November 9, 2004

Andrew Hanson
Midwest Environmental Advocates
702 East Johnson Street
Madison, Wisconsin 53703

Re: Wisconsin's Proposed Odor Management Worksheet

Dear Mr. Hanson:

Thank you for the opportunity to comment on the Odor Management Worksheet that is being evaluated for regulatory use in Wisconsin. I have provided site-specific air quality modeling for livestock operations in Minnesota for the past 8 years. The modeling has been performed in conjunction with obtaining permits for new and expanding feedlots and with public nuisance lawsuits. I have also been hired by the Minnesota Pollution Control Agency (MPCA) to perform local and regional air quality modeling for assessing the impacts of livestock operations in a three county area in western Minnesota as part of the Hancock Pro-Pork Environmental Impact Statement (EIS). The modeling has examined hydrogen sulfide, ammonia, chemistry-based odor indices, and olfactometry-based odor indices. During these 8 years of air quality modeling of livestock operations, I have developed a sense of what is acceptable to regulatory agencies and the courts. In addition to my consulting work, I teach environmental engineering at the University of Minnesota.

The proposed Odor Management Worksheet appears to be a repackaged version of the Odor for Feedlots Setback Estimation Tool (OFFSET) developed at the University of Minnesota. In particular, the Worksheet's Curves A and B are just a different means of expressing the mathematical relationship between setback distance and odor emissions found in OFFSET. The Worksheet's Curve A is identical to OFFSET's 94 percent annoyance free condition and the Worksheet's Curve B is identical to OFFSET's 98 percent annoyance free condition. Because the air quality modeling components of the Odor Management Worksheet (Curves A and B) and OFFSET are identical, any limitations that apply to OFFSET apply to the Odor Management Worksheet.

A fundamental problem with OFFSET is that it is not based, from a regulatory perspective, on an acceptable air quality model. OFFSET is based on the INPUFF model,[1] which is not listed in Appendix W to the Revision to the Guideline for Air Quality Models in the federal regulations as an acceptable air quality model according the U.S. Environmental Protection Agency.[2] Because

[1] Petersen W. B. and Lavdas L. 1986. INPUFF 2.0 – A multiple source Gaussian puff dispersion algorithm. User's Guide. EPA-600/8-86/024

[2] U.S. EPA. 2003. *Revision to the Guideline for Air Quality Models.* 40 *CFR* Ch. 1, Part 51, Appendix W (April 15, 2004 Edition).

INPUFF is not listed in Appendix W, the MPCA does not accept any OFFSET-generated data during the environmental review process and permitting process for new and expanding livestock operations. For the Hancock Pro-Pork EIS, both the MPCA and the Minnesota Environmental Quality Board supported the use of site-specific modeling with the EPA-approved CALPUFF model instead of OFFSET, because the use of INPUFF as a non-listed air quality model would be hard to defend in any post-EIS challenges by environmental groups. Although a direct challenge has not yet occurred, the potential inadmissibility of OFFSET data in court should be a concern to any livestock operation.

In addition to not being a regulatory approved model, the use of INPUFF in assessing the air quality impacts associated with feedlots is highly questionable. The combination of INPUFF and OFFSET results in a poor tool to estimating setback requirements as indicated in the following paragraph obtained from a technical review published by the Minnesota Environmental Quality Board:

> "The review findings indicate that the INPUFF-2 model is not an appropriate choice for assessing the impact of low-level, distributed emission sources such as feedlot sources. This model, which is designed for point sources, does not account for the spatial distribution of source emissions, and near-field predictions (within about 500 m of sources) are therefore not reliable. U of M researchers have applied empirical scaling factors to "tune" model predictions to match observed odor levels. In light of this model calibration, the model performance reported in the U of M publications is not a valid demonstration that the approach is either valid or reliable."[3]

Another limitation with the INPUFF/OFFSET combination is the inability to account for changes in emission rates as a function of wind speed. While this is less of a concern when modeling the emission of gases from livestock barns, it is a major limitation when modeling the emissions from livestock manure basins. As shown in Figure 1, the emission of odorous gases increases rapidly with increases in wind speed. The INPUFF/OFFSET combination assumes that the same odor emission rate, *i.e.*, the relatively low emission rates measured at the low air velocities found within floating emission chambers. By not considering the rapid increase in odorous gas emissions with increases in wind speed, the INPUFF/OFFSET combination and the proposed Wisconsin Odor Management Worksheet "under protect" residences near manure storage basins to offensive odors.

In addition to the intrinsic limitations of the INPUFF air quality model, there are several fundamental problems with the development of the setback curves. The OFFSET and Odor Management Worksheet setback curves are based on the premise that the strongest odor episodes are found at near calm wind speeds. This is not the case at livestock feedlots with manure basins, where the strongest odor episodes are often associated with wind speeds between 12 and 20 miles per hour. Hence, the fundamental OFFSET assumption of when odor episodes occur is flawed and the annoyance frequencies associated with the setback curves are invalid when the

[3] MEQB. 2001. *Final Technical Work Paper for Air Quality and Odor Impacts*. Minnesota Environmental Quality Board, St. Paul, MN. Prepared by Earth Tech, Minneapolis, MN.

feedlot has a manure basin. The OFFSET setback curves should not be used to evaluate odor emissions from manure basins.

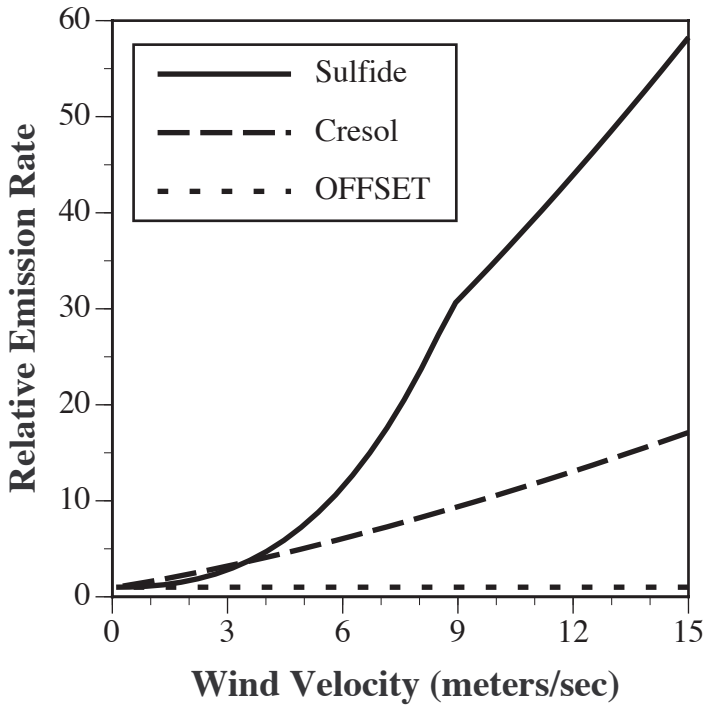


Figure 1. Odorous gas emission rates for uncovered manure basins as a function of wind speed. Most odorous gases will have response curves between the sulfide and cresol response curves. The plotted emission rates are relative to the emission rate at a 0.1 meters/sec wind velocity, which is a typical air velocity in an emission flux chamber. OFFSET does not account for wind effects on basin emission rates. (1 meter/sec = 2.24 mph)

With regard to the assumed weather conditions used in developing the OFFSET and Odor Management Worksheet setback curves, I have two nagging questions. First, the setback curves are based on Minnesota annual wind roses. Are the annual wind roses for Wisconsin identical to those in Minnesota? If the wind roses are not identical, then Wisconsin needs to develop its own setback curves. Second, in developing the setback curves, the University of Minnesota assigned odor episode frequencies to selected wind rose conditions (wind speed and atmospheric stability). Did the University consider the impact mixing height on odor episode frequency?

Another fundamental problem with OFFSET is related to the interpretation of the INPUFF-generated odor intensities. Typically, air quality models calculate hourly gas concentrations (60-minute time-averaged concentrations) to assess maximum impacts, because this is the minimum averaging time specified in regulatory guidance, this is the averaging time used in

most modeling verification studies, and weather data is often compiled on an hourly basis. It is puzzling to note that the OFFSET and Odor Management Worksheet setback curves are based on two-hour time-averaged gas concentrations when the wind rose data used to the develop the setback curves was apparently hourly. Basing the setback curves on two-hour time-averaged gas concentrations instead of one-hour time-averaged gas concentrations means that the setback curves are based on concentrations that are 87 percent of the hourly concentrations. Thus, the setback curves are underestimating odor impacts.

The OFFSET and Odor Management Worksheet setback curves assume that a livestock odor intensity of 75 detection-threshold odor units (OU, d/t) is the threshold of annoyance. This annoyance threshold was not obtained from studies examining the response of the general population to livestock odors. Instead, the annoyance threshold was arbitrarily defined using as guidance the owner's manual for the olfactometry machine that the University of Minnesota used in developing its odor emission database. To my knowledge, the public (or for that manner a laboratory-scale study) has not evaluated the appropriateness of the annoyance threshold used in the OFFSET and Odor Management Worksheet setback curves.

The other fundamental problem with the assumed annoyance threshold is related to time averaging. During olfactometery measurements, the nose of the panelist is only exposed to the odorous gas for seconds. However, the OFFSET and Odor Management Worksheet setback curves assume an exposure of 2 hours. An odor intensity that an odor panelist may find to be merely detectable in a short-term field or olfactometery measurement could be annoying if present for an hour or longer. Similarly, an odor intensity that is faintly annoying when present for a few seconds could by severely annoying when present for 2 hours. OFFSET documentation provides no guidance on how the annoyance threshold derived from virtually instantaneous exposure correlates to the 2-hour time intervals assumed in the setback curves. In other words, if the instantaneous annoyance threshold has been arbitrarily set at 75 OU (d/t), what is the 2-hour annoyance threshold? Without knowing the answer to this question, how can you develop setback curves based on 2-hour exposures?

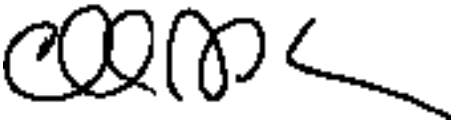
Another problem with OFFSET is the assumed odor emission rates from swine barns. The University of Minnesota database was developed by collecting gas samples in Tedlar bags and shipping the bags to the olfactometery laboratory for analysis. The problem is with the bags. The dust particles present in the air exhausted from the hog barns adsorbs to the sides of the bags. In the laboratory, the odor panelist never smells the odor from the dust particles, because the dust never makes it to the sampling port. It stays in the bag. Researchers at Iowa State University indicate that about 75 percent of the odor from hog barns is associated with the dust. Thus, the odor emission rates in the University of Minnesota database are a factor of 4 too small, because the dust-related odors were never assessed.

In summary, the proposed Wisconsin Odor Management Worksheet is based on the air quality model that is not approved for regulatory purposes, is deemed inappropriate for modeling emissions from livestock feedlots, and should never be used to model the emissions from a manure basin. In addition to the intrinsic limitations of the air quality model, there are fundamental problems with development of the setback curves including the assumed weather conditions, the assumed instantaneous annoyance threshold, and the appropriateness of using an

instantaneous annoyance threshold to define annoyance during a 2-hour exposure. These limitations and conceptual problems should preclude the regulatory use of the proposed Wisconsin Odor Management Worksheet.

If you have any questions or concerns, please call my office at 612-824-6662.

Sincerely,



Charles J. Gantzer, Ph.D.
President