Brackish-Water Intrusion from the Chesapeake Bay, Annapolis Neck, Maryland

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Ground water supplies in some areas near the Chesapeake Bay are threatened by brackish-water intrusion from the bay. There is concern among water managers that continued increased pumpage from the aquifers will further increase brackish water intrusion into the aquifers.

Residential growth in the Annapolis Neck area of northern Anne Arundel County, Maryland, has resulted in increased pumpage from individual wells. Most of this pumpage is from the shallow Aquia aquifer. Concomitant with this increased residential growth has been a general lowering of hydraulic heads for the Aquia aquifer. In this area, the Aquia aquifer is interconnected with the Chesapeake Bay and the surrounding estuaries. Brackish water from the bay intrudes into the base of the aquifer where an interface is formed with the freshwater. Lowering hydraulic heads could cause brackish water to move slowly upward in the aquifer. Thus, the general lowering of hydraulic heads in the Annapolis Neck area could in time cause some wells to pump brackish water.

The Maryland Geological Survey and the U.S. Geological Survey, in cooperation with the Anne Arundel County Office of Planning and Zoning, undertook a 4-year investigation to study the impact of brackish-water intrusion into the aquifers underlying the Annapolis Neck peninsula. The investigation was undertaken at several scales. First, to understand the regional system, a three-dimensional ground-water-flow model, which encompassed an area of 870 square miles, simulated flow for a layered system of five aquifers. Results of the simulations indicate that ground-water recharge occurs primarily along the spine of the Annapolis Neck peninsula and that discharge is to the bay and the estuaries.

A more detailed study, on a smaller scale, was conducted to determine the location and nature of the interface between the freshwater and brackish water in the Aquia aquifer. Five wells were installed along a 340-foot linear section and screened above and below the interface. Concentrations of total dissolved solids were as low as 270 milligrams per liter in the freshwater, and as high as 12,000 milligrams per liter in the brackish water below the interface. A two-dimensional, solute-transport model of the section was calibrated to pressure heads and to dissolved solids concentrations. Model simulations indicate that a small difference in screen depth for a typical domestic pumping well set near the interface can make a substantial difference in the freshwater life of water in the well. Simulations also indicated that the extent and rate of brackish-water intrusion into the Aquia aquifer depends on the amount of freshwater diverted landward of the pumping site and on the decline in water levels that result.