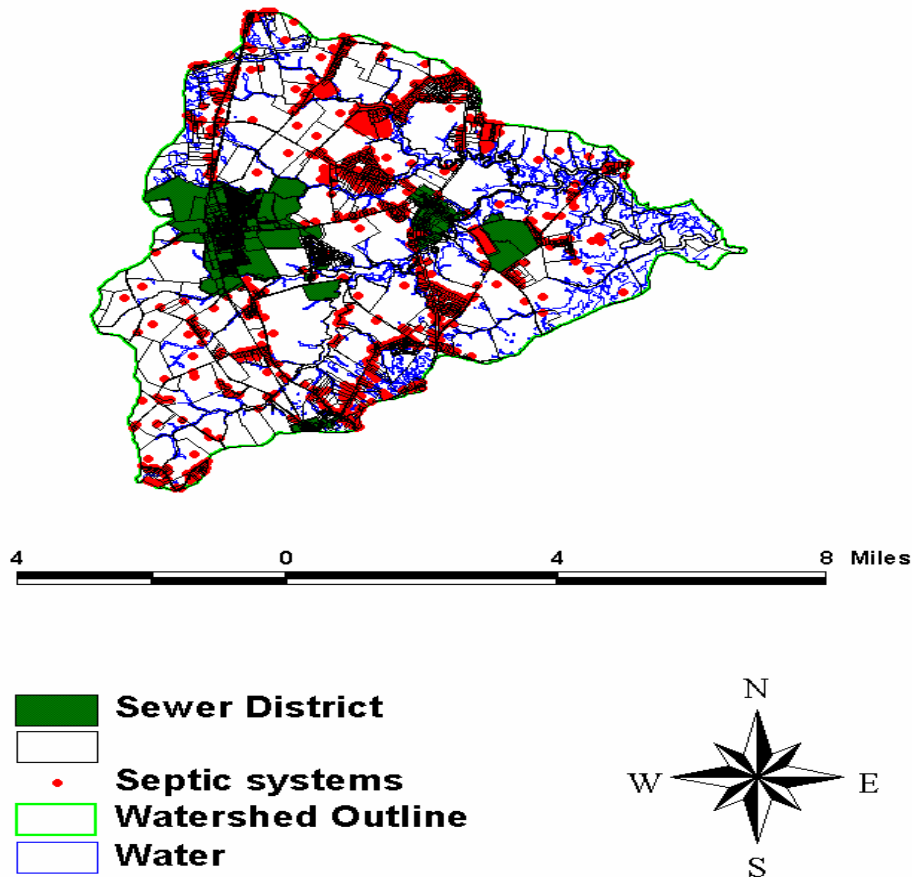


SEPTIC SYSTEMS AND NITROGEN AND PHOSPHORUS LOADING

Septic System and Sewer District locations within the Appoquinimink Watershed



DEFINITION

As of 1997, the Appoquinimink watershed had 1733 septic systems. Since 1997 an addition 650 lots were approved where septic systems would need to be used. In 1997, there were 2220 parcels within the sewer district, primarily around Middletown, Odessa and Townsend. At least 119 new lots within the sewer district have been plotted since 1997.

In 1994, a scientist studied nitrate reduction in groundwater over time after the elimination of septic systems from 100 homes around Moore's Lake. The groundwater under 31 homes in the area was analyzed for nitrate content. The data gathered showed that the groundwater lost its nitrate load at a rate of 0.33 mg/l per year (nitrates = 10.68-0.33 year, $R^2=99.4\%$).

Water Quality Impacts & Typical Loadings

Of the nonpoint sources of nitrogen that enters the Appoquinimink River per day, an estimated 168 pounds could come from septic systems. An estimated 5.4 pounds/day of phosphorus could enter the River from septic systems. These estimated loadings may be over stated for several reasons. Many of the existing septic systems were constructed under septic regulations amended in 1987. (In 1990 the State assumed responsibility of New Castle septic system program.) These regulations required larger waste or effluent disposal areas. Since 1998, two-septic systems (an initial and a replacement) must be installed under County code. Starting this year New Castle County will enforce septic tank pumping on a 3-year cycle. Thus, management measures tend to discourage property owners

from allowing their systems to fail and further pollute the waters.

Also, scientists have determined that 48% of total phosphorous is removed from the septic system through routinely pumping the septic tank¹. Consequently, only 52% of the total phosphorous in the effluent could leach into the soil beneath the drainfield. Most of the waste from the tanks is taken to the Wilmington Treatment Plant; thus nutrients will be removed from the watershed. The soils in the watershed have good assimilation capacity for phosphorus and have a much longer retention time for nitrogen than some of the sandier soils within the State. Consequently, the actual reduction achieved with BMPs will be quite small.

AQUIFER PARAMETERS TO ESTIMATE LOAD SEPTIC SYSTEMS*

Size of Appoquinimink Watershed	30,2392 ac
Hydraulic Conductivity ^a of Columbia Aquifer ^b	290 ft/day ¹
Hydraulic gradient ^c of Columbia Aquifer	0.002 ft/ft ¹
Aquifer mixing thickness	15-40 feet
Aquifer width	3364 feet

- ^aHydraulic conductivity is the rate at which water can move through permeable aquifers
- ^bAquifers are geologic formations that are saturated and sufficiently permeable to transmit water to wells.
- ^cHydraulic gradient is the driving force that moves the water through the aquifer.
- ¹Hydraulic conductivity and can range from 0 to 290 ft./day ,hydraulic gradient can range from 0.00088 to 0.002 ft./ft from "Design Development and Implementation of a Groundwater Quality Monitoring Network for Southern new Castle County, DE" 1996 Phase I

SEPTIC SYSTEM PARAMETERS USED TO ESTIMATE LOAD FROM SEPTIC SYSTEMS

# of Septic Systems	2983 ^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 ^c

- ^aDetermined by Whole Basin Study Chesapeake Team
- ^bFinal 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.
- ^cEPA Estimate is 63 mg/l NO₃-N

HYDROLOGIC PARAMETERS TO ESTIMATE SEPTIC SYSTEM LOAD

Average Nitrate Concentrations in Groundwater	6.68 mg/l NO ₃ -N ^{ab}
Average Total Phosphorous Concentrations in Groundwater	0.01 mg/l P ^{ab}
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

- ^aReported by Whole Basin Study Chesapeake Team as referenced from various published sources.
- ^bfrom "Design Development and Implementation of a Groundwater Quality Monitoring Network for Southern new Castle County, DE" 1996 Phase I.

ESTIMATED SEPTIC SYSTEM LOADING RATES FOR NITRATE-N AND TOTAL PHOSPHOROUS¹

Parameter	Exiting Aquifer	lbs/ day
Nitrate Loads From Existing Conditions with Septic Systems	3.25- 6.68 mg/l NO ₃ -N	824 -1043
Nitrate Loads From Existing Conditions with No Septic Systems (Comparison) ²	2.3 -2.8 mg/l NO ₃ -N	656-875
Total Phosphorous Loads From Existing Conditions with Septic Systems	0.29-0.31 mg/l TP	7.8-11.9
Total Phosphorous Loads From Existing Conditions with No Septic Systems (Comparison)	0.01-0.2-mg/l TP	2.45-6.5

¹Calculations 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.

MANAGEMENT TECHNIQUES & TYPICAL REDUCTIONS

Projecting a 76% increase in septic systems operating within the basin only slightly increases the phosphorus loads to the ground water loads are increased only slightly. The potential nitrogen reduction from switching to septic systems is the difference in the nitrogen concentration of the septic effluent (approximately 53 mg/l) and the sewer discharge (26.6 mg/l). This change would result in a 50% reduction in nitrogen (Technical Appendix for *Maryland's Tributary Strategies*, 1996). It does make good environmental sense to systematically remove septic systems adjacent to the sewer areas around Middletown, Odessa and the Water Farm Spray facility.

TMELINE & COSTS

According to a study done on septic system removal from Moore's Lake area in Kent County, Delaware, it was determined that groundwater loads from those septic systems is reduced very slowly and it could take as long as 19 years to remove this load from the groundwater.

Author: Lyle A. Jones, Wetlands /Soil Assessment Branch (302.739.4590)

APPOQUINIMINK 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 Appoquinimink Tributary Action Team for citizens and stakeholders.

For additional information, contact the:

Watershed Assessment Section
 Department of Natural Resources and Environmental Control
 820 Silver Lake Blvd., Suite 220
 Dover, Delaware 19904-2464
 (302) 739-4590



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¹ "Integrated Risk Assessment/Risk Management as Applied to Decentralized Wastewater Treatment: A High-level Framework" edited by Dan Jones of Oak Ridge Research Laboratory (May 2000), see Gold and Sims citing Pell and Nyberg (1998).