PROJECT SUMMARY

Title: **Impacts of Privately Sewered Subdivisions on Groundwater Quality in Dane County, Wisconsin**

Project ID: **R/UW-OSW-001**

Investigator(s): Dr. Kenneth R. Bradbury, Hydrogeologist/Professor, Wisconsin Geological and Natural History Survey, University of Wisconsin-Extension

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Period of Contract: July 1, 2001 to June 30, 2003

Background/Need: Urban development of rural areas is a significant land-use issue in Wisconsin and in many other parts of the United States. Septic tank and leach field treatment of wastewater can release contaminants such as nitrate, bacteria, viruses, and hazardous household chemicals to groundwater systems, posing potential threats to nearby wells and surface water. Potential groundwater contamination is often cited as justification for discouraging or prohibiting new unsewered rural developments, particularly in environmentally sensitive areas with high water tables or shallow bedrock, yet few field studies are available to document groundwater impacts.

Objectives: This project was initiated as a long-term monitoring study to document groundwater conditions before, during, and after construction of an unsewered rural subdivision that employs alternative on-site wastewater treatment technologies.

Methods: Site investigations consisted of hydrogeologic studies and water sampling with the goals of understanding the geology of the site, local groundwater movement, and background groundwater quality. Shallow piezometers and deeper bedrock wells were used to characterize the field site and to sample for major ions, indicator species, and atrazine. Isotopes of nitrogen were used to distinguish nitrate sources.

Results and Discussion:

Two aquifers are present at the site – a shallow unlithified aquifer composed of glacial sediment and a bedrock aquifer. Water levels in site wells ranged from 7 to 54 feet below the land surface. Most recharge occurs during the spring months, with declining water levels the rest of the year. During spring recharge, the aquifer responds rapidly to

precipitation, snowmelt, and ground thaw, although the magnitude of this response varies with location across the field site. Prior to subdivision construction almost all of the water samples collected from shallow wells at the Savannah Valley site showed evidence of human impact, as median values of nitrate-N (6.2 mg/L), sodium (17.0 mg/L), chloride (19.3 mg/L), and conductivity (821 μS/cm) were much higher than would be expected in an undeveloped area. Significant temporal and spatial variability in groundwater chemistry existed across the field site prior to subdivision construction. This variability can be explained by 1) seasonal variations in recharge, 2) local loading patterns, 3) aquifer heterogeneities, and 4) surface topography. Groundwater nitrate beneath the Savannah Valley subdivision site appears to have originated from both synthetic and organic (cow manure) fertilizers, as the measured $\delta^{15}N$ values fall between the typical values for the two sources.

Conclusions/Implications/ Recommendations:

For this study we installed monitoring equipment and acquired nearly two years of groundwater monitoring data prior to the construction of new homes at a rural subdivision site in south-central Wisconsin. The most important finding is the high variability - in both space and time - of groundwater quality across this relatively small subdivision site. Concentrations of chemical parameters just below the water table exceeded drinking water standards for nitrate and atrazine in some wells and showed evidence of land-use impacts (agricultural use and highway salting) in many wells. Concentrations in deeper bedrock wells, although lower and less variable, also showed evidence of impacts from land use. Groundwater monitoring should continue at the Savannah Valley site as the subdivision is developed and septic systems come into use. The background data collected prior to development provides a necessary benchmark against which to compare future land-use impacts.

Related Publications :

Wilcox, J.D. 2003. Variability of groundwater chemistry in an agricultural setting and implications for assessing impacts of land use change. University of Wisconsin-Madison. M.S. Thesis. 121p.

Key Words: Groundwater, subdivisions, nitrate, land use

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