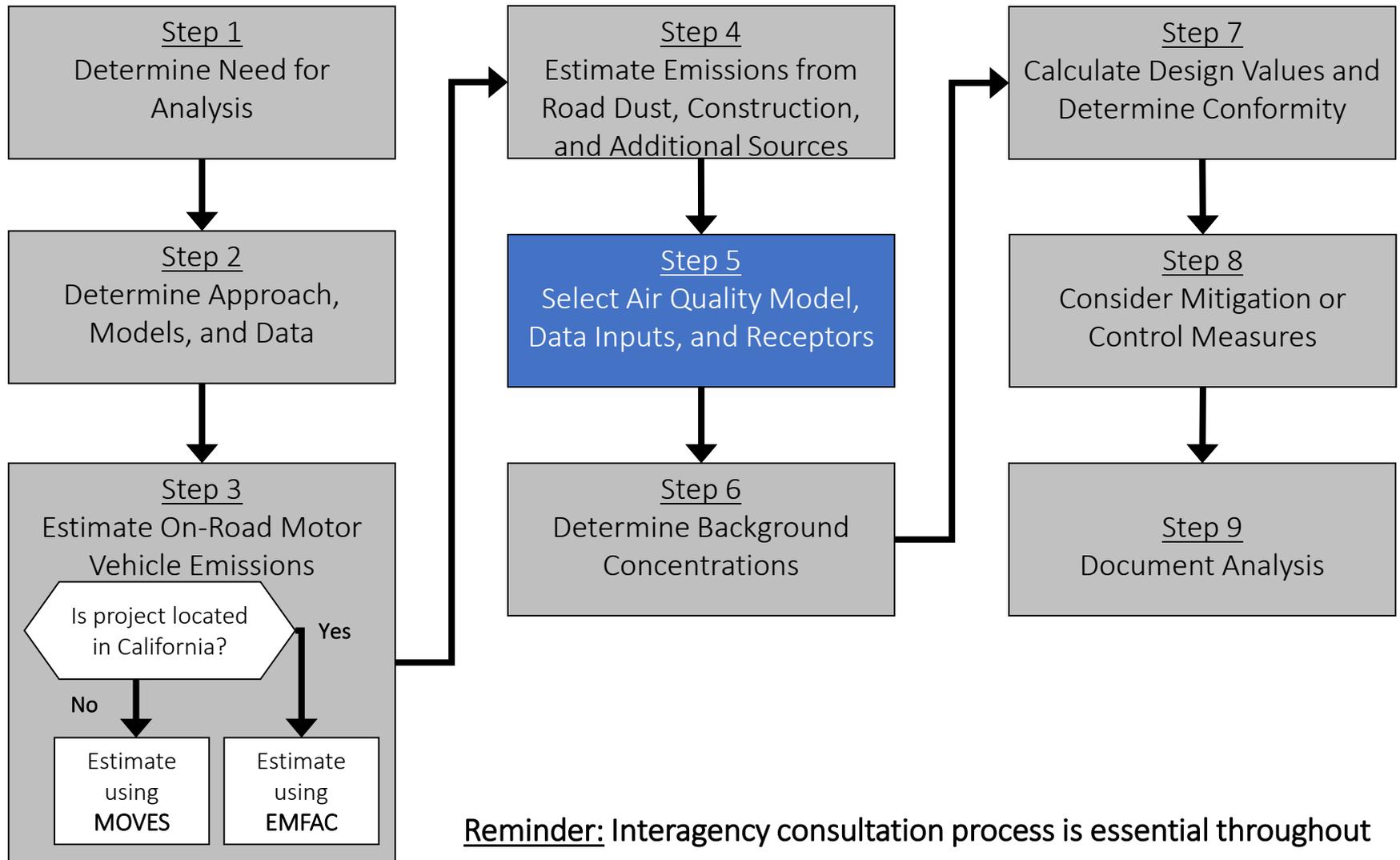


Module 5

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
- [CAL3QHCR User's Guide](#) (Addendum to the User's Guide to CAL3QHC Version 2.0)
- 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 and Long-Term
Pollutant Applicability:	Inert Pollutants
Regulatory Applicability:	Highways
Level of Sophistication:	Gaussian
Mathematical Class:	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

CAL3QHCR Resources



<https://www.epa.gov/scram/air-quality-dispersion-modeling>

Environmental Topics

Laws & Regulations

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Support Center for Regulatory Atmospheric Modeling (SCRAM)

SCRAM Home

Air Quality Models

Model Applications and Tools

Modeling Guidance and Support

Meteorological Data and Processors

Conferences and Workshops

Reports and Journal Articles

Related Links

Air Quality Dispersion Modeling

Dispersion modeling uses mathematical formulations to characterize the atmospheric processes that disperse a pollutant emitted by a source. Based on emissions and [meteorological inputs](#), a dispersion model can be used to predict concentrations at selected downwind receptor locations. These air quality models are used to determine compliance with National Ambient Air Quality Standards (NAAQS), and other regulatory requirements such as New Source Review (NSR) and Prevention of Significant Deterioration (PSD) regulations. These models are addressed in Appendix A of EPA's *Guideline on Air Quality Models* (also published as [Appendix W \(PDF\)](#) of 40 CFR Part 51), which was originally published in April 1978 to provide consistency and equity in the use of modeling within the U.S. air quality management system. These guidelines are periodically revised to ensure that new model developments or expanded regulatory requirements are incorporated.

This site provides links for dispersion models and other related tools and information as follows:

Preferred/Recommended Models - Refined air quality models that are currently listed in [Appendix W \(PDF\)](#) (45 pp, 803 K, [About PDF](#)) and are required to be used for State Implementation Plan (SIP) revisions for existing sources and NSR and PSD programs.



CAL3QHCR Resources

<https://www.epa.gov/scram/air-quality-dispersion-modeling-preferred-and-recommended-models>

Support Center for Regulatory Atmospheric Modeling (SCRAM)

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SCRAM Home

Air Quality Models

Model Applications and Tools

Modeling Guidance and Support

Meteorological Data and Processors

Conferences and Workshops

Reports and Journal Articles

Related Links

Air Quality Dispersion Modeling - Preferred and Recommended Models

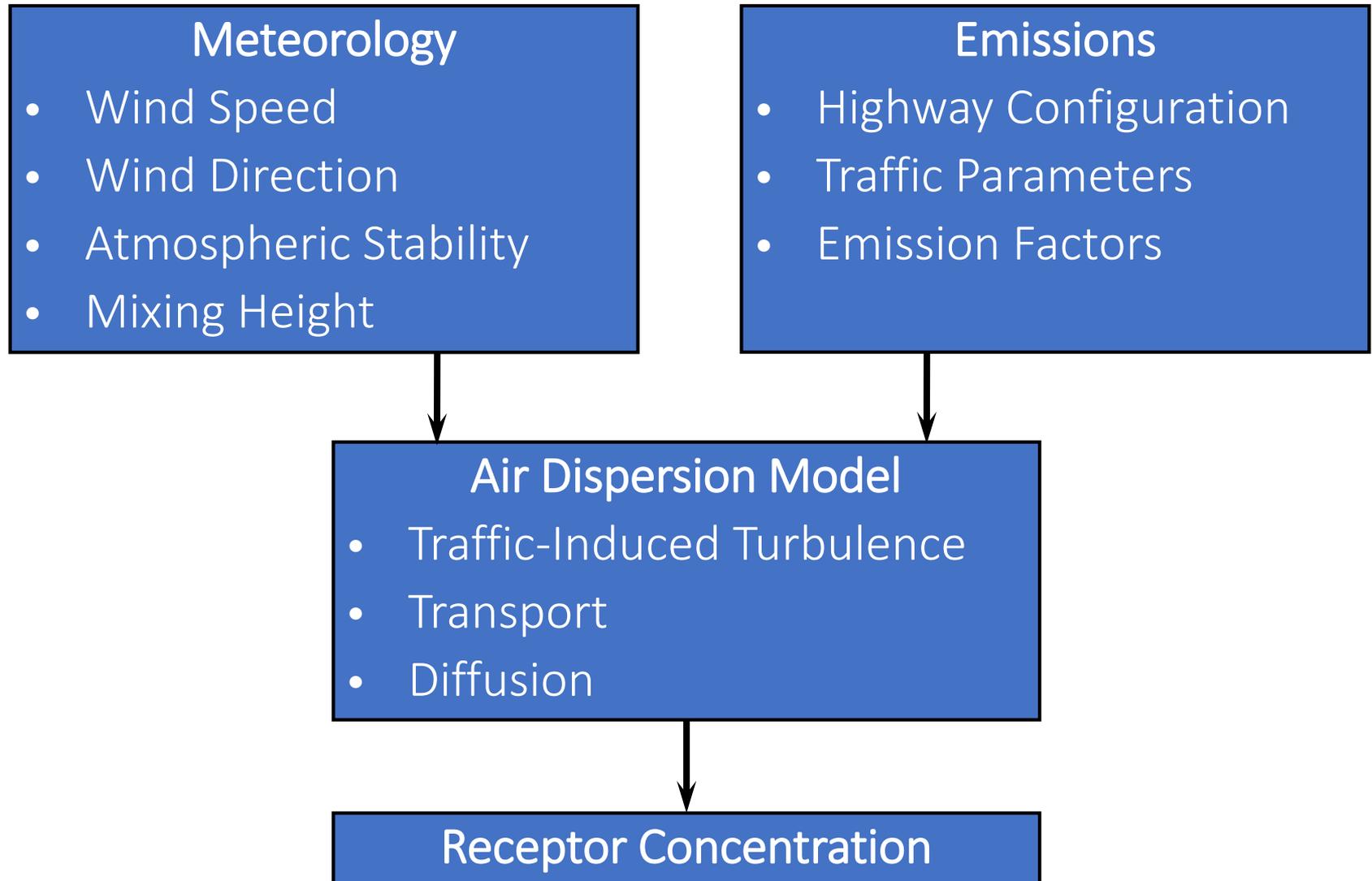
These refined dispersion models are listed in [Appendix W \(PDF\)](#) (45 pp, 803 K, [About PDF](#)) and are required to be used for State Implementation Plan (SIP) revisions for existing sources and for New Source Review (NSR) and Prevention of Significant Deterioration (PSD) programs. The models in this section include the following:

[AERMOD Modeling System](#) - A steady-state plume model that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain.

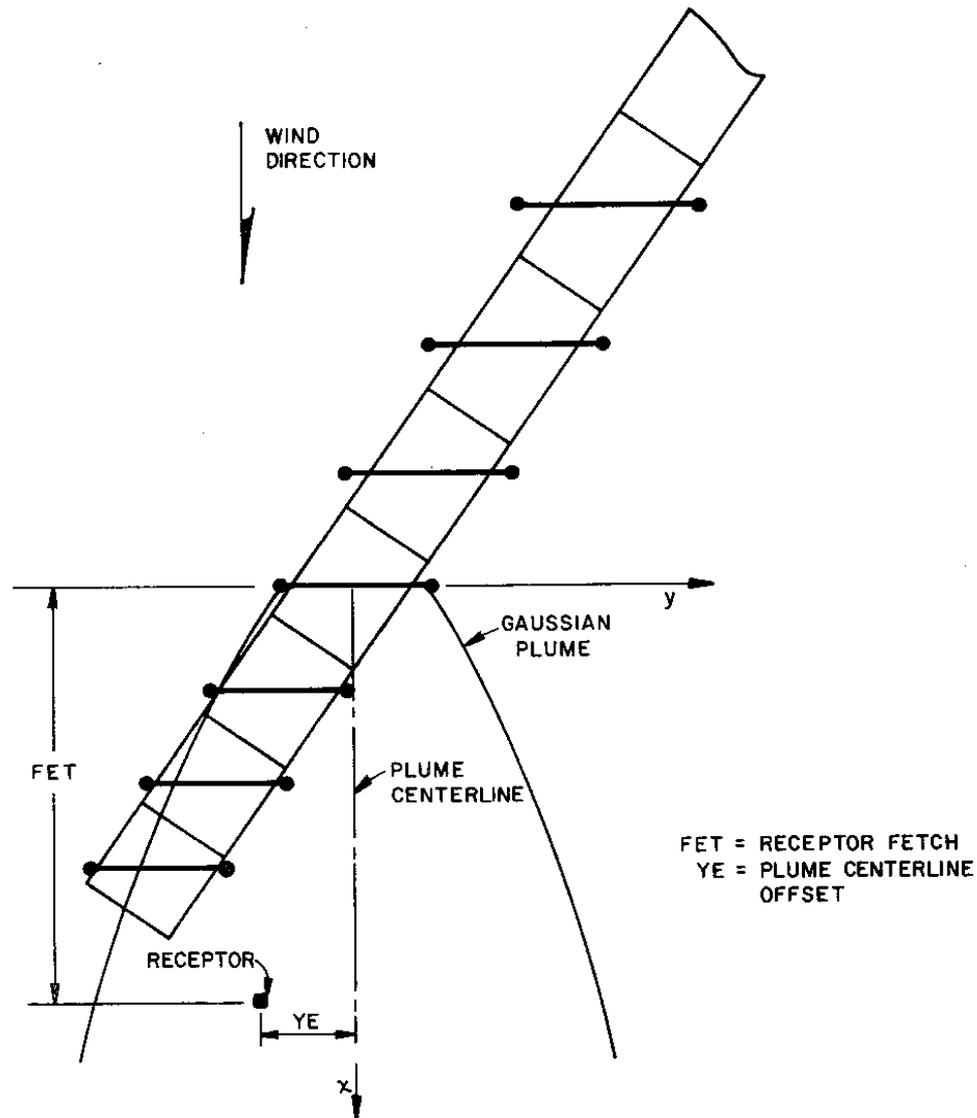
[CALPUFF Modeling System](#) - A non-steady-state puff dispersion model that simulates the effects of time- and space-varying meteorological conditions on pollution transport, transformation, and removal. CALPUFF can be applied for long-range transport and for complex terrain.

[Other Models](#) - Other dispersion models including [BLP](#), [CALINE3](#), [CAL3QHC/CAL3QHCR](#), [CTDMPLUS](#), and [OCD](#).

Air Dispersion Model Conception

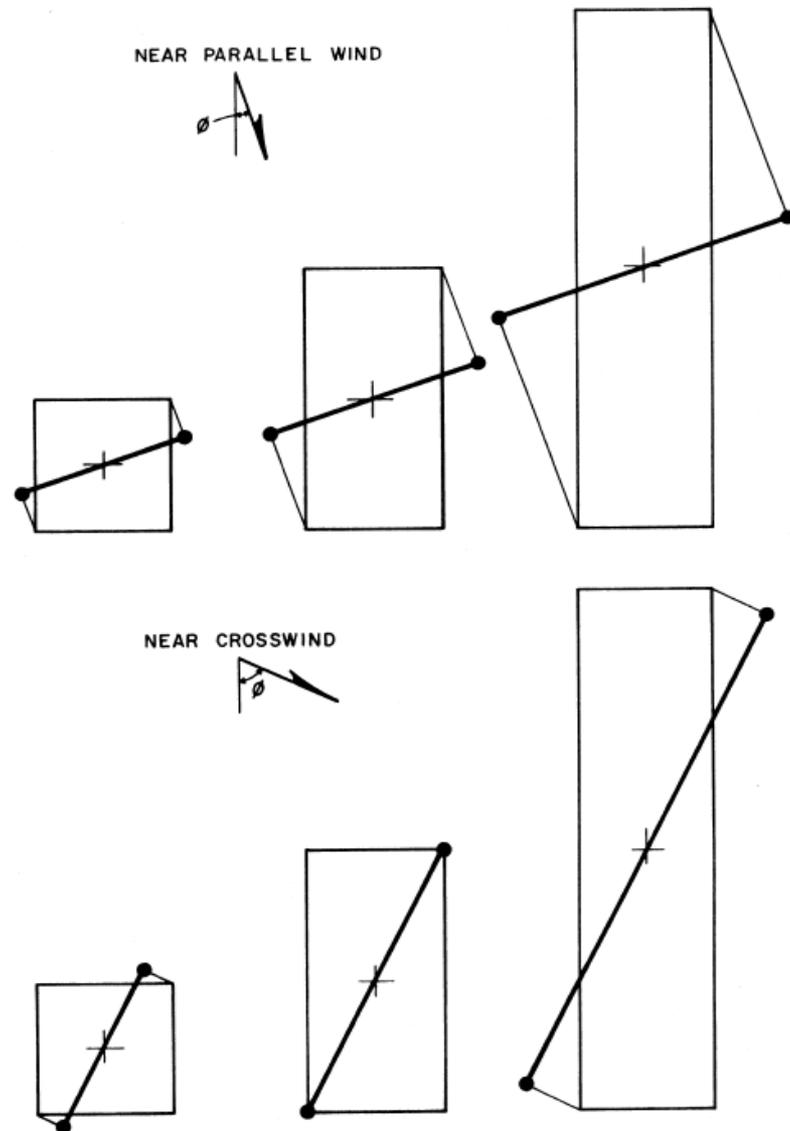


Plume Dispersion in CAL3QHCR



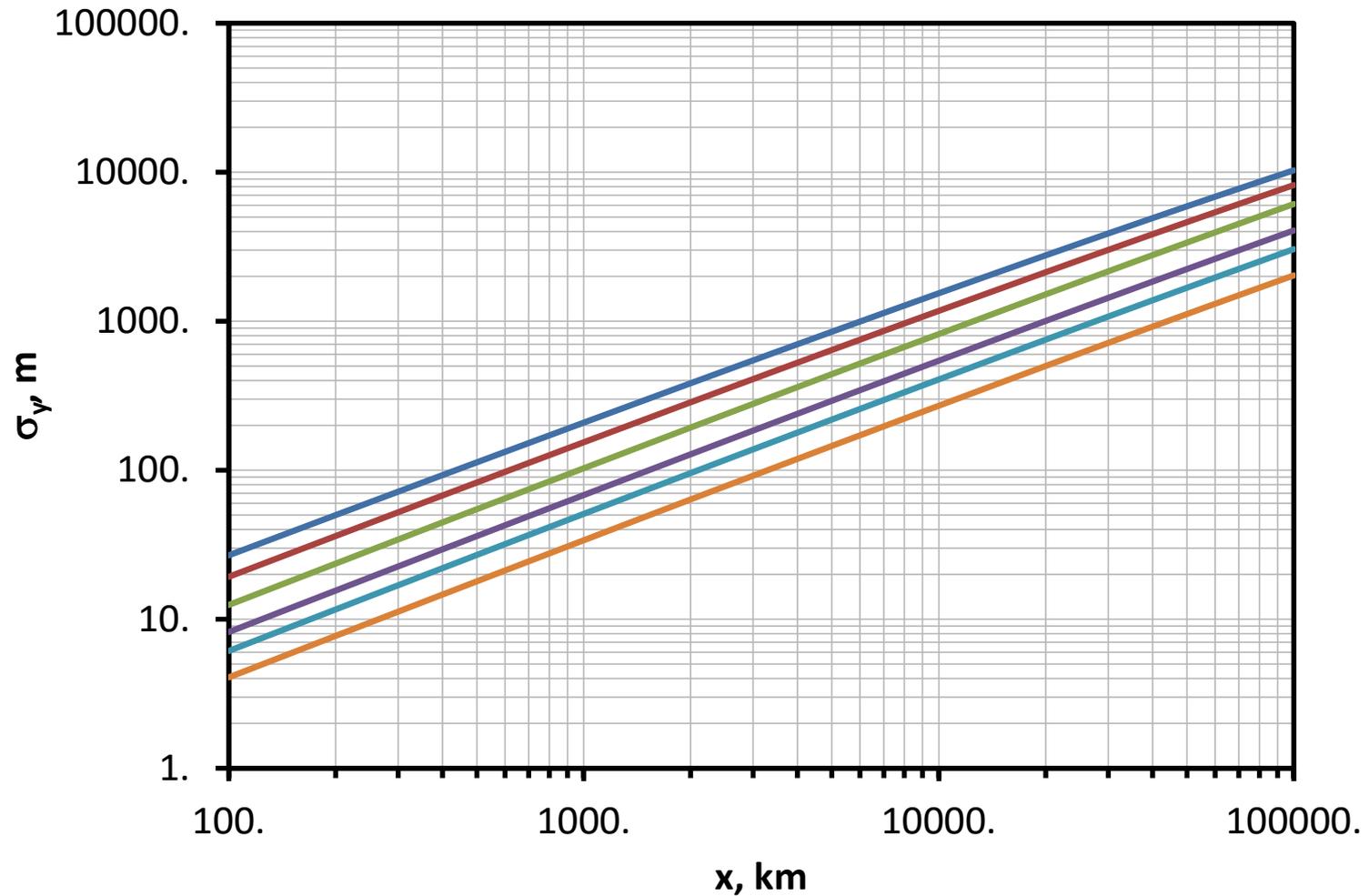
from Benson, 1979

Plume Width by Wind Angle



from Benson, 1979

Horizontal Dispersion Parameter

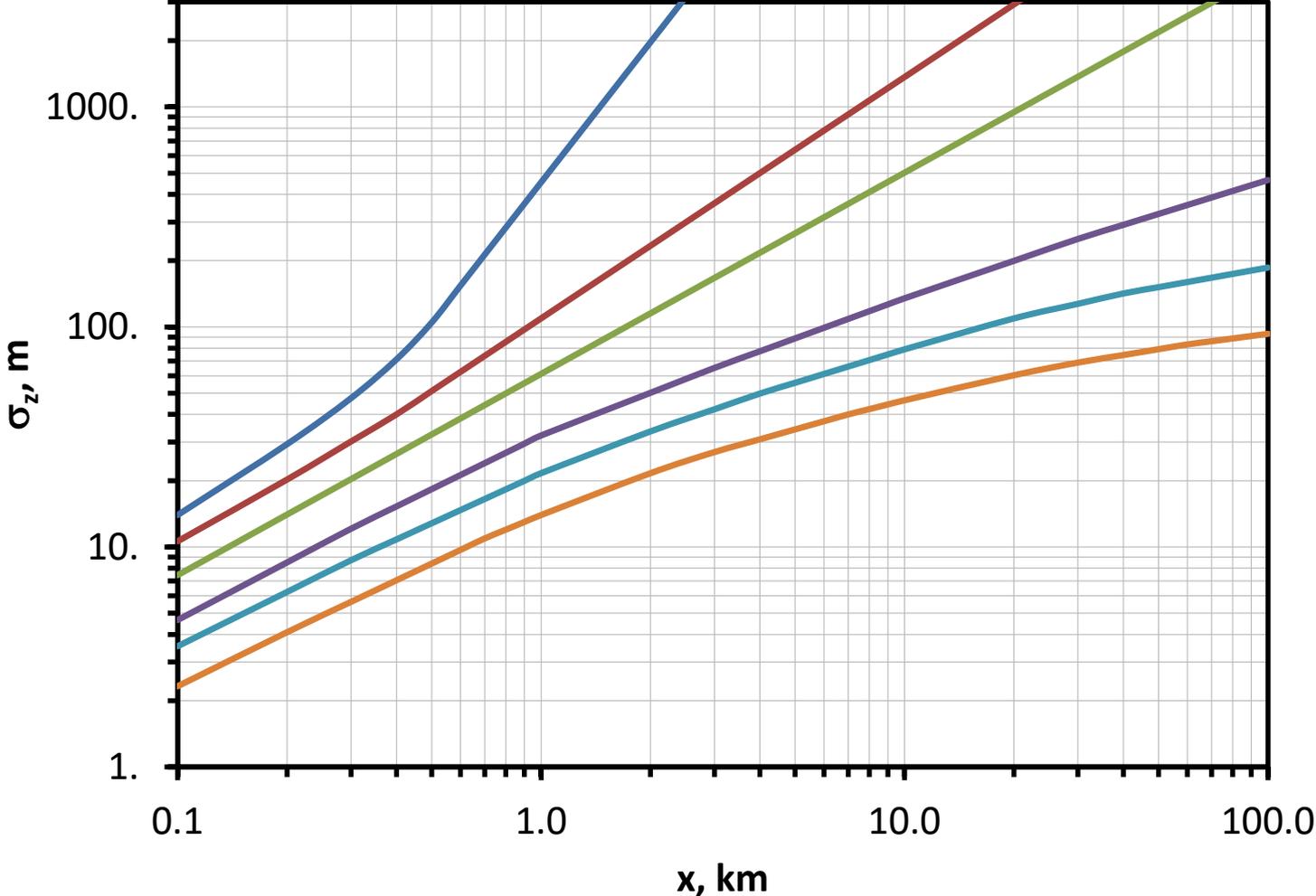


Stability Class: — A — B — C — D — E — F

adapted from Slade, 1968



Vertical Dispersion Parameter

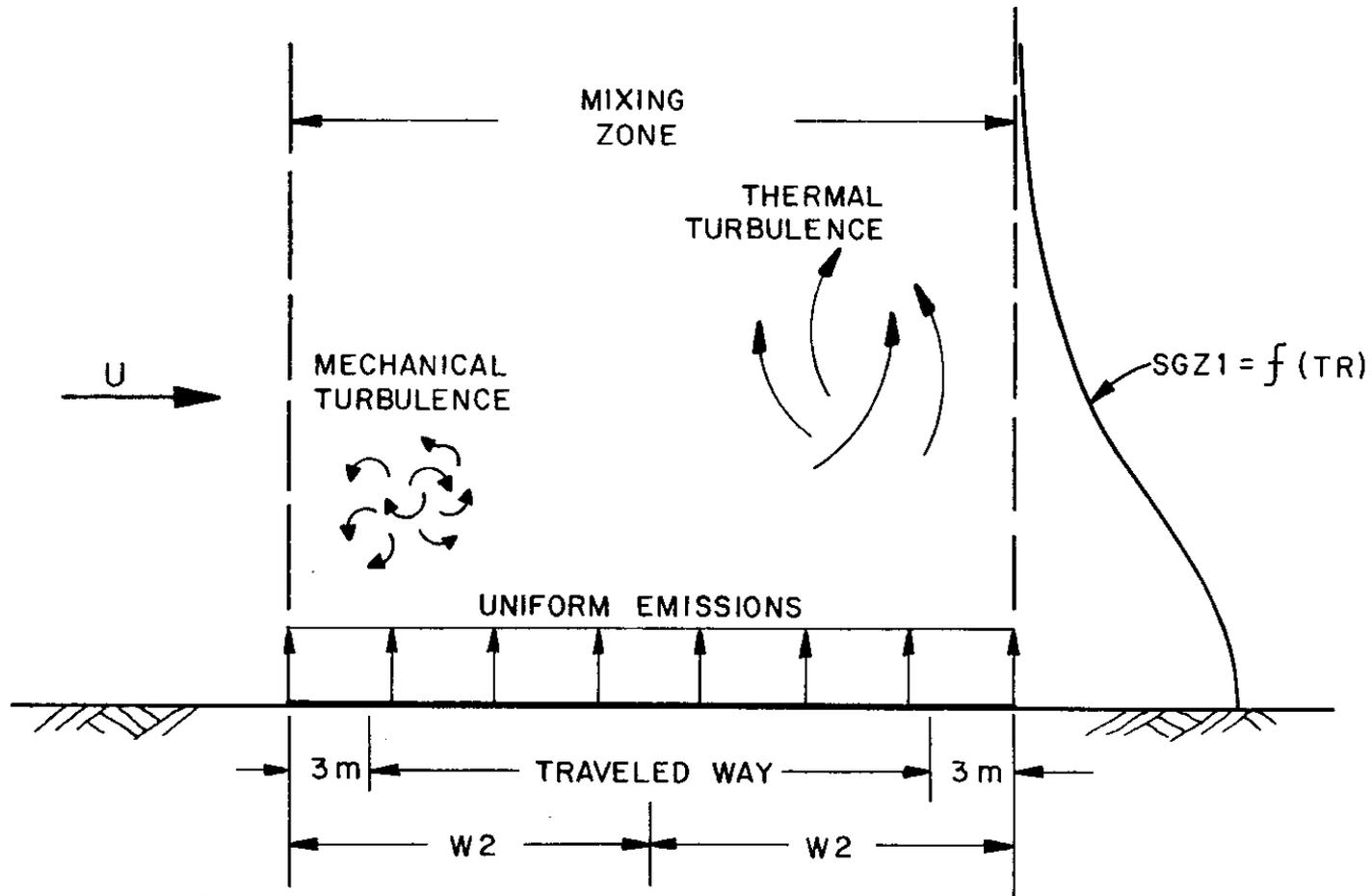


adapted from Slade, 1968

Stability Class: — A — B — C — D — E — F



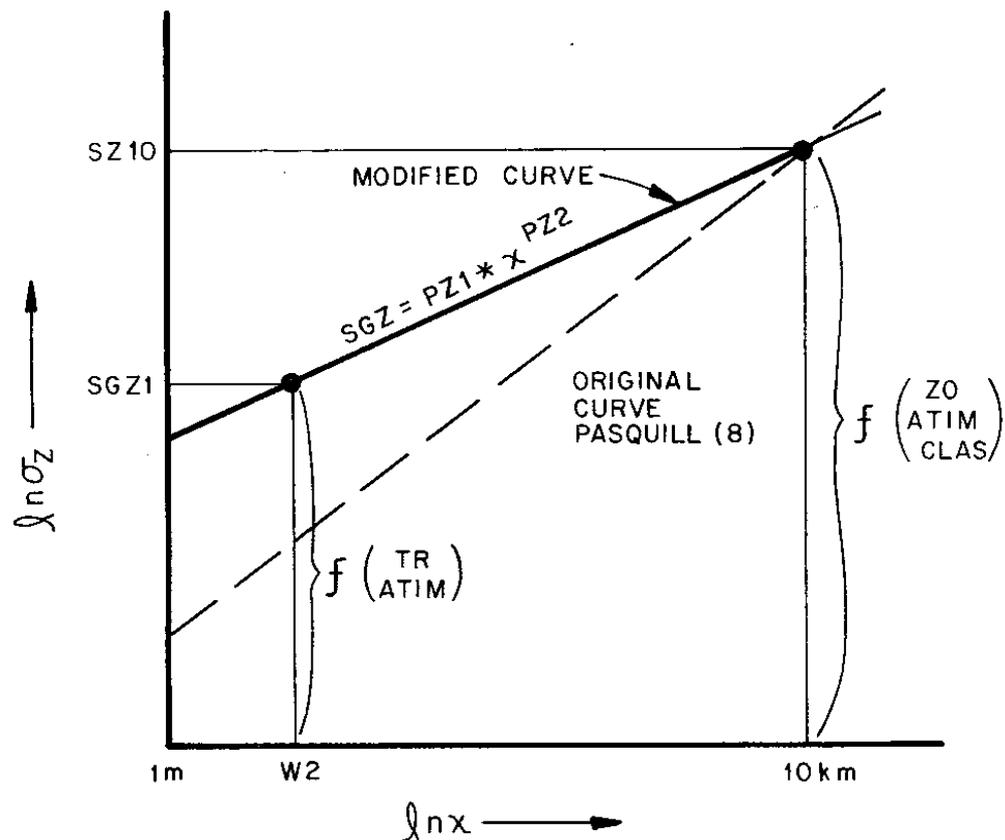
Uniform Mixing Zone



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

from Benson, 1979

Vertical Dispersion Parameter



- ZO = AERODYNAMIC ROUGHNESS
- ATIM = AVERAGING TIME
- CLAS = STABILITY CLASS
- TR = MIXING ZONE RESIDENCE TIME
- x = 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

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

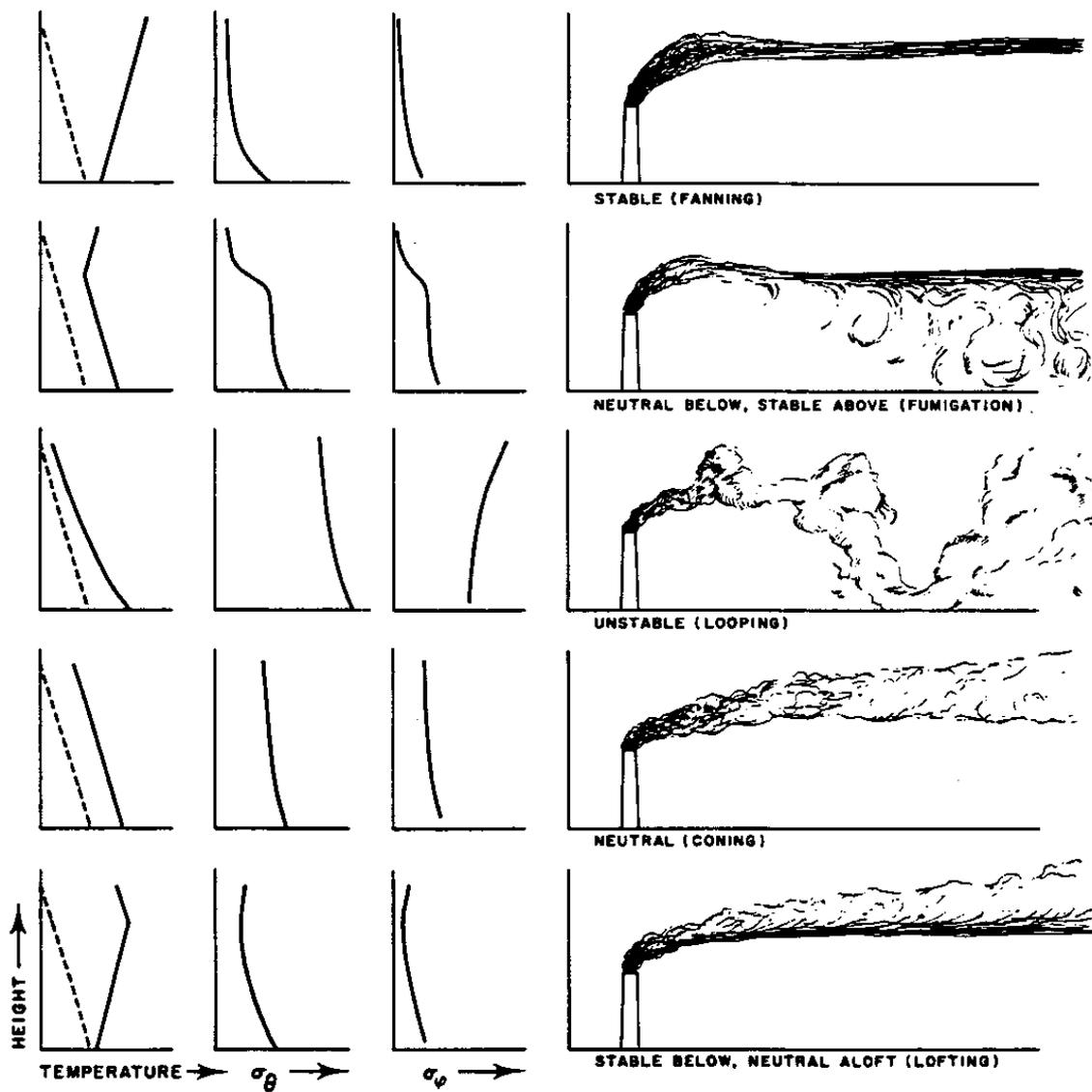
where $SGZ1_{ATIM}$ is the vertical dispersion parameter at the edge of the mixing zone for a specified averaging time of ATIM

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

D: Neutral

B: Moderately Unstable

E: Slightly Stable

C: Slightly Unstable

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

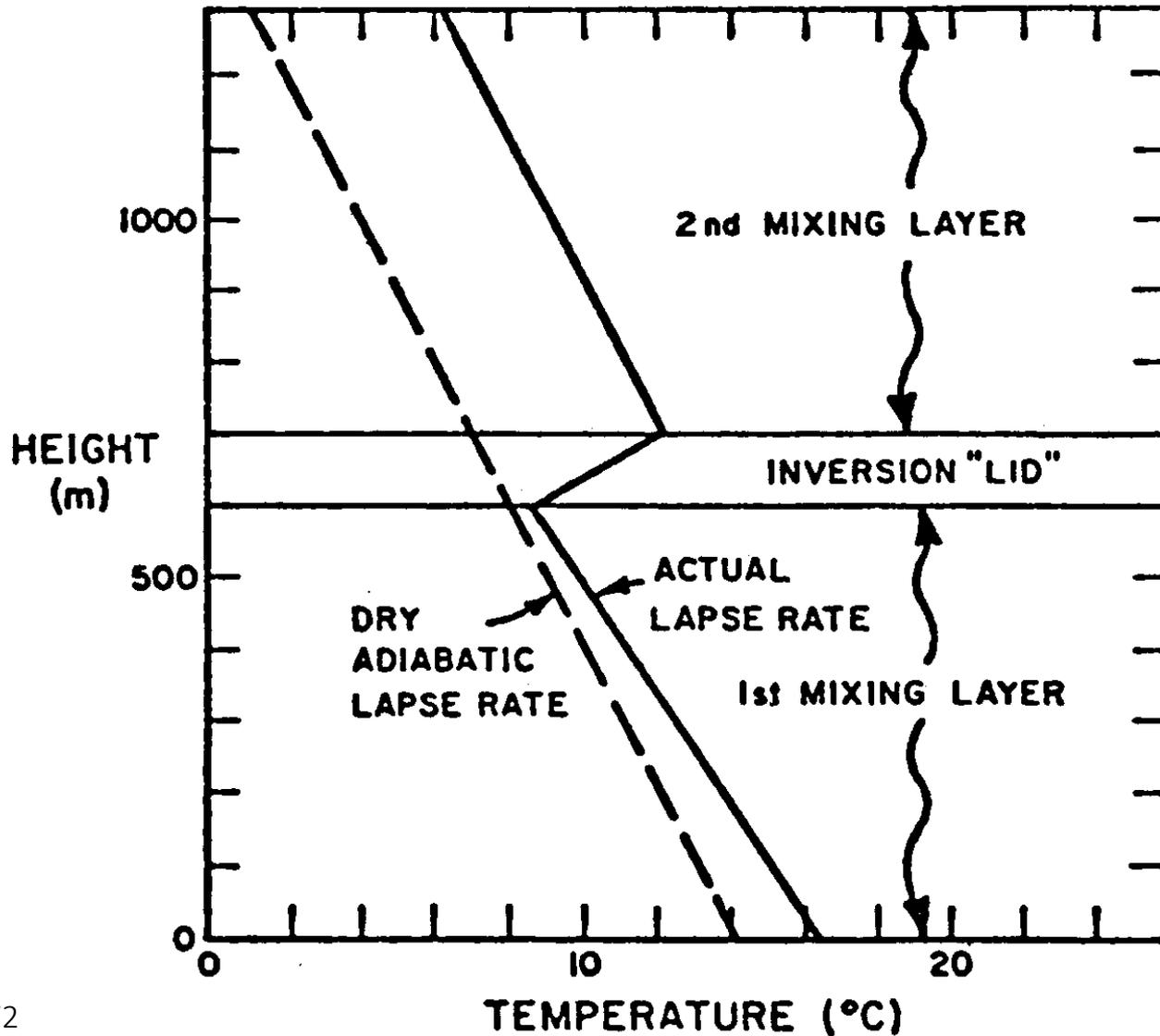
- Night: 1 hour before sunset to 1 hour after sunrise
- D stability should be used (regardless of wind speed) for:
 - Overcast conditions during day or night
and
 - Any sky condition during the hour preceding or following night

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

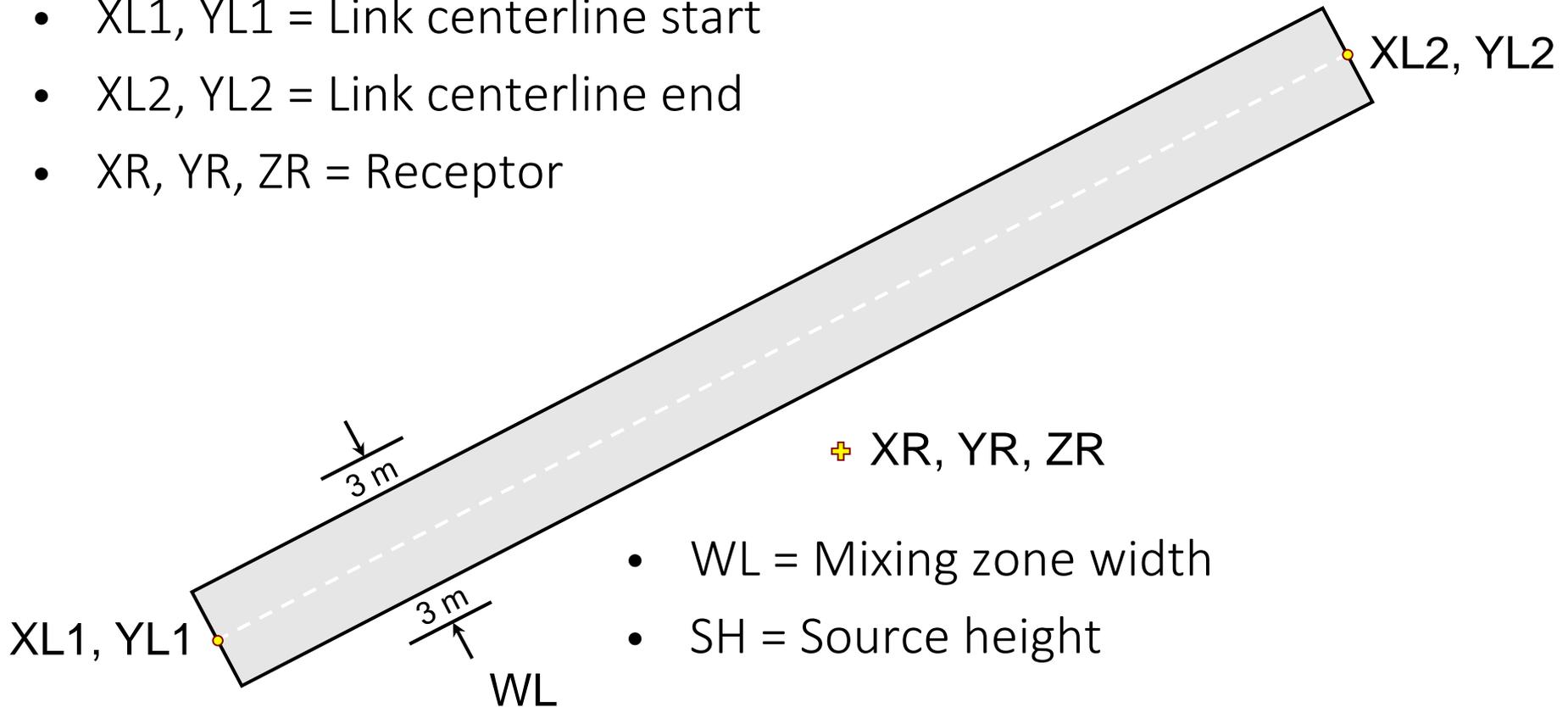


from Beaton, 1972

Link / Receptor Configuration

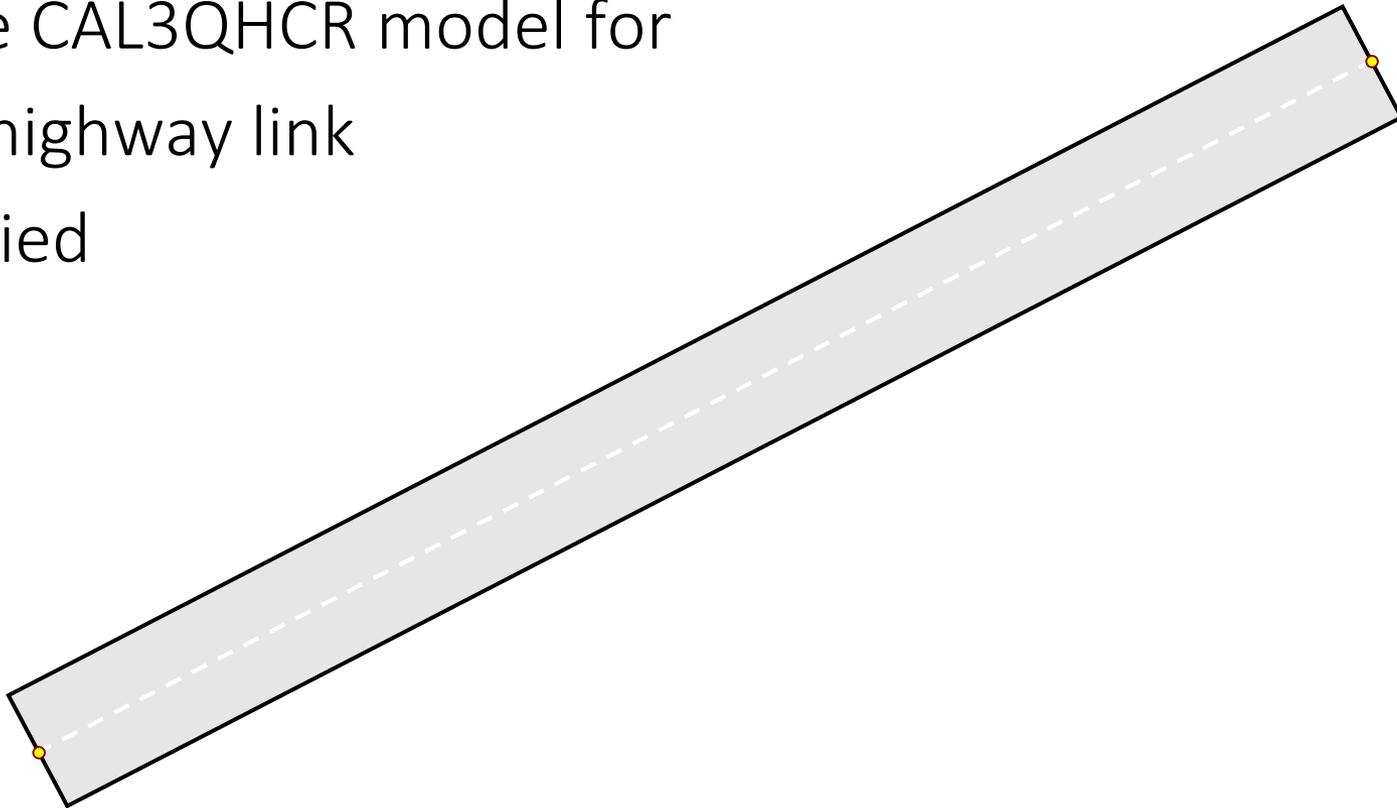
Location Coordinates

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



Link Emission Rates

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

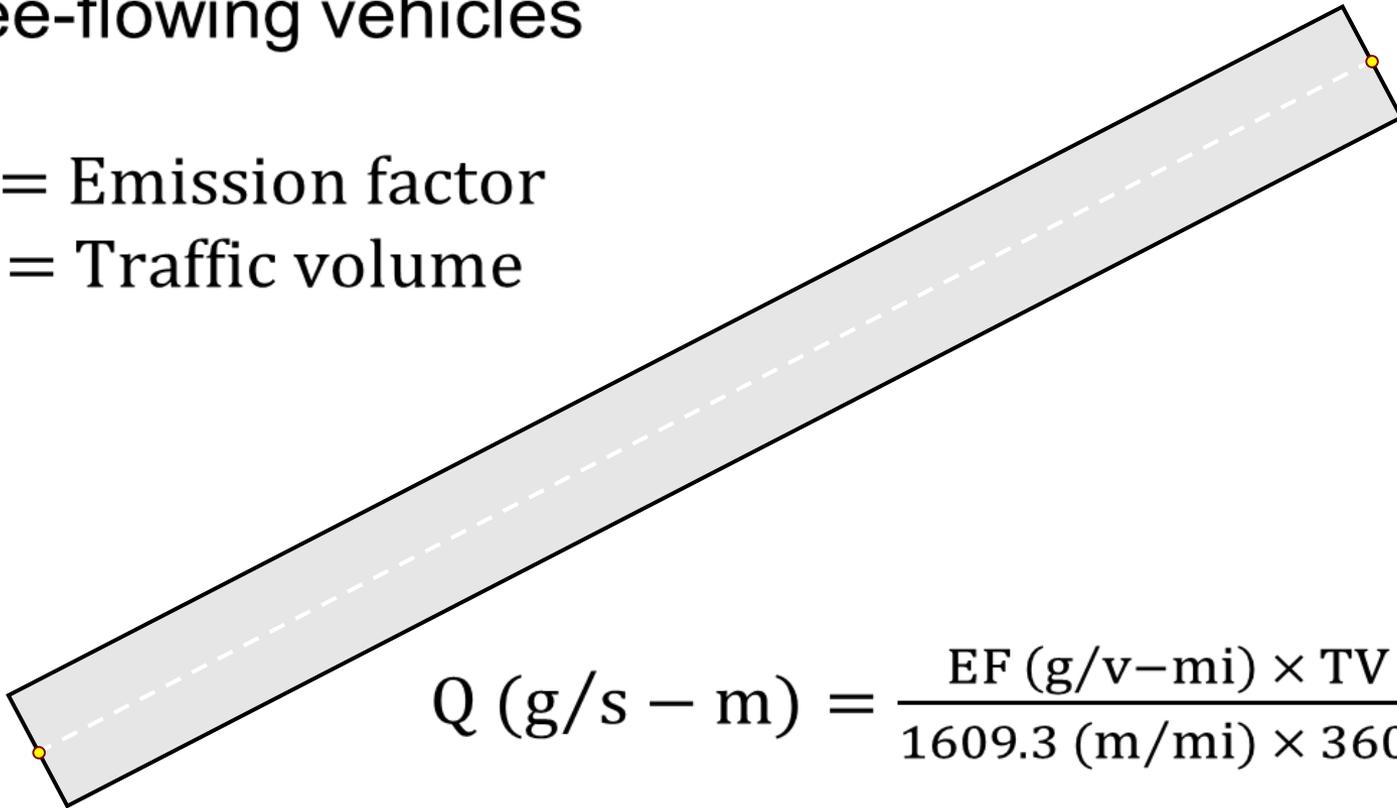


Link Emission Rates

Uniform emission rate,
Free-flowing vehicles

EF = Emission factor

TV = Traffic volume



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

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

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
- Highway Configuration
 - location coordinates
 - height of breathing zone
- 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

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

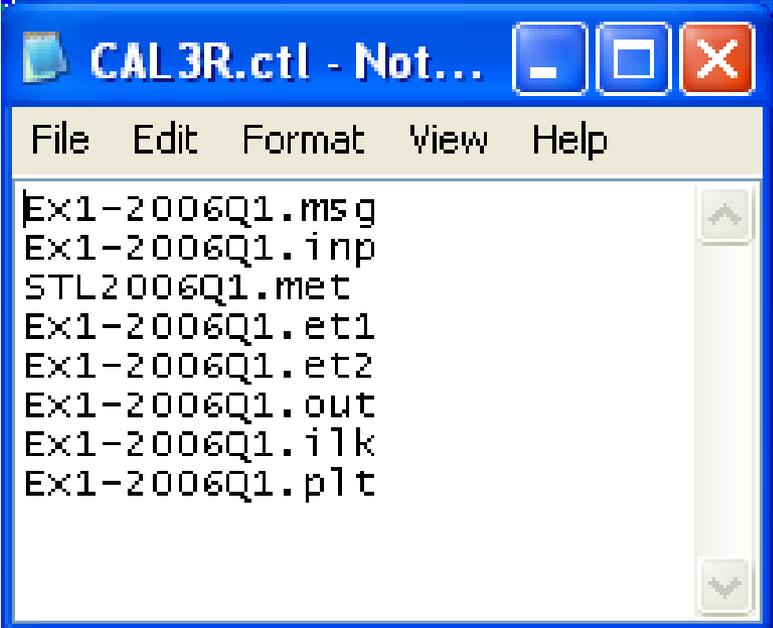
- Step 1 – Create an Input File, *.INP
 - Use a Text Editor
 - like Notepad, supplied with Windows®
 - Use a Word Processor
 - Caution: be sure to use the “Save As” command to save as a Plain Text file
 - Use Microsoft Excel®
 - Caution: be sure to “Save As” a CSV (Comma Delimited file) – requires subsequent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

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

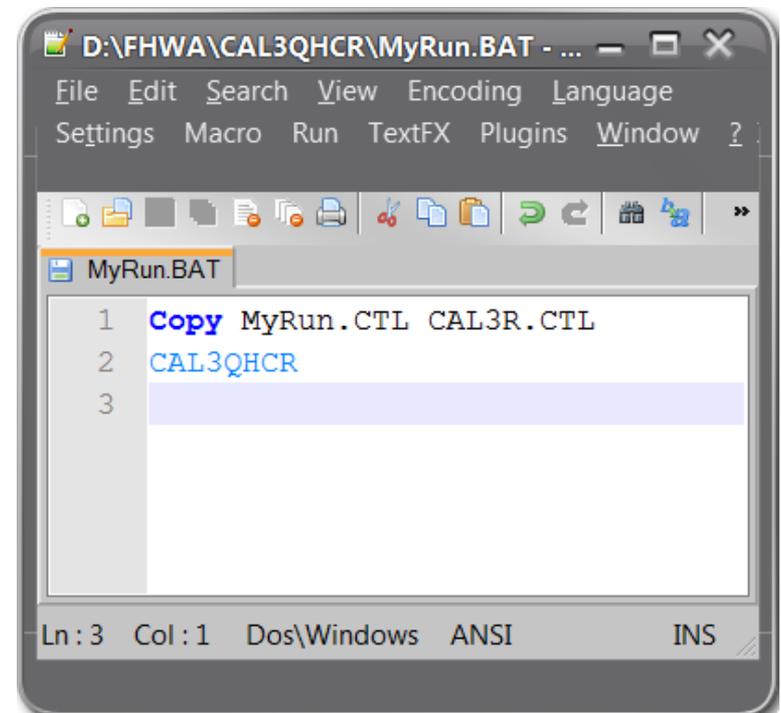
^b CAL3QHCR-generated file



```
Ex1-2006Q1.msg
Ex1-2006Q1.inp
STL2006Q1.met
Ex1-2006Q1.et1
Ex1-2006Q1.et2
Ex1-2006Q1.out
Ex1-2006Q1.ilK
Ex1-2006Q1.plt
```

Run the Model – Step 3

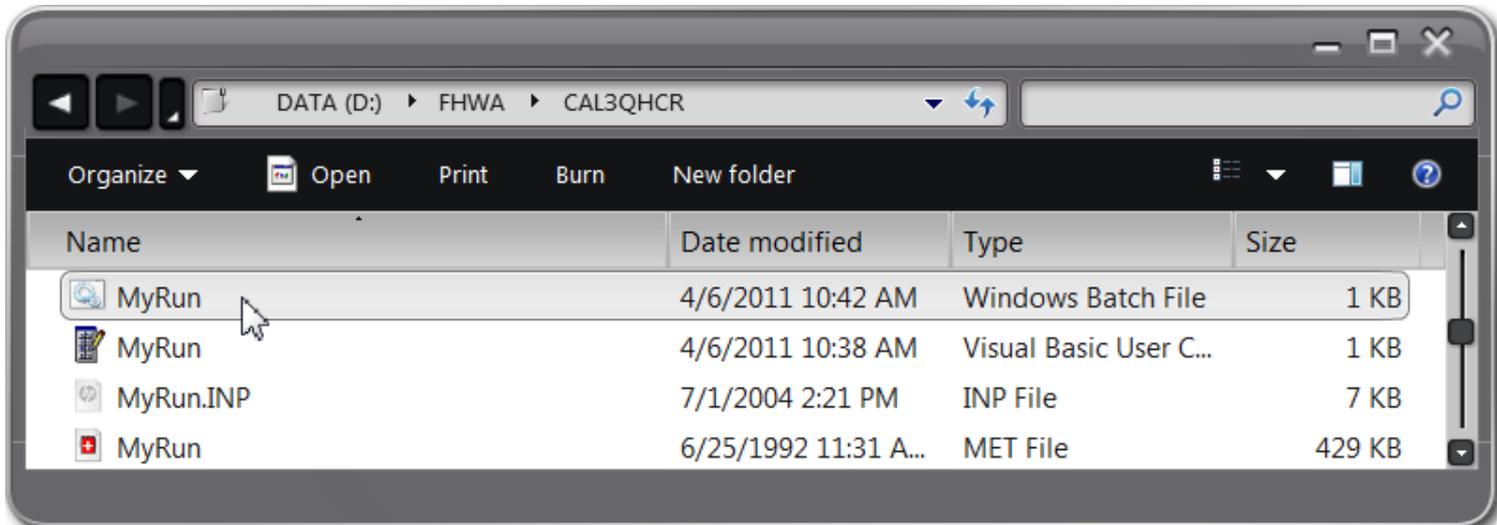
- Step 3 – Create a Batch File for executing the CAL3QHCR run, *.BAT
 - Use a text editor to specify DOS commands:
 - Copy the Control File created in Step 2 to the CAL3QHCR default Control File, CAL3R.CTL
 - Execute CAL3QHCR



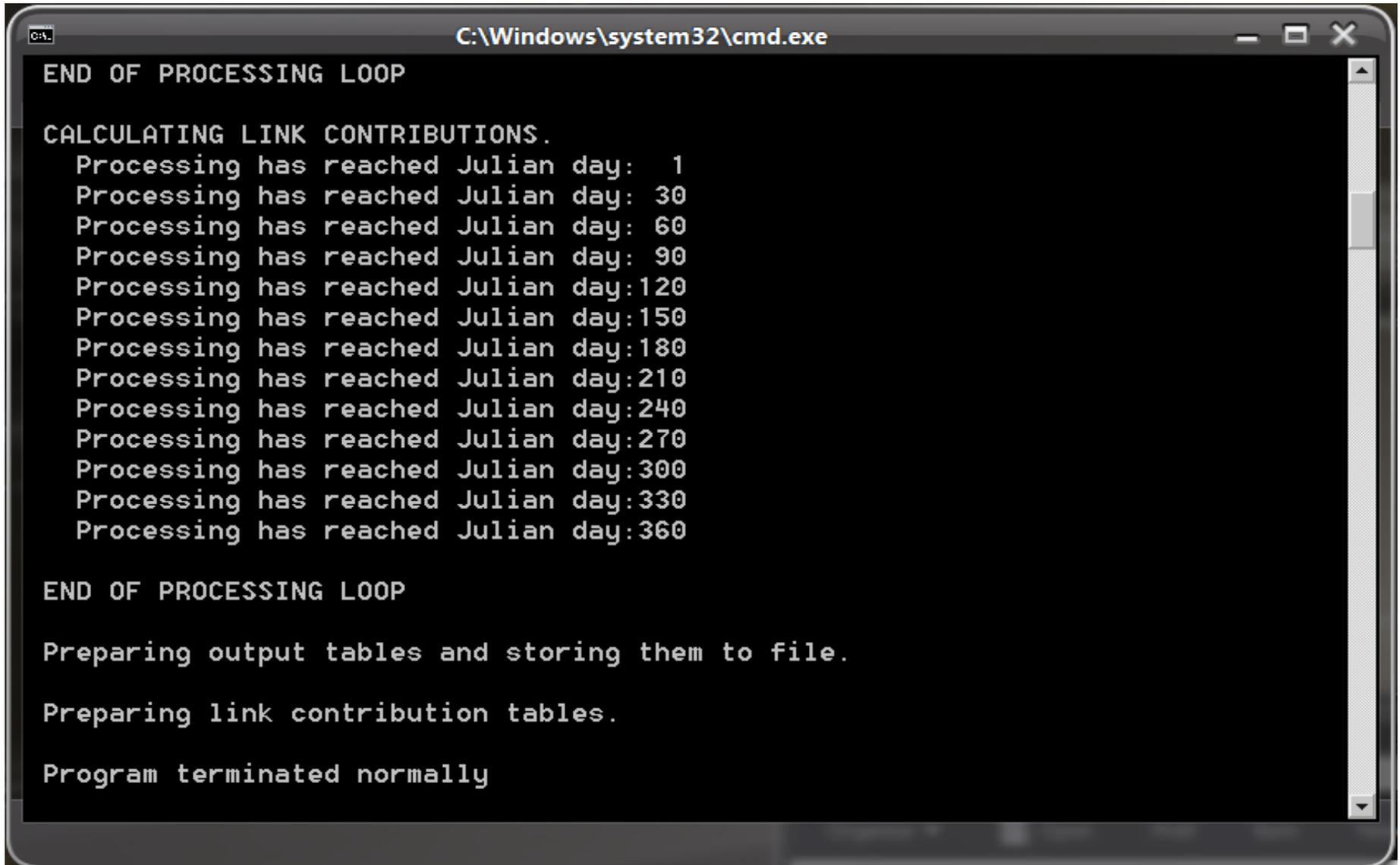
```
D:\FHWA\CAL3QHCR\MyRun.BAT - ...
File Edit Search View Encoding Language
Settings Macro Run TextFX Plugins Window ?
MyRun.BAT
1 Copy MyRun.CTL CAL3R.CTL
2 CAL3QHCR
3
Ln:3 Col:1 Dos\Windows ANSI INS
```

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



```
C:\Windows\system32\cmd.exe

END OF PROCESSING LOOP

CALCULATING LINK CONTRIBUTIONS.
  Processing has reached Julian day:  1
  Processing has reached Julian day: 30
  Processing has reached Julian day: 60
  Processing has reached Julian day: 90
  Processing has reached Julian day:120
  Processing has reached Julian day:150
  Processing has reached Julian day:180
  Processing has reached Julian day:210
  Processing has reached Julian day:240
  Processing has reached Julian day:270
  Processing has reached Julian day:300
  Processing has reached Julian day:330
  Processing has reached Julian day:360

END OF PROCESSING LOOP

Preparing output tables and storing them to file.

Preparing link contribution tables.

Program terminated normally
```

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

```
Command Prompt
Directory of C:\cal3ghcr\R
[.]          [..]      build.bat      C1C.BAT        C1C.CTL
C1C.ET1      C1C.ET2      C1C.ILK        C1C.INP        C1C.MSG
C1C.OUT      C1CET1.DIF   C1CET2.DIF     C1CILK.DIF     C1CMSG.DIF
C1COUT.DIF   C1CT.ET1     C1CT.ET2       C1CT.ILK       C1CT.MSG
C1CT.OUT     C1CT.PLT     cal3ghcr.exe   cal3ghcr.for   cal3rctl
FCR1C.BAT    FCMED.BAT    FCR1C.BAT     FCR1P.BAT     FCR2C.BAT
FCR2P.BAT    Med.BAT      Med.CTL        MED.ET1        MED.ET2
MED.ILK      Med.INP      MED.MSG        MED.OUT        MEDET1.DIF
MEDET2.DIF   MEDILK.DIF   MEDMSG.DIF     MEDOUT.DIF     MEDT.ET1
MEDT.ET2     MEDT.ILK     MEDT.MSG       MEDT.OUT       MEDT.PLT
PIT-64.MET   R1C.BAT      R1C.CTL        R1C.ET1        R1C.ET2
R1C.ILK      R1C.INP      R1C.MSG        R1C.OUT        R1CET1.DIF
R1CET2.DIF   R1CILK.DIF   R1CMSG.DIF     R1COUT.DIF     R1CT.ET1
R1CT.ET2     R1CT.ILK     R1CT.MSG       R1CT.OUT       R1CT.PLT
R1P.BAT      R1P.CTL      R1P.ET1        R1P.ET2        R1P.ILK
R1P.INP      R1P.MSG      R1P.OUT        R1PET1.DIF     R1PET2.DIF
R1PILK.DIF   R1PMSG.DIF   R1POUT.DIF     R1PT.ET1       R1PT.ET2
R1PT.ILK     R1PT.MSG     R1PT.OUT       R1PT.PLT       R2C.BAT
R2C.CTL      R2C.ET1      R2C.ET2        R2C.ILK        R2C.INP
R2C.MSG      R2C.OUT      R2CET1.DIF     R2CET2.DIF     R2CILK.DIF
R2CMSG.DIF   R2COUT.DIF   R2CT.ET1       R2CT.ET2       R2CT.ILK
R2CT.MSG     R2CT.OUT     R2CT.PLT       R2P.BAT        R2P.CTL
R2p.ET1      R2p.ET2     R2p.ILK        R2P.INP        R2P.MSG
R2p.OUT      R2PET1.DIF   R2PET2.DIF     R2PILK.DIF     R2PMSG.DIF
R2POUT.DIF   R2PT.ET1     R2PT.ET2       R2PT.ILK       R2PT.MSG
R2PT.OUT     R2PT.PLT     readmeR.txt    S2422590.ASC   TC1.MET
128 File(s)  7,518,188 bytes
2 Dir(s)    324,092,248,064 bytes free

C:\cal3ghcr\R>_
```

Run the Model – Step 4, Option 2

```
C:\> Command Prompt

C:\> Example Analysis>copy CP-2010Q4.ct1 CAL3R.ct1
1 file(s) copied.

C:\> Example Analysis>CAL3QHCR
READ IN: CP-2010Q4.msg
READ IN: CP-2010Q4.inp
READ IN: STL2010Q4.met
READ IN: CP-2010Q4.et1
READ IN: CP-2010Q4.et2
READ IN: CP-2010Q4.out
READ IN: CP-2010Q4.ilc
READ IN: CP-2010Q4.plt

READING INPUT FROM THE MAIN CONTROL FILE

      Run start date: 10/01/10      Julian: 274
      end date: 12/31/10      Julian: 365

READING DATA FROM THE MET FILE
READING RECEPTOR LOCATIONS FROM THE CONTROL FILE
READING LINK <ETS> DATA FROM THE MAIN INPUT FILE
      End of ETS processing subroutine.

FINISHED READING CONTROL FILE INPUT
ENTERING MAIN PROCESSING LOOP
      Processing has reached Julian day:274
      Processing has reached Julian day:300
      Processing has reached Julian day:330
      Processing has reached Julian day:360

END OF PROCESSING LOOP

Preparing output tables and storing them to file.
Program terminated normally

C:\> Example Analysis>
```

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

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 uni ts)
YR	Real	Y- coordinate of receptor (user uni ts)
ZR	Real	Z- coordinate of receptor (user uni ts)
*** 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

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

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

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

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**

Constructing an Input File

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

#1: 'JOB', ATIM, Z0, 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: JTI ER, '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]									

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						

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

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      ZO = 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
-----

RECEPTOR          *          COORDINATES (FT)          *
                    *          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

```
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File Edit Format View Help

CAL3QHCR (Dated: 13196)
PAGE: 2

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

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

Receptor Data
-----

      RECEPTOR          *          COORDINATES (FT)
                        *          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
HOURL   * 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

0 CAL3QHCR (Dated: 13196) PAGE: 3

DATE : 07/16/13
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.

Rcpt#	Highest Conc	Ending Day Hr	Calm	Second Highest Conc	Highest Ending Day Hr	Calm	Third Highest Conc	Highest Ending Day Hr	Calm	Fourth Highest Conc	Highest Ending Day Hr	Calm	Fifth Highest Conc	Highest Ending Day Hr	Calm	Sixth Highest Conc	Highest Ending 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 Number	Maximum Conc	Ending 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

0 CAL3QHCR (Dated: 13196) PAGE: 4

DATE : 07/16/13
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.

Rcpt#	Total Conc	Ending Day Hr	Ambient Backgnd	Total Link	Link +1	Link +2	Link +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.

Rcpt#	Total Conc	Ending Day Hr	Ambient Backgnd	Total Link	Link +1	Link +2	Link +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.

Rcpt#	Total Conc	Ending Day Hr	Ambient Backgnd	Total Link	Link +1	Link +2	Link +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

```
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File Edit Format View Help
0                                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.
Rcpt# 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

0 CAL3QHCR (Dated: 13196)

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

PAGE: 6

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

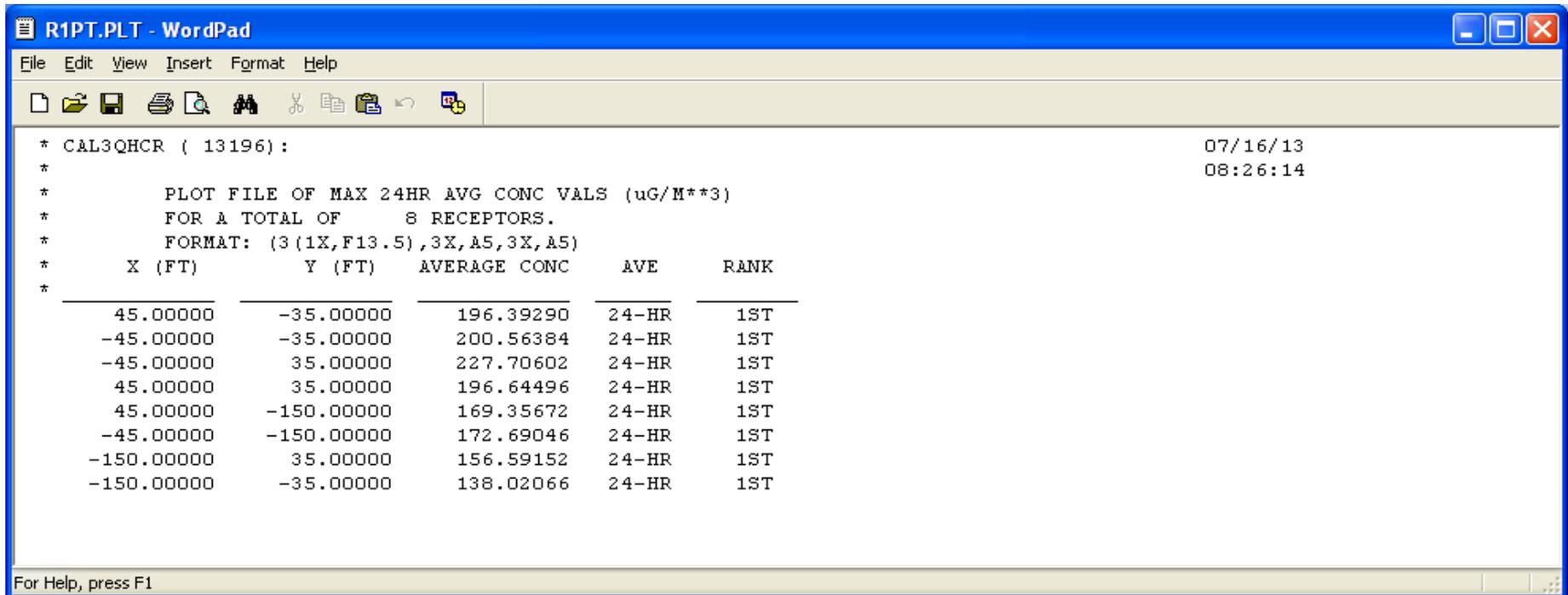
CALM DURATION FREQUENCY

Hours of Consecutive Calm winds	Frequency of 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) (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)
2	55	(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) (87,24)(170, 2)(198, 3)(209,24)(233, 1)(248, 1)(254,23)(269,23)(280, 1)(300,22) (312, 3)(320, 9) (142,24)(143, 6)(147, 2)(169, 4)(178, 7)(188, 4)(189, 6)(228, 3)(254, 6)(286,23) (295, 1)(307, 8) (59, 6)(199, 6)(238, 2)(259, 3)(288, 5)(298, 6) (229, 7)(286, 3)(310, 2) (220, 6)(252, 5) (253, 7)(305, 9)(309, 9)
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) (87,24)(170, 2)(198, 3)(209,24)(233, 1)(248, 1)(254,23)(269,23)(280, 1)(300,22) (312, 3)(320, 9) (142,24)(143, 6)(147, 2)(169, 4)(178, 7)(188, 4)(189, 6)(228, 3)(254, 6)(286,23) (295, 1)(307, 8) (59, 6)(199, 6)(238, 2)(259, 3)(288, 5)(298, 6) (229, 7)(286, 3)(310, 2) (220, 6)(252, 5) (253, 7)(305, 9)(309, 9)
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) (142,24)(143, 6)(147, 2)(169, 4)(178, 7)(188, 4)(189, 6)(228, 3)(254, 6)(286,23) (295, 1)(307, 8) (59, 6)(199, 6)(238, 2)(259, 3)(288, 5)(298, 6) (229, 7)(286, 3)(310, 2) (220, 6)(252, 5) (253, 7)(305, 9)(309, 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) (59, 6)(199, 6)(238, 2)(259, 3)(288, 5)(298, 6) (229, 7)(286, 3)(310, 2) (220, 6)(252, 5) (253, 7)(305, 9)(309, 9)
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)



```
* 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	X	X	X	X	X	X	√ (if modeling urban source)
CAL3QHCR	X	X	X			√	√ (if modeling urban source)

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

√ – Necessary dispersion model input

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

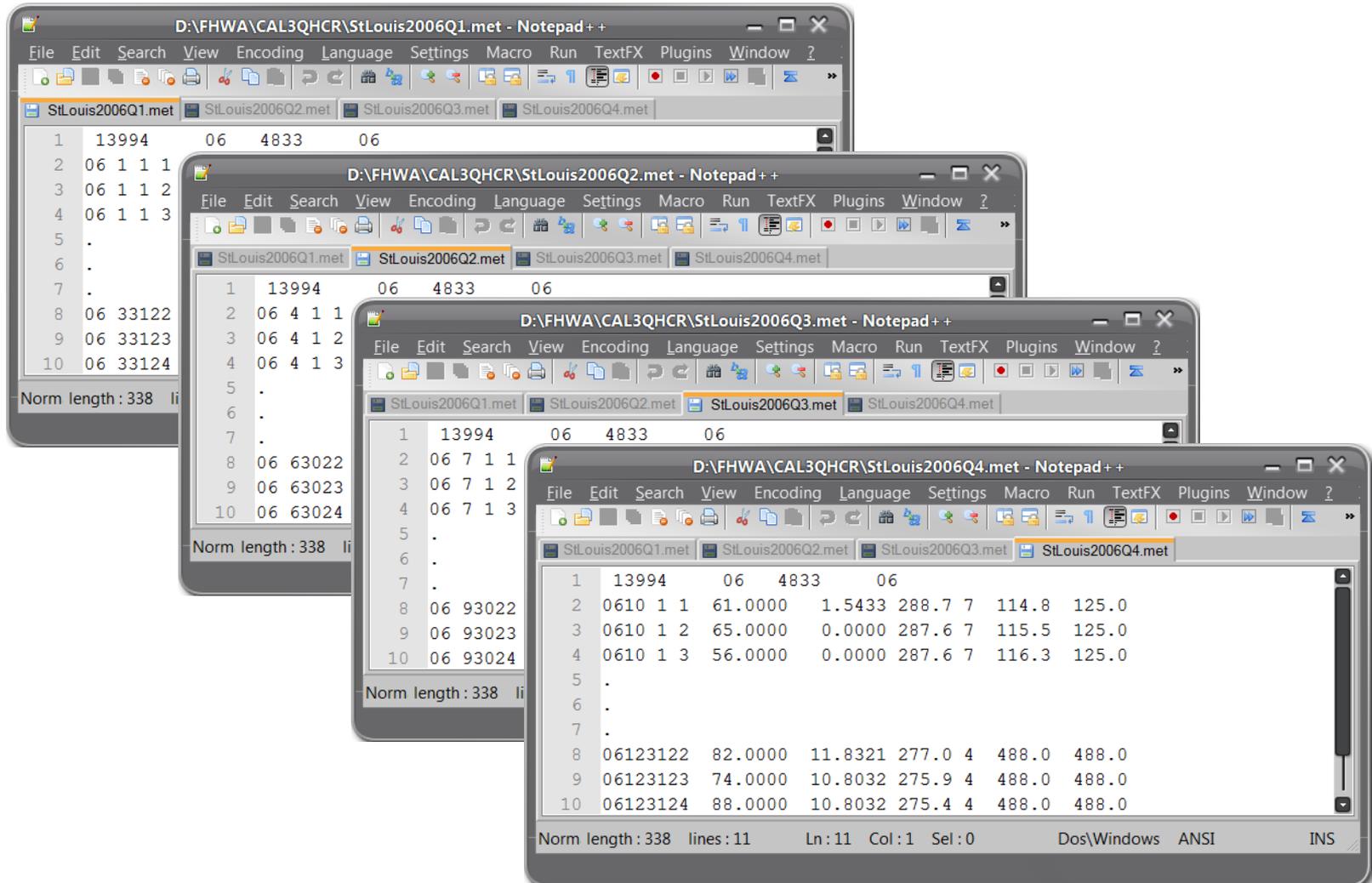
Met Data Processing Steps



- 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



NOTE: Map coordinates are in feet

Link Configurations

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

Link Traffic Volumes

- 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.

	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

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

- 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

0
                                CAL3QHCR (Dated: 13196)
DATE : 07/22/13
TIME : 11:18:33
                                PAGE: 3

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.

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

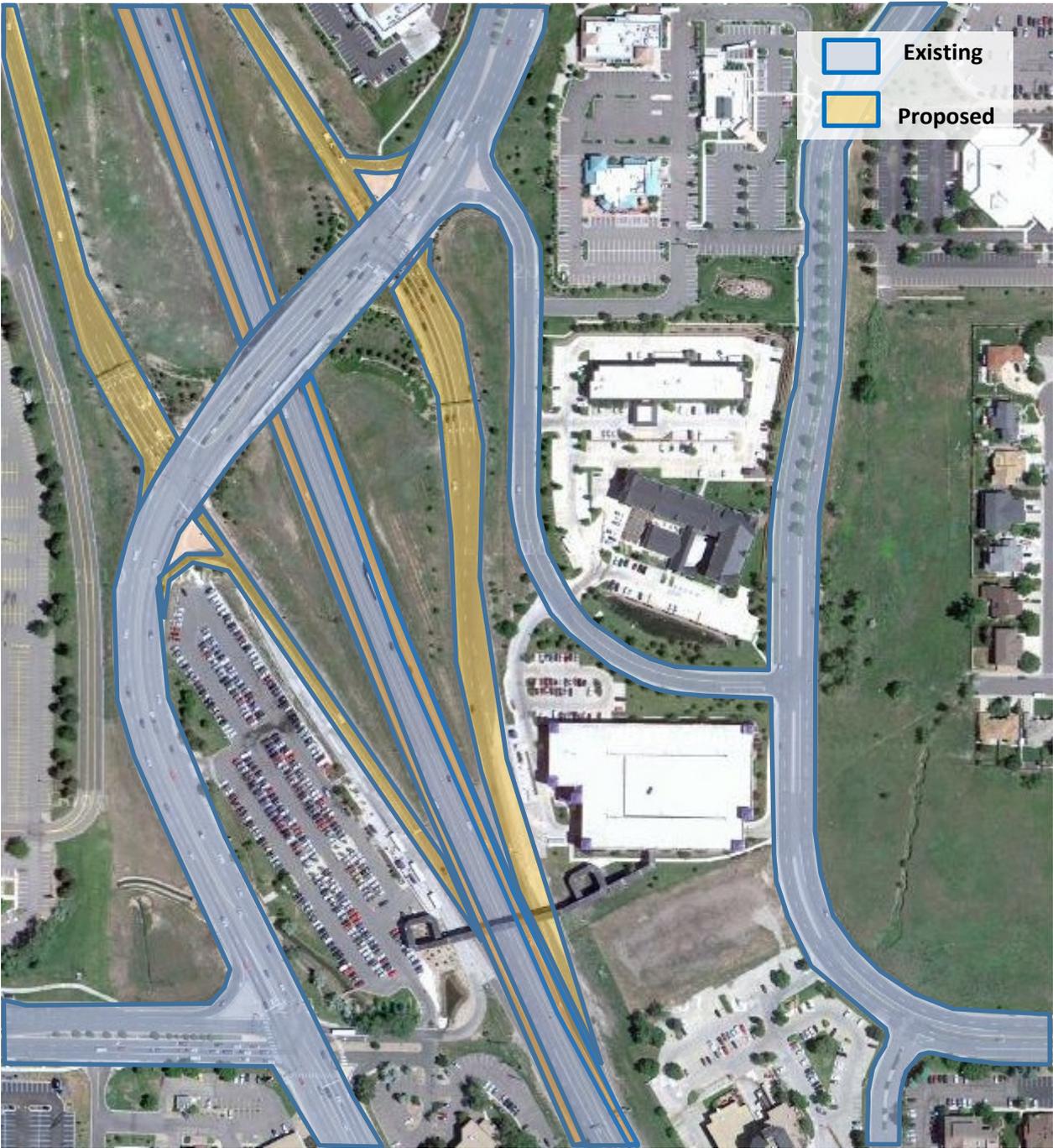
Example Analysis

- 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





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

The screenshot shows the MySQL Query Browser interface. The title bar reads "MySQL Query Browser - Connection: @localhost:3306". The menu bar includes File, Edit, View, Query, Script, Tools, Window, and Help. The toolbar contains various icons for navigation and execution, including buttons for "SELECT", "FROM", "WHERE", "GROUP", "HAVING", "ORDER", "SET", and "CREATE".

The "Resultset 1" tab is active, displaying the following SQL query in the "SQL Query Area":
`1 SELECT * FROM `transit_exercise_rates_out`.`pm25_grams_per_veh_mile`;`

The results are shown in a table with the following columns: movesRunId, yearId, monthId, hourId, linkId, pollutant, and GramsPerVehMile. The table contains 18 rows of data, all for the year 2020, month 1, and hour 1. The pollutant is "Total PM2.5" and the GramsPerVehMile values range from approximately 0.035 to 0.107.

The "Schemata" panel on the right shows a tree view of the database schema, including tables like training_*, transit_exercise_*, and pm25_grams_per_veh_mile. The "Syntax" panel at the bottom right lists various SQL statement categories such as Data Definition Statements, Data Manipulation Statements, and MySQL Utility Statements.

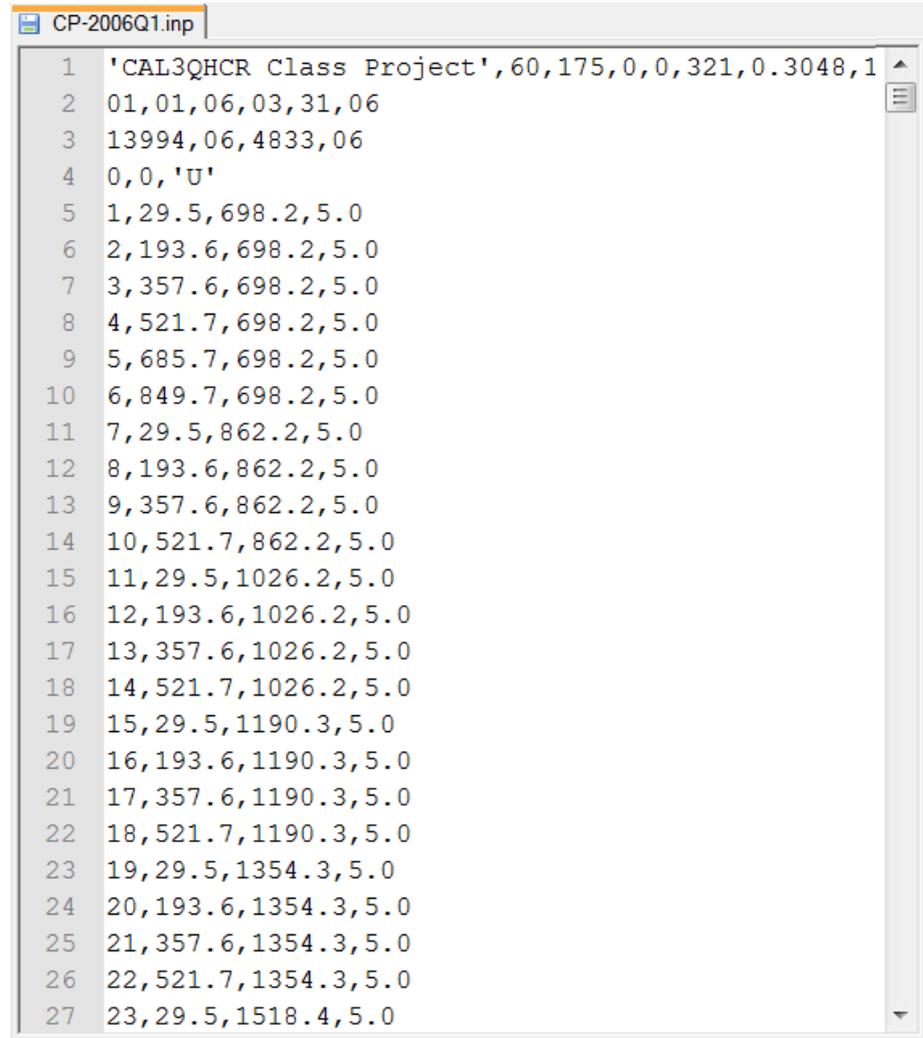
At the bottom of the window, a status bar indicates "1184 rows fetched in 0.0076s (0.0014s)".

movesRunId	yearId	monthId	hourId	linkId	pollutant	GramsPerVehMile
1	2020	1	1	1	Total PM2.5	0.0583888315...
1	2020	1	1	2	Total PM2.5	0.0354544451...
1	2020	1	1	3	Total PM2.5	0.0354545038...
1	2020	1	1	4	Total PM2.5	0.0354545143...
1	2020	1	1	5	Total PM2.5	0.1065697711...
1	2020	1	1	6	Total PM2.5	0.0484066217...
1	2020	1	1	7	Total PM2.5	0.0354543748...
1	2020	1	1	8	Total PM2.5	0.0354545288...
1	2020	1	1	9	Total PM2.5	0.0712118530...
1	2020	1	1	10	Total PM2.5	0.1065699139...
1	2020	1	1	11	Total PM2.5	0.1065694522...
1	2020	1	1	12	Total PM2.5	0.1065696959...
1	2020	1	1	13	Total PM2.5	0.0354545513...
1	2020	1	1	14	Total PM2.5	0.0354544355...
1	2020	1	1	15	Total PM2.5	0.0440312796...
1	2020	1	1	16	Total PM2.5	0.0440311275...
1	2020	1	1	17	Total PM2.5	0.0440310649...
1	2020	1	1	18	Total PM2.5	0.0670511401

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

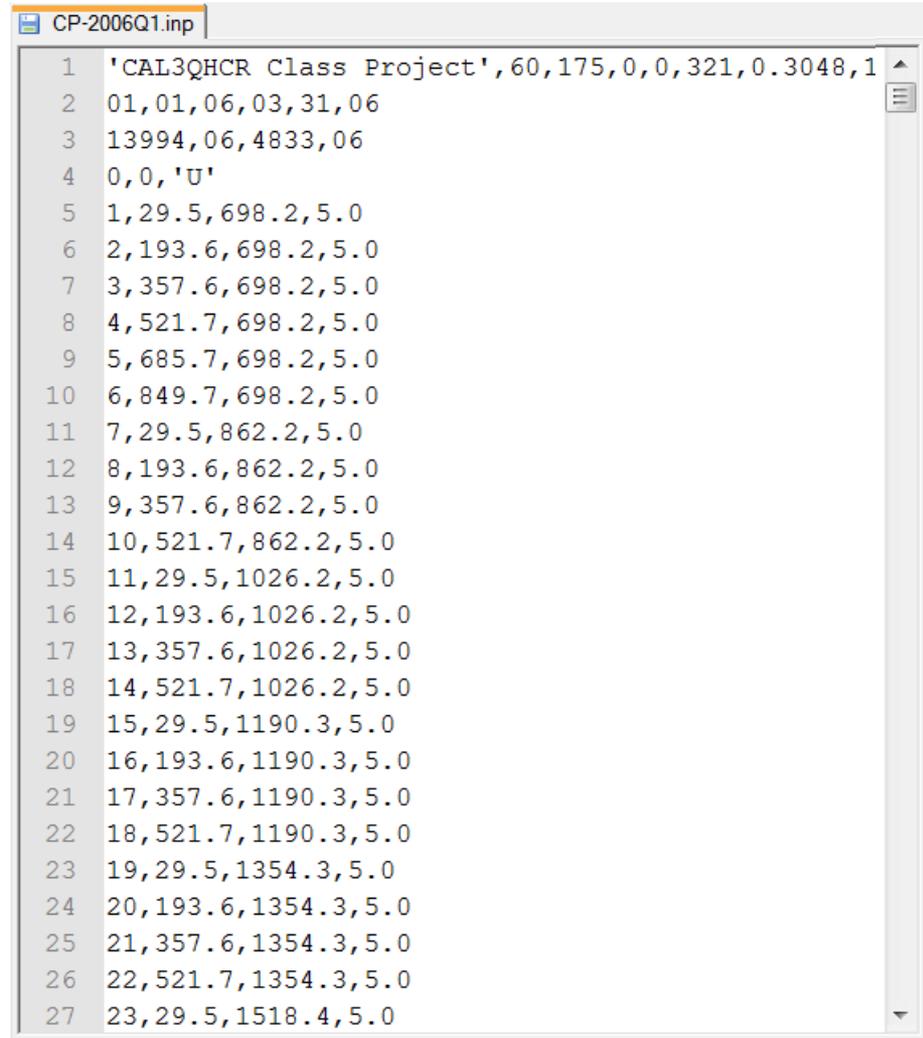


```
CP-2006Q1.inp
1 'CAL3QHCR Class Project',60,175,0,0,321,0.3048,1
2 01,01,06,03,31,06
3 13994,06,4833,06
4 0,0,'U'
5 1,29.5,698.2,5.0
6 2,193.6,698.2,5.0
7 3,357.6,698.2,5.0
8 4,521.7,698.2,5.0
9 5,685.7,698.2,5.0
10 6,849.7,698.2,5.0
11 7,29.5,862.2,5.0
12 8,193.6,862.2,5.0
13 9,357.6,862.2,5.0
14 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
- 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
```

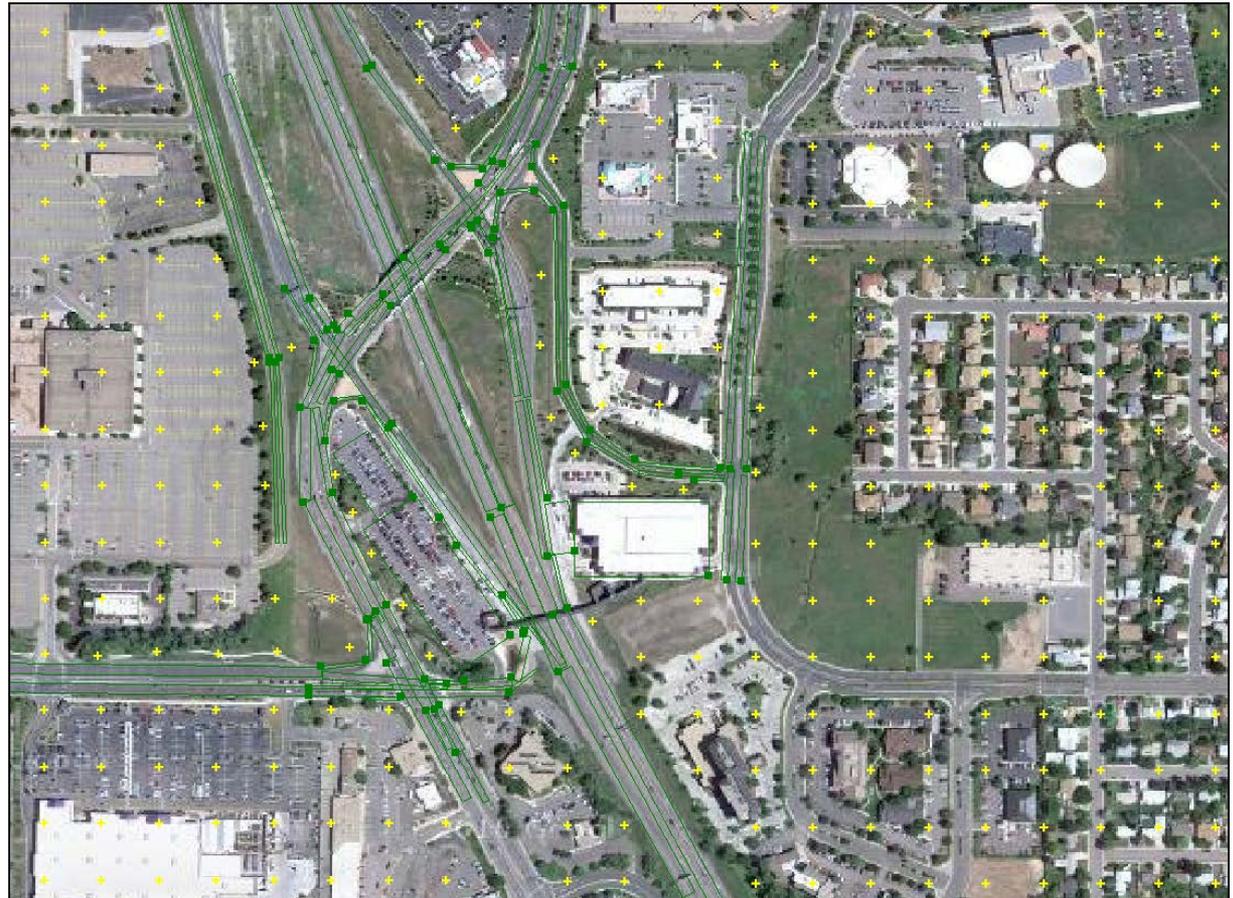
#5: 'RCP', XR, YR, ZR

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

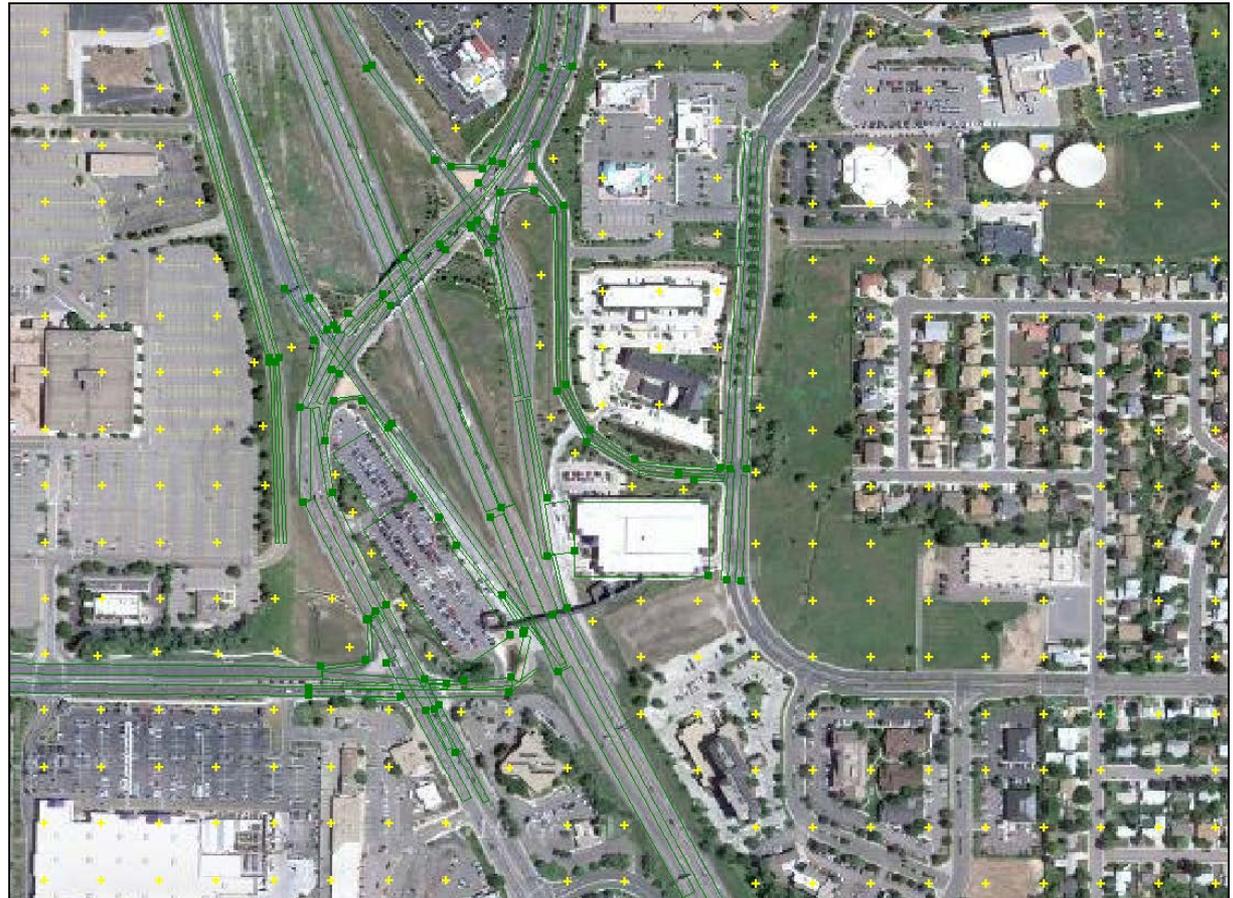
```
CP-2006Q1.inp
326 2, 'P'
327 1,1,1,1,1,1,1 #9: COD, IQ
328 '1st Quarter - 2006',83 #10: 'LNK', 'TYP', XL1, YL1, XL2, YL2, SH, WL
329 1,1
330 '1A-Int A NW ent ramp', 'AG',957.4,2236.4,1150.7,1971.4,0.0,43.7
331 2,1
332 '1B-Int A NW ent ramp', 'AG',956.5,2235.9,714.0,2695.9,0.0,43.7
333 3,1
334 '2-Int 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

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

Line Number	Record ID	Value 1	Value 2
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

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

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

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

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

CAL3QHCR Input File

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

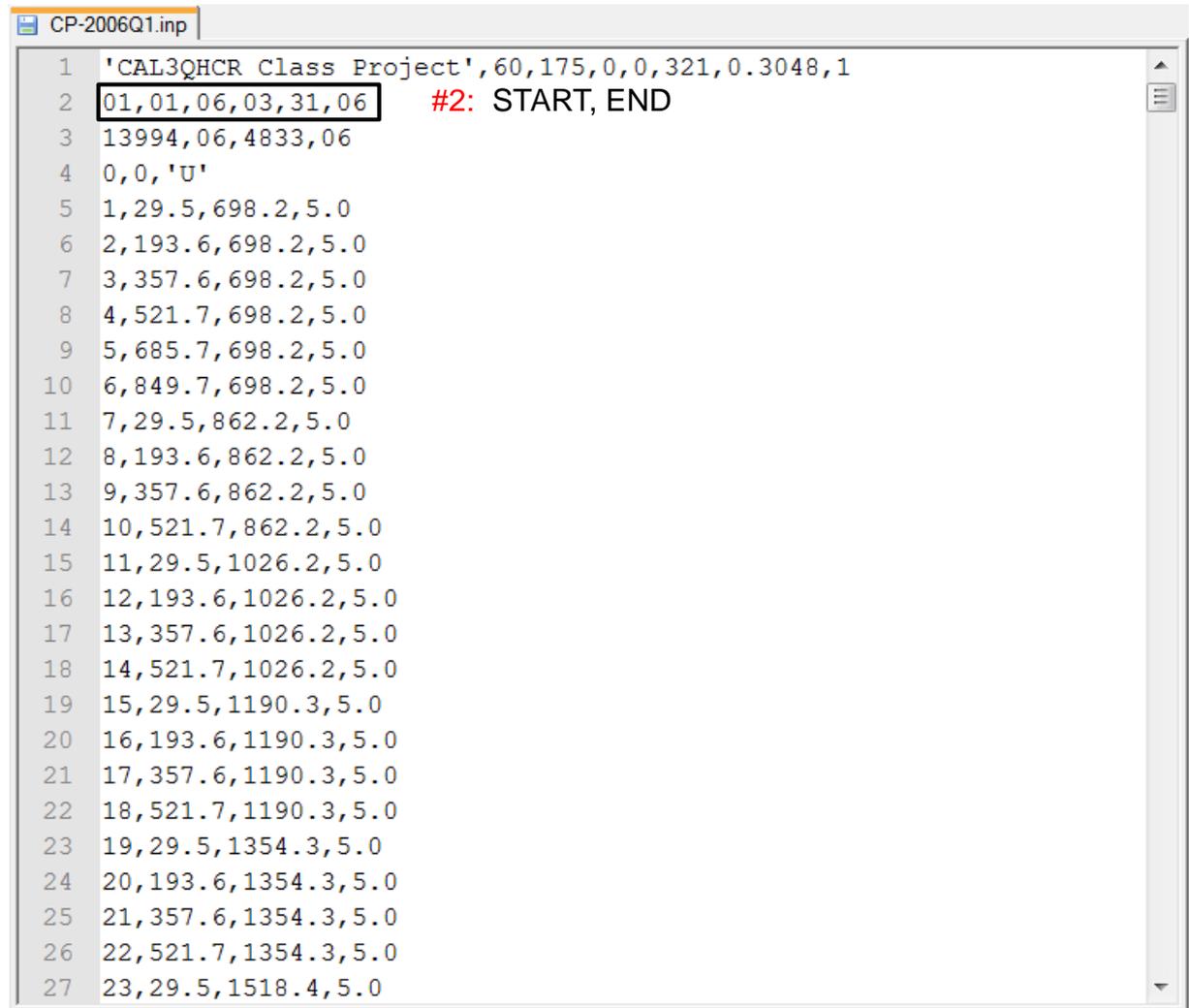
- Two representing peak traffic and two representing off-peak traffic
- ...for each of four calendar quarters
- Quarter 4 shown

	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

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 #2: START, END
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

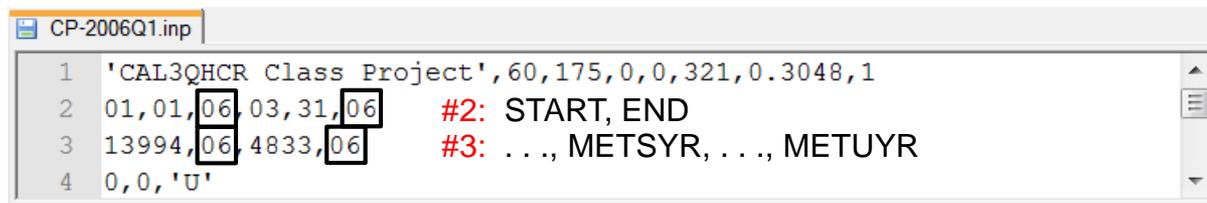
Data that will change by year:

- 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 #3: ..., METSYR, ..., METUYR
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
```

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

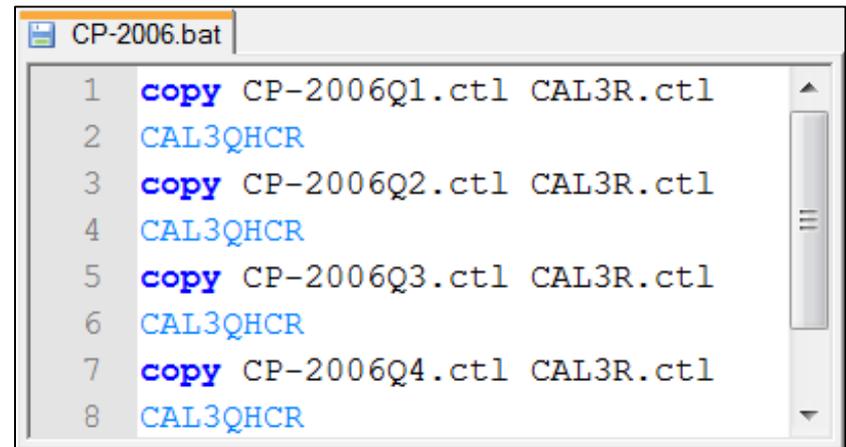
- 20 input data files:
 - CP-2006Q1.inp
 - CP-2006Q2.inp
 - CP-2006Q3.inp
 - CP-2006Q4.inp
 - CP-2007Q1.inp
 - CP-2007Q2.inp
 - CP-2007Q3.inp
 - CP-2007Q4.inp
 - CP-2008Q1.inp
 - CP-2008Q2.inp
 - CP-2008Q3.inp
 - CP-2008Q4.inp
 - CP-2009Q1.inp
 - CP-2009Q2.inp
 - CP-2009Q3.inp
 - CP-2009Q4.inp
 - CP-2010Q1.inp
 - 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.ct1 CAL3R.ct1
2 CAL3QHCR
3 copy CP-2006Q2.ct1 CAL3R.ct1
4 CAL3QHCR
5 copy CP-2006Q3.ct1 CAL3R.ct1
6 CAL3QHCR
7 copy CP-2006Q4.ct1 CAL3R.ct1
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?