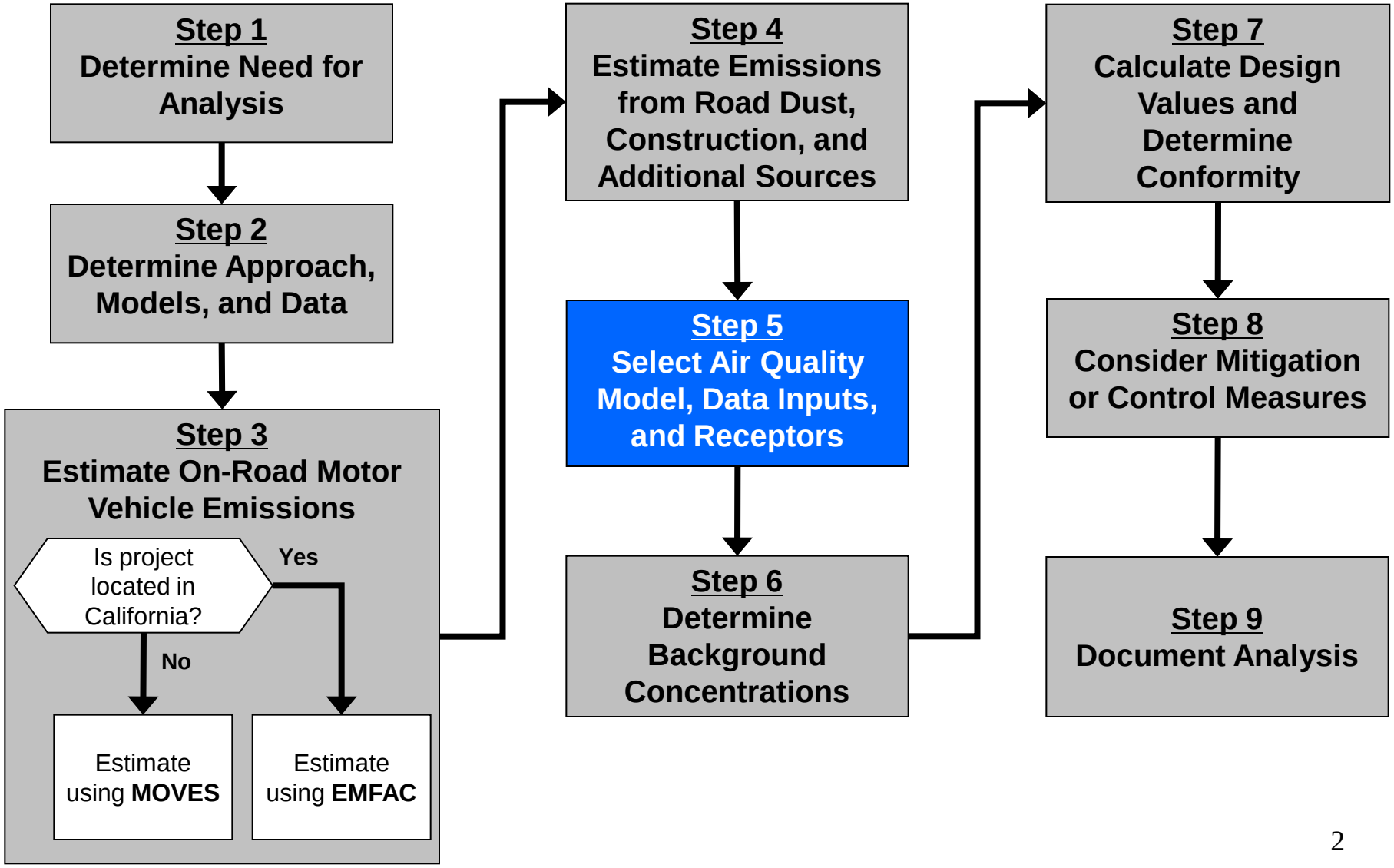
Module 4

Using AERMOD for PM Hot-Spot Analyses

Completing a PM Hot-spot Analysis



Module Overview

- What is AERMOD?
- Structure of an AERMOD input file
- Running AERMOD with the “mobile” sample input file
- Hands-on exercise: running AERMOD for a simple highway
- Running AERMOD for the example analysis

Key References

- PM Hot-spot Guidance, Sections 7, 8 and Appendix J
- AERMOD Implementation Guide
- “User’s Guide for the AMS/EPA Regulatory Model – AERMOD” (AERMOD User Guide)
- AERMET User Guide
- EPA’s SCRAM website: www.epa.gov/ttn/scram
  - » www.epa.gov/scram001/
  - » www.epa.gov/ttn/scram/dispersion_prefrec.htm#aermod

What is 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

What is AERMOD?

- AERMOD design criteria:
  - » Use up-to-date science
  - » Capture essential physical processes
  - » Apply over a range of meteorology
  - » Support diverse uses with flexible options for input and output
  - » Able to evolve, and be easily updated

Guidance Reference:

Section 7.3.1

What is AERMOD?

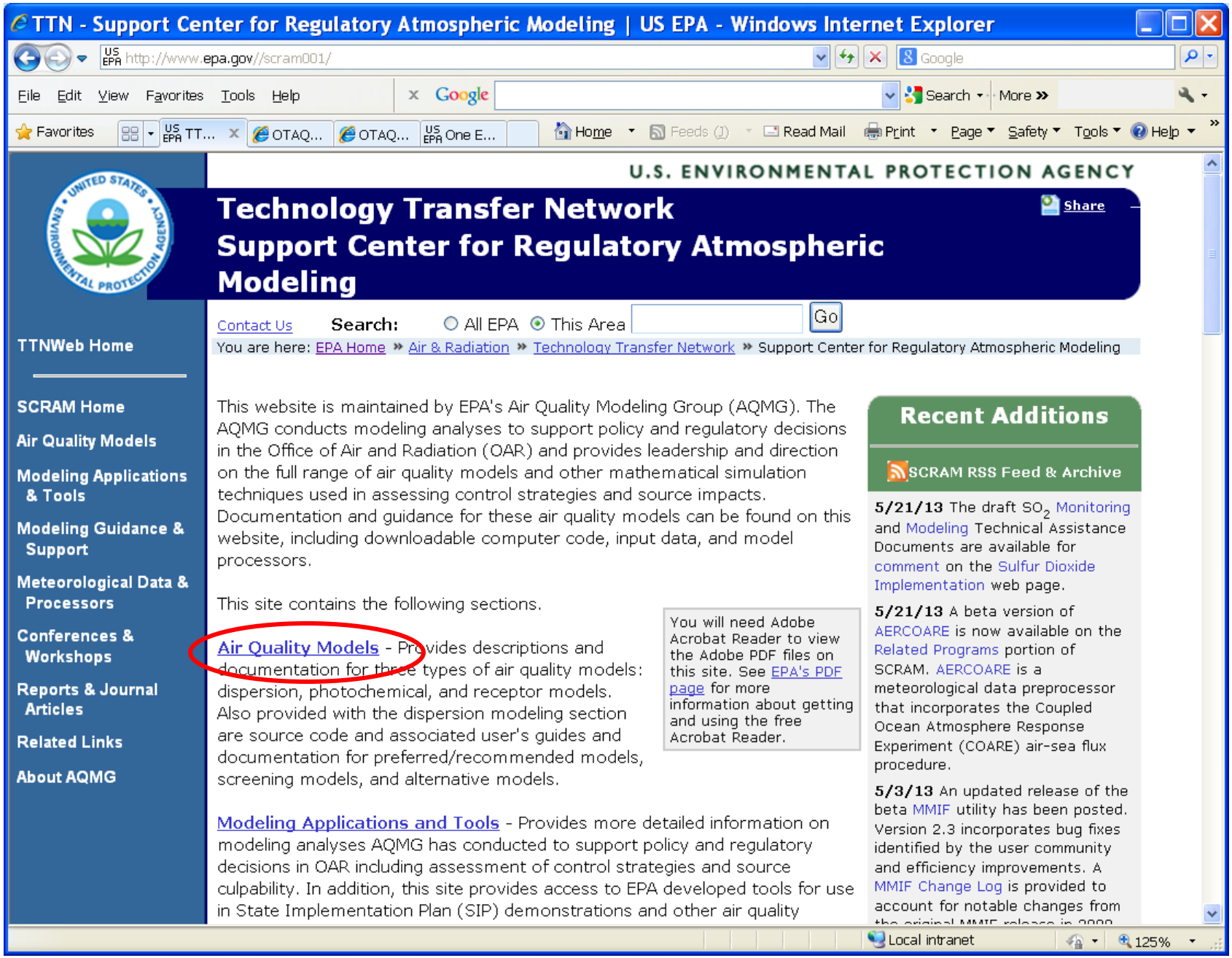
Key dates:

- 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 December 2012, found on AERMOD website along with:
  - » An updated AERMOD User's Guide Addendum, and
  - » AERMOD Model Change Bulletin #8 – describes the modifications made to the model in this latest update

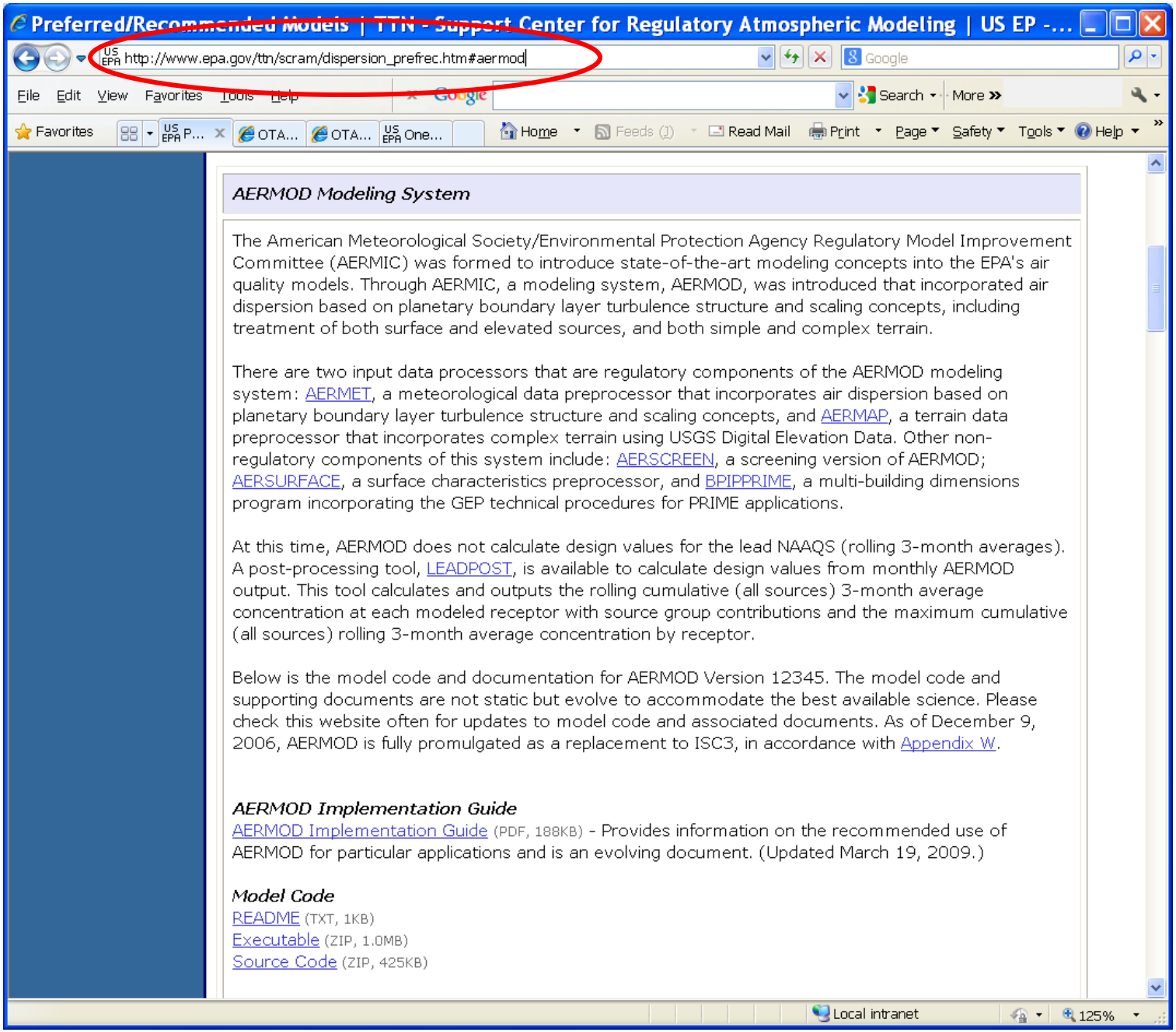
Guidance Reference:

Section 7.3.1

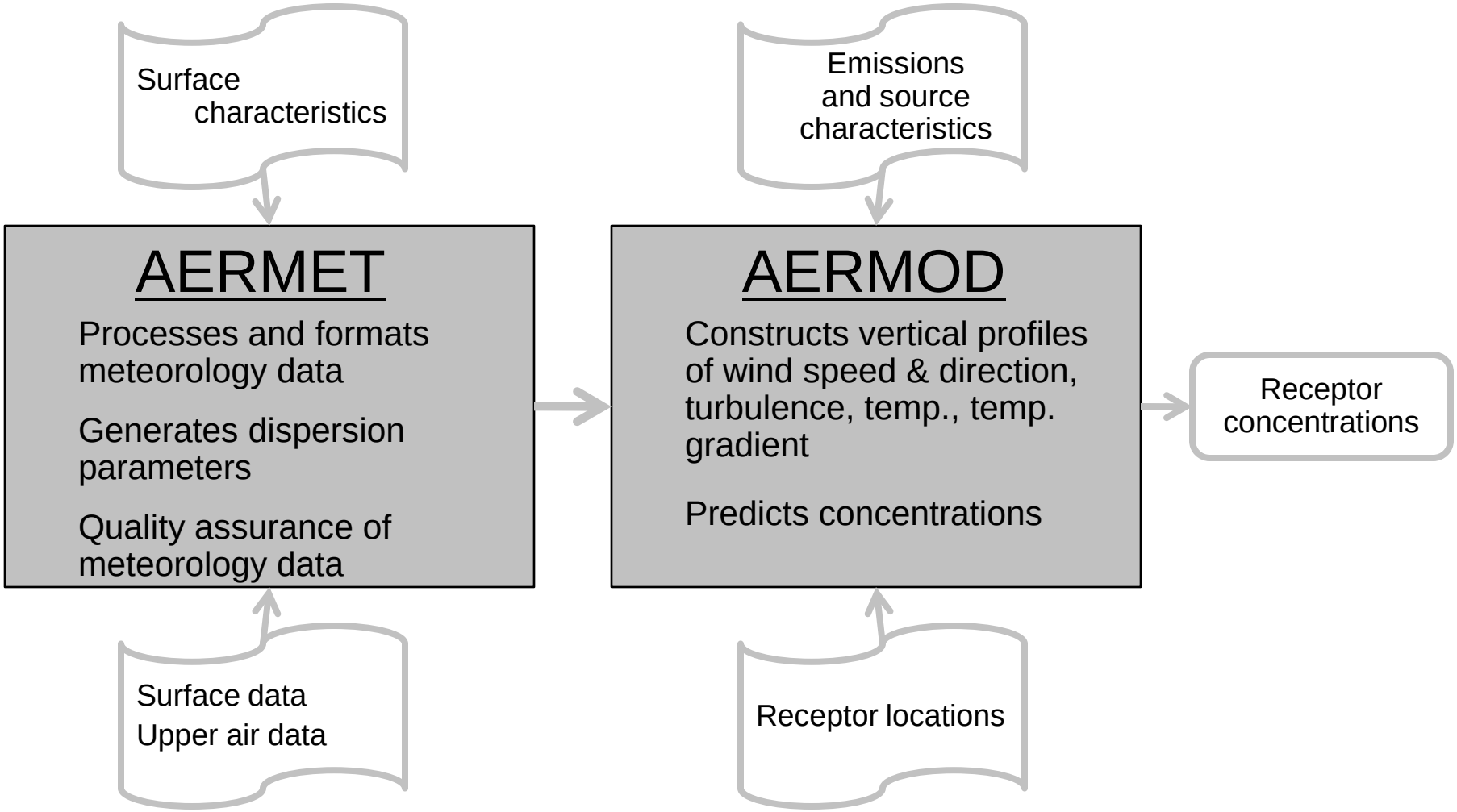
www.epa.gov/scram001/



www.epa.gov/ttn/scram/dispersion_prefrec.htm#aermod



Information Flow in AERMOD



AERMAP – a preprocessor used for elevated sources in complex terrain; not relevant for most hot-spot analyses

AERMET and AERMOD

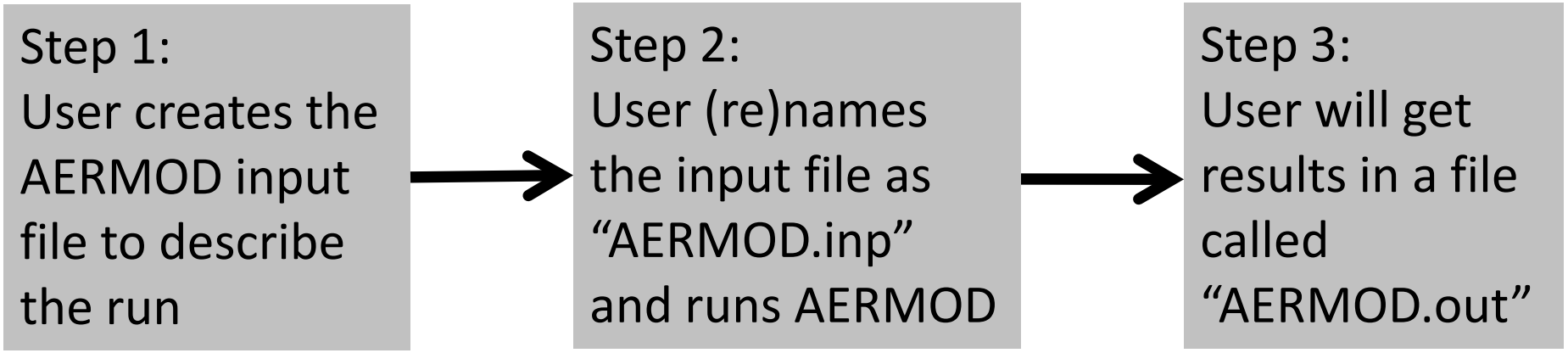
- Obtaining representative met data is a critical component of PM hot-spot analyses
  - » Discussed in Module 3
- AERMET is used to prepare met data for AERMOD
  - » Surface met data
  - » Profile met data
- Project sponsors will most likely obtain representative pre-processed met data from state or local air agencies
  - » Where such met data files are available, running AERMET is not necessary
- AERMET not covered in this course

AERMOD Interfaces

- Course uses AERMOD model from EPA's website
- Users may want to obtain one of several commercial AERMOD interfaces
  - » Interface may streamline some steps (e.g., receptor placement) and offer additional features (e.g., a mapping feature of model results)
- Before using a commercial interface, verify that it is consistent with the latest version of AERMOD
  - » See Dec. 2007 OAQPS memo: www.epa.gov/ttn/scram/guidance_clarificationmemos.htm
- Material in Module 4 is relevant even if using an interface

Running AERMOD

General steps…



- The AERMOD input file is always named "AERMOD.inp" and the output is always named "AERMOD.out"
- Note – These files will be overwritten when AERMOD is run again

AERMOD: A Spatial Model

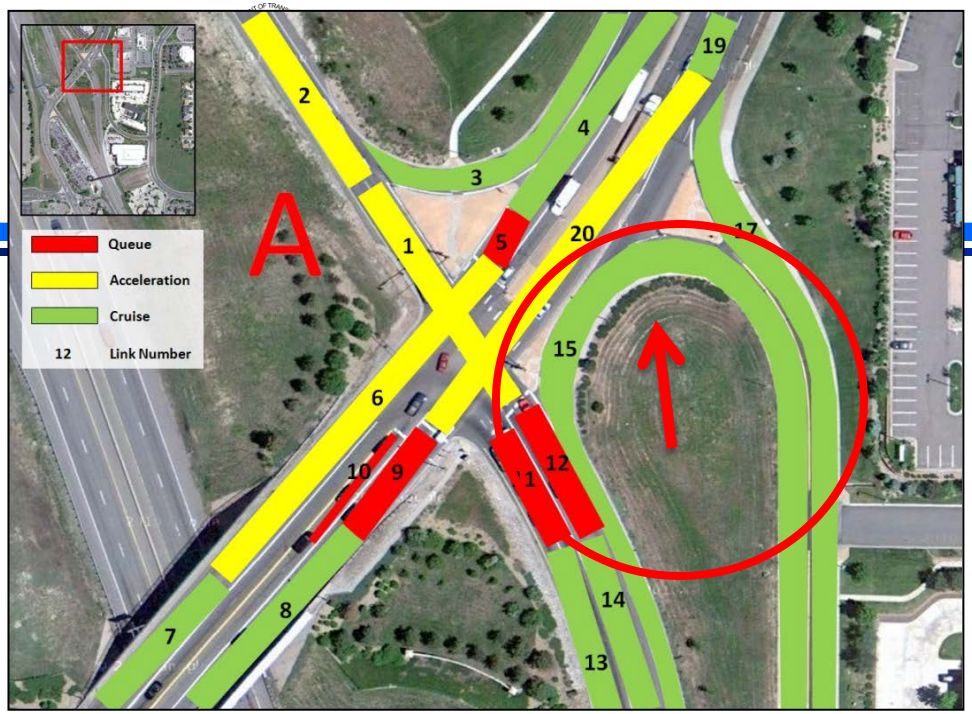
- In an AERMOD input file, users need to specify coordinates (x, y, and optional z) for:
  - Where *emissions* are occurring, i.e., the user defines the locations of emission sources, and
  - Where AERMOD should look at *concentrations*, i.e., the user defines the locations of receptors
- Coordinates can be defined arbitrarily or with pre-defined grid
  - E.g., Universal Transverse Mercator (UTM) coordinate system

Defining Sources in AERMOD

- Emission ***sources*** in AERMOD are based on ***links*** defined for MOVES
  - » MOVES links differ by activity: operating modes, speeds, volumes
  - » Each MOVES 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

Illustration from the Example Analysis

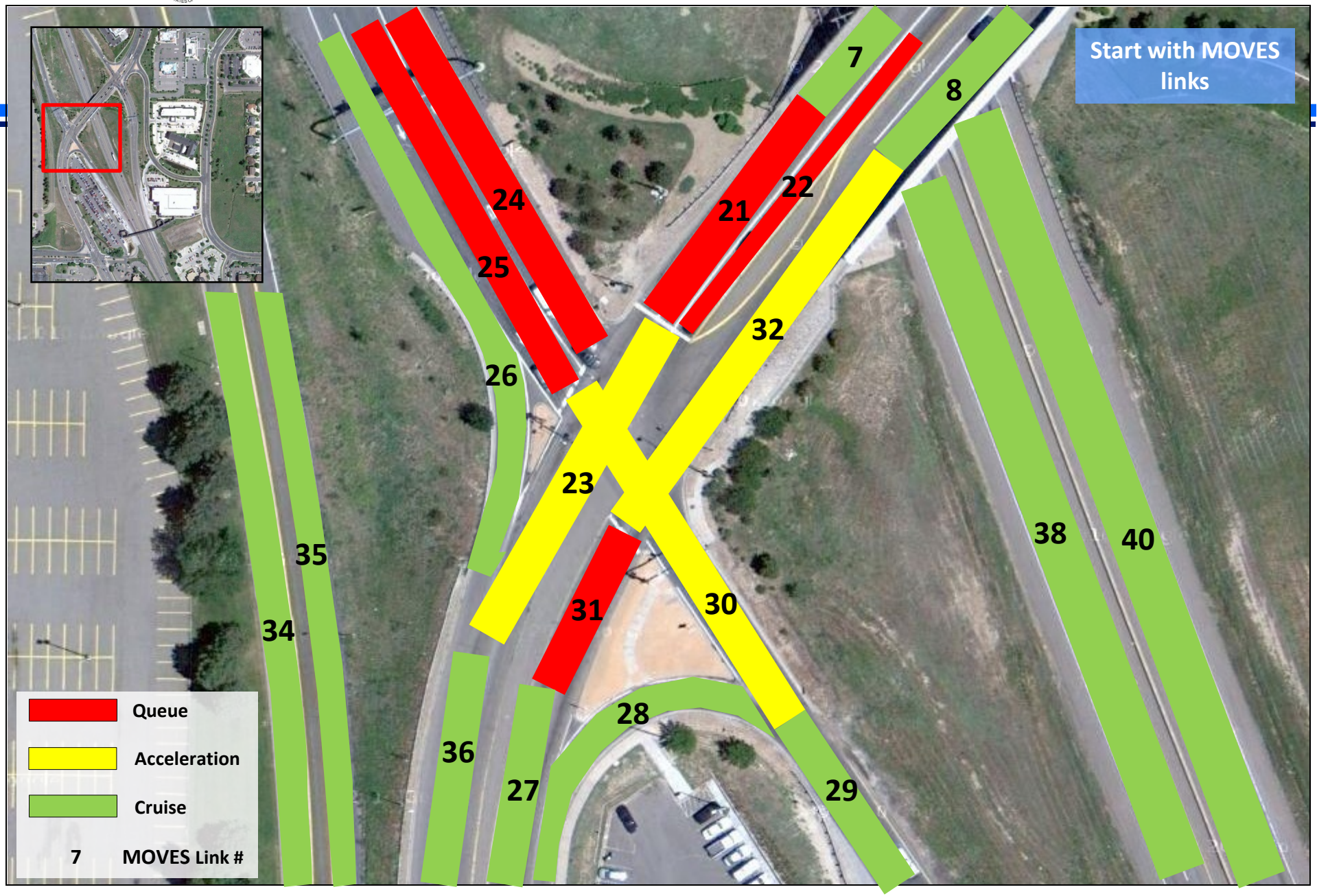


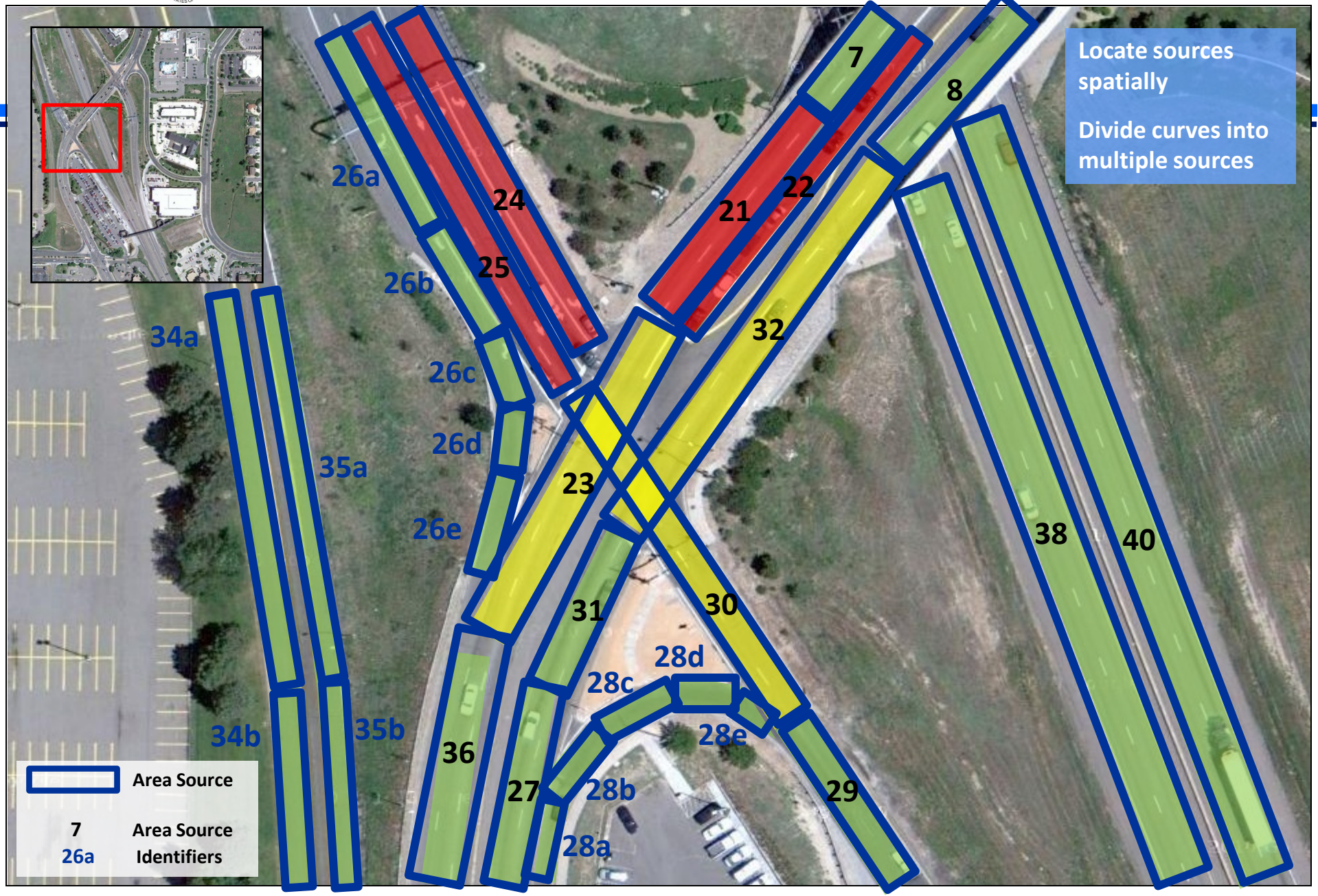
- Every MOVES link (in color) is at least one AERMOD source
- A link may translate to multiple AERMOD sources
  - » MOVES link 15 (curve) has same activity for entire link; several AERMOD sources are defined for this link to account for the curve

Note: the example analysis is illustrative

Gaps/overlaps between sources should be minimized in practice

Exercise: Define AERMOD Sources


Start with MOVES links
7
8
24
25
21
22
26
32
23
35
34
31
30
38
40
28
36
27
29
Queue
Acceleration
Cruise
7 MOVES Link #


Locate sources spatially
Divide curves into multiple sources
7
8
26a
24
25
21
22
26b
32
34a
26c
26d
35a
23
26e
38
40
31
30
28d
28c
34b
35b
28e
36
27
28b
29
28a
Area Source
7 Area Source
26a Identifiers

AERMOD Input File Structure

An input file is structured by “pathways” as ordered:

CO	Control – describes the run
SO	Source – describes emission sources
RE	Receptor – describes receptor locations
ME	Meteorology – describes which files
OU	Output – describes type of output

An additional pathway, EV for “Event,” is not necessary for hot-spot analyses; not covered in this course

Let's look at an input file...

- Create a folder on your C: drive called "AERMOD"
  - (e.g., start from desktop: "my computer")
- On desktop, open folder "PM Hot-spot 3-Day Training Files"
  - Open folder "AERMOD files"
    - Open folder "Sample AERMOD run"
- Copy these 4 files from "Sample AERMOD run" to C: AERMOD
  - AE_mobile_sample_file.inp *(the input file)*
  - aermet2.pfl *(profile met data)*
  - aermet2.sfc *(surface met data)*
  - aermod.exe *(the AERMOD model)*

AERMOD Sample Input File

- We created a sample file to illustrate a transportation project for this course
  - One source emitting PM_{10} – could be either a highway or transit project
  - Sample input file is illustrative only
  - More relevant than the sample input file that comes with AERMOD when downloaded from the web
    - Represents a stack emitting SO_2

Why look at the sample input file?

- Illustrates the input file structure
  - » Provides an example of what we'll be creating

- Introduces model concepts and syntax
  - » For each pathway, we'll cover guidance for PM hot-spot analyses
    - – Where slides include syntax from the AERMOD user guide, keywords or parameters in parentheses are optional, e.g.:

    Syntax: **URBANOPT** Urbpop (Urbname) (UrbRoughness)

AE_mobile_sample_file.inp - Notepad

File Edit Format View Help

```
**To run this example input file, copy it as "AERMOD.INP" and type:
**
**    AERMOD
**
** The results for this example are found in file "ae_PMhotspot_test.out"
** In this example, an area source is illustrated, which is relevant for
** both highway and transit projects.
** This example is for illustration purposes only.  6/15/2011
**--------------------------------------------------------------------

CO STARTING
   TITLEONE  An Example Transportation Project
   MODELOPT  FLAT  CONC
   POLLUTID  PM10
   AVERTIME  24
   URBANOPT  200000
   FLAGPOLE  1.8
   RUNORNOT  RUN
CO FINISHED

**-------------------------------------

SO STARTING
**                Srcid     Srctyp  X  Y (Z)
**                ------    ------  -- -- --
   LOCATION       PROJECT   AREA    0  0  0

** Area source parameters
** User guide:  Srcid     Aremis  Relhgt   Xinit    Yinit     Angle  Szinit
**                        g/s/m2          length-X  length-y
**                ------- ------  ------  -------  -------   -----  ------
   SRCPARAM       PROJECT   0.00005    2      50        25        0      1

   URBANSRC  PROJECT
   SRCGROUP  ALL

SO FINISHED

** Area source called "Project" is a 50 X 25 rectangle,
** with its southwest corner sitting at coordinates 0, 0 (the origin)
** Source parameters are illustrative only -- consult PM hot-spot guidance
**-------------------------------------

RE STARTING
RE GRIDCART INNER STA
** User guide:          Xinit Xnum Xdelta Yinit Ynum Ydelta
**                      ----- ---- ------ ----- ---- ------
                  XYINC -100   11    25    -100   10   25
RE GRIDCART INNER END
```

Sample Input File: First half

AE_mobile_sample_file.inp - Notepad

File Edit Format View Help

```
RE STARTING
RE GRIDCART INNER STA
** User guide:          Xinit Xnum Xdelta Yinit Ynum Ydelta
**                      ----- ---- ------ ----- ---- ------
                  XYINC -100   11    25    -100   10   25
RE GRIDCART INNER END

** "Inner" receptor grid extends 100 meters beyond the project
** in both X and Y directions, at 25 meter spacing
** Some receptors will be at locations within the source

RE GRIDCART OUTER STA
** User guide:    XPNTS Gridx1 Gridx2 Gridx3 Gridx4 ...
**                YPNTS Gridy1 Gridy2 Gridy3 Gridy4 ...
**                ------ ------ ------ ------
                  XPNTS  -500   -400   -300   -200  -100 0 100 150 250 350 450 550
                  YPNTS  -500   -400   -300   -200  -100 0 100 125 225 325 425 525
RE GRIDCART OUTER END

** "Outer" receptor grid extends 500 meters beyond the project
** in both X & Y directions, 100 m apart (except X @ 100-150, and Y @ 100-125)
** Some receptors will be at locations within the source
RE FINISHED

**----------------------------------

ME STARTING

   SURFFILE  aermet2.sfc
   PROFFILE  aermet2.pfl
   SURFDATA  14735  1988  ALBANY,NY
   UAIRDATA  14735  1988  ALBANY,NY

   SITEDATA  99999  1988  HUDSON
   PROFBASE  0.0  METERS
ME FINISHED

**----------------------------------

OU STARTING
   RECTABLE 24 FIRST
** (There are only 4 days of met data in the met data file, so model cannot
** provide 6th highest concentration)
   POSTFILE  24 ALL PLOT PROJECT_24hr.pst
OU FINISHED
```

Sample Input File: Second half

AERMOD Input File Conventions

- AERMOD User Guide refers to **keywords** and **parameters** as either “mandatory” (for AERMOD to run) or “optional”
  - » However, some “optional” keywords and parameters are necessary for PM hot-spot analyses
  - » **Keywords** are 8 characters
    - – All pathways begin with keyword **STARTING** and end with keyword **FINISHED**
    - – Other keyword order not critical, except in the SO pathway
  - » **Parameters** are either numbers or secondary keywords
    - – Parameter order matters, (except for secondary keywords), but spacing between them doesn’t
- Consult User Guide (e.g., Appendix B reference table)
  - » Indicates what’s mandatory vs. optional, syntax for each keyword, whether a particular order is necessary, etc.

AERMOD Input File Conventions

Example pathway, from **STARTING** to **FINISHED**:

```
CO STARTING
CO TITLEONE    Simple AERMOD Run
CO MODELOPT  CONC   FLAT
CO AVERTIME   24
CO URBANOPT  200000
CO FLAGPOLE   1.8
CO POLLUTID   PM10
CO RUNORNOT RUN
CO FINISHED
```

Pathway (2 letters)	Keyword (8 letters)	Parameters (one or more)

AERMOD Input File Conventions

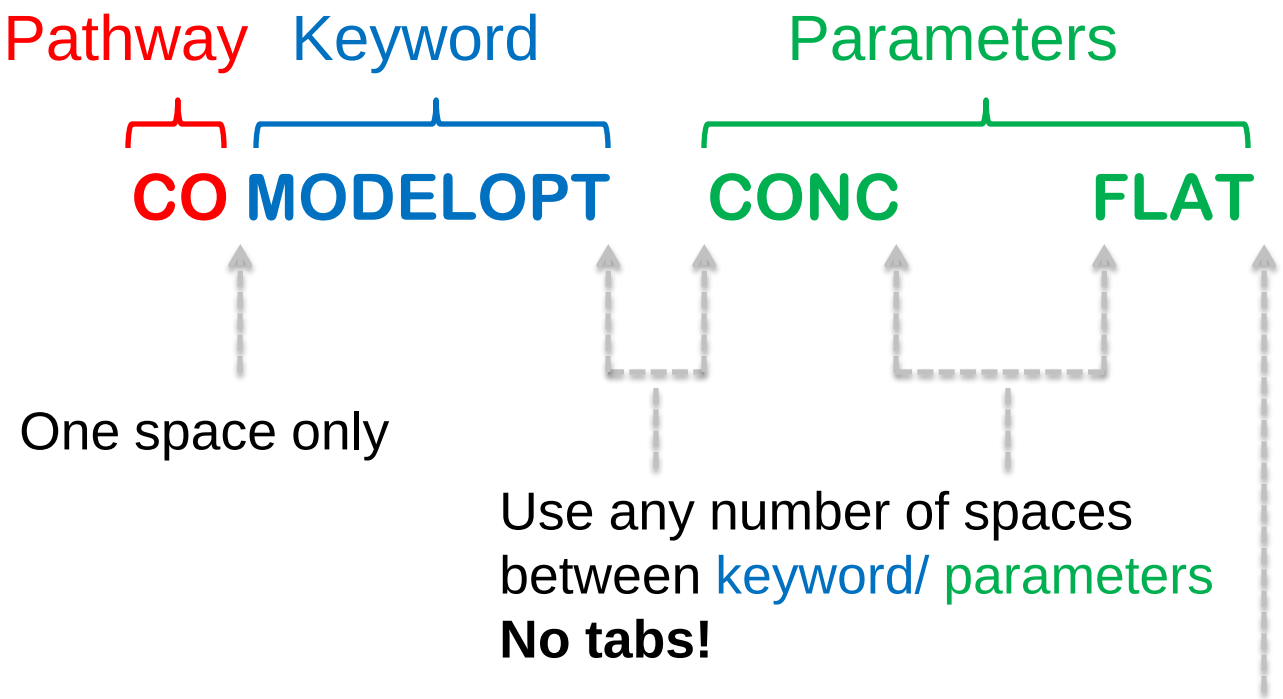
Same example could also look like this:

```
CO STARTING
   TITLEONE   Simple AERMOD Run
   MODELOPT  CONC   FLAT
   AVERTIME   24
   URBANOPT  200000
   FLAGPOLE   1.8
   POLLUTID   PM10
   RUNORNOT RUN
CO FINISHED
```

Pathway Keyword Parameters

AERMOD Input File Conventions

Example of one line:



Input File Comment Lines

- Comment lines start with “**”
  - “**” tells AERMOD “don’t read this”

- Use “**” to insert blank lines or text:
  - Blank lines can be used to break up pathways, sources, etc.

  - Text can be used to label input information, source parameters, etc. For example:

    ** North perimeter driveway

    ** I-80/Platt Rd NE exit ramp

AERMOD Units

- All numeric inputs (input file) are metric:
  - Length: meters
  - Speed: meters per second
  - Temperature: kelvin
  - Emission rates: default units for inputs are
    - Grams per second (g/s) for **point** and **volume** sources
    - Grams per second per square meter ($g/s/m^2$) for **area** sources
- Output (concentrations): units are $\mu g/m^3$

AERMOD Input File Structure

CO

SO

RE

ME

OU

Control – information about the run, e.g.:

- Run title
- Concentration or deposition
- Averaging time
- Run with errors or quit?

Control Pathway – Sample Input File

AE_mobile_sample_file.inp - Notepad

File Edit Format View Help

```
**To run this example input file, copy it as "AERMOD.INP" and type:
**
**    AERMOD
**
** The results for this example are found in file "ae_PMhotspot_test.out"
** In this example, an area source is illustrated, which is relevant for
** both highway and transit projects.
** This example is for illustration purposes only.  6/15/2011
**--------------------------------------------------------------------

CO STARTING
   TITLEONE  An Example Transportation Project
   MODELOPT  FLAT  CONC
   POLLUTID  PM10
   AVERTIME  24
   URBANOPT  200000
   FLAGPOLE  1.8
   RUNORNOT  RUN
CO FINISHED

**-------------------------------------

SO STARTING
**               Srcid     Srctyp  X  Y (Z)
**               ------    ------  -- -- --
   LOCATION      PROJECT   AREA    0  0  0

** Area source parameters
** User guide:  Srcid     Aremis   Relhgt   Xinit     Yinit     Angle  Szinit
**                        g/s/m2           length-X  length-y
**               -------  ------   -------   -------   -----  ------
   SRCPARAM      PROJECT  0.00005    2        50         25       0      1
```

For PM hot-spot analyses, CO pathway keywords needed between **STARTING** and **FINISHED** are:

- **TITLEONE**
- **MODELOPT**
- **POLLUTID**
- **AVERTIME**
- **URBANOPT**
- **FLAGPOLE**
- **RUNORNOT**

Keywords described on next slides

Control Pathway – TITLEONE

AE_mobile_sample_file.inp - Notepad

File Edit Format View Help

```
**To run this example input file, copy it as "AERMOD.INP" and type:
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**
** The results for this example are found in file "ae_PMhotspot_test.out"
** In this example, an area source is illustrated, which is relevant for
** both highway and transit projects.
** This example is for illustration purposes only.  6/15/2011
**--------------------------------------------------------------------

CO STARTING
   TITLEONE  An Example Transportation Project
   MODELOPT  FLAT  CONC
   POLLUTID  PM10
   AVERTIME  24
   URBANOPT  200000
   FLAGPOLE  1.8
   RUNORNOT  RUN
CO FINISHED

**-------------------------------------

SO STARTING
**               Srcid     Srctyp  X  Y (Z)
**               ------    ------  -- -- --
   LOCATION      PROJECT   AREA    0  0  0

** Area source parameters
** User guide:  Srcid     Aremis  Relhgt   Xinit    Yinit     Angle  Szinit
**                        g/s/m2          length-X  length-y
**               -------   ------  ------   -------  -------   -----  ------
   SRCPARAM      PROJECT   0.00005    2       50        25        0      1
```

Use keyword **TITLEONE** to specify a title line that will appear on each page of the printed output file (only first 68 characters will be printed)

Optional keyword **TITLETWO** can be used to add a second line

Control Pathway - MODELOPT

- Use keyword **MODELOPT** to control the modeling options for a particular run through parameters

- Relevant parameters for PM hot-spot analyses:
  - **CONC** should be used to tell AERMOD to model concentrations (instead of deposition)
  - **FLAT** should be used to tell AERMOD that the terrain is flat (flat terrain assumed for most highway and transit projects)
    - **DFAULT** may be appropriate instead of **FLAT** when modeling certain nearby elevated sources; use interagency consultation
  - These parameters are secondary keywords so can be in any order
- *Complete this line for a PM hot-spot analysis:*

```
CO MODELOPT _____ _____
```

Guidance Reference:

Appendix J.5.1

Control Pathway – Sample Input File

AE_mobile_sample_file.inp - Notepad

File Edit Format View Help

```
**To run this example input file, copy it as "AERMOD.INP" and type:
**
**    AERMOD
**
** The results for this example are found in file "ae_PMhotspot_test.out"
** In this example, an area source is illustrated, which is relevant for
** both highway and transit projects.
** This example is for illustration purposes only.  6/15/2011
**--------------------------------------------------------------------

CO STARTING
   TITLEONE  An Example Transportation Project
   MODELOPT  FLAT  CONC
   POLLUTID  PM10
   AVERTIME  24
   URBANOPT  200000
   FLAGPOLE  1.8
   RUNORNOT  RUN
CO FINISHED

**-------------------------------------

SO STARTING
**               Srcid     Srctyp  X  Y (Z)
**               ------    ------  -- -- --
   LOCATION      PROJECT   AREA    0  0  0

** Area source parameters
** User guide:  Srcid      Aremis  Relhgt   Xinit     Yinit      Angle  Szinit
**                         g/s/m2          length-X  length-y
**               -------   ------  ------   -------   -------    -----  ------
   SRCPARAM      PROJECT   0.00005    2       50        25         0      1
```

The sample input file tells AERMOD to model flat terrain and concentrations

(For numerical parameters, order matters; for secondary keywords **CONC** and **FLAT**, order doesn't matter)

Control Pathway - POLLUTID

- Use keyword **POLLUTID** to identify which pollutant AERMOD is modeling
  - » User can enter up to 8 characters (e.g., “PM2.5”)
    - – $PM_{2.5}$ can be entered as: PM25, PM2.5, PM-2.5, PM-25
    - – PM_{10} can be entered as: PM10, PM-10
  - » Output will be labeled with what user enters
  - » AERMOD has processing options that are specific to $PM_{2.5}$ and PM_{10}

- *Complete this line for a $PM_{2.5}$ nonattainment area:*

  CO _____ _____

Control Pathway – Sample Input File

AE_mobile_sample_file.inp - Notepad

File Edit Format View Help

```
**To run this example input file, copy it as "AERMOD.INP" and type:
**
**    AERMOD
**
** The results for this example are found in file "ae_PMhotspot_test.out"
** In this example, an area source is illustrated, which is relevant for
** both highway and transit projects.
** This example is for illustration purposes only.  6/15/2011
**-------------------------------------------------------------------

CO STARTING
   TITLEONE  An Example Transportation Project
   MODELOPT  FLAT  CONC
   POLLUTID  PM10
   AVERTIME  24
   URBANOPT  200000
   FLAGPOLE  1.8
   RUNORNOT  RUN
CO FINISHED

**-------------------------------------

SO STARTING
**              Srcid     Srctyp  X  Y (Z)
**              ------    ------  -- -- --
   LOCATION     PROJECT   AREA    0  0  0

** Area source parameters
** User guide:  Srcid     Aremis  Relhgt   Xinit    Yinit     Angle  Szinit
**                        g/s/m2          length-X  length-y
**              -------   ------  ------   -------  -------   -----  ------
   SRCPARAM     PROJECT   0.00005    2       50        25        0      1
```

The sample input file tells AERMOD that PM_{10} is being modeled

Control Pathway - AVERTIME

Use keyword **AVERTIME** to select averaging periods, with the time period following the keyword

For this NAAQS,	Use:	Which will:
Annual $PM_{2.5}$	CO AVERTIME ANNUAL *Or*	Average concentrations over each year of met data, then averages these averages
	CO AVERTIME PERIOD*	Average concentrations over entire met data period, so can be used when you have 5 years of met data
24-hour $PM_{2.5}$	CO AVERTIME 24	Average across each 24-hour period from the available met data
24-hour PM_{10}	CO AVERTIME 24	Average across each 24-hour period from the available met data

*Cannot use both “annual” and “period” in the same run

Guidance Reference:

Appendix J.6.1

Control Pathway – Sample Input File

AE_mobile_sample_file.inp - Notepad

File Edit Format View Help

```
**To run this example input file, copy it as "AERMOD.INP" and type:
**
**    AERMOD
**
** The results for this example are found in file "ae_PMhotspot_test.out"
** In this example, an area source is illustrated, which is relevant for
** both highway and transit projects.
** This example is for illustration purposes only.  6/15/2011
**--------------------------------------------------------------------

CO STARTING
   TITLEONE  An Example Transportation Project
   MODELOPT  FLAT  CONC
   POLLUTID  PM10
   AVERTIME  24
   URBANOPT  200000
   FLAGPOLE  1.8
   RUNORNOT  RUN
CO FINISHED

**-------------------------------------

SO STARTING
**              Srcid     Srctyp  X  Y (Z)
**              ------    ------  -- -- --
   LOCATION     PROJECT   AREA    0  0  0

** Area source parameters
** User guide:  Srcid     Aremis  Relhgt   Xinit    Yinit     Angle  Szinit
**                        g/s/m2          length-X  length-y
**              -------   ------  ------   -------  -------   -----  ------
   SRCPARAM     PROJECT   0.00005    2       50        25        0      1
```

The sample input file tells AERMOD to average concentrations over 24 hours

Guidance Reference:

Appendix J.6.1

Control Pathway - URBANOPT

- Use keyword **URBANOPT** to tell AERMOD to incorporate urban effects on dispersion
  - Syntax for single urban areas:

    CO URBANOPT Urbpop (Urbname) (UrbRoughness)
  - **URBANOPT** should be selected based on the location of the project, not the met data site
  - Requires population of the urban area, e.g. “100000”
  - Use default value of 1 meter for **UrbRoughness** parameter (default is used when parameter omitted)
  - Use of this keyword increases dispersion, because of urban heat island effect
- *Complete this line for a project in an area with an urban population of 350,000:*

Guidance Reference:

Sec 7.5.5 & App J.4.1

Control Pathway – Sample Input File

AE_mobile_sample_file.inp - Notepad

File Edit Format View Help

```
**To run this example input file, copy it as "AERMOD.INP" and type:
**
**    AERMOD
**
** The results for this example are found in file "ae_PMhotspot_test.out"
** In this example, an area source is illustrated, which is relevant for
** both highway and transit projects.
** This example is for illustration purposes only.  6/15/2011
**-----------------------------------------------------------------

CO STARTING
   TITLEONE  An Example Transportation Project
   MODELOPT  FLAT  CONC
   POLLUTID  PM10
   AVERTIME  24
   URBANOPT  200000
   FLAGPOLE  1.8
   RUNORNOT  RUN
CO FINISHED

**-------------------------------------

SO STARTING
**              Srcid     Srctyp  X  Y (Z)
**              ------    ------  -- -- --
   LOCATION     PROJECT   AREA    0  0  0

** Area source parameters
** User guide:  Srcid     Aremis  Relhgt   Xinit    Yinit     Angle  Szinit
**                        g/s/m2          length-X  length-y
**              -------   ------  ------   -------  -------   -----  ------
   SRCPARAM     PROJECT   0.00005    2       50        25        0      1
```

The sample input file tells AERMOD that the project is located in an urban area of 200K

Control Pathway - FLAGPOLE

- Use keyword **FLAGPOLE** to define receptor height
  - » Note – Entered in the CO pathway rather than the RE (receptor) pathway
  - » Followed by user-specified height to be applied to all receptors, unless specified in RE pathway
  - » Usually 1.8 meters or less (*Q for class*: Why?)

- *Define receptor height for an AERMOD run:*

Control Pathway – Sample Input File

AE_mobile_sample_file.inp - Notepad

File Edit Format View Help

```
**To run this example input file, copy it as "AERMOD.INP" and type:
**
**    AERMOD
**
** The results for this example are found in file "ae_PMhotspot_test.out"
** In this example, an area source is illustrated, which is relevant for
** both highway and transit projects.
** This example is for illustration purposes only.  6/15/2011
**-------------------------------------------------------------------

CO STARTING
   TITLEONE  An Example Transportation Project
   MODELOPT  FLAT  CONC
   POLLUTID  PM10
   AVERTIME  24
   URBANOPT  200000
   FLAGPOLE  1.8
   RUNORNOT  RUN
CO FINISHED

**-------------------------------------

SO STARTING
**              Srcid     Srctyp  X  Y (Z)
**              ------    ------  -- -- --
   LOCATION     PROJECT   AREA    0  0  0

** Area source parameters
** User guide:  Srcid     Aremis  Relhgt   Xinit    Yinit     Angle  Szinit
**                        g/s/m2          length-X  length-y
**              -------   ------  ------   -------  -------   -----  ------
   SRCPARAM     PROJECT   0.00005    2       50        25        0      1
```

The sample input file tells AERMOD that all receptors will be 1.8 meters high

Control Pathway – RUNORNOT

- Use keyword **RUNORNOT** to tell the model whether to run or to process setup information only
  - » **RUN** tells AERMOD to run full model calculations
    - – Fatal flaws will halt the run; other potential errors will not
  - » **NOT** tells AERMOD to process setup data and report errors, but no dispersion calculations will be made
    - – **Tip**: set model **NOT** to run, debug errors, then set model to **RUN** (to avoid wasting time generating erroneous results)
- *Complete the line assuming this is the first time you're running the input file:*

CO _____ ____

Control Pathway – Sample Input File

AE_mobile_sample_file.inp - Notepad

File Edit Format View Help

```
**To run this example input file, copy it as "AERMOD.INP" and type:
**
**    AERMOD
**
** The results for this example are found in file "ae_PMhotspot_test.out"
** In this example, an area source is illustrated, which is relevant for
** both highway and transit projects.
** This example is for illustration purposes only.  6/15/2011
**--------------------------------------------------------------------

CO STARTING
   TITLEONE  An Example Transportation Project
   MODELOPT  FLAT  CONC
   POLLUTID  PM10
   AVERTIME  24
   URBANOPT  200000
   FLAGPOLE  1.8
   RUNORNOT  RUN
CO FINISHED

**-------------------------------------

SO STARTING
**               Srcid     Srctyp  X  Y (Z)
**               ------    ------  -- -- --
   LOCATION      PROJECT   AREA    0  0  0

** Area source parameters
** User guide:  Srcid     Aremis  Relhgt   Xinit    Yinit     Angle  Szinit
**                        g/s/m2          length-X  length-y
**               -------  ------  ------   -------  -------   -----  ------
   SRCPARAM      PROJECT   0.00005    2      50        25        0      1
```

The sample input file tells AERMOD to run

(We know it works)

Control Pathway – Your Turn

- *Complete the Control pathway for an AERMOD run for a PM hot-spot analysis where:*
  - » Terrain is flat
  - » NAAQS of interest: annual PM2.5
  - » Project will be located in a city with a population of 594,000
  - » Receptors are at a typical breathing height

```
CO ___________
CO TITLEONE  ____________________
CO __________ FLAT ____
__ __________ _______
__ __________ _______
__ __________ 594000
CO FLAGPOLE ___
CO __________ NOT
CO FINISHED
```

AERMOD Input File Structure

CO

SO

RE

ME

OU

Source information (recall sources are based on MOVES links)

- Each source is defined – type, location, emissions, etc.

Types of Sources in AERMOD

	Point Source	Area Source*	Volume Source*
Different source types could be used in a hot-spot analysis to represent:	• Bus garage or transit terminal exhaust stacks	• Transit or freight terminals • Parking lots • Highways and intersections	

* Use either area or volume sources in AERMOD to simulate a line source; new AERMOD feature allows area sources to be described as a line

Guidance Reference:

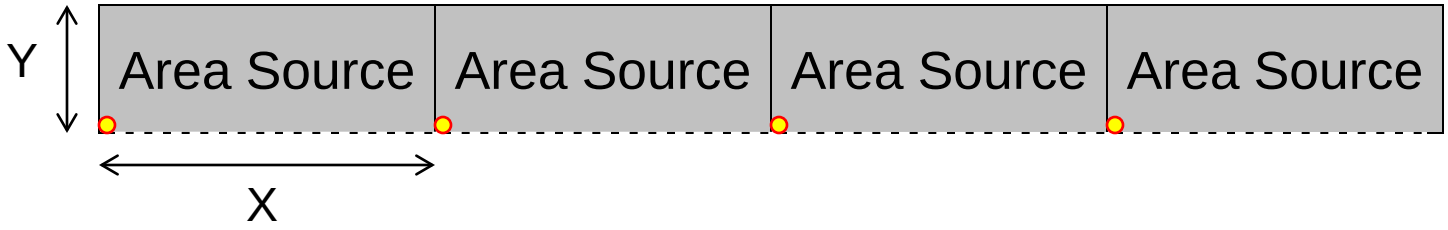
Sec 7.3.2 & App J.3.3-4

Representing Roads in AERMOD

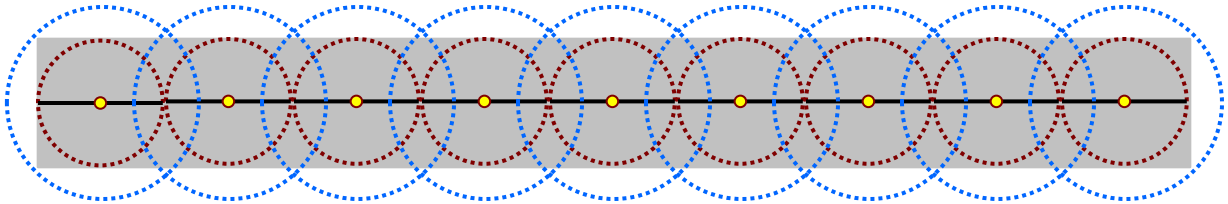
- For modeling purposes, the *road* can be considered the source, rather than the vehicles (given turbulence created by vehicles, convection created by the road heating up, and other phenomena)

A road is a **line source**:

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



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



Source Pathway – Keywords

The Source pathway is where all links (and any other sources that need to be modeled) are described

Source pathway keywords needed for PM hot-spot analyses:

SO STARTING
- **LOCATION**
- **SRCPARAM**
- **SRCGROUP**
- **URBANSRC**
- **EMISFACT**

SO FINISHED

Keywords covered on subsequent slides

Reference: AERMOD User Guide 2.4.2

Source Pathway – Keywords

- **LOCATION**
  SRCPARAM
  SRCGROUP
  } must always be present in this order

- A **LOCATION** and **SRCPARAM** statement is needed for each source

Group statements by keyword

LOCATION LINK1…
LOCATION LINK2…
SRCPARAM LINK1…
SRCPARAM LINK2…

Or by source:

LOCATION LINK1…
SRCPARAM LINK1…
LOCATION LINK2…
SRCPARAM LINK2…

- A **SRCGROUP** statement is needed for each group of sources (might be just one)

Source Pathway – Sample Input File

AE_mobile_sample_file.inp - Notepad

File Edit Format View Help

```
**------------------------------------

SO STARTING
**              Srcid      Srctyp  X  Y (Z)
**              ------     ------  -- -- --
   LOCATION     PROJECT    AREA    0  0  0

** Area source parameters
** User guide:  Srcid      Aremis  Relhgt   Xinit     Yinit     Angle  Szinit
**                         g/s/m2          length-X  length-y
**              -------    ------  ------  -------   -------   -----  ------
   SRCPARAM     PROJECT    0.00005    2      50        25        0      1


   URBANSRC  PROJECT
   SRCGROUP  ALL

SO FINISHED

** Area source called "Project" is a 50 X 25 rectangle,
** With its southwest corner sitting at coordinates 0, 0 (the origin)
** Source parameters are illustrative only -- consult PM hot-spot guidance
**------------------------------------


RE STARTING
RE GRIDCART INNER STA
** User guide:          Xinit Xnum Xdelta Yinit Ynum Ydelta
**                      ----- ---- ------ ----- ---- ------
                 XYINC -100   11    25    -100   10   25
RE GRIDCART INNER END
```

LOCATION

SRCPARAM

URBANSRC

SRCGROUP

Source Pathway – LOCATION

- Use keyword **LOCATION** to identify a single source ID (name), what type of source it is, and its location
  - » Needed for each unique source (e.g., link)
  - » Each source needs to be defined in x, y, z coordinates

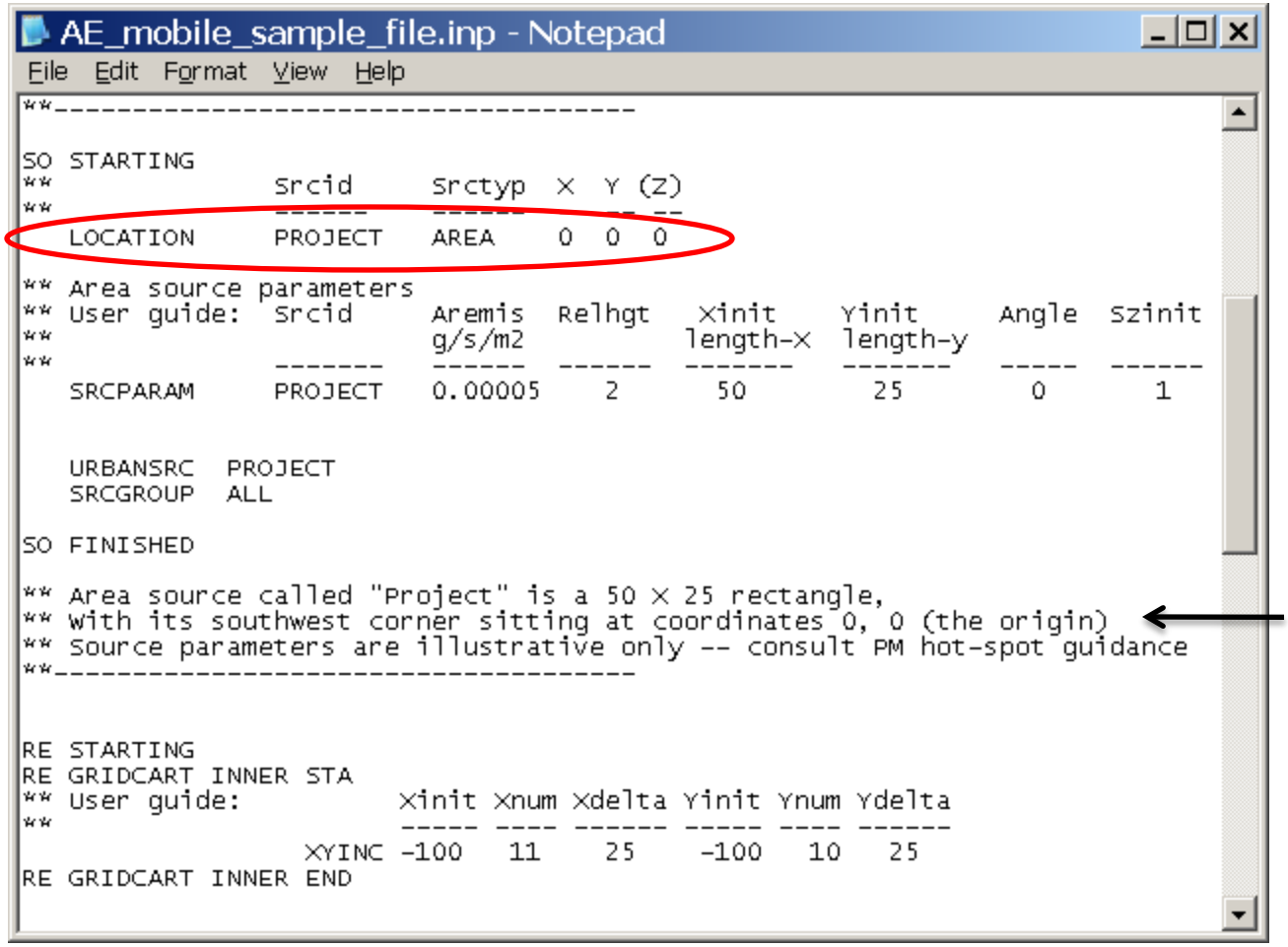
- Syntax: **SO LOCATION Srcid Srctyp x y (z)**
  - » Srcid = user defined, alphanumeric id up to 12 characters

    Tip: Base the source id on the MOVES link number, e.g., MOVES link 15 is split into several source id's, each with a **LOCATION** statement (for Srcid LINK15a, Srcid LINK15b etc.)
  - » Srctyp = **POINT**, **VOLUME**, **AREA**, **LINE, AREAPOLY**, or **AREACIRC**
  - » X, Y, Z coordinates
    - – Z is optional and can be left out
    - – Srctype **LINE** followed by two sets of x, y coordinates (the midpoint of each end)

Guidance Reference:

Sec 7.3.2 & App J.3.3

Source Pathway – Sample Input File



LOCATION

...the source id "PROJECT" is an area source with coordinates of 0, 0, 0 meters

Coordinates are for the SW corner of this rectangle, as noted on the comment line

Source Pathway – LOCATION

- *Complete the LOCATION statement for Link1 and Link2, which are rectangular road segments modeled as area sources*
  - » Link 1 (x, y) coordinates: (289, 679.9)
  - » Link 2 (x, y) coordinates: (299.5, 673)

```
SO LOCATION LINK1 _____ ___ _____ __
SO LOCATION _____ _____ ___ _____ __
```

Options for Specifying **AREA** Sources in AERMOD

1. **AREA**: used to specify a rectangle
   - » X, Y : the vertex of the southwest corner if no angle specified

2. **LINE**: also used to specify a rectangle
   - » More information on next slide

3. **AREAPOLY**: used to specify an area source as an irregularly-shaped polygon of 3 to 20 sides
   - » X, Y: the first vertex of the polygon

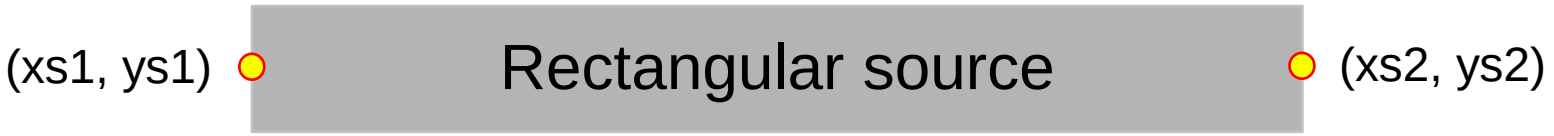
4. **AREACIRC**: used to specify a circular-shaped source
   - » Modeled as an equal-area polygon of 20 sides
   - » X, Y: the center of the source
   - » Unlikely to be used for transportation projects; not covered in this course (see AERMOD user guide for more)

- PM Hot-spot Guidance allows any of these options to be used for transportation projects

LINE: a New Option for Specifying **AREA** Sources in AERMOD

- **LINE** added to the December 2012 version of AERMOD
  - » An alternative to **AREA** source type for rectangular sources
  - » Produces identical results as **AREA** for equivalent source inputs
  - » Specify start and end point of the line in LOCATION, and width in SRCPARAM

- Syntax: **SO LOCATION Srcid LINE xs1 ys1 xs2 ys2 (z)**
  - » Srcid = user defined, alphanumeric id up to 12 characters
  - » Xs1, Ys1 are the coordinates for the midpoint of one end of the line; Xs2, Ys2 are the coordinates for the midpoint of the other end
  - » Z is optional and can be left out



Source Pathway – SRCPARAM

- Use keyword **SRCPARAM** to specify source parameters for a particular source ID named in a previous **LOCATION** statement
  - e.g., how much the source emits
  - Will be needed for each unique source id

- Parameters that follow **SRCPARAM** vary based on "srctyp:"
  - Point
  - Area
  - Areapoly
  - Line
  - Volume

Source Pathway – SRCPARAM **Point** Sources

- Syntax for keyword **SRCPARAM** for point sources:
  SO SRCPARAM Srcid Ptemis Stkhgt Stktmp Stkvel Stkdia

  - Srcid = use same alphanumeric identifier as in **LOCATION**
  - Ptemis = emission rate in grams per second
  - Stkhgt = release height above ground in meters
  - Stktmp = stack gas exit temperature in kelvin
  - Stkvel = stack gas exit velocity in meters per second
  - Stkdia = stack inside diameter in meters

Transportation Examples of Point Sources

- Tunnel ventilation towers
- Transit or other terminal exhaust stacks

Tunnel ventilation tower

Source Pathway – SRCPARAM
Point Sources

- Example:

  SO SRCPARAM STACK1 16.71 25 444.0 22.7 2.74

- *For this example, indicate the following and include units as appropriate*
  - » Source ID: _____
  - » Emission rate: _____
  - » Release height: _____
  - » Exit temperature: _____
  - » Exit velocity: _____
  - » Inside stack diameter: _____

Source Pathway – **Point** Sources

- May also need to address building downwash
  - » Air mixing downward on the downwind side of a building
- AERMOD can model the effects through the BPIPPRIME building downwash pre-processor
- Not covered in this training

Guidance Reference:

Appendix J.3.3 & J.3.4

Source Pathway – SRCPARAM **Area** Sources

- Syntax for keyword **SRCPARAM** for area sources:

  SO SRCPARAM Srcid Aremis Relhgt Xinit Yinit Angle Szinit

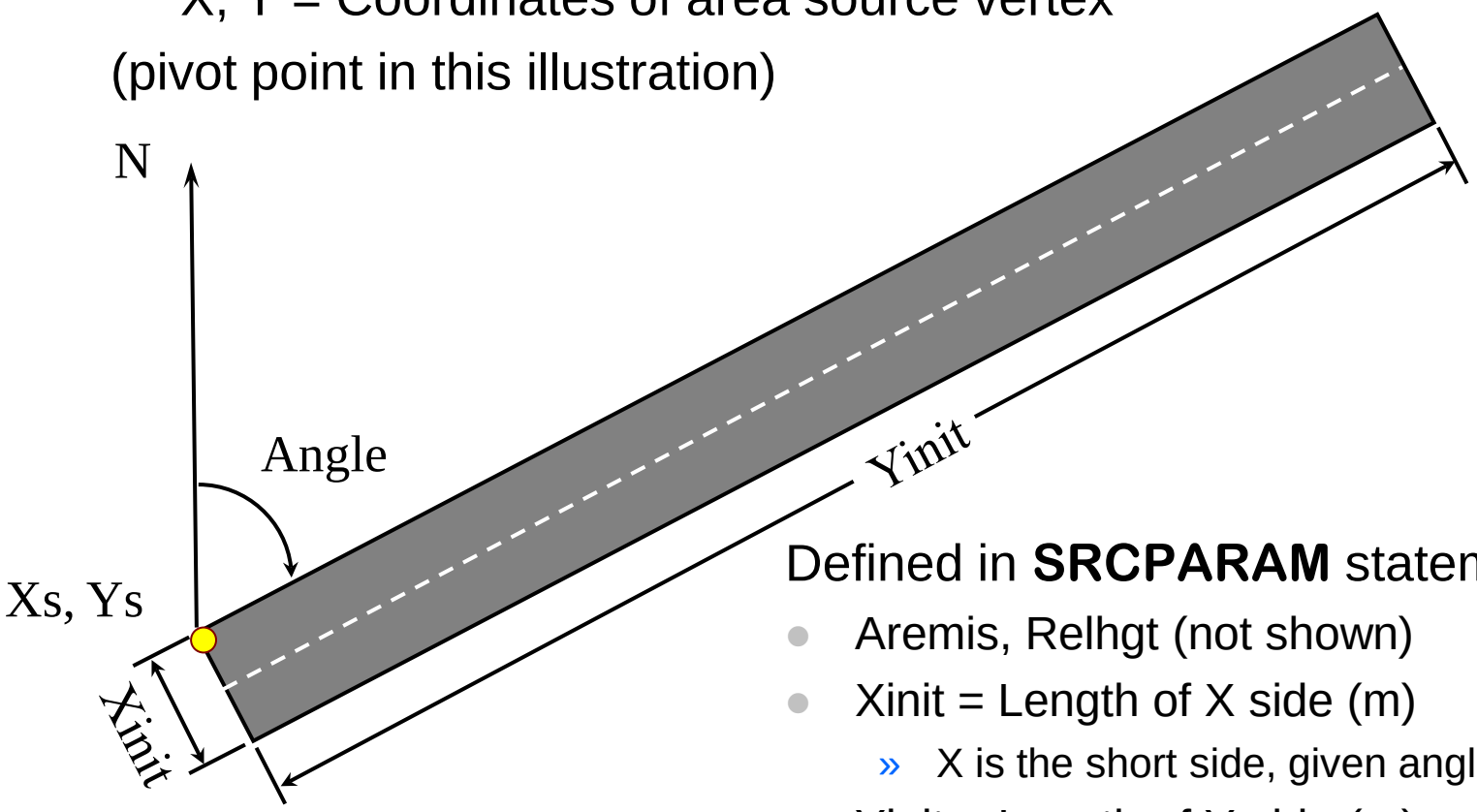
  - **Srcid** = use same alphanumeric identifier as in **LOCATION**
  - **Aremis** = area emission rate in g/s/m^2
  - **Relhgt** = release height above ground in meters
  - **Xinit** = length of X side of the area (in east-west direction if Angle 0°) in meters
  - **Yinit** = length of Y side (in north-south direction if Angle is 0°) in m
    - If width & length differ by more than 100 x, AERMOD produces a warning message ; does not affect model run
  - **Angle** = orientation angle for rectangular area (in deg from north, measured positive clockwise)
  - **Szinit** = initial vertical dispersion coefficient in meters

A Highway Link as an **Area** Source

Defined in **LOCATION** statement:

- X, Y = Coordinates of area source vertex

(pivot point in this illustration)



Defined in **SRCPARAM** statement:

- Aremis, Relhgt (not shown)
- Xinit = Length of X side (m)
  - » X is the short side, given angle of rotation
- Yinit = Length of Y side (m)
- Angle = orientation angle
- Szinit (not shown)

Source Pathway – SRCPARAM
LINE-type **Area** Sources

- Syntax for keyword **SRCPARAM** for LINE sources:

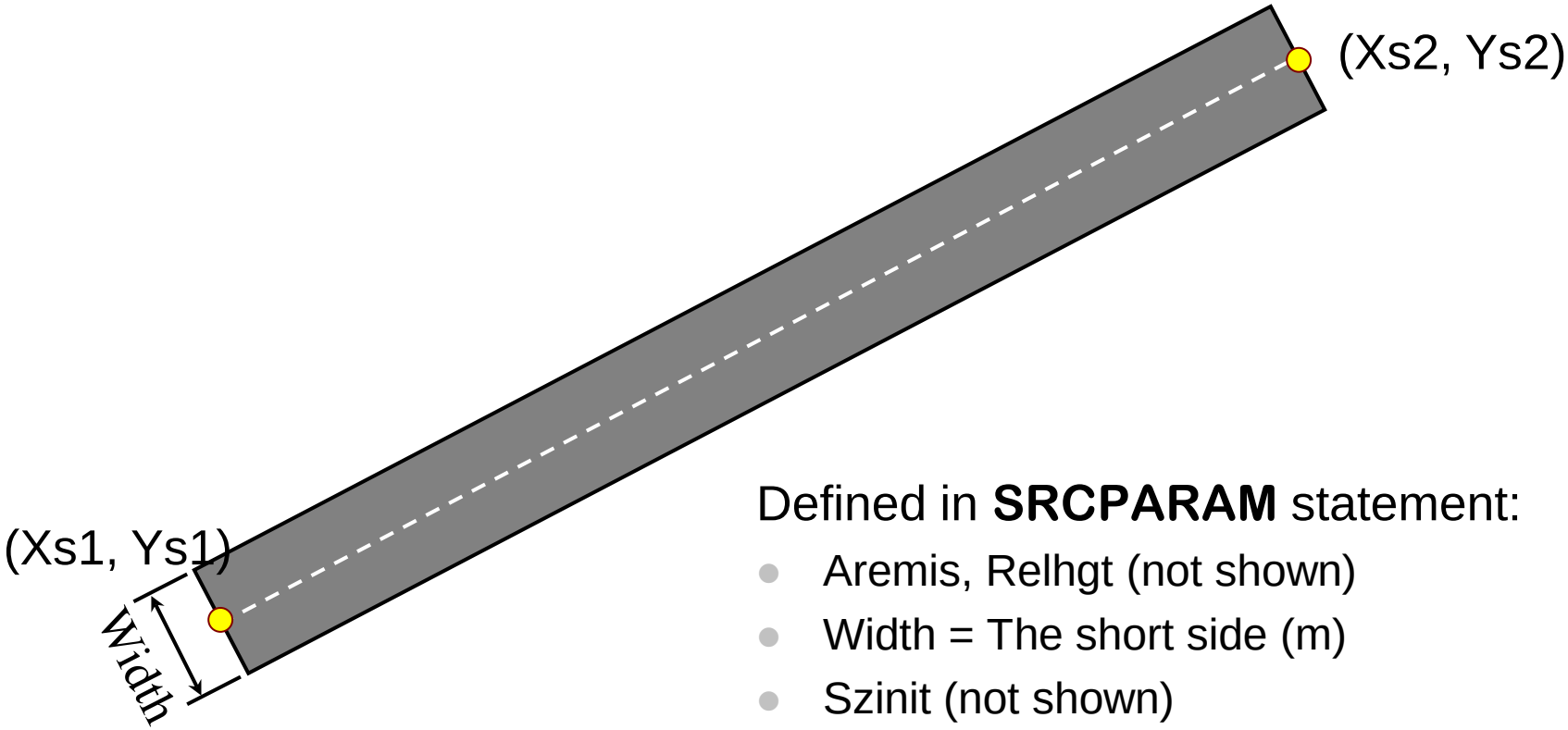
  SO SRCPARAM Srcid Lnemis Relhgt Width Szinit

  - **Srcid** = use same alphanumeric identifier as in **LOCATION**
  - **Lnemis** = area emission rate in g/s/m^2
  - **Relhgt** = release height above ground in meters
  - **Width** = width of the source in in meters
    - If width & length differ by more than 100 x, AERMOD produces a warning message ; does not affect model run
  - **Szinit** = initial vertical dispersion coefficient in meters

A Highway Link as a **LINE**-type **Area** Source

Defined in **LOCATION** statement:

- Xs1, Ys1, Xs2, Ys2 = Coordinates of midpoint of ends



Defined in **SRCPARAM** statement:

- Aremis, Relhgt (not shown)
- Width = The short side (m)
- Szinit (not shown)

Source Pathway – SRCPARAM
Area Sources

- Emission information from MOVES, e.g., from the two MOVES mini runs:

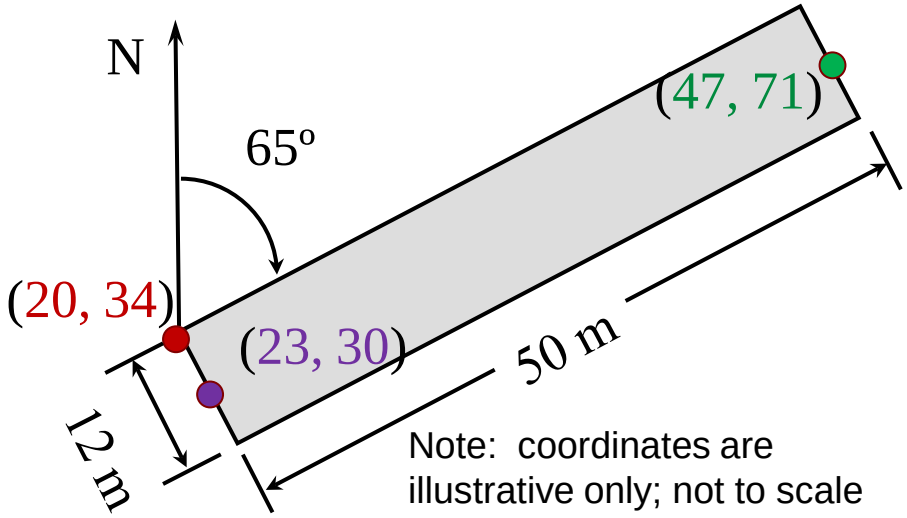
movesRunID	linkID	pollutantID	gramsPerHour
1	1	Total PM10	9.1084408434...
1	2	Total PM10	8.5155121996...
2	1	Total PM10	6.9325177883...
2	2	Total PM10	6.3830091860...

- ***Q for class:*** what other information do we need to convert MOVES output for an AERMOD input file?

  (recall **Aremis** and **Lnemis** = area emission rate in g/s/m^2)

Source Pathway – Your Turn

- *Complete the LOCATION and SRCPARAM statements for this source using AREA and LINE*
  - » Source emits 0.00042 g/s/m^2
  - » From a release height of 2.5 m
  - » Szinit is1.5 m



If srctyp **AREA** is used:

```
SO _________ LINK3A ______ __ __ __
SO SRCPARAM LINK3A ______ ____ __ __ 65 __
```

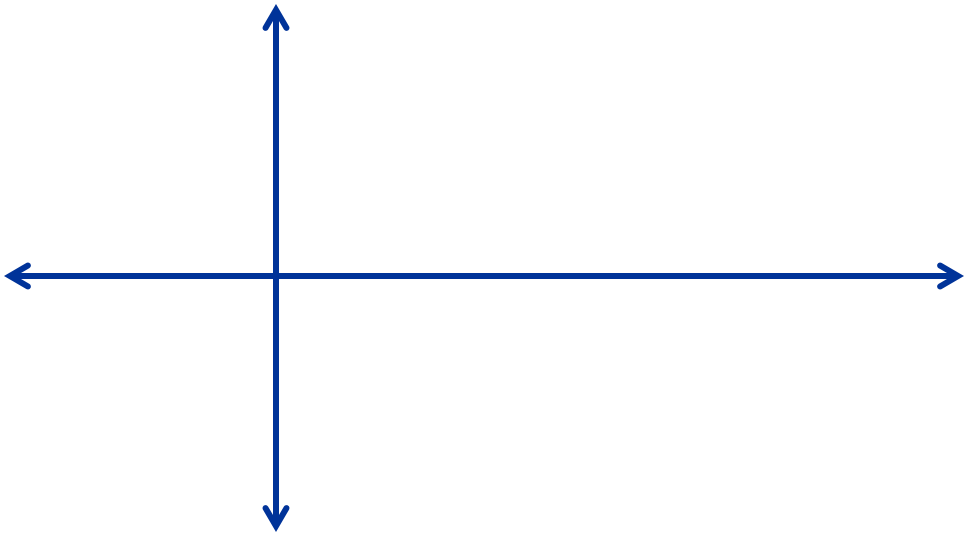
If srctyp **LINE** is used:

```
SO _________ LINK3A ______ __ __ __ __ __
SO SRCPARAM LINK3A ______ ____ __ __
```

Source Pathway – Sample Input File

- *Sketch the source below based on LOCATION and SRCPARAM statements:*

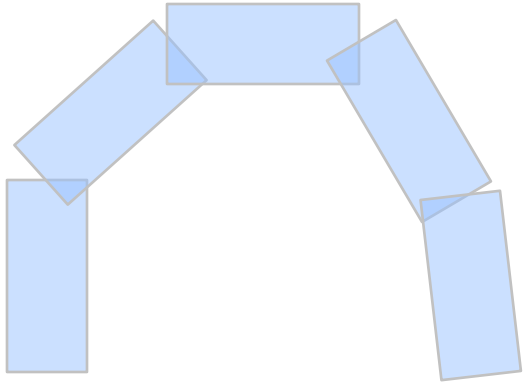
```
SO LOCATION PROJECT AREA 0 0 0
SO SRCPARAM PROJECT 0.00005 2 50 25 0 1
```



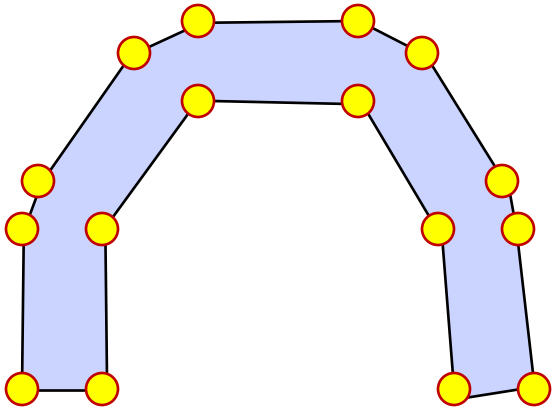
Acceptable Approaches: **AREA** and **AREAPOLY**

- When **AREA** is used for roadways, minimize gaps and overlaps between sources
  - » Gaps can result in underestimated concentrations
  - » Overlaps can result in overestimated concentrations
- **AREAPOLY** allows user to define source shapes more precisely
  - » User defines specific coordinates of vertices (dots)
  - » Commercial AERMOD interfaces may allow user to define shapes easily

A curved link can be defined with **AREA** sources:



The same curved link can be defined with **AREAPOLY**:



Source Pathway – SRCPARAM **Areapoly** Sources

- Syntax for keyword **SRCPARAM** for **AREAPOLY** sources:

  SO SRCPARAM Srcid Aremis Relhgt Nverts (Szinit)

  - Srcid = use same alphanumeric identifier as in **LOCATION**
  - Aremis = area emission rate in g/s/m^2
  - Relhgt = release height above ground in meters
  - Nverts = number of vertices (or sides) of the area source polygon
  - Szinit = initial vertical dispersion coefficient in meters

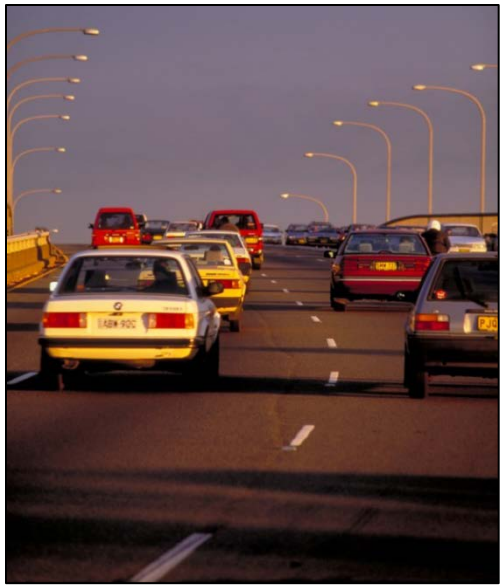
- Syntax for keyword **AREAVERT** for **AREAPOLY** sources:

  SO AREAVERT Srcid Xv(1) Yv(1) Xv(2) Yv(2)… Xv(i) Yv(i)

  - Xv(i) and Yv(i) are the x- and y- coordinates of the vertices of the area source polygon
  - There must be Nverts pairs of coordinates for the area source
  - First vertex, Xv(1), Yv(1), must match x, y in **LOCATION** statement
  - Remaining vertices may be defined either clockwise or counter-clockwise

Source Pathway – Release Height (Relhgt)

- May be estimated from the midpoint of the initial vertical dimension:
  - » For moving light-duty vehicles, 1.3 meters
  - » For moving heavy-duty vehicles, 3.4 meters



Guidance Reference:

Appendix J.3.3

Source Pathway – Release Height (Relhgt)

- Release height of mixed fleets may be estimated using an emissions-weighted or volume-weighted average:
  - » Emissions-weighted average: e.g.,

    Light-duty = 40% of emissions

    Heavy-duty = 60% of emissions,

    Source release height = (0.4 * 1.3) + (0.6 * 3.4) = 2.6 meters

- Or, could be based on traffic volumes:

  light-duty/heavy-duty vehicle fractions

Guidance Reference:

Appendix J.3.3

Source Pathway – Guidance
Initial Vertical Dimension Coefficient

- Assume the *initial vertical dimension* is about 1.7 times the average vehicle height, to account for the effects of vehicle-induced turbulence:
  - For light-duty vehicles: about 2.6 meters
  - For heavy-duty vehicles: about 6.8 meters

- For mixed fleets, estimate the initial vertical dimension using an emissions-weighted or volume-weighted average, e.g.:
  - Light-duty vehicles= 40% of emissions
  - Heavy duty vehicles = 60% of emissions
  - Initial vertical dimension = (0.4 * 2.6) + (0.6 * 6.8) = 5.1 meters

- Calculate Initial Vertical Dispersion Coefficient (Szinit)
  - Divide the *initial vertical dimension* of the source by 2.15
  - For typical light-duty vehicles: Szinit = 1.2 meters
  - For typical heavy-duty vehicles: Szinit = 3.2 meters

Source Pathway – Sample Input File

AE_mobile_sample_file.inp - Notepad

File Edit Format View Help

```
**------------------------------------

SO STARTING
**              Srcid     Srctyp  X  Y (Z)
**              ------    ------  -- -- --
   LOCATION     PROJECT   AREA    0  0  0

** Area source parameters
** User guide:  Srcid     Aremis  Relhgt   Xinit     Yinit     Angle  Szinit
**                        g/s/m2          length-X  length-y
**              -------   ------  ------  -------   -------   -----  ------
   SRCPARAM     PROJECT   0.00005    2       50        25        0      1


   URBANSRC  PROJECT
   SRCGROUP  ALL

SO FINISHED

** Area source called "Project" is a 50 X 25 rectangle,
** with its southwest corner sitting at coordinates 0, 0 (the origin)
** Source parameters are illustrative only -- consult PM hot-spot guidance
**------------------------------------


RE STARTING
RE GRIDCART INNER STA
** User guide:          Xinit Xnum Xdelta Yinit Ynum Ydelta
**                      ----- ---- ------ ----- ---- ------
                 XYINC -100   11    25    -100   10    25
RE GRIDCART INNER END

** "Inner" receptor grid extends 100 meters beyond the project
```

Units are meters

SRCPARAM

The source "Project":

- Emits 0.00005 g/s/m^2 = the base emission rate
- Release height = 2 m
- Is 50 m by 25 m
- At 0 degree angle
- With initial vertical dispersion coefficient of 1 m

Note: parameters are illustrative only; consult PM hot-spot guidance

Source Pathway – SRCPARAM **Volume** Sources

- Keyword **SRCPARAM** is followed by
  - » Srcid = use same identifier as in **LOCATION**
  - » Vlemis = volume emission rate in g/s
  - » Relhgt = release height (center of volume) above ground in meters
  - » Syinit = initial lateral dispersion coefficient (i.e., length of Y side divided by 2.15) of the volume in meters
  - » Szinit = initial vertical dispersion coefficient (i.e., vertical dimension divided by 2.15) of volume in meters
- See PM hot-spot guidance for more information

Guidance Reference:

Appendix J.3.3

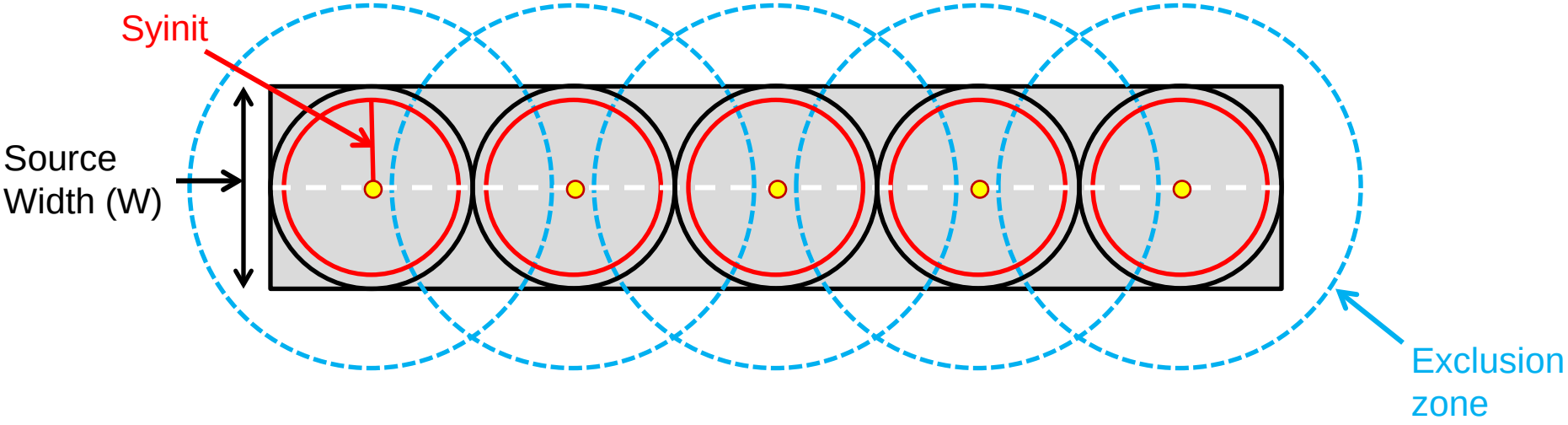
A Highway Link as a Series of **Volume** Sources

Defined in **LOCATION** statement:

- Xs, Ys = Coordinates of volume source center

Defined in **SRCPARAM** statement:

- Vlemis, Relhgt (not shown)
- Syinit = Initial lateral dispersion coefficient (W / 2.15)
- Szinit not shown



Exclusion zone (radius = Syinit * 2.15 + 0.99 m)

Volume Sources

Issues to consider when using volume sources:

1. Source width

2. Spacing

Volume Sources: Appropriate Width

- Receptors should not be placed within exclusion zone
  - based on EPA guidance from OAQPS
  - concentrations are not calculated within it
- Receptors should be sited as near as 5 m from a source (e.g., the edge of a traffic lane)
- Because of the exclusion zone, the width of a volume source should be **≤ 8 m**
  - Typical highway lane = 12 ft (3.6 m)
- Model any 3 lane or larger highway using
  - Volume sources for each lane, or
  - Area sources

Guidance Reference:

Section 7.6.2

Lane Width

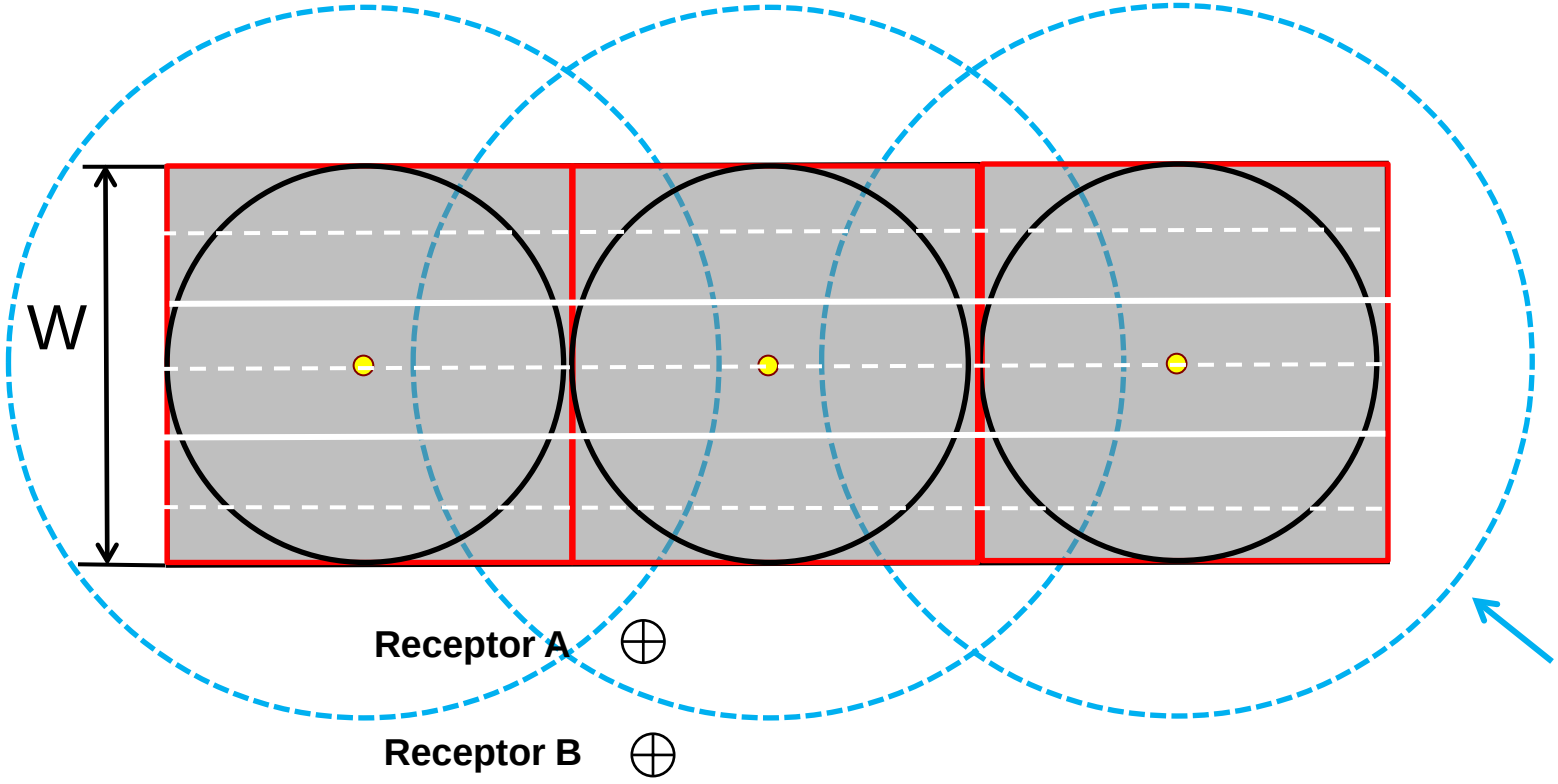
Ranges for Lane Width

Type of Roadway	Rural		Urban	
	US (feet)	Metric (meters)	US (feet)	Metric (meters)
Freeway	12	3.6	12	3.6
Ramps (1-lane)	12-30	3.6-9.2	12-30	3.6-9.2
Arterial	11-12	3.3-3.6	10-12	3.0-3.6
Collector	10-12	3.0-3.6	10-12	3.0-3.6
Local	9-12	2.7-3.6	9-12	2.7-3.6

(Source: A Policy on Geometric Design of Highways and Streets, AASHTO)
Found at http://safety.fhwa.dot.gov/geometric/pubs/mitigationstrategies/chapter3/3_lanewidth.htm

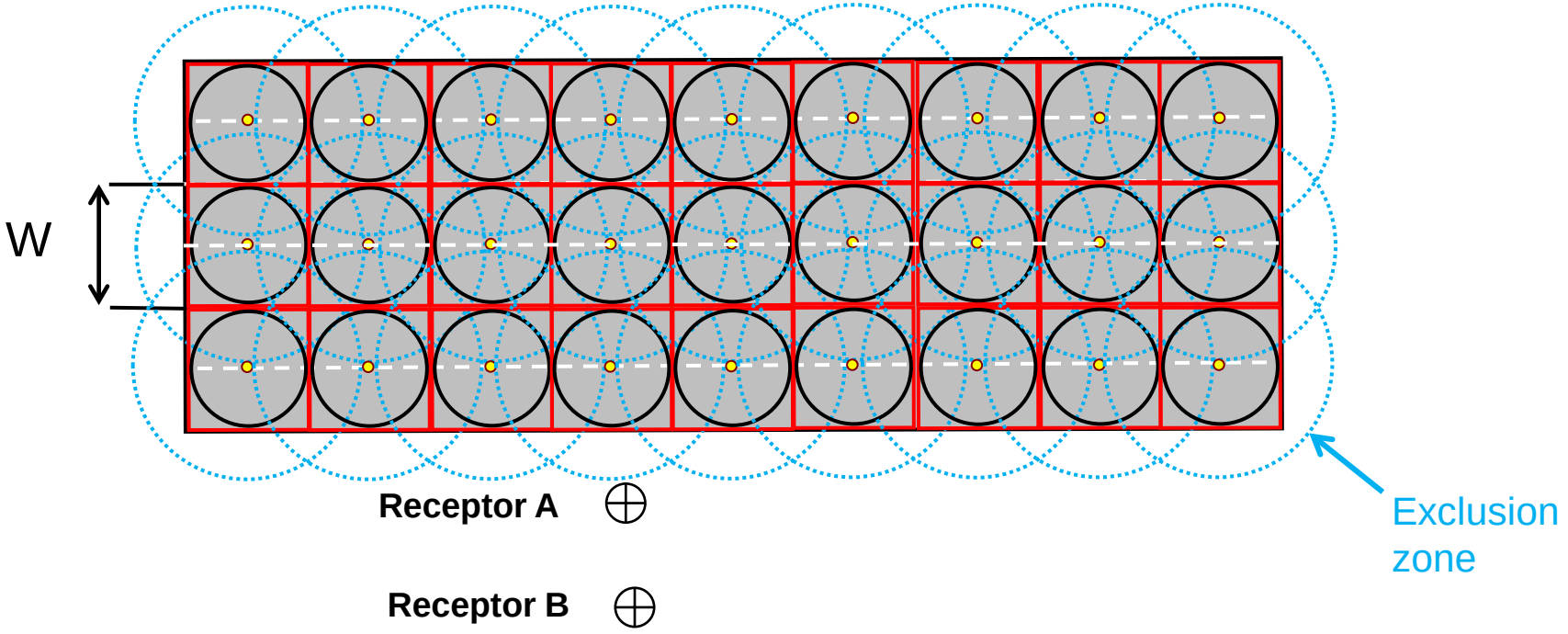
Incorrect Volume Source Width

- Volume sources are too wide, excluding area where receptors should be placed
- W = Link width



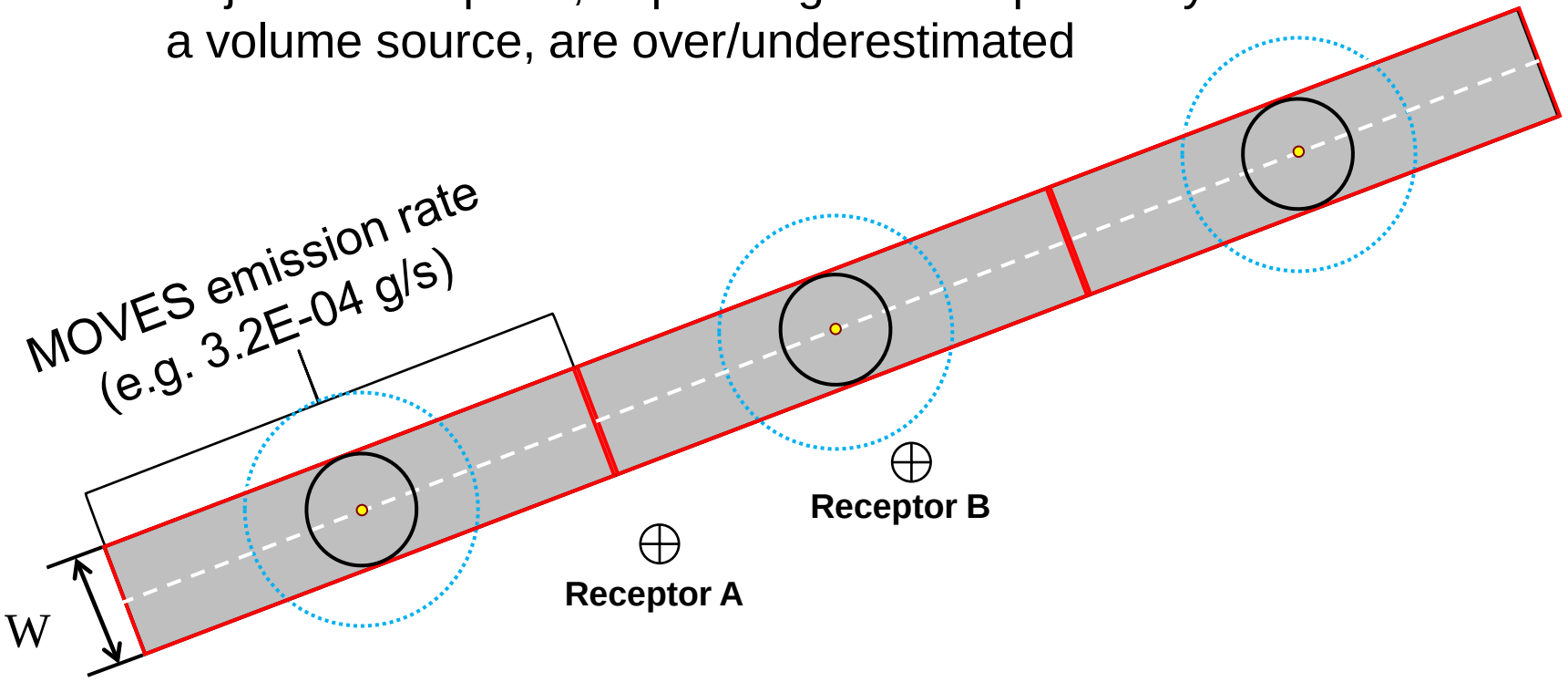
Correct Volume Source Width

- Volume sources are no more than 8 m wide
  - » Receptor A is no longer in the exclusion zone



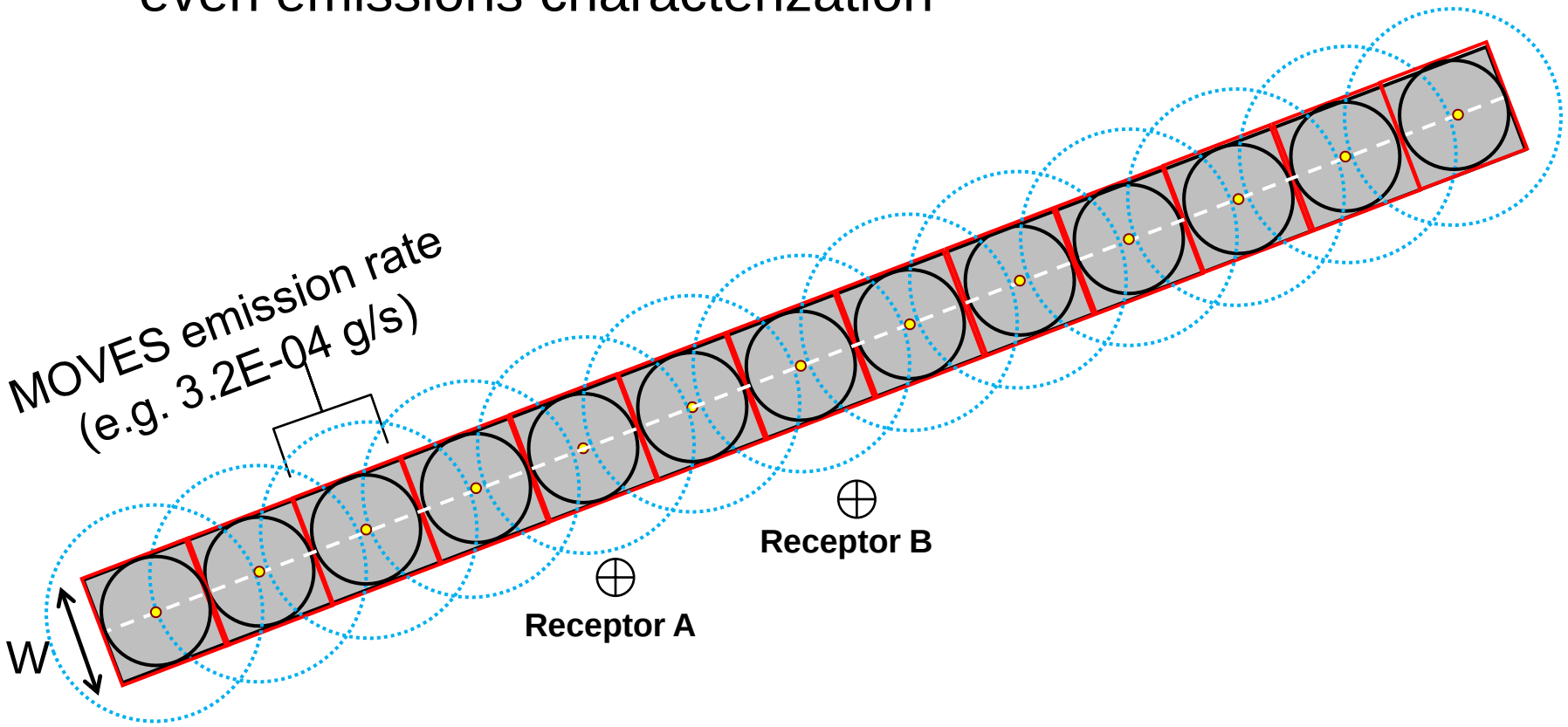
Incorrect Volume Source Spacing

- Volume sources are spaced too far apart, which creates a non-uniform emission characterization
- Adjacent receptors, depending on their proximity to the center of a volume source, are over/underestimated



Correct Volume Source Spacing

- Adjacent volume sources, spaced properly, create an even emissions characterization



Additional Options for **Area** and **Volume** Sources

- For source representing both light-duty (LD) and heavy-duty (HD) vehicles, AERMOD allows Syinit, Szinit, and Relhgt to change by hour of the day
  - » May want to consider if % of heavy-duty vehicles changes significantly through day
  - » See the PM hot-spot guidance for more information

- Alternative approach to modeling light-duty and heavy-duty sources:
  - » Create two superimposed versions of each roadway source, representing LD and HD traffic
  - » Assign Syinit, Szinit, and Relhgt specific to light-duty or heavy-duty traffic for each link
  - » **SRCGROUP** allows tracking HD & LD contributions separately

Guidance Reference:

Appendix J.3.3

Source Pathway – URBANSRC

- Use keyword **URBANSRC** to define which sources will emit under urban dispersion conditions
  - When keyword **URBANOPT** is used in **CO** pathway, keyword **URBANSRC** is used in **SO** pathway
- Keyword **URBANSRC** followed by either
  - all “urban” sourceIDs
  - or word **ALL** – when there is only one urban area, and all sources should be treated as urban (most cases)
- Applies to point, area, and volume sources
- Examples:

```
SO URBANSRC  LINK1  LINK2  LINK3  LINK4  LINK5
SO URBANSRC ALL
```

Source Pathway – Sample Input File

AE_mobile_sample_file.inp - Notepad

File Edit Format View Help

```
**-------------------------------------

SO STARTING
**                Srcid      Srctyp  X  Y (Z)
**                ------     ------  -- -- --
   LOCATION       PROJECT    AREA    0  0  0

** Area source parameters
** User guide:   Srcid      Aremis   Relhgt   Xinit     Yinit      Angle  Szinit
**                          g/s/m2            length-X  length-y
**                -------    ------  ------   -------   -------    -----  ------
   SRCPARAM       PROJECT    0.00005    2       50         25         0       1


   URBANSRC   PROJECT
   SRCGROUP   ALL

SO FINISHED

** Area source called "Project" is a 50 X 25 rectangle,
** With its southwest corner sitting at coordinates 0, 0 (the origin)
** Source parameters are illustrative only -- consult PM hot-spot guidance
**-------------------------------------


RE STARTING
RE GRIDCART INNER STA
** User guide:           Xinit Xnum Xdelta Yinit Ynum Ydelta
**                        ----- ---- ------ ----- ---- ------
                  XYINC -100   11    25    -100   10   25
RE GRIDCART INNER END

** "Inner" receptor grid extends 100 meters beyond the project
```

URBANSRC
Indicates that source “Project” is an urban source

Source Pathway – SRCGROUP

- Use keyword **SRCGROUP** to group contributions from particular sources together

  Syntax: **SO SRCGROUP GroupID (SourceIDs** and/or **SrcRanges)**

  - The user provides the "groupID" name
  - SourceIDs are the same as used in **LOCATION**
  - SrcRanges can be used with SourceIDs that vary by number

- There must be at least one source group, which may be **all** sources:

  SRCGROUP ALL

Source Pathway – SRCGROUP

- Users may want to separate contributions of various sources, for example:
  - » Terminal / highway contributions

    SRCGROUP HIGHWAY EBI40 WBI40 (shows source IDs)

    SRCGROUP TERMINAL TERM1-TERM4 (shows SrcRange)

  - » Project / nearby source contributions

    SRCGROUP PROJECT LINK1-LINK15 (shows SrcRange)

    SRCGROUP PORT PORT1-PORT8 (shows SrcRange)

  - » Light-duty / heavy-duty traffic (if modeled separately)

    SRCGROUP CAR LGT1-LGT12 (shows SrcRange)

    SRCGROUP TRUCK HVY1-HVY12 (shows SrcRange)

Source Pathway – Sample Input File

AE_mobile_sample_file.inp - Notepad

File Edit Format View Help

```
**-------------------------------------

SO STARTING
**                Srcid      Srctyp  X  Y (Z)
**                ------     ------  -- -- --
   LOCATION       PROJECT    AREA    0  0  0

** Area source parameters
** User guide:   Srcid      Aremis   Relhgt   Xinit     Yinit      Angle  Szinit
**                          g/s/m2            length-X  length-y
**                -------   ------   ------   -------   -------    -----  ------
   SRCPARAM       PROJECT   0.00005    2       50         25         0       1


   URBANSRC  PROJECT
   SRCGROUP  ALL

SO FINISHED

** Area source called "Project" is a 50 X 25 rectangle,
** With its southwest corner sitting at coordinates 0, 0 (the origin)
** Source parameters are illustrative only -- consult PM hot-spot guidance
**-------------------------------------


RE STARTING
RE GRIDCART INNER STA
** User guide:           Xinit Xnum Xdelta Yinit Ynum Ydelta
**                        ----- ---- ------ ----- ---- ------
                  XYINC -100   11    25    -100   10   25
RE GRIDCART INNER END

** "Inner" receptor grid extends 100 meters beyond the project
```

SRCGROUP

Concentrations from all sources (only one in this case) reported together

Source Pathway – EMISFACT

- Use keyword **EMISFACT** to vary emission rates by season, hour of day, etc.
  - » Allows use of MOVES or EMFAC emission factors in AERMOD input file

- Keyword **EMISFACT** followed by…
  - » sourceID
  - » **Qflag** (secondary keyword)

Guidance Reference:

Appendix J.3.5

Source Pathway – EMISFACT

- **Qflag** (secondary keyword) indicates how emissions will vary:
  - **SEASON** – seasonally (n=4)
  - **MONTH** – monthly (n=12)
  - **HROFDY** – by hour-of-day (n=24)
  - **SEASHR** – season by hour-of-day (n=96)
  - **SHRDOW** –season by hour-of-day and day-of-week (M-F, Sat, Sun) (n=288)
  - **SHRDOW7** –season by hour-of-day by day-of-week, seven days of week (n=672)

- Guidance recommends using **SEASHR** for MOVES output by hour and season for typical traffic data
  - If additional data available, use another **Qflag** word (**SHRDOW**, **SHRDOW7**) to provide more detail

Source Pathway – EMISFACT

Example showing **EMISFACT** with **SEASHR** (factors by season, and hour of day)

SEASHR factors begin with Winter, 12 a.m. – 1 a.m. (reported as "1 a.m.")

```
SO EMISFACT LINK1    SEASHR 0.37 0.44 0.51 0.58 0.65 0.72 0.79 0.86
SO EMISFACT LINK1    SEASHR 0.93 1.00 0.93 0.86 0.79 0.72 0.65 0.72
SO EMISFACT LINK1    SEASHR 0.79 0.86 1.00 0.93 0.86 0.79 0.72 0.65
SO EMISFACT LINK1    SEASHR 0.37 0.44 0.51 0.58 0.65 0.72 0.79 0.86
SO EMISFACT LINK1    SEASHR 0.93 1.00 0.93 0.86 0.79 0.72 0.65 0.72
SO EMISFACT LINK1    SEASHR 0.79 0.86 1.00 0.93 0.86 0.79 0.72 0.65
SO EMISFACT LINK1    SEASHR 0.37 0.44 0.51 0.58 0.65 0.72 0.79 0.86
SO EMISFACT LINK1    SEASHR 0.93 1.00 0.93 0.86 0.79 0.72 0.65 0.72
SO EMISFACT LINK1    SEASHR 0.79 0.86 1.00 0.93 0.86 0.79 0.72 0.65
SO EMISFACT LINK1    SEASHR 0.37 0.44 0.51 0.58 0.65 0.72 0.79 0.86
SO EMISFACT LINK1    SEASHR 0.93 1.00 0.93 0.86 0.79 0.72 0.65 0.72
SO EMISFACT LINK1    SEASHR 0.79 0.86 1.00 0.93 0.86 0.79 0.72 0.65
```

Winter factors

Spring factors

Summer factors

Fall factors

Source Pathway – EMISFACT

- The 96 factors following **SEASHR** (4 seasons, 24 hours) vary the emission rate defined for each source
  - E.g., if SEASHR factor = 0.9, and
  - Source emission rate = 5 g/s/m^2,
  - AERMOD calculates that the source emits 4.5 g/s/m^2 in that specific hour and season

Q for class: In what statement is the emission rate defined?

- Keyword: _____

- **Tip**: Define emission rate = 1; then in **SEASHR** use MOVES emission factors

Source Pathway – EMISFACT

- **SEASHR** factors will be derived from MOVES output (quarters, hours)

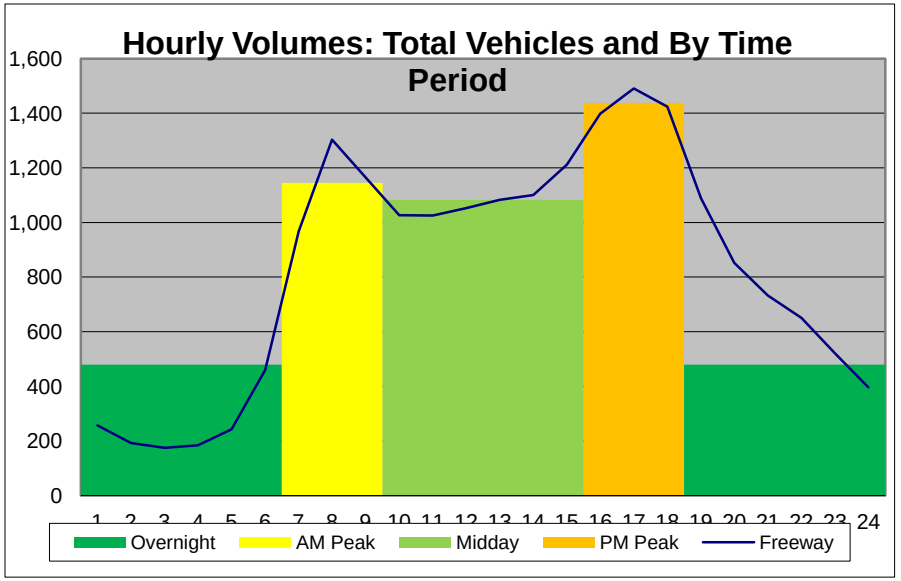
- AERMOD seasons are:
  - » Winter (Dec., Jan., Feb.): factors based on Jan MOVES runs
  - » Spring (Mar., Apr., May): factors based on April MOVES runs
  - » Summer (Jun., Jul., Aug.): factors based on July MOVES runs
  - » Fall (Sep., Oct., Nov.): factors based on October MOVES runs

- For each of 4 quarters/seasons, you have four MOVES runs for weekday time periods:
  - » Morning peak (AM)
  - » Midday (MD)
  - » Evening peak (PM)
  - » Overnight (ON)

Source Pathway – EMISFACT

From *Module 2*, one suggested approach:

- Use morning peak MOVES run for 6 – 9 a.m.
- Use midday MOVES run for 9 a.m. – 4 p.m.
- Use evening peak MOVES run for 4 – 7 p.m.
- Use overnight MOVES run for 7 p.m. – 6 a.m.



Fill in factors for 24 hours of Winter, if base emissions rate = 1 and MOVES output is as follows:

- Morning peak: 0.025 Evening peak: 0.027
- Midday: 0.013 Overnight: 0.011

```
SO EMISFACT LINK1   SEASHR _____ _____ _____ _____ _____ _____ _____ _____
SO EMISFACT LINK1   SEASHR _____ _____ _____ _____ _____ _____ _____ _____
SO EMISFACT LINK1   SEASHR _____ _____ _____ _____ _____ _____ _____ _____
```

Source Pathway – EMISFACT

- A unique EMISFACT table is needed for each source
- *For class discussion:*
  - » MOVES “Link15” (curve) is divided into three AERMOD sources: Link15a, Link15b, and Link15c
  - » *For each season and hour, would the emissions rate for Link15 in g/s/m^2 apply to all three AERMOD sources?*
  - » *Should the **g/s/m^2** emissions rate be divided by 3, since there are three sources? Why or why not?*
  - » *Will the EMISFACT tables for each of these three sources be different or identical?*

AERMOD Input File Structure

CO

SO

RE

ME

OU

Receptor information

- Number and location

Receptor Pathway – Keywords

Receptor pathway keywords for PM hot-spot analyses:

RE STARTING
- **DISCCART**
- **DISCPOLR**
- **GRIDCART**
- **GRIDPOLR**

RE FINISHED

Receptors can be located using one or more of these keywords

Placing Receptors for AQ Modeling

- Receptor spacing should be of sufficient resolution to capture concentration gradients around the locations of maximum modeled concentrations
  - » Receptors should begin 5 m from roadway edge, extending out ~500 m
  - » Dense spacing (e.g., 25 m) near areas of potential high concentrations (near-road), less dense (e.g., 100 m) farther away from high emitting sources
- Place receptors in locations public can access (e.g., sidewalks, neighborhoods, parks)
- Consider excluding locations where public cannot access (e.g., fenced private property, within right-of-way, on-facility)

Guidance Reference:

Sections 7.5 and 7.6

Receptor Pathway -- Keywords

- Receptors can be located in discrete locations (**DISCCART**, **DISCPOLR**)
  - » Advantage: receptors are placed where you want them, and not where you don't (e.g., within the project)
- And/or, networks of receptors can be created (**GRIDCART**, **GRIDPOLR**)
  - » Advantage: cover a large area and not miss any locations
  - » A polar grid (receptors radiating from a center point) could be useful for certain projects, e.g. terminal projects
- Commercial interfaces allow users to choose areas (from map) on which to lay down a grid of receptors
  - » Creates a series of discrete receptors in AERMOD

Receptor Pathway – Discrete Receptors

- Use keyword **DISCCART** and/or **DISCPOLR** to define discrete Cartesian and polar coordinates
  - » Defines an individual receptor in a specific location

- Discrete receptors can be placed instead of, or in addition to, a network
  - » May be needed to fill in gaps in network(s)
  - » Useful to avoid placing receptors in locations where not necessary (e.g., right-of-way)
  - » Useful for specific locations such as
    - – Those in close proximity to the project;
    - – Schools, houses, buildings;
    - – Areas previously identified as high concentration

Receptor Pathway – DISCART

- Keyword **DISCCART**
- Syntax:

  DISCCART Xcoord Ycoord (Z)

  - » All receptors have unique X,Y coordinates
  - » Z coordinates (Zelev, Zhill, Zflag) are optional and unnecessary for PM hot-spot analyses if already defined **FLAGPOLE** keyword
    - – Refer to AERMOD user guide for description of different Zs
    - – ***Q for class***: In what pathway do you define **FLAGPOLE**?

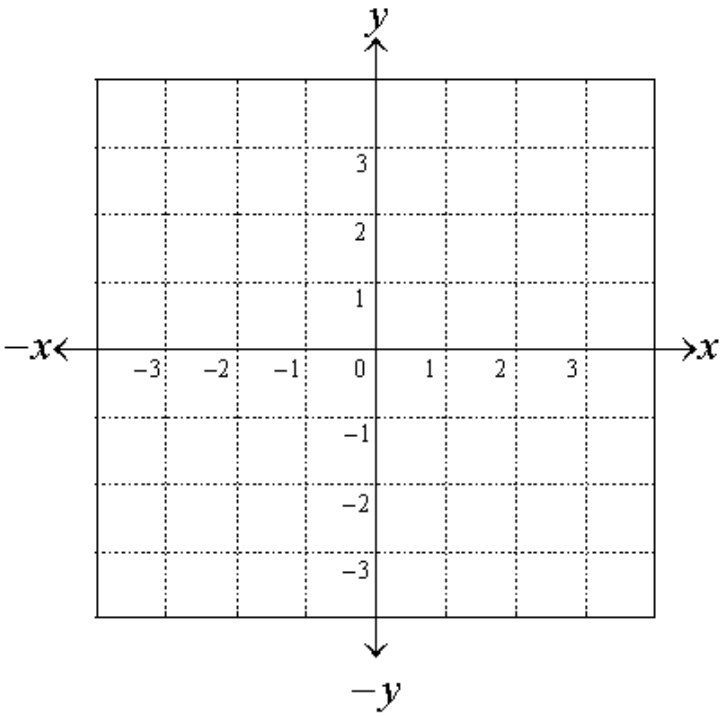
Example:

RE DISCCART 9.0 212.8

Receptor Pathway – DISCCART

Plot the receptors on the grid shown, based on the following statements:

```
RE DISCART -3  2
RE DISCART -3  1
RE DISCART -2.5  1.5
RE DISCART -2  2
RE DISCART -2  1
RE DISCART -1  -1.5
RE DISCART 1.5  -3
RE DISCART 1.5  -1.5
RE DISCART 1.5  1
RE DISCART 1.5  2
RE DISCART 1.5  3
RE DISCART 1.5  3.5
```



Receptor Pathway – DISCPOLR

- Keyword **DISCPOLR**
- Syntax:

  DISCPOLR Srcid Dist Direct

  - Srcid: source as named in **LOCATION**
  - Dist: downwind distance to the receptor location
  - Direct: Direction to receptor location, in degrees clockwise from North

Example:

RE DISCPOLR TERM1 10 90

...places a discrete receptor 10 meters directly east of “TERM1”

Receptor Networks

- Keywords **GRIDCART** and **GRIDPOLR** set up networks of receptors

- With a network, AERMOD will calculate concentrations at locations that may not be necessary to consider
  - » E.g., in the right-of-way, or in fenced-off areas

- AERMOD allows multiple receptor networks, may be useful for….
  - » Placing a coarser network over the whole project area
  - » Locating a denser network over a smaller area where maximum impacts are expected

Receptor Pathway – GRIDCART

- Use **GRIDCART** to define receptors in a Cartesian (square grid) network

- Syntax, Option 1:

RE GRIDCART Netid STA

XYINC Xinit Xnum Xdelta Yinit Ynum Ydelta

RE GRIDCART Netid END

  - STA/END: indicates start/end of GRIDCART subpathway; repeat for each new Netid
  - Netid: user-defined name for the receptor network
  - Xinit: starting x-axis grid location in meters
  - Xnum: number of x-axis receptors
  - Xdelta: spacing in meters between x-axis receptors
  - (Same for Yinit, Ynum, Ydelta)

Receptor Pathway – Sample Input File

AE_mobile_sample_file.inp - Notepad

File Edit Format View Help

```
**--------------------------------

RE STARTING
RE GRIDCART INNER STA
** User guide:          Xinit Xnum Xdelta Yinit Ynum Ydelta
**                      ----- ---- ------ ----- ---- ------
                XYINC -100   11    25    -100   10   25
RE GRIDCART INNER END

** "Inner" receptor grid extends 100 meters beyond the project
** in both X and Y directions, at 25 meter spacing
** Some receptors will be at locations within the source

RE GRIDCART OUTER STA
** User guide:    XPNTS Gridx1 Gridx2 Gridx3 Gridx4 ...
**                YPNTS Gridy1 Gridy2 Gridy3 Gridy4 ...
**                ------ ------ ------ ------
                XPNTS  -500   -400   -300   -200  -100 0 100 150 250 350 450 550
                YPNTS  -500   -400   -300   -200  -100 0 100 125 225 325 425 525
RE GRIDCART OUTER END

** "Outer" receptor grid extends 500 meters beyond the project
** in both X & Y directions, 100 m apart (except X @ 100-150, and Y @ 100-125)
** Some receptors will be at locations within the source
RE FINISHED
```

Initial x, y, coordinates and delta between locations are in meters

Shows Option 1:

Network name is "Inner"

XYINC defines an 11 x 10 receptor grid:

- Begins at x, y = (-100, -100)
- x and y spacing both 25 meters
- 110 receptors

Receptor Pathway – GRIDCART

- Syntax, Option 2:

RE GRIDCART Netid STA
XPNTS Gridx1 Gridx2 … Gridxn
YPNTS Gridy1 Gridy2…Gridyn
RE GRIDCART Netid END

  - » STA/END: indicates start/end of GRIDCART subpathway; repeat for each new Netid
  - » Netid: user-defined name for the receptor network
  - » XPNTS: keyword followed by defined x-coordinates (Gridx1, Gridx2, etc.)
  - » YPNTS: keyword followed by defined y-coordinates

Receptor Pathway – GRIDCART

AE_mobile_sample_file.inp - Notepad

File Edit Format View Help

```
**------------------------------------

RE STARTING
RE GRIDCART INNER STA
** User guide:          Xinit Xnum Xdelta Yinit Ynum Ydelta
**                      ----- ---- ------ ----- ---- ------
                  XYINC -100   11    25    -100   10   25
RE GRIDCART INNER END

** "Inner" receptor grid extends 100 meters beyond the project
** in both X and Y directions, at 25 meter spacing
** Some receptors will be at locations within the source

RE GRIDCART OUTER STA
** User guide:    XPNTS Gridx1 Gridx2 Gridx3 Gridx4 ...
**                YPNTS Gridy1 Gridy2 Gridy3 Gridy4 ...
**                ------ ------ ------ ------
                  XPNTS  -500   -400   -300   -200  -100 0 100 150 250 350 450 550
                  YPNTS  -500   -400   -300   -200  -100 0 100 125 225 325 425 525
RE GRIDCART OUTER END

** "Outer" receptor grid extends 500 meters beyond the project
** in both X & Y directions, 100 m apart (except X @ 100-150, and Y @ 100-125)
** Some receptors will be at locations within the source
RE FINISHED
```

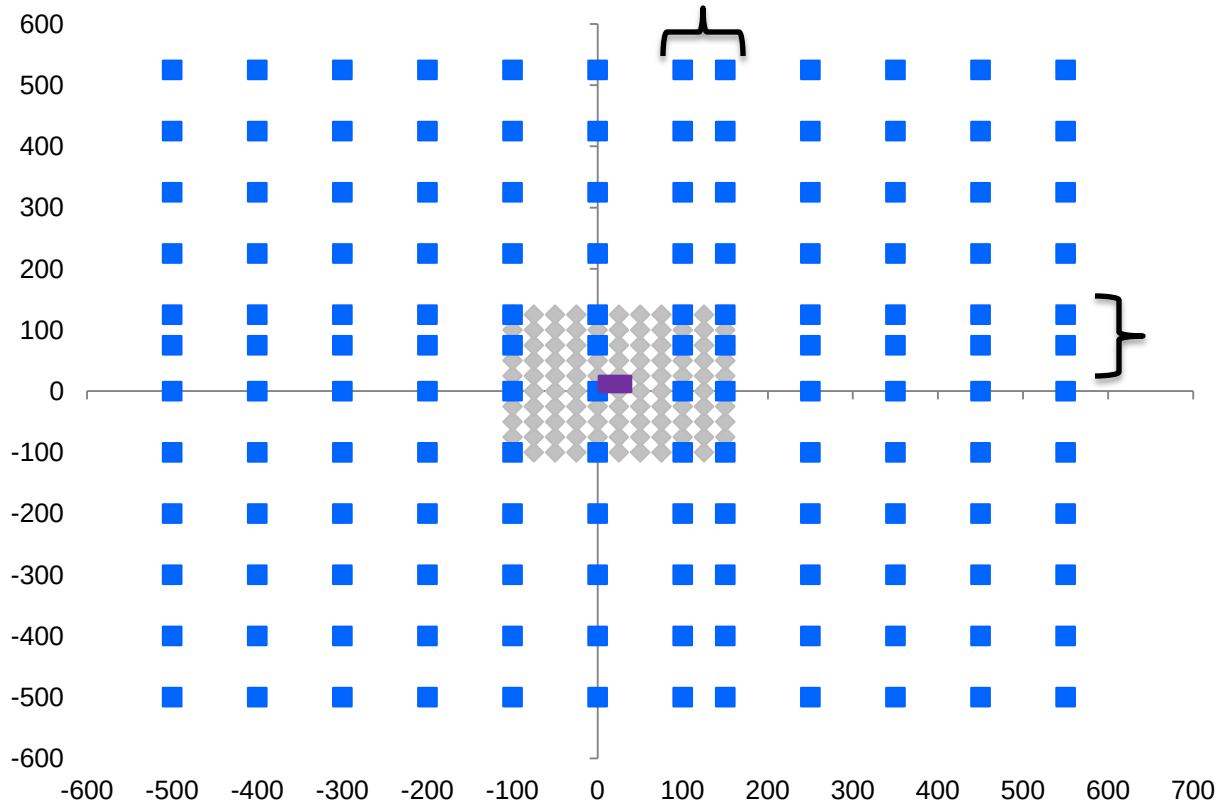
Shows Option 2:

Network name is "Outer"

- STA/END is sub-pathway
- XPNTS defines the X-axis coordinates for the grid, in meters

- YPNTS defines the Y-axis coordinates for the grid, in meters
- 100 meter spacing, except where bracketed

Sample Input File Receptor Grids



Key:

- Source
  - » 50 m x 25 m
- Inner grid
  - » X-axis: -100 to 150, 25 m spacing,11 across
  - » Y-axis: -100 to 125, 25 m spacing,10 high
- Outer grid
  - » X-axis: -500 to 550
  - » Y-axis: -500 to 525
  - » 100 m spacing, except where bracketed

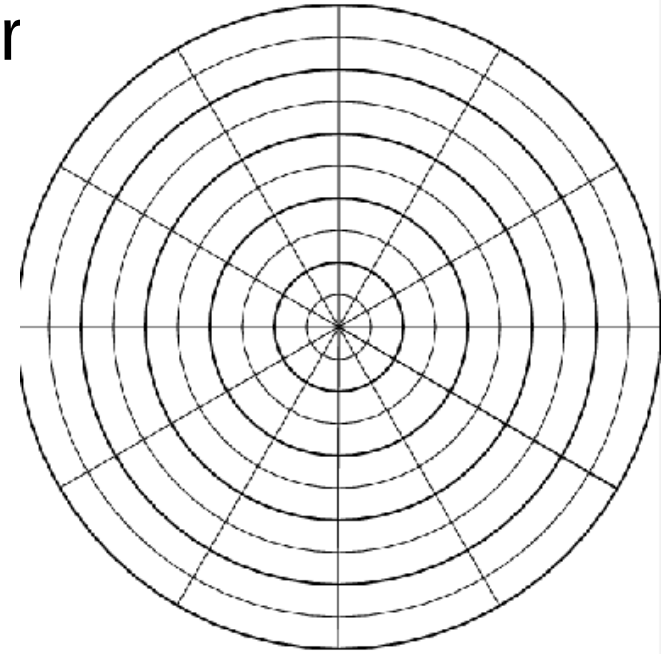
Using grids, some receptors locations may end up too close (within the project or within 5 meters); these receptors should not be used (PM Hot-spot Guidance, Section 7.6.2)

Receptor Pathway – GRIDPOLR

- Use keyword **GRIDPOLR** to define a polar grid network
  - » Typically used for setting up a circular grid around a point source
  - » Could be appropriate for a transit terminal

- Receptors are closer together nearer to the source, and spaced farther apart further from the source

- See AERMOD user guide for additional information



AERMOD Input File Structure

CO

SO

RE

ME

OU

Meteorology information, e.g.:

- Names of met data files
- Where data is from

How Air Quality Models Consider Met Data

Air Quality Model	Upper Air Data	Surface Data		Surface Characteristics			Urban Dispersion
	Vertical temp profile, etc.	Wind/ temp	Cloud cover	Albedo	Bowen ratio	Surface roughness	Urban population
AERMOD							√ **(if modeling urban source)**
CAL3QHCR						√	√ **(if modeling urban source)**

- ● Necessary met preprocessor input (will be included in preprocessed met data)
- √ Necessary dispersion model input

From Module 3

AERMOD Capabilities for Met Data

- How many years of met data are needed?
  - » Off-site data (e.g., airport data): **5 consecutive years**
    - – Will be the case for most PM hot-spot analyses
    - – Use the *most recent* 5 consecutive years
  - » Site-specific data: **at least 1 year**
- The years of met data used affects number of air quality model runs needed per PM hot-spot analysis scenario:

Air Quality Model	Number of Runs with 5 Years of Off-Site Met Data	Number of Runs with 1 year of Site-Specific Met Data
AERMOD	**1-5**	**1**
CAL3QHCR	20	4

From Module 3

Guidance Reference: Section 7.5

Determining the Number of Model Runs

- If using five years of met data – two options for running AERMOD:

  (1) Concatenate met data into one file containing all five years and run AERMOD once

  - » Preferred option, as post processing AERMOD output is easier with concatenated met data

  (2) Run AERMOD five times, once with each year of met data

- If using one year of on-site met data, only one run necessary

Guidance Reference:

Section 7.5.3

Obtaining Met Data

- In most cases, transportation agencies (e.g., state DOTs) can acquire representative processed met data for AERMOD from state air agencies
  - » E.g., most recent 5 consecutive years of representative off-site data (most common)
  - » Assess representativeness based on latest *AERMOD Implementation Guide*

- Surface station data should be from an ASOS station
  - » Met data should be processed with AERMINUTE and the most recent version of AERMET
  - » Appropriate threshold value: 0.5 m/s (Consistent with *OAQPS guidance in March 8, 2013 memo)*

- Latest version of AERMOD (version 12345):
  - » **Will not run** with met data from AERMET version 06341
  - » **Will run** with met data from AERMET version 11059, but will generate a warning message
  - » EPA strongly encourages using met data from AERMET version 12345

Processing Met Data for AERMOD

- AERMET pre-processing program is used to produce necessary files for AERMOD
  - **Many state and local air agencies will have pre-processed met files representative of project area (see Module 3) for use in AERMOD**
  - Running AERMET is not covered in this course

- Surface (.sfc) and profile ("upper air") (.pfl) met data files will include:
  - Wind speed/direction, cloud cover, sky cover, surface roughness, Bowen ratio, albedo (.sfc)
  - Vertical temperature profile (.pfl)

Guidance Reference:

Section 7.5.2 and 7.5.4

Meteorology Pathway Keywords

- Use **SURFFILE** to identify the surface met data file
  - » Followed by the file name (.sfc)
- Use **PROFFILE** to identify the profile (upper air) met data file
  - » Followed by the file name (.pfl)
- Use **SURFDATA** and **UAIRDATA** to i.d. the met data station
  - » Followed by station ID (e.g. 14735) and year (location optional)
- Use **PROFBASE** to indicate met data station elevation
  - » Followed by met station elevation, above sea level (m)

Example:

```
ME SURFFILE  C:\AERMOD\EWR91_95.SFC
ME PROFFILE  C:\AERMOD\EWR91_95.PFL
ME SURFDATA  14734  1991
ME UAIRDATA  93755  1991
ME PROFBASE  0
```

Meteorology Pathway – Sample Input File

AE_mobile_sample_file.inp - Notepad

File Edit Format View Help

```
** Some receptors will be at locations within the source

RE GRIDCART OUTER STA
** User guide:    XPNTS Gridx1 Gridx2 Gridx3 Gridx4 ...
**               YPNTS Gridy1 Gridy2 Gridy3 Gridy4 ...
**                     ------ ------ ------ ------
                 XPNTS  -500   -400   -300   -200  -100 0 100 150 250 350 450 550
                 YPNTS  -500   -400   -300   -200  -100 0 100 125 225 325 425 525
RE GRIDCART OUTER END

** "Outer" receptor grid extends 500 meters beyond the project
** in both X & Y directions, 100 m apart (except X @ 100-150, and Y @ 100-125)
** Some receptors will be at locations within the source
RE FINISHED

**----------------------------------

ME STARTING

   SURFFILE  aermet2.sfc
   PROFFILE  aermet2.pfl
   SURFDATA  14735  1988  ALBANY,NY
   UAIRDATA  14735  1988  ALBANY,NY

   SITEDATA  99999  1988  HUDSON
   PROFBASE  0.0  METERS
ME FINISHED

**----------------------------------

OU STARTING
   RECTABLE 24 FIRST
** (There are only 4 days of met data in the met data file, so model cannot
** provide 6th highest concentration)
   POSTFILE  24 ALL PLOT PROJECT_24hr.pst
OU FINISHED
```

SURFFILE and **PROFFILE**

Files of surface and upper air profile data

SURFDATA and **UAIRDATA**

- Station #
- Data period
- Station name

Meteorology Pathway – Sample Input File

AE_mobile_sample_file.inp - Notepad

File Edit Format View Help

```
** Some receptors will be at locations within the source

RE GRIDCART OUTER STA
** User guide:    XPNTS Gridx1 Gridx2 Gridx3 Gridx4 ...
**               YPNTS Gridy1 Gridy2 Gridy3 Gridy4 ...
**                     ------ ------ ------ ------
                 XPNTS  -500   -400   -300   -200  -100 0 100 150 250 350 450 550
                 YPNTS  -500   -400   -300   -200  -100 0 100 125 225 325 425 525
RE GRIDCART OUTER END

** "Outer" receptor grid extends 500 meters beyond the project
** in both X & Y directions, 100 m apart (except X @ 100-150, and Y @ 100-125)
** Some receptors will be at locations within the source
RE FINISHED

**----------------------------------

ME STARTING

   SURFFILE  aermet2.sfc
   PROFFILE  aermet2.pfl
   SURFDATA  14735  1988  ALBANY,NY
   UAIRDATA  14735  1988  ALBANY,NY

   SITEDATA  99999  1988  HUDSON
   PROFBASE  0.0  METERS
ME FINISHED

**----------------------------------

OU STARTING
   RECTABLE 24 FIRST
** (There are only 4 days of met data in the met data file, so model cannot
** provide 6th highest concentration)
   POSTFILE  24 ALL PLOT PROJECT_24hr.pst
OU FINISHED
```

SITEDATA
(optional)
If any site-specific data are used

PROFBASE
Elevation of base of surface met. tower over mean sea level (MSL)

AERMOD Input File Structure

CO

SO

RE

ME

OU

Output information

- What data do you want in the output file?

Output Pathway – Guidance

- For PM hot-spot analyses, the most useful keyword options for output are:
  - **RECTABLE** – Used to specify values by receptor for output file (in AERMOD.out)
  - **POSTFILE** – Used to write results to a mass storage file for post-processing (user specifies file name)

- Recommended output keywords for design value calculation:
  - Annual $PM_{2.5}$ NAAQS: **RECTABLE**
  - 24-hour $PM_{2.5}$ NAAQS: **POSTFILE**
  - 24-hour PM_{10} NAAQS: **RECTABLE**
    - Select high-sixth-high receptor from output when using 5 years of met data

Guidance Reference:

Appendix J.6.1

Output Pathway - RECTABLE

- Syntax for keyword **RECTABLE**:

OU RECTABLE Aveper **FIRST**

Or: **OU RECTABLE** Aveper **1st**

  - » Where the Aveper parameter is the short term averaging period (e.g., 1, 3, 8 or 24 hr) for which the receptor table is selected
  - » The secondary keywords, **FIRST, SECOND, … SIXTH,** etc., indicate which high values are to be summarized by receptor for that averaging period

Example:

OU RECTABLE 24 SIXTH

Output Pathway - POSTFILE

- Syntax for keyword **POSTFILE:**

  OU POSTFILE Aveper Grpid Format Filnam

  - Aveper: the averaging period (**24** for 24-hour averages, **ANNUAL** for annual averages)
  - Grpid: Source group ID (defined in SO pathway with **SRCGROUP**) for **POSTFILE** option
  - Format: Specifies format of the **POSTFILE** output, (**PLOT** to obtain formatted files of receptor locations (x- and y-coordinates) and concentrations)
  - Filnam: specifies output file name where the **POSTFILE** results are written

Output Pathway – Sample Input File

AE_mobile_sample_file.inp - Notepad

File Edit Format View Help

```
** Some receptors will be at locations within the source

RE GRIDCART OUTER STA
** User guide:    XPNTS Gridx1 Gridx2 Gridx3 Gridx4 ...
**               YPNTS Gridy1 Gridy2 Gridy3 Gridy4 ...
**                     ------ ------ ------ ------
                 XPNTS  -500   -400   -300   -200  -100 0 100 150 250 350 450 550
                 YPNTS  -500   -400   -300   -200  -100 0 100 125 225 325 425 525
RE GRIDCART OUTER END

** "Outer" receptor grid extends 500 meters beyond the project
** in both X & Y directions, 100 m apart (except X @ 100-150, and Y @ 100-125)
** Some receptors will be at locations within the source
RE FINISHED

**----------------------------------

ME STARTING

   SURFFILE  aermet2.sfc
   PROFFILE  aermet2.pfl
   SURFDATA  14735  1988  ALBANY,NY
   UAIRDATA  14735  1988  ALBANY,NY

   SITEDATA  99999  1988  HUDSON
   PROFBASE  0.0  METERS
ME FINISHED

**----------------------------------

OU STARTING
   RECTABLE 24 FIRST
** (There are only 4 days of met data in the met data file, so model cannot
** provide 6th highest concentration)
   POSTFILE  24 ALL PLOT PROJECT_24hr.pst
OU FINISHED
```

RECTABLE

For the averaging period specified (24 hours), provides the top (first) value for each receptor in AERMOD.out

POSTFILE

Creates a file called "Project_24hr.pst" with results for post-processing

Information Needed for Design Value Calculations

NAAQS	In CO pathway, specify:	In OU pathway, specify:
Annual $PM_{2.5}$ NAAQS	**AVERTIME ANNUAL** or **AVERTIME PERIOD**	Either **RECTABLE** or **POSTFILE**
24-hour $PM_{2.5}$ NAAQS (First Tier Calculation)	**AVERTIME 24**	**RECTABLE 24 1ST** (to get the highest 24-hour concentration at each receptor)
24-hour $PM_{2.5}$ NAAQS (Second Tier Calculation)	**AVERTIME 24**	**POSTFILE** (data need to be post-processed to get 5 year averages for each quarter)
24-hour PM_{10}	**AVERTIME 24**	**RECTABLE 24 SIXTH** (to get the 6th highest 24 hour concentration at each receptor)

*Design value calculations will be covered in **Module 6***

Output Pathway - POSTFILE

Label each part of this statement:

OU POSTFILE 24 ALL PLOT ALL_24hr.pst

Output Pathway – Error Messages

- AERMOD provides several ways to identify errors
- Output includes message summary table, with 3 types of messages:
  - E (for errors): fatal flaws that halt the run
  - W (for warnings): indicate possible errors, but don't halt run
  - I (for informational messages): FYIs
- Letters are followed by 3-digit codes, grouped by process stage:
  - 100 - 199 Input Runstream Image Structure Processing
  - 200 - 299 Parameter Setup Processing
  - 300 - 399 Data and Quality Assurance Processing
  - 400 - 499 Run Time Message Processing
  - 500 - 599 Input/Output Message Processing

Output Pathway – Error Messages

- Example:

  ```
  CO E100 8 EXPATH: Invalid Pathway
  Specified. The Troubled Pathway is FF
  ```

  - (FF = Fixed format)

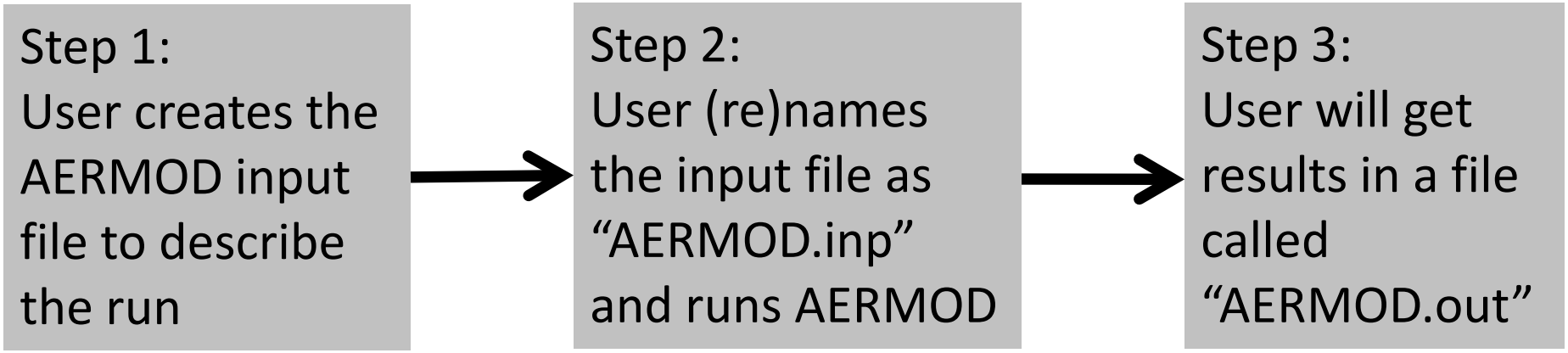
- Use AERMOD User Guide, Appendix C to decode and correct error

Running AERMOD with the sample input file

Then we'll look at the output file

Review: Running AERMOD

General steps…



- The AERMOD input file is always named "AERMOD.inp" and the output is always named "AERMOD.out"
- Note – These files will be overwritten when AERMOD is run again

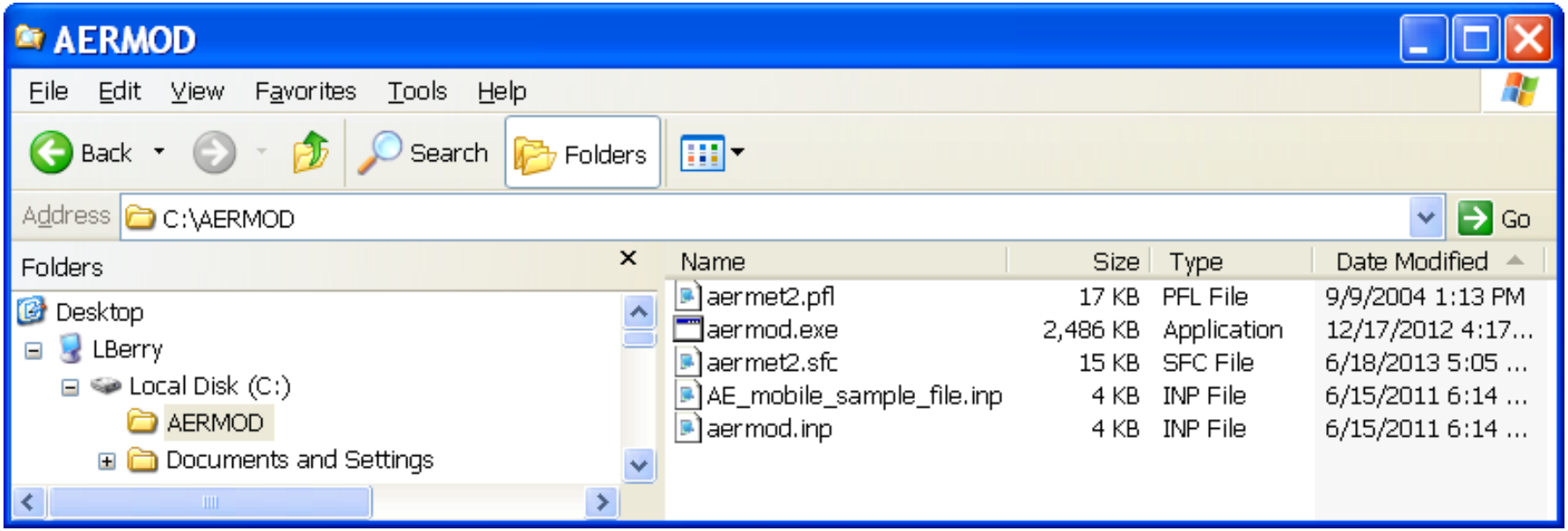
Tips for Managing Files

Suggestions:

- Save an input file with a descriptive name
  - E.g., “AE_input_hwy10_build.inp”
- Then *copy* it as “AERMOD.inp” to run it
  - The previous “AERMOD.inp” will be overwritten when AERMOD is run again
- Use an existing input file to create additional input files
  - E.g., create no-build input file from build input file
  - Save each with a descriptive name
- Rename output file similar to the input file
  - E.g., “AE_output_hwy10_build.out”

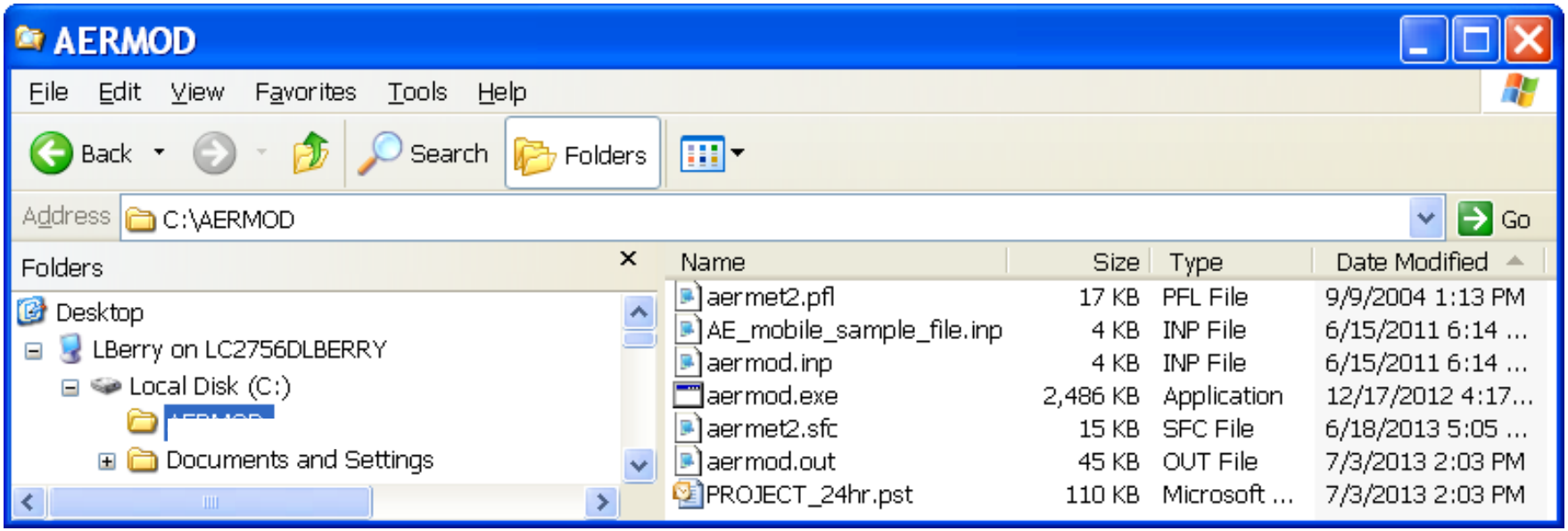
Running AERMOD

- Go to folder we created, C:\AERMOD
  - » (e.g., start from desktop: “my computer”)
- Make a copy of “AE_mobile_sample_file.inp”
- Rename the copy “aermod.inp”
- Double-click “aermod.exe”



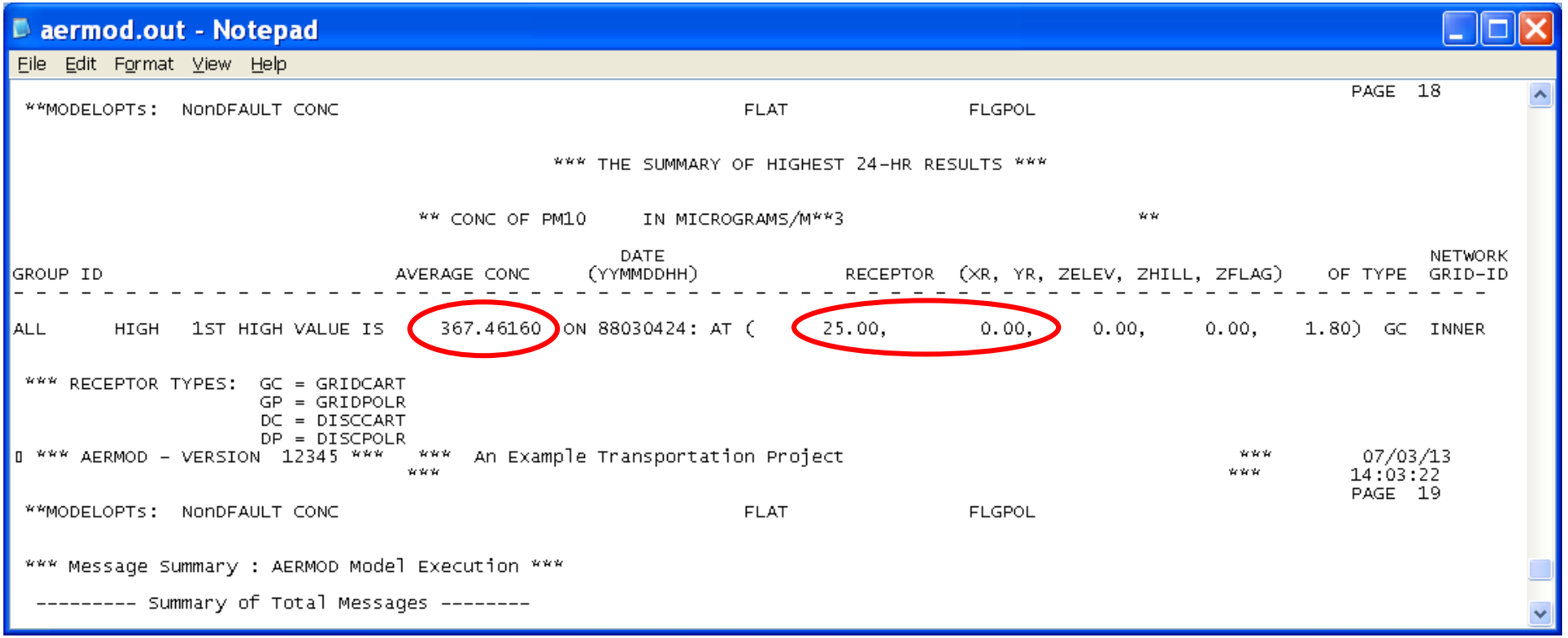
AERMOD Output

- Run produces “aermod.out” and “PROJECT_24hr.pst” in C:\AERMOD folder
  - » **Tip**: Re-name “aermod.out” immediately since it will be overwritten when AERMOD is run again
  - » ***Q for class***: What is the maximum 24-hour concentration at any receptor?



Output from the Sample Input Run

- AERMOD.out, p. 18, (also on p.13): highest concentration is at the receptor with coordinates (25, 0)
  - » Receptors within 5 meters of a project should not be used (PM Hot-spot Guidance, Section 7.6.2)



aermod.out - Notepad

File Edit Format View Help

```
                                                                                                    PAGE  18
 **MODELOPTs:  NonDFAULT CONC                                    FLAT              FLGPOL

                                          *** THE SUMMARY OF HIGHEST 24-HR RESULTS ***

                                    ** CONC OF PM10      IN MICROGRAMS/M**3                      **

                                                  DATE                                                    NETWORK
GROUP ID                          AVERAGE CONC    (YYMMDDHH)          RECEPTOR  (XR, YR, ZELEV, ZHILL, ZFLAG)   OF TYPE  GRID-ID
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

ALL      HIGH   1ST HIGH VALUE IS    367.46160  ON 88030424: AT (     25.00,        0.00,    0.00,     0.00,    1.80)  GC  INNER

 *** RECEPTOR TYPES:  GC = GRIDCART
                      GP = GRIDPOLR
                      DC = DISCCART
                      DP = DISCPOLR
 *** AERMOD - VERSION  12345 ***   ***  An Example Transportation Project                          ***        07/03/13
                                  ***                                                             ***       14:03:22
                                                                                                           PAGE  19
 **MODELOPTs:  NonDFAULT CONC                                    FLAT              FLGPOL

 *** Message Summary : AERMOD Model Execution ***

  --------- Summary of Total Messages --------
```

Postfile from Sample Input Run

Includes 24-hour conc. for each met data day, for each receptor

PROJECT_24hr.pst - Notepad

File Edit Format View Help

```
* AERMOD ( 12345):  An Example Transportation Project                    07/03/13
* MODELING OPTIONS USED:                                                 14:03:22
* NonDFAULT CONC                                FLAT              FLGPOL


*          POST/PLOT FILE OF CONCURRENT 24-HR VALUES FOR SOURCE GROUP: ALL
*          FOR A TOTAL OF   254 RECEPTORS.
*          FORMAT: (3(1X,F13.5),3(1X,F8.2),2X,A6,2X,A8,2X,I8.8,2X,A8)

*       X             Y        AVERAGE CONC    ZELEV    ZHILL    ZFLAG     AVE      GRP       DATE       NET ID
*  ____________  ____________  ____________  ________ ________ ________ ________ ________ ________ ________
    -100.00000    -100.00000       0.00000     0.00     0.00     1.80   24-HR    ALL      88030124   INNER
     -75.00000    -100.00000       0.00100     0.00     0.00     1.80   24-HR    ALL      88030124   INNER
     -50.00000    -100.00000       0.07465     0.00     0.00     1.80   24-HR    ALL      88030124   INNER
     -25.00000    -100.00000       0.80924     0.00     0.00     1.80   24-HR    ALL      88030124   INNER
       0.00000    -100.00000       2.97581     0.00     0.00     1.80   24-HR    ALL      88030124   INNER
      25.00000    -100.00000       5.90317     0.00     0.00     1.80   24-HR    ALL      88030124   INNER
      50.00000    -100.00000       8.13748     0.00     0.00     1.80   24-HR    ALL      88030124   INNER
      75.00000    -100.00000       9.26755     0.00     0.00     1.80   24-HR    ALL      88030124   INNER
     100.00000    -100.00000       9.54646     0.00     0.00     1.80   24-HR    ALL      88030124   INNER
     125.00000    -100.00000       9.25967     0.00     0.00     1.80   24-HR    ALL      88030124   INNER
     150.00000    -100.00000       8.61053     0.00     0.00     1.80   24-HR    ALL      88030124   INNER
    -100.00000     -75.00000       0.00000     0.00     0.00     1.80   24-HR    ALL      88030124   INNER
     -75.00000     -75.00000       0.00000     0.00     0.00     1.80   24-HR    ALL      88030124   INNER
     -50.00000     -75.00000       0.02174     0.00     0.00     1.80   24-HR    ALL      88030124   INNER
     -25.00000     -75.00000       0.82686     0.00     0.00     1.80   24-HR    ALL      88030124   INNER
       0.00000     -75.00000       4.45133     0.00     0.00     1.80   24-HR    ALL      88030124   INNER
      25.00000     -75.00000       9.76443     0.00     0.00     1.80   24-HR    ALL      88030124   INNER
      50.00000     -75.00000      13.24976     0.00     0.00     1.80   24-HR    ALL      88030124   INNER
      75.00000     -75.00000      14.38568     0.00     0.00     1.80   24-HR    ALL      88030124   INNER
     100.00000     -75.00000      14.06260     0.00     0.00     1.80   24-HR    ALL      88030124   INNER
     125.00000     -75.00000      12.83069     0.00     0.00     1.80   24-HR    ALL      88030124   INNER
     150.00000     -75.00000      11.19808     0.00     0.00     1.80   24-HR    ALL      88030124   INNER
    -100.00000     -50.00000       0.00000     0.00     0.00     1.80   24-HR    ALL      88030124   INNER
     -75.00000     -50.00000       0.00000     0.00     0.00     1.80   24-HR    ALL      88030124   INNER
     -50.00000     -50.00000       0.00104     0.00     0.00     1.80   24-HR    ALL      88030124   INNER
```

Hands-on Exercise: "Mini-AERMOD Run"

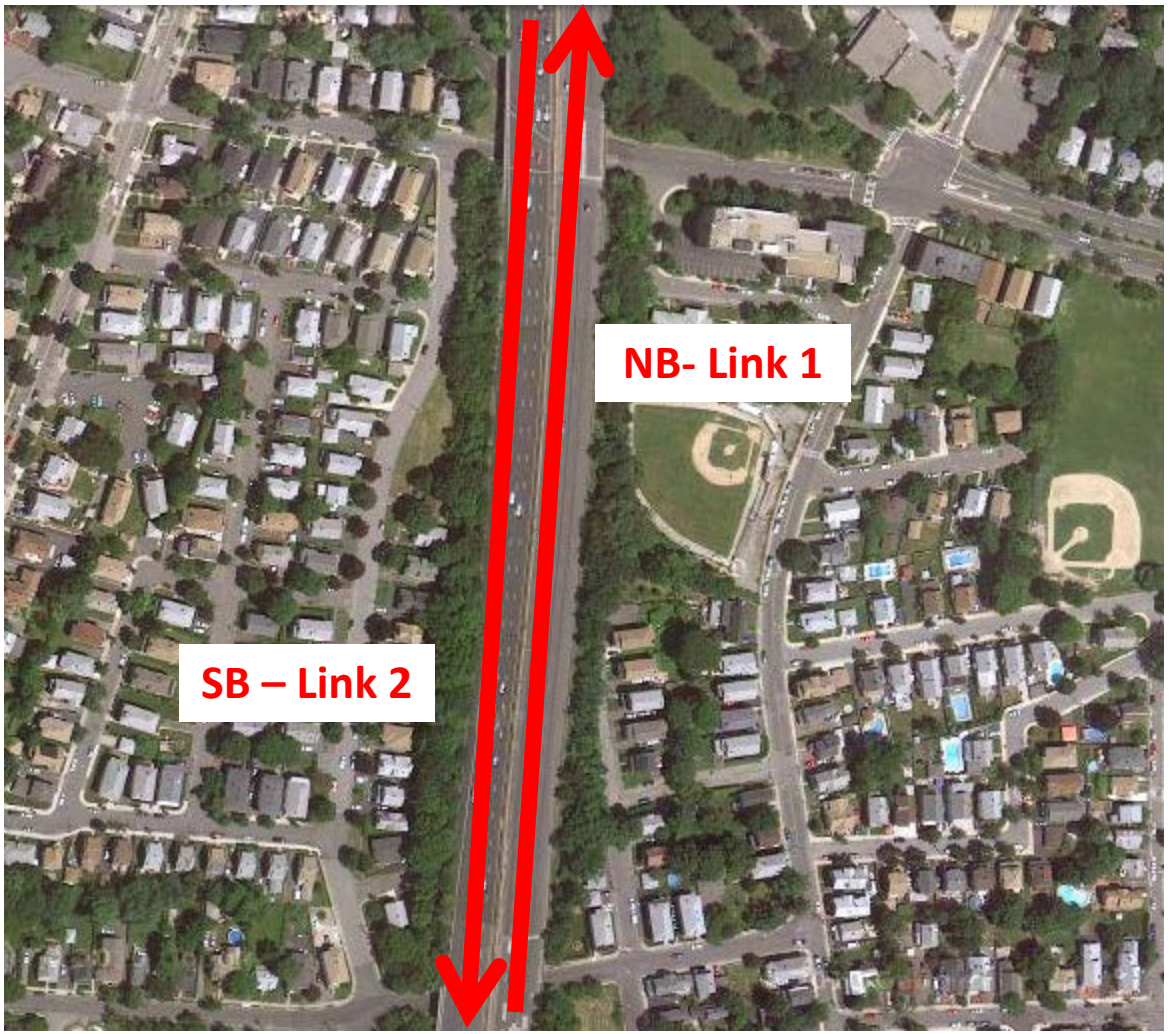
Running AERMOD for a simple highway

Mini-AERMOD Run

- Mini-run is illustrative only
- Project consists of a two-lane highway (same project as in Module 2)
  - » Uses emission rates calculated from the mini-MOVES run
- Example scenario covers one hour (12 a.m.- 1 a.m.)
  - » Emission rates from 16 MOVES runs would typically be needed
- Project located in a 24-hour PM_{10} nonattainment area
- For simplicity, only one year of met data used

Simple Highway Project

Example:
Simple, 2-lane highway



AERMOD Modeling Plan

- Urban dispersion option will be used
  - With a population of 100,000
- Relevant NAAQS is the 24-hour PM10 NAAQS: averaging time of 24 hours will be used
- FLAGPOLE receptors will be set to a height of 1.8 meters (per the guidance)

AERMOD Modeling Plan

- Each MOVES link will be modeled as one area source, with **LINE** option (see pp. 59 and 67):

SO LOCATION Srcid LINE xs1 ys1 xs2 ys2 (z)

SO SRCPARAM Srcid Lnemis Relhgt Width Szinit

AERMOD Parameters	Info specific to this highway
NB link: (xs1, ys1), (xs2, ys2)	(-833.0,-284.8), (600.8,1097.0)
SB link: (xs1, ys1), (xs2, ys2)	(-836.7,-288.0), (597.1,1106.4)
Lnemis	Emission rates from MOVES (next slides…)
Relhgt	1.3 meters
Width of each source:	3 meters
Initial vertical dispersion coeff (Szinit)	1.2 meters

MOVES Emission Rates

MOVES_output.xlsx

	A	B	C	D	E	F	G	H	I
1	movesRur	yearId	monthId	hourId	linkId	pollutantId	GramsPerHour		
2	1	2011	7	1	1	Total PM10	9.108441		
3	1	2011	7	1	2	Total PM10	8.515512		
4	**2**	**2011**	**7**	**1**	**1**	**Total PM10**	**6.932518**		
5	**2**	**2011**	**7**	**1**	**2**	**Total PM10**	**6.383009**		
6									
7									
8									

MOVES Output | Source Information | Receptors

- Rates from 2nd MOVES run (linkdrive schedules) will be used for this example (from Module 2)
- 2nd run selected because it better represents the travel activity on these links

Calculating Emission Rates (g/sec/m^2)

- From Module 2: emissions rates from the mini-run are:
  - » Link 1: 6.932518 g/hr
  - » Link 2: 6.383009 g/hr

- This rate has to be converted to g/s/m^2

  (Can be done in any order, keep track of units)

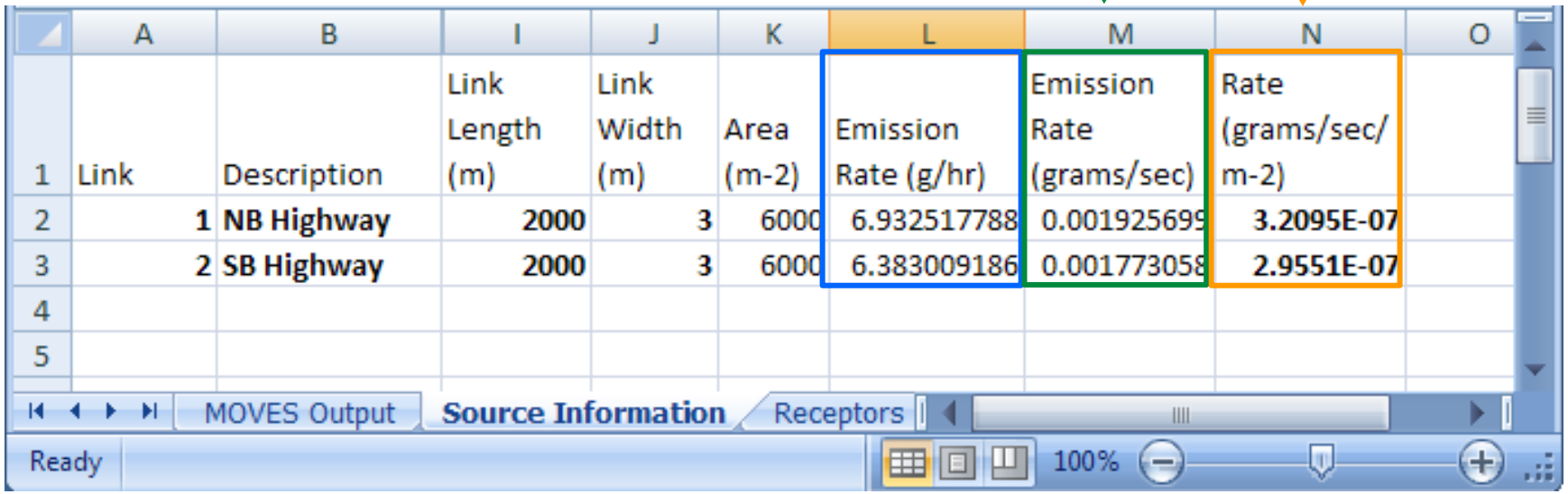
  - » Divide by seconds per hour: g/~~hr~~ x ~~hr~~/sec = g/sec
  - » Divide by m^2: g/sec x $1/m^2$ = g/sec/m^2

Calculating Emission Rates (g/sec/m^2)

- Conversion is shown below, starting with g/hr (MOVES output in column L)
  - » Divide by 3600 seconds per hour
  - » Divide by 6000 m^2 (source area)

÷ by 3600 for g/sec

÷ by m^2 (column K) for g/s/m^2



	A	B	I	J	K	L	M	N	O
1	Link	Description	Link Length (m)	Link Width (m)	Area (m-2)	Emission Rate (g/hr)	Emission Rate (grams/sec)	Rate (grams/sec/ m-2)	
2	1	NB Highway	2000	3	6000	6.932517788	0.001925699	3.2095E-07	
3	2	SB Highway	2000	3	6000	6.383009186	0.001773058	2.9551E-07	
4									
5									

MOVES Output | Source Information | Receptors

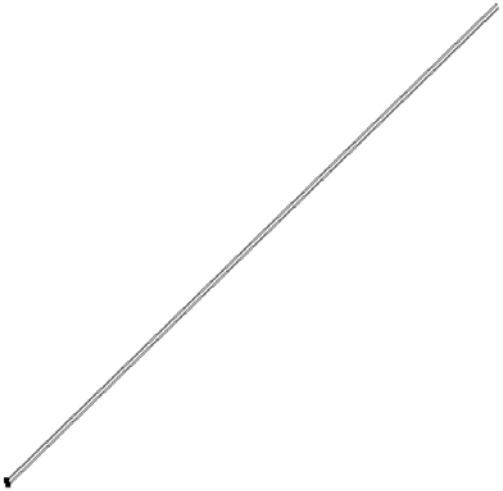
Ready 100%

Other Parameters Needed to Define LINE Source

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Link	Description	X1	Y1	X2	Y2	Release Height (m)	Vert. Dispersion Coefficien	Link Length (m)	Link Width (m)	Area (m-2)	Emission Rate (g/hr)	Emission Rate (grams/sec)	Rate (grams/sec/ m-2)
2	1	NB Highway	-833	-284.8	600.8	1097	1.3	1.2	2000	3	6000	6.932517788	0.001925699	3.2095E-07
3	2	SB Highway	-836.7	-288	597.1	1106.4	1.3	1.2	2000	3	6000	6.383009186	0.001773058	2.9551E-07
4														

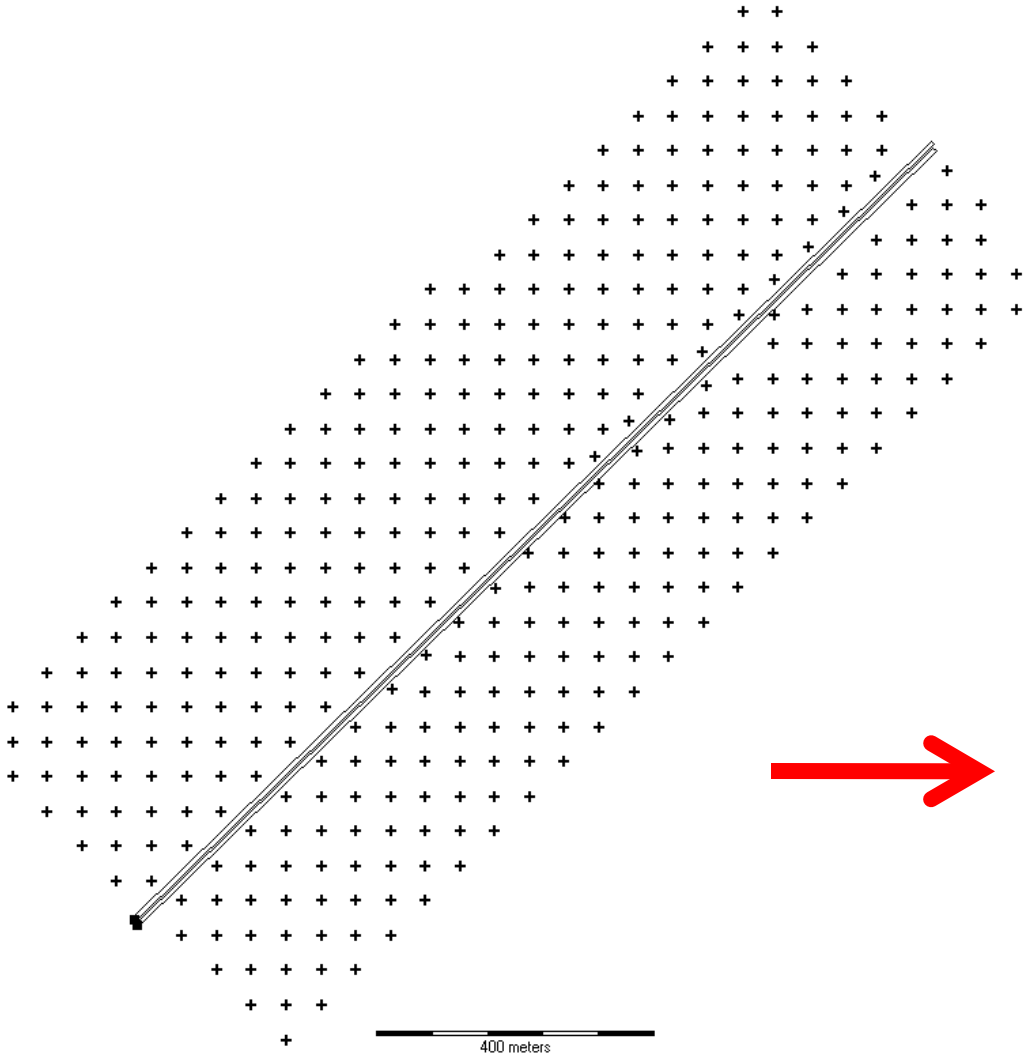
MOVES Output | Source Information | Receptors

Ready 100%



- Coordinates of midpoints of each end (arbitrary origin), source area
- Release height and initial vertical dispersion coefficient (Szinit)

Adding Receptors (file: receptors.txt)



A grid is applied using discrete receptors (X,Y coordinates set-up in excel with an arbitrary 0,0 origin)

receptors.txt - Notepad

File Edit Format View Help

```
RE STARTING
RE ELEVUNIT  METERS
RE DISCCART  -862.7  -233.0
RE DISCCART  -812.7  -233.0
RE DISCCART  -912.7  -183.0
RE DISCCART  -862.7  -183.0
RE DISCCART  -812.7  -183.0
RE DISCCART  -762.7  -183.0
RE DISCCART  -962.7  -133.0
RE DISCCART  -912.7  -133.0
RE DISCCART  -862.7  -133.0
RE DISCCART  -812.7  -133.0
RE DISCCART  -762.7  -133.0
RE DISCCART  -712.7  -133.0
RE DISCCART  -1012.7  -83.0
RE DISCCART  -962.7  -83.0
RE DISCCART  -912.7  -83.0
RE DISCCART  -862.7  -83.0
RE DISCCART  -812.7  -83.0
RE DISCCART  -762.7  -83.0
RE DISCCART  -712.7  -83.0
RE DISCCART  -662.7  -83.0
RE DISCCART  -1012.7  -33.0
RE DISCCART  -962.7  -33.0
RE DISCCART  -912.7  -33.0
RE DISCCART  -862.7  -33.0
RE DISCCART  -812.7  -33.0
RE DISCCART  -762.7  -33.0
RE DISCCART  -712.7  -33.0
RE DISCCART  -662.7  -33.0
RE DISCCART  -612.7  -33.0
RE DISCCART  -1012.7  17.0
RE DISCCART  -962.7  17.0
RE DISCCART  -912.7  17.0
RE DISCCART  -862.7  17.0
RE DISCCART  -812.7  17.0
```

Defining Meteorology Pathway

- Surface File: msn00.sfc
- Profile File: msn00.pfl
- Surface ID: 14837
- Surface year: 2000
- Upper Air Data ID: 00014898
- Upper Air Data year: 2000
- Base Elevation: 0 meters

Output Pathway

- Get output defined as a RECTABLE
  - » 24 hour average
  - » 6th highest

AERMOD Input File Structure

Now we'll create the AERMOD input file following the order we described earlier:

CO	Control – describes the run
SO	Source – describes emission sources
RE	Receptor – describes receptor locations
ME	Meteorology – describes which files
OU	Output – describes type of output

Use information provided in hand-out to generate AERMOD input file – Save as AERMOD.inp

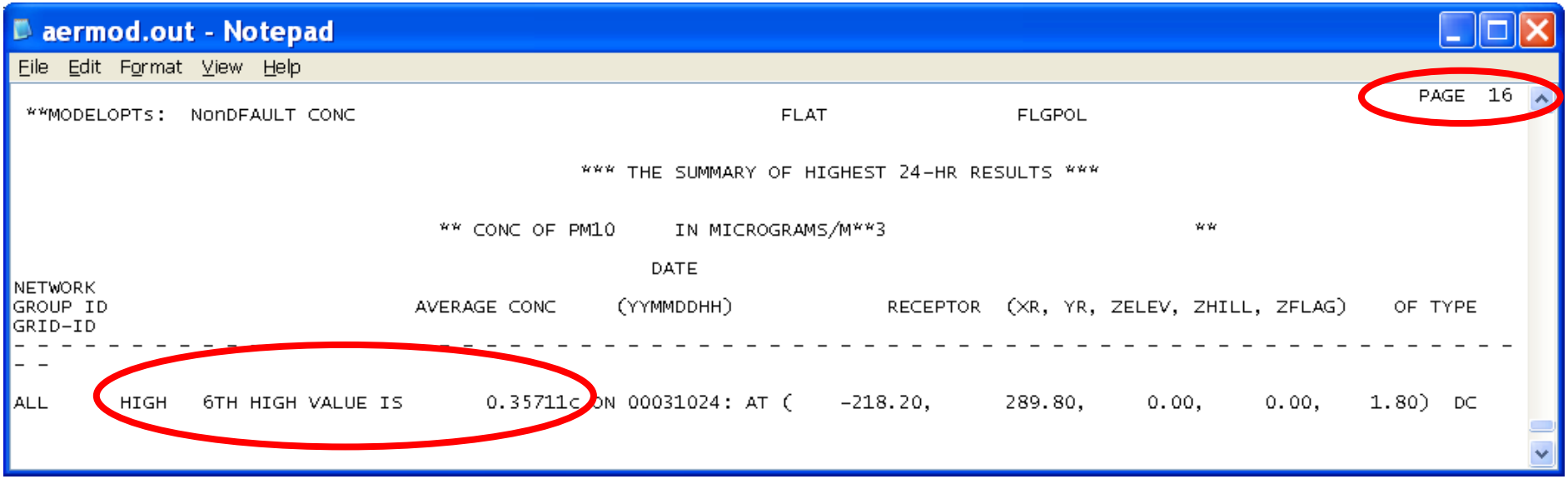
Running AERMOD

- Copy these 3 files from “Mini-AERMOD run” to C:AERMOD
  - AERMOD.inp *(the input file we created)*
  - Msn00.pfl *(profile met data)*
  - Msn00.sfc *(surface met data)*

- Running AERMOD: from C:\AERMOD, double-click “aermod.exe”

Reviewing the Run Results

High-6th-high receptor reported in AERMOD.out, p. 16



Simple Run Completed

- The high-6th-high receptor concentration is 0.35711 µg/m^3

- Project sponsor would use this value in calculating the design value
  - » These additional steps not covered for this exercise
  - » Design value covered in **Module 7**

Running AERMOD for the Example Analysis

AERMOD Modeling Plan

- Urban dispersion option will be used
  - Population of 100,000 used
- PM concentrations will be averaged daily (for 24-hour NAAQS) and annually (for annual NAAQS)
- FLAGPOLE receptors will be set to a height of 1.8 meters (per the guidance)
- Five years of met data will be used for one AERMOD run
  - Pre-formatted data provided by state AQ agency
  - AERMET will not be run

AERMOD Modeling Plan

- Area sources will be used to simulate line sources
  - MOVES links will be modeled as one or more area sources (e.g., more may be needed to model curved links or irregularly shaped parking areas)
  - Note: project is illustrative; gaps/overlaps between sources should be minimized in practice
  - MOVES output will be converted to grams/s/m^2
    - EMISFACT table will be created for each source to vary emissions by season and hour (96 rates per source)
    - A “base-rate” will be defined as 1 for each source
  - Assigned X,Y coordinates, length, width, and orientation angle

AERMOD Modeling Plan

- Emission characterization of highway/arterial links
  - Release height of 1.3 meters
  - Initial vertical dispersion coefficient of 1.2 meters
- Emission characterization of bus-only links
  - Release height of 3.4 meters
  - Initial vertical dispersion coefficient of 3.2 meters
- Emission characterization of parking garage
  - Modeled as a single area source*
  - Release height of 25 meters
  - Initial vertical dispersion coefficient of 20 meters

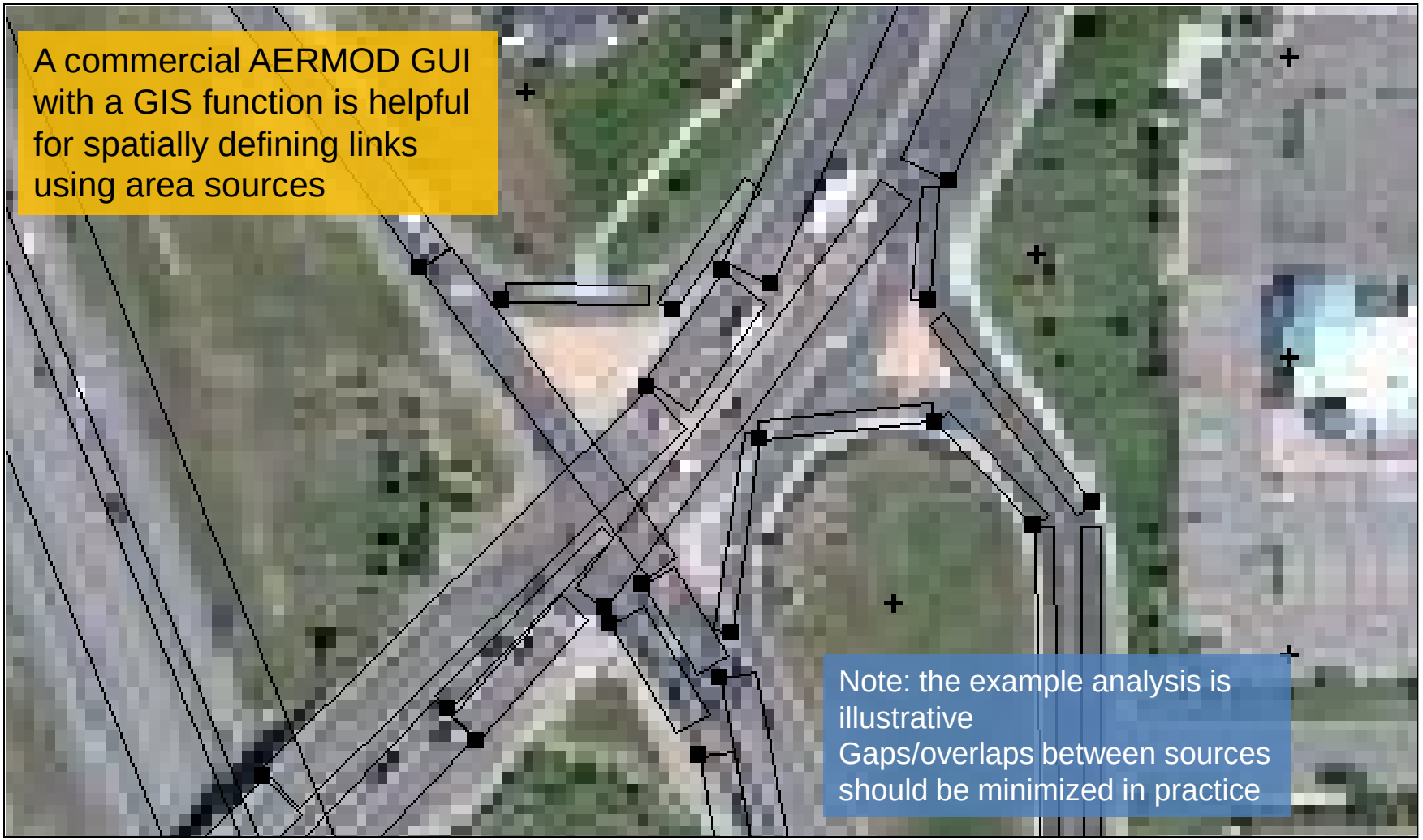
*Done for simplicity… parking garages are complicated sources and may require multiple area or volume sources arranged at multiple heights

AERMOD Modeling Plan

- Output will be obtained as POSTFILEs
  - 24 hour averages (for 24-hour $PM_{2.5}$ NAAQS)
  - Annual averages (for annual $PM_{2.5}$ NAAQS)

AERMOD Area Sources

AERMOD Area Sources



AERMOD Input File

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File Edit Format View Help

```
CO STARTING
CO TITLEONE  Hotspot Training Exercise
CO MODELOPT  FLAT  CONC
CO RUNORNOT  RUN
CO AVERTIME  24  ANNUAL
CO URBANOPT  100000
CO FLAGPOLE  1.8
CO POLLUTID  PM2.5
CO FINISHED

SO STARTING
SO ELEVUNIT  METERS
SO LOCATION  1A        AREA      289.4  679.9  0
** SRCDESCR  intersection (A) NW bound entrance ramp
SO LOCATION  1B        AREA      294.2  682.9  0
** SRCDESCR  intersection (A) NW bound entrance ramp
SO LOCATION  3A        AREA      362.3  593.7  0
** SRCDESCR  intersection (A) WB RT lane
SO LOCATION  3B        AREA      390.6  592.1  0
** SRCDESCR  intersection (A) WB RT lane
SO LOCATION  4A        AREA      407.0  596.5  0
** SRCDESCR  intersection (A) SW bound approach
SO LOCATION  4B        AREA      442.9  680.9  0
** SRCDESCR  intersection (A) SW bound approach
SO LOCATION  5         AREA      398.8  598.6  0
** SRCDESCR  intersection (A) SW bound queue
SO LOCATION  6         AREA      386.4  579.0  0
** SRCDESCR  intersection (A) SW bound departure
SO LOCATION  7         AREA      322  514.2  0
** SRCDESCR  intersection (A) SW bound connect
SO LOCATION  8         AREA      310.0  471.2  0
** SRCDESCR  intersection (A) NE bound approach
SO LOCATION  9         AREA      358.0  520.2  0
** SRCDESCR  intersection (A) NE bound queue
SO LOCATION  10        AREA      353.1  525.6  0
** SRCDESCR  intersection (A) NB LT queue
SO LOCATION  11        AREA      380.3  539.8  0
** SRCDESCR  intersection (A) WB LT queue
SO LOCATION  12        AREA      385.7  546.3  0
** SRCDESCR  intersection (A) NB queue
SO LOCATION  13        AREA      395.0  517.6  0
** SRCDESCR  intersection (A) WB LT approach
SO LOCATION  14        AREA      398.7  530.8  0
** SRCDESCR  intersection (A) NB approach
SO LOCATION  15A       AREA      400.4  538.2  0
** SRCDESCR  intersection (A) SB to E Transit Center
SO LOCATION  15B       AREA      405.2  570.6  0
** SRCDESCR  intersection (A) SB to E Transit Center
```

CO pathway information entered

Link Locations defined as X, Y, Z coordinates

AERMOD Input File

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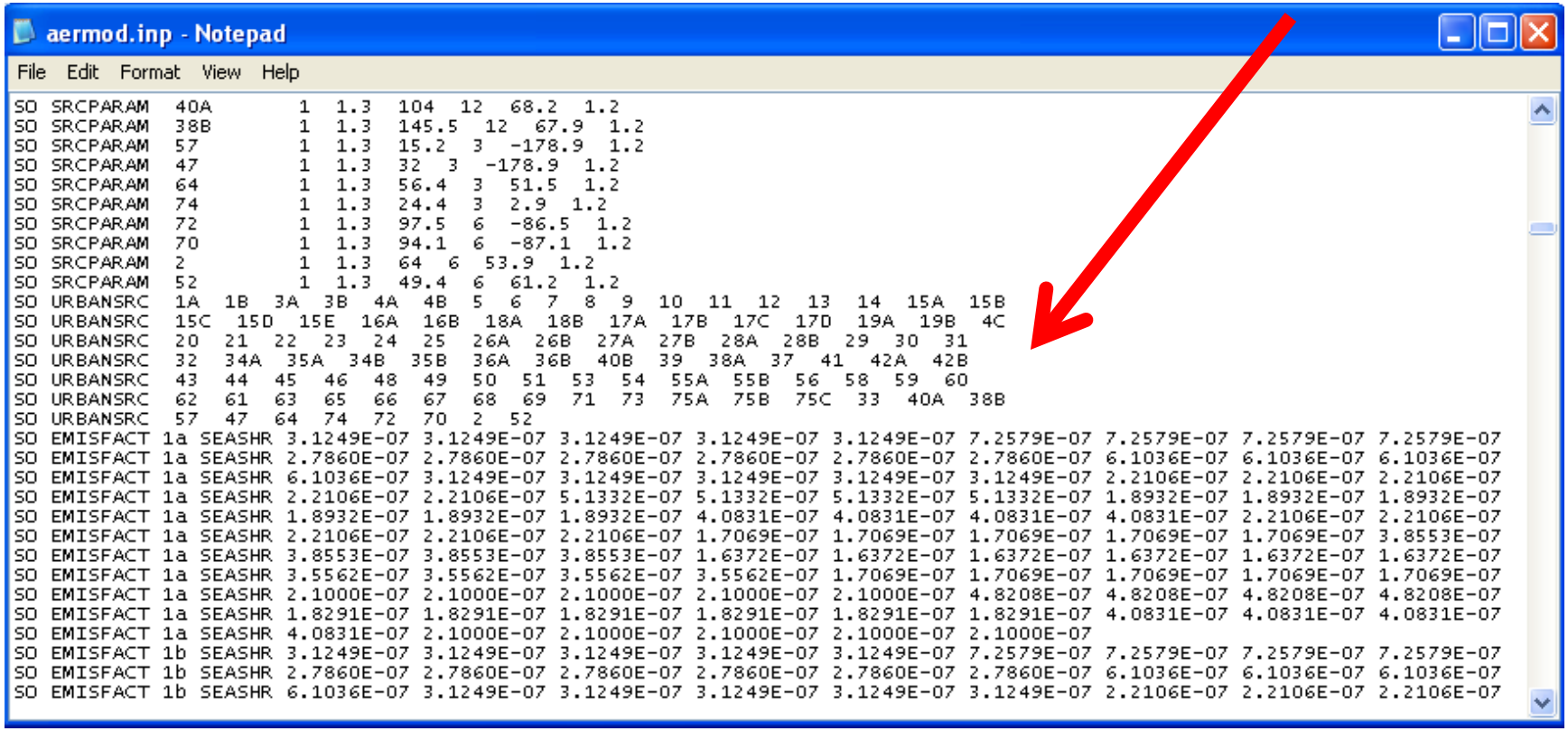
```
SO LOCATION  57         AREA      358.8  137.4  0
** SRCDESCR  intersection (C) WB LTqueue
SO LOCATION  47         AREA      318.3  126.5  0
** SRCDESCR  intersection (C) EB RTqueue
SO LOCATION  64         AREA      406.9  215.8  0
** SRCDESCR  West Bus terminal highway on-ramp
SO LOCATION  74         AREA      574.3  318.1  0
** SRCDESCR  Parkway entrace queue
SO LOCATION  72         AREA      602.4  229.4  0
** SRCDESCR  Parkway SB
SO LOCATION  70         AREA      614.9  227.9  0
** SRCDESCR  Parkway NB
SO LOCATION  2          AREA      348.5  599.1  0
** SRCDESCR  intersection (A) NW bound entrance ramp
SO LOCATION  52         AREA      366.2  76.6   0
** SRCDESCR  intersection (C) NB approach
SO SRCPARAM  1A         1  1.3  100  6  53.9  1.2
SO SRCPARAM  1B         1  1.3  158.5  6  -117.8  1.2
SO SRCPARAM  3A         1  1.3  24  3  1.2  1.2
SO SRCPARAM  3B         1  1.3  25  3  -54.8  1.2
SO SRCPARAM  4A         1  1.3  89  9  -65.8  1.2
SO SRCPARAM  4B         1  1.3  91.3  9  -82.4  1.2
SO SRCPARAM  5          1  1.3  22.1  9  125.5  1.2
SO SRCPARAM  6          1  1.3  90.5  9  135.6  1.2
SO SRCPARAM  7          1  1.3  68.9  9  134.5  1.2
SO SRCPARAM  8          1  1.3  68.6  9  -46.3  1.2
SO SRCPARAM  9          1  1.3  27.4  6  -48.0  1.2
SO SRCPARAM  10         1  1.3  39.6  3  -45.9  1.2
SO SRCPARAM  11         1  1.3  21.3  6  59.1  1.2
SO SRCPARAM  12         1  1.3  17.5  6  58.8  1.2
SO SRCPARAM  13         1  1.3  127.9  6  80.2  1.2
SO SRCPARAM  14         1  1.3  142.7  6  79.4  1.2
SO SRCPARAM  15A        1  1.3  33.6  3  -81.6  1.2
SO SRCPARAM  15B        1  1.3  28.9  3  -6.4  1.2
SO SRCPARAM  15C        1  1.3  23.9  3  46.0  1.2
SO SRCPARAM  15D        1  1.3  158.6  3  89.1  1.2
SO SRCPARAM  15E        1  1.3  49.1  3  60.5  1.2
SO SRCPARAM  16A        1  1.3  51.4  3  31.4  1.2
SO SRCPARAM  16B        1  1.3  35.1  3  -175.1  1.2
SO SRCPARAM  18A        1  1.3  71.5  3  -175.3  1.2
SO SRCPARAM  18B        1  1.3  44.9  3  -145.4  1.2
SO SRCPARAM  17A        1  1.3  43.3  3  -116.2  1.2
SO SRCPARAM  17B        1  1.3  154.8  3  -90.2  1.2
SO SRCPARAM  17C        1  1.3  40.3  3  -127.9  1.2
SO SRCPARAM  17D        1  1.3  19.2  3  -84.3  1.2
SO SRCPARAM  19A        1  1.3  71.8  9  -65.9  1.2
SO SRCPARAM  19B        1  1.3  143.6  9  -85.0  1.2
SO SRCPARAM  4C         1  1.3  52.8  9  -87.9  1.2
```

Source Parameters defined for each link:

- Emission Rate: “base rate” referenced by EMISFACT table for hourly/seasonal variation in emission rates
- Release Height
- Area Source Length
- Area Source Width
- Area Source Angle (360 deg)
- Initial Vertical Dimension

AERMOD Input File

All sources modeled under urban dispersion conditions
SO URBANSRC



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```
SO SRCPARAM  40A        1  1.3  104  12  68.2  1.2
SO SRCPARAM  38B        1  1.3  145.5  12  67.9  1.2
SO SRCPARAM  57         1  1.3  15.2  3  -178.9  1.2
SO SRCPARAM  47         1  1.3  32  3  -178.9  1.2
SO SRCPARAM  64         1  1.3  56.4  3  51.5  1.2
SO SRCPARAM  74         1  1.3  24.4  3  2.9  1.2
SO SRCPARAM  72         1  1.3  97.5  6  -86.5  1.2
SO SRCPARAM  70         1  1.3  94.1  6  -87.1  1.2
SO SRCPARAM  2          1  1.3  64  6  53.9  1.2
SO SRCPARAM  52         1  1.3  49.4  6  61.2  1.2
SO URBANSRC  1A  1B  3A  3B  4A  4B  5  6  7  8  9  10  11  12  13  14  15A  15B
SO URBANSRC  15C  15D  15E  16A  16B  18A  18B  17A  17B  17C  17D  19A  19B  4C
SO URBANSRC  20  21  22  23  24  25  26A  26B  27A  27B  28A  28B  29  30  31
SO URBANSRC  32  34A  35A  34B  35B  36A  36B  40B  39  38A  37  41  42A  42B
SO URBANSRC  43  44  45  46  48  49  50  51  53  54  55A  55B  56  58  59  60
SO URBANSRC  62  61  63  65  66  67  68  69  71  73  75A  75B  75C  33  40A  38B
SO URBANSRC  57  47  64  74  72  70  2  52
SO EMISFACT 1a SEASHR 3.1249E-07 3.1249E-07 3.1249E-07 3.1249E-07 3.1249E-07 7.2579E-07 7.2579E-07 7.2579E-07 7.2579E-07
SO EMISFACT 1a SEASHR 2.7860E-07 2.7860E-07 2.7860E-07 2.7860E-07 2.7860E-07 2.7860E-07 6.1036E-07 6.1036E-07 6.1036E-07
SO EMISFACT 1a SEASHR 6.1036E-07 3.1249E-07 3.1249E-07 3.1249E-07 3.1249E-07 3.1249E-07 2.2106E-07 2.2106E-07 2.2106E-07
SO EMISFACT 1a SEASHR 2.2106E-07 2.2106E-07 5.1332E-07 5.1332E-07 5.1332E-07 5.1332E-07 1.8932E-07 1.8932E-07 1.8932E-07
SO EMISFACT 1a SEASHR 1.8932E-07 1.8932E-07 1.8932E-07 4.0831E-07 4.0831E-07 4.0831E-07 4.0831E-07 2.2106E-07 2.2106E-07
SO EMISFACT 1a SEASHR 2.2106E-07 2.2106E-07 2.2106E-07 1.7069E-07 1.7069E-07 1.7069E-07 1.7069E-07 1.7069E-07 3.8553E-07
SO EMISFACT 1a SEASHR 3.8553E-07 3.8553E-07 3.8553E-07 1.6372E-07 1.6372E-07 1.6372E-07 1.6372E-07 1.6372E-07 1.6372E-07
SO EMISFACT 1a SEASHR 3.5562E-07 3.5562E-07 3.5562E-07 3.5562E-07 1.7069E-07 1.7069E-07 1.7069E-07 1.7069E-07 1.7069E-07
SO EMISFACT 1a SEASHR 2.1000E-07 2.1000E-07 2.1000E-07 2.1000E-07 2.1000E-07 4.8208E-07 4.8208E-07 4.8208E-07 4.8208E-07
SO EMISFACT 1a SEASHR 1.8291E-07 1.8291E-07 1.8291E-07 1.8291E-07 1.8291E-07 1.8291E-07 4.0831E-07 4.0831E-07 4.0831E-07
SO EMISFACT 1a SEASHR 4.0831E-07 2.1000E-07 2.1000E-07 2.1000E-07 2.1000E-07 2.1000E-07
SO EMISFACT 1b SEASHR 3.1249E-07 3.1249E-07 3.1249E-07 3.1249E-07 3.1249E-07 7.2579E-07 7.2579E-07 7.2579E-07 7.2579E-07
SO EMISFACT 1b SEASHR 2.7860E-07 2.7860E-07 2.7860E-07 2.7860E-07 2.7860E-07 2.7860E-07 6.1036E-07 6.1036E-07 6.1036E-07
SO EMISFACT 1b SEASHR 6.1036E-07 3.1249E-07 3.1249E-07 3.1249E-07 3.1249E-07 3.1249E-07 2.2106E-07 2.2106E-07 2.2106E-07
```

Q for class: To indicate urban dispersion conditions, we listed every source individually. How else could we have done it?

EMISFACT Keyword

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```
SO SRCPARAM  72         1  1.3  97.5  6  -86.5  1.2
SO SRCPARAM  70         1  1.3  94.1  6  -87.1  1.2
SO SRCPARAM  2          1  1.3  64  6  53.9  1.2
SO SRCPARAM  52         1  1.3  49.4  6  61.2  1.2
SO URBANSRC  1A  1B  3A  3B  4A  4B  5  6  7  8  9  10  11  12  13  14  15A  15B
SO URBANSRC  15C  15D  15E  16A  16B  18A  18B  17A  17B  17C  17D  19A  19B  4C
SO URBANSRC  20  21  22  23  24  25  26A  26B  27A  27B  28A  28B  29  30  31
SO URBANSRC  32  34A  35A  34B  35B  36A  36B  40B  39  38A  37  41  42A  42B
SO URBANSRC  43  44  45  46  48  49  50  51  53  54  55A  55B  56  58  59  60
SO URBANSRC  62  61  63  65  66  67  68  69  71  73  75A  75B  75C  33  40A  38B
SO URBANSRC  57  47  64  74  72  70  2  52
SO EMISFACT 1a SEASHR 3.1249E-07 3.1249E-07 3.1249E-07 3.1249E-07 3.1249E-07 7.2579E-07 7.2579E-07 7.2579E-07 7.2579E-07
SO EMISFACT 1a SEASHR 2.7860E-07 2.7860E-07 2.7860E-07 2.7860E-07 2.7860E-07 2.7860E-07 6.1036E-07 6.1036E-07 6.1036E-07
SO EMISFACT 1a SEASHR 6.1036E-07 3.1249E-07 3.1249E-07 3.1249E-07 3.1249E-07 3.1249E-07 2.2106E-07 2.2106E-07 2.2106E-07
SO EMISFACT 1a SEASHR 2.2106E-07 2.2106E-07 5.1332E-07 5.1332E-07 5.1332E-07 5.1332E-07 1.8932E-07 1.8932E-07 1.8932E-07
SO EMISFACT 1a SEASHR 1.8932E-07 1.8932E-07 1.8932E-07 4.0831E-07 4.0831E-07 4.0831E-07 4.0831E-07 2.2106E-07 2.2106E-07
SO EMISFACT 1a SEASHR 2.2106E-07 2.2106E-07 2.2106E-07 1.7069E-07 1.7069E-07 1.7069E-07 1.7069E-07 1.7069E-07 3.8553E-07
SO EMISFACT 1a SEASHR 3.8553E-07 3.8553E-07 3.8553E-07 1.6372E-07 1.6372E-07 1.6372E-07 1.6372E-07 1.6372E-07 1.6372E-07
SO EMISFACT 1a SEASHR 3.5562E-07 3.5562E-07 3.5562E-07 3.5562E-07 1.7069E-07 1.7069E-07 1.7069E-07 1.7069E-07 1.7069E-07
SO EMISFACT 1a SEASHR 2.1000E-07 2.1000E-07 2.1000E-07 2.1000E-07 2.1000E-07 4.8208E-07 4.8208E-07 4.8208E-07 4.8208E-07
SO EMISFACT 1a SEASHR 1.8291E-07 1.8291E-07 1.8291E-07 1.8291E-07 1.8291E-07 1.8291E-07 4.0831E-07 4.0831E-07 4.0831E-07
SO EMISFACT 1a SEASHR 4.0831E-07 2.1000E-07 2.1000E-07 2.1000E-07 2.1000E-07 2.1000E-07
SO EMISFACT 1b SEASHR 3.1249E-07 3.1249E-07 3.1249E-07 3.1249E-07 3.1249E-07 7.2579E-07 7.2579E-07 7.2579E-07 7.2579E-07
SO EMISFACT 1b SEASHR 2.7860E-07 2.7860E-07 2.7860E-07 2.7860E-07 2.7860E-07 2.7860E-07 6.1036E-07 6.1036E-07 6.1036E-07
SO EMISFACT 1b SEASHR 6.1036E-07 3.1249E-07 3.1249E-07 3.1249E-07 3.1249E-07 3.1249E-07 2.2106E-07 2.2106E-07 2.2106E-07
SO EMISFACT 1b SEASHR 2.2106E-07 2.2106E-07 5.1332E-07 5.1332E-07 5.1332E-07 5.1332E-07 1.8932E-07 1.8932E-07 1.8932E-07
SO EMISFACT 1b SEASHR 1.8932E-07 1.8932E-07 1.8932E-07 4.0831E-07 4.0831E-07 4.0831E-07 4.0831E-07 2.2106E-07 2.2106E-07
SO EMISFACT 1b SEASHR 2.2106E-07 2.2106E-07 2.2106E-07 1.7069E-07 1.7069E-07 1.7069E-07 1.7069E-07 1.7069E-07 3.8553E-07
SO EMISFACT 1b SEASHR 3.8553E-07 3.8553E-07 3.8553E-07 1.6372E-07 1.6372E-07 1.6372E-07 1.6372E-07 1.6372E-07 1.6372E-07
SO EMISFACT 1b SEASHR 3.5562E-07 3.5562E-07 3.5562E-07 3.5562E-07 1.7069E-07 1.7069E-07 1.7069E-07 1.7069E-07 1.7069E-07
SO EMISFACT 1b SEASHR 2.1000E-07 2.1000E-07 2.1000E-07 2.1000E-07 2.1000E-07 4.8208E-07 4.8208E-07 4.8208E-07 4.8208E-07
SO EMISFACT 1b SEASHR 1.8291E-07 1.8291E-07 1.8291E-07 1.8291E-07 1.8291E-07 1.8291E-07 4.0831E-07 4.0831E-07 4.0831E-07
SO EMISFACT 1b SEASHR 4.0831E-07 2.1000E-07 2.1000E-07 2.1000E-07 2.1000E-07 2.1000E-07
SO EMISFACT 2 SEASHR 2.4075E-07 2.4075E-07 2.4075E-07 2.4075E-07 2.4075E-07 5.6388E-07 5.6388E-07 5.6388E-07 5.6388E-07
SO EMISFACT 2 SEASHR 2.1237E-07 2.1237E-07 2.1237E-07 2.1237E-07 2.1237E-07 2.1237E-07 4.6693E-07 4.6693E-07 4.6693E-07
SO EMISFACT 2 SEASHR 4.6693E-07 2.4075E-07 2.4075E-07 2.4075E-07 2.4075E-07 2.4075E-07 1.6417E-07 1.6417E-07 1.6417E-07
SO EMISFACT 2 SEASHR 1.6417E-07 1.6417E-07 3.8542E-07 3.8542E-07 3.8542E-07 3.8542E-07 1.3759E-07 1.3759E-07 1.3759E-07
SO EMISFACT 2 SEASHR 1.3759E-07 1.3759E-07 1.3759E-07 2.9722E-07 2.9722E-07 2.9722E-07 2.9722E-07 1.6417E-07 1.6417E-07
SO EMISFACT 2 SEASHR 1.6417E-07 1.6417E-07 1.6417E-07 1.2198E-07 1.2198E-07 1.2198E-07 1.2198E-07 1.2198E-07 2.7809E-07
SO EMISFACT 2 SEASHR 2.7809E-07 2.7809E-07 2.7809E-07 1.1615E-07 1.1615E-07 1.1615E-07 1.1615E-07 1.1615E-07 1.1615E-07
SO EMISFACT 2 SEASHR 2.5296E-07 2.5296E-07 2.5296E-07 2.5296E-07 1.2198E-07 1.2198E-07 1.2198E-07 1.2198E-07 1.2198E-07
SO EMISFACT 2 SEASHR 1.5491E-07 1.5491E-07 1.5491E-07 1.5491E-07 1.5491E-07 3.5918E-07 3.5918E-07 3.5918E-07 3.5918E-07
SO EMISFACT 2 SEASHR 1.3222E-07 1.3222E-07 1.3222E-07 1.3222E-07 1.3222E-07 1.3222E-07 2.9722E-07 2.9722E-07 2.9722E-07
```

- Used to vary emissions by time period

- SEASHR requires 96 factors of base rate
  - 4 seasons, 24 hours
  - Begins with [winter, hour 1], then [winter, hour 2], etc.

Generating EMISFACT table

- The table does not use emission rates explicitly, but requires “factors” of a “base emission rate” that will account for variations in emission rates for each time period

- Defining a “base emission rate” of “1” will allow emission rates (g/s/m-2) to be entered in the EMISFACT table directly – greatly simplifying the generation of this table

- The below example shows 96 rate “factors” for a source (1a) – 24 hrs x 4 seasons with a “base emission rate” of 1

```
SO SRCPARAM  1A        1  1.3  100  6  53.9  1.2
```

```
SO EMISFACT 1a SEASHR 3.1249E-07 3.1249E-07 3.1249E-07 3.1249E-07 3.1249E-07 7.2579E-07 7.2579E-07 7.2579E-07 7.2579E-07
SO EMISFACT 1a SEASHR 2.7860E-07 2.7860E-07 2.7860E-07 2.7860E-07 2.7860E-07 2.7860E-07 6.1036E-07 6.1036E-07 6.1036E-07
SO EMISFACT 1a SEASHR 6.1036E-07 3.1249E-07 3.1249E-07 3.1249E-07 3.1249E-07 3.1249E-07 2.2106E-07 2.2106E-07 2.2106E-07
SO EMISFACT 1a SEASHR 2.2106E-07 2.2106E-07 5.1332E-07 5.1332E-07 5.1332E-07 5.1332E-07 1.8932E-07 1.8932E-07 1.8932E-07
SO EMISFACT 1a SEASHR 1.8932E-07 1.8932E-07 1.8932E-07 4.0831E-07 4.0831E-07 4.0831E-07 4.0831E-07 2.2106E-07 2.2106E-07
SO EMISFACT 1a SEASHR 2.2106E-07 2.2106E-07 2.2106E-07 1.7069E-07 1.7069E-07 1.7069E-07 1.7069E-07 1.7069E-07 3.8553E-07
SO EMISFACT 1a SEASHR 3.8553E-07 3.8553E-07 3.8553E-07 1.6372E-07 1.6372E-07 1.6372E-07 1.6372E-07 1.6372E-07 1.6372E-07
SO EMISFACT 1a SEASHR 3.5562E-07 3.5562E-07 3.5562E-07 3.5562E-07 1.7069E-07 1.7069E-07 1.7069E-07 1.7069E-07 1.7069E-07
SO EMISFACT 1a SEASHR 2.1000E-07 2.1000E-07 2.1000E-07 2.1000E-07 2.1000E-07 4.8208E-07 4.8208E-07 4.8208E-07 4.8208E-07
SO EMISFACT 1a SEASHR 1.8291E-07 1.8291E-07 1.8291E-07 1.8291E-07 1.8291E-07 1.8291E-07 4.0831E-07 4.0831E-07 4.0831E-07
SO EMISFACT 1a SEASHR 4.0831E-07 2.1000E-07 2.1000E-07 2.1000E-07 2.1000E-07 2.1000E-07
```

Generating EMISFACT table

- AERMOD uses a specific format for EMISFACT tables
- 96 “factors”:
  - Hours 1 through 24, season 1 through season 4

```
SO EMISFACT 1a SEASHR 3.1249E-07 3.1249E-07 3.1249E-07 3.1249E-07 3.1249E-07 7.2579E-07 7.2579E-07 7.2579E-07 7.2579E-07
SO EMISFACT 1a SEASHR 2.7860E-07 2.7860E-07 2.7860E-07 2.7860E-07 2.7860E-07 2.7860E-07 6.1036E-07 6.1036E-07 6.1036E-07
SO EMISFACT 1a SEASHR 6.1036E-07 3.1249E-07 3.1249E-07 3.1249E-07 3.1249E-07 3.1249E-07 2.2106E-07 2.2106E-07 2.2106E-07
SO EMISFACT 1a SEASHR 2.2106E-07 2.2106E-07 5.1332E-07 5.1332E-07 5.1332E-07 5.1332E-07 1.8932E-07 1.8932E-07 1.8932E-07
SO EMISFACT 1a SEASHR 1.8932E-07 1.8932E-07 1.8932E-07 4.0831E-07 4.0831E-07 4.0831E-07 4.0831E-07 2.2106E-07 2.2106E-07
SO EMISFACT 1a SEASHR 2.2106E-07 2.2106E-07 2.2106E-07 1.7069E-07 1.7069E-07 1.7069E-07 1.7069E-07 1.7069E-07 3.8553E-07
SO EMISFACT 1a SEASHR 3.8553E-07 3.8553E-07 3.8553E-07 1.6372E-07 1.6372E-07 1.6372E-07 1.6372E-07 1.6372E-07 1.6372E-07
SO EMISFACT 1a SEASHR 3.5562E-07 3.5562E-07 3.5562E-07 3.5562E-07 1.7069E-07 1.7069E-07 1.7069E-07 1.7069E-07 1.7069E-07
SO EMISFACT 1a SEASHR 2.1000E-07 2.1000E-07 2.1000E-07 2.1000E-07 2.1000E-07 4.8208E-07 4.8208E-07 4.8208E-07 4.8208E-07
SO EMISFACT 1a SEASHR 1.8291E-07 1.8291E-07 1.8291E-07 1.8291E-07 1.8291E-07 1.8291E-07 4.0831E-07 4.0831E-07 4.0831E-07
SO EMISFACT 1a SEASHR 4.0831E-07 2.1000E-07 2.1000E-07 2.1000E-07 2.1000E-07 2.1000E-07
```

- With many sources, this formatting can be automated using EPA’s **MOVES2AERMOD** tool (an interface between MOVES and AERMOD)
  - Used for running links only, off-network and idle links are post-processed separately

MOVES2AERMOD

Use to create an EMISFACT table from MOVES output when you have 16 MOVES runs:

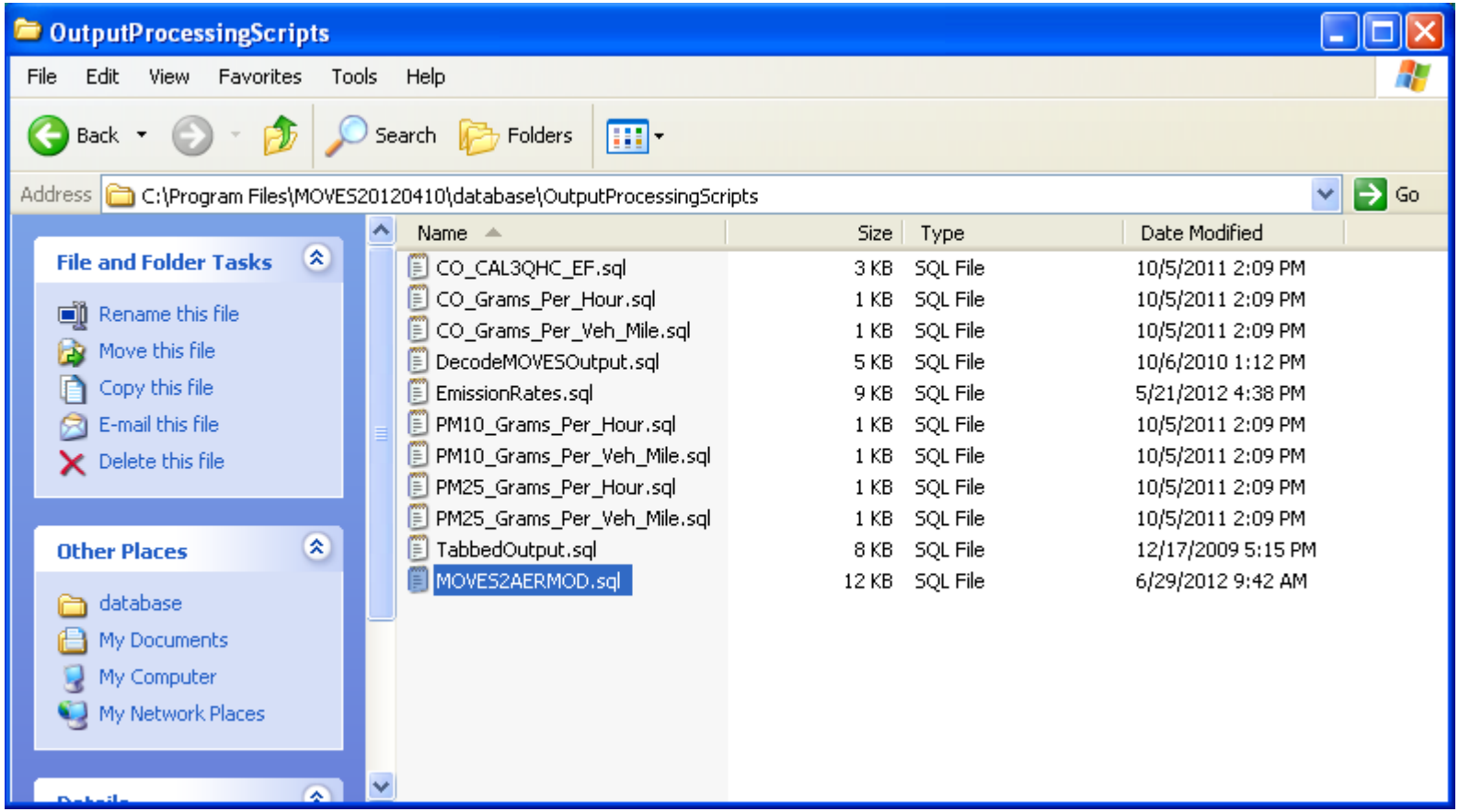
1. Copy MOVES2AERMOD script to C:\Program Files\MOVES20120410\database\OutputProcessingScripts

2. Copy Folder “MOVES2AERMOD input files” directly to C:\

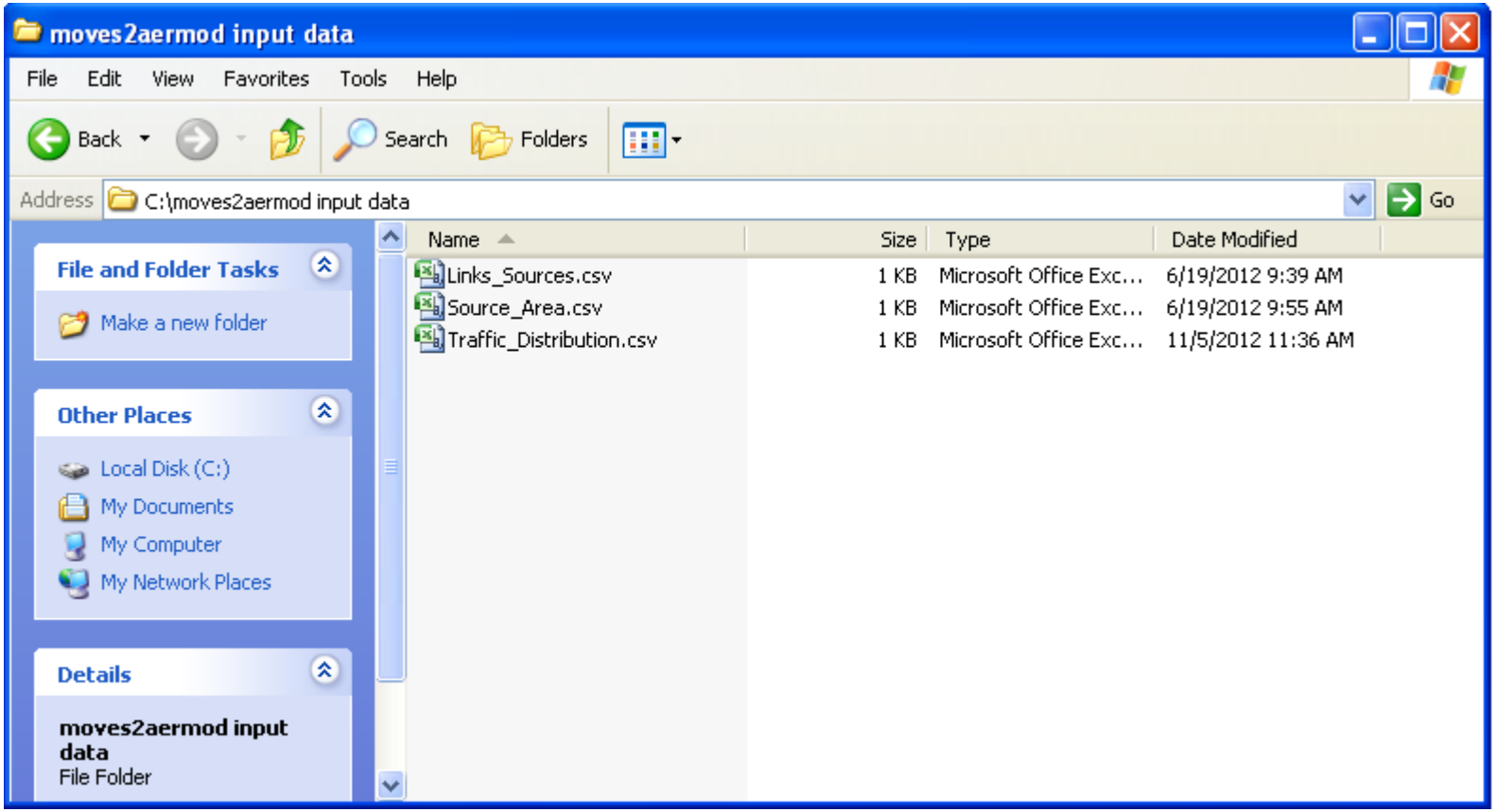
3. Edit input files:
   - Links_sources.csv – Maps MOVES links to AERMOD sources
   - Source_Area.csv – Describes area of each MOVES link
   - Traffic_Distribution.csv – Describes the peak/off-peak periods

4. Run MOVES2AERMOD in MOVES

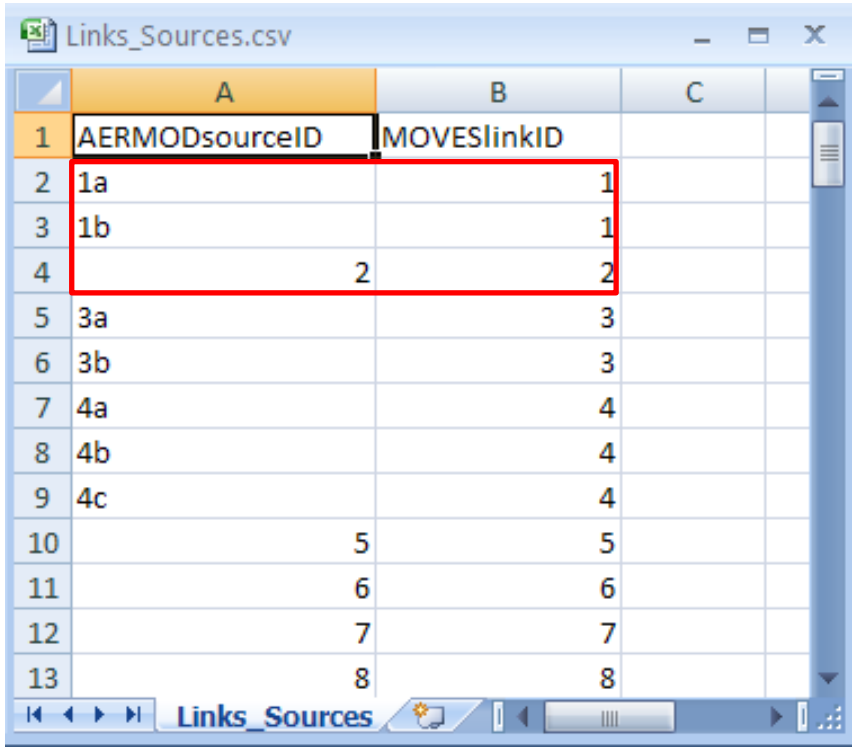
Copy MOVES2AERMOD script



Copy Folder “MOVES2AERMOD input files”



Edit input files – Links_Sources.csv



	A	B	C
1	AERMODsourceID	MOVESlinkID	
2	1a	1	
3	1b	1	
4	2	2	
5	3a	3	
6	3b	3	
7	4a	4	
8	4b	4	
9	4c	4	
10	5	5	
11	6	6	
12	7	7	
13	8	8	

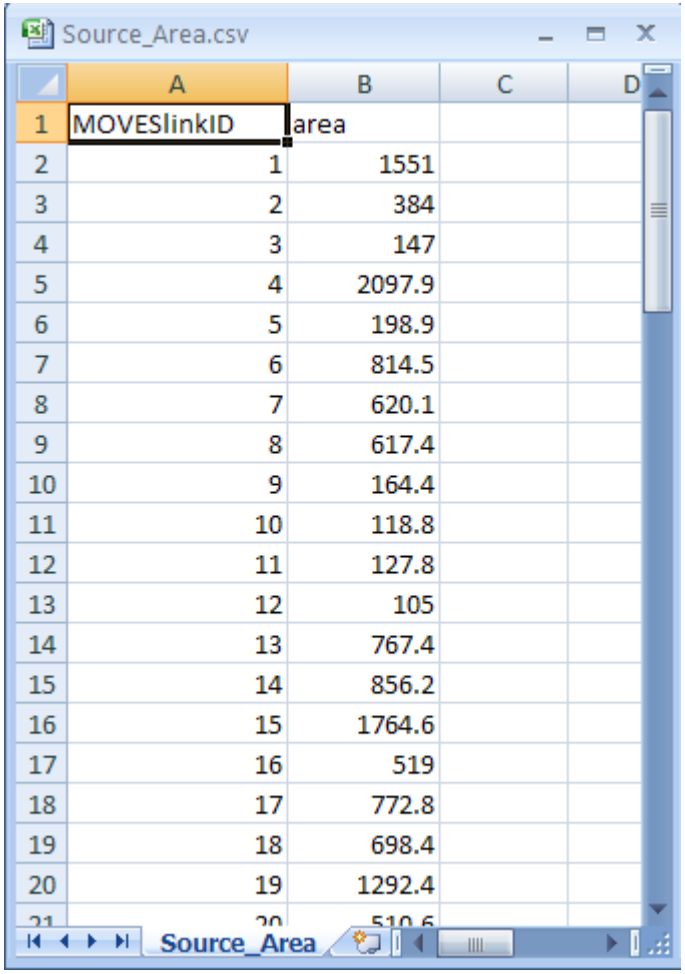
In this table, list each AERMOD source and its corresponding MOVES link

Depending on geometry, links may be modeled as multiple AERMOD sources (Link 1 to AERMOD Source 1a, 1b)

Or…

As a single source (Link 2 to AERMOD Source 2)

Edit input files – Source_area.csv



Source_Area.csv

	A	B	C	D
1	MOVESlinkID	area		
2	1	1551		
3	2	384		
4	3	147		
5	4	2097.9		
6	5	198.9		
7	6	814.5		
8	7	620.1		
9	8	617.4		
10	9	164.4		
11	10	118.8		
12	11	127.8		
13	12	105		
14	13	767.4		
15	14	856.2		
16	15	1764.6		
17	16	519		
18	17	772.8		
19	18	698.4		
20	19	1292.4		
21	20	510.6		

Source_Area

In this table, list each MOVES link and provide the area (m^2) of each, calculated as roadway width (e.g., 3 m per lane of traffic) multiplied by link length

Edit input files – traffic_distribution.csv

Traffic_Distribution.csv

	A	B	C	D
1	seasonId	hourId	Distribution	
2	1	1	101	
3	1	2	101	
4	1	3	101	
5	1	4	101	
6	1	5	101	
7	1	6	107	
8	1	7	107	
9	1	8	107	
10	1	9	107	
11	1	10	113	
12	1	11	113	
13	1	12	113	
14	1	13	113	
15	1	14	113	
16	1	15	113	
17	1	16	119	
18	1	17	119	
19	1	18	119	
20	1	19	119	
21	1	20	101	
22	1	21	101	
23	1	22	101	
24	1	23	101	
25	1	24	101	
26	4	1	401	
27	4	2	401	
28	4	3	401	
29	4	4	401	

Traffic_Distribution

In this table, tell the model which MOVES run to use for each hour of each season

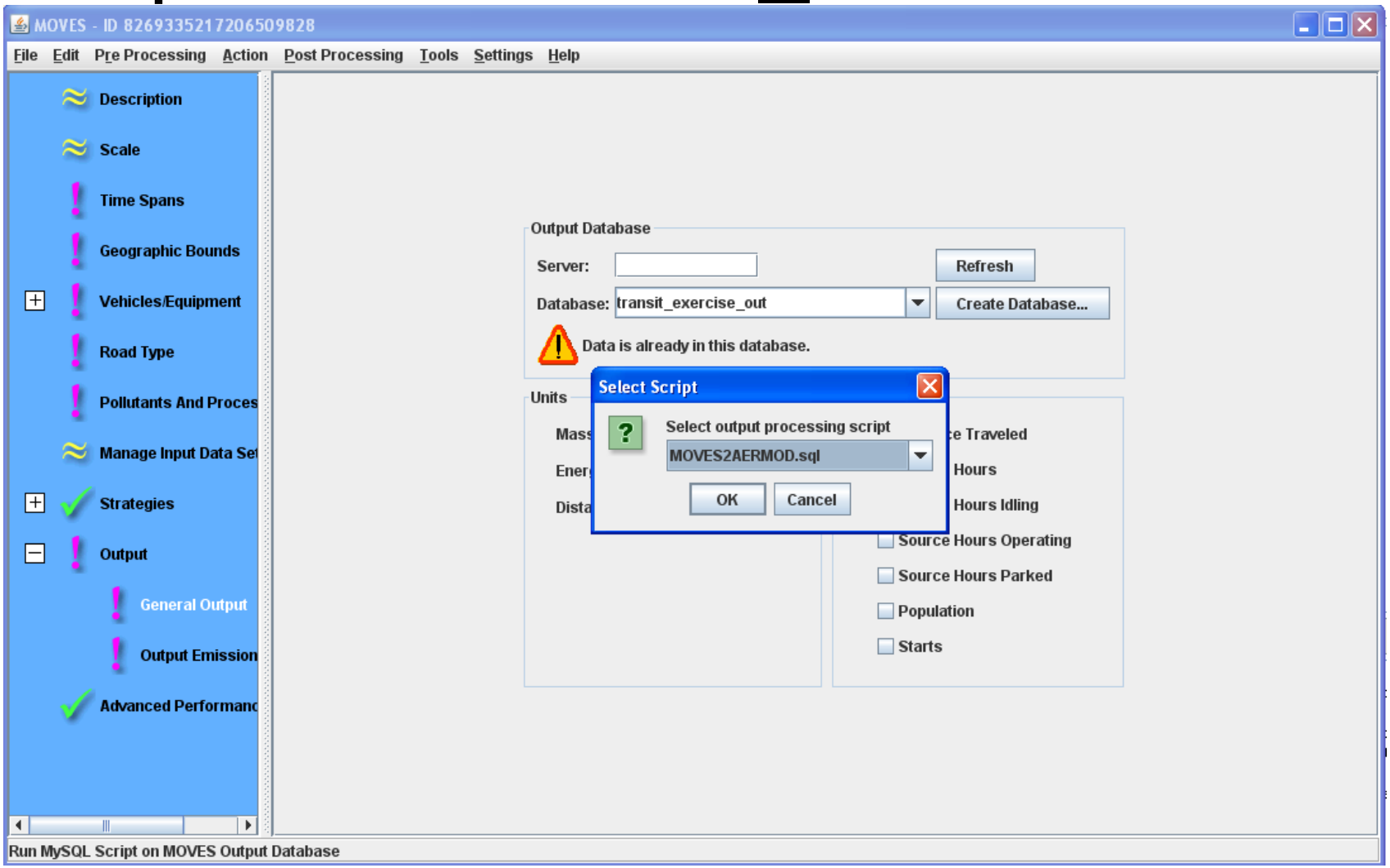
- Essentially, which MOVES run to pull emission rates from ("Distribution" column)

Number in "Distribution" column is MOVES month (1, 4, 7, 10) and hour, e.g.:

- 101 = January 12am MOVES run
- 1001 = October 12 am MOVES run

Follow this pattern for all sources

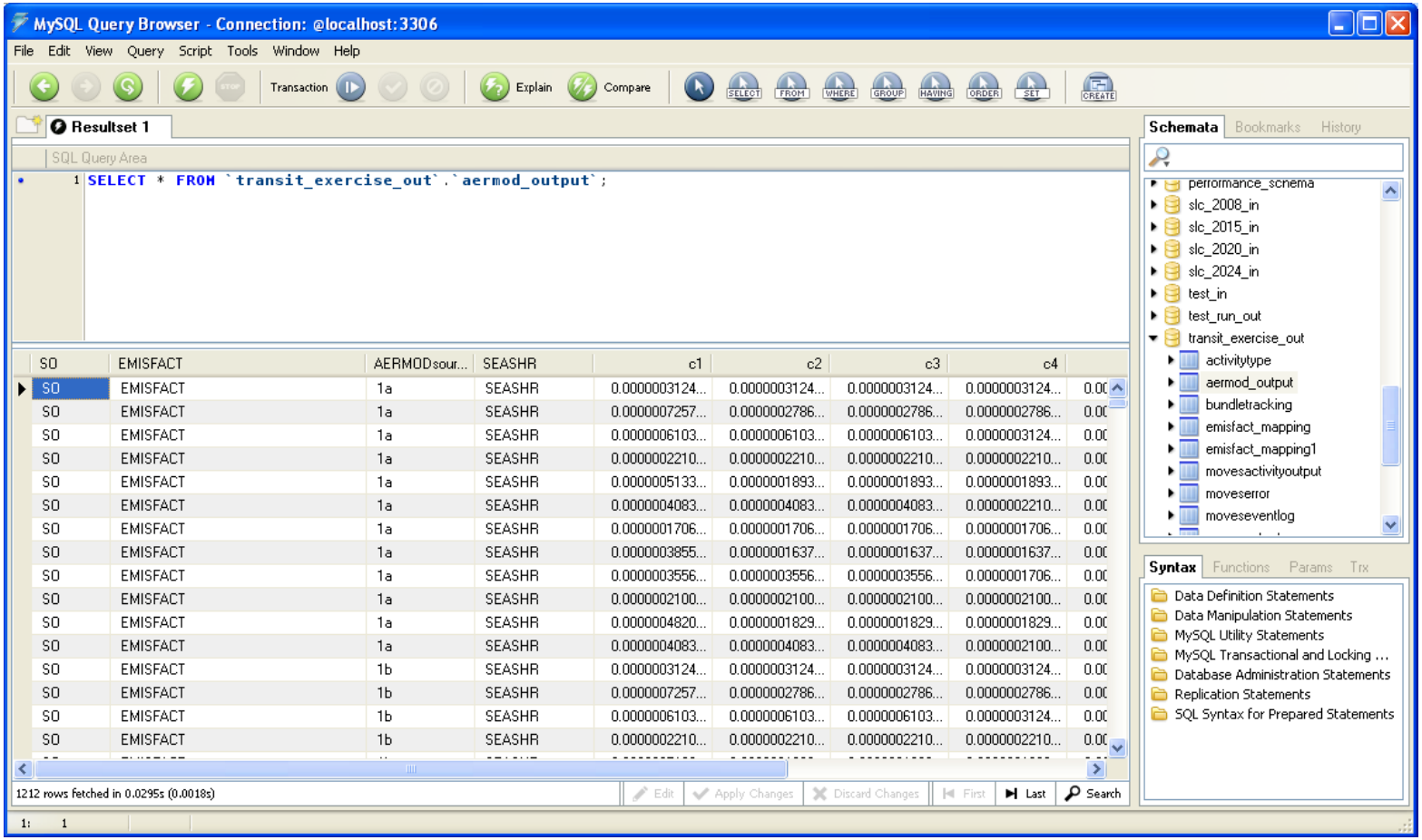
Edit input files – traffic_distribution.csv



Ensure output database is selected in General Output

Run MOVES2AERMOD script through Post Processing menu > run MySQL script on Output Database

SEASONHR EMISFACT Table



Located in MOVES output database – table “aermod_output”

File> export resultset as > .csv file > EMISFACT.csv

EMISFACT.csv

	A	B	C	D	E	F	G	H	I	J	K	L
1	SO	EMISFACT	AERMODs	SEASHR	c1	c2	c3	c4	c5	c6	c7	c8
2	SO	EMISFACT	1a	SEASHR	3.12E-07	3.12E-07	3.12E-07	3.12E-07	3.12E-07	7.26E-07	7.26E-07	7.26E-07
3	SO	EMISFACT	1a	SEASHR	7.26E-07	2.79E-07	2.79E-07	2.79E-07	2.79E-07	2.79E-07	2.79E-07	6.1E-07
4	SO	EMISFACT	1a	SEASHR	6.1E-07	6.1E-07	6.1E-07	3.12E-07	3.12E-07	3.12E-07	3.12E-07	3.12E-07
5	SO	EMISFACT	1a	SEASHR	2.21E-07	2.21E-07	2.21E-07	2.21E-07	2.21E-07	5.13E-07	5.13E-07	5.13E-07
6	SO	EMISFACT	1a	SEASHR	5.13E-07	1.89E-07	1.89E-07	1.89E-07	1.89E-07	1.89E-07	1.89E-07	4.08E-07
7	SO	EMISFACT	1a	SEASHR	4.08E-07	4.08E-07	4.08E-07	2.21E-07	2.21E-07	2.21E-07	2.21E-07	2.21E-07
8	SO	EMISFACT	1a	SEASHR	1.71E-07	1.71E-07	1.71E-07	1.71E-07	1.71E-07	3.86E-07	3.86E-07	3.86E-07
9	SO	EMISFACT	1a	SEASHR	3.86E-07	1.64E-07	1.64E-07	1.64E-07	1.64E-07	1.64E-07	1.64E-07	3.56E-07
10	SO	EMISFACT	1a	SEASHR	3.56E-07	3.56E-07	3.56E-07	1.71E-07	1.71E-07	1.71E-07	1.71E-07	1.71E-07
11	SO	EMISFACT	1a	SEASHR	2.1E-07	2.1E-07	2.1E-07	2.1E-07	2.1E-07	4.82E-07	4.82E-07	4.82E-07
12	SO	EMISFACT	1a	SEASHR	4.82E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	4.08E-07
13	SO	EMISFACT	1a	SEASHR	4.08E-07	4.08E-07	4.08E-07	2.1E-07	2.1E-07	2.1E-07	2.1E-07	2.1E-07
14	SO	EMISFACT	1b	SEASHR	3.12E-07	3.12E-07	3.12E-07	3.12E-07	3.12E-07	7.26E-07	7.26E-07	7.26E-07
15	SO	EMISFACT	1b	SEASHR	7.26E-07	2.79E-07	2.79E-07	2.79E-07	2.79E-07	2.79E-07	2.79E-07	6.1E-07
16	SO	EMISFACT	1b	SEASHR	6.1E-07	6.1E-07	6.1E-07	3.12E-07	3.12E-07	3.12E-07	3.12E-07	3.12E-07
17	SO	EMISFACT	1b	SEASHR	2.21E-07	2.21E-07	2.21E-07	2.21E-07	2.21E-07	5.13E-07	5.13E-07	5.13E-07
18	SO	EMISFACT	1b	SEASHR	5.13E-07	1.89E-07	1.89E-07	1.89E-07	1.89E-07	1.89E-07	1.89E-07	4.08E-07
19	SO	EMISFACT	1b	SEASHR	4.08E-07	4.08E-07	4.08E-07	2.21E-07	2.21E-07	2.21E-07	2.21E-07	2.21E-07
20	SO	EMISFACT	1b	SEASHR	1.71E-07	1.71E-07	1.71E-07	1.71E-07	1.71E-07	3.86E-07	3.86E-07	3.86E-07
21	SO	EMISFACT	1b	SEASHR	3.86E-07	1.64E-07	1.64E-07	1.64E-07	1.64E-07	1.64E-07	1.64E-07	3.56E-07
22	SO	EMISFACT	1b	SEASHR	3.56E-07	3.56E-07	3.56E-07	1.71E-07	1.71E-07	1.71E-07	1.71E-07	1.71E-07
23	SO	EMISFACT	1b	SEASHR	2.1E-07	2.1E-07	2.1E-07	2.1E-07	2.1E-07	4.82E-07	4.82E-07	4.82E-07
24	SO	EMISFACT	1b	SEASHR	4.82E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	4.08E-07
25	SO	EMISFACT	1b	SEASHR	4.08E-07	4.08E-07	4.08E-07	2.1E-07	2.1E-07	2.1E-07	2.1E-07	2.1E-07
26	SO	EMISFACT	2	SEASHR	2.41E-07	2.41E-07	2.41E-07	2.41E-07	2.41E-07	5.64E-07	5.64E-07	5.64E-07
27	SO	EMISFACT	2	SEASHR	5.64E-07	2.12E-07	2.12E-07	2.12E-07	2.12E-07	2.12E-07	2.12E-07	4.67E-07
28	SO	EMISFACT	2	SEASHR	4.67E-07	4.67E-07	4.67E-07	2.41E-07	2.41E-07	2.41E-07	2.41E-07	2.41E-07

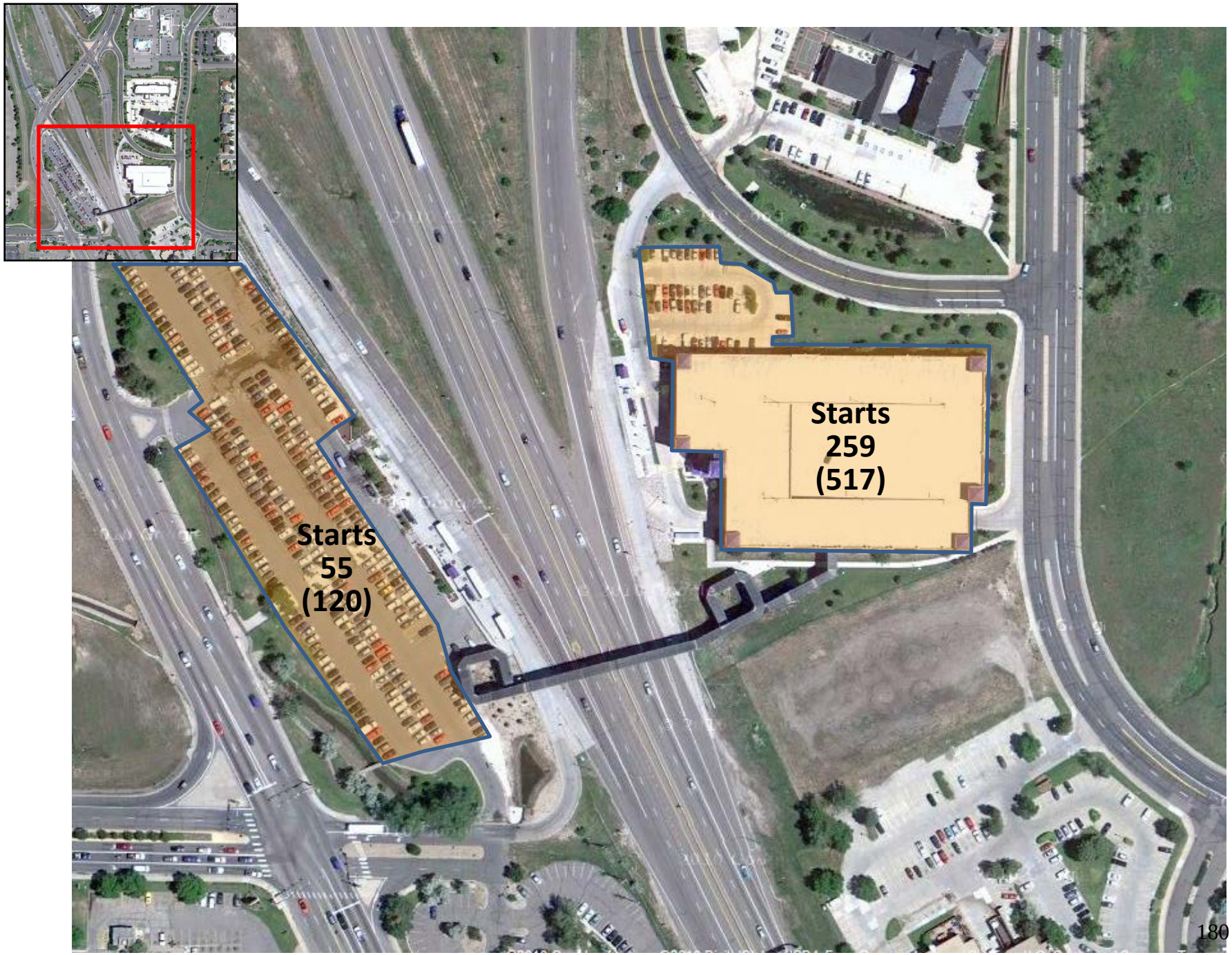
Copy all rows and columns, paste in text file. Then, delete first row. Select “find and replace,” replace tabs with a single space… creates a space delimited file.

Creating EMISFAC table for parking lots…

- MOVES can only model one off-network link per run
- Many projects may have multiple areas of starting vehicles – including the example analysis

Solution:

- A grams/start rate can be calculated for each of the 16 time periods
- These rates can be applied to each area of start activity (grams/start x number of starts)
  - Fleet mix must be identical in all areas for this approach to work


Starts
55
(120)
Starts
259
(517)

Emission Rates for Parking Lots - Starts

- Only one off-network link modeled in MOVES
- The project has multiple areas of start activity with differing area sizes and number of starts
- Separate calculation is needed to convert results to an area specific emission rate:

  total start emissions > grams/start > total grams per parking area > grams/sec/m^2

  Demonstrated in **Starts_EMISFACT.xls** spreadsheet

Start Rates

Project traffic data has vehicle start data for two areas:

- West parking lot (orange), and
- East parking garage (green)

Only LD vehicles are expected to be starting

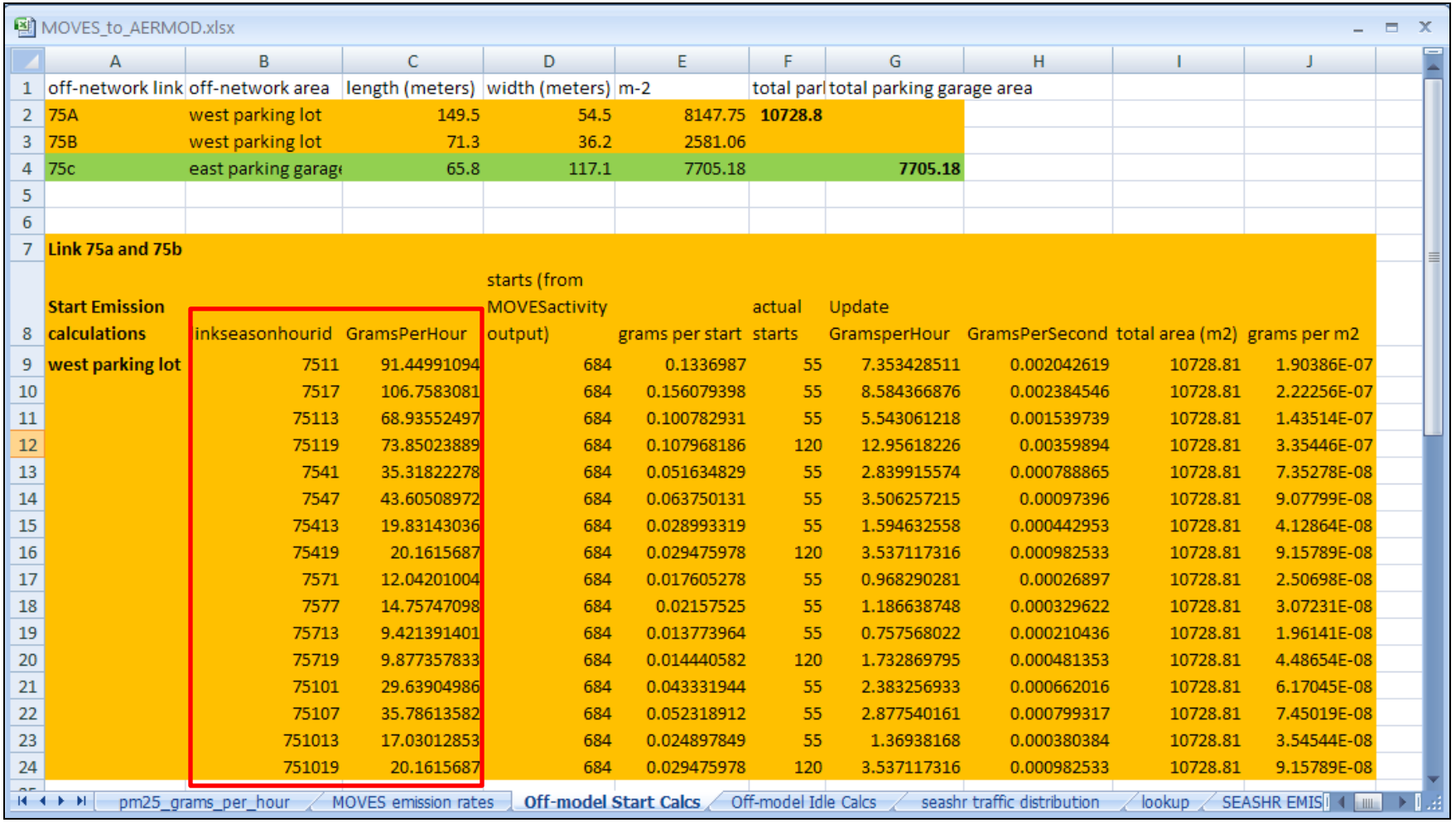
Area is calculated for each respective off-network link

MOVES_to_AERMOD.xlsx

	A	B	C	D	E	F	G	H
1	off-network link	off-network area	length (meters)	width (meters)	m2	total parking lot area	total parking garage area	
2	75A	west parking lot	149.5	54.5	8147.75	**10728.81**		
3	75B	west parking lot	71.3	36.2	2581.06			
4	75c	east parking garage	65.8	117.1	7705.18		**7705.18**	
5								
6								
7	**Link 75a and 75b**							
8	**Start Emission calculations**	linkseasonhourid	GramsPerHour	number of starts (from MOVESactivityoutput)	grams per start	actual starts	Update GramsperHour	GramsPerSeco
9	**west parking lot**	7511	91.44991094	233	0.392488888	55	21.58688885	0.005996
10		7517	106.7583081	233	0.458190163	55	25.20045898	0.007000
11		75113	68.93552497	233	0.295860622	55	16.27233422	0.004520
12		75119	73.85023889	451	0.163747758	120	19.64973097	0.005458
13		7541	35.31822278	233	0.151580355	55	8.336919539	0.002315
14		7547	43.60508972	233	0.187146308	55	10.29304693	0.00285
15		75413	19.83143036	233	0.085113435	55	4.681238926	0.001300
16		75419	20.1615687	451	0.044704143	120	5.364497215	0.001490
17		7571	12.04201004	233	0.051682447	55	2.842534559	0.000789
18		7577	14.75747098	233	0.063336785	55	3.483523193	0.000967
19		75713	9.421391401	233	0.040435156	55	2.223933593	0.000617
20		75719	9.877357833	451	0.021901015	120	2.628121818	0.000730
21		75101	29.63904986	233	0.127206223	55	6.996342241	0.001943
22		75107	35.78613582	233	0.153588566	55	8.447371117	0.002346
23		751013	17.03012853	233	0.07309068	55	4.019987422	0.001116
24		751019	20.1615687	451	0.044704143	120	5.364497215	0.001490
25								
26	**Link 75c (Link 76 in MOVES emission rates tab)**							
27	**Start Emission calculations**							
28	**east parking garage**	linkseasonhourid	GramsPerHour	number of starts (from MOVESactivityoutput)	grams per start	actual starts	Update GramsperHour	GramsPerSeco
29		7511	91.44991094	233	0.392488888	259	101.654622	0.028237
30		7517	106.7583081	233	0.458190163	259	118.6712523	0.032964
31		75113	68.93552497	233	0.295860622	259	76.62790115	0.021285

pm25_grams_per_hour | MOVES emission rates | **Off-model Start Calcs** | Off-model Idle Calcs | seashr traffic distribution | lookup | SEASHR EMISFAC

Start Rates



MOVES_to_AERMOD.xlsx

	A	B	C	D	E	F	G	H	I	J
1	off-network link	off-network area	length (meters)	width (meters)	m-2	total par	total parking garage area			
2	75A	west parking lot	149.5	54.5	8147.75	**10728.8**				
3	75B	west parking lot	71.3	36.2	2581.06					
4	75c	east parking garag	65.8	117.1	7705.18		**7705.18**			
5										
6										
7	**Link 75a and 75b**									
8	**Start Emission calculations**	inkseasonhourid	GramsPerHour	starts (from MOVESactivity output)	grams per start	actual starts	Update GramsperHour	GramsPerSecond	total area (m2)	grams per m2
9	**west parking lot**	7511	91.44991094	684	0.1336987	55	7.353428511	0.002042619	10728.81	1.90386E-07
10		7517	106.7583081	684	0.156079398	55	8.584366876	0.002384546	10728.81	2.22256E-07
11		75113	68.93552497	684	0.100782931	55	5.543061218	0.001539739	10728.81	1.43514E-07
12		75119	73.85023889	684	0.107968186	120	12.95618226	0.00359894	10728.81	3.35446E-07
13		7541	35.31822278	684	0.051634829	55	2.839915574	0.000788865	10728.81	7.35278E-08
14		7547	43.60508972	684	0.063750131	55	3.506257215	0.00097396	10728.81	9.07799E-08
15		75413	19.83143036	684	0.028993319	55	1.594632558	0.000442953	10728.81	4.12864E-08
16		75419	20.1615687	684	0.029475978	120	3.537117316	0.000982533	10728.81	9.15789E-08
17		7571	12.04201004	684	0.017605278	55	0.968290281	0.00026897	10728.81	2.50698E-08
18		7577	14.75747098	684	0.02157525	55	1.186638748	0.000329622	10728.81	3.07231E-08
19		75713	9.421391401	684	0.013773964	55	0.757568022	0.000210436	10728.81	1.96141E-08
20		75719	9.877357833	684	0.014440582	120	1.732869795	0.000481353	10728.81	4.48654E-08
21		75101	29.63904986	684	0.043331944	55	2.383256933	0.000662016	10728.81	6.17045E-08
22		75107	35.78613582	684	0.052318912	55	2.877540161	0.000799317	10728.81	7.45019E-08
23		751013	17.03012853	684	0.024897849	55	1.36938168	0.000380384	10728.81	3.54544E-08
24		751019	20.1615687	684	0.029475978	120	3.537117316	0.000982533	10728.81	9.15789E-08

pm25_grams_per_hour | MOVES emission rates | **Off-model Start Calcs** | Off-model Idle Calcs | seashr traffic distribution | lookup | SEASHR EMIS

From MOVES emission rate tab, linkseasonhourid code and gramsperhour emissions copied

Start Rates

MOVES_to_AERMOD.xlsx

	A	B	C	D	E	F	G	H	I	J
1	off-network link	off-network area	length (meters)	width (meters)	m-2	total par	total parking garage area			
2	75A	west parking lot	149.5	54.5	8147.75	**10728.8**				
3	75B	west parking lot	71.3	36.2	2581.06					
4	75c	east parking garag	65.8	117.1	7705.18		**7705.18**			
5										
6										
7	**Link 75a and 75b**									
8	**Start Emission calculations**	linkseasonhourid	GramsPerHour	starts (from MOVESactivity output)	grams per start	actual starts	Update GramsperHour	GramsPerSecond	total area (m2)	grams per m2
9	**west parking lot**	7511	91.44991094	684	0.1336987	55	7.353428511	0.002042619	10728.81	1.90386E-07
10		7517	106.7583081	684	0.156079398	55	8.584366876	0.002384546	10728.81	2.22256E-07
11		75113	68.93552497	684	0.100782931	55	5.543061218	0.001539739	10728.81	1.43514E-07
12		75119	73.85023889	684	0.107968186	120	12.95618226	0.00359894	10728.81	3.35446E-07
13		7541	35.31822278	684	0.051634829	55	2.839915574	0.000788865	10728.81	7.35278E-08
14		7547	43.60508972	684	0.063750131	55	3.506257215	0.00097396	10728.81	9.07799E-08
15		75413	19.83143036	684	0.028993319	55	1.594632558	0.000442953	10728.81	4.12864E-08
16		75419	20.1615687	684	0.029475978	120	3.537117316	0.000982533	10728.81	9.15789E-08
17		7571	12.04201004	684	0.017605278	55	0.968290281	0.00026897	10728.81	2.50698E-08
18		7577	14.75747098	684	0.02157525	55	1.186638748	0.000329622	10728.81	3.07231E-08
19		75713	9.421391401	684	0.013773964	55	0.757568022	0.000210436	10728.81	1.96141E-08
20		75719	9.877357833	684	0.014440582	120	1.732869795	0.000481353	10728.81	4.48654E-08
21		75101	29.63904986	684	0.043331944	55	2.383256933	0.000662016	10728.81	6.17045E-08
22		75107	35.78613582	684	0.052318912	55	2.877540161	0.000799317	10728.81	7.45019E-08
23		751013	17.03012853	684	0.024897849	55	1.36938168	0.000380384	10728.81	3.54544E-08
24		751019	20.1615687	684	0.029475978	120	3.537117316	0.000982533	10728.81	9.15789E-08

pm25_grams_per_hour | MOVES emission rates | **Off-model Start Calcs** | Off-model Idle Calcs | seashr traffic distribution | lookup | SEASHR EMIS

Starts obtained from MySQL MOVESactivityOutput table (activitytypeid = 7)

Start Rates

MOVES_to_AERMOD.xlsx

	A	B	C	D	E	F	G	H	I	J
1	off-network link	off-network area	length (meters)	width (meters)	m-2	total par	total parking garage area			
2	75A	west parking lot	149.5	54.5	8147.75	**10728.8**				
3	75B	west parking lot	71.3	36.2	2581.06					
4	75c	east parking garag	65.8	117.1	7705.18		**7705.18**			
5										
6										
7	**Link 75a and 75b**									
8	**Start Emission calculations**	linkseasonhourid	GramsPerHour	starts (from MOVESactivity output)	grams per start	actual starts	Update GramsperHour	GramsPerSecond	total area (m2)	grams per m2
9	**west parking lot**	7511	91.44991094	684	0.1336987	55	7.353428511	0.002042619	10728.81	1.90386E-07
10		7517	106.7583081	684	0.156079398	55	8.584366876	0.002384546	10728.81	2.22256E-07
11		75113	68.93552497	684	0.100782931	55	5.543061218	0.001539739	10728.81	1.43514E-07
12		75119	73.85023889	684	0.107968186	120	12.95618226	0.00359894	10728.81	3.35446E-07
13		7541	35.31822278	684	0.051634829	55	2.839915574	0.000788865	10728.81	7.35278E-08
14		7547	43.60508972	684	0.063750131	55	3.506257215	0.00097396	10728.81	9.07799E-08
15		75413	19.83143036	684	0.028993319	55	1.594632558	0.000442953	10728.81	4.12864E-08
16		75419	20.1615687	684	0.029475978	120	3.537117316	0.000982533	10728.81	9.15789E-08
17		7571	12.04201004	684	0.017605278	55	0.968290281	0.00026897	10728.81	2.50698E-08
18		7577	14.75747098	684	0.02157525	55	1.186638748	0.000329622	10728.81	3.07231E-08
19		75713	9.421391401	684	0.013773964	55	0.757568022	0.000210436	10728.81	1.96141E-08
20		75719	9.877357833	684	0.014440582	120	1.732869795	0.000481353	10728.81	4.48654E-08
21		75101	29.63904986	684	0.043331944	55	2.383256933	0.000662016	10728.81	6.17045E-08
22		75107	35.78613582	684	0.052318912	55	2.877540161	0.000799317	10728.81	7.45019E-08
23		751013	17.03012853	684	0.024897849	55	1.36938168	0.000380384	10728.81	3.54544E-08
24		751019	20.1615687	684	0.029475978	120	3.537117316	0.000982533	10728.81	9.15789E-08

pm25_grams_per_hour | MOVES emission rates | **Off-model Start Calcs** | Off-model Idle Calcs | seashr traffic distribution | lookup | SEASHR EMIS

Grams per start for each time period calculated: Gramsperhour divided by starts

Start Rates

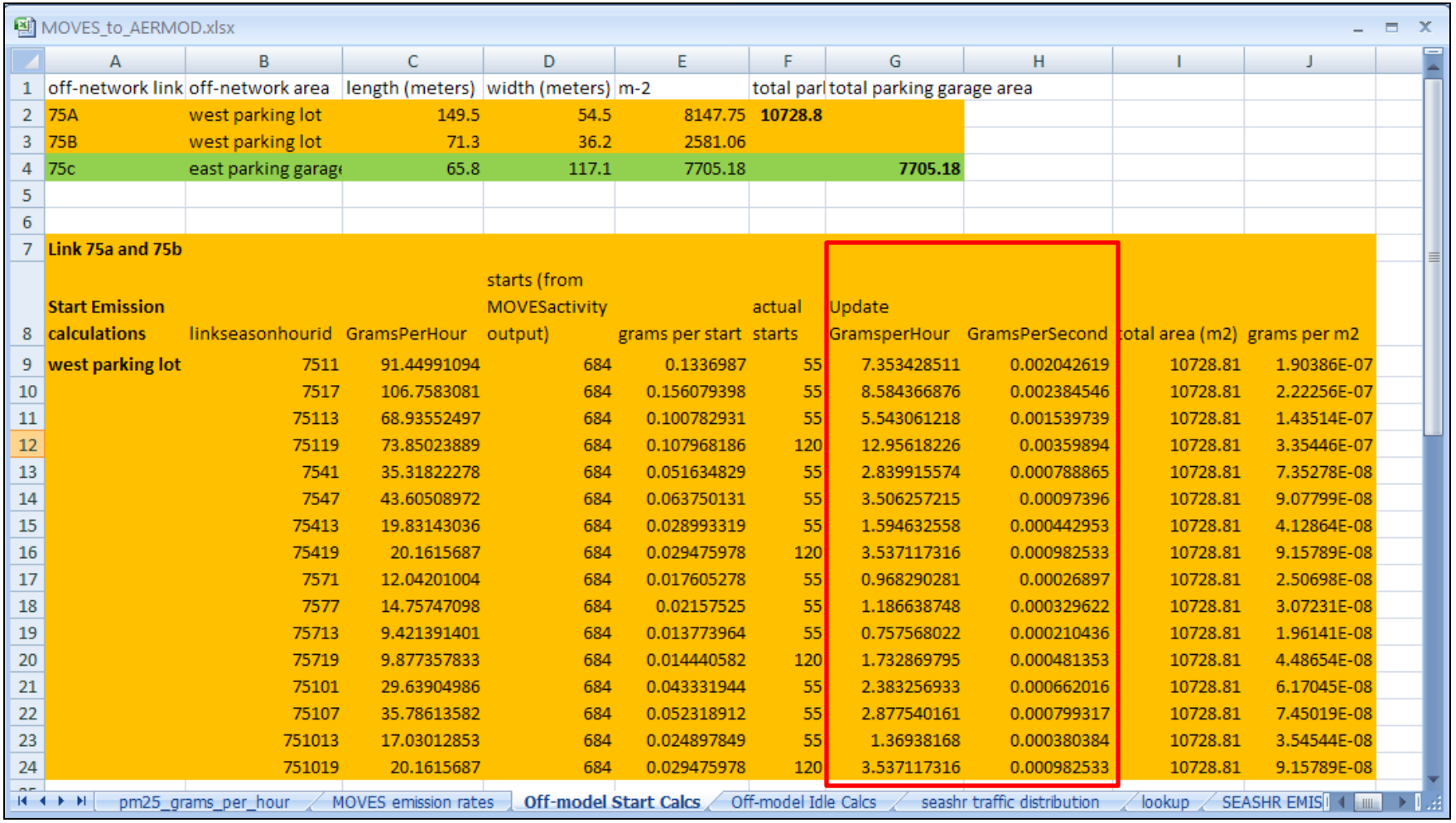
MOVES_to_AERMOD.xlsx

	A	B	C	D	E	F	G	H	I	J
1	off-network link	off-network area	length (meters)	width (meters)	m-2	total par	total parking garage area			
2	75A	west parking lot	149.5	54.5	8147.75	**10728.8**				
3	75B	west parking lot	71.3	36.2	2581.06					
4	75c	east parking garag	65.8	117.1	7705.18		**7705.18**			
5										
6										
7	**Link 75a and 75b**									
8	**Start Emission calculations**	linkseasonhourid	GramsPerHour	starts (from MOVESactivity output)	grams per start	actual starts	Update GramsperHour	GramsPerSecond	total area (m2)	grams per m2
9	**west parking lot**	7511	91.44991094	684	0.1336987	55	7.353428511	0.002042619	10728.81	1.90386E-07
10		7517	106.7583081	684	0.156079398	55	8.584366876	0.002384546	10728.81	2.22256E-07
11		75113	68.93552497	684	0.100782931	55	5.543061218	0.001539739	10728.81	1.43514E-07
12		75119	73.85023889	684	0.107968186	120	12.95618226	0.00359894	10728.81	3.35446E-07
13		7541	35.31822278	684	0.051634829	55	2.839915574	0.000788865	10728.81	7.35278E-08
14		7547	43.60508972	684	0.063750131	55	3.506257215	0.00097396	10728.81	9.07799E-08
15		75413	19.83143036	684	0.028993319	55	1.594632558	0.000442953	10728.81	4.12864E-08
16		75419	20.1615687	684	0.029475978	120	3.537117316	0.000982533	10728.81	9.15789E-08
17		7571	12.04201004	684	0.017605278	55	0.968290281	0.00026897	10728.81	2.50698E-08
18		7577	14.75747098	684	0.02157525	55	1.186638748	0.000329622	10728.81	3.07231E-08
19		75713	9.421391401	684	0.013773964	55	0.757568022	0.000210436	10728.81	1.96141E-08
20		75719	9.877357833	684	0.014440582	120	1.732869795	0.000481353	10728.81	4.48654E-08
21		75101	29.63904986	684	0.043331944	55	2.383256933	0.000662016	10728.81	6.17045E-08
22		75107	35.78613582	684	0.052318912	55	2.877540161	0.000799317	10728.81	7.45019E-08
23		751013	17.03012853	684	0.024897849	55	1.36938168	0.000380384	10728.81	3.54544E-08
24		751019	20.1615687	684	0.029475978	120	3.537117316	0.000982533	10728.81	9.15789E-08

pm25_grams_per_hour | MOVES emission rates | **Off-model Start Calcs** | Off-model Idle Calcs | seashr traffic distribution | lookup | SEASHR EMIS

An “actual” Grams per hour for each time period is calculated: Grams per start is multiplied by the “actual” number of starts from the traffic data

Start Rates



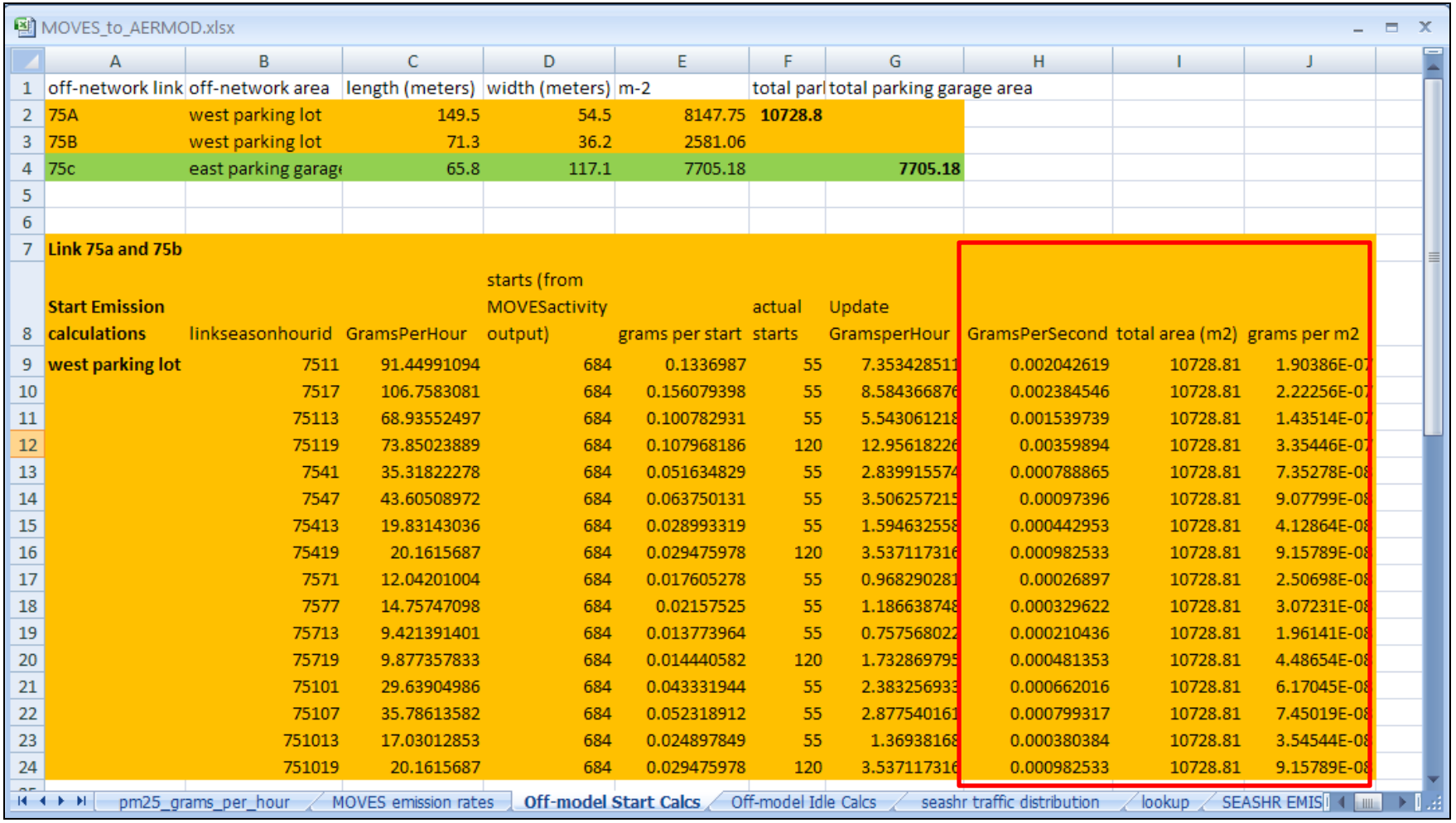
MOVES_to_AERMOD.xlsx

	A	B	C	D	E	F	G	H	I	J
1	off-network link	off-network area	length (meters)	width (meters)	m-2	total par	total parking garage area			
2	75A	west parking lot	149.5	54.5	8147.75	**10728.8**				
3	75B	west parking lot	71.3	36.2	2581.06					
4	75c	east parking garag	65.8	117.1	7705.18		**7705.18**			
5										
6										
7	**Link 75a and 75b**									
8	**Start Emission calculations**	linkseasonhourid	GramsPerHour	starts (from MOVESactivity output)	grams per start	actual starts	Update GramsperHour	GramsPerSecond	total area (m2)	grams per m2
9	**west parking lot**	7511	91.44991094	684	0.1336987	55	7.353428511	0.002042619	10728.81	1.90386E-07
10		7517	106.7583081	684	0.156079398	55	8.584366876	0.002384546	10728.81	2.22256E-07
11		75113	68.93552497	684	0.100782931	55	5.543061218	0.001539739	10728.81	1.43514E-07
12		75119	73.85023889	684	0.107968186	120	12.95618226	0.00359894	10728.81	3.35446E-07
13		7541	35.31822278	684	0.051634829	55	2.839915574	0.000788865	10728.81	7.35278E-08
14		7547	43.60508972	684	0.063750131	55	3.506257215	0.00097396	10728.81	9.07799E-08
15		75413	19.83143036	684	0.028993319	55	1.594632558	0.000442953	10728.81	4.12864E-08
16		75419	20.1615687	684	0.029475978	120	3.537117316	0.000982533	10728.81	9.15789E-08
17		7571	12.04201004	684	0.017605278	55	0.968290281	0.00026897	10728.81	2.50698E-08
18		7577	14.75747098	684	0.02157525	55	1.186638748	0.000329622	10728.81	3.07231E-08
19		75713	9.421391401	684	0.013773964	55	0.757568022	0.000210436	10728.81	1.96141E-08
20		75719	9.877357833	684	0.014440582	120	1.732869795	0.000481353	10728.81	4.48654E-08
21		75101	29.63904986	684	0.043331944	55	2.383256933	0.000662016	10728.81	6.17045E-08
22		75107	35.78613582	684	0.052318912	55	2.877540161	0.000799317	10728.81	7.45019E-08
23		751013	17.03012853	684	0.024897849	55	1.36938168	0.000380384	10728.81	3.54544E-08
24		751019	20.1615687	684	0.029475978	120	3.537117316	0.000982533	10728.81	9.15789E-08

pm25_grams_per_hour | MOVES emission rates | **Off-model Start Calcs** | Off-model Idle Calcs | seashr traffic distribution | lookup | SEASHR EMIS

Grams per hour is divided by 3600 to get a grams/second for each time period

Start Rates



MOVES_to_AERMOD.xlsx

	A	B	C	D	E	F	G	H	I	J
1	off-network link	off-network area	length (meters)	width (meters)	m-2	total par	total parking garage area			
2	75A	west parking lot	149.5	54.5	8147.75	**10728.8**				
3	75B	west parking lot	71.3	36.2	2581.06					
4	75c	east parking garag	65.8	117.1	7705.18		**7705.18**			
5										
6										
7	**Link 75a and 75b**									
8	**Start Emission calculations**	linkseasonhourid	GramsPerHour	starts (from MOVESactivity output)	grams per start	actual starts	Update GramsperHour	GramsPerSecond	total area (m2)	grams per m2
9	**west parking lot**	7511	91.44991094	684	0.1336987	55	7.353428511	0.002042619	10728.81	1.90386E-07
10		7517	106.7583081	684	0.156079398	55	8.584366876	0.002384546	10728.81	2.22256E-07
11		75113	68.93552497	684	0.100782931	55	5.543061218	0.001539739	10728.81	1.43514E-07
12		75119	73.85023889	684	0.107968186	120	12.95618226	0.00359894	10728.81	3.35446E-07
13		7541	35.31822278	684	0.051634829	55	2.839915574	0.000788865	10728.81	7.35278E-08
14		7547	43.60508972	684	0.063750131	55	3.506257215	0.00097396	10728.81	9.07799E-08
15		75413	19.83143036	684	0.028993319	55	1.594632558	0.000442953	10728.81	4.12864E-08
16		75419	20.1615687	684	0.029475978	120	3.537117316	0.000982533	10728.81	9.15789E-08
17		7571	12.04201004	684	0.017605278	55	0.968290281	0.00026897	10728.81	2.50698E-08
18		7577	14.75747098	684	0.02157525	55	1.186638748	0.000329622	10728.81	3.07231E-08
19		75713	9.421391401	684	0.013773964	55	0.757568022	0.000210436	10728.81	1.96141E-08
20		75719	9.877357833	684	0.014440582	120	1.732869795	0.000481353	10728.81	4.48654E-08
21		75101	29.63904986	684	0.043331944	55	2.383256933	0.000662016	10728.81	6.17045E-08
22		75107	35.78613582	684	0.052318912	55	2.877540161	0.000799317	10728.81	7.45019E-08
23		751013	17.03012853	684	0.024897849	55	1.36938168	0.000380384	10728.81	3.54544E-08
24		751019	20.1615687	684	0.029475978	120	3.537117316	0.000982533	10728.81	9.15789E-08

pm25_grams_per_hour | MOVES emission rates | **Off-model Start Calcs** | Off-model Idle Calcs | seashr traffic distribution | lookup | SEASHR EMIS

Grams per second is divided by the total parking lot area to calculate a grams/sec/m^2 value, these values are copied into the MOVES2AERMOD generate EMISFACT table in the appropriate source (75a, 75b, 75c) and seasonhr

Emission Rates for Bus Pick-up Lanes - Idle

- Modeled as link 61 (west) and link 67 (east) with “0 mph” average speed in MOVES
- Emissions were calculated for buses idling the entire hour
- Since buses only idle 3 minutes out of the hour, an additional calculation is necessary:

From the MOVES2AERMOD generated EMISFACT table (sources 61 and 67), divide the grams/s/m2 rate by 20 (3 min/60 min)

Paste EMISFACT table into AERMOD input file

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```
SO SRCPARAM  40A       1  1.3  104  12  68.2  1.2
SO SRCPARAM  38B       1  1.3  145.5  12  67.9  1.2
SO SRCPARAM  57        1  1.3  15.2  3  -178.9  1.2
SO SRCPARAM  47        1  1.3  32  3  -178.9  1.2
SO SRCPARAM  64        1  1.3  56.4  3  51.5  1.2
SO SRCPARAM  74        1  1.3  24.4  3  2.9  1.2
SO SRCPARAM  72        1  1.3  97.5  6  -86.5  1.2
SO SRCPARAM  70        1  1.3  94.1  6  -87.1  1.2
SO SRCPARAM  2         1  1.3  64  6  53.9  1.2
SO SRCPARAM  52        1  1.3  49.4  6  61.2  1.2
SO URBANSRC  1A  1B  3A  3B  4A  4B  5  6  7  8  9  10  11  12  13  14  15A  15B
SO URBANSRC  15C  15D  15E  16A  16B  18A  18B  17A  17B  17C  17D  19A  19B  4C
SO URBANSRC  20  21  22  23  24  25  26A  26B  27A  27B  28A  28B  29  30  31
SO URBANSRC  32  34A  35A  34B  35B  36A  36B  40B  39  38A  37  41  42A  42B
SO URBANSRC  43  44  45  46  48  49  50  51  53  54  55A  55B  56  58  59  60
SO URBANSRC  62  61  63  65  66  67  68  69  71  73  75A  75B  75C  33  40A  38B
SO URBANSRC  57  47  64  74  72  70  2  52
SO EMISFACT 1a SEASHR 3.12487E-07 3.12487E-07 3.12487E-07 3.12487E-07 7.25791E-07 7.25791E-07 7.25791E-07
SO EMISFACT 1a SEASHR 7.25791E-07 2.78601E-07 2.78601E-07 2.78601E-07 2.78601E-07 2.78601E-07 6.1036E-07
SO EMISFACT 1a SEASHR 6.1036E-07 6.1036E-07 6.1036E-07 3.12487E-07 3.12487E-07 3.12487E-07 3.12487E-07
SO EMISFACT 1a SEASHR 2.21061E-07 2.21061E-07 2.21061E-07 2.21061E-07 2.21061E-07 5.13317E-07 5.13317E-07 5.13317E-07
SO EMISFACT 1a SEASHR 5.13317E-07 1.89323E-07 1.89323E-07 1.89323E-07 1.89323E-07 1.89323E-07 1.89323E-07 4.08309E-07
SO EMISFACT 1a SEASHR 4.08309E-07 4.08309E-07 4.08309E-07 2.21061E-07 2.21061E-07 2.21061E-07 2.21061E-07 2.21061E-07
SO EMISFACT 1a SEASHR 1.7069E-07 1.7069E-07 1.7069E-07 1.7069E-07 1.7069E-07 3.85527E-07 3.85527E-07 3.85527E-07
SO EMISFACT 1a SEASHR 3.85527E-07 1.63723E-07 1.63723E-07 1.63723E-07 1.63723E-07 1.63723E-07 1.63723E-07 3.55617E-07
SO EMISFACT 1a SEASHR 3.55617E-07 3.55617E-07 3.55617E-07 1.7069E-07 1.7069E-07 1.7069E-07 1.7069E-07 1.7069E-07
SO EMISFACT 1a SEASHR 2.10003E-07 2.10003E-07 2.10003E-07 2.10003E-07 2.10003E-07 4.82082E-07 4.82082E-07 4.82082E-07
SO EMISFACT 1a SEASHR 4.82082E-07 1.82914E-07 1.82914E-07 1.82914E-07 1.82914E-07 1.82914E-07 1.82914E-07 4.08309E-07
SO EMISFACT 1a SEASHR 4.08309E-07 4.08309E-07 4.08309E-07 2.10003E-07 2.10003E-07 2.10003E-07 2.10003E-07 2.10003E-07
SO EMISFACT 1b SEASHR 3.12487E-07 3.12487E-07 3.12487E-07 3.12487E-07 3.12487E-07 7.25791E-07 7.25791E-07 7.25791E-07
SO EMISFACT 1b SEASHR 7.25791E-07 2.78601E-07 2.78601E-07 2.78601E-07 2.78601E-07 2.78601E-07 2.78601E-07 6.1036E-07
SO EMISFACT 1b SEASHR 6.1036E-07 6.1036E-07 6.1036E-07 3.12487E-07 3.12487E-07 3.12487E-07 3.12487E-07 3.12487E-07
SO EMISFACT 1b SEASHR 2.21061E-07 2.21061E-07 2.21061E-07 2.21061E-07 2.21061E-07 5.13317E-07 5.13317E-07 5.13317E-07
SO EMISFACT 1b SEASHR 5.13317E-07 1.89323E-07 1.89323E-07 1.89323E-07 1.89323E-07 1.89323E-07 1.89323E-07 4.08309E-07
SO EMISFACT 1b SEASHR 4.08309E-07 4.08309E-07 4.08309E-07 2.21061E-07 2.21061E-07 2.21061E-07 2.21061E-07 2.21061E-07
SO EMISFACT 1b SEASHR 1.7069E-07 1.7069E-07 1.7069E-07 1.7069E-07 1.7069E-07 3.85527E-07 3.85527E-07 3.85527E-07
SO EMISFACT 1b SEASHR 3.85527E-07 1.63723E-07 1.63723E-07 1.63723E-07 1.63723E-07 1.63723E-07 1.63723E-07 3.55617E-07
SO EMISFACT 1b SEASHR 3.55617E-07 3.55617E-07 3.55617E-07 1.7069E-07 1.7069E-07 1.7069E-07 1.7069E-07 1.7069E-07
SO EMISFACT 1b SEASHR 2.10003E-07 2.10003E-07 2.10003E-07 2.10003E-07 2.10003E-07 4.82082E-07 4.82082E-07 4.82082E-07
SO EMISFACT 1b SEASHR 4.82082E-07 1.82914E-07 1.82914E-07 1.82914E-07 1.82914E-07 1.82914E-07 1.82914E-07 4.08309E-07
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Defining Receptors

Defining Receptors

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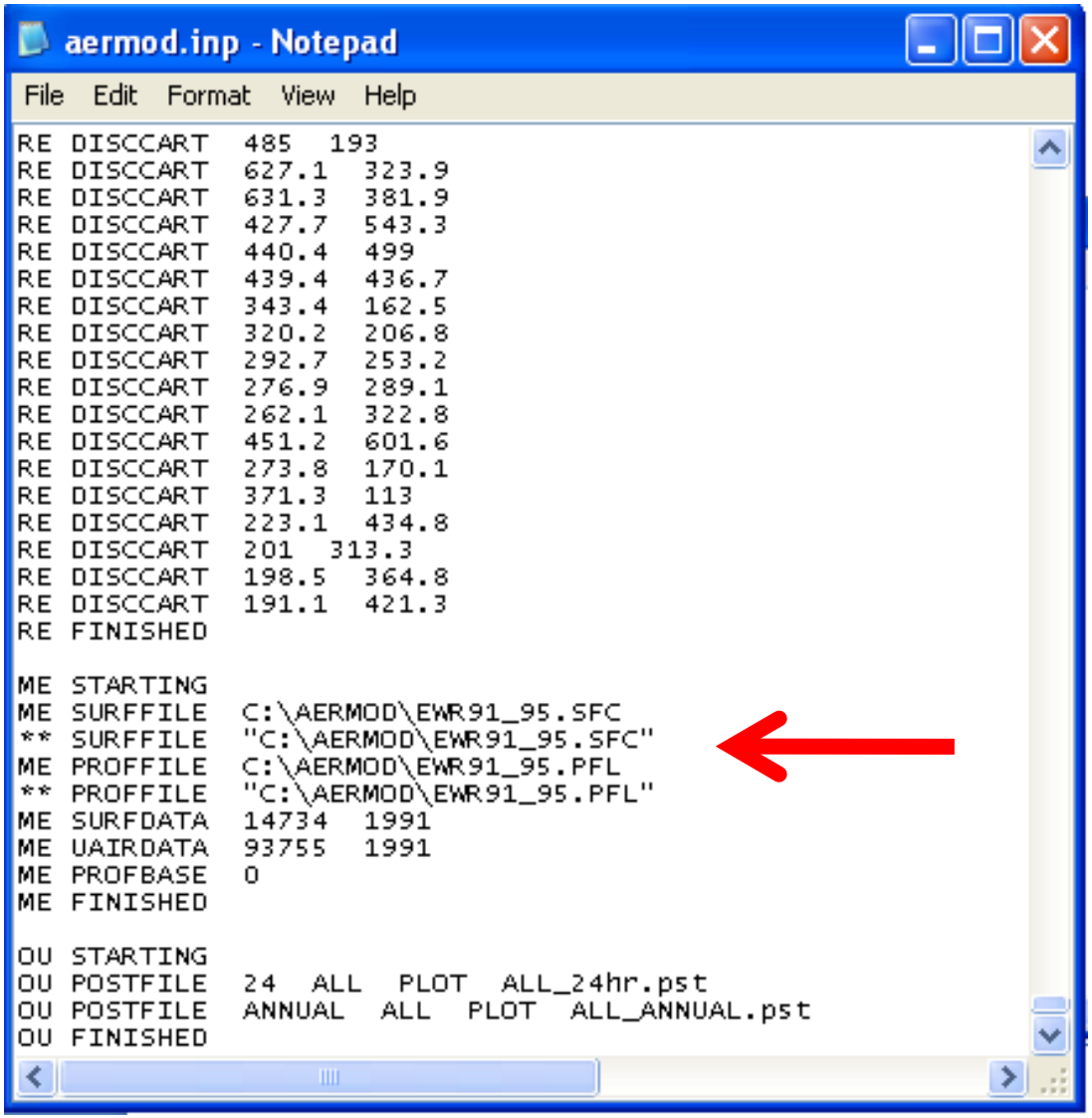
```
SO EMISFACT  75c  SEASHR  4.5292  4.5292  4.5292  1.5443  1.5443  1.5443  1.5443  1.5443  1.8925
SO EMISFACT  75c  SEASHR  1.8925  1.8925  1.8925  1.2082  1.2082  1.2082  1.2082  1.2082  1.2082
SO EMISFACT  75c  SEASHR  1.3063  1.3063  1.3063  1.3063  1.5443  1.5443  1.5443  1.5443  1.5443
SO EMISFACT  75c  SEASHR  3.8009  3.8009  3.8009  3.8009  3.8009  4.5892  4.5892  4.5892  4.5892
SO EMISFACT  75c  SEASHR  2.1840  2.1840  2.1840  2.1840  2.1840  2.1840  2.6664  2.6664  2.6664
SO EMISFACT  75c  SEASHR  2.6664  3.8009  3.8009  3.8009  3.8009  3.8009
SO SRCGROUP ALL
SO FINISHED

RE STARTING
RE ELEVUNIT  METERS
RE DISCCART  9.0  212.8
RE DISCCART  59.0  212.8
RE DISCCART  109.0  212.8
RE DISCCART  159.0  212.8
RE DISCCART  209.0  212.8
RE DISCCART  259.0  212.8
RE DISCCART  9.0  262.8
RE DISCCART  59.0  262.8
RE DISCCART  109.0  262.8
RE DISCCART  159.0  262.8
RE DISCCART  9.0  312.8
RE DISCCART  59.0  312.8
RE DISCCART  109.0  312.8
RE DISCCART  159.0  312.8
RE DISCCART  9.0  362.8
RE DISCCART  59.0  362.8
RE DISCCART  109.0  362.8
RE DISCCART  159.0  362.8
RE DISCCART  9.0  412.8
RE DISCCART  59.0  412.8
RE DISCCART  109.0  412.8
RE DISCCART  159.0  412.8
RE DISCCART  9.0  462.8
RE DISCCART  59.0  462.8
RE DISCCART  109.0  462.8
RE DISCCART  159.0  462.8
RE DISCCART  9.0  512.8
RE DISCCART  59.0  512.8
RE DISCCART  109.0  512.8
RE DISCCART  159.0  512.8
```

Discrete receptors are defined with X,Y coordinate

Flagpole height specified earlier as 1.8 m in CO FLAGPOLE

Defining Meteorological Data

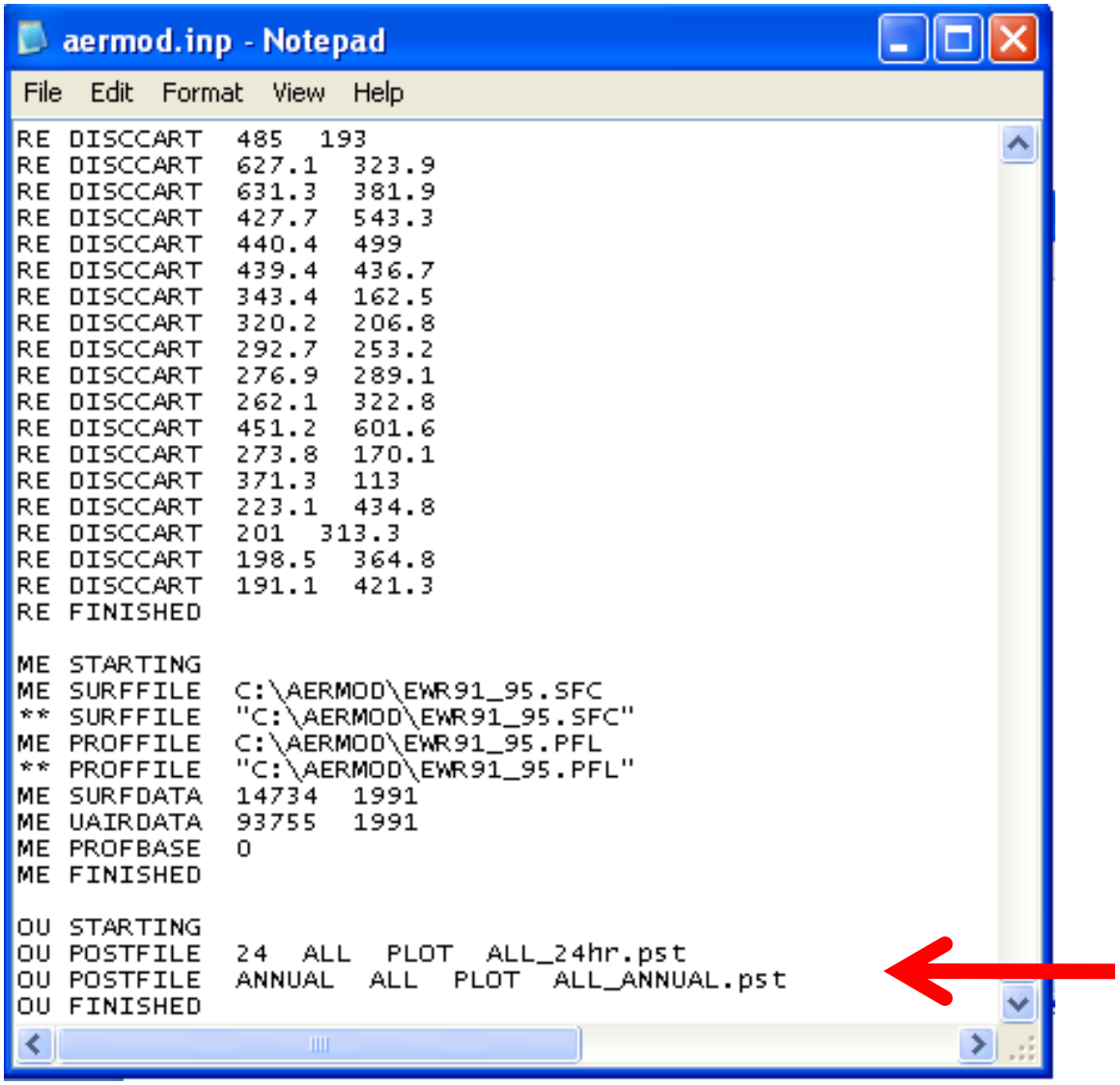


Meteorological data must be located at the defined path:

- Surface (.SFC)
- Profile (.PFL)

Also station IDs, beginning measurement year (1991), and base elevation (0 meters)

Specifying Output Format



POSTFILE recommended for both 24-hour and annual standard

Output files specified:
All_24hr.pst
ALL_ANNUAL.pst

Running AERMOD

- The completed AERMOD input file and met data files for the example analysis are found on your desktop...

- Open folder “3-Day Course Files”
  - Open folder “AERMOD files”
  - Open folder “Example Analysis” containing
    - AERMOD.inp *(the input file described)*
    - AERMOD.exe *(the aermod executable program)*
    - EWR91_95.pfl *(profile met data)*
    - EWR91_95.sfc *(surface met data)*

- Double click AERMOD.exe

AERMOD Output – Annual PostFile

ALL_ANNUAL.pst - Notepad

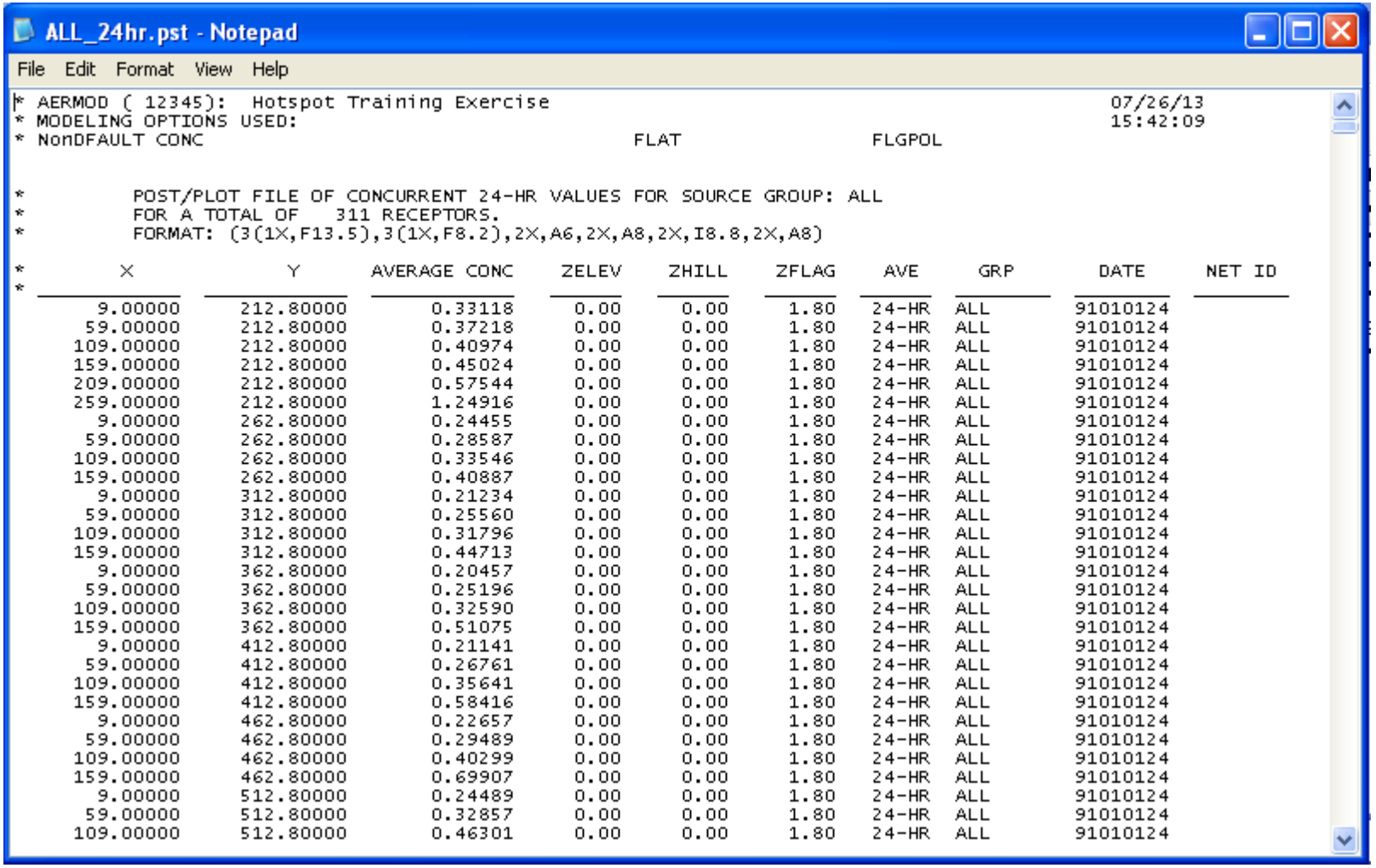
File Edit Format View Help

```
* AERMOD ( 12345):  Hotspot Training Exercise                                  07/26/13
* MODELING OPTIONS USED:                                                       15:42:09
* NonDFAULT CONC                                  FLAT              FLGPOL


*          POST/PLOT FILE OF ANNUAL VALUES FOR SOURCE GROUP: ALL
*          FOR A TOTAL OF   311 RECEPTORS.
*          FORMAT: (3(1X,F13.5),3(1X,F8.2),2X,A6,2X,A8,2X,I8.8,2X,A8)

*        X             Y          AVERAGE CONC    ZELEV    ZHILL    ZFLAG     AVE      GRP       NUM YRS   NET ID
* ____________  ____________  ____________  _____  _____  _____  ______  ______  ________  ____________
      9.00000     212.80000       0.14878   0.00   0.00   1.80  ANNUAL  ALL     00000005
     59.00000     212.80000       0.19716   0.00   0.00   1.80  ANNUAL  ALL     00000005
    109.00000     212.80000       0.24701   0.00   0.00   1.80  ANNUAL  ALL     00000005
    159.00000     212.80000       0.31782   0.00   0.00   1.80  ANNUAL  ALL     00000005
    209.00000     212.80000       0.40556   0.00   0.00   1.80  ANNUAL  ALL     00000005
    259.00000     212.80000       0.53328   0.00   0.00   1.80  ANNUAL  ALL     00000005
      9.00000     262.80000       0.12277   0.00   0.00   1.80  ANNUAL  ALL     00000005
     59.00000     262.80000       0.16471   0.00   0.00   1.80  ANNUAL  ALL     00000005
    109.00000     262.80000       0.21805   0.00   0.00   1.80  ANNUAL  ALL     00000005
    159.00000     262.80000       0.30416   0.00   0.00   1.80  ANNUAL  ALL     00000005
      9.00000     312.80000       0.11537   0.00   0.00   1.80  ANNUAL  ALL     00000005
     59.00000     312.80000       0.15569   0.00   0.00   1.80  ANNUAL  ALL     00000005
    109.00000     312.80000       0.21238   0.00   0.00   1.80  ANNUAL  ALL     00000005
    159.00000     312.80000       0.31074   0.00   0.00   1.80  ANNUAL  ALL     00000005
      9.00000     362.80000       0.11196   0.00   0.00   1.80  ANNUAL  ALL     00000005
     59.00000     362.80000       0.15425   0.00   0.00   1.80  ANNUAL  ALL     00000005
    109.00000     362.80000       0.21634   0.00   0.00   1.80  ANNUAL  ALL     00000005
    159.00000     362.80000       0.32557   0.00   0.00   1.80  ANNUAL  ALL     00000005
      9.00000     412.80000       0.10969   0.00   0.00   1.80  ANNUAL  ALL     00000005
     59.00000     412.80000       0.15537   0.00   0.00   1.80  ANNUAL  ALL     00000005
    109.00000     412.80000       0.22486   0.00   0.00   1.80  ANNUAL  ALL     00000005
    159.00000     412.80000       0.35044   0.00   0.00   1.80  ANNUAL  ALL     00000005
      9.00000     462.80000       0.10751   0.00   0.00   1.80  ANNUAL  ALL     00000005
     59.00000     462.80000       0.15695   0.00   0.00   1.80  ANNUAL  ALL     00000005
    109.00000     462.80000       0.23630   0.00   0.00   1.80  ANNUAL  ALL     00000005
    159.00000     462.80000       0.39357   0.00   0.00   1.80  ANNUAL  ALL     00000005
      9.00000     512.80000       0.10484   0.00   0.00   1.80  ANNUAL  ALL     00000005
     59.00000     512.80000       0.15790   0.00   0.00   1.80  ANNUAL  ALL     00000005
    109.00000     512.80000       0.25069   0.00   0.00   1.80  ANNUAL  ALL     00000005
```

AERMOD Output – 24 hr PostFile



ALL_24hr.pst - Notepad

File Edit Format View Help

```
* AERMOD ( 12345):  Hotspot Training Exercise                                  07/26/13
* MODELING OPTIONS USED:                                                       15:42:09
* NonDFAULT CONC                                  FLAT              FLGPOL


*          POST/PLOT FILE OF CONCURRENT 24-HR VALUES FOR SOURCE GROUP: ALL
*          FOR A TOTAL OF    311 RECEPTORS.
*          FORMAT: (3(1X,F13.5),3(1X,F8.2),2X,A6,2X,A8,2X,I8.8,2X,A8)

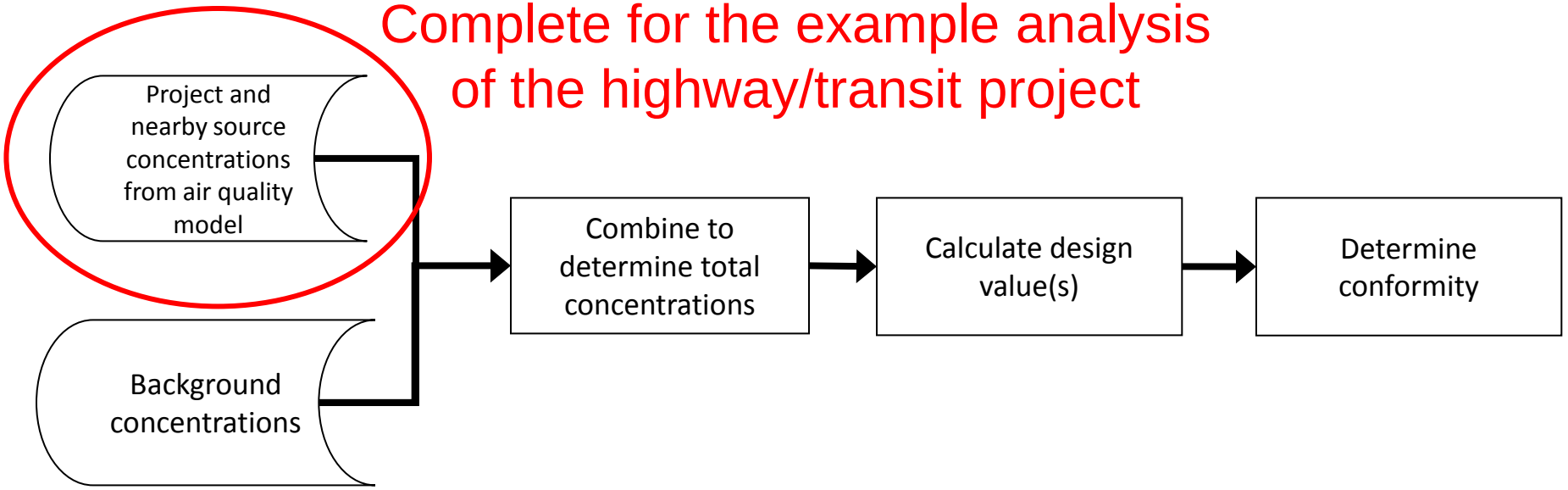
*        X             Y        AVERAGE CONC    ZELEV    ZHILL    ZFLAG     AVE      GRP       DATE       NET ID
*  ____________  ____________  ____________  ________ ________ ________ ________ ________ ________ ____________
      9.00000     212.80000       0.33118      0.00     0.00     1.80   24-HR    ALL      91010124
     59.00000     212.80000       0.37218      0.00     0.00     1.80   24-HR    ALL      91010124
    109.00000     212.80000       0.40974      0.00     0.00     1.80   24-HR    ALL      91010124
    159.00000     212.80000       0.45024      0.00     0.00     1.80   24-HR    ALL      91010124
    209.00000     212.80000       0.57544      0.00     0.00     1.80   24-HR    ALL      91010124
    259.00000     212.80000       1.24916      0.00     0.00     1.80   24-HR    ALL      91010124
      9.00000     262.80000       0.24455      0.00     0.00     1.80   24-HR    ALL      91010124
     59.00000     262.80000       0.28587      0.00     0.00     1.80   24-HR    ALL      91010124
    109.00000     262.80000       0.33546      0.00     0.00     1.80   24-HR    ALL      91010124
    159.00000     262.80000       0.40887      0.00     0.00     1.80   24-HR    ALL      91010124
      9.00000     312.80000       0.21234      0.00     0.00     1.80   24-HR    ALL      91010124
     59.00000     312.80000       0.25560      0.00     0.00     1.80   24-HR    ALL      91010124
    109.00000     312.80000       0.31796      0.00     0.00     1.80   24-HR    ALL      91010124
    159.00000     312.80000       0.44713      0.00     0.00     1.80   24-HR    ALL      91010124
      9.00000     362.80000       0.20457      0.00     0.00     1.80   24-HR    ALL      91010124
     59.00000     362.80000       0.25196      0.00     0.00     1.80   24-HR    ALL      91010124
    109.00000     362.80000       0.32590      0.00     0.00     1.80   24-HR    ALL      91010124
    159.00000     362.80000       0.51075      0.00     0.00     1.80   24-HR    ALL      91010124
      9.00000     412.80000       0.21141      0.00     0.00     1.80   24-HR    ALL      91010124
     59.00000     412.80000       0.26761      0.00     0.00     1.80   24-HR    ALL      91010124
    109.00000     412.80000       0.35641      0.00     0.00     1.80   24-HR    ALL      91010124
    159.00000     412.80000       0.58416      0.00     0.00     1.80   24-HR    ALL      91010124
      9.00000     462.80000       0.22657      0.00     0.00     1.80   24-HR    ALL      91010124
     59.00000     462.80000       0.29489      0.00     0.00     1.80   24-HR    ALL      91010124
    109.00000     462.80000       0.40299      0.00     0.00     1.80   24-HR    ALL      91010124
    159.00000     462.80000       0.69907      0.00     0.00     1.80   24-HR    ALL      91010124
      9.00000     512.80000       0.24489      0.00     0.00     1.80   24-HR    ALL      91010124
     59.00000     512.80000       0.32857      0.00     0.00     1.80   24-HR    ALL      91010124
    109.00000     512.80000       0.46301      0.00     0.00     1.80   24-HR    ALL      91010124
```

Contour Plot of Annual Average Concentrations

AERMOD Output – Next Steps

- We now have AERMOD output files for the example analysis for both the annual and 24-hour $PM_{2.5}$ NAAQS

- We will combine these air quality modeling results with representative background data (from **Module 6**) to calculate project design values in **Module 7**



End of Module 4

Questions?