

Open Burning – Land Clearing Debris Area Source Category Calculation **Methodology Sheet**

I. Source Category: Open Burning – Land Clearing Debris

II. Pollutants: VOC, NO_x, SO_x, CO, PM₁₀ and PM_{2.5}

III. SCC: 2610000500

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}), particulate matter with an aerodynamic diameter of less than or equal to 10 microns (PM₁₀), volatile organic compounds (VOC), Nitrogen oxides (NO_x), Carbon monoxide (CO) and Sulfur oxides (SO_x) from open burning of land clearing debris.

V. Current Methodology:

Open burning is the unconfined burning of wood, leaves, land clearing debris, household waste, and agricultural crop waste. Land clearing debris refers to the clearing of land for new construction and the burning of organic material (i.e., trees, shrubs and other vegetation). The clearing of land for the construction of new buildings and highways often results in debris consisting of trees, shrubs, and brush. This debris may be burned in place but it is usually collected in piles for burning. The burning of land clearing wastes may be practiced by private individuals, corporations, and government agencies (e.g., highway construction department). There are no federal laws restricting the open burning of land clearing wastes, although state or local laws may exist.

The number of acres distributed by residential, non-residential and roadway construction are estimated and then these values are added together to obtain a county-level estimate of total acres disturbed by land-clearing. County-level emissions from land clearing debris are then calculated by multiplying the total acres disturbed by construction by a weighted loading factor and emission factor.

The BELD3 database in BEIS was used to determine the number of acres of hardwoods, soft woods, and grasses in each county. Acreage loading factors were weighted according the percent contribution of each type of vegetation class to the total land area for each county. The loading factors for slash hardwood and slash softwood were further adjusted by a factor of 1.5 to account for the mass of tree that is below the soil surface that would also be subject to burning once the land is cleared. Apply weighted county loading factor to number of acres disturbed by land clearing activities to estimate the amount of material or fuel subject to burning.

This source is now included in the EPA Area Source Emissions Model (ASEM).

VI. Emission Calculation:

A. Annual Emissions

1. Calculate County-specific Fuel Loading factor

a. Equation:

$$FL_{CO} = \left[\frac{ACRES_{HW-CO-j}}{ACRES_{TOTAL-CO-j}} * FL_{HW} \right] + \left[\frac{ACRES_{SW-CO-j}}{ACRES_{TOTAL-CO-j}} * FL_{SW} \right] + \left[\frac{ACRES_{GRASS-CO-j}}{ACRES_{TOTAL-CO-j}} * FL_{GRASS} \right]$$

b. Variables:

- FL_{CO}. County-specific Fuel Loading factor
- ACRES_{HW-CO-j}. Acres of hardwood in county j (BELD database)
- ACRES_{SW-CO-j}. Acres of softwood in county j (BELD database)
- ACRES_{GRASS-CO-j}. Acres of grass in county j (BELD database)
- ACRES_{TOTAL-CO-j}. Total areage in county j (BELD database)
- FL_{xx}. Average fuel loading factors specific to vegetation. Average loading factors from EIIP Chapter 16 – Open Burning are as follows:

EIIP Chapter 16 – Open Burning (Revised Final January 2001)		
Table 16.4-6: Fuel Loading Factors – For Land Clearing Debris		
Source	Debris Type	Fuel Loading Factor (tons/acre)
AP-42; Ward. et al..1989	Hardwood slash	66
	Long-needle pine slash	21
	Mixed conifer slash	54
IPCC, 1994	Grasslands	4.5

Adjusted average loading factors are as follows:

Fuel Type	Fuel Loading (tons/acre)
Hardwood	99 = 66 * 1.5
Softwood	57 = [(54 + 21)/2] * 1.5
Grass	4.5

2. Calculate Annual emissions from open burning

a. Equation:

$$E_{OB-LCD-ANN} = \frac{AD_{R,C,RC} * FL_{CO} * EF_{OB-i}}{2000}$$

b. Variables:

- E_{OB-ANN} . Annual emissions from open burning
- $AD_{R,C,RC}$. Acres Disturbed (Total for residential, commercial and road construction)
- FL_{CO} . County-specific Fuel Loading factor
- EF_{OB-i} . Open burning emission factor for pollutant i in lbs. / ton.
Emissions factors for VOC, NO_x, CO, SO₂, PM₁₀ and PM_{2.5} obtained from AP-42 Table 2.5-1, Emission Factors for Open Burning of Municipal Refuse:

Pollutant	Emission Factor (Lbs./ ton)	Source of Data
VOC	18	AP-42 Table 2.5-5
CO	140	AP-42 Table 2.5-5
PM ₁₀	17	AP-42 Table 2.5-5
PM _{2.5}	17	AP-42 Table 2.5-5
NO _x	4.0	AP-42 Chapter 13.1, Wildfires and Prescribed Burning, Example on Page 13.1-3
SO _x	Negligible	AP-42 Chapter 13.1, Wildfires and Prescribed Burning, Example on Page 13.1-3

B. Ozone Season Daily Emissions

Ozone Season Daily (OSD) emissions calculated by multiplying annual emissions by 0.25 then dividing by 92.

1. Equations:

$$E_{OB-LCD-DAY} = \frac{E_{OB-LCD-ANN} * \frac{P_{SEASON-j}}{P_{ANNUAL-j}}}{92}$$

2. Variables:

- a. $E_{OB-LCD-DAY}$. Ozone season daily emissions from open burning of land clearing debris
- b. $P_{SEASON-j}$. Open burning permits issued seasonally in County j
- c. $P_{ANNUAL-j}$. Open burning permits issued annually in County j
- d. 92. Days in the ozone season (June through August)

C. 1999 Sample Calculation (Allegany County, Maryland)

1. Annual Emissions Estimate:

a. County-specific Fuel Loading Factor Calculation:

$$FL_{CO} = \left[\frac{ACRES_{HW - CO - j}}{ACRES_{TOTAL - CO - j}} * FL_{HW} \right] + \left[\frac{ACRES_{SW - CO - j}}{ACRES_{TOTAL - CO - j}} * FL_{SW} \right] + \left[\frac{ACRES_{GRASS - CO - j}}{ACRES_{TOTAL - CO - j}} * FL_{GRASS} \right]$$

$$FL_{CO} = \left[\frac{197,120.5}{273,331.07} * 99 \right] + \left[\frac{10,964.42}{273,331.07} * 57 \right] + \left[\frac{741.31}{273,331.07} * 4.5 \right]$$

$$FL_{CO} = 73.7 \text{ tons/acre}$$

b. Total Acres-disturbed in County Calculation:

$$AD_{R,C,RC} = AD_{ResidentialConstruction} + AD_{CommercialConstruction} + AD_{RoadConstruction}$$

$$AD_{R,C,RC} = 28.93 + 78.09 + 53.82$$

$$AD_{R,C,RC} = 160.83$$

c. Emission Calculation:

$$E_{OB - LCD - ANN} = \frac{AD_{R,C,RC} * FL_{CO} * EF_{OB - i}}{2000}$$

$$E_{OB - LCD - ANN} = \frac{160.83 * 73.7 * 17}{2000}$$

$$E_{OB - LCD - ANN} = 100.75 \text{ tons PM}_{10} \text{ per year in Allegany County}$$

2. Ozone Season Daily Emission Estimate:

$$E_{OB - LCD - OSD} = \frac{E_{OB - LCD - ANN} * \frac{Permits_{Season - j}}{Permits_{Annual - j}}}{92}$$

$$E_{OB - LCD - OSD} = \frac{100.75 * \frac{378}{4582}}{92}$$

$$E_{OB - LCD - OSD} = 0.09 \text{ tons PM}_{10} / \text{ ozone season day from open burning of land clearing debris in Allegany County.}$$

VII. Point Source Adjustments:

Emissions for this source category have not been reported in the point source inventory, therefore no adjustment of the area source emissions is required.

VIII. Adjustments for Controls:

No controls are available for this source category.

IX. Spatial Adjustments:

Seasonal/monthly variations in open burning of land clearing debris can be determined by a survey of permits issued.

X. Temporal Adjustments:

Data for temporal allocation is not available for this source.

XI. Assumptions:

- A. National estimate of housing permit data and housing stats (Census)
- B. National estimate of acres cleared per housing unit type (earlier work by MRI)
- C. National estimate of 1.6 acres disturbed per \$1 million spent on non-residential construction (Census)
- D. Since average land cover was assumed, no consideration of the particular land cover type for any particular construction activity.
- E. All acreage from residential construction is assumed to be cleared and all debris burned.
- F. Emissions from road clearing projects were based largely on the cost of road construction obtained from the NCDOT (North Carolina Department of Transportation)

XII. Rule Effectiveness:

Any rules regulating emissions (such as burning bans) or requiring permits may affect this source category.

XIII. Uncertainties/Shortcomings of Methodology

- A. EPA uses an average of the vegetation type (from BELD3) in each county to determine fuel loading. Obviously the fuel loading for any specific project will be different from the county average.
- B. EPA assumes that all debris is burned.
- C. Similarly, EPA uses a single estimate of 1.6 acres of land disturbed per 10⁶ dollars spent for all commercial/industrial construction. It is likely that this number varies significantly depending on the type of structure and area of the country where the construction is taking place.
- D. EPA based the emission estimates for road clearing largely on the cost of road construction obtained from the North Carolina Department of Transportation. These estimates are used for the entire country, even though labor costs, land costs, and costs to prepare the road bed in different types of terrain vary significantly in different locations.

XIV. Recommendations to Improve Methods/Data

- A. The use of local information on the amount and type of biomass per acre in specific areas, and local information on how much of the land clearing debris that is actually burned would significantly improve this methodology (Air Agency or local planning agencies)
- B. Estimates of specific counties with burning bans, and specification of counties where wastes are burned (Air Agency/Solid Waste Management Organization)
- C. State estimates used to determine costs and corresponding size of road and non-residential construction projects (State Department of Transportation, Development or Commerce Agencies)

XV. Additional Information/Guidance:

EPA Contact: Mr. Roy Huntley
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AP-42, Section 2.5:

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

Area Source Emissions Model:

www.epa.gov/ttn/chief/software/asem/index.html

Biogenic Emissions Inventory System:

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

County Level Emission Density Maps:

www.epa.gov/ttn/chief/eiip/pm25inventory/densitymaps.pdf

EIIP Document on Conducting Surveys:

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

EIIP Document on Open Burning:

www.epa.gov/ttn/chief/eiip/techreport/volume03/iii16_apr2001.pdf

NEI Inventory Methodology Description:

<ftp://ftp.epa.gov/EmisInventory/finalnei99ver2/criteria/>

XVI. References:

AP42 Section 2.5, "Open Burning," Environmental Protection Agency, October 1992.

Emission Inventory Improvement Program (EIIP) Chapter 16 – Open Burning January 2001) Environmental Protection Agency, January 2001.

Emission Inventory Improvement Program, EIIP Document Series - Volume IX,
Particulate Emissions, Construction Land Clearing Waste Burning
<http://www.epa.gov/ttn/chief/eiip/techreport/volume09/conbrn3.pdf>

Maryland Department of the Environment, *Calculation Methodologies (draft)*, June 2002.

U.S. Environmental Protection Agency. *Current Methods Used to Estimate Emissions, 1985-1999* Procedures Document for National Emission Inventory, Criteria Air Pollutants 1985-1999, March 2001, EPA-454/R-01-006.