

NATURAL AND HUMAN INFLUENCES ON WATER QUALITY IN A SHALLOW REGIONAL UNCONSOLIDATED AQUIFER, NORTHERN ATLANTIC COASTAL PLAIN

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ABSTRACT

Data collected from more than 400 wells in the surficial unconfined aquifer in the Northern Atlantic Coastal Plain (New York through North Carolina) were compiled and analyzed to improve understanding of multiple natural and human influences on water quality in such shallow regional aquifers. The Coastal Plain includes a variety of land uses (including forest, agriculture, and densely populated urban areas) and hydrogeologic conditions. Unconfined ground water commonly occurs within 20 to 30 feet of the land surface, and typically moves along relatively short flow paths to local streams within a few decades. The aquifer provides drinking water in many parts of the Coastal Plain and the majority of flow in local streams. Unconsolidated sediments composing the aquifer are generally permeable in many areas, however, and unconfined ground water in these areas is vulnerable to human influences. Water quality in the aquifer was evaluated at the regional scale in a variety of settings, and along local flowpaths in agricultural areas in four selected hydrogeologic settings. Insights gained from local studies are useful for interpreting and understanding broader patterns and variability observed at the regional scale.

Geochemical patterns were identified and described through principal components analysis on major ions, and correlation and logistic regression were used to relate observed concentrations of nitrate and selected pesticide compounds (atrazine, metolachlor, simazine, and deethylatrazine, an atrazine degradate) and volatile organic compounds (VOCs) (chloroform, 1,1,1-trichloroethane, tetrachlorethene, and methyl tert-butyl ether) to likely influences, such as observed geochemical patterns, land use, hydrogeology, and soils. Variability in major ions is related primarily to ionic strength and redox condition. Concentrations of nitrate, pesticides, and VOCs are related to natural conditions, as well as the distribution of likely sources reflected in land use. Nitrate is most common in aerobic ground water and in relatively well-drained areas, for example; concentrations greater than 0.4 milligrams per liter may result from a variety of human activities, although concentrations greater than 3 milligrams per liter are more likely in agricultural areas. Atrazine, deethylatrazine, and metolachlor are also related to geochemical patterns, likely because ground-water geochemistry reflects hydrogeologic and soil conditions affecting pesticide transport to the water table. Results demonstrate the value of geochemical information along with the distribution of sources and other influences to understanding the regional occurrence of selected compounds in ground water. Such influences are not unique to the Northern Atlantic Coastal Plain, and observations and interpretations are relevant to broader areas.

KEY WORDS

Nutrients, pesticides, hydrogeology, geochemistry, shallow aquifer