Title: **Relationships between Private Well Water, Stream Base Flow Water, and Land Use in the Tomorrow-Waupaca River Watershed**

Project I.D.: DNR Project # 132

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Period of Contract: Beginning July 1, 1997 through June 31, 1999.

Background/Need: To monitor changes in groundwater quality and establish base line groundwater quality, especially as Best Management Practices are adopted.

Objectives: To evaluate the potential for using stream base flow water quality as a measure of mean groundwater quality in a watershed.

Methods: Thirty-eight sights on the Tomorrow-Waupaca River (Portage and Waupaca Counties, Wisconsin) and its tributaries were sampled during base flow conditions from 1994-1999. The stream water results were compared to water quality results from over 3500 private wells sampled in the watershed with a focus on nitrate-N, chloride and atrazine.

Results and Discussion: Results indicate that this approach is a valid method for evaluating groundwater quality in the watershed when the basin is second order or larger. For the most accurate assessment of the groundwater quality base flow sampling needs to be carried out in the winter. Sampling should be done at least annually.

Conclusions/ Implications/ Recommendations:

- Winter base flow nitrate-N data correlated to mean groundwater quality in the second and third order watersheds, indicating it could be used as a low cost means of monitoring groundwater quality in watersheds.

- Poor correlations between stream water quality and private water quality in first order sub-basins are believed to be largely due to a lack of representative private well samples. Use of stream samples to represent average groundwater quality should sill be valid in these sub-basins, and may be even more valid than in larger basins due to the shorter residence time of groundwater.

- Summer base flow concentrations of nitrate-N were consistently lower than winter values indicating that the most valid time of year for stream data collection to correlate to groundwater quality is during winter months.

- Standard deviation of the nitrate-N data indicates that enough year to year variability occurs in some watersheds to require annual sampling if long term trends are to be documented.

- In general chloride showed a poorer correlation than did nitrate-N between groundwater and surface water winter base flow data. Use of road salts in winter is a probable cause of this poor correlation.

- Triazine data indicated higher values in groundwater than in surface water for second and third order sub-basins while the opposite was true for the first order sub-basins. More research is needed to verify and identify the cause of these apparent trends.

- Winter base flow sampling should include stream gauging, as it is important when estimating the land area contributing to the base flow of the stream being monitored.

- Nitrate-N concentrations found in groundwater correlated closely to an estimate that 35% of nitrogen fertilizer if applied at UW Extension recommended rates is leaching to groundwater. Refining these estimates by documenting the actual amount of fertilizer use for each crop, in each field, in each sub basin, would be desirable and should be a part of future watershed programs. Similar data on pesticide use would be very useful in correlating to its presence in the environment.

Related Publications: A document is being submitted to the publication Ground Water for review.

Key Words: Nitrate-nitrogen, agricultural contaminants, base flow sampling.

Funding: Wisconsin Department of Natural Resources.

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.