

**Open Burning Residential Household and Yard Waste Area Source Category
Calculation Methodology Sheet**

<u>I. Source Category:</u> Household Waste Burning	<u>II. SCC:</u> 2610030000
Yard Waste Burning – Leaves	2610000100
Yard Waste Burning – Brush	2610000400 and 2610040400

III. Pollutants: PM₁₀ and PM_{2.5}

IV. Description:

This document describes the methodology to be used to calculate emissions of particulate matter with an aerodynamic diameter of less than or equal to 2.5 microns (PM_{2.5}) and particulate matter with an aerodynamic diameter of less than or equal to 10 microns (PM_{2.5}) from Open Burning Residential Household and Yard Waste activities.

V. Current Methodology:

Emissions from this category were estimated in a survey on the MANE-VU region conducted by E.H. Pechan and Associates (MANE-VU, 2003). The purpose of the survey was to obtain data for developing activity estimates and control information that would form the basis of an improved open burning emission inventory for MANE-VU.

VI. Emission Calculation:

A. Emission Rate

a. Emission Rate of all Pollutants

i. Equation for Emissions of PM₁₀ and PM_{2.5}

$$W_t = (HH * B_t * M) * EF_i * F$$

ii. Variables

- W_t. Emissions of waste burned per time period (lbs)
- HH. Number of households that burn
- B_t. Number of burns per time period
- M. Mass of waste per burn (tons)
- EF_(i). Emission factor in lbs per ton waste

Recommended Emission Factors for Household Waste Burning			
Pollutant	Emission Factor	Units	Source
PM ₁₀	38	lbs/ton mass burned	EPA, 1997

PM _{2.5}	34.8	lb/ton mass burned	EPA, 1997
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Recommended Emission Factors for Yard Waste Burning – Leaves			
Pollutant	Emission Factor	Units	Source
PM ₁₀	22	lbs/ton mass burned	Hayes et al, 2002
PM _{2.5}	22	lb/ton mass burned	Hayes et al, 2002

Recommended Emission Factors for Yard Waste Burning – Brush			
Pollutant	Emission Factor	Units	Source
PM ₁₀	19.73	lbs/ton mass burned	EPA, 1996
PM _{2.5}	15.21	lb/ton mass burned	EPA, 1996

- F. Fraction of material actually burned. The total waste mass must be adjusted by the fraction of waste that actually burned prior to multiplying by the emission factor to estimate emissions. In 1997 EPA Developed the following values for the average fraction of waste burned.

Activity	Average Fraction of Waste Burned
Household Waste Burning	0.491
Yard Waste Burning – Leaves	0.936
Yard Waste Burning – Brush	0.936

VII. Point Source Adjustments:

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

VIII. Adjustments for Controls:

If an area has controls or prohibitions on residential burning, controlled emissions are calculated using the following method:

A. Equation

$$E_c = E_{uc} * [1-(CE)(RP)(RE)]$$

B. Variables

- E_c. Controlled area source emissions
- E_{uc}. Uncontrolled area source emissions
- CE. Percent Control Efficiency/100

- RP. Percent Rule Penetration/100
- RE. Percent Rule effectiveness/100

IX. Spatial Adjustments:

The data from the MANE-VU open burning survey (MANE-VU, 2003) is at county-level so no allocations are needed.

X. Temporal Adjustments:

Leave burning is expected to occur only in the fall, while yard waste and household hazardous waste burning are expected to fluctuate monthly. The monthly, weekly, weekday, and weekend day temporal allocations can be found in an open burning survey performed for the MANE-VU region (MANE-VU, 2003).

XI. Assumptions:

The effectiveness of the survey hinges on the fact that respondents represented typical open burners in the region, and a large enough sample was used.

XII. Rule Effectiveness:

Many localities within MANE-VU have rules restricting open burning. In MANE-VU's open burning survey (MANE-VU, 2003), rule effectiveness was measured and applied to the inventory using the following equation:

$$RE = N_H * F_H$$

Where,

RE = Rule Effectiveness

N_H = Number of households violating the open burning rules

F_H = Fraction of households performing open burning and houses in the region

XIII. Uncertainties/Shortcomings of Methodology

The MANE-VU funded survey to improve the Open Burning Activity information eliminated previous uncertainties in the methodology.

XIV. Recommendations to Improve Methods/Data

The MANE-VU funded survey to improve the Open Burning Activity information improved the accuracy of the methodology as recommended by EPA.

XV. Additional Information/Guidance:

EPA Contact: Mr. Roy Huntley, MD-14
 Emission Factor and Inventory Group
 E-mail: Huntley.roy@epa.gov
 Telephone: 919-541-1060

MANE-VU report, "Open Burning in Residential Areas, Emissions Inventory Development Report"

www.marama.org/visibility/

Characterization of Municipal Solid Waste in the U.S. 1998

www.epa.gov/epaoswer/non-hw/muncpl/msw98.htm

AP-42, Section 2.5

www.epa.gov/ttn/chief/ap42/ch02/final/c02s05.pdf

NEI Methodology Description:

www.epa.gov/ttn/chief/publications.html#reports (section 4.4.9.6.1, page 4-129) Note: This document is currently being revised.

EIIP Document on Open Burning

www.epa.gov/ttn/chief/eiip/techreport/volume03/iii16.pdf

EIIP Document on Conducting Surveys

www.epa.gov/ttn/chief/eiip/techreport/volume03/iii24.pdf

Biogenic Emissions Inventory Systems

www.epa.gov/ttnchie1/emch/models/beis/index.html

XVI. References:

Emission Inventory Improvement Program, EIIP Document Series - Volume IX, Residential Yard Waste Burning – Leaves

<http://www.epa.gov/ttn/chief/eiip/techreport/volume09/leaves3.pdf>

Emission Inventory Improvement Program, EIIP Document Series - Volume IX, Residential Yard Waste Open Burning

<http://www.epa.gov/ttn/chief/eiip/techreport/volume09/opnres3.pdf>

Hays, M.D., C.D. Geron, K.J. Linna, N.D. Smith and J.J. Shauer, “Speciation of Gas-Phase and Fine Particle Emissions from Burning of Foliar Fuels,” *Environmental Science & Technology*, Volume 36, Number 11, 2002.

MANE-VU, *Open Burning in Residential Areas, Emissions Inventory Development Report*, prepared by E.H. Pechan and Associates, Inc., January, 2003.

U.S. Environmental Protection Agency, *Evaluation of Emissions from the Open Burning of Household Waste in Barrels*, EPA-600/R-97-134a, 1997.

U.S. Environmental Protection Agency, *Evaluation of Emissions from the Open Burning on Land-Clearing Debris*, Final Report, EPA-600/r-96-128, October 1996.