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PM2.5 Hot Spot Analysis
June 20, 2013
Tier Two
Illinois Department of Transportation

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Need for PM Analysis

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- EPA guidance requires a quantitative PM analysis (December 2010) if the project is deemed to be a "Project of Air Quality Concern"

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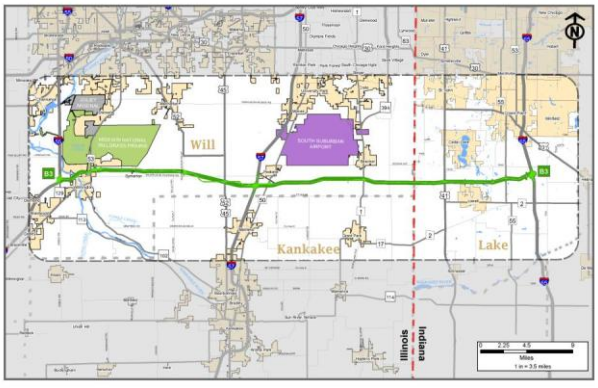
Project Location

- The project traverses Will County, Illinois and Lake County, Indiana



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- Will County is nonattainment for annual $PM_{2.5}$
- Lake County is maintenance for annual $PM_{2.5}$
- Significant increase of diesel trucks anticipated

Table 5-1. Preliminary Projected 2040 Bi-Directional ADT [1]

Alternative B3 Section	Projected 2040 ADT		
	Passenger Car	Truck	Total
I-55 to IL 53	22,400	6,600	29,000
IL 53 to Wilton-Center Road	12,900	6,300	19,200
Wilton-Center Road to US 45	16,200	8,000	24,200
US 45 to I-57	11,600	8,100	19,700
I-57 to IL 50	17,800	7,700	25,500
IL 50 to IL 1	11,300	7,300	18,600
IL 1 to US 41	9,800	7,600	17,400
US 41 to SR 55	9,200	7,400	16,600
SR 55 to I-65	11,600	7,300	18,900

[1] These travel demand projections are considered preliminary and subject to refinement based on additional modeling to be performed based on continuing analysis of interchange locations and types, and road closure determinations.

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- Classified as a “Project of Air Quality Concern” by Tier II Consultation Group on 2/14/13.

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Analysis Approach

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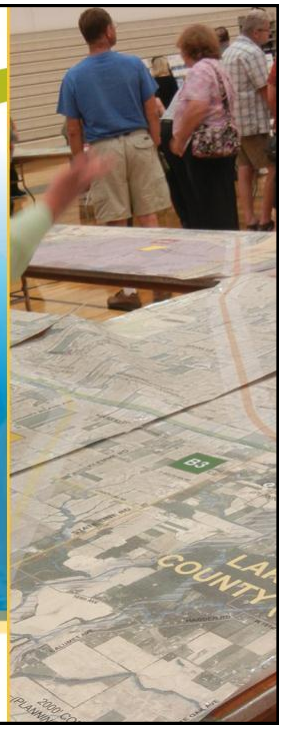
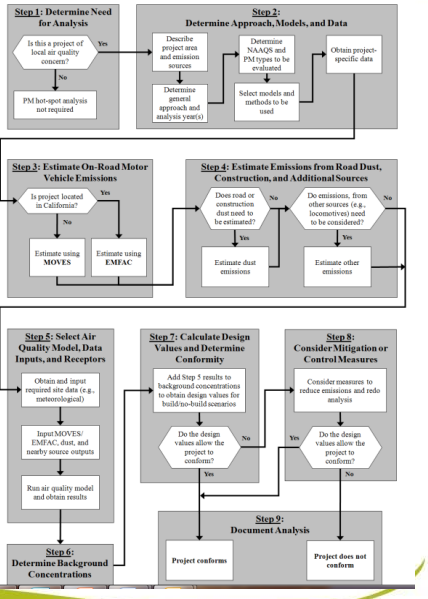


Overview of PM Quantitative Hot-spot Analysis



Analysis Approach

- The analysis will be performed for the year of highest expected emissions (No Build & Build). Currently we are determining if that will be the project's opening year (2018) or the project's design year (2040).
- The analysis will include only directly emitted $PM_{2.5}$ emissions. Re-entrained road dust will not be included because the SIPs do not identify that such emissions are a significant contributor to the PM2.5 air quality in the study areas.
- The analysis will use the latest version of EPA's MOVES emissions model (MOVES2010b)
- MOVES input files have been obtained from CMAP and NIRPC

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Modeling

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Modeling

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- USEPA's MOVES emissions model will be run for four time periods – A.M. peak, P.M. peak, midday and off-peak

Name	Description	From	To	# of Hours	Time period
Period 1	Overnight	8:00 PM	6:00 AM	10	Off peak
Period 2	Pre- AM Shoulder	6:00 AM	7:00 AM	1	AM peak
Period 3	AM Peak	7:00 AM	9:00 AM	2	AM peak
Period 4	Post- AM Shoulder	9:00 AM	10:00 AM	1	AM peak
Period 5	Midday	10:00 AM	2:00 PM	4	Midday
Period 6	Pre- PM Shoulder	2:00 PM	4:00 PM	2	Midday
Period 7	PM Peak	4:00 PM	6:00 PM	2	PM peak
Period 8	Post- PM Shoulder	6:00 PM	8:00 PM	2	PM peak

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Modeling

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- MOVES will be run for four different months – January, April, July and October – to account for different climate conditions throughout the year
- For every link, 16 emissions factors (4 time periods * 4 seasons) will be developed

Modeling

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- USEPA's CAL3QHCR air dispersion model will be used to estimate concentrations of $PM_{2.5}$
- CAL3QHCR uses traffic data, emission factor data, and meteorological data to estimate ground-level concentrations of $PM_{2.5}$ at a series of receptors
- Link-specific inputs include length, mixing zone width, hourly volume, and emission factor

Modeling

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- Five consecutive years of meteorological data will be used for the dispersion modeling analysis; CAL3QHCR does not distinguish between emissions changes due to seasonal differences
- Therefore, each season will be run separately, for a total of 20 model runs per scenario (5 years of met data * 4 time periods)

Modeling

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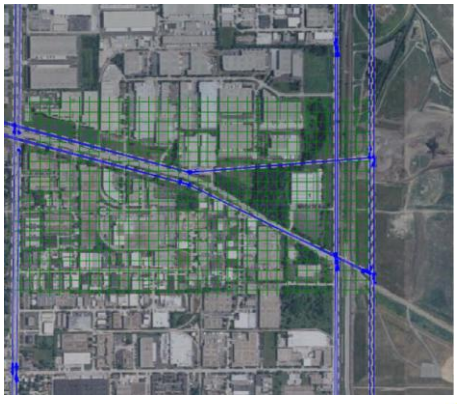
- Receptors will be placed in order to estimate the highest concentrations of $PM_{2.5}$ using a grid pattern.



Site Selection

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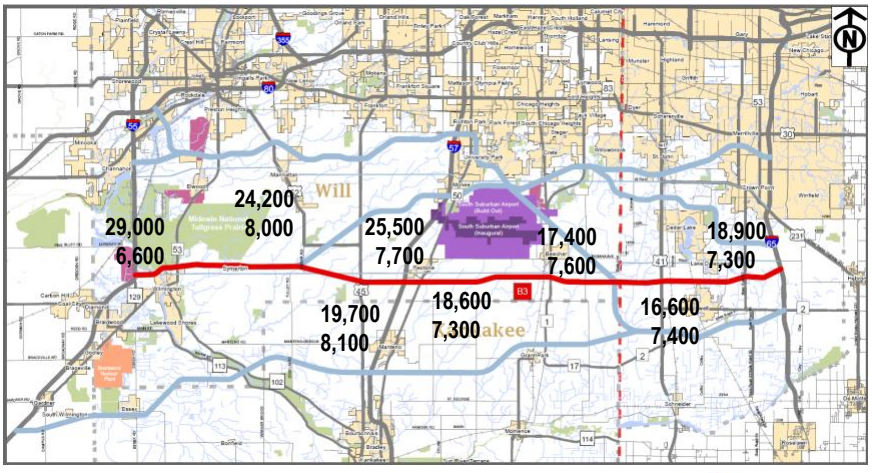
Tolled Volumes



2040 Average Daily Traffic = 10,000
2040 Truck Average Daily Traffic = 5,000

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Possible Analysis Sites – Wilton Center to US 45 (2nd highest truck volume)

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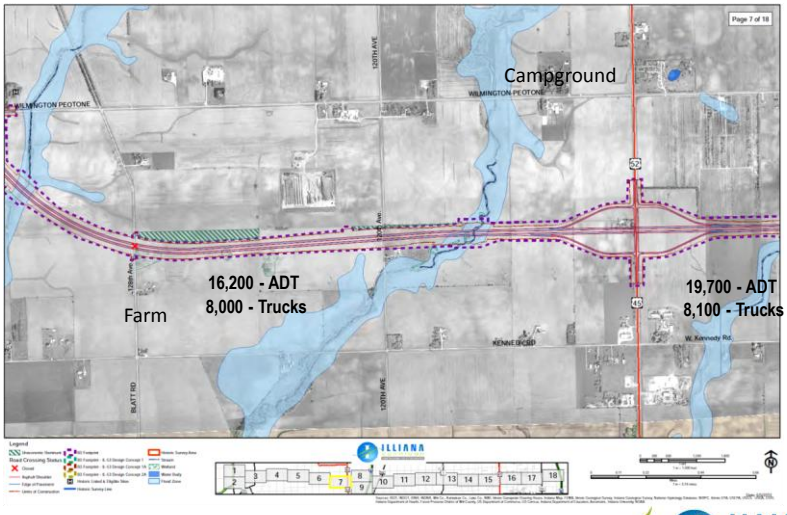

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Possible Analysis Sites – US 45 to I-57 (1st highest truck volume)

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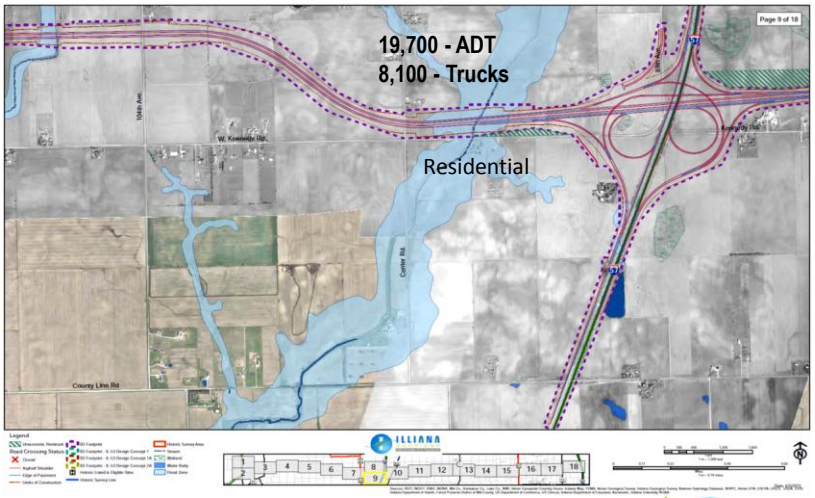

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Possible Analysis Sites – I-57 to IL-50 (3rd highest truck volume)

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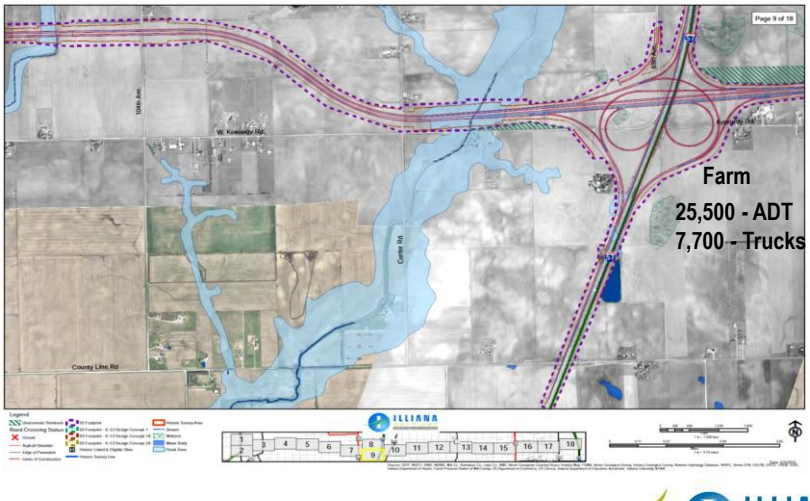

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Possible Analysis Sites – IL 1 to US 41 (4th highest truck volume)

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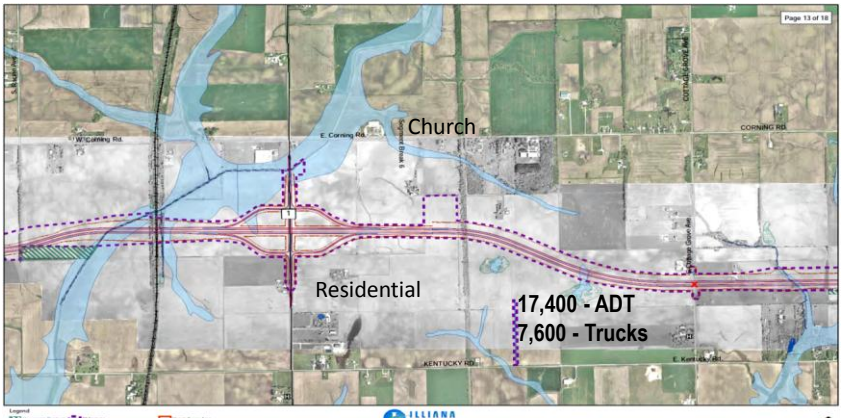

Possible Analysis Sites – US 41 to SR 55 (5th highest truck volume)

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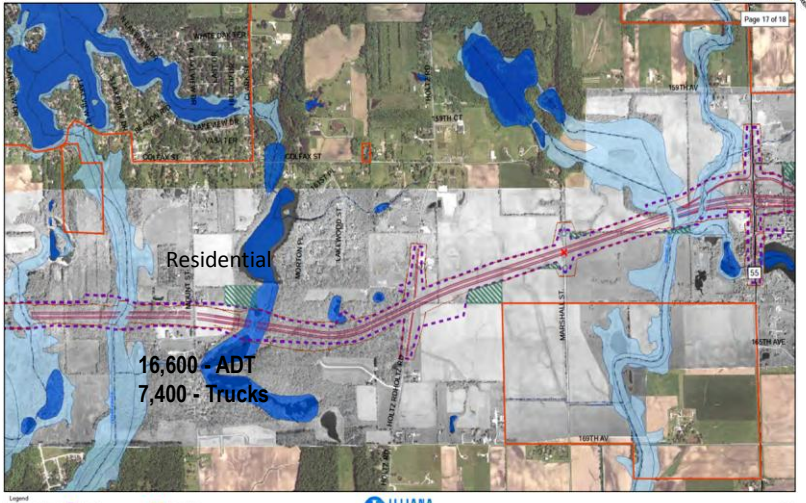
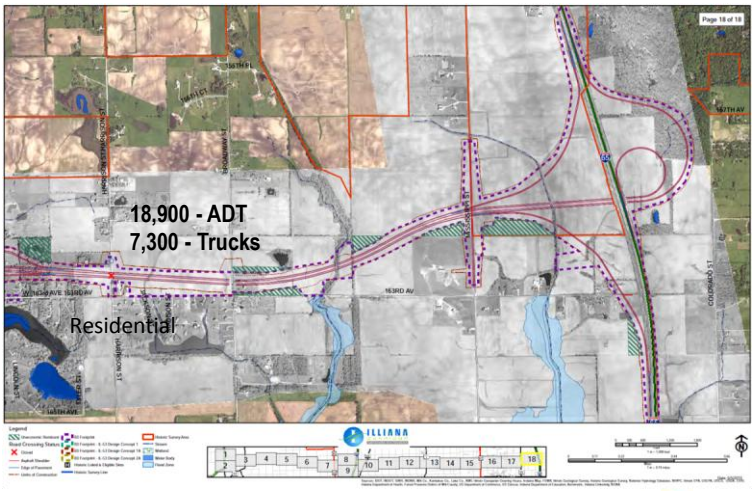


Possible Analysis Sites – SR 55 to I-65 (6th highest truck volume)



Analysis

- Based on the location of sensitive receptors and truck volumes, we are recommending the following three locations undergo a detailed analysis:
  - **US 45 to I-57** – Highest truck volumes, nearby residential, new interchange and farm nearby – will also encompass 3rd highest truck volume site (I-57 to IL 50).
  - **IL 1 to US 41** – 4th highest truck volumes, crosses both states, new interchange, has nearby sensitive receptors.
  - **3rd location** – choice between either of the termini:
    - **I-55 to IL 53** – has the highest overall ADT and sensitive receptors nearby such as Midewin Tallgrass Prairie – 8th highest truck volumes, but 1st highest total traffic
    - **SR 55 to I-65** – nearby sensitive receptors – 6th highest truck volumes, 6th highest total traffic.

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Results

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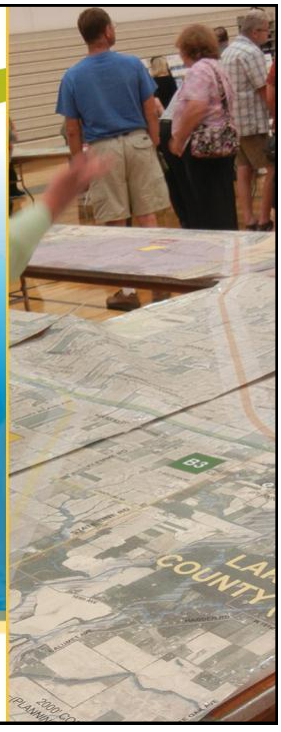

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Results

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- Data from $PM_{2.5}$ monitors in the project vicinity will be evaluated for the most representative (closest) and most conservative (highest) background values
- Once selected and confirmed through interagency consultation, the background value(s) will be added to the CAL3QHCR modeled design values for comparison to the NAAQS

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Results

- Background data will be obtained from USEPA's AirData website. We recommend the Braidwood Monitoring Site (Regional Scale, in project area).

Braidwood Monitoring Site

Air Pollutant	Standard/ Exceedance	Braidwood, Illinois Com Ed Training Center 36400 S. Essex Road		
		2010	2011	2012
Carbon Monoxide (CO)	Max. 1-hour Concentration (ppm)	NM	NM	NM
	Max. 8-hour Concentration (ppm)	NM	NM	NM
	# Days>Federal 1-hour Std. of >35 ppm	NM	NM	NM
	# Days>Federal 8-hour Std. of >9 ppm	NM	NM	NM
Ozone (O_3)	Max. 1-hour Concentration (ppm)	0.08	0.106	0.08
	Max. 8-hour Concentration (ppm)	0.075	0.091	0.076
	# Days>Federal 8-hour Std. Of >0.075 ppm	0	1	1
Nitrogen Dioxide (NO_2)	Max. 1-hour Concentration (ppb)	NM	NM	NM
	# Days>Federal 1-hour Std. Of >100 ppb	NM	NM	NM
Sulfur Dioxide (SO_2)	Max. 1-hour Concentration (ppb)	NM	NM	NM
	# Days>Federal 1-hour Std. of >75 ppb	NM	NM	NM
Suspended Particulates (PM_{10})	Max. 24-hour Concentration ($\mu g/m^3$)	NM	NM	NM
	#Days>Fed. 24-hour Std. of>150 $\mu g/m^3$	NM	NM	NM
Suspended Particulates ($PM_{2.5}$)	Max. 24-hour Concentration ($\mu g/m^3$)	28.7	28.8	24.5
	#Days>Fed. 24-hour Std. of>35 $\mu g/m^3$	0	0	0
	National Annual Average ($\mu g/m^3$)	10.0	10.4	9.4
Lead	Maximum 24-Hour Concentration ($\mu g/m^3$)	NM	NM	NM

Source: U.S. EPA AirData, 2013 - http://www.epa.gov/airdata/

NM = Not measured

Results

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- The annual $PM_{2.5}$ design value is currently defined as the average of three consecutive years' annual averages, each estimated using equally-weighted quarterly averages
- The NAAQS is met when the three-year average concentration is less than or equal to the annual $PM_{2.5}$ NAAQS (currently 12.0 µg/m³)
- If the design value in the build scenario is less than or equal to the relevant PM NAAQS at appropriate receptors, then the project meets conformity requirements

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Mitigation

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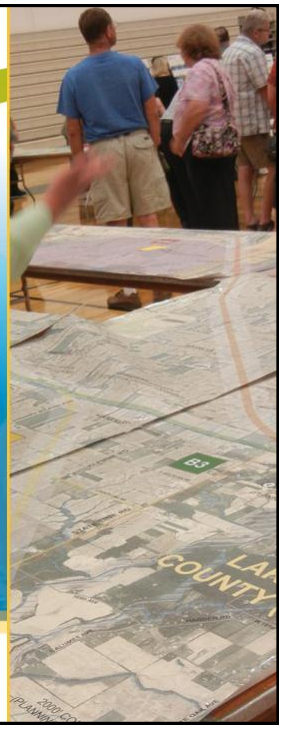

Mitigation

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- If the project does not meet conformity requirements, mitigation or control measures to reduce emissions in the project area may be considered
- These include retrofitting and replacing vehicles, cleaner fuels, reducing idling, redesigning the project, and controlling fugitive dust and other emission sources

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Documentation

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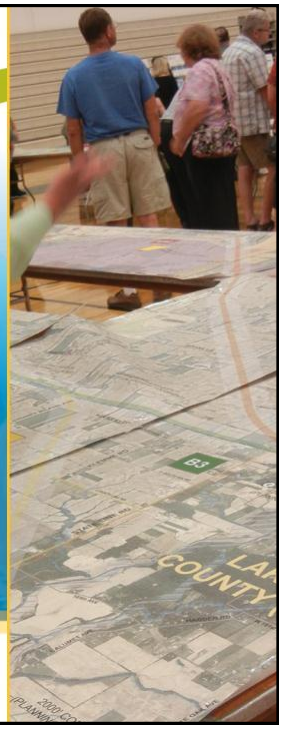

Documentation

- The PM hotspot analysis and results will be documented in an Air Quality Technical Report
- Due to the large volume of input and output files created for this analysis, they will be available electronically upon request