# Surface Waters: Ammonium is Not Ammonia – Part Three

**By John Sawyer, Department of Agronomy and Matt Helmers, Department of Agricultural and Biosystems Engineering**

Two previous *ICM News* articles outlined the difference between ammonium and ammonia, the relationship between the two nitrogen forms, and the implication of a combined (ammonium-N plus ammonia-N) analysis related to water quality criteria for aquatic life and chlorination treatment for drinking water. This article focuses on the potential sourcing of ammonium and ammonia in surface waters.

Ammonium and ammonia in surface water systems can originate from many sources, and are naturally occurring forms of nitrogen. Predominant sources will vary on a watershed or sub-watershed basis. Also, sources and concentrations are greatly influenced by hydrology, including timing and volume of water runoff.

It is difficult, if not impossible, to separate the effects of both source and hydrology. This makes the issue of ammonium and ammonia in surface water systems complex and can complicate implementation of practices to moderate movement to water systems. Of main importance is targeting sources or practices that have the potential to significantly reduce delivery to a surface water system. Equally important is that management practices need to vary depending upon specific situations.

Following is a list of possible sources of ammonium and ammonia in surface water systems. These are in no particular order, and are not ranked in order of importance or greatest possible impact. There are likely other sources not listed.

Land-applied manure and biosolids, septic systems, raw sewage, snow, rainfall, animal feedlot runoff, surface runoff into tile inlets, eroded soil and sediment, airborne ammonia, direct deposit by aquatic organisms, wildlife manure, land-applied fertilizer (ammonium containing) for crop and turf production, fertilizer on sidewalks and driveways, manure storage structures, manure stockpiles, manure spills, fertilizer facilities, fertilizer spills, decay of aquatic organisms and organic materials in water.

The source(s) of greatest importance (in regard to surface water quality) in one watershed may be quite different in another watershed. Sources could also be point (exact source location) or non-point (diffuse source), and can vary depending upon the time of year.

For example, with wintertime application of manure and fertilizer to cropland, the risk of runoff to surface water increases due to greater chance of the manure or fertilizer not interacting with soil, with that risk increasing further when soil is frozen, there is heavy snow cover and especially if applied shortly before a rapid melting event.

Even with other times of application, such as springtime when rainfall can be intense, if there is a runoff event shortly after surface application the potential for runoff increases because the manure or fertilizer has not had adequate time to interact with the soil. However, the time of year may have less impact on something like animal feedlot runoff

if there is little interaction with soil downstream of the feedlot either in non-frozen or frozen soil conditions.

Quite interestingly, because snow readily absorbs ammonia, it can have quite high concentrations of ammonium/ammonia. This is not something that most individuals would think of, and a good example of why understanding sources and quantifying sources is important to provide a greater likelihood that any change in management practices will result in an improvement in water quality.

Despite this, it is equally as important for everyone to consider the implications of their actions in regard to potential for ammonium or ammonia to reach surface water systems. This is good for organisms that live in the water and for municipalities that use surface water for their drinking water supply.

*John Sawyer is a professor of agronomy, with extension and research responsibilities in soil fertility and nutrient management, and Matt Helmers is an assistant professor of Agricultural and Biosystems Engineering with extension and research responsibilities in hydrology and water quality.*