

PATHOGENS IN BEDROCK AQUIFERS

A DETAILED STUDY OF THE PRESENCE AND TRANSPORT OF PATHOGENS IN URBANIZED SETTINGS WITH PRIVATE BEDROCK WELLS

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WHY DID WE DO THIS RESEARCH?

Groundwater accounts for approximately 30% of the domestic water supply in Canada, the majority of which is obtained from privately-owned wells. In significant portions of the country, bedrock aquifers used for domestic water supply are protected by only a thin cover of soil. These have long been suspected to be highly vulnerable to surface sources of contamination from on-site waste systems (septic systems).

This study (2007 - 2010) evaluated the occurrence of pathogens such as bacteria and human enteric viruses in bedrock aquifers across the country and explored the transport mechanisms that might have led to their presence. The results from this research are relevant for homeowners, public health authorities and provincial regulators.



HOW WAS THE RESEARCH CONDUCTED?

1. Pathogens were surveyed in well water at three locations across Canada (Newfoundland, Ontario and British Columbia). 61 samples were collected from 28 wells drilled at the three locations. Molecular polymerase chain reaction techniques were utilized to analyze for virus presence.
2. The transport processes of pathogens were investigated in the discrete fractures that make up the pathways through which groundwater flows in bedrock. This was done using laboratory samples of fractures and in controlled field settings using solid particles of appropriate size as surrogates for viruses and bacteria.

WHAT WERE THE RESULTS?

37.7% of samples and 58.1% of wells tested positive for human enteric viruses. Virus presence was found to increase linearly with housing density.

Both the field and laboratory transport studies showed that bacteria and virus-sized particles were transported more rapidly than solutes carried by the same fluid. The virus-sized particles showed slightly more retention in the transport system relative to bacteria due to interaction with the fracture walls.

WHAT ARE THE IMPLICATIONS FOR STAKEHOLDERS AND DECISION MAKERS?

- Bacteria and human enteric viruses occur relatively frequently in private wells drilled in bedrock water supplies across the country. The number of pathogens in the positive samples was typically very low, just above drinking water standards.
- Lab studies on bedrock fractures show rapid migration of pathogen-sized particles, pointing to the vulnerability of this water source.
- The occurrence of human enteric viruses was observed to correlate to the density of nearby septic systems.
- Results from this project suggest that the absence of commonly-tested bacteria such as E.Coli at any given time does not necessarily indicate the absence of viruses. More research into this issue is clearly warranted.
- Frequent sampling for bacteria by homeowners is strongly encouraged to identify at-risk wells.
- To reduce the risk of pathogen intake from surface sources, provincial authorities should consider modifying well construction regulations to deepen the protective casing required for this type of geological setting.