Groundwater contamination by agricultural nitrate: a 'multi-point source' conceptual model

Cathy Ryan
Department of Geology, St. Francis Xavier University, Antigonish, Nova Scotia B2G 2W5, Canada

The agricultural 'non-point source' conceptual model for groundwater impacts caused by the standard use of nitrogen fertilizers holds that N reaches the groundwater in a laterally homogeneous front. Groundwater nitrate concentrations are assumed to be horizontally constant both spatially and temporally. Typically, one-time sampling of a single multi-level sampler is considered sufficient to characterize groundwater nitrate impacts under any given farm field.

Groundwater nitrate concentrations, observed during a ten-month intensive monitoring study in shallow groundwater at a southern Ontario field site, exhibited high spatial and temporal variability and did not reconcile with this conceptual model. Field data at the site support an alternative 'multi- or micro-point source' conceptual model which incorporates (i) preferential flow through the vadose zone; and (ii) a 'stagnant flow' zone in the upper metre of the phreatic aquifer. At field sites where the multi-point source conceptual model is valid, the usual method of investigating groundwater nitrate from agricultural sources is inadequate.