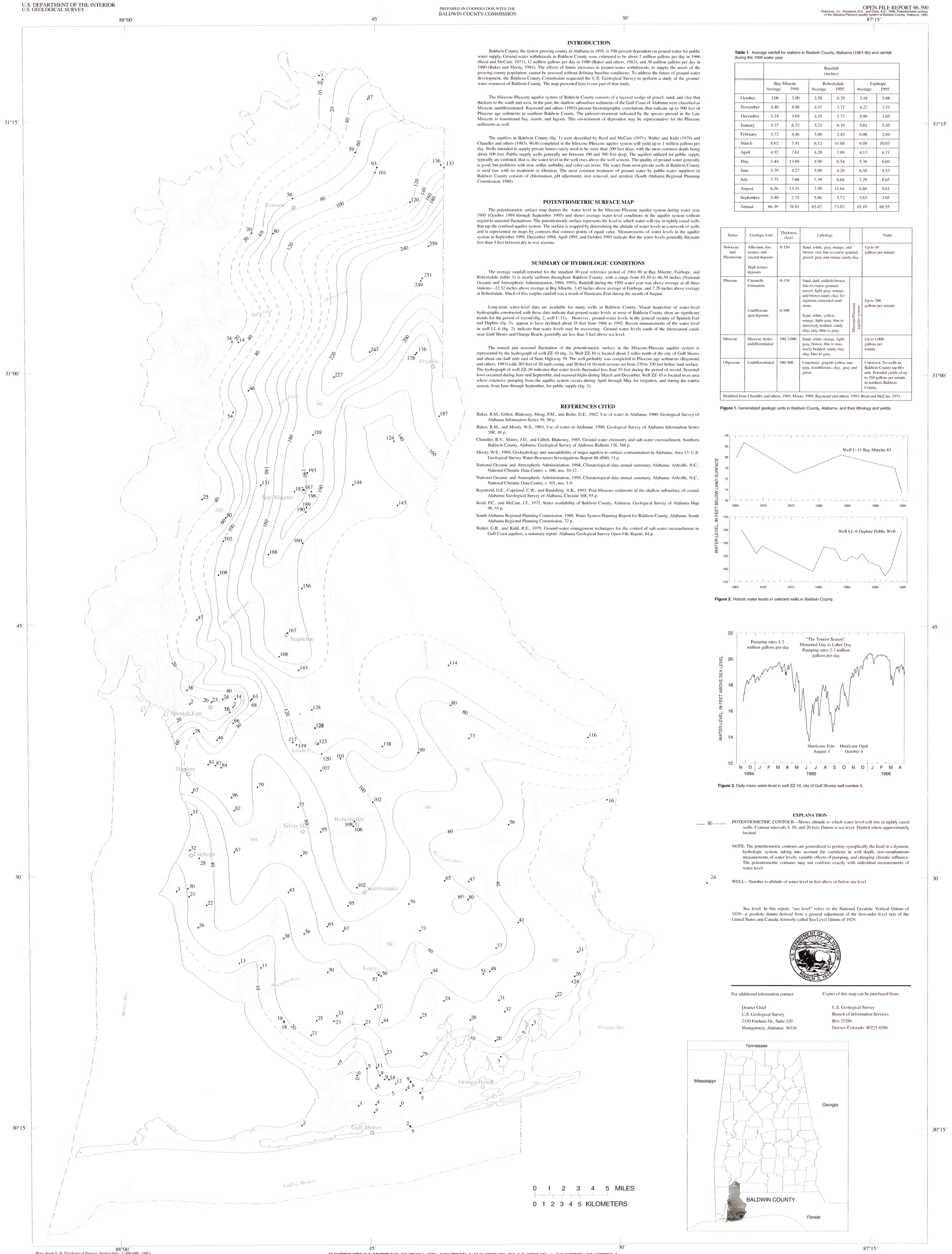
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
BALDWIN COUNTY COMMISSION

OPEN-FILE REPORT 96-590
Robinson, J.L., Moreland, R.S., and Clark, A.E., 1996, Potentiometric surface of the Miocene-Pliocene aquifer system of Baldwin County, Alabama, 1995



INTRODUCTION

Baldwin County, the fastest growing county in Alabama in 1995, is 100-percent dependent on ground water for public water supply. Ground-water withdrawals in Baldwin County were estimated to be about 7 million gallons per day in 1966 (Reed and McCain, 1971), 12 million gallons per day in 1980 (Baker and others, 1982), and 30 million gallons per day in 1990 (Baker and Mooty, 1993). The effects of future increases in ground-water withdrawals, to supply the needs of the growing county population, cannot be assessed without defining baseline conditions. To address the future of ground-water development, the Baldwin County Commission requested the U.S. Geological Survey to perform a study of the ground-water resources of Baldwin County. The map presented here is one part of that study.

The Miocene-Pliocene aquifer system of Baldwin County consists of a layered wedge of gravel, sand, and clay that thickens to the south and west. In the past, the shallow subsurface sediments of the Gulf Coast of Alabama were classified as Miocene undifferentiated. Raymond and others (1993) present biostratigraphic correlations that indicate up to 500 feet of Pliocene age sediments in southern Baldwin County. The paleoenvironment indicated by the species present in the Late Miocene is transitional bay, marsh, and lagoon. This environment of deposition may be representative for the Pliocene sediments as well.

The aquifers in Baldwin County (fig. 1) were described by Reed and McCain (1971), Walter and Kidd (1979) and Chandler and others (1985). Wells completed in the Miocene-Pliocene aquifer system will yield up to 1 million gallons per day. Wells intended to supply private homes rarely need to be more than 200 feet deep, with the most common depth being about 100 feet. Public-supply wells generally are between 100 and 300 feet deep. The aquifers utilized for public supply typically are confined, that is, the water level in the well rises above the well screens. The quality of ground water generally is good, but problems with iron, sulfur, turbidity, and color can occur. The water from most private wells in Baldwin County is used raw with no treatment or filtration. The most common treatment of ground water by public-water suppliers in Baldwin County consists of chlorination, pH adjustment, iron removal, and aeration (South Alabama Regional Planning Commission, 1988).

POTENTIOMETRIC SURFACE MAP

The potentiometric surface map depicts the water level in the Miocene-Pliocene aquifer system during water year 1995 (October 1994 through September 1995) and shows average water-level conditions in the aquifer system without regard to seasonal fluctuations. The potentiometric surface represents the level to which water will rise in tightly cased wells that tap the confined aquifer system. The surface is mapped by determining the altitude of water levels in a network of wells and is represented on maps by contours that connect points of equal value. Measurements of water levels in the aquifer system in September 1994, December 1994, April 1995, and October 1995 indicate that the water levels generally fluctuate less than 5 feet between dry to wet seasons.

SUMMARY OF HYDROLOGIC CONDITIONS

The average rainfall reported for the standard 30-year reference period of 1961-90 at Bay Minette, Fairhope, and Robertsdale (table 1) is nearly uniform throughout Baldwin County, with a range from 65.10 to 66.39 inches (National Oceanic and Atmospheric Administration, 1994, 1995). Rainfall during the 1995 water year was above average at all three stations—12.52 inches above average at Bay Minette, 3.45 inches above average at Fairhope, and 7.20 inches above average at Robertsdale. Much of this surplus rainfall was a result of Hurricane Erin during the month of August.

Long-term water-level data are available for many wells in Baldwin County. Visual inspection of water-level hydrographs constructed with these data indicate that ground-water levels in most of Baldwin County show no significant trends for the period of record (fig. 2, well U-11). However, ground-water levels in the general vicinity of Spanish Fort and Daphne (fig. 2), appear to have declined about 35 feet from 1966 to 1992. Recent measurements of the water level in well LL-6 (fig. 2) indicate that water levels may be recovering. Ground-water levels south of the intercoastal canal, near Gulf Shores and Orange Beach, generally are less than 5 feet above sea level.

The annual and seasonal fluctuation of the potentiometric surface in the Miocene-Pliocene aquifer system is represented by the hydrograph of well ZZ-10 (fig. 3). Well ZZ-10 is located about 5 miles north of the city of Gulf Shores and about one-half mile east of State Highway 59. The well probably was completed in Pliocene age sediments (Raymond and others, 1993) with 265 feet of 20-inch casing, and 50 feet of 10-inch screens set from 270 to 320 feet below land surface. The hydrograph of well ZZ-10 indicates that water levels fluctuated less than 10 feet during the period of record. Seasonal lows occurred during June and September, and seasonal highs during March and December. Well ZZ-10 is located in an area where extensive pumping from the aquifer system occurs during April through May for irrigation, and during the tourist season, from June through September, for public supply (fig. 3).

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Table 1. Average rainfall for stations in Baldwin County, Alabama (1961-90) and rainfall during the 1995 water year

	Rainfall (inches)					
	Bay Minette		Robertsdale		Fairhope	
	Average	1995	Average	1995	Average	1995
October	3.08	3.90	3.58	6.29	3.18	5.88
November	4.40	4.98	4.57	3.71	4.22	3.71
December	5.74	3.04	4.55	1.77	4.90	2.05
January	5.37	6.22	5.23	6.19	5.01	5.45
February	5.72	4.46	5.86	2.45	6.06	2.84
March	6.62	7.41	6.12	11.88	6.08	10.03
April	4.52	7.61	4.20	7.89	4.13	6.71
May	5.44	13.88	4.98	6.54	5.36	6.04
June	5.79	4.27	5.98	4.28	6.56	4.53
July	7.75	7.04	7.39	6.66	7.29	8.65
August	6.56	13.35	7.50	11.64	6.66	9.61
September	5.40	2.75	5.86	3.72	5.65	3.05
Annual	66.39	78.91	65.82	73.02	65.10	68.55

Series	Geologic Unit	Thickness (feet)	Lithology		Yield
Holocene and Pleistocene	Alluvium, low terrace, and coastal deposits High terrace deposits	0-150	Sand, white, gray, orange, and brown, very fine to coarse-grained; gravel; gray and orange sandy clay.		Up to 10 gallons per minute
Pliocene	Citronelle Formation Undifferentiated deposits	0-130 0-500	Sand, dark-reddish-brown, fine to coarse-grained; gravel, light-gray, orange, and brown sandy clay; ferruginous cemented sandstone. Sand, white, yellow, orange, light-gray, thin to massively bedded; sandy clay, clay, blue to gray.	Miocene/Pliocene aquifer system	Up to 700 gallons per minute
Miocene	Miocene Series undifferentiated	100-3,000	Sand, white, orange, light-gray, brown, thin to massively bedded; sandy clay, clay, blue to gray.		Up to 1,000 gallons per minute
Oligocene	Undifferentiated	100-500	Limestone, grayish-yellow and gray, fossiliferous; clay, gray and green.		Unknown. No wells in Baldwin County tap this unit. Potential yields of up to 350 gallons per minute in northern Baldwin County.
Modified from Chandler and others, 1985; Mooty, 1988; Raymond and others, 1993; Reed and McCain, 1971.					

Figure 1. Generalized geologic units in Baldwin County, Alabama, and their lithology and yields.

Figure 2. Historic water levels in selected wells in Baldwin County.

Figure 3. Daily mean water level in well ZZ-10, city of Gulf Shores well number 5.

EXPLANA TION

— 30 ------ POTENTIOMETRIC CONTOUR—Shows altitude to which water level will rise in tightly cased wells. Contour intervals 5, 10, and 20 feet. Datum is sea level. Dashed where approximately located

NOTE: The potentiometric contours are generalized to portray synoptically the head in a dynamic hydrologic system, taking into account the variations in well depth, non-simultaneous measurements of water levels, variable effects of pumping, and changing climatic influence. The potentiometric contours may not conform exactly with individual measurements of water level

• 24 WELL—Number is altitude of water level in feet above or below sea level

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

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Copies of this map can be purchased from:

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Base from U.S. Geological Survey digital data, 1:100,000, 1983
Universal Transverse Mercator projection,
Zone 17

POTENTIOMETRIC SURFACE OF THE MIOCENE-PLIOCENE AQUIFER SYSTEM OF BALDWIN COUNTY, ALABAMA, 1995

By
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