REQUEST FOR REDESIGNATION AND MAINTENANCE PLAN UNDER THE ANNUAL NATIONAL AMBIENT AIR QUALITY STANDARD FOR FINE PARTICLES

For the Indiana Portion
of the

Louisville KY-IN
Nonattainment Area for Fine Particles

Jefferson County (Madison Township), Clark and Floyd Counties, Indiana

Prepared By:
The Indiana Department of Environmental Management

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REQUEST FOR REDESIGNATION AND MAINTENANCE PLAN UNDER THE ANNUAL NATIONAL AMBIENT AIR QUALITY STANDARD FOR FINE PARTICLES

LOUISVILLE KY-IN AREA

1.0 INTRODUCTION

This document supports Indiana's request that Jefferson County (Madison Township) and Clark and Floyd counties, Indiana, which are part of the Louisville KY-IN nonattainment area for fine particles (herein referred to as the "Louisville Area"), be redesignated from nonattainment to attainment of the 1997 annual standard for fine particles. All monitors for fine particles in the Louisville Area have recorded three years of quality assured ambient air quality monitoring data for the years 2008 through 2010, demonstrating attainment with the annual standard for fine particles; therefore, Indiana's portion of the Louisville Area is eligible for redesignation.

Section 107 of the Clean Air Act (CAA) establishes specific requirements to be met in order for an area to be considered for redesignation, including:

(a) A determination that the area has attained the annual standard for fine particles.
(b) A State Implementation Plan (SIP) for the area under Section 110(k) that is fully approved.
(c) A determination that the improvement in air quality is due to permanent and enforceable reductions in emissions resulting from implementation of the SIP and other federal requirements.
(d) A maintenance plan under Section 175A that is fully approved.
(e) A determination that all Section 110 and Part D requirements have been met.

A maintenance plan provides for the continued attainment of the air quality standard by an area for a period of ten years after the United States Environmental Protection Agency (U.S. EPA) has formally redesignated the area to attainment. The plan also provides assurances that even if there is a subsequent exceedance of the air quality standard, then measures in the maintenance plan will prevent any future occurrences through contingency measures that would be triggered.

This document addresses each of these requirements, and provides additional information to support continued compliance with the annual standard for fine particles.

1.1 Background

The CAA requires states with areas designated nonattainment of the applicable National Ambient Air Quality Standard (NAAQS) for fine particles to develop SIPs to expeditiously attain and maintain the standard. In 1997, U.S. EPA set daily and annual air quality standards for fine particles ($PM_{2.5}$), as shown in Table 1.1. The terms "fine particles" and "$PM_{2.5}$" are used synonymously throughout this document. The $PM_{2.5}$ standards were legally challenged and upheld by the U.S. Supreme Court in February of 2001. In 1999, the Indiana Department of

Environmental Management (IDEM) began monitoring for fine particle concentrations. U.S. EPA designated areas in Indiana under the annual standard for fine particles on December 17, 2004, as attainment, nonattainment or unclassifiable, with an effective date of April 5, 2005.

Table 1.1
National Ambient Air Quality Standards for Fine Particles

	Annual	24-Hour
1997 $PM_{2.5}$ Standards	**15 µg/m^3*** Annual arithmetic mean, averaged over three years	**65 µg/m^3** 24-hour average, 98th percentile, averaged over three years
2006 $PM_{2.5}$ Standards	**15 µg/m^3** Annual arithmetic mean, averaged over three years	**35 µg/m^3** 24-hour average, 98th percentile, averaged over three years

* micrograms per cubic meter (µg/m^3)

Note: The Louisville Area meets the 1997 and 2006 24-hour NAAQS for fine particles. Since this area is solely designated nonattainment under the 1997 annual standard for fine particles, this document only addresses the annual standard.

On December 17, 2004, based on 2001 through 2003 monitoring data, U.S. EPA designated the Louisville Area as nonattainment of the annual standard for fine particles (40 CFR 81.315). The Louisville Area is subject to Section 172 of the CAA, including the development of a plan to reduce nitrogen oxides (NO_x), sulfur dioxide (SO_2), and direct $PM_{2.5}$ emissions and a demonstration that the area will meet the annual standard for fine particles by April 5, 2010. In order to satisfy these requirements, Indiana submitted an attainment demonstration to U.S. EPA on April 3, 2008, demonstrating that with the combination of clean air measures and the implementation of local and federally required control measures, air quality in the nonattainment area would meet the annual NAAQS for fine particles by April 5, 2010, with an ample margin of safety. The Louisville Area monitors have continued to meet the annual NAAQS for fine particles since the end of 2008.

There were no fine particle monitors in the Louisville Area that violated the 1997 24-hour standard for fine particles and none that currently violate the 2006 24-hour standard for fine particles. As a result, the Louisville Area was designated nonattainment for fine particles solely under the 1997 annual standard. Therefore, this document pertains only to the 1997 annual standard for fine particles.

The Louisville nonattainment area for fine particles, as defined in Section 1.2, has not previously been subject to nonattainment area rulemakings for fine particles. However, Clark and Floyd counties, Indiana and Bullitt, Oldham, and Jefferson counties, Kentucky, have been subject to nonattainment area rulemakings under the 1-hour ozone standard. The 1-hour ozone standard was revoked on June 15, 2005. These counties have also been subject to nonattainment rulemakings under the 8-hour ozone standard. Clark and Floyd counties were redesignated to attainment and classified as maintenance under the 8-hour ozone standard on July 19, 2007. Bullitt, Oldham, and Jefferson counties were redesignated to attainment and classified as maintenance on August 6, 2007.

1.2 Geographical Description

The Louisville nonattainment area for fine particles consists of Jefferson County (Madison Township) and Clark and Floyd counties, Indiana, and Bullitt and Jefferson counties, Kentucky. The Louisville Area contains such cities as Clarksville, New Albany, and Madison in Indiana and Louisville in Kentucky. This area is depicted in Figure 3.1.

The agencies responsible for assuring the nonattainment area for fine particles complies with the CAA requirements are:

- IDEM, which is responsible for Jefferson County (Madison Township) and Clark and Floyd counties, Indiana.
- The Louisville Metro Air Pollution Control District (LMAPCD), which is responsible for Jefferson County, Kentucky.
- The Kentucky Department for Environmental Protection (KDEP), which is responsible for Bullitt County, Kentucky. The KDEP is requesting redesignation of Kentucky's portion of the nonattainment area.

These three agencies have worked cooperatively with U.S. EPA Regions IV and V to address attainment planning issues.

Although the agencies have worked together on a comprehensive plan for the multi-state nonattainment area, the State of Kentucky is required to make a separate submittal for its portion of the planning components to U.S. EPA. This submittal only covers Jefferson County (Madison Township) and Clark and Floyd counties, Indiana.

1.3 Status of Air Quality

Monitoring data for fine particles for the three years, 2008 through 2010, demonstrates that air quality has met the annual NAAQS for fine particles in the Louisville Area. This fact, accompanied by the permanent and enforceable reductions in emission levels discussed in Section 4.0, justifies a redesignation to attainment for the area based on Section 107(d)(3)(E) of the CAA.

2.0 REQUIREMENTS FOR REDESIGNATION

2.1 General

Section 110 and Part D of the CAA list a number of requirements that must be met by nonattainment areas prior to consideration for redesignation to attainment. In addition, U.S. EPA has published detailed guidance in a document entitled "Procedures for Processing Requests to Redesignate Areas to Attainment", issued September 4, 1992, to Regional Air Directors. This document is hereafter referred to as "Redesignation Guidance". This Request for Redesignation and Maintenance Plan is based on the Redesignation Guidance, supplemented with additional guidance received from staff of the Attainment Planning and Maintenance Section of U.S. EPA Region V. The specific requirements for redesignation are listed below.

2.2 Fine Particle Monitoring

1) A demonstration that the annual standard for fine particles, as published in 40 Code of Federal Regulations (CFR) 50.13, has been attained. Fine particle monitoring data must show that violations of the annual ambient standard are no longer occurring.

2) Ambient monitoring data quality-assured in accordance with 40 CFR 58.15, recorded in the U.S. EPA Air Quality System (AQS) database, and available for public view.

3) A showing that the three-year average of annual values, based on data from all monitoring sites in the area or its affected downwind environs, do not exceed 15.0 $\mu g/m^3$. This showing must rely on three complete, consecutive calendar years of quality assured data.

4) A commitment that, once redesignated, the state will continue to operate an appropriate monitoring network to verify the area is in compliance (maintenance) with the standard.

2.3 Emission Inventory

1) A comprehensive emission inventory of the precursors of fine particles (direct $PM_{2.5}$, NO_x, and SO_2) completed for the base year (2008, in this case).

2) A projection of the emission inventory to a year at least ten years following redesignation.

3) A demonstration that the projected level of emissions is sufficient to maintain the annual standard for fine particles.

4) A demonstration that improvement in air quality between the year violations occurred and the year attainment was achieved is based on permanent and enforceable emission reductions and not on temporary adverse economic conditions or unusually favorable meteorology.

5) Provisions for future updates of the inventory to enable tracking of the emission levels, including emission inventory statements from emission sources.

2.4 Modeling Demonstration

While no modeling is required for redesignating nonattainment areas, IDEM has evaluated the results of federal control-case modeling to demonstrate that compliance with the standard will be maintained.

2.5 Controls and Regulations

1) A U.S. EPA-approved SIP control strategy that includes Reasonably Available Control Technology (RACT) requirements for existing stationary sources covered by Control Technology Guidelines (CTG) and non-CTG RACT for all major sources.

2) Evidence that control measures required in past SIP revisions have been fully implemented.

3) Acceptable provisions to provide for new source review.

4) Assurances that existing controls will remain in effect after redesignation, unless the state demonstrates through photochemical modeling that the standard can be maintained without one or more controls.

5) If appropriate, a commitment to adopt a requirement that all transportation plans conform with, and are consistent with, the SIP.

2.6 Corrective Actions for Potential Future Violations of the Fine Particle Standard

1) A commitment to submit a revised plan eight years after redesignation.

2) A commitment to expeditiously enact and implement additional contingency control measures in response to exceeding specified predetermined levels (triggers) or in the event that future violations of the ambient standard occur.

3) A list of potential contingency measures that would be implemented in such an event.

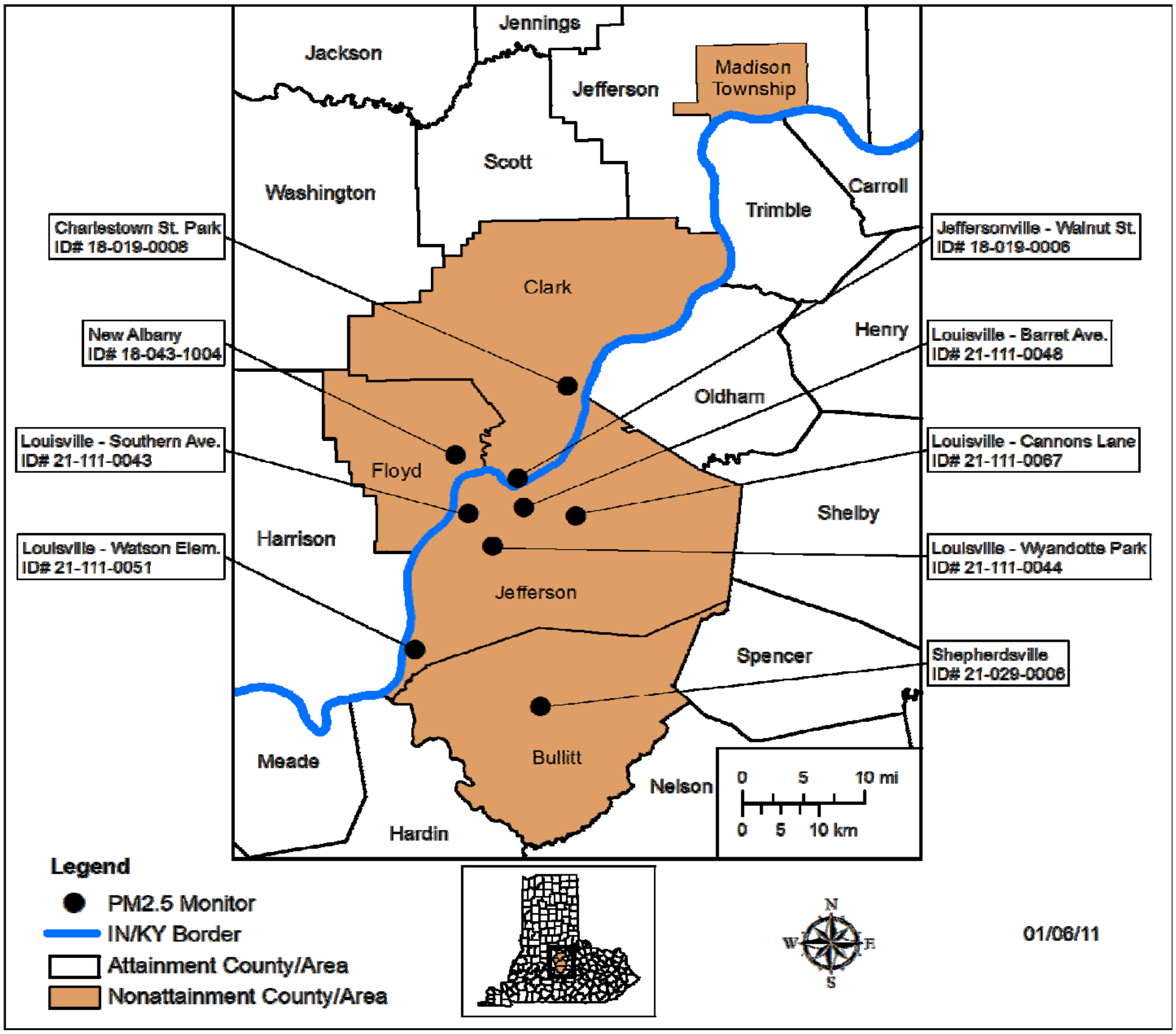
4) A list of NO_x, SO_2, and direct $PM_{2.5}$ sources potentially subject to future controls.

3.0 FINE PARTICLE MONITORING

3.1 Fine Particle Monitoring Network

There are currently eight Federal Reference Method monitors measuring fine particle concentrations in this nonattainment area. Three monitors are located in Indiana's portion of the nonattainment area and are operated by IDEM's Office of Air Quality (OAQ). Five monitors located in Kentucky's portion of the nonattainment area are operated by the LMAPCD. The monitor readings from 2008 through 2010 are shown in Tables 3.1, 3.2, and Appendix A and were retrieved from U.S. EPA's AQS database. The locations of the monitoring sites for this nonattainment area are shown in Figure 3.1. The Barret Avenue monitor (21-111-0048) located in Jefferson County, Kentucky was discontinued on December 31, 2008.

Figure 3.1
Louisville Basic Nonattainment Area



3.2 Ambient Fine Particle Monitoring Data

The following information summarizes U.S. EPA's "Guideline on Data Handling Conventions for the PM NAAQS," U.S. EPA-454/R-99-008, April 1999. Three complete years of fine particle monitoring data are required to demonstrate attainment at a monitoring site. The annual ambient air quality standard for fine particles is met at an ambient air quality monitoring site when the three-year average of the annual average of fine particle concentrations is less than or equal to 15.0 µg/m^3. When this occurs, the site is said to be in attainment. While calculating design values, three significant digits must be carried in the computations, with final values rounded to the nearest 0.1 µg/m^3. Decimals of 0.05 or greater are rounded up, and those less than 0.05 are rounded down, so that 15.049 µg/m^3 is the largest concentration that is less than or equal to 15.0 µg/m^3. Values at or below 15.0 µg/m^3 meet the standard. Values equal to or greater than 15.1 µg/m^3 exceed the standard.

Data handling procedures are applied on an individual basis at each monitor in the area. An individual site's three-year average of the annual average fine particle concentration is also called the site's *design value*. An area is in compliance with the annual NAAQS for fine particles only if all monitoring sites meet the NAAQS. The air quality design value for the area is the highest design value among all sites in the area. Table 3.1 outlines the annual fine particle values by site and the 2008 through 2010 design values for the three active fine particle monitoring sites in Indiana's portion of the Louisville Area. Table 3.2 outlines the annual fine particle values by site and the 2008 through 2010 design values for the six fine particle monitoring sites (five active and one recently discontinued) in Kentucky's portion of the Louisville Area. Appendix A contains the complete monitoring data summary from 2000 to 2010 for all of the Louisville Area monitors.

Table 3.1
Monitoring Data for Indiana's Portion of the Louisville Area
(Annual Average and 2008 through 2010 Design Values)

SITE ID	COUNTY	SITE NAME	YEAR	Annual Average (µg/m^3)	2008-2010 Design Value (µg/m^3)
18-019-0006	Clark	Jeffersonville – Walnut Street	2008	14.48	**14.1**
			2009	13.01	
			2010	14.67	
18-019-0008	Clark	Charlestown State Park	2008	13.44	**12.2**
			2009	10.84	
			2010	12.45	
18-089-2004	Floyd	New Albany	2008	12.70	**12.8**
			2009	11.91	
			2010	13.80	

Red Text Indicates Incomplete Data

The Charlestown State Park monitor began operation on July 2, 2008.

Table 3.2
Monitoring Data for Kentucky's Portion of the Louisville Area
(Annual Average and 2008 through 2010 Design Values)

SITE ID	COUNTY	SITE NAME	YEAR	Annual Average (µg/m^3)	2008-2010 Design Value (µg/m^3)
21-029-0006	Bullitt	Shepherdsville	2008	12.84	**12.70**
			2009	11.81	
			2010	13.45	
21-111-0043	Jefferson	Southern Avenue	2008	13.17	**12.95**
			2009	12.21	
			2010	13.47	
21-111-0044	Jefferson	Wyandotte Park	2008	13.41	**13.20**
			2009	12.45	
			2010	13.74	
21-111-0048	Jefferson	Barret Avenue	2008	13.44	**13.44**
			2009	N/A	
			2010	N/A	
21-111-0051	Jefferson	Watson Elementary	2008	12.78	**13.07**
			2009	11.59	
			2010	14.83	
21-111-0067	Jefferson	Cannons Lane	2008	N/A	**12.47**
			2009	11.67	
			2010	13.27	

Blue Text Indicates Design Value Based on One Year of Data

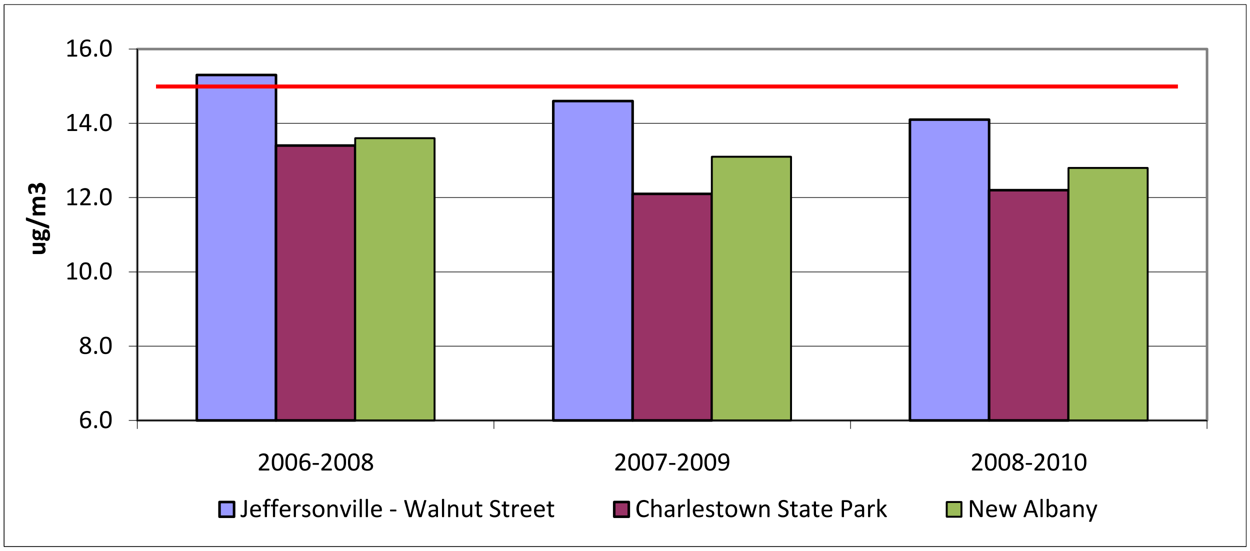
Green Text Indicates Design Value Based on Two Years of Data

The Barrett Avenue monitor discontinued operation on December 31, 2008.

The Cannons Lane monitor began operation on January 1, 2009.

Graph 3.1 visually demonstrates the 2006 through 2010 design values for Indiana's portion of the Louisville Area. Graph 3.2 visually demonstrates the 2006 through 2010 design values for Kentucky's portion of the Louisville Area.

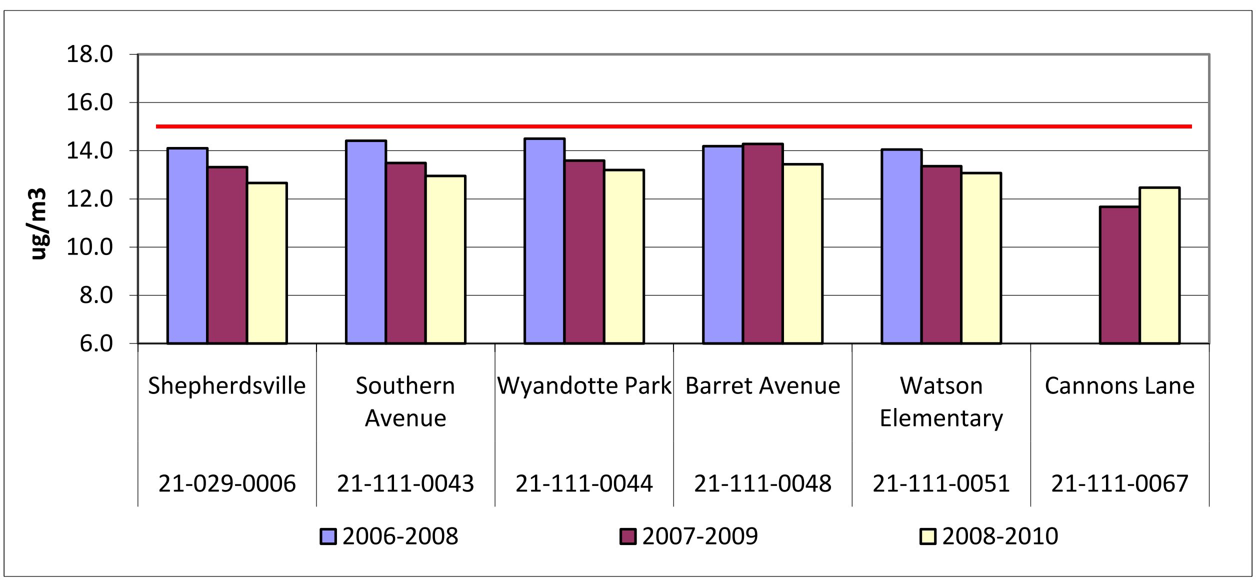
Graph 3.1
Fine Particle Design Values for Indiana's Portion of the Louisville Area, 2006 through 2010



Red line represents the annual standard for fine particles of 15 µg/m^3.

The Charlestown State Park monitor began operation on July 2, 2008.

Graph 3.2
Fine Particle Design Values for Kentucky's Portion of the Louisville Area, 2006 through 2010



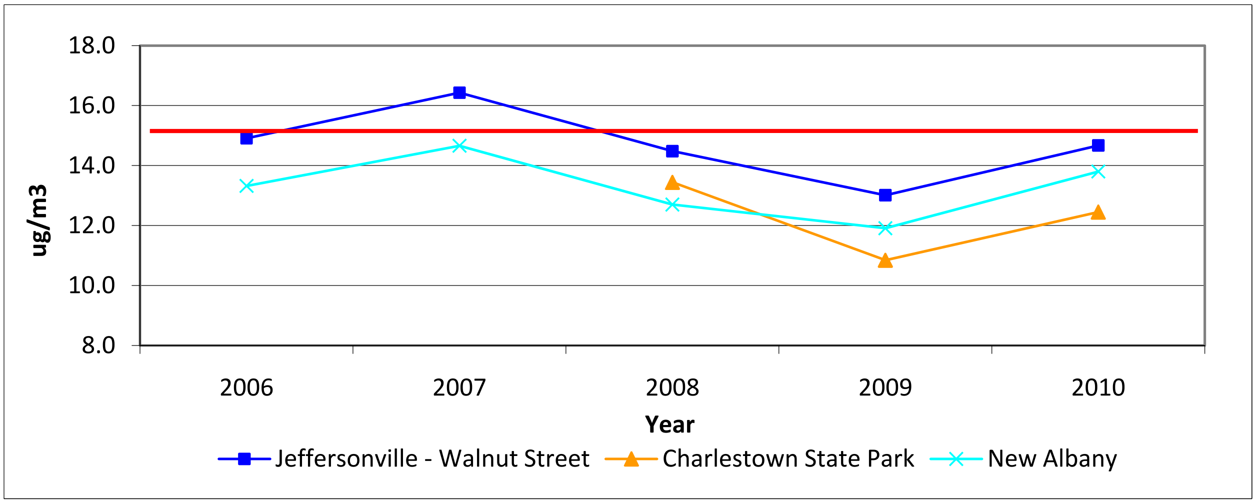
Red line represents the annual standard for fine particles of 15 µg/m^3.

The Barrett Avenue monitor discontinued operation on December 31, 2008.

The Cannons Lane monitor began operation on January 1, 2009.

The design values for Clark and Floyd counties, Indiana, along with the nonattainment area in its entirety, demonstrate that the annual NAAQS for fine particles has been attained.

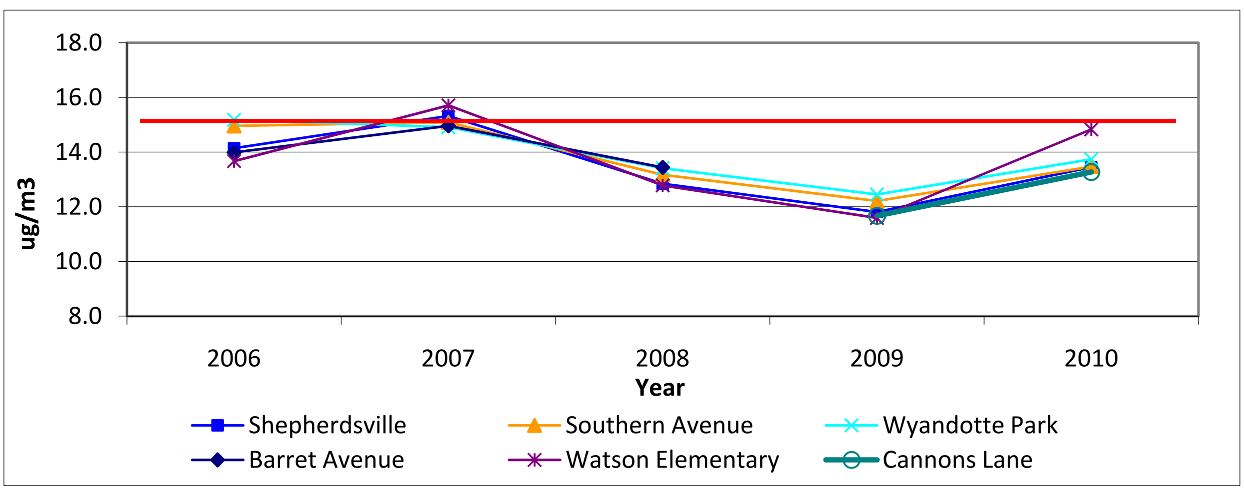
Graph 3.3
Annual Fine Particle Trends for Indiana's Portion of the Louisville Area, 2006 through 2010



Red line represents the annual standard for fine particles of 15 µg/m^3.

The Charlestown State Park monitor began operation on July 2, 2008.

Graph 3.4
Annual Fine Particle Trends for Kentucky's Portion of the Louisville Area, 2006 through 2010



Red line represents the annual standard for fine particles of 15 µg/m^3.

The Barrett Avenue monitor discontinued operation on December 31, 2008.

The Cannons Lane monitor began operation on January 1, 2009.

Graphs 3.1 and 3.2 show the trends in design values, while Graphs 3.3 and 3.4 show the trends for annual fine particles. The area's design values have recently trended downward, as emissions have declined both regionally and locally due to programs such as the Acid Rain program and cleaner automobiles and fuels. U.S. EPA's rule to control nitrogen oxides from specific source categories (40 CFR Parts 51, 72, 75, and 96, published on October 17, 1998, and referred to as the "NO_x SIP Call") has significantly reduced emissions from large electric generating units (EGUs), industrial boilers, and cement kilns. Indiana's NO_x SIP Call Rule was adopted into the Indiana Administrative Code (IAC) on June 6, 2001 at 326 IAC 10-3 and 326 ICA 10-4. The elevated fine particle values for 2005 are considered an abnormal occurrence. An analysis of meteorological conditions and monitoring values is included in Section 7.0 and supports the conclusion that attainment of the standard as of 2010 is not the result of unusually favorable meteorological conditions. It is expected that this downward trend will persist as the above programs continue and U.S. EPA's proposed Clean Air Transport Rule (Transport Rule) is implemented.

3.3 Quality Assurance

Indiana and Kentucky have quality assured all data shown in Appendix A in accordance with 40 CFR 58.10 and recorded the data in the AQS database and, thus, the data is available to the public.

3.4 Continued Monitoring

Indiana and Kentucky commit to continue monitoring fine particle concentrations at the active sites indicated in Tables 3.1 and 3.2, and Appendix A. IDEM will consult with U.S. EPA Region V staff prior to making changes to the existing Indiana monitoring network through the annual network review should changes become necessary in the future. IDEM will continue to quality assure the Indiana monitoring data to meet the requirements of 40 CFR 58. IDEM will enter all data into AQS on a timely basis in accordance with federal guidelines.

4.0 EMISSION INVENTORY

U.S. EPA's Redesignation Guidance and Implementation Rule requires the submittal of a comprehensive inventory of precursor emissions for fine particles (NO_x, SO_2, and direct $PM_{2.5}$) representative of the year when the area achieved attainment of the annual NAAQS for fine particles (base year). IDEM is using 2008 as the base year. Consistent with the federal implementation rule for fine particles, IDEM and U.S. EPA do not consider volatile organic compounds (VOCs) or ammonia (NH_3) to be significant contributors to fine particles. IDEM must also demonstrate that the improvement in air quality between the year that violations occurred and the year that attainment was achieved is based on permanent and enforceable emission reductions. Other requirements related to the emission inventory include: a projection of the emission inventory to a year at least ten years following redesignation; a demonstration that the projected level of emissions is sufficient to maintain the annual standard for fine particles; and a commitment to provide future updates of the inventory to enable tracking of emission levels during the ten year maintenance period. The following subsections address each of these requirements.

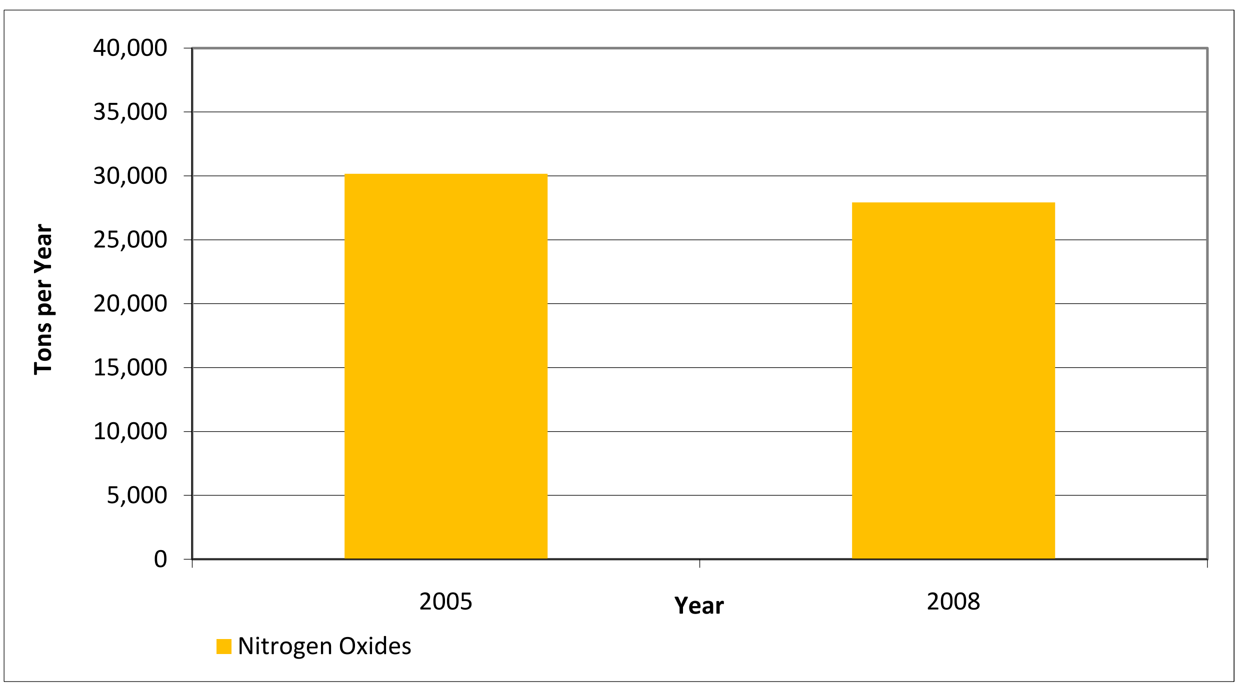
4.1 Emission Trends

Point Sources

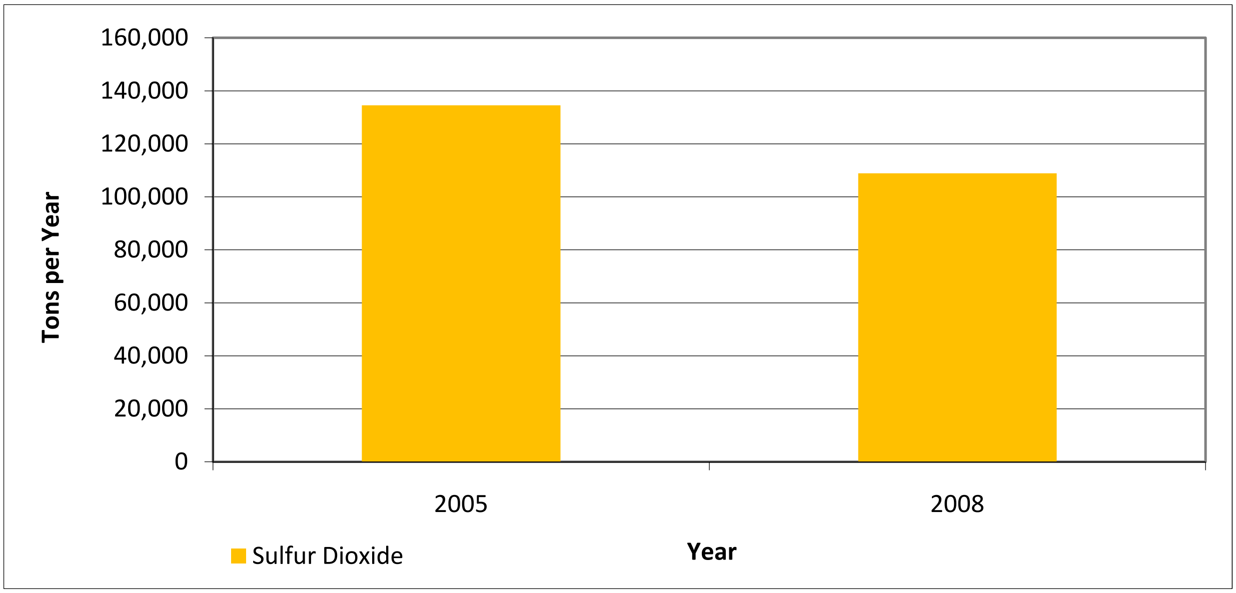
The point source data are obtained from Indiana's emissions reporting program and are based on county point source totals. Clark, Floyd, and Jefferson counties, Indiana, had a 7.43% reduction in NO_x point source emissions, a 19.07% reduction in SO_2 point source emissions, and a 11.09% reduction in direct $PM_{2.5}$ point source emissions from 2005 to 2008. Graphs 4.1, 4.2, and 4.3 demonstrate the trends in point source emissions of NO_x, SO_2, and direct $PM_{2.5}$ for these counties.

The Louisville Area had a slight increase of 1.62% NO_x point source emissions, a 16.50% reduction in SO_2 point source emissions, and a 9.07% reduction in direct $PM_{2.5}$ point source emissions from 2005 to 2008. Point source data for the Louisville Area is a combination of data from Indiana's and Kentucky's emissions reporting programs. Graphs 4.4, 4.5, and 4.6 show the trends in point source emissions of total NO_x, SO_2, and direct $PM_{2.5}$ emissions for the Louisville Area. Graphs and data tables of emissions for the point source category can be found in Appendix B.

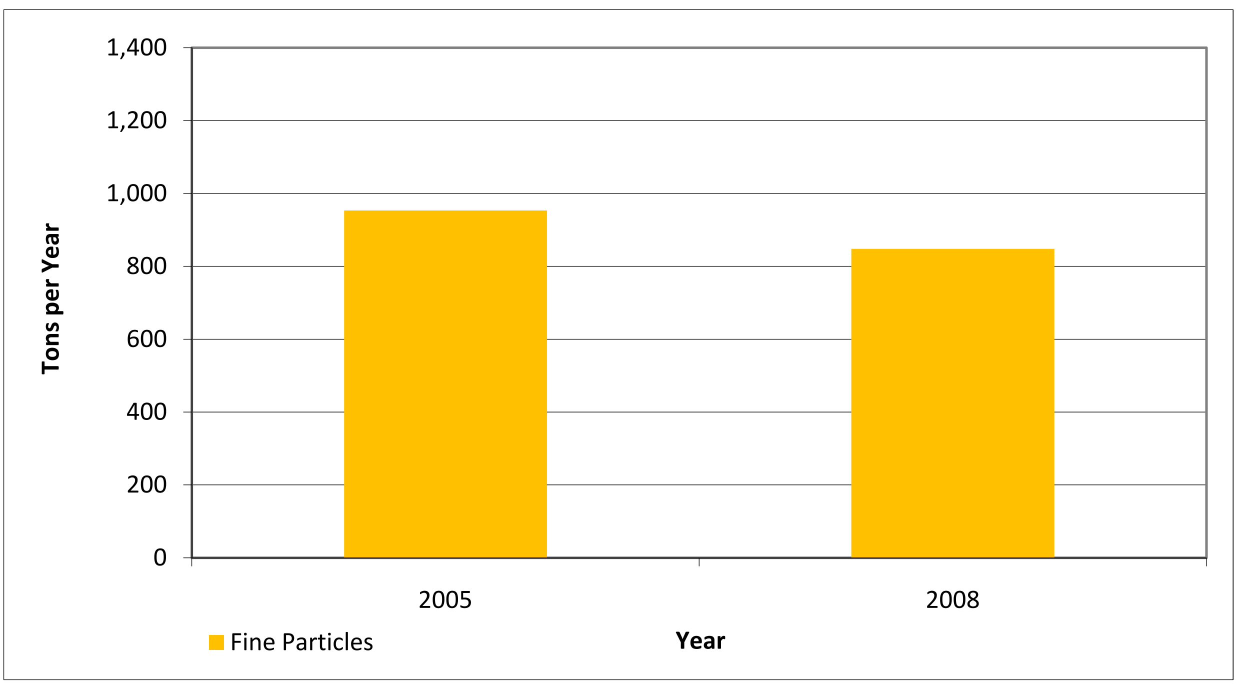
Graph 4.1
NO_x Point Source Emissions Trend, Clark, Floyd, and Jefferson Counties, Indiana, 2005 and 2008



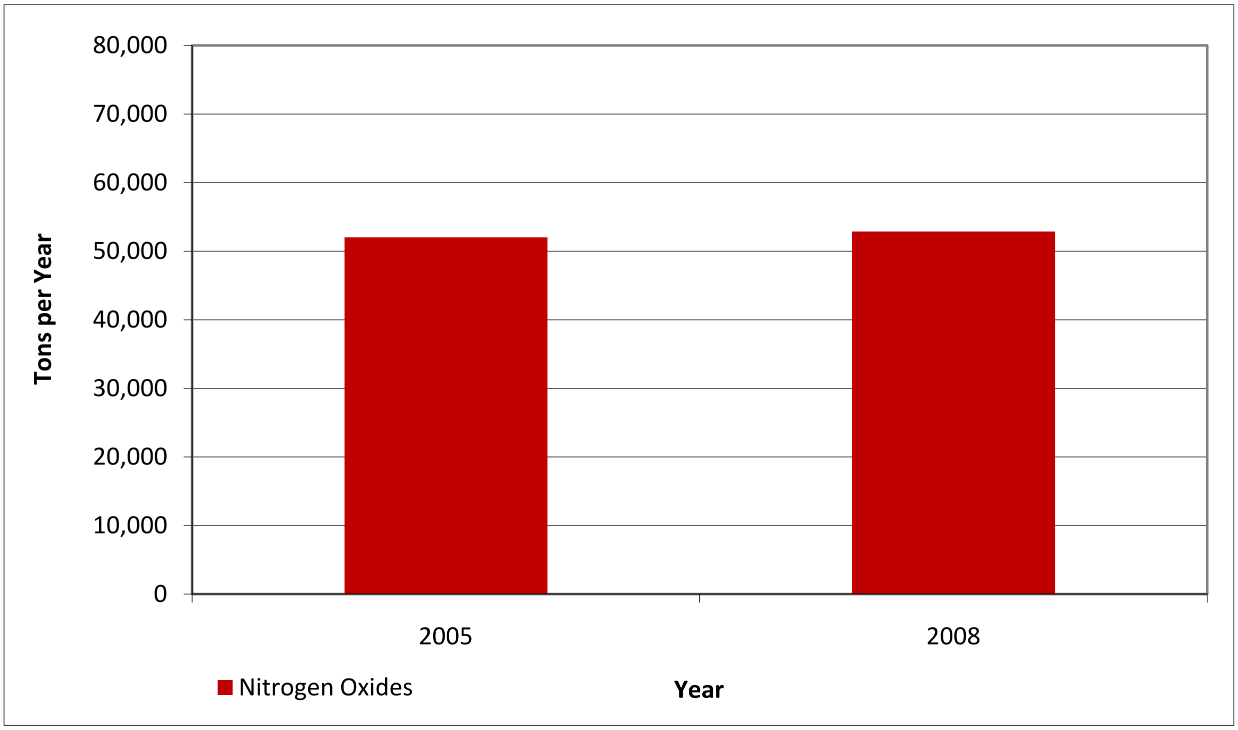
Graph 4.2
SO_2 Point Source Emissions Trend, Clark, Floyd, and Jefferson Counties, Indiana, 2005 and 2008



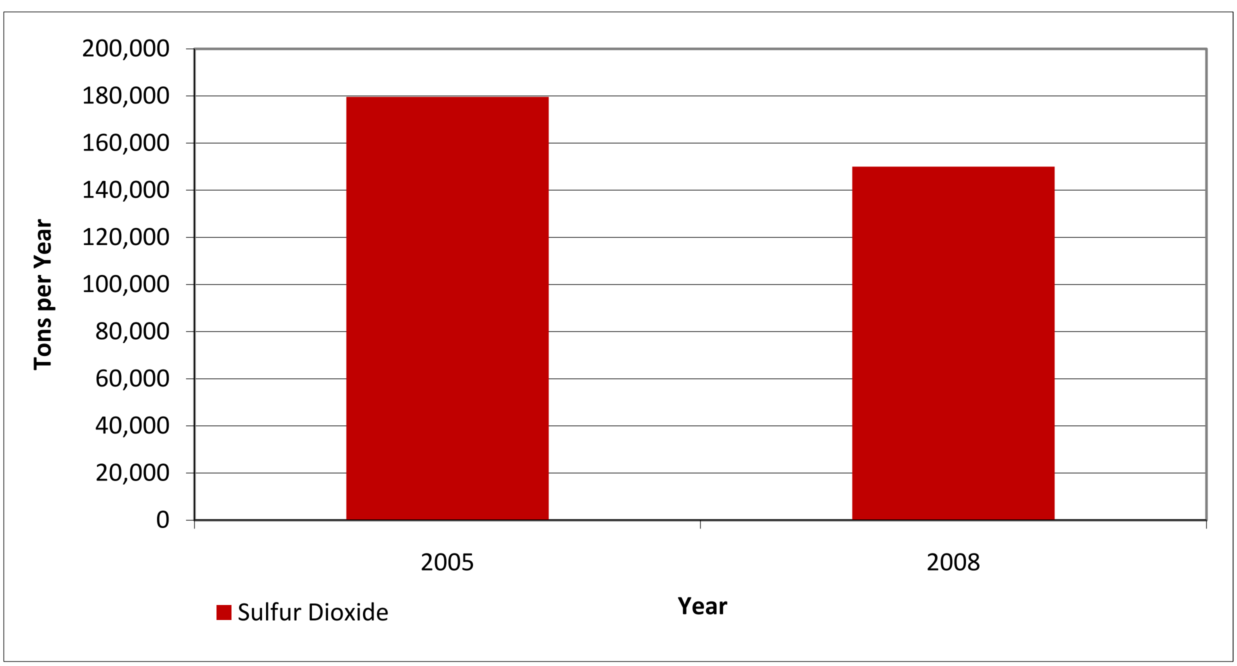
Graph 4.3
Direct $PM_{2.5}$ Point Source Emissions Trend, Clark, Floyd, and Jefferson Counties, Indiana, 2005 and 2008



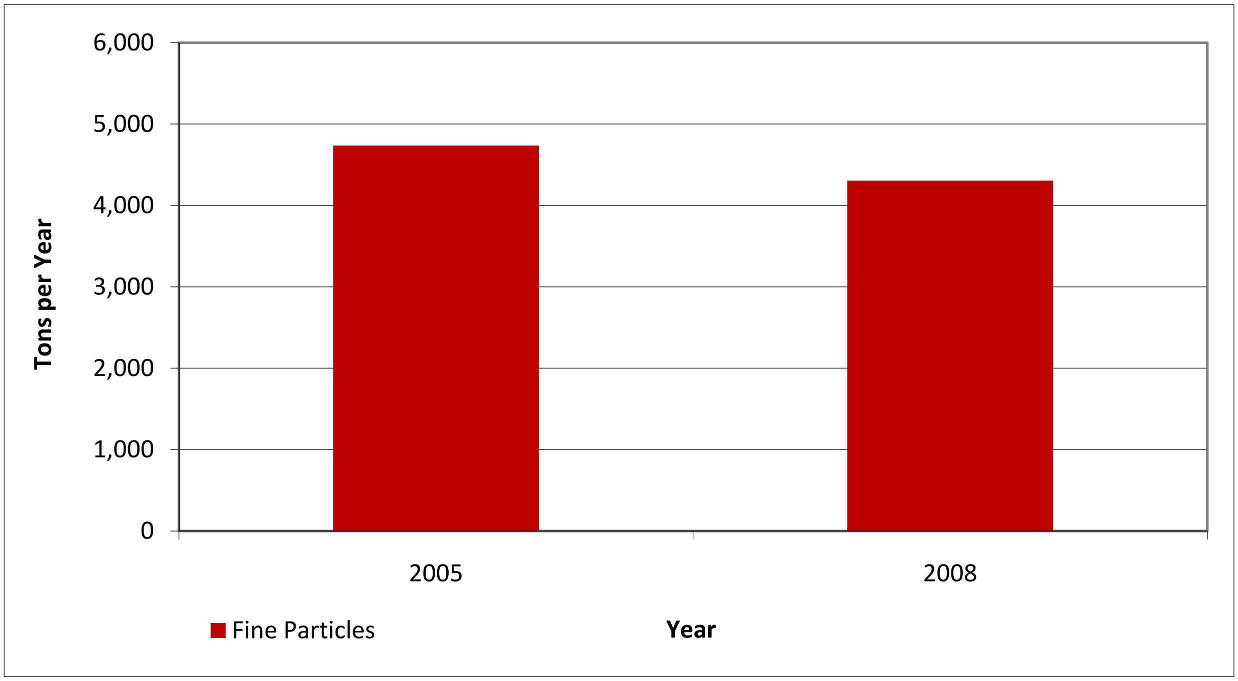
Graph 4.4
NO_x Point Source Emissions Trend, Louisville Area, 2005 and 2008



Graph 4.5
SO_2 Point Source Emissions Trend, Louisville Area, 2005 and 2008



Graph 4.6
Direct $PM_{2.5}$ Point Source Emissions Trend, Louisville Area, 2005 and 2008



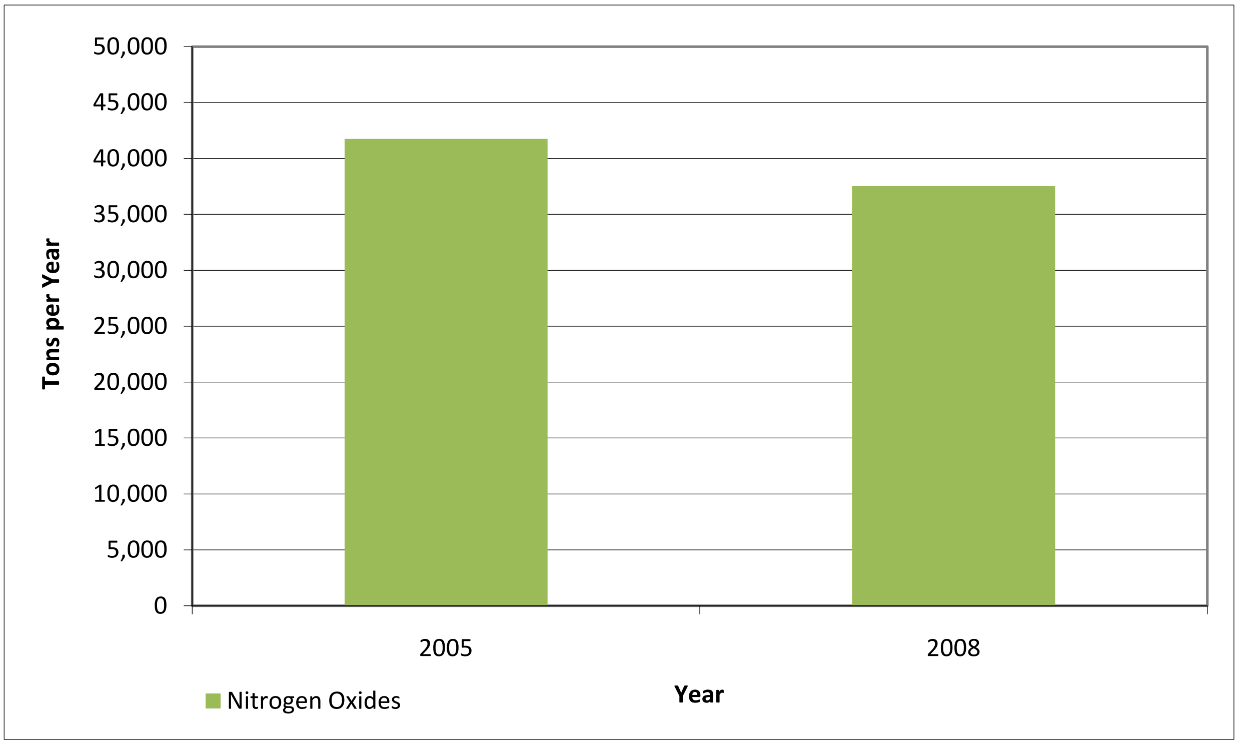
All Anthropogenic Sources

Periodic inventories, which include emissions from all sectors (mobile, area, nonroad, and point source), were prepared for 2005 and 2008. The 2008 data were extrapolated from the 2005 emission inventory. Regional NO_x emission reductions affect fine particle levels in the Louisville Area far more so than NO_x emission reductions within the nonattainment area itself. These emission trends roughly follow the years of monitored trends discussed in Section 3.0. There is a downward trend in NO_x and SO_2 emissions from 2005 to 2008 in Clark, Floyd and Jefferson counties, Indiana, as well as the Louisville Area. The decrease in NO_x can be largely attributed to the impact of the NO_x SIP Call. Graphs and data tables of emissions from each source category are available in Appendix C.

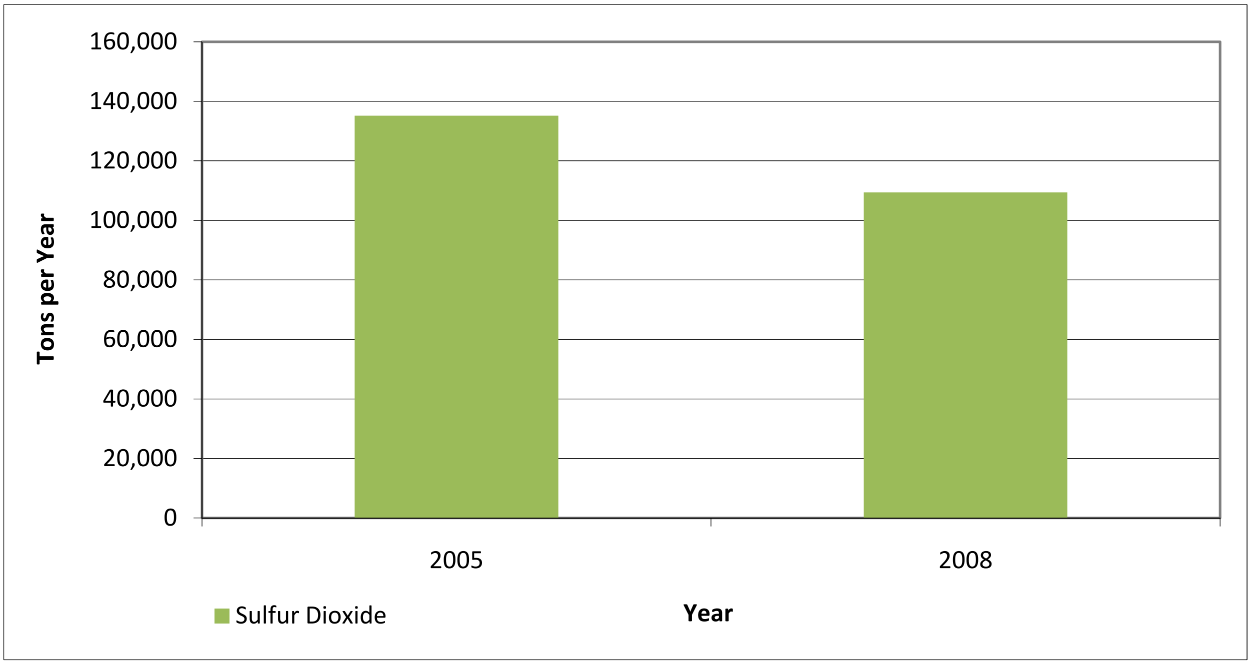
Mobile emission inventories and projections for all counties in the Louisville Area were prepared by the Kentuckiana Regional Planning and Development Agency (KIPDA), Indiana Department of Transportation (INDOT), and IDEM and are explained in further detail in Section 5.0. All 2005 data for Clark, Floyd, and Jefferson counties, Indiana are from the 2005 periodic inventory which has been identified as one of the preferred databases for SIP development. All 2008 emissions were extrapolated from the 2005 Lake Michigan Air Directors Consortium's (LADCO's) modeling inventory, using LADCO's growth factors, for all sectors except point sources (electrical generating units and non-electrical generating units). Point source emissions for 2008 were compiled from Indiana's annual emission inventory database.

Graphs 4.7, 4.8, and 4.9 show the trends in anthropogenic emissions for Clark, Floyd, and Jefferson counties, Indiana. Graphs 4.10, 4.11, and 4.12 show the trends in anthropogenic emissions for the Louisville Area. The emission inventory development and emissions projection discussion below, with the exception of the mobile emission inventory and projections, identify procedures used by IDEM and LADCO regarding emissions for the Louisville Area.

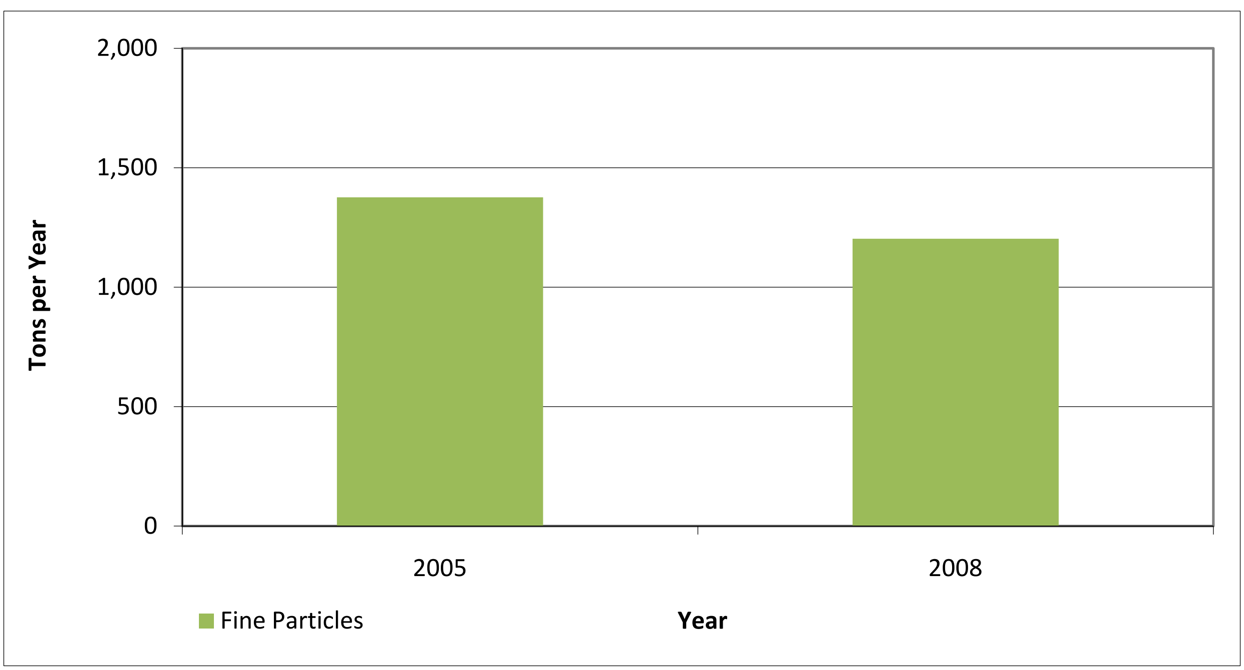
Graph 4.7
NO_x Emissions Trend, All Sources, Clark, Floyd, and Jefferson Counties, Indiana, 2005 and 2008



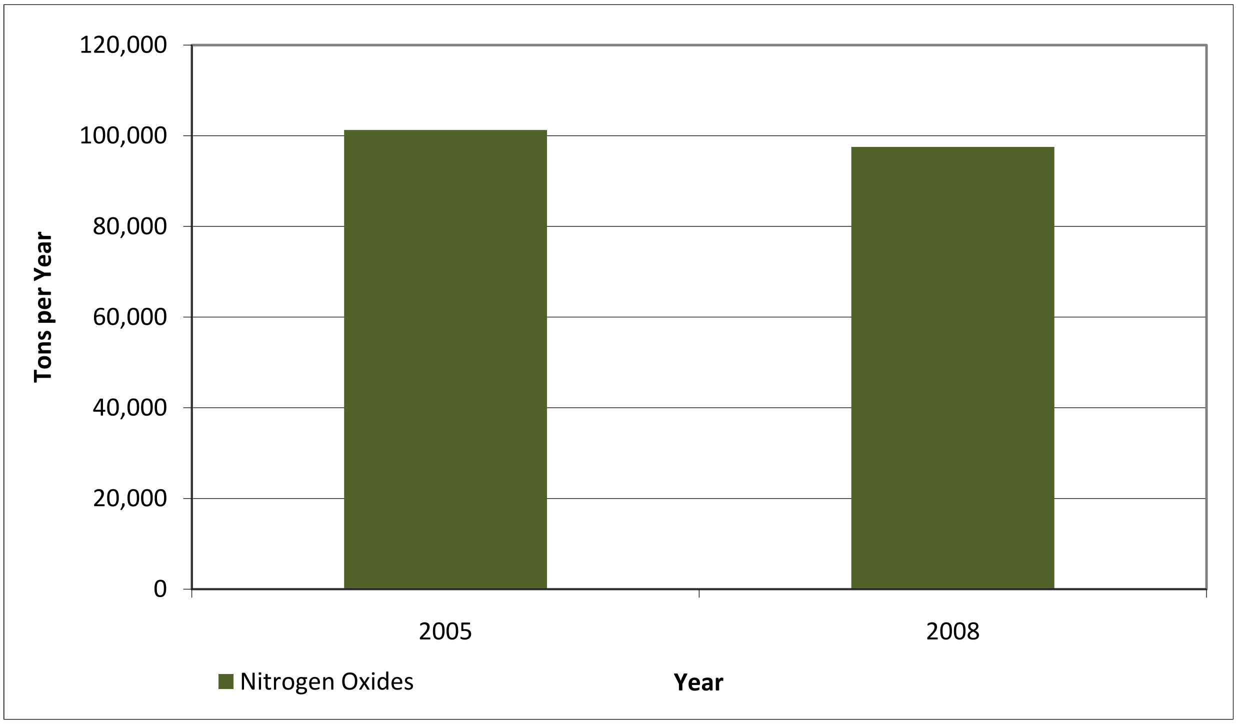
Graph 4.8
SO_2 Emissions Trend, All Sources, Clark, Floyd, and Jefferson Counties, Indiana, 2005 and 2008



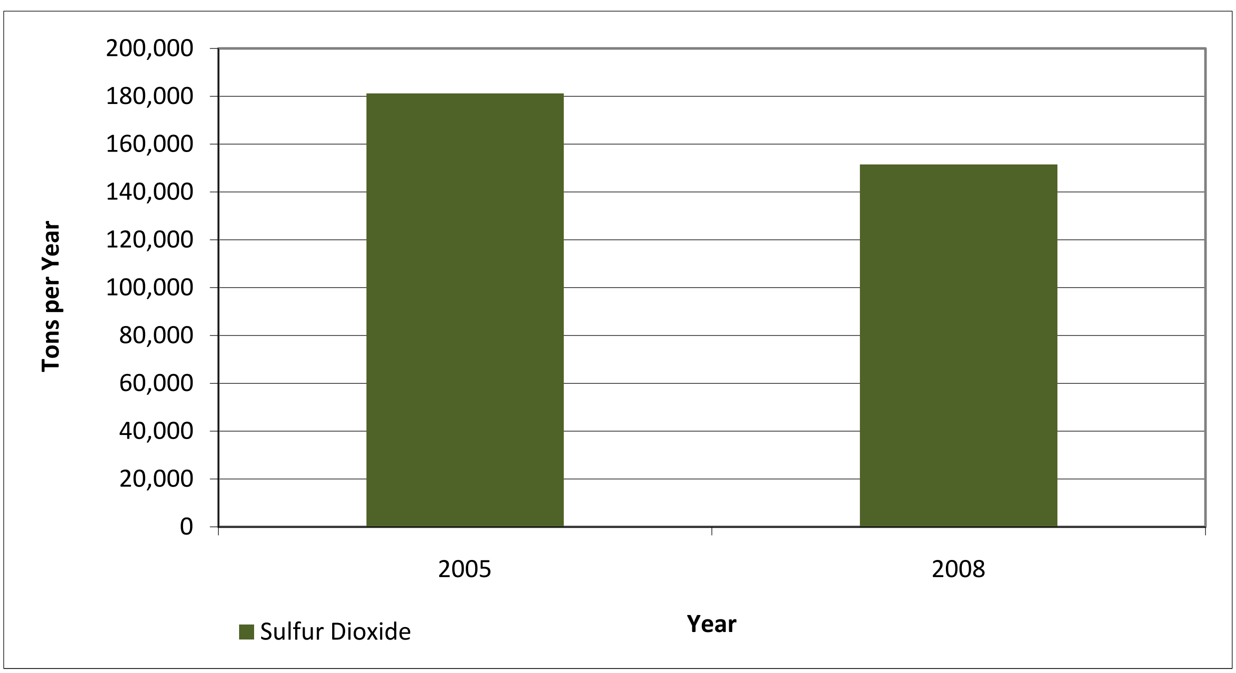
Graph 4.9
Direct $PM_{2.5}$ Emissions Trend, All Sources, Clark, Floyd, and Jefferson Counties, Indiana, 2005 and 2008



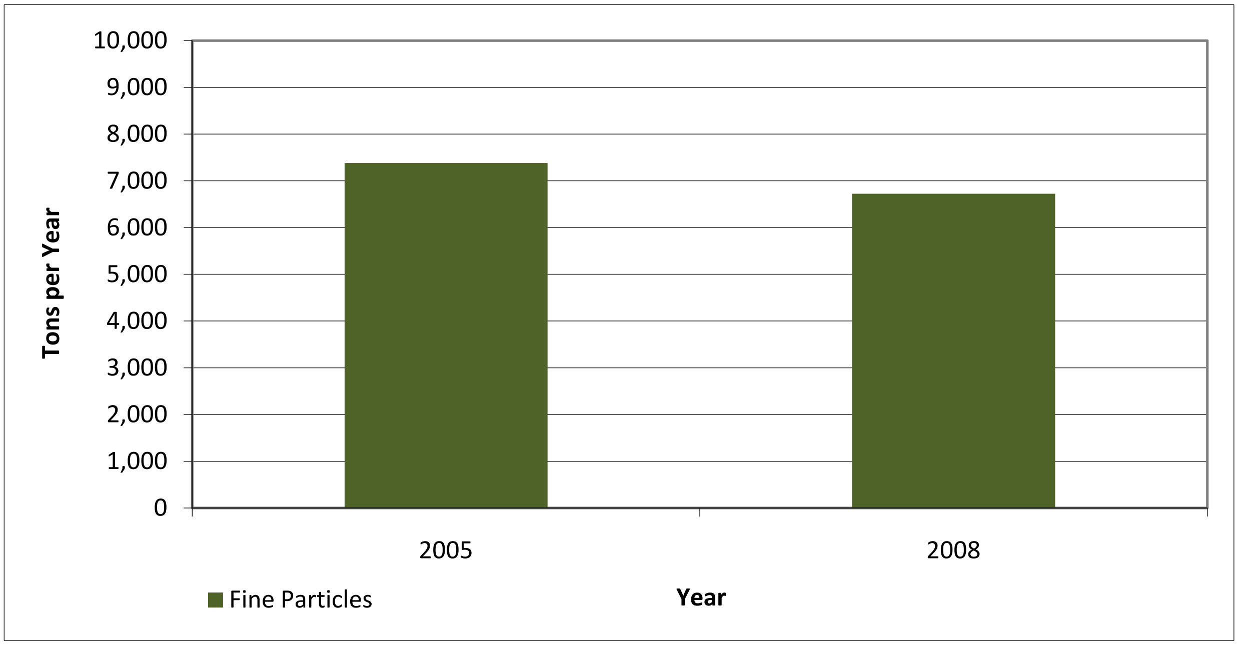
Graph 4.10
NO_x Emissions Trend, All Sources, Louisville Area, 2005 and 2008



Graph 4.11
SO_2 Emissions Trend, All Sources, Louisville Area, 2005 and 2008



Graph 4.12
Direct $PM_{2.5}$ Emissions Trend, All Sources, Louisville Area, 2005 and 2008



EGU Sources

Both NO_x and SO_2 emissions have decreased substantially in the Louisville Area in response to national programs affecting all EGUs, such as the Acid Rain program and the NO_x SIP Call. Other sectors of the inventory also impact the formation of fine particles, but large regional sources, such as EGUs, have a substantial impact on the formation of fine particles. The data was taken from U.S. EPA's Clean Air Markets database.[1]

As part of the NO_x SIP Call, the states were required to adopt into their rules a budget for all large EGUs. Indiana's budget is referenced in 326 IAC 10-4. The budget represents a statewide cap on NO_x emissions. Although each unit is allocated emissions based upon historic heat input, utilities can meet this budget by over-controlling certain units or purchasing credits from the market to account for overages at other units. To summarize, NO_x emissions have dramatically decreased over the years represented on these graphs.

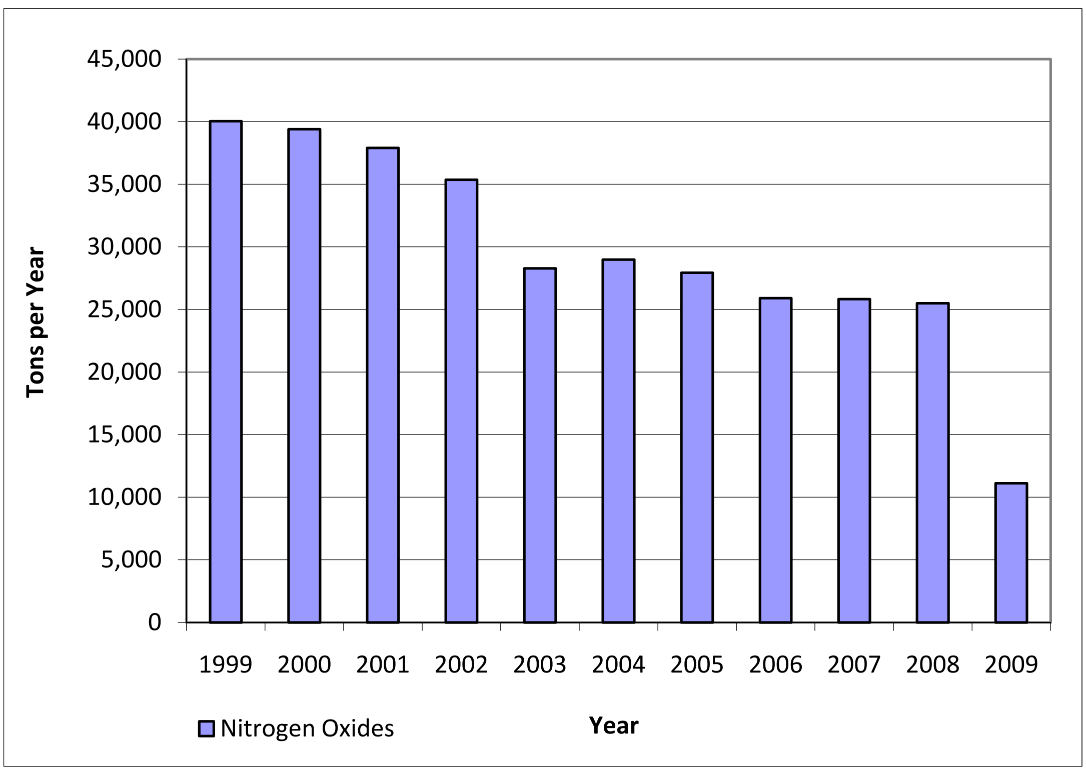
These emissions, capped by the state rule, are expected to remain near these levels throughout the maintenance period covered by this request. The state cap for the NOx SIP Call remained in place through 2008, at which time the Clean Air Interstate Rule (CAIR) program superseded it. CAIR, issued in March 2005, adopted by the Indiana Air Pollution Control Board on November 1, 2006, and implemented beginning in 2010, will continue to reduce regional EGU NO_x emissions statewide by approximately another 17% by 2015 and 57% for EGU SO_2 emissions by

[1] http://www.epa.gov/airmarkets

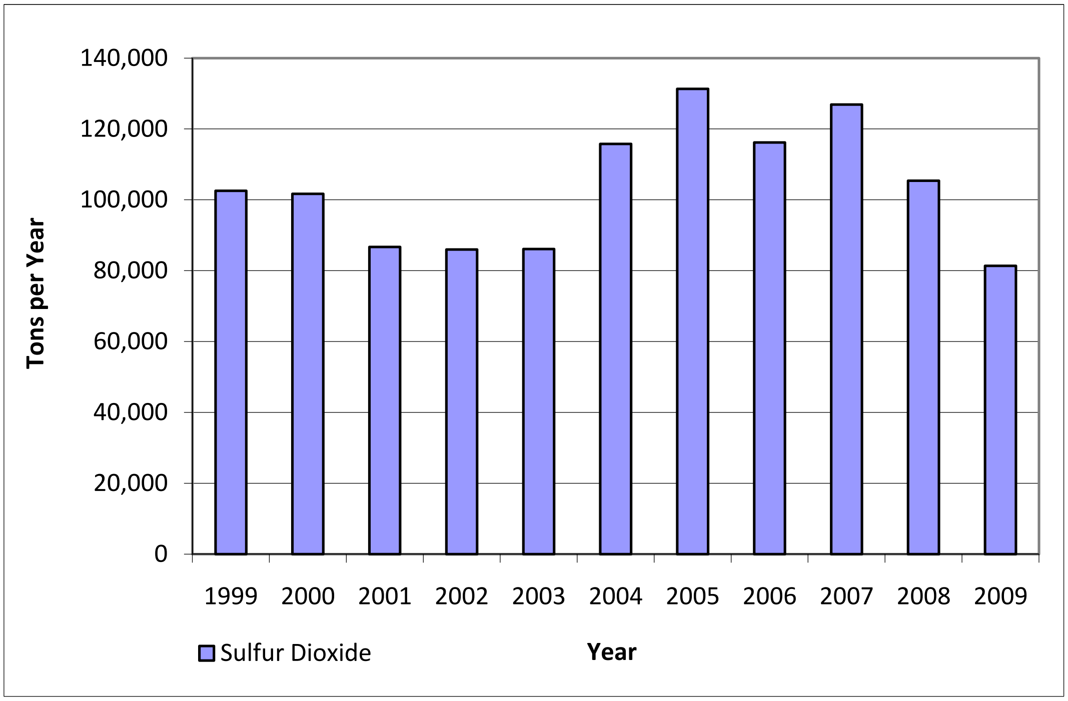
2015. The D.C. Circuit court's vacatur of CAIR in July of 2008 and subsequent remand without vacatur of CAIR in December 2008, directs U.S. EPA to revise the CAIR rule in the future. The proposed Clean Air Transport Rule (CAIR's replacement rule) will result in similar or greater emission reductions than assumed within the current emission inventories once it is implemented.

There are two EGUs located in Indiana's portion of the nonattainment area: The Duke Energy Indiana – Gallagher Generating Station in Floyd County, Indiana and the Indiana Kentucky Electric Corporation (IKEC) – Clifty Creek Power Plant in Jefferson County, Indiana. As the result of a recent settlement with U.S. EPA to resolve violations of the CAA's new source review requirements, the Duke Energy Indiana – Gallagher Generating Station will be shutting down two of its four coal-fired EGUs (Units 1 and 3) by no later than February 1, 2012. The settlement also establishes overall NO_x and SO_2 caps. The remaining units (Units 2 and 4) have recently installed dry sorbent control technology to reduce SO_2. Graphs 4.13 and 4.14 depict the trends in NO_x and SO_2 EGU emissions in Floyd and Jefferson counties, Indiana for the years 1999 through 2009. Graphs 4.15 and 4.16 depict the trends in NO_x and SO_2 emissions from EGUs in the Louisville Area for the years 1999 through 2009. Graphs and data tables of emissions from the EGU source category can be found in Appendix D.

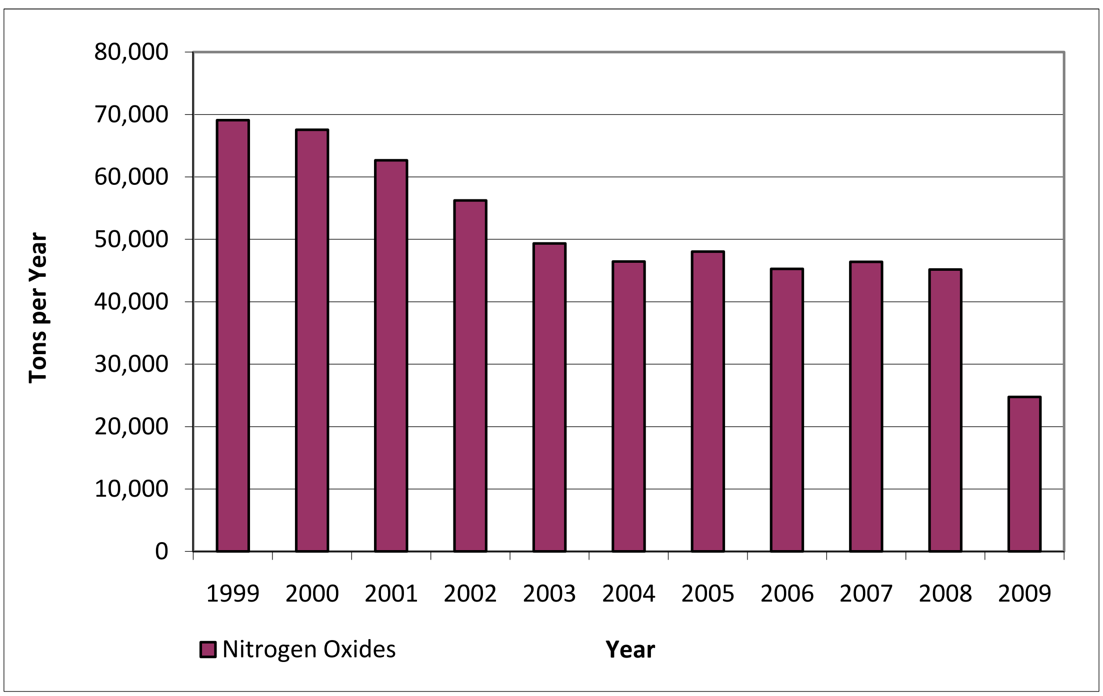
Graph 4.13
NO_x Emissions from EGUs, Floyd and Jefferson Counties, Indiana, 1999 to 2009



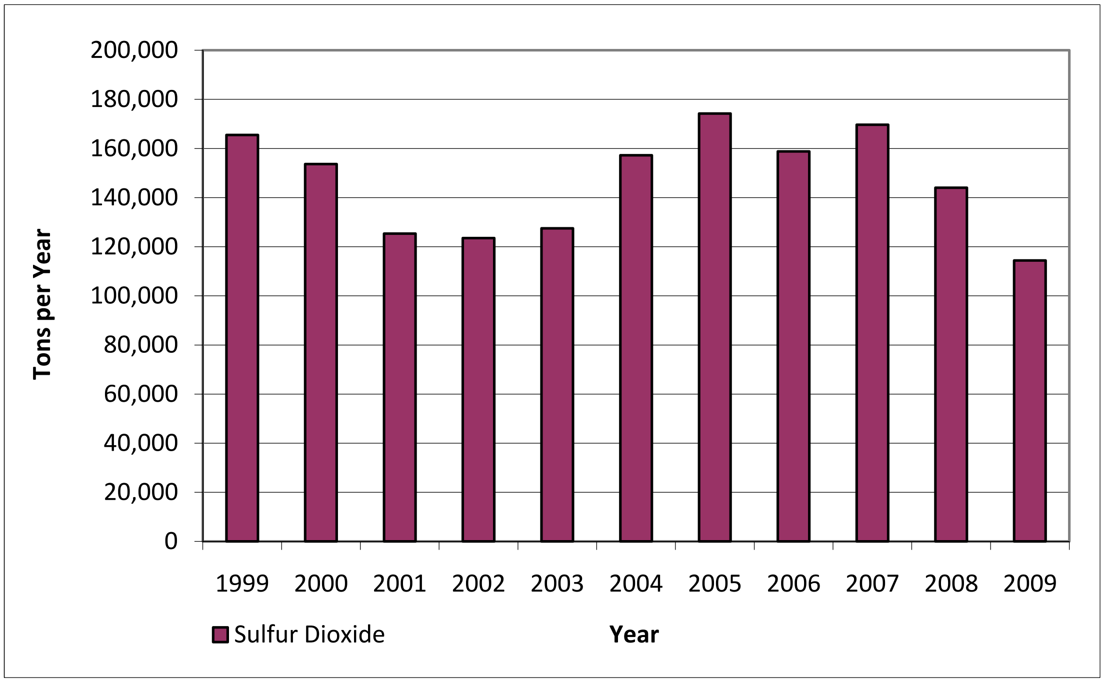
Graph 4.14
SO_2 Emissions from EGUs, Floyd, and Jefferson Counties, Indiana, 1999 to 2009



Graph 4.15
NO_x Emissions from EGUs, Louisville Area, 1999 to 2009



Graph 4.16
SO_2 Emissions from EGUs, Louisville Area, 1999 to 2009



4.2 Base Year Inventory

IDEM prepared a comprehensive inventory for the Louisville Area, including area, mobile, nonroad, and point sources for direct $PM_{2.5}$, NO_x, and SO_2 for 2005 and 2008 (the years with the most complete emission inventory available at this time). The 2008 emission inventory represents a base year for maintenance purposes. The 2007 implementation rule for the annual standard for fine particles states that NO_x, SO_2, and direct $PM_{2.5}$ are the regulated precursors for fine particles. Ammonia and VOCs are not required to be addressed unless the state or U.S. EPA make a technical demonstration that emissions of these pollutants from sources in the state significantly contribute to $PM_{2.5}$ concentrations in a given nonattainment area. U.S. EPA and IDEM have not determined that ammonia or VOCs are significant contributors to fine particles formation in Indiana. IDEM's 2008 base year inventory was developed as follows:

- Area sources were extrapolated from the Indiana 2005 periodic inventory submitted to U.S. EPA.
- Mobile source emissions were calculated from U.S. EPA's Motor Vehicle Emission Simulator (MOVES) model-produced emission factors and data extracted from the region's travel-demand model. These emissions were then interpolated as needed to determine 2008 base year values.
- Point source information was compiled from IDEM's emission inventory database and U.S. EPA's Clean Air Markets acid rain database.
- Biogenic emissions are not specifically included in these summaries, but are included in the photochemical modeling results presented in Section 7.0.

- Nonroad emissions were extrapolated from the 2005 National Emissions Inventory (NEI). To address concerns about the accuracy of some of the categories in U.S. EPA's nonroad emissions model, LADCO contracted with two companies to review the base data and make recommendations. One of the contractors also estimated emissions for two nonroad categories not included in U.S. EPA's nonroad model. Emissions were estimated for commercial marine vessels and railroads. The recreational motorboat population and spatial surrogates (used to assign emissions to each) were also significantly updated. The populations for the construction equipment category were also reviewed and updated based upon surveys completed in the Midwest. The temporal allocation for agricultural sources was also updated. A new nonroad estimation model was provided by U.S. EPA for the 2005 analysis.
- Area, nonroad, mobile, and point source emissions data referenced for Kentucky's portion of the Louisville Area were provided by LAMPCD, KDEP, and KIPDA. This inventory was prepared using similar methodologies.

Appendix C contains data tables and graphs of these emissions.

4.3 Emission Projections

In consultation with U.S. EPA and other stakeholders, IDEM selected the year 2025 as the maintenance year for this redesignation request. This document contains projected emission inventories for 2015 and 2025. These emission projections were prepared by IDEM, with assistance from LADCO, LAMPCD, KDEP, and KIPDA.

The detailed 2015 and 2025 emission inventory for the Louisville Area can be found in Appendix E. Emission trends are an important gauge for continued compliance with the annual standard for fine particles. Therefore, IDEM performed an initial comparison of the inventories for the base year of 2008, interim year of 2015, and maintenance year of 2025 for Clark, Floyd, and Jefferson counties, Indiana, as well as the entire Louisville Area.

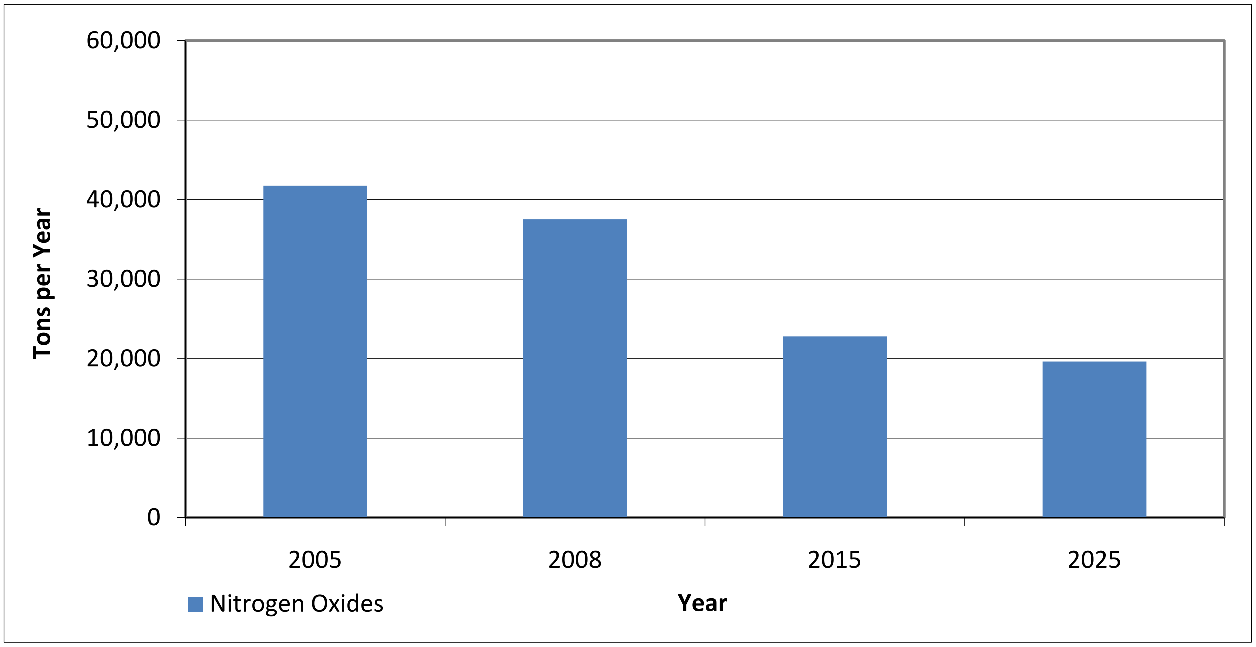
The 2005 LADCO modeling inventory was used as the basis for estimated emissions for the years 2008, 2015, and 2025, using LADCO's growth factors, for all sectors except point sources (electric generating units and non-electric generating units). Point source emissions for 2005 and 2008 were compiled from Indiana's annual emission inventory database. The 2015 interim year emissions were interpolated based on the 2009 and 2018 LADCO modeling inventory, using LADCO's growth factors, for all sectors. The 2025 maintenance year emissions were extrapolated from the 2018 LADCO modeling inventory.

The projected emission inventories for 2015 and 2025 for Kentucky's portion of the Louisville Area were provided by LAMPCD, KDEP, and KIPDA.

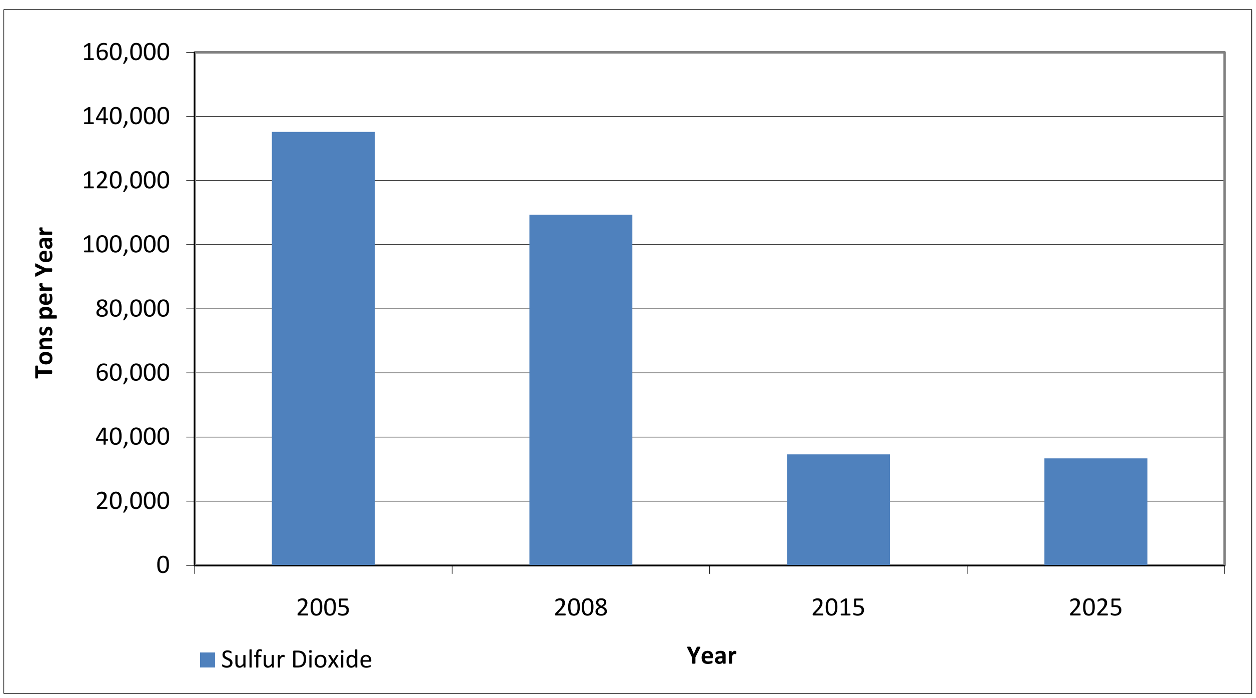
Graphs 4.17, 4.18, 4.19, and 4.20 visually compare 2005 and 2008 (base year) NO_x, SO_2, and direct $PM_{2.5}$ total estimated emissions with the 2015 and 2025 projected emissions for Clark, Floyd, and Jefferson counties, Indiana. Graphs 4.21, 4.22, 4.23, and 4.24 visually compare the 2005 and 2008 (base year) NO_x, SO_2, and direct $PM_{2.5}$ total estimated emissions with the 2015 and 2025 projected emissions for the Louisville Area. Mobile source emission inventories are further described in Section 5.0. In addition to LADCO's estimates, point source emissions were projected based upon the statewide EGU NO_x budgets from Indiana's NO_x rule. NO_x and SO_2 EGU emission estimates for 2015 and 2025 for the IKEC – Clifty Creek Power Plant were projected using the budgets from the proposed Clean Air Transport Rule and Options 1 and 2 from the recent Notice of Data Availability. Since it is likely that the finalized rule will include a budget approximating one of these, IDEM used the option with the highest allotment to develop conservative projections. Further, the Duke Energy Indiana/U.S. EPA consent decree provides overall NO_x and SO_2 caps for the Duke Energy – Gallagher Generating Station in Floyd County, Indiana. The emissions allowed under these caps are similar to those in the Transport Rule. Therefore, IDEM is confident that NO_x and SO_2 emissions in 2015 and 2025 will be close to or below the projections. Additionally, the SO_2 and NO_x allocations for the Duke Energy Indiana – Gallagher Generating Station and IKEC – Clifty Creek Power Plant for 2014 and beyond within the proposed Clean Air Transport Rule are less than 2009 actual emissions. Direct $PM_{2.5}$ emission estimates for 2015 and 2025 for the IKEC – Clifty Creek Power Plant were projected using the limits from the new proposed National Emission Standards for Hazardous Air Pollutants for coal and oil-fired EGUs. The Duke Energy – Gallagher Generating Station replaced the electrostatic precipitators with baghouses on all four of their EGU units in late 2007 and early 2008. This reduced direct $PM_{2.5}$ emissions below base year levels. Duke Energy Indiana will also be shutting down two of its four coal-fired EGUs (Units 1 and 3) by no later than February 1, 2012. The remaining units (Units 2 and 4) have recently installed dry sorbent control technology to reduce SO_2. This will further reduce direct $PM_{2.5}$ emissions below base year levels.

The Tennessee Valley Authority has also recently entered into a consent decree with U.S. EPA that establishes system-wide annual tonnage limits for NO_x and SO_2 for its eleven coal-fired power plants located in Alabama, Kentucky, and Tennessee. NO_x will be limited to 100,600 tons per year beginning in 2011 and capped at 52,000 tons per year in 2018 and each year thereafter. SO_2 will be limited to 285,000 tons per year beginning in 2011 and capped at 110,000 tons per year in 2019 and each year thereafter. This will result in significant regional NO_x and SO_2 reductions, further ensuring that the area will continue to maintain compliance with the standard with an increasing margin of safety. Graphs and data tables of emissions from the EGU source category can be found in Appendix D.

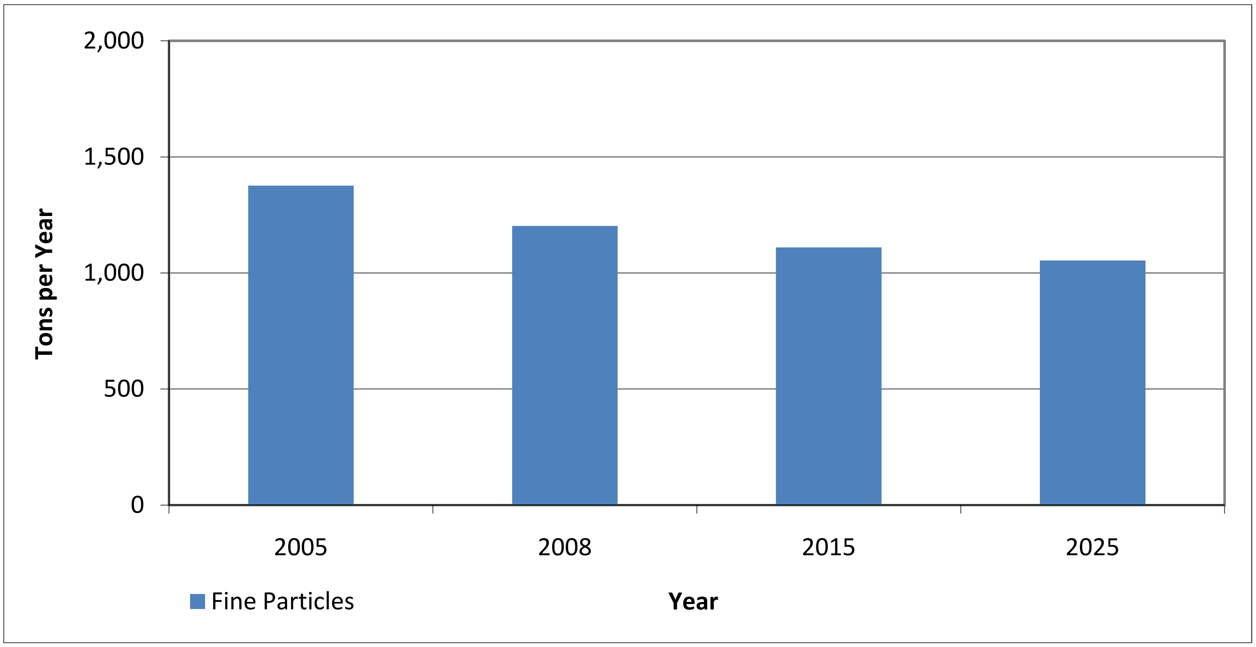
Graph 4.17
Comparison of 2005, 2008, 2015, and 2025 Projected NO_x Emissions, Clark, Floyd, and Jefferson Counties, Indiana



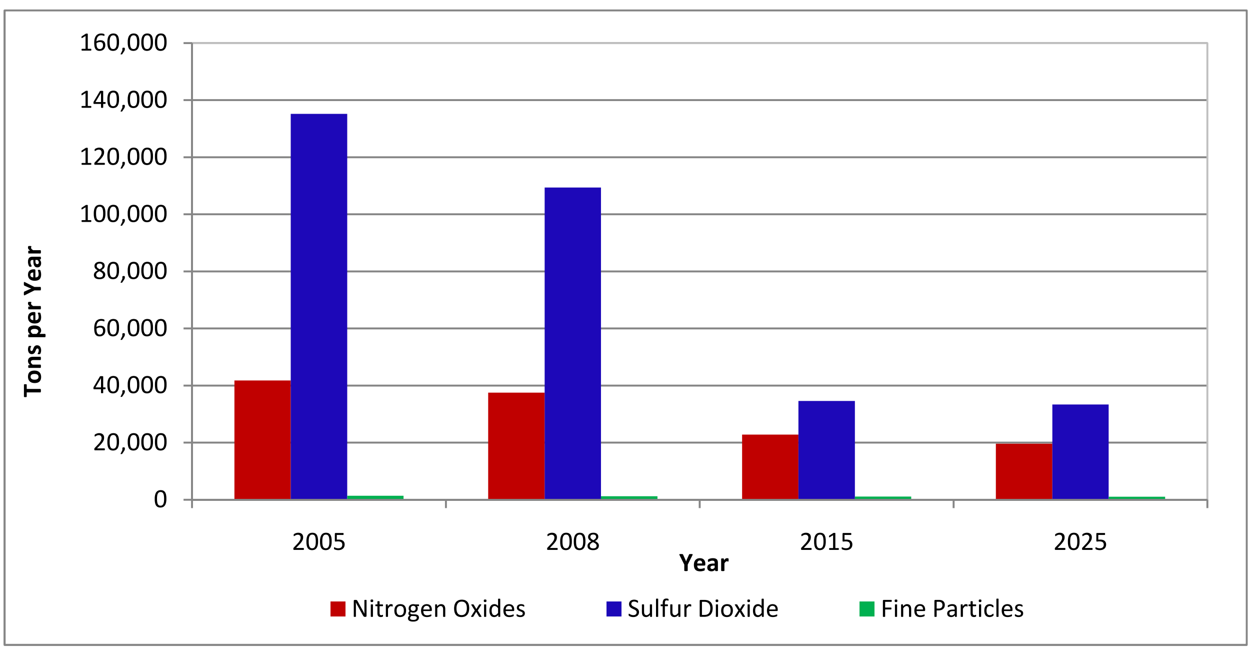
Graph 4.18
Comparison of 2005, 2008, 2015, and 2025 Projected SO_2 Emissions, Clark, Floyd, and Jefferson Counties, Indiana



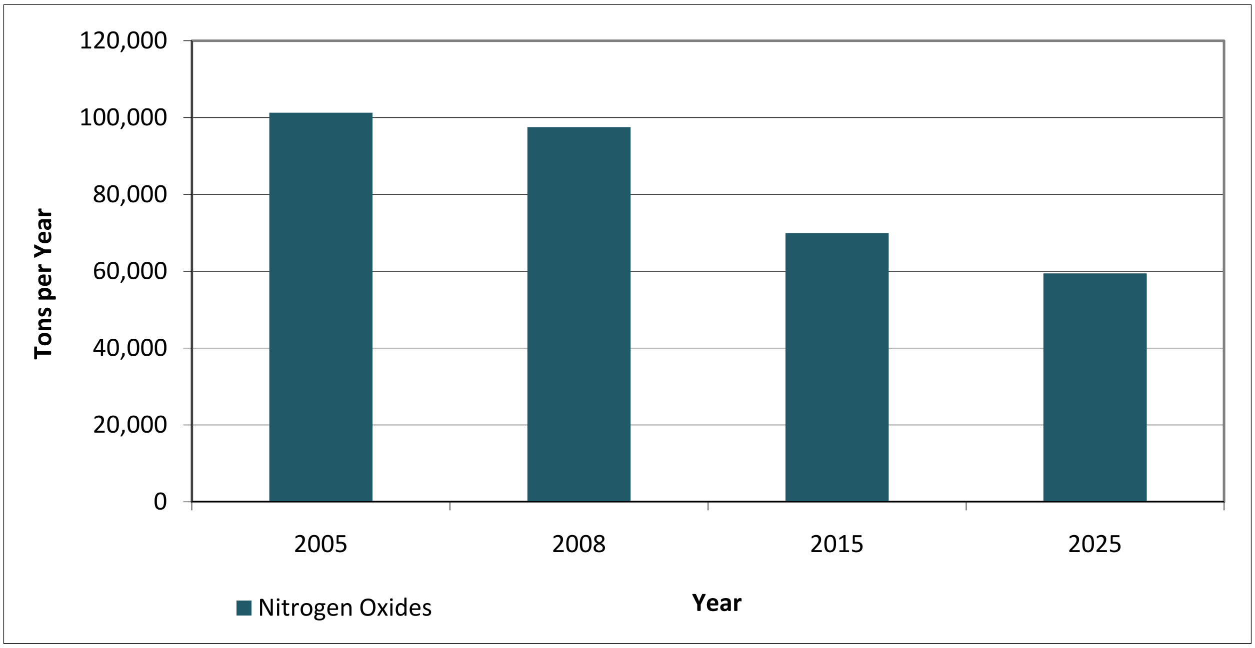
Graph 4.19
Comparison of 2005, 2008, 2015, and 2025 Projected Direct $PM_{2.5}$ Emissions, Clark, Floyd, and Jefferson Counties, Indiana



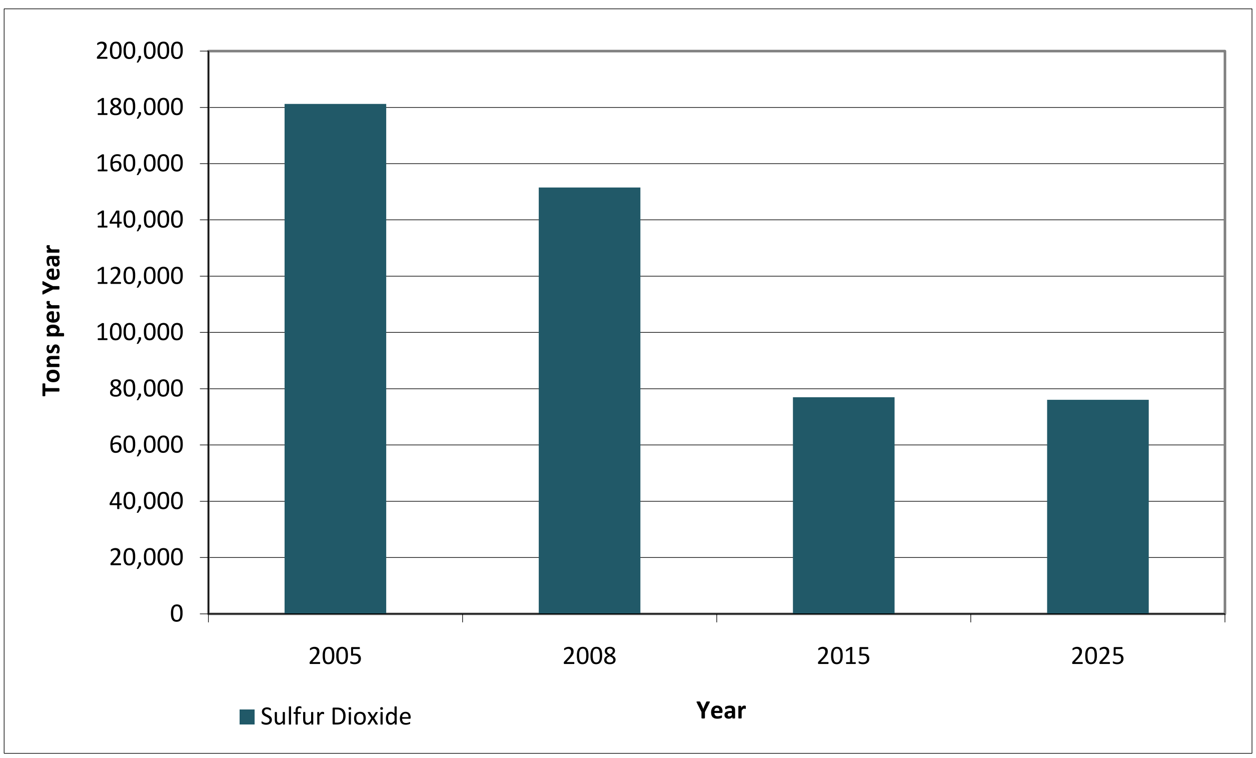
Graph 4.20
Comparison of 2005, 2008, 2015, and 2025 Projected NO_x, SO_2, and Direct $PM_{2.5}$ Emissions, Clark, Floyd, and Jefferson Counties, Indiana



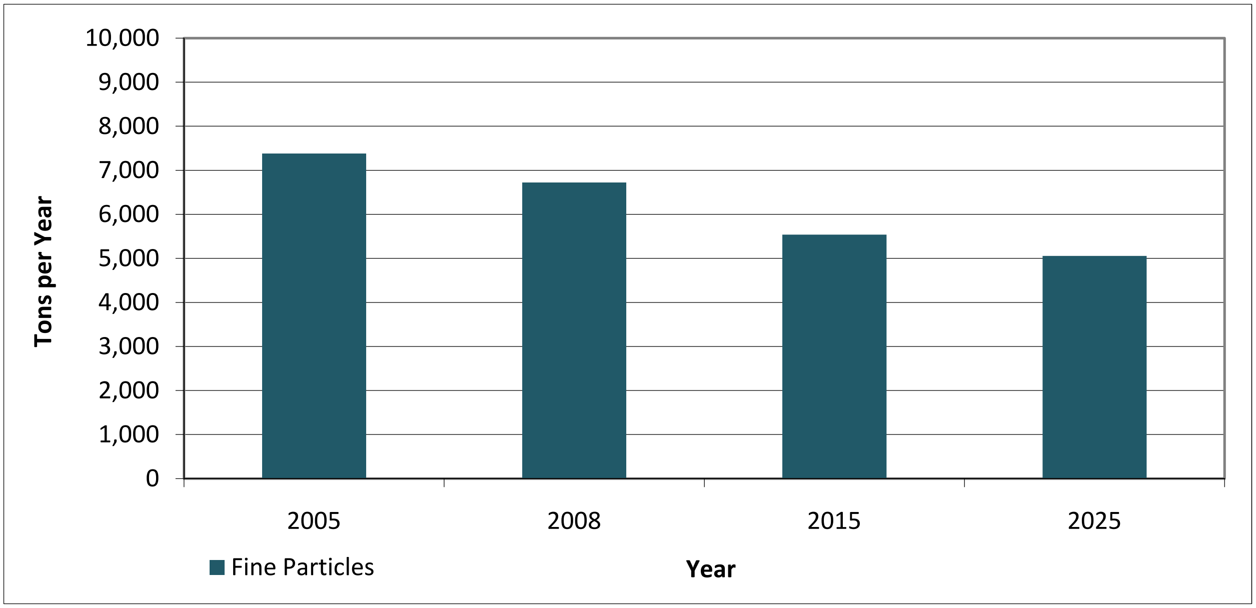
Graph 4.21
Comparison of 2005, 2008, 2015, and 2025 Projected NO_x Emissions, Louisville Area



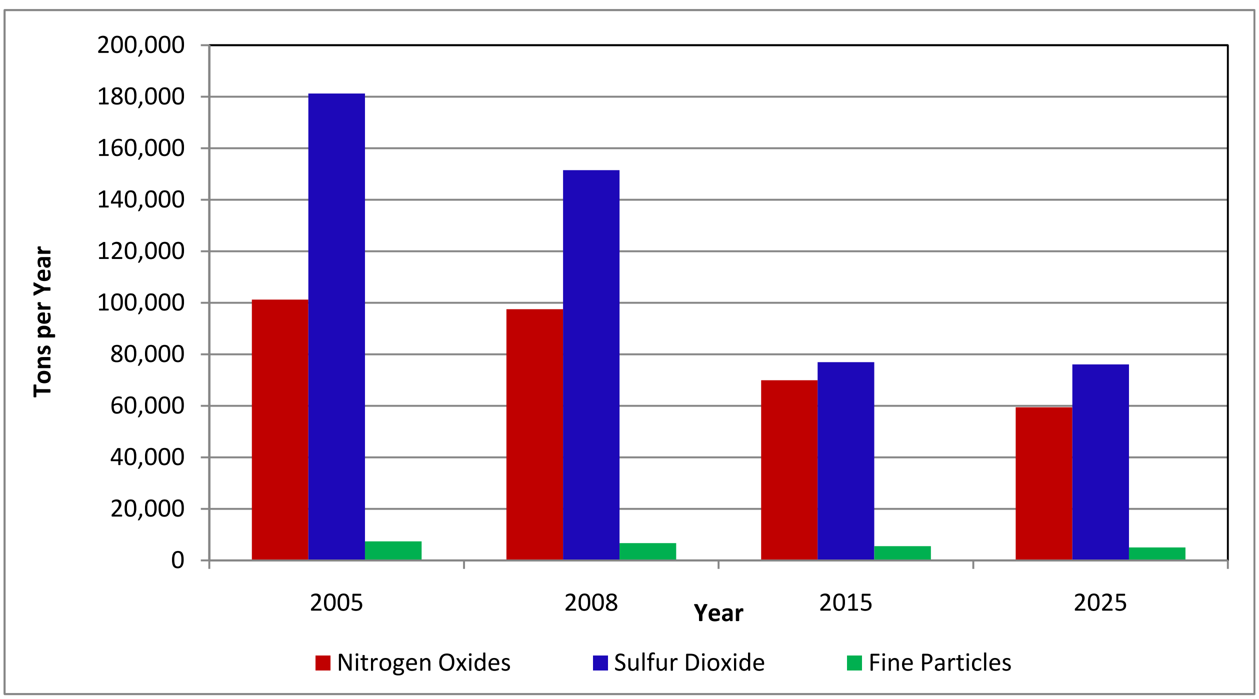
Graph 4.22
Comparison of 2005, 2008, 2015, and 2025 Projected SO_2 Emissions, Louisville Area



Graph 4.23
Comparison of 2005, 2008, 2015, and 2025 Projected Direct $PM_{2.5}$ Emissions, Louisville Area



Graph 4.24
Comparison of 2005, 2008, 2015 and 2025 Projected NO_x, SO_2, and Direct $PM_{2.5}$ Emissions, Louisville Area



NO_x emissions within Clark, Floyd, and Jefferson counties, Indiana are projected to decline by 47.70% between 2008 and 2025. NO_x emissions within the Louisville Area are projected to decline by 39.04% between 2008 and 2025. Emission reduction benefits from U.S. EPA rules covering the NO_x SIP Call, Tier 2 Motor Vehicle Emission Standards and Gasoline Sulfur Control Requirements, Heavy-Duty Highway Engine Rule, and the Nonroad Diesel Engine Rule are factored into the changes. Additionally, due to implementation of the NO_x SIP Call across the eastern United States, NO_x and fine particle levels entering the Louisville Area will also be decreased. SO_2 emissions within Clark, Floyd, and Jefferson counties, Indiana are projected to decrease by 69.52% between 2008 and 2025. SO_2 emissions within the Louisville Area are projected to decline by 49.78% between 2008 and 2025. Direct $PM_{2.5}$ emissions within Clark, Floyd, and Jefferson counties, Indiana are projected to decrease by 12.35% between 2008 and 2025. Direct $PM_{2.5}$ emissions within the Louisville Area are projected to decline by 24.81% between 2008 and 2025.

Table 4.1
Comparison of 2008 Estimated and 2025 Projected Emission Estimates, Clark, Floyd, and Jefferson Counties, Indiana (Tons per Year)

	2008	2025	Change	% Change
NO_x	37,526.06	19,627.44	-17,898.62	47.70% decrease
SO_2	109,372.52	33,340.99	-76,031.53	69.52% decrease
Direct $PM_{2.5}$	1,202.47	1,054.00	-148.47	12.35% decrease

Table 4.2
Comparison of 2008 Estimated and 2025 Projected Emission Estimates, Louisville Area (Tons per Year)

	2008	2025	Change	% Change
NO_x	97,533.93	59,455.17	-38,078.76	39.04% decrease
SO_2	151,503.01	76,082.07	-75,420.94	49.78% decrease
Direct $PM_{2.5}$	6,724.02	5,055.61	-1,668.41	24.81% decrease

4.4 Demonstration of Maintenance

Quality-assured ambient air quality data from all the monitoring sites indicate that air quality in Indiana's portion of the nonattainment area met the annual standard for fine particles for the three-year period ending in 2010. U.S. EPA's Redesignation Guidance states, "A state may generally demonstrate maintenance of the NAAQS by either showing that future emissions of a pollutant or its precursors will not exceed the level of the attainment inventory, or by modeling to show that the future mix of sources and emission rates will not cause a violation of the NAAQS". Section 3.0 of this document shows that the Louisville Area has, in fact, measured attainment for fine particles for the three consecutive periods ending in 2008, 2009, and 2010. Additionally, emission projections outlined in Section 4.0 of this document clearly illustrate that regional NO_x, SO_2, and direct $PM_{2.5}$ emissions in the area will continue to decline leading to local reductions between 2008 (base year) and 2025 (maintenance plan horizon). Section 7.0 further discusses the implications of these emission trends and provides an analysis to support these conclusions.

In Indiana, major point sources in all counties are required to submit emissions information once every three years, or annually, if the NO_x or SO_2 potential to emit is greater than 2,500 tons per year, in accordance with the Emission Reporting Rule, 326 IAC 2-6. IDEM prepares a new periodic inventory for all precursor emission sectors every three years. These precursor emission inventories will be prepared for 2011, 2014, and 2017, as necessary, to comply with the inventory reporting requirements established in the CAA. Emissions information will be compared to the 2008 base year and the 2025 projected maintenance year inventories to assess emission trends, as necessary, to assure continued compliance with the annual standard for fine particles.

4.5 Permanent and Enforceable Emission Reductions

Permanent and enforceable reductions of NO_x and SO_2 have contributed to the attainment of the annual standard for fine particles. Some of these reductions were due to the implementation of the NO_x SIP Call rule and some were due to the application of tighter federal standards on motor vehicles and fuels.

Section 6.0 identifies the emission control measures specific to Clark, Floyd, and Jefferson counties, Indiana, as well as the implementation status of each measure.

4.6 Provisions for Future Updates

As required by Section 175A(b) of the CAA, Indiana commits to submit to the Administrator, eight years after redesignation, an additional revision of this SIP. The revision will contain Indiana's plan for maintaining the national primary fine particles air quality standard for ten years beyond the first ten-year period after redesignation.

5.0 TRANSPORTATION CONFORMITY BUDGETS

U.S. EPA requirements outlined in 40 CFR 93.118(e)(4) stipulate that motor vehicle emission budgets (MVEBs) for direct $PM_{2.5}$ and NO_x be established as part of a SIP. The MVEBs are necessary to demonstrate conformance of transportation plans and improvement programs with the SIP.

The following is a summary of the detailed mobile input and output calculation files located in Appendix F.

5.1 Onroad Emission Estimates

KIPDA is the Metropolitan Planning Organization (MPO) for Clark and Floyd Counties in Indiana, as well as Bullitt, Jefferson, and Oldham Counties in Kentucky. All of the MPO counties except for Oldham County are in the nonattainment area for fine particles. Madison Township in Jefferson County, Indiana is also in the nonattainment area. KIPDA maintains a travel demand forecast model that is used to simulate the traffic in the area and to predict what traffic would be in future years given growth expectations. The model is used mostly to identify where travel capacity will be needed and to determine the infrastructure requirements necessary to meet that need. It is also used to support the calculation of mobile source emissions. The travel demand forecast model is used to predict the total daily vehicle miles traveled (VMT) and the U.S. EPA software program referred to as MOVES is used to produce emission factors to calculate the emissions per mile. The product of these two outputs, once combined, is the estimated total amount of pollution emitted by the onroad vehicles for the area analyzed. Madison Township in Jefferson County, Indiana does not fall under the jurisdiction of KIPDA. In cases such as this, INDOT's Highway Performance Monitoring System (HPMS) baseline data is used to estimate and project mobile source emissions. This is a national program that requires state Departments of Transportation to collect traffic counts throughout the state on a regular basis under a certain regulated method. This HPMS data is collected and provided by INDOT and was used for these areas beyond KIPDA's jurisdiction.

5.2 Overview

Broadly described, MOVES is used to generate "emission factors", which are the average emissions per mile (grams/mile) for fine particle precursors, including NO_x, SO_2, and direct $PM_{2.5}$. There are numerous variables that can affect the emission factors. The vehicle fleet (vehicles on the road), age, and the vehicle types have a major effect on the emission factors. The facility-type on which vehicles are traveling (MOVES facility types are Freeway, Arterial, Local, and Ramp) and the vehicle speeds also affect the emission factor values. Meteorological factors such as air temperature and humidity affect emission factors, as does fuel type, such as low Reid Vapor Pressure gasoline. These data are estimated using the *best available data* to create emission factors for NO_x, SO_2, and direct $PM_{2.5}$. After emission factors are generated, they must be multiplied by the VMT to determine the quantity of vehicle-related emissions. This information is derived from the travel demand model (TDM).

It should be noted that each year analyzed will have different emission factors, volumes, speeds, and likely results in additional modeling. MOVES input summary and RunSpec parameters can be found in Appendix F. The full MOVES modeling package, including input and output documentation, is provided electronically in Appendix F.

5.3 Emission Estimations

Table 5.1 outlines the onroad emission estimates for the entire nonattainment area for the years 2005, 2008 (base/attainment year), 2015 (interim year), and 2025 (horizon year). The following emission estimates are based on the actual TDM network runs for the years 2005, 2008, 2015, and 2025.

Table 5.1
Emission Estimations for Onroad Mobile Sources for the Louisville Area

Kentucky Emissions (Bullitt and Jefferson County)	2005	2008	2015	2025
Direct $PM_{2.5}$ (tons/year)	805.38	712.46	395.37	217.84
NO_x (tons/year)	25,193.80	21,914.85	12,042.31	6,285.38
Indiana Emissions (Madison Township in Jefferson County, Clark and Floyd Counties)				
Direct $PM_{2.5}$ (tons/year)	250.23	210.91	109.58	63.93
NO_x (tons/year)	7,550.76	6,245.60	3,349.82	1,811.80
Louisville Area Emission Totals				
Direct $PM_{2.5}$ (tons/year)	1,055.61	923.37	504.95	281.77
NO_x (tons/year)	32,744.56	28,160.45	15,392.13	8,097.18

Table 5.2 contains the MVEBs for the entire nonattainment area for the years 2015 and 2025.

Table 5.2
Motor Vehicle Emission Budgets for the Louisville Area

	2015	2025
Direct $PM_{2.5}$ (tons/year)	580.69	324.04
NO_x (tons/year)	17,700.95	9,311.76

Consistent with the federal implementation rule for fine particles, IDEM does not consider mobile source SO_2 emissions to be a significant contributor to fine particles for this nonattainment area, as SO_2 from mobile sources constitutes less than 0.2% of the area's total anthropogenic SO_2 emissions for the years 2005, 2008, 2015, and 2025.

This document creates an interim year budget for 2015 and a horizon year budget for 2025 for the entire nonattainment area. These budgets are based on the 2008 onroad source emission inventory used to support photochemical modeling for the same year, and has incorporated an appropriate safety margin as described below.

In an effort to accommodate future variations in TDMs and the VMT forecast when no change to the network is planned, IDEM consulted with the interagency consultation group, including U.S. EPA Region V, to determine a reasonable approach to address this variation. The interagency consultation group approved a 15% safety margin for direct $PM_{2.5}$ mobile source emission estimates for the years 2015 and 2025, and a 15% safety margin for NO_x mobile source emission estimates for the years 2015 and 2025.

The safety margins are appropriate because: 1) there is an acknowledged potential variation in the VMT forecast and potential estimated mobile source emissions due to expected modifications to TDM and mobile emissions models; and, 2) the total decrease in emissions from all sources is sufficient to accommodate the safety margin allocations detailed above to mobile sources while still continuing to maintain total emissions in the Louisville Area well below the 2008 attainment level of emissions. These safety margins were calculated by adding a straight-line percentage to the mobile source emission estimates for the years 2015 and 2025. Safety margin, as defined by the conformity rule, looks at the total emissions from all sources in the nonattainment area. The resulting 2015 and 2025 MVEBs for direct $PM_{2.5}$ and NO_x emissions remain well below the 2008 base year emissions referenced in Table 5.1.

In summary, for Indiana and Kentucky combined, the mobile budget safety margin allocation translates into:

- An allocation of 75.74 tons/year for $PM_{2.5}$ and 2,308.82 tons/year for NO_x for 2015.
- An allocation of 42.27 tons/year for $PM_{2.5}$ and 1,214.58 tons/year for NO_x for 2025.

The federal rule at 40 CFR 93.101 defines safety margin as the amount by which the total projected emissions from all sources of a given pollutant are less than the total emissions that would satisfy the applicable requirement for reasonable further progress, attainment, or maintenance. When compared to the overall safety margin as defined by 40 CFR 93.101, it is evident that this allocation to mobile sources is significantly below the total safety margin for all sources in the Louisville Area as detailed in Table 4.2.

While IDEM believes that this is sufficient to support the requested increase, IDEM and its partners will be conducting additional air quality modeling which will include the adjusted mobile source emissions, as well as any additional corrections and modifications that may be necessary due to the constant review and evaluation of the model inputs.

All methodologies, latest planning assumptions, and margins of safety were determined to be appropriate through the interagency consultation process.

6.0 CONTROL MEASURES AND REGULATIONS

This section provides specific information on the control measures that have been or will be implemented in Jefferson County (Madison Township) and Clark and Floyd counties, Indiana, including CAA requirements and additional state or local measures implemented beyond CAA requirements.

6.1 Reasonably Available Control Technology (RACT)

As required by Section 172 of the CAA, in the mid-1990s, Indiana promulgated rules requiring RACT for emissions of VOCs. There were no specific rules required by the CAA, such as RACT for existing sources, beyond statewide rules. Statewide RACT rules have applied to all new sources locating in Indiana since that time. The Indiana rules are found in 326 IAC 8. The following is a listing of applicable rules:

326 IAC 8-1-6	Best Available Control Technology for Non-Specific Sources
326 IAC 8-2	Surface Coating Emission Limitations
326 IAC 8-3	Solvent Degreasing Operations
326 IAC 8-4	Petroleum Sources
326 IAC 8-5	Miscellaneous Operation
326 IAC 8-6	Organic Solvent Emission Limitations

Since Jefferson County (Madison Township) and Clark and Floyd counties, Indiana attained the annual standard for fine particles prior to an Attainment SIP or RACT SIP being due, and since the Implementation Rule for fine particles stipulates that states are only required to draft and implement RACT rules for the precursor emission reductions necessary to attain the standard, no further RACT rules are required for this area. These Indiana rules are CAA requirements already in the SIP and provide secondary benefits for $PM_{2.5}$.

6.2 Implementation of Past SIP Revisions

The Louisville Area was designated nonattainment for the annual standard for fine particles in 2003 and the area attained the standard well in advance of its attainment deadline of 2010. As a result, Indiana is no longer required to develop and submit an Attainment SIP or RACT SIP for this area under the annual NAAQS for fine particles.

6.3 Nitrogen Oxides Rule

The U.S. EPA NO_x SIP Call required twenty-two states to adopt rules that would result in significant emission reductions from large EGUs, industrial boilers, and cement kilns in the eastern United States. The Indiana rule was adopted in 2001. Beginning in 2004, this rule accounts for a reduction of approximately 31% of all NO_x emissions statewide compared to previous uncontrolled years.

Twenty-one other states have also adopted these rules. The result is that significant reductions have occurred regionally and within the nonattainment area because of the number of affected units within the region. From Graphs 4.13 and 4.15, it can be seen that emissions covered by this program have been trending downward since 1999. Table 6.1, compiled from data taken from the U.S. EPA Clean Air Markets web site, quantifies the gradual NO_x reductions that have occurred in Indiana as a result of Title IV (Acid Rain) of the CAA and the NO_x SIP Call Rule. The NOx SIP Call cap stayed in place through 2008, at which time the caps in the CAIR program superseded it. Since CAIR is a regional cap and trade program, it cannot be predicted at this time what affect this will have on EGU units located in the nonattainment area or other upwind counties.

Further, U.S. EPA published Phase II of the NO_x SIP Call that established a budget for large (emissions of greater than 1 ton per day) stationary internal combustion engines. In Indiana, the rule decreases emissions statewide from natural gas compressor stations by 4,263 tons during the ozone season (April through September). The Indiana Phase II NOx SIP Call Rule became effective February 26, 2006 and implementation began in 2007.

Table 6.1
Trends in EGU NO_x Emissions Statewide in Indiana

Year	NO_x Emissions (tons/year)
1999	347,216.5
2000	334,522.1
2001	315,419.7
2002	281,146.1
2003	260,980.0
2004	224,311.3
2005	207,981.6
2006	202,728.0
2007	196,553.1
2008	196,134.5
2009	110,968.9
Budget 2009-2014	108,935
Budget 2015 and later	90,779

6.4 Measures Beyond Clean Air Act SIP Requirements

Reductions in fine particle precursor emissions have occurred, or are anticipated to occur, as a result of local and federal programs. These additional control measures include those listed in this section.

Tier 2 Vehicle Standards[2]

Federal Tier 2 motor vehicle standards require all passenger vehicles in a manufacturer's fleet, including light-duty trucks and sport utility vehicles (SUVs), to meet an average standard of 0.07 grams of NO_x per mile. Implementation began in 2004 and was completed in 2007. The Tier 2 standards also cover passenger vehicles over 8,500 pounds gross vehicle weight rating (larger pickup trucks and SUVs), which are not covered by the current Tier 1 standards. For these vehicles, the standards were phased in beginning in 2008, with full compliance in 2009. The new standards require vehicles to be 77% to 95% cleaner than those on the road prior to the program. The Tier 2 standards also reduced the sulfur content of gasoline to 30 parts per million (ppm) beginning in January 2006. Most gasoline sold in Indiana prior to January 2006 had a sulfur content of about 500 ppm. Sulfur occurs naturally in gasoline, but interferes with the operation of catalytic converters on vehicles resulting in higher NO_x emissions. Lower sulfur gasoline is necessary to achieve the Tier 2 vehicle emission standards.

[2] http://www.epa.gov/fedrgstr/EPA-AIR/2000/February/Day-10/a19a.htm

Heavy-Duty Gasoline and Diesel Highway Vehicle Standards[3]

New U.S. EPA standards designed to reduce NO_x and VOC emissions from heavy-duty gasoline and diesel highway vehicles took effect in 2004. A second phase of standards and testing procedures that began in 2007, reduced $PM_{2.5}$ emissions from heavy-duty highway engines and also reduced highway diesel fuel sulfur content to 15 ppm since the sulfur can damage emission control devices. The total program is expected to achieve a 90% reduction in direct $PM_{2.5}$ emissions and a 95% reduction in NO_x emissions for these new engines using low sulfur diesel, compared to existing engines using higher sulfur content diesel. There will also be SO_2 reductions from these rules although U.S. EPA has not quantified the expected reductions.

Large Nonroad Diesel Engine Standards[4]

In May 2004, U.S. EPA promulgated new rules for large nonroad diesel engines, such as those used in construction, agricultural, and industrial equipment, to be phased in between 2008 and 2014. The nonroad diesel rules also reduce the allowable sulfur in nonroad diesel fuel by over 99%. Prior to 2006, nonroad diesel fuel averaged approximately 3,400 ppm sulfur. This rule limited nonroad diesel sulfur content to 500 ppm by 2006 with a further reduction to 15 ppm by 2010. The combined engine and fuel rules will reduce NO_x and PM emissions from large nonroad diesel engines by over 90%, compared to current nonroad engines using higher sulfur content diesel.

Nonroad Spark-Ignition Engines and Recreational Engine Standards

This standard, effective in July 2003, regulates NO_x, VOCs, and carbon monoxide (CO) for groups of previously unregulated nonroad engines. The standard applies to all new engines sold in the United States and imported after the standards went into effect. The standard applies to large spark-ignition engines (forklifts and airport ground service equipment), recreational vehicles (off-highway motorcycles and all-terrain vehicles), and recreational marine diesel engines. The regulation varies based upon the type of engine and vehicle.

The emissions from large spark-ignition engines contribute to ozone formation and ambient CO and $PM_{2.5}$ levels in urban areas. Tier 1 of this standard was implemented in 2004 and Tier 2 started in 2007. Like the large spark-ignition engines, emissions from recreational vehicles contribute to ozone and fine particle formation and ambient CO and $PM_{2.5}$ levels. For Model Year 2006 off-highway motorcycles and all-terrain vehicles, at least 50% of a manufacture's fleet was required to meet the new exhaust emissions standard and 100% of the fleet was required to meet the standards in 2007. Recreational marine diesel engines over 37 kilowatts are used in yachts, cruisers, and other types of pleasure craft. Emissions from recreational marine engines contribute to ozone formation and PM levels, especially surrounding marinas.

When all of the nonroad spark-ignition engines and recreational engine standards are fully implemented, an overall 72% reduction in VOC, 80% reduction in NO_x, and 56% reduction in CO emissions is expected by 2020.

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[3] http://www.epa.gov/fedrgstr/EPA-AIR/1997/October/Day-21/a27494.htm
[4] http://www.epa.gov/fedrgstr/EPA-AIR/1998/October/Day-23/a24836.htm

Reciprocating Internal Combustion Engine Standards[5]

This new standard, effective in May 2010, regulates emissions of air toxics from existing diesel powered stationary reciprocating internal combustion engines that meet specific site rating, age, and size criteria. These engines are typically used at industrial facilities (e.g. power, chemical, and manufacturing plants) to generate electricity for compressors and pumps and to produce electricity to pump water for flood and fire control during emergencies.

The standard applies to stationary diesel engines: (1) used at area sources of air toxics and constructed or reconstructed before June 12, 2006; (2) used at major sources of air toxics, having a site rating of less than or equal to 500 horsepower, and constructed or reconstructed before June 12, 2006; and, (3) used at major sources of air toxics for non-emergency purposes, having a site rating of greater than 500 horsepower, and constructed or reconstructed before December 19, 2002.

Operators of existing engines will be required to: (1) install emissions control equipment that would limit air toxics up to 70% for stationary non-emergency engines with a site rating greater than 300 horsepower; (2) perform emission tests to demonstrate engine performance and compliance with rule requirements; and, (3) burn ultra-low sulfur fuel in stationary non-emergency engines with a site rating greater than 300 horsepower.

When all of the reciprocating internal combustion engine standards are fully implemented in 2013, U.S. EPA estimates that emissions from these engines will reduce air toxics by approximately 1,000 tons per year (tpy), $PM_{2.5}$ by 2,800 tpy, CO by 14,000 tpy, and VOC by 27,000 tpy.

Category 3 Marine Diesel Engine Standards[6]

This new standard, effective in June 2010, promulgates more stringent exhaust emission standards for new large marine diesel engines with per-cylinder displacement at or above 30 liters (commonly referred to as Category 3 compression-ignition marine engines) as part of a coordinated strategy to address emissions from all ships that affect U.S. air quality. These emission standards are equivalent to those adopted in the amendments to Annex VI to the International Convention for the Prevention of Pollution from Ships (MARPOL Annex VI). The emission standards apply in two stages—near-term standards for newly built engines will apply beginning in 2011; long-term standards requiring an 80% reduction in NO_x emissions will begin in 2016.

U.S. EPA is adopting changes to the diesel fuel program to allow for the production and sale of diesel fuel with up to 1,000 ppm sulfur for use in Category 3 marine vessels. The regulations generally forbid production and sale of fuels with more than 1,000 ppm sulfur for use in most U.S. waters, unless operators achieve equivalent emission reductions in other ways.

5 http://www.epa.gov/ttn/atw/rice/fr03mr10.pdf
6 http://www.regulations.gov/search/Regs/home.html#documentDetail?R=0900006480ae43a6

U.S. EPA is also adopting provisions to apply some emission and fuel standards to foreign-flagged and in-use vessels that are covered by MARPOL Annex VI.

When this strategy is fully implemented in 2030, U.S. EPA estimates that NO_x and $PM_{2.5}$ emissions in the U.S. will be reduced by approximately 1.2 million tpy and 143,000 tpy, respectively.

Clean Air Interstate Rule (CAIR)

On May 12, 2005, U.S. EPA promulgated the "Rule to Reduce Interstate Transport of Fine Particulate Matter and Ozone (Clean Air Interstate Rule); Revisions to Acid Rain Program; Revisions to the NO_x SIP Call"; Final Rule (70 FR 25162). This rule established the requirement for states to adopt rules limiting the emissions of NO_x and SO_2 and provided a model rule for the states to use in developing their rules to meet federal requirements. The purpose of CAIR was to reduce interstate transport of precursors to fine particles and ozone.

CAIR applies to: (1) any stationary, fossil-fuel-fired boiler or stationary, fossil-fuel-fired combustion turbine, a generator with a nameplate capacity of more than 25 megawatt electrical (MWe) producing electricity for sale; and (2) a unit that qualifies as a cogeneration unit during the 12-month period starting on the date that the unit first produces electricity and continues to qualify as a cogeneration unit, a cogeneration unit serving at any time a generator with a nameplate capacity of more than 25 MWe and supplying in any calendar year more than one-third of the unit's potential electric output capacity or 219,000 megawatt hours (MWh), whichever is greater, to any utility power distribution system for sale.

This rule provides annual state caps for NO_x and SO_2 in two phases, with the Phase I caps for NO_x and SO_2 starting in 2009 and 2010, respectively. Phase II caps become effective in 2015. U.S. EPA is allowing the caps to be met through a cap and trade program if a state chooses to participate in the program.

In response to U.S. EPA's rulemaking, IDEM adopted a state rule in 2006 based on the model federal rule. IDEM's rule includes annual and seasonal NO_x trading programs, and an annual SO_2 trading program. This rule requires compliance effective January 1, 2009.

SO_2 emissions from power plants in the 28 eastern states and the District of Columbia covered by CAIR will be cut by 4.3 million tons by 2009 and reduced by an additional 5.4 million tons in 2015. NO_x emissions will be cut by 1.7 million tons by 2009 and reduced by an additional 1.3 million tons in 2015. The D.C. Circuit court's vacatur of CAIR in July of 2008 and subsequent remand without vacatur of CAIR in December of 2008 directs U.S. EPA to revise or replace CAIR in order to properly address the deficiencies outlined by the court.

Since the court's opinion made it clear that CAIR is deficient and must be revised or replaced, the program cannot be defined as permanent and enforceable for SIP purposes. On July 6, 2010, U.S. EPA proposed the Clean Air Transport Rule to replace CAIR. The Clean Air Transport Rule will result in even greater benefits than CAIR and than what is assumed within the emission inventories and modeling.

Together, these rules will substantially reduce local and regional sources of fine particle precursors. The modeling analyses discussed in Section 7.0 include these rules and show the reductions in annual fine particle concentrations expected to result from the implementation of these rules.

6.5 Controls to Remain in Effect

IDEM commits to maintain the control measures listed above after redesignation, or submit to U.S. EPA, as a SIP revision, any changes to its rules or emission limits applicable to NO_x, SO_2, or direct $PM_{2.5}$ sources as required for maintenance of the annual standard for fine particles in Jefferson County (Madison Township) and Clark and Floyd counties, Indiana.

Indiana, through IDEM's Office of Air Quality and its Compliance and Enforcement Branch, has the legal authority and necessary resources to actively enforce any violations of its rules or permit provisions. After redesignation, it intends to continue enforcing all rules that relate to the emission of fine particles and fine particle precursors in Jefferson County (Madison Township) and Clark and Floyd counties.

6.6 New Source Review Provisions

Indiana has a long standing and fully implemented New Source Review (NSR) program that is outlined in rule 326 IAC 2. The rule includes provisions for the Prevention of Significant Deterioration (PSD) permitting program in 326 IAC 2-2 and the emissions offset rule in 326 IAC 2-3. Indiana's PSD program was conditionally approved on March 3, 2003 (68 FR 9892) and received final approval on May 20, 2004 (69 FR 29071) by U.S. EPA as part of the SIP.

Any emission unit that is not listed in the 2005 emission inventory, or for which credit through the shutdown or curtailment of operations was taken in demonstrating attainment, will not be allowed to construct, reopen, modify, or reconstruct without meeting all applicable permit rule requirements. The review process will be identical to that used for new sources. Once the area is redesignated, OAQ will implement NSR through the PSD program, which requires an air quality analysis to evaluate whether the new source will threaten the NAAQS.

7.0 MODELING AND METEOROLOGY

Although U.S. EPA Redesignation Guidance does not require modeling for fine particle nonattainment areas seeking redesignation, extensive modeling has been performed for the Louisville Area to determine the effect of national emission control strategies on fine particle levels. These modeling analyses determined that the Louisville Area, including Clark and Floyd counties, Indiana, are significantly impacted by regional transport of fine particles and its precursors, and that regional NO_x and SO_2 reductions are an effective way to attain the annual standard for fine particles in this area. Future year modeled annual fine particle concentrations are expected to be reduced by 0.3 to 0.9 $\mu g/m^3$ from baseline design values. Examples of these modeling analyses are described in this section and can also be found in Appendix J.

7.1 Summary of Modeling Results to Support Rulemakings

U.S. EPA Modeling for Clean Air Transport Rule 2010[7]

U.S. EPA performed modeling to support the emission reductions associated with the proposed Clean Air Transport Rule. U.S. EPA used the Comprehensive Air Quality Model with Extensions (CAMx, version 5), applied to the 2005 meteorology, as processed by the Mesoscale Model (MM5), version 3.7.4. Emissions input into CAMx included SO_2, NO_x, VOCs, NH_3, and direct $PM_{2.5}$ for 2005. The modeling was based on the annual fine particle design values calculated from 2003 through 2005, 2004 through 2006, and 2005 through 2007. Future year modeling was conducted, which included the Louisville Area, and the future year design values for 2012 and 2014 were evaluated for attainment of the annual NAAQS for fine particles of 15 $\mu g/m^3$, as shown in Table 7.1. Fine particle concentrations are accounted for by modeling both the base future year emissions and then the emission reductions associated with the Clean Air Transport Rule. U.S. EPA found that the model performance met the suggested benchmark performance goals within or close to the ranges found in other comparable modeling applications.

Table 7.1
Clean Air Transport Rule Modeling Results from U.S. EPA
(Using 2003 through 2007 Design Values)

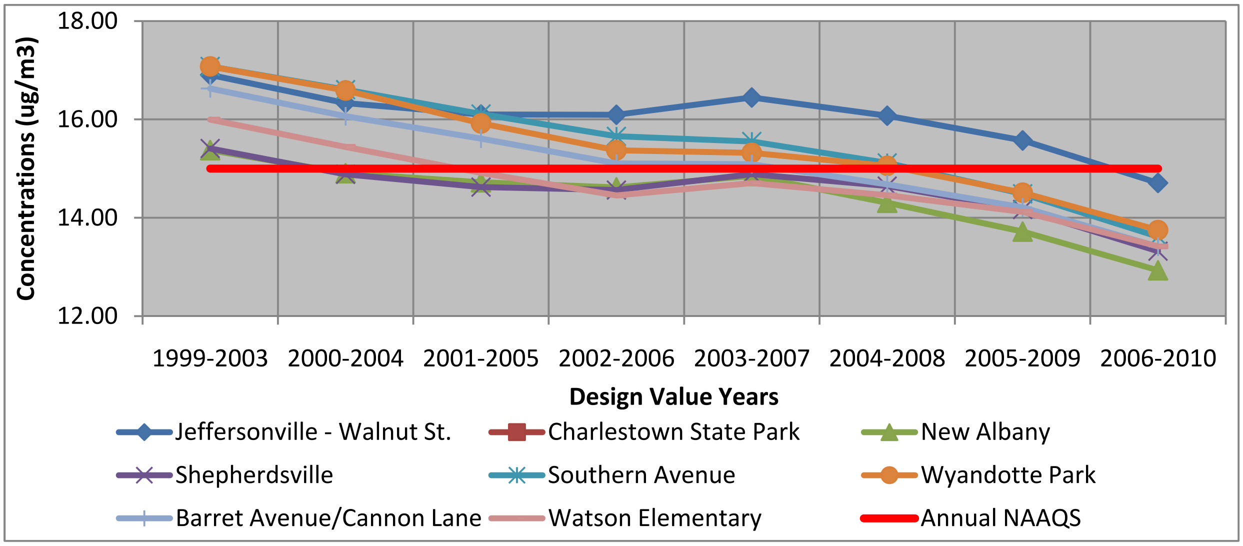
SITE ID	SITE NAME	COUNTY	Design Value 2003 – 2007 ($\mu g/m^3$)	Future Design Value 2012 Base ($\mu g/m^3$)	Future Design Value 2014 Base ($\mu g/m^3$)
18-019-0006	Jeffersonville – Walnut St.	Clark.	16.40	15.96	15.46
18-043-1004	New Albany	Floyd	14.80	14.50	14.04
21-029-0006	Carpenter Street	Bullitt – KY	14.90	14.58	14.07
21-093-0006	Elizabethtown	Hardin – KY	13.58	13.34	12.82
21-111-0043	Southern Avenue	Jefferson – KY	15.53	15.19	14.71
21-111-0044	Wyandotte Park	Jefferson – KY	15.31	14.93	14.45
21-111-0048	Barret Avenue	Jefferson – KY	15.25	14.87	14.38
21-111-0051	Watson Elementary	Jefferson – KY	14.70	14.43	13.95

Modeling results show that the base future year modeling with emission reductions from the Clean Air Transport Rule will account for a 0.3 to 0.4 $\mu g/m^3$ decrease in concentrations for 2012, as well as a 0.8 to 0.9 $\mu g/m^3$ decrease in concentrations for 2014 in the Louisville Area.

While results of U.S. EPA's Clean Air Transport Rule modeling show modeled $PM_{2.5}$ concentrations above the standard with base case emissions at the Jeffersonville, Indiana – Walnut Street $PM_{2.5}$ monitor (Clark County), it should be noted that the base year design value used by U.S. EPA was taken from 2003 through 2007 and is higher than current 2006 through 2010 design values in the Louisville Area. Graph 7.1 shows the downward trend of the design values from 1999 through 2010 from the $PM_{2.5}$ monitors in the Louisville Area. In fact, all design values are below the annual standard for fine particles.

[7] http://www.epa.gov/airquality/transport/pdfs/TR_AQModeling_TSD.pdf

Graph 7.1
$PM_{2.5}$ Design Value Trends for the Louisville Area, 1999 to 2010



The resulting decrease of the design value at the Jeffersonville, Indiana – Walnut Street $PM_{2.5}$ monitor is 1.74 $\mu g/m^3$ and 1.92 $\mu g/m^3$ at the New Albany, Indiana $PM_{2.5}$ monitor (Floyd County). The annual $PM_{2.5}$ design values for the Louisville Area monitors have dropped with the 2006 through 2010 design values ranging from 1.29 $\mu g/m^3$ to 1.93 $\mu g/m^3$ less than the 2003 through 2007 design values modeled by U.S. EPA. Therefore, U.S. EPA's Clean Air Transport Rule modeling, using the current 2006 through 2010 design values, showed lower modeled concentrations approaching the annual NAAQS for fine particles (15.0 $\mu g/m^3$). Results of this modeling are shown below in Table 7.2 and are based on the relative response factors (RRFs) calculated from the annual $PM_{2.5}$ future year base case results divided by the 2003 through 2007 $PM_{2.5}$ base case design values. This is a simplistic version of $PM_{2.5}$ RRF calculations and is used only as a weight of evidence demonstration of future year modeled results.

Table 7.2
Clean Air Transport Rule Modeling Results from U.S. EPA
(Using 2006 through 2010 Design Values)

SITE ID	SITE NAME	COUNTY	Design Value 2006-2010 ($\mu g/m^3$)	2012 RRF	Future Design Value 2012 Base ($\mu g/m^3$)	2014 RRF	Future Design Value 2014 Base ($\mu g/m^3$)
18-019-0006	Jeffersonville – Walnut Street	Clark	14.71	0.973	14.31	0.943	13.49
18-043-1004	New Albany	Floyd	12.93	0.980	12.67	0.949	12.02
21-029-0006	Carpenter Street	Bullitt – KY	13.32	0.979	13.03	0.944	12.31
21-111-0043	Elizabethtown	Jefferson – KY	13.62	0.978	13.37	0.947	12.63
21-111-0044	Southern Avenue	Jefferson – KY	13.75	0.975	13.45	0.944	12.74
21-111-0048	Wyandotte Park	Jefferson – KY	13.41	0.975	13.08	0.943	12.35
21-111-0051	Barret Avenue	Jefferson – K Y	13.42	0.982	13.08	0.949	12.34

As can be seen, modeled results are lower when current annual fine particle design values are used to determine future year modeling. Using the 2006 through 2010 design values, all Louisville Area $PM_{2.5}$ monitoring sites would not exceed the annual NAAQS for fine particles in 2012 and remain below the annual $PM_{2.5}$ NAAQS in 2014.

LADCO Modeling for the Clean Air Interstate Rule (CAIR)

LADCO conducted modeling to determine the impact of CAIR in the Midwest. LADCO's modeling used the CAMx model applied to the year 2005 meteorology, as processed by the MM5. Emissions input into CAMx included SO_2, NO_x, VOCs, NH_3, and direct $PM_{2.5}$ for 2005. The modeling was based on 2003 through 2007 design values. Future year modeling for 2012 and 2018 was conducted and the future year design values were determined without the emission reductions associated with CAIR (Round 6), as shown in Table 7.3. The U.S. Clean Air Transport Rule is expected to provide reductions above and beyond CAIR.

Table 7.3
LADCO Round 6 Modeling Results
for Annual $PM_{2.5}$ – Without CAIR Emission Reductions
(Using 2003 – 2007 Design Values)

SITE ID	SITE NAME	COUNTY	Design Value 2003-2007 (µg/m^3)	Base-case 2012 (µg/m^3)	Base-case 2018 (µg/m^3)
18-019-0006	Jeffersonville – Walnut St.	Clark	16.5	15.6	15.5
18-043-1004	New Albany	Floyd	14.9	14.0	13.8
21-029-0006	Carpenter Street	Bullitt – KY	14.9	14.2	14.1
21-093-0006	Elizabethtown	Hardin – KY	13.6	12.8	12.7
21-111-0043	Southern Avenue	Jefferson – KY	15.6	14.6	14.4
21-111-0044	Wyandotte Park	Jefferson – KY	15.3	14.5	14.4
21-111-0048	Barret Avenue	Jefferson – KY	15.1	14.3	14.2
21-111-0051	Watson Elementary	Jefferson – KY	14.8	13.9	13.8

LADCO based its Round 6 modeling on annual design values from 2003 through 2007. Current annual fine particle design values have dropped since this design value period, as shown previously in Graph 7.1. A decrease of the design values from 2003 through 2007 to 2006 through 2010 at the Jeffersonville – Walnut Street $PM_{2.5}$ monitor of 1.74 µg/m^3 and 1.92 µg/m^3 at the New Albany, Indiana $PM_{2.5}$ monitor occurred. The design values for the Louisville Area monitors have dropped with the 2006 through 2010 design values ranging from 1.29 µg/m^3 to 1.93 µg/m^3 less than the 2003 through 2007 design values. The 2006 through 2010 design values were multiplied by the RRFs calculations, based on the future year design values divided by the 2003 through 2007 design value. These results are shown in Table 7.4.

Table 7.4
LADCO Round 6 Modeling Results
for Annual $PM_{2.5}$ – Without CAIR Emission Reductions
(Using 2006 – 2010 Design Values)

SITE ID	SITE NAME	COUNTY	Design Value 2006-2010 (µg/m^3)	2012 RRF	Base-case 2012 (µg/m^3)	2018 RRF	Base-case 2018 (µg/m^3)
18-019-0006	Jeffersonville – Walnut St.	Clark	14.71	0.945	13.9	0.939	13.8
18-043-1004	New Albany	Floyd	12.93	0.940	12.1	0.926	12.0
21-029-0006	Carpenter Street	Bullitt – KY	13.32	0.953	12.7	0.946	12.6
21-111-0043	Southern Avenue	Jefferson – KY	13.62	0.936	12.7	0.923	12.6
21-111-0044	Wyandotte Park	Jefferson – KY	13.75	0.948	13.0	0.941	12.9
21-111-0048	Barret Avenue/Cannon Lane	Jefferson – KY	13.41	0.947	12.7	0.940	12.6
21-111-0051	Watson Elementary	Jefferson – KY	13.42	0.939	12.6	0.932	12.5

As can be seen, annual $PM_{2.5}$ modeled results are lower when current design values are used to determine future year modeling. Using the 2006 through 2010 design values, all Louisville Area monitoring sites will be below the annual NAAQS for fine particles by 2012 and will continue to decrease thereafter.

7.2 LADCO Round 5 Speciated Modeled Attainment Test Results

The Speciated Modeled Attainment Test (SMAT) is the attainment test for annual fine particles. To determine the future year annual fine particle concentrations, speciated data is calculated. The different species that were modeled and are associated with fine particles include sulfates, nitrates, organic carbon, elemental carbon, ammonium, particle bound water, “other” primary inorganic fine particles, and passively collected mass. The SMAT results from LADCO’s Round 5 modeling are listed below. Round 5 modeled the emission reductions associated with CAIR so the results reflect the impacts from CAIR. Percent ranges of the model results from the Jeffersonville, Indiana – Walnut Street and New Albany $PM_{2.5}$ monitors in Clark and Floyd counties, Indiana, were broken down into the speciated constituents of fine particle emissions. The percent change from the observed speciated data in 2005 to the future year modeled results for 2009 are listed in Table 7.5. While these modeling results are outdated, this weight of evidence demonstration shows the reduction potential from national emission control measures for the $PM_{2.5}$ species in southern Indiana. An updated analysis will be conducted at a later time, using more current emissions and meteorological data and for a relevant future year projection.

Table 7.5
LADCO Round 5 SMAT Modeling Results for Southern Indiana
(Percent decrease from observed to modeled concentrations)

Species of $PM_{2.5}$	2009
Sulfates	30%
Nitrates	0%
Organic Carbon	0%
Elemental Carbon	14% - 16%
Ammonium	24% - 26%
Particle Bound Water	25% - 29%

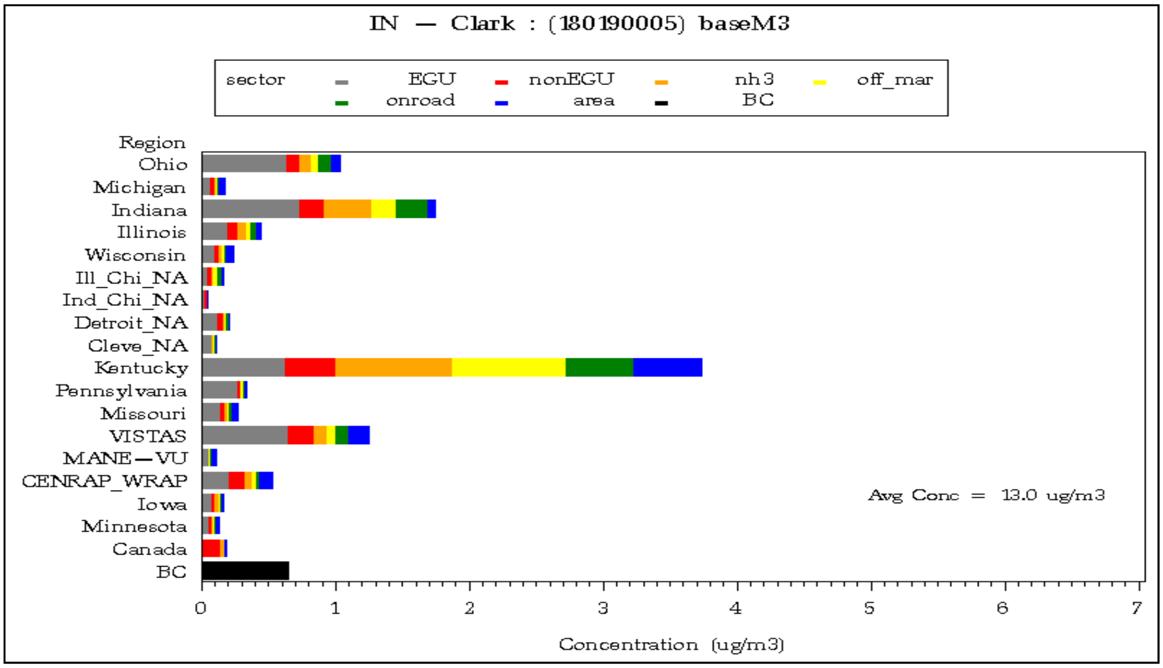
The results demonstrate that sulfate, ammonium, elemental carbon, and particle bound water concentration decreases are projected to be at least 14% in the future year 2009. LADCO modeling shows good performance for sulfates and elemental carbon predicted baseline concentrations, slight over-prediction for nitrate concentrations, and under-predictions of organic carbon concentrations. Overall, model performance is adequate for SIP planning and gives a good idea of the effects of emission reductions from national emission control measures on southern Indiana.

7.3 LADCO Round 5 Particulate Source Apportionment Results

Particulate Source Apportionment (PSAT) modeling was conducted by LADCO. The results of the PSAT modeling show the regional contributions by emission sectors on each monitor that was modeled. Chart 7.1 displays the PSAT modeling results for the Jeffersonville –Walnut Street fine particle monitor in Clark County, Indiana. Kentucky was the biggest regional contributor to the monitor with Indiana, Ohio, and the remaining Visibility Improvement State and Tribal Association of the Southeast (VISTAS) Regional Planning Organization states (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia and the Eastern Band of the Cherokee Indians) also being significant contributors.

The PSAT Round 5 modeling results indicate that the majority of Indiana's emission sector contributions to fine particle concentrations come from EGUs, ammonium emission sources, mobile, non-EGU sources, off-road (including marine, aircraft, and railroad), and area emission sources. These results are considered to be representative of Clark, Floyd, and Jefferson counties, Indiana as EGU, ammonium, and non-EGU emissions impact the entire area.

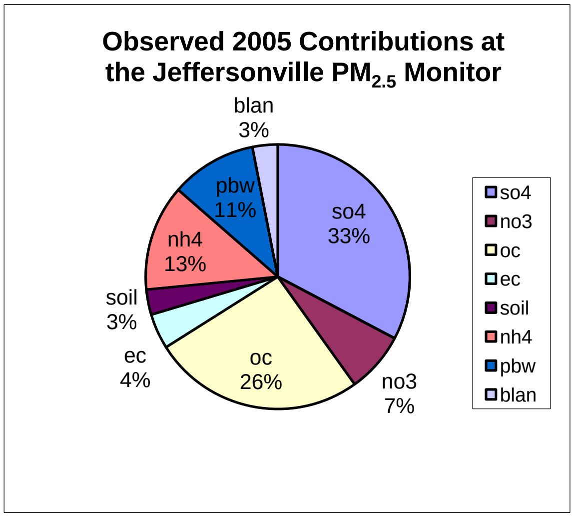
Chart 7.1
Regional/Emission Sector Particulate Source Apportionment Technology (PSAT) Test Results, Jeffersonville, Indiana – Walnut Street $PM_{2.5}$ Monitor



The following pie charts depict the contribution by species to fine particle concentrations at the Louisville Area monitors. The pie charts include both the observed 2005 contributions and 2009 modeled contributions for each monitor. Since the monitors are in close proximity to each other, results are fairly similar in the distribution of species concentrations among the monitors. Charts 7.2 through 7.9 cover the eight fine particle monitors in the Louisville Area that are used to determine compliance with the annual NAAQS for fine particles.

The speciation listed in the pie charts include SO_4 – sulfate mass, NO_3 – nitrate mass, OC – organic carbon mass, EC – elemental carbon mass, Soil – crustal material mass, NH_4 – ammonium mass, PBW – particle bound water mass, and BLAN – passively collected mass.

Chart 7.2
Modeled Contributions by Species at the Jeffersonville, Indiana Walnut Street PM $_{2.5}$ Monitor
(Observed Concentrations = 16.2 µg/m^3) (Modeled Concentrations =13.6 µg/m^3)



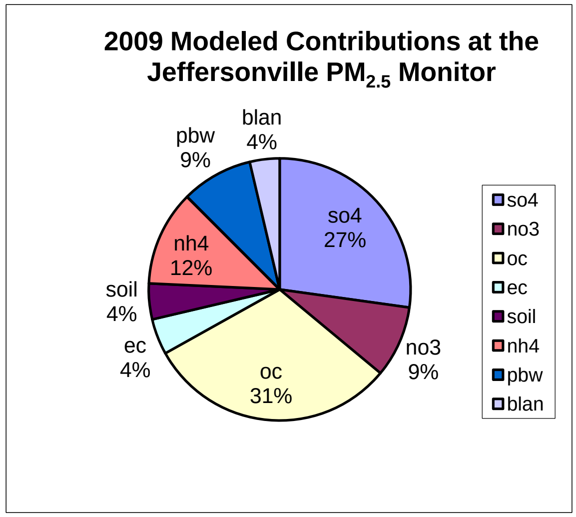
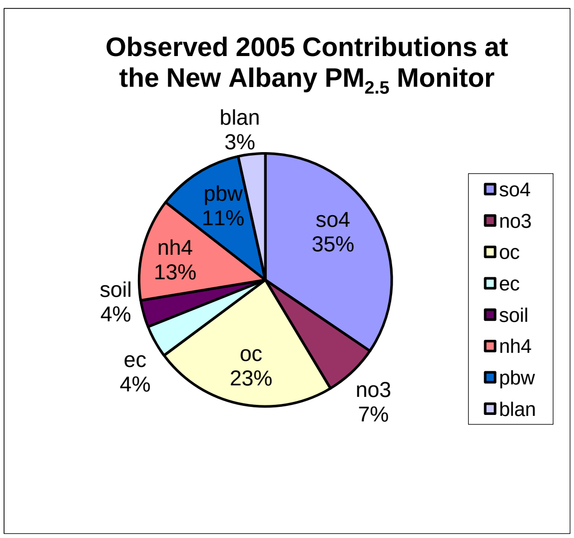


Chart 7.3
Modeled Contribution by Species at the New Albany, Indiana PM$_{2.5}$ Monitor
(Observed Concentrations = 14.5 µg/m^3) (Modeled Concentrations =12.1 µg/m^3)



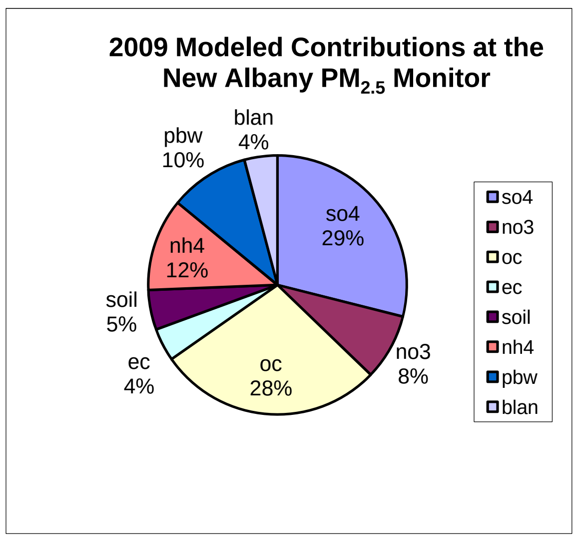
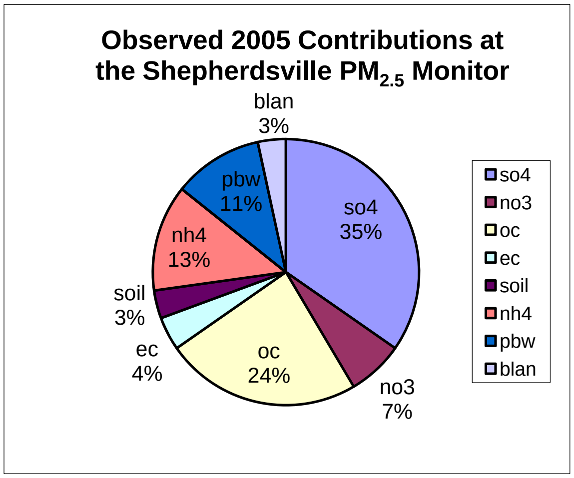


Chart 7.4
Modeled Contribution by Species at the Carpenter Street – Shepherdsville, Kentucky $PM_{2.5}$ Monitor
(Observed Concentrations = 14.7 µg/m^3) (Modeled Concentrations =12.4 µg/m^3)



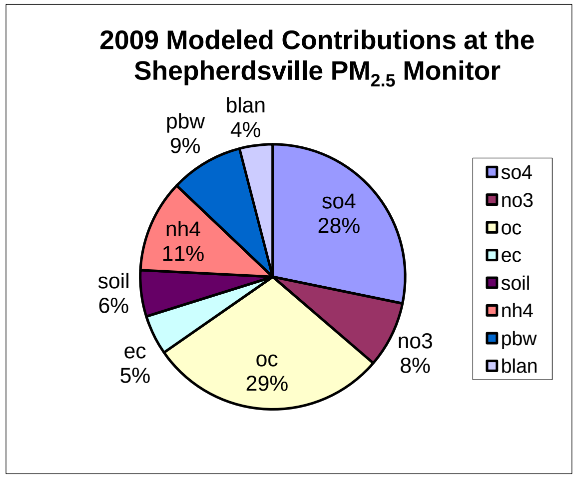
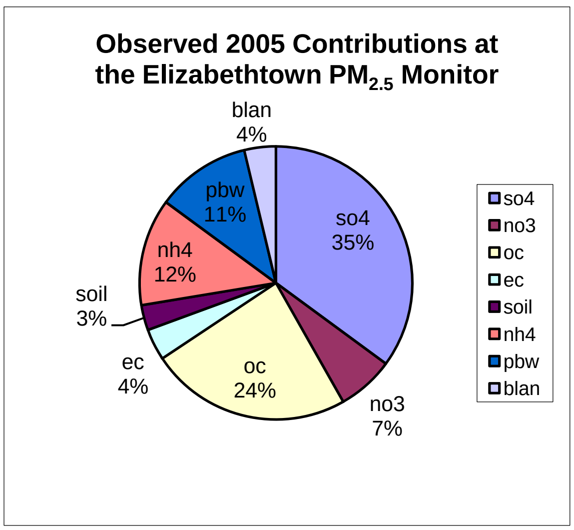


Chart 7.5
Modeled Contribution by Species at the Elizabethtown, Kentucky $PM_{2.5}$ Monitor
(Observed Concentrations = 13.4 µg/m^3) (Modeled Concentrations =11.2 µg/m^3)



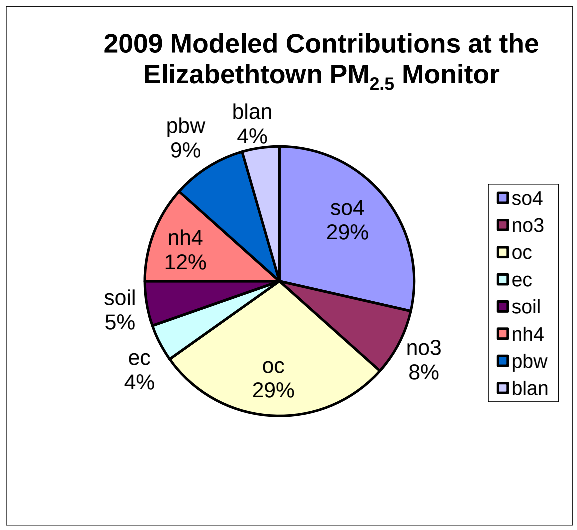
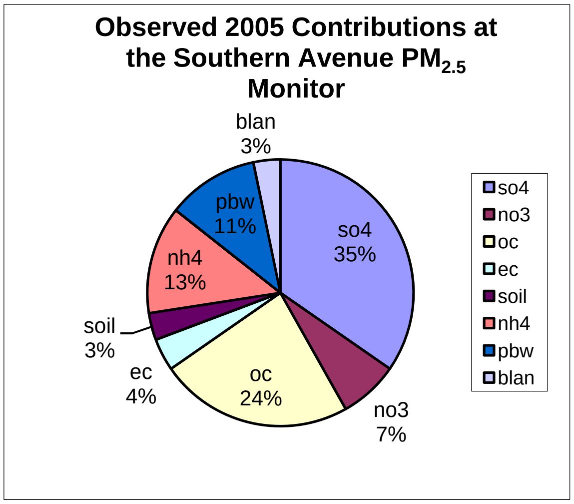


Chart 7.6
Modeled Contribution by Species at the Southern Avenue – Louisville, Kentucky $PM_{2.5}$ Monitor
(Observed Concentrations = 15.3 µg/m^3) (Modeled Concentrations =12.8 µg/m^3)



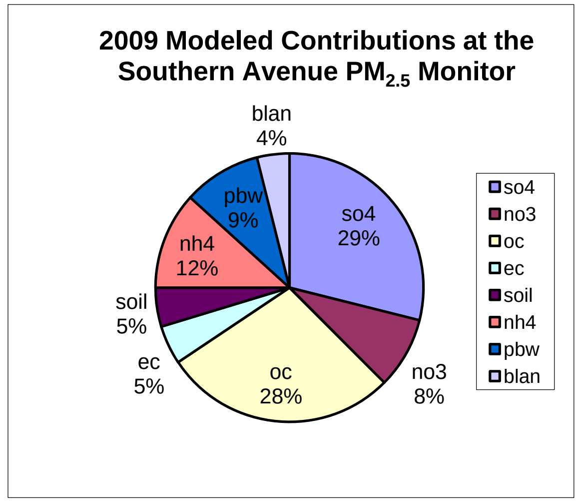
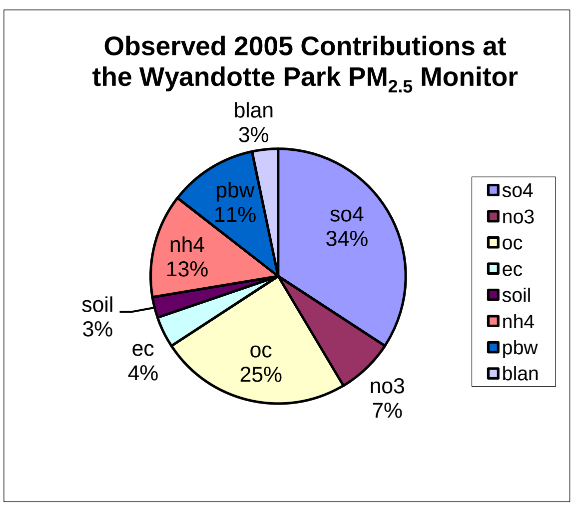


Chart 7.7
Modeled Contribution by Species at the Wyandotte Park – Louisville, Kentucky $PM_{2.5}$ Monitor
(Observed Concentrations = 15.2 µg/m^3) (Modeled Concentrations =12.8 µg/m^3)



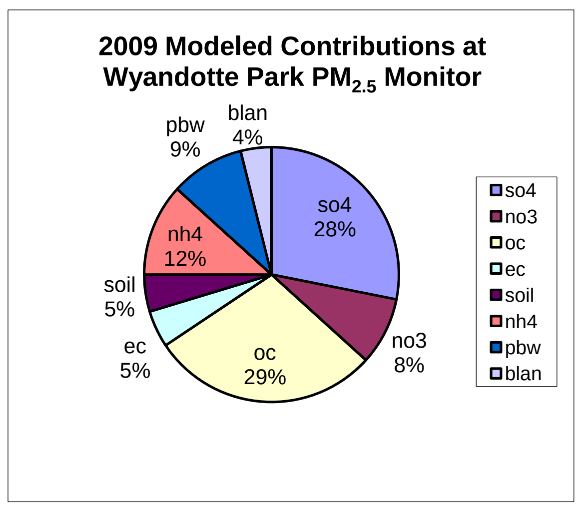


Chart 7.8
Modeled Contribution by Species at the Barret Avenue –
Louisville, Kentucky $PM_{2.5}$ Monitor
(Observed Concentrations = 14.8 μg/m^3) (Modeled Concentrations =12.6 μg/m^3)

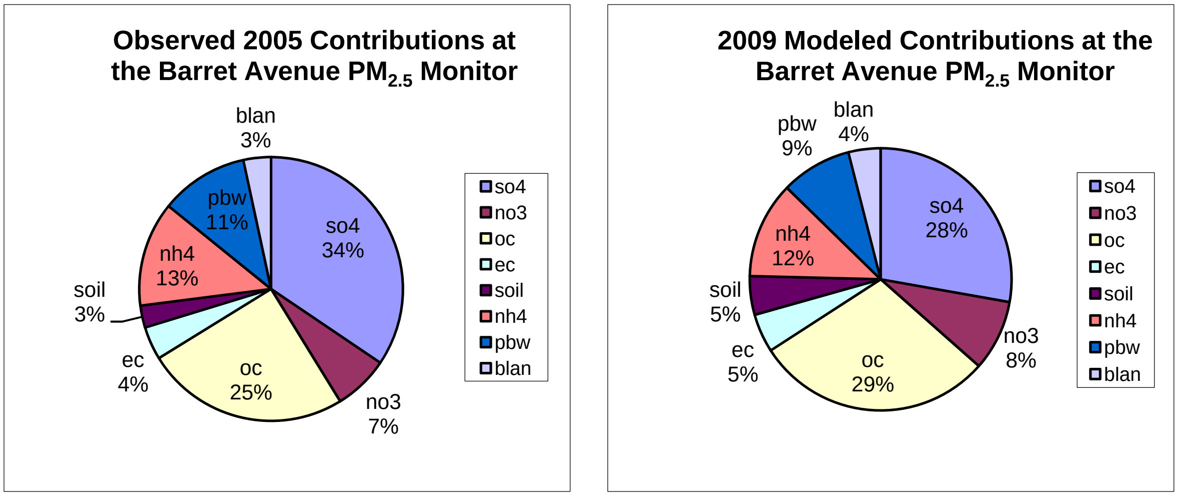
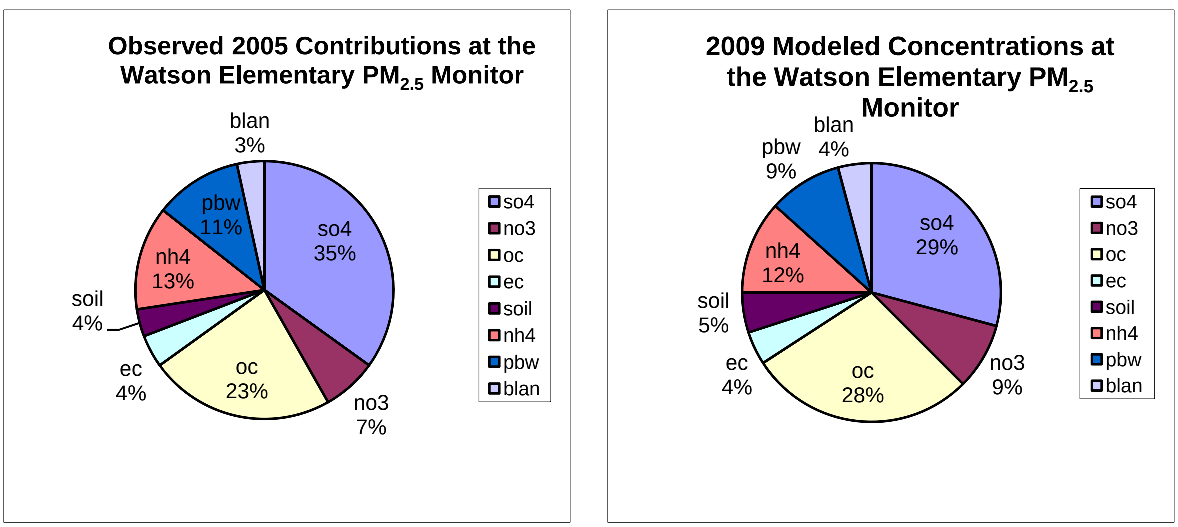


Chart 7.9
Modeled Contribution by Species at the Watson Elementary –
Louisville, Kentucky $PM_{2.5}$ Monitor
(Observed Concentrations = 14.6 μg/m^3) (Modeled Concentrations =12.0 μg/m^3)



Results of the Round 5 PSAT modeling for the Louisville Area fine particle monitors show the highest pollutant contributors to base-case and future year fine particle concentrations are sulfate, organic carbon, ammonium, and nitrate. Future year modeling shows decreases in sulfates (due to the emission reductions from CAIR) and ammonium. The future year modeling did show slight increases in nitrates from the base-case modeled concentrations.

7.4 Summary of Existing Modeling Results

U.S. EPA and LADCO modeling for future year design values have consistently shown that existing national emission control measures will bring the Louisville Area into attainment of the annual NAAQS for fine particles. Emission control measures to be implemented in the next several years will help air quality meet the standard in the future. Modeling support for CAIR has shown that future year design values for the Louisville Area will continue to attain the annual standard for fine particles with modeled future year design values below 15 $\mu g/m^3$. U.S. EPA future year modeling of national emission control strategies, based on current design values, shows that the Louisville Area will approach the annual NAAQS for fine particles. Future national and local emission control strategies will ensure that the Louisville Area will maintain lower fine particle concentrations with an increasing margin of safety.

7.5 Meteorological Analysis for the Louisville Area

Meteorological conditions are one of the most important factors that influence development and transport of fine particles. Stagnant surface conditions during any time of the year and upper air ridging provides conducive conditions for development and transport of fine particles. Ultimately, passage of surface cold fronts with a clean air mass change will lower fine particle readings in the Louisville Area.

7.6 Surface Air Conditions Present during High Fine Particle Concentration Days

Higher annual concentrations of fine particles tend to correlate with warmer temperatures and lighter wind speeds, although high fine particle episodes can occur in the summer or winter. It should be noted that higher annual fine particle concentrations are driven by individual days with higher fine particle concentrations throughout the monitored year. Therefore, it is difficult to attribute higher fine particle concentrations to annualized meteorological rankings. Review of several of the higher fine particle concentration episodes over the past few years reveals that conditions were hot in the summer with temperatures in the middle 80ºs Fahrenheit (ºF) or higher and average wind speeds were fairly light. Fall and winter days with higher fine particle concentrations had near normal temperatures, but wind speeds were very light and humidity was higher.

7.7 Upper Air Conditions Present during High Fine Particle Concentration Days

Upper air ridges and more stagnant surface wind conditions predominately affect development and build up of fine particles. Slow moving upper air ridges can effectively suppress mixing within the many levels of the atmosphere and cause pollutants to build up over time. Inversions or increases in temperature with a rise in altitude will prevent mixing with air from the upper atmosphere. These conditions can occur at any time of the year and are evident in elevated fine particle episodes in spring, summer, fall, and winter months. Review of surface and upper air features of higher fine particle concentration days showed stagnant surface conditions and upper air ridges existed on those days and helped in the buildup of fine particle concentrations.

7.8 Analyses of Atmospheric Conditions during High Fine Particle Concentration Days

Analyses were conducted to determine the atmospheric conditions that are most prevalent during higher fine particle concentration days in Indiana. LADCO applied a Classification and Regression Tree (CART) analysis to data from Indiana that correlated different levels of fine particle concentrations to meteorological conditions from 1999 to 2004 (Donna Kenski, 2005). This type of analysis evaluates meteorological conditions, such as temperature, pressure, wind speed, wind direction, relative humidity, and dew point temperatures at the surface, as well as morning and evening mixing heights in the upper atmosphere which were present when higher concentrations of fine particles were monitored. Results of this CART analysis indicated factors that played a larger role in higher fine particle concentrations in Indiana were warm-weather conditions with high dew points, southwest winds, and high evening mixing heights. Previous day's concentrations of fine particles play a key role in higher impacts as well.

Fine particles are made up of several constituents, including direct $PM_{2.5}$, sulfates, nitrates, ammonium, organic carbon, and elemental carbon. Depending on the time of the year, concentrations of fine particle constituents vary, with nitrates being more prevalent in the winter and sulfates more prevalent in the summer. Sulfates and nitrates emission reductions have the biggest impact on lower future year fine particle concentrations.

7.9 Summary of Air Quality Index Days for the Louisville Area

An analysis was conducted to review the daily fine particle concentrations over a year to determine the Air Quality Index (AQI) trends. Chart 7.10 shows by year (2000 through 2010), the percentage of days during the calendar year on which fine particle concentrations reached the AQI ranges for "Good" (0 to 15.3 $\mu g/m^3$), "Moderate" (15.4 $\mu g/m^3$ to 40.4 $\mu g/m^3$), and "Unhealthy for Sensitive Groups (USG)" (40.5 $\mu g/m^3$ to 65.4 $\mu g/m^3$). There were no days that fine particle levels reached the "Unhealthy" level of 65.5 $\mu g/m^3$ to 150.4 $\mu g/m^3$.

Chart 7.10
Distribution of $PM_{2.5}$ Concentration Days on the Air Quality Index (AQI) Levels of Health Concern for the Louisville Area

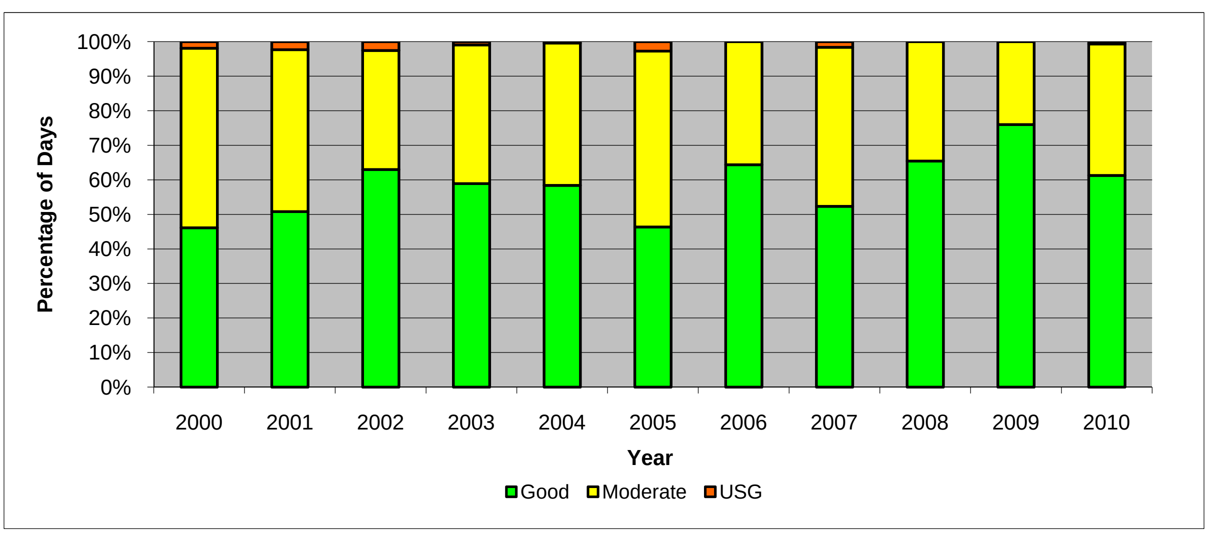


Table 7.6 shows how the years ranked for the three AQI ranges. The year 2009 had the most "Good" concentration days during the 11-year period analyzed (2000 through 2010). The year 2000 had the most "Moderate" concentration days and the year 2005 had the most "USG" concentration days with no days recorded in 2006, 2008, and 2009. As can be seen, weather plays a large role in fine particle concentration development and transport as 2001, 2002, 2005, and 2007 were warmer than normal summers which translated to moderate and unhealthy for sensitive group levels of air quality.

Table 7.6
Ranking and Percentage of Highest Number of Days at AQI Levels of Health Concern

Ranking	Good	Moderate	Unhealthy for Sensitive Group
1st	**2009** – 76%	**2000** – 52%	**2005** – 3%
2nd	**2008** – 65%	**2005** – 51%	**2002** – 3%
3rd	**2006** – 64%	**2001** – 47%	**2000** – 2%
4th	**2002** – 63%	**2007** – 46%	**2001** – 2%
5th	**2010** – 61%	**2004** – 41%	**2007** – 2%
6th	**2003** – 59%	**2003** – 40%	**2003** – 1%
7th	**2004** – 58%	**2010** – 38%	**2010** – 1%
8th	**2007** – 52%	**2006** – 36%	**2004** – 1%
9th	**2001** – 51%	**2008** – 35%	
10th	**2005** – 46%	**2002** – 34%	
11th	**2000** – 46%	**2009** – 24%	

7.10 Summary of Meteorological Analysis for the Louisville Area

Annual fine particle concentrations in the Louisville Area are driven by higher fine particle concentration days that can occur during any time of the year. Conditions that are most prevalent during higher fine particle concentration days are lighter winds, higher relative humidity, and above average temperatures in the summer, and near normal temperatures in the fall, winter, or spring. Approximately 70% of the days when $PM_{2.5}$ concentrations were in the USG range occurred in the summer months with maximum high temperatures of 80ºF or above. Weather plays a large role in fine particle concentration development and transport as 2001, 2002, 2005, and 2006 were warmer than normal summers which translated to more days of "moderate and unhealthy for sensitive group" levels of air quality and near normal temperatures in the fall, winter, or spring. Upper air weather patterns generally include ridging over the area with stagnant conditions at the surface caused by lower mixing heights and stable conditions for summer episodes and ridging or troughs over the area in the fall, winter, or spring episodes. Surface winds from any direction can transport pollutants from surrounding areas into the Louisville Area. Nitrates are bigger contributors to fine particle concentrations in the winter and sulfates are bigger contributors to fine particle concentrations in the summer.

8.0 CORRECTIVE ACTIONS

8.1 Commitment to Revise Plan

As noted in Section 4.6, IDEM commits to review and revise, as appropriate, its Maintenance Plan eight years after redesignation, as required by Section 175A of the CAA.

8.2 Commitment for Contingency Measures

IDEM will monitor fine particle concentrations to determine whether trends indicate higher values or whether emissions appear to be increasing. If it is determined that fine particle levels and emissions are increasing and action is necessary to reverse that trend, IDEM will take action to reverse the noted trend, prior to a violation of the standard occurring.

IDEM commits to adopt and expeditiously implement necessary corrective action in accordance with an Action Level Response described below.

Action Level Response

An Action Level Response shall be prompted whenever a violation of the standard (three-year average annual arithmetic mean value of 15.1 $\mu g/m^3$ or greater) occurs. In the event that the Action Level is triggered and is not found to be due to an atypical unfavorable meteorological condition, exceptional event, malfunction, or noncompliance with a permit condition or rule requirement, IDEM will determine additional control measures needed to assure future attainment of the annual NAAQS for fine particles. In this case, measures that can be implemented in a short time will be selected in order to be in place within eighteen months from the end of the year that prompted the Action Level Response.

Control Measure Selection and Implementation

Adoption of any additional control measures is subject to the necessary administrative and legal processes. This process will include publication of notices, an opportunity for public hearing, and other measures required by Indiana law for rulemaking by state environmental boards.

If a new measure or control is already promulgated and scheduled to be implemented at the federal or state level, and that measure or control is determined to be sufficient to address the upward trend in air quality, additional local measures may be unnecessary. Furthermore, IDEM will submit to U.S. EPA an analysis to demonstrate that the proposed measures are adequate to return the area to attainment.

8.3 Contingency Measures

Contingency measures to be considered will be selected from a comprehensive list of measures deemed appropriate and effective at the time the selection is made. Listed below are example measures that may be considered. The selection of measures will be based upon cost-effectiveness, emission reduction potential, economic and social considerations, or other factors that IDEM deems appropriate. IDEM will solicit input from interested and affected persons in the maintenance area prior to selecting appropriate contingency measures. All of the listed contingency measures are potentially effective or proven methods of obtaining significant reductions of fine particle precursor emissions. Because it is not possible at this time to determine what control measure will be appropriate at an unspecified time in the future, the list of contingency measures outlined below is not comprehensive. IDEM anticipates that if contingency measures should ever be necessary, it is unlikely that a significant number (i.e., all those listed below) will be required.

1) Vehicle inspection and maintenance program.
2) Alternative fuel and diesel retrofit programs for fleet vehicle operations.
3) Require NO_x or SO_2 emission offsets for new and modified major sources.
4) Require NO_x or SO_2 emission offsets for new and modified minor sources.
5) Increase the ratio of emission offsets required for new sources.
6) Require NO_x or SO_2 controls on new minor sources (less than 100 tons).
7) Wood stove change out program.
8) Various emission reduction measures or dust suppressant for unpaved roads and/or parking lots.
9) Idling Restrictions.
10) Broader geographic applicability of existing measures.
11) One or more transportation control measures sufficient to achieve at least a 0.5% reduction in actual area-wide precursor emissions. Transportation measures will be selected from the following, based upon the factors listed above, after consultation with affected local governments:
    a) Trip reduction programs, including, but not limited to, employer-based transportation management plans, area wide rideshare programs, work schedule changes, and telecommuting.
    b) Transit improvements.
    c) Traffic flow improvements.
    d) Other new or innovative transportation measures not yet in widespread use that affected state and local governments deem appropriate.

No contingency measure shall be implemented without providing the opportunity for full public participation during which the relative costs and benefits of individual measures, at the time they are under consideration, can be fully evaluated.

9.0 PUBLIC PARTICIPATION

Indiana published notification for a public hearing and solicitation for public comment concerning the draft Redesignation Petition and Maintenance Plan on IDEM's website[8] on April 27, 2011, with publication in the following newspapers on the following dates:

[8] http://www.in.gov/idem/4658.htm

1) The Indianapolis Star, Indianapolis, Indiana (May 5, 2011).
2) The New Albany Tribune, New Albany, Indiana (April 26, 2011).
3) The Evening News, Jeffersonville, Indiana (April 26, 2011).
4) The Madison Courier, Madison, Indiana (April 22, 2011).

A public hearing to receive comments concerning the redesignation request was conducted on May 26, 2011, at the Jefferson Township Public Library, Clarksville Branch in Clarksville, Indiana. No comments were received at the public hearing. The public comment period closed on May 29, 2011. One comment letter was received during the public comment period. Appendix K includes a copy of the public notice, public hearing script, certifications of newspaper publication of the public notice, the official transcript from the public hearing, and a detailed summary of and response to substantive comments.

10.0 CONCLUSIONS

Jefferson County (Madison Township) and Clark and Floyd counties, Indiana, have attained the annual NAAQS for fine particles. This petition demonstrates that Jefferson County (Madison Township) and Clark and Floyd counties, Indiana, have complied with the applicable provisions of the CAA regarding redesignation of nonattainment areas for fine particles. IDEM has prepared a State Implementation and Maintenance Plan that meets the requirement of Section 110(a)(1) of the CAA.

Indiana has performed an analysis that shows the air quality improvements are due to permanent and enforceable measures and that additional significant regional NO_x and SO_2 reductions following implementation of the Phase II NO_x SIP Call rule and CAIR or its replacement rule will ensure continued compliance (maintenance) with the standard. Furthermore, emission projections indicate that NO_x and SO_2 emissions will continue to decline, ensuring that the area continues to maintain compliance with the standard and provide for an increased margin of safety. Based on this presentation, Jefferson County (Madison Township) and Clark and Floyd counties, Indiana, meet the requirements for redesignation under the CAA (Section 107(d)(3)) and U.S. EPA guidance for fine particles.

Consistent with the authority granted to U.S. EPA, the State of Indiana requests that Jefferson County (Madison Township) and Clark and Floyd counties, Indiana, be redesignated to attainment for the annual fine particles standard simultaneously with U.S. EPA approval of this State Implementation and Maintenance Plan.