Ammonia Impacts on Groundwater and Downstream Estuaries

Overview:

Excess nitrogen loading to both the Chesapeake Bay and local groundwater aquifers, from which many public and private wells within Southcentral Pennsylvania draw drinking water, originates primarily from agricultural sources (specifically commercial fertilizers and animal manures).

Key Facts Regarding Ammonia:

- Currently, about 80% of Pennsylvania's portion of the total nitrogen load to the Bay originates from agricultural sources.
- Of this agricultural load, roughly half is from commercial fertilizers, and about half is from animal wastes (much of which is used as organic fertilizers). In some counties, higher nitrogen loads are coming from commercial fertilizers, whereas in others, higher loads are coming from animal manures.
- Historically, commercial fertilizers represented the larger portion of the combined total of inorganic and organic fertilizers used for agricultural purposes in Southcentral Pennsylvania. However, recent increases in concentrated animal operations (both livestock and poultry) in this region have led to proportionally higher nitrogen loads coming from animal wastes.
- With animal wastes, much of the nitrogen is in the form of ammonium (NH_4) or ammonia (NH_3), both of which are highly volatile and easily converted to nitrates that can leach to groundwater. Much of the remaining organic nitrogen can be converted to nitrates as well.
- In contrast to ammonia gas releases from smokestacks, ammonia gas discharged from livestock is not under pressure or heat and therefore settles locally (i.e., within a short distance of the source).
- In arid climates, such as the Central Valley in California, ammonia also poses a public health hazard as it combines with other elements in the atmosphere to form fine (inhalable) particulate matter (PM 2.5) which is a public health hazard and a regulated air emission.

While sediment and phosphorus compounds are stable and tend to settle locally, verified nitrogen reductions to the Bay are of equal value regardless of source or location due to nitrogen's mobility. A pound of nitrogen to the Bay reduced has equal value no matter its source or origin.

Key Facts Regarding Nitrogen Loading in the Chesapeake Bay:

- Recent EPA models have determined that the majority of nitrogen loading to Bay is coming from the lower Susquehanna watersheds, with large concentrations from animal agriculture.
- Up to 60% of total nitrogen loading to the Bay comes from groundwater discharge.
- Nitrogen is the cost driver for Bay TMDL compliance.

Key facts regarding ammonia impact on local groundwater sources used by public water systems (PWS) for drinking water:

- There is a direct correlation between large concentrations of livestock agriculture and PWS whose nitrogen concentrations have increased over time and, in many cases, fail to meet federal drinking water standards for nitrogen.
- The groundwater supplies for one third of PWS in Lancaster County (150) have been deemed to be impaired and would fail to meet state and federal drinking water standards for nitrogen unless nitrogen was removed prior to distribution. York County has 16 nitrogen impaired sources
- The total number of statewide impaired PWS for nitrogen in 2016 is 293, according to the Pennsylvania DEP; and 231 are in six lower Susquehanna watershed counties (Berks, Chester, Franklin, Lancaster, Lebanon and York).
- Local public water utilities with groundwater supplies that fail to meet state and federal nitrogen drinking water standards are treating the groundwater to meet those standards at costs ranging from $16 to $35 per lb. of nitrogen removed.
- The Pennsylvania DEP does not regulate private wells. Residents on private wells in areas with nitrogen-impaired groundwater bear the burden of this public health risk and absorb the cost of upgrading their wells, installing in-house treatment systems, or buying bottled water.

Conclusion:

Communities with large concentrations of animal agriculture will have significant ammonia deposition to the surrounding land area. Its conversion and subsequent seepage into the ground will result in elevated concentrations of nitrogen in groundwater (primarily in the form of nitrates), which, over time, can seriously limit the ability of local PWSs to meet federal drinking water standards for nitrogen without implementing expensive nitrogen removal processes. The higher the nitrogen concentration in the groundwater, the greater the nitrogen discharges to the Bay.

Pennsylvania's Bay program is primarily focused on runoff, which will not specifically address other ammonia-related impacts such as discharge of nitrogen from deeper groundwater sources and high nitrogen levels in local drinking water supplies.

Presently, Pennsylvania's nitrogen mandate remains in default of its Bay TMDL targets. Once ammonia nitrogen is released into the environment the cost of capture and treatment increases exponentially.

SB 799 will provide a recurring revenue stream in support of a competitively-bid procurement program, enabling private sector agriculture to adopt low cost onsite manure technology that will capture and treat ammonia, PRIOR to its release into the atmosphere. This will address the Bay mandate at a cost reduction of up to 80%.

SB 799 requires that verifiable local benefits be valued as an offset to the Bay cost. As a result, in locations with nitrogen impaired groundwater-based drinking water supplies, onsite livestock and poultry waste treatment systems could use the costs of reducing nitrogen concentrations to meet federal drinking water standards as an offset to the Bay mandate cost. For example, a $16 to $35 per lb existing cost of reducing nitrogen to meet federal drinking water standards could be applied as an offset to the Bay credit bid proposal. Consequently, privately financed waste treatment systems for verified nitrogen Bay reductions in watersheds with impaired public drinking water sources could result in a negative net cost as a result of financial benefits to the local PWS's.