OPTIMIZATION OF GROUND-WATER PUMPAGE DISTRIBUTION TO LIMIT CHLORIDE PLUME EXPANSION IN THE UPPER FLORIDAN AQUIFER NEAR BRUNSWICK, GEORGIA

Gregory S. Cherry and Dorothy F. Payne

AUTHORS: Hydrologists, U.S. Geological Survey, 3039 Amwiler Road, Suite 130, Peachtree Business Center, Atlanta, Georgia 30360-2824.
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Abstract. Since the late 1950s, and until recently, the salinity of ground water in the Upper Floridan aquifer near downtown Brunswick, Georgia, has increased, with chloride concentrations exceeding 250 milligrams per liter in an area of about 2-square miles (Fig. 1). Pumping from the Upper Floridan aquifer has lowered water levels in the aquifer and resulted in an upward hydraulic gradient between the highly saline Fernandina permeable zone of the Lower Floridan aquifer and the normally freshwater Upper Floridan aquifer. Saltwater likely enters the Upper Floridan aquifer through localized, vertically oriented conduits of high permeability, and moves laterally in response to the distribution of stresses within the aquifer (Maslia and Prowell, 1990). Comparison of maps showing the distribution of dissolved chloride in the Upper Floridan aquifer during 2001 (Leeth and others, 2003) and 2005 Cherry (2006), indicates the lateral extent of the plume has largely stabilized, probably as a result of long-term decrease in pumpage. Hypothetically, by maintaining an optimal lateral hydraulic gradient and flow toward the plume and the major pumping centers, additional pumpage for ground-water supply may be possible without causing further expansion and increase in salinity of the plume in the Upper Floridan aquifer (Ahlfeld and others, 2005).

During 1980–2005, water use by local industries in the Brunswick area decreased by nearly half, from 78.3 million gallons per day (Mgal/d) during 1980, to 41.1 Mgal/d during 2005, and water use for public supply decreased from 11.8 Mgal/d during 1980, to 8.9 Mgal/d during 2005 (J.L. Fanning, U.S. Geological Survey, written commun., 2006; Fanning, 2003; Fig. 2). As the population in the Brunswick area continues to grow, additional ground-water pumpage will be required to address public-supply needs.

To examine the potential for increased pumpage while containing the saltwater plume, ground-water flow management optimization simulations are being conducted using a model based on an existing regional MODFLOW model of coastal Georgia and adjacent parts of Florida and South Carolina (Payne and others, 2005). Model input and observation data are being updated to 2004 conditions and the model grid is being refined for higher resolution of the simulated hydraulic gradient near the plume. After recalibration, the model will be used as a basis for various pumpage optimization scenarios using the Ground-Water Management Process code (Ahlfeld and others, 2005). In general, pumpage will be optimized for maximum supply while maintaining a specified hydraulic gradient to contain the saltwater plume.

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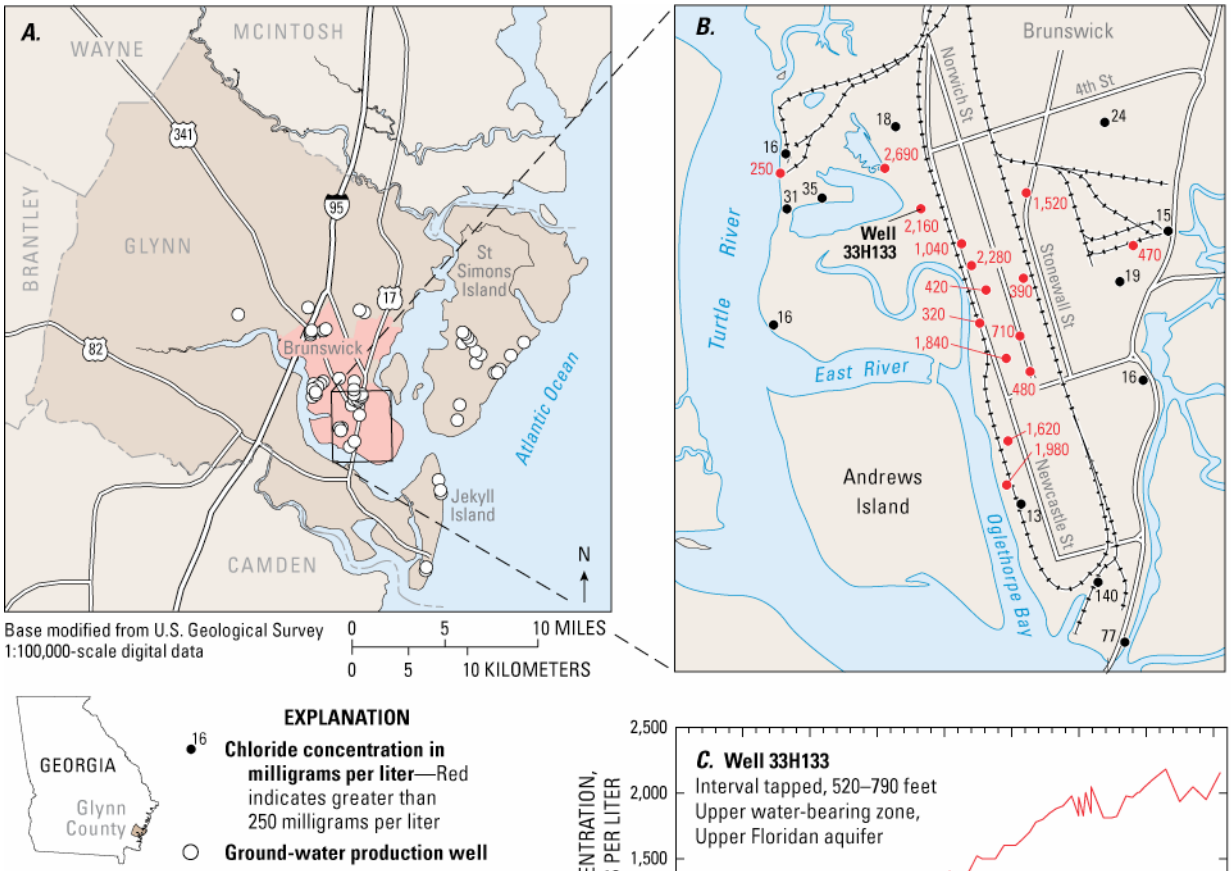

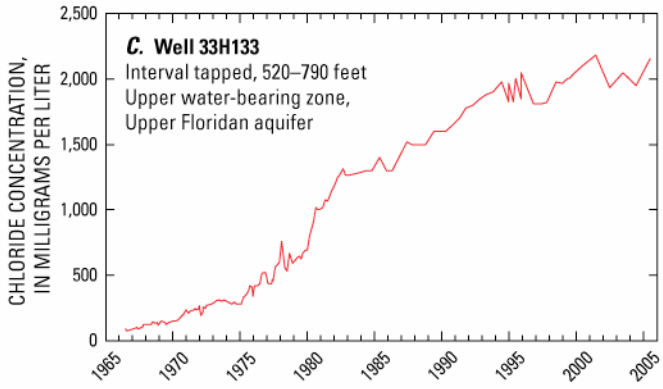

Figure 1. (*A*) Brunswick–Glynn County, Georgia, area; dissolved chloride concentrations in ground-water samples from selected wells completed in the upper water-bearing zone of the Upper Floridan aquifer near downtown Brunswick during June 2005; and (*B*) dissolved chloride concentration in well 33H133, 1965–2005 (modified from Cherry, 2006).

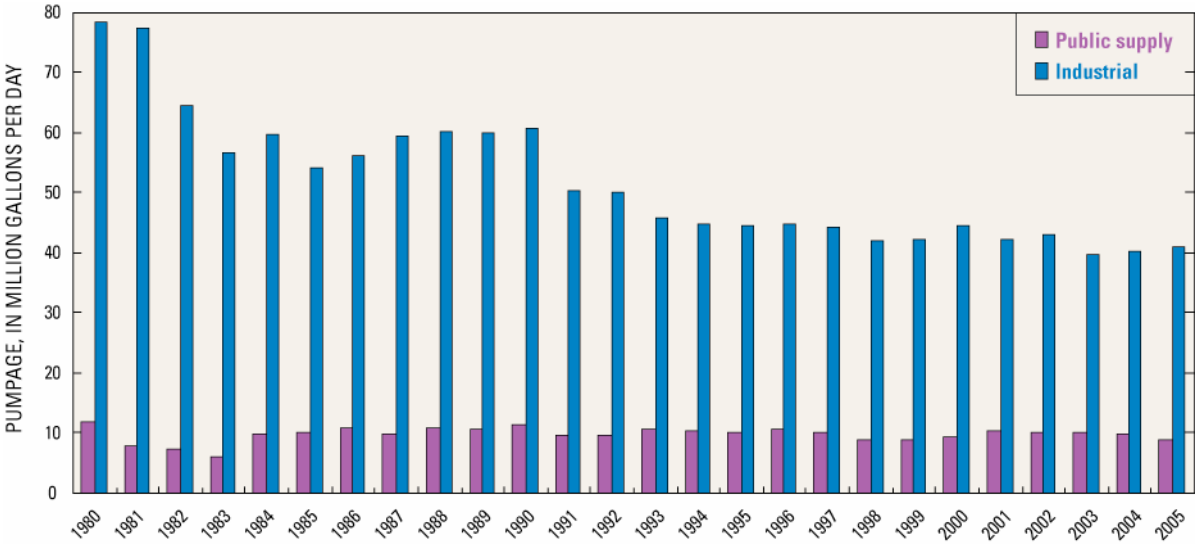

Figure 2. Major ground-water pumpage from the Upper Floridan aquifer for the Brunswick–Glynn County, Georgia, area, 1980–2005 (modified from Cherry, 2006).