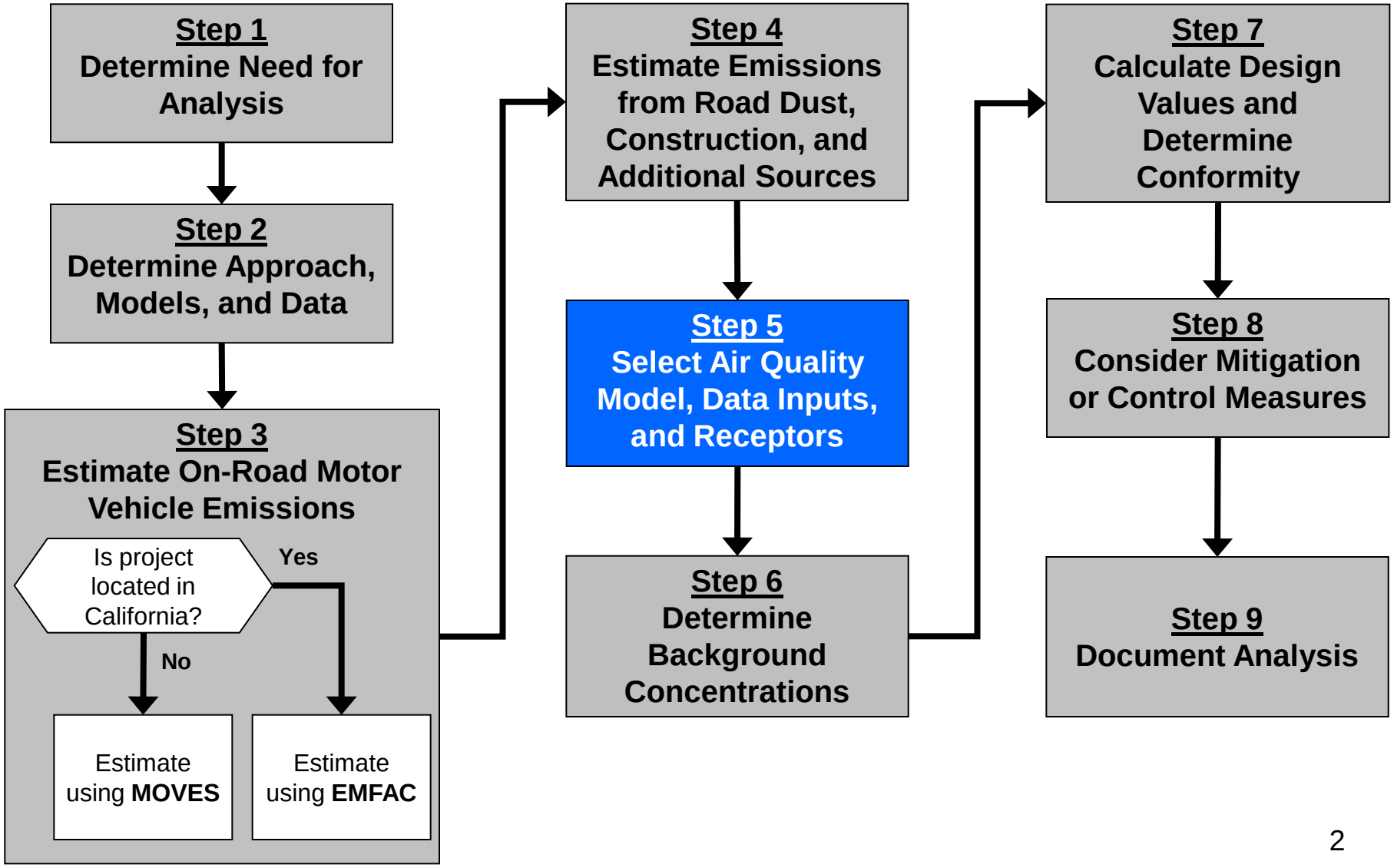
Module 5

Using CAL3QHCR for PM Hot-Spot Analyses

Completing a PM Hot-spot Analysis



Module Overview

- Introducing the CAL3QHCR Model
- Mathematical Basis Overview
- Summary of Data Requirements
- About the Computer Program
- Mechanics of Running the Model
- Input / Output Files
- Class Exercises

Key References

- PM Hot-spot Guidance, Section 7 and Appendix J
- Addendum to the User's Guide to CAL3QHC Version 2.0 (CAL3QHCR User's Guide)
- CALINE3 – A Versatile Dispersion Model for Predicting Air Pollution Levels Near Highways and Arterial Streets
- Meteorological Processor for Regulatory Models (MPRM) User's Guide

CAL3QHCR

Atmospheric Scale:	Project-Level
Exposure Scale:	Short-Term & Long-Term
Pollutant Applicability:	Inert Pollutants
Regulatory Applicability:	Highways
Mathematical Class:	Gaussian
Level of Sophistication:	Refined

Regulatory Applicability

- CO Hot-spot Analysis:
  - CALINE3
    - Highways with freely flowing traffic
  - CAL3QHC
    - Highways with freely flowing traffic
    - Signalized intersections
  - CAL3QHCR
    - Tier I: account for hourly variations in transport meteorology over an annual data record
    - Tier II: account for hourly variations in emissions (traffic volumes and emission factors) and transport meteorology over a year

Regulatory Applicability

- PM Hot-spot Analysis:
  - CAL3QHCR
    - Tier II: account for hourly variations in emissions (traffic volumes and emission factors) and transport meteorology over a year
    - Queuing algorithm should not be used

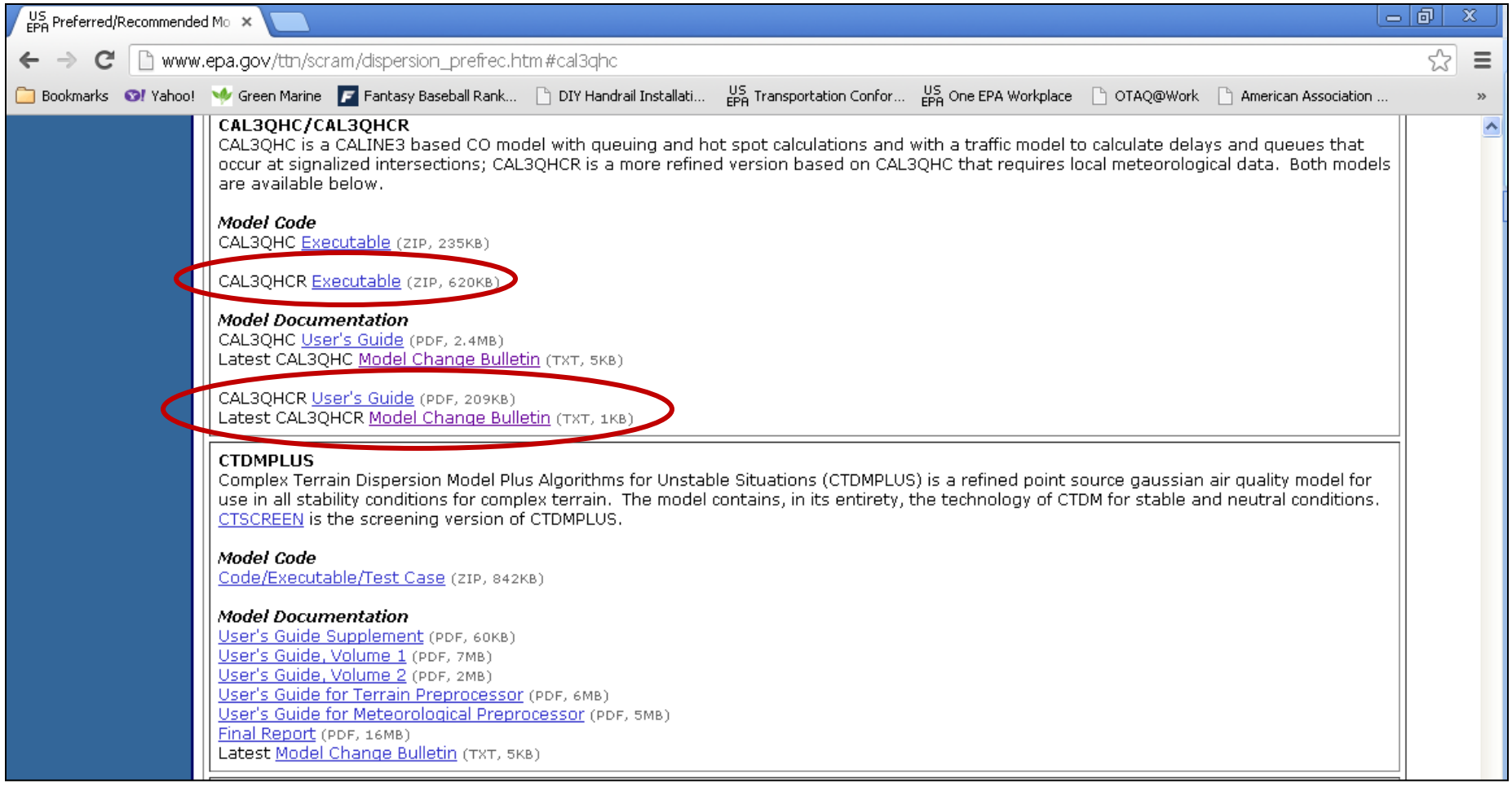
- Screening analysis with CALINE3, CAL3QHC, or CAL3QHCR Tier I are not recommended in EPA's Quantitative PM Hot-spot Guidance

Guidance Reference:

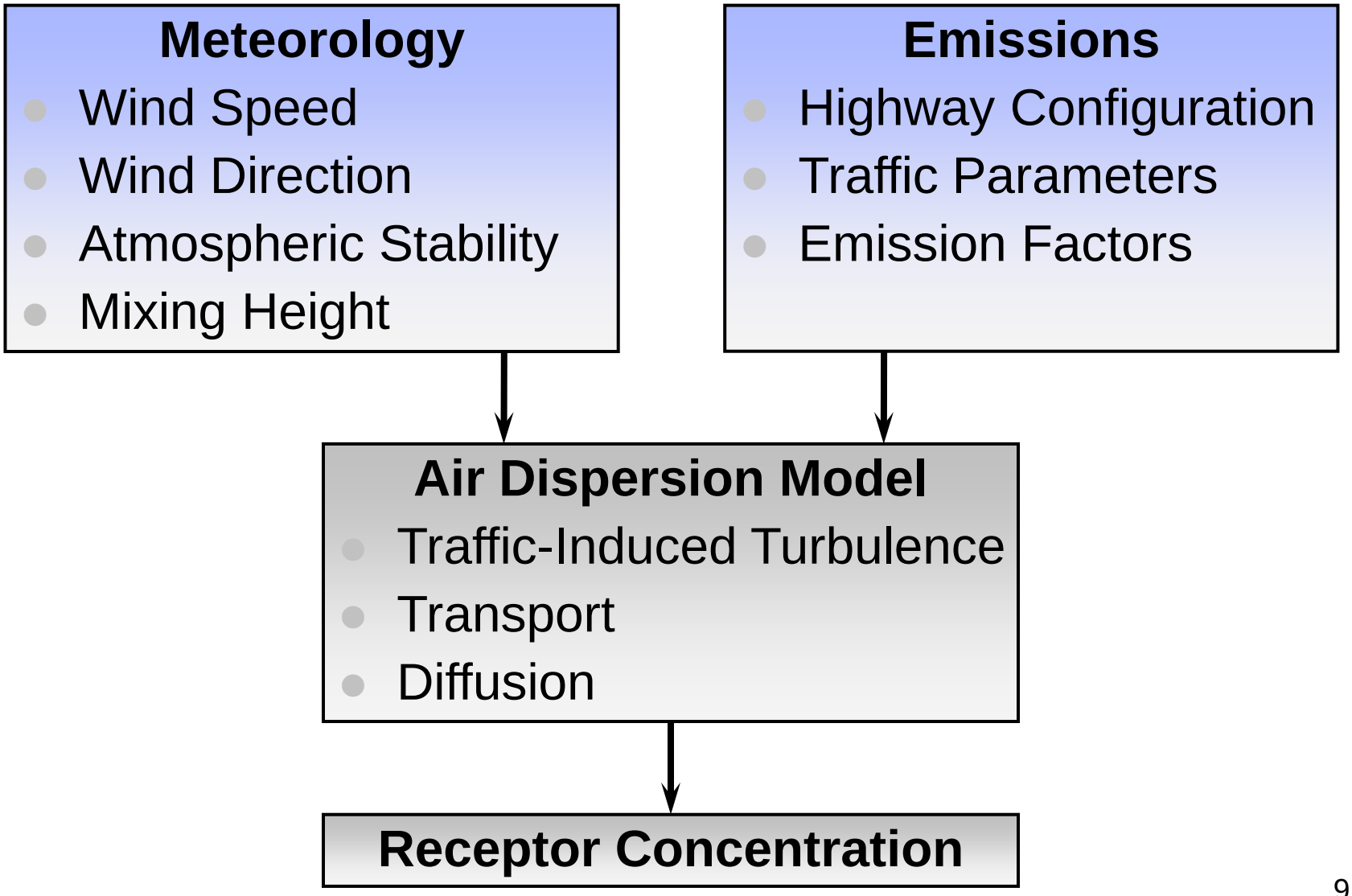
Sec 7.3.1 & App J.3.2

CAL3QHCR Resources

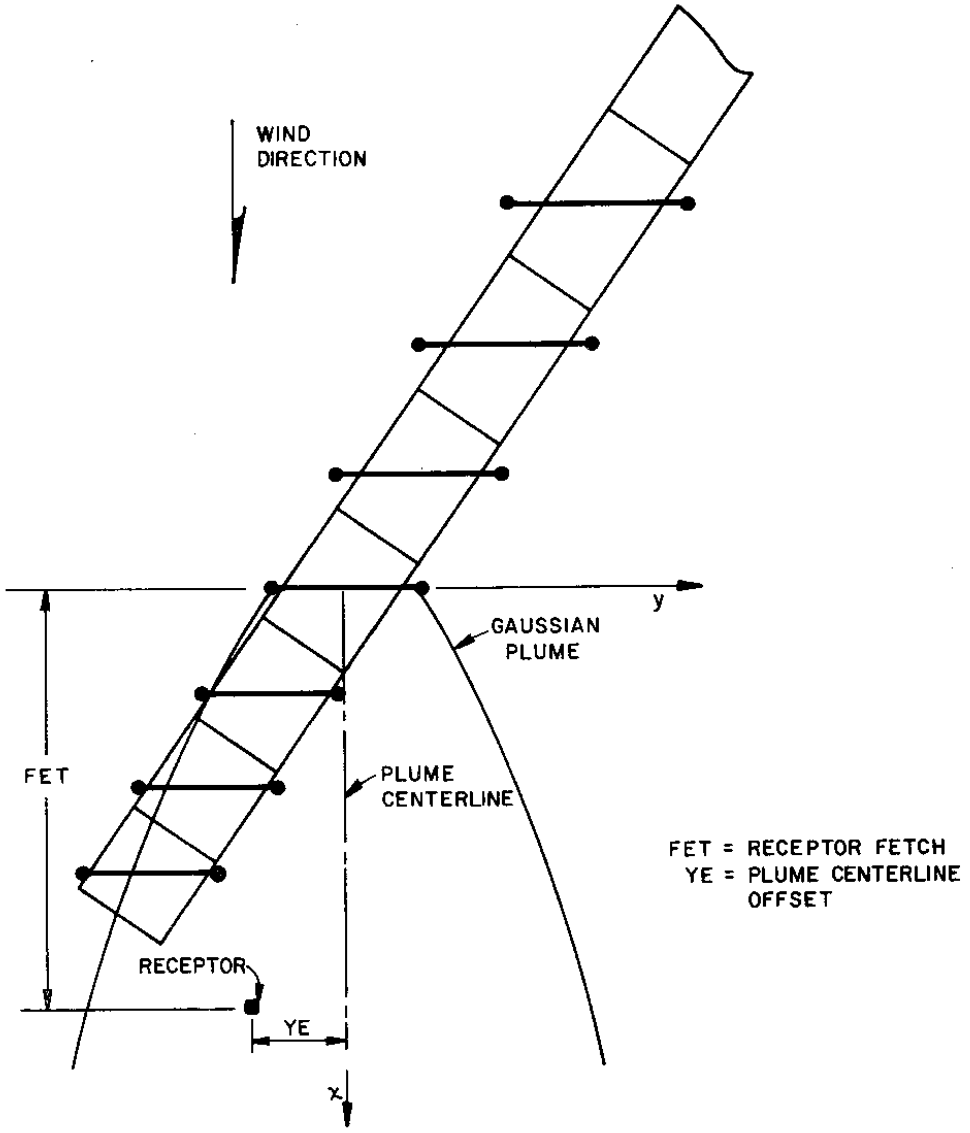
www.epa.gov/ttn/scram/dispersion_prefrec.htm#cal3qhc



Air Dispersion Model Conception

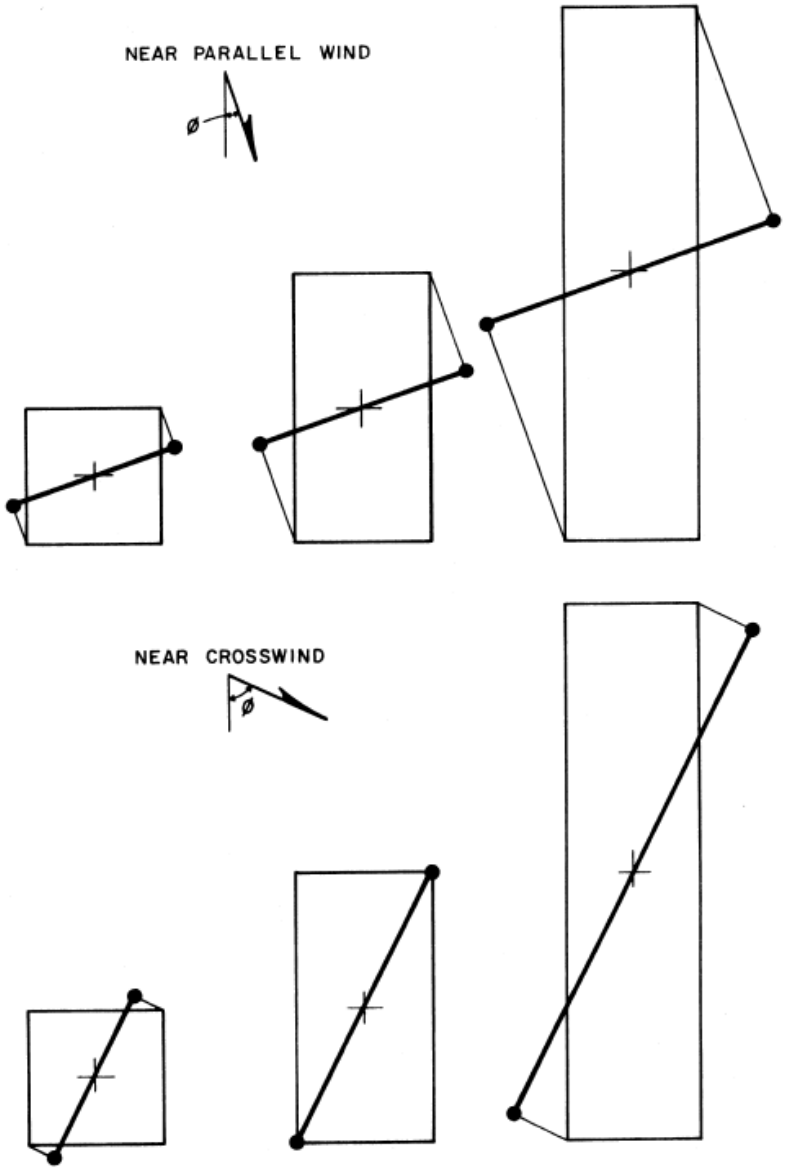


Plume Dispersion in CAL3QHCR



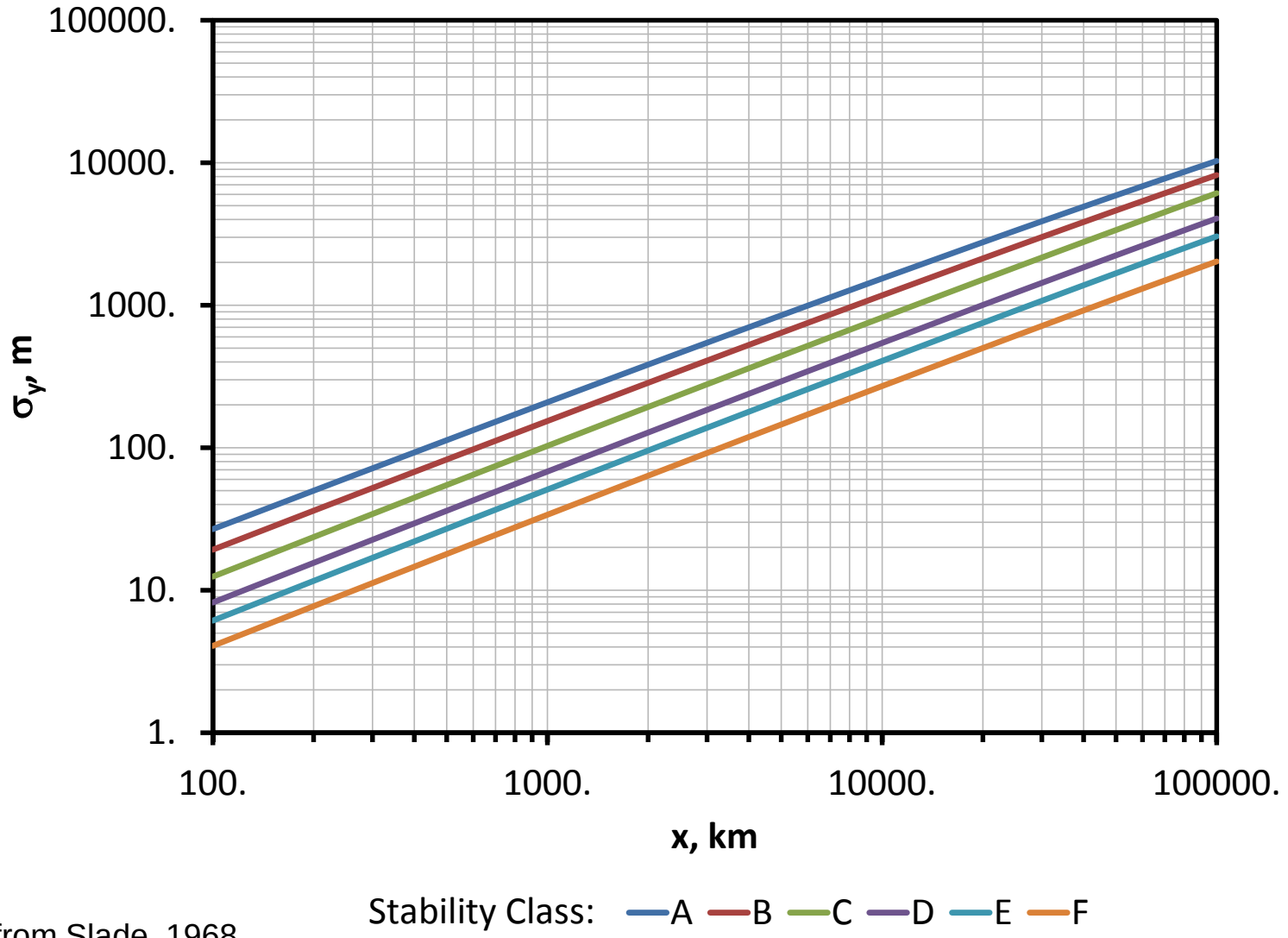
from Benson, 1979

Plume Width by Wind Angle



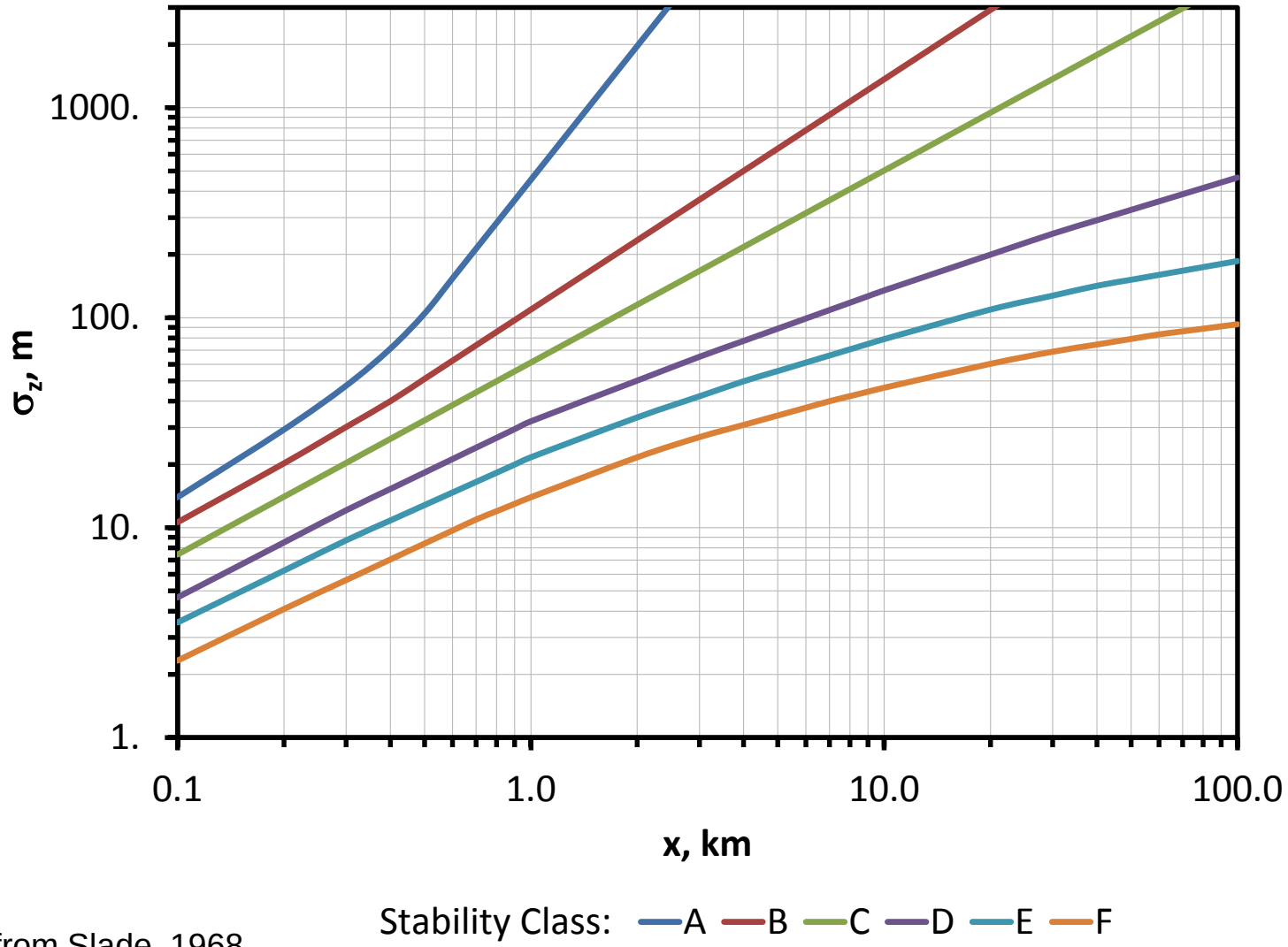
from Benson, 1979

Horizontal Dispersion Parameter



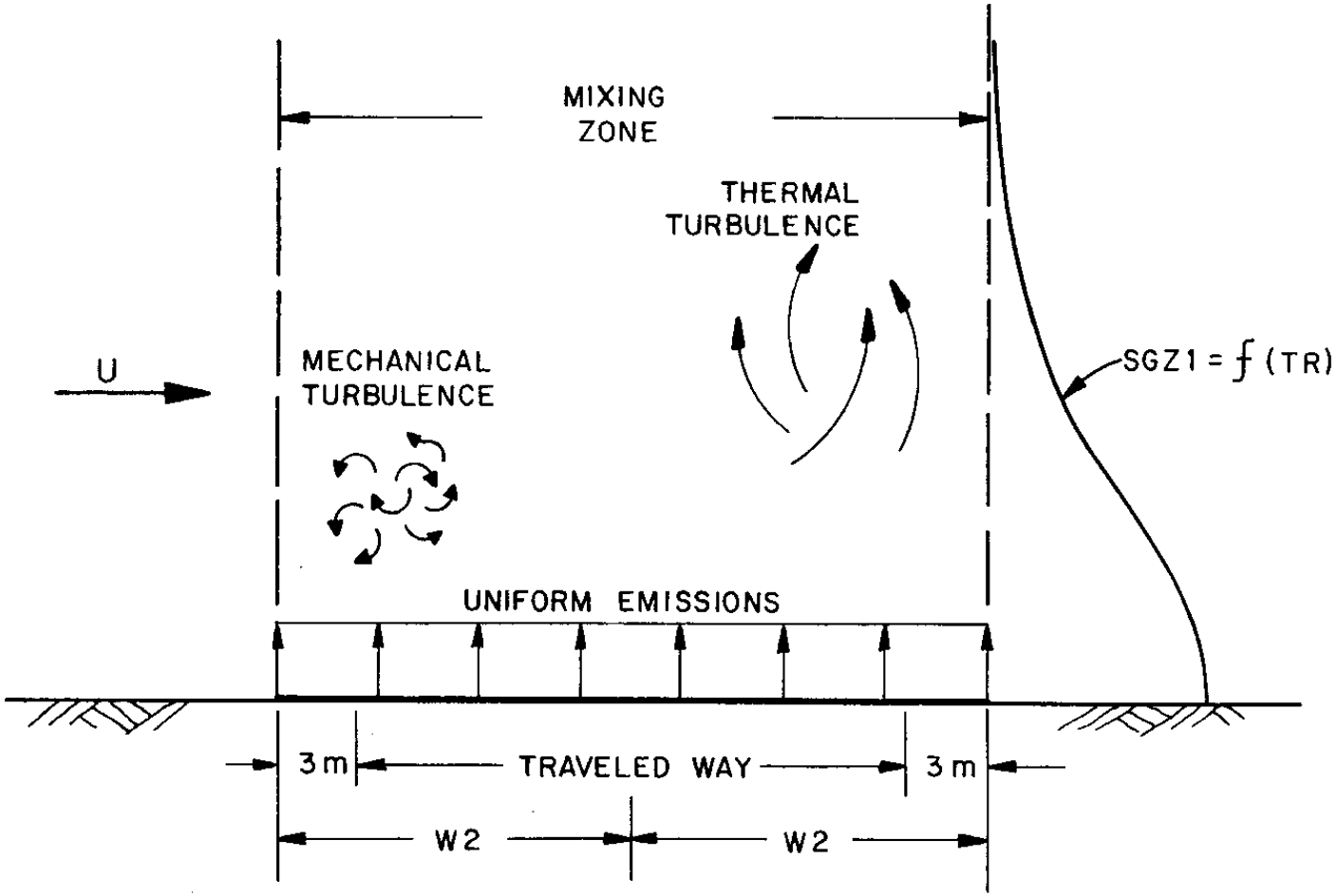
adapted from Slade, 1968

Vertical Dispersion Parameter



adapted from Slade, 1968

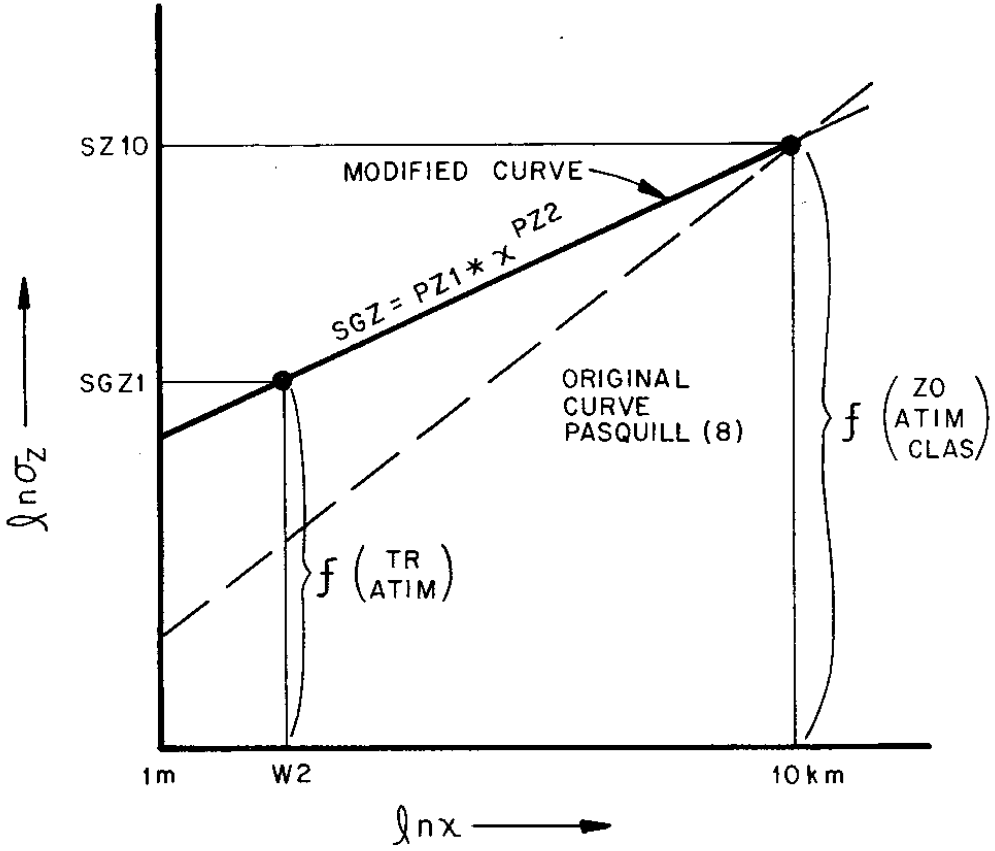
Uniform Mixing Zone



from Benson, 1979

SGZ1 = INITIAL VERTICAL DISPERSION PARAMETER
TR = MIXING ZONE RESIDENCE TIME

Vertical Dispersion Parameter



ZO = AERODYNAMIC ROUGHNESS
ATIM = AVERAGING TIME
CLAS = STABILITY CLASS
TR = MIXING ZONE RESIDENCE TIME
χ = PLUME CENTERLINE AXIS
σ_z = VERTICAL DISPERSION PARAMETER

from Benson, 1979

Vertical Dispersion Parameter

$$SGZ1_{30} = 1.8 + 0.11 \times TR$$

where $SGZ1_{30}$ is the vertical dispersion parameter at the edge of the mixing zone for a 30 min averaging time (based on the General Motors sulfate experiments) and

TR is the mixing zone residence time

$$TR = \frac{W2}{2}$$

where $W2$ is the highway half-width

Vertical Dispersion Parameter

$$SGZ1_{ATIM} = SGZ1_{30} \left(\frac{ATIM}{30}\right)^{0.2}$$

where $SGZ1_{ATIM}$ is the vertical dispersion parameter at the edge of the mixing zone for a specified averaging time of $ATIM$

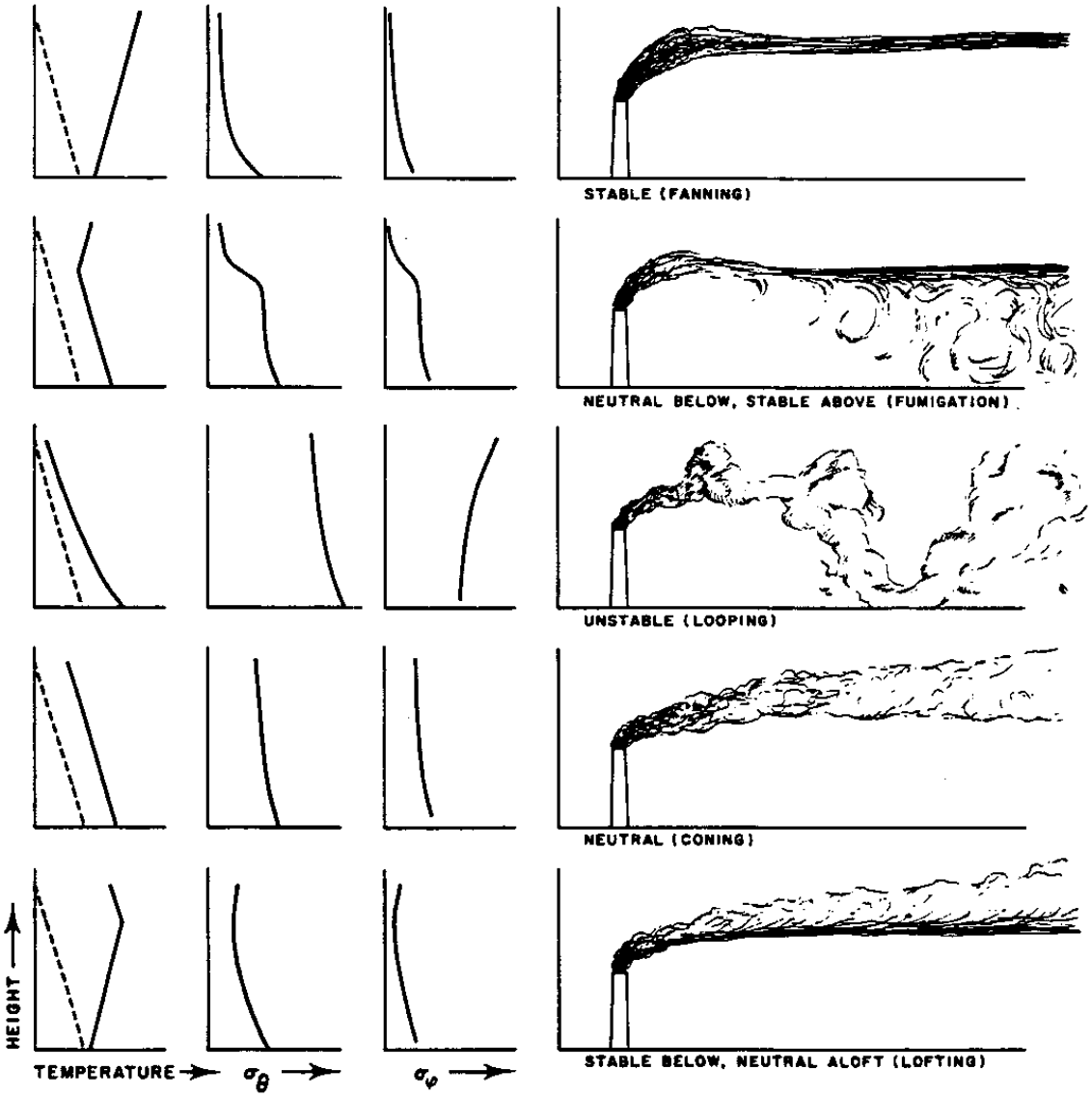
Vertical Dispersion Parameter

$$SGZ10_{ATIM,\ Z0} = SZ10\left(\frac{ATIM}{3}\right)^{0.2}\left(\frac{Z0}{10}\right)^{0.07}$$

where $SZ10_{ATIM,\ Z0}$ is the vertical dispersion parameter at 10 km for a specified averaging time and surface roughness ($Z0$) and

$SZ10$ is the Pasquill-Gifford vertical dispersion parameter at 10 km (refer to slide 13)

Vertical Plume Dispersion



from Slade, 1968

Key to Stability Categories

A: Extremely unstable
B: Moderately unstable
C: Slightly unstable
D: Neutral
E: Slightly stable
F: Moderately stable

Surface Wind Speed (m/s)	Daytime Insolation			Nighttime Conditions	
	Strong	Moderate	Slight	≥ 4/8 Clouds	≤ 3/8 Clouds
< 2	A	A-B	B		
2	A-B	B	C	E	F
4	B	B-C	C	D	E
6	C	C-D	D	D	D
> 6	C	D	D	D	D

Adapted from Slade, 1968

Additional Criteria

- Night: 1 hour before sunset to 1 hour after sunrise

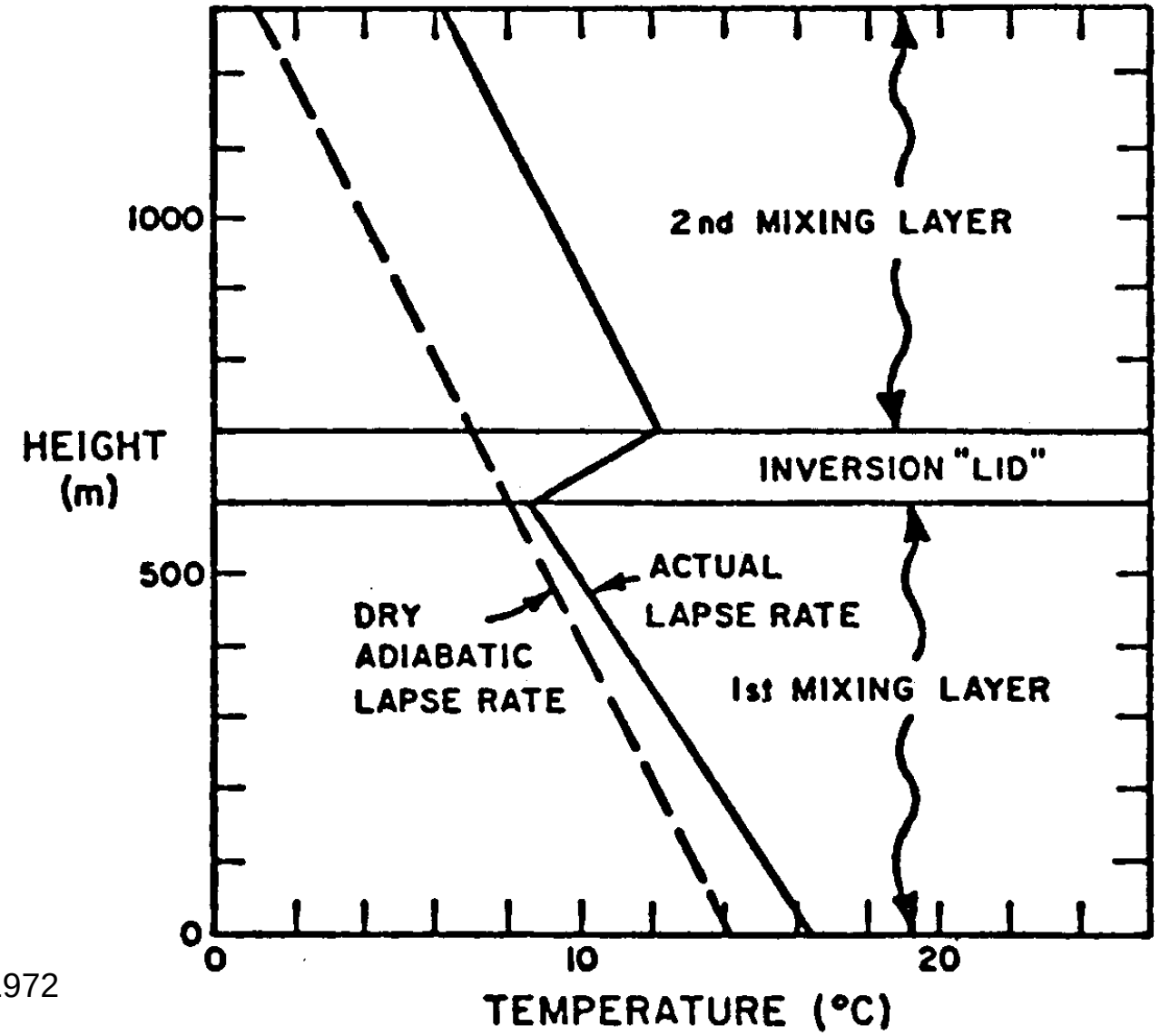
- D stability should be used (regardless of wind speed) for:
  - » Overcast conditions during day or night
    and
  - » Any sky condition during the hour preceding or following night

Surface Roughness Values

Type of Surface	z_0 (cm)
Smooth mud flats	0.001
Tarmac (pavement)	0.002
Dry lake bed	0.003
Smooth desert	0.03
Grass (5-6 cm)	0.75
Grass (4 cm)	0.14
Alfalfa (15.2 cm)	2.72
Grass (60-70 cm)	11.4
Wheat (60 cm)	22
Corn (220 cm)	74
Citrus orchard	198
Fir forest	283
City land use	
Single family Residential	108
Apartment residential	370
Office	175
Central Business District	321
Park	127

from Benson, 1979

Mixing Height

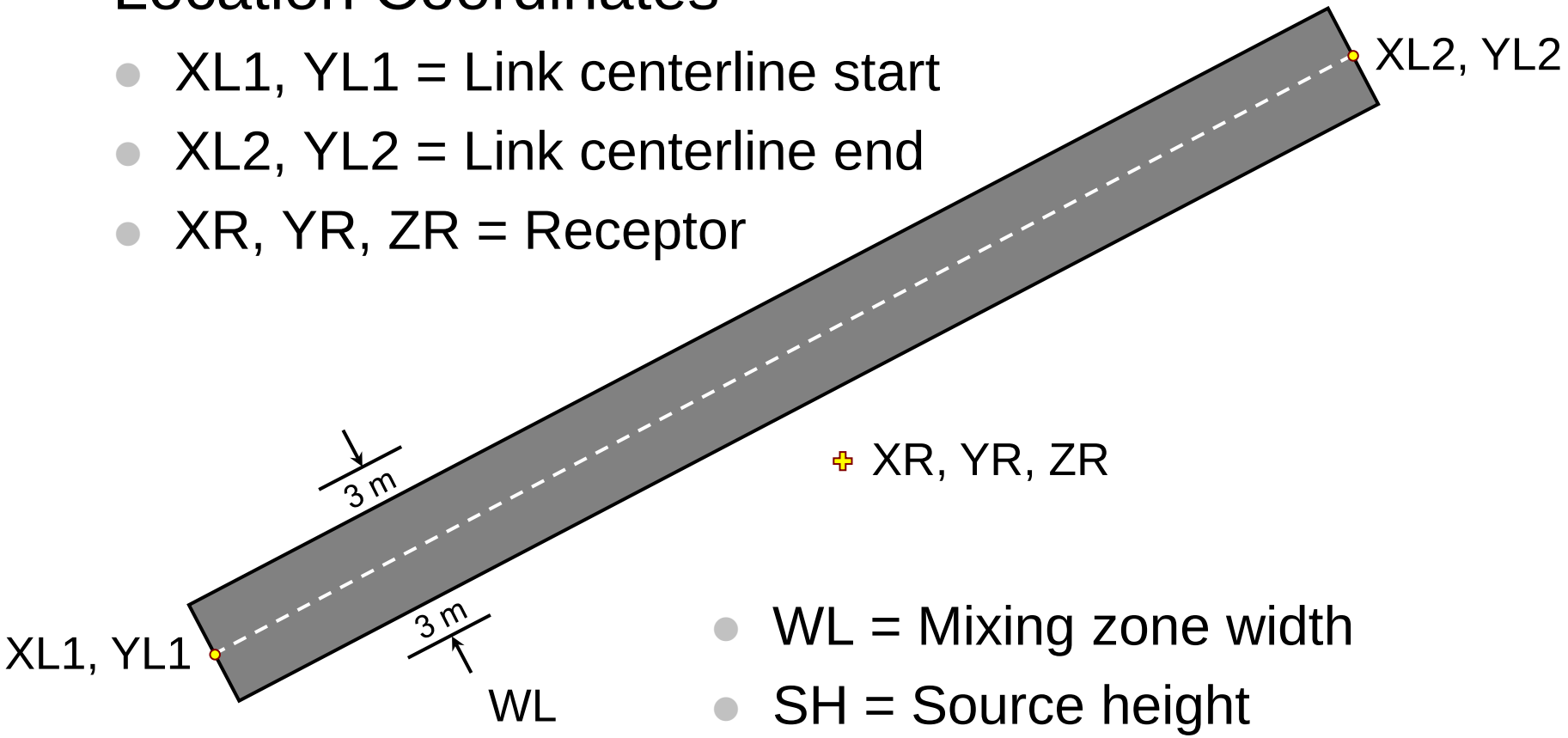


from Beaton, 1972

Link / Receptor Configuration

Location Coordinates

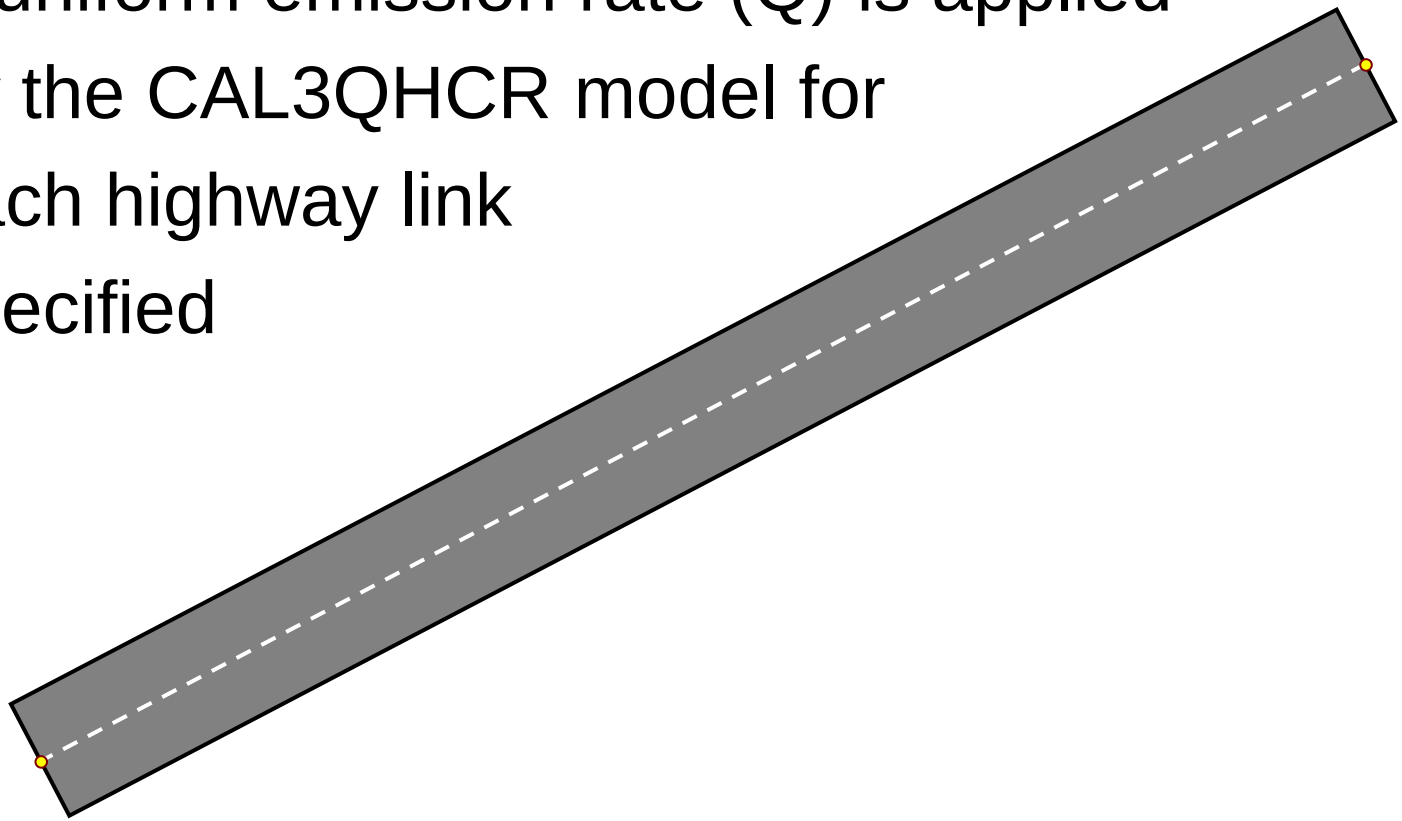
- XL1, YL1 = Link centerline start
- XL2, YL2 = Link centerline end
- XR, YR, ZR = Receptor



- WL = Mixing zone width
- SH = Source height

Link Emission Rates

A uniform emission rate (Q) is applied by the CAL3QHCR model for each highway link specified



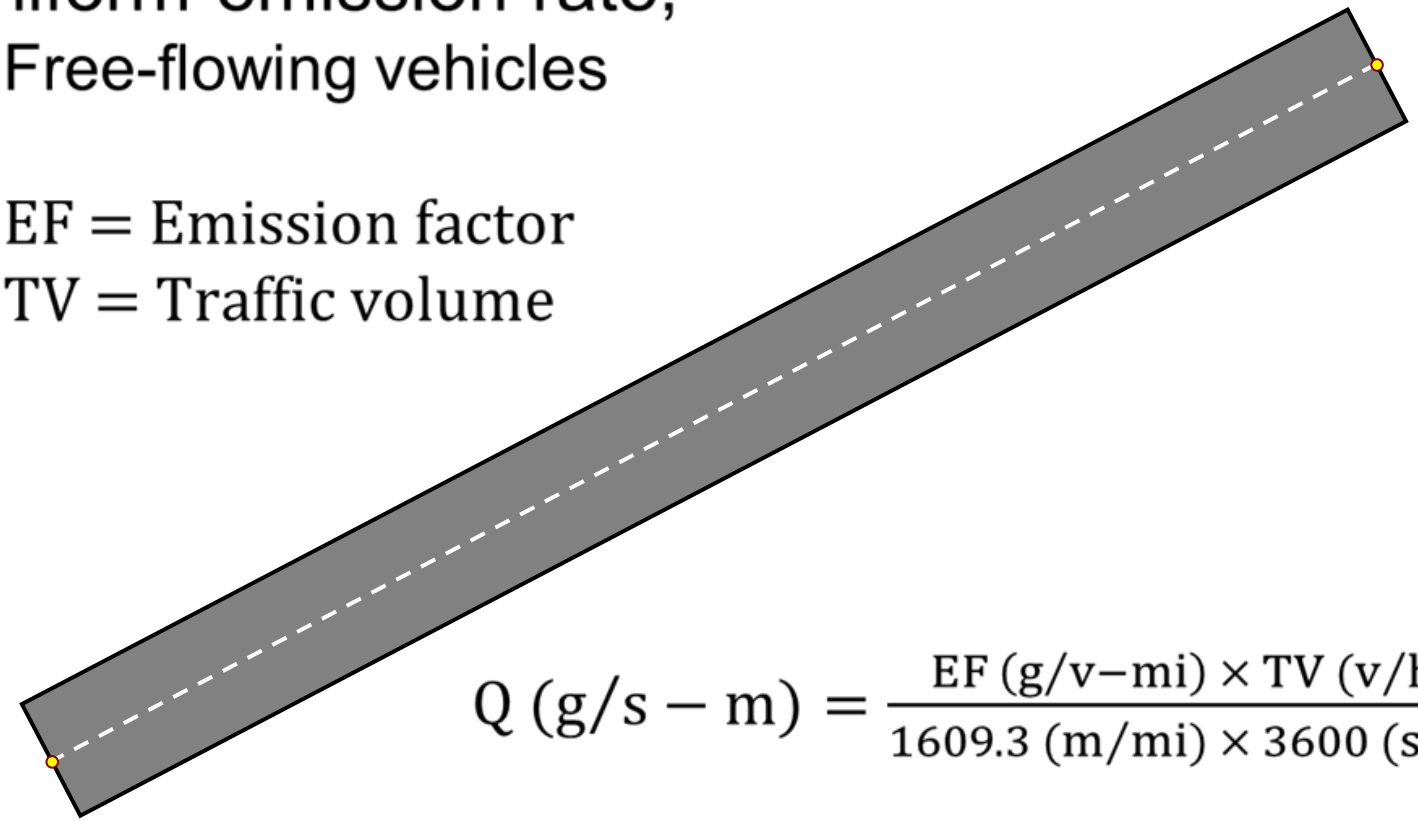
Link Emission Rates

Uniform emission rate,

Free-flowing vehicles

$\mathrm{EF} = \text{Emission factor}$

$\mathrm{TV} = \text{Traffic volume}$



$$Q\ (\mathrm{g/s-m}) = \frac{\mathrm{EF\ (g/v-mi)} \times \mathrm{TV\ (v/hr)}}{1609.3\ (\mathrm{m/mi}) \times 3600\ (\mathrm{s/hr})}$$

$$= 1.726\mathrm{E}{-7} \times \mathrm{EF} \times \mathrm{TV}$$

Inherent Assumptions

- Steady-state dispersion
- Dispersion parameters are empirically determined
- Pollutants are inert
- The ground is a perfect plume reflector
- Emissions are from continuous sources

Summary of Data Requirements

Receptor Location	receptor name location coordinates height of breathing zone
Highway Configuration	
Emissions	
Meteorology	

Summary of Data Requirements

Receptor Location

Highway Configuration	traffic flow
	link name
	centerline coordinates
	source height
	mixing zone width
Emissions	
Meteorology	

Summary of Data Requirements

Receptor Location	
Highway Configuration	
Emissions	traffic volume emission factor
Meteorology	

Summary of Data Requirements

Receptor Location

Highway Configuration

Emissions

Meteorology	averaging time
	surface roughness
	settling velocity
	deposition velocity
	background concentration
	external data file

Summary of Data Requirements

Receptor Location

Highway Configuration

Emissions

Meteorology

external data file:

- wind flow vector
- wind speed
- ambient temperature
- stability class
- rural mixing height
- urban mixing height

About the CAL3QHCR Program

- The CAL3QHCR (dated 13196) program and support files are distributed by EPA in R.ZIP:
  - CAL3QHCR.FOR – The CAL3QHCR source code
  - CAL3QHCR.EXE – The CAL3QHCR executable code

Tips for Managing Files

- Use a descriptive root filename
- *.BAT[a] – for executing a DOS file batch command for running CAL3QHCR
- *.CTL[a] – control file with a list of input and output filenames; these names are read in by the program
- *.MSG[b] – file containing error and other messages
- *.INP[a] – input data file

[a] User-created file

[b] CAL3QHCR-generated file

Tips for Managing Files

- *.MET[a] – input meteorological data files
- *.ET1[b] – copy of vehicular emissions, traffic volume, and signalization (ETS) data as read from the input control file
- *.ET2[b] – preprocessed *.ET1 data
- *.ILK[b] – link variable data output file
- *.OUT[b] – main output file
- *.PLT[b] – output plotfile

[a] User-created file

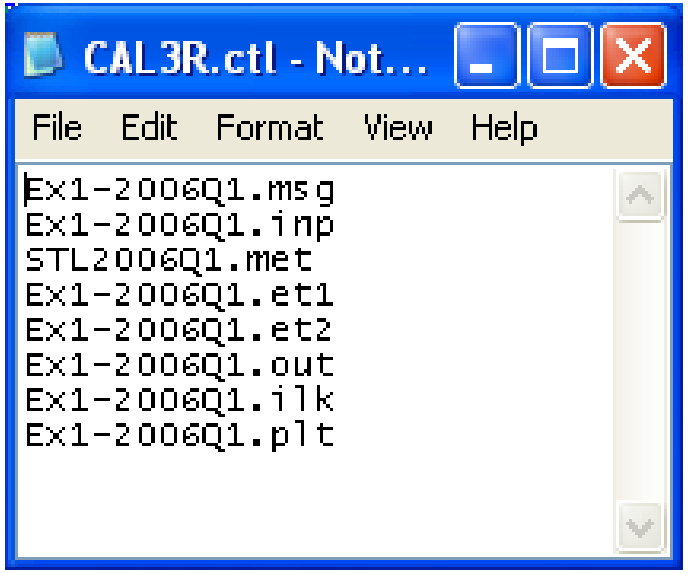
[b] CAL3QHCR-generated file

Run the Model – Step 1

- Step 1 – Create an Input File, *.INP
  - » Use a Text Editor
    - – like Notepad, supplied with Windows®
  - » Use a Word Processor
    - – Caution: be sure to use the “Save As” command to save as a Plain Text file
  - » Use Microsoft Excel®
    - – Caution: be sure to “Save As” a CSV (Comma Delimited file) – requires subsequent editing
  - » Use a Free Commercial Text Editor
    - – NoteTab Light, Notepad++, Programmer’s Notepad, orTotalEdit

Run the Model – Step 2

- Step 2 – Create a Control File, *.CTL
  - » Use a text editor to specify the path and filenames required by CAL3QHCR to complete a run, in the following order:
    - Messages (e.g., *.MSG)[b]
    - Input Data (e.g., *.INP)[a]
    - Meteorology (e.g., *.MET)[a]
    - ET1 File (e.g., *.ET1)[b]
    - ET2 File (e.g., *.ET2)[b]
    - Output File (e.g., *.OUT)[b]
    - Link Data (e.g., *.ILK)[b]
    - Plot File (e.g., *.PLT)[b]

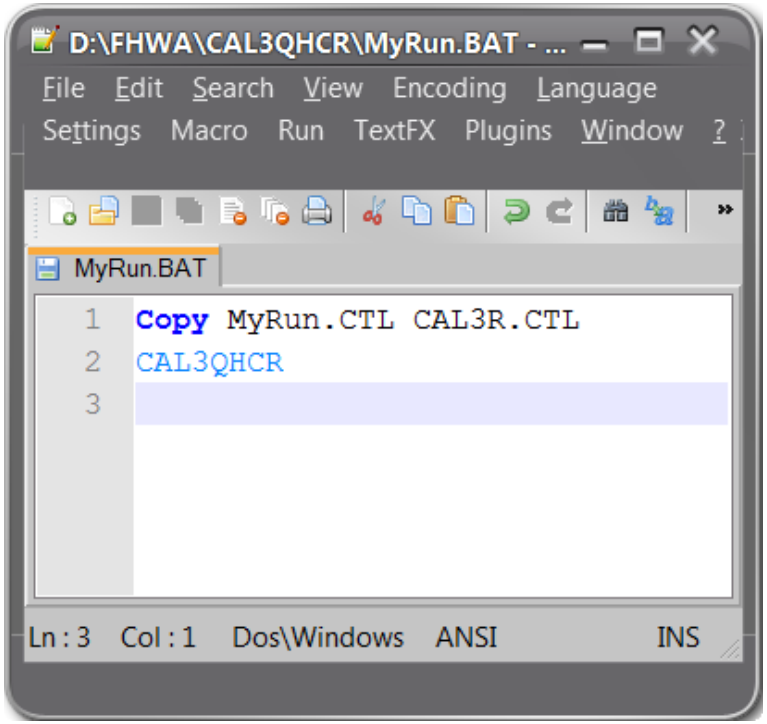


[a] User-created file

[b] CAL3QHCR-generated file

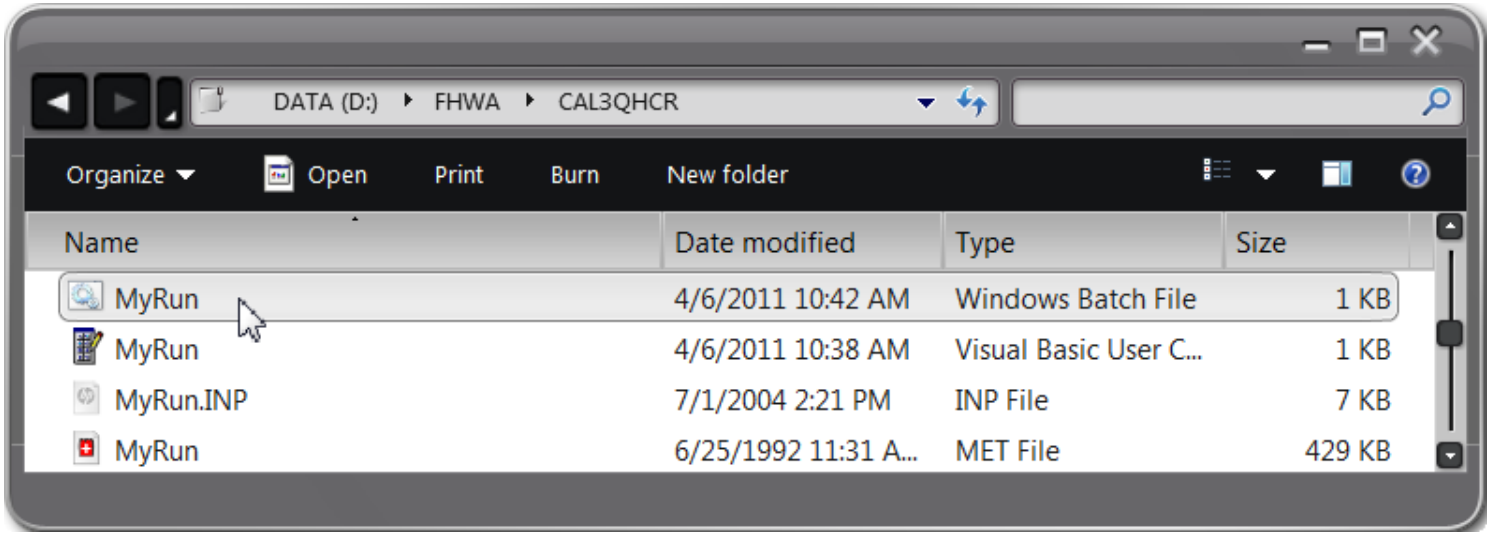
Run the Model – Step 3

- Step 3 – Create a Batch File for executing the CAL3QHCR run, *.BAT
  - » Use a text editor to specify DOS commands:
    - – Copy the Control File created in Step 2 to the CAL3QHCR default Control File, CAL3R.CTL
    - – Execute CAL3QHCR

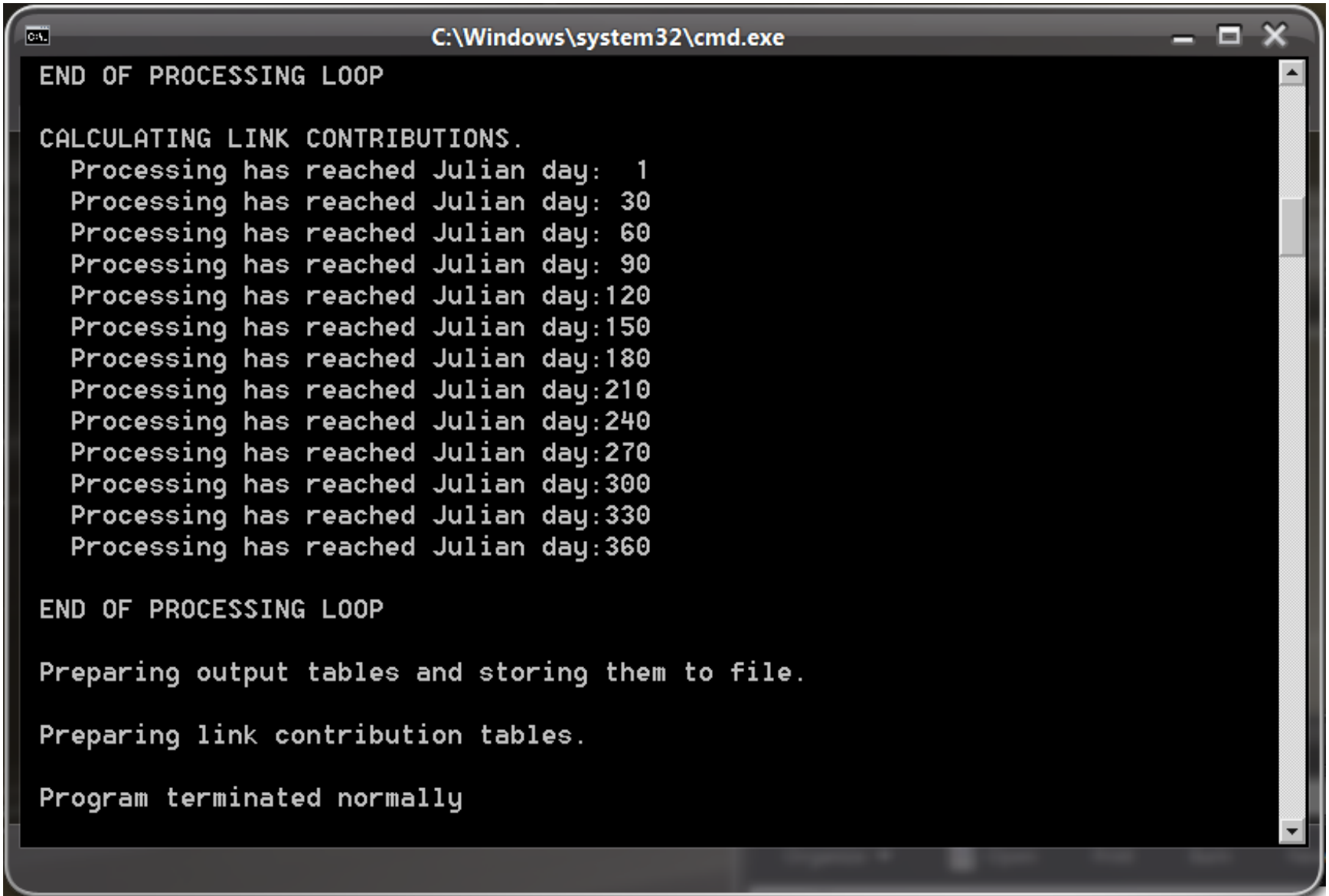


Run the Model – Step 4, Option 1

- Step 4 – Execute the Batch File created in Step 3 (Option 1)
  - » Open Windows Explorer, i.e.:
    - – Right-click the Windows Start Icon
    - – Select Open Windows Explorer
  - » Double-click on the Batch Filename



Run the Model – Step 4, Option 1



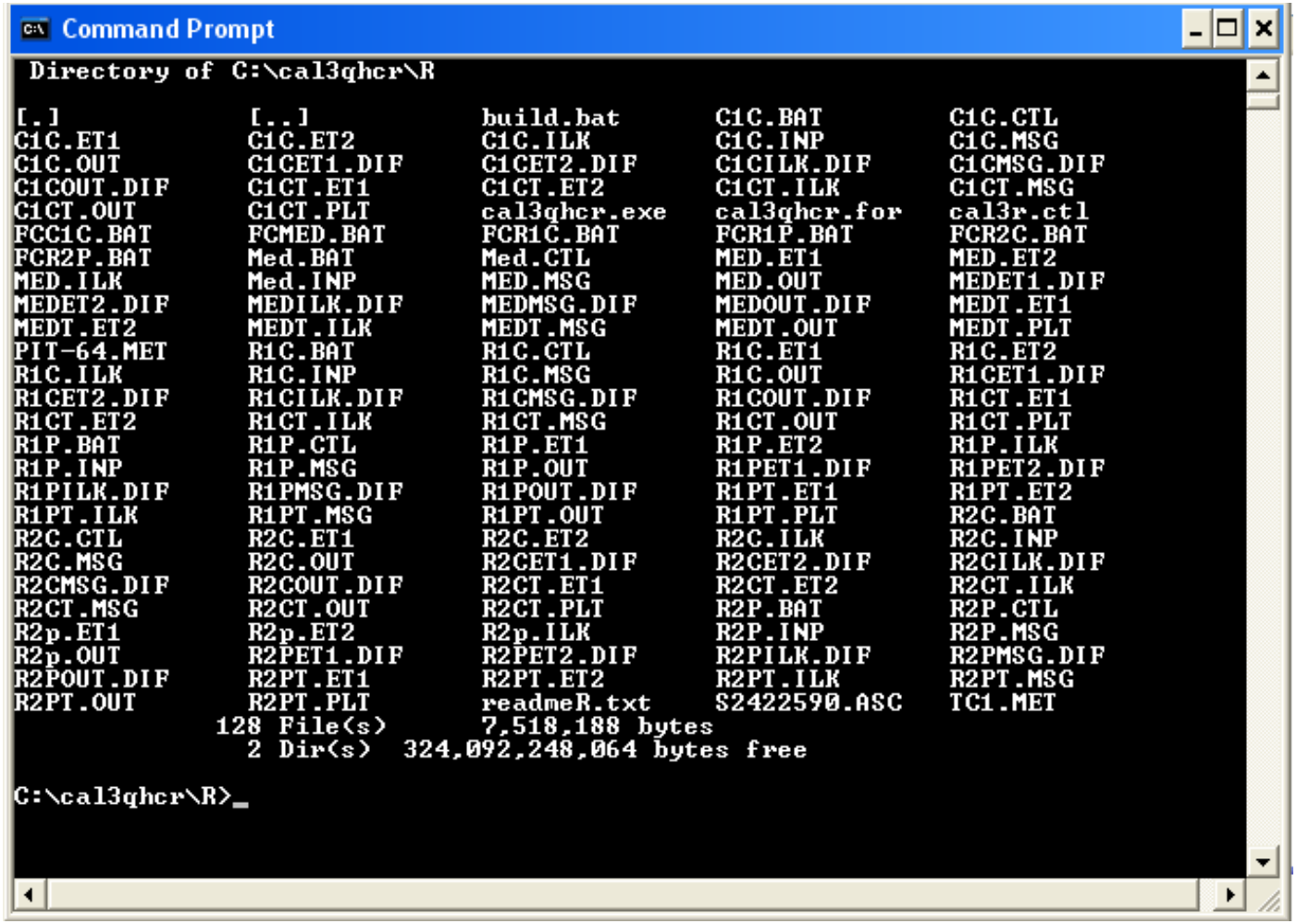
Run the Model – Step 4, Option 2

- Step 4 – Execute the Batch File Created in Step 3 (Option 2)
  - » Open a Command Prompt Window, i.e.:
    - – Click the Windows Start Icon
    - – Select All Programs
    - – Select Accessories
    - – Select Command Prompt
  - » Navigate to the folder containing the Batch File created in Step 3
  - » Enter the Batch Filename created in Step 3

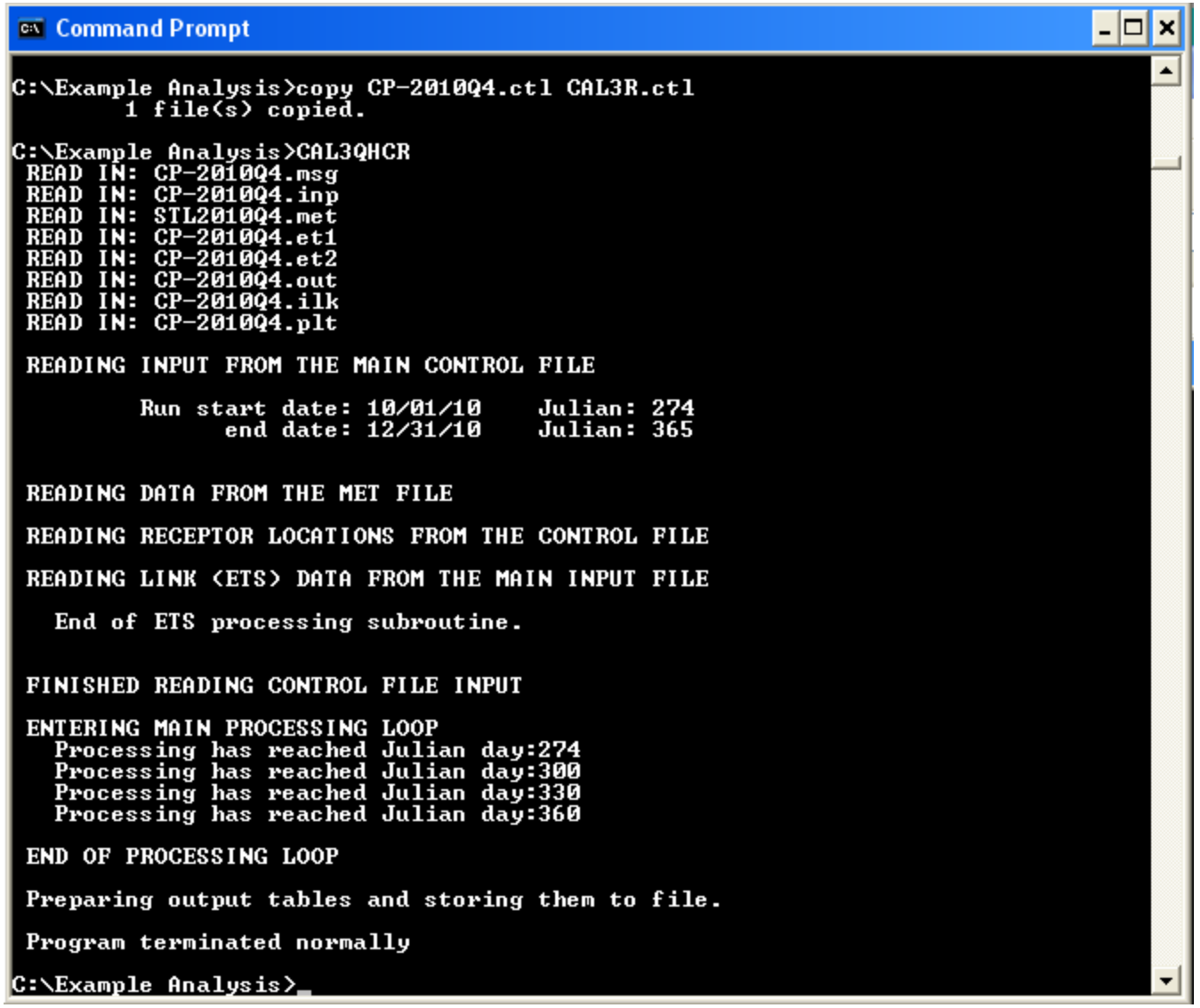
Run the Model – Step 4, Option 2

- Some useful DOS Commands for navigation:
  - C:\> Example Command Prompt
  - C:\> d: Navigate to Drive D:
  - D:\> cd Change Directories
  - D:\> dir Obtain Directory (list)
  - D:\> dir /w Obtain Directory (wide list)
  - D:\> cls Clear Screen

Run the Model – Step 4, Option 2



Run the Model – Step 4, Option 2



Filename Specifications

- Enter the full pathname for files outside the CAL3QHCR application folder (e.g., C:\DIR\SUBDIR\ROOTNAME.EXT)

- The full pathname is optional for files within the CAL3QHCR application folder

- CAL3QHCR uses an additional file (CAL3R.MSG) to store error and other types of messages. The file is overwritten each time CAL3QHCR is executed

Input File Structure

CHARACTER	A string of alphanumeric (Char) characters that are bracketed by single quotes (e.g., 'SR 1 – NB Lanes')
INTEGER	A number with no decimal (Int) point (e.g., 12)
REAL (Real)	A number with a decimal point separating the whole number portion from the fractional number portion (e.g., 234.16)

Input File Structure

*** Record Type 1 ***		
'JOB'	Char	Job title/description, up to 40 characters
ATIM	Real	Run averaging time (min)
Z0	Real	Surface roughness (cm)
VS	Real	Settling velocity (cm/s)
VD	Real	Deposition velocity (cm/s)
NR	Int	Number of receptors, maximum = 60
SCAL	Real	Scale conversion factor, user units to meters
IOPT	Int	Output units, 1 = feet; 0 = meters

Recommendations

- Record Type 1
  - » Averaging time should be 60 min, since predictions are performed for a 1-hour period
  - » Surface roughness should be within the range of 3 cm to 400 cm
  - » Settling velocity should be 0 cm/s to reflect negligible gravitational settling
  - » Deposition velocity should be 0 cm/s to reflect negligible deposition effects

Input File Structure

*** Record Type 2 ***		
START	Int	Processing start date (month, day, year) in MO DY YR format
END	Int	Processing end date (month, day, year) in MO DY YR format
*** START and END year must match ***		

Recommendations

- Record Type 2
  - » At a minimum, quarterly model runs are required to account for the quarterly variation of emissions
  - » 5 years of off-site meteorological data are required, by quarter
  - » Processing start and end dates should be quarterly

Guidance Reference:

Section 7.3.1

Input File Structure

*** Record Type 3 ***		
METSF	Int	Surface meteorological data station number
METSYR	Int	Surface meteorological data year in YY format
METUA	Int	Upper air meteorological data station number
METUYR	Int	Upper air meteorological data year in YY format

Recommendations

- Record Type 3
  - If available, use met files prepared for regulatory applications by the air agency
  - Wind speeds should be at least 1 m/s
  - To facilitate the required quarterly model runs, the meteorological data files must be configured by quarter

Input File Structure

*** Record Type 4 ***		
FLINK	Int	Print link contributions, 1 = YES; 0 = NO
FAMB	Int	Include background concentrations in results, 1 = YES; 0 = NO
'RU'	Char	Land use selection, 'R' = Rural; 'U' = Urban

Recommendations

- Record Type 4
  - » Do not include hourly background PM concentrations in the model runs
  - » Background concentrations are determined separately (described in **Module 6**)
  - » Background concentrations are then added to model results to calculate design values
  - » For determining whether land use is rural or urban, refer to **PM Hot-spot Guidance, Section 7.5.5**

Input File Structure

*** Record Type 5 ***		
'RCP'	Char	Receptor name, up to 20 characters
XR	Real	X-coordinate of receptor (user units)
YR	Real	Y-coordinate of receptor (user units)
ZR	Real	Z-coordinate of receptor (user units)
*** Repeat Record 5 for each receptor ***		

Recommendations

- Record Type 5
  - » Receptors should always be located outside of the mixing zone (link width)
  - » Receptor height should represent the typical ground-level breathing height of 1.8 m (5.9 ft) or less
  - » Guidance on the placement of receptors was previously described in **Module 3**

Input File Structure

*** Record Type 6 ***		
JTIER	Int	Tier approach, 1 = Tier I; 2 = Tier II
'MODE'	Char	Pollutant (units), 'C' = CO (ppm); 'P' = PM (ug/m3)

Recommendations

- Record Type 6
  - » Select a Tier II approach (JTIER = 2) to account for hourly variations in emissions and meteorology
  - » Select Mode 'P' for PM

Guidance Reference:

Appendix J.2.2

Input File Structure

*** Record Type 7 ***		
IPATRY	Int	Day of week patterns for hourly emissions, traffic, & signalization (ETS) values; assigned in the order: M T W T F S S
		Up to 7 patterns may be assigned. An example distinguishing weekday and weekend travel (2 patterns) 1 1 1 1 1 2 2

Recommendations

- Record Type 7
  - For PM Hot-spot analyses, traffic and emissions activity is generally defined for a typical weekday, i.e., one pattern for all seven days – 1 1 1 1 1 1 1
  - If there are more MOVES runs than the minimum specified, they should be modeled and linked to the correct days using IPATRY

Guidance Reference:

Appendix J.2.2

Input File Structure

*** Record Type 8 ***		
'RUN'	Char	Run title/description, up to 40 characters
NUMLNK	Int	Number of links, maximum = 120

Input File Structure

*** Record Type 9 ***		
COD	Int	Link number
IQ	Int	Traffic flow, 1 = free-flow link; 2 = queue link

Recommendations

- Record Type 9
  - » Specify free-flow link traffic flow (IQ = 1)
  - » Do not specify the queue link traffic flow (IQ = 2) as the queuing algorithm in CAL3QHCR should not be used
  - » Idling vehicles should be accounted for by reflecting idle activity patterns in the MOVES modeling

Guidance Reference:

Sec 7.3.1 & App J.2.2

Input File Structure

*** Record Type 10 ***		
For IQ = 1,		
'LNK'	Char	Link name, up to 20 characters
'TYP'	Char	Link type: 'AG' = at-grade; 'FL' = fill; 'BR' = bridge; and 'DP' = depressed
XL1	Real	Link X-coordinate start point (user units)
YL1	Real	Link Y-coordinate start point (user units)
. . .		

Input File Structure (continued)

*** Record Type 10 (continued) ***		
. . .		
XL2	Real	Link X-coordinate end point (user units)
YL2	Real	Link Y-coordinate end point (user units)
SH	Real	Source height (user units)
WL	Real	Mixing zone width (user units)
*** Repeat records 9 and 10 in succession for each link ***		

Recommendations

- Record Type 10
  - » A new link is required when there is a change in link width, link orientation, traffic volume, travel speed, or emission factor
  - » In most cases, a link type of “at-grade” (‘AG’) should be used
  - » For a succession of links, the start coordinates of the next link usually equals the end coordinates of the prior link, i.e., no gaps or overlaps

Recommendations

- Record Type 10 (continued)
  - » Source height should be within ± 10 m (± 32 ft)
  - » In most cases, a source height of 0 m should be used
  - » Mixing zone width is defined as the width of the travelled roadway plus 3 m (10 ft) on either side
  - » Link length must always be greater than the mixing zone width

Guidance Reference:

Appendix J.3.1

Input File Structure

*** Record Type 11 ***		
HE	Int	Hour ending
AMB	Int	Hourly ambient background concentration (ppm for CO, ug/m3 for PM)

Recommendations

- Record Type 11
  - » Hourly ambient background concentration should be set to zero
  - » Background concentrations are determined separately (as described in **Module 6**)
  - » Background concentrations are then added to model results to calculate design values as described in **Module 7**

Input File Structure

*** Record Type 12 ***		
COD	Int	Link number
VPHL	Real	Hourly traffic volume (veh/hr)
EFL	Real	Hourly emission factor (g/veh-mi)
*** Repeat Records 11 and 12 in succession for each of 24 hours for each traffic pattern ***		
*** Repeat Record 12 in succession for each link for the hour ***		

Recommendations

- Record Type 12
  - » Hourly traffic volume and emission factors are applied uniformly to the entire link length
  - » Emission factors are defined as g/v-mi
    - – Specify the emission rates option in MOVES
  - » All relevant pollutants and processes should be summed for a single “rateperdistance” emission factor per link
    - – MOVES post-processing scripts are available to complete this step as described in **Module 2**

Guidance Reference:

Appendix J.2.2

Constructing an Input File

- Twelve record types of data are entered in free format (comma or space delimited):

```
#1:  'JOB', ATIM, ZO, VS, VD, NR, SCAL, IOPT
#2:  START, END
#3:  METSF, METSYR, METUA, METUYR
#4:  FLINK, FAMB, 'RU'
#5:  'RCP', XR, YR, ZR
     [repeat #5 for each receptor]
#6:  JTIER, 'MODE'
#7:  IPATRY
```

Constructing an Input File

```
#8:   'RUN', NUMLNK
#9:   COD, IQ
#10:  'LNK', 'TYP', X1, Y1, X2, Y2, SH, WL
      (for IQ=1)
      [repeat #9 and #10 in succession
       for each link]
#11:  HE, AMB
#12:  COD, VPHL, EFL (for IQ = 1)
      [repeat #11 and #12 in succession for each
       of 24 hours for each traffic pattern]
      [repeat #12 in succession for each link
       for the hour]
```

Constructing an Input File

```
 #1:  'EXAMPLE - TWO WAY INTERSECTION (EX-1)' 60. 175. 0. 0. 8 0.3048 1
 #2:  1 1 64 12 31 64
 #3:  94823 64 94823 64
 #4:  1 1 'U'
 #5:  'REC 1 (SE CORNER)  '    45.   -35.  6.0
 #5:  'REC 2 (SW CORNER)  '   -45.   -35.  6.0
 #5:  'REC 3 (NW CORNER)  '   -45.    35.  6.0
 #5:  'REC 4 (NE CORNER)  '    45.    35.  6.0
 #5:  'REC 5 (E MID-MAIN) '    45.  -150.  6.0
 #5:  'REC 6 (W MID-MAIN) '   -45.  -150.  6.0
 #5:  'REC 7 (N MID-LOCAL)'  -150.    35.  6.0
 #5:  'REC 8 (S MID-LOCAL)'  -150.   -35.  6.0
 #6:  2 'p'
 #7:  1 1 1 1 1 2 3
 #8:  'MAIN ST. AND LOCAL ST. INTERSECTION' 3
 #9:  1 1
#10:  'Main St.NB Appr/Dep' 'AG'    10. -1000.   10.  1000.  0.  40.
 #9:  2 1
#10:  'Main St.SB Appr/Dep' 'AG'   -10.  1000.  -10. -1000.  0.  40.
 #9:  3 1
#10:  'Local St.Appr.Dep. ' 'AG' -1000.     0. 1000.     0.  0.  40.
```

Constructing an Input File

```
#11:  1  50.0
#12:  1  300.0  3.00
#12:  2  240.0  3.00
#12:  3  200.0  3.00
.
.
.
#11: 24   50.0
#12:  1  450.0  3.00
#12:  2  360.0  3.00
#12:  3  300.0  3.00
#11:  1   50.0
#12:  1  350.0  3.00
#12:  2  280.0  3.00
#12:  3  233.3  3.00
.
.
.
#11: 24   50.0
#12:  1 1500.0  3.00
#12:  2 1200.0  3.00
#12:  3 1000.0  3.00
```

Constructing an Input File

```
#11:  1   50.0
#12:  1 1500.0  3.00
#12:  2 1200.0  3.00
#12:  3 1000.0  3.00
.
.
.
#11: 24   50.0
#12:  1  288.3  3.00
#12:  2  230.7  3.00
#12:  3  192.2  3.00
```

Constructing an Input File

Excel Template

	A	B	C	D	E	F	G	H	I	J	K
1	#1:	'JOB'	ATIM	ZO	VS	VD	NR	SCAL	IOPT		
2		'CAL3QHCR Class Project'	60	175	0	0	311	0.3048	1		
3	#2:	STARTMO	STARTDY	STARTYR	ENDMO	ENDDY	ENDYR				
4		01	01	06	03	31	06				
5	#3:	METSF	METSYR	METUA	METUYR						
6		13994	06	4833	06						
7	#4:	FLINK	FAMB	'RU'							
8		0	0	'U'							
9	#5:	'RCP'	XR	YR	ZR						
10		'1'	29.5	698.2	5.0						
11	#6:	JTIER	'MODE'								
12		2	'P'								
13	#7:	IPATRY1	IPATRY2	IPATRY3	IPATRY4	IPATRY5	IPATRY6	IPATRY7			
14		1	1	1	1	1	1	1			
15	#8:	'RUN'	NUMLNK								
16		'1st Quarter - 2006'	91								
17	#9:	COD	IQ								
18		1	1								
19	#10:	'LNK'	TYP	X1	Y1	X2	Y2	SH	WL	(for	IQ=1)
20		[repeat #9 and #10 in succession for each link]									
21		'1A-Int A NW ent ramp'	'AG'	957.428	2236.44	1150.73	1971.35	0	43.685		
22	#11:	HE	AMB								
23		1	0								
24	#12:	COD	VPHL	EFL	(for	IQ	=	1)			
25		[repeat #11 and #12 in succession for each of 24 hours for each traffic pattern]									

CAL3QHCR Input File Template | Example CSV File | Class Project CSV File Q1 | Cla

Constructing an Input File

Delete Column A; “Save As” a CSV file

	A	B	C	D	E	F	G	H	I	J
1	#1:	'CAL3QHCR Class Project'	60	175	0	0	5	0.3048	1	
2	#2:	01	01	06	03	31	06			
3	#3:	13994	06	4833	06					
4	#4:	0	0	'U'						
5	#5:	1	29.5	698.2	5.0					
6	#5:	2	193.6	698.2	5.0					
7	#5:	3	357.6	698.2	5.0					
8	#5:	4	521.7	698.2	5.0					
9	#5:	5	685.7	698.2	5.0					
10	#6:	2	'P'							
11	#7:	1	1	1	1	1	1	1		
12	#8:	'1st Quarter - 2006'	5							
13	#9:	1	1							
14	#10:	'1A-Int A NW ent ramp'	'AG'	957.4	2236.4	1150.7	1971.4	0.0	43.7	
15	#9:	2	1							
16	#10:	'1B-Int A NW ent ramp'	'AG'	956.5	2235.9	714.0	2695.9	0.0	43.7	
17	#9:	3	1							
18	#10:	'2-Int A NW ent ramp'	'AG'	1151.3	1971.4	1275.0	1801.7	0.0	43.7	
19	#9:	4	1							
20	#10:	'3A-Int A WB RT lane'	'AG'	1188.8	1952.8	1267.5	1951.1	0.0	31.7	
21	#9:	5	1							
22	#10:	'3B-Int A WB RT lane'	'AG'	1277.5	1945.4	1324.8	2012.4	0.0	31.7	
23	#11:	1	0							
24	#12:	1	186	0.058389						
25	#12:	2	186	0.058389						

CAL3QHCR Input File Template | **Example CSV File** | Class Project CSV File Q1 | Cla

Constructing an Input File

Remove Extraneous Commas

Example CSV File.csv

```
1  'CAL3QHCR Class Project',60,175,0,0,5,0.3048,1
2  01,01,06,03,31,06,,
3  13994,06,4833,06,,,,
4  0,0,'U',,,,,
5  1,29.5,698.2,5.0,,,,
6  2,193.6,698.2,5.0,,,,
7  3,357.6,698.2,5.0,,,,
8  4,521.7,698.2,5.0,,,,
9  5,685.7,698.2,5.0,,,,
10 2,'P',,,,,,
11 1,1,1,1,1,1,1,
12 '1st Quarter - 2006',5,,,,,,
13 1,1,,,,,,
14 '1A-Int A NW ent ramp','AG',957.4,2236.4,1150.7,1971.4,0.0,43.7
15 2,1,,,,,,
16 '1B-Int A NW ent ramp','AG',956.5,2235.9,714.0,2695.9,0.0,43.7
17 3,1,,,,,,
18 '2-Int A NW ent ramp','AG',1151.3,1971.4,1275.0,1801.7,0.0,43.7
19 4,1,,,,,,
20 '3A-Int A WB RT lane','AG',1188.8,1952.8,1267.5,1951.1,0.0,31.7
21 5,1,,,,,,
22 '3B-Int A WB RT lane','AG',1277.5,1945.4,1324.8,2012.4,0.0,31.7
23 1,0,,,,,,
24 1,186,0.058389,,,,,
25 2,186,0.058389,,,,,
26 3,237,0.035454,,,,,
27 4,51,0.035454,,,,,
```

Constructing an Input File

Resulting Input File

Example CSV File.csv

```
1  'CAL3QHCR Class Project',60,175,0,0,5,0.3048,1
2  01,01,06,03,31,06
3  13994,06,4833,06
4  0,0,'U'
5  1,29.5,698.2,5.0
6  2,193.6,698.2,5.0
7  3,357.6,698.2,5.0
8  4,521.7,698.2,5.0
9  5,685.7,698.2,5.0
10 2,'P'
11 1,1,1,1,1,1,1
12 '1st Quarter - 2006',5
13 1,1
14 '1A-Int A NW ent ramp','AG',957.4,2236.4,1150.7,1971.4,0.0,43.7
15 2,1
16 '1B-Int A NW ent ramp','AG',956.5,2235.9,714.0,2695.9,0.0,43.7
17 3,1
18 '2-Int A NW ent ramp','AG',1151.3,1971.4,1275.0,1801.7,0.0,43.7
19 4,1
20 '3A-Int A WB RT lane','AG',1188.8,1952.8,1267.5,1951.1,0.0,31.7
21 5,1
22 '3B-Int A WB RT lane','AG',1277.5,1945.4,1324.8,2012.4,0.0,31.7
23 1,0
24 1,186,0.058389
25 2,186,0.058389
26 3,237,0.035454
27 4,51,0.035454
```

Output File Structure

- Text output
  - » CAL3QHCR 13196 reports the 6 highest 24-hour average PM concentrations, plus the period average PM concentrations, in the output file (*.OUT)
  - » 120 characters per line
  - » Print or display an output file with a text editor or word processor
  - » With a word processor, recommend using a non-proportional font (such as) so that columns align properly

Guidance Reference:

Appendix J.6.2

R1PT.OUT

R1PT.OUT - Notepad

File Edit Format View Help

```
                                                CAL3QHCR (Dated: 13196)

 DATE : 07/16/13                                                                    PAGE:  1
 TIME : 08:26:11

 JOB: EXAMPLE OF PM-10 ROADWAY HOT SPOT                  RUN: MAIN ST. BETWEEN DISTANT INTERSECTIONS

   ====================
   General Information
   ====================

     Run start date: 01/01/64    Julian:   1
           end date: 12/31/64    Julian: 366

     A Tier 1 approach was used for input data preparation.

     The MODE flag has been set to p for calculating PM averages.

     Ambient background concentrations are included in the averages below.


   Site & Meteorological Constants
   -------------------------------
     VS =   0.0 CM/S       VD =   0.0 CM/S       Z0 = 175. CM     ATIM =  60.

       Met. Sfc. Sta. Id & Yr = 94823    64
       Upper Air Sta. Id & Yr = 94823    64

     Urban mixing heights were processed.

     In 1964, Julian day 1 is a Wednesday.


   Link Data Constants - (Variable data in *.LNK file)
   -------------------

         LINK DESCRIPTION     *         LINK COORDINATES (FT)          *   LENGTH   BRG  TYPE    H     W  NLANES
                              *     X1        Y1        X2       Y2    *    (FT)   (DEG)        (FT)  (FT)
    -------------------------*-----------------------------------------*-----------------------------------
      1. Main St.NB Appr/Dep *     10.0   -1000.0      10.0    1000.0 *    2000.    360.  AG    0.0  40.0
      2. Main St.SB Appr/Dep *    -10.0    1000.0     -10.0   -1000.0 *    2000.    180.  AG    0.0  40.0
      3. Local St.Appr./Dep  *  -1000.0       0.0    1000.0       0.0 *    2000.     90.  AG    0.0  40.0

   Receptor Data
   -------------

                              *          COORDINATES (FT)
         RECEPTOR             *         X          Y          Z
    -------------------------*-----------------------------------
      1. REC 1 (SE MIDPOINT)  *        45.0       -35.0        6.0
      2. REC 2 (SW MIDPOINT)  *       -45.0       -35.0        6.0
      3. REC 3 (NW MIDPOINT)  *       -45.0        35.0        6.0
      4. REC 4 (NE MIDPOINT)  *        45.0        35.0        6.0
      5. REC 5 (E MID-MAIN)   *        45.0      -150.0        6.0
```

R1PT.OUT

R1PT.OUT - Notepad

File Edit Format View Help

```
                                                CAL3QHCR (Dated: 13196)

     DATE : 07/16/13                                                                    PAGE:  2
     TIME : 08:26:11

     JOB: EXAMPLE OF PM-10 ROADWAY HOT SPOT                  RUN: MAIN ST. BETWEEN DISTANT INTERSECTIONS

       Receptor Data
       -------------

                                 *          COORDINATES (FT)
            RECEPTOR             *         X          Y          Z
        -------------------------*-------------------------------------
         6. REC 6 (W MID-MAIN)   *       -45.0     -150.0        6.0
         7. REC 7 (N FAR-MAIN)   *      -150.0       35.0        6.0
         8. REC 8 (S FAR-MAIN)   *      -150.0      -35.0        6.0

       Model Results
       -------------

         Remarks : In search of the wind direction corresponding
                   to the maximum concentration, only the first
                   direction, of the directions with the same maximum
                   concentrations, is indicated as the maximum.

                 * MAXIMUM HOURLY CONCENTRATIONS WITH ANY AMBIENT BACKGROUND CONCENTRATIONS (BKG) ADDED
                 *   (MICROGRAMS/M**3)
                 *   REC0001  REC0002  REC0003  REC0004  REC0005  REC0006  REC0007  REC0008
         ----------*-------------------------------------------------------------------------------
         MAX+BKG * 412.9652 381.9921 424.7938 392.0609 356.4049 330.7981 273.6232 269.7002
         - BKG   *  50.0000  50.0000  50.0000  50.0000  50.0000  50.0000  50.0000  50.0000
         ----------*-------------------------------------------------------------------------------
           MAX   * 362.9652 331.9921 374.7938 342.0609 306.4049 280.7981 223.6232 219.7002
         WIND DIR*     328       80      168      228      328      168      107       80
         JULIAN  *     154      306       22      159      154       22      154      306
         HOUR    *       1       24        9       20        1        9        2       24


         THE HIGHEST CONCENTRATION OF  424.7938 UG/M**3 OCCURRED AT RECEPTOR REC0003.
```

R1PT.OUT

R1PT.OUT - Notepad

File Edit Format View Help

```
                                                CAL3QHCR (Dated: 13196)

     DATE : 07/16/13                                                                    PAGE:  3
     TIME : 08:26:11

     JOB: EXAMPLE OF PM-10 ROADWAY HOT SPOT                  RUN: MAIN ST. BETWEEN DISTANT INTERSECTIONS

       ==============
       Output Section
       ==============

       NOTES PERTAINING TO THE REPORT

         1.  THE HIGHEST AVERAGE IN EACH OF THE FIRST TWO COLUMNS OF EACH TABLE BELOW ARE SUFFIXED BY AN ASTERISK (*).
             FOR PM OUTPUT, THERE IS ONLY ONE COLUMN AND ASTERISK FOR THE ANNUAL AVERAGE/PERIOD OF CONCERN TABLE.

         2.  THE NUMBERS IN PARENTHESES ARE THE JULIAN DAY AND ENDING HOUR FOR THE PRECEDING AVERAGE.

         3.  THE NUMBER OF CALM HOURS USED IN PRODUCING EACH AVERAGE ARE PREFIXED BY A C.


       PRIMARY AND SECONDARY AVERAGES.

         SIX HIGHEST 24-HOUR END-TO-END AVERAGE CONCENTRATIONS IN MICROGRAMS/M**3
         INCLUDING AMBIENT BACKGROUND CONCENTRATIONS.

          Highest                Second Highest         Third Highest          Fourth Highest         Fifth Highest          Sixth Highest
 Rcptr          Ending                 Ending                 Ending                 Ending                 Ending                 Ending
 No.    Conc  Day Hr  Calm     Conc  Day Hr  Calm     Conc  Day Hr  Calm     Conc  Day Hr  Calm     Conc  Day Hr  Calm     Conc  Day Hr  Calm

 1 196.3929 (177,24) C 0 178.5712 (232,24) C 3 177.5193 (182,24) C 3 177.3578 ( 53,24) C 3 176.6059 ( 34,24) C 1 175.3931 (297,24) C 1
 2 200.5638 (306,24) C 5 187.6656 (338,24) C 2 186.0542 (251,24) C 4 185.9499 (110,24) C 1 185.0858 (190,24) C 2 183.0828 (246,24) C 2
 3 227.7060*(329,24) C 7 209.9906*(338,24) C 2 199.8850 (306,24) C 5 198.0377 (345,24) C 0 193.2741 ( 31,24) C 2 192.2264 (266,24) C 1
 4 196.6450 (347,24) C 2 193.6965 (182,24) C 3 193.3652 (314,24) C 1 183.9364 (201,24) C 2 176.7032 (181,24) C 0 172.2290 (302,24) C 5
 5 169.3567 (177,24) C 0 162.2623 (182,24) C 3 158.5169 (347,24) C 2 156.3345 (314,24) C 1 155.4557 (232,24) C 3 154.4510 (297,24) C 1
 6 172.6905 (338,24) C 2 169.1879 (306,24) C 5 168.7845 (110,24) C 1 166.0201 (329,24) C 7 159.7351 (251,24) C 4 158.4597 (246,24) C 2
 7 156.5915 (329,24) C 7 142.6181 (338,24) C 2 138.9705 (266,24) C 1 138.3498 (345,24) C 0 137.2820 (306,24) C 5 136.4953 ( 31,24) C 2
 8 138.0207 (306,24) C 5 128.9047 (251,24) C 4 128.8732 (190,24) C 2 126.1906 (246,24) C 2 125.3878 ( 49,24) C 5 124.3924 (202,24) C 6

         THE HIGHEST ANNUAL AVERAGE CONCENTRATIONS
                 IN MICROGRAMS/M**3
         INCLUDING AMBIENT BACKGROUND CONCENTRATIONS.

            Receptor        Maximum   Ending
             Number          Conc     Day Hr  Calm
               1           112.2207  (366,24) C 592
               2           104.3290  (366,24) C 592
               3           109.1065  (366,24) C 592
               4           116.9981* (366,24) C 592
               5           100.8026  (366,24) C 592
               6            92.9126  (366,24) C 592
               7            84.8696  (366,24) C 592
               8            80.0952  (366,24) C 592
```

R1PT.OUT

R1PT.OUT - Notepad

File Edit Format View Help

```
                                                CAL3QHCR (Dated: 13196)

     DATE : 07/16/13                                                                    PAGE:  4
     TIME : 08:26:11

     JOB: EXAMPLE OF PM-10 ROADWAY HOT SPOT                  RUN: MAIN ST. BETWEEN DISTANT INTERSECTIONS  |

       LINK CONTRIBUTION TABLES


         MAXIMUM 24-HOUR AVERAGED LINK CONTRIBUTIONS
                 IN MICROGRAMS/M**3
         INCLUDING AMBIENT BACKGROUND CONCENTRATIONS.

           Rcptr Total   Ending  Ambient  Total    Link   Link   Link
            No.    Conc   Day Hr  Backgnd   Link     +1     +2     +3

             1  196.3929 (177,24)    50.00  146.3929  66.8493 38.9734 40.5703
             2  200.5638 (306,24)    50.00  150.5638  53.7728 56.4621 40.3289
             3  227.7060 (329,24)    47.22  180.4838  56.8142 62.2342 61.4354
             4  196.6450 (347,24)    50.00  146.6449  69.9829 38.3718 38.2902
             5  169.3567 (177,24)    50.00  119.3567  66.8351 38.9601 13.5615
             6  172.6905 (338,24)    50.00  122.6905  56.7772 60.8649  5.0483
             7  156.5915 (329,24)    47.22  109.3693  25.3112 22.4339 61.6241
             8  138.0207 (306,24)    50.00   88.0207  25.0844 22.1302 40.8060

         SECOND HIGHEST 24-HOUR AVERAGED LINK CONTRIBUTIONS
                 IN MICROGRAMS/M**3
         INCLUDING AMBIENT BACKGROUND CONCENTRATIONS.

           Rcptr Total   Ending  Ambient  Total    Link   Link   Link
            No.    Conc   Day Hr  Backgnd   Link     +1     +2     +3

             1  178.5712 (232,24)    50.00  128.5712  59.5227 34.5420 34.5065
             2  187.6656 (338,24)    50.00  137.6656  56.8586 60.9204 19.8867
             3  209.9906 (338,24)    50.00  159.9906  56.8983 60.9481 42.1443
             4  193.6965 (182,24)    50.00  143.6966  67.3392 40.0425 36.3149
             5  162.2623 (182,24)    50.00  112.2623  67.1938 39.9082  5.1603
             6  169.1879 (306,24)    50.00  119.1879  53.7205 56.4217  9.0456
             7  142.6181 (338,24)    50.00   92.6181  26.7167 23.5927 42.3086
             8  128.9047 (251,24)    50.00   78.9047  21.3804 18.9256 38.5987

         MAXIMUM ANNUAL AVERAGED LINK CONTRIBUTIONS
                 IN MICROGRAMS/M**3
         INCLUDING AMBIENT BACKGROUND CONCENTRATIONS.

           Rcptr Total   Ending  Ambient  Total    Link   Link   Link
            No.    Conc   Day Hr  Backgnd   Link     +1     +2     +3

             1  112.2207 (366,24)    50.00   62.2209  29.2894 16.7163 16.2151
             2  104.3290 (366,24)    50.00   54.3295  17.8638 20.2682 16.1975
             3  109.1065 (366,24)    50.00   59.1065  17.8784 20.2799 20.9482
             4  116.9981 (366,24)    50.00   66.9982  29.3039 16.7278 20.9666
             5  100.8026 (366,24)    50.00   50.8028  29.2426 16.6790  4.8812
             6   92.9126 (366,24)    50.00   42.9126  17.8158 20.2300  4.8667
             7   84.8696 (366,24)    50.00   34.8697   7.3441  6.6153 20.9102
```

R1PT.OUT

R1PT.OUT - Notepad

File Edit Format View Help

```
                                                CAL3QHCR (Dated: 13196)

     DATE : 07/16/13                                                                    PAGE:  5
     TIME : 08:26:11

     JOB: EXAMPLE OF PM-10 ROADWAY HOT SPOT                  RUN: MAIN ST. BETWEEN DISTANT INTERSECTIONS

       LINK CONTRIBUTION TABLES


         MAXIMUM ANNUAL AVERAGED LINK CONTRIBUTIONS
                 IN MICROGRAMS/M**3
         INCLUDING AMBIENT BACKGROUND CONCENTRATIONS.

           Rcptr Total  Ending  Ambient  Total   Link  Link  Link
            No.   Conc  Day Hr  Backgnd   Link    +1    +2    +3

             8  80.0952 (366,24)    50.00   30.0953  7.3303  6.6040 16.1610
```

R1PT.OUT

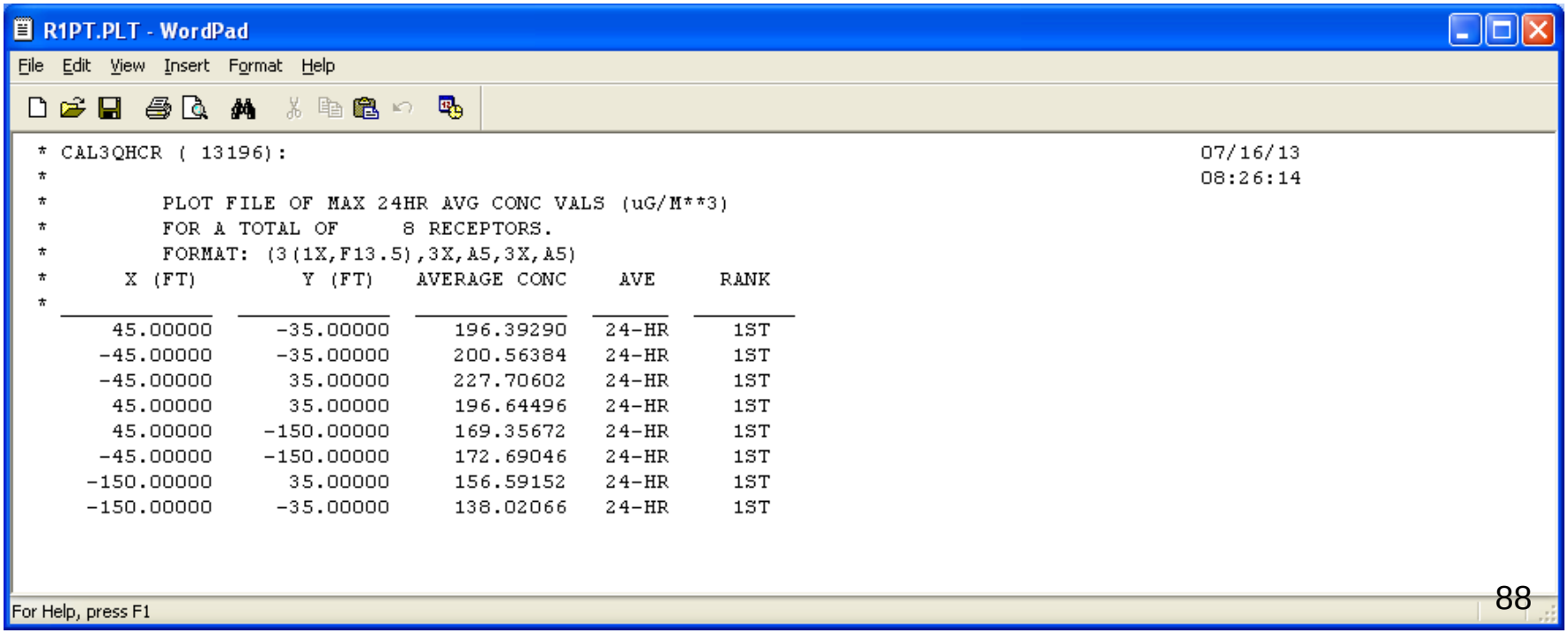
R1PT.OUT - Notepad

File Edit Format View Help

```
                                                CAL3QHCR (Dated: 13196)

     DATE : 07/16/13                                                                    PAGE:  6
     TIME : 08:26:11

     JOB: EXAMPLE OF PM-10 ROADWAY HOT SPOT                  RUN: MAIN ST. BETWEEN DISTANT INTERSECTIONS


                                                CALM DURATION FREQUENCY

        Hours of      Frequency
      Consecutive        of
      Calm Winds     Occurrence    (Julian day/hour ending) of Significant Occurrences

            1            188       (  7,13)( 11,  5)( 11,13)( 21,24)( 23,19)( 29,  5)( 31,  3)( 31,  6)( 34,24)( 35,  6)
                                   ( 40,18)( 42,23)( 43,  5)( 46,  2)( 46,14)( 48,  5)( 54,  2)( 54,  6)( 56,  2)( 59,  8)
                                   ( 62,  6)( 62,23)( 71,19)( 72,23)( 73,  4)( 73,  8)( 76,  8)( 83,  4)( 84,23)( 85,  1)
                                   (105,  7)(110,18)(111,20)(125,  5)(126,  2)(126,  4)(132,21)(136,  8)(137,  4)(137,  6)
                                   (143,21)(144,  1)(154,  4)(154,  6)(156,  6)(158,  1)(160,24)(164,  1)(169,  6)(174,  4)
                                   (174,20)(175,21)(179,  6)(180,  5)(180,24)(182,  3)(182,  6)(184,  1)(188,  7)(188,24)
                                   (190,  2)(190,24)(191,  4)(191,  6)(192,  1)(192,  6)(193,  3)(193,23)(195,24)(198,  8)
                                   (199,20)(201,21)(201,24)(202,  2)(202,  5)(202,23)(203,  6)(204,  2)(204,  5)(204,  7)
                                   (205,22)(205,24)(206,  2)(206,  4)(210,  5)(212,  2)(214,  9)(214,21)(214,23)(215,  2)
                                   (215,  4)(215,21)(228,23)(230,  3)(233,  4)(238,  5)(239,22)(240,  2)(242,  3)(242,21)
                                   (242,23)(243,  1)(243,23)(244,  2)(244,  5)(246,22)(246,24)(247,  7)(248,  5)(250,22)
                                   (253,21)(255,  1)(257,24)(258,  3)(259,24)(260,21)(261,  1)(261,  6)(261,  8)(261,21)
                                   (261,24)(262,  3)(262,  7)(263,  1)(263,  3)(266,  4)(267,  3)(270,  1)(270,  5)(271,21)
                                   (273,14)(273,20)(276,  8)(277,  1)(280,23)(285,  8)(285,19)(288,19)(288,22)(289,  7)
                                   (289,18)(289,20)(289,24)(291,18)(292,  4)(292,  8)(294,  6)(297,23)(299,  4)(300,  6)
                                   (300,  8)(301,  4)(301,  7)(301,19)(302,  5)(306,  7)(306,15)(306,20)(307,  2)(308,  7)
                                   (308,22)(309,17)(311,19)(311,21)(312,18)(312,21)(314,  5)(315,  1)(319,11)(319,21)
                                   (320,20)(324,15)(329,  4)(329,  6)(336,  8)(338,21)(338,23)(339,11)(344,19)(344,21)
                                   (346,  8)(347,  5)(347,16)(356,19)(356,21)(357,  1)(357,23)(363,19)
            2             55       ( 23,24)( 24,  3)( 29,  8)( 36,18)( 43,  3)( 46,  6)( 48,22)( 49,  3)(102,  3)(111,24)
                                   (125,23)(136,  6)(139,  2)(139,  6)(156,  3)(157,21)(174,23)(193,  1)(196,  4)(198,  6)
                                   (198,23)(200,23)(203,  2)(203,22)(205,  1)(205,  5)(205,  8)(208,23)(222,24)(242,  6)
                                   (247,  3)(249,24)(250,  3)(250,  6)(250,  9)(261,  4)(262,20)(262,23)(272,  1)(279,  5)
                                   (281,  7)(286,  7)(288,  8)(289,  1)(299,  2)(301,23)(302,  2)(302,23)(306,23)(328,22)
                                   (329,  9)(344,24)(355,24)(356,  8)(361,10)
            3             27       ( 18,23)( 45,24)( 49,  7)( 53,  7)(102,  7)(107,  2)(144,  6)(160,  7)(180,22)(183,  2)
                                   (193,  7)(194,  3)(199,24)(202,21)(209,  4)(218,  3)(228,  7)(230,  7)(243,  6)(280,  5)
                                   (281,  3)(289,  5)(301,  2)(312,  7)(320,  4)(329,19)(356,  4)
            4             12       ( 87,24)(170,  2)(198,  3)(209,24)(233,  1)(248,  1)(254,23)(269,23)(280,  1)(300,22)
                                   (312,  3)(320,  9)
            5             12       (142,24)(143,  6)(147,  2)(169,  4)(178,  7)(188,  4)(189,  6)(228,  3)(254,  6)(286,23)
                                   (295,  1)(307,  8)
            6              6       ( 59,  6)(199,  6)(238,  2)(259,  3)(288,  5)(298,  6)
            7              3       (229,  7)(286,  3)(310,  2)
            9              2       (220,  6)(252,  5)
           10              3       (253,  7)(305,  9)(309,  9)

     Program terminated normally
```

Plot File Structure

- CAL3QHCR reports the highest 24-hour averaged concentrations at each receptor in the plot file (*.PLT), similar to an AERMOD plot file
- Added in CAL3QHCR (13196)



R1PT.PLT - WordPad

File Edit View Insert Format Help

```
 * CAL3QHCR ( 13196):                                                  07/16/13
 *                                                                     08:26:14
 *          PLOT FILE OF MAX 24HR AVG CONC VALS (uG/M**3)
 *          FOR A TOTAL OF     8 RECEPTORS.
 *          FORMAT: (3(1X,F13.5),3X,A5,3X,A5)
 *       X (FT)         Y (FT)    AVERAGE CONC     AVE      RANK
 * _____________  _____________  _____________  _____  _________
      45.00000      -35.00000      196.39290   24-HR      1ST
     -45.00000      -35.00000      200.56384   24-HR      1ST
     -45.00000       35.00000      227.70602   24-HR      1ST
      45.00000       35.00000      196.64496   24-HR      1ST
      45.00000     -150.00000      169.35672   24-HR      1ST
     -45.00000     -150.00000      172.69046   24-HR      1ST
    -150.00000       35.00000      156.59152   24-HR      1ST
    -150.00000      -35.00000      138.02066   24-HR      1ST
```

For Help, press F1

How Air Quality Models Consider Met Data

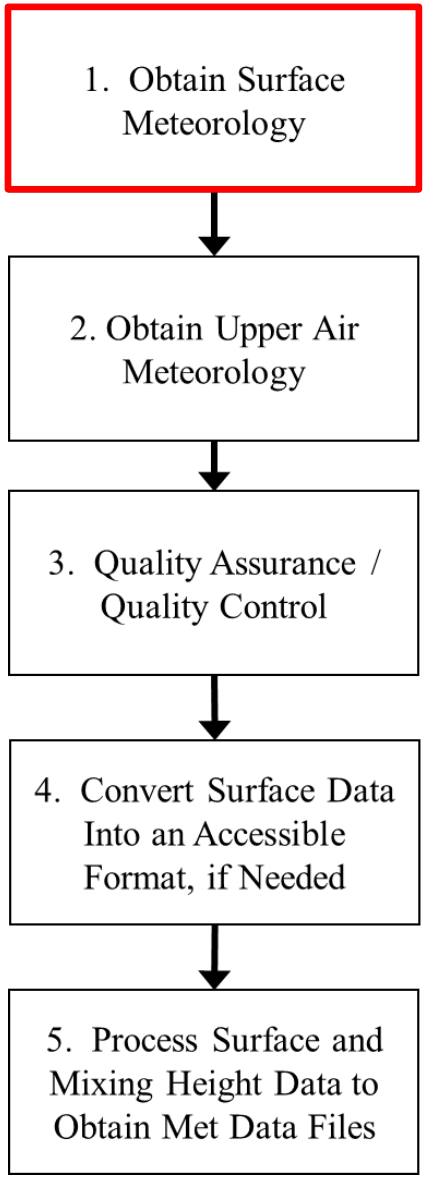
Air Quality Model	Upper Air Data	Surface Data		Surface Characteristics			Urban Dispersion
	Vertical temp profile, etc.	Wind/ temp	Cloud cover	Albedo	Bowen ratio	Surface roughness	Urban population
AERMOD							√ **(if modeling urban source)**
CAL3QHCR						√	√ **(if modeling urban source)**

Necessary met preprocessor input (will be included in preprocessed met data)

√ Necessary dispersion model input

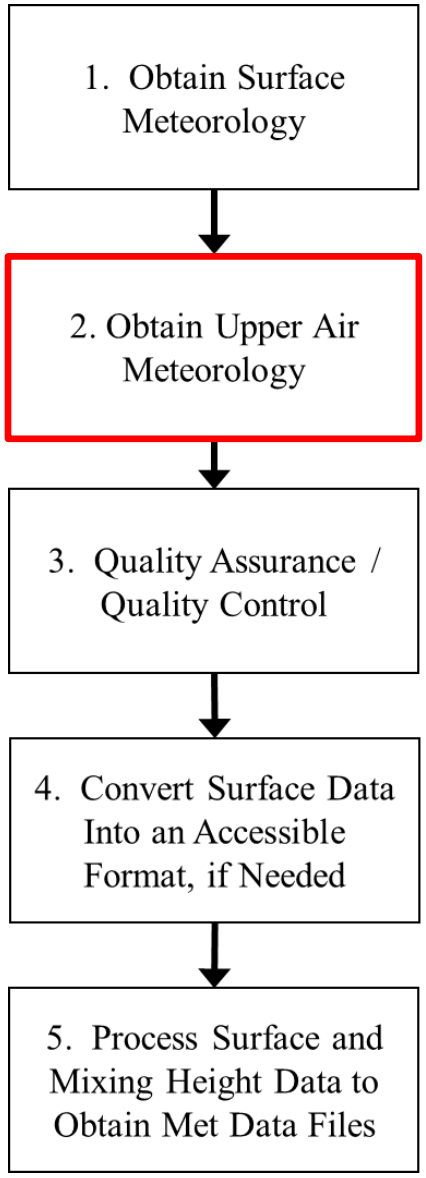
From Module 3

Met Data Processing Steps



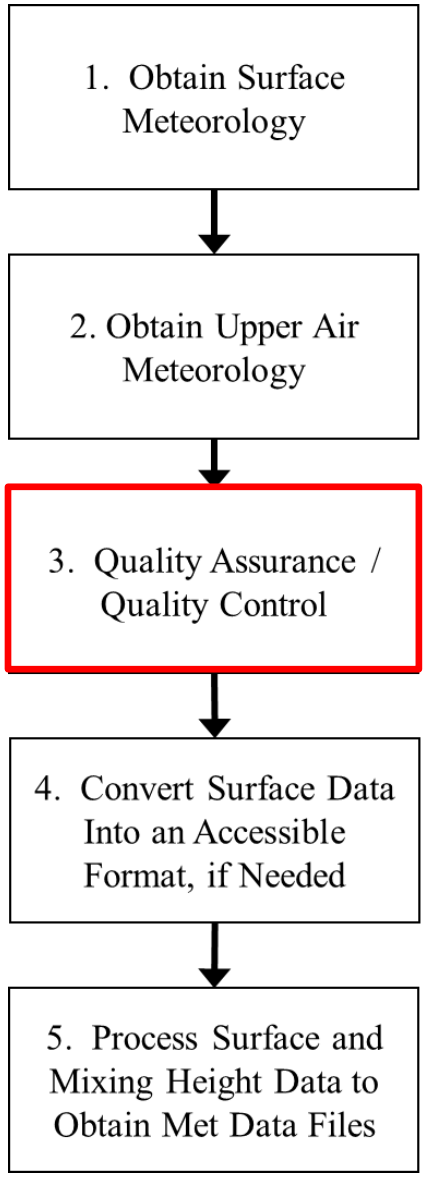
- Step 1: Surface meteorology can be obtained from a variety of sources (see **Module 3**)
  - » Most surface data are 1-hour measurements or observations
  - » More recent data are collected in 1-minute resolution
    - – AERMINUTE averages 1-minute data over an hour

Met Data Processing Steps



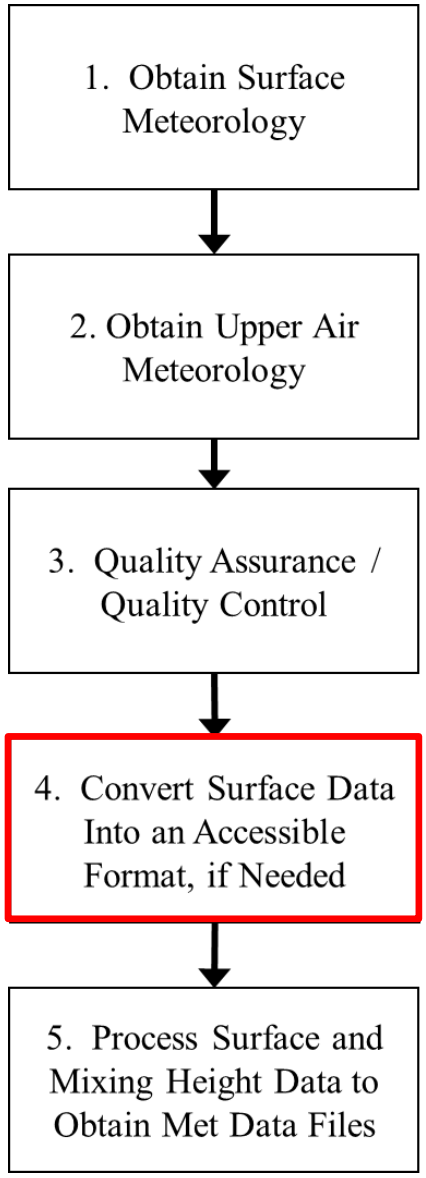
- Step 2: Sources of upper air meteorology are provided in **Module 3**
  - » If radiosonde data are obtained, process the data using EPA's Mixing Height Program to obtain mixing heights
  - » http://www.epa.gov/scram001/metobsdata_procaccprogs.htm

Met Data Processing Steps



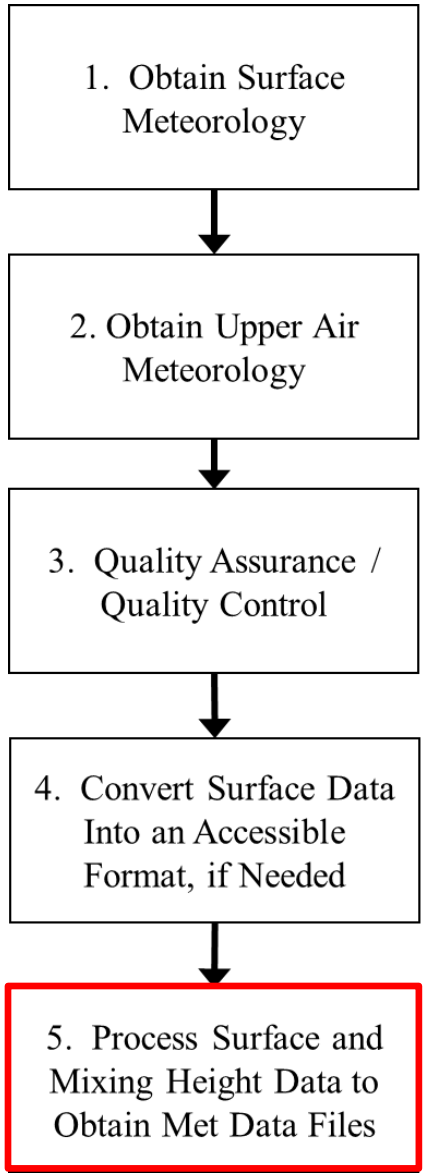
- Step 3: Refer to EPA's Quality Assurance / Quality Control requirements
  - » "Procedures for Substituting Values for Missing NWS Meteorological Data for Use in Regulatory Air Quality Models"
  - » http://www.epa.gov/scram001/surface/missdata.txt

Met Data Processing Steps



- Step 4: Convert surface data into an accessible format, if needed
  - » Refer to Chapter 4 in "Analysis of the Affect Of ASOS-Derived Meteorological Data or Refined Modeling"
  - » www.epa.gov/ttn/scram/guidance/met/asos.pdf

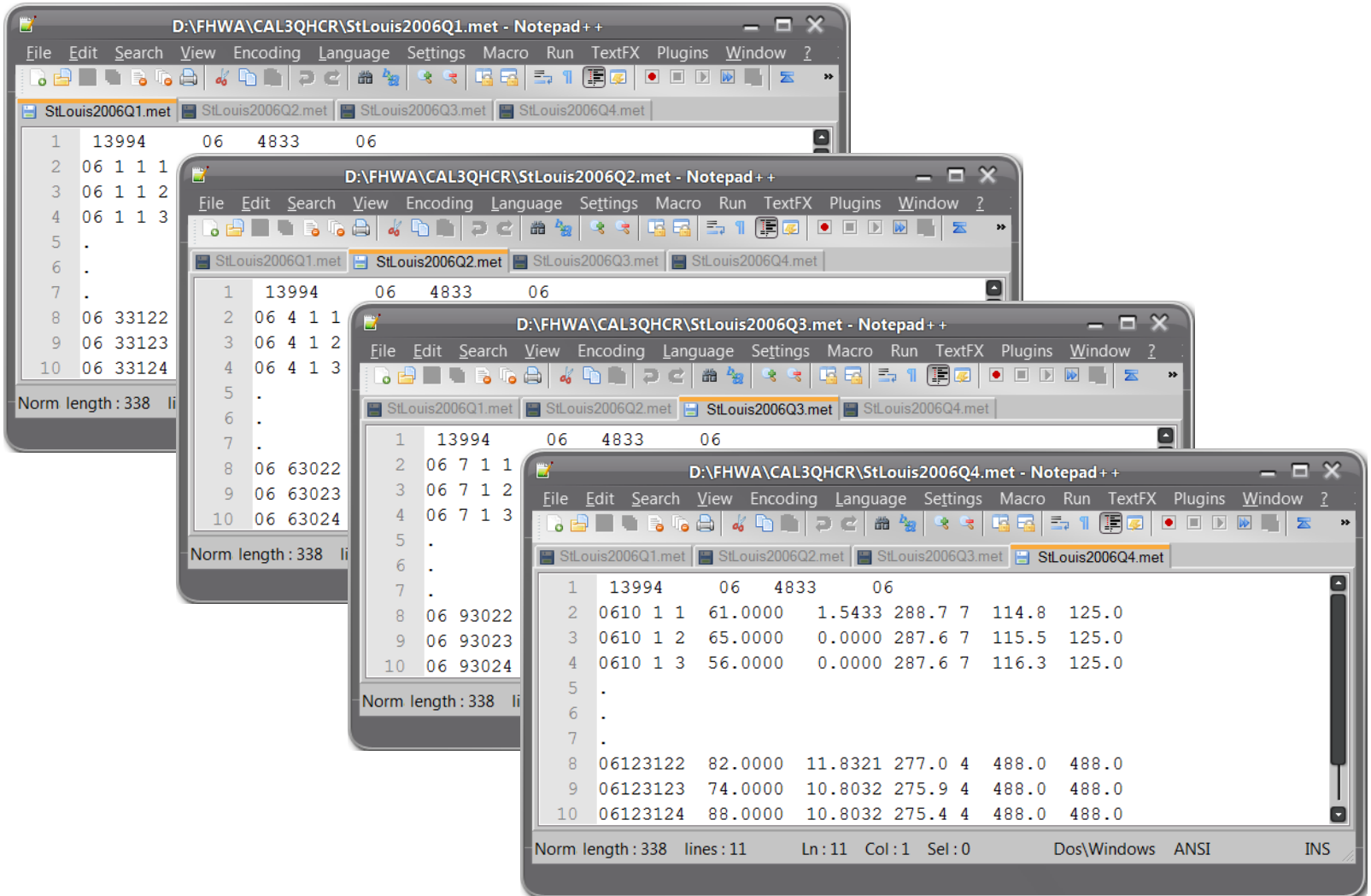
Met Data Processing Steps



- Step 5: Process surface hourly data and mixing height data to obtain meteorological data files
  - » AERMET/MPRM
    - – Stage 1: Extract and quality assurance
    - – Stage 2: Merge
    - – Stage 3: Process and create files for use in dispersion modeling

Met Data Processing Steps

- Step 6: Segregate Files by Quarter



CAL3QHCR Test Cases

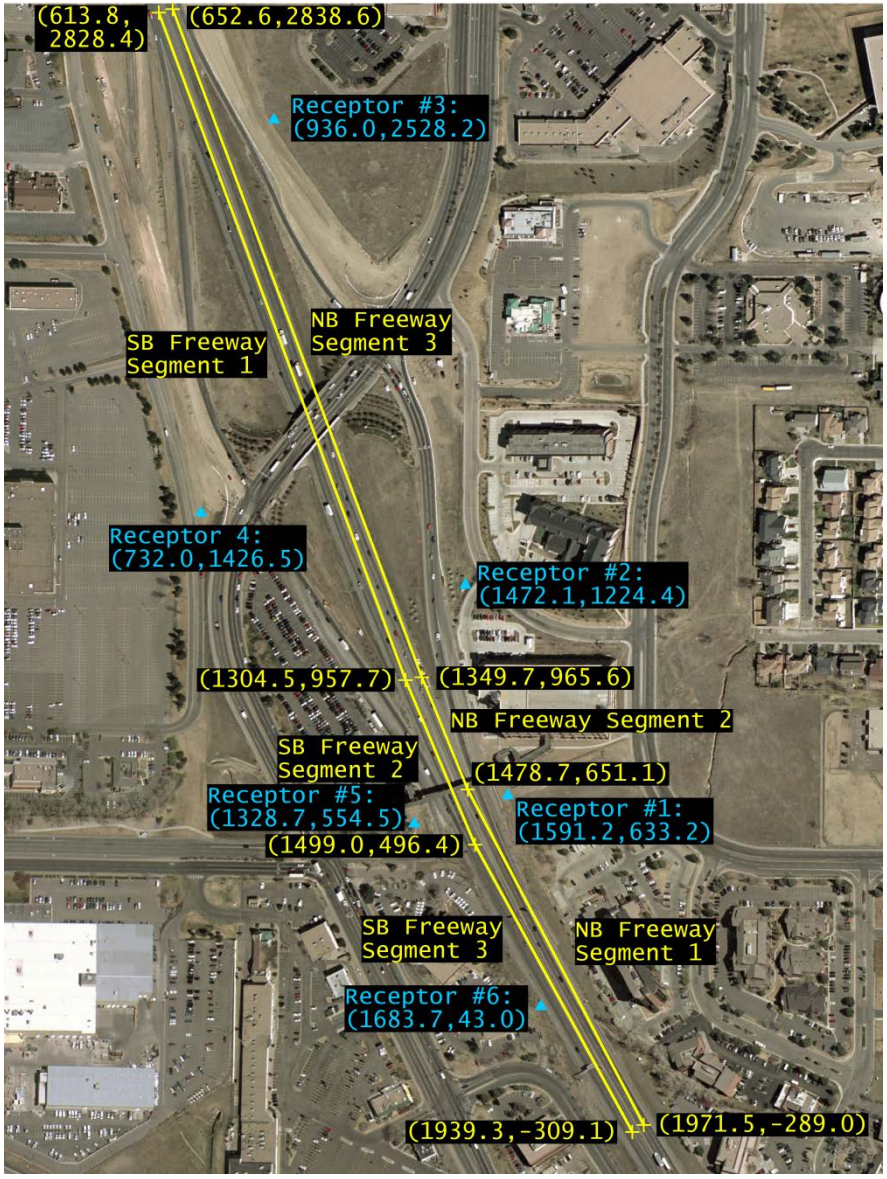
- Test cases are provided by OAQPS to ensure that CAL3QHCR predictions produced locally match reference results
  - C1C – Emulated Tier I example for CO
  - R1C – Tier I example for CO
  - R2C – Tier II example for CO
  - R1P – Tier I example for PM-10
  - R2P – Tier II example for PM-10
- Test cases are not created to reflect EPA guidance
- Test file names ending with “T” (e.g., R1PT.OUT) reflect use of latest version of CAL3QHCR (13196)

Class Exercise 1

- Based on the information provided, run CAL3QHCR for a subset of receptors and highway links from the Example Analysis
- Select Quarter 1 meteorology from St. Louis, Missouri for 2006
- Simulate a typical day using traffic volumes and MOVES emission factors from the four time periods supplied for Quarter 1

Receptor / Link Map

Map coordinates are in feet



Link Configurations

- Four 12-foot lanes in each direction
- All segments at-grade

Link Traffic Volumes

	A	B	C	D
1			VPHL	
2			Traffic Volume (vph)	
3			ON, MD	AM, PM
4	Link #	Link Description	Off-Peak	Peak
5	1	'NB Freeway Segment 1'	2775	6032
6	2	'NB Freeway Segment 2'	2519	5476
7	3	'NB Freeway Segment 3'	2519	5476
8	4	'SB Freeway Segment 1'	1960	4260
9	5	'SB Freeway Segment 2'	1960	4260
10	6	'SB Freeway Segment 3'	2337	5079

Link VPHL EFL | Receptors | MOV

- ON Off-Peak: 7 p.m. – 6 a.m.
- MD Off-Peak: 9 a.m. – 4 p.m.
- AM Peak: 6 a.m. – 9 a.m.
- PM Peak: 4 p.m. – 7 p.m.

MOVES Emission Factors – Q1

	A	B	C	D	E	F	G
1	movesRun	yearID	monthID	hourID	linkID	pollutant	Grams/veh-mile
2	1	2020	1	1	1	Total PM2.5	0.044152
3	1	2020	1	1	2	Total PM2.5	0.044179
4	1	2020	1	1	3	Total PM2.5	0.044179
5	1	2020	1	1	4	Total PM2.5	0.044214
6	1	2020	1	1	5	Total PM2.5	0.044214
7	1	2020	1	1	6	Total PM2.5	0.028208
8	2	2020	1	7	1	Total PM2.5	0.049007
9	2	2020	1	7	2	Total PM2.5	0.047895
10	2	2020	1	7	3	Total PM2.5	0.047895
11	2	2020	1	7	4	Total PM2.5	0.046441
12	2	2020	1	7	5	Total PM2.5	0.046441
13	2	2020	1	7	6	Total PM2.5	0.030816
14	3	2020	1	13	1	Total PM2.5	0.040609
15	3	2020	1	13	2	Total PM2.5	0.040632
16	3	2020	1	13	3	Total PM2.5	0.040632
17	3	2020	1	13	4	Total PM2.5	0.040661
18	3	2020	1	13	5	Total PM2.5	0.040661
19	3	2020	1	13	6	Total PM2.5	0.024339
20	4	2020	1	19	1	Total PM2.5	0.043451
21	4	2020	1	19	2	Total PM2.5	0.042375
22	4	2020	1	19	3	Total PM2.5	0.042375
23	4	2020	1	19	4	Total PM2.5	0.040970
24	4	2020	1	19	5	Total PM2.5	0.040970
25	4	2020	1	19	6	Total PM2.5	0.024820

Link VPHL EFL | Receptors | MOVES Output

- hourID 1 = ON Off-Peak
- hourID 7 = AM Peak
- hourID 13 = MD Off-Peak
- hourID 19 = PM Peak

Meteorology

- St. Louis, Missouri – 2006 Meteorology
  - » Surface Station Number: 13994
  - » Upper Air Station Number: 4833
  - » Filename: STL2006Q1.met

Run CAL3QHCR

- Step 1: Create an input file (*.INP)
  - » May use Excel Spreadsheet Template
- Step 2: Create a control file (*.CTL)
- Step 3: Create a batch file for executing the CAL3QHCR run (*.BAT)
- Step 4: Execute the batch file created in Step 3
- Summarize the results:
  - » 6 highest 24-hour average $PM_{2.5}$ concentrations
  - » Quarterly average $PM_{2.5}$ concentration

Class Exercise 1 – Results

Ex1-2006Q1.out - Notepad

File Edit Format View Help

```
                                                    CAL3QHCR (Dated: 13196)

     DATE : 07/22/13                                                                    PAGE:  3
     TIME : 11:18:33

     JOB: CAL3QHCR Training Exercise 1                          RUN: 1st Quarter - 2006

       ==============
       Output Section
       ==============

       NOTES PERTAINING TO THE REPORT

         1.  THE HIGHEST AVERAGE IN EACH OF THE FIRST TWO COLUMNS OF EACH TABLE BELOW ARE SUFFIXED BY AN ASTERISK (*).
             FOR PM OUTPUT, THERE IS ONLY ONE COLUMN AND ASTERISK FOR THE ANNUAL AVERAGE/PERIOD OF CONCERN TABLE.

         2.  THE NUMBERS IN PARENTHESES ARE THE JULIAN DAY AND ENDING HOUR FOR THE PRECEDING AVERAGE.

         3.  THE NUMBER OF CALM HOURS USED IN PRODUCING EACH AVERAGE ARE PREFIXED BY A C.


       PRIMARY AND SECONDARY AVERAGES.

         SIX HIGHEST 24-HOUR END-TO-END AVERAGE CONCENTRATIONS IN MICROGRAMS/M**3
         EXCLUDING AMBIENT BACKGROUND CONCENTRATIONS.

              Highest                  Second Highest           Third Highest            Fourth Highest           Fifth Highest            Sixth Highest
       Rcptr         Ending                   Ending                   Ending                   Ending                   Ending                   Ending
       No.   Conc  Day Hr  Calm     Conc  Day Hr  Calm     Conc  Day Hr  Calm     Conc  Day Hr  Calm     Conc  Day Hr  Calm     Conc  Day Hr
Calm


       1   2.3641 ( 38,24) C 4    2.2710 ( 37,24) C 0    2.1825 ( 51,24) C 0    2.0186 ( 81,24) C 2    1.7879 ( 53,24) C 1    1.7530 ( 41,24) C 0
       2   1.6134 ( 38,24) C 4    1.4426 ( 37,24) C 0    1.2536 ( 51,24) C 0    1.0923 ( 81,24) C 2    1.0007 ( 53,24) C 1    0.9865 ( 41,24) C 0
       3   1.7089 ( 38,24) C 4    1.5164 ( 51,24) C 0    1.3880 ( 37,24) C 0    1.1297 ( 31,24) C 1    1.1095 ( 53,24) C 1    1.0769 ( 41,24) C 0
       4   0.6760 ( 63,24) C 0    0.6650 ( 59,24) C 3    0.5561 ( 22,24) C 4    0.5137 ( 33,24) C 4    0.5074 ( 88,24) C 4    0.4853 ( 74,24) C 4
       5   1.5894 ( 39,24) C 6    1.4458 ( 22,24) C 4    1.4363 ( 59,24) C 3    1.3820 ( 63,24) C 0    1.1462 ( 76,24) C 1    1.0987 ( 33,24) C 4
       6   2.4028*( 22,24) C 4    2.3065*( 39,24) C 6    2.1658 ( 59,24) C 3    2.1137 ( 63,24) C 0    1.9757 ( 62,24) C 4    1.8920 ( 76,24) C 1

         THE HIGHEST  90 - DAY AVERAGE CONCENTRATIONS
                IN MICROGRAMS/M**3
         EXCLUDING AMBIENT BACKGROUND CONCENTRATIONS.

            Receptor        Maximum  Ending
             Number         Conc      Day Hr   Calm
               1           0.9532*  ( 90,24) C 115
               2           0.5158   ( 90,24) C 115
               3           0.5655   ( 90,24) C 115
               4           0.1540   ( 90,24) C 115
               5           0.3584   ( 90,24) C 115
               6           0.6122   ( 90,24) C 115
```

Example Analysis

- Run CAL3QHCR for the Example Analysis
- This is an extension of Class Exercise 1 to include 321 receptors and 83 links
- 5 years of meteorology are used, separated by quarter, for a total of 20 CAL3QHCR runs
- The runs will produce the highest 24-hour average and period average PM concentrations, by quarter

Example Analysis

- Annual average PM concentrations will be obtained by off-model computations from the period averages

- Receptor and highway link coordinates were converted from data used in the AERMOD Example Analysis, minus the transit components

Project Details

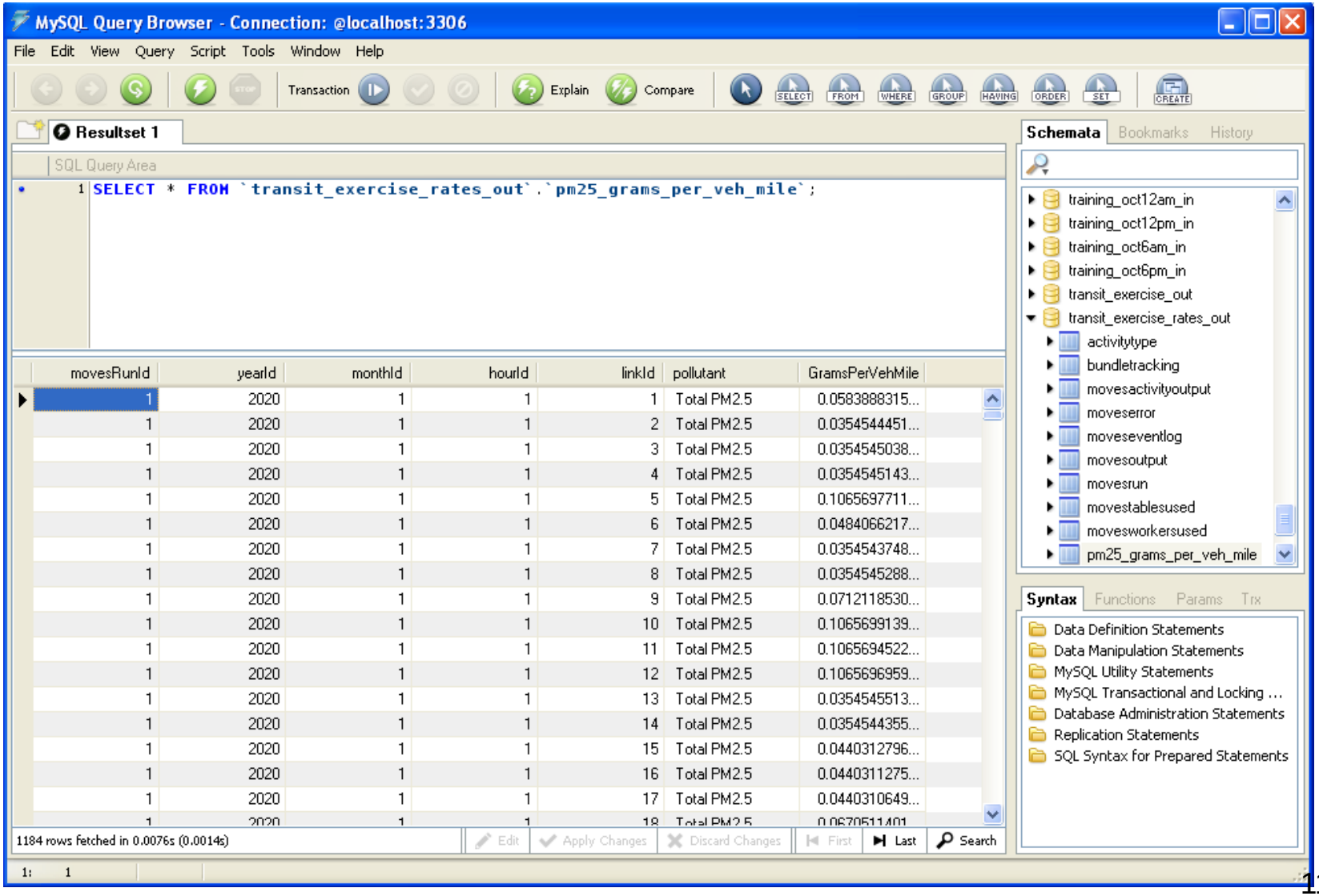
- The project is a lane expansion of the existing highway and the addition of an interchange (on/off ramps)
- MOVES will be run to generate emission rates
- The air quality analysis for the project will be done with CAL3QHCR


Existing
Proposed

Project Details

- Location: Washtenaw County, MI
- The project is expected to be completed in 2019
  - » Year of expected peak emissions (analysis year): 2020
  - » Three-hour am/pm peak periods
- Determined through interagency consultation to be a project of local air quality concern
- The area surrounding the project is primarily residential and commercial, with no nearby sources that need to be included in modeling

MOVES Grams per Mile Emission Rates



CAL3QHCR Input File

Tips:

- Create an input file for one quarter and one year to use as a base file
- Most of the data entered will not change by quarter or by year
- Copy the base file (e.g., Q1) and use it as the basis for the remaining three quarters in that year

CP-2006Q1.inp

```
1  'CAL3QHCR Class Project',60,175,0,0,321,0.3048,1
2  01,01,06,03,31,06
3  13994,06,4833,06
4  0,0,'U'
5  1,29.5,698.2,5.0
6  2,193.6,698.2,5.0
7  3,357.6,698.2,5.0
8  4,521.7,698.2,5.0
9  5,685.7,698.2,5.0
10 6,849.7,698.2,5.0
11 7,29.5,862.2,5.0
12 8,193.6,862.2,5.0
13 9,357.6,862.2,5.0
14 10,521.7,862.2,5.0
15 11,29.5,1026.2,5.0
16 12,193.6,1026.2,5.0
17 13,357.6,1026.2,5.0
18 14,521.7,1026.2,5.0
19 15,29.5,1190.3,5.0
20 16,193.6,1190.3,5.0
21 17,357.6,1190.3,5.0
22 18,521.7,1190.3,5.0
23 19,29.5,1354.3,5.0
24 20,193.6,1354.3,5.0
25 21,357.6,1354.3,5.0
26 22,521.7,1354.3,5.0
27 23,29.5,1518.4,5.0
```

CAL3QHCR Input File

Tips:

- Information that changes by quarter includes meteorology and MOVES emission factors
- Now use the four quarterly data files created for a single year as base files for the remaining four years

CP-2006Q1.inp

```
1  'CAL3QHCR Class Project',60,175,0,0,321,0.3048,1
2  01,01,06,03,31,06
3  13994,06,4833,06
4  0,0,'U'
5  1,29.5,698.2,5.0
6  2,193.6,698.2,5.0
7  3,357.6,698.2,5.0
8  4,521.7,698.2,5.0
9  5,685.7,698.2,5.0
10 6,849.7,698.2,5.0
11 7,29.5,862.2,5.0
12 8,193.6,862.2,5.0
13 9,357.6,862.2,5.0
14 10,521.7,862.2,5.0
15 11,29.5,1026.2,5.0
16 12,193.6,1026.2,5.0
17 13,357.6,1026.2,5.0
18 14,521.7,1026.2,5.0
19 15,29.5,1190.3,5.0
20 16,193.6,1190.3,5.0
21 17,357.6,1190.3,5.0
22 18,521.7,1190.3,5.0
23 19,29.5,1354.3,5.0
24 20,193.6,1354.3,5.0
25 21,357.6,1354.3,5.0
26 22,521.7,1354.3,5.0
27 23,29.5,1518.4,5.0
```

CAL3QHCR Input File

Tips:

- The only information that changes by year is the calendar year designation

CP-2006Q1.inp

```
1  'CAL3QHCR Class Project',60,175,0,0,321,0.3048,1
2  01,01,06,03,31,06
3  13994,06,4833,06
4  0,0,'U'
5  1,29.5,698.2,5.0
6  2,193.6,698.2,5.0
7  3,357.6,698.2,5.0
8  4,521.7,698.2,5.0
9  5,685.7,698.2,5.0
10 6,849.7,698.2,5.0
11 7,29.5,862.2,5.0
12 8,193.6,862.2,5.0
13 9,357.6,862.2,5.0
14 10,521.7,862.2,5.0
15 11,29.5,1026.2,5.0
16 12,193.6,1026.2,5.0
17 13,357.6,1026.2,5.0
18 14,521.7,1026.2,5.0
19 15,29.5,1190.3,5.0
20 16,193.6,1190.3,5.0
21 17,357.6,1190.3,5.0
22 18,521.7,1190.3,5.0
23 19,29.5,1354.3,5.0
24 20,193.6,1354.3,5.0
25 21,357.6,1354.3,5.0
26 22,521.7,1354.3,5.0
27 23,29.5,1518.4,5.0
```

CAL3QHCR Input File

Pertinent data that will not change by quarter or by year:

- Record Type 1
  - Averaging time
  - Surface roughness
  - Settling velocity
  - Deposition velocity
  - Number of receptors
  - Scale conversion factor
- Record Type 4
  - Land use selection

CP-2006Q1.inp

```
1  'CAL3QHCR Class Project',60,175,0,0,321,0.3048,1
2  01,01,06,03,31,06          #1:  . . ., ATIM, Z0, VS, ZD, NR, SCAL, . . .
3  13994,06,4833,06
4  0,0,'U'                    #4:  'RU'
5  1,29.5,698.2,5.0
6  2,193.6,698.2,5.0
7  3,357.6,698.2,5.0
8  4,521.7,698.2,5.0
9  5,685.7,698.2,5.0
10 6,849.7,698.2,5.0
11 7,29.5,862.2,5.0
12 8,193.6,862.2,5.0
13 9,357.6,862.2,5.0
14 10,521.7,862.2,5.0
15 11,29.5,1026.2,5.0
16 12,193.6,1026.2,5.0
17 13,357.6,1026.2,5.0
18 14,521.7,1026.2,5.0
19 15,29.5,1190.3,5.0
20 16,193.6,1190.3,5.0
21 17,357.6,1190.3,5.0
22 18,521.7,1190.3,5.0
23 19,29.5,1354.3,5.0
24 20,193.6,1354.3,5.0
25 21,357.6,1354.3,5.0
26 22,521.7,1354.3,5.0
27 23,29.5,1518.4,5.0
```

CAL3QHCR Input File

Pertinent data that will not change by quarter or by year:

- Record Type 5
  - Receptor name
  - x-coordinate of receptor
  - y-coordinate of receptor
  - z-coordinate of receptor

CP-2006Q1.inp

```
1  'CAL3QHCR Class Project',60,175,0,0,321,0.3048,1
2  01,01,06,03,31,06
3  13994,06,4833,06
4  0,0,'U'
5  1,29.5,698.2,5.0
6  2,193.6,698.2,5.0
7  3,357.6,698.2,5.0
8  4,521.7,698.2,5.0
9  5,685.7,698.2,5.0
10 6,849.7,698.2,5.0
11 7,29.5,862.2,5.0
12 8,193.6,862.2,5.0
13 9,357.6,862.2,5.0
14 10,521.7,862.2,5.0
15 11,29.5,1026.2,5.0
16 12,193.6,1026.2,5.0
17 13,357.6,1026.2,5.0
18 14,521.7,1026.2,5.0
19 15,29.5,1190.3,5.0
20 16,193.6,1190.3,5.0
21 17,357.6,1190.3,5.0
22 18,521.7,1190.3,5.0
23 19,29.5,1354.3,5.0
24 20,193.6,1354.3,5.0
25 21,357.6,1354.3,5.0
26 22,521.7,1354.3,5.0
27 23,29.5,1518.4,5.0
```

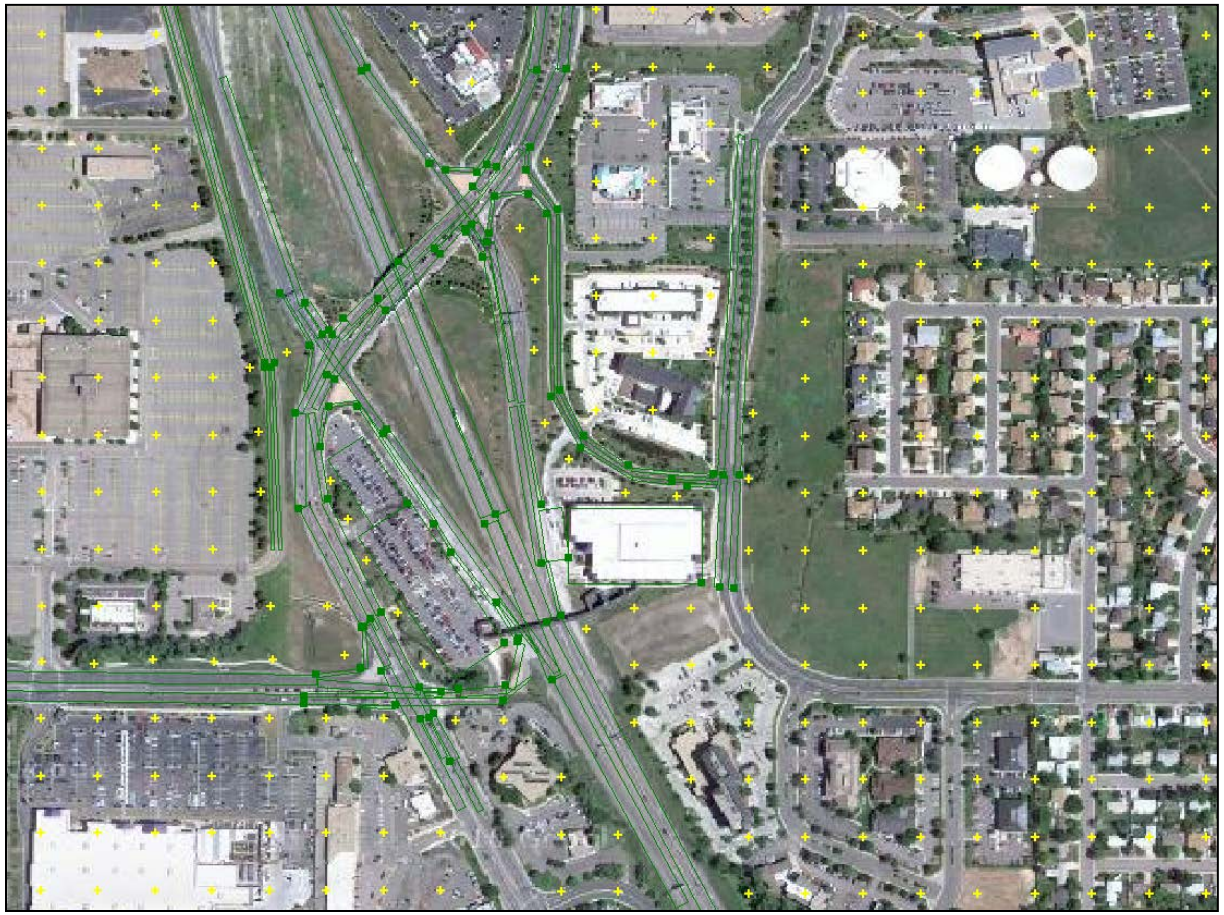
#5: 'RCP', XR, YR, ZR

CAL3QHCR Input File

Receptor coordinates were converted from data used in the AERMOD Example Analysis

Digitizers can be used with scaled maps to obtain coordinates

- GRASS GIS: free, open source
- Didger 4: commercial
- CAL3QHCR GUI: commercial



CAL3QHCR Input File

Pertinent data that will not change by quarter or by year:

- Record Type 6
  - Tier approach
  - Pollutant
- Record Type 7
  - Day of week patterns for hourly emissions, traffic, & signalization values
- Record Type 8
  - Number of links

CP-2006Q1.inp

```
326 2,'P'                                   #6:  JTIER, 'MODE'
327 1,1,1,1,1,1,1                           #7:  IPATRY
328 '1st Quarter - 2006',83                 #8:  . . ., NUMLNK
329 1,1
330 '1A-Int A NW ent ramp','AG',957.4,2236.4,1150.7,1971.4,0.0,43.7
331 2,1
332 '1B-Int A NW ent ramp','AG',956.5,2235.9,714.0,2695.9,0.0,43.7
333 3,1
334 '2-Int A NW ent ramp','AG',1151.3,1971.4,1275.0,1801.7,0.0,43.7
335 4,1
336 '3A-Int A WB RT lane','AG',1188.8,1952.8,1267.5,1951.1,0.0,31.7
337 5,1
338 '3B-Int A WB RT lane','AG',1277.5,1945.4,1324.8,2012.4,0.0,31.7
339 6,1
340 '4A-Int A SW approach','AG',1321.8,1963.1,1441.5,2229.4,0.0,55.7
341 7,1
342 '4B-Int A SW approach','AG',1438.4,2235.9,1478.1,2532.8,0.0,55.7
343 8,1
344 '4C-Int A SW approach','AG',1474.4,2526.1,1480.8,2699.2,0.0,55.7
345 9,1
346 '5-Int A SW queue','AG',1320.4,1955.3,1278.3,1896.3,0.0,55.7
347 10,1
348 '6-Int A SW departure','AG',1278.0,1889.1,1065.9,1681.3,0.0,55.7
349 11,1
350 '7-Int A SW connect','AG',1067.0,1676.7,908.5,1515.4,0.0,55.7
351 12,1
352 '8-Int A NE approach','AG',1006.4,1556.1,1161.9,1718.8,0.0,55.7
```

CAL3QHCR Input File

Pertinent data that will not change by quarter or by year:

- Record Type 9
  - Link number
  - Traffic flow
- Record Type 10
  - Link name
  - Link type
  - Link x-coordinate start point
  - Link y-coordinate start point
  - Link x-coordinate end point
  - Link y-coordinate end point
  - Source height
  - Mixing zone width

CP-2006Q1.inp

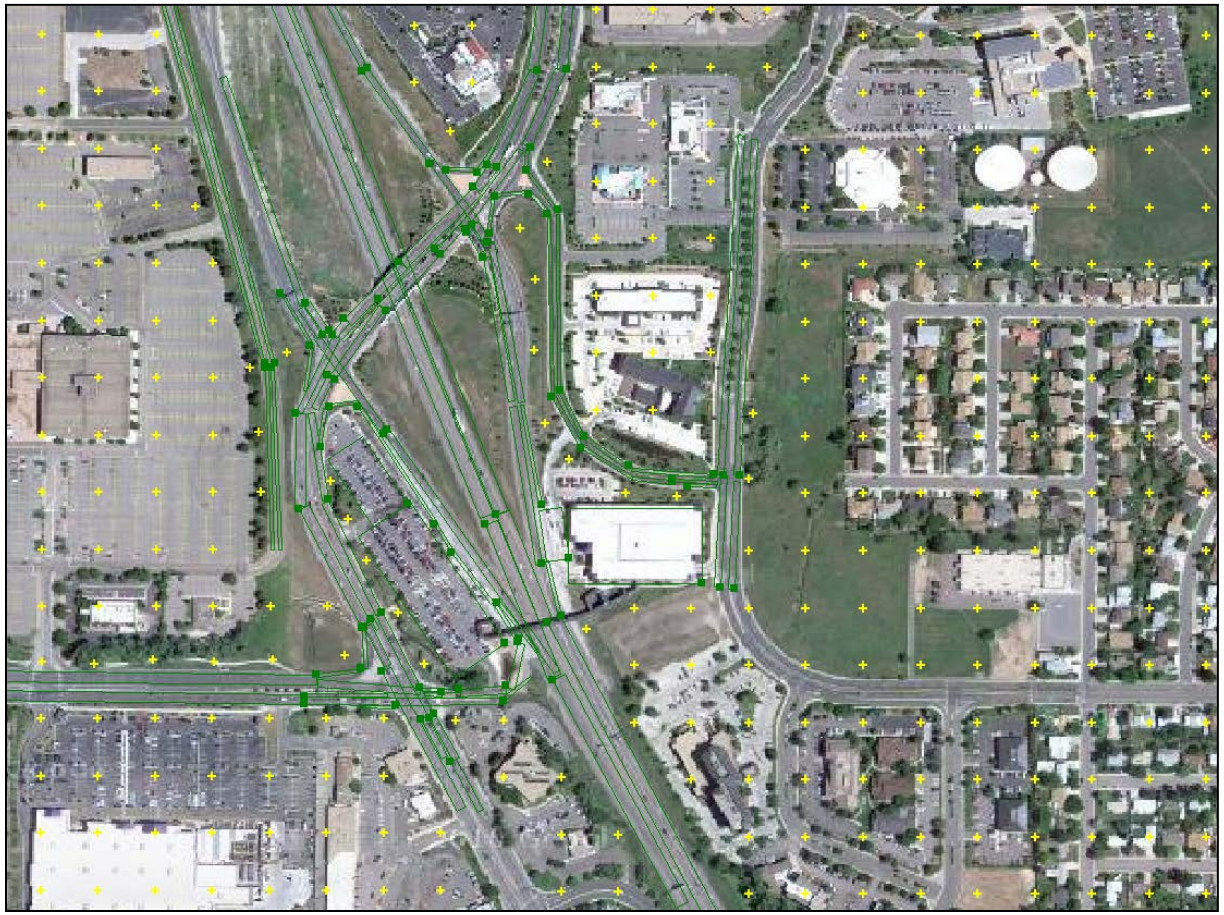
```
2,'P'
1,1,1,1,1,1,1,1                    #9:  COD, IQ
'1st Quarter - 2006',83            #10: 'LNK', 'TYP', XL1, YL1, XL2, YL2, SH, WL
1,1
'1A-Int A NW ent ramp','AG',957.4,2236.4,1150.7,1971.4,0.0,43.7
2,1
'1B-Int A NW ent ramp','AG',956.5,2235.9,714.0,2695.9,0.0,43.7
3,1
'2-Int A NW ent ramp','AG',1151.3,1971.4,1275.0,1801.7,0.0,43.7
4,1
'3A-Int A WB RT lane','AG',1188.8,1952.8,1267.5,1951.1,0.0,31.7
5,1
'3B-Int A WB RT lane','AG',1277.5,1945.4,1324.8,2012.4,0.0,31.7
6,1
'4A-Int A SW approach','AG',1321.8,1963.1,1441.5,2229.4,0.0,55.7
7,1
'4B-Int A SW approach','AG',1438.4,2235.9,1478.1,2532.8,0.0,55.7
8,1
'4C-Int A SW approach','AG',1474.4,2526.1,1480.8,2699.2,0.0,55.7
9,1
'5-Int A SW queue','AG',1320.4,1955.3,1278.3,1896.3,0.0,55.7
10,1
'6-Int A SW departure','AG',1278.0,1889.1,1065.9,1681.3,0.0,55.7
11,1
'7-Int A SW connect','AG',1067.0,1676.7,908.5,1515.4,0.0,55.7
12,1
'8-Int A NE approach','AG',1006.4,1556.1,1161.9,1718.8,0.0,55.7
```

CAL3QHCR Input File

Highway link coordinates were converted from data used in the AERMOD Example Analysis, minus the transit components

Digitizers can be used with scaled maps to obtain coordinates

Note: Highway links as converted are not shown (to be developed)



CAL3QHCR Input File

Pertinent data that will not change by quarter or by year:

- Record Type 12
  - Hourly traffic volume

CP-2006Q1.inp

```
495  1,0
496  1,186,0.058389
497  2,186,0.058389
498  3,237,0.035454
499  4,51,0.035454
500  5,51,0.035454
501  6,214,0.035454
502  7,214,0.035454
503  8,214,0.035454
504  9,163,0.106570
505  10,276,0.048406
506  11,276,0.035455
507  12,333,0.035455
508  13,235,0.071212
509  14,98,0.106570
510  15,113,0.106570
511  16,88,0.106570
512  17,113,0.035455
513  18,143,0.035454
514  19,55,0.044031
515  20,55,0.044031
516  21,55,0.044031
517  22,55,0.044031
518  23,55,0.044031
519  24,55,0.044031
520  25,55,0.044031
521  26,28,0.044031
```

#12: . . ., VPHL, . . .

CAL3QHCR Input File

Traffic volumes are assigned by hour for a minimum of four different time periods:

- Two representing peak traffic and two representing off-peak traffic

	A	B	C	D	E	F
1						
2					VPHL	
3					ON, MD	AM, PM
4	Link Count	Link #	linkID	20 Character Link Description	Off-Peak	Peak
5	1	1A	1	'1A-Int A NW ent ramp'	186	404
6	2	1B	1	'1B-Int A NW ent ramp'	186	404
7	3	2	2	'2-Int A NW ent ramp'	237	514
8	4	3A	3	'3A-Int A WB RT lane'	51	110
9	5	3B	3	'3B-Int A WB RT lane'	51	110
10	6	4A	4	'4A-Int A SW approach'	214	465
11	7	4B	4	'4B-Int A SW approach'	214	465
12	8	4C	4	'4C-Int A SW approach'	214	465
13	9	5	5	'5-Int A SW queue'	163	355
14	10	6	6	'6-Int A SW departure'	276	600
15	11	7	7	'7-Int A SW connect'	276	600
16	12	8	8	'8-Int A NE approach'	333	724
17	13	9	9	'9-Int A NE queue'	235	511
18	14	10	10	'10-Int A NB LT queue'	98	213
19	15	11	11	'11-Int A WB LT queue'	113	245
20	16	12	12	'12-Int A NB queue'	88	191
21	17	13	13	'13-Int A WB LT appr'	113	245
22	18	14	14	'14-Int A NB approach'	143	311
23	19	15A	15	'15A-Int A SB'	55	120
24	20	15B	15	'15B-Int A SB'	55	120
25	21	15C	15	'15C-Int A SB'	55	120
26	22	15D	15	'15D-Int A SB'	55	120

Link VPHL EFL | Traffic Data wo Transit | MOVES

CAL3QHCR Input File

Data that will change by quarter:

- Record Type 12
  - Hourly emission factor (MOVES results)

CP-2006Q1.inp

```
495  1,0
496  1,186,0.058389
497  2,186,0.058389
498  3,237,0.035454
499  4,51,0.035454
500  5,51,0.035454
501  6,214,0.035454
502  7,214,0.035454
503  8,214,0.035454
504  9,163,0.106570
505  10,276,0.048406
506  11,276,0.035455
507  12,333,0.035455
508  13,235,0.071212
509  14,98,0.106570
510  15,113,0.106570
511  16,88,0.106570
512  17,113,0.035455
513  18,143,0.035454
514  19,55,0.044031
515  20,55,0.044031
516  21,55,0.044031
517  22,55,0.044031
518  23,55,0.044031
519  24,55,0.044031
520  25,55,0.044031
521  26,28,0.044031
```

#12: . . ., . . ., EFL

CAL3QHCR Input File

MOVES emission factors are assigned by hour for a minimum of four different time periods…

- Two representing peak traffic and two representing off-peak traffic

…for each of four calendar quarters

- Quarter 1 shown

	A	B	C	D	G	H	I	J
1								
2					Quarter 1 (1-3) - monthID 1			
3					ON, 1-5; 20-24	AM, 6-9	MD, 10-15	PM, 16-19
4	Link Count	Link #	linkID	20 Character Link Description	hourID 1	hourID 7	hourID 13	hourID 19
5	1	1A	1	'1A-Int A NW ent ramp'	0.058389	0.062437	0.052057	0.052507
6	2	1B	1	'1B-Int A NW ent ramp'	0.058389	0.062437	0.052057	0.052507
7	3	2	2	'2-Int A NW ent ramp'	0.035454	0.038127	0.031275	0.031571
8	4	3A	3	'3A-Int A WB RT lane'	0.035454	0.038127	0.031275	0.031571
9	5	3B	3	'3B-Int A WB RT lane'	0.035454	0.038127	0.031275	0.031571
10	6	4A	4	'4A-Int A SW approach'	0.035454	0.038127	0.031275	0.031571
11	7	4B	4	'4B-Int A SW approach'	0.035454	0.038127	0.031275	0.031571
12	8	4C	4	'4C-Int A SW approach'	0.035454	0.038127	0.031275	0.031571
13	9	5	5	'5-Int A SW queue'	0.106570	0.113156	0.096268	0.096999
14	10	6	6	'6-Int A SW departure'	0.048406	0.051649	0.043336	0.043696
15	11	7	7	'7-Int A SW connect'	0.035455	0.038127	0.031275	0.031571
16	12	8	8	'8-Int A NE approach'	0.035455	0.038127	0.031275	0.031571
17	13	9	9	'9-Int A NE queue'	0.071212	0.109886	0.063679	0.094093
18	14	10	10	'10-Int A NB LT queue'	0.106570	0.113156	0.096267	0.096999
19	15	11	11	'11-Int A WB LT queue'	0.106570	0.113156	0.096268	0.096999
20	16	12	12	'12-Int A NB queue'	0.106570	0.113156	0.096267	0.096999
21	17	13	13	'13-Int A WB LT appr'	0.035455	0.038127	0.031275	0.031572
22	18	14	14	'14-Int A NB approach'	0.035454	0.038127	0.031275	0.031571
23	19	15A	15	'15A-Int A SB'	0.044031	0.047042	0.039322	0.039657
24	20	15B	15	'15B-Int A SB'	0.044031	0.047042	0.039322	0.039657
25	21	15C	15	'15C-Int A SB'	0.044031	0.047042	0.039322	0.039657
26	22	15D	15	'15D-Int A SB'	0.044031	0.047042	0.039322	0.039657
27	23	15E	15	'15E-Int A SB'	0.044031	0.047042	0.039322	0.039657
28	24	16A	16	'16A-Int A SB'	0.044031	0.047041	0.039322	0.039657
29	25	16B	16	'16B-Int A SB'	0.044031	0.047041	0.039322	0.039657
30	26	17A	17	'17A-Int A NB'	0.044031	0.047042	0.039322	0.039657
31	27	17B	17	'17B-Int A NB'	0.044031	0.047042	0.039322	0.039657

Link VPHL EFL | Traffic Data wo Transit | MOVESOutput | Receptor Co

CAL3QHCR Input File

MOVES emission factors are assigned by hour for a minimum of four different time periods…

- Two representing peak traffic and two representing off-peak traffic

…for each of four calendar quarters

- Quarter 2 shown

	A	B	C	D	K	L	M	N
1								
2					Quarter 2 (4-6) - monthID 4			
3					ON, 1-5; 20-24	AM, 6-9	MD, 10-15	PM, 16-19
4	Link Count	Link #	linkID	20 Character Link Description	hourID 1	hourID 7	hourID 13	hourID 19
5	1	1A	1	'1A-Int A NW ent ramp'	0.041306	0.044158	0.035375	0.035125
6	2	1B	1	'1B-Int A NW ent ramp'	0.041306	0.044158	0.035375	0.035125
7	3	2	2	'2-Int A NW ent ramp'	0.024177	0.026060	0.020262	0.020097
8	4	3A	3	'3A-Int A WB RT lane'	0.024177	0.026060	0.020262	0.020097
9	5	3B	3	'3B-Int A WB RT lane'	0.024177	0.026060	0.020262	0.020097
10	6	4A	4	'4A-Int A SW approach'	0.024177	0.026060	0.020262	0.020097
11	7	4B	4	'4B-Int A SW approach'	0.024177	0.026060	0.020262	0.020097
12	8	4C	4	'4C-Int A SW approach'	0.024177	0.026060	0.020262	0.020097
13	9	5	5	'5-Int A SW queue'	0.078774	0.083416	0.069125	0.068717
14	10	6	6	'6-Int A SW departure'	0.034725	0.037010	0.029976	0.029775
15	11	7	7	'7-Int A SW connect'	0.024177	0.026060	0.020262	0.020097
16	12	8	8	'8-Int A NE approach'	0.024177	0.026060	0.020262	0.020097
17	13	9	9	'9-Int A NE queue'	0.050887	0.080816	0.043831	0.066448
18	14	10	10	'10-Int A NB LT queue'	0.078774	0.083416	0.069125	0.068717
19	15	11	11	'11-Int A WB LT queue'	0.078774	0.083416	0.069125	0.068717
20	16	12	12	'12-Int A NB queue'	0.078774	0.083416	0.069125	0.068717
21	17	13	13	'13-Int A WB LT appr'	0.024177	0.026060	0.020262	0.020097
22	18	14	14	'14-Int A NB approach'	0.024177	0.026060	0.020262	0.020097
23	19	15A	15	'15A-Int A SB'	0.031327	0.033448	0.026916	0.026730
24	20	15B	15	'15B-Int A SB'	0.031327	0.033448	0.026916	0.026730
25	21	15C	15	'15C-Int A SB'	0.031327	0.033448	0.026916	0.026730
26	22	15D	15	'15D-Int A SB'	0.031327	0.033448	0.026916	0.026730
27	23	15E	15	'15E-Int A SB'	0.031327	0.033448	0.026916	0.026730
28	24	16A	16	'16A-Int A SB'	0.031326	0.033448	0.026916	0.026730
29	25	16B	16	'16B-Int A SB'	0.031326	0.033448	0.026916	0.026730
30	26	17A	17	'17A-Int A NB'	0.031327	0.033448	0.026916	0.026730
31	27	17B	17	'17B-Int A NB'	0.031327	0.033448	0.026916	0.026730

Link VPHL EFL | Traffic Data wo Transit | MOVESOutput | Receptor Co

CAL3QHCR Input File

MOVES emission factors are assigned by hour for a minimum of four different time periods…

- Two representing peak traffic and two representing off-peak traffic

…for each of four calendar quarters

- Quarter 3 shown

	A	B	C	D	O	P	Q	R
1								
2					Quarter 3 (7-9) - monthID 7			
3					ON, 1-5; 20-24	AM, 6-9	MD, 10-15	PM, 16-19
4	Link Count	Link #	linkID	20 Character Link Description	hourID 1	hourID 7	hourID 13	hourID 19
5	1	1A	1	'1A-Int A NW ent ramp'	0.031894	0.033165	0.030592	0.030592
6	2	1B	1	'1B-Int A NW ent ramp'	0.031894	0.033165	0.030592	0.030592
7	3	2	2	'2-Int A NW ent ramp'	0.017964	0.018803	0.017104	0.017104
8	4	3A	3	'3A-Int A WB RT lane'	0.017964	0.018803	0.017104	0.017104
9	5	3B	3	'3B-Int A WB RT lane'	0.017964	0.018803	0.017104	0.017104
10	6	4A	4	'4A-Int A SW approach'	0.017964	0.018803	0.017104	0.017104
11	7	4B	4	'4B-Int A SW approach'	0.017964	0.018803	0.017104	0.017104
12	8	4C	4	'4C-Int A SW approach'	0.017964	0.018803	0.017104	0.017104
13	9	5	5	'5-Int A SW queue'	0.063460	0.065529	0.061347	0.061348
14	10	6	6	'6-Int A SW departure'	0.027187	0.028206	0.026145	0.026145
15	11	7	7	'7-Int A SW connect'	0.017964	0.018803	0.017104	0.017104
16	12	8	8	'8-Int A NE approach'	0.017964	0.018803	0.017104	0.017104
17	13	9	9	'9-Int A NE queue'	0.039689	0.063332	0.038141	0.059245
18	14	10	10	'10-Int A NB LT queue'	0.063460	0.065529	0.061347	0.061348
19	15	11	11	'11-Int A WB LT queue'	0.063460	0.065529	0.061347	0.061348
20	16	12	12	'12-Int A NB queue'	0.063460	0.065529	0.061347	0.061348
21	17	13	13	'13-Int A WB LT appr'	0.017964	0.018803	0.017104	0.017104
22	18	14	14	'14-Int A NB approach'	0.017964	0.018803	0.017104	0.017104
23	19	15A	15	'15A-Int A SB'	0.024327	0.025273	0.023359	0.023359
24	20	15B	15	'15B-Int A SB'	0.024327	0.025273	0.023359	0.023359
25	21	15C	15	'15C-Int A SB'	0.024327	0.025273	0.023359	0.023359
26	22	15D	15	'15D-Int A SB'	0.024327	0.025273	0.023359	0.023359
27	23	15E	15	'15E-Int A SB'	0.024327	0.025273	0.023359	0.023359
28	24	16A	16	'16A-Int A SB'	0.024327	0.025273	0.023359	0.023359
29	25	16B	16	'16B-Int A SB'	0.024327	0.025273	0.023359	0.023359
30	26	17A	17	'17A-Int A NB'	0.024327	0.025273	0.023359	0.023359
31	27	17B	17	'17B-Int A NB'	0.024327	0.025273	0.023359	0.023359

Link VPHL EFL | Traffic Data wo Transit | MOVESOutput | Receptor Co

CAL3QHCR Input File

MOVES emission factors are assigned by hour for a minimum of four different time periods…

- Two representing peak traffic and two representing off-peak traffic

…for each of four calendar quarters

- Quarter 4 shown

	A	B	C	D	S	T	U	V
1								
2					Quarter 4 (10-12) - monthID 10			
3					ON, 1-5; 20-24	AM, 6-9	MD, 10-15	PM, 16-19
4	Link Count	Link #	linkID	20 Character Link Description	hourID 1	hourID 7	hourID 13	hourID 19
5	1	1A	1	'1A-Int A NW ent ramp'	0.039239	0.041471	0.034178	0.035125
6	2	1B	1	'1B-Int A NW ent ramp'	0.039239	0.041471	0.034178	0.035125
7	3	2	2	'2-Int A NW ent ramp'	0.022813	0.024286	0.019471	0.020097
8	4	3A	3	'3A-Int A WB RT lane'	0.022813	0.024286	0.019472	0.020097
9	5	3B	3	'3B-Int A WB RT lane'	0.022813	0.024286	0.019472	0.020097
10	6	4A	4	'4A-Int A SW approach'	0.022813	0.024286	0.019471	0.020097
11	7	4B	4	'4B-Int A SW approach'	0.022813	0.024286	0.019471	0.020097
12	8	4C	4	'4C-Int A SW approach'	0.022813	0.024286	0.019471	0.020097
13	9	5	5	'5-Int A SW queue'	0.075412	0.079044	0.067176	0.068717
14	10	6	6	'6-Int A SW departure'	0.033070	0.034858	0.029016	0.029775
15	11	7	7	'7-Int A SW connect'	0.022813	0.024286	0.019471	0.020097
16	12	8	8	'8-Int A NE approach'	0.022813	0.024286	0.019472	0.020097
17	13	9	9	'9-Int A NE queue'	0.048429	0.076542	0.042407	0.066448
18	14	10	10	'10-Int A NB LT queue'	0.075412	0.079044	0.067176	0.068717
19	15	11	11	'11-Int A WB LT queue'	0.075412	0.079044	0.067176	0.068717
20	16	12	12	'12-Int A NB queue'	0.075412	0.079044	0.067176	0.068717
21	17	13	13	'13-Int A WB LT appr'	0.022813	0.024287	0.019472	0.020097
22	18	14	14	'14-Int A NB approach'	0.022813	0.024287	0.019472	0.020097
23	19	15A	15	'15A-Int A SB'	0.029790	0.031450	0.026026	0.026730
24	20	15B	15	'15B-Int A SB'	0.029790	0.031450	0.026026	0.026730
25	21	15C	15	'15C-Int A SB'	0.029790	0.031450	0.026026	0.026730
26	22	15D	15	'15D-Int A SB'	0.029790	0.031450	0.026026	0.026730
27	23	15E	15	'15E-Int A SB'	0.029790	0.031450	0.026026	0.026730
28	24	16A	16	'16A-Int A SB'	0.029790	0.031450	0.026026	0.026730
29	25	16B	16	'16B-Int A SB'	0.029790	0.031450	0.026026	0.026730
30	26	17A	17	'17A-Int A NB'	0.029790	0.031450	0.026026	0.026730
31	27	17B	17	'17B-Int A NB'	0.029790	0.031450	0.026026	0.026730

Link VPHL EFL | Traffic Data wo Transit | MOVESOutput | Receptor Co

CAL3QHCR Input File

Data that will change by quarter and year:

- Record Type 2
  - Processing start date
  - Processing end date

CP-2006Q1.inp

```
1  'CAL3QHCR Class Project',60,175,0,0,321,0.3048,1
2  01,01,06,03,31,06
3  13994,06,4833,06
4  0,0,'U'
5  1,29.5,698.2,5.0
6  2,193.6,698.2,5.0
7  3,357.6,698.2,5.0
8  4,521.7,698.2,5.0
9  5,685.7,698.2,5.0
10 6,849.7,698.2,5.0
11 7,29.5,862.2,5.0
12 8,193.6,862.2,5.0
13 9,357.6,862.2,5.0
14 10,521.7,862.2,5.0
15 11,29.5,1026.2,5.0
16 12,193.6,1026.2,5.0
17 13,357.6,1026.2,5.0
18 14,521.7,1026.2,5.0
19 15,29.5,1190.3,5.0
20 16,193.6,1190.3,5.0
21 17,357.6,1190.3,5.0
22 18,521.7,1190.3,5.0
23 19,29.5,1354.3,5.0
24 20,193.6,1354.3,5.0
25 21,357.6,1354.3,5.0
26 22,521.7,1354.3,5.0
27 23,29.5,1518.4,5.0
```

#2: START, END

CAL3QHCR Input File

Data that will change by year:

- Record Type 3
  - Surface met data year
  - Upper air met data year

CP-2006Q1.inp

```
1  'CAL3QHCR Class Project',60,175,0,0,321,0.3048,1
2  01,01,06,03,31,06
3  13994,06,4833,06
4  0,0,'U'
5  1,29.5,698.2,5.0
6  2,193.6,698.2,5.0
7  3,357.6,698.2,5.0
8  4,521.7,698.2,5.0
9  5,685.7,698.2,5.0
10 6,849.7,698.2,5.0
11 7,29.5,862.2,5.0
12 8,193.6,862.2,5.0
13 9,357.6,862.2,5.0
14 10,521.7,862.2,5.0
15 11,29.5,1026.2,5.0
16 12,193.6,1026.2,5.0
17 13,357.6,1026.2,5.0
18 14,521.7,1026.2,5.0
19 15,29.5,1190.3,5.0
20 16,193.6,1190.3,5.0
21 17,357.6,1190.3,5.0
22 18,521.7,1190.3,5.0
23 19,29.5,1354.3,5.0
24 20,193.6,1354.3,5.0
25 21,357.6,1354.3,5.0
26 22,521.7,1354.3,5.0
27 23,29.5,1518.4,5.0
```

#3: . . ., METSYR, . . ., METUYR

Executing CAL3QHCR

- 20 Input Data Files
  - » 4 per year, i.e., quarterly files:
    - – CP-2006Q1.inp
    - – CP-2006Q2.inp
    - – CP-2006Q3.inp
    - – CP-2006Q4.inp
  - » Pattern repeated for years 2006 – 2010
    - – Only the year designation changes in the files

CP-2006Q1.inp

```
1  'CAL3QHCR Class Project',60,175,0,0,321,0.3048,1
2  01,01,06,03,31,06      #2:  START, END
3  13994,06,4833,06       #3:  . . ., METSYR, . . ., METUYR
4  0,0,'U'
```

Executing CAL3QHCR

- 20 input data files:
  - CP-2006Q1.inp
  - CP-2006Q2.inp
  - CP-2006Q3.inp
  - CP-2006Q4.inp
  - CP-2007Q1.inp
  - CP-2007Q2.inp
  - CP-2007Q3.inp
  - CP-2007Q4.inp
  - CP-2008Q1.inp
  - CP-2008Q2.inp
  - CP-2008Q3.inp
  - CP-2008Q4.inp
  - CP-2009Q1.inp
  - CP-2009Q2.inp
  - CP-2009Q3.inp
  - CP-2009Q4.inp
  - CP-2010Q1.inp
  - CP-2010Q2.inp
  - CP-2010Q3.inp
  - CP-2010Q4.inp

Executing CAL3QHCR

- 20 control files are needed to manage the files accessed by CAL3QHCR:
  - CP-2006Q1.ctl
  - CP-2006Q2.ctl
  - CP-2006Q3.ctl
  - CP-2006Q4.ctl
  - CP-2007Q1.ctl
  - CP-2007Q2.ctl
  - CP-2007Q3.ctl
  - CP-2007Q4.ctl
  - CP-2008Q1.ctl
  - CP-2008Q2.ctl
  - CP-2008Q3.ctl
  - CP-2008Q4.ctl
  - CP-2009Q1.ctl
  - CP-2009Q2.ctl
  - CP-2009Q3.ctl
  - CP-2009Q4.ctl
  - CP-2010Q1.ctl
  - CP-2010Q2.ctl
  - CP-2010Q3.ctl
  - CP-2010Q4.ctl

Executing CAL3QHCR

- Batch files can be used to implement the control files by CAL3QHCR
  - » 1 per year was used for the Example Analysis:
    - CP-2006.bat
    - CP-2007.bat
    - CP-2008.bat
    - CP-2009.bat
    - CP-2010.bat

CP-2006.bat

```
1  copy CP-2006Q1.ctl CAL3R.ctl
2  CAL3QHCR
3  copy CP-2006Q2.ctl CAL3R.ctl
4  CAL3QHCR
5  copy CP-2006Q3.ctl CAL3R.ctl
6  CAL3QHCR
7  copy CP-2006Q4.ctl CAL3R.ctl
8  CAL3QHCR
```

Executing CAL3QHCR

- 20 output files are created containing the CAL3QHCR results:
  - CP-2006Q1.out
  - CP-2006Q2.out
  - CP-2006Q3.out
  - CP-2006Q4.out
  - CP-2007Q1.out
  - CP-2007Q2.out
  - CP-2007Q3.out
  - CP-2007Q4.out
  - CP-2008Q1.out
  - CP-2008Q2.out
  - CP-2008Q3.out
  - CP-2008Q4.out
  - CP-2009Q1.out
  - CP-2009Q2.out
  - CP-2009Q3.out
  - CP-2009Q4.out
  - CP-2010Q1.out
  - CP-2010Q2.out
  - CP-2010Q3.out
  - CP-2010Q4.out

Executing CAL3QHCR

- 20 plot files are created containing the CAL3QHCR results:
  - CP-2006Q1.plt
  - CP-2006Q2.plt
  - CP-2006Q3.plt
  - CP-2006Q4.plt
  - CP-2007Q1.plt
  - CP-2007Q2.plt
  - CP-2007Q3.plt
  - CP-2007Q4.plt
  - CP-2008Q1.plt
  - CP-2008Q2.plt
  - CP-2008Q3.plt
  - CP-2008Q4.plt
  - CP-2009Q1.plt
  - CP-2009Q2.plt
  - CP-2009Q3.plt
  - CP-2009Q4.plt
  - CP-2010Q1.plt
  - CP-2010Q2.plt
  - CP-2010Q3.plt
  - CP-2010Q4.plt

End of Module 5

Questions?