		9-06-72		250	1,160	--
		11-06-72		290	1,150	--
		1-08-73		220	1,130	--
		5-14-73		220	1,010	--
		7-09-73		210	1,050	--
		9-04-73		210	1,020	--
		11-06-73		210	1,040	--
		1-02-74		200	990	--
		3-04-74		200	1,000	--
		5-21-74		180	940	--
		7-10-74		180	940	--
		9-26-74		1,100	3,590	--
		1-24-78		1,000	3,410	26.0
		5-18-78		550	4,150	25.0
		9-27-78		1,200	4,150	25.0
		5-16-79		1,200	3,900	24.0
		9-19-79		1,100	3,800	25.5
		5-13-80		1,200	4,000	26.5
		9-18-80		1,200	4,200	25.5

Well No.	Identification No.	Date	Depth (feet)	Chloride (mg/L as Cl)	Specific conductance (μS/cm)	Temperature (°C)
32	281046082470802	5-29-81	112	1,100	3,800	--
		9-22-81		1,000	3,350	24.5
		5-12-82		950	3,300	24.5
		9-15-82		1,000	3,600	25.0
		5-17-83		1,000	3,300	24.5
		5-17-84		1,100	3,620	24.5
		9-12-84		1,000	3,550	24.5
		5-15-85		1,000	3,610	24.5
		9-11-85		1,000	2,870	24.0
36	281051082442801	3-04-76	70	300	1,400	--
		5-14-76		410	1,670	--
		9-10-76		390	1,550	--
		1-07-77		510	1,950	--
		3-28-77		540	2,080	--
		5-10-77		570	2,210	--
		9-20-77		280	1,310	25.0
		1-24-78		430	1,760	25.0
		5-18-78		530	2,010	25.5
		9-27-78		340	1,500	25.0
58	281106082443901	8-02-66	--	50	430	--
59	281106082443902	8-02-66	150	41	430	--
60	281106082443903	8-02-66	30	41	410	--
64	281113082443801	5-14-76	90	56	515	--
		9-10-76		62	560	--
		1-07-77		60	590	--
		3-28-77		54	500	--
		5-10-77		62	550	--
		9-20-77		48	477	25.5
		1-25-78		48	460	25.0
		5-19-78		50	473	24.5
		9-27-78		50	491	--
75	281124082353001	8-13-63	365	12	285	--
80	281128082445501	9-23-75	100	180	875	--
		3-09-76		180	940	--
		5-14-76		59	549	--
		9-10-76		81	590	--
		1-07-77		95	650	--
		5-10-77		180	970	--
		1-31-78		69	500	26.0
		5-18-78		190	900	24.5

Well No.	Identification No.	Date	Depth (feet)	Chloride (mg/L as Cl)	Specific conduc-tance (µS/cm)	Tempera-ture (°C)
80	281128082445501	9-27-78	100	74	620	25.0
96	281209082465202	8-02-66	69	670	2,300	--
97	281214082101901	8-02-66	17	36	290	--
99	281219082465101	8-01-66	35	1,300	13,800	--
100	281219082465102	8-01-66	43	6,000	17,600	--
104	281222082393401	6-29-65	301	--	375	24.0
105	281223082442301	1-13-65	5	8	310	--
107	281223082442301	9-23-75	37	43	570	--
		3-09-76		34	540	--
		5-14-76		29	550	--
		9-10-76		46	540	--
		1-07-77		45	550	--
		3-28-77		42	520	--
		5-10-77		45	540	--
		9-20-77		82	690	25.5
		1-24-78		72	630	25.0
		5-18-78		66	612	25.0
		9-27-78		74	670	26.0
109	281226082465301	8-02-76	--	218	1,050	--
113	281236082424901	2-01-73	171	62	410	--
		2-01-73		1,600	5,500	--
116	281244082425501	2-01-73	157	58	550	--
		2-01-73		160	825	--
		2-01-73		1,400	4,890	--
136	281324082435601	5-22-73	162	960	3,500	--
		5-10-74		840	3,150	--
		7-14-75		1,000	3,720	--
		9-16-75		970	3,560	25.5
		3-09-76		710	3,580	--
		5-13-76		890	3,500	--
		9-10-76		990	3,500	--
		1-07-77		960	3,550	--
		3-28-77		990	3,590	--
		5-10-77		970	3,580	26.0
		9-20-77		950	3,580	25.5
		1-24-78		940	3,390	25.0
137	281324082443301	8-02-66	32	84	620	--
138	281328082425501	7-14-69	102	650	2,520	--
155	281353082421301	5-22-73	311	310	1,510	--
180	281445082414501	5-22-73	425	330	1,290	--

Well No.	Identification No.	Date	Depth (feet)	Chloride (mg/L as Cl)	Specific conduc-tance (µS/cm)	Tempera-ture (°C)
180	281445082414501	5-10-74	425	440	1,890	--
		7-14-75		440	1,850	--
		9-16-75		460	1,910	--
		3-09-76		520	1,910	--
		5-13-76		420	1,930	--
		1-07-77		630	7,500	25.0
		3-28-77		880	5,200	--
		1-24-78		440	1,750	24.5
		5-18-78		--	1,800	25.0
		9-27-78		490	2,100	26.0
		5-16-79		520	2,200	25.0
		9-19-79		520	2,100	26.0
		5-13-80		520	2,100	25.5
		9-18-80		580	2,300	25.5
		5-11-81		520	2,150	25.0
		9-22-81		550	2,110	24.5
181	281445082414502	9-05-69	108	14	410	--
198	281504082422801	9-23-75	--	22	315	--
		3-09-76		54	489	--
201	281510082421001	9-23-75	270	36	383	--
		3-09-76		110	670	--
		4-19-76		58	530	--
		5-14-76		50	520	--
230	281531082430301	1-13-65	15	64	520	--
231	281532082412301	12-06-71	582	4,700	18,200	--
		1-04-72		5,000	17,900	--
		3-02-72		4,700	19,000	--
		5-10-72		4,900	18,800	--
		6-07-72		5,200	19,300	--
		7-05-72		5,100	20,000	--
		9-06-72		6,200	19,500	--
		1-09-73		6,400	20,100	--
		5-15-73		6,400	18,800	--
		6-10-73		6,000	19,000	--
		9-05-73		6,400	19,300	--
		11-06-73		6,400	19,700	--
		1-03-74		7,000	20,500	--
		3-05-74		6,600	20,000	--
		5-22-74		6,200	20,000	--

Well No.	Identification No.	Date	Depth (feet)	Chloride (mg/L as Cl)	Specific conduc-tance (µS/cm)	Tempera-ture (°C)
231	281532082412301	7-10-74	582	7,400	27,500	--
		9-04-74		7,400	21,900	--
		1-02-75		6,800	21,300	--
		2-25-75		4,400	21,700	--
		5-27-75		7,200	21,800	--
		7-30-75		7,200	22,200	27.0
		10-20-75		7,200	21,300	--
		12-12-75		7,400	22,500	--
		2-05-76		7,300	22,000	--
		4-07-76		7,800	23,100	--
		6-04-76		7,700	22,800	--
		6-30-76		7,600	22,200	--
		7-30-76		7,600	23,000	--
		9-09-76		8,100	23,000	--
		10-06-76		7,800	23,000	--
		1-04-77		8,100	23,800	--
		2-10-77		8,100	22,400	--
		3-02-77		7,600	22,000	--
		3-29-77		8,300	24,000	--
		5-04-77		7,900	22,600	--
		6-01-77		8,600	24,000	--
		6-30-77		8,200	23,600	28.5
		8-03-77		8,400	24,900	--
		8-31-77		8,400	25,200	--
		9-20-77		7,900	23,300	--
		11-01-77		8,000	24,800	27.0
		12-07-77		8,600	23,000	25.0
		12-27-77		8,700	23,200	26.0
		2-01-78		8,000	21,800	25.0
		3-06-78		8,300	23,800	24.5
		4-03-78		8,300	24,600	24.0
		4-26-78		8,000	24,400	24.0
		6-08-78		7,900	24,200	25.0
		6-30-78		--	23,900	25.5
		8-02-78		9,100	23,600	23.5
		9-08-78		8,700	27,000	24.5
		10-10-78		8,100	24,500	26.0
		11-03-78		6,900	20,000	25.0
		12-05-78		6,200	18,100	24.0
		1-12-79		7,000	19,600	25.0

Well No.	Identification No.	Date	Depth (feet)	Chloride (mg/L as Cl)	Specific conductance (µS/cm)	Temperature (°C)
231	281532082412301	2-06-79	582	7,000	19,500	25.0
		3-01-79		7,000	20,000	24.5
		3-27-79		6,900	20,000	23.0
		5-03-79		7,000	20,700	24.0
		6-05-79		6,900	20,200	24.0
		6-28-79		6,900	19,800	24.5
		7-31-79		6,900	19,000	24.5
		9-11-79		8,600	24,200	25.0
		11-01-79		6,900	20,500	24.5
		12-03-79		6,900	20,600	24.0
		1-08-80		6,900	18,800	24.0
		2-04-80		7,300	21,500	24.5
		3-10-80		7,600	22,100	24.5
		4-02-80		7,700	21,500	25.0
		5-06-80		7,800	22,100	24.0
		6-02-80		7,700	22,400	24.5
		11-04-80		7,500	22,000	26.0
		1-09-81		7,800	17,000	25.0
		3-02-81		7,750	22,200	25.0
		5-04-81		7,700	22,600	29.0
		5-29-81		9,300	26,700	26.0
		6-02-81		9,400	28,000	30.0
		9-02-81		9,400	27,800	30.5
		11-03-81		9,600	28,500	25.5
		1-05-82		9,500	25,500	26.0
		3-02-82		9,600	26,500	23.5
		5-05-82		9,300	--	27.0
		7-02-82		9,600	--	29.0
		9-08-82		9,200	26,200	26.0
		5-04-83		9,200	26,000	25.5
		5-01-84		8,600	26,500	25.0
		8-29-84		8,900	28,000	25.5
		5-08-85		9,500	28,500	26.0
		9-11-85		9,800	28,500	25.0
233	281533082422401	9-23-75	93	22	314	--
		3-09-76		12	368	--
		5-14-76		95	620	--
236	281543082421201	9-23-75	200	22	318	--
		3-09-76		12	364	--
		4-19-76		110	680	--

Well No.	Identification No.	Date	Depth (feet)	Chloride (mg/L as Cl)	Specific conduc-tance (µS/cm)	Tempera-ture (°C)
236	281543082421201	5-14-76	200	110	670	--
246	281612082285201	11-02-65	10	--	25	--
260	281642082440201	5-22-73	75	16,000	42,000	--
		5-10-74		16,000	43,000	--
		7-14-75		16,000	42,600	--
		3-09-76		16,000	42,300	--
		5-13-76		14,000	44,300	--
		9-10-76		16,000	41,500	--
		1-07-77		16,000	42,000	--
		3-28-77		16,000	41,500	--
		5-10-77		16,000	41,000	--
		9-20-77		16,000	42,000	24.0
		1-25-78		16,000	38,500	25.0
		5-18-78		16,000	42,000	24.0
		9-27-78		16,000	41,000	25.0
		5-16-79		16,000	34,500	24.0
		9-19-79		16,000	44,000	26.0
		5-13-80		16,000	41,000	25.5
		9-18-80		20,000	42,000	24.5
		5-11-81		16,000	41,000	24.0
		9-22-81		15,700	--	24.0
		5-12-82		16,000	41,000	24.0
		9-15-82		16,000	42,000	24.5
		5-17-83		16,000	38,500	24.5
		5-17-84		16,000	38,900	24.5
		9-12-84		16,000	41,600	24.0
		5-17-85		16,000	41,000	24.5
		9-11-85		15,000	39,100	24.0
263	281648082430201	5-10-74	235	660	2,450	--
		7-14-75		810	3,240	--
		9-16-75		880	3,160	24.0
		3-09-76		1,200	4,080	--
		5-13-76		960	3,850	--
		9-10-76		1,100	3,790	--
		1-07-77		1,100	3,700	--
		3-28-77		1,100	3,850	--
		5-10-77		1,200	4,300	--
		9-20-77		1,100	4,130	24.0
		1-24-78		760	2,730	24.5
		5-18-78		1,100	3,990	25.0

Well No.	Identification No.	Date	Depth (feet)	Chloride (mg/L as Cl)	Specific conductance (μS/cm)	Temperature (°C)
263	281648082430201	9-27-78	235	1,200	4,300	24.0
		5-16-79		980	3,650	23.0
		9-19-79		880	3,100	24.0
		5-13-80		1,200	4,000	25.0
		9-18-80		1,200	4,300	24.0
		5-11-81		1,400	4,900	23.5
		9-22-81		1,100	3,800	23.0
		5-12-82		1,300	4,600	23.5
		9-15-82		1,200	4,200	24.0
268	281652082423301	9-16-75	200	--	367	--
		3-11-76		110	700	--
		5-13-76		98	720	--
		9-10-76		110	675	--
		1-07-77		110	720	--
		3-28-77		110	710	--
		5-10-77		120	720	--
		9-20-77		110	720	24.0
		1-24-78		110	690	24.0
		5-18-78		140	745	23.5
		9-27-78		130	800	25.0
		5-16-79		82	660	23.5
		9-19-79		89	649	25.5
		5-13-80		77	575	26.5
		9-18-80		74	629	25.0
		5-11-81		67	595	25.5
		5-17-83		110	690	24.0
		5-17-84		--	607	24.0
		9-12-84		97	668	23.5
		5-17-85		100	725	24.0
		9-11-85		87	685	24.0
285	281715082164401	6-08-64	150	--	225	--
311	281803082420501	9-23-75	125	20	600	--
		3-09-76		28	610	--
		5-14-76		29	590	--
		9-10-76		30	620	--
		1-07-77		33	660	--
		3-28-77		30	650	--
		5-10-77		32	660	--
		9-20-77		36	630	24.5
		1-25-78		48	690	24.5

Well No.	Identification No.	Date	Depth (feet)	Chloride (mg/L as Cl)	Specific conduc-tance (μS/cm)	Tempera-ture (°C)
311	281803082420501	5-18-78	125	59	725	24.0
		9-27-78		60	828	25.0
319	281818082422501	7-07-66	77	25	490	--
320	281820082422501	7-07-66	--	--	425	--
332	281858082415501	9-23-75	107	57	690	--
		3-09-76		90	840	--
		5-14-76		94	790	--
		5-10-77		80	790	--
		9-20-77		95	810	25.0
		1-25-78		98	790	25.0
		5-18-78		96	815	24.5
		9-27-78		85	850	25.0
336	281917082420901	7-19-79	139	850	3,200	27.0
		9-13-79		760	2,620	25.0
		12-27-79		830	2,700	22.5
		1-29-80		740	2,420	23.0
		3-16-80		860	3,050	23.5
		5-21-80		910	2,140	24.5
		7-14-80		860	3,110	26.0
		9-25-80		750	2,690	24.5
		11-04-80		780	2,750	24.5
		1-09-81		820	3,050	25.0
		3-03-81		804	2,980	25.0
		5-04-81		840	2,940	26.0
		7-02-81		860	3,080	29.5
		9-03-81		820	2,890	33.0
		11-05-81		860	3,280	25.0
		1-05-82		850	3,390	24.5
		3-03-82		880	3,100	24.5
		5-05-82		840	3,390	25.0
		7-07-82		860	3,300	27.0
		9-09-82		870	3,340	25.0
		11-02-82		830	3,300	25.0
		1-04-83		850	3,200	25.0
		3-02-83		920	3,300	25.0
		7-06-83		920	--	25.0
		11-03-83		860	3,000	24.5
		1-09-84		870	3,100	23.0
		3-05-84		840	3,200	24.5
		7-06-84		800	3,300	25.0

Well No.	Identification No.	Date	Depth (feet)	Chloride (mg/L as Cl)	Specific conduc-tance (µS/cm)	Tempera-ture (°C)
336	281917082420901	11-02-84	139	830	3,100	25.0
		1-04-85		860	--	23.0
		3-05-85		820	3,300	22.5
		7-01-85		890	3,400	25.5
		9-06-85		--	3,500	25.0
		11-05-85		880	3,600	24.5
337	281918082264601	6-18-64	73	--	170	--
338	281918082264602	10-28-75	7	--	200	26.0
339	281921082420201	7-07-66	30	142	960	--
340	281922082403901	1-19-79	200	4,400	13,900	27.0
		9-13-79		4,300	13,200	25.5
		12-27-79		4,000	11,200	23.0
		1-29-80		4,000	11,600	23.0
		3-18-80		4,100	10,900	23.0
		5-21-80		4,100	13,000	24.0
		7-14-80		3,900	11,800	26.5
		10-02-80		3,900	11,600	25.5
		11-18-80		3,700	11,000	24.0
		1-14-81		3,600	9,100	24.5
		3-19-81		3,600	10,100	24.5
		5-08-81		3,600	10,500	24.0
		7-10-81		3,500	11,000	23.5
		9-14-81		3,500	11,200	25.5
		11-04-81		3,400	--	24.5
		1-14-82		3,300	11,100	23.5
		3-03-82		3,300	10,000	23.5
		5-14-82		3,300	10,100	23.0
		7-06-82		3,200	11,000	25.0
		9-10-82		3,200	10,100	25.0
		12-03-82		3,200	10,400	24.5
		2-01-83		3,100	10,000	25.0
		4-01-83		2,900	8,900	24.5
		5-03-83		3,100	9,500	24.5
		11-02-83		3,020	9,800	25.0
		1-05-84		2,900	9,850	24.0
		3-05-84		2,900	9,300	24.5
		5-01-84		2,800	9,200	25.0
		8-29-84		2,800	9,100	25.0
		1-04-85		2,700	8,100	24.0
		3-05-85		2,800	8,900	24.0

Well No.	Identification No.	Date	Depth (feet)	Chloride (mg/L as Cl)	Specific conductance (µS/cm)	Temperature (°C)
340	281922082403901	5-02-85	200	2,800	9,000	25.0
		9-06-85		2,800	9,300	25.0
		11-05-85		2,700	9,300	24.5
343	281926082212901	6-19-64	113	--	180	25.0
354	281948082415301	9-23-75	94	12	218	--
		3-09-76		12	315	--
		5-13-76		14	318	--
		9-10-76		14	300	--
		1-07-77		13	322	--
		3-28-77		14	322	--
		5-10-77		14	321	--
		9-20-77		14	310	24.0
		1-25-78		16	300	24.0
		5-18-78		17	325	24.0
		9-27-78		16	345	24.0
		5-16-79		16	338	23.5
		9-19-79		17	351	24.0
		5-13-80		18	328	25.5
		9-18-80		20	345-	24.0
		5-11-81		15	370	24.0
		9-22-81		18	--	23.0
		5-12-82		17	338	23.5
		9-15-82		16	329	24.0
		5-17-83		16	--	24.0
		5-17-84		16	323	24.0
		9-12-84		18	338	23.5
		5-17-85		17	330	24.0
		9-11-85		21	345	23.5
357	281954082413401	9-16-75	100	28	372	25.5
		3-09-76		31	386	--
		5-13-76		30	390	--
		9-10-76		24	370	--
		1-07-77		30	390	--
		3-28-77		31	392	--
		5-10-77		39	420	--
		9-20-77		34	397	--
		1-25-78		34	380	--
		5-18-78		40	425	26.5
		9-27-78		39	440	25.0
		5-16-79		29	390	26.0

Well No.	Identification No.	Date	Depth (feet)	Chloride (mg/L as Cl)	Specific conductance (µS/cm)	Temperature (°C)
357	281954082413401	9-19-79	100	24	355	27.0
		5-13-80		23	470	26.5
		9-18-80		26	505	26.0
		5-11-81		15	355	25.5
		9-22-81		20	291	24.5
		5-12-82		15	340	25.0
		9-15-82		16	342	25.0
		5-17-83		18	308	--
		5-17-84		16	327	25.0
		9-12-84		16	351	26.0
		5-17-85		15	341	25.0
		9-11-85		15	350	25.0
358	281954082414401	10-27-65	14	--	100	26.0
362	282009082373801	6-16-64	73	--	325	--
363	282009082373802	10-27-65	9	--	50	--
403	282152082413701	4-06-66	27	1,260	4,550	--
404	282152082413801	2-07-65	22	840	3,200	--
		7-06-66		620	2,500	--
412	282158082170801	2-05-64	699	41	350	23.0
413	282202082414901	7-06-66	72	202	1,000	--
422	282228082410301	7-07-66	--	37	450	--
423	282229082405801	5-22-73	178	9,200	26,100	--
		5-10-74		12,000	32,000	--
		7-14-75		8,700	25,800	--
		9-23-75		10,000	28,200	--
		3-09-76		10,000	27,800	--
		5-13-76		8,500	27,900	--
		9-10-76		9,700	27,100	--
		1-07-77		9,600	27,000	25.5
		3-28-77		9,600	26,500	--
		5-10-77		9,400	27,000	--
		9-20-77		9,100	26,200	26.5
		1-25-78		12,000	30,000	25.5
		5-18-78		10,000	30,000	26.5
		9-20-78		--	26,500	25.0
		9-27-78		9,400	26,500	25.0
		5-16-79		9,200	24,500	24.0
		9-19-79		9,500	27,200	25.5
		5-13-80		9,700	28,000	26.0
		9-18-80		9,000	25,500	25.5

Well No.	Identification No.	Date	Depth (feet)	Chloride (mg/L as Cl)	Specific conduc- tance (µS/cm)	Tempera- ture (°C)
423	282229082405801	5-11-81	178	12,000	31,500	25.0
		5-29-81		12,000	31,700	--
		9-22-81		9,200	--	24.0
		5-12-82		11,000	30,500	25.0
		9-15-82		12,000	33,200	25.0
		5-17-83		11,000	--	25.0
		9-13-83		12,000	--	--
		5-17-84		11,000	31,500	25.0
		9-12-84		12,000	31,800	24.5
		5-17-85		11,000	30,900	25.0
		9-11-85		11,000	30,700	24.5
424	282229082415701	5-22-73	30	11,000	31,200	--
		7-14-75		13,000	32,900	--
439	282253082404001	9-23-75	85	51	550	--
		3-09-76		51	600	--
		5-14-76		50	580	--
		9-10-76		50	540	--
		1-07-77		50	560	--
		3-28-77		52	570	--
		5-10-77		49	555	--
		9-20-77		45	575	27.5
		1-25-78		45	555	25.0
		5-18-78		48	620	26.5
458	282325082400601	7-06-66	--	195	930	--
466	282339082395801	9-16-75	112	12	381	26.0
		3-09-76		16	412	--
		5-13-76		10	371	--
		9-08-76		13	275	--
		1-07-77		10	384	--
		3-28-77		11	390	--
		5-10-77		11	390	26.0
		9-20-77		94	665	27.0
		1-31-78		30	430	24.5
		5-18-78		22	425	24.5
		9-27-78		25	450	25.0
		5-16-79		20	432	24.0
		9-19-79		15	400	25.5
		5-13-80		16	420	25.5
		9-18-80		14	430	25.0
477	282408082385001	9-23-75	72	5	203	--

Well No.	Identification No.	Date	Depth (feet)	Chloride (mg/L as Cl)	Specific conduc- tance (µS/cm)	Tempera- ture (°C)
477	282408082385001	3-09-76	72	6	218	--
		5-14-76		6	210	--
		9-10-76		14	199	--
		1-07-77		7	213	--
		3-28-77		5	211	--
		5-10-77		5.2	213	--
		9-20-77		7.5	208	29.0
		1-25-78		8.7	200	--
		5-18-78		16	241	26.0
		9-27-78		9	220	--
484	282413082392401	9-23-75	82	9	234	--
		3-09-76		9	243	--
		5-14-76		11	250	--
		9-10-76		13	254	--
		1-07-77		15	281	--
		3-28-77		17	292	--
		5-10-77		11	275	--
		9-20-77		21	285	26.5
		1-25-78		13	255	24.5
		5-18-78		14	288	26.0
		9-27-78		15	282	27.0
489	282418082392701	9-23-75	135	12	205	--
		3-09-76		12	278	--
		5-14-76		13	271	--
		9-10-76		13	264	--
		1-07-77		12	255	--
		3-28-77		12	268	--
		5-10-77		12	270	--
		9-20-77		13	274	27.5
		1-25-78		12	270	24.5
		5-18-78		12	265	25.5
		9-27-78		13	272	26.5
494	282427082392801	7-06-66	--	9	310	--
517	282512082394201	7-05-66	--	35	465	--
519	282512082394301	9-23-75	111	33	483	--
		3-09-76		31	520	--
		5-14-76		38	500	--
		9-10-76		36	495	--
		1-07-77		34	491	--
		3-28-77		37	500	--

Well No.	Identification No.	Date	Depth (feet)	Chloride (mg/L as Cl)	Specific conductance (μS/cm)	Temperature (°C)
519	282519082394301	5-10-77	111	38	500	--
		9-20-77		38	515	27.5
		1-25-78		42	490	--
		5-18-78		45	550	27.5
		9-27-78		50	570	--

APPENDIX D: Data-Collection Sites on Streams, Lakes, Springs, and Sinkholes

[Locations are shown in figure 5]

Site No.	Identification No.	Station name	Downstream water number
		Streams	
1	2815230823158	Anclote River near Fivay Junction	02309648
2	2813390823554	Anclote River near Odessa	02309740
3	2812500824000	Anclote River near Elfers	02310000
4	2811380824307	Anclote River at Perrine Road near Elfers	02310050
5	2810180821142	Anclote River at mouth at Anclote	
6	2812540824155	Anclote River below Seven Springs near Elfers	
7	2813170823802	Anclote River at Starkey well field	
8	2813170823805	Anclote River below South Branch near Odessa	
9	2813330823733	Anclote River at power line near Odessa	
10	2813390823556	Anclote River near Odessa	
11	2819100823906	Bear Creek near Hudson	02310350
12	2819380823959	Bear Creek near Plaza Drive near Hudson	02310352
13	2819500824022	Bear Creek below Bear Sink	02310355
14	2822320821947	Cypress Creek near Darby	02303358
15	2819250822303	Cypress Creek near San Antonio	02303400
16	2816430822435	Cypress Creek near Drexel	02303408
17	2811080822403	Cypress Creek at Worthington Gardens	02303420
18	2818470822311	Cypress Creek at ACL Railroad	
19	2820400822305	Cypress Creek drainage canal	
20	2822550821048	Dade City Canal near Dade City	02311700
21	2824260820955	Dade City Canal at Mud Lake near Dade City	02311750
22	2825500820511	Devils Creek near Lacoochee	02311836
23	2810540824241	Duck Slough near Elfers	
24	2817200823150	Fivemile Creek near Fivay Junction	02310285
25	2815440823400	Fivemile Creek at mouth near Fivay Junction	
26	2818140820335	Gator Creek at mouth near Branchborough	
27	2815320820620	Hillsborough River near Richland, Polk County	02301870
28	2811070821103	Hillsborough River above Crystal Springs	02301990
29	2810430821121	Hillsborough River below Crystal Springs	02302010
30	2810180821142	Hillsborough River above confluence with big ditch	

Site No.	Identification No.	Station name	Downstream water number
31	2808590821357	Hillsborough River near Zephyrhills, Hillsborough County (not in fig. 5)	02303000
32	2823060822922	Jumping Gully at Loyce	02310240
33	2822440823103	Jumping Gully at mouth near Greenfield	
34	2825580823926	Magnolia Springs Run at Aripeka	02310410
35	2820060822340	Marsh near Cypress Creek and SR 52	
36	2824430822827	Masaryktown Canal at U.S. 41 near Masaryktown	02310225
37	2822530821112	Pasco Packing Co. canal near Dade City	02311698
38	2814100824145	Pithlachascotee River near New Port Richey	02309925
39	2819440823213	Pithlachascotee River near Fivay Junction	02310280
40	2815190823937	Pithlachascotee River near New Port Richey	02310300
41	2814140824138	Pithlachascotee River at Rowan Road near New Port Richey	02310304
42	2814060824202	Pithlachascotee River near Richey Lakes	02310305
43	2814240824312	Pithlachascotee River at New Port Richey	02310307
44	2816100824336	Pithlachascotee River at Port Richey	02310310
45	2815210823834	Pithlachascotee River at Starkey well field	
46	2816180823546	Pithlachascotee River at Crocket Ranch near New Port Richey	
47	2816320823540	Pithlachascotee River at Crocket Lake near Port Richey	
48	2816340824437	Pithlachascotee River at mouth at Port Richey	
49		Rock Sink Tributary near Port Richey	
50	2811080823313	South Branch Anclote River near Odessa	02309848
51	2812150823542	South Branch Anclote River at Odessa	02309900
52	2813200823635	South Branch Anclote River at mouth at Odessa	
53	2811080822707	Thirteen Mile Run near Drexel	02303512
54	2812540822324	Trout Creek Tributary near Worthington Gardens	02303344
55	2818420820322	Withlacoochee River near Compressco	02310947
56	2816160820553	Withlacoochee-Hillsborough overflow near Richland	02311000
57	2817090820624	Withlacoochee River near Richland	02311005
58	2821080820734	Withlacoochee River near Dade City	02311500
59	2826330820948	Withlacoochee River near Lacoochee	02311787
60	2828470821040	Withlacoochee River at Trilby	02312000

Site No.	Identification No.	Station name	Downstream water number
61	2825280820901	Withlacoochee River at Dobes Hole	
62	2828320821145	Withlacoochee River at U.S. Highway 98	
		<u>Lakes and Sinkholes</u>	
63	2819340824019	Bear Sink	
64	2819380824021	Bear Sink #2	
65	2813150822715	Bell Lake near Drexel	02303439
66	2810500822710	Bird Lake at Land O'Lakes	02303513
67	2811220823436	Black Lake near Odessa	02309869
68	2824100821450	Lake Blanton at Blanton	02312016
69	2820350824120	Briar Sink	
70	2810190822901	Browns Lake near Lutz	02306700
71	2811030822926	Camp Lake near Denham	02309814
72	2820200821602	Clear Lake at San Antonio	02311600
73	2823250823437	Coffee Sink	
74	2824040823013	Crews Lake (North) near Loyce	02310227
75	2823300823040	Crews Lake (South) near Loyce	02310260
76	2824010823028	Crews Lake Sink A	
77	2823550823016	Crews Lake Sink B	
78	2815100822742	Curve Lake near Drexel	02303416
79	2815290822614	Deane Lake near Drexel	02303412
80	2819090821836	Drief Lake near San Antonio	
81	2826100821455	Lake Dowling near Blanton	02312022
82	2812520822631	East Lake near Drexel	02303450
83	2821150821015	Ferguson Lake near Dade City	02311655
84	2820050823838	Frierson Lake near Bayonet Point	02310364
85	2817100823957	Garden Lake	
86	2820420824122	Golfball Sink	
87	2821250822805	Goose Lake near Loyce	02310228
88	2826000821955	Hancock Lake near Dixie	02310232
88A	2825580821956	Hancock Lake at center near Spring Hill	
89	2825590821940	Hancock Lake Sink	
90	2820410824205	Hazel Sink	
91	2824040823013	Hernasco Sink	
92	2823280821754	Lake Iola near San Antonio	
93	2818220824058	Jessamine Lake	
94	2812380822652	Lake Joyce	
95	2817430821736	King Lake near San Antonio	02303379
96	2813460822721	King Lake at Drexel	02303438

Site No.	Identification No.	Station name	Downstream water number
97	2811140822852	Lake Linda at Denham	02309765
98	2825200821855	Middle Lake	
99	2824440821807	Moody Lake near San Antonio	02310231
99A		Moody Lake, East	
99B		Moody Lake, West	
100	2817150823937	Moon Lake near New Port Richey	02310290
101	2820100824107	Nexus Sink	
102	2820530822344	Oakes Pond	
103	2812120822743	Lake Padgett near Lutz	02303440
103A	2812430822717	Lake Padgett North	
103B	2811510822744	Lake Padgett South	
104	2810400823446	Parker Lake near Odessa	02309872
105	2819100821320	Lake Pasadena near Dade City	02301940
106	2823050822917	Pasco Lake near Loyce	
107	2819150823045	Lake Pierce at Fivay Junction	02310282
108	2822310822317	Pond near Big Fish Lake	
109	2820590822207	Ray Pond near San Antonio	02301935
110	2815130824150	Richey Lake	
111	2824050823440	Rock Sink	
112	2816440823959	Rocky Sink	
113	2820020824059	Round Sink	
114	2811590822659	Saxon Lake	02303486
114A	2811540822652	Saxon Lake East	
114B	2812050822713	Saxon Lake West	
115	2820500824125	Smokehouse Pond	
116	2820250824119	Stratomax Sink	
117	2814140822808	Lake Thomas at Drexel	02309584
117A	281427082280001	Lake Thomas 0.5 mile southeast of center	
117B	281427082281002	Lake Thomas 0.3 mile southeast of center	
117C	281427082281003	Lake Thomas south of center	
117D	281427082281004	Lake Thomas southwest of center	
117E	281427082281005	Lake Thomas at center	
117F	281427082281006	Lake Thomas west of center	
117G	281427082281007	Lake Thomas north of center	
118	2811150822515	Twin Lakes near Land O'Lakes	02303419
119	2814150822027	Unnamed lake at Wesley Chapel	02303336
120	2815530824030	Unnamed lake near New Port Richey	02310309
121	2826000823301	Unnamed lake near Loyce	02310434
122	2820550823302	Unnamed lake #22	
123	2826000823301	Unnamed sink	

Site No.	Identification No.	Station name	Downstream water number
124	2816110821207	White Turkey Pond near Dade City	02301962
125	2817000824007	Lake Worrell near New Port Richey	02310320
126	2819050822650	Lake Y near Ehren	02310229
		Springs	
127	2810300821120	Crystal Springs near Zephyrhills	02302000
128	2823500824121	Horseshoe Springs near Hudson	02310370
129	2821530824211	Hudson Spring	
130	2824510823944	Isabella Spring	
131	2825580823926	Magnolia Spring	
132	2817330824306	Salt Spring	
133	2817330824306	Salt Springs near Port Richey	02310315
134	2812510823957	Seven Srings near Elfers	
135	2823520824027	Unnamed spring near Aripeka	02310373
136	2814250824302	Unnamed spring #1A	
137	2814250824302	Unnamed spring #1B	
138	2817550824233	Unnamed spring #2	
139	2822060824132	Unnamed spring #3	
140	2823480824119	Unnamed spring #5	

APPENDIX E: Chemical Analyses of Water, Stage, and Discharge from Streams Lakes, Springs, and Sinkholes

[μS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; μg/L, micrograms per liter; ft^3/s, cubic feet per second]

Site No.	Station name	Date	Temperature (°C)	Color (platinum-cobalt units)
	Anclote River			
3	02310000	10-24-84	23.0	20
		10-24-85	24.0	120
	Cypress Creek			
15	02303400	10-24-84	21.5	50
17	02303420	10-23-85	23.0	280
	Hillsborough River			
28	02301990	11-09-59	--	120
		5-25-66	--	15
		5-11-67	23.5	5
		4-29-68	24.0	5
		5-09-69	25.0	5
		6-04-70	23.5	15
		4-06-71	22.0	--
29	02302010	5-25-66	--	0
		5-11-67	24.5	5
	Pithlachascotee River			
39	02310280	5-23-84	22.0	60
		4-15-85	19.5	60
40	02310300	5-23-84	22.0	60
		10-22-84	22.0	140
		4-15-85	19.0	20
		10-21-85	24.0	200
	Withlacoochee River			
55	02310947	6-18-84	28.0	110
56	02311000	6-21-84	--	100
58	02311500	6-22-84	28.5	80
		9-04-85	26.0	320
59	02311787	2-25-59	25.5	100
		2-26-59	28.0	120
		11-13-59	--	162
		11-29-60	--	110
		5-25-61	27.5	10
		4-13-81	31.0	40
61	282528082090100	4-13-81	25.0	55
	Bear Sink			
63	281934082401900	3-03-85	21.0	--
		3-21-85	18.0	--
		1-03-85	19.0	40

Site No.	Station name	Date	Temperature (°C)	Color (platinum-cobalt units)
64	Bear Sink #2 281938082402100	1-03-85	18.0	35
[1]65	Bell Lake 02303439	10-25-84	26.5	18
[1]72	Clear Lake 02311600	1-31-85	15.0	7
[1]75	Crews Lake South 02310260	7-25-84	32.0	62
76	Crews Lake Sink A 282401082302800	2-12-85	15.0	30
[1]82	East Lake 02303450	10-25-84	28.0	17
[1]85	Garden Lake 281710082395700	7-26-84	27.0	130
[1]88	Hancock Lake 02310232	4-16-80	21.0	50
91	Hernasco Sink 282404082301300	4-23-65	--	20
		5-23-66	--	30
		5-19-67	30.0	30
		5-22-68	35.0	35
		2-12-85	17.0	<5
		9-06-85	28.0	--
[1]92	Lake Iola 02310230	4-16-80	21.0	22
		9-11-85	30.0	5
[1]93	Jessamine Lake 281822082405800	4-16-80	23.0	106
		9-11-85	29.0	35
[1]94	Lake Joyce 281238082265200	10-25-84	27.0	22
[1]96	King Lake 02303438	10-25-84	28.0	21

[1]Analysis by lab other than U.S. Geological Survey. Source of data, Southwest Florida Water Management District.

Site No.	Station name	Date	Temperature (°C)	Color (platinum-cobalt units)
	Middle Lake			
[1]98	282520082185500	4-16-80	21.0	92
		9-10-85	30.0	65
	Moody Lake			
[1]99	02310231	4-16-80	23.0	104
[1]99A	East	9-10-85	29.5	70
[1]99B	West	9-10-85	30.0	70
	Moon Lake			
[1]100	02310290	2-29-84	16.0	25
	Lake Padgett			
[1]103	02303440	5-22-65	--	5
		5-13-66	--	5
		5-18-67	28.0	5
		4-30-68	25.0	5
		11-15-68	19.0	10
		5-15-69	26.0	0
		5-27-70	28.0	0
		4-08-71	19.0	--
		10-25-84	26.0	15
[1]103A	2812430822717	5-02-80	24.0	10
[1]103B	2811510822744	5-02-80	24.0	5
	Lake Pasadena			
105	02301940	11-21-68	16.0	30
	Pasco Lake			
[1]106	02310238	7-25-84	31.0	82
	Lake Pierce			
[1]107	02310282	7-25-84	30.5	27
	Ray Pond			
109	02301935	11-21-68	--	80
	Richey Lake			
[1]110	281513082415000	2-29-84	15.0	168
	Rocky Sink			
112	281644082395900	2-12-85	20.5	--
	Saxon Lake			
114	02303486	4-05-68	--	40
		[1]10-25-84	27.5	31
114A	2811540822652	5-05-80	--	10
114B	2812050822713	5-05-80	--	10

Site No.	Station name	Date	Temperature (°C)	Color (platinum-cobalt units)
	Unnamed lake #22			
[1]122	282055082330200	7-25-84	29.0	78
	White Turkey Pond			
124	02301962	12-20-68	20.0	60
	Lake Worrell			
[1]125	02310320	2-29-84	15.0	116
	Crystal Springs			
127	02302000	7-19-23	--	--
		7-01-46	24.0	5
		5-01-68	24.0	0
		5-09-69	25.0	5
		6-04-70	24.0	0
		4-20-72	24.0	0
		10-11-72	--	5
		5-18-76	24.5	--
		8-10-76	25.0	17
		11-09-76	23.5	2
		2-03-77	24.5	2
		4-26-77	23.0	--

Site No.	Specific conductance (μS/cm)	pH (units)	Instantaneous discharge (ft^3/s)	Stage (feet above sea level)
3	410	6.6	--	--
	295	6.8	--	--
15	265	7.3	--	70.18
17	220	6.8	--	43.09
28	78	7.1	--	--
	303	7.4	20	52.11
	299	7.4	7.1	51.62
	310	7.7	6.9	51.56
	305	8.4	10	--
	295	8.5	17	51.97
	338	---	12	51.92
29	293	7.7	76	49.13
	287	8.0	59	48.60
39	143	7.2	3.3	51.44
	143	7.0	--	51.10
40	285	7.4	.1	17.61
	170	6.8	--	18.00
	258	7.3	--	17.49
	115	7.5	--	18.44
55	133	7.5	3.5	5.60
56	176	---	--	--
58	240	6.6	26	69.64
	--	5.5	--	--
59	194	7.3	--	--
	164	7.7	--	--
	71	7.0	--	--
	116	7.7	--	--
	308	---	72	--
	310	---	1.4	--
61	325	---	3.3	--
63	302	7.0	--	--
	295	6.8	--	--
	298	7.1	--	--
64	355	7.0	--	--
65	149	7.6	--	--
72	171	7.4	--	--
75	60	7.4	--	--
76	122	7.2	--	--

Site No.	Specific conductance (μS/cm)	pH (units)	Instantaneous discharge (ft^3/s)	Stage (feet above sea level)
82	226	7.7	--	--
85	103	6.8	--	--
88	86	---	--	--
91	65	6.5	--	--
	65	6.6	--	--
	190	6.6	--	--
	246	6.5	--	--
	210	7.1	--	--
	100	6.8	--	--
92	64	7.6	--	--
	159	7.5	--	--
93	--	6.8	--	--
	140	6.6	--	--
94	273	8.0	--	--
96	141	8.0	--	--
98	107	6.5	--	--
	113	8.8	--	--
99	103	6.5	--	--
99A	117	8.3	--	--
99B	122	8.2	--	--
100	99	7.2	--	--
103	129	6.5	--	--
	140	7.1	--	68.98
	153	6.6	--	69.88
	151	6.7	--	--
	134	6.3	--	69.86
	144	6.8	--	68.68
	122	6.8	--	69.63
	128	---	--	69.73
	168	7.6	--	--
103A	155	7.6	--	69.84
103B	158	7.4	--	69.84
105	101	5.5	--	--
106	43	6.0	--	--
107	42	6.0	--	--

Site No.	Specific conductance (µS/cm)	pH (units)	Instantaneous discharge (ft^3/s)	Stage (feet above sea level)
109	72	5.7	--	--
110	214	7.4	--	--
112	282	6.6	--	--
114	210	6.9	--	--
	192	7.2	--	--
114A	204	6.8	--	69.78
114B	211	6.7	--	69.78
122	42	6.0	--	--
124	420	6.9	--	--
125	143	7.4	--	--
127	--	---	56	--
	29	7.7	20	--
	289	7.7	--	--
	294	8.0	54	--
	270	8.4	51	--
	291	8.0	--	--
	302	8.0	--	--
	150	7.3	--	--
	150	7.3	--	--
	290	7.6	--	--
	302	7.8	--	--
	300	7.3	--	--

Site No.	Hardness (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Chloride, dissolved (mg/L as Cl)	Sulfate, dissolved (mg/L as SO_4)
3	--	--	---	--	--	11.0	22.0
	--	6.7	4.2	7.2	1.9	13.0	3.9
15	--	24	4.2	6.2	5.2	18.0	3.2
17	--	35	3.1	6.3	5.9	16.0	3.2
28	34	12	1.0	3.5	.1	7.2	.8
	142	53	2.5	5.1	.6	8.6	5.8
	150	55	3.2	4.1	.3	9.0	5.2
	150	54	3.5	4.1	.2	9.0	5.5
	151	56	2.8	4.4	.5	8.0	5.6
	144	53	2.9	5.8	1.1	12.0	10.0
	--	--	---	--	--	--	--
29	140	51	3.1	4.1	.3	6.2	7.0
	139	50	3.4	3.7	.3	7.0	5.6
39	--	17	2.5	5.4	1.3	9.3	29.0
	--	19	2.1	5.3	1.2	13.0	10.0
40	--	47	4.0	5.6	1.0	10.0	43.0
	--	25	2.2	4.9	1.3	10.0	4.8
	--	44	3.6	6.3	1.3	13.0	16.0
	--	16	1.7	4.9	5.7	14.0	1.7
55	--	17	2.7	7.6	.4	18.0	<9.5
56	--	28	2.8	7.0	1.1	14.0	< .2
58	--	35	3.4	8.8	.6	17.0	< .2
	--	11	1.4	3.9	1.0	7.8	.8
59	80	27	3.0	9.0	.3	12.0	6.0
	69	23	2.8	7.9	.2	12.0	7.6
	29	10	1.0	4.1	.1	11.0	3.2
	48	17	1.3	5.4	.4	10.0	5.6
	136	46	5.1	11.0	1.0	12.0	8.8
	140	47	4.6	13.0	1.6	17.0	--
61	140	51	4.0	11.0	.7	17.0	--
63	--	--	---	9.1	.6	15.0	14.0
	--	--	---	7.2	1.4	18.0	22.0
	--	48.0	2.6	7.5	.8	15.0	10.0
64	--	65.0	2.2	7.8	1.3	14.0	5.3
65	48	9	3.6	--	--	19.0	10.1
72	55	12	5.0	--	--	22.2	8.0
75	28	6.5	3.0	--	--	5.0	1.3

Site No.	Hardness (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Chloride, dissolved (mg/L as Cl)	Sulfate, dissolved (mg/L as SO_4)
76	--	20.0	0.8	2.4	0.8	5.3	0.4
82	65	12.0	5.7	---	--	28.0	22.0
85	65	12	8.4	---	--	5.0	1.3
88	70	6.5	2.9	---	--	11.0	5.6
91	--	--	---	4.9	.4	10.0	2.4
	--	--	--	4.6	.3	8.0	1.6
	--	--	--	6.4	1.6	12.0	.4
	--	--	--	12.0	2.8	20.0	.2
	--	38.0	2.1	3.5	.9	6.8	1.0
	--	--	--	---	--	5.0	2.0
92	52	12.0	5.7	---	--	16.3	15.8
	62	14.0	6.4	---	--	18.0	6.4
93	36	6.5	4.9	---	--	14.0	6.2
	60	10	8.5	---	--	18.0	7.0
94	73	19	5.2	---	--	33.0	33.0
96	26	9	3.8	---	--	18.0	10.0
98	36	7.3	4.4	---	--	14.5	2.3
	44	11.2	3.9	---	--	14.0	2.3
99	34	6.5	4.4	---	--	14.0	2.3
99A	43	11.0	3.8	---	--	13.0	3.2
99B	43	11.0	3.8	---	--	13.0	2.6
100	24	6.7	1.3	---	--	15.5	6.0
103	34	10	2.2	8.3	3.7	16.0	20.0
	35	7.5	4.0	9.4	3.7	13.0	22.0
	38	8.5	4.3	11.0	4.0	16.0	24.0
	38	7.8	4.4	10.0	4.0	18.0	24.0
	32	5.9	4.2	10.0	3.7	17.0	24.0
	34	6.4	4.3	12.0	4.0	17.0	26.0
	32	6.9	3.7	8.5	3.1	15.0	19.0
	--	--	--	---	--	--	--
	48	12.0	3.9	---	--	22.0	13.5
103A	44	12.0	3.4	9.5	4.1	17.0	12.0
103B	47	13.0	3.5	9.5	4.2	17.0	14.0

Site No.	Hardness (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Chloride, dissolved (mg/L as Cl)	Sulfate, dissolved (mg/L as SO_4)
105	17	2.8	2.4	9.9	2.2	20.0	10.0
106	24	4.9	3.0	---	--	3.0	1.3
107	16	3.2	2.0	---	--	6.0	3.7
109	16	4.8	1.1	5.1	2.6	12.0	5.6
110	63	16	2.7	---	--	30.0	9.9
112	--	--	--	---	--	--	--
114	60	--	--	---	--	--	--
	52	9	5.6	---	--	28.0	24.0
114A	67	18	5.3	12.0	5.4	21.0	24.0
114B	67	18	5.3	12.0	5.3	21.0	23.0
122	24	4	3.4	---	--	3.0	1.4
124	89	29	4.0	24.0	26.0	43.0	5.6
125	65	21	1.7	---	--	10.0	1.7
127	153	53	5.0	---	--	5.5	9.3
	146	52	4.0	4.0	.4	5.4	--
	138	49	3.7	3.6	.3	7.0	6.2
	145	53	3.3	3.6	.2	6.5	7.2
	132	47	3.5	3.7	.2	7.0	6.4
	140	5.2	3.4	3.5	.2	6.0	6.4
	140	49	4.2	4.5	.6	6.0	8.0
	150	53	3.7	4.0	.3	6.4	6.9
	140	52	3.0	3.9	.4	6.7	6.1
	150	53	3.6	4.0	.3	6.4	6.1
	150	53	3.7	4.0	.3	6.6	5.8
	150	51	4.4	4.0	.3	6.5	4.0

Site No.	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Iron, dissolved (µg/L as Fe)	Alkalinity (mg/L as $CaCO_3$)	Bicarbonate (mg/L as HCO_3)	Carbonate (mg/L as CO_3)
3	0.2	11.0	--	149	--	--
	.2	8.8	--	0	--	--
15	.2	6.6	--	98	--	--
17	.4	7.7	--	0	--	--
28	.2	3.1	--	33	40	0
	.3	8.4	50	138	168	--
	.2	8.8	10	141	172	0
	.2	10.0	20	144	176	0
	.2	4.6	0	151	168	8
	.2	8.8	--	134	147	8
	--	8.4	--	--	--	--
29	.3	9.7	0	135	165	--
	.2	9.3	0	131	160	0
39	.2	3.6	--	18	--	--
	.1	4.9	--	37	--	--
40	.1	5.8	--	88	--	--
	.2	5.8	--	57	--	--
	.1	5.3	--	102	--	--
	.2	6.4	--	50	--	--
55	.1	3.9	490	35	--	--
56	.2	1.3	--	63	--	--
58	.1	6.1	200	93	--	--
	.3	4.3	--	20	--	--
59	.2	5.6	--	154	94	46
	.2	4.9	--	124	76	37
	.1	3.6	--	50	31	15
	.2	4.8	--	86	52	26
	.2	8.4	--	279	170	84
	.3	.6	--	131	160	0
61	.3	.4	--	141	172	0
63	--	--	--	125	--	--
	--	--	--	88	--	--
	.1	5.3	120	111	--	--
64	.1	7.5	130	163	--	--
65	.3	--	--	29	--	--
72	<.1	--	--	37	--	--
75	<.1	--	--	17	--	--
76	.2	<.1	50	52	--	--

Site No.	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Iron, dissolved (μg/L as Fe)	Alkalinity (mg/L as $CaCO_3$)	Bicar-bonate (mg/L as HCO_3)	Carbonate (mg/L as CO_3)
82	0.4	--	--	24	--	--
85	<.1	--	--	36	--	--
88	.1	--	--	19	--	--
91	--	--	--	12	--	--
	--	--	--	15	--	--
	--	--	--	67	--	--
	--	--	--	71	--	--
	.1	2.1	130	98	119	--
	--	--	--	9	11	--
92	.1	--	--	28	--	--
	.1	--	--	33	--	--
93	<.1	--	--	21	--	--
	.1	--	--	34	--	--
94	.3	--	--	38	--	--
96	.3	--	--	23	--	--
98	.1	--	--	23	--	--
	.1	--	--	22	--	--
99	.1	--	--	18	--	--
99A	.1	--	--	21	--	--
99B	.1	--	--	21	--	--
100	.1	--	--	11	--	--
103	.2	.4	--	15	18	--
	.1	0	20	18	22	--
	.2	1.0	0	16	20	--
	.3	0	10	16	20	--
	.2	.3	--	12	15	--
	.2	.1	0	10	12	--
	.2	.5	--	13	16	--
	--	.2	--	--	--	--
	.3	--	--	24	--	--
103A	.2	.3	80	26	32	--
103B	.2	.3	20	30	36	--
105	.2	2.8	--	6	7	--
106	<.1	--	--	6	--	--

Site No.	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Iron, dissolved (μg/L as Fe)	Alkalinity (mg/L as $CaCO_3$)	Bicar-bonate (mg/L as HCO_3)	Carbonate (mg/L as CO_3)
107	<0.1	--	--	7	--	--
109	.2	4.7	--	10	12	--
110	.1	--	--	44	--	--
112	--	--	50	--	--	--
114	--	--	20	27	33	--
	.3	--	--	19	--	--
114A	.1	.2	60	39	48	--
114B	.1	.1	--	46	56	--
122	<.1	--	--	6	--	--
124	.3	5.6	--	128	156	--
125	.1	--	--	45	--	--
127	--	14.0	--	138	168	--
	.1	10.0	20	139	170	--
	.2	10.0	10	136	166	0
	.2	11.0	0	125	164	0
	.2	9.7	--	126	146	4
	.2	11.0	10	134	164	0
	.2	9.8	--	135	164	0
	.1	11.0	--	98	119	0
	.2	11.0	--	140	171	0
	.1	10.0	--	130	159	0
	.1	10.0	--	130	159	0
	.1	11.0	--	130	160	0

Site No.	Strontium, dissolved (μg/L as Sr)	Solids, residue at 180°C, dissolved (mg/L)	Solids, sum of constituents, dissolved (mg/L)	Nitrogen, organic, total (mg/L as N)	Nitrogen, ammonia, total (mg/L as N)	Nitrogen, nitrite, dissolved (mg/L as N)
3	--	243	--	--	--	--
	270	216	--	--	--	--
15	--	160	--	--	--	--
17	140	220	--	--	--	--
28	--	82	48	--	--	--
	--	--	168	--	--	--
	240	175	174	--	--	--
	230	180	177	--	--	--
	--	173	173	--	--	--
	--	186	178	0.14	--	--
	--	--	--	.57	--	--
29	--	--	--	--	--	--
	210	--	--	--	--	--
39	90	103	--	--	--	--
	75	92	--	--	--	--
40	290	183	--	--	--	--
	180	109	--	--	--	--
	210	162	--	--	--	--
	130	156	--	--	--	--
55	81	154	--	--	0.02	--
56	130	122	--	--	.19	--
58	100	182	--	--	.11	--
	40	108	--	--	<.01	--
59	--	139	155	--	--	--
	--	126	133	--	--	--
	--	79	63	--	--	--
	--	136	96	--	--	--
	--	195	177	--	--	--
	260	192	--	--	--	--
61	160	210	--	--	--	--
63	--	188	--	--	.05	--
	--	160	--	--	.06	--
	110	170	--	--	--	0.01
64	--	--	--	--	--	--
65	--	--	--	1.21	.01	--
72	--	--	--	.64	.01	--
75	--	--	--	.62	.01	--

Site No.	Strontium, dissolved (µg/L as Sr)	Solids, residue at 180°C, dissolved (mg/L)	Solids, sum of constituents, dissolved (mg/L)	Nitrogen, organic, total (mg/L as N)	Nitrogen, ammonia, total (mg/L as N)	Nitrogen, nitrite, dissolved (mg/L as N)
76	60	74	--	--	--	0.01
82	--	--	--	1.14	<0.01	--
85	--	--	--	.85	.02	--
88	--	--	1.9	--	--	--
91	--	33	--	--	--	--
	--	31	--	--	--	--
	--	100	--	--	--	--
	--	130	--	--	--	--
	90	134	--	--	--	.02
	--	39	--	--	.02	.01
92	--	--	--	--	--	--
	--	--	--	.68	.01	--
93	--	--	--	--	--	--
	--	--	--	1.18	.03	--
94	--	--	--	1.10	.01	--
96	--	--	--	1.01	.01	--
98	--	--	--	--	--	--
	--	--	--	1.05	.01	--
99	--	--	--	--	--	--
99A	--	--	--	1.19	.01	--
99B	--	--	--	1.13	.01	--
100	--	--	--	.82	.03	--
103	--	--	70	--	--	--
	--	--	71	--	--	--
	--	88	80	--	--	--
	--	93	82	--	--	--
	--	77	73	.37	.02	--
	--	82	76	--	--	--
	--	88	65	.41	.00	--
	--	--	--	.55	.05	--
	--	--	--	.87	<.01	--
103A	--	97	74	.70	.05	--
103B	--	100	80	.81	.02	--

Site No.	Strontium, dissolved (µg/L as Sr)	Solids, residue at 180°C, dissolved (mg/L)	Solids, sum of constituents, dissolved (mg/L)	Nitrogen, organic, total (mg/L as N)	Nitrogen, ammonia, total (mg/L as N)	Nitrogen, nitrite, dissolved (mg/L as N)
105	--	70	55	--	--	--
106	--	--	--	0.83	0.01	--
107	--	--	--	.48	.01	--
109	--	70	46	--	--	--
110	--	--	--	1.63	.16	--
112	250	198	--	--	--	0.01
114	--	--	--	.79	.04	--
	--	--	--	.99	.01	--
114A	--	137	112	.81	.09	--
114B	--	130	109	.69	--	--
122	--	--	--	.48	.01	--
124	0	257	259	1.70	--	--
125	--	--	--	.85	.06	--
127	--	--	177	--	--	--
	--	--	166	--	--	--
	240	176	167	--	--	--
	--	169	168	--	--	--
	--	167	159	--	--	--
	280	166	120	.17	.00	.00
	280	171	163	--	--	<.01
	--	152	144	--	.09	--
	--	160	168	.12	<.01	--
	--	140	162	.00	<.01	--
	--	174	162	.06	.05	--
	--	177	160	.02	<.01	--

Site No.	Nitrogen, nitrate, dissolved (mg/L as N)	Nitrogen, ammonia, organic, total (mg/L as N)	Nitrogen, nitrate, dissolved (mg/L as NO_3)	Phosphate, ortho, dissolved (mg/L as PO_4)	Phosphorus, total (mg/L as P)	Lead, dissolved (mg/L)	Zinc, dissolved (mg/L)	Chromium, dissolved (mg/L)
3	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
15	--	--	--	--	--	--	--	--
17	--	--	--	--	--	--	--	--
28	0.07	--	0.3	--	--	--	--	--
	--	--	.4	0.31	--	--	--	--
	--	--	2.7	.00	--	--	--	--
	--	--	3.6	--	--	--	--	--
	--	--	0.0	.01	--	--	--	--
	--	--	3.4	1.10	--	--	--	--
	--	--	2.5	1.30	--	--	--	--
29	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
39	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
40	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
55	--	1.20	--	--	0.54	--	--	--
56	--	1.50	--	--	.09	--	--	--
58	--	1.00	--	--	.04	--	--	--
	--	1.30	--	--	.14	--	--	--
59	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
61	--	--	--	--	--	--	--	--
63	--	--	--	--	.02	--	--	--
	--	--	--	--	.10	--	--	--
	--	--	--	--	--	10	3	10
64	--	--	--	--	--	10	12	10
65	--	--	--	<.01	--	--	--	--
72	--	--	--	<.01	--	--	--	--

Site No.	Nitrogen, nitrate, dissolved (mg/L as N)	Nitrogen, ammonia, organic, total (mg/L as N)	Nitrogen, nitrate, dissolved (mg/L as NO_3)	Phosphate, ortho, dissolved (mg/L as PO_4)	Phosphorus, total (mg/L as P)	Lead, dissolved (mg/L)	Zinc, dissolved (mg/L)	Chromium, dissolved (mg/L)
75	--	--	--	0.04	--	--	--	--
76	--	--	--	--	--	300	20	<10
82	--	--	--	<.01	--	--	--	--
85	--	--	--	.12	--	--	--	--
88	--	--	--	--	--	--	--	--
91	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--
	--	--	--	--	.61	--	--	--
	--	--	--	--	.23	--	--	--
	--	--	--	--	--	200	20	10
	--	--	--	--	.03	--	--	--
92	--	--	--	--	--	--	--	--
	--	--	--	.04	--	--	--	--
93	--	--	--	--	--	--	--	--
	--	--	--	<.01	--	--	--	--
94	--	--	--	<.01	--	--	--	--
96	--	--	--	<.01	--	--	--	--
98	--	--	--	--	--	--	--	--
	--	--	--	<.01	--	--	--	--
99	--	--	--	--	--	--	--	--
99A	--	--	--	<.01	--	--	--	--
99B	--	--	--	<.01	--	--	--	--
100	--	--	--	<.01	--	--	--	--
103	0.02	--	--	--	--	--	--	--
	.11	--	--	--	--	--	--	--
	.11	--	--	--	--	--	--	--
	.36	--	--	--	--	--	--	--
	.09	--	--	--	--	--	--	--
	.00	--	--	--	--	--	--	--
	.00	--	--	--	--	--	--	--
	.00	--	--	--	--	--	--	--
	--	--	<.01	--	--	--	--	--

Site No.	Nitrogen, nitrate, dissolved (mg/L as N)	Nitrogen, ammonia, organic, total (mg/L as N)	Nitrogen, nitrate, dissolved (mg/L as NO_3)	Phosphate, ortho, dissolved (mg/L as PO_4)	Phosphorus, total (mg/L as P)	Lead, dissolved (mg/L)	Zinc, dissolved (mg/L)	Chromium, dissolved (mg/L)
103A	0.00	--	--	--	--	0	--	1
103B	.00	--	--	--	--	0	--	1
105	--	--	1.5	--	--	--	--	--
106	--	--	--	0.12	--	--	--	--
107	--	--	--	.01	--	--	--	--
109	--	--	3.7	--	--	--	--	--
110	--	--	--	.42	--	--	--	--
112	--	--	--	--	--	--	--	--
114	.01	--	--	--	--	--	--	--
	--	--	--	<.01	--	--	--	--
114A	.00	--	--	--	--	1	--	1
114B	--	--	--	--	--	1	--	1
122	--	--	--	.01	--	--	--	--
124	--	--	.0	9.50	--	40	370	--
125	--	--	--	.03	--	--	--	--
127	.09	--	.4	--	--	--	--	--
	.18	--	.8	--	--	--	--	--
	--	--	4.3	.28	--	--	--	--
	--	--	2.4	.02	--	--	--	--
	--	--	4.9	.12	--	--	--	--
	--	--	--	--	0.04	--	--	--
	--	--	--	--	--	--	--	--
	--	--	--	--	.21	--	--	--
	--	--	--	--	.07	--	--	--
	--	<0.10	--	--	.04	--	--	--
	--	.11	--	--	.04	--	--	--
	--	.02	--	--	.04	--	--	--

APPENDIX F: Water Levels in the Surficial Aquifer, September 1984

Well No.	Identification No.	Well name	Well depth (feet)	Casing depth (feet)	Altitude of land surface (feet)	Elevation of water above sea level (feet)
1	281017082234701	S. 862 on I-75 at county line	22	--	57.50	45.54
10	281023082305702	St. Petersburg #41 shallow	19	17	59	56.29
18	281035082305702	St. Petersburg #42 shallow	22	20	59	56.47
25	281042082304602	St. Petersburg #43 shallow	23	21	60	56.85
30	281046082303102	St. Petersburg #44 shallow	22	20	61	57.67
35	281050082305902	St. Petersburg #46 shallow	22	20	59.27	56.30
38	281053082310402	St. Petersburg #105 shallow	20	--	57.82	56.08
41	281055082302402	St. Petersburg #45 shallow	20	18	61	57.51
43	281056082303302	Pasco WF #233 shallow	--	--	58	55.67
48	281101082292502	Harry Matts shallow	9	8	68	62.72
54	281104082310502	St. Petersburg #47 shallow	21	19	59	54.95
56	281104082312002	St. Petersburg #48 shallow	16	14	61	57.20
57	281106082312201	Pasco WF #230 shallow	--	--	59	57.73
68	281118082305902	St. Petersburg #49 shallow	22	20	60	56.05
70	281120082245501	ROMP 80 shallow	19	--	80.55	71.65
72	281120082302702	Pasco WF #220 shallow	15	14	59.70	54.16
78	281126082303802	St. Petersburg #50 shallow	19	17	59	56.35
79	281126082305701	Pasco WF #231 shallow	--	--	60	58.78
84	281137082352801	U.S.G.S. #302 shallow	10	8	54	50.55
86	281139082315301	SR 54 #215 shallow	10	9	61	53.80
89	281143082304703	SR 54 shallow	5	5	60	57.69
91	281151082210901	SR 581 #801 shallow	10	8	57.50	54.27
95	281157082304101	Pasco well field #227 shallow	--	--	59	57.50
103	281222082384302	Starkey #700 shallow	12	10	34	30.67
105	281222082393402	7 Springs SR 54 shallow	5	3	36	32.29

Well No.	Identification No.	Well name	Well depth (feet)	Casing depth (feet)	Altitude of land surface (feet)	Elevation of water above sea level (feet)
106	281222082393403	7 Springs shallow	11	9	35.04	31.81
115	281244082320302	USGS #744 shallow	--	--	55	48.46
120	281254082291201	Bexley #224 shallow	12	8	68.50	64.60
127	281309082311302	Bexley #743 shallow	20	17	59.61	55.68
167	281424082365201	Starkey WF EMW 7	14	--	36	31.39
170	281427082382802	Starkey #728 shallow	18	16	35.20	29.89
173	281431082371802	Starkey #730 shallow	17	14	36.40	33.73
174	281432082211401	USGS #853 on I-75 shallow	--	--	85	75.75
177	281436082380101	Starkey WF EMW 4	--	--	36	33.39
183	281446082354302	Starkey SN2 shallow	--	--	50	46.85
184	281447082371002	Starkey #731 shallow	--	--	30	35.92
186	281448082301802	Bexley 2 shallow	--	--	70	65.26
188	281451082380702	Starkey 20 shallow	22	--	41	31.46
190	281453082380302	Starkey #707 shallow	22	20	38.37	30.88
193	281500082384502	Starkey #710 shallow	30	20	42.70	27.79
194	281501082380901	Starkey EMW 3	--	--	--	27.94
197	281504082104802	Old Wire Road and SR 52 shallow	17	17	87	Dry
200	281509082385401	Starkey W2S WT	--	--	21.20	22.82
209	281516082361201	Starkey EMW 6	--	--	--	33.26
216	281520082314502	Bexley #734 shallow	11	8	60	58.35
217	281521082380601	Starkey WF EMW 5	12	--	32	31.56
221	281525082383601	Starkey WF SH EMW 5	18	--	20	20.08
228	281530082381301	Starkey WF SP4	16	--	34	28.39
229	281530082384801	Starkey SM-1 SH	--	--	21	23.18
235	281535082241302	Cypress Creek TMR-5 shallow	--	--	64	60.56
242	281558082264602	Pasco 13 shallow	--	--	80	77.05
248	281615082242501	Cypress Creek 2 shallow	12	10	68.82	65.91
254	281636082372002	Moon Lake shallow	25	22	38.69	33.79
256	281637082233502	Cypress Creek WF #829 shallow	13	8	70	66.47
266	281650082244502	Cypress Creek TMR-4 shallow	--	--	63.84	58.15

Well No.	Identification No.	Well name	Well depth (feet)	Casing depth (feet)	Altitude of land surface (feet)	Elevation of water above sea level (feet)
275	281656082251202	Cypress Creek WF #831 shallow	12	9	60.20	60.67
278	281657082303302	Bexley #733 shallow	--	--	68	66.16
286	281715082164402	SR 577 shallow	21	18	130	123.28
288	281719082224802	Cypress Creek TMR-1 shallow	--	--	70	61.53
289	281723082231201	Cypress Creek #827 shallow	10	--	70.80	63.86
292	281723082234602	Cypress Creek WF #826 shallow	--	--	65	62.59
300	281746082233702	Cypress Creek TMR-3 shallow	11	--	65.41	60.59
302	281748082225302	Cypress Creek WF E-108 shallow	--	--	69	66.57
309	281801082225102	Cypress Creek E-107 shallow	--	--	71	67.42
315	281809082224403	Cypress Creek WF E-106 shallow	--	--	72	66.89
323	281828082223201	Cypress Creek WF #824 shallow	12	--	74	66.19
326	281844082224101	Cypress Creek 822 shallow	--	--	75	73.62
328	281845082224002	Cypress Creek TMR-2 shallow	--	--	78	70.06
331	281850082221302	Cypress Creek WF #821 shallow	--	--	73	72.77
338	281918082264602	SR 52 east of Gowers Corner SH	7	7	79.50	75.82
344	281926082212902	SR 52 and 581 shallow	12	12	85	85.36
356	281949082332002	SR 52 west of Gowers Corner SH	23	20	56.68	53.79
363	282009082373802	SR 52 shallow	9	9	33	28.23
392	282141082335201	Mays Road shallow well	--	--	46	40.79
394	282142082283702	Cross Bar WF A shallow	23	--	77	69.22
401	282148082281802	Cross Bar WF A-1 shallow	23	--	70	69.21
402	282148082300701	Fivay 732 shallow	10	8	72	67.38
410	282154082280402	Cross Bar WF A-2 shallow	23	--	74	69.83
415	282207082271102	Cross Bar WF A-3 shallow	21	18	71.8	69.72
426	282232082164401	577/578 shallow	12	12	232	Dry

Well No.	Identification No.	Well name	Well depth (feet)	Casing depth (feet)	Altitude of land surface (feet)	Elevation of water above sea level (feet)
445	282259082282802	Cross Bar WF B-1 shallow	23	19	72	66.43
447	282302082290301	Cross Bar WF S-1	21	--	71	65.75
452	282313082284302	Cross Bar WF B-2 shallow	23	--	72	65.76
456	282323082343301	Hays Road shallow	27	20	41	30.45
462	282326082285202	Cross Bar WF B-3 shallow	21	19	68.3	62.20
476	282408082274202	Cross Bar WF C-1 shallow	21	--	72	53.14
481	282411082261402	Cross Bar WF C-3 shallow	27	23	74	60.94
491	282419082271202	Cross Bar WF N-2 shallow	30	--	70.32	56.02
499	282430082271202	Cross Bar WF N-1 shallow	35	--	70.28	55.41
504	282441082271202	Cross Bar WF N-12 shallow	41	--	67	52.68
514	282504082280302	NWO-2 shallow	32	--	66	51.18
516	282505082271102	NRW shallow	21	--	65	51.83
524	282540082275702	Masaryktown shallow	19	9	66	52.33
534	282723082142301	575 west of Trilby shallow	14	0	118	Dry

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