Appendix B

Incomplete Data Analysis

Introduction

Nine $PM_{2.5}$ monitoring sites in Indiana produced data for 2005-2007 that is deemed incomplete due to missing data, meaning that the 2005-2007 average value cannot be truly determined. Four of those monitors (Jasper Sports Complex, Jasper Golf Course, Gary Water Plant and South Bend Shields Dr) have only been monitoring for a short amount of time and do not have three years of data to determine the 2005-2007 design value. The other five monitors (Shenandoah, Elkhart, Highland, Michigan City and Terre Haute-Lafayette St) deemed incomplete have periods of missing data due to various reasons.

U.S. EPA's monitoring guidance stipulates that a minimum of 75% of the data per quarter must be available in order to determine if the design value represents attainment. If less than 75% of the data is valid, then the maximum quarterly value for that given quarter over the three-year period is substituted for all missing samples for that quarter. This method is obviously a very conservative methodology for calculating an average value. In determining whether a monitor with incomplete data attains the daily $PM_{2.5}$ standard, U.S. EPA encourages states to explore alternative methods for evaluating the data. Although according to the *Guideline on Data Handling Conventions for the PM NAAQS*, issued April 1999, U.S. EPA states that the incomplete design value is still identified as the monitors true design value. Therefore, an analysis of missing data was conducted and this section details the scenarios for filling in the missing data.

Calculation of the Daily $PM_{2.5}$ Standard

The U.S. EPA developed a "*Guideline for Data Handling Conventions for the PM NAAQS*", released in April 1999, to assess compliance with the standard. The daily $PM_{2.5}$ standard was set at 65.0 micrograms per cubic meter ($\mu g/m^3$). On September 21, 2006 U.S. EPA revised the daily $PM_{2.5}$ standard and lowered it to 35 $\mu g/m^3$. The daily standard is met when the 3-year average of the 98^{th} percentile of the 24-hour concentrations at each monitor in an area is less than or equal to 35.0 $\mu g/m^3$. Any design value above this is a violation of the standard.

Missing Data Review

Jasper Sports Complex

The Jasper Sports Complex monitor located in Jasper, Indiana in Dubois County began operation on February 1, 2006. This monitor has only been monitoring for a short amount of time and does not have three full years of data to determine the 2005-2007 design value. According to U.S. EPA guidance, the 2005-2007 design value and monitoring data for the Jasper Sports Complex monitor is incomplete and no data substitutions were done.

Jasper Golf Course

The Jasper Golf Course monitor located in Jasper, Indiana in Dubois County began operation on February 1, 2006. This monitor has only been monitoring for a short amount of time and does not have three full years of data to determine the 2005-2007 design value. According to U.S. EPA guidance, the 2005-2007 design value and monitoring data for the Jasper Golf Course monitor is incomplete and no data substitutions were done.

Gary Water Plant

The Gary Water Plant monitor located in Gary, Indiana in Lake County began operation on July 1, 2005. This monitor has only been monitoring for a short amount of time and does not have three full years of data to

determine the 2005-2007 design value. According to U.S. EPA guidance, the 2005-2007 design value and monitoring data for the Gary Water Plant monitor is incomplete and no data substitutions were done.

South Bend Shields Dr

The South Bend Shields Dr monitor located in South Bend, Indiana in St. Joseph County began operation on June 6, 2006. This monitor has only been monitoring for a short amount of time and does not have three full years of data to determine the 2005-2007 design value. According to U.S. EPA guidance, the 2005-2007 design value and monitoring data for the South Bend Shields Dr monitor is incomplete and no data substitutions were done.

Elkhart

During the third quarter of 2005 the Elkhart monitor located in Elkhart County, Indiana, Site ID 18-039-0003, recorded an overall Valid Data Return (VDR) for $PM_{2.5}$ of 30% for the third quarter. For the remaining quarters of 2005 the Elkhart monitor had an overall valid VDR over 75% and specifically was 93% for the first quarter; 100% for the second quarter, and 94% for the fourth quarter. Also during the first quarter of 2007 the Elkhart monitor recorded an overall VDR of 58% for the first quarter. For the remaining quarters of 2007 the Elkhart monitor had an overall valid VDR over 75% and specifically was 95% for the second quarter, 89% for the third quarter and 76% for the fourth quarter. According to U.S. EPA guidance, the 2005-2007 design value and monitoring data for the Elkhart monitor located in Elkhart County, Indiana is incomplete. The U.S. EPA required VDR is 75%.

Examining the third quarter of 2005 for the Elkhart monitor, there were 21 total days that had missing data. All 21 days in the third quarter with missing data were a result of a calibration. The dates in the third quarter of 2005 that data was missing at the monitor are July 15-September 13, 2005. The Elkhart monitor had 37 days with missing data in the first quarter of 2007 with various qualifier codes including Machine Malfunction, Collection Error, Filter Damage, Sample Time out of Limits and Maintenance/Routine Repairs. The dates in the first quarter of 2007 that the data was missing at the Elkhart monitor are Jan 6-8, 14-16, 27-29, February 3-13, 15, 18, 21, 28 and March 1-6, 9-14, and 20.

IDEM conducted an analysis of the missing data during the third quarter of 2005 and the first quarter of 2007 for the Elkhart monitor and the table below provides a summary of the captured data for 2005 and 2007 along with alternate methods for evaluating and substituting for the missing data.

Elkhart Monitor (180390003) Data Substituted for 2005 Only

	AVERAGE A Average based on no substitution. Using this average makes the data incomplete since the required VDR is 75% and the 3rd Quarter 2005 VDR is only 30%.	**AVERAGE B** Average based on substituting historic high value for any day that had missing data in the 3rd Quarter of 2005. The historic high value of 39.4 is the highest value that occurred in the 3rd Quarter on September 8, 2002.	**AVERAGE C** Average based on substituting highest value that occurred in the 3rd Quarter of the years 2005-2007 for any day that had missing data in the 3rd Quarter of 2005. The highest value in the 3rd Quarter for the years 2005-2007 of 33.2 occurred in the 3rd Quarter of 2007 on September 6.	**AVERAGE D** Average based on substituting 3rd Quarter 2005 quarterly max for any day that had missing data in the 3rd Quarter of 2005. The 3rd Quarter 2005 quarterly max is 26.7 which occurred on September 22, 2005.	**AVERAGE E** Average based on substituting the average of the 3rd Quarter values from years 2006 and 2007 for any day that had missing data in the 3rd Quarter of 2005. The average of the 3rd Quarter values from the years 2006 and 2007 is 13.56.	**AVERAGE F** Average based on substituting the average of the 1st, 2nd, and 4th Quarters from 2005 for any day that had missing data in the 3rd Quarter of 2005. The average of the 1st, 2nd and 4th Quarters of 2005 is 15.1.
2004 98th %	31.4	31.4	31.4	31.4	31.4	31.4
2005 98th %	40.8	39.4	36.2	36.2	36.2	36.2
2006 98th %	25.5	25.3	25.3	25.3	25.3	25.3
2007 98th %	34.6	34.6	34.6	34.6	34.6	34.6
04-06 Design Value	32.567 (33)	32.033 (32)	30.967 (31)	30.967 (31)	30.967 (31)	30.967 (31)
05-07 Design Value	33.633 (34)	33.1 (33)	32.033 (32)	32.033 (32)	32.033 (32)	32.033 (32)
Calculation for 2005 98%	97 values*0.98 % = 95.06 truncate to interger 95 add 1 = 96 value at 96th ranking is 40.8 so 40.8 is the 98th % for 2005	118 values *0.98% = 115.64 truncate to interger 115 add 1 = 116 value at 116th ranking is 39.4 so 39.4 is the 98th % for 2005 using this substitution	118 values *0.98% = 115.64 truncate to interger 115 add 1 = 116 value at 116th ranking is 36.2 so 36.2 is the 98th % for 2005 using this substitution	118 values *0.98% = 115.64 truncate to interger 115 add 1 = 116 value at 116th ranking is 36.2 so 36.2 is the 98th % for 2005 using this substitution	118 values *0.98% = 115.64 truncate to interger 115 add 1 = 116 value at 116th ranking is 36.2 so 36.2 is the 98th % for 2005 using this substitution	118 values *0.98% = 115.64 truncate to interger 115 add 1 = 116 value at 116th ranking is 36.2 so 36.2 is the 98th % for 2005 using this substitution

Elkhart Monitor (180390003) Data Substituted for 2007 Only

	AVERAGE A Average based on no substitution. Using this average makes the data incomplete since the required VDR is 75% and the 1st Quarter 2007 VDR is only 58%.	**AVERAGE B** Average based on substituting historic high value for any day that had missing data in the 1st Quarter of 2007. The historic high value of 60.7 is the highest value that occurred in the 1st Quarter on March 1, 2003	**AVERAGE C** Average based on substituting highest value that occurred in the 1st Quarter of the years 2005-2007 for any day that had missing data in the 1st Quarter of 2007. The highest value in the 1st Quarter for the years 2005-2007 of 51.7 occurred in the 1st Quarter of 2005 on February 3.	**AVERAGE D** Average based on substituting 1st Quarter 2007 quarterly max for any day that had missing data in the 1st Quarter of 2007. The 1st Quarter 2007 quarterly max is 28.8 which occurred on February 20, 2007.	**AVERAGE E** Average based on substituting the average of the 1st Quarter values from years 2005 and 2006 for any day that had missing data in the 1st Quarter of 2007. The average of the 1st Quarter values from the years 2005 and 2006 is 15.01.	**AVERAGE F** Average based on substituting the average of the 2nd, 3rd, and 4th Quarters from 2007 for any day that had missing data in the 1st Quarter of 2007. The average of the 1st, 2nd and 3rd Quarters of 2007 is 13.99.
2004 98th %	31.4	31.4	31.4	31.4	31.4	31.4
2005 98th %	40.8	40.8	40.8	40.8	40.8	40.8
2006 98th %	25.3	25.3	25.3	25.3	25.3	25.3
2007 98th %	34.6	60.7	51.7	33.2	33.2	33.2
04-06 Design Value	32.567 (33)	32.567 (33)	32.567 (33)	32.567 (33)	32.567 (33)	32.567 (33)
05-07 Design Value	33.633 (34)	42.267 (42)	39.267 (39)	33.1 (33)	33.1 (33)	33.1 (33)
Calculation for 2007 98%	289 values*0.98 % = 283.22 truncate to interger 283 add 1 = 284 value at 284th ranking is 34.6 so 34.6 is the 98th % for 2007	326 values *0.98% = 319.48 truncate to interger 319 add 1 = 320 value at 320th ranking is 60.7 so 60.7 is the 98th % for 2007 using this substitution	326 values *0.98% = 319.48 truncate to interger 319 add 1 = 320 value at 320th ranking is 51.7 so 51.7 is the 98th % for 2007 using this substitution	326 values *0.98% = 319.48 truncate to interger 319 add 1 = 320 value at 320th ranking is 33.2 so 33.2 is the 98th % for 2007 using this substitution	326 values *0.98% = 319.48 truncate to interger 319 add 1 = 320 value at 320th ranking is 33.2 so 33.2 is the 98th % for 2007 using this substitution	326 values *0.98% = 319.48 truncate to interger 319 add 1 = 320 value at 320th ranking is 33.2 so 33.2 is the 98th % for 2007 using this substitution

Elkhart Monitor (180390003) 2005 and 2007 Calculations

	AVERAGE A 2005 Average based on no substitution. Using this average makes the data incomplete since the required VDR is 75% and the 3rd Quarter 2005 VDR is only 30%.	**AVERAGE B 2005** Average based on substituting historic high value for any day that had missing data in the 3rd Quarter of 2005. The historic high value of 39.4 is the highest value that occurred in the 3rd Quarter on September 8, 2002.	**AVERAGE C 2005** Average based on substituting highest value that occurred in the 3rd Quarter of the years 2005-2007 for any day that had missing data in the 3rd Quarter of 2005. The highest value in the 3rd Quarter for the years 2005-2007 of 33.2 occurred in the 3rd Quarter of 2007 on September 6.	**AVERAGE D 2005** Average based on substituting 3rd Quarter 2005 quarterly max for any day that had missing data in the 3rd Quarter of 2005. The 3rd Quarter 2005 quarterly max is 26.7 which occurred on September 22, 2005.	**AVERAGE E 2005** Average based on substituting the average of the 3rd Quarter values from years 2006 and 2007 for any day that had missing data in the 3rd Quarter of 2005. The average of the 3rd Quarter values from the years 2006 and 2007 is 13.56.	**AVERAGE F 2005** Average based on substituting the average of the 1st, 2nd, and 4th Quarters from 2005 for any day that had missing data in the 3rd Quarter of 2005. The average of the 1st, 2nd and 4th Quarters of 2005 is 15.1.
	AVERAGE A 2007 Average based on no substitution. Using this average makes the data incomplete since the required VDR is 75% and the 1st Quarter 2007 VDR is only 58%.	**AVERAGE B 2007** Average based on substituting historic high value for any day that had missing data in the 1st Quarter of 2007. The historic high value of 60.7 is the highest value that occurred in the 1st Quarter on March 1, 2003	**AVERAGE C 2007** Average based on substituting highest value that occurred in the 1st Quarter of the years 2005-2007 for any day that had missing data in the 1st Quarter of 2007. The highest value in the 1st Quarter for the years 2005-2007 of 51.7 occurred in the 1st Quarter of 2005 on February 3.	**AVERAGE D 2007** Average based on substituting 1st Quarter 2007 quarterly max for any day that had missing data in the 1st Quarter of 2007. The 1st Quarter 2007 quarterly max is 28.8 which occurred on February 20, 2007.	**AVERAGE E 2007** Average based on substituting the average of the 1st Quarter values from years 2005 and 2006 for any day that had missing data in the 1st Quarter of 2007. The average of the 1st Quarter values from the years 2005 and 2006 is 15.01.	**AVERAGE F 2007** Average based on substituting the average of the 2nd, 3rd, and 4th Quarters from 2007 for any day that had missing data in the 1st Quarter of 2007. The average of the 1st, 2nd and 3rd Quarters of 2007 is 13.99.
2004 98th %	31.4	31.4	31.4	31.4	31.4	31.4
2005 98th %	40.8	39.4	36.2	36.2	36.2	36.2
2006 98th %	25.3	25.3	25.3	25.3	25.3	25.3
2007 98th %	34.6	60.7	51.7	33.2	33.2	33.2
04-06 Design Value	32.567 (33)	32.033 (32)	30.967 (31)	30.967 (31)	30.967 (31)	30.967 (31)
05-07 Design Value	33.633 (34)	41.8 (42)	37.733 (38)	31.567 (32)	31.567 (32)	31.567 (32)
Calculation for 2005 98%	97 values*0.98 % = 95.06 truncate to interger 95 add 1 = 96 value at 96th ranking is 40.8 so 40.8 is the 98th % for 2005	118 values *0.98% = 115.64 truncate to interger 115 add 1 = 116 value at 116th ranking is 39.4 so 39.4 is the 98th % for 2005 using this substitution	118 values *0.98% = 115.64 truncate to interger 115 add 1 = 116 value at 116th ranking is 36.2 so 36.2 is the 98th % for 2005 using this substitution	118 values *0.98% = 115.64 truncate to interger 115 add 1 = 116 value at 116th ranking is 36.2 so 36.2 is the 98th % for 2005 using this substitution	118 values *0.98% = 115.64 truncate to interger 115 add 1 = 116 value at 116th ranking is 36.2 so 36.2 is the 98th % for 2005 using this substitution	118 values *0.98% = 115.64 truncate to interger 115 add 1 = 116 value at 116th ranking is 36.2 so 36.2 is the 98th % for 2005 using this substitution
Calculation for 2007 98%	289 values*0.98 % = 283.22 truncate to interger 283 add 1 = 284 value at 284th ranking is 34.6 so 34.6 is the 98th % for 2007	326 values *0.98% = 319.48 truncate to interger 319 add 1 = 320 value at 320th ranking is 60.7 so 60.7 is the 98th % for 2007 using this substitution	326 values *0.98% = 319.48 truncate to interger 319 add 1 = 320 value at 320th ranking is 51.7 so 51.7 is the 98th % for 2007 using this substitution	326 values *0.98% = 319.48 truncate to interger 319 add 1 = 320 value at 320th ranking is 33.2 so 33.2 is the 98th % for 2007 using this substitution	326 values *0.98% = 319.48 truncate to interger 319 add 1 = 320 value at 320th ranking is 33.2 so 33.2 is the 98th % for 2007 using this substitution	326 values *0.98% = 319.48 truncate to interger 319 add 1 = 320 value at 320th ranking is 33.2 so 33.2 is the 98th % for 2007 using this substitution

Shenandoah

During the fourth quarter of 2006 the Shenandoah monitor located in Henry County, Indiana, Site ID 18-065-0003, recorded an overall Valid Data Return (VDR) for $PM_{2.5}$ of 45% for the fourth quarter. For the remaining quarters of 2006 the Shenandoah monitor had an overall valid VDR over 75% and specifically was 100% for the first quarter; 86% for the second quarter, and 100% for the third quarter. According to U.S. EPA guidance, the 2005-2007 design value and monitoring data for the Shenandoah monitor located in Henry County, Indiana is incomplete. The U.S. EPA required VDR is 75%.

Examining the fourth quarter of 2006 for the Shenandoah monitor, there were 17 total days that had missing data with various qualifier codes including Machine Malfunction, Miscellaneous Void, Filter Damage, Sample Time out of Limits and Collection Error. The dates in the fourth quarter of 2006 that the data was missing at the Shenandoah monitor are October 11-16, 28, November 4-7, 16-22 and December 1, 13-31st..

IDEM conducted an analysis of the missing data during the fourth quarter of 2006 for the Shenandoah monitor and the table below provides a summary of the captured data for 2006 along with alternate methods for evaluating and substituting for the missing data.

Shenandoah Monitor (180650003)						
	AVERAGE A Average based on no substitution. Using this average makes the data incomplete since the required VDR is 75% and the 4th Quarter 2006 VDR is only 45%.	**AVERAGE B** Average based on substituting historic high value for any day that had missing data in the 4th Quarter of 2006. The historic high value of 36.2 is the highest value that occurred in the 4th Quarter on November 18, 2001.	**AVERAGE C** Average based on substituting highest value that occurred in the 4th Quarter of the years 2005-2007 for any day that had missing data in the 4th Quarter of 2006. The highest value in the 4th Quarter for the years 2005-2007 of 34.6 occurred in the 4th Quarter of 2007 on December 20.	**AVERAGE D** Average based on substituting 4th Quarter 2006 quarterly max for any day that had missing data in the 4th Quarter of 2006. The 4th Quarter 2006 quarterly max is 14.4 which occurred on November 13, 2006	**AVERAGE E** Average based on substituting the average of the 4th Quarter values from years 2006 and 2007 for any day that had missing data in the 4th Quarter of 2006. The average of the 4th Quarter values from the years 2005 and 2007 is 12.31.	**AVERAGE F** Average based on substituting the average of the 1st, 2nd, and 3rd Quarters from 2006 for any day that had missing data in the 4th Quarter of 2006. The average of the 1st, 2nd and 3rd Quarters of 2006 is 11.82.
2004 98th %	26.9	26.9	26.9	26.9	26.9	26.9
2005 98th %	37.3	37.3	37.3	37.3	37.3	37.3
2006 98th %	27.2	36.2	34.6	27.2	27.2	27.2
2007 98th %	32.4	32.4	32.4	32.4	32.4	32.4
04-06 Design Value	30.467 (30)	33.467 (33)	32.933 (33)	30.467 (30)	30.467 (30)	30.467 (30)
05-07 Design Value	32.3 (32)	32.3 (32)	32.3 (32)	32.3 (32)	32.3 (32)	32.3 (32)
Calculation for 2006 98%	101 values*0.98 % = 98.98 truncate to interger 98 add 1 = 99 value at 99th ranking is 27.2 so 27.2 is the 98th % for 2006	118 values *0.98% = 115.64 truncate to interger 115 add 1 = 116 value at 116th ranking is 36.2 so 36.2 is the 98th % for 2006 using this substitution	118 values *0.98% = 115.64 truncate to interger 115 add 1 = 116 value at 116th ranking is 34.6 so 34.6 is the 98th % for 2006 using this substitution	118 values *0.98% = 115.64 truncate to interger 115 add 1 = 116 value at 116th ranking is 27.2 so 27.2 is the 98th % for 2006 using this substitution	118 values *0.98% = 115.64 truncate to interger 115 add 1 = 116 value at 116th ranking is 27.2 so 27.2 is the 98th % for 2006 using this substitution	118 values *0.98% = 115.64 truncate to interger 115 add 1 = 116 value at 116th ranking is 27.2 so 27.2 is the 98th % for 2006 using this substitution

Highland

During the second and third quarters of 2007 the Highland monitor located in Lake County, Indiana, Site ID 18-089-0027, recorded an overall Valid Data Return (VDR) for $PM_{2.5}$ of 57% for the second quarter and 74% for the third quarter. For the remaining quarters of 2007 the Highland monitor had an overall valid VDR over 75% and specifically was 90% for the first quarter; and 86% for the fourth quarter. According to U.S. EPA guidance, the 2005-2007 design value and monitoring data for the Highland monitor located in Lake County, Indiana is incomplete. The U.S. EPA required VDR is 75%.

Examining the second and third quarters of 2007 for the Highland monitor, there were 21 total days that had missing data. 13 days in the second quarter and 6 days in the third quarter of 2007 were due to a Power Failure the other two missing days in the third quarter were due to a Collection Error and a Machine Malfunction. The dates in the second and third quarters of 2007 that the data was missing at the Highland monitor are April 27-30, May 9-15, 27, June 11-30, July 1-17 and September 21 and 30th.

IDEM conducted an analysis of the missing data during the second and third quarters of 2007 for the Highland monitor and the table below provides a summary of the captured data for 2007 along with alternate methods for evaluating and substituting for the missing data.

Highland (180890027)						
	2nd Quarter AVERAGE A Average based on no substitution. Using this average makes the data incomplete since the required VDR is 75% and the 2nd Quarter 2007 VDR is only 57%.	**2nd Quarter AVERAGE B** Average based on substituting historic high value for any day that had missing data in the 3rd Quarter of 2007. The historic high value of 47 is the highest value that occurred in the 2nd Quarter on June 27, 2005	**2nd Quarter AVERAGE C** Average based on substituting highest value that occurred in the 2nd Quarter of the years 2005-2007 for any day that had missing data in the 2nd Quarter of 2007. The highest value in the 2nd Quarter for the years 2005-2007 of 30.9 occurred in the 2nd Quarter of 2007 on May 30.	**2nd Quarter AVERAGE D** Average based on substituting 2nd Quarter 2007 quarterly max for any day that had missing data in the 2nd Quarter of 2007. The 2nd Quarter 2007 quarterly max is 30.9 which occurred on May 30, 2007	**2nd Quarter AVERAGE E** Average based on substituting the average of the 2nd Quarter values from years 2005 and 2006 for any day that had missing data in the 2nd Quarter of 2007. The average of the 2nd Quarter values from the years 2005 and 2006 is 12.26.	**2nd Quarter AVERAGE F** Average based on substituting the average of the 1st, 3rd, and 4th Quarters from 2007 for any day that had missing data in the 2nd Quarter of 2007. The average of the 1st, 3rd and 4th Quarters of 2007 is 13.66.
	3rd Quarter AVERAGE A Average based on no substitution. Using this average makes the data incomplete since the required VDR is 75% and the 3rd Quarter 2007 VDR is only 74%.	**3rd Quarter AVERAGE B** Average based on substituting historic high value for any day that had missing data in the 3rd Quarter of 2007. The historic high value of 40.9 is the highest value that occurred in the 3rd Quarter on September 8, 2002	**3rd Quarter AVERAGE C** Average based on substituting highest value that occurred in the 3rd Quarter of the years 2005-2007 for any day that had missing data in the 3rd Quarter of 2007. The highest value in the 3rd Quarter for the years 2005-2007 of 34.6 occurred in the 3rd Quarter of 2005 on September 10.	**3rd Quarter AVERAGE D** Average based on substituting 3rd Quarter 2007 quarterly max for any day that had missing data in the 3rd Quarter of 2007. The 3rd Quarter 2007 quarterly max is 27.3 which occurred on August 1, 2007.	**3rd Quarter AVERAGE E** Average based on substituting the average of the 3rd Quarter values from years 2005 and 2006 for any day that had missing data in the 3rd Quarter of 2007. The average of the 3rd Quarter values from the years 2005 and 2006 is 15.62	**3rd Quarter AVERAGE F** Average based on substituting the average of the 1st, 2nd, and 4th Quarters from 2007 for any day that had missing data in the 3rd Quarter of 2007. The average of the 1st, 2nd and 4th Quarters of 2007 is 13.10.
2004 98th %	30.1	30.1	30.1	30.1	30.1	30.1
2005 98th %	37.1	37.1	37.1	37.1	37.1	37.1
2006 98th %	25.8	25.8	25.8	25.8	25.8	25.8
2007 98th %	34.1	47	34.6	30.9	30.9	30.9
04-06 Design Value	31 (31)	31 (31)	31 (31)	31 (31)	31 (31)	31 (31)
05-07 Design Value	32.333 (32)	36.633 (37)	32.5 (33)	31.267 (31)	31.267 (31)	31.267 (31)
Calculation for 2007 98%	93 values*0.98 % = 91.14 truncate to interger 91 add 1 = 92 value at 92nd ranking is 34.1 so 34.1 is the 98th % for 2007	114 values *0.98% = 111.72 truncate to interger 111 add 1 = 112 value at 112th ranking is 47 so 47 is the 98th % for 2007 using this substitution	114 values *0.98% = 111.72 truncate to interger 111 add 1 = 112 value at 112th ranking is 34.6 so 34.6 is the 98th % for 2007 using this substitution	114 values *0.98% = 111.72 truncate to interger 111 add 1 = 112 value at 112th ranking is 30.9 so 30.9 is the 98th % for 2007 using this substitution	114 values *0.98% = 111.72 truncate to interger 111 add 1 = 112 value at 112th ranking is 30.9 so 30.9 is the 98th % for 2007 using this substitution	114 values *0.98% = 111.72 truncate to interger 111 add 1 = 112 value at 112th ranking is 30.9 so 30.9 is the 98th % for 2007 using this substitution

Michigan City

During the first quarter of 2005 the Michigan City monitor located in LaPorte County, Indiana, Site ID 18-091-0011, recorded an overall Valid Data Return (VDR) for $PM_{2.5}$ of 73% for the first quarter. For the remaining quarters of 2005 the Michigan City monitor had an overall valid VDR over 75% and specifically was 87% for the second quarter, 100% for the third quarter and 100% for the fourth quarter. Also during the third quarter of 2006 the Michigan City monitor recorded an overall VDR of 55% for the third quarter. For the remaining quarters of 2006 the Michigan City monitor had an overall valid VDR over 75% and specifically was 97% for the first quarter, 83% for the second quarter, and 87% for the fourth quarter. According to U.S. EPA guidance, the 2005-2007 design value and monitoring data for the Michigan City monitor located in LaPorte County, Indiana is incomplete. The U.S. EPA required VDR is 75%.

Examining the first quarter of 2005 for the Michigan City monitor, there were 8 total days that had missing data due to various qualifier codes such as Machine Malfunction, Collection Error and Lab Error. The dates in the first quarter of 2005 that data was missing at the monitor are January 25-31, and February 12-15, 21-27. The Michigan City monitor had 14 days with missing data in the third quarter of 2006 with various qualifier codes including Machine Malfunction, Power Failure, Construction/Repairs in Area and Collection Error. The dates in the third quarter of 2006 that the data was missing at the Michigan City monitor are July 13-16, 22-25, August 24, 29 and September 2-5, 11, 23-26.

IDEM conducted an analysis of the missing data during the first quarter of 2005 and the third quarter of 2006 for the Michigan City monitor and the table below provides a summary of the captured data for 2005 and 2006 along with alternate methods for evaluating and substituting for the missing data.

Michigan City (180910011) Data Substituted for 2005 Only

	AVERAGE A Average based on no substitution. Using this average makes the data incomplete since the required VDR is 75% and the 1st Quarter 2005 VDR is only 73%.	**AVERAGE B** Average based on substituting historic high value for any day that had missing data in the 1st Quarter of 2005. The historic high value of 48.9 is the highest value that occurred in the 1st Quarter on March 1, 2003	**AVERAGE C** Average based on substituting highest value that occurred in the 1st Quarter of the years 2005-2007 for any day that had missing data in the 1st Quarter of 2005. The highest value in the 1st Quarter for the years 2005-2007 is 32.4 which occured on February 3, 2005	**AVERAGE D** Average based on substituting 1st Quarter 2005 quarterly max for any day that had missing data in the 1st Quarter of 2005. The 1st Quarter 2005 quarterly max is 32.4 which occurred on February 3, 2005.	**AVERAGE E** Average based on substituting the average of the 1st Quarter values from years 2006 and 2007 for any day that had missing data in the 1st Quarter of 2005. The average of the 1st Quarter values from the years 2006 and 2007 is 11.63.	**AVERAGE F** Average based on substituting the average of the 2nd, 3rd, and 4th Quarters from 2005 for any day that had missing data in the 1st Quarter of 2005. The average of the 2nd, 3rd and 4th Quarters of 2005 is 14.24.
2004 98th %	31.6	31.6	31.6	31.6	31.6	31.6
2005 98th %	37.5	48.9	37.5	37.5	37.5	37.5
2006 98th %	25.5	25.5	25.5	25.5	25.5	25.5
2007 98th %	31.5	31.5	31.5	31.5	31.5	31.5
04-06 Design Value	31.533 (32)	35.333 (35)	31.533 (32)	31.533 (32)	31.533 (32)	31.533 (32)
05-07 Design Value	31.5 (32)	35.3 (35)	31.5 (32)	31.5 (32)	31.5 (32)	31.5 (32)
Calculation for 2005 98%	109 values*0.98 % = 106.82 truncate to interger 106 add 1 = 107 value at 107th ranking is 37.5 so 37.5 is the 98th % for 2005	117 values *0.98% = 114.66 truncate to interger 114 add 1 = 115 value at 115th ranking is 48.9 so 48.9 is the 98th % for 2005 using this substitution	117 values *0.98% = 114.66 truncate to interger 114 add 1 = 115 value at 115th ranking is 37.5 so 37.5 is the 98th % for 2005 using this substitution	117 values *0.98% = 114.66 truncate to interger 114 add 1 = 115 value at 115th ranking is 37.5 so 37.5 is the 98th % for 2005 using this substitution	117 values *0.98% = 114.66 truncate to interger 114 add 1 = 115 value at 115th ranking is 37.5 so 37.5 is the 98th % for 2005 using this substitution	117 values *0.98% = 114.66 truncate to interger 114 add 1 = 115 value at 115th ranking is 37.5 so 37.5 is the 98th % for 2005 using this substitution

Michigan City (180910011) Data Substituted for 2006 Only

	AVERAGE A Average based on no substitution. Using this average makes the data incomplete since the required VDR is 75% and the 3rd Quarter 2006 VDR is only 55%.	**AVERAGE B** Average based on substituting historic high value for any day that had missing data in the 3rd Quarter of 2006. The historic high value of 39.6 is the highest value that occurred in the 3rd Quarter on August 8, 2001.	**AVERAGE C** Average based on substituting highest value that occurred in the 3rd Quarter of the years 2005-2007 for any day that had missing data in the 3rd Quarter of 2006. The highest value in the 3rd Quarter for the years 2005-2007 is 37.9 which occured on August 8, 2005	**AVERAGE D** Average based on substituting 3rd Quarter 2006 quarterly max for any day that had missing data in the 3rd Quarter of 2006. The 3rd Quarter 2006 quarterly max is 29.5 which occurred on August 18, 2006.	**AVERAGE E** Average based on substituting the average of the 3rd Quarter values from years 2005 and 2007 for any day that had missing data in the 3rd Quarter of 2006. The average of the 3rd Quarter values from the years 2005 and 2007 is 13.46.	**AVERAGE F** Average based on substituting the average of the 1st, 2nd, and 4th Quarters from 2006 for any day that had missing data in the 3rf Quarter of 2006. The average of the 1st, 2nd, and 4th Quarters of 2006 is 10.32.
2004 98th %	31.6	31.6	31.6	31.6	31.6	31.6
2005 98th %	37.5	48.9	37.5	37.5	37.5	37.5
2006 98th %	25.5	39.6	37.9	29.5	25.5	25.5
2007 98th %	31.5	31.5	31.5	31.5	31.5	31.5
04-06 Design Value	31.533 (32)	40.033 (40)	35.667 (36)	32.867 (33)	31.533 (32)	31.533 (32)
05-07 Design Value	31.5 (32)	40 (40)	35.633 (36)	32.833 (33)	31.5 (32)	31.5 (32)
Calculation for 2005 98%	98 values*0.98 % = 96.04 truncate to interger 96 add 1 = 97 value at 97th ranking is 25.5 so 25.5 is the 98th % for 2006	112 values *0.98% = 109.76 truncate to interger 109 add 1 = 110 value at 110th ranking is 39.6 so 39.6 is the 98th % for 2006 using this substitution	112 values *0.98% = 109.76 truncate to interger 109 add 1 = 110 value at 110th ranking is 37.9 so 37.9 is the 98th % for 2006 using this substitution	112 values *0.98% = 109.76 truncate to interger 109 add 1 = 110 value at 110th ranking is 29.5 so 29.5 is the 98th % for 2006 using this substitution	112 values *0.98% = 109.76 truncate to interger 109 add 1 = 110 value at 110th ranking is 25.5 so 25.5 is the 98th % for 2006 using this substitution	112 values *0.98% = 109.76 truncate to interger 109 add 1 = 110 value at 110th ranking is 25.5 so 25.5 is the 98th % for 2006 using this substitution

Michigan City (180910011) 2005 and 2006 Calculations

	AVERAGE A 2005 Average based on no substitution. Using this average makes the data incomplete since the required VDR is 75% and the 1st Quarter 2005 VDR is only 73%.	**AVERAGE B 2005** Average based on substituting historic high value for any day that had missing data in the 1st Quarter of 2005. The historic high value of 48.9 is the highest value that occurred in the 1st Quarter on March 1, 2003	**AVERAGE C 2005** Average based on substituting highest value that occurred in the 1st Quarter of the years 2005-2007 for any day that had missing data in the 1st Quarter of 2005. The highest value in the 1st Quarter for the years 2005-2007 is 32.4 which occured on February 3, 2005	**AVERAGE D 2005** Average based on substituting 1st Quarter 2005 quarterly max for any day that had missing data in the 1st Quarter of 2005. The 1st Quarter 2005 quarterly max is 32.4 which occurred on February 3, 2005.	**AVERAGE E 2005** Average based on substituting the average of the 1st Quarter values from years 2006 and 2007 for any day that had missing data in the 1st Quarter of 2005. The average of the 1st Quarter values from the years 2006 and 2007 is 11.63.	**AVERAGE F 2005** Average based on substituting the average of the 2nd, 3rd, and 4th Quarters from 2005 for any day that had missing data in the 1st Quarter of 2005. The average of the 2nd, 3rd and 4th Quarters of 2005 is 14.24.
	AVERAGE A 2006 Average based on no substitution. Using this average makes the data incomplete since the required VDR is 75% and the 3rd Quarter 2006 VDR is only 55%.	**AVERAGE B 2006** Average based on substituting historic high value for any day that had missing data in the 3rd Quarter of 2006. The historic high value of 39.6 is the highest value that occurred in the 3rd Quarter on August 8, 2001.	**AVERAGE C 2006** Average based on substituting highest value that occurred in the 3rd Quarter of the years 2005-2007 for any day that had missing data in the 3rd Quarter of 2006. The highest value in the 3rd Quarter for the years 2005-2007 is 37.9 which occured on August 8, 2005	**AVERAGE D 2006** Average based on substituting 3rd Quarter 2006 quarterly max for any day that had missing data in the 3rd Quarter of 2006. The 3rd Quarter 2006 quarterly max is 29.5 which occurred on August 18, 2006.	**AVERAGE E 2006** Average based on substituting the average of the 3rd Quarter values from years 2005 and 2007 for any day that had missing data in the 3rd Quarter of 2006. The average of the 3rd Quarter values from the years 2005 and 2007 is 13.46.	**AVERAGE F 2006** Average based on substituting the average of the 1st, 2nd, and 4th Quarters from 2006 for any day that had missing data in the 3rf Quarter of 2006. The average of the 1st, 2nd, and 4th Quarters of 2006 is 10.32.
2004 98th %	31.6	31.6	31.6	31.6	31.6	31.6
2005 98th %	37.5	48.9	37.5	37.5	37.5	37.5
2006 98th %	25.5	39.6	37.9	29.5	25.5	25.5
2007 98th %	31.5	31.5	31.5	31.5	31.5	31.5
04-06 Design Value	31.533 (31)	40.033 (40)	35.667 (36)	32.867 (33)	31.533 (31)	31.533 (31)
05-07 Design Value	31.5 (32)	40 (40)	35.633 (36)	32.833 (33)	31.5 (32)	31.5 (32)
Calculation for 2005 98%	109 values*0.98 % = 106.82 truncate to interger 106 add 1 = 107 value at 107th ranking is 37.5 so 37.5 is the 98th % for 2005	117 values *0.98% = 114.66 truncate to interger 114 add 1 = 115 value at 115th ranking is 48.9 so 48.9 is the 98th % for 2005 using this substitution	117 values *0.98% = 114.66 truncate to interger 114 add 1 = 115 value at 115th ranking is 37.5 so 37.5 is the 98th % for 2005 using this substitution	117 values *0.98% = 114.66 truncate to interger 114 add 1 = 115 value at 115th ranking is 37.5 so 37.5 is the 98th % for 2005 using this substitution	117 values *0.98% = 114.66 truncate to interger 114 add 1 = 115 value at 115th ranking is 37.5 so 37.5 is the 98th % for 2005 using this substitution	117 values *0.98% = 114.66 truncate to interger 114 add 1 = 115 value at 115th ranking is 37.5 so 37.5 is the 98th % for 2005 using this substitution
Calculation for 2006 98%	98 values*0.98 % = 96.04 truncate to interger 96 add 1 = 97 value at 97th ranking is 25.5 so 25.5 is the 98th % for 2006	112 values *0.98% = 109.76 truncate to interger 109 add 1 = 110 value at 110th ranking is 39.6 so 39.6 is the 98th % for 2006 using this substitution	112 values *0.98% = 109.76 truncate to interger 109 add 1 = 110 value at 110th ranking is 37.9 so 37.9 is the 98th % for 2006 using this substitution	112 values *0.98% = 109.76 truncate to interger 109 add 1 = 110 value at 110th ranking is 29.5 so 29.5 is the 98th % for 2006 using this substitution	112 values *0.98% = 109.76 truncate to interger 109 add 1 = 110 value at 110th ranking is 25.5 so 25.5 is the 98th % for 2006 using this substitution	112 values *0.98% = 109.76 truncate to interger 109 add 1 = 110 value at 110th ranking is 25.5 so 25.5 is the 98th % for 2006 using this substitution

Terre Haute-Lafayette St

During the second quarter of 2006 the Terre Haute Lafayette St monitor located in Vigo County, Indiana, Site ID 18-167-0018, recorded an overall Valid Data Return (VDR) for $PM_{2.5}$ of 73% for the second quarter. For the remaining quarters of 2006 the Terre Haute Lafayette St monitor had an overall valid VDR over 75% and specifically was 100% for the first quarter; 100% for the third quarter, and 97% for the fourth quarter. According to U.S. EPA guidance, the 2005-2007 design value and monitoring data for the Terre Haute Lafayette St monitor located in Vigo County, Indiana is incomplete. The U.S. EPA required VDR is 75%.

Examining the second quarter of 2006 for the Terre Haute monitor, there were 8 total days that had missing data with various qualifier codes including Machine Malfunction, Collection Error, Filter Damage and Power Failure. The dates in the second quarter of 2006 that the data was missing at the Terre Haute Lafayette St monitor are April 8-11, May 5-8, 14 and June 7, 16-19.

IDEM conducted an analysis of the missing data during the second quarter of 2006 for the Terre Haute Lafayette St monitor and the table below provides a summary of the captured data for 2006 along with alternate methods for evaluating and substituting for the missing data.

Terre Haute Lafayette St (181670018)						
	AVERAGE A Average based on no substitution. Using this average makes the data incomplete since the required VDR is 75% and the 2nd Quarter 2006 VDR is only 73%.	**AVERAGE B** Average based on substituting historic high value for any day that had missing data in the 2nd Quarter of 2006. The historic high value of 49 is the highest value that occurred in the 2nd Quarter on June 27, 2005	**AVERAGE C** Average based on substituting highest value that occurred in the 2nd Quarter of the years 2005-2007 for any day that had missing data in the 2nd Quarter of 2006. The highest value in the 2nd Quarter for the years 2005-2007 is 49 which occured on June 27, 2005	**AVERAGE D** Average based on substituting 2nd Quarter 2006 quarterly max for any day that had missing data in the 2nd Quarter of 2006. The 2nd Quarter 2006 quarterly max is 23.6 which occurred on May 29, 2006.	**AVERAGE E** Average based on substituting the average of the 2nd Quarter values from years 2005 and 2007 for any day that had missing data in the 2nd Quarter of 2006. The average of the 2nd Quarter values from the years 2005 and 2007 is 12.53.	**AVERAGE F** Average based on substituting the average of the 1st, 3rd, and 4th Quarters from 2006 for any day that had missing data in the 2nd Quarter of 2006. The average of the 1st, 3rd and 4th Quarters of 2006 is 13.40.
2004 98th %	26.9	26.9	26.9	26.9	26.9	26.9
2005 98th %	43.1	43.1	43.1	43.1	43.1	43.1
2006 98th %	31	49	49	31	31	31
2007 98th %	31	31	31	31	31	31
04-06 Design Value	33.667 (34)	39.667 (40)	39.667 (40)	33.667 (34)	33.667 (34)	33.667 (34)
05-07 Design Value	35.033 (35)	41.033 (41)	41.033 (41)	35.033 (35)	35.033 (35)	35.033 (35)
Calculation for 2005 98%	113 values*0.98 % = 110.74 truncate to interger 110 add 1 = 111 value at 111th ranking is 31 so 31 is the 98th % for 2006	121 values *0.98% = 118.58 truncate to interger 118 add 1 = 119 value at 119th ranking is 49 so 49 is the 98th % for 2006 using this substitution	121 values *0.98% = 118.58 truncate to interger 118 add 1 = 119 value at 119th ranking is 49 so 49 is the 98th % for 2006 using this substitution	121 values *0.98% = 118.58 truncate to interger 118 add 1 = 119 value at 119th ranking is 31 so 31 is the 98th % for 2006 using this substitution	121 values *0.98% = 118.58 truncate to interger 118 add 1 = 119 value at 119th ranking is 31 so 31 is the 98th % for 2006 using this substitution	121 values *0.98% = 118.58 truncate to interger 118 add 1 = 119 value at 119th ranking is 31 so 31 is the 98th % for 2006 using this substitution

Substituting for Missing Data (Averages B-F)

The substitution procedure for data below the required 75% VDR is a conservative mechanism to ascertain the likelihood that a site would meet or not meet the standards if the site had collected the 75% criteria. The incomplete design value identified as Average A is more indicative of the monitor's air shed than the artificial recalculated design values explained below.

Average A: Three-year average based on no substitution, calculated according to U.S. EPA guidance. Using this average makes the data incomplete since the required VDR is 75%. U.S. EPA states that the incomplete design value is still identified as the monitors true design value.

Averages B and C: Three-year averages based on substitution, calculated according to U.S. EPA guidance. For Average B the historic high value was substituted for any day that had missing data. For Average C the highest value from the years 2005-2007 was substituted for any day that had missing data. Using Average B provides conservative numbers by using the highest values ever recorded for a particular quarter which in most cases produces a value that is over the standard. Using Average C provides more current data than Average B by using the highs from the 3-year design period. It is IDEM's understanding that U.S. EPA is starting to use this calculation rather than Average B. In this case, however it is not as conservative as Average B and in some cases it makes the three-year averages over the standard.

Averages D, E and F: Three-year averages based on substitution. For Average D the quarterly max was substituted for any day that had missing data. Average E substituted the average of the quarters from the other two years for any missing data and Average F substituted the average of the other three quarters for the missing data. In this case, Averages D, E and F are not as conservative as Averages B and C and results in values below the daily standard.

Conclusions

Nine $PM_{2.5}$ monitoring sites in Indiana produced data for 2005-2007 that is deemed incomplete due to missing data, meaning that the 2005-2007 average value cannot be truly determined. Four of those monitors (Jasper Sports Complex, Jasper Golf Course, Gary Water Plant and South Bend Shields Dr) have only been monitoring for a short amount of time and do not have three years of data to determine the 2005-2007 design value. The other five monitors (Shenandoah, Elkhart, Highland, Michigan City and Terre Haute-Lafayette St) deemed incomplete have periods of missing data due to various reasons.

U.S. EPA guidance recommends substituting the quarterly maximum value (Averages B and C which is the worst-case scenario) which in most cases results in the values being above the standard. However, IDEM does not believe that the substitutions in the scenarios above necessarily result in a value representative of the $PM_{2.5}$ concentrations registered at the monitors.

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Appendix C

Unmonitored Area Analysis

Introduction

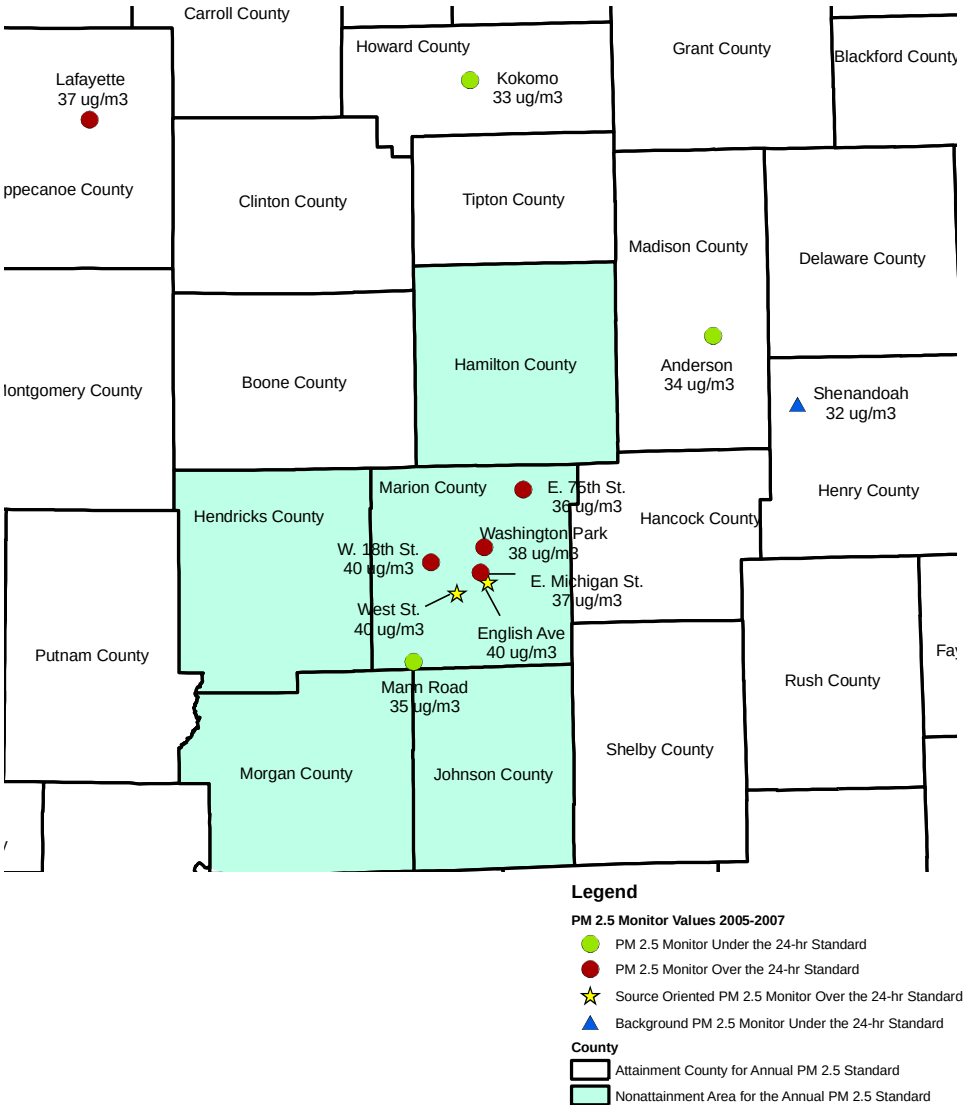
U.S. EPA has recommended, in its "Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$ and Regional Haze" (EPA-454/B-07-002, April 2007), an "unmonitored area analysis" for areas without monitors that could potentially exceed the NAAQS if monitors existed in those areas. The "unmonitored area analysis" uses a combination of ambient data to provide spatial fields for monitored and unmonitored areas and model output for predicted concentrations throughout a region. Hamilton, Hendricks, Johnson and Morgan counties were designated as nonattainment for the annual fine particle standard despite the fact that there are no fine particle monitors in those counties. These four counties are adjacent to Marion County, which has monitors in the southwest, central, and northeastern portions of the county. The following is an unmonitored area analysis for these four counties.

Indiana Monitoring Network

Ambient fine particle monitors in the Central Indiana area provide adequate coverage, as per 40 CFR, Part 58, Appendix D, 4.7. Indiana has placed fine particle monitors as per this guidance that based the number of monitors on the population of the metropolitan statistical area (MSA) and the design values for monitored areas. The monitors are therefore concentrated in the more urban areas where higher pollutant concentrations are expected. Aside from Marion County there are fine particle monitors located in nearby Madison, Howard, Henry and Tippecanoe Counties, which have MSAs with populations greater than 100,000. While these monitors were sited due to the proximity to the urban center of their respective MSAs, the resulting design values between these monitors are comparable with the latest 3 year values (2005-2007) and range between 32 and 37 $\mu g/m^3$. Figure 1 shows the Central Indiana $PM_{2.5}$ monitoring network.

Figure 1

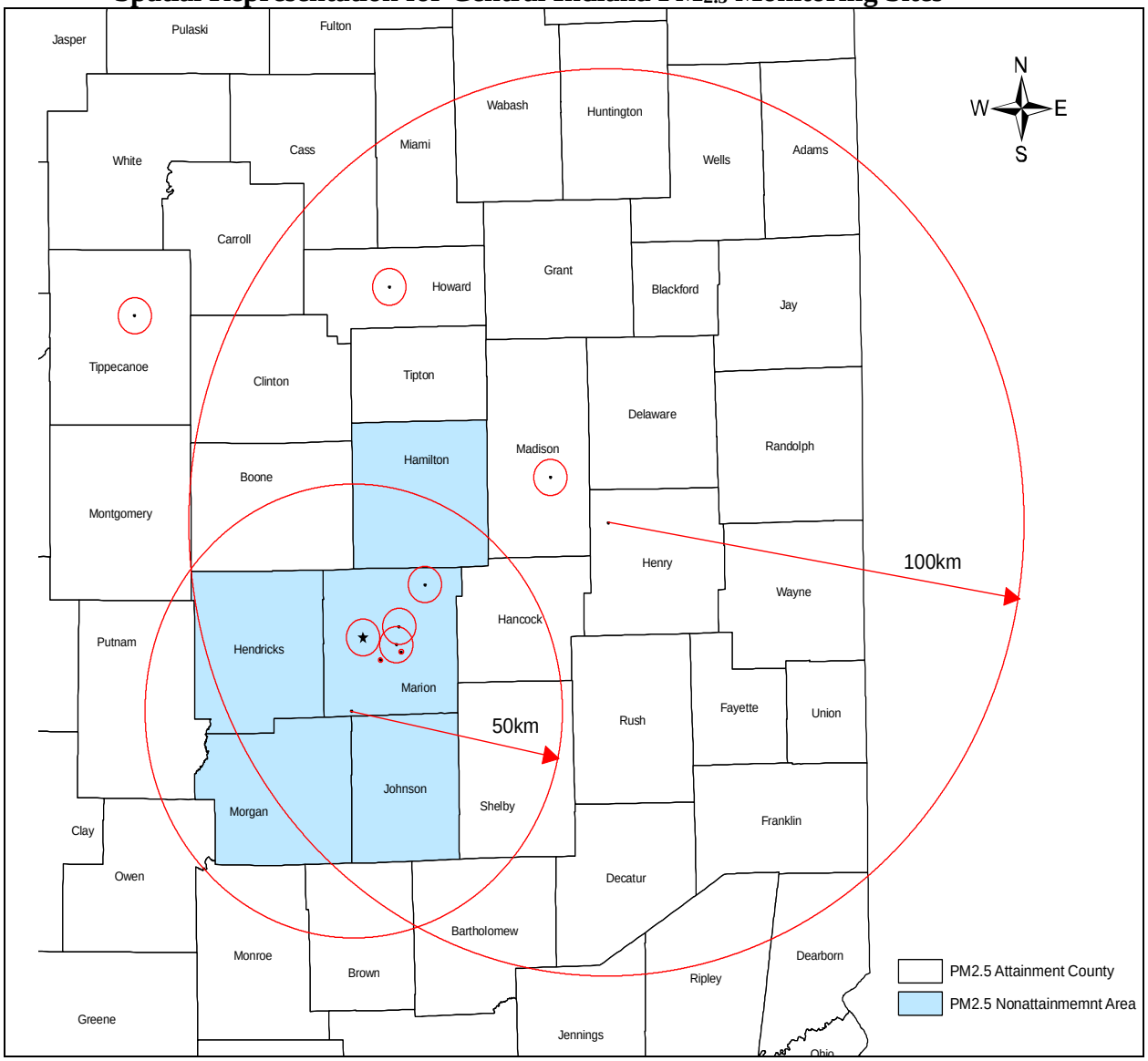
Central Indiana PM 2.5 Monitors



Regional, Urban and Neighborhood Monitors

Figure 2 below shows the Central Indiana monitors. The circles surrounding the monitors indicate the spatial scale of coverage for each of the monitors. The spatial scale of representation describes the physical dimensions of the air parcel measured at and near the monitor. In the rural areas, the air quality in the spatial coverages of the regional and urban monitor is considered to have similar concentrations. The monitors shown in Figure 2 are those closest to the unmonitored nonattainment areas for the annual $PM_{2.5}$ standard.

Figure 2
Spatial Representation for Central Indiana $PM_{2.5}$ Monitoring Sites



A regional monitor has a spatial scale of representation which extends from tens to hundreds of kilometers from the monitoring site. The Shenandoah fine particle monitor, located in Henry County, represents a regional scale monitor. This monitor measures air quality representative of a geographic range that includes most of the Central Indiana annual $PM_{2.5}$ nonattainment area. The Shenandoah fine particle monitor's current daily $PM_{2.5}$ 3-year design value (2005-2007) is 32 $\mu g/m^3$; indicating low, rural area readings.

An urban monitor has a spatial scale of representation which extends from 4 to 50 kilometers from the monitoring site. The Indianapolis Mann Road fine particle monitor is an urban monitor and its spatial scale of representation extends into Hendricks, Morgan and Johnson counties. The Mann Road monitor represents a downwind urban scale

monitor, whose air quality monitoring extends out 50 kilometers, from Morgan and Johnson counties while Hendricks County is located approximately 10 miles to the west of the Mann Road monitor. The Mann Road fine particle monitor's current daily $PM_{2.5}$ 3-year design value (2005-2007) is 35 $\mu g/m^3$.

A neighborhood monitor has a spatial scale of representation which extends from 0.5 to 4.0 kilometers from the monitoring site. Hamilton County would be considered downwind of the Indianapolis East 75th Street monitor, located approximately 4 kilometers to the south of Hamilton County. The Indianapolis Washington Park, East 75th Street, West 18th Street and East Michigan Street fine particle monitors are neighborhood monitors with spatial extent up to 4 kilometers with uniform land use. While the neighborhood monitors represent a small portion of an urban area, the daily concentrations are fairly consistent for urbanized $PM_{2.5}$ concentrations. $PM_{2.5}$ concentrations in less populated areas and more rural settings would be expected to be lower.

24-hr $PM_{2.5}$ Monitor Values

Tables 1 and 2 below show the daily 98th percentile values and the daily site design values for Central Indiana from 2000-2007. The highlighted fine particle monitors in the table are those located outside the urban center of Indianapolis, Mann Road, E. 75th St. and the monitors in Henry and Madison Counties, which typically have lower annual design values than the three monitors impacted by emissions from the Indianapolis urban core.

Average differences in concentrations between the rural monitors and urban monitors range from 32 $\mu g/m^3$ to 40 $\mu g/m^3$ for a three year design value. In addition, the Henry County monitor shows lower design values that would represent the eastern portion of Hamilton county. It appears that the higher annual fine particle concentrations are found in or near the urban center of Indianapolis. This fact is shown in the daily 98th percentile values and the three year daily site design values for each of the five Marion County fine particle monitors and surrounding county monitors over the past 8 years (2000-2007).

The Indiana Department of Environmental Management (IDEM) maintains four monitoring sites that are intended to reflect air quality in a relatively small geographic area directly influenced by a specific source or sources of air pollution, commonly referred to as source oriented monitors. Two of these monitors are located in Indianapolis; S. West St and English Ave. U.S. EPA visited the four monitoring sites to determine if the monitors should be used in comparison of the daily standard. While the source oriented monitors in Marion County have population nearby they are largely influenced by nearby sources. These monitors are not used to determine attainment with the annual fine particles standard but U.S. EPA determined they could be compared to the daily standard. IDEM considers these to be hot spots and not reflective of the true air quality in the area. IDEM will work with the sources to address emissions that are contributing to the high annual values at these sites.

IDEM also operates five other monitors in the $PM_{2.5}$ monitoring network that collect background fine particle concentrations. One of these monitors (Shenandoah) is located in Central Indiana. U.S. EPA determined that this monitor is not used for comparison to the annual fine particles standard but is compared to the daily fine particle standard.

Table 1
Daily 98th Percentile Values for Central Indiana from 2000 – 2007

County	Site	2000	2001	2002	2003	2004	2005	2006	2007
Marion	Mann Road	33.5	31.0	39.6	33.7	29.3	39.4	31.0	35.6
Marion	Washington Park	36.5	37.2	35.0	39.3	31.0	42.5	31.7	38.8
Marion	E. 75th St.	35.1	35.9	33.3	38.0	28.7	43.4	30.7	33.5
Marion	S. West St.	36.8	36.4	36.5	37.9	31.7	43.9	37.5	38.3
Marion	English Ave	39.5	44.1	44.8	39.4	31.1	44.0	36.2	38.8
Marion	W. 18th St.	36.3	38.5	26.8	36.2	31.9	45.7	34.8	38.4
Marion	E. Michigan St.	35.7	39.5	36.7	36.7	31.3	40.3	33.5	37.2
Madison	Anderson	33.1	36.8	34.2	35.5	28.2	38.3	28.0	34.3
Henry	Shenandoah	19.8	30.7	29.7	31.4	26.9	37.3	27.2	32.4
Howard	Kokomo	34.3	38.1	29.7	33.1	27.6	37.6	27.6	33.6
Tippecanoe	Lafayette	34.0	35.5	29.4	34.5	26.4	49.3	27.0	34.2

Table 2
Daily Site Design Values for Central Indiana from 2000 – 2007

County	Site	00-02	01-03	02-04	03-05	04-06	05-07
Marion	Mann Road	35	35	34	34	33	35
Marion	Washington Park	36	37	35	38	35	38
Marion	E. 75th St.	35	36	33	37	34	36
Marion	S. West St.	37	37	35	38	38	40
Marion	English Ave	43	43	38	38	37	40
Marion	W. 18th St.	34	34	32	38	37	40
Marion	E. Michigan St.	37	38	35	36	35	37
Madison	Anderson	35	36	33	34	32	34
Henry	Shenandoah H.S.	27	31	29	32	30	32
Howard	Kokomo	34	34	30	33	31	33
Tippecanoe	Lafayette	33	33	30	37	34	37

Red text indicates the Daily Site Design Value is above the 24-hr Standard of 35 µg/m^3. Also note that the 24-hr standard was revised and lowered on September 21, 2006 so values above 35 µg/m^3 during the years of 2000-2005 are not considered over the standard since the daily 24-hr $PM_{2.5}$ standard during that time was still 65 µg/m^3.

Unmonitored Area Analysis

U.S. EPA has developed the "Modeled Attainment Test Software" (MATS) to spatially interpret data, adjust spatial fields with modeled output gradients and multiply the fields by modeled Relative Reduction Factors (RRFs). However, the $PM_{2.5}$ portion of MATS is not available at this time. U.S. EPA guidance recommends using nearby ambient data as well as modeled output to determine the concentrations in unmonitored areas. In the case of the unmonitored areas of Hamilton, Hendricks, Johnson and Morgan Counties, ambient monitored data in Marion County shows decreasing design values and future year modeled results at all Marion County fine particle monitors as falling below the daily 24-hr fine particle standard.

A Review of the LADCO Round 5 modeling results for Marion County and other Central Indiana $PM_{2.5}$ monitoring sites are shown in Table 3. The highlighted values in the table below accent the Marion County monitors and their decreasing design values and future year modeled results. The 2009 modeled results show that the highest modeled concentrations will be 34 $\mu g/m^3$ at the Mann Road monitor. However the Mann Road monitor was discontinued at the end of 2007. The next highest future year value is 32 $\mu g/m^3$ found at both of the source oriented monitors (S. West St. and English Ave.) in Marion County. Given the fact that these two monitor are directly influenced by nearby sources the next highest value in Marion County is 29 $\mu g/m^3$ at Washington Park. This value is 6 $\mu g/m^3$ below the daily fine particle standard of 35.0 $\mu g/m^3$ with other modeled results in Marion County and other nearby areas being much lower. Modeling results for 2012 and 2018 indicate future year design values will continue to decrease in all areas. These results confirm that the adjacent U.S. EPA designated nonattainment counties of Hamilton, Hendricks, Johnson and Morgan will be in attainment of the daily fine particle standard by 2009 and continue through 2018 as modeled fine particle concentrations are less than 34 $\mu g/m^3$ and continue to decrease into the future.

Table 3.7
Modeling Results for Central Indiana $PM_{2.5}$ Monitors for 2009, 2012 and 2018

Monitor	Site	County	2005 Base Year	2009 Future Year	2012 Future Year	2018 Future Year
180650003	Shenandoah	Henry	32	25	26	26
180670003	Kokomo	Howard	33	27	25	24
180950009	Anderson	Madison	34	29	28	27
180970042	Mann Road	Marion	39	34	29	30
180970043	S. West St.	Marion	38	32	34	34
180970066	English Ave	Marion	37	32	32	33
180970078	Washington Park	Marion	36	29	32	32
180970079	E. 75th St.	Marion	39	32	29	30
180970081	W. 18th St.	Marion	36	28	32	32
180970083	E. Michigan St.	Marion	32	25	28	29
181570008	Lafayette	Tippecanoe	37	30	30	31

Appendix D

Chicago Area Analysis

Introduction

Indiana has four counties (Jasper, Lake, Newton and Porter) that are part of the Chicago MSA. Within the Indiana portion of the MSA, Lake and Porter counties account for the majority of the emissions, population, and vehicle miles traveled (VMT). Lake County is the only Indiana County in Northwest Indiana that has monitors over the 24-hr fine particulate standard. Porter County does not significantly impact monitored violations in Lake County or the Chicago area. Indiana has conducted an evaluation to determine the impacts Porter County sources on fine particle monitors in Lake County, Indiana and the Chicago area. As a result, Indiana has determined that emissions Porter County do not affect the downwind area's ability to attain the 24-hour standard. Therefore Porter County should be designated separately from Lake County, Indiana and the rest of the Chicago MSA.

Monitoring Network

Indiana has four counties (Jasper, Lake, Newton and Porter) that are part of the Chicago MSA. Indiana does not have any $PM_{2.5}$ monitors in Jasper or Newton County. There are 8 monitors (including two source oriented monitors) in Lake County and 2 monitors in Porter County, Indiana. There are 19 monitors in the Chicago area including one background monitor and two source oriented monitors. Of all of the Indiana and Illinois monitors in the Chicago MSA, only two of the Indiana monitors are over the 24-hour fine particle standard (East Chicago and Gary Burr Street-which is a source oriented monitor) and 11 of the Illinois monitors (including nine ambient and two source oriented monitors) are violating the 24-hour fine particles standard. Figure 1 shows the Indiana and Illinois monitors located within the Chicago nonattainment area along with the monitoring site number and the 2005 through 2007 24-hr design values. Table 1 lists the daily 98^{th} percentile values and the three year daily site design values for 2004-2007. The highlighted values in the table are over the 24-hr fine particulate standard.

Figure 1
Chicago-Indiana $PM_{2.5}$ Monitoring Locations

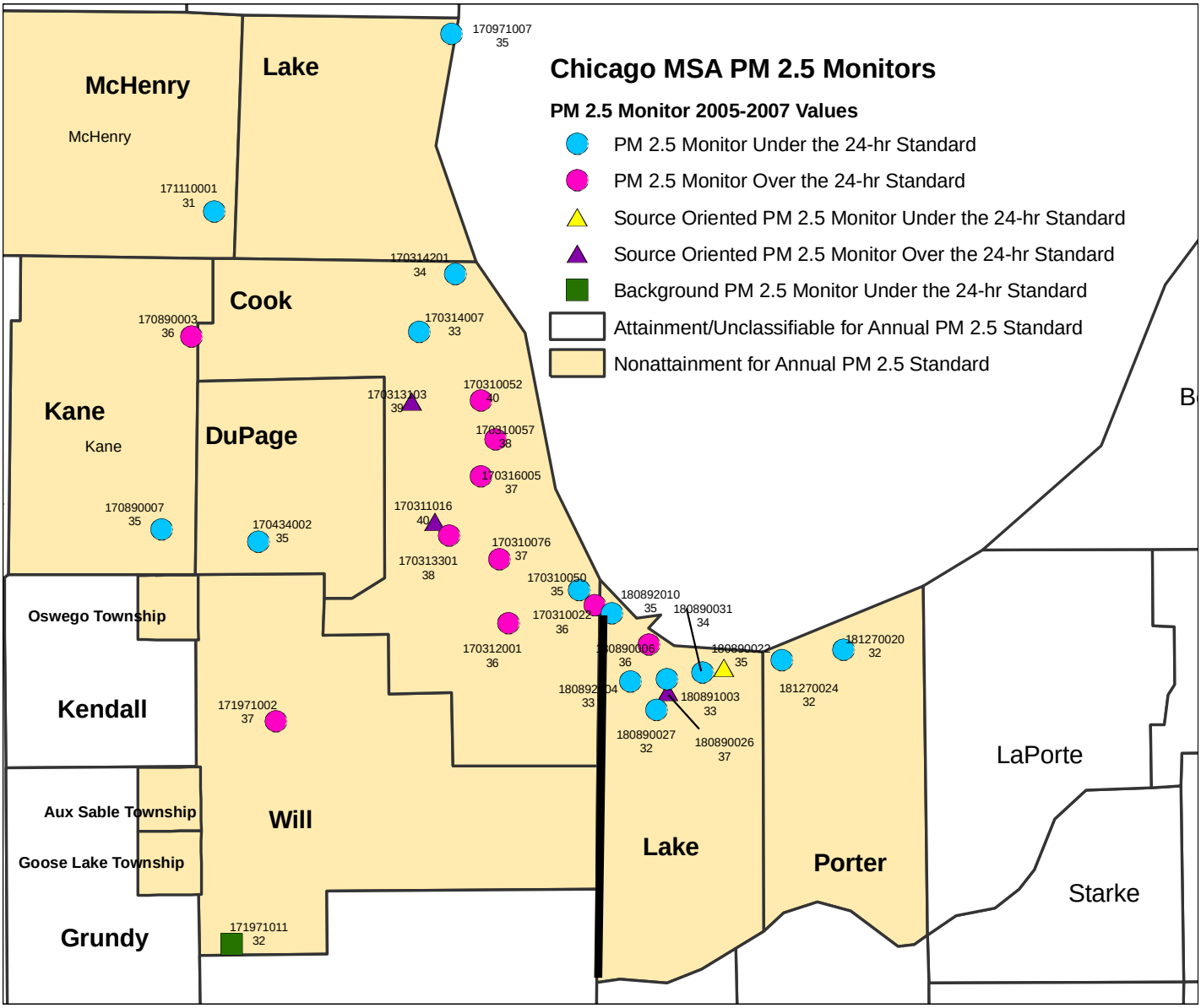


Table 1

AIRS Site ID	State	County	City	2004	2005	2006	2007	2004-2006 Design Value	2005-2007 Design Value
170310014	IL	Cook	Chicago	33.4	Monitor Discontinued				
170310022	IL	Cook	Chicago	32.5	45.7	27.0	35.7	35.1	36.1
170310050	IL	Cook	Chicago	34.2	45.0	26.6	33.6	35.3	35.1
170310052	IL	Cook	Chicago	38.8	48.3	31.6	39.4	39.6	39.8
170310057	IL	Cook	Chicago	33.1	46.5	27.7	38.9	35.8	37.7
170310076	IL	Cook	Chicago	39.7	45.1	29.0	37.2	37.9	37.1
170311016	IL	Cook	McCook	42.6	51.5	32.9	36.8	42.3	40.4
170312001	IL	Cook	Blue Island	38.5	43.8	28.1	35.1	36.8	35.7
170313103	IL	Cook	Schiller Park	40.7	50.3	30.0	36.6	40.3	39.0
170313301	IL	Cook	Summit	42.4	49.1	27.4	36.7	39.6	37.7
170314007	IL	Cook	Des Plaines	35.0	38.5	26.8	33.9	33.4	33.1
170314201	IL	Cook	Northbrook	26.1	37.7	27.0	36.8	30.3	33.8
170316005	IL	Cook	Cicero	42.5	44.6	29.2	36.9	38.8	36.9
170434002	IL	DuPage	Naperville	31.9	42.0	25.1	37.8	33.0	35.0
170890003	IL	Kane	Elgin	25.8	41.2	29.8	35.4	32.3	35.5
170890007	IL	Kane	Aurora		43.6	25.4	35.5	34.5*	34.8
170971007	IL	Lake	Ill Beach St.	26.3	46.6	25.6	32.8	32.8	35.0
171110001	IL	McHenry	Cary	27.5	37.6	27.6	28.6	30.9	31.3
171971002	IL	Will	Joliet	35.4	45.3	25.9	38.8	35.5	36.7
171971011	IL	Will	Braidwood	23.6	43.8	21.6	29.3	29.7	31.6
180890006	IN	Lake	East Chicago	33.0	39.9	29.4	37.2	34.1	35.5
180890022	IN	Lake	Gary IITRI	45.8	40.4	28.5	35.2	38.2	34.7
180890026	IN	Lake	Gary Burr St	38.6	43.7	30.4	36.8	37.6	36.9
180890027	IN	Lake	Highland	30.1	37.1	25.8	34.1	31.0	32.3
180890031	IN	Lake	Gary Water		39.6	27.1	36.2	32.9*	34.0
180891003	IN	Lake	Gary Ivanhoe	30.5	39.0	25.8	33.8	31.7	32.8
180892004	IN	Lake	Hammond Purdue	31.9	37.6	26.2	34.9	31.9	32.9
180892010	IN	Lake	Hammond Robertsdale	28.4	40.9	27.9	35.2	32.4	34.6
181270020	IN	Porter	Dunes Nat. Lakeshore	29.7	37.6	26.6	30.6	31.3	31.6
181270024	IN	Porter	Ogden Dunes	29.1	37.5	26.1	33.3	30.9	32.3
								* Two Year Average	
								Nonattainment	

Green Text is a background monitor compared to the 24-hr standard
Blue Text is a source oriented monitor compared to the 24-hr standard
Red Text means the data is incomplete—see Appendix B.

Impacts of Lake and Porter County

There are two (170310050 and 170310022) Illinois monitors that are located very close to the lakefront and the Indiana state line, and should be more directly impacted by emissions from Lake and Porter County sources, only one of them is over the 24-hr fine particulate standard (170310022), see Figure 1. The Indiana monitor that is the closest to the lakefront and the Illinois state line (180892010) is measuring attainment of the standard. If emissions from Lake and Porter counties were significantly contributing to the violating monitors in Illinois, we would expect to see higher levels at all of the monitors located between Indiana and the other violating Illinois monitors as well. The Illinois monitors that measure values above the 24-hr standard for fine particles are more inland and are most likely affected by local sources, specifically mobile source emissions. The Illinois monitoring sites that are over the 24-hr fine particulate standard are located within close proximity of the convergence of several major interstates, expressways, downtown Chicago and various commercial and industrial regions.

Lake and Porter Counties' Emissions Totals

According to the Northwestern Indiana Regional Planning Commission's conformity analysis northwest Indiana's share of the total nonattainment area emissions are around 10%.

		2002	2010	2020	2030
NE Illinois	**Direct PM**	3,070.78	1,634.99	1,042.49	1,029.25
	NOx	167,630.81	78,495.92	26,035.81	18,853.12
NW Indiana	**Direct PM**	562.64	159.16	114.31	116.47
	NOx	30,397.97	8,459.90	3,002.86	2,065.35
Nonattainment Area	**Direct PM**	3,633.42	1,794.15	1,156.80	1,145.72
	NOx	198,028.78	86,955.82	29,038.67	20,918.47
NW Indiana Share of Emissions	**Direct PM**	15.49%	8.87%	9.88%	10.17%
	NOx	15.35%	9.73%	10.34%	9.87%

Lake and Porter Counties' Emissions Distribution

The Lake Michigan Air Directors Consortium (LADCO) conducted its Round 5, Base M3 photochemical modeling for annual and 24-hour $PM_{2.5}$. Different emission sector emissions were developed by various methods from 2005 emissions for input into the model. Weekday, Saturday and Sunday emissions profiles were generated for each of the emission sectors. Point source emissions were developed from state emission inventories with EGU and non-EGU point source emissions based on CEM data from the MRPO states. On-road emissions were created through the CONCEPT emissions model which used transportation data from 24 networks. This data was supplied by state and local planning agencies. Off-road emissions were taken from NMIM 2005 data and calculated with EMS. Area emissions were taken from state and contractor data and developed with EMS.

Table 2 shows the Lake and Porter distribution of emissions by pollutant while Table 3 shows the Lake and Porter County distribution of emissions based on different emission sectors.

Table 2

Emissions Breakdown by Pollutant								
	Winter (ton/yr)				**Summer (tons/yr)**			
Pollutant	**Lake**		**Porter**		**Lake**		**Porter**	
	Total (t/yr)	**% Total**	**Total (t/yr)**	**% Total**	**Total (t/yr)**	**% Total**	**Total (t/yr)**	**% Total**
NOx	83.46	60%	56.61	40%	63.90	62%	39.82	38%
VOC	33.50	70%	14.24	30%	46.41	69%	20.38	31%
SO2	76.45	54%	65.50	46%	76.55	51%	73.20	49%
PM2.5	8.78	66%	4.47	34%	8.54	64%	4.79	36%
NH3	3.16	64%	1.76	36%	4.58	59%	3.20	41%
TOTAL	**205.36**	**59%**	**142.57**	**41%**	**199.97**	**58.6%**	**141.40**	**41.4%**

Table 3

Emissions Breakdown by Emission Sector								
	Winter (ton/yr)				Summer (tons/yr)			
Emission Sector	Lake		Porter		Lake		Porter	
	Total (t/yr)	% Total	Total (t/yr)	% Total	Total (t/yr)	% Total	Total (t/yr)	% Total
Area_other	28.83	73%	10.49	27%	22.86	71%	9.42	29%
Area_nonroad	10.50	73%	3.87	27%	25.67	69%	11.54	31%
Area_mar	8.00	70%	3.48	30%	8.86	68%	4.22	32%
NH3	0.39	50%	0.39	50%	1.73	49%	1.78	51%
MOTV	27.51	70%	11.75	30%	24.75	69%	11.18	31%
LOWP_EGU	0.09	53%	0.08	47%	0.09	55%	0.07	45%
LOWP_nonutil	4.48	87%	0.65	13%	5.74	90%	0.64	10%
PTSR_nonutil	71.80	62%	44.57	38%	69.96	62%	43.47	38%
PTSR_EGU	53.74	44%	67.28	56%	40.31	41%	59.07	59%
TOTAL	**205.36**	**59%**	**142.57**	**41%**	**199.97**	**58.6%**	**141.40**	**41.4%**

LADCO listed Lake and Porter Counties together as the Indiana portion of the Chicago nonattainment area (Ind_Chi_NA) in the Particulate Source Apportionment (PSAT) modeling. Comparison of the emissions from a summer and winter weekday profile showed that Lake County emissions account for approximately 60% of the emissions modeled for Ind_Chi_NA while Porter County emissions account for 40%. These comparisons were based from analyzing both the pollutant and emission sectors in those counties. Therefore, modeled impacts from each county can be estimated using the percentage of the emissions distribution among the two counties with Lake County contributing approximately 60% and Porter County contributing approximately 40% of the Ind_Chi_NA $PM_{2.5}$ impacts on surrounding monitors.

Attainment Modeling Results

Table 4 below shows the Round 5 annual and 24-hour $PM_{2.5}$ modeling results for Northwest Indiana and Northeast Illinois. Highlighted values are above the standard. The results show 24-hour $PM_{2.5}$ concentrations will decrease from baseline design values by 1 to 4 $\mu g/m^3$ in 2009, 2012 and 2018. Seven Illinois monitoring sites showed modeled concentrations above the 24-hour $PM_{2.5}$ NAAQS of 35 $\mu g/m^3$ in 2009. Annual concentrations will decrease between 1 and 2 $\mu g/m^3$ over the modeling period. One Illinois monitoring site and one Indiana monitoring site showed modeled concentrations above the annual $PM_{2.5}$ NAAQS of 15 $\mu g/m^3$ in 2009.

Table 4

				24-Hour			Annual		
				2009	2012	2018	2009	2012	2018
				FYDV	FYDV	FYDV	FYDV	FYDV	FYDV
170310022	IL	Cook	3535 E. 114st St.	**36**	**36**	**35**	13.9	13.8	13.6
170310050	IL	Cook	103rd and Luella	34	33	33	13.6	13.5	13.4
170310052	IL	Cook	4850 Wilson Ave.	**36**	**36**	**35**	14.2	14.2	13.8
170310057	IL	Cook	1745 N. Springfield	31	31	30	13.7	13.7	13.5
170310076	IL	Cook	7801 Lawndale	**35**	**34**	34	13.7	13.7	13.5
170311016	IL	Cook	50th St. and Glencoe	**40**	**40**	**39**	**15.4**	**15.3**	14.8
170312001	IL	Cook	12700 Sacremento	34	34	34	13.6	13.5	13.3
170313103	IL	Cook	4743 Mannheim Rd.	**39**	**40**	**39**	14.9	14.8	14.3
170313301	IL	Cook	60th St & 74th Ave.	**38**	**38**	**37**	14.1	14.0	13.8
170314007	IL	Cook	9511 W. Harrison St.	31	32	31	11.5	11.5	11.1
170314201	IL	Cook	750 Dundee Road	28	29	28	11.5	11.5	11.1
170316005	IL	Cook	13th St. & 50th Ave.	**38**	**38**	**37**	14.4	14.3	14.1
180890006	IN	Lake	East Chicago	33	32	32	13.1	13.0	12.8
180890022	IN	Lake	Gary IITRI	34	34	**35**	14.5	14.3	13.9
180890026	IN	Lake	Burr St.	33	34	32	**15.4**	**15.2**	14.8
180890027	IN	Lake	Eldon Ready Sch.	29	30	29	12.3	12.2	11.8
180890031	IN	Lake	Gary Water Plant	24	24	26	12.9	12.7	12.3
180891003	IN	Lake	Gary - Ivanhoe Sch.	29	29	29	12.4	12.3	11.9
180892004	IN	Lake	Hammond - Purdue	31	31	30	12.8	12.7	12.5
180892010	IN	Lake	Hammond - Robertsdale	30	30	29	12.6	12.6	12.4
180910011	IN	LaPorte	Michigan City	27	27	26	10.8	10.7	10.3
180910012	IN	LaPorte	LaPorte	28	27	26	11.1	11.0	10.6
181270020	IN	Porter	Natl. Lakeshore	25	25	26	11.2	11.0	10.7
181270024	IN	Porter	Ogden Dunes	26	26	27	11.6	11.5	11.1
260770008	MI	Kalamazoo	Kalamazoo	28	27	27	11.4	11.3	10.8

PSAT Modeling Results

PSAT modeling results show the impacts for each modeled region in the domain on the Wilson Ave. and Cicero, Illinois $PM_{2.5}$ monitors. There were two Indiana regions that were modeled for their contributions on $PM_{2.5}$ concentrations. The Ind_Chi_NA region includes combined emissions from Lake and Porter Counties only while the Indiana region includes emissions from all other counties within the state. It should be noted that the modeled PSAT results are for annual $PM_{2.5}$ concentrations; however 24-hour $PM_{2.5}$ modeled results are expected to be similar.

Table 5 shows the PSAT results for the Wilson Ave, Chicago, Cook County, Illinois $PM_{2.5}$ monitoring site showed that the Ind_Chi_NA region had a 4% contribution on $PM_{2.5}$ concentrations. The modeled $PM_{2.5}$ concentration from Ind_Chi_NA on the Illinois PM2.5 monitors was 0.48 $\mu g/m^3$. The highest overall regional impacts on the Wilson Ave. $PM_{2.5}$ monitor come from the Illinois portion of the Chicago nonattainment area (Ill_Chi_NA), Wisconsin and Illinois. BC represents boundary conditions or pollutants that are present at the edge of the modeling domain that are transported into the Midwest. Based on the emissions distribution between Lake and Porter County, Lake County would have 60% of the 0.48 $\mu g/m^3$

impact from Ind_Chi_NA or 0.29 μg/m^3 with Porter County's contributions at 40% of the 0.48 μg/m^3 impact or 0.19 μg/m^3.

Table 5

Monitor ID	Modeled Impact (μg/m^3)	Region	% of Impact on Total Concentration
170310052	5.30822	Ill_Chi_NA	39.2%
170310052	1.02514	Wisconsin	7.6%
170310052	0.89986	Illinois	6.6%
170310052	0.88348	BC	6.5%
170310052	0.77316	Indiana	5.7%
170310052	0.74075	Michigan	5.5%
170310052	0.66221	CENRAP_WRAP	4.9%
170310052	0.47995	Ind_Chi_NA	3.5%
170310052	0.41248	Ohio	3.0%
170310052	0.38762	Iowa	2.9%
170310052	0.3305	VISTAS	2.4%
170310052	0.33007	Missouri	2.4%
170310052	0.32369	Detroit_NA	2.4%
170310052	0.32005	Minnesota	2.4%
170310052	0.23191	Kentucky	1.7%
170310052	0.18058	Pennsylvania	1.3%
170310052	0.10355	WestVirginia	0.8%
170310052	0.08364	Clvlnd_NA	0.6%
170310052	0.0625	MANEVU	0.5%

Table 6 shows the PSAT results for the Cicero, Cook County, Illinois $PM_{2.5}$ monitoring site showed that the Ind_Chi_NA region had a 6% contribution on $PM_{2.5}$ concentrations. The modeled $PM_{2.5}$ concentrations from Ind_Chi_NA on the Illinois $PM_{2.5}$ monitor was 0.83 μg/m^3. The highest impacts on the Cicero $PM_{2.5}$ monitor come from the Ill_Chi_NA, Illinois and Wisconsin. Based on the emissions distribution between Lake and Porter County, Lake County would have 60% of the 0.83 μg/m^3 or 0.50 μg/m^3 with Porter County's contribution at 40% or 0.33 μg/m^3.

Table 6

Monitor ID	Modeled Impact (μg/m^3)	Region	% of Impact on Total Concentration
170316005	5.72974	Ill_Chi_NA	39.6%
170316005	1.04486	Illinois	7.2%
170316005	0.9024	Wisconsin	6.2%
170316005	0.88294	BC	6.1%
170316005	0.85782	Indiana	5.9%
170316005	0.83413	Ind_Chi_NA	5.8%
170316005	0.69539	CENRAP_WRAP	4.8%
170316005	0.61528	Michigan	4.3%
170316005	0.42395	Ohio	2.9%
170316005	0.41655	Iowa	2.9%
170316005	0.35962	VISTAS	2.5%
170316005	0.34959	Missouri	2.4%
170316005	0.33608	Detroit_NA	2.3%
170316005	0.31838	Minnesota	2.2%
170316005	0.24688	Kentucky	1.7%
170316005	0.18797	Pennsylvania	1.3%
170316005	0.10747	WestVirginia	0.7%
170316005	0.08443	Clvlnd_NA	0.6%
170316005	0.06414	MANEVU	0.4%

PSAT charts below show the impacts of all the regional areas that were modeled. Lake and Porter County emissions were listed under Ind_Chi_NA and have less than one microgram per cubic meter ($\mu g/m^3$) impact on the Illinois monitoring sites. While the modeled results are similar for each of the Illinois fine particle monitoring sites due to the 36 kilometer grid resolution used in the photochemical modeling, the impacts show the overwhelming impacts from all the Illinois counties in the Chicago nonattainment area (Ill_Chi_NA) with lesser contributions from Wisconsin, Illinois (excluding all the Illinois counties in the Chicago nonattainment area (Ill_Chi_NA emissions)), Indiana (excluding Lake and Porter County emissions in the Chicago nonattainment area (Ind_Chi_NA)), Michigan, CENRAP_WRAP regional planning organization emissions and the Lake and Porter County emissions in the Chicago nonattainment area (Ind_Chi_NA).

There are seventeen PSAT charts included in this analysis to determine the modeled impacts: seven northeast Illinois $PM_{2.5}$ monitors, nine northwest Indiana $PM_{2.5}$ monitors and one southwest Michigan $PM_{2.5}$ monitor. Table 7 lists the modeled impacts on these $PM_{2.5}$ monitors. The impacts from Indiana's portion of the Chicago nonattainment area emissions ranged between 0.5 and 0.8 $\mu g/m^3$ at the Illinois $PM_{2.5}$ monitoring sites, between 0.5 and 2.2 $\mu g/m^3$ at the Indiana $PM_{2.5}$ monitoring sites and 0.2 $\mu g/m^3$ at the Michigan $PM_{2.5}$ monitoring site.

Using the 60%/40% breakdown of Lake and Porter County emissions, modeled PSAT results show that Lake County would have between a 0.3 and 0.5 $\mu g/m^3$ impact on Cook Co. IL monitors, 1.3 $\mu g/m^3$ impact on Porter County monitors, 0.8 $\mu g/m^3$ impact on LaPorte County monitors and 0.1 $\mu g/m^3$ impact on the Kalamazoo County, MI monitor.

Porter County would have between a 0.2 and 0.3 $\mu g/m^3$ impact on Cook Co. IL monitors, 0.2 to 0.9 $\mu g/m^3$ impact on Lake County monitors, 0.6 $\mu g/m^3$ impact on LaPorte County monitors and 0.1 $\mu g/m^3$ impact on the Kalamazoo County, MI monitor.

Table 7

Monitor ID	Monitor Site - State	County	Modeled Impacts from Lake/Porter
170310022	3535 E. 114th St. - IL	Cook	0.8 $\mu g/m^3$
170310050	103rd and Luella - IL	Cook	0.8 $\mu g/m^3$
170310052	4850 Wilson Ave. - IL	Cook	0.5 $\mu g/m^3$
170310057	1745 N. Springfield - IL	Cook	0.8 $\mu g/m^3$
170310076	7801 Lawndale - IL	Cook	0.8 $\mu g/m^3$
170313301	60th St. & 74th Ave. - IL	Cook	0.8 $\mu g/m^3$
170316005	13th St. & 50th Ave. - IL	Cook	0.8 $\mu g/m^3$
180890006	East Chicago – IN	Lake	0.8 $\mu g/m^3$
180890027	Highland – IN	Lake	0.5 $\mu g/m^3$
180891003	Ivanhoe School – IN	Lake	2.2 $\mu g/m^3$
180892004	Hammond – Purdue – IN	Lake	0.8 $\mu g/m^3$
180892010	Hammond – Robertsdale – IN	Lake	0.8 $\mu g/m^3$
180910011	Michigan City – IN	LaPorte	1.4 $\mu g/m^3$
180910012	LaPorte - IN	LaPorte	1.4 $\mu g/m^3$
181270020	National Lakeshore – IN	Porter	2.2 $\mu g/m^3$
181270024	Ogden Dunes - IN	Porter	2.2 $\mu g/m^3$
260770008	Kalamazoo - MI	Kalamazoo	0.2 $\mu g/m^3$

The PSAT charts show all the regions modeled and their impacts on the individual $PM_{2.5}$ monitors in Illinois, Indiana and Michigan. Indiana's portion of the Chicago nonattainment area with the emission sector breakdown is highlighted with arrows.

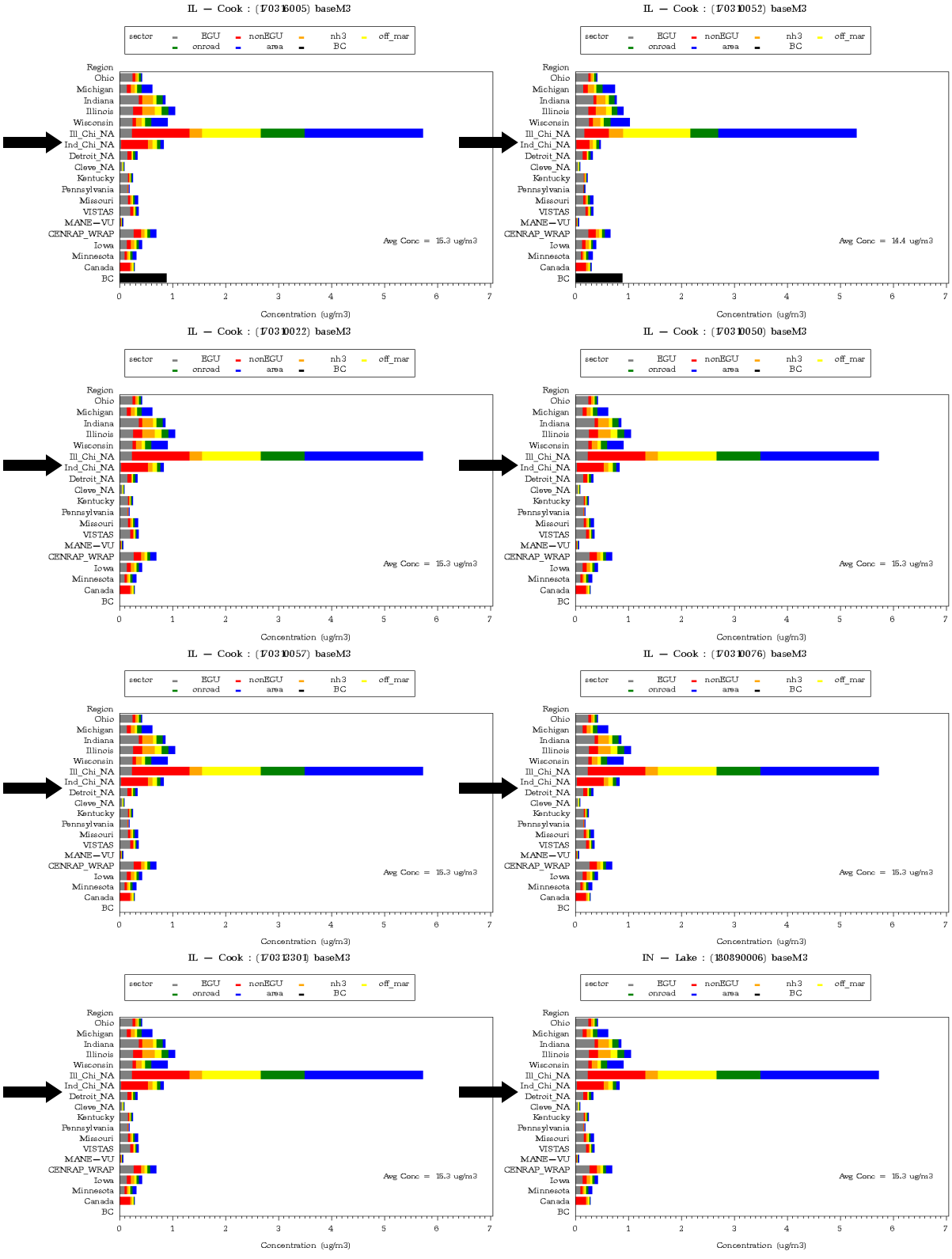
The emission sector breakdown for Lake and Porter Counties indicate that non-EGU sources are the major contributors to $PM_{2.5}$ concentrations at the Illinois $PM_{2.5}$ monitors with less impacts from marine, air, and rail; ammonia; onroad and area emissions.

The emission sector breakdown for Lake and Porter Counties' $PM_{2.5}$ impacts on Lake County indicates that non-EGU sources were the major contributors to $PM_{2.5}$ concentrations with lesser impacts from area; marine, air, and rail; ammonia and onroad emissions.

The emission sector breakdown for Lake and Porter Counties' $PM_{2.5}$ impacts on Porter County indicates that non-EGU sources were the major contributors with lesser impacts from area; marine, air, and rail; ammonia and onroad emissions.

The emission sector breakdown for Lake and Porter Counties' $PM_{2.5}$ impacts on LaPorte County indicates that ammonia sources were the major contributors to $PM_{2.5}$ concentrations with lesser impacts from area; marine, air, and rail; onroad and non-EGU emissions.

The emission sector breakdown for Lake and Porter Counties' $PM_{2.5}$ impacts on Kalamazoo County, Michigan indicates that the contributions to $PM_{2.5}$ concentrations are from non-EGU and ammonia emissions and total less than 0.2 $\mu g/m^3$.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IL — Cook : (170310076) baseM3
IL — Cook : (170312301) baseM3
IN — Lake : (180890006) baseM3
sector EGU nonEGU nh3 off_mar onroad area BC
Region
Ohio
Michigan
Indiana
Illinois
Wisconsin
Ill_Chi_NA
Ind_Chi_NA
Detroit_NA
Cleve_NA
Kentucky
Pennsylvania
Missouri
VISTAS
MANE—VU
CENRAP_WRAP
Iowa
Minnesota
Canada
BC
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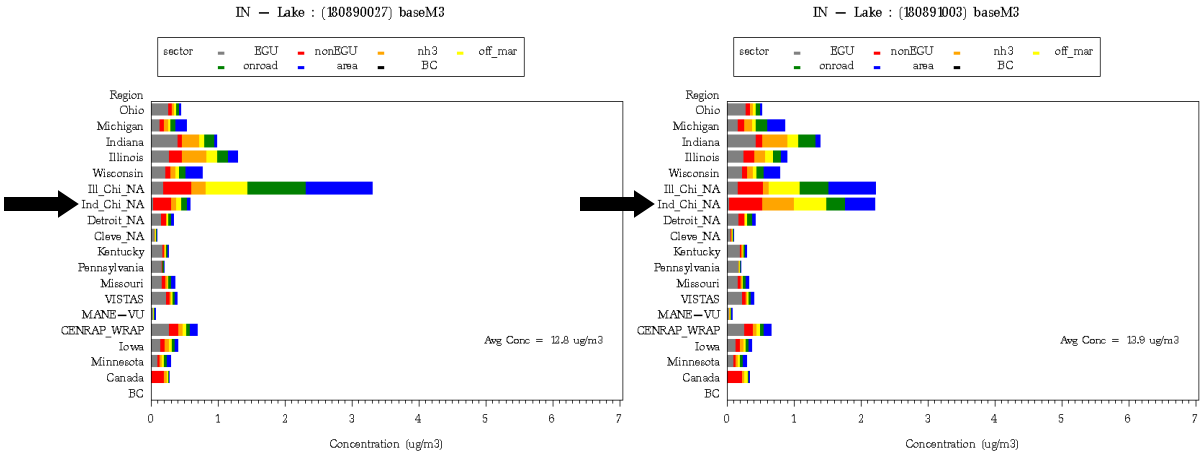
Concentration (ug/m3)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Indiana
Illinois
Wisconsin
Ill_Chi_NA
Ind_Chi_NA
Detroit_NA
Cleve_NA
Kentucky
Pennsylvania
Missouri
VISTAS
MANE—VU
CENRAP_WRAP
Iowa
Minnesota
Canada
BC
Avg Conc = 12.8 ug/m3
0 1 2 3 4 5 6 7
Concentration (ug/m3)

IN — Lake : (180891003) baseM3
sector EGU nonEGU nh3 off_mar onroad area BC
Region
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Michigan
Indiana
Illinois
Wisconsin
Ill_Chi_NA
Ind_Chi_NA
Detroit_NA
Cleve_NA
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Missouri
VISTAS
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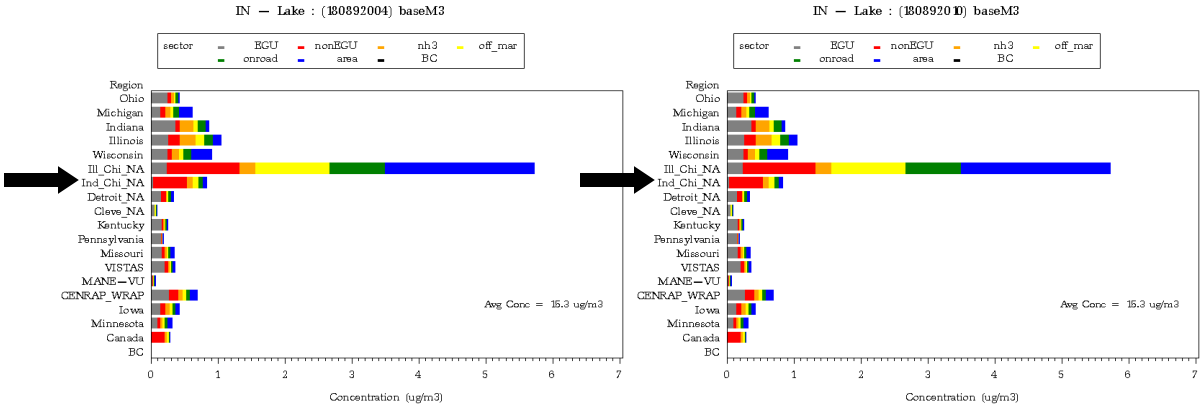
Concentration (ug/m3)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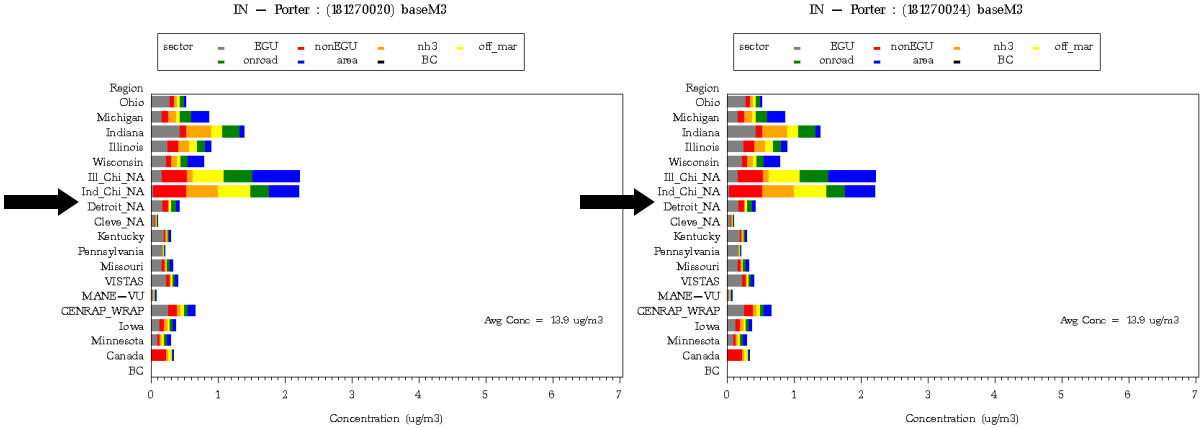
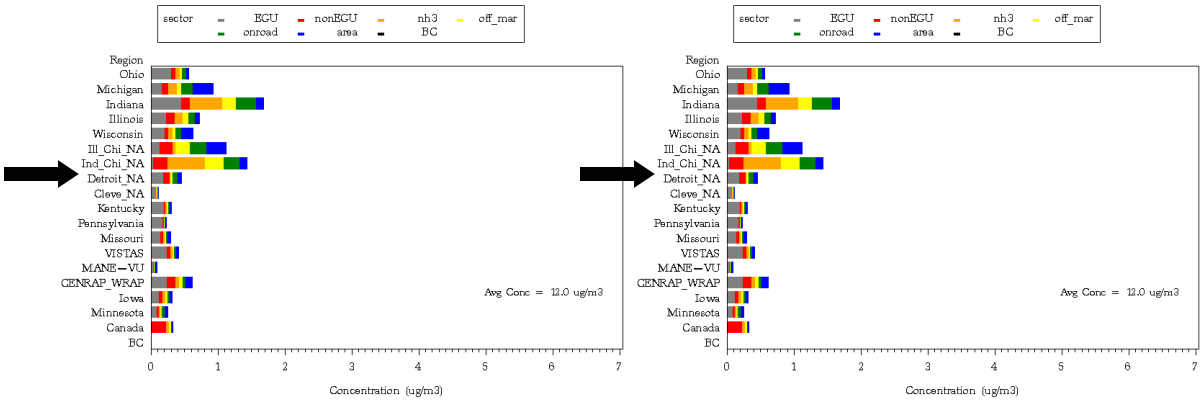
sector EGU nonEGU nh3 off_mar onroad area BC
Region
Ohio
Michigan
Indiana
Illinois
Wisconsin
Ill_Chi_NA
Ind_Chi_NA
Detroit_NA
Cleve_NA
Kentucky
Pennsylvania
Missouri
VISTAS
MANE—VU
CENRAP_WRAP
Iowa
Minnesota
Canada
BC
Avg Conc = 15.3 ug/m3
0 1 2 3 4 5 6 7
Concentration (ug/m3)

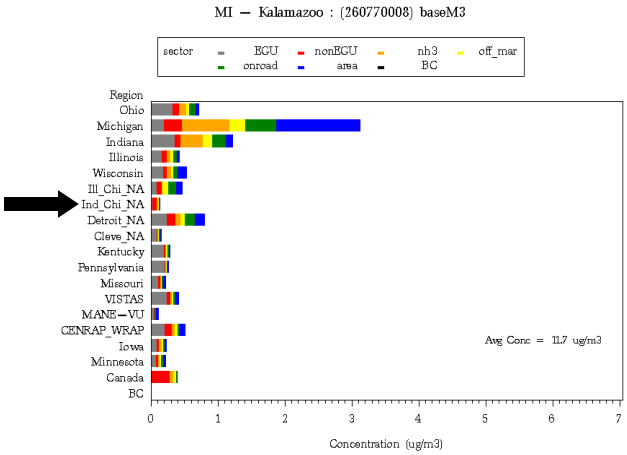
IN — Lake : (180892010) baseM3
sector EGU nonEGU nh3 off_mar onroad area BC
Region
Ohio
Michigan
Indiana
Illinois
Wisconsin
Ill_Chi_NA
Ind_Chi_NA
Detroit_NA
Cleve_NA
Kentucky
Pennsylvania
Missouri
VISTAS
MANE—VU
CENRAP_WRAP
Iowa
Minnesota
Canada
BC
Avg Conc = 15.3 ug/m3
0 1 2 3 4 5 6 7
Concentration (ug/m3)


IN — Porter : (181270020) baseM3
sector EGU nonEGU nh3 off_mar onroad area BC
Region
Ohio
Michigan
Indiana
Illinois
Wisconsin
Ill_Chi_NA
Ind_Chi_NA
Detroit_NA
Cleve_NA
Kentucky
Pennsylvania
Missouri
VISTAS
MANE—VU
CENRAP_WRAP
Iowa
Minnesota
Canada
BC
Avg Conc = 13.9 ug/m3
0 1 2 3 4 5 6 7
Concentration (ug/m3)

IN — Porter : (181270024) baseM3
sector EGU nonEGU nh3 off_mar onroad area BC
Region
Ohio
Michigan
Indiana
Illinois
Wisconsin
Ill_Chi_NA
Ind_Chi_NA
Detroit_NA
Cleve_NA
Kentucky
Pennsylvania
Missouri
VISTAS
MANE—VU
CENRAP_WRAP
Iowa
Minnesota
Canada
BC
Avg Conc = 13.9 ug/m3
0 1 2 3 4 5 6 7
Concentration (ug/m3)


IN — LaPorte : (180910011) baseM3
sector EGU nonEGU nh3 off_mar onroad area BC
Region
Ohio
Michigan
Indiana
Illinois
Wisconsin
Ill_Chi_NA
Ind_Chi_NA
Detroit_NA
Cleve_NA
Kentucky
Pennsylvania
Missouri
VISTAS
MANE—VU
CENRAP_WRAP
Iowa
Minnesota
Canada
BC
Avg Conc = 12.0 ug/m3
0 1 2 3 4 5 6 7
Concentration (ug/m3)

IN — LaPorte : (180910012) baseM3
sector EGU nonEGU nh3 off_mar onroad area BC
Region
Ohio
Michigan
Indiana
Illinois
Wisconsin
Ill_Chi_NA
Ind_Chi_NA
Detroit_NA
Cleve_NA
Kentucky
Pennsylvania
Missouri
VISTAS
MANE—VU
CENRAP_WRAP
Iowa
Minnesota
Canada
BC
Avg Conc = 12.0 ug/m3
0 1 2 3 4 5 6 7
Concentration (ug/m3)



Review of the overall regional impacts showed the Ill_Chi_NA impacts come mainly from area sources, non-EGU and marine, area and railroad emissions, indicating that more local emissions impact the monitors in Cook County, Illinois.

Emission Controls

Lake and Porter counties are subject to the most stringent group of emission controls within the State of Indiana. This collection of permanent and enforceable controls is equally as stringent as those that apply elsewhere within the Chicago MSA, and in some cases, are more stringent. For example, organic carbon accounts for a significant portion of fine particle mass and it is believed that the majority of organic carbon in urban areas originates from mobile source emissions, especially poorly maintained vehicles. Indiana believes that the majority of the Illinois monitors that are above the 24-hr fine particulate standard are affected by "urban excess", mostly attributable to localized mobile sources.

Indiana is confident that the portion of the total vehicle miles traveled (VMT) in close proximity to these sites from vehicles registered in Lake and Porter counties is a small percentage of the total VMT affecting these monitoring sites. Regardless, vehicles registered in Lake and Porter counties are subject to reformulated gasoline and enhanced vehicle inspection and maintenance requirements. Enhanced vehicle inspection and maintenance is the most effective control for organic carbon. Indiana maintains a comprehensive vehicle inspection and maintenance program in Lake and Porter counties for all vehicles of model year 1976 and newer. Lake and Porter counties' motor vehicle control program is more stringent[1] than that which applies to the vast majority of the fleet that accounts for the VMT and long-term idling in close proximity to the aforementioned sites. In fact, the greatest portion of the fleet defined as "high-emitters" for organic carbon and other precursors are pre-1996 model year vehicles, none of which are subject to vehicle inspection and maintenance requirements in Illinois.

[1] The Illinois vehicle emissions testing program is limited to model years 1996 and newer.

Furthermore, the violating monitors within the Chicago area are affected more by emissions deriving from Wisconsin, presumably primarily from Southeast Wisconsin, than from Lake and Porter counties. The U.S. EPA did not designate any portion of Wisconsin, including the Southeast counties, nonattainment under the annual standard for fine particles.

Conclusions

If emissions deriving from Lake and Porter Counties were significantly contributing to the violating monitors in Illinois, IDEM would expect to see similar elevated values at the sites located between Lake and Porter Counties and the other Illinois monitoring sites that are over the 24-hr fine particulate standard.

Review of Lake and Porter County emissions show that the breakdown of the Indiana portion of the Chicago nonattainment area is approximately 60% of the emissions are from Lake County and 40% of the emissions come from Porter County.

PSAT photochemical modeling results showed that Lake and Porter Counties had modeled impacts from 0.5 to 0.8 $\mu g/m^3$ on the Illinois $PM_{2.5}$ monitors. Modeled impacts from Lake and Porter County emissions on Lake County $PM_{2.5}$ monitors were between 0.5 to 2.2 $\mu g/m^3$ with impacts on Porter County $PM_{2.5}$ monitors of 2.2 ug/m3 and 1.4 $\mu g/m^3$ on LaPorte County $PM_{2.5}$ monitors.

The locations of the violating monitors in the Chicago MSA results in elevated concentrations representative of "urban excess", primarily attributable to localized mobile source emissions. Indiana is confident that its contribution to this localized effect is negligible.