Introduction to EPA’s Quantitative PM Hot-spot Analysis Conformity Guidance

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Overview

- Transportation conformity basics for PM hot-spot analyses

- Overview of EPA’s quantitative PM hot-spot analysis guidance
  - Additional focus on using AERMOD for analyses

- Upcoming training opportunities
Statutory and Regulatory Requirements

- CAA section 176(c) requires that federally supported transportation projects in nonattainment and maintenance areas cannot:
  - Cause or contribute to new air quality violations,
  - Worsen existing violations, or
  - Delay timely attainment of the NAAQS or interim milestones

- Conformity rule section 93.123(b)(1) requires a PM hot-spot analysis only for projects of local air quality concern
  - Example: new or expanded highway/transit projects with a significant number of diesel vehicles
  - PM hot-spot analyses are not required for other projects
What Is a Hot-spot Analysis?

- Section 93.101 defines as an estimation of likely future localized pollutant concentrations and a comparison to the relevant NAAQS
  - This is smaller than an entire nonattainment or maintenance area

- Assesses air quality impacts in the area substantially affected by the project

- When required, included within a project-level conformity determination
What Is the Focus of a Hot-spot Analysis?
Projects Requiring a Hot-spot Analysis

- New highway projects that have a significant number of diesel vehicles, and expanded highway projects that have a significant increase in the number of diesel vehicles

- Projects affecting intersections that are at Level-of-Service D, E, or F with a significant number of diesel vehicles, or those that will change to Level-of-Service D, E, or F because of increased traffic volumes from a significant number of diesel vehicles related to the project
Projects Requiring a Hot-spot Analysis

- New bus and rail terminals and transfer points that have a significant number of diesel vehicles congregating at a single location

- Expanded bus and rail terminals and transfer points that significantly increase the number of diesel vehicles congregating at a single location

- Projects in or affecting locations, areas, or categories of sites which are identified in the PM$_{2.5}$ or PM$_{10}$ SIP (approved or adequate submitted SIP) as sites of violation or possible violation
More About Hot-spot Analyses

- PM Hot-spot Guidance focuses on refined PM hot-spot analyses, rather than screening analyses
  - Refined analyses rely on detailed local information for build and no-build scenarios
  - Much different than screening modeling for CO NAAQS

- A hot-spot analysis is a build/no-build analysis:
  - Compares AQ concentrations with the project (build scenario) to either the NAAQS or to AQ concentrations without the project (no-build scenario)

- Emissions modeling, air quality modeling, and background data are all necessary
How is Conformity Met in a Hot-spot Analysis?

Project meets conformity requirements, if at each appropriate receptor:

PM concentration of build ≤ NAAQS, or
PM concentration of build ≤ PM concentration of no-build

Example:
Conformity is met at a receptor in a 2006 24-hour PM$_{2.5}$ NAAQS area in either of these cases:

Build (with project) 34 µg/m$^3$
NAAQS: 35 µg/m$^3$

or, if:

Build (with project) 36 µg/m$^3$ (above the NAAQS)
No-build (without project) 37 µg/m$^3$
On December 20, 2010, EPA announced in the Federal Register the release of two technical guidance documents:

- *Transportation Conformity Guidance for Quantitative Hot-spot Analyses in PM\textsubscript{2.5} and PM\textsubscript{10} Nonattainment and Maintenance Areas*
- *Using MOVES in Project-Level Carbon Monoxide Analyses*
  - Supersedes the emission factor sections from EPA’s 1992 Guideline on Modeling CO from Roadway Intersections

EPA also approved MOVES2010a for use in PM and CO hot-spot analyses and EMFAC2007 for PM hot-spot analyses in California:

- 2-year conformity grace period ends December 20, 2012
Purpose of PM Hot-spot Guidance

Describe how to complete a quantitative hot-spot analysis in PM$_{2.5}$ and PM$_{10}$ nonattainment and maintenance areas for transportation conformity

1. Combine project and nearby source concentrations from air quality model
2. Combine to determine total concentrations
3. Calculate design value(s)
4. Determine conformity

Guidance Reference:
Section 1.1
Completing a PM Hot-spot Analysis

Step 1: Determine Need for Analysis

Step 2: Determine Approach, Models, and Data

Step 3: Estimate On-Road Motor Vehicle Emissions

Is project located in California?

- Yes
  - Estimate using MOVES
  - Estimate using EMFAC

- No

Step 4: Estimate Emissions from Road Dust, Construction, and Additional Sources

Step 5: Select Air Quality Model, Data Inputs, and Receptors

Step 6: Determine Background Concentrations

Step 7: Calculate Design Values and Determine Conformity

Step 8: Consider Mitigation or Control Measures

Step 9: Document Analysis

Remark: Interagency consultation process is essential throughout

PM Hot-spot Guidance, Exhibit 3-1
Step 1 and 2: Pre-Modeling Actions

- **Step 1: Determine need for analysis**
  - PM hot-spot analyses required for projects of local air quality concern only

- **Step 2: Determine approach, models, and data requirements**
  - Geographic area and emissions sources
  - General analysis approach
  - Analysis year(s)
  - PM NAAQS to be evaluated
  - Type of PM emissions to be modeled
  - Emissions and air quality models and methods to be used
  - Schedule for conducting analysis and points of consultation
Step 3 and 4: Estimate Emissions and Dust

- **Step 3**: Guidance describes how to use MOVES (EMFAC in California) to estimate the project’s PM emissions from
  - Exhaust
  - Brake wear
  - Tire wear

- **Step 4**: Guidance describes how to estimate road dust, construction, and additional sources of emissions
  - PM$_{2.5}$ areas: road dust would be estimated if SIP budgets include it (prior to SIP, if found significant)
  - PM$_{10}$ areas: road dust always estimated for hot-spot analyses
  - See guidance for additional information about methods, as well as other sources of emissions and dust
Step 5: Select Air Quality Model, Data, and Receptors

- Select an air quality model
  - Characterize emission sources
  - Obtain representative meteorological and other data
  - Specify receptors throughout project area

- Guidance consistent with how air quality modeling done for other regulatory programs
  - Relies on EPA’s “Guideline on Air Quality Models” (Appendix W to 40 CFR Part 51)
Selecting an Appropriate Air Quality Model

<table>
<thead>
<tr>
<th>Type of Project</th>
<th>Recommended Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highway and intersection projects</td>
<td>AERMOD, CAL3QHCR</td>
</tr>
<tr>
<td>Transit, freight, and other terminal projects</td>
<td>AERMOD</td>
</tr>
<tr>
<td>Projects that involve both highway/intersections and terminals, and/or nearby sources</td>
<td>AERMOD</td>
</tr>
</tbody>
</table>

- Recommendations are consistent with EPA’s current recommended models in Appendix W
- CAL3QHC is not appropriate for modeling refined PM hot-spot analyses
# How Models Represent Emissions

<table>
<thead>
<tr>
<th>Source</th>
<th>Line Source</th>
<th>Point Source</th>
<th>Area Source</th>
<th>Volume Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>AERMOD</td>
<td>√ *</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>CAL3QHCR</td>
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</tbody>
</table>

* AERMOD can simulate line sources using a series of adjacent area or volume sources
About AERMOD

- **American Meteorological Society/EPA Regulatory Model**
  » Developed by AMS/EPA Regulatory Model Improvement Committee (AERMIC)

- Models concentrations from dispersion of any primary (i.e., directly emitted) pollutant

- A steady-state Gaussian plume model

- Includes advanced dispersion science algorithms
  » How convection affects atmospheric mixing
  » Advanced handling of urban sources
  » Links winds with surrounding surfaces
About AERMOD

Key dates:

- Proposed as replacement for ISCST3 in 2000
  - Additional improvements made 2001
  - Notice of Data Availability for AERMOD issued 2003

- Promulgated as EPA’s preferred model 2005

- Latest version of AERMOD was released April 2011, found on AERMOD website along with:
  - An updated AERMOD User’s Guide Addendum, and
  - AERMOD Model Change Bulletin #5 – describes the modifications made to the model in this latest update
About AERMOD

AERMET
Processes and formats meteorology data
Generates dispersion parameters
Quality assurance of meteorology data

AERMOD
Constructs vertical profiles of wind speed & direction, turbulence, temp., temp. gradient
Predicts concentrations

Surface characteristics
Emissions and source characteristics

Surface data
Upper air data

Receptor concentrations
Receptor locations

AERMAP – a preprocessor used for elevated sources in complex terrain; not relevant for most hot-spot analyses
Obtaining representative met data is a critical component of PM hot-spot analyses.

AERMOD can process 5 years of met data in a single run.

- Guidance specifies 5 years of met data, consistent with 40 CFR Part 51, Appendix W, when off-site data is used (one year if site-specific data is used).

Project sponsors will most likely obtain representative pre-processed met data from state or local air agencies.
**Steps to Using AERMOD**

**General steps…**

1. **Step 1** Create an AERMOD input file to describe the run
2. **Step 2** Rename the input file as “AERMOD.inp” and run AERMOD
3. **Step 3** Get results in a file called “AERMOD.out”

- User creates an input file describing the pollutant, emission sources, receptors, meteorology, etc.

- User can specify output type based on NAAQS being evaluated
In an AERMOD input file, users need to specify coordinates (x, y, and optional z) for:

- Where *emissions* are occurring, i.e., the user defines the locations of emission sources, and
- Where AERMOD should look at *concentrations*, i.e., the user defines the locations of receptors

Coordinates can be defined arbitrarily or with pre-defined grid
- e.g., Universal Transverse Mercator (UTM) coordinate system
Emission sources in AERMOD are based on links defined for MOVES

- For MOVES, links are defined based on differences in activity: operating modes, speeds, volumes
- Each link will have a unique emissions rate, and will thus be at least one source in AERMOD
  - E.g., 3 links defined for an intersection in MOVES would need to be at least 3 different sources in AERMOD

- Curved MOVES links will need to be modeled as more than one AERMOD source
Representing Roads in AERMOD

For modeling purposes, the *road* can be considered the source, rather than the vehicles

» Given turbulence created by vehicles, convection created by the road heating up, and other phenomena

A road is a **line source**: 

That can be modeled as a series of **area sources**: 

Or as a series of **volume sources**: 

[Diagram of a road as a line source, area sources, and volume sources]
AERMOD can produce output files in multiple formats. Below, a RECTABLE shows the highest 24-hour concentrations for all receptors in a grid.
More Information About AERMOD

- Guidance provides additional details on AERMOD inputs

- 3-day training on PM hot-spot guidance extensively covers developing inputs and running AERMOD for these analyses
  » Details later

- AERMOD model, user guide, and technical guidance can be found on EPA’s SCRAM website: [www.epa.gov/scram001/](http://www.epa.gov/scram001/)
“Background” includes sources not from the project that affect concentrations in the project area

» In general, nearby sources would be modeled only when affected by the project
» Impacts of other sources captured by background concentrations

Sources for background data:

» Representative AQ monitoring data from one or more AQ monitors – most likely source
» Chemical Transport Model (CTM) data/output
» Section 93.123(c)(2) method (for limited cases in \( PM_{10} \) areas)
» Other options as approved by EPA
Step 7: Calculating Design Values and Determining Conformity

- For conformity purposes, a “design value” is a statistic that describes future air quality concentrations in the project area that can be compared to a particular NAAQS.

- Each NAAQS calculates design values differently.

**Completed in Steps 1-5**

- Project and nearby source concentrations from air quality model

**Completed in Step 6**

- Background concentrations

**Completed in Step 6**

- Combine to determine total concentrations

**Calculate design value(s)**

**Determine conformity**

Guidance Reference: Section 3.8 & 9
Steps 8 & 9: Mitigation and Documentation

● Step 8: Consider mitigation and control measures
  » If necessary, can be considered at any point in an analysis
  » Guidance includes list of potential measures and where to go for details

● Step 9: Document the PM hot-spot analysis
  » Documentation should be sufficient to show project meets conformity rule hot-spot requirements
  » Guidance includes list of aspects of the analysis that should be documented
Guidance Appendices

- App. A: Clearinghouse of resources for PM hot-spot analyses
- App. B: Examples of projects of local air quality concern
- App. C: Projects needing analyses in certain PM$_{10}$ areas
- App. D: Characterizing intersection links for MOVES
- App. E/F: Abbreviated PM hot-spot analysis examples (using MOVES) for a highway and transit project
- App. G/H: Examples of how to configure and run EMFAC for a highway and transit project
- App. I: Estimating locomotive emissions
- App. J: Air quality modeling inputs and other details
- App. K: Examples of calculating design values
Upcoming Training: 3-Day Course

- EPA and DOT have developed a 3-day course on completing a quantitative PM hot-spot analysis using the guidance.

- Technical, hands-on course focused on modeling:
  - MOVES2010a at the project scale (EMFAC2007 in Calif.)
  - AERMOD
  - CAL3QHCR

- Course includes:
  - Additional tools and tips (e.g., a design value conformity tool)
  - Simple, hands-on exercises
  - A comprehensive class project demonstrating how the guidance and models would be used in practice
Upcoming Training: 3-Day Course

- See EPA’s website for details and scheduled dates & locations: [www.epa.gov/otaq/stateresources/transconf/training.htm](http://www.epa.gov/otaq/stateresources/transconf/training.htm)
  - Columbus (July 26-28)
  - Seattle (Aug. 2-4)
  - Newark (Aug. 16-18)
  - Sacramento (Sept. 19-21)  Note: EMFAC taught instead of MOVES
  - Atlanta (Sept. 13-15)
  - Baltimore (TBD)

- Other future dates & locations
  - Email us at Conformity-hotspot@epa.gov with potential training locations
  - Contact Meg Patulski at (734) 214-4842 or patulski.meg@epa.gov
Course Outline – Day 1

Module 1: Overview of PM Hot-Spot Analysis Requirements and Process

Module 2: Using MOVES at the Project Level

Begin the class project (example) using MOVES
Course Outline – Day 2

**Module 3**: Selecting an Air Quality Model, Data Inputs, and Receptors

**Module 4**: Using AERMOD for PM Hot-Spot Analyses

Continue the *class project* using AERMOD
Course Outline – Day 3

**Module 5**: Using CAL3QHCR for PM hot-spot analyses (continue the *class project*)

**Module 6**: Determining Background Concentrations

**Module 7**: Calculating Design Values and Determining Conformity

Calculate design values for the *class project*
For More Information

- See EPA’s conformity website for:
  - Regulations, policy guidance, FR notices, training
  - [http://www.epa.gov/otaq/stateresources/transconf/policy.htm#project](http://www.epa.gov/otaq/stateresources/transconf/policy.htm#project)

- See EPA’s MOVES website for:
  - Software, MOVES MySQL scripts, technical documentation, and other helpful background materials
  - [www.epa.gov/otaq/models/moves/](http://www.epa.gov/otaq/models/moves/)

- Questions?
  - General questions on PM hot-spot guidance
    - patulski.meg@epa.gov
  - General questions on CO project-level MOVES guidance
    - bizot.david@epa.gov
  - Technical questions about both guidance documents:
    - conformity-hotspot@epa.gov