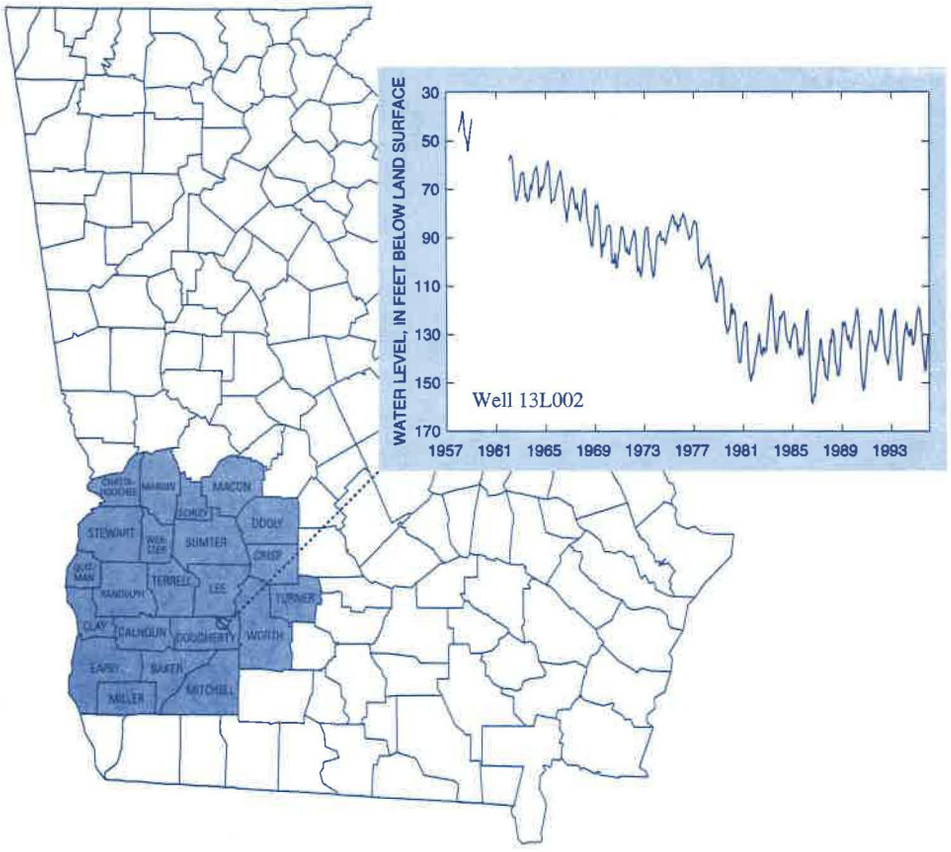
POTENTIOMETRIC SURFACES (FALL 1994) AND WATER-LEVEL FLUCTUATIONS AND TRENDS IN THE CLAYTON AND CLAIBORNE AQUIFERS IN SOUTHWESTERN GEORGIA

by
Nancy L. Barber



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U.S. DEPARTMENT OF THE INTERIOR
U.S. Geological Survey

GEORGIA DEPARTMENT OF NATURAL RESOURCES
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HYDROLOGIC ATLAS 21

GEORGIA DEPARTMENT OF NATURAL RESOURCES
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INTRODUCTION

The Clayton and Claiborne aquifers in southwestern Georgia are used principally for irrigation, public supply, and industrial purposes. The aquifers are of limited areal extent, but are important sources of water. Water use from the Clayton aquifer was about 44 million gallons per day (Mgal/d) during 1990. Water use from the Claiborne aquifer was about 67 Mgal/d during 1990 (data from U.S. Geological Survey, Georgia Water-Use Data System).

The Clayton aquifer consists mainly of limestone and some sand of Paleocene age. The aquifer varies in thickness from less than 50 feet (ft) near the outcrop area in Quitman, Stewart, and Webster Counties to more than 350 ft in Early County (McFadden and Perriello, 1983, p. 8-10).

The Claiborne aquifer overlies the Clayton aquifer, and is separated from it by clay-rich beds of Paleocene and Eocene age. The Claiborne aquifer consists of sand of middle Eocene age. The aquifer varies in thickness from less than 50 ft near the outcrop area in Clay, Randolph, Terrell, Sumter, and Dooly Counties, to more than 200 ft in eastern Dougherty County (McFadden and Perriello, 1983, p. 8-14).

This report presents potentiometric-surface maps of the Clayton and Claiborne aquifers. These maps were constructed using water-level measurements made during the fall of 1994 in 64 wells completed in the Clayton aquifer and in 82 wells completed in the Claiborne aquifer.

POTENTIOMETRIC SURFACES

The potentiometric-surface maps show the approximate altitude at which water would have risen in a tightly cased well from October 31 to November 4, 1994. In the outcrop area of the aquifers, especially the Claiborne aquifer, where a significant degree of stream-aquifer interaction occurs (Long, 1989, plates 2 and 3), the potentiometric surface is greatly simplified. In areas where water-level data were unavailable for 1994, the general shape of the contours was defined on the basis of previous potentiometric maps by Peck and others (1992).

Comparison of the potentiometric surfaces for October-November 1994 (this report) and November 1991 (Peck and others, 1992, p. 88 and 98) indicates that water levels in the Clayton and Claiborne aquifers generally were similar during these two periods. Comparison of water levels in specific wells indicates that most water levels were higher during October-November 1994 than during November 1991, and that most water-level increases were less than 10 ft. The configuration of the potentiometric surfaces for both aquifers for 1991 and 1994 were similar; water levels were higher in the outcrop areas than in downdip areas, and water levels were lower in the Albany area.

WATER-LEVEL FLUCTUATIONS AND TRENDS

Water levels in the Clayton and Claiborne aquifers rise in winter and early spring when evapotranspiration and pumping for irrigation are low and precipitation is high; water levels decline in summer and fall during the irrigation season when evapotranspiration and pumping for irrigation are high and precipitation is low (Clarke and others, 1984, sheet 4; Long, 1989, plates 2 and 3). The water levels during October-November in a given year generally represent the lowest water levels in these aquifers. However, in 1994, water levels during October-November generally were higher than in the winter of the previous year as a result of decreased irrigation withdrawal during 1994. In July 1994, much of the area of the Clayton and Claiborne aquifers was flooded as a result of heavy rainfall associated with Tropical Storm Alberto (Stamey, 1995, p. 313). Many summer crops were damaged or destroyed by the flood, which greatly reduced the need for irrigation during the remainder of the year.

Ground-water levels are monitored continuously in 12 wells completed in the Clayton aquifer and 21 wells completed in the Claiborne aquifer; 5 water-level hydrographs are shown for each aquifer. These hydrographs illustrate the fluctuations of water levels in the aquifers caused by seasonal changes in recharge (precipitation) and discharge (evapotranspiration and pumping).

The hydrograph for well 11L001, completed in the Claiborne aquifer and located in the agricultural area in western Dougherty County, illustrates both the seasonal changes in water levels and the increase in water levels as a result of the 1994 flood. During 1993 (a typical year), the water level in well 11L001 rose during the first third of the year, when precipitation was high, evapotranspiration was low, and before most irrigation pumping began. The water level declined throughout the summer and fall during the period of irrigation pumping, lower precipitation, and high evapotranspiration, before beginning to rise again at the end of the year as irrigation pumping was reduced and winter precipitation recharged the aquifer.

During 1994, the water level rose during the first third of the year as the aquifer continued to be recharged from winter rains, and then began to decline as irrigation pumping started. However, above-average rainfall during June, July, and August (Cressler and others, 1995, p. 8), and crop losses from the flooding associated with Tropical Storm Alberto, reduced the amount of irrigation pumping for the remainder of the summer, and the water level rose for much of the rest of 1994. Water levels in Albany-area wells, such as 13L002 (Clayton aquifer) and 13L011 (Claiborne aquifer), show a less-pronounced seasonal variation because the public-supply and industrial pumping in the Albany area is more uniform throughout the year than the irrigation pumping in other areas.

Water-level trends in the Clayton aquifer generally are related to trends in pumping. In the Albany area (as illustrated in the hydrograph for well 13L002), the water level declined from 1957 to the mid-1970's, as pumping by the city of Albany increased. The rate of decline increased from 1977 to 1981 as seasonal irrigation pumping increased (Clarke and others, 1984). Since 1981, water levels have stabilized because of two factors: the Georgia Environmental Protection Division imposed restrictions on pumping by the city of Albany, and the city instituted a management strategy using water levels to determine which wells to pump (D.W. Hicks, U.S. Geological Survey, oral commun., 1996). Outside the Albany area, the water level in the Clayton aquifer declined and the seasonal variation increased during the late 1970's, primarily in response to the increase in irrigation pumping from this aquifer (Clarke and others, 1984). Since the late 1980's, water levels have been stable or increased (wells 07N001, 11L002, and 14P014), with the exception of well 06K009, in northern Early County, where the water level generally has declined since 1989.

Water-level trends in the Claiborne aquifer from the late 1970's through 1995 are shown in two hydrographs: for well 13L011 in the Albany area, and for well 11L001 in western Dougherty County. In the Albany area, the water level in the Claiborne aquifer declined from 1977 to 1981, and was stable or increased slightly from 1981 through 1995. The water level in well 11L001 generally declined from 1978 to 1995; however, the water level increased from 1981 to 1983 and from 1986 to 1991. The water level in wells 09M009, 11P015, and 15R007 (all wells are located near the outcrop area of the Claiborne aquifer), declined until 1988-89, then generally increased through 1995.

REFERENCES CITED

Clarke, J.S., Faye, R.E., and Brooks, Rebekah, 1984, Hydrogeology of the Clayton aquifer of southwest Georgia: Georgia Geologic Survey Hydrologic Atlas 13, 6 plates.

Cressler, A.M., Jones, L.E., and Joiner, C.N., 1995, Ground-water conditions in Georgia, 1994: U.S. Geological Survey Open-File Report 95-302, 135 p.

Georgia Geologic Survey, 1976, Geologic map of Georgia: Atlanta, Ga., scale 1:500,000.

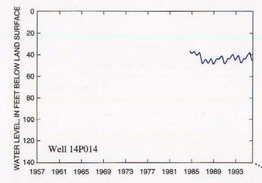
Long, A.F., 1989, Hydrogeology of the Clayton and Claiborne aquifer systems: Georgia Geologic Survey Hydrologic Atlas 19, 6 plates.

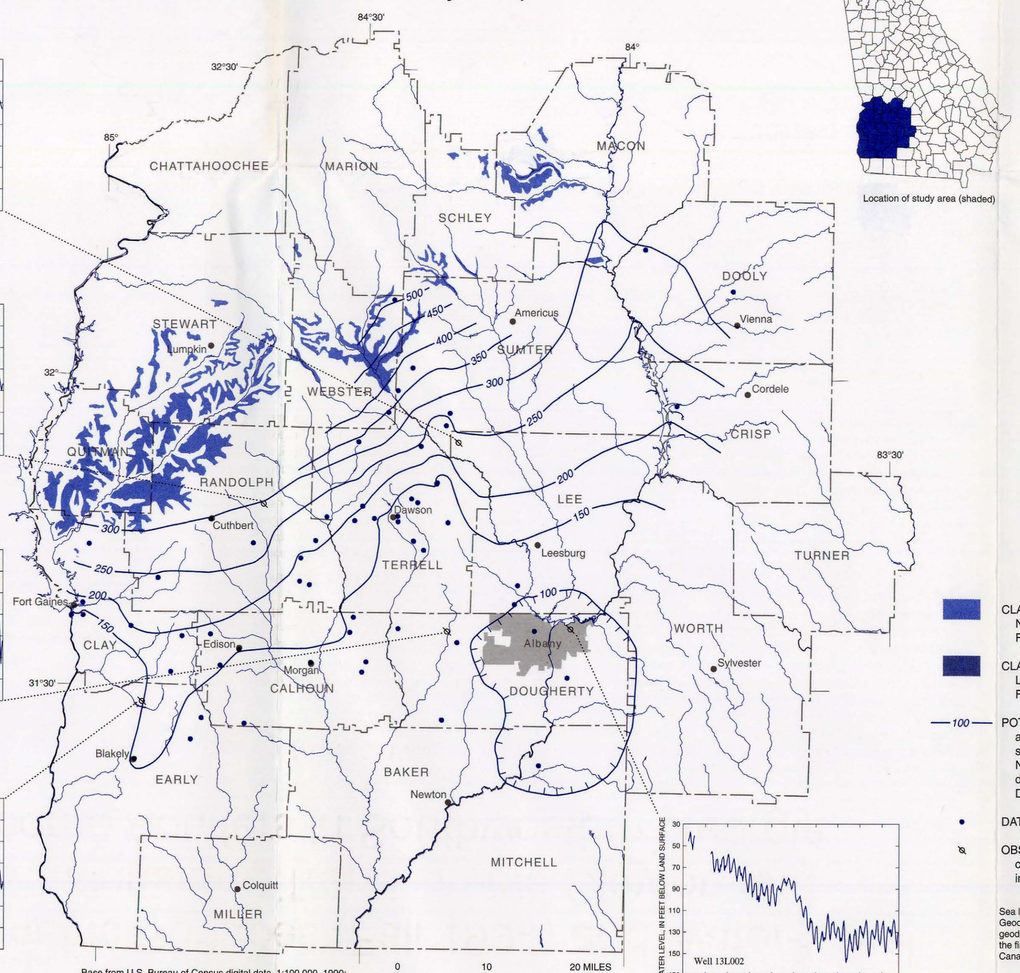
McFadden, S.S., and Perriello, D.P., 1983, Hydrogeology of the Clayton and Claiborne aquifers in southwestern Georgia: Georgia Geologic Survey Information Circular 55, 59 p.

Peck, M.F., Joiner, C.N., and Cressler, A.M., 1992, Ground-water conditions in Georgia, 1991: U.S. Geological Survey Open-File Report 92-470, 137 p.

Stamey, T.C., 1995, Floods in central and southwestern Georgia in July 1994, *in* Hatcher, K.J., *ed.*, Proceedings of the 1995 Georgia Water Resources Conference: Carl Vinson Institute of Government, The University of Georgia, Athens, Ga., p. 313-316.

Clayton Aquifer





Base from U.S. Bureau of Census digital data, 1:100,000, 1990; and U.S. Geological Survey digital data, 1:100,000, 1977-1981, Albers Equal-Area Conic projection: Standard parallels 29°30' and 45°30', central meridian 83°30'; Geology from Georgia Geologic Survey, 1976

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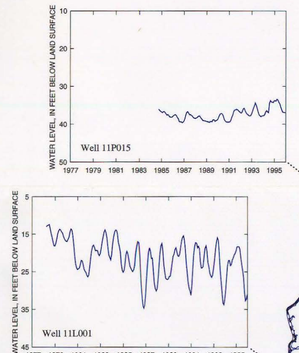
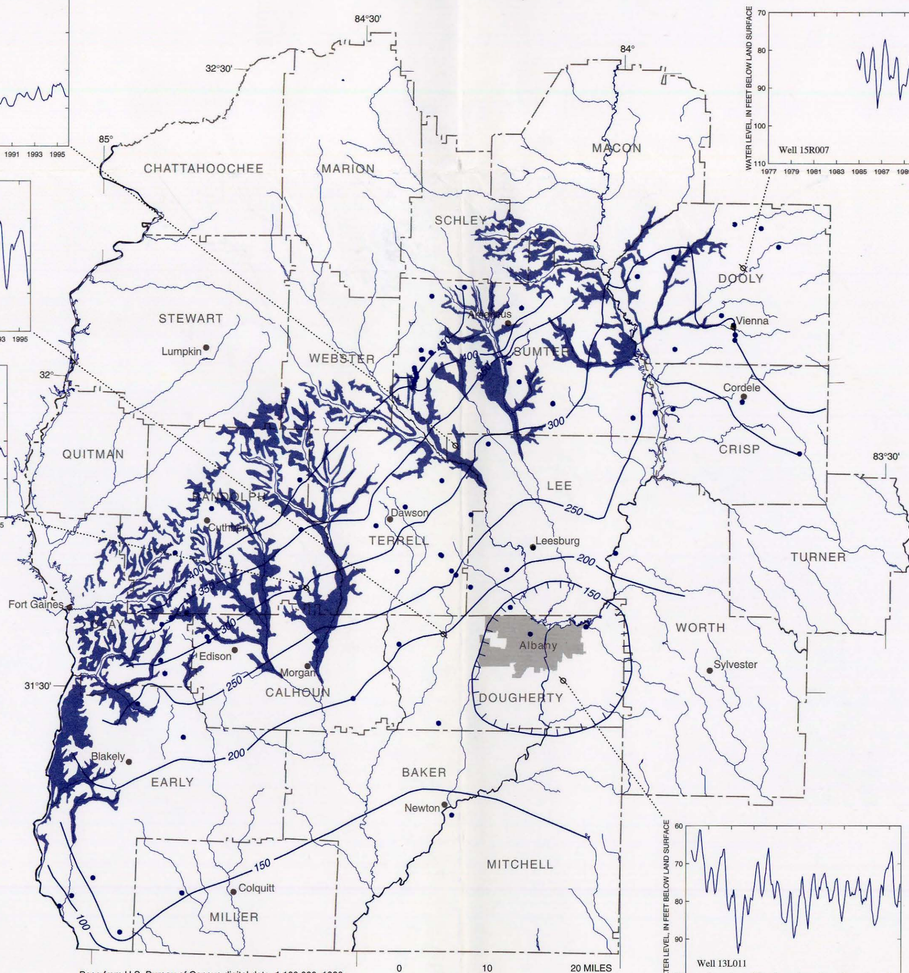
Claiborne Aquifer





EXPLANATION

CLAYTON AQUIFER OUTCROP—Nanafalia, Porters Creek, and Clayton Formations, undifferentiated

CLAIBORNE AQUIFER OUTCROP—Lisbon, Tallahatta, and Claiborne Formations, undifferentiated

100 — POTENTIOMETRIC CONTOUR—Shows altitude at which water level would have stood in tightly cased wells October-November 1994. Hachures indicate depressions. Contour interval 50 feet. Datum is sea level

DATA POINT

OBSERVATION WELL—Equipped with continuous recorder. Hydrograph included in this report

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."

Base from U.S. Bureau of Census digital data, 1:100,000, 1990; and U.S. Geological Survey digital data, 1:100,000, 1977-1981, Albers Equal-Area Conic projection: Standard parallels 29°30' and 45°30', central meridian 83°30'; Geology from Georgia Geologic Survey, 1976

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