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Via email: schell.bob@epa.gov

Re: Biogenic Greenhouse Gas Emissions Report by RTI International

Dear Mr. Schell:

The National Association of Clean Water Agencies (NACWA) offers the following comments and recommendations on the December 14, 2010 report submitted to the U.S. Environmental Protection Agency (EPA) by RTI International, *Greenhouse Gas Emissions Estimation Methodologies for Biogenic Emissions from Selected Source Categories: Solid Waste Disposal, Wastewater Treatment, Ethanol Fermentation* ("RTI report"). NACWA represents the interests of nearly 300 public wastewater treatment agencies, which treat and reclaim a majority of the wastewater generated each day throughout the nation. NACWA's members are aware of EPA's new Clean Air Act (CAA) regulations on greenhouse gas (GHG) emissions, and are concerned that emissions from wastewater treatment facilities be characterized correctly.

EPA apparently posted the RTI report on its website without seeking comment from the public or the industries that the report analyzes. NACWA has reviewed the Wastewater Treatment chapter of the RTI report and believes that it could have significant ramifications for the wastewater industry related to the calculation and reporting of GHG emissions for the federal mandatory reporting rule, various state mandatory reporting rules, and the federal Prevention of Significant Deterioration (PSD) and Title V operating permit programs. Biogenic emissions are included in some state reporting and regulatory programs, and may eventually be included in the PSD and Title V programs after EPA completes its study of these emissions. With little other guidance available for regulators and wastewater utilities to use in calculating biogenic emissions, the RTI report could be used for regulatory purposes. NACWA asks that EPA remove the RTI report from its website while it considers the comments and recommendations in this letter and seeks additional expert and/or public review of the report. NACWA also asks that EPA clarify when and how this document should be used.

Overall, the approach outlined in the RTI report will lead to inflated and misleading emissions estimates for wastewater treatment, as shown in the attached figure. This figure compares the emissions calculated with different methods for a conventional activated sludge publicly owned treatment work (POTW) treating 400 million gallons per day (MGD). Each of the methods depicted in the figure use slightly different approaches. The RTI report method and the California Air Resources Board (CARB) Mandatory Reporting Rule method include all GHG emissions from POTWs – biogenic carbon dioxide (CO₂), anthropogenic CO₂, methane (CH₄), and nitrous oxide (N₂O). The EPA *Inventory of U.S. Greenhouse Gas Emissions and Sinks* excludes biogenic emissions and the EPA Mandatory Reporting Rule only includes emissions from stationary combustion units, not the wastewater treatment process. While some variation is expected between methods, this figure illustrates the dramatic overestimation of biogenic CO₂ and methane that occurs with the methods in the RTI report.

The RTI report emissions estimates are shown for several digester gas scenarios. The digester gas flow is estimated in two ways: scaled up from measured digester gas production and properties at a POTW and estimated from Equations 3-6 and 3-7 in the RTI report, using biological oxygen demand (BOD). For each of these two estimates of digester gas flow, emissions estimates are shown for scenarios of releasing the gas and combusting the gas. NACWA believes that the gas release scenario is unrealistic, as discussed in more detail below.

NACWA's primary recommendations for improving the RTI report are:

- At the beginning of each chapter of the report, include the statement on page 1-2 that the report does not represent official EPA policy or standards;
- Consider the influence of primary treatment on CO₂ and CH₄ emissions; and
- Revise the recommendations for calculating N₂O emissions that are based on ongoing research.

These recommendations are explained in detail below, along with several other recommendations for revising the RTI report.

“Non-Policy” Disclaimer

The first two paragraphs of page 1-2 in Chapter 1 of the RTI report explain that the report does not represent official EPA policy or standards, does not establish requirements to use the methods under CAA programs, and does not differentiate fugitive emissions for air permitting requirements. NACWA believes that this “non-policy” disclaimer should be repeated at the beginning of every subsequent chapter.

There are several reasons for this request. First, it is very easy for the various chapters on biogenic emissions sources to become separated from the introductory chapter and for the reader to lose sight of the fact that the document is not intended to state official EPA policy, establish prescriptive requirements, or endorse a particular method of calculating emissions. Second, NACWA believes that many regulators and community members will defer to this guidance and will extract from it numbers and calculation procedures to be used in more than just an informational manner, such as establishing and arguing permit limits and compliance. Finally, NACWA is particularly concerned that the RTI report will be used inappropriately by regulators as their principal tool for calculating POTW GHG emissions for the purposes of PSD potential-to-emit (PTE) determinations and Title V applicability.

Since EPA has announced that it will delay for three years the consideration of biogenic emissions for PSD and Title V purposes, the RTI report may be the only EPA-sanctioned assessment of the biogenic aspects of wastewater treatment for several years. Because this report will likely be used for any regulatory purposes in the meantime, NACWA asks that the disclaimers in the first two complete paragraphs on Page 1-2 be added to the beginning of each chapter in the report and that the other suggestions in this letter be seriously considered.

Primary Treatment

The RTI document ignores the settleable solids or “primary treatment” aspect of wastewater treatment and thereby creates considerable confusion in using most of the equations in Chapter 3 pertaining to CO₂ and CH₄ generation.

The first sentence in Chapter 3 describes the general flow regime that occurs at wastewater treatment plants, but does not mention settleable solids or “primary treatment,” which provides a rich substrate for digestion. “Primary treatment” is mentioned only once in the entire chapter, in the third sentence of the first paragraph. While many extended aeration plants do not have primary sedimentation, most other facilities do. Of the facilities that digest waste activated sludge, most also digest their primary sludge. This treatment of primary sludge is neglected as the empirical equations considered on Pages 3-4 and 3-5 seem to only consider biologically produced sludge, i.e., waste activated sludge (WAS).

The first complete paragraph under Table 3-1 states, “Equations 3-4 and 3-5 provide a method for estimating the CO₂ and CH₄ emissions resulting from the digestion of biological solids **generated** in the wastewater treatment system” (emphasis added). This sentence seems to refer only to the secondary or biological waste activated sludge that grows as the result of dissolved organics destruction. The term Q_s in both equations, defined as “waste sludge stream flow rate,” corroborates this interpretation. But then the document goes on to say, at the top of page 3-6, that “For most digesters, however, the only solids entering the unit are those **generated** in the wastewater treatment system” (emphasis added), from which Equations 3-6 and 3-7 flow. This indicates that these two equations are also only applicable to WAS.

Moreover, the second full paragraph on page 3-6 states that Equations 3-4 and 3-5 must be used (rather than Equations 3-6 and 3-7) for those situations where the sludge digester is the *only* biological treatment process at the facility and where additional waste streams are fed to the sludge digester. If any one of these situations is true, then the reader is directed back to Equations 3-4 and 3-5 which again, are only for WAS since they contain the term Q_s ; hence the logic for the use of the equations is circular and erroneous as there is no mathematical mechanism to consider primary sludge digestion.

One of the qualifications listed for when Equations 3-4 and 3-5 must be used is “the sludge digester is the only biological treatment process at the facility.” Clearly, an activated sludge process is needed to produce the WAS flow, Q_s , so this restriction does not make sense.

Also, the same biomass yield factor, λ , cannot be applied when oxygen demand is defined in terms of BOD *and* COD. For municipal wastewaters, the ratio between BOD and COD typically varies between 1.6 and 2.3; therefore, the yield factor utilized for the BOD-based calculation would need to be effectively halved to obtain the same result as the COD-based equation. In general, BOD and COD are used interchangeably in the document, which is not correct since the two parameters differ significantly in the forms of oxygen demand they represent.

Nitrous Oxide Emissions

Quantifying wastewater N_2O emissions is extremely complicated, and NACWA has numerous concerns with the N_2O emissions characterization discussed in Part 3.3 of the report.

RTI cites an interim 2010 report from an ongoing study prepared by Dr. Kartik Chandran of Columbia University under the auspices of the Water Environment Research Foundation (WERF) that will not be finished until 2012. While this is the most comprehensive and scientifically assembled body of testing work on the subject to date, there are additional plants from which emissions are currently being measured and the results, though thoroughly reviewed by the WERF Project Subcommittee (the steering committee), are still incomplete and have not been fully vetted with the wastewater community

As an example, Equation 3-8 in the RTI report is erroneous for several of reasons. The emission factor $\text{EF}_{\text{N}_2\text{O}}$ of 0.0050 (or alternatively 0.5%) g N_2O -N/g influent TKN emitted is attributed to Dr. Chandran. The RTI report describes Equation 3-8 as a method “to estimate N_2O emissions for both aerobic and anaerobic processes using an *average* value for the percent of influent TKN emitted as N_2O ...” (emphasis added). NACWA presumes this “average” number must derive from Table 4-1 of the WERF interim report that lists the biological nutrient removal (BNR) processes that were tested. The concept of taking an average of this data for use in an emission factor is not supported by Dr. Chandran’s research, and was not the intent of the WERF study. Dr. Chandran’s report makes no attempt to estimate the number of facilities that might employ the particular technology sampled, something that more appropriately might be reflected in a weighted average of the data shown and population served, if the population portion of the equation was known. The variability observed during the WERF study also confirms that an average emissions factor is not relevant for this sector. Because of the very complicated process dynamics and the very wide range of treatment processes in the field, NACWA believes that dynamic modeling, and not unrealistically conservative emissions factors, should be used to characterize the wastewater industry.

The POTWs sampled for the WERF study only partially represent the various biological nutrient reduction (BNR) practices across the industry. EPA should keep in mind that of the approximately 15,000 POTWs in the United States¹, the vast majority do not deliberately nitrify/denitrify. Of the 12 plants sampled in the WERF study, only three are non-BNR facilities. It is therefore inappropriate to use the WERF database to characterize the vast majority and numerous configurations of the non-BNR plants that exist around the United States. NACWA suggests modifying the third sentence in the last paragraph of page 3-10 to reflect this fact by changing “both with and without biological nutrient removal” to “most with biological nutrient removal and some without.”

Even if the simple mathematical average of the WERF data is calculated, as indicated in the RTI report, 0.0050 is clearly not the result. We presume this is an inadvertent error carried over from either the Intergovernmental Panel on Climate Change (IPCC) literature or EPA’s GHG *Inventory*, where the same number is used as the default emission factor for “post effluent conversion.” The term “post effluent conversion” informally refers to the fractional conversion of wastewater plant effluent nitrogen to N_2O after it has been discharged to a receiving water body. The IPCC and EPA consider this release to be the largest source of N_2O emissions associated with the wastewater industry.

¹ Appendix I, EPA Clean Watershed Needs Survey (CWNS), 2008

Equation 3-8 also seems to suggest that the N_2O emissions across the entire wastewater treatment plant are represented by the 0.0050 factor. The 0.0050 number in both the IPCC and EPA *Inventory* represents the portion of N_2O resulting from the conversion of nitrogen in the plant *effluent* upon discharge to the receiving water body. Although it is not clear from the RTI report, Equation 3-8 seems to agglomerate post effluent conversion phenomena *and* controlled aerobic/anaerobic biological processes that occur within the plant. NACWA believes that Dr. Chandran's recommendation to consider TKN in the plant influent is being confused with RTI's use of the 0.0050 factor.

The RTI report states on page 3-10 that "the amount of nitrogen in the wastewater influent is the principal factor in determining the extent of the N_2O generation potential in wastewater treatment plants (WWTPs)." However, the WERF study to date has concluded that the principal determinant of N_2O emissions is the diurnal variation in the nitrogen loading to the treatment plant, rather than steady-state total mass loading of nitrogen received. This was conclusively demonstrated at plants with large collection systems that produced very little N_2O versus much smaller flow plants with severe diurnal swings. Furthermore, given the very high degree of spatial and temporal variation of measured N_2O emissions, the development, calibration, and validation of dynamic mechanistic process models that capture such variability would be more appropriate than lumped emission factors or flow normalized emission factors.

Other Recommendations

NACWA also offers the following comments for consideration:

- The RTI report ignores specialty organic chemicals used in the wastewater treatment industry, such as methanol and polymers, which are oxidized in part or in whole to CO_2 , particularly where nutrient removal is required to low levels. Focusing on reduction of these external sources of CO_2 , rather than biogenic sources over which POTWs have no control, might allow utilities to find ways to meaningfully limit CO_2 emissions.
- The document assumes that the worst case hourly emissions rate is, in essence, the highest possible organic load in terms of BOD, COD, or total organic carbon (TOC) multiplied by the maximum anticipated flow rate or wastewater treatment system capacity. This would result in a significant overestimation of the potential emissions from a wastewater treatment plant, since maximum concentrations of precursors would never coincide with maximum plant flowrates. Furthermore, since greenhouse gases are not like traditional criteria pollutants, there is no need to calculate hourly maximums since these well-mixed and long residence time gases do not have significant acute impacts. The document should be revised to correct the worst case assumption or eliminate the hourly calculation.
- BOD, COD, and TOC cannot be used interchangeably as is frequently shown in the RTI report.
- The sample calculation on page 3-9 presents unrealistically inflated worst case emissions estimates for a wastewater treatment system. Assuming the complete venting of all of the digester gas without combustion is not realistic, because most state health and safety regulations would prohibit such a practice. Most POTWs with anaerobic digesters flare the digester gas or reuse it in other combustion devices. The sample calculations presented in the RTI report should present a reasonable real-world example of what transpires at POTWs instead of an unrealistic scenario that will be misleading to

regulators. Please also note that the reference to Equation 3-2 (for methane) in this example is incorrect and that RTI should have cited Equation 3-1.

- The process symbology in Figure 3-3 for the denitrification pathway appears to be incorrect. N_2O is produced from the reduction of NO which is subsequently reduced to N_2 .

NACWA appreciates EPA's consideration of these comments. Again, NACWA recommends that the RTI report be removed from EPA's website until it is revised and sufficiently qualified as to its appropriate use. NACWA would be willing to meet with EPA to further discuss possible revisions to the report. Please contact me at 202/296-9836 or cfinley@nacwa.org if you have any questions.

Sincerely,



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