June 6, 2014

Rick Stevens
U.S. Environmental Protection Agency
William Jefferson Clinton Building
1200 Pennsylvania Avenue, NW, Mail Code: 4304T
Washington, DC 20460
Via Electronic Mail: stevens.rick@epa.gov

Re: Review of Technical Background Document: Biosolids Exposure and Hazard Assessment

Dear Rick,

The National Association of Clean Water Agencies (NACWA) appreciates the opportunity to comment on the peer review draft of the *Technical Background Document: Biosolids Exposure and Hazard Assessment*. NACWA formed an ad-hoc working group of members to review the draft and our comments are summarized below.

Overall, the NACWA working group felt like the document is an improvement over the 2004 assessment, but remains very conservative as detailed in some of our comments. Of particular interest to our members was the assessment's evaluation of nutrients. We understand that EPA's eco-regional criteria for nutrients are currently the only benchmarks the Agency relies on, but there is a long history of debate and concern regarding how the eco-regional criteria were developed. NACWA has consistently opposed their use as a foundation for state water quality standards and most if not all states have opted not to use the eco-regional criteria approach due to the lack of linkage between the criteria values and designated uses. In addition, to the extent that phosphorus levels in biosolids require any type of additional control, that decision should be left to the states overseeing the program so that controls can be better tailored to water quality needs.

Given that there were some ecological Hazard Quotients (HQ) that exceeded 1 for the land application scenario and human health HQ's that exceeded 1 for the unlined lagoon scenario, NACWA is curious as to EPA's next steps. There is a long discussion in the document on the high level of uncertainty and the fact that the

assessment is extremely conservative – which NACWA concurs with – but it is not clear how the outputs of the assessment will be used. NACWA is concerned about carrying forward the conservative assumptions into the next phase.

Some of the exposure assumptions in the assessment are extremely conservative and overestimate exposure. For example, the assumption that the little brown bat obtains 100 percent of its diet from biosolids-amended fields is unrealistic. The document discusses sources of uncertainty, including the compounding effect of using such conservative assumptions, but it does not discuss how this uncertainty may be addressed in future analyses. Consideration should be given to doing a sensitivity analysis where less conservative assumptions regarding pollutant concentrations, exposure assumptions, etc. are used for those pollutants where the HQ was greater than 1 before any preliminary decisions are made with regard to regulatory changes.

Source Modeling

Concerning the land application of biosolids, in Table 3-1 (Physical Characteristics of Biosolids) of section 3.1.3 (Analysis Phase>Source Modeling>Properties of Biosolids), the assumption is made that biosolids that are land applied are 40 percent total solids (TS). It is stated in the report that the 40 percent TS value corresponds to approximately the 85th percentile of the 2006-2007 TNSSS solids distribution. Based on our experience, the 40 percent TS value is too high. The utilities participating in our working group reported that solids concentrations in the 20-25 percent range would be more realistic. We ask that EPA provide the ranked percentile data used in justifying the 40 percent TS along with the rationale for selecting the 85th percentile value. Biosolids that have such a high percent of total solids are usually compost or pelletized material. Applying a more accurate solids value would give the model a higher degree of accuracy in estimating the amounts of pollutants being applied to farm fields.

Given the current diversity in types of biosolids available for land application, the narrow scope of biosolid types considered for land application modeling is inappropriate. Biosolid treatment technology has improved in the past decade with increasingly more stringent site management requirements. It is important to have a clear understanding of the risks associated with different grades of biosolids in order to accurately estimate the potential receptor exposure rates.

Regarding the 10 percent solids concentration value used in modeling lagoon disposal of biosolids, NACWA recommends that a lower percent solids value be used. Biosolids destined for lagoon disposal have a much lower percent TS value to allow for easier transfer and to save in dewatering costs. Additionally, such a high solid concentration does not adequately capture the potential for dissolved pollutants to percolate into the groundwater section of the model. By lowering the percent TS value of lagoon disposed biosolids the model would be more capable of estimating potential pollutant exposure through the groundwater model pathways.

Human Health Results

Based on NACWA's review, for the land application scenario, all results, even the very conservative "total ingestion" pathway, were less than the level of concern. Screening level surface disposal groundwater results exceeded levels of concern for only three chemicals (manganese, molybdenum, and nitrite), and only in unlined lagoons. Those HQs ranged from 3.3 for molybdenum to 7.8 for nitrite.
EPA used chemical-specific concentration distributions from the TNSSS as part of the Monte Carlo evaluation as recommended by the National Research Council's (NRC's) publication Science and Decisions: Advancing Risk Assessment (NRC, 2009, typically referred to as the "silver book"). While the current assessment is a

significant improvement over the 2004 assessment, as noted above, EPA uses unrealistically conservative assumptions for the soil-to-plant and plant-to-milk transfer pathways. EPA used an unrealistically high biotransfer factor which over predicted HQ (>1) for silver in both soil-to-plant and plant-to-milk transfer pathways. Biotransfer is dependent on solubility and more typical solubility rates are: silver chloride is 0.00193 g/L, silver oxide is 0.00020 g/L, and silver sulfide is 8.5–12 mg/L.

Ecological Results

The main ecological analysis addressed risks from the land application scenario to ecological receptors from direct contact with contaminated media and from the ingestion of contaminated food and feed. Results exceeded levels of concern for four chemicals: barium (direct contact, aquatic community, HQ of 73), manganese (direct contact, aquatic community, HQ of 4.1; and ingestion, little brown bat, HQ of 1.3), pyrene (direct contact, soil biota HQ of 1.1), and silver (direct contact, aquatic community, HQ of 85). Some of these high HQ could be resulted from unrealistic assumptions such as:

- Unrealistically high loads of eroded solids estimated by the LAU model that were input to the surface water model, which caused overestimation of predicted dose for both direct contact and ingestion pathways for ecological receptors and as a result over predicted HQ (>1) for barium, manganese, pyrene, and silver.

- For the surface disposal scenario, a lagoon was modeled as a non-aerated surface impoundment. The modeled lagoon consists of an aerobic liquid compartment overlying an anaerobic liquid compartment. Both liquid compartments overlie an anaerobic consolidated sediment compartment. The compartmentalization of the lagoon into aerobic and anaerobic zones is reasonable, however, in the aerobic liquid compartment, in the presence of enough oxygen, ammonium will be converted to nitrite initially, and then very rapidly to nitrate. Nitrite would unlikely accumulate in any significant amount in a lagoon system under steady-state conditions because the maximum growth rate of Nitrobacter, the main genus of bacteria responsible for nitrite oxidation, is considerably higher than the maximum growth rate of Nitrosomonas, the main genus of bacteria responsible for ammonium oxidation. Nitrite accumulation would only occur if there was an inhibitor specific to Nitrobacter that would eliminate this genus of bacteria from the lagoon, but for the purposes of modeling it must be assumed the full range of nitrifying bacteria are present. Research shows (Lukicheva et al., 2012) that nitrate/nitrite concentrations in non-aerated lagoons range from 190 to 1900 mg/kg in the first 15 cm of the lagoons, but was not present in any subsurface layers. Although ammonia was oxidized in the aerobic surface layer of the lagoon, there was no oxidation of ammonia or reduction of nitrate to nitrite in the subsurface layers. Nitrate that migrates into an anaerobic subsurface or anaerobic sediment compartment of a lagoon would result in denitrification to the volatile nitrogen compounds N2, N2O, or NO and not nitrite. There is no scientific evidence to suggest that nitrite would migrate through an anaerobic liquid and sediment compartment and into the soil without undergoing denitrification to N2, N2O, or NO, unless it is assumed that these compartments are biologically inactive. Thus, denitrification needs to be more fully considered in the model.

- All chemical properties, such as partitioning coefficients in Appendix E, and therefore transport assumptions are seemingly based on the elemental forms of manganese (CAS# 7439-96-5) and silver (CAS# 7440-22-4). Speciation of redox active metals, such as these, determines their water solubility, bioavailability, and mobility in the environment. The modeling description lists five geochemical

master variables (groundwater composition, pH, concentration of iron oxide adsorption sites, and concentration of dissolved and particulate natural organic matter) used in MINTEQA2 modeling resulting in nonlinear Kd versus aqueous metal concentration curves for combinations of the master variable settings. Redox couples used in MINTEQA2, however, were not discussed. It is critical that redox couples in MINTEQA2 be used or that all reasonable redox states for these metals be modeled for these same environmental conditions. Manganese, for example, would be expected to be in the form Mn(III/IV)(hydr)oxide (MnOOH or MnO2) in aerobic aqueous environments, such as the surface of a sewage lagoon, and reduced to Mn(II) in anaerobic subsurface layers. At higher oxidation states, such as MnOOH or MnO2, manganese would not be expected to be mobile in lagoons or soils, but would likely precipitate from solution at near-neutral pH values. Manganese could be more mobile when reduced to Mn(II) but in that redox state it would be likely complexed by organic matter and organic acids which are abundant in the lagoons.

Citation: Lukicheva, I., T. Guanglong, A. Cox, T. Granato, and K. Pagilla. 2012. Anaerobic and aerobic transformations affecting stability of dewatered sludge during long-term storage in a lagoon. Water Environ. Res. 84(17): 17-24

Additional Comments

- It appears the biosolids matrix was not used in determining uptake rates and for many of the fate and transport assumptions. This is a major deficiency if confirmed.

- There should be a bio and phyto availability mechanism illustrated as a release mechanism. (Page 2-2)

- For silver, which has an eco-toxicity HQ greater than 1 for the land application scenario, the document notes that the majority of data is based on laboratory studies using metal salt (AgNO3). This combination likely overestimates exposure compared to silver in a biosolids matrix and the overestimate may be significant. In the water quality world, we have tools like the water effects ratio to compensate for this, but there is no such approach to adjust in this application

- Under Exposure Routes, there should be mention of plant and animal uptake (Page 2-4)

- In the first Run Loop, it states that loading to index reservoir and farm pond occur for 150 years. In the 2004 assessment, EPA assumed every other year for 100 years. Later in the document it assumes a maximum of 80 years (40 applications). The exact site life assumed should be clarified (Page 2-11)

- It is unclear in the chemical properties section whether beef and milk biotransfer factors for organic compounds (or non-organic) are from within the biosolids matrix? This needs to be clarified and revisited if possible. The behavior of compounds is entirely different when within a biosolids matrix (Page 2-16)

- There is no buffer to the farm pond. This would be a non-compliant application. This should be changed to include the ten meter buffer. It is noteworthy that most, perhaps all, states have site access and use restrictions, including setback distances from waterbodies, wells, etc. These should be used to

ground truth the construct of land application and impoundment exposure pathway scenarios (Page 2-21; 3-12)

- It is a significant over-estimation to assume that between 10 and 80 percent of every 427 acre watershed in the US receives biosolids applications. This contrasts sharply with the dioxin assessment which estimated that 0.1 percent of all tillable acres in the nation received biosolids (2-21)

- A maximum site life of 40 years is assumed, in contrast to earlier assumptions of 150 years. Since application is assumed to occur every other year, does that mean that there is a maximum of 20 applications? This is far less than any of the earlier risk assessments assumed (Page 3-3)

- Figure 3-1 does not depict any plant and animal uptake and transfer. Again, in the fate and transport modeling, the document does not seem to evaluate them from within a biosolids matrix (Page 3-9)

- Air dispersion release and transport models also do not appear to assume a biosolids matrix as the pollutant source (Page 3-10)

- It appears that all pollutant concentrations in groundwater and surface water are completely dissolved. Since many pollutants in biosolids are hydrophobic, they are more likely to be in sediment than in the water column (Page 3-19 and throughout the document).

Thank you again for the opportunity to review the Technical Background Document. Please contact me at 202-833-9106 or chornback@nacwa.org should you have any questions.

Sincerely,

Chris Hornback
Senior Director, Regulatory Affairs