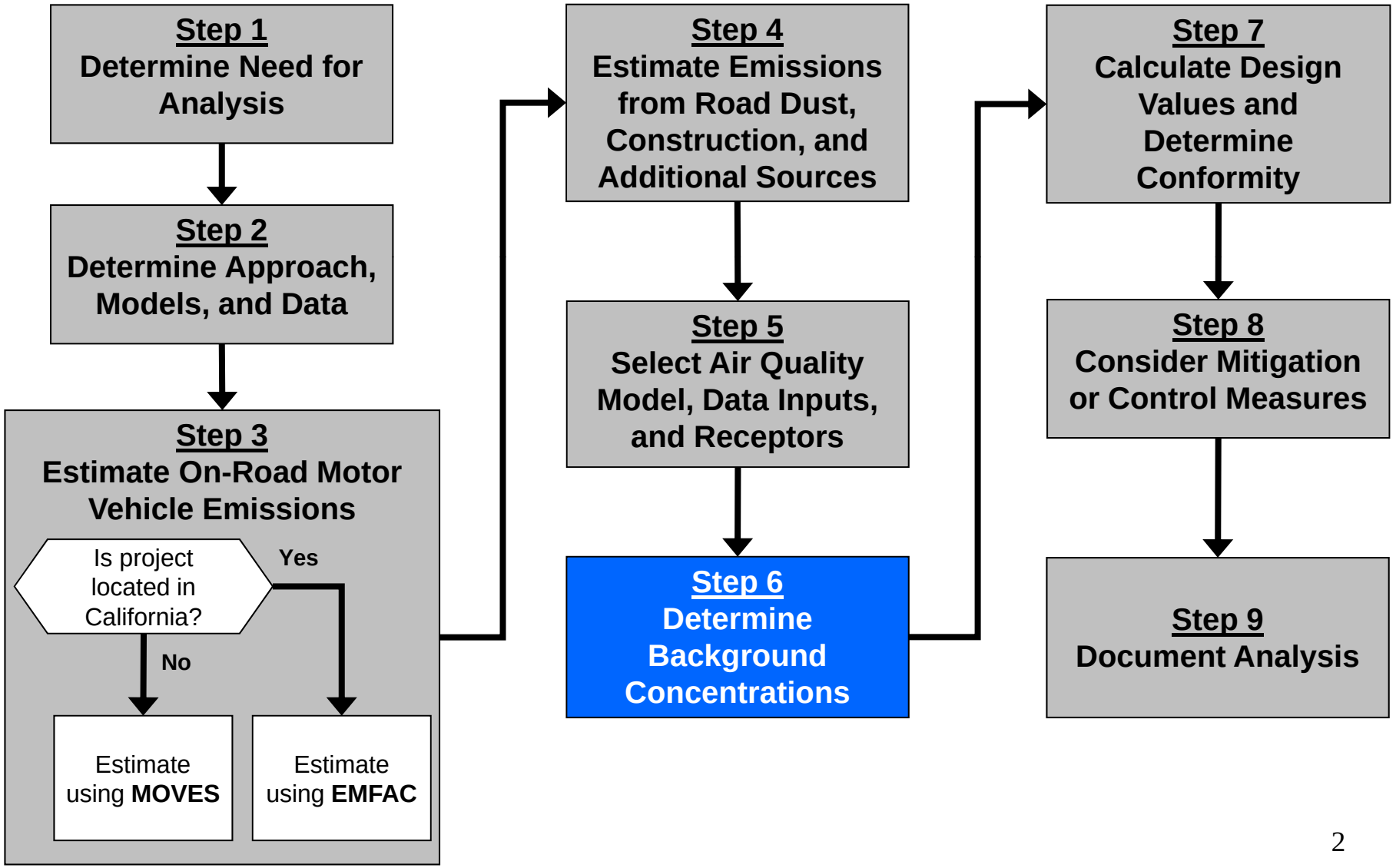
Module 6

Determining Background Concentrations

05/22/12

Completing a PM Hot-spot Analysis



Module Overview

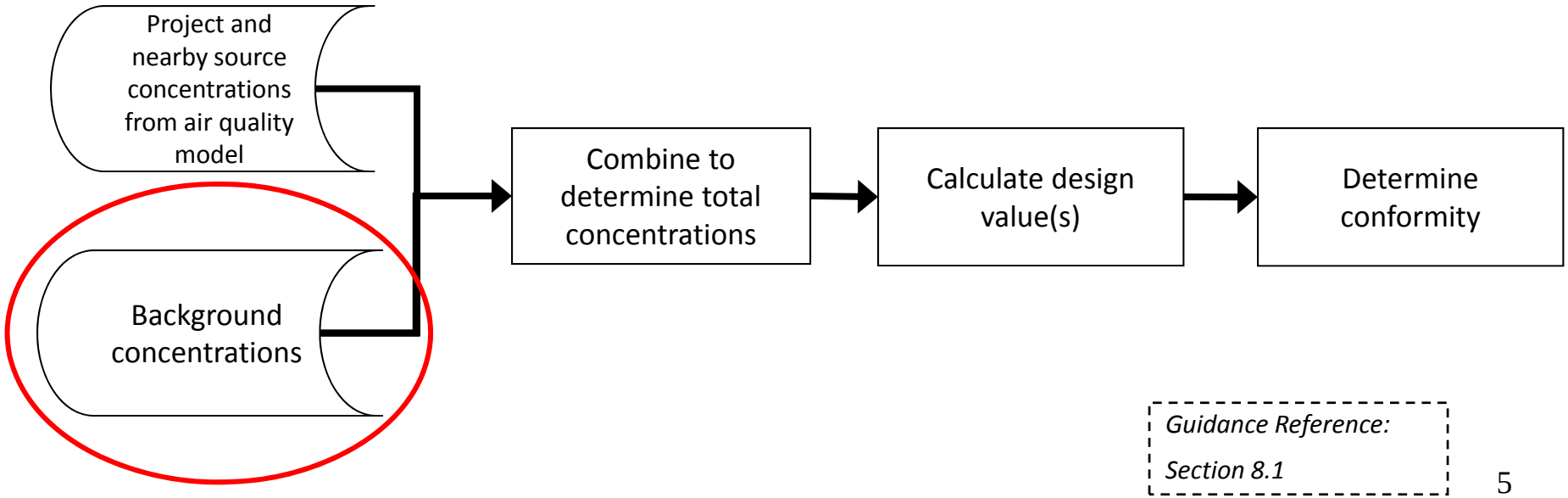
- What are background concentrations?
- What are nearby sources and when do they require modeling?
- What options are available for determining background concentrations?
- Preparing background data for the example analysis

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, Sections 8.2.1 & 8.2.3
- "Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$ and Regional Haze" (EPA-454/B-07-002, April 2007)
- EPA's SCRAM website: www.epa.gov/ttn/scram

Where Do Background Concentrations Fit Into the Analysis?

- Section 93.123(c)(1) requires PM hot-spot analyses to estimate total emissions burden of direct emissions (both project and background)
- Background concentrations are combined with air quality modeling results to generate design values and determine project conformity



Guidance Reference:
Section 8.1

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

Guidance Reference:

Section 8.1

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 modeling networks, etc.
- Applies throughout this module

Guidance Reference:

Section 8.2

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 not affected by the project (e.g., stationary sources)
  - » In limited cases, include in modeling if not captured in representative background data

Guidance Reference:

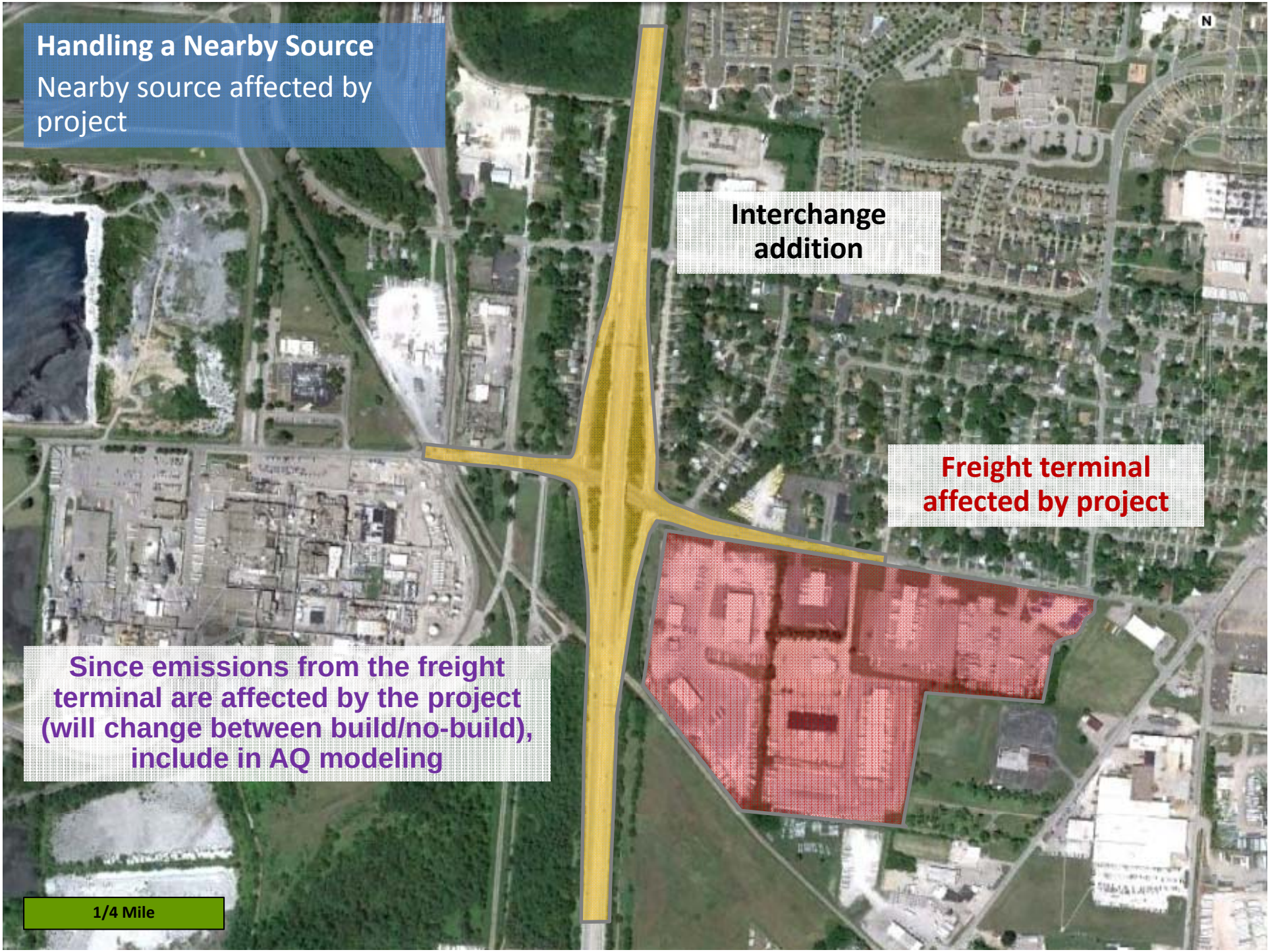
Section 8.2

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
- Guidance provides procedures for generating emission factors from locomotives in Appendix I
- Consult with state and local air agency

Guidance Reference:

Section 8.2


Handling a Nearby Source
Nearby source affected by project
Interchange addition
Freight terminal affected by project
Since emissions from the freight terminal are affected by the project (will change between build/no-build), include in AQ modeling
1/4 Mile
N

Determining the Project Area with a Nearby Source

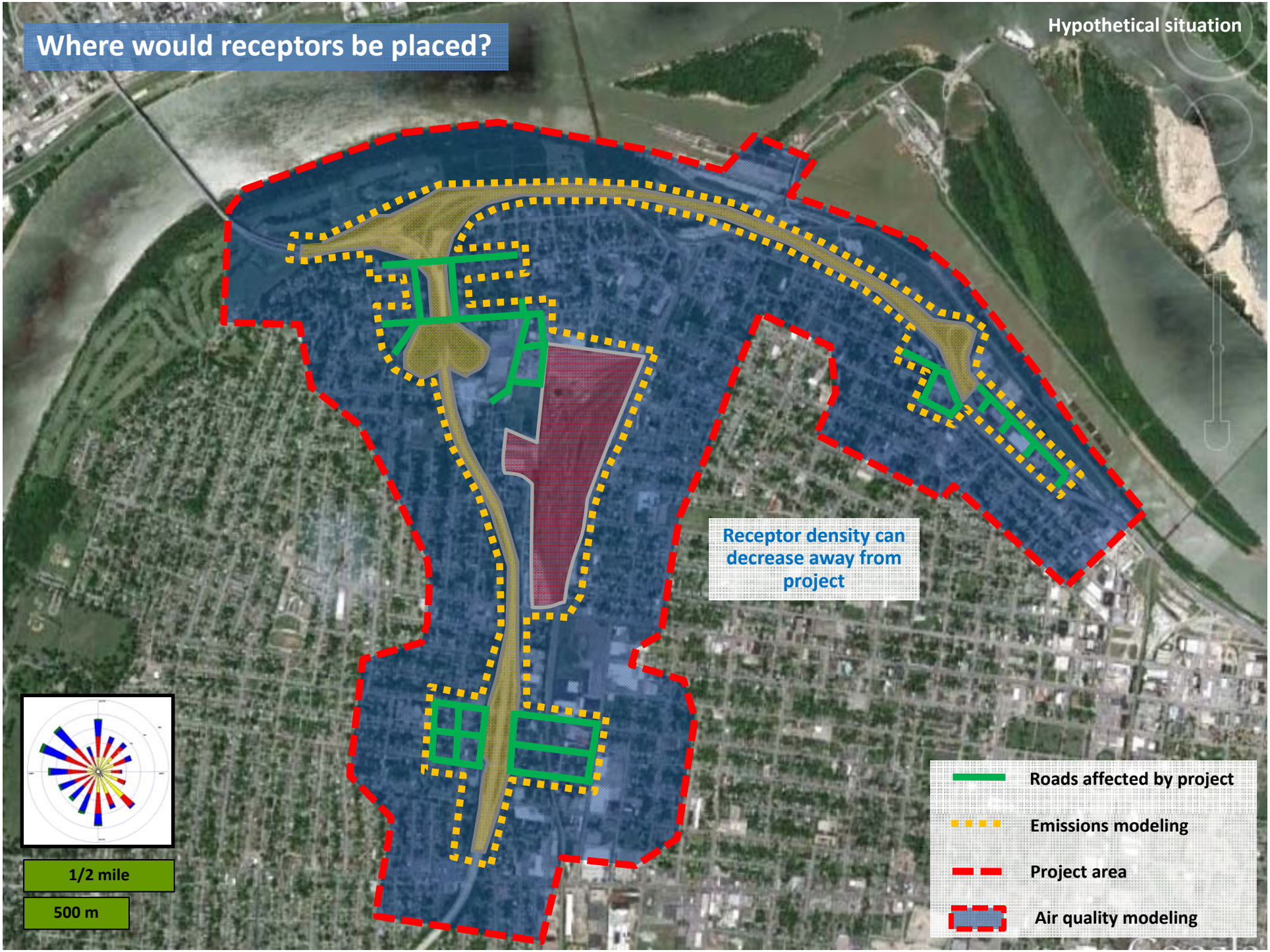
- Let's revisit "What is the Project Area: Case A" from **Module 3**, this time with a nearby source that requires modeling.
- Case A was an expansion of an existing highway segment (~4 miles) with associated interchange reconfiguration.
- Now, a nearby source that is not part of the project (a rail yard) is adjacent to the highway. It is affected by the project, as 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
Emissions of project, affected roads, and rail yard would be modeled
1/2 mile
500 m
Roads affected by project
Emissions modeling
Project area
Air quality modeling


Where would receptors be placed?
Hypothetical situation
Receptor density can decrease away from project
1/2 mile
500 m
Roads affected by project
Emissions modeling
Project area
Air quality modeling

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.

Determining Background Concentrations

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

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

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

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

Guidance Reference:

Section 8.3.1

Considering Monitor Representativeness

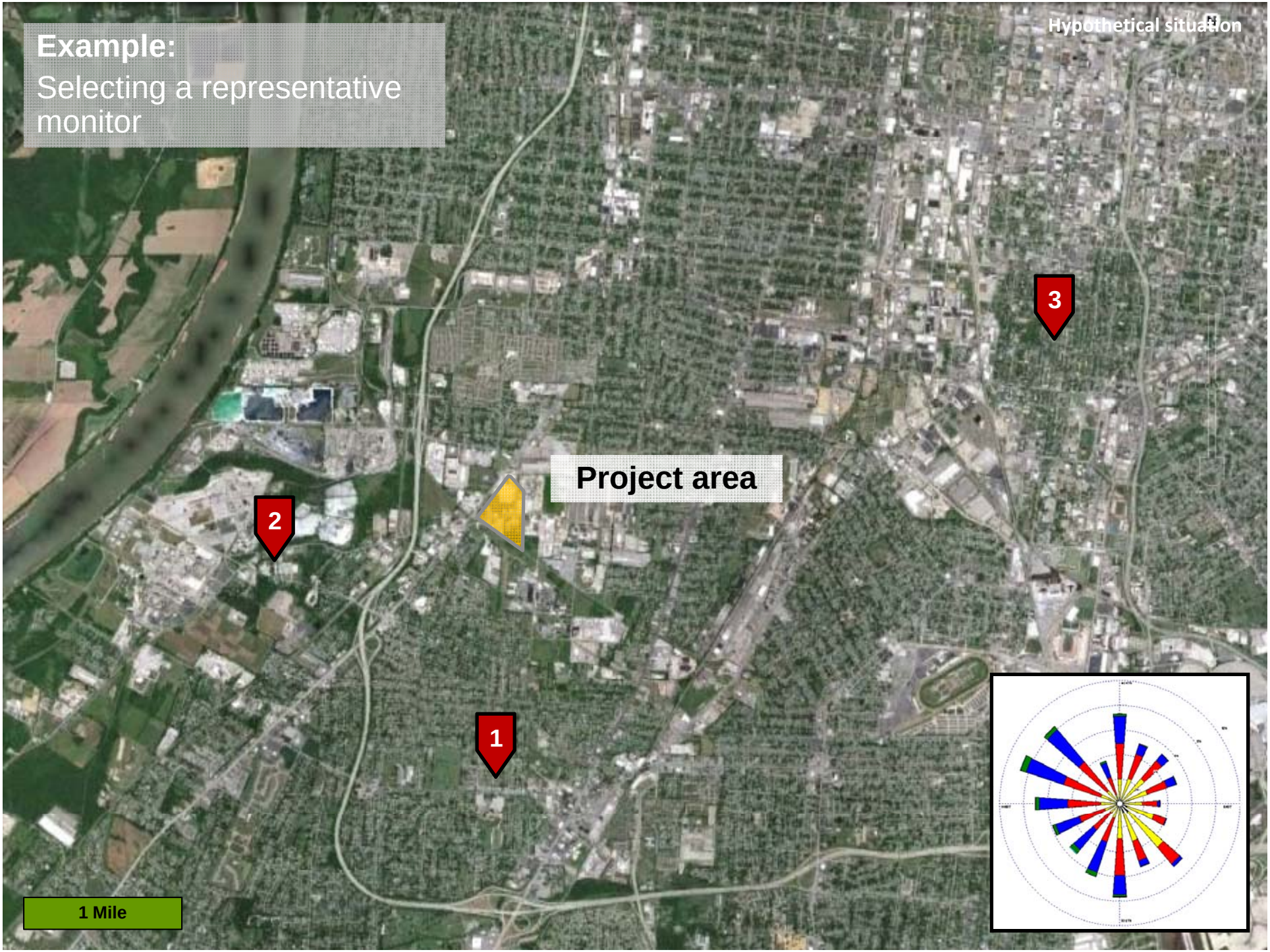
- Similar characteristics between monitor location and project area
  - » Is there the same density/mix of sources?
  - » Does monitor capture nearby source emissions?
  - » Are land use/terrain similar?
  - » Are monitor and project at similar height?
  - » What is the purpose of the monitor and it's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

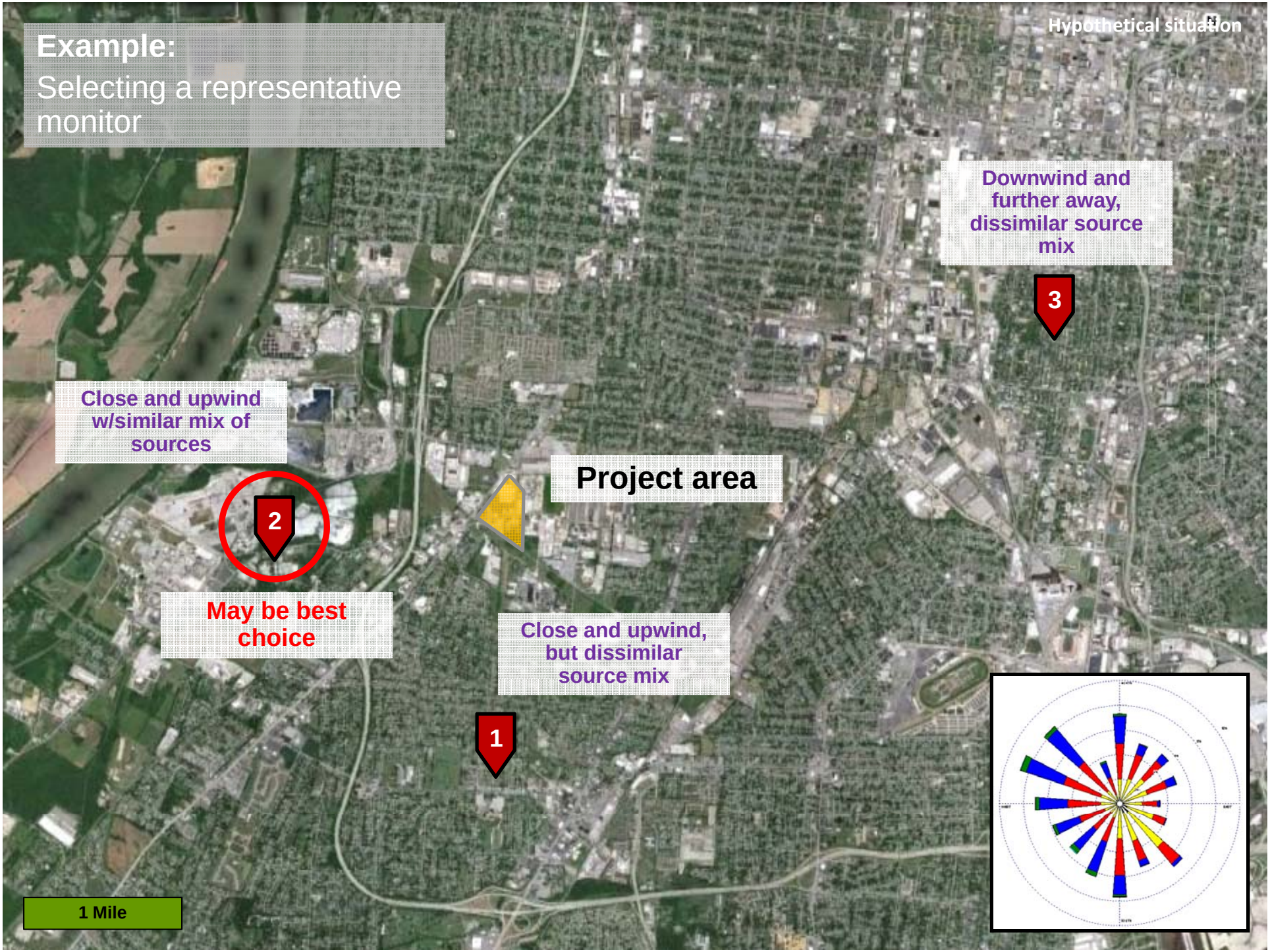
- Distance of monitor from project area
  - » Closer monitors often are more representative – but not always
  - » Weigh all considerations

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

Guidance Reference:

Section 8.3.1


Example:
Selecting a representative monitor
Hypothetical situation
Project area
1
2
3
1 Mile


Example:
Selecting a representative monitor
Hypothetical situation
Downwind and further away, dissimilar source mix
3
Close and upwind w/similar mix of sources
Project area
2
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

Guidance Reference:

Section 8.3.1

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

Guidance Reference:

Sections 8.3.1 & 9.3

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

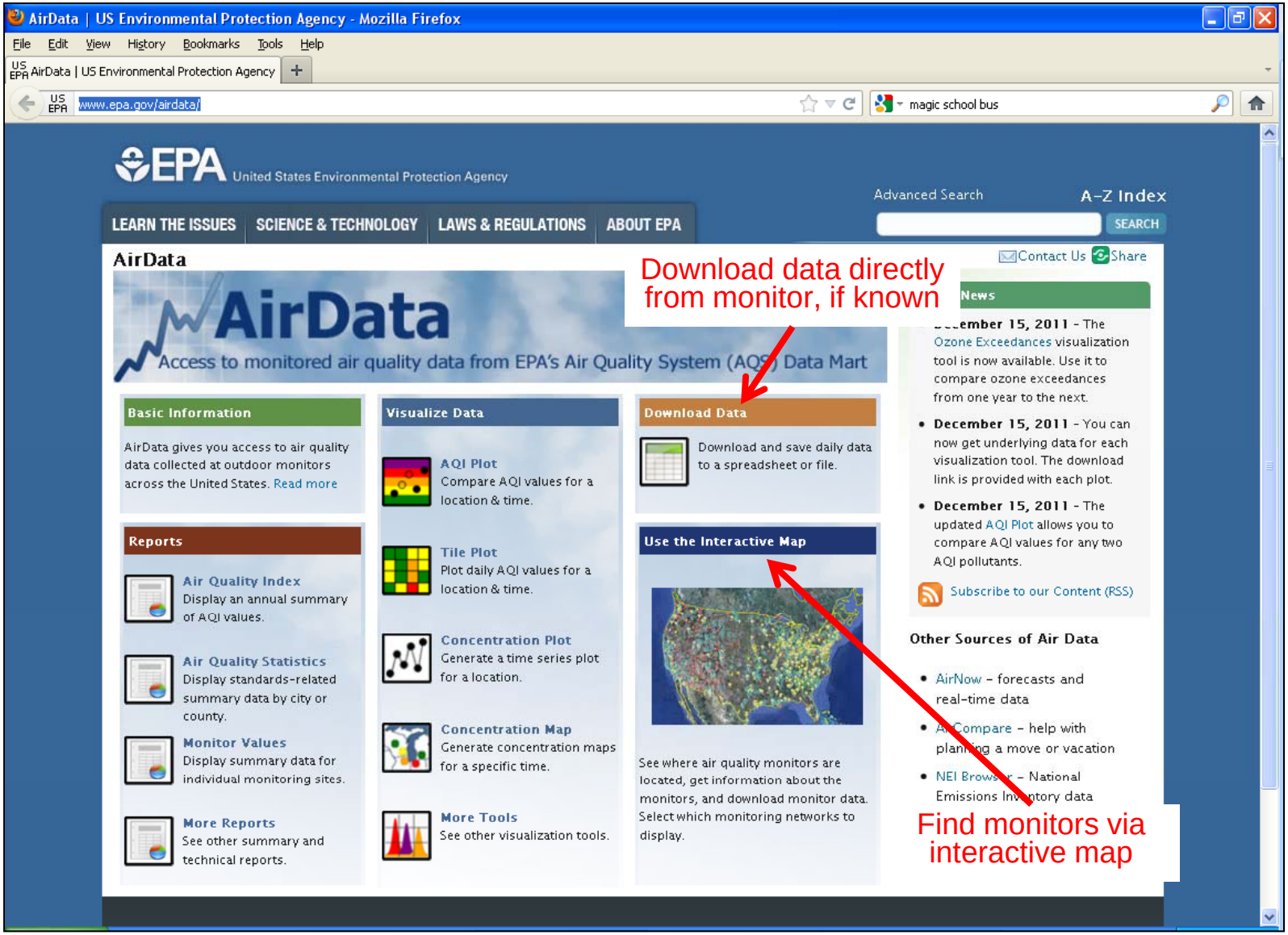
- Monitor selected should be appropriate for use for regulatory purposes (FRM or FEM)

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

Guidance Reference:

Section 8.3.1

Using EPA's AirData Website



Using Chemical Transport Models

- CTMs are photochemical models used in SIPs and EPA regulatory analyses that can be used to predict **future year** concentrations.

- Two CTM options might be available for PM hot-spot analyses:

  1. Future year PM concentrations may already be available from existing state, local, or EPA air quality modeling for representative monitor

  2. Future year PM concentrations can be created by post-processing CTM outputs that are available

Guidance Reference:

Section 8.3.2

CTM Options

- Two different kinds of future-year CTM outputs:
  - » Values calculated at monitoring locations
  - » Values calculated at grid cells (gridded spatial fields)
- EPA's Modeled Attainment Test Software (MATS) program can produce both types of data
  - » www.epa.gov/scram001/modelingapps_mats.htm
- 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

Guidance Reference:
Section 8.3.2

Using CTMs - Guidance

- Data should be representative of the project area

- EPA's "Guidance on the Use of Models and Other Analyses 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/final-03-pm-rh-guidance.pdf

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

Guidance Reference:
Section 8.3.2

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

Guidance Reference:

Section 8.3.3

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

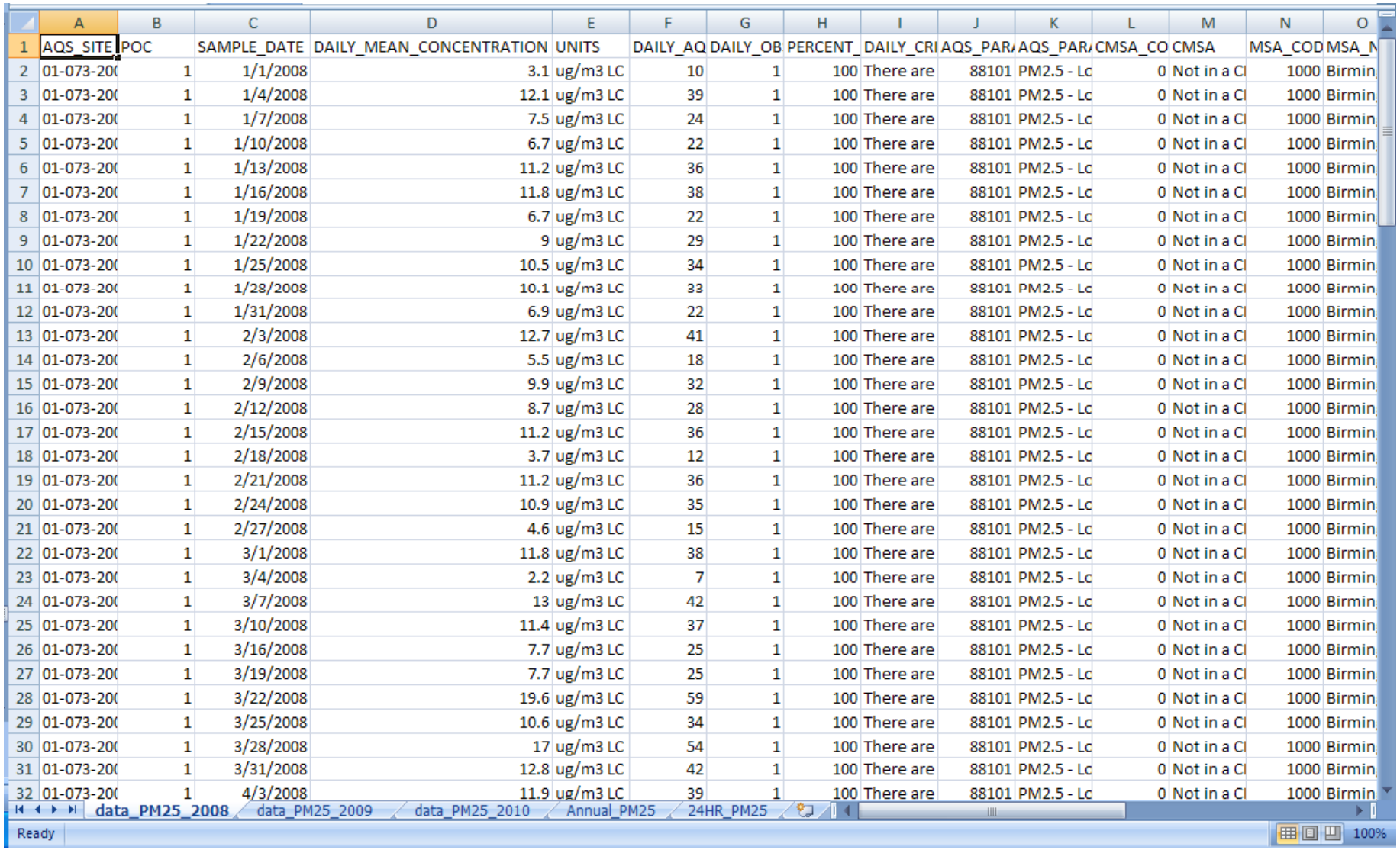
Obtaining Background Data from Monitor

- For our example analysis, we have found a single monitor that has been deemed representative of $PM_{2.5}$ background concentrations in the project area

- Data was obtained from EPA's AirData website
  - » Per guidance, selected the three most recently available years: 2008, 2009, and 2010
  - » Monitor selected used a one-in-three day monitoring cycle

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

Monitor Data for 2008



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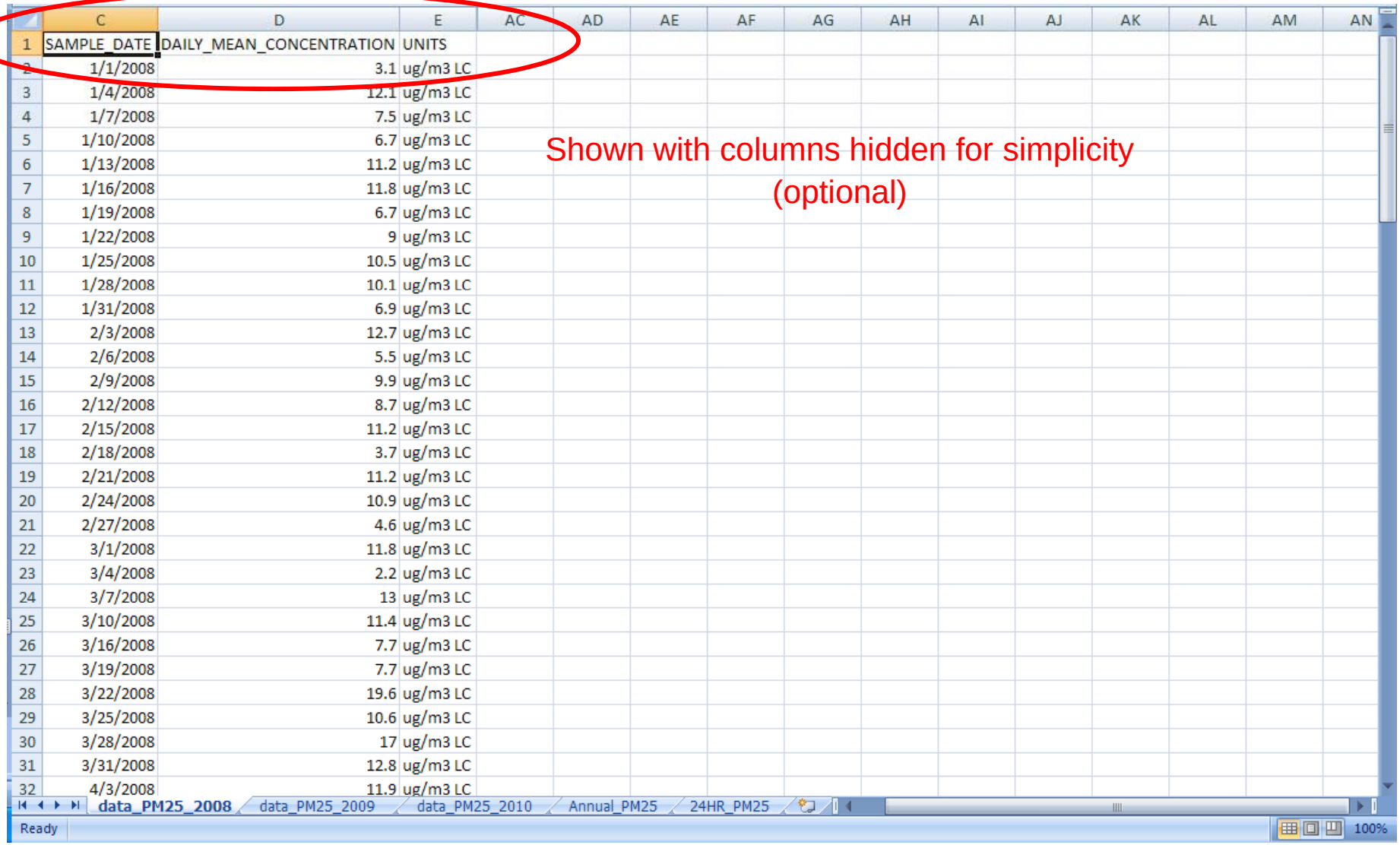
Monitor Data for 2008



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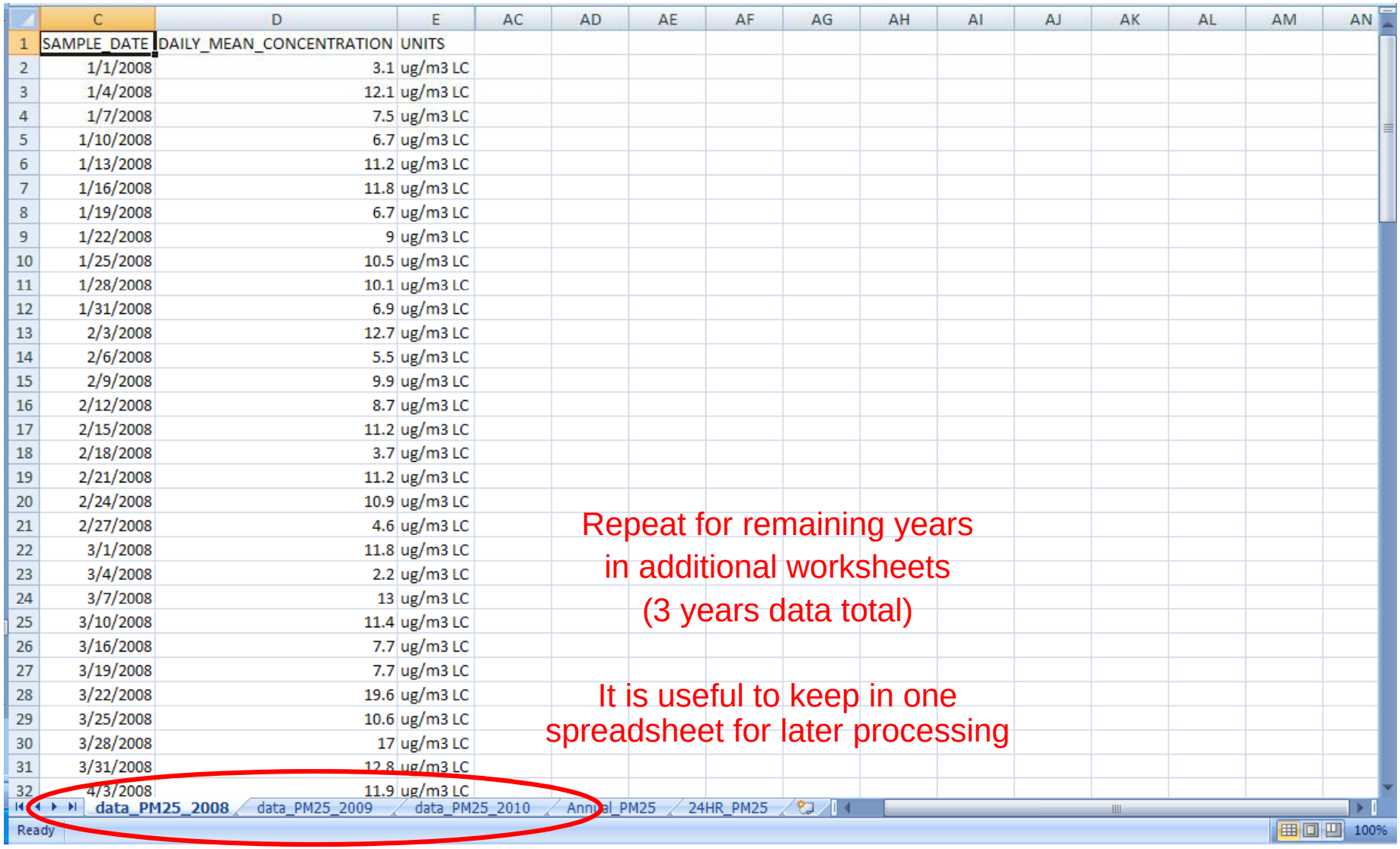
26	3/16/2008	7.7	ug/m3 LC												
27	3/19/2008	7.7	ug/m3 LC												
28	3/22/2008	19.6	ug/m3 LC												
29	3/25/2008	10.6	ug/m3 LC												
30	3/28/2008	17	ug/m3 LC												
31	3/31/2008	12.8	ug/m3 LC												
32	4/3/2008	11.9	ug/m3 LC												

Monitor Data for 2009 and 2010



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6	1/13/2008	11.2	ug/m3 LC
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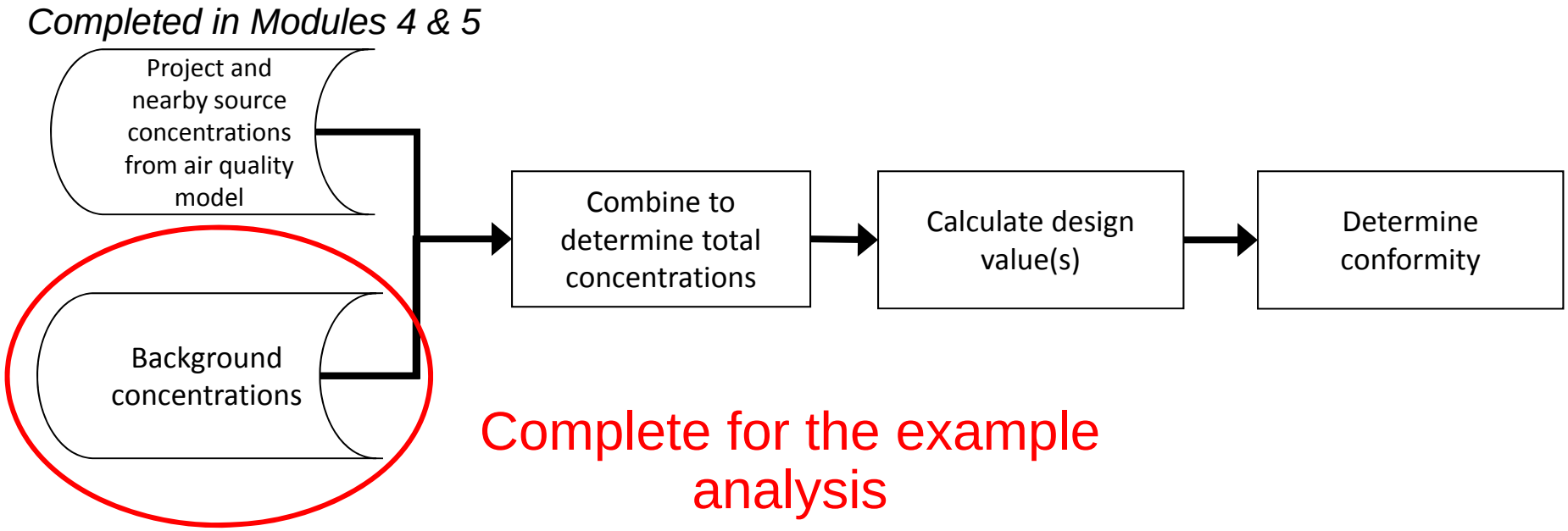
31	3/31/2008	12.8	ug/m3 LC
32	4/3/2008	11.9	ug/m3 LC

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

It is useful to keep 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 5** to calculate design values and determine conformity for our example analysis in **Module 7**



End of Module 6

Questions?