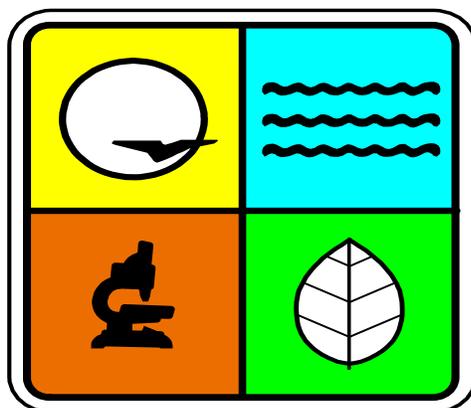


FINE PARTICLE (PM_{2.5}) BOUNDARY
RECOMMENDATION

And

**Technical Support Document for the Determination of
Boundaries in Missouri for the October, 2006
24-Hour Particulate Matter 2.5
National Ambient Air Quality Standard**



Adoption
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FINE PARTICLE BOUNDARY RECOMMENDATION

Introduction

This purpose of this document is to summarize the analysis of the 24-hour National Ambient Air Quality Standard (NAAQS) for Fine Particulate Matter 2.5 Microns (PM_{2.5}) in Missouri to support a recommendation to EPA for designation of geographic areas in the state as attainment for PM_{2.5}. In general, the analysis is based on information collected from the years 2004 - 2006 and the June 8, 2007 U.S. Environmental Protection Agency (EPA) guidance for developing the PM_{2.5} designation recommendations. The Missouri Department of Natural Resources' Air Pollution Control Program developed the "Technical Support Document For Determination of Nonattainment Area Boundaries in Missouri For the PM_{2.5} National Ambient Air Quality Standards" to assemble the information necessary to make the recommendations and to address each EPA criteria in detail.

Summary of Recommendation

This recommendation has been developed based on a review of the technical information as required by EPA guidance. Of primary consideration is a review of the counties that do meet or that do not contribute to ambient air quality in a nearby area that does meet the PM_{2.5} NAAQS.

There are no 24-hour PM_{2.5} monitors in the Missouri portion of the St. Louis PM_{2.5} annual NAAQS nonattainment area that currently violate the 24-hour PM_{2.5} NAAQS. A consistent level of attainment across the Missouri portion is provided for by the other 24-hour NAAQS. Therefore, the state of Missouri is recommending an attainment/unclassifiable designation.

Background

On January 17, 2006, EPA promulgated the amendment of PM₁₀ and PM_{2.5} air quality standards (71 Federal Register 2620). On October 17, 2006, EPA adopted PM₁₀ and PM_{2.5} air quality standards (71 Federal Register 61144). PM₁₀ and PM_{2.5} refer to fine particles with aerodynamic diameters average less than 10 and 2.5 microns. These standards were based on a number of health studies showing that increased exposure to PM_{2.5} is correlated with increased mortality and a range of serious health effects, including aggravation of lung disease, asthma attacks, and heart problems. EPA retained the PM_{2.5} annual standard of 15 micrograms per cubic meter and revised the 24-hour PM_{2.5} standard from 65 micrograms per cubic meter to 35 micrograms per cubic meter. Under the same action, EPA retained the existing 24-hour PM₁₀ and revoked the annual PM₁₀ standard.

PM_{2.5}

Fine particles (PM_{2.5}) are generally emitted from activities such as industrial and residential combustion and from vehicle exhaust. Fine particles are also formed in the atmosphere when gases such as sulfur dioxide, nitrogen oxides, and volatile organic compounds, also emitted largely by combustion activities, are chemically transformed in the atmosphere into particles.

The designation process is the first step of addressing this important public health issue. The Clean Air Act allows each state to recommend initial designations of the attainment status for all areas of the State. Section 107(d)(1) of the Act allows each state the opportunity to recommend attainment/unclassifiable and nonattainment areas including appropriate boundaries. EPA can then accept the recommendations or make modifications, as it deems necessary.

The deadline for submittal of Missouri's recommendation is December 18, 2007. By August 20, 2008, EPA is to notify Missouri concerning any modifications to the recommendation, and allow for comments to those changes. The deadline for EPA to finalize the boundary designation is December 18, 2008. This process may be extended up to one (1) year if EPA has insufficient information to make designations.

Upon designation, states have three years to prepare State Implementation Plans (SIPs) to address PM_{2.5}. EPA published an implementation rule on April 25, 2007, that established requirements for PM_{2.5} nonattainment areas. The deadline for attaining the PM_{2.5} standard is no later than five (5) years after the formal submittal of the PM_{2.5} SIP. As it currently stands, states will have to submit their PM_{2.5} SIPs due April 2012 (or 2013 if the date is extended) with the attainment date of April 2013 or 2014, five (5) years after designation date, and up to with a possible extension of up to five (5) years, (2018 or 2019).

Criteria for Designation

EPA published a guidance document titled "Guidance for Determining Boundaries of 24-hour Fine Particle Attainment and Nonattainment Areas" on June 8, 2007. This guidance was written to outline the information that states are expected to consider when making their nonattainment boundary recommendations. In that guidance, EPA recommends that the Metropolitan Statistical Area (MSA) or Consolidated Metropolitan Statistical Area serve as the presumptive boundary for the PM_{2.5} nonattainment area. The presumptive use of the MSA is based on evidence that violations of the PM_{2.5} standard generally include a significant urban-scale contribution as well as significant regional contributions.

To add or remove geography from the presumptive boundary (the Metropolitan Statistical Area), EPA's guidance requires each state to address the following factors:

- Emissions

- Air Quality
- Population Density and Degree of Urbanization including Commercial Development
- Traffic and Commuting Patterns
- Expected Growth
- Meteorological Influences (Weather and Transport Patterns)
- Geography and Topography
- Jurisdictional Boundaries
- Level of Current Emission Controls (Emission Control Potential)

Analysis of these factors may suggest nonattainment boundaries that are either larger or smaller than the MSA.

Process for Developing Recommendation

The department's Air Pollution Control Program developed this document and it was widely shared with stakeholders. Informational meetings with stakeholders were held on July 5th and 10th and September 11th and 20th, 2007, where the proposed recommendation was presented and discussed. The document was then presented at public hearing on October 25, 2007, before the Missouri Air Conservation Commission (MACC).

Boundary Considerations – Technical Discussion

This evaluation was limited to the Missouri counties. Counties or portions of counties that exhibit a pattern of significant contribution are included in the consideration of the St. Louis PM_{2.5} area. A review of the contributing factors must be done in a consistent manner. In some cases a review of one of the factors argue for inclusion, but a review of other factors may not. The decision of whether or not a county is included must be made in a holistic fashion. Due to the fact that each county has unique characteristics, each county must be evaluated through comparison to other counties.

Section 107(d)(1)(A) of the Clean Air Act defines a nonattainment area as any area that does not meet or that contributes to nearby areas not meeting the ambient air quality standard. The implementation of specific control strategies is not a part of this analysis. The selection of control strategies falls under the SIP process not the process of establishing nonattainment boundaries.

As the area with the highest PM_{2.5} levels in Missouri, it was determined that a first analysis of the St. Louis area and close counties was most appropriate. Following is a summarization of that analysis.

- **City of St. Louis**

All sites in St. Louis City are monitoring attainment of the 24-hour standard, at a consistent level. A comparison of monitoring data between urban and rural sites suggests that the rural background PM_{2.5} mass concentration is approximately 11 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) on an annual average. Therefore, the urban excess ranges up to 5 micrograms or so averaged annually. Only Granite City and VFW sites in Illinois, are in violation of 24-hour NAAQS standard.

PM_{2.5} speciation data provides insight. Sulfate tends to be high in the summer and contributes to summer mass peaks and Nitrate tends to be high in the winter and contribute to winter mass peaks. Organic and elemental carbon peaks don't show as much seasonality, but tend to occur more in the fall. As explained in the Technical Support Document (page 18) the urban excess can be further characterized by species as follows: Sulfate $\sim 0.5 \mu\text{g}/\text{m}^3$, Nitrate $\sim 1.8 \mu\text{g}/\text{m}^3$, Total Carbonaceous Mass $\sim 3.6 \mu\text{g}/\text{m}^3$, and Crustal $\sim 0.3 \mu\text{g}/\text{m}^3$. The data shows that the total carbonaceous mass is the species that contributes most to the urban excess. This conclusion has been confirmed in other studies around the country. It is likely that the carbonaceous mass has more of a local origin, and is less likely to be from transport. However, it is also apparent from speciation data that excess carbon is not the primary reason for high PM_{2.5} episodes in Missouri.

In comparison with the other Missouri counties the City of St. Louis is second in total VOC emissions, second in total NO_x emissions, fifth in total SO_x emissions, and fifth in total PM_{2.5} emissions. The City of St. Louis also ranks second in mobile emissions for every primary and secondary PM_{2.5} pollutant. (Note: total includes Point, Area, and Mobile sources only). Despite these emission levels, the design value for St. Louis City monitors is 33.6, well within attainment of the standard.

Traffic and commuting patterns as well as population density and degree of urbanization show connectivity of the City with the rest of the St. Louis, Missouri area. The population of the City of St. Louis is expected to decrease over time, but the area will retain a significant commuter base.

Conclusion: Given the fact that several monitors in St. Louis City show consistent levels of PM_{2.5} below the 24-hour standard, it is clear that emissions and other factors which indicate the connection of the City to the area are not causation for violations of the 24-hour PM_{2.5} NAAQS. This supports a recommendation of attainment/unclassifiable for, St. Louis City.

- **St. Louis County**

There are no monitors in St. Louis County that violate the 24-hour PM_{2.5} NAAQS. A comparison of monitoring data between urban and rural sites suggests that the rural background PM_{2.5} mass concentration is approximately 11 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$). Therefore, the urban excess in St. Louis County ranges up to 4 micrograms or so.

Approximately 46 percent of the total VOCs emitted in the Missouri MSA are from St. Louis County, ranking this County as the highest VOC emitting county in the Missouri MSA. St. Louis County also ranks first in total NO_x emissions, fourth in total SO_x emissions, first in total PM_{2.5} emissions, and second in total Ammonium (NH₃) emissions. Despite these emission levels, the design value for St. Louis County monitors is 32.3, well within attainment of the standard.

The population of St. Louis County exceeds the population of the other counties in the Missouri MSA, comprising 15.9% of the total population in 2005 of the Missouri MSA. The population of St. Louis County is expected to gradually increase.

Traffic and commuting patterns. St. Louis County leads all other Missouri MSA counties in Vehicle Miles Traveled (VMT). In comparison to other counties, the connectivity of residence to work location is also high.

Conclusion: A review of the various factors considered in the Technical Support Document for St. Louis County show that while emissions are significant, coupled with the ambient data, they are not causation of violations of the 24-hour PM_{2.5} NAAQS. Based on the connectivity of the other factors with areas of the St. Louis Missouri area, this supports a recommendation of attainment/unclassifiable for St. Louis County.

- **St. Charles County**

There are no monitors in St. Charles County that violate the 24-hour PM_{2.5} NAAQS. Values are very consistent with St. Louis City and St. Louis County levels. Analysis of speciation data for St. Louis City (Blair), Jefferson County (Arnold) and Ste. Genevieve (Bonne Terre) show patterns for PM_{2.5} species for the area. As mentioned previously, Sulfate, tends to be high in the summer and contributes to summer mass peaks and Nitrate tends to be high in the winter and contributes to winter mass peaks. Organic and elemental carbon peaks don't show as much seasonality, but tend to occur more in the fall. Indications are that for high episodes in the Missouri side of the area, regional sulfates and urban regional nitrate are the primary drivers for high Missouri episodes.

St. Charles is the third ranked county in the Missouri MSA in total VOC emissions, representing approximately 13 percent of the total. St. Charles also has significant NO_x emissions, ranking third in this category as well. St. Charles ranks second in total SO_x emissions and third in total PM_{2.5} emissions. Only an estimated 948.5 tons per year of NH₃ are emitted in St. Charles County, even below some of the Missouri counties that surround the Missouri MSA.

After St. Louis County and St. Louis City, St. Charles has the next highest population comprising approximately 15.4 percent in 2005 of the Missouri MSA. The population of St. Charles is expected to continue at an estimated growth rate of 23.4 percent by the year 2020.

St. Charles County has a significant amount of vehicle activity and high daily VMT. There is a great deal of connectivity of St. Charles residents with work locations located in St. Louis County and St. Louis City.

While the population of St. Charles is relatively high, portions of the county are certainly not considered urbanized. The population density drops off as the distance increases from the primary highways. Along the major highways, however, the population density is significant.

Conclusion: A review of the various factors considered in the Technical Support Document for St Charles County show that while emissions are significant, coupled with the ambient data, they are not causation of violations of the 24-hour PM_{2.5} NAAQS. Based on the connectivity of the other factors with areas of the Missouri portion of the area, this supports a recommendation of attainment/unclassifiable for St. Charles County.

- **Franklin County**

There are no PM_{2.5} monitors located in Franklin County. Because it is on the western edge of the MSA, wind patterns generally carry emissions to the north-northeast in summer, with some greater frequency of southeast in winter. Monitors in St. Charles County, St. Louis County and Jefferson County are nearest, and show a great degree of consistency with regard to the 24-hour PM_{2.5} standard.

There is significant overall VMT in Franklin County. The connectivity of Franklin County to the other foregoing MSA counties is considerable. 31 percent of Franklin County residents work in St. Louis County or St. Louis City, and 95 percent work in the MSA.

Large portions of Franklin County could be classified as rural, but there are pockets of significant population density and urbanization. The population of Franklin County is estimated to be in 2005 about 100,937, comprising approximately 5.1 percent of the total population of the Missouri MSA. The population of Franklin County is expected to grow quite rapidly at an expected rate of approximately 14.7 percent by 2020.

Compared to the foregoing counties, Franklin County has lower total VOC emissions. This does not indicate that they are insignificant however. Franklin County also has significant total NOx emissions and ranks first in SOx emissions (approximately 28 percent of the total NOx emissions of the Missouri MSA). There are several point sources located in Franklin County, and mobile emissions also play a significant role.

Conclusion: Emissions in Franklin County do not appear to be the causation of high PM_{2.5} in violation of the 24-hour NAAQS in counties where primary wind impacts are expected to the north-northeast and southwest. Those counties show levels below the PM_{2.5} 24-hour NAAQS, which are very consistent. Other factors such as traffic, population trends, and connectivity show connection to the St. Louis side of the area,

which has consistent air quality well below the PM_{2.5} 24-hour standard. This supports a recommendation of attainment/unclassifiable for Franklin County.

- **Jefferson County**

There are no monitors in Jefferson County that violate the 24-hour PM_{2.5} NAAQS. Values are very consistent with St. Louis City, St. Louis County, and St. Charles County levels.

Emissions from Jefferson County generally exceed those of Franklin. Of the Missouri MSA, Jefferson County is responsible for approximately 10 percent of the total VOC emissions (rank 4), 13 percent of the total NO_x emissions (rank 4), 24 percent of the total SO_x emissions (rank 3), and 21 percent of the total PM_{2.5} emissions (rank 2). Primary wind directions to the north in summer affect St. Louis City and County primarily, where air quality is below the 24-hour standard, with monitored values consistent between sites and with monitoring in Jefferson County.

Much of the analysis of traffic, population and connectivity analysis of Franklin County can be applied to Jefferson County. The population of the northern part in Jefferson County is much denser than the southern part of the county. There are pockets of urbanization, with most of the population located along major transportation corridors like Interstate 55. Much of the southern part of Jefferson County is rural. In 2005, an estimated 10.8 percent of the people living in the Missouri MSA live in Jefferson County, but much growth is expected. The population of Jefferson County is expected to increase by approximately 15.2 percent over the next 20 years.

Conclusion: Emissions in Jefferson County do not appear to be the causation of high PM_{2.5} in counties where primary wind impacts are expected to the north. In fact, those counties show levels well below the PM_{2.5} 24-hour NAAQS, which are very consistent. Other factors such as traffic, population trends, and connectivity show connection to the St. Louis Missouri side of the area, which has consistent air quality well below the PM_{2.5} 24-hour standard. This supports a recommendation of attainment/unclassifiable for Jefferson County.

- **Lincoln and Warren Counties**

There are no PM_{2.5} monitors located in Lincoln or Warren Counties.

Emissions are much lower in Lincoln and Warren County as compared to the other counties of the Missouri MSA. Together these counties are responsible for only 5 percent of the total VOC emissions of the Missouri MSA. Of the Missouri MSA, Lincoln and Warren together represent only 3 percent of the total NO_x emissions, 0.3 percent of the total SO_x emissions, and even though the counties are largely rural only a combined

16 percent of NH₃ emissions. The amount and distance of emissions do not support inclusion of these counties in the PM_{2.5} nonattainment area.

There is significant connectivity, but the population of these counties and the population density of these counties are quite low. The combined population of Lincoln and Warren Counties for 2005 is only an estimated 63,693, which is approximately 3.5 percent of the total population of the Missouri MSA.

Interstate 70 goes through Warren County and is associated with significant VMT. The population of these counties is also expected to have dramatic growth over the next twenty years. Both of these points, however, are mitigated by the fact that the population is very low.

Conclusion: Population growth and VMT on Interstate 70 are significant, however, the very low emission rates and the relatively large distance from the most populous parts of the MSA indicate that Lincoln and Warren Counties are not of significance in consideration of PM_{2.5} impacts and should be recommended as attainment/unclassifiable.

- **Surrounding Counties**

In general the population of the surrounding counties (St. Francois, Washington, Crawford, Pike, Ste. Genevieve, Gasconade, and Montgomery) is expected to have strong growth over the next twenty years. Emissions totals are generally quite low. For total VOC these counties range from only 1.6 percent (Montgomery County) of the total Missouri MSA up to only 4.1 percent (St. Francois County). Emissions of NO_x are also generally low, and range from 0.84 percent (Washington County) of the Missouri MSA up to only 6.5 percent (Pike County). The same applies to emissions of SO_x. SO_x emissions from Crawford County are only 0.06 percent of the total Missouri MSA, with Pike County at 8.0 percent. In addition to the relatively low emission rates, it is important to note that these counties are much more distant from the urban core than the counties recommended for inclusion in the PM_{2.5} nonattainment area. Overall population and population density are generally quite low as well. St. Francois County has the highest population in this group of surrounding counties, with a 2005 estimated population of 59,831 (about 3 percent of the total population of the Missouri MSA). On the other end of the spectrum Montgomery County has a 2005 estimated population of 12,269 (approximately 0.6 percent of the total Missouri MSA population). The population of most of these counties is expected to grow (with the exception of Pike County) over the next twenty years.

Ste. Genevieve County and Pike County do have some current and permitted major sources as well, but again these are located quite a distance from the bi-state urban core. The nearest monitors to the north (Ste. Genevieve County) and the South (Pike County) are below the 24-hour NAAQS, so that it is not believed that these sources are a causation for PM_{2.5} violations.

With the exception of St. Francois County, much of the VMT in these surrounding counties are associated with interstate highways. There is generally much lower connectivity in these surrounding counties, than there is in the counties of the Missouri

MSA. The non-point source emissions from the surrounding counties are very low in comparison to the Missouri MSA.

Conclusion: While there are a few large point sources located in the surrounding counties, the overall conclusion is that emissions in these counties are not a causation for violations of the PM_{2.5} standard in the Missouri area. The population density and rural nature of these counties also clearly supports this conclusion.

Kansas City Area and Remainder of Missouri Counties

There were eight Federal Reference Method (FRM) PM_{2.5} monitoring sites in the Kansas City area during 2004 to 2006, three in Missouri and five in Kansas. There were four FRM PM_{2.5} monitors in outstate Missouri (the remainder of the State outside the St. Louis and Kansas City areas). Design values based on 24-hour averages for Kansas City and outstate Missouri sites varied in a similar manner to annual averages. None of the Kansas City area sites or outstate Missouri sites exceeded the 24-hour standard during 2004 to 2006 (Table 3.1-1, TSD).

Conclusion: While the Kansas City area is highly populated and urban, the sources of PM_{2.5} located in the area emit pollutants at a level which are not violations of the PM_{2.5} standard. The rural areas and smaller urban centers of outstate Missouri also clearly do not contain sources that are a cause of PM_{2.5} levels of concern for violation of the 24-hour standard. Counties in these areas should be designated as attainment.