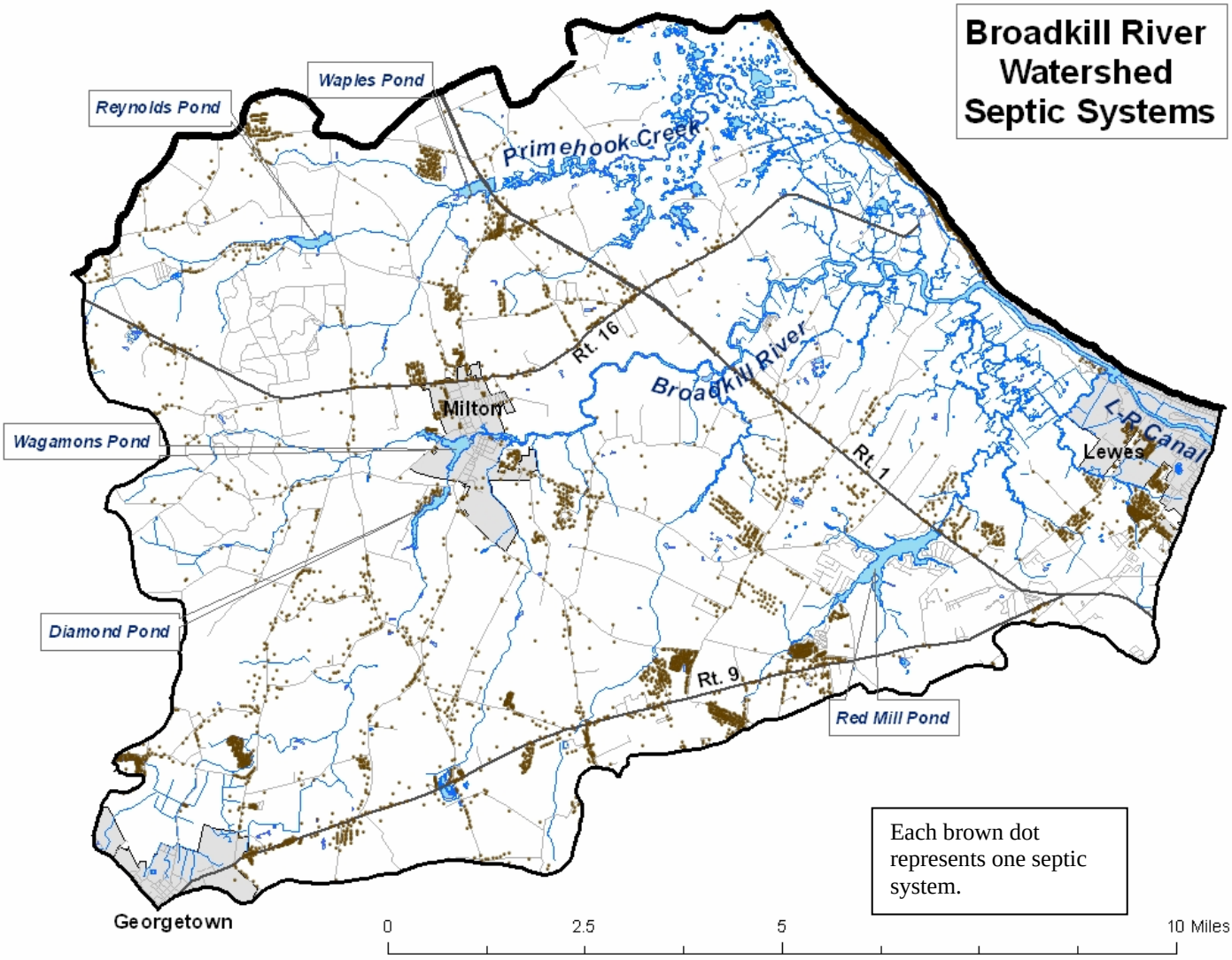
# NITROGEN AND PHOSPHORUS LOADING FROM SEPTIC SYSTEMS




## ISSUE DEFINITION

The cumulative impact of onsite wastewater disposal systems (OWDS), mostly individual septic systems, in the Broadkill watershed has been a major concern. As a result, 1073 septic systems have been eliminated around Red Mill Pond by Sussex County. However, there have been approximately 30 new subdivisions proposed for this watershed since 2004. These proposed subdivisions will occupy some 4964 acres within the watershed, with most of these new subdivisions utilizing some type of septic disposal system for their wastewater.

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. Nitrate contributions from septic systems take years to be removed from the ground surface waters.

In 1994, scientists studied the nitrate content of the groundwater of 31 homes near Moores Lake, located in the St. Jones watershed.[2] The data showed nitrate reductions in the groundwater over a 19- year study period. The reduction 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.

[2] Blaier, Scott. 1994. Moores Lake: A study of the effect of septic systems on groundwater quality. DNREC.

# WATER QUALITY IMPACTS & TYPICAL LOADINGS

Approximately 261 (lbs/day) of nonpoint total nitrogen and about 17 lbs/day of phosphorous enter the Broadkill River. These loads were calculated using a model published by several researchers[5]. 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 overstated for several reasons. Many 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 tank.[3] Consequently, only 52% of the total phosphorous in the effluent could leach into the soil beneath the drainfield. The Red Mill Pond study which was conducted primarily within this watershed demonstrated that approximately 85% of the phosphorous is absorbed by the soil under the drainfield.[1] The soils found in the Red Mill Pond study area were are representative of the entire watershed. 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.

[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 LOADS FROM SEPTIC SYSTEMS** [5]

| | |
|---|---|
| Size of Broadkill Watershed | 68622 ac |
| Hydraulic Conductivity of Columbia Aquifer | 150 ft/day[4] |
| Hydraulic gradient of Columbia Aquifer | 0.0025 ft/ft[4] |
| Aquifer mixing thickness | 100 feet |
| Aquifer width | 54680 feet |

[4]Hydraulic conductivity is the rate at which water can move through permeable aquifer.
[4]Aquifer is a geologic formation that is saturated and is sufficiently permeable to transmit water to wells.
[4]Hydraulic gradient is the driving force that moves the water through the aquifer.

**SEPTIC SYSTEM PARAMETERS USED TO ESTIMATE LOADS FROM SEPTIC SYSTEMS**

| | |
|---|---|
| # of Septic Systems | 4619[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 DNREC Watershed Assessment Section
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 $NO_3$-N

# 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 0.9 lbs of nitrogen and 0.34 lbs of phosphorous per system could be eliminated.

**HYDROLOGIC PARAMETERS USED TO ESTIMATE LOADS FROM SEPTIC SYSTEMS**

| | |
|---|---|
| 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 PHOSPHOROUS**[5]

| Parameter | lbs/ day |
|---|---|
| Nitrate Loads From Existing Conditions with Septic Systems | 2282 |
| Nitrate Loads From Existing Conditions with No Septic Systems (Comparison)[1] | 2026 |
| **Potential Nitrate Loads from Septic Systems (Assuming some loss through biological processes )** | **2261** |
| **Potential Phosphorous Load from Septic Systems (Assuming some soil absorption)** | **17** |

[5]Calculations 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.

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## BROADKILL WATERSHED

*This fact sheet was prepared for citizens and stakeholders by the Delaware Department of Natural Resources and Environmental Control, at the request of the Broadkill Tributary Action Team.*

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