PROJECT SUMMARY

Title	**Evaluating Chemical Tracers in Suburban Groundwater as Indicators of Nitrate-Nitrogen Sources**
Project Identification	**Wisconsin DNR Project #219**
Investigators	Paul M. McGinley, Professor, Center for Watershed Science and Education, University of Wisconsin-Stevens Point
	William M. DeVita, Laboratory Manager, Center for Watershed Science and Education, University of Wisconsin-Stevens Point
	Amy L. Nitka, Analytical Chemist, Center for Watershed Science and Education, University of Wisconsin-Stevens Point
Period of Contract	7/1/2013-6/30/2015
Background & Need	Nitrate-nitrogen concentrations exceed the drinking water standard in nine percent of Wisconsin's private wells and forty-seven community water system wells. It has been estimated that up to ninety percent of the nitrogen that contaminates groundwater is from agricultural sources, but on-site wastewater systems may also be important sources of groundwater nitrate-nitrogen in some areas. It is important that the source of nitrate-nitrogen to an individual well be understood to make appropriate land management and treatment decisions.
Objectives	The objective of this study was to develop a chemical method for distinguishing between fertilizer and on-site waste sources of nitrate to a well by analyzing other compounds that are likely present in groundwater recharge from those sources.
Methods	A group of likely tracers for on-site waste and agricultural nitrate contamination were identified through literature review and previous research. The ideal tracer is ubiquitous in the source water, mobile in groundwater, resistant to degradation and detectable at environmentally relevant concentrations. Analytical methods were refined to concentrate and analyze the on-site waste indicator compounds. That group included pharmaceuticals, artificial sweeteners and personal care products. Five pesticide metabolites and a bovine antibiotic were included as agricultural

source indicators. Water samples were collected five times over two years from eighteen private wells in a suburban area with a history of nitrate-N contamination. Two sets of monitoring wells were installed near the private wells to understand the vertical variation in water quality in the study area.

Results & Discussion

Ninety six percent of the samples from the private wells and all of the monitoring well samples in this suburban study area that had a nitrate-N concentration greater than 3 mg N/L also had at least one of four contaminant source indicators. Those indicators were the artificial sweeteners acesulfame or sucralose, the pharmaceutical sulfamethoxazole or the agricultural pesticide metabolite metolachlor ESA. In the monitoring wells, on-site waste tracers were found in the shallower wells and agricultural tracers were found in the deeper wells. That was consistent with recharging water moving deeper into the aquifer with increasing distance in this suburban area.

Conclusions & Implications

The artificial sweeteners acesulfame and sucralose were consistently found at detectable concentrations in on-site waste contaminated water with a nitrate concentration greater than 3 mg N/L. Because both of these tracers have been registered for use in foods for more than fifteen years, they would appear to be reliable chemical tracers for distinguishing on-site waste nitrate-N contamination.

Related Publications

Nitka, A., W. DeVita, P. McGinley. 2015. Peering into the 21st Century: Chemical Tracers for Nitrate Source Identification. Presented at the Annual Meeting of the Wisconsin Water Association. Wisconsin Dells, WI. September 10, 2015.

Nitka, A. W. DeVita, P. McGinley. 2015. Evaluating Chemical Tracers in Suburban Groundwater as Indicators of Nitrate-Nitrogen Sources. Published abstract and poster presentation at the Wisconsin Section American Water Resources Association Annual Conference. Oconomowoc, WI. March 5 - 6, 2015.

Key Words

Nitrate, On-site waste systems, contaminant source tracking

Funding