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Seepage of Groundwater Nitrate from a Riparian Agroecosystem into the Wye River Estuary

K.W. Staver
R. B. Brinsfield

University of Maryland, College of Agriculture and Natural Resources, Wye Research and Education Center, P.O. Box 169, Queenstown, Maryland 21658

ABSTRACT: Intensive research in Chesapeake Bay has indicated that reductions in nitrogen inputs to the bay will be necessary to restore water quality to levels needed for resurgence of bay living resources. Fall-line water quality monitoring efforts have characterized diffuse-source nitrogen inputs from a large percentage of the bay drainage basin, but relatively little information exists regarding rates of nitrogen delivery to tidal waters from coastal plain regions. Extensive nitrate contamination of shallow groundwater due to agricultural activities coupled with the dominant role of subsurface flow in discharge from Coastal Plain regions of the drainage basin, creates the potential for high rates of nitrogen delivery to tidal waters via groundwater seepage. This study utilized intensive hydrologic and water chemistry monitoring from April 1992 through September 1994 to determine the spatial characteristics of the groundwater- estuarine interface, as well as the rates of subsurface nitrogen transport from an agricultural field into nearshore waters of the Wye River, a subestuary of Chesapeake Bay. The hydrogeologic characteristics of the study site resulted in groundwater discharge to the Wye River occurring almost exclusively within 15 m of the shoreline. Calculated groundwater discharge rates were found to vary widely in the short term due to tidal fluctuations but in the long term were driven by seasonal changes in groundwater recharge rates. The zone of groundwater discharge contracted shoreward during summer months of low discharge, and expanded to a maximum width of approximately 15 m during high discharge periods in late winter. Average discharge rates were more than five times higher in winter versus summer months. Groundwater nitrate concentrations entering the discharge zone were relatively stable throughout the study period, with little evidence of denitrification

or nitrate uptake by riparian vegetation. Consequently, nitrogen discharge patterns reflected the strong seasonality in groundwater discharge. Annual nitrate-N discharge was approximately 1.2 kg m⁻¹ of shoreline, indicating drainage basin rates of nitrogen delivery to tidal waters of approximately 60 kg ha⁻¹.