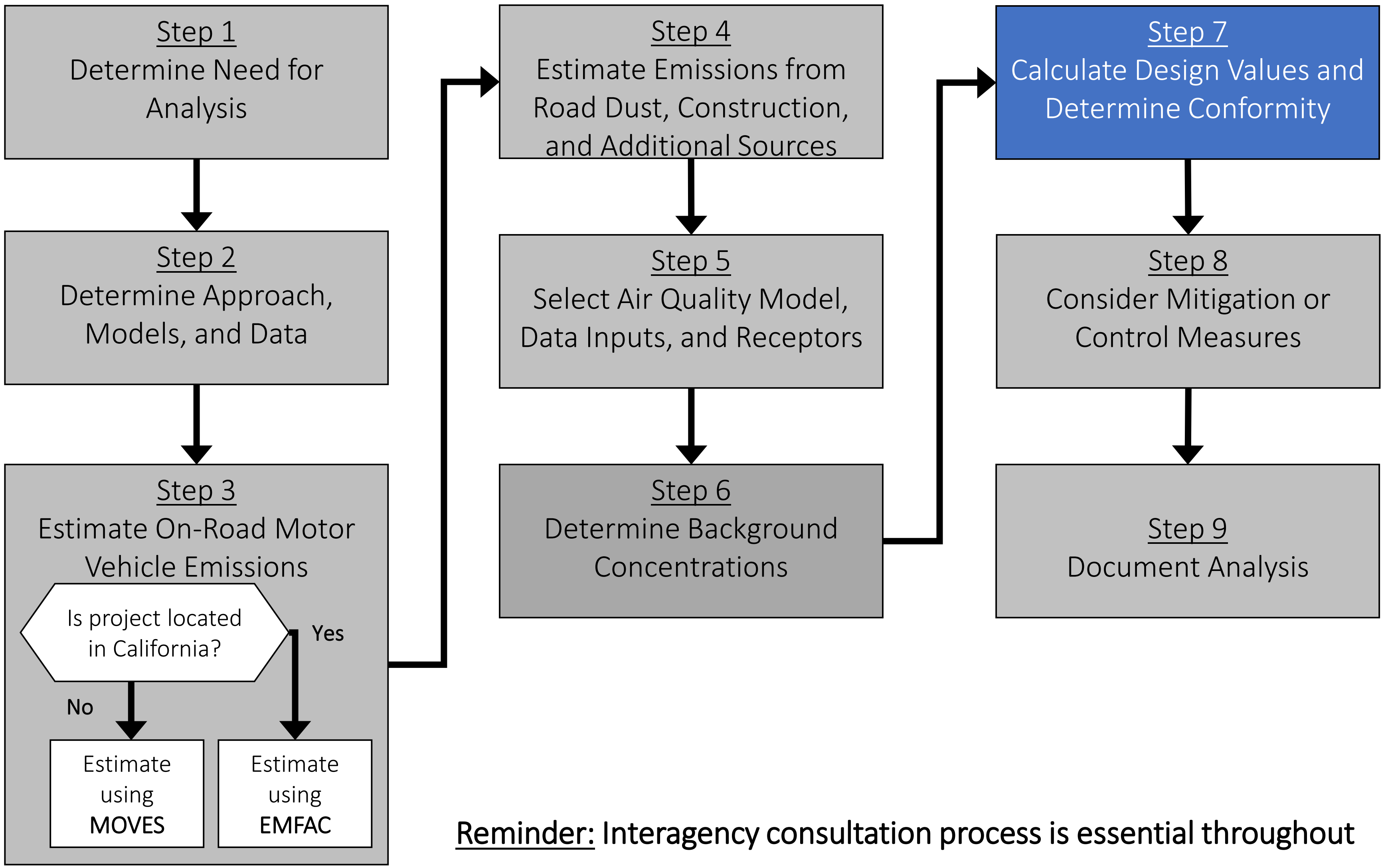
Module 7
Calculating Design Values & Determining Conformity

Completing a PM Hot-spot Analysis



<u>Reminder:</u> Interagency consultation process is essential throughout

Module Overview

- What is a design value?
- Design value procedure and data preparation for each PM NAAQS
  - Annual $PM_{2.5}$ NAAQS
  - 24-hour $PM_{2.5}$ NAAQS
  - 24-hour PM_{10} NAAQS
- Determining appropriate receptors for the Annual $PM_{2.5}$ NAAQS
- Calculating design values and determining conformity for our example analysis

Key References

- PM Hot-spot Guidance, Section 9 and Appendix K
- Design value regulations for monitoring data (40 CFR Part 50)
- Conformity rule, Sections 93.105(c)(1)(i) & 93.123(c)(1)
- Air quality monitoring regulations (40 CFR Part 58)

What is a Design Value?

- A design value is a statistic that describes the air quality status of a given location relative to the level of the NAAQS

- In PM hot-spot analyses, a design value is a statistic that describes a future air quality concentration in the project area that can be compared to a NAAQS
  - Project design values are used to determine conformity

  - Generally, project design values are calculated by combining:
    - Air quality modeling results (project and nearby sources that are modeled) and
    - Air quality monitoring data (background from other sources)

Recall from Module 6: there are other options for estimating future background concentrations; this module focuses on using monitoring data

Using DVs to Determine Conformity

- Guidance describes how to calculate design values for each of the current PM NAAQS, consistent with:
  - How NAAQS are established, and
  - How design values are calculated for other purposes

- Conformity is met if the design value for every appropriate receptor in the build scenario is less than or equal to
  - The NAAQS, or
  - The same receptor in the no-build scenario

- Exception: when a "new" violation in the build scenario can be considered a "relocated" violation in the no-build scenario
  - Only limited cases – would only be the case where there is a clear relationship between such changes
  - Determined through interagency consultation

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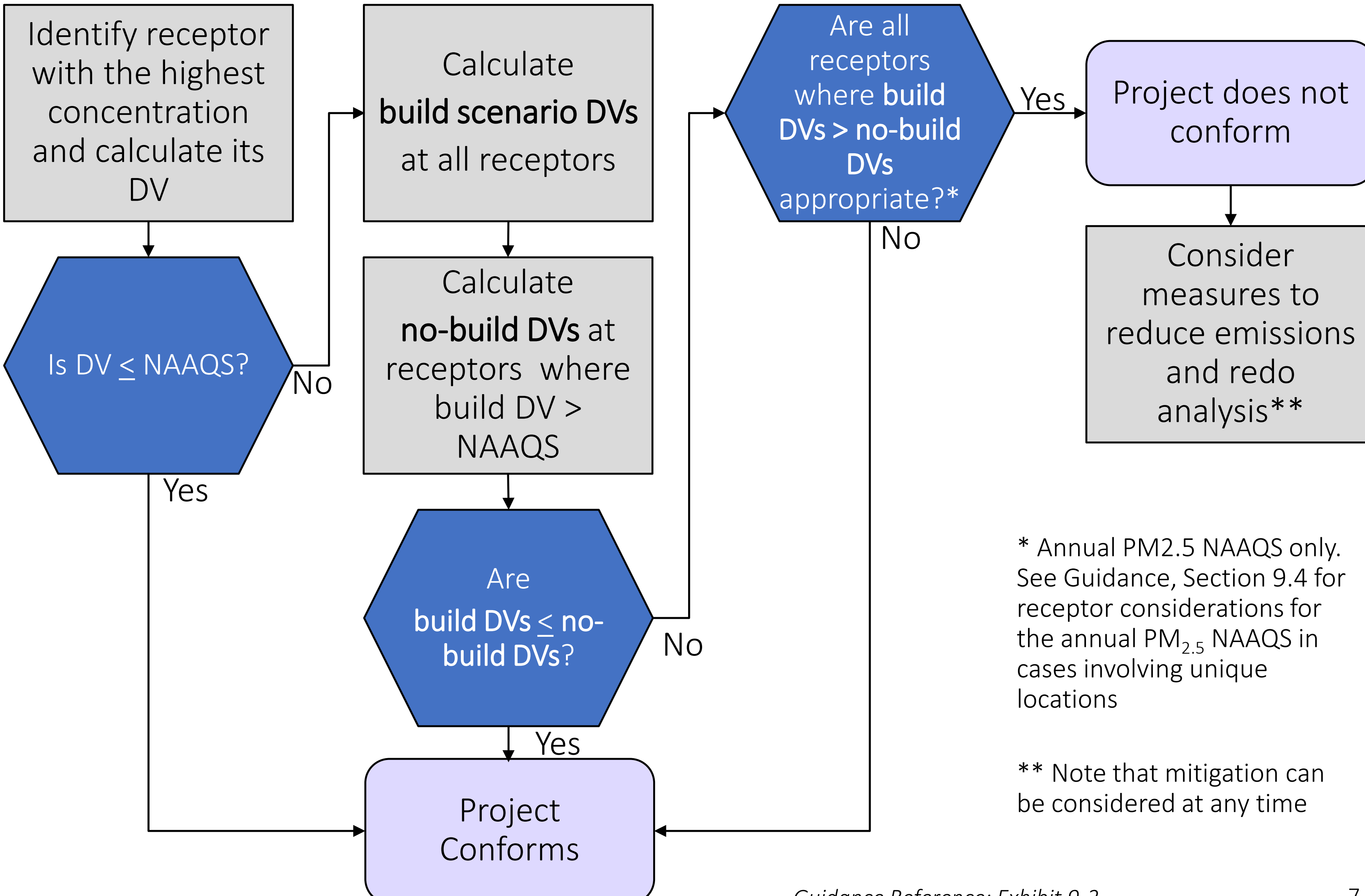
Guidance Reference: Section 9.2

Using DVs to Determine Conformity



* Annual PM2.5 NAAQS only. See Guidance, Section 9.4 for receptor considerations for the annual $PM_{2.5}$ NAAQS in cases involving unique locations

** Note that mitigation can be considered at any time

Guidance Reference: Exhibit 9-2

Calculating Design Values for the Annual $PM_{2.5}$ NAAQS

Annual PM2.5 NAAQS

- 2012 NAAQS =12.0 µg/m^3
- 1997 NAAQS = 15.0 µg/m^3 (applies only in a few areas, where not yet revoked)

- The annual $PM_{2.5}$ design value is defined as the average of 3 years' annual averages:

$$\text{Annual } PM_{2.5} \text{ DV} = \frac{(\text{[Year 1 avg]} + \text{[Year 2 avg]} + \text{[Year 3 avg]})}{3}$$

  - Each annual average is calculated using equally-weighted quarterly averages air quality monitoring data

  - DV is rounded to the nearest tenth of a µg/m^3 at the end of the calculation

Guidance Reference: Section 9.3.2

Annual PM2.5 NAAQS

- To calculate the design value for the hot-spot analysis, you need:

- Air quality modeling results
  - Average annual concentrations from the project and any nearby sources that are modeled
  - For this course, assume these are based on 5 years of off-site meteorology data

- Air quality monitoring data
  - 12 quarters of background concentration measurements (4 quarters for 3 consecutive years)

Annual PM2.5 NAAQS – Build Scenario

- Step 1 – Using Modeling Results
  - For each receptor, calculate the average annual concentrations from air quality modeling results for each year of met data used (e.g., a 5-year average for each receptor, when using 5 years of met data)
  - AERMOD can produce a 5-year average value for each receptor with the following keywords:
    - For CO pathway, set AVERTIME to ANNUAL, POLLUTID to PM2.5,
    - For OU pathway, specify RECTABLE and optional, PLOTFILE
  - If using CAL3QHCR, calculate four quarterly averages in each of 5 met data years, and average these 20 averages
- Step 2 – Receptor Identification:
  - Identify receptor with the highest average annual modeled concentration

Annual PM2.5 NAAQS – Build Scenario

- Step 3 – Background Concentration:
  - Calculate average annual monitor background concentration (average 4 quarters of monitor data in each year, then average the 3 years):

Background Data					
Monitor Data Year	Quarter 1 (Q1)	Quarter 2 (Q2)	Quarter 3 (Q3)	Quarter 4 (Q4)	Avg annual Concentration:
Year 1	Q1Y1	Q2Y1	Q3Y1	Q4Y1	(Sum of row) ÷ 4
Year 2	Q1Y2	Q2Y2	Q3Y2	Q4Y2	(Sum of row) ÷ 4
Year 3	Q1Y3	Q2Y3	Q3Y3	Q4Y3	(Sum of row) ÷ 4
Average annual monitor background concentration:					(Sum of column) ÷ 3

Annual PM2.5 NAAQS – Build Scenario

- Step 4 – Build Scenario Design Value Calculation:

  Step 2 result (receptor with the highest annual avg modeled concentration)

  \+ Step 3 result (average annual monitor background concentration)

  Step 4 result (Build Scenario DV concentration)

- Step 5 – Round to nearest 0.1 $\mu g/m^3$

- Compare the highest receptor DV to the NAAQS:
  - If the Build Scenario DV $\leq$ annual $PM_{2.5}$ NAAQS:
    - project conforms
  - If the Build Scenario DV > annual $PM_{2.5}$ NAAQS:
    - a build/no-build comparison is needed, discussed next

Guidance Reference: Section 9.3.2

Annual PM2.5 NAAQS – Build/No-Build

- Step 6 – See Step 1 for the average annual model results for **all** receptors

- Step 7 – For each receptor, add:

  Step 1 values (model results)

  \+ Step 3 result (average annual monitor background concentration)

  Step 7 results (Build Scenario DV concentration)

- Step 8 – Round to nearest 0.1 μg/m^3 and identify **all** receptors where revised Build Scenario DV > annual $PM_{2.5}$ NAAQS

- Step 9: Using **no-build** air quality modeling results, repeat calculations in Step 1 at each receptor identified in Step 8

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Guidance Reference: Section 9.3.2

Annual PM2.5 NAAQS – Build/No-Build

- Step 10: For each of these receptors where DV > NAAQS:

  Step 9 results (No-Build average annual modeled concentration)
  \+ Step 3 results (average annual monitor background concentration)
  Step 10 results (No-Build Scenario DVs)

- Step 11 - Round to nearest 0.1 $\mu g/m^3$
- Compare build and no-build DVs:
  - If at all receptors identified in Step 8, build DV ≤ no-build DV, project conforms
  - If build DV > no-build DV at any receptor, project does not conform*
    - Consider additional mitigation/control measures

*Note: Determine if any receptors are at unique locations – next slide

Annual $PM_{2.5}$ NAAQS – Receptor Appropriateness

- Conformity rule section 93.123(c)(1) requires PM hot-spot analysis to be based on "appropriate receptor location[s]"
  - If conformity is met at all receptors, it is unnecessary to determine appropriateness
  - If not, consider whether a receptor is appropriate to compare to the NAAQS

- Annual $PM_{2.5}$ NAAQS is to be monitored at "area-wide" locations (40 CFR Part 58.30(a))
  - To be consistent with the revised annual $PM_{2.5}$ NAAQS, appropriate receptors for hot-spot analysis must also represent "area-wide" air quality

- At receptors where DV > the annual $PM_{2.5}$ NAAQS or the no-build DV:
  - Are receptors at unique locations (e.g., tunnel entrance, a nearby point source, or other relatively unique location)? Then perhaps not appropriate
  - Are there a number of similar adjacent receptors? Maybe they do represent area-wide air quality
  - Important to make this determination through the interagency consultation process

Guidance Reference: Section 9.4

Calculating Design Values and Determining Conformity for the Annual $PM_{2.5}$ NAAQS

Using the Example Analysis

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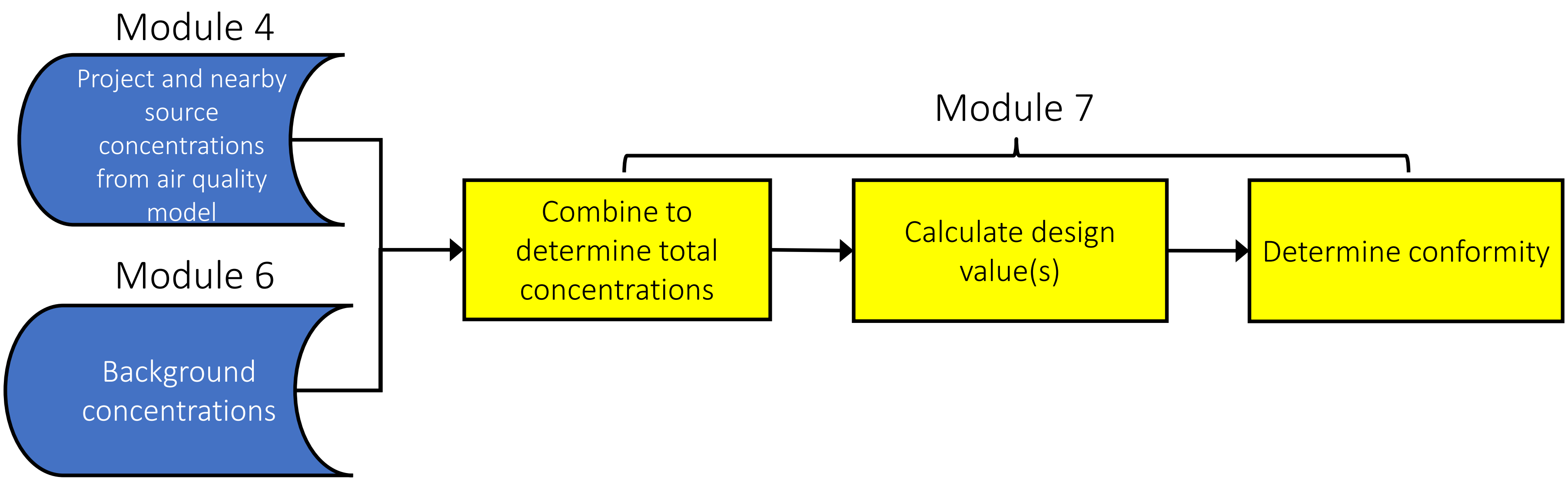
Determining DVs for the Example Analysis

- We have outputs from AERMOD from Module 4 and representative background data from Module 6

- We will combine these inputs to determine design values and conformity for the project



Steps 1 & 2: Using Modeling Results, Identify Receptor with Highest Average Annual Concentration

	A	B	C	D	E	F	G	H		
1	*	X	Y	AVERAGE CONC	ZELEV	ZHILL	ZFLAG	AVE	GRP	N
2	*									
3		9	212.8	0.25635	0.00	0.00	1.80	ANNUAL	ALL	000
4		59	212.8	0.31296	0.00	0.00	1.80	ANNUAL	ALL	000
5		109	212.8	0.36868	0.00	0.00	1.80	ANNUAL	ALL	000
6		159	212.8	0.43278	0.00	0.00	1.80	ANNUAL	ALL	000
7		209	212.8	0.51881	0.00	0.00	1.80	ANNUAL	ALL	000
8		259	212.8	0.68399	0.00	0.00	1.80	ANNUAL	ALL	000
9		9	262.8	0.22662	0.00	0.00	1.80	ANNUAL	ALL	000
10		59	262.8	0.27676	0.00	0.00	1.80	ANNUAL	ALL	000
11		109	262.8	0.34062	0.00	0.00	1.80	ANNUAL	ALL	000
12		159	262.8	0.43983	0.00	0.00	1.80	ANNUAL	ALL	000
13		9	312.8	0.22309	0.00	0.00	1.80	ANNUAL	ALL	000
14		59	312.8	0.27317	0.00	0.00	1.80	ANNUAL	ALL	000
15		109	312.8	0.34548	0.00	0.00	1.80	ANNUAL	ALL	000
16		159	312.8	0.47458	0.00	0.00	1.80	ANNUAL	ALL	000
17		9	362.8	0.22532	0.00	0.00	1.80	ANNUAL	ALL	000
18		59	362.8	0.2773	0.00	0.00	1.80	ANNUAL	ALL	000
19		109	362.8	0.35541	0.00	0.00	1.80	ANNUAL	ALL	000

All_ANNUAL

From Excel, open the plotfile "All_ANNUAL.plt"

Use the "Text Import Wizard":

- Import started row 7
- 3 columns important: X, Y, and AVERAGE CONC
- Remaining information imported as one column, for easy deletion

Steps 1 & 2: Using Modeling Results, Identify Receptor with Highest Average Annual Concentration

	A	B	C	D	E	F	G	H
1	* X	Y	AVERAGE CONC	ZELEV	ZHILL	ZFLAG	AVE	GRP	NUI
2	*	_______	_______	_______	_______	_______	_______	_______	_______
3	9	212.8	0.25635	0.00	0.00	1.80	ANNUAL	ALL	0000
4	59	212.8	0.31296	0.00	0.00	1.80	ANNUAL	ALL	00000005
5	109	212.8	0.36868	0.00	0.00	1.80	ANNUAL	ALL	00000005
6	159	212.8	0.43278	0.00	0.00	1.80	ANNUAL	ALL	00000005
7	209	212.8	0.51881	0.00	0.00	1.80	ANNUAL	ALL	00000005
8	259	212.8	0.68399	0.00	0.00	1.80	ANNUAL	ALL	00000005
9	9	262.8	0.22662	0.00	0.00	1.80	ANNUAL	ALL	00000005
10	59	262.8	0.27676	0.00	0.00	1.80	ANNUAL	ALL	00000005
11	109	262.8	0.34062	0.00	0.00	1.80	ANNUAL	ALL	00000005
12	159	262.8	0.43983	0.00	0.00	1.80	ANNUAL	ALL	00000005
13	9	312.8	0.22309	0.00	0.00	1.80	ANNUAL	ALL	00000005
14	59	312.8	0.27317	0.00	0.00	1.80	ANNUAL	ALL	00000005
15	109	312.8	0.34548	0.00	0.00	1.80	ANNUAL	ALL	00000005
16	159	312.8	0.47458	0.00	0.00	1.80	ANNUAL	ALL	00000005
17	9	362.8	0.22532	0.00	0.00	1.80	ANNUAL	ALL	00000005
18	59	362.8	0.2773	0.00	0.00	1.80	ANNUAL	ALL	00000005
19	109	362.8	0.35541	0.00	0.00	1.80	ANNUAL	ALL	00000005

All_ANNUAL

Delete unnecessary columns and rows (grayed out)

Steps 1 & 2: Using Modeling Results, Identify Receptor with Highest Average Annual Concentration

	A	B	C	D	E	F	G
1	X	Y	AVERAGE CONC				
2	485	193	2.44129				
3	527.1	111.5	2.08443				
4	448.7	373.2	1.44893				
5	527.1	161.5	1.4486				
6	470	341.8	1.40724				
7	577.1	61.5	1.29746				
8	527.1	211.5	1.25787				
9	439.4	436.7	1.24902				
10	519.6	312.4	1.21251				
11	343.4	162.5	1.20524				
12	335.3	670.6	1.19698				
13	223.1	434.8	1.16014				
14	366.2	628.4	1.15365				
15	285.3	770.6	1.14124				
16	320.2	206.8	1.13118				
17	427.7	543.3	1.1033				
18	262.1	322.8	1.09031				
19	564.2	309.3	1.07925				

All_ANNUAL

Select sheet and sort by column with Average Conc, from Largest to Smallest

Receptor with largest annual average concentration is (485,193): 2.44129 μg/m^3

Set aside while Background prepared…

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Step 3: Calculate Average Annual Monitor Concentration

	A	C	D	R	S	T	U	V
78	3/18/2014	14.9	ug/m3 LC		14.9			
79	3/19/2014	13.7	ug/m3 LC		13.7			
80	3/20/2014	10.1	ug/m3 LC		10.1			
81	3/21/2014	11.2	ug/m3 LC		11.2			
82	3/22/2014	10.1	ug/m3 LC		10.1			
83	3/23/2014	6.2	ug/m3 LC		6.2			
84	3/24/2014	7.9	ug/m3 LC		7.9			
85	3/25/2014	8.6	ug/m3 LC		8.6			
86	3/26/2014	8.3	ug/m3 LC		8.3			
87	3/27/2014	10.4	ug/m3 LC		10.4			
88	3/28/2014	10.9	ug/m3 LC		10.9			
89	3/29/2014	12.6	ug/m3 LC		12.6			
90	3/30/2014	9.7	ug/m3 LC		9.7			
91	3/31/2014	10.9	ug/m3 LC		10.9			
92	4/1/2014	8.6	ug/m3 LC		895.7		Avg Q1:	9.952222
93	4/2/2014	9.1	ug/m3 LC					
94	4/3/2014	8.3	ug/m3 LC					

Washtenaw PM2.5_data_2014 | 2015 | ...

Open monitor data files. Calculate average for each quarter of each year. (Excel functions used.)

Year 2014, Quarter 1 shown

Note that quarters do not all have the same number of days

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Step 3: Calculate Average Annual Monitor Concentration

	A	B	C	D	E	F
1		**Q1**	**Q2**	**Q3**	**Q4**	**Average**
2	**2014**	9.95222	9.04176	11.0629	8.35056	9.60187
3	**2015**	9.27556	8.83483	10.3196	8.49341	9.23084
4	**2016**	7.77826	7.83626	7.89464	8.11494	7.90603
5						8.91291

... | 2015 | 2016 | **Annual_PM2.5 Average**

Quarterly averages are placed in new spreadsheet and average for all years calculated (see Step 3).

This result is then ready to be added to modeled result

Steps 4 & 5: Add Results, Round and Compare

- Step 4:

  Step 2 result: 2.44129 $\mu g/m^3$

  \+ Step 3 result: 8.91291 $\mu g/m^3$

  Step 4 result: 11.35420 $\mu g/m^3$

- Step 5 – Round to nearest 0.1 $\mu g/m^3$: 11.4 $\mu g/m^3$

- Compare the highest receptor DV to the NAAQS:
  - 11.4 $\mu g/m^3$ < 12.0 $\mu g/m^3$
  - Project conforms for the Annual PM2.5 NAAQS; additional build/no-build steps are not needed

Calculating Design Values for the 24-Hour $PM_{2.5}$ NAAQS

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24-hour $PM_{2.5}$ NAAQS

- 2006 24-hour $PM_{2.5}$ NAAQS = 35 $\mu g/m^3$
- 1997 24-hour $PM_{2.5}$ NAAQS = 65 $\mu g/m^3$

- The 24-hour $PM_{2.5}$ design value is the average of three consecutive years' 98th percentile (98th %tile) concentrations of 24-hour values:

$$\text{24-hour } PM_{2.5} \text{ DV} = \frac{(\text{[Year1 98}^{th}\text{ \%ile] + [Year2 98}^{th}\text{ \%ile] + [Year3 98}^{th}\text{ \%ile]})}{3}$$

  - Determining 98th percentile covered in this section
  - DV is rounded to the nearest 1 $\mu g/m^3$ at the end of the calculation

Guidance Reference: Section 9.3.3

24-hour $PM_{2.5}$ NAAQS

Two analysis options, or tiers, available for DV calculation

1. Recommend beginning with first tier approach, as less post-processing is needed
    - Covered by next slides

2. Could also begin with a second tier approach, if interagency consultation determines first tier is overly conservative
    - Second tier includes following general steps:
        - Calculate *quarterly* 98^{th} percentile values from monitoring data
        - Add quarterly background concentrations to AERMOD input file
        - Run AERMOD to generate 98^{th} percentile concentration at each receptor
    - Covered in PM Hot-spot Guidance Appendix L

24-hour $PM_{2.5}$ NAAQS

- To calculate the design value for the hot-spot analysis, you need:

- Air quality modeling results
  - For each receptor, the 5-year average of the 98^{th} percentile 24-hour concentration

- Air quality monitoring data
  - 12 quarters of background concentration measurements (4 quarters for 3 consecutive years)

24-hour $PM_{2.5}$ NAAQS

Tier 1 approach: add 5-year average 98th percentile modeled concentration to 3-year average 98th percentile background concentration

- Step 1: From air quality modeling results for the build scenario, identify the receptor with the **highest 5-year average 98th percentile 24-hour concentration:**
  - AERMOD reports the 5-year average 98th percentile 24-hour concentration, in the PLOTFILE:
    - "All_eighth_24hr.plt"

Guidance Reference: Section 9.3.3

24-hour $PM_{2.5}$ NAAQS

- Step 2: Calculate the average 98th percentile 24-hour background concentration from the 3 most recent years of monitoring data:
  - Count the number of 24-hour background measurements for each year (this may vary by year)
  - For each year, sort the measurements from highest to lowest
  - Using the table at right, determine which rank corresponds to the 98th percentile for each year
  - Average the three 98th percentile values

98th Percentile Ranking Table	
Number of Background Concentration Values	Rank of Value Corresponding to 98th Percentile
1 – 50	1
51 – 100	2
101 – 150	3
151 – 200	4
201 – 250	5
251 – 300	6
301 – 350	7
351 – 366	8

24-hour $PM_{2.5}$ NAAQS

- Step 3: Add:

  Step 1 result (average 98th %ile modeled concentration)

  \+ Step 2 result (average 98th %ile background concentration)

  Step 3 result (Build Scenario DV, round to nearest 1 μg/m^3)

- Compare DV to the NAAQS:
  - If the Build Scenario DV $\leq$ 35 μg/m^3, project conforms
  - If DV > NAAQS, there are two options:
    - Complete analysis for all receptors, and for all receptors where build DV > NAAQS, calculate no-build scenario DVs
      - If build DV $\leq$ no-build DV for all receptors, project conforms
    - Or conduct a 2nd Tier analysis (PM Hot-spot Guidance Appendix L)

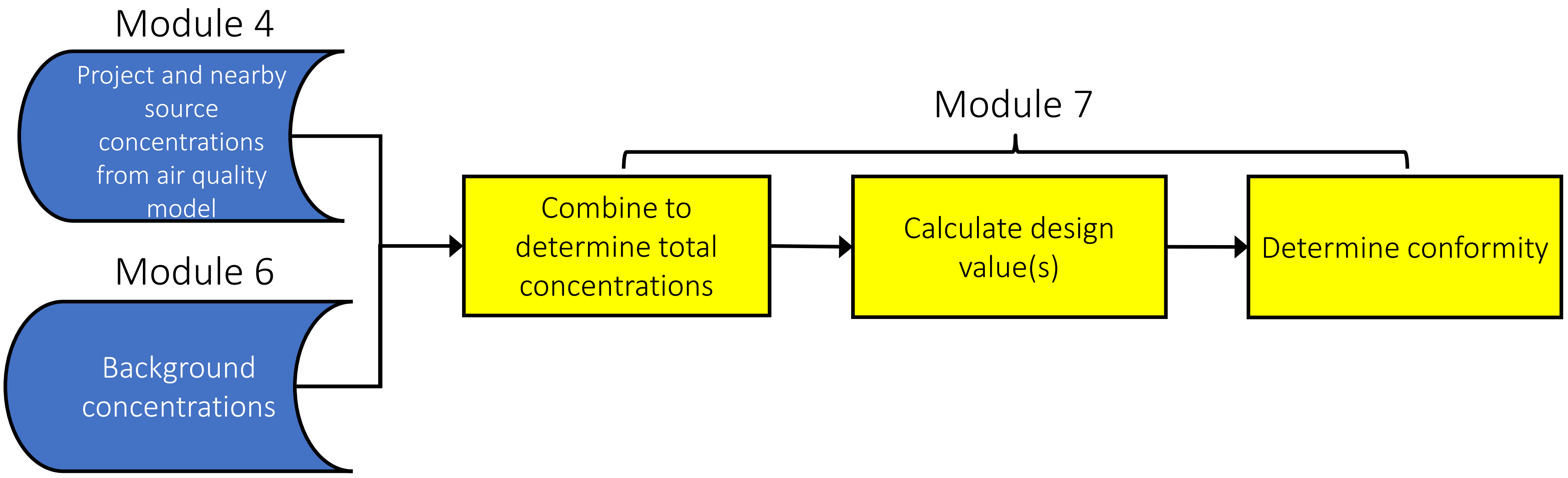
Calculating Design Values and Determining Conformity for the 24-Hour $PM_{2.5}$ NAAQS

Using the Example Analysis

Determining DVs for the Example Analysis

- We have outputs from AERMOD from Module 4 and representative background data from Module 6

- We will combine these inputs to determine design values and conformity for the project



Step 1: Identify Highest 98th Percentile Modeled Concentration

	A	B	C	D	E		F				
1	*	X	Y	AVERAGE CONC	ZELEV	ZH	AVER CON	DAT			
2	*										
3		9	212.8	1.06449	0.00	0.0	1.07	110			
4		59	212.8	1.20855	0.00	0.0	1.21454	111			
5		109	212.8	1.39418	0.00	0.0	1.34791	111			
6		159	212.8	1.56871	0.00	0.0	1.49652	110			
7		209	212.8	1.84679	0.00	0.0	1.72957	111			
8		259	212.8	2.40604	0.00	0.0	2.24865	111			
9		9	262.8	1.04415	0.00	0.0	1.05747	110			
10		59	262.8	1.22309	0.00	0.0	1.22297	110			
11		109	262.8	1.46143	0.00	0.0	1.43557	111			
12		159	262.8	1.82328	0.00	0.0	1.75383	111			
13		9	312.8	1.06637	0.00	0.0	1.06701	110			
14		59	312.8	1.25979	0.00	0.0	1.21405	111			
15		109	312.8	1.54948	0.00	0.0	1.40452	11122124	1.53978	12121524	1.
16		159	312.8	2.01823	0.00	0.0	1.85677	11013024	1.99269	12122424	2.
17		9	362.8	1.12623	0.00	0.0	1.06047	11122124	1.03521	12032324	1.

All_eighth_24hr

From Excel, open the plotfile “All_eighth_24hr.plt”

As before, use the “Text Import Wizard”:

- Import started row 7
- 3 columns important: X, Y, and AVERAGE CONC
- Remaining information imported and can be deleted

EPA

Step 1: Identify Highest 98th Percentile Modeled Concentration

	A	B	C	D	E		F	G			
1	*	X	Y	AVERAGE CONC	ZELEV	ZH	AVER CON	DATE			
2	*										
3		9	212.8	1.06449	0.00	0.0	1.07	11013124			1.
4		59	212.8	1.20855	0.00	0.0	1.21454	11122124	1.18948	12111924	1.
5		109	212.8	1.39418	0.00	0.0	1.34791	11122124	1.38614	12111924	1.
6		159	212.8	1.56871	0.00	0.0	1.49652	11033024	1.56672	12120824	1.
7		209	212.8	1.84679	0.00	0.0	1.72957	11101024	1.88763	12122824	1.
8		259	212.8	2.40604	0.00	0.0	2.24865	11101024	2.5135	12021924	2.
9		9	262.8	1.04415	0.00	0.0	1.05747	11013124	1.02387	12122824	1.
10		59	262.8	1.22309	0.00	0.0	1.22297	11013124	1.18424	12111924	1.
11		109	262.8	1.46143	0.00	0.0	1.43557	11122124	1.43829	12121524	1
12		159	262.8	1.82328	0.00	0.0	1.75383	11122124	1.80071	12121524	1
13		9	312.8	1.06637	0.00	0.0	1.06701	11013124	0.99359	12011124	1.
14		59	312.8	1.25979	0.00	0.0	1.21405	11122124	1.21502	12111924	1.
15		109	312.8	1.54948	0.00	0.0	1.40452	11122124	1.53978	12121524	1.
16		159	312.8	2.01823	0.00	0.0	1.85677	11013024	1.99269	12122424	2.
17		9	362.8	1.12623	0.00	0.0	1.06047	11122124	1.03521	12032324	1.

All_eighth_24hr

Delete unnecessary columns and rows (grayed out)

Step 1: Identify Highest 98th Percentile Modeled Concentration

	A	B	C
1	X	Y	AVERAGE CONC
2	485	193	5.74653
3	527.1	111.5	5.15072
4	527.1	161.5	3.686
5	448.7	373.2	3.68237
6	470	341.8	3.51151
7	513.2	13.1	3.3836
8	577.1	61.5	3.33489
9	198.5	364.8	3.27515
10	439.4	436.7	3.2083
11	527.1	211.5	3.19976
12	201	313.3	3.15639
13	335.3	670.6	3.14873
14	320.2	206.8	3.11745
15	519.6	312.4	3.10277
16	285.3	770.6	3.08144
17	292.7	253.2	3.08103

All_eighth_24hr

Select sheet and sort by column with Average Conc, from Largest to Smallest

Receptor with largest average 98th percentile concentration is (485,193): 5.74653 µg/m^3

Set aside while Background prepared…

Step 2: Calculate the average 98th percentile 24-hour background concentration from the 3 most recent years of monitoring data

- Using the background data from Washtenaw County:
  - Count the number of 24-hour background measurements for each year (done using Excel)
  - For each year, sort the measurements from highest to lowest (done using Excel)
  - Using the table on slide 32, determine which rank corresponds to the 98th percentile for each year
  - Average the three 98th percentile values

Year	Number of measurements	Rank corresponding to 98th percentile	Value of that rank
2014	359	8th	20.0
2015	362	8th	19.6
2016	324	7th	14.9
		3-year average 98th Percentile:	18.167

Step 3: Add Step 1 and Step 2 Results

98th percentile modeled concentration:	5.74653
98th percentile background concentration:	+ 18.16667
Step 3 result:	23.91319

Round to nearest 1 μg/m^3 : 24

Compare to NAAQS: 24 μg/m^3 < 35 μg/m^3 , (24-hour PM2.5 NAAQS), therefore project conforms

- If DV > NAAQS, either modeling no-build concentrations or Tier 2 analysis would be conducted

Calculating Design Values for the 24-hour PM_{10} NAAQS

24-hour PM_{10} NAAQS

- Compliance with the NAAQS is based on the expected number of exceedances of the level (150 µg/m^3)

- NAAQS is met when expected number of exceedances, averaged over 3 consecutive years, is $\leq$ 1.0 :

  Expected exceedances = [total exceedances in 3 years] ÷ 3

- Design value is rounded to nearest 10 µg/m^3

Guidance Reference: Section 9.3.4

24-hour PM_{10} NAAQS

To calculate the design value, you need:

- Air quality modeling results
  - If you used 5 years of met data for air quality modeling, calculate the 6th highest 24-hour modeled concentration at each receptor
- Air quality monitoring data
  - 12 quarters of background concentration measurements (4 quarters for 3 consecutive years)

24-hour PM_{10} NAAQS

- Step 1: For each receptor, identify the 6th highest 24-hour modeled concentration at each receptor across 5 years of met data

  - AERMOD can produce these values:
    - **CO** pathway: Specify **AVERTIME 24, POLLUTID PM10**
    - **OU** pathway: Specify **RECTABLE 24 6**
    - These selections will generate the 6th highest concentration across the 5 years of met data for each receptor in "aermod.out"

- Step 2: Identify the receptor with the highest 6th highest 24-hour concentration
  - "aermod.out" includes this highest 6th highest value near the bottom

Steps 1 & 2: The receptor with the highest “6th highest” 24-hour modeled concentration is identified

PM10H6H_output.txt - Notepad

File Edit Format View Help

```
                        *** THE   6TH HIGHEST 24-HR AVERAGE CONCENTRATION   VALUES FOR SOURCE GROUP:  PROJECT  ***
                              INCLUDING SOURCE(S):      LINK1    , LINK2    , LINK3    , LINK5    , LINK4    , LINK7    , LINK8    ,
         LINK9    , LINK6    ,

                                           *** DISCRETE CARTESIAN RECEPTOR POINTS ***

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

     X-COORD (M)  Y-COORD (M)         CONC      (YYMMDDHH)             X-COORD (M)  Y-COORD (M)
 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
         -185.20       -68.50       1.19763  (94041324)                -180.20       -68.50
         -175.20       -68.50       1.65840c (95022824)                -170.20       -68.50
         -165.20       -68.50       2.34931c (92012824)                -160.20       -68.50
         -155.20       -68.50       2.49902c (91072624)                -150.20       -68.50
         -145.20       -68.50       2.49965c (93101524)                -140.20       -68.50
         -135.20       -68.50       2.41171c (93111024)                -130.20       -68.50
         -125.20       -68.50       2.19417  (92020324)                -120.20       -68.50
         -115.20       -68.50       2.01533  (94121824)                -110.20       -68.50
         -105.20       -68.50       1.87890c (91010324)                -100.20       -68.50
          -95.20       -68.50       1.70189  (95121224)                -185.20       -63.50
         -180.20       -63.50       1.52154  (94041324)                -175.20       -63.50
         -170.20       -63.50       2.29864c (95022824)                -165.20       -63.50
         -160.20       -63.50       2.80098c (91021824)                -155.20       -63.50
         -150.20       -63.50       2.80472c (93101524)                -145.20       -63.50       2.81320c (93101524)
         -140.20       -63.50       2.78635c (93101524)                -135.20       -63.50       2.75226c (93111024)
         -130.20       -63.50       2.63883  (91021924)                -125.20       -63.50       2.51908c (91010324)
         -120.20       -63.50       2.44829  (91072724)                -115.20       -63.50       2.32923  (94121824)
         -110.20       -63.50       2.32954  (93110724)                -105.20       -63.50       2.17072c (91010324)
         -100.20       -63.50       2.04829  (95121224)                 -95.20       -63.50       1.88252  (91101224)
         -185.20       -58.50       1.24533  (94041324)                -180.20       -58.50       1.58453  (94041324)
         -175.20       -58.50       2.02500  (94041324)                -170.20       -58.50       2.47549  (94041324)
         -165.20       -58.50       3.09437c (91102324)                -160.20       -58.50       3.28599c (91021824)
         -155.20       -58.50       3.30983  (95011224)                -150.20       -58.50       3.26450c (91021824)
         -145.20       -58.50       3.18707  (92122924)                -140.20       -58.50       3.19570  (92122924)
         -135.20       -58.50       3.13641  (95011224)                -130.20       -58.50       2.99487c (93101524)
         -125.20       -58.50       2.86225  (91021924)                -120.20       -58.50       2.75042  (91081224)
         -115.20       -58.50       2.78615c (91031624)                -110.20       -58.50       2.68703  (91092824)
         -105.20       -58.50       2.52422  (91092824)                -100.20       -58.50       2.38279  (91032524)
         -175.20       -38.50       1.70923  (93011424)                -170.20       -38.50       2.09168c (92022224)
         -100.20       -38.50       2.46729c (95112324)                 -95.20       -38.50       2.10214c (94012024)
         -185.20       -33.50       1.10191  (93041524)                -180.20       -33.50       1.34635  (93041524)
         -175.20       -33.50       1.64744  (95031624)                -170.20       -33.50       2.09788  (93050524)
         -100.20       -33.50       2.55401c (95112324)                 -95.20       -33.50       2.22003c (91120724)
         -185.20       -28.50       1.06986  (93041524)                -180.20       -28.50       1.31654  (92042124)
         -175.20       -28.50       1.65081  (92042124)                -170.20       -28.50       2.20333  (93050524)
         -100.20       -28.50       2.86019c (95112324)                 -95.20       -28.50       2.44142  (94020224)
         -185.20       -23.50       1.05040  (93050524)                -180.20       -23.50       1.26702  (92042124)
         -175.20       -23.50       1.53686  (92042124)                -170.20       -23.50       1.90265  (94061124)


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

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

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

PROJECT  HIGH  6TH HIGH VALUE IS     3.65486c ON 91102224: AT (   -110.20,     -23.50,      0.00,      0.00,      1.80)  DC
```

Receptor with highest 6th high value is specifically noted in AERMOD output (aermod.out) – no further action needed

24-hour PM_{10} NAAQS

- Step 3: Identify the appropriate 24-hour monitor value for the background concentration from the 3 most recent years of monitoring data, based on the following table:

Number of Background Concentrations from the Monitor	Monitor Value Used for DV Calculation
< 347	Highest value
348 - 695	Second highest
696-1042	Third highest
1043-1096	Fourth highest

24-hour PM_{10} NAAQS

- Step 4: Add:

  Step 1 result (highest 6th highest modeled concentration)

  \+ Step 2 result (appropriate background monitor concentration)

  Step 4 result (DV at receptor with highest 6th high concentration)

- Step 5: Round to the nearest 10 $\mu g/m^3$
- Assessment
  - If build DV $\leq$ 24-hour PM10 NAAQS (150 $\mu g/m^3$): project conforms
  - If DV > NAAQS in analysis, complete a build/no-build analysis for all receptors – shown on next slides

24-hour PM_{10} NAAQS

Build Scenario

- Step 6: For each receptor, add

  Step 1 result (6th highest modeled concentration)

  \+ Step 3 result (appropriate background monitor concentration)

  Step 6 result (**Build scenario DVs**)

- Step 7: Round DVs to nearest 10 μg/m^3 and identify all receptors where build scenario DVs > 150 μg/m^3

24-hour PM_{10} NAAQS

No-Build Scenario

- Step 8: From **no-build** AQ modeling results, identify the **6th highest** modeled **concentration** at each receptor identified in Step 7

- Step 9: Add

  Step 8 result (6th highest modeled concentration)

  \+ Step 2 result (appropriate background monitor concentration)

  Step 9 result (**No-build scenario DVs**)

- Step 10: Round to the nearest 10 μg/m³
- For each receptor identified in Step 7, compare build and no-build DVs; if build DVs ≤ no-build DVs, conformity is met

Questions?

End of Module 7

Wrap Up

- What did we cover?
  - General requirements in accordance with EPA PM Hot-spot Guidance
  - How to complete a PM hot-spot analyses using MOVES at the project level and AERMOD to complete air quality modeling
  - How to obtain and use background concentrations
  - Calculating design values and determining conformity
- Any questions on any of the course material?

Keep in Mind

- Sources of help include:
  - EPA's Quantitative PM Hot-spot Guidance
  - EPA's websites for MOVES modeling, air quality modeling, and monitoring data
  - Examples - this training, FHWA's webpage
  - EPA Regional Offices – involve EPA early to ensure analysis meets regulatory requirements. Regional Offices can contact EPA OTAQ as needed

- A modeling protocol is useful: describes the modeling to be done before the time is spent modeling
  - Can save time
  - Helpful for decision making and interagency consultation
  - See Appendix W

Wrap Up

- Before you leave, please return course evaluation sheet
  - Feedback will be used to iterate and improve the course

- Pick up your course completion certificate

- Thank you!