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TECHNICAL MEMORANDUM

TO:	Eberhard Roeder; Elke Ursin; Paul Booher; Mark Hooks
FROM:	Dick Otis
DATE:	January 31, 2007
RE:	Further Discussion of the Quantification Strategy for Assessing Nitrogen Contributions from OWTS

Thank you for your response last week to my last memo. I want to add some additional comments to better clarify my thinking.

First, regarding raw wastewater versus septic tank effluent; both types of data are necessary. However, I have less faith in using pollutant concentrations in septic tank effluent as a means to estimate loadings versus using raw wastewater. Why I believe this is because using concentrations requires that good flow data are also available. Rarely, are such data obtained from onsite systems and seldom are measured concurrently with pollutant concentrations. As a result, average daily flows must be estimated and often overestimated resulting in an overestimation of the pollutant loading. Fortunately for nitrogen, most of the mass of nitrogen in domestic wastewater comes from our diets and so we have a pretty good idea of what individuals will contribute each day. Of course, their full daily contributions are not always made to the septic tank, but we do have a pretty solid number for what humans generate daily and from that we can assume a percentage of that which reaches the septic tank. Since we are really concerned about the mass of nitrogen released to the environment by onsite systems rather than concentrations, we can avoid the need for estimating daily flows.

I have collected some domestic septage data, which is necessary to estimate the mass of nitrogen that is retained in the septic tank and removed in septage. Knowing the pumpout rates, number of occupants, and nitrogen contributions we can estimate the gallons of septage generated per capita per year. Any nitrate that enters the tank will be denitrified immediately, which we cannot estimate without knowing what is in the raw wastewater and the remainder retained in the tank will be in the septage. Subtracting this mass from the mass in the raw wastewater, we have an independent estimate of the total mass of nitrogen in the septic tank effluent that we can compare to the C*Q data. We can choose whether to use these data.

Second, regarding other pretreatment units; here again, is where we have problems with the lack of good flow data. Without accurate flow data, it is hard to differentiate performances between different treatment processes and equipment. This is illustrated in the table Damann and I put together for the ASA monograph. Performance measures either as percent removals or ranges of concentrations overlap and no flow data are provided. What that table shows is more of the impacts of particular processes.

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It is the processes that are important in this study. The species of nitrogen discharged by the pretreatment systems, whether septic tanks only or with more advanced treatment processes, and the environmental conditions of the receiving environments to which the pretreated wastewater is discharged are the determining factors in the fate and transport of the nitrogen to groundwater and hence to surface waters. We can use the data in the monograph to estimate the removal of nitrogen in the treated effluent (but its accuracy is tenuous because flow data are not given). But what is more important is the species of nitrogen discharged and the texture, ambient moisture content, and organic content of the soil receiving the discharge. In finer textured, wet soils with some organic content, data show that nearly complete removal of the nitrogen is achieved if the nitrogen is in the form of nitrate. If not, the nitrogen, in the form of ammonium, will be adsorbed by the soil until it can be nitrified when the soil dries and reaerates. When this occurs, it can move again and, depending on whether it moves through anaerobic soils with some organic content, the nitrate may or may not be denitrified. In well-drained soils with a deeper saturated zone, the species of nitrogen discharged by the pretreatment units is less of an issue since the well drained soils are aerated and nitrification can proceed. What the soil conditions are after the nitrogen moves through the nitrification zone will determine what amount of nitrogen will be removed. (Alkalinity can also is a critical parameter which is needed to achieve nitrification, but I you indicate that raw water data indicate that sufficient alkalinity is present in the drinking water so I won't pursue this further.)

Following this argument, the treatment process rather than the treatment unit is what is important to be able to estimate nitrogen removal. With respect to pretreatment, it is whether the nitrogen is in the form of organic and ammonium or nitrate. (Therefore, it is not so important whether the pretreatment is provided by an ATU or a mound. I look at a mound as a bottomless sand filter, which discharges nitrified effluent to a scarified natural soil surface. You mentioned in your email that you found ammonium downstream from a mound, which is unusual and suggests that the sand fill was very moist.) If the wastewater is partially denitrified, I would assume the remaining nitrogen is in the form of nitrate.

Again, following this argument, we will need to classify the various soil mapping units in the area by their texture, moisture content, and organic content. We can use this same data to estimate the fate of nitrogen some distance from the onsite systems also. What data I am trying to find in the literature now is denitrifying rates versus moisture and organic content. I am thinking now that we could develop a very simple predictive spreadsheet model to make estimates. I don't think we can rely on specific monitoring data from various systems to develop credible estimates.

Finally, I am putting all the literature references in a searchable database for you, which can be added to in the future. It should be a good resource.