Title: **Nitrogen Removal in Renovated Municipal Wastewater Rapid Infiltration Basins**

Project I.D.: DNR Project No. 97

Investigators: Thomas A. Gilbert, P.E., Environmental Engineer, DNR, Bureau of Wastewater Management
Bruce S. Oman, P.E., Environmental Engineer, DNR, Marinette Area Office, Lake Michigan District

Period of Contract: August 6, 1991 through June 30, 1993

Background/Need: Approximately 125 municipalities in Wisconsin utilize the "rapid infiltration" type of wastewater land application system (also commonly referred to as "absorption pond" or "seepage cell" systems). Most existing systems were not specifically designed for compliance with Wisconsin NR 140 groundwater standards. The majority of absorption pond systems employ lagoon systems for treatment. Lagoon systems cannot consistently produce an effluent with less than 10 mg/l total nitrogen. Nevertheless, groundwater monitoring data indicates that many of these systems may comply or only marginally exceed the nitrate public health groundwater standard of 10 mg/l. The storage of wastewater during the winter, coupled with infiltration basins providing low infiltration rates (which may enhance nitrogen removal in the soil profile) may provide a cost-effective method for existing lagoon systems to comply with groundwater standards.

Objectives: To investigate the feasibility of soil modification as a method to reduce infiltration rates and enhance nitrogen removal in absorption ponds receiving municipal wastewater effluent.

Methods: Five test infiltration basins (each approximately 30 by 50 feet) were constructed within one infiltration basin at the Florence wastewater treatment facility. The existing native soil was left in one cell as a control. Different soil types were brought in and placed in the other four cells. Lysimeter devices were installed to collect samples of water after percolation through the upper soil profile in each cell. Effluent from the Florence aerated treatment lagoons was applied to the test cells from August to November in 1992, and from May to December in 1993.

Results: From May to August of 1993, the applied total nitrogen ranged from 24.2 to 34.1 mg/l. No significant nitrogen removal occurred in the control test cell (number 3) during this time period. Test cell 1 contained two feet of cover soil consisting of 88.6% sand, and 11.4% fines (approximately 6.4% silt and 5.0% clay). Infiltration rates were reduced to an average of 15.3 in./day, and 46% nitrogen removal occurred in Cell 1. Test Cell 2 contained the same soil as Cell 1, but experienced a significantly higher infiltration rate (28.7 in./day), and no significant nitrogen removal occurred. The one remaining test cell (number 5) contained finer soil than in cells 1 or 2, and produced low infiltration rates comparable to cell 1, but nitrogen removal was highly variable and no removal occurred on an average basis.

Conclusions: Covering an existing rapidly permeable sandy soil with two feet of less permeable soil, with a higher percentage of fines, was successful in producing substantially lower infiltration rates and longer retention times in the soil profile. In one test cell this improved nitrogen removal within the soil profile to 46%. The removal resulted from partial nitrification and subsequent denitrification of the applied ammonium-nitrogen.

The lack of consistent nitrogen removal in two other test cells demonstrates that nitrogen removal by microbial processes is not only a function of infiltration rate, but other environmental factors which need to be recognized and managed properly.

Implications/ Recommendations: Municipalities with absorption pond systems that experience difficulty complying with groundwater standards may consider supplemental soil as a method to renovate infiltration basins and enhance nitrogen removal.

Key Words: wastewater renovation, rapid infiltration, nitrogen, nitrification, denitrification

Funding: DNR, Supplemental funding was provided by the DNR Bureau of Wastewater Management.

Final Report: A final report containing more detailed information on this project is available for loan from Wisconsin's Water Library, University of Wisconsin - Madison, 1975 Willow Drive, Madison, Wisconsin 53706 (608) 262-3069.