CSREES National Water Quality Program

Title: Scaling and Modeling of Stream and Ground Water Quality in the East Mahantango Creek Watershed

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State: PA **Region:** Mid-Atlantic **Year of Funding:** 2001

Theme: Watershed Management

Situation: Scaling of water quality in watersheds may facilitate effective monitoring and modeling of nutrients in stream networks. Ground water is more costly and difficult to sample than stream water. If stream baseflow water could be used to monitor ground water in watersheds predominantly fed by ground water, it could then provide a cost-effective way to assess overall watershed water quality and ground water quality change that may occur in response to land use and management practices. This is being studied in the East Mahantango Creek Watershed in Pennsylvania.

Objectives: 1) To test the potential use of stream orders, landscape variables, and fractals as scaling factors for watershed water quality; 2) To investigate the relationships between stream water and ground water and the feasibility of using stream baseflow as an indicator of ground water quality.

Methods: The studied watershed is delineated into numerous sub-basins based on stream orders. Thirty-one sampling sites representing different orders of sub-basins were selected for regular collections of stream baseflow along with well water. Nitrate nitrogen, total nitrogen, and total phosphorus in water samples are analyzed. A referenced flow method based on unit contribution area is employed to estimate flows at sampling sites. Landscape factors such as land use, topography, geology, and soils are analyzed for each sub-basin.

Partnerships: The USDA-ARS Pasture System and Watershed Management Unit (PSWMU) is our research partner. PSWMU provided rich background information of the studied watershed and considerable historical data, including land uses, geology, climate, flow and water quality data of past 40 years. Scientists at PSWMU also assist us in flow measurements and the sampling of stream and ground waters.

Research: This is mainly a research project, with training of graduate students. However, the research results would have significant implications for extension and outreach.

Resources: The USDA-ARS Pasture System and Watershed Management Unit contributes some of their resources and staff time in assisting us in field data collections.

Results: Outcomes: With increasing stream order, nitrate-nitrogen loading increased in a power function, while nitrate and total nitrogen concentration showed a decreasing trend. Stream order could be used to aid in scaling nitrogen concentration and loading during baseflow periods. Landscape variables and land use variations partly explain the observed variations within the same stream orders. Fractal properties of stream network may be used for estimating nutrient loading.