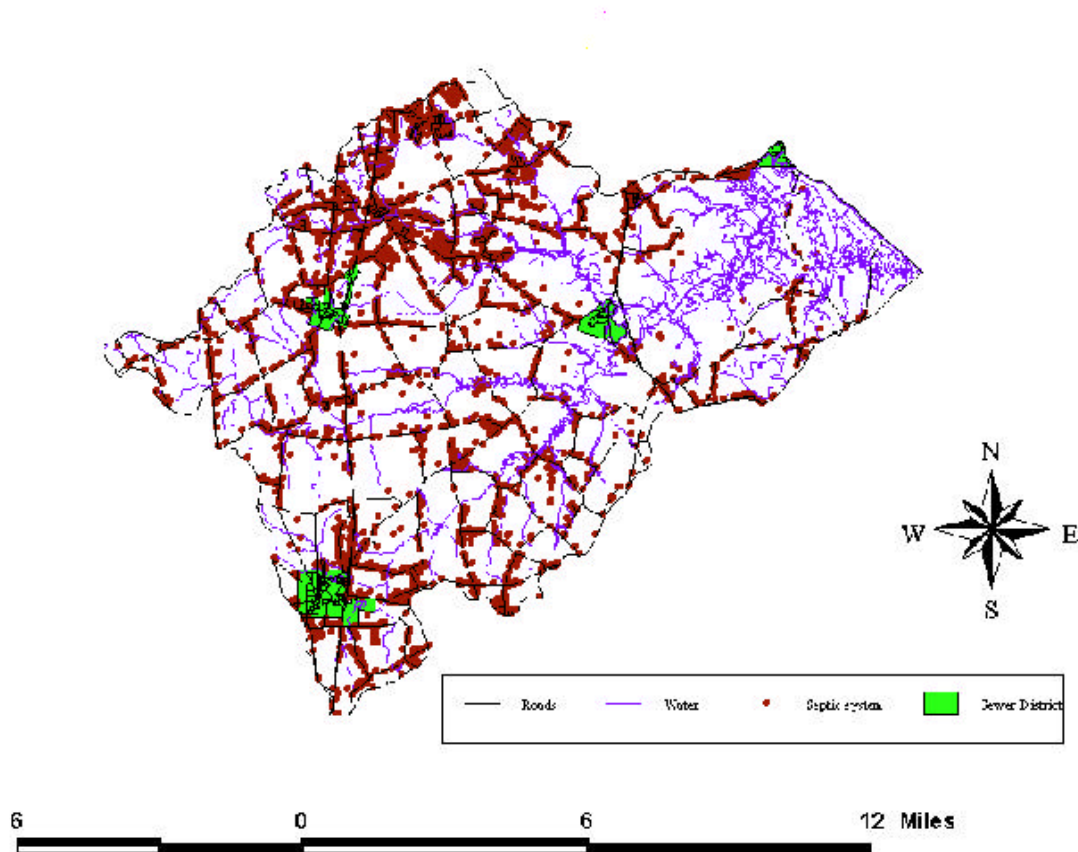


SEPTIC SYSTEMS AND NITROGEN AND PHOSPHORUS LOADING

Septic System and Sewer District Locations within the Murderkill Watershed



Issue Definition

As of 1997, 5238 homes and other structures in the Murderkill watershed were served by septic systems¹. Since 1997, an additional 69 lots were developed requiring the use of septic systems bringing the total septic systems in the watershed to 5307.

In Delaware, surface and ground water are directly connected; consequently, impacts on one will affect the other. In the summer, surface water flow is primarily groundwater seepage into the stream. Nutrients from septic systems will reach the surface water through the groundwater.

In 1994, scientists studied nitrate content of the groundwater of 31 homes near Moores Lake, located in the St. Jones watershed². The data showed nitrate reductions in the

groundwater over a 19- year study period. The loss was the result of removing septic systems from the properties and connecting the properties to the county sewer. Groundwater lost nitrates at a rate of 0.33 mg/l per year over the course of the study. Thus, nitrate contributions from septic systems take years to remove from the groundwater and consequently from surface waters.

Water Quality Impacts & Typical Loadings

Approximately 35% of the nonpoint total nitrogen (278 lb per day) and about 5% of the phosphorous loads (10.4 lb per day) that enter the Murderkill River could come from septic systems. These loads were calculated using a model published by several researchers. The model used hydrogeological conditions in the watershed, septic system numbers and various parameters from several studies that are cited within this fact sheet. However, these estimated loadings might be over stated for several reasons. Many

¹ Determined by Whole Basin Study Chesapeake Team

² Blaier, Scott. 1994. Moores Lake: A study of the effect of septic systems on groundwater quality. Delaware Department of Natural Resources and Environmental Control.

of the existing septic systems were constructed under the 1985 amended septic regulations. These regulations require larger drainfields resulting in a lower effluent loading rates for the soil (gallons of effluent per square foot of drainfield) and a vertical separation from the ground water table. Lower loading rates allow the soil more time to renovate the effluent. Scientists have determined that 48% of total phosphorous is removed from the nonpoint source through routinely pumping the septic tank³. Consequently, only 52% of the total phosphorous in the effluent could leach into the soil beneath the drainfield. The Red Mill Pond study demonstrated that approximately 85% of the phosphorous is absorbed by the soil under the drainfield¹. This watershed has soils that are very similar to the soils around Red Mill Pond. Thus, the soils in this watershed have good assimilation capacity for phosphorus and in addition, have a much longer retention time for nitrogen than some of the sandier textured soils within the State. Consequently, the actual reduction achieved with best management practices (BMPs) will be less.

³. "Integrated Risk Assessment/Risk Management as Applied to Decentralized Wastewater Treatment: A High-Level Framework" edited by Daniel Jones of Oak Ridge Research Laboratory (May 2000).

AQUIFER PARAMETERS USED TO ESTIMATE SEPTIC SYSTEMS LOADS⁵

Size of Murderkill Watershed	68,000 ac
Hydraulic Conductivity of Columbia Aquifer	75 ft/day ⁴
Hydraulic gradient of Columbia Aquifer	75 ft/ft ⁴
Aquifer mixing thickness	20 feet
Aquifer width	3364 feet

⁴Hydraulic conductivity is the rate at which water can move through permeable aquifer.

⁴Aquifer is a geologic formation that is saturated and is sufficiently permeable to transmit water to wells.

⁴Hydraulic gradient is the driving force that moves the water through the aquifer.

SEPTIC SYSTEM PARAMETERS USED TO ESTIMATE LOAD FROM SEPTIC SYSTEMS

# of Septic Systems	5307 ^a
Average Effluent Generated from Single Dwelling	221 gal/day ^b
Average Nitrate Load in Effluent	59.3 mg/l NO ₃ -N ^{bc}
Average Total Phosphorous Load In Effluent	15.7 mg/l ^b

a- Determined by Whole Basin Study Chesapeake Team

b- Final Report Red Mill Pond (1994)- Non-point Study on Septic Systems loading to Red Mill Pond (Two sites in New Castle County were included in a 319NPS protect. [A project (1997) to Renovate Failing Gravity Septic Systems with Earthworms.] These two sites average water usage was 190 and 287 gallons per day.

c- EPA Estimate is 63 mg/l NO₃-N

HYDROLOGIC PARAMETERS USED TO ESTIMATE SEPTIC SYSTEM LOADS

Average Nitrate Concentrations in Groundwater	6.7 mg/l NO ₃ -N ^a
Average Total Phosphorous Concentrations in Groundwater	0.01 mg/l P ^a
Average Nitrate Concentrations in Precipitation	2.0 mg/l NO ₃ -N
Average Total Phosphorous Concentrations in Precipitation	0.00 mg/l P
Groundwater Recharge by Precipitation	14 inches per year

ESTIMATED SEPTIC SYSTEM LOADING FOR TOTAL NITRATE AND PHOSPHOROUS⁵

Parameter	lbs/ day
Nitrate Loads From Existing Conditions with Septic Systems	1544
Nitrate Loads From Existing Conditions with No Septic Systems (Comparison) ¹	1266
Potential Nitrate Loads Septic Systems (Assuming no loss through biological processes)	278
Total Phosphorous Loads From Existing Conditions with Septic Systems	10.5
Total Phosphorous Loads From Existing Conditions with No Septic Systems (Comparison)	0.13
Potential phosphorous load from septic systems (Assuming no loss through by soil absorption)	10.4

⁵Calculations were done using a model published (Estimating Ground-Water Quality Impacts from On-Site Sewage Treatment Systems by B. J. Bauman and W. M. Schafer) in On-Site Wastewater Treatment- Proceedings of the Fourth National Symposium on Individual and Small Community Sewage Systems held at New Orleans, Louisiana, December 10-11, 1984.

MURDERKILL WATERSHED

This fact sheet was prepared by the Delaware Department of Natural Resources and Environmental Control's Whole Basin Team, at the request of the Murderkill Tributary Action Team for citizens and stakeholders.

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MANAGEMENT TECHNIQUES & TYPICAL REDUCTIONS

There is significant potential to reduce the non-point nitrogen load to the River by eliminating septic systems and connecting them to county sewer where practical (Technical Appendix for *Maryland's Tributary Strategies*, 1996). By mandating routine (once every three years) pumping of septic tanks in the watershed, approximately 5 lbs of phosphorous could be eliminated.