## Groundwater nitrate contamination by agri-chemicals: refining the conceptual model

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Groundwater is the principle source of potable water for about 40% of the Canadian population. In rural areas, including most agricultural regions, it accounts for more than 90%. Non-point source contamination of groundwater by widespread use of nitrogen fertilizer in the agricultural sector is currently one of the focal issues in hydrogeology. Although nitrate is the most common chemical contaminant in groundwater, it remains one of the most poorly understood and least regu-

lated sources of groundwater contamination. Before this issue can be adequately addressed, however, a useful conceptual model of groundwater contamination by agricultural nitrate must be refined.

Until recently, the conceptual model for non-point source contamination assumed nitrate reached the groundwater table in a laterally homogeneous manner, and resulting groundwater nitrate concentrations were presumed to be horizontally constant. Based on this conceptual model, one-time sampling of a single, multi-level groundwater sampler would characterize groundwater nitrate under any given farm field.

There is, however, a mounting body of evidence indicating this conceptual model is inadequate. Field studies conducted in Strathroy, Ontario are generating a detailed picture of nitrate in the subsurface under three different agricultural management practices over time. A high degree of spatial and temporal variability in non-point source groundwater nitrate has been observed, contrary to the predictions of the earlier conceptual model.

Further insight into nitrate variability has been attained through the application and subsequent observation of a non-point source tracer. Potassium Bromide (KBr) was used because background concentrations are not detectable, which permits excellent resolution of recharging water (as opposed to nitrate, where high background concentrations can obscure recently infiltrated water). The results of the tracer test indicate an unprecedented degree of variability in subsurface transport, again discordant with the homogeneous conceptual model.

The amount of nitrate leaching under these fields is significant and apparently varies considerably under differing farm management strategies. Estimates indicate that up to 50% of fertilizer nitrogen applied to the fields is leached to the groundwater. Both the economic and groundwater implications are obvious.

Nitrate contamination of groundwater is a very real and growing problem, however, until the development of a clear conceptual understanding is completed, it is impossible to evaluate which particular farming practices will minimize contamination or to postulate a long term prognosis for the issue.