GROUND-WATER LEVELS IN GEORGIA, 2001

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Abstract. The U.S. Geological Survey continuously monitors ground-water levels in a network of wells completed in major aquifers of the State of Georgia. This network includes 17 wells in the surficial aquifer, 12 wells in the upper and lower Brunswick aquifers, 73 wells in the Upper Floridan aquifer, 10 wells in the Lower Floridan aquifer and underlying units, 12 wells in the Claiborne aquifer, 1 well in the Gordon aquifer, 11 wells in the Clayton aquifer, 11 wells in the Cretaceous aquifer system, 2 wells in Paleozoic-rock aquifers, and 7 wells in crystalline-rock aquifers. Data from these 156 wells were evaluated to determine whether mean-annual ground-water levels were within, below, or above the normal range during 2001, based on summary statistics for the period of record. Information from these summaries indicates that statewide water levels during 2001 were nearly evenly divided between below normal and normal to above normal. Finally, below normal water levels were observed in nearly all of the aquifers monitored, largely reflecting climatic effects from drought and pumping.

INTRODUCTION

Monitoring ground-water levels is important for management of water resources. The U.S. Geological Survey (USGS)—in cooperation with State, Federal, and local agencies—collects and disseminates ground-water-level data from a network of wells completed in major aquifers of Georgia (Fig. 1). This paper presents an overview of ground-water-levels in selected aquifers in Georgia during 2001, based on continuous water-level measurements obtained from 156 wells. Of the 156 wells, 146 are equipped with electronic data recorders that record at 60-minute intervals and are retrieved monthly, and 13 are equipped with real-time satellite telemetry that records at 60-minute intervals and transmits data every 4 hours. Telemetered data are displayed on the USGS Georgia District Web site at URL: http://water.usgs.gov/ga/nwis/current?type=gw.

Method of Study

Median water levels for 2001 were compared to period-of-record normal water levels to determine if water levels were above normal, below normal, or normal. In this paper, the normal range is defined as those water-level observations during the subject year that lie between the 25th and 75th percentiles (first and third quartiles), also known as the inter-quartile range, for the period of record. This can be shown by examining a graphical representation of these values known as a boxplot (Fig. 2) (Leeth and others, 2003).

The results of comparing median water levels for 2001 with period-of-record normal water levels are graphically depicted on maps (Fig. 1) by either an up arrow—2001 monthly mean water levels above period-of-record normal range; a down arrow—2001 monthly mean water levels below period-of-record normal range; or a circle—2001 monthly mean water levels within the period-of-record normal range.

Occurrence of Ground Water

Contrasting geologic features and landforms of the physiographic provinces of Georgia affect the occurrence of ground water in the State. Surficial aquifers are present in each of the physiographic provinces and are generally under water-table (unconfined) conditions. The most productive aquifers are in the Coastal Plain in the southern half of the State and include, in order of descending depth, the surficial aquifer, the Brunswick aquifer system (Clarke, 2003), the Upper and Lower Floridan aquifers, the Claiborne and Gordon aquifers, the Clayton aquifer, and the Cretaceous aquifer system. In the Piedmont and Blue Ridge Provinces of northern Georgia, ground water occurs in the regolith and in fractures in crystalline bedrock (referred to as “crystalline-rock aquifers”). In the Valley and Ridge and Appalachian Plateau Provinces, ground water occurs largely in secondary openings in folded and faulted sedimentary and metasedimentary rocks (referred to as “Paleozoic-rock aquifers”).

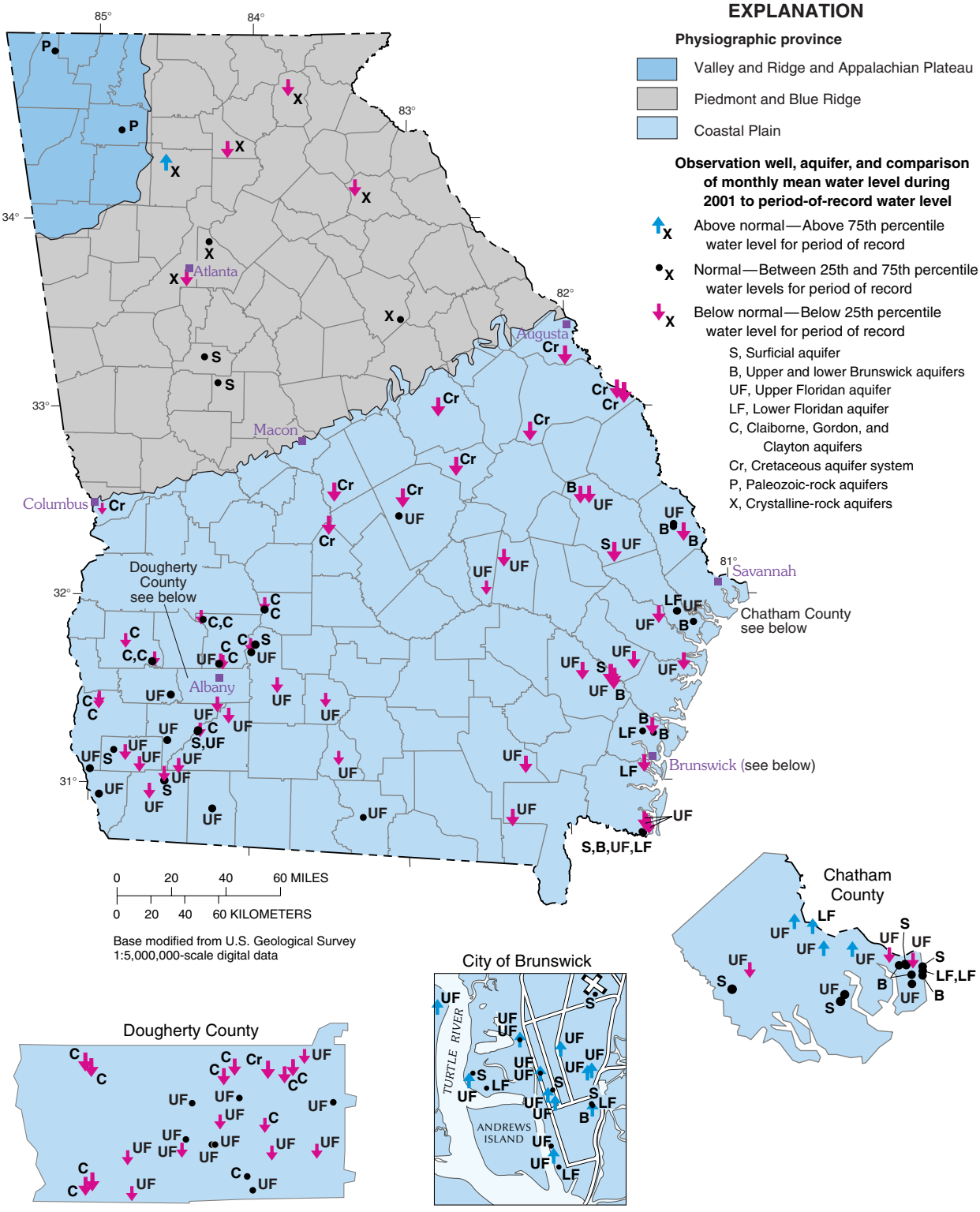

Figure 1. Physiographic provinces, observations wells, and aquifer and depiction of comparision of monthly mean water level during 2001 to period-of-record water level.

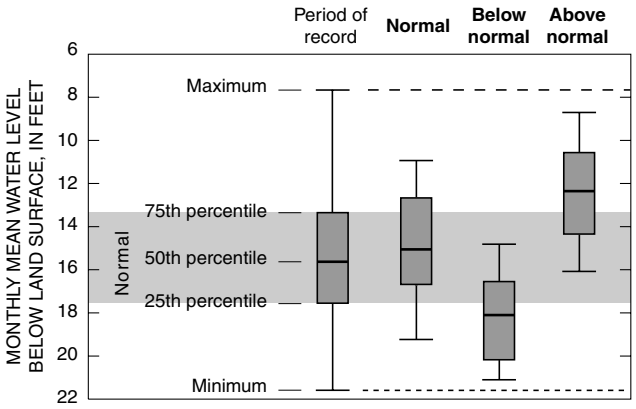

Figure 2. Boxplot showing normal, below normal, and above normal water-level range and maximum and minimum water level.

Changes in ground-water levels measured in wells are caused by changes in storage in aquifers—when recharge exceeds discharge, ground-water levels rise, and when discharge exceeds recharge, ground-water levels decline. Recharge varies in response to precipitation and surface-water infiltration to an aquifer. Discharge occurs as natural flow from an aquifer to streams and springs, as evapotranspiration, and as withdrawal from wells. Water levels typically show a cyclic pattern of seasonal fluctuation, with higher water levels in the winter and spring due to greater recharge, and lower water levels in the summer and fall due to less recharge, greater evapotranspiration, and increased pumping. Ground-water pumping is the most significant human activity that affects the amount of ground water in storage and rate of discharge from an aquifer (Taylor and Alley, 2001).

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During 2001, Georgia was in the third year of a prolonged drought throughout most of the State. This drought impacted ground-water levels by providing less recharge to aquifers and causing increased water demand, primarily in agricultural areas. During 2001, ground-water levels in the Statewide network were below normal in 49 percent of the wells, and normal or above normal in 51 percent of the wells (Table 1). In the northern half of the State, water levels were mostly normal or above normal (64 percent of the wells), whereas in the southern half of the State, water levels were evenly divided between below normal and normal or above normal. These variations reflect differences in the proximity of a well to aquifer recharge areas, and differences in ground-water pumping.

Water in the surficial aquifers typically is in contact with the atmosphere (referred to as an unconfined or water-table aquifer), but locally may be under pressure exerted by overlying sediments or rocks (referred to as a confined aquifer). Where unconfined, water levels change quickly in response to recharge and discharge. Consequently, hydrographs from these wells show a strong relation to climate. During 2001, water levels in 15 of the 17 wells measured were within the normal range, indicating some recovery from the effects of drought. Water levels in two wells in the confined part of the surficial aquifer in coastal Georgia were below normal, reflecting the influence of nearby pumping.

Water in the Brunswick aquifer system is confined throughout the aquifer. During 2001, water levels in 8 wells were in the normal range to above normal range and 4 wells were below the normal range. These variations reflect differences in local pumping, interaquifer leakage effects, and recharge.

Table 1. Percentage of water levels in the normal to above normal range and below the normal range, by aquifer or aquifer system, and geographic region, Georgia, 2001

[—, not applicable]

	Water levels normal or above normal		Water levels below normal		Total
	Number of wells	Percent of total	Number of wells	Percent of total	
By aquifer or aquifer system					
Surficial aquifers	15	88	2	12	17
Brunswick aquifer system	8	67	4	33	12
Upper Floridan aquifer	39	53	34	47	73
Lower Floridan aquifer	9	90	1	10	10
Claiborne and Gordon aquifers	2	15	11	85	13
Clayton aquifer	2	18	9	82	11
Cretaceous aquifer system	0	—	11	100	11
Paleozoic-rock aquifer	2	100	0	—	2
Crystalline-rock aquifer	3	43	4	57	7
Total	**80**	**51**	**76**	**49**	**156**
By geographic region					
North of Fall Line	7	64	4	36	11
South of Fall Line	73	50	72	50	145

The Upper Floridan aquifer is confined throughout most of its extent (Fig. 1), except where it crops out or is near land surface and in areas of karst topography in parts of southwestern and south-central Georgia. During 2001, ground-water levels in the Upper Floridan aquifer were nearly evenly divided between below normal and normal to above normal. Below normal water levels were observed near pumping areas in the southwestern, south-central, east-central, and coastal parts of the State. In parts of coastal Georgia, water levels in the Upper Floridan aquifer were normal or above normal during 2001, because of conservation and decreased water use, especially in the Savannah and Brunswick areas. Wells with water levels below normal during 2001 are mostly in areas further away from the Savannah and Brunswick pumping centers, reflecting changing pumping patterns in those areas.

Water is confined and influenced mostly by pumpage in the Lower Floridan aquifer and underlying units in coastal Georgia. Water levels were within or above the normal range in 9 of the 10 wells monitored during 2001; one well was below normal. Currently (2003), the Lower Floridan is not widely used in coastal Georgia; therefore, pumping effects are minimal.

The Claiborne and Gordon aquifers in southwest and east-central Georgia can be under confined or unconfined conditions. During 2001, water levels monitored were below normal in 10 of the 12 Claiborne aquifer wells and 1 Gordon aquifer well, likely reflecting increased pumping during drought.

Water is confined and influenced mostly by pumping in the Clayton aquifer in southwest Georgia. Water levels were below normal in 9 of the 11 wells monitored, reflecting increased pumping resulting from drought conditions.

In the Cretaceous aquifer system, ground water is mostly confined but can be unconfined in stream valleys. Water levels were below the normal range in all 11 wells monitored during 2001, reflecting declines related to ground-water pumpage.

Water occurs under confined conditions in the Paleozoic-rock aquifers of northwestern Georgia. Water levels in the two wells were in the normal range during 2001, reflecting recovery from drought effects during the previous 3 years.

In the crystalline-rock aquifers of the Piedmont and Blue Ridge Province, water is present in discontinuous joints and fractures and may be confined or unconfined. Crystalline-rock aquifers typically have local extent and can be highly affected by localized water use and climate. Water levels in four of the seven monitored wells were below the normal range and in three of the wells were above or within the normal range during 2001.

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