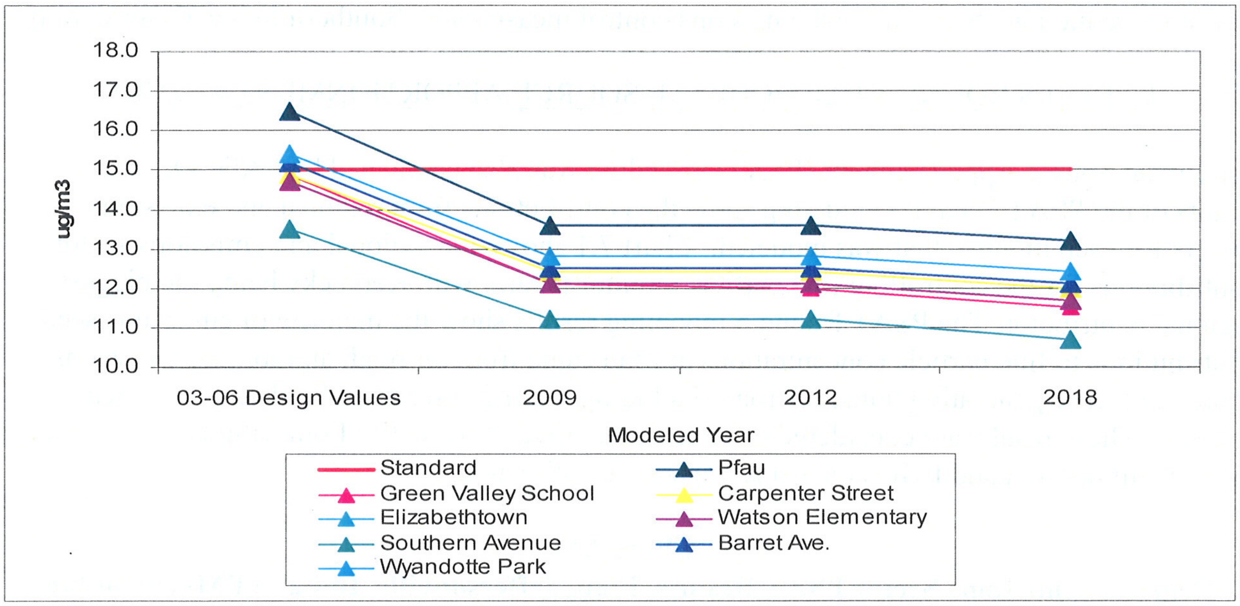
Figure 7.1
Graph of Modeling Results for the Louisville KY-IN Area $PM_{2.5}$ Monitors for 2009, 2012 and 2018



7.2 <u>LADCO'S ROUND 5 SPECIATED MODELED ATTAINMENT TEST RESULTS</u>

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. Percent ranges of the model results from the two fine particle monitors in Southern Indiana were broken down into these speciated constituents of fine particle emissions. The percent reductions from the observed speciated data in 2005 to the future year modeled results for 2009 are listed in Table 7.2.

Table 7.2
LADCO's Round 5 SMAT Modeling Results for Southern Indiana
(Percent reduction from 2005 observed to 2009 modeled concentrations)

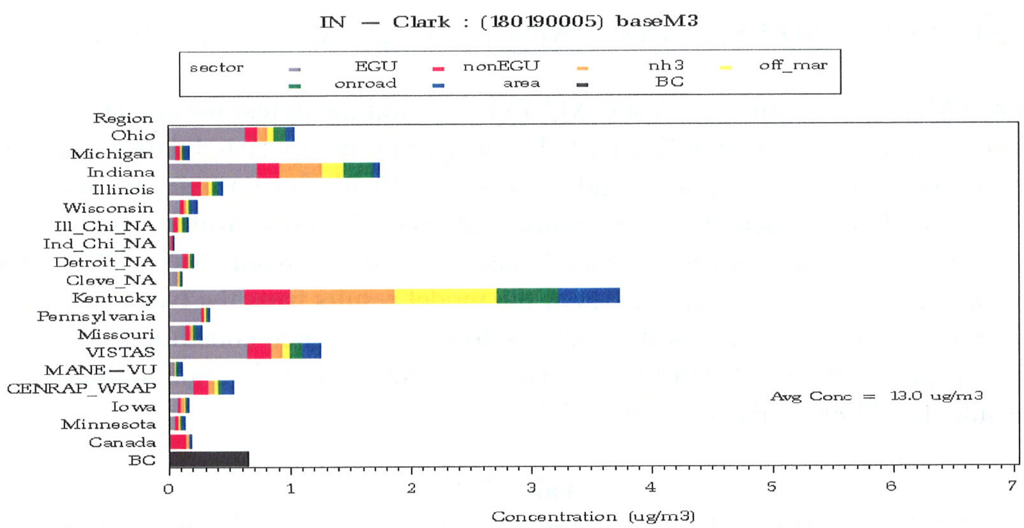
Species of $PM_{2.5}$	2009
Sulfates	-30%
Nitrates	0%
Organic Carbon	0%
Elemental Carbon	-14% to -17%
Ammonium	-24% to -26%
Particle Bound Water	-25% to -29%

The results show that sulfate, elemental carbon and ammonium concentration decreases are projected to occur by 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 emissions reductions from national emissions control measures on Southern Indiana's air quality.

7.3 LADCO'S ROUND 5 PARTICULATE SOURCE APPORTIONMENT RESULTS

Particulate Source Apportionment (PSAT) modeling was also conducted by LADCO. The results of the PSAT Round 5 modeling show the contributions from regional and emissions sectors for each monitor that was modeled. Chart 7.1 shows the regional and emissions sector contributions for the controlling fine particle monitor (Pfau), with Kentucky being the biggest regional contributor. The PSAT Round 5 modeling results show the majority of emissions sector contributions to fine particle concentrations at Pfau came from on-road, ammonium emissions sources, electric generating units, off-road (including marine, aircraft and railroad) and area sources. These results are considered to be representative of the entire Louisville KY-IN area as mobile, ammonium and EGU emissions impact the entire area.

Chart 7.1
Regional/Emissions Sector PSAT Results, Pfau, Jeffersonville, Indiana $PM_{2.5}$ Monitor



The following pie charts depict the species contributions to fine particle concentrations at the Southern Indiana monitors. The pie charts include both the observed 2005 contributions and future year 2009 modeled contributions for each monitor. Since the monitors are in close proximity of each other, results are fairly similar in the distribution of species concentrations among the monitors. Charts 7.2 and 7.3 cover the two fine particle monitors in Indiana's portion of the Louisville KY-IN nonattainment area that are used to determine compliance with the annual NAAQS.

Chart 7.2
Pie Charts of the Modeled Species Contributions to the Pfau – Jeffersonville, IN $PM_{2.5}$ Monitor
(Observed Concentration = 16.5 $\mu g/m^3$) (Modeled Concentration = 13.6 $\mu g/m^3$)

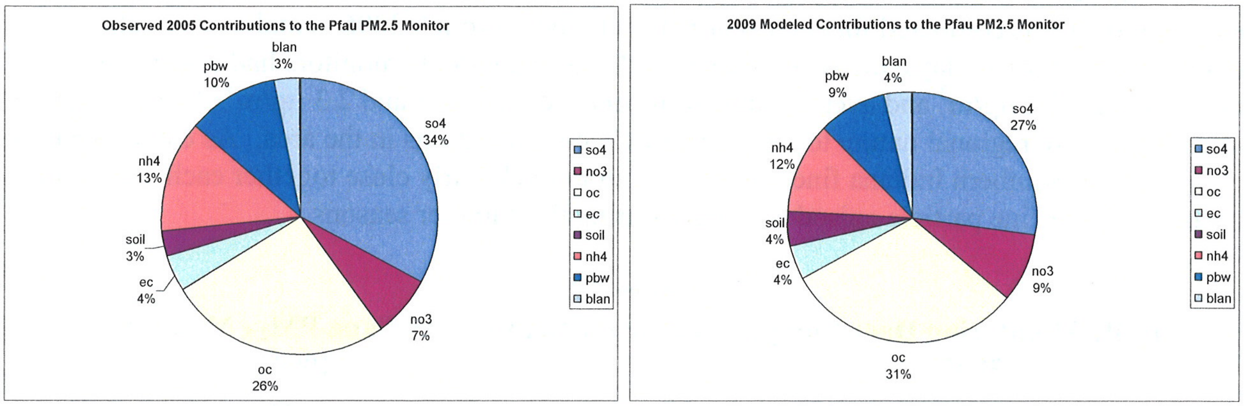
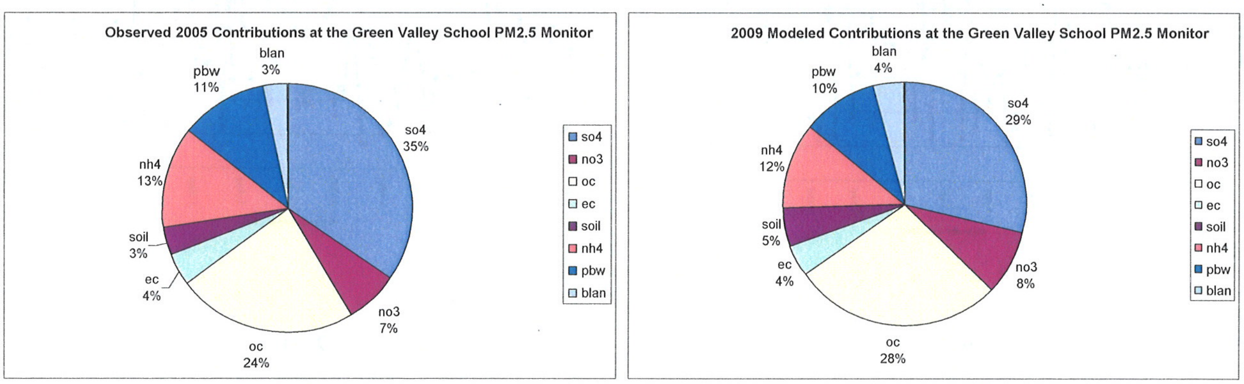


Chart 7.3
Pie Charts of the Modeled Species Contributions to the Green Valley School - New Albany, IN $PM_{2.5}$ Monitor
(Observed Concentration = 14.9 $\mu g/m^3$) (Modeled Concentration = 12.1 $\mu g/m^3$)



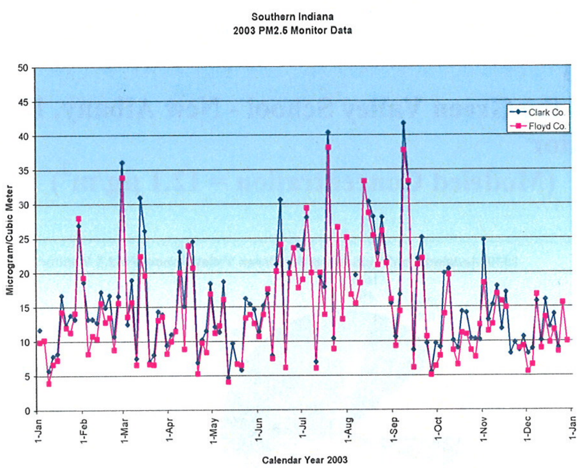
Results of the Round 5 PSAT modeling for the Southern Indiana fine particle monitors show the highest pollutant contributors to basecase and future year fine particle concentrations are sulfate, organic carbon, ammonium and nitrate. Future year modeling shows decreases in sulfates (due to the emissions reductions from CAIR) and ammonium. The future year modeling did show slight increases in organic carbon and nitrates from the basecase modeled concentrations. However, these increases are offset by the larger decreases in sulfates.

7.4 DAILY MONITORED DATA COMPARISON FOR THE SOUTHERN INDIANA $PM_{2.5}$ MONITORING SITES

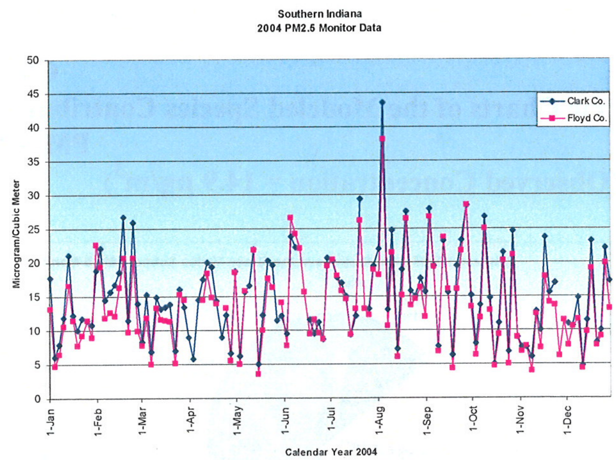
The consistent PSAT results are evident in the monitoring data throughout Southern Indiana, as the trends for each fine particle monitor follow each other on a daily and annual basis. The daily monitored data was compared for each year between 2003 through 2006. Analyzed for all monitored fine particle days, the two Southern Indiana fine particle monitors had average daily impacts within 2.2 $\mu g/m^3$ and average annual impacts between 1.3 and 2.3 $\mu g/m^3$ of each other, indicating a more regional nature to the fine particle concentrations in the area. As can be seen in Figure 7.2, the Southern Indiana fine particle monitors track fairly close together each year with unusually higher fine particle episodes evident during the summer seasons.

Figure 7.2
Daily Monitoring Data Comparison for the Southern Indiana $PM_{2.5}$ Monitors

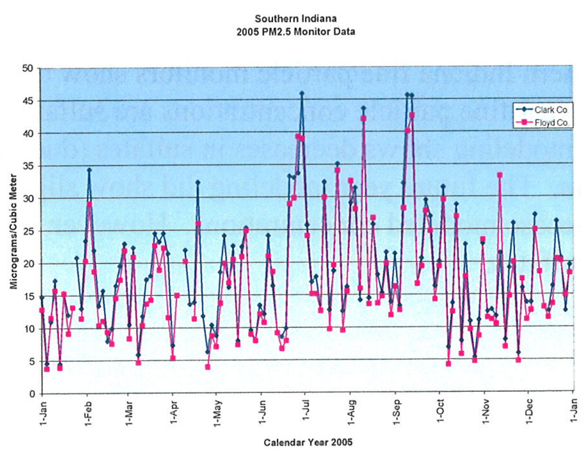
2003



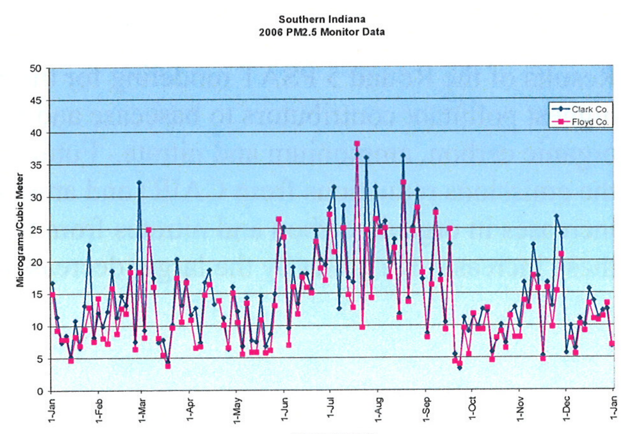
2004



2005



2006



7.5 SUMMARY OF ASSOCIATION FOR SOUTHEASTERN INTEGRATED PLANNING (ASIP) MODELING FOR KENTUCKY

Kentucky is located in a different U.S. EPA region than Indiana. Region 4 has a separate technical support group that conducts emissions, monitoring and photochemical modeling for all the Region 4 states, including Kentucky. This group is known as the Association for Southeastern Integrated Planning (ASIP). ASIP has conducted photochemical modeling for fine particles, using the Community Multiscale Air Quality (CMAQ) model with its Base G4 emissions and meteorology taken from 2002.

Modeling results for the Louisville KY-IN fine particle nonattainment area show the highest modeled annual fine particle concentrations for Clark County, Indiana and Jefferson County, Kentucky, will be less than the annual fine particle NAAQS of 15.0 ug/m^3. ASIP modeled at both a 36 kilometer and 12 kilometer grid resolution and both the 36km and 12 km results showed modeled values to be less than 15.0 ug/m^3.

Table 7.3
ASIP's Base G4 Annual $PM_{2.5}$ Modeling Results

Monitor ID	Monitor Name	County	Design Value 2000-2004	Future Year 2009 12 km
			(µg/m^3)	(µg/m^3)
18-019-0006	Pfau	Clark	16.84	14.86
18-043-1004	Green Valley School	Floyd	14.89	13.03
21-029-0006	Carpenter Street	Bullitt	14.88	13.06
21-093-0006	Elizabethtown	Hardin	13.97	12.16
21-111-0043	Southern Avenue	Jefferson	[a]	[a]
21-111-0044	Wyandotte Park	Jefferson	16.58	14.76
21-111-0048	Barret Ave.	Jefferson	16.06	14.18
21-111-0051	Watson Elementary	Jefferson	15.44	13.62

[a] No Speciated Modeled Attainment Test data available

Further results can be found in Appendix J, which shows charts of all Indiana and Kentucky fine particle sites and the results of the BaseG4 modeling. All sites fall below the annual fine particle NAAQS.

Results from the LADCO and ASIP modeling are different for a number of reasons. LADCO used the Comprehensive Air Quality Model with extension (CAMx) while ASIP used the Community Multiscale Air Quality model (CMAQ). Both models are photochemical models but have different computing algorithms. Another difference is the baseyear emissions and meteorological data modeled; LADCO modeled 2005 emissions and 2005 meteorology while ASIP modeled 2002 emissions and 2005 meteorology. Fine particle-conducive conditions were evident for both years with higher fine particle readings evident in Southern Indiana in 2005.

7.6 SUMMARY OF ATTAINMENT TEST MODELING RESULTS

Indiana, in conjunction with the LADCO has performed technical analyses of the air quality in the Midwest in order to develop SIPs for areas that do not presently attain current NAAQS, including the Louisville KY-IN area. LADCO provided the technical support in order to conduct the air quality analyses necessary to demonstrate future-year compliance with the current annual NAAQS for fine particles. Results of the attainment test for fine particles for the Louisville KY-IN area show that the area will attain the current annual NAAQS for fine particles by 2009, one year before the attainment date deadline of 2010.

Additional analyses, using particulate source apportionment (PSAT) and outputs from the Speciated Modeled Attainment Test (SMAT), show that regional, emissions sector and species contributions to fine particle concentrations overall in the Louisville KY-IN area will be further reduced in the future. Species contributions are fairly consistent between the Southern Indiana monitors and emissions reductions will result in similar decreases in fine particle concentrations, as well as species contributions to fine particle composition throughout the Louisville KY-IN nonattainment area. Sulfates are the highest contributing species of fine particles composition in the Louisville KY-IN area and will be reduced as a result of the Clean Air Interstate Rule, as well as other emissions control regulations.

LADCO modeling for future year design values shows that existing national emissions control measures will reduce fine particle concentrations in the Louisville KY-IN area and bring the nonattainment counties into attainment of the annual NAAQS for fine particles. Emissions control measures to be implemented in the next several years, including the Clean Air Interstate Rule, will help the area attain the annual standard for fine particles with modeled future year design values well below 15.0 $\mu g/m^3$. Future national and local emissions control strategies will ensure that each county designated as part of the Louisville KY-IN nonattainment area will continue to attain the annual standard for fine particles (15.0 $\mu g/m^3$) with an increasing margin of safety over time.

8.0 MOBILE SOURCE EMISSIONS BUDGET

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

8.1 ON-ROAD EMISSIONS ESTIMATIONS

The Kentuckiana Regional Planning and Development Agency (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 fine particle nonattainment area as is Madison Township in Jefferson County, Indiana.

An interagency consultation group consisting of representatives from KIPDA, the Kentucky Transportation Cabinet, the Louisville Metro Air Pollution Control District, the Indiana Department of Transportation, the Indiana Department of Environmental Management, the Federal Highway Administration, the Federal Transit Administration, the Environmental Protection Agency, Kentucky Environmental and Public Protection Cabinet, and local transit and environmental quality providers jointly determine the mobile vehicle emissions budgets.

KIPDA maintains a travel demand forecasting model that is used to simulate the traffic in the area and to predict what that traffic will be like 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 forecasting model is used to predict the total daily VMT and MOBILE6 (see Section 8.2) is used to calculate the emissions per mile. The product of these two outputs, once combined, is the total amount of pollution emitted by the on-road vehicles for the particular analyzed area. All of these modeling results are compiled into a regional emissions analysis, which is adopted following a public involvement period.

8.2 OVERVIEW

Broadly described, MOBILE6 is used to determine "emission factors", which are the average emissions per mile (grams/mile) for direct $PM_{2.5}$ and $PM_{2.5}$ precursors, including NO_x and SO_2. There are numerous variables that can affect the emission factors. The vehicle fleet (vehicles on the road) age and the vehicle-type have a major effect on the emission factors. The facility type the vehicles are traveling on (MOBILE6 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 the emission factors and any Vehicle Inspection/Maintenance program in the area will also affect emissions. These data are estimated using the *best available data* (see Section 8.3) to create emission factors for direct $PM_{2.5}$ and $PM_{2.5}$ precursors including NO_x and SO_2. After emission factors are determined, the emission factor(s) must be multiplied by the VMT to determine the quantity of vehicle-related emissions. The VMT information is derived from the travel demand forecasting model. It should be noted that each year analyzed will have different emission factors, volumes, speeds, and likely some additional roadway sections.

8.3 BEST AVAILABLE DATA

Depending on the details of the travel demand forecasting model, much of MOBILE6 input data for emission factor computation can be found in the model, but some must come from other sources.

Vehicle Age Distribution

MOBILE6 has sixteen (16) different vehicle-type categories differentiated by weight. The first five (5) are generally passenger vehicles: cars, vans and SUVs. The others are different sized trucks and buses and the last is motorcycles. This MOBILE6 vehicle age distribution describes what fraction of each of the 16 vehicle-types is one year old, two years old, etc., up to the 25-and-older category. MOBILE6 has a default age profile of each vehicle-type taken from national surveys.

Due to its geographic proximity to Louisville, Southeastern Indiana is a through-traffic area for an enormous amount of freight transportation. National default age profiles make sense to use for freight vehicles, but for passenger vehicles, local data exists and was used for the age distribution for these first five (5) MOBILE6 vehicle-types.

Vehicle Identification Numbers (VIN) provided by the Indiana Bureau of Motor Vehicles (BMV) for the year 2003 for Clark, Floyd and Jefferson Counties were decoded and split into the first five (5) MOBILE6 vehicle-types. These age distributions are not expected to change much over time so they do not change for the different analysis years.

Speeds

Speeds can be an input to MOBILE6 in two different ways. MOBILE6 assumes Local and Ramp facility-types have fixed speeds of 12.9 and 34.6 mph, respectively. This cannot be changed; only Arterial and Freeway speeds can be input to MOBILE6. There is an Average Speed command that allows the average Freeway or Arterial speeds to be input. This is used extensively when building cross-reference tables for the emission factors mentioned previously. The most accurate and thorough MOBILE6 speed input method is to input speeds via two speed tables (one for Arterials and one for Freeways) which contain the fraction of VMT for each hour of the day that occurs in 14 speed-bins: 0-2.5mph, 2.5-7.5mph…up to >62.5 mph. Speeds that occur during the peak hours are slower than the off peak, for example MOBILE6 does contain national average default speeds that are useful for comparison purposes.

KIPDA uses the latter, more thorough method of inputting speeds. The travel model data is used to calculate a speed for each section of roadway. The roadway section volume, length and calculated speed are used to determine the VMT fraction to place into the proper speed bin in the speed tables.

Socioeconomic data
Travel demand forecasting models contain hundreds of Traffic Analysis Zones (TAZs) that have zone-specific information regarding population, households and employment, among other things. This data is commonly referred to as the "socioeconomic data". This data is updated most accurately when new census data comes out. This model was updated in 2005 based on 2000 census data.

8.4 ANALYSIS YEARS

The travel demand forecasting model also contains the road network, thus, the information is time specific. KIPDA has modeled the years 2002 and 2009. Each future analysis year scenario contains the road network based on KIPDA's long range transportation plan (and Transportation Improvement Program for the near term) that KIPDA expects to exist by the end of that year with the accompanying socioeconomic forecasts.

8.5 EMISSIONS ESTIMATIONS

Table 8.1 outlines the on-road emission estimates for the entire nonattainment area for the years 2002, 2005 and 2009. The 2002 and 2009 emission estimates are based on the actual travel demand forecasting model network for the years 2002 and 2009. The 2005 emissions estimates are interpolated values based on the 2002 and 2009 emissions estimates.

Table 8.1
Emissions Estimations for On-Road Mobile Sources

	2002	2005	2009
$PM_{2.5}$ (tons/year)	521.20	442.27	337.04
NO_x (tons/year)	35,440.81	28,997.24	20,405.80

Table 8.2 contains the mobile vehicle emissions budget (Budget) for 2009.

Table 8.2
Mobile Vehicle Emissions Budget

	2009
$PM_{2.5}$ (tons/year)	353.89
NO_x (tons/year)	21,426.09

Consistent with the federal implementation rule for fine particles, Indiana does not consider sulfur dioxide (SO_2) emissions from mobile sources to be a significant contributor to fine particle levels for this nonattainment area, as they constitute less than one percent (0.74%) of the area's projected total SO_2 emissions.

This document creates a motor vehicle emissions budget (Budget) for 2009 for the entire nonattainment area that describes the maximum on-road emissions that cannot be exceeded from the year 2009 and beyond. A reasonable cushion was applied to the projected 2009 emissions levels in establishing the $PM_{2.5}$ and NO_x Budgets. The emission estimates are derived from the MPO's travel demand forecasting model and MOBILE6 as described above. Cushions are used to accommodate the impact of refined assumptions in the process. The 2009 Budget with a reasonable cushion applied to it still remains well below the projected 2009 total $PM_{2.5}$ and NO_x base year emissions referenced in Table 8.1.

All methodologies, latest planning assumptions and the cushion were determined through the interagency consultation process.

9.0 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, emissions reduction potential, economic and social considerations or other factors that IDEM deems appropriate. IDEM will solicit input from interested and affected persons in the nonattainment 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. Indiana 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) Alternative fuel and diesel retrofit programs for fleet vehicle operations.
2) Require NO_x or SO_2 emission offsets for new and modified major sources.
3) Require NO_x or SO_2 emission offsets for new and modified minor sources.
4) Increase the ratio of emission offsets required for new sources.
5) Require NO_x or SO_2 controls on new minor sources (less than 100 tons).
6 Wood stove change-out program
7) Require increased recovery efficiency at sulfur recovery plants
8) Various emissions 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 half a percent (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 affects state and local governments deemed appropriate.
12) Enhanced vehicle inspection and maintenance program.

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.

10.0 PUBLIC PARTICIPATION

Indiana published notification for a public hearing and solicitation for public comment concerning the draft Attainment Demonstration Plan in the Indianapolis Star, Indianapolis, Indiana; the New Albany Tribune, New Albany, Indiana; the Evening News, Jeffersonville, Indiana; and the Madison Courier, Madison, Indiana, on or before April 4, 2008.

A public hearing to receive comments on the attainment demonstration plan was held on May 7, 2008, at the Clarksville Branch Library, 1312 Eastern Boulevard, Clarksville, Indiana and no comments were received. The public comment period closed on May 9, 2008. Two comment letters were received during the public comment period. A follow-up comment letter was also received after the public comment period. Appendix I includes a copy of the public notice, certifications of publication, the transcript from the public hearing, public hearing attendance record, copies of all written comments received and a summary of comments received that includes IDEM's responses, as applicable.

11.0 CONCLUSION

Monitored air quality in the Louisville KY-IN area has shown improvement in fine particle levels as a result of national and local control strategies implemented since designation. In fact, the current design value for the nonattainment area is within 1.2 micrograms per cubic meter of the standard. The design value in the area has dropped since 2001 and is predicted to continue to decline and achieve compliance with the standard in an expedient fashion.

This demonstration shows that NO_x and SO_2 emissions reductions since designation have had a positive effect on regional fine particle levels. This attainment demonstration shows that once the photochemical modeling results are considered along with additional national, regional, and local control measures to be phased-in or implemented in 2008 and 2009, air quality in the area will achieve attainment of the annual NAAQS for fine particles by April 5, 2010, and provide for an ample margin of safety.

This plan satisfies Indiana's obligation under Section 172(c) of the CAA to demonstrate how the area will attain the air quality annual standard for fine particles by the attainment date, and, as a result, realize cleaner air. The development of this plan will bring this region into compliance with state and federal fine particle air quality standards, and provide real progress in the state's journey toward cleaner air.