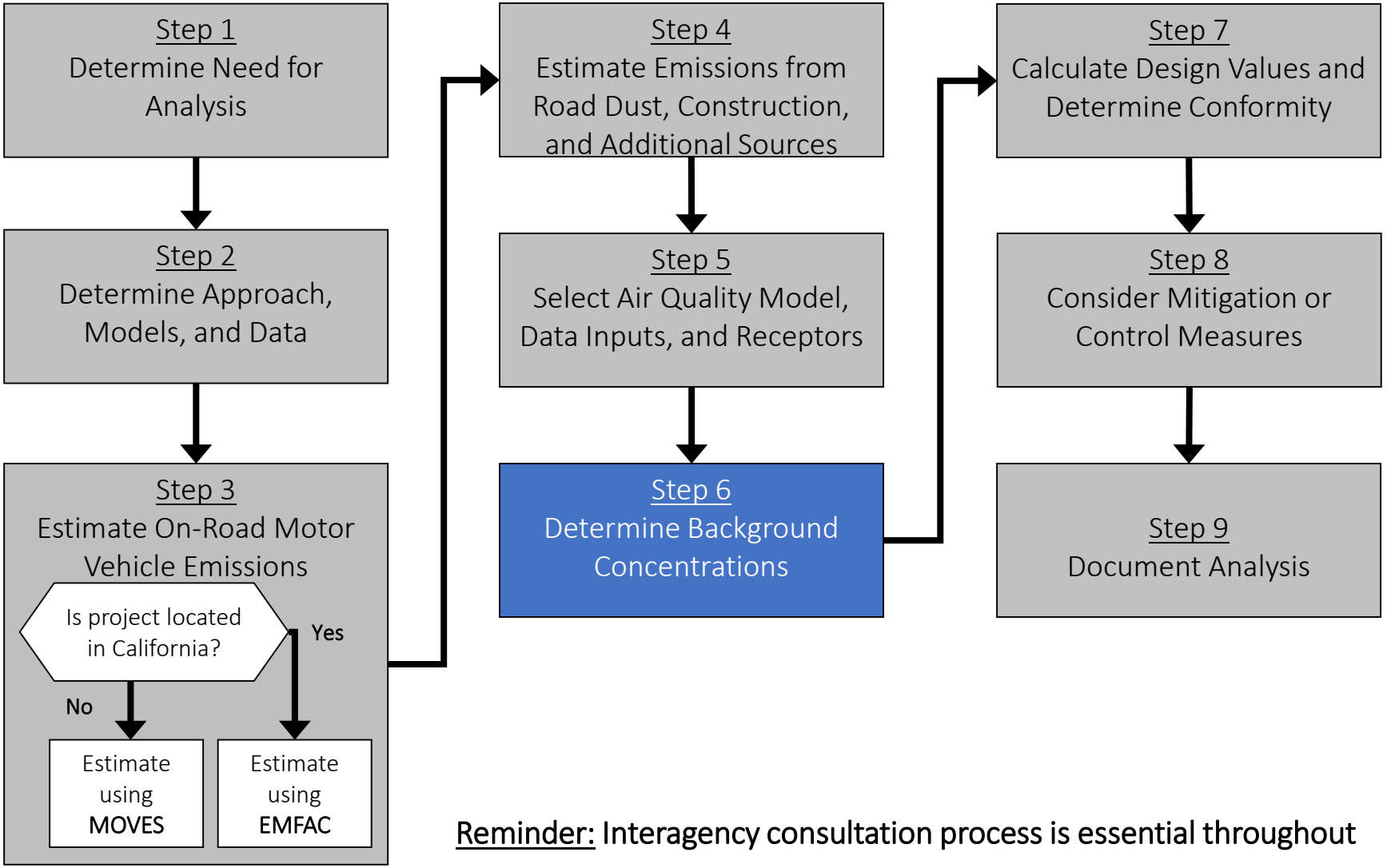
Module 6
Determining Background Concentrations

EPA

Completing a PM Hot-spot Analysis



Reminder: Interagency consultation process is essential throughout

Module Overview

- Background concentrations
- Nearby Sources
- Options for Determining Background Concentrations
- Preparing background data for the example analysis

Key References

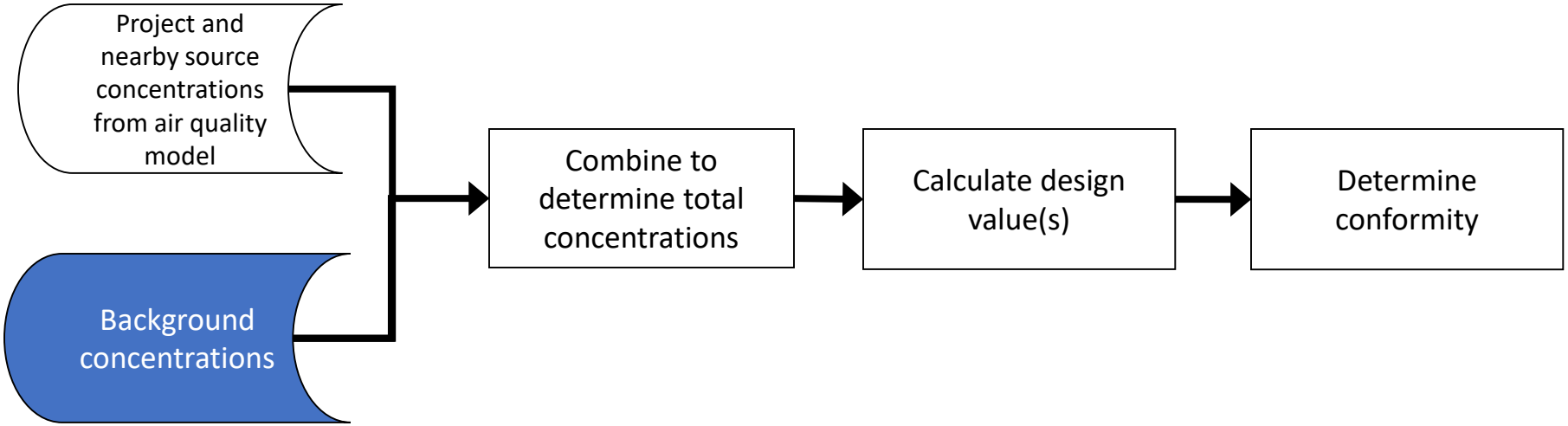
- PM Hot-spot Guidance, Section 8
- Conformity rule, Sections 93.105(c)(1)(i) and 93.123(c)
- 40 CFR Part 51, Appendix W, Section 8.3
- "Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5 and Regional Haze" (EPA-454/B-07-002, April 2007)
- EPA's Support Center for Regulatory Atmospheric Modeling (SCRAM) website

Background Concentrations

How Do Background Concentrations Fit In?

- Section 93.123(c)(1) states that "estimated pollutant concentrations must be based on the total emission burden which may result from the implementation of the project, summed together with future background concentrations…"
  - ***Note:*** *options for future background concentrations described in this module; often latest background concentrations from monitors used*

- Background concentrations are combined with air quality modeling results to generate design values and determine project conformity



What Do Background Concentrations Include?

- "Background concentrations" are those emissions not from the project that also affect the project area from nearby sources and other sources

  - Nearby sources: Individual sources other than the project that contribute to ambient PM concentrations in the project area

  - Other sources: Emissions not from project or any nearby source that is modeled

- Will be different for PM compared to CO. PM typically more complex with types of emission sources

Using Interagency Consultation

- Evaluating and choosing background for a hot-spot analysis must be made through interagency consultation process (40 CFR 93.105(c)(1)(i)). Examples:
  - How to handle nearby source emissions
  - What representative background data to use

- State and local air quality agencies have primary expertise, data, and understanding of project area

- EPA Regional Offices are key resource due to expertise with SIP modeling, air quality monitoring networks, etc.

- Applies throughout this module

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Guidance Reference: Section 8.2

Nearby Sources

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Handling Nearby Source Emissions

- Nearby sources: Individual sources other than the project that contribute to ambient PM concentrations in the project area

- In general, nearby sources need to be specifically included in AQ modeling only when affected by the project
  - Example: a port, rail yard, or intermodal terminal where emissions will increase as result of a highway project

- Most PM hot-spot analyses will not involve modeling of nearby sources that are not affected by the project (e.g., stationary sources)
  - In limited cases, include in modeling if not captured in background concentrations for the project area

Handling Nearby Source Emissions

- AERMOD is recommended when nearby sources are modeled
  - Add to the AERMOD input file
  - Ensure consistency with coordinate system used (e.g., place in appropriate location relative to the project)
  - Use source-specific emission factors

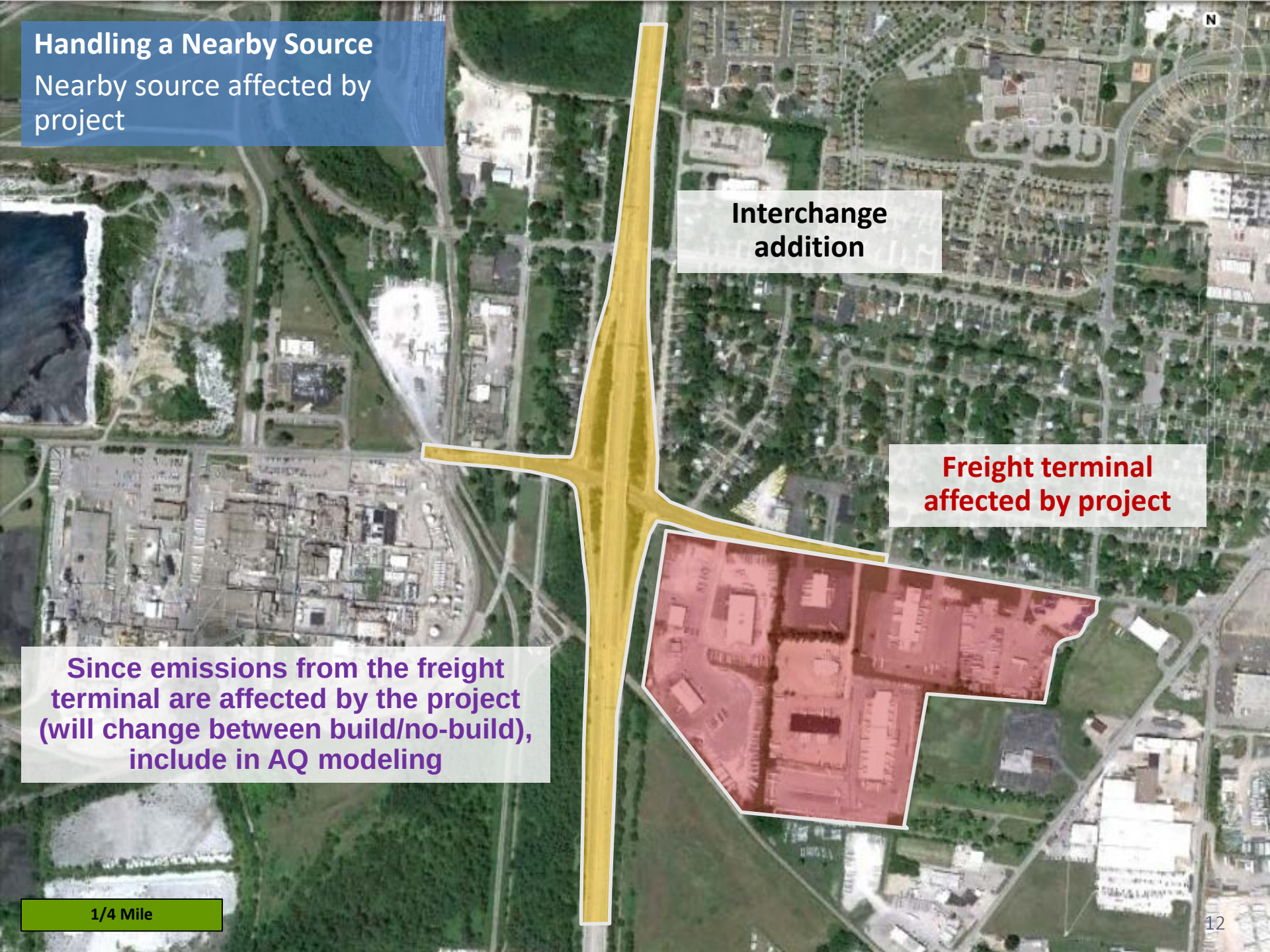
- Emission factors used should be consistent with any permits and other regulatory purposes

- PM Hot-spot Guidance Appendix I provides procedures for generating emission factors from locomotives

- Consult with state and local air agency

Handling a Nearby Source

Nearby source affected by project



Determining the Project Area with a Nearby Source

- Let's revisit "What is the Project Area: Case A" from Module 3, this time with a nearby source that requires modeling.

- Case A was an expansion of an existing highway segment (~4 miles) with associated interchange reconfiguration.

- Now, suppose a nearby source that is not part of the project (a rail yard) is adjacent to the highway
  - It is affected by the project: the local railroad company expects that additional trucks will take advantage of the highway expansion to use this rail yard to deliver goods for intermodal transfer


Case A Revisited:
Highway widening & intersection reconstruction with nearby source
Hypothetical situation
Project footprint
Rail yard affected by project
1/2 mile
500 m

Determining the Project Area with a Nearby Source

- In contrast to the original situation, how would the rail yard be treated in this analysis?

- Where would receptors be placed for air quality modeling?

Where would receptors be placed?

Hypothetical situation

Where would receptors be placed?

Hypothetical situation

Determining the Project Area: Case A

- In contrast to the original situation, how would the rail yard be treated in this analysis?
  - The rail yard would be included in air quality modeling because its emissions are changing between the no-build and build scenarios
  - This is in addition to the highway and interchange

- Where would receptors be placed for air quality modeling?
  - Receptors should be placed in appropriate locations to estimate the highest concentrations and possible violation of a NAAQS
  - Receptors are not needed in the highway right-of-way, locations not accessible to the public, etc.

Options for Determining Background Concentrations

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Determining Background Concentrations

- Includes emissions from other sources as well as nearby sources *not* included in air quality modeling

- Options for background concentrations include:
  - Using data from one or more air quality monitors
  - Using a chemical transport model (CTM)
  - Using an on-road mobile source adjustment factor
  - Other options as considered by EPA

- Use same background concentrations for build and no-build scenarios at all receptors

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Guidance Reference: Section 8.3

Using a Single Monitor

- Monitor used should be as representative of the project area as is possible

- Most likely option

- Critical to obtaining an accurate design value for the project

- Simplest approach: consider monitor closest to and upwind of the project

- However, several factors should be evaluated when considering if a monitor is representative

Considering Monitor Representativeness

- Similar characteristics between monitor location and project area
  - Is there the same density/mix of sources?
  - Does monitor capture nearby source emissions?
  - Are land use/terrain similar?
  - Are monitor and project at similar height?
  - What is the purpose of the monitor and it's geographic representation?

- Distance of monitor from project area
  - Closer monitors often are more representative – but not always
  - Weigh all considerations

- Wind patterns between monitor and project area
  - Upwind monitors are more likely to be representative. Give preference, when appropriate

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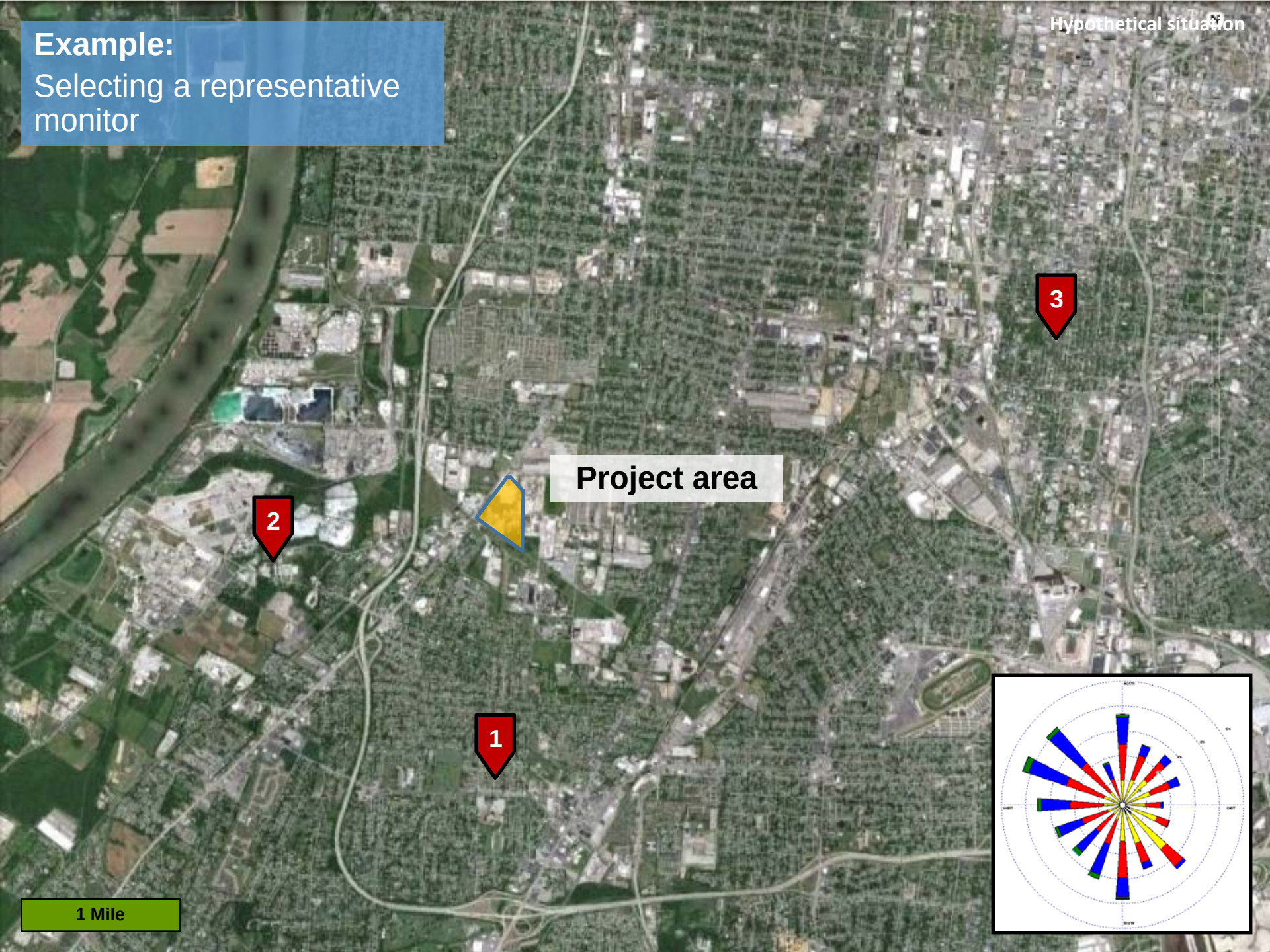
Guidance Reference: Section 8.3.1

Example:
Selecting a representative monitor

Hypothetical situation



Example:
Selecting a representative monitor

Hypothetical situation

Downwind and further away, dissimilar source mix

3

Close and upwind w/similar mix of sources

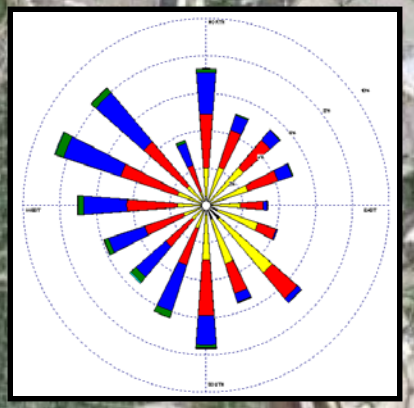
2

Project area

May be best choice

Close and upwind, but dissimilar source mix

1



1 Mile

Interpolating Between Several Monitors

- Option when a single monitor is not deemed representative
- Can address gradient in concentrations across an area
- There are several methods available; see PM Hot-Spot Guidance for details
- Interagency consultation should be used prior to selecting this method

Using Ambient Monitoring Data - Guidance

- Use the three most recently available years of monitoring data for PM hot-spot analyses

- Do not use monitoring data for which EPA has granted data exclusion under the exceptional events rule

- Use interagency consultation process to determine most appropriate monitor(s) for specific project

Using Ambient Monitoring Data

- Project sponsors, state and local air agencies, and EPA Regional Offices should identify appropriate data, along with monitor's…
  - Location
  - Purpose
  - Geographic scale
  - Nearby land uses
  - Sampling frequency

- Monitor selected should be appropriate for use for regulatory purposes (FRM or FEM)

- Air quality monitor data can also be found at EPA's AirData website: www.epa.gov/outdoor-air-quality-data

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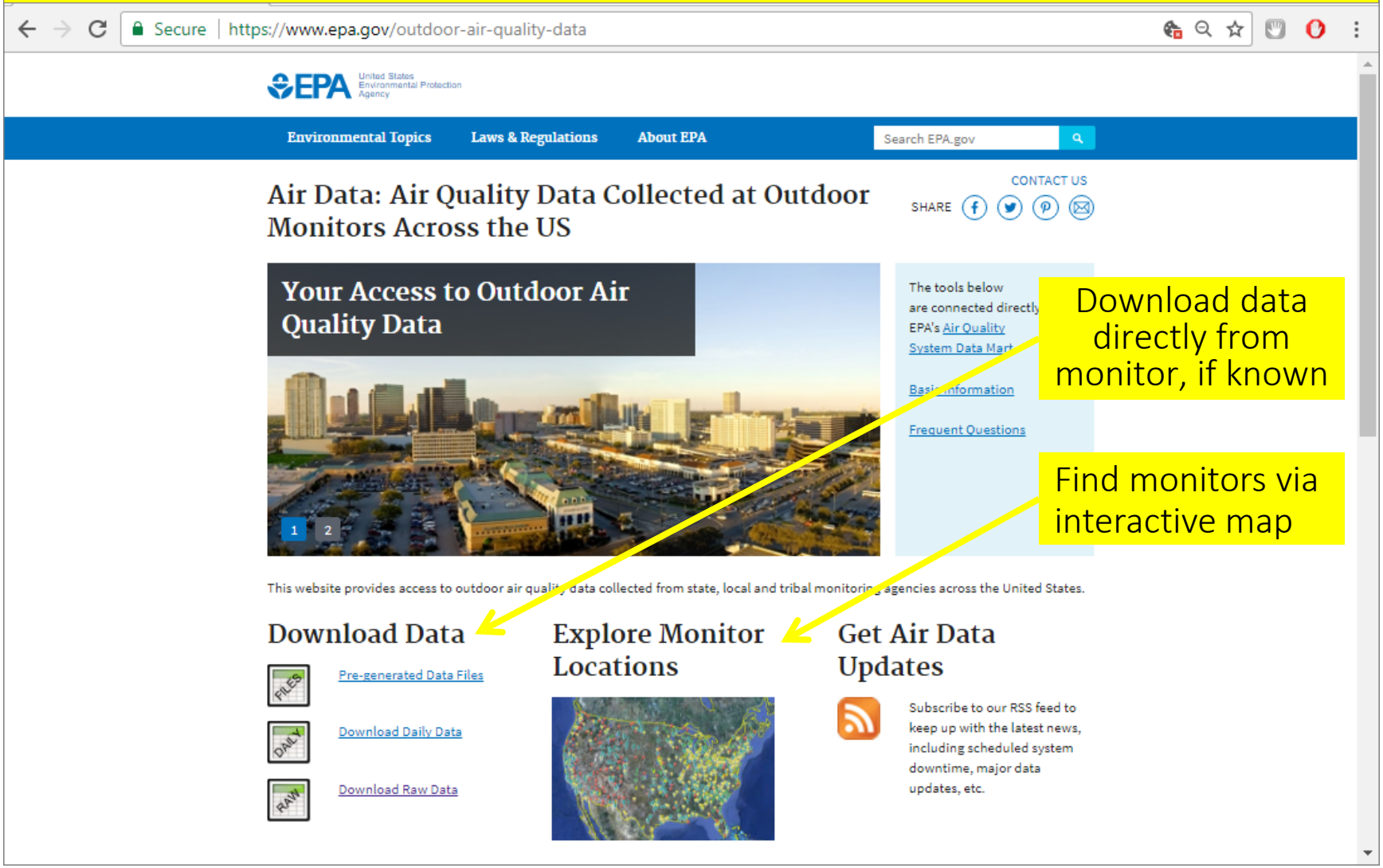
Guidance Reference: Section 8.3.1

Using EPA's AirData Website

www.epa.gov/outdoor-air-quality-data



Using Chemical Transport Models

- CTMs are photochemical models used in SIPs and EPA regulatory analyses that can be used to predict future year concentrations.
  - In these analyses, CTM modeling is completed for a base and future year, and the resulting PM concentrations are used to develop relative response factors (RRFs)
  - RFFs are then used to adjust the air quality monitoring data from the base year of the SIP

- Two CTM options might be available for PM hot-spot analyses:
  - Future year PM concentrations may already be available from existing state, local, or EPA air quality modeling for representative monitor
  - Future year PM concentrations can be created by post-processing CTM outputs that are available

CTM Options

- EPA's Modeled Attainment Test Software (MATS) program can produce both types of data
  - www.epa.gov/scram/photochemical-modeling-tools

- Check with air quality agencies for data
  - Project sponsors are not expected to run CTMs for an analysis

- Consult with EPA Regional Offices, OTAQ, and OAQPS and use interagency consultation process before using any CTM options

Using CTMs - Guidance

- Data should be representative of the project area

- EPA's "Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze" includes recommended procedures on projecting $PM_{2.5}$ concentrations using CTMs: www.epa.gov/ttn/scram/guidance/guide/Draft_O3-PM-RH_Modeling_Guidance-2014.pdf

- See PM Hot-spot Guidance for criteria and more details when using CTM options

Using An On-Road Mobile Source Adjustment Factor

- If appropriate, would follow section 93.123(c)(2)
  - Calculate an adjustment factor ratio of future to current traffic and the ratio of future to current emission factors
  - Apply adjustment factor to representative AQ monitor data

- Not a viable option in $PM_{2.5}$ areas and most PM_{10} areas

- Option in limited cases in PM_{10} areas that are dominated by on-road mobile emissions (e.g., 75% or more of inventory)
  - Consult with EPA Regional Office to determine if option should be considered on a case-by-case basis

Class Experiences with Background & Monitoring Data

- Does anyone have experience with collecting, selecting, or using air quality monitor data for regulatory purposes?
  - Successes, challenges, lessons learned?
  - What agencies/sources has this data or helped obtain it?

- Does anyone have experience with CTM modeling?
  - Any thoughts on how it might apply for a PM hot-spot analysis?
  - What agencies/sources completed the CTM modeling or had access to the data?

- Other thoughts or recommendations to share?

Preparing Background Data for the Example Analysis

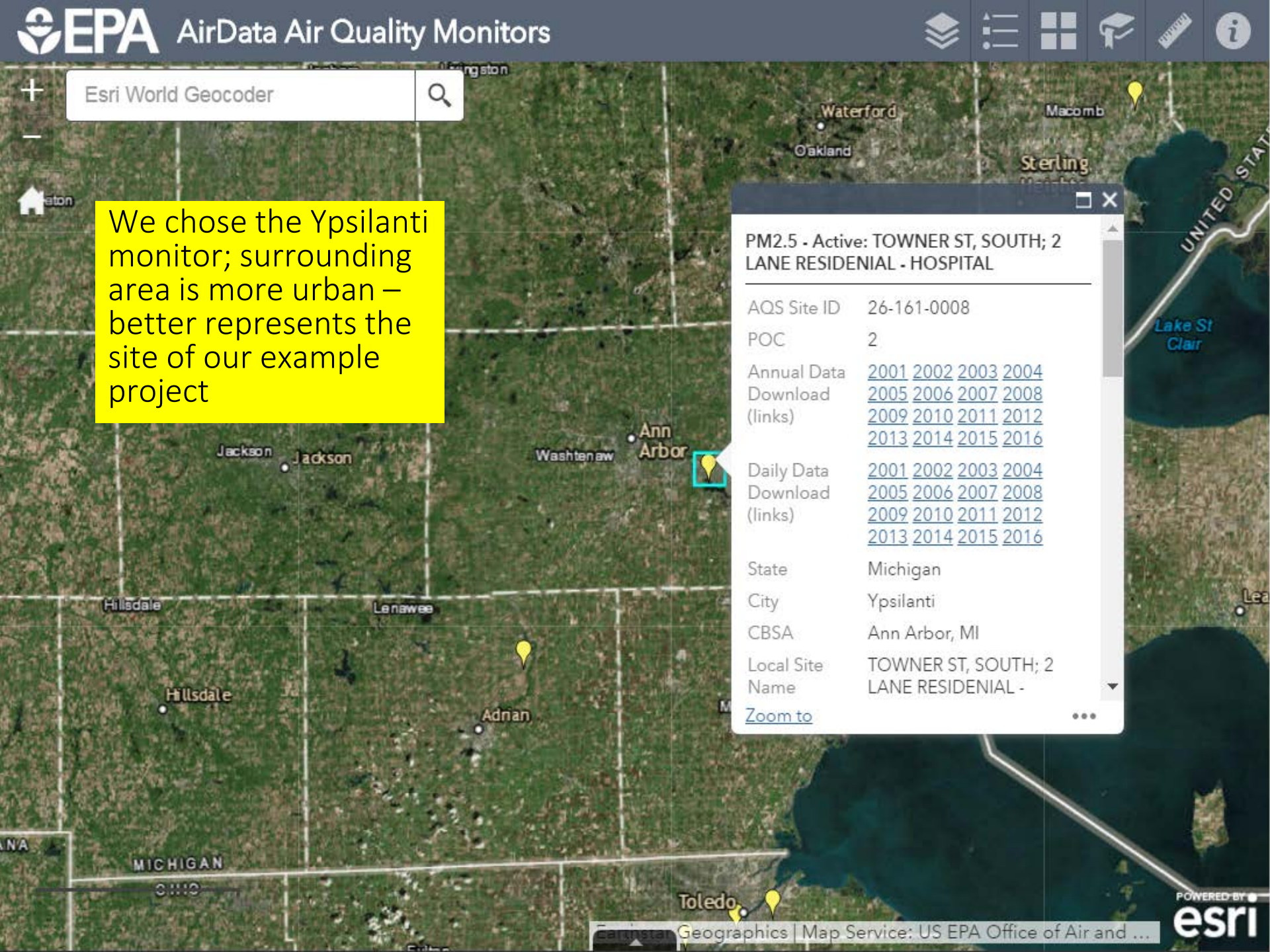
Obtaining Background Data from Monitor

- For our example analysis, we have chosen a single monitor that has been deemed representative of PM2.5 background concentrations in the project area
  - From Module 2: the location of the project is Washtenaw County, MI

- Data was obtained from EPA's AirData website
  - Per guidance, selected the three most recently available years: 2014, 2015, and 2016
  - Monitor selected uses an every day monitoring cycle
    - Other monitors at the site take readings 1:3 and 1:6 days

- For ease of use when calculating design values later, data from all three years are brought into a single Excel spreadsheet (see following slides)


EPA AirData Air Quality Monitors
Esri World Geocoder
Yellow pins represent the PM2.5 monitors -
Which monitor is most representative of our project location?
Waterford
Oakland
Macomb
Sterling Heights
Farmington Hills
Novi
Southfield
Livonia
Wayne
Lake St Clair
Westland
Canton
Dearborn Heights
Detroit
Windsor
Taylor
Essex
Ann Arbor
Washtenaw
Jackson
Jackson
Hillsdale
Lenawee
Hillsdale
Adrian
Monroe
Toledo
MICHIGAN
OHIO
Geographics | Map Service: US EPA Office of Air and ...
POWERED BY esri


EPA AirData Air Quality Monitors
Esri World Geocoder
We chose the Ypsilanti monitor; surrounding area is more urban – better represents the site of our example project
PM2.5 - Active: TOWNER ST, SOUTH; 2 LANE RESIDENIAL - HOSPITAL
AQS Site ID 26-161-0008
POC 2
Annual Data Download (links) 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016
Daily Data Download (links) 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016
State Michigan
City Ypsilanti
CBSA Ann Arbor, MI
Local Site Name TOWNER ST, SOUTH; 2 LANE RESIDENIAL -
Zoom to
Waterford
Oakland
Macomb
Sterling
Lake St Clair
Ann Arbor
Washtenaw
Jackson
Hillsdale
Lenawee
Adrian
Toledo
MICHIGAN
OHIO
Geographics | Map Service: US EPA Office of Air and ...
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Air Data: Air Quality Data Collected at Outdoor Monitors Across the US

CONTACT US

SHARE

Your Access to Outdoor Air Quality Data

The tools below are connected directly to EPA's Air Quality System Data Mart.

Basic Information

Frequent Questions

This website provides access to outdoor air quality data collected from state, local and tribal monitoring agencies across the United States.

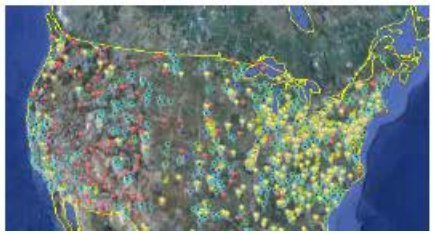
Download Data

Pre-generated Data Files

Download Daily Data

Download Raw Data

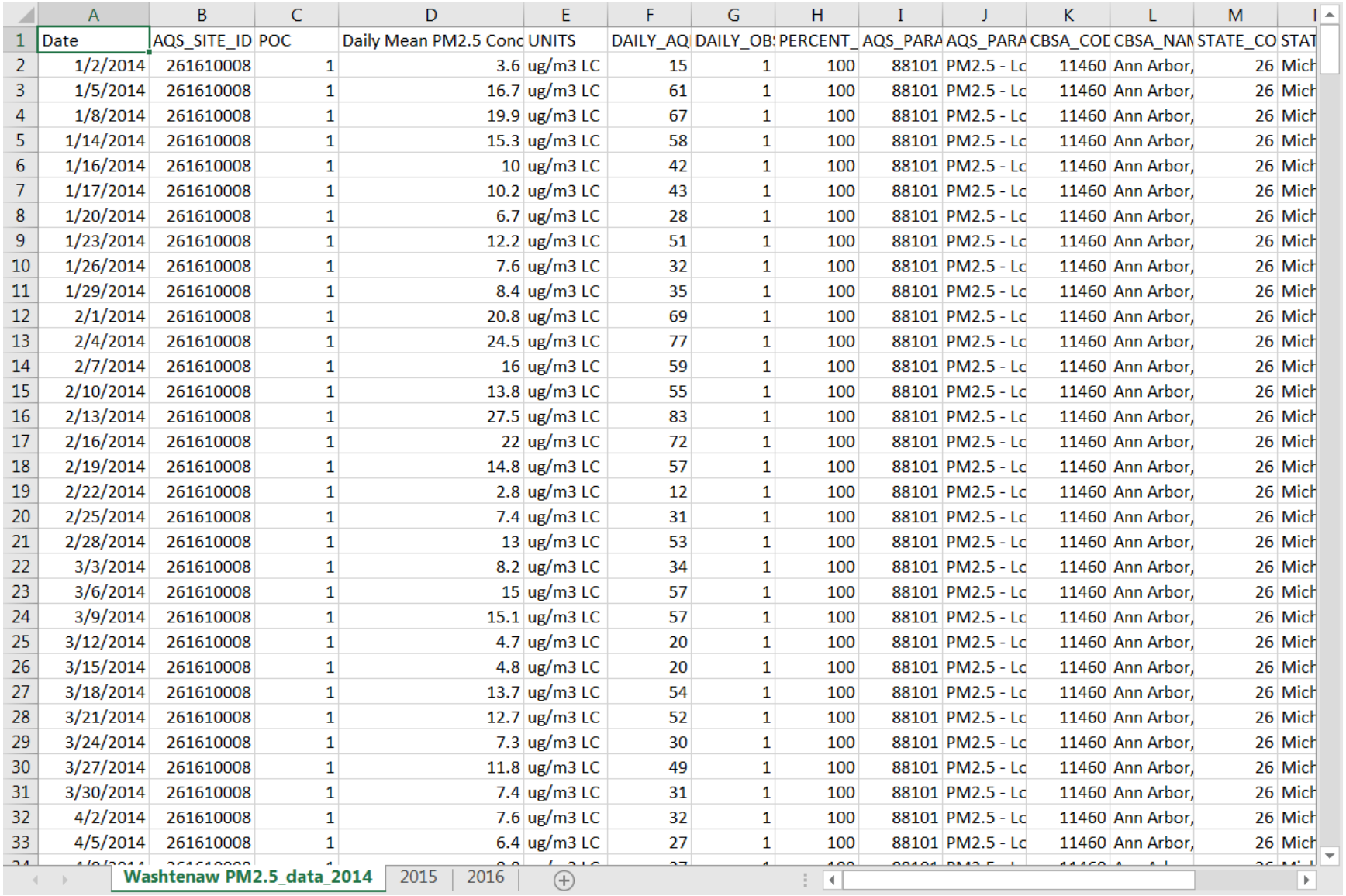
Explore Monitor Locations



Get Air Data Updates

Subscribe to our RSS feed to keep up with the latest news, including scheduled system downtime, major data updates, etc.

Monitor Data for 2014



	A	B	C	D	E	F	G	H	I	J	K	L	M	
1	Date	AQS_SITE_ID	POC	Daily Mean PM2.5 Conc	UNITS	DAILY_AQ	DAILY_OB	PERCENT_	AQS_PARA	AQS_PARA	CBSA_COI	CBSA_NAI	STATE_CO	STAT
2	1/2/2014	261610008	1	3.6	ug/m3 LC	15	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich
3	1/5/2014	261610008	1	16.7	ug/m3 LC	61	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich
4	1/8/2014	261610008	1	19.9	ug/m3 LC	67	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich
5	1/14/2014	261610008	1	15.3	ug/m3 LC	58	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich
6	1/16/2014	261610008	1	10	ug/m3 LC	42	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich
7	1/17/2014	261610008	1	10.2	ug/m3 LC	43	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich
8	1/20/2014	261610008	1	6.7	ug/m3 LC	28	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich
9	1/23/2014	261610008	1	12.2	ug/m3 LC	51	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich
10	1/26/2014	261610008	1	7.6	ug/m3 LC	32	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich
11	1/29/2014	261610008	1	8.4	ug/m3 LC	35	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich
12	2/1/2014	261610008	1	20.8	ug/m3 LC	69	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich
13	2/4/2014	261610008	1	24.5	ug/m3 LC	77	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich
14	2/7/2014	261610008	1	16	ug/m3 LC	59	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich
15	2/10/2014	261610008	1	13.8	ug/m3 LC	55	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich
16	2/13/2014	261610008	1	27.5	ug/m3 LC	83	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich
17	2/16/2014	261610008	1	22	ug/m3 LC	72	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich
18	2/19/2014	261610008	1	14.8	ug/m3 LC	57	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich
19	2/22/2014	261610008	1	2.8	ug/m3 LC	12	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich
20	2/25/2014	261610008	1	7.4	ug/m3 LC	31	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich
21	2/28/2014	261610008	1	13	ug/m3 LC	53	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich
22	3/3/2014	261610008	1	8.2	ug/m3 LC	34	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich
23	3/6/2014	261610008	1	15	ug/m3 LC	57	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich
24	3/9/2014	261610008	1	15.1	ug/m3 LC	57	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich
25	3/12/2014	261610008	1	4.7	ug/m3 LC	20	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich
26	3/15/2014	261610008	1	4.8	ug/m3 LC	20	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich
27	3/18/2014	261610008	1	13.7	ug/m3 LC	54	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich
28	3/21/2014	261610008	1	12.7	ug/m3 LC	52	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich
29	3/24/2014	261610008	1	7.3	ug/m3 LC	30	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich
30	3/27/2014	261610008	1	11.8	ug/m3 LC	49	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich
31	3/30/2014	261610008	1	7.4	ug/m3 LC	31	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich
32	4/2/2014	261610008	1	7.6	ug/m3 LC	32	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich
33	4/5/2014	261610008	1	6.4	ug/m3 LC	27	1	100	88101	PM2.5 - Lc	11460	Ann Arbor,	26	Mich

Washtenaw PM2.5_data_2014 | 2015 | 2016

Monitor Data for 2014

	A	C	D	E	S	T	U	V	W	X	Y	Z	AA	AB
1	Date	POC	Daily Mean PM2.5 Conc	UNITS										
2	1/2/2014	1	3.6	ug/m3 LC										
3	1/5/2014	1	16.7	ug/m3 LC										
4	1/8/2014	1	19.9	ug/m3 LC										
5	1/14/2014	1	15.3	ug/m3 LC										
6	1/16/2014	1	10	ug/m3 LC										
7	1/17/2014	1	10.2	ug/m3 LC										
8	1/20/2014	1	6.7	ug/m3 LC										
9	1/23/2014	1	12.2	ug/m3 LC										
10	1/26/2014	1	7.6	ug/m3 LC										
11	1/29/2014	1	8.4	ug/m3 LC										
12	2/1/2014	1	20.8	ug/m3 LC										
13	2/4/2014	1	24.5	ug/m3 LC										
14	2/7/2014	1	16	ug/m3 LC										
15	2/10/2014	1	13.8	ug/m3 LC										
16	2/13/2014	1	27.5	ug/m3 LC										
17	2/16/2014	1	22	ug/m3 LC										
18	2/19/2014	1	14.8	ug/m3 LC										
19	2/22/2014	1	2.8	ug/m3 LC										
20	2/25/2014	1	7.4	ug/m3 LC										
21	2/28/2014	1	13	ug/m3 LC										
22	3/3/2014	1	8.2	ug/m3 LC										
23	3/6/2014	1	15	ug/m3 LC										
24	3/9/2014	1	15.1	ug/m3 LC										
25	3/12/2014	1	4.7	ug/m3 LC										
26	3/15/2014	1	4.8	ug/m3 LC										
27	3/18/2014	1	13.7	ug/m3 LC										
28	3/21/2014	1	12.7	ug/m3 LC										
29	3/24/2014	1	7.3	ug/m3 LC										
30	3/27/2014	1	11.8	ug/m3 LC										
31	3/30/2014	1	7.4	ug/m3 LC										
32	4/2/2014	1	7.6	ug/m3 LC										
33	4/5/2014	1	6.4	ug/m3 LC										

Washtenaw PM2.5_data_2014 | 2015 | 2016

Shown with columns hidden for simplicity (optional)

Monitor Data for 2015 and 2016

	A	C	D	E
1	Date	POC	Daily Mean PM2.5 Conc	UNITS
2	1/3/2015	1	14.1	ug/m3 LC
3	1/6/2015	1	7.5	ug/m3 LC
4	1/12/2015	1	11.6	ug/m3 LC
5	1/15/2015	1	30.6	ug/m3 LC
6	1/18/2015	1	8.2	ug/m3 LC
7	1/21/2015	1	15	ug/m3 LC
8	1/24/2015	1	15.8	ug/m3 LC
9	1/27/2015	1	9.6	ug/m3 LC
10	1/30/2015	1	3.9	ug/m3 LC
11	2/2/2015	1	4.8	ug/m3 LC
12	2/5/2015	1	7.1	ug/m3 LC
13	2/8/2015	1	25.7	ug/m3 LC
14	2/11/2015	1	20.3	ug/m3 LC
15	2/17/2015	1	18.8	ug/m3 LC
16	2/26/2015	1	8.1	ug/m3 LC
17	3/1/2015	1	16.6	ug/m3 LC
18	3/4/2015	1	10.6	ug/m3 LC
19	3/7/2015	1	20.6	ug/m3 LC
20	3/10/2015	1	31.1	ug/m3 LC
21	3/13/2015	1	9.5	ug/m3 LC
22	3/16/2015	1	7.4	ug/m3 LC
23	3/19/2015	1	5	ug/m3 LC
24	3/22/2015	1	4.5	ug/m3 LC
25	3/25/2015	1	15.6	ug/m3 LC
26	3/28/2015	1	5.3	ug/m3 LC
27	3/31/2015	1	6.8	ug/m3 LC
28	4/3/2015	1	5.1	ug/m3 LC
29	4/6/2015	1	11.7	ug/m3 LC
30	4/9/2015	1	10	ug/m3 LC
31	4/12/2015	1	8.2	ug/m3 LC
32	4/15/2015	1	5.6	ug/m3 LC
33	4/18/2015	1	9.3	ug/m3 LC

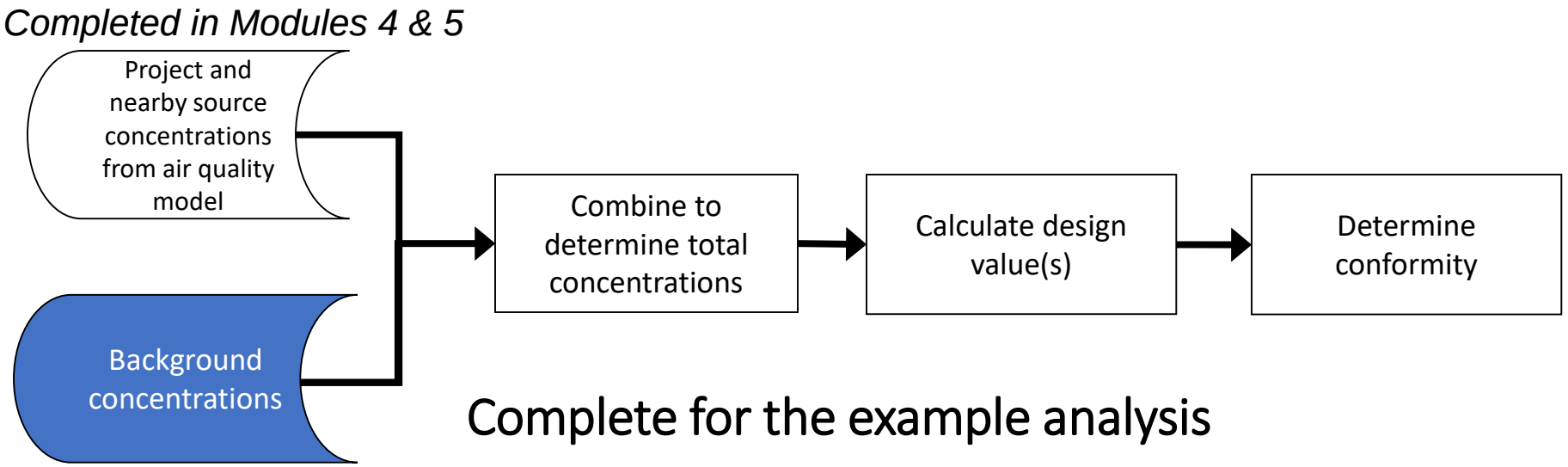
Washtenaw PM2.5_data_2014 | 2015 | 2016

Repeat for remaining years in additional worksheets (3 years of data total)

It is useful to include all data in one spreadsheet for later processing

Background Data Prepared

- Background data from the monitor is now ready to be combined with air quality modeling results from Modules 4 and Module 5 to calculate design values and determine conformity for our example analysis in Module 7



Questions?
End of Module 6

EPA