Fertilizer Application Area Source Category Calculation Methodology Sheet

I. Source Category:		**II. SCC:**	
	Anhydrous Ammonia		2801700001
	Aqua Ammonia		2801700002
	Nitrogen Solutions		2801700003
	Urea		2801700004
	Ammonium Nitrate		2801700005
	Ammonium Sulfate		2801700006
	Ammonium Thiosulfate		2801700007
	Other Straight Nitrogen		2801700008
	Ammonium Phosphates		2801700009
	N-P-K		2801700010

III. Pollutant: NH_3

IV. Description:

This document describes the methodology to be used to calculate emissions of ammonia (NH_3) from Fertilizer Application.

V. Current Methodology:

Estimates of the total use of fertilizers are commonly obtained from the Association of American Plant Food Control Officials (AAPFCO). There are a number of sources of emissions factors available for fertilizer application. In a report for the Midwest RPO, Sonoma Technology (LADCO, 2003) recommends using European Environment Agency (EEA) (EEA, 2001) emission factors. The current version of the CMU model uses EEA emission factors for all fertilizer source categories except for Ammonium Thiosulfate, which uses Battye emission factor.

VI. Emission Calculation:

A. Emissions

a. Emissions of all Pollutants

i. Equation for Emissions of NH_3

$$E_{(i)} = EF_{(i)} * N_{(co)}$$

ii. Variables

-$E_{(i).}$ NH_3 Emissions

- $N_{(co)}$. The activity data used to estimate NH3 emissions can be obtained from the Commercial Fertilizers Database compiled by the Tennessee Valley Authority (TVA) which is now maintained by Association of American Plant Food Control Officials. This database includes county-level usage of over 100 different types of fertilizers, including those that emit NH_3. A hard copy of this information is available from the Association of American Plant Food Control Officials (AAPFCO).

- $EF_{(i)}$. Emission factor in pounds per ton nitrogen applied
Sonoma Technology Inc (LADCO, 2003) recommends the use of the European Environment Agency (EEA) emission factors, as they consider fertilizer type, soil type and climate.

Alternative Emission Factors Recommended for Fertilizer Application [e]

Fertilizer Type	Battye et al., 1994 (kg NH_3/Mg N)(% of N released as NH3)	Weerden and Jarvis, 1997 (% of applied N content)	CMU Emission Factor (% of applied N content)	Corsi et al., 2000 (kg NH_3/Mg N) (range)	EEA, 2001 Group I[f] (% of total N applied)	EEA, 2001 Group II[g] (% of total N applied)	EEA, 2001 Group III[h] (% of total N applied)
Anhydrous Ammonia	12 (1%)		4%[b]	49 (12-121)	4%	4%	4%[b]
Aqua Ammonia	12 (1%)		4%[b]	12			4%[c]
Nitrogen Solutions	30 (2.5%)		8%[b]	30	8%	8%	8%[b]
Urea	182 (15%)	12-23%	1.5%[b]	121 (61-279)	20%	15%	15%[b]
Ammonium Nitrate	25 (2.1%)	1-1.6%	1-2%[b]	24 (10-121)	3%	2%	1%[b]
Ammonium Sulfate	97 (8%)		5%[b] CT, ME, MA, VT, NY; other M-V states 1%	140 (97-182)	15%	10%	5%[b]
Calcium ammonium nitrate			1-2%[b]	24	3%	2%	1%[b]
Ammonium Thiosulfate	30 (2.5%)		2.5%[a]				2.5%[a]
Other Straight Nitrogen	30 (2.5%)			30			
Ammonium Phosphates	48 (4%)		5%[b]	55 (49-61)	5%	5%	5%[b]
N-P-K	48 (4.8%)			49	3%	2%	1%[b]
Potassium nitrate			2%[a]				1%[b]
Miscellaneous (spring)			6-7%[b]				7%[d]
Miscellaneous (fall)			6-7%[b]				7%[d]

[a] Battye et al 1994
[b] European Environment Agency (2001).
[c] Equal to anhydrous ammonia.
[d] Weighted average.
[e] LADCO, 2003
[f] Group I – Warm temperate areas with a large proportion of calcareous soils (e.g., Greece, Spain). Subtropical and continental climates would be expected to fall into this Group.[b]
[g] Group II – Temperate and warm-temperate areas with some calcareous soils (or managed with soil pH>7), but with large areas of acidic soils (e.g., Italy, France, United Kingdom, Ireland, Protugal, Belgium, Netherlands, Luxembourg).[b]

[h] Group III – Temperate and cool-temperate areas with largely acidic soils (e.g. Scandinavian countries, Germany, Switzerland, Austria).[b]

VII. Point Source Adjustments:

No point source emissions were subtracted from the area source inventory.

VIII. Adjustments for Controls:

No controls are available for this source category.

IX. Spatial Adjustments:

The use data is at county-level so no allocations are needed.

X. Temporal Adjustments:

Data for temporal allocation is not available for this source using this methodology. The Carnegie Mellon University (CMU) model allows further seasonal allocations.

XI. Assumptions:

A. Total amount of fertilizer sold by county.

XII. Rule Effectiveness:

There are no known rules that would affect these calculations.

XIII. Uncertainties/Shortcomings of Methodology

A. Manure and other forms of animal waste may be used as fertilizers, but are not included in this category

B. The emissions from fertilizer application depend significantly on the external conditions, the type of soil, amount of moisture, and treatment during or immediately following application (plowing, disking, watering). The aggregate factors neglect these differences.

C. All fertilizer is assumed to be applied in the county in which it is sold.

D. Fertilizers are applied at specific times in the preparation and growth cycles. This method assumes emissions are an annual average.

XIV. Recommendations to Improve Methods/Data

A. Determine any use of manure of animal waste fertilizer slurry and include in the inventory.

B. Update the local information on fertilizer use in each county on a regular basis.

C. Develop local information on the application methods that alter the emissions rate characteristics (are fields plowed immediately after application, etc.)

XV. Additional Information/Guidance:

EPA Contact: Mr. Dallas Safriet, MD-14
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Ammonia Emission Factors Report
www.epa.gov/ttn/chief/efdocs/ammonia.pdf

Carnegie Mellon University Ammonia Emissions Model
http://www.cmu.edu/ammonia/

Commercial Fertilizers Database
Association of American Plant Food Control Officials (AAPFCO) at www.aapfco.org . AAPFCO sells the electronic databases for $150 per year for the prior two fertilizer years and $50 per year for all other years from 1985.

NEI Methodology Description:
www.epa.gov/ttn/chief//publications.html#reports (Section 4.8.1.3.4, page 4-248)

XVI. References:

Asman, William, A.H., *Ammonia Emissions in Europe: Updated Emission and Emission Variations,* National Institute of Public Health and Environmental Protection, Biltoven, The Netherlands, May 1992.

U.S. Environmental Protection Agency. *Documentation for Version 2 of the 1999 NEI for Criteria Air Pollutants, Area Sources*, November 2002.

Battye, R., Battye W., Overcash, C., and Fudge S. *Development and Selection of Ammonia Emission Factors.* Final report prepared for U.S. Environmental Protection Agency, 1994.

European Environment Agency, *Joint EMEP/CORINAIR Atmospheric Emission Invntory Guidebook,* Third Edition. Copenhagen: European Environment Agency, 2001.

Lake Michigan Air Directors Consortium (LADCO), *Recommended Improvements to the CMU Ammonia Emission Inventory Model for Use by LADCO,* prepared by Sonoma Technology, Inc., March, 2003.