
Guidance on Quantitative PM Hot-spot Analyses for Transportation Conformity

U.S. Environmental Protection Agency

February 9, 2011

Welcome

- EPA's Office of Transportation and Air Quality is holding today's webinar
- Purpose of today's webinar is to provide an overview of EPA's quantitative PM hot-spot guidance
- Today's presenters are:
 - » Meg Patulski
 - » David Bizot
 - » Chris Dresser
 - » Chad Bailey
 - » Gary Dolce
 - » Laura Berry

Coordination on Guidance Development

- Several EPA offices, FHWA, and FTA
- CARB and Caltrans for EMFAC section
- Draft PM hot-spot guidance released for public comment May 26, 2010
 - » EPA received 15 sets of comments
- Guidance is consistent with existing regulations and guidance for conformity, the PM NAAQS, SIPs, and other regulatory programs

Webinar Outline

1. Background
2. Overview of guidance
3. Abbreviated PM hot-spot analysis example
4. Outreach and training

Webinar Logistics

- Please use “question box” on your control panel to send your questions
 - » We’ll pause periodically during the webinar to answer them
- During this webinar, we’ll conduct a few polls
 - » Please participate

Attendee Control Panel

My Details

Shows the attendee name and Satisfaction Rating. Attendees can change their Satisfaction Rating by clicking on the drop-down arrow

Webinar Info

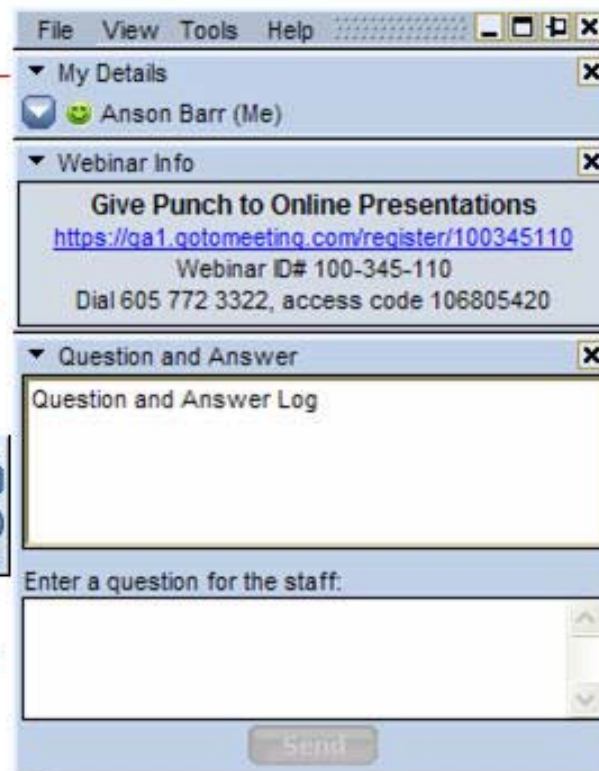
Provided for quick reference

Grab Tab

Enables attendees to minimize the Control Panel to the side of their desktops and still access Viewer tools

Question and Answer

If turned on by an organizer, attendees can submit questions and review answers. Broadcast messages from an organizer will also show here



Part 1: Background

What is transportation conformity?

- 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 national ambient air quality standards or interim milestones
- Conformity rule establishes requirements for transportation plans, TIPs, and federally funded or approved projects in nonattainment and maintenance areas
 - » Some projects require a hot-spot analysis

What is a hot-spot analysis?

- An estimation of likely future localized pollutant concentrations and a comparison to the relevant NAAQS
 - » Required for certain projects in $PM_{2.5}$, PM_{10} , and CO nonattainment and maintenance areas
- Assesses air quality impacts on a scale smaller than an entire nonattainment or maintenance area
 - » The area substantially affected by the project (the “project area”)

New Guidance and Models

- EPA announced release of two technical guidance documents in the FR in December 20, 2010
 - » Quantitative PM_{2.5} and PM₁₀ hot-spot guidance
 - » Project-level CO MOVES guidance
- EPA also approved MOVES2010a for use in PM and CO hot-spot analyses; and EMFAC2007 approved for PM hot-spot analyses in CA
 - » 2-year conformity grace period ends December 20, 2012

When are quantitative PM hot-spot analyses required?

- Beginning December 20, 2012, **quantitative** PM hot-spot analyses are required
 - » Exception: a **qualitative** PM hot-spot analysis begun before December 20, 2012 can be completed
- Until December 20, 2012:
 - » Any PM hot-spot analyses required can continue to be done **qualitatively**
 - » **Quantitative** analyses can be completed, if desired
- Hot-spot analysis grace period is separate from MOVES2010 grace period for regional conformity analyses

Guidance Reference:

Section 1.2

Purpose of PM Hot-spot Guidance

- How to complete a quantitative hot-spot analysis in $PM_{2.5}$ and PM_{10} nonattainment and maintenance areas
 - » Emissions from the project and any nearby sources
 - » Background from other sources
- Addresses hot-spot analyses for the annual $PM_{2.5}$ NAAQS, the 24-hour $PM_{2.5}$ NAAQS, and the 24-hour PM_{10} NAAQS
- Does not change existing conformity requirements (e.g., what projects require a PM hot-spot analysis)

Hot-spot Analyses Are Build/No-build Analyses

- In general, a PM hot-spot analysis compares AQ concentrations **with** the proposed project (the build scenario) to AQ concentrations **without** the project (the no-build scenario)
- Build scenario cannot produce new NAAQS violations, worsen existing NAAQS violations, or delay timely attainment as compared to no-build scenario
- Project meets conformity requirements, if at each appropriate receptor:

$$\text{PM concentration of build} \leq \text{NAAQS, or} \\ \text{PM concentration of no-build}$$

- For example, conformity would be met at a receptor in a 2006 PM_{2.5} NAAQS area if:
 - » NAAQS: 35 µg/m³
 - » Build (with project) 36 µg/m³
 - » No-build (without project) 37 µg/m³

Guidance Reference:
Section 2.4

Agency Roles and Consultation

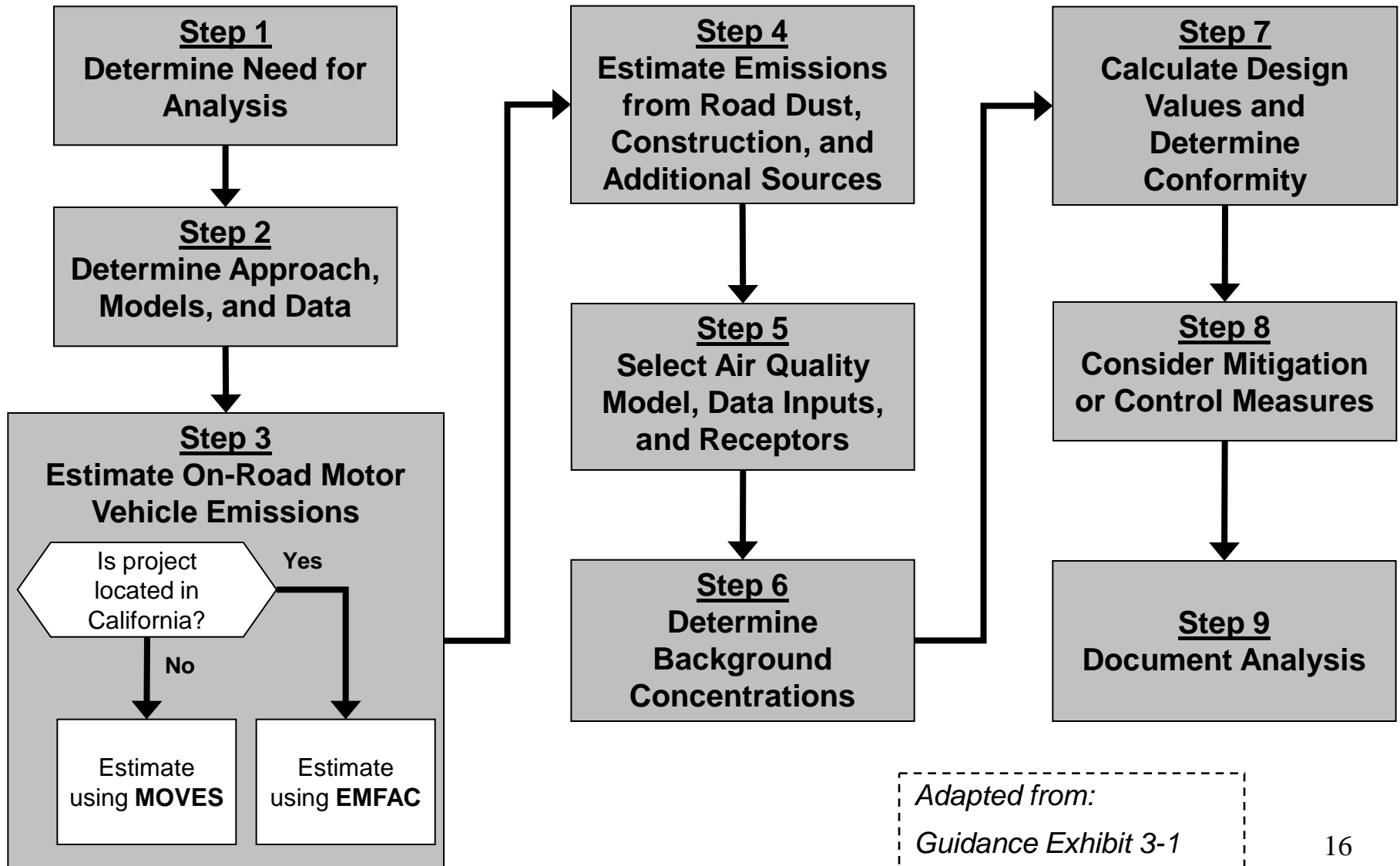
- The project sponsor (e.g., a state DOT or transit agency) is the lead agency in developing the analysis
- FHWA/FTA make the project-level conformity determination and provide technical assistance
- EPA writes the conformity regulations/guidance and provides technical assistance
- State and local AQ agencies and MPOs may provide data to be used in hot-spot analyses (varies per area)
- Agencies have discretion for how consultation can be satisfied

Guidance Reference:

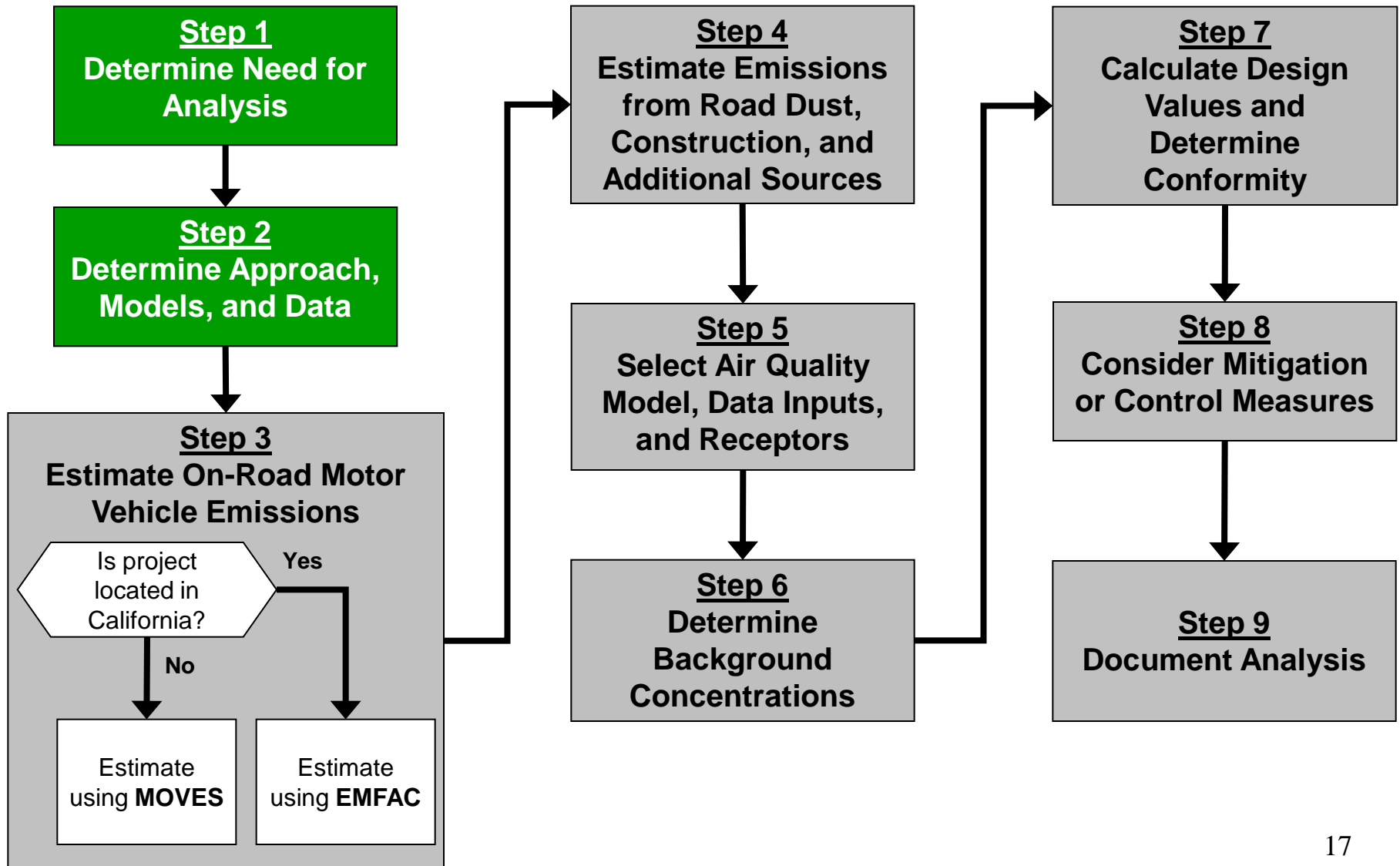
Sections 2.3 and 2.9

Part 2: Overview of Guidance

The PM Hot-spot Analysis Process



The PM Hot-spot Analysis Process



Pre-Modeling Steps

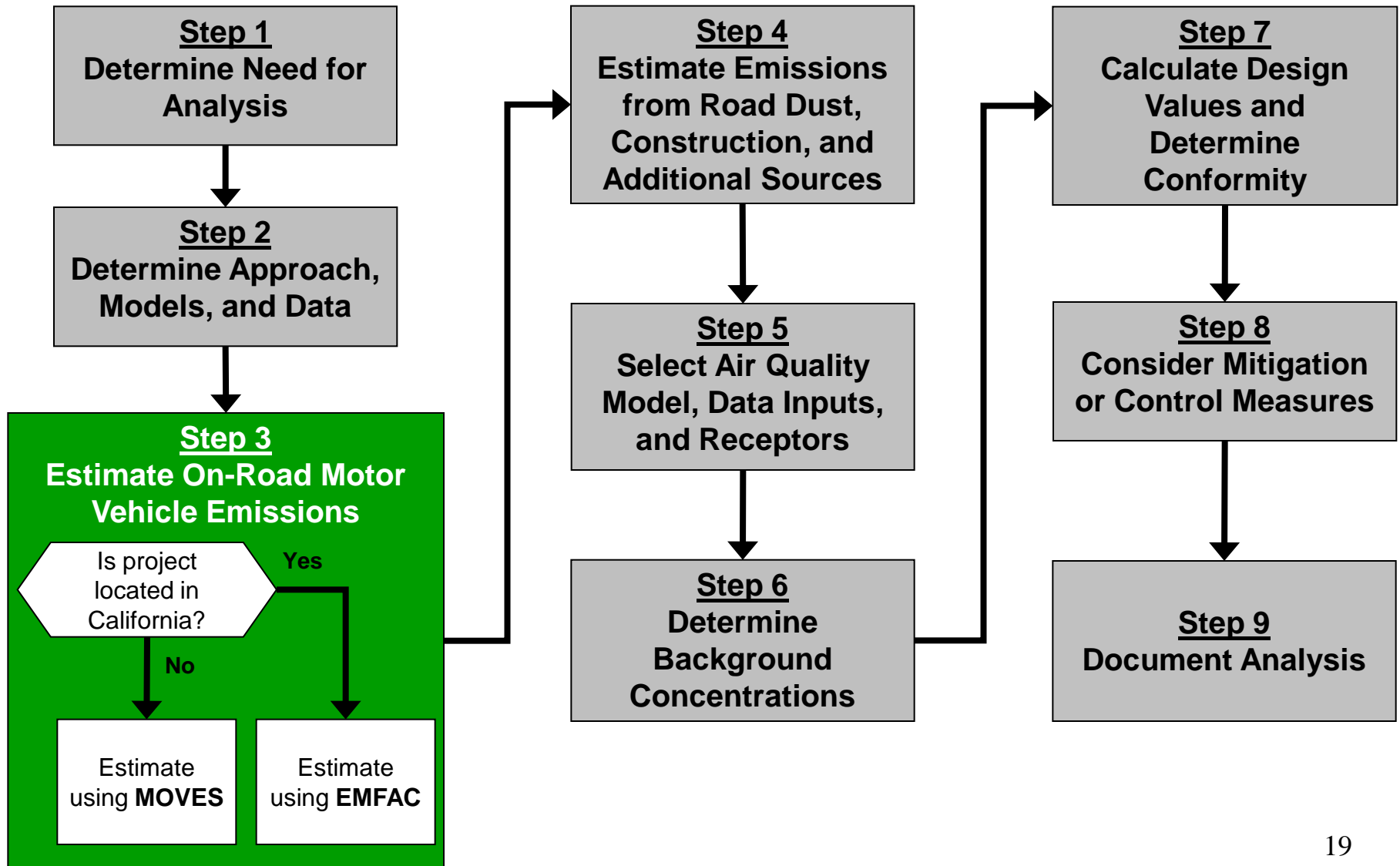
- Step 1: Determine need for analysis
 - » PM hot-spot analyses required for projects of local air quality concern only

- 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

Guidance Reference:

Sections 3.2 and 3.3

The PM Hot-spot Analysis Process



Step 3: Estimate On-road Motor Vehicle Emissions

- Guidance describes how to estimate the project's PM emissions from:
 - » Exhaust
 - » Brake wear
 - » Tire wear
- MOVES to be used in most states
- EMFAC to be used for projects in California

MOVES

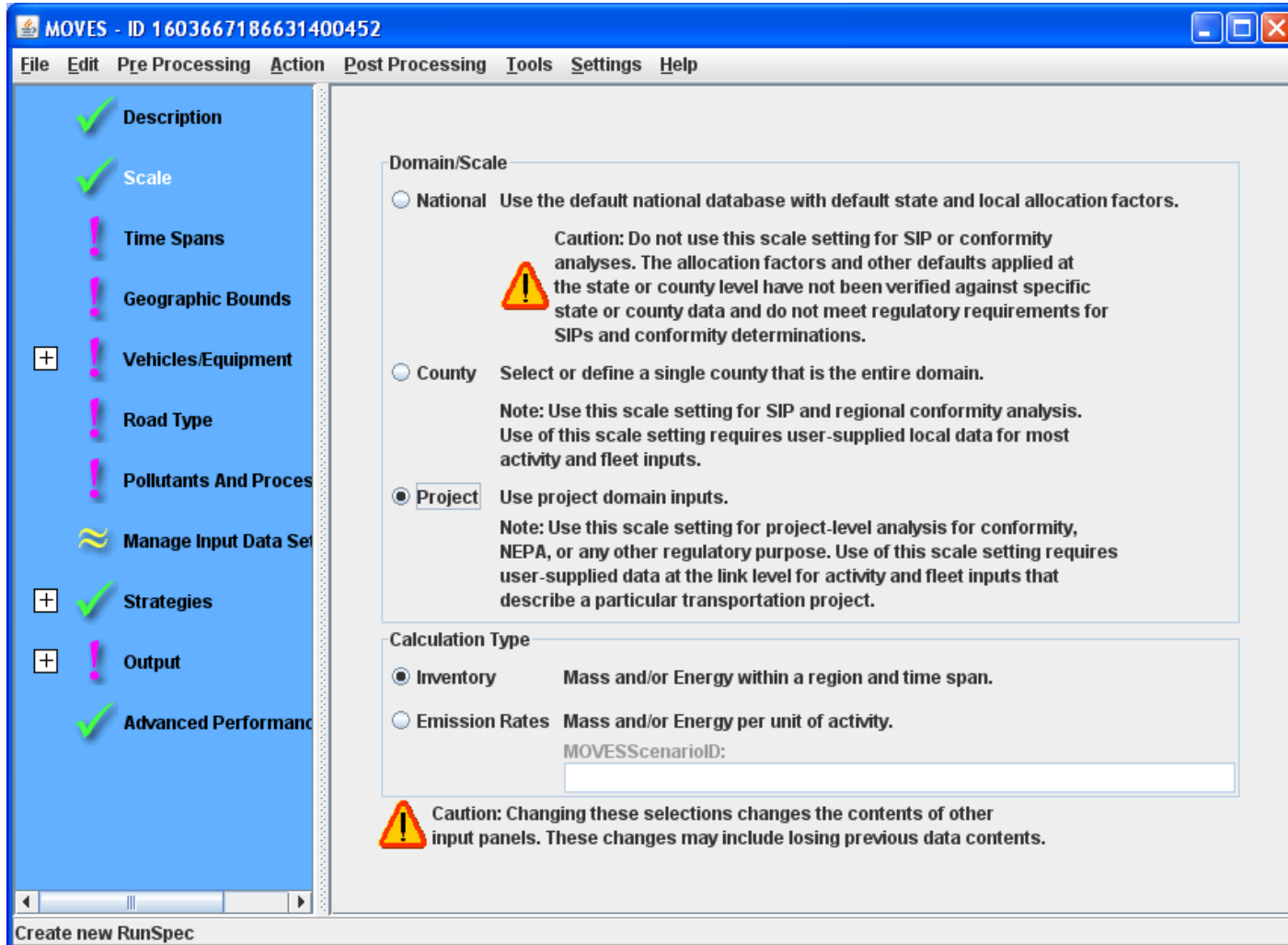
- **M**Otor **V**ehicle **E**mission **S**imulator
- State-of-the-art modeling framework
 - » Designed to allow easier incorporation of large amounts of in-use data from a variety of sources
- MOVES2010 released in December 2009

Guidance Reference:

Section 4

MOVES2010

Uses a graphical user interface (GUI):



Using MOVES for PM Hot-spot Analyses

- Offers three scales of analysis
 - » National – Uses national defaults
 - » County – Requires regional-specific data
 - » **Project** – Requires project-specific data; used for hot-spot analyses
- Users can define link level activity for both on-road and “off-network” links
 - » Quality of results depends on quality of input activity data
- Emission processes relevant for PM hot-spot analyses include running, starts, extended idling, crank case, brake wear, and tire wear

Guidance Reference:

Section 4

Using MOVES for PM Hot-spot Analyses

- A. Divide project into links to account for emissions at different locations and speeds
 - » Roadway link (highway and intersection projects)
 - » Off-network link (transit and other terminal projects)

- B. Determine number of MOVES runs
 - » In most cases, 16 runs is suggested for either build or no-build scenario
 - January, April, July, and October
 - Four weekday time periods: morning peak, midday, evening peak, and overnight
 - » Using MOVES with typical vs. additional travel activity data

- C. Generate run specification (“RunSpec”) for using MOVES at the project level

Guidance Reference:

Section 4 and Appendices D, E, F

Using MOVES for PM Hot-spot Analyses

- D. Enter project details into Project Data Manager
 - » Guidance describes when to use project-specific, regional, or default data
 - » Three options provided for describing vehicle activity (average speed, link drive schedule, and operating mode distribution)

- E. Generate emission factors for air quality modeling
 - » AERMOD (grams/hour)
 - » CAL3QHCR (grams/vehicle-mile)

Guidance Reference:

Section 4 and Appendices D, E, F

Post-Processing MOVES Output

- Results of a MOVES run are stored in database output tables
- Guidance provides instructions for post-processing by user
- EPA is also developing a way to streamline this process

MOVES Scripts for Hot-spot Analyses

- Since guidance's release, EPA has developed new MOVES "scripts" to automate post-processing of output for use in hot-spot analyses
 - » Will be released once testing complete
- Scripts simplify process and limit potential error
- Once finalized, scripts will be posted to MOVES web site:
 - » www.epa.gov/otaq/models/moves/index.htm
- Users will be able to download scripts
 - » Once saved to appropriate MOVES folder, users can execute via MOVES post-processing pull-down menu

MOVES Scripts for Hot-spot Analyses

Coming soon:

Script Name:	Produces:
"PM10 Grams Per Hour"	an EF for each link as grams/hour (AERMOD)
"PM10 Grams Per Mile"	an EF for each link as grams/veh-mile (CAL3QHCR)
"PM2.5 Grams Per Hour"	an EF for each link as grams/hour (AERMOD)
"PM2.5 Grams Per Mile"	an EF for each link as grams/veh-mile (CAL3QHCR)

Note: MOVES scripts also being developed for CO project-level analyses.

EMFAC

- California **EM**ission **FAC**tor model
- Current version: EMFAC2007
- Models PM emission rates in the “Emfac” mode for Running, Starting, and Extended Idling

Guidance Reference:

Section 5 and Appendices G, H

Using EMFAC for PM Hot-spot Analyses

- A. Divide project into links to account for emissions at different locations and speeds
 - » Roadway link (highway and intersection projects)
 - » Off-network link (transit and other terminal projects)

- B. Determine number of EMFAC runs
 - » In most cases, one run is needed per pollutant (per build or no-build scenario) unless fleet mix varies by time period

- C. Specify Basic Scenario Inputs
 - » Select geographic area, year, and determine if fleet activity varies by season or month
 - » Select annual average or develop month/season scenarios
 - » Modify vehicle classes if needed

Guidance Reference:

Section 5 and Appendices G, H

Using EMFAC for PM Hot-spot Analyses

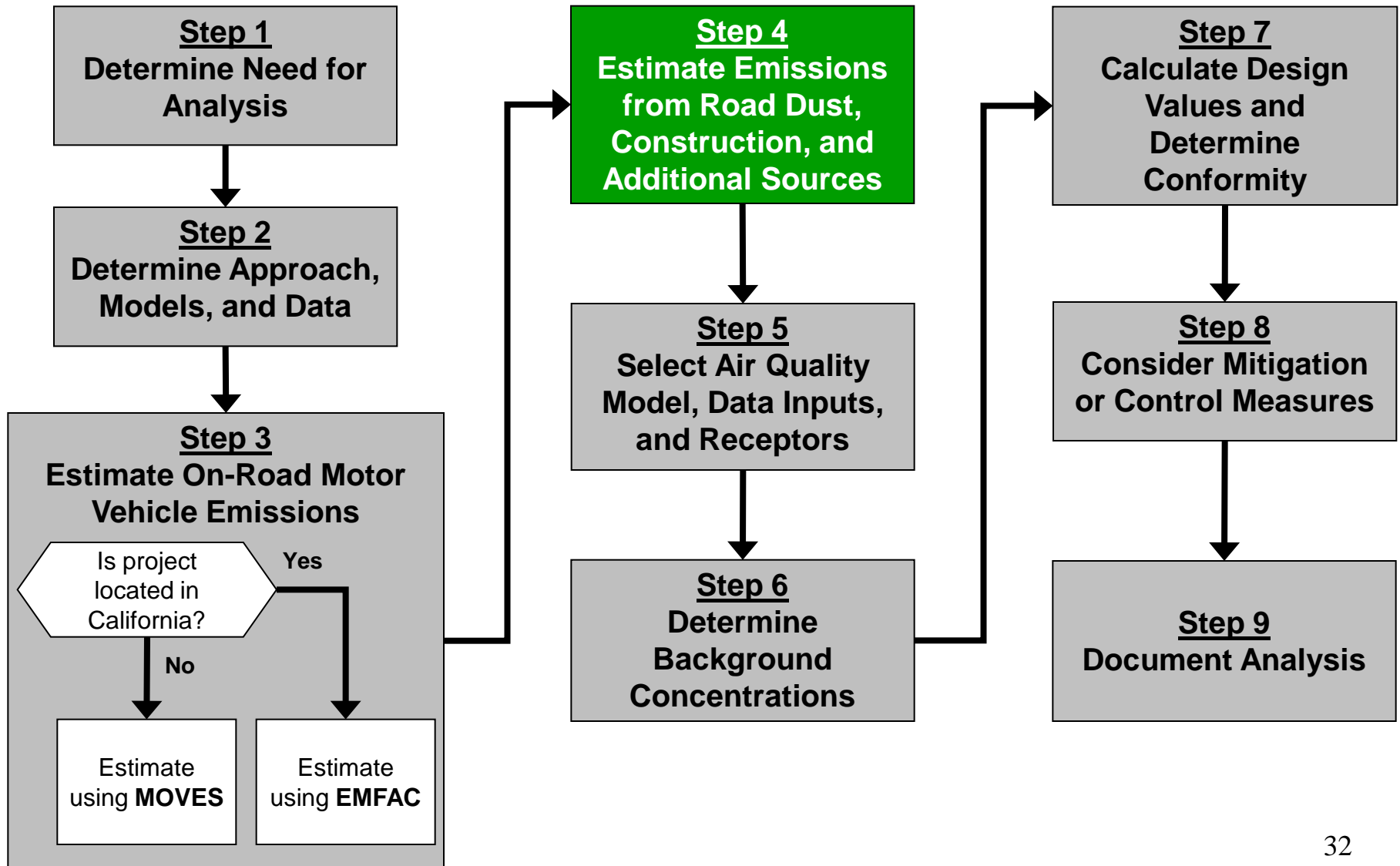
- D.** Configure emission factor outputs and edit program constants
 - » In “Emfac” mode, configure temperature, relative humidity, and speed
 - » Select output particulate and summary rate file
 - » Change distributions of VMT, trips, and vehicle population to reflect fleet mix

- E.** Generate emission factors for air quality modeling
 - » AERMOD (grams/hour)
 - » CAL3QHCR (grams/vehicle-mile)

Guidance Reference:

Section 5 and Appendices G, H

The PM Hot-spot Analysis Process



Step 4: Estimate Dust and Other Emissions

Dust:

- Road dust may need to be estimated:
 - » PM_{2.5} areas: reentrained road dust would be estimated if SIP budgets include it (prior to SIP, if found significant)
 - » PM₁₀ areas: reentrained road dust always estimated for hot-spot analyses
- Construction dust would not be estimated if considered temporary
- Use AP-42 or local methods for any dust estimates

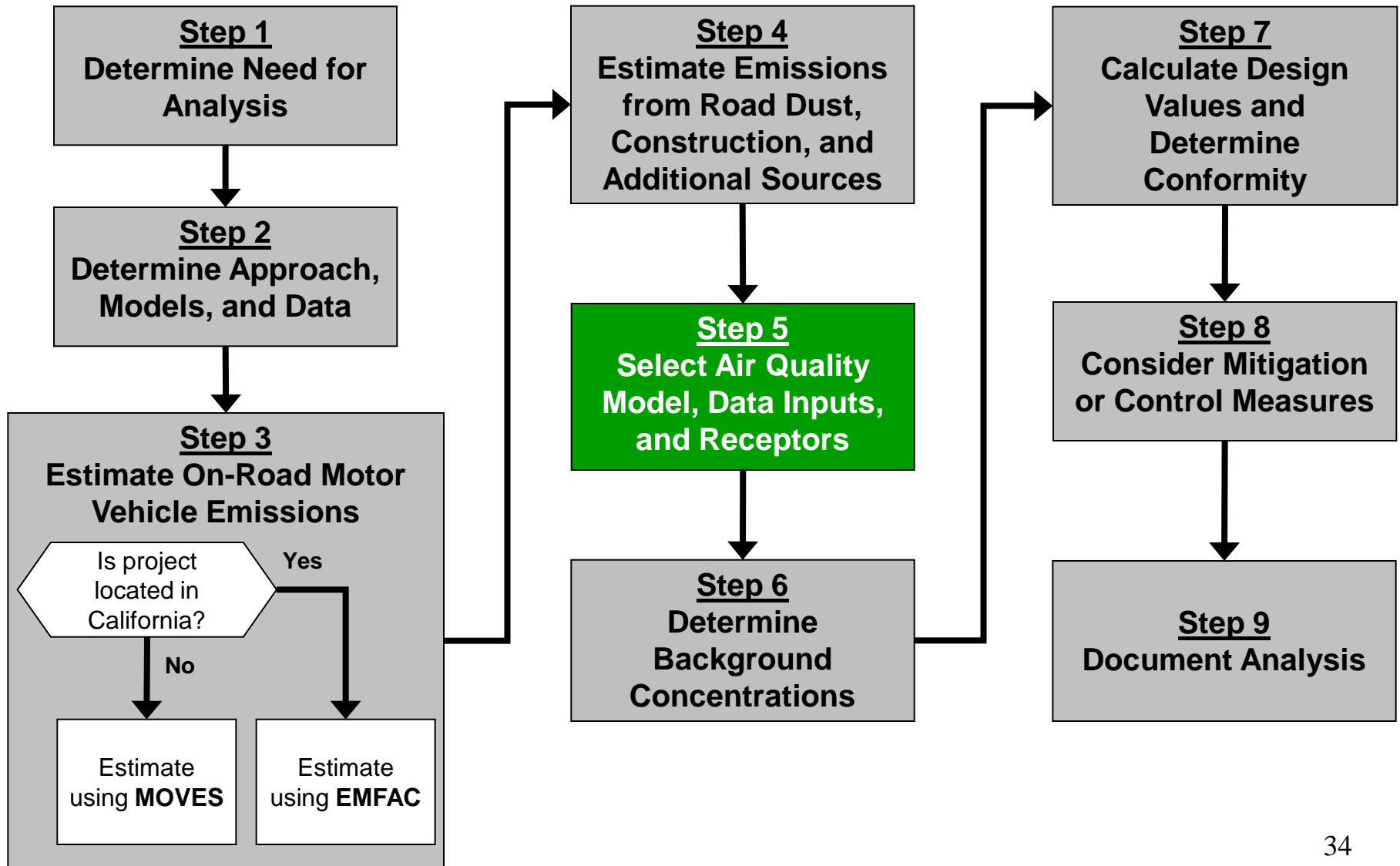
Other Emissions:

- Other emissions could include:
 - » Exhaust from construction-related vehicles and equipment
 - » Locomotive emissions from a freight rail terminal
 - » Adjacent highway with activity that is significantly affected by the project

Guidance Reference:

Sections 6, 8 and Appendix I

The PM Hot-spot Analysis Process



Step 5: Select Air Quality Model, Data and Receptors

- A. Select air quality model
 - B. Characterize emission sources
 - C. Obtain representative meteorological and other data
 - D. Specify receptors throughout project area
 - E. Run air quality model
-
- 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)

*Guidance Reference:
Section 7 and Appendix J*

Recommended Air Quality Models

Type of Project	Recommended Model
Highway and intersection projects	AERMOD, CAL3QHCR
Transit, freight, and other terminal projects	AERMOD
Projects that involve both highway/intersections and terminals, and/or nearby sources	AERMOD

Note: Alternate models determined on case-by-case basis through Appendix W process.

*Guidance Reference:
Exhibit 7-2*

Air Quality Modeling

Includes:

- The project, and
- Nearby sources, in certain cases:
 - » If emissions from the nearby source change as a result of the project
 - » If the nearby source's air quality impact is not adequately captured by background
- See Section 8.2 of Appendix W to 40 CFR Part 51

Guidance Reference:

Sections 7.4, 8, and Appendix J

Characterizing Sources

- To run, air quality models need
 - » Location, timing, and rate of emissions; and
 - » Physical dimensions of a source
- Road links
 - » Location, timing, and rate of emissions come from MOVES/EMFAC, and traffic data
 - » Physical dimensions of “roadway source” should account for vehicle-induced turbulence
 - Hard-coded in CAL3QHCR
 - User-specified in AERMOD (see Appendix J)
- Off-network links
 - » Location: use separate sources to represent variation within a terminal (e.g., separate sources for bus lot, driveway)
 - » Timing: should be consistent with MOVES/EMFAC and traffic data
 - » Dimensions: should account for source’s physical conditions

Guidance Reference:

Section 7.4 and Appendix J

Obtaining Meteorological Data

- Obtain representative meteorological data
 - » Use 5 years of representative off-site surface data (most common)
 - Alternatively, use 1 year of site-specific data (if available)
 - Consistent with EPA meteorological monitoring guidance
 - » Upper air soundings from a representative site
 - » Assess representativeness based on latest *AERMOD Implementation Guide*, for both AERMOD and CAL3QHCR

- Quality check and format the data using relevant EPA meteorological pre-processing software
 - » For CAL3QHCR: MPRM
 - » For AERMOD: AERMET

Guidance Reference:

Section 7.5 and Appendix J

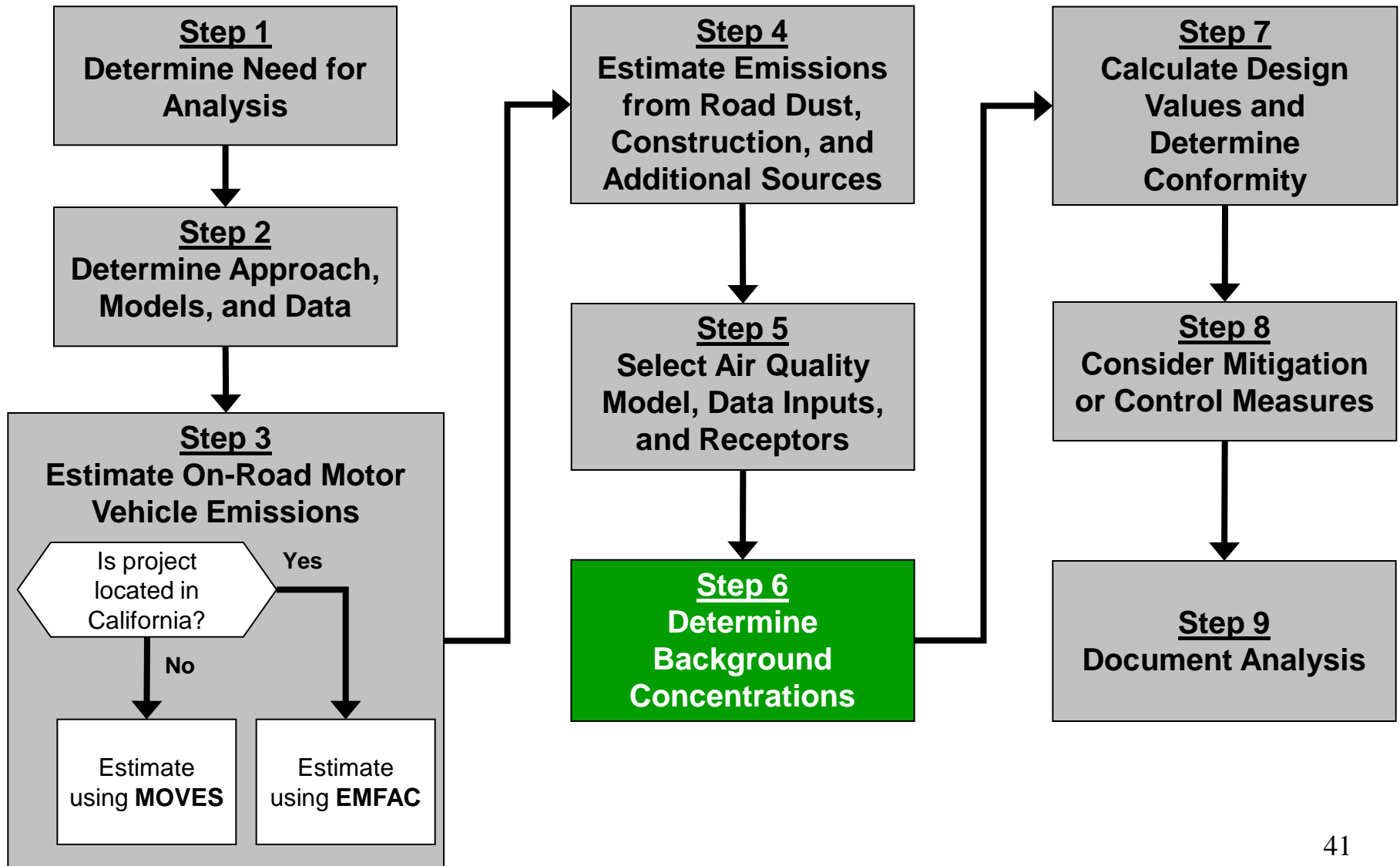
Specifying Receptors

- Conformity rule requires NAAQS to be evaluated “at appropriate receptor locations”
 - » Receptors are locations where an air quality model predicts air quality concentrations
- General guidance provided for all PM NAAQS
 - » Receptor spacing should be of sufficient resolution to capture concentration gradients around the locations of maximum modeled concentrations
 - » Consider locations where public cannot access (e.g., fenced private property, within right-of-way)
- Additional guidance also provided for PM_{2.5} NAAQS

Guidance Reference:

Section 7.6

The PM Hot-spot Analysis Process



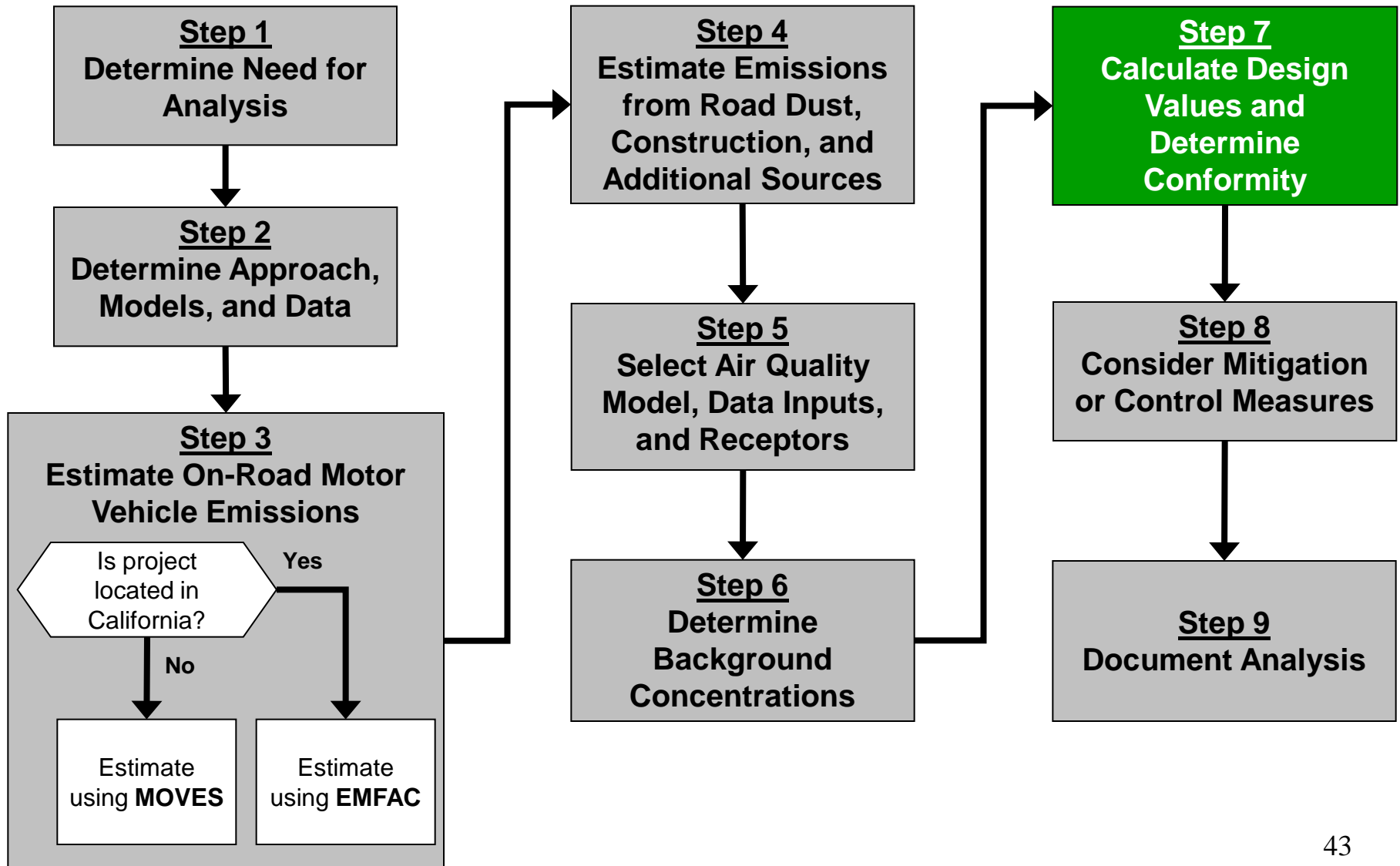
Step 6: Determine Background Concentrations

- “Background” includes other sources that affect concentrations in project area
 - » Some nearby sources may need to be modeled
 - » Impacts of other sources captured by background concentrations
- Background options for PM hot-spot analyses:
 1. Representative AQ monitoring data from one AQ monitor or interpolate between several monitors
 2. Chemical Transport Model (CTM) output
 3. Section 93.123(c)(2) method (for limited cases in PM₁₀ areas)
 4. Other options can be considered by EPA

Guidance Reference:

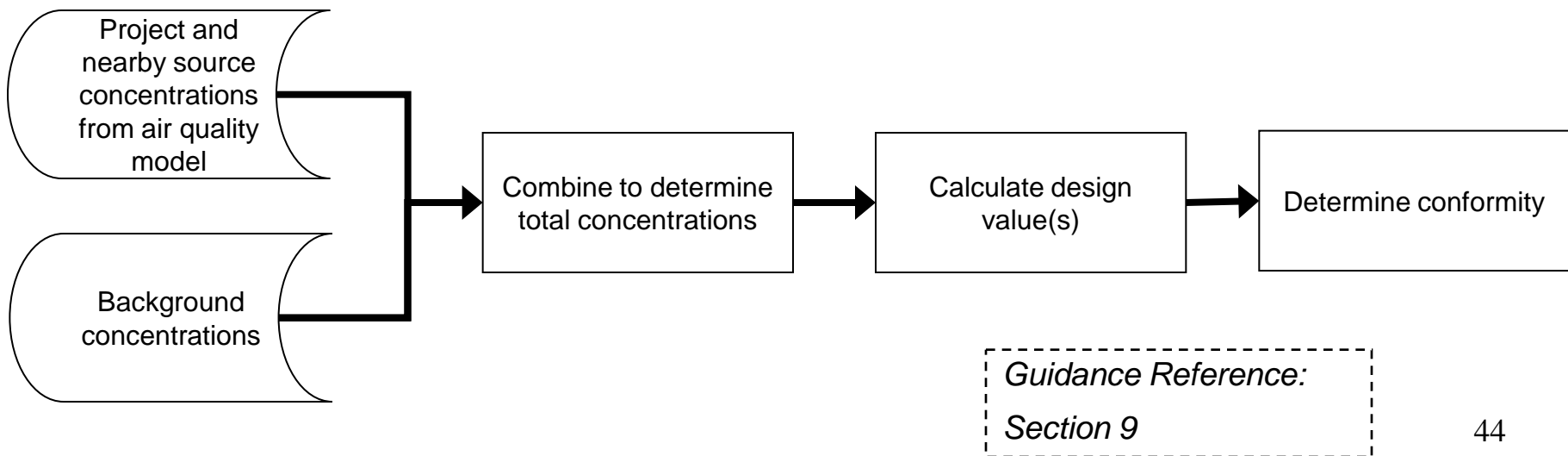
Section 8

The PM Hot-spot Analysis Process



Step 7: Calculate Design Values

- For PM hot-spot analyses, a design value is a statistic that describes a future air quality concentration in the project area that can be compared to a NAAQS
- Project design values are used to determine conformity
- In general, design values are calculated by combining:
 - » Air quality modeling results (project and nearby sources) and
 - » Air quality monitoring data (background from other sources)



Compare Results & Determine Conformity

- Guidance describes how to calculate design values for:
 - » Annual PM_{2.5} NAAQS
 - » 24-hour PM_{2.5} NAAQS
 - » 24-hour PM₁₀ NAAQS
- Guidance is consistent with how NAAQS are established and how design values are calculated for other purposes
- Conformity is met if the design value for every appropriate receptor in the build scenario is less than or equal to the NAAQS or the same receptor in the no-build scenario
 - » May be certain cases where an apparent “new” violation in the build scenario is actually a “relocated” violation from a different receptor in the no-build scenario

Guidance Reference:

Section 9

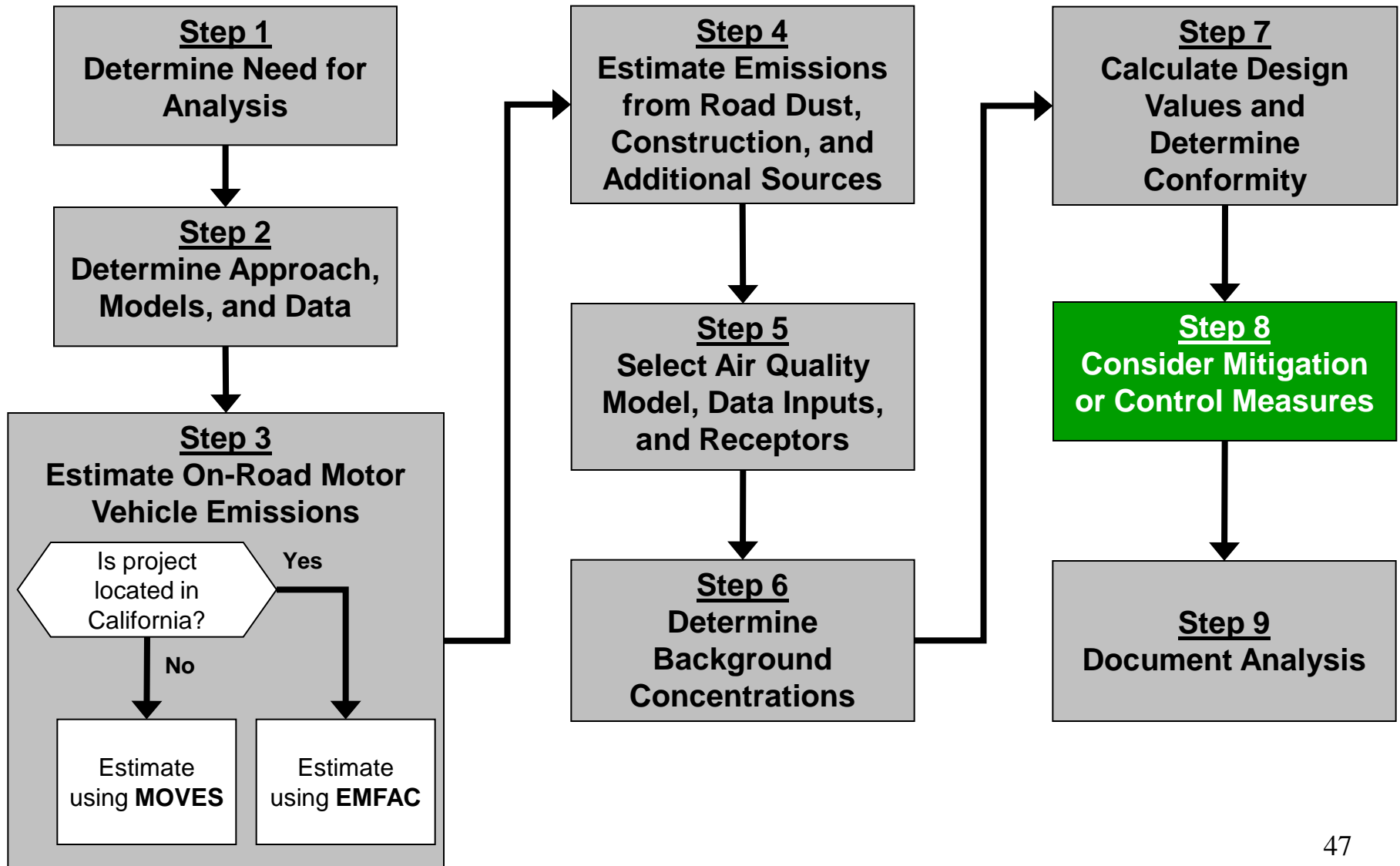
Determining Appropriate Receptors for Annual PM_{2.5} NAAQS

- After design values are calculated, it may be necessary to determine whether a receptor is appropriate to compare to the annual PM_{2.5} NAAQS
 - » Unnecessary if conformity is met at all receptors
- Appropriate receptors for annual PM_{2.5} NAAQS need to:
 - » Be population-oriented (can be determined before AQ modeling), and
 - » Represent “community-wide air quality” (determined after AQ modeling)
- Guidance is consistent with how NAAQS is established and monitored for air quality planning purposes
 - » In March 2006 final rule, EPA stated that guidance would be consistent with PM_{2.5} monitoring regs

Guidance Reference:

Section 9.4

The PM Hot-spot Analysis Process



Step 8: Consider Mitigation or Control Measures

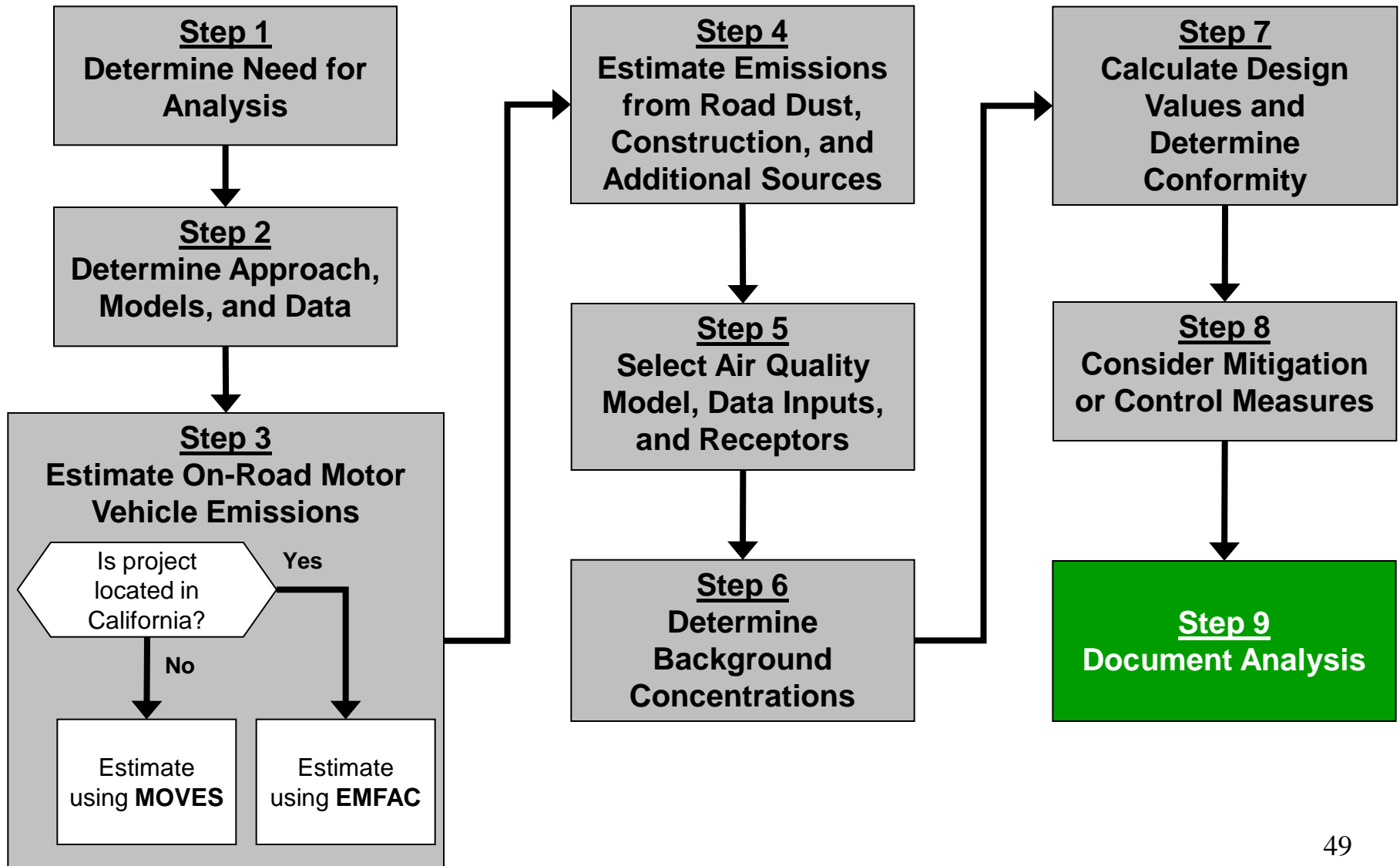
- It may be necessary to consider mitigation or control measures

- Guidance describes measures that might be considered, by category:
 - » Retrofitting, replacing vehicles/engines, and using cleaner fuels
 - » Reducing idling
 - » Redesigning the transportation project
 - » Controlling fugitive dust
 - » Controlling other sources of emissions
 - » Other measures may be available

Guidance Reference:

Section 10

The PM Hot-spot Analysis Process



Step 9: Document PM Hot-spot Analysis

- Need sufficient documentation to show project meets conformity rule requirements
- Documentation should include:
 - » Description of proposed project
 - » Analysis year(s) examined and factors considered in choosing
 - » Emissions modeling, including inputs and results
 - » Dust emissions and other source modeling, as applicable
 - » Air quality modeling data, including inputs and results and description of receptors employed
 - » Assumptions used to determine background concentrations
 - » Discussion of any mitigation or control measures
 - » Description of interagency consultation and public participation
 - » Conclusion of how project meets conformity rule requirements

*Guidance Reference:
Sections 3.10 and 9.5*

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 PM₁₀ areas
- App D: How to characterize 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 on 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 how to calculate design values

Part 3: Abbreviated PM Hot-spot Analysis Example

Hypothetical Project: Build Scenario Illustrated

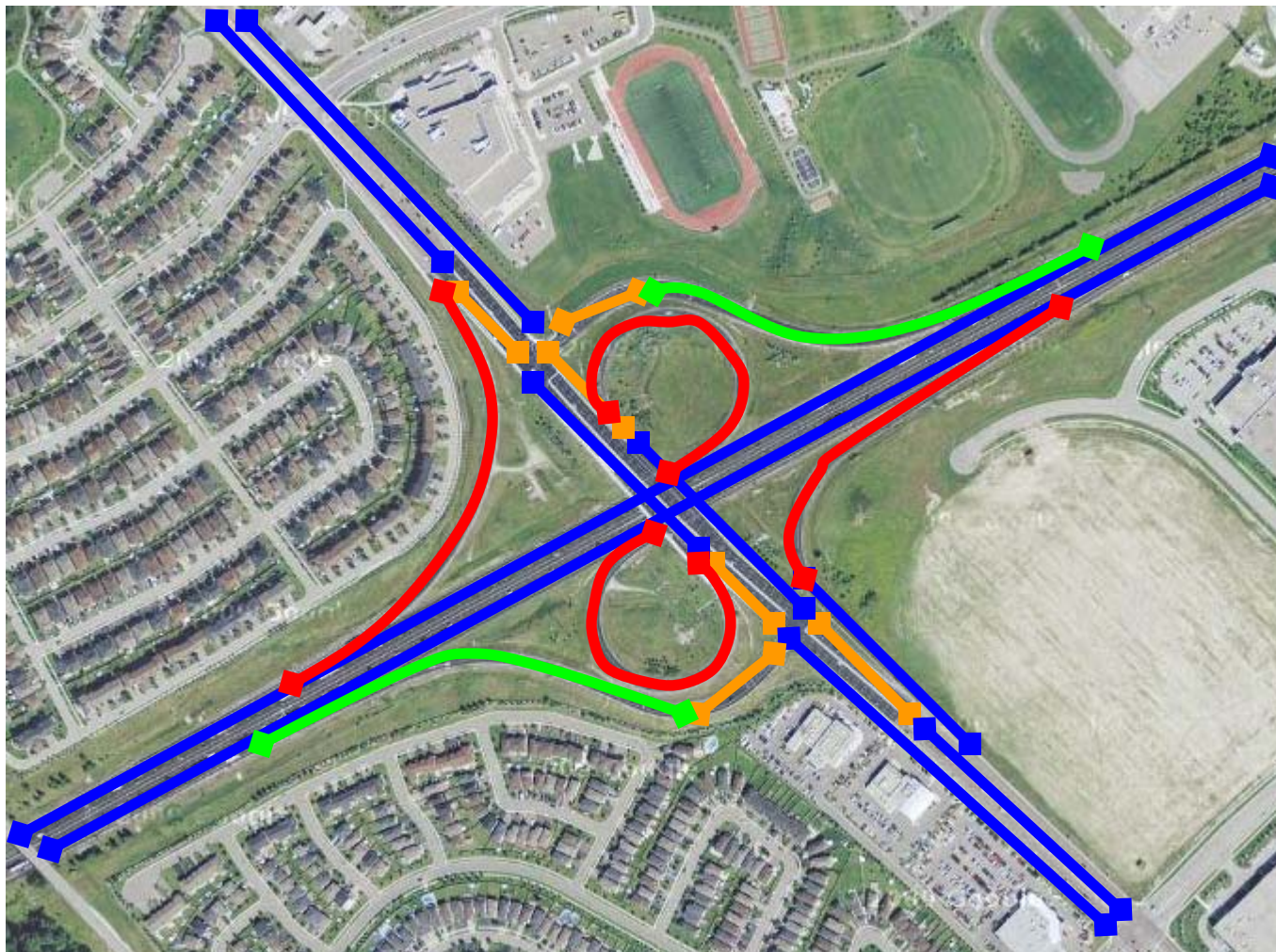


Project: A state DOT is building a new highway interchange and exit ramps are being added to a 6-lane freeway to allow trucks access to local businesses.

Hypothetical Project Description

- Located in an area that is nonattainment for both the 2006 24-hour and the annual PM_{2.5} NAAQS
 - » Four calendar quarters evaluated in analysis year
- Not located in California, so MOVES is used
 - » No road dust or construction emissions
- No nearby sources need to be modeled
 - » Either AERMOD or CAL3QHCR could be used (highway/intersection project)
- Representative background concentrations can be obtained from a nearby monitor outside project area

Assigning MOVES Links



Blue - free-flow links

Red - acceleration links (entry ramps)

Orange - idle/queue links at signalized intersections

Green - deceleration links (exit ramps)

Modeling the Build Scenario for Both PM NAAQS



Receptors are placed in all areas outside project right-of-way (green line) consistent with applicable requirements.

Placing Receptors for Air Quality Modeling

Example:
Using
AERMOD
Autogrid
Feature.

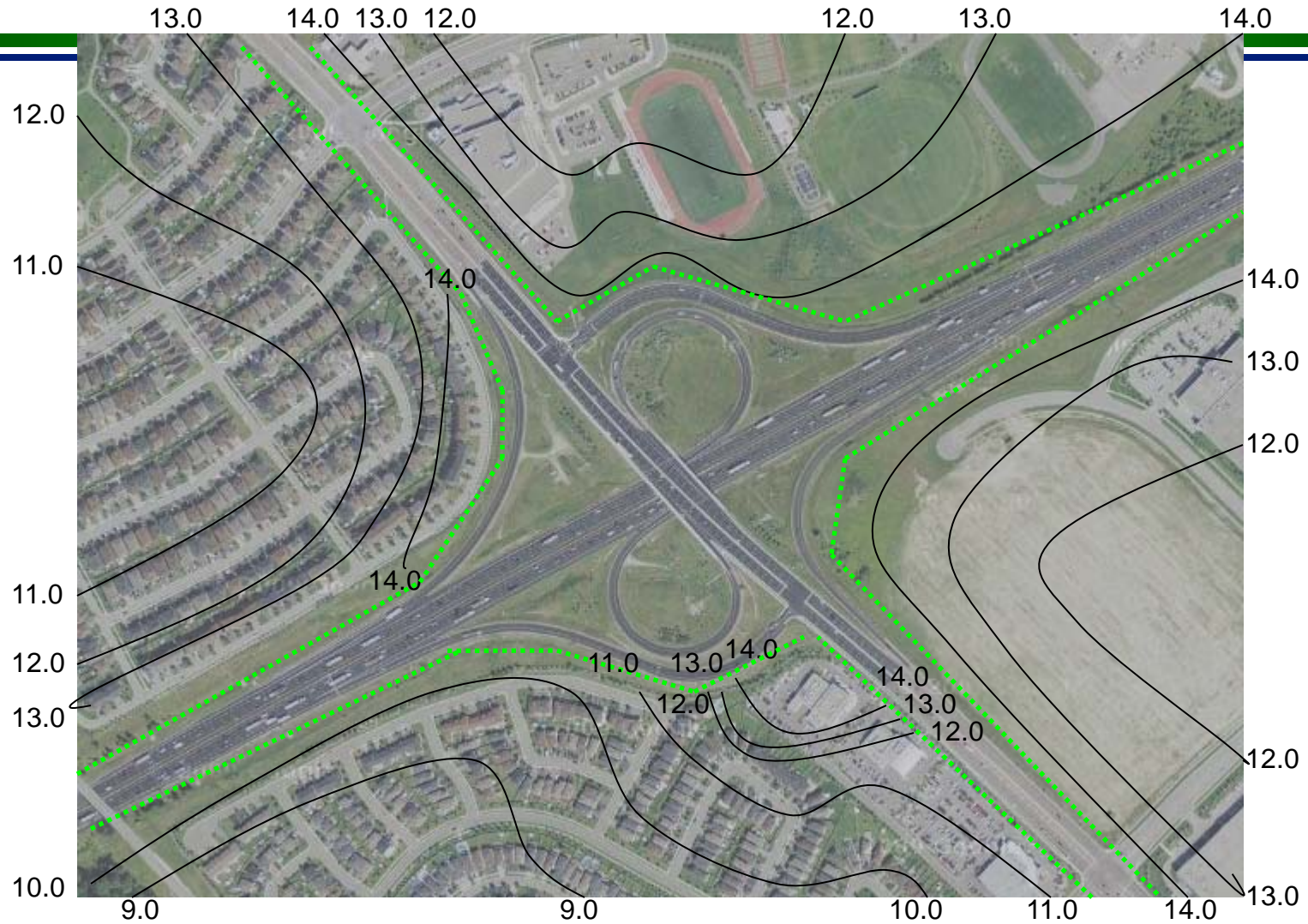


Receptor network is case-by-case determination based on topography, climatology, and other factors. Arrow shows fenced area not accessible to public (receptors not to be considered).

Calculating Design Values and Determining Conformity

- Results for annual PM_{2.5} NAAQS (see next slide)
 - » Design value at highest receptor: 14.5 µg/m³
 - » Annual PM_{2.5} NAAQS: 15.0 µg/m³
 - » Conformity is met at all receptors, since the design value at the receptor with the highest concentration is below NAAQS
- Results for 2006 24-hour PM_{2.5} NAAQS (not shown)
 - » Design value at highest receptor: 34 µg/m³
 - » 2006 24-hour PM_{2.5} NAAQS: 35 µg/m³
 - » Conformity is met at all receptors, since the design value at the receptor with the highest concentration is below NAAQS

Design Values for Annual PM_{2.5} NAAQS



Contour plot of modeled concentrations + background contribution ($\mu\text{g}/\text{m}^3$) at receptors.

Additional Considerations

- Note that, if concentrations for build scenario had exceeded either $PM_{2.5}$ NAAQS, project sponsor could:
 - » Model the no-build scenario
 - Project would conform if design values in build scenario were less than or equal to those in no-build scenario
 - » Add mitigation or control measures and remodel the build scenario to see if at or below NAAQS
 - » For annual $PM_{2.5}$ NAAQS only, use consultation process to determine whether receptor(s) is not appropriate

Part 4: Outreach and Training

Outreach

To date:

- December 2010:
 - » FR announcement, final guidance documents, fact sheet, and Q's & A's
- Today's webinar
- New mailbox: conformity-hotspot@epa.gov for any hot-spot related questions

Upcoming:

- Hands-on training course

Plans for Hands-on Training

- EPA and DOT are developing a multi-day PM hot-spot training course
 - » Will be a technical, hands-on course
 - » Will focus on using models: MOVES at the project scale (EMFAC in CA), AERMOD, and CAL3QHCR
- Training targeted to begin in spring 2011
- Specific dates and locations TBD
 - » Web page to be updated with dates and locations:
www.epa.gov/otaq/stateresources/transconf/training.htm

About Hands-on Training

- Three-day course will cover *most* material in the PM Hot-Spot Guidance
 - » Other material may be covered in future webinars
- Participants will work through an example PM hot-spot analysis
 - » Example will include both highway, intersection, and transit components
 - » Scope and complexity of example is intended to be similar to an actual project of local air quality concern

For More Information

- See EPA's conformity website for:
 - » Regulations, policy guidance, FR notices, training
 - » 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/
- 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