4.0 Analyses of Individual Nonattainment Areas

4.4 Region 4 Nonattainment Areas

4.4.3 Tennessee

Tennessee
Area Designations For the
24-Hour Fine Particle National Ambient Air Quality Standard

The table below identifies the counties in Tennessee that EPA intends to designate as not attaining the 2006 24-hour fine particle ($PM_{2.5}$) standard.[1] A county will be designated as nonattainment if it has an air quality monitor that is violating the standard or if the county is determined to be contributing to the violation of the standard.

Area	Tennessee Recommended Nonattainment Counties	EPA's Intended Nonattainment Counties
Clarksville, TN-KY	Montgomery (unclassifiable)	Montgomery Humphreys (partial) Stewart (partial)
Knoxville, TN	Attainment	Anderson Blount Knox Loudon Roane (partial)

<u>EPA Technical Analysis for Clarksville, TN-KY</u>

<u>Discussion</u>

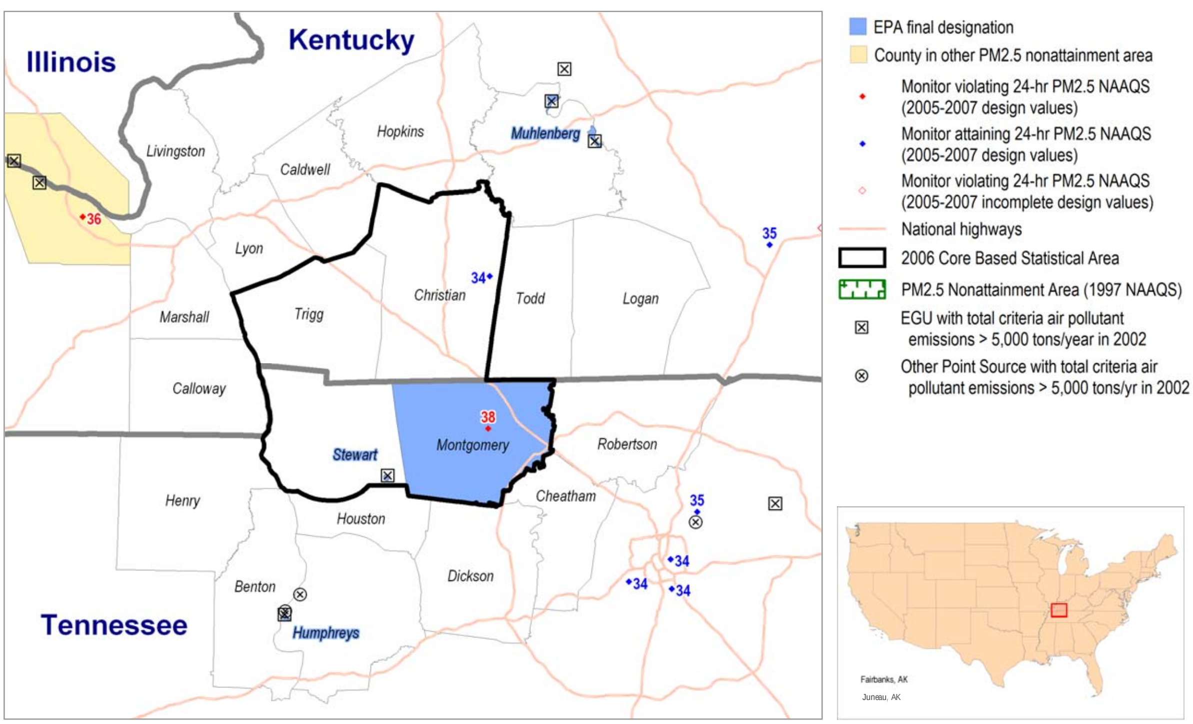
Pursuant to section 107(d) of the Clean Air Act, EPA must designate as nonattainment those areas that violate the NAAQS and those areas that contribute to violations. This technical analysis for the Clarksville, TN-KY area identifies the counties with monitors that violate the 24-hour $PM_{2.5}$ standard and evaluates the counties that potentially contribute to fine particle concentrations in the area. EPA has evaluated these counties based on the weight of evidence of the following nine factors recommended in EPA guidance and any other relevant information:

[1] EPA designated nonattainment areas for the 1997 fine particle standards in 2005. In 2006, the 24-hour $PM_{2.5}$ standard was revised from 65 micrograms per cubic meter (average of 98^{th} percentile values for 3 consecutive years) to 35 micrograms per cubic meter; the level of the annual standard for $PM_{2.5}$ remained unchanged at 15 micrograms per cubic meter (average of annual averages for 3 consecutive years).

- pollutant emissions
- air quality data
- population density and degree of urbanization
- traffic and commuting patterns
- growth
- meteorology
- geography and topography
- jurisdictional boundaries
- level of control of emissions sources

Figure 1 is a map of the counties in the area and other relevant information such as the locations and design values of air quality monitors, and the metropolitan area boundary.

Figure 1. Clarksville, TN-KY MSA



In December 2007, Tennessee recommended that the entire state be designated "attainment/unclassifiable." In summer of 2008, analysis of 2005-2007 Federal Reference Method monitoring data indicated that a monitor in Clarksville, TN (Montgomery County) was violating the standard with a design value of 37 ug/m3. Tennessee revised its recommendation in June 2008, requesting that designation for the Clarksville area be deferred or that Montgomery County be designated as "unclassifiable" for the 2006 24-hour $PM_{2.5}$ standard. (See Tennessee Department of

Environment and Conservation (TDEC) letters dated December 13, 2007, June 10, 2008, and October 20, 2008)

In August 2008, EPA notified Tennessee of its intent to designate Stewart and Humphreys Counties as contributing counties in the Clarksville nonattainment area. In this letter, EPA also requested that if the State wished to provide comments on EPA's intended designation, it should do so by October 20, 2008. EPA stated that it would consider any additional information (e.g., on power plants or partial county areas) provided by the state in making final decisions on the designations. Tennessee revised its recommendation in October 2008 to again request that Montgomery County be designated as "unclassifiable" for the 2006 24-hour $PM_{2.5}$ standard based on air quality data from 2005-2007, and also requested that EPA designate Stewart and Humphreys Counties as "attainment." However, the State also clarified that if EPA determines that Stewart and Humphreys Counties must be designated as "nonattainment," EPA should designate only a portion of those counties as nonattainment, and recommended specific census blocks including power plants with high emissions.

Based on EPA's technical analysis described below, EPA has designated Montgomery, Stewart (partial), and Humphreys (partial) Counties, Tennessee as nonattainment for the 24-hour $PM_{2.5}$ air-quality standard as part of the Clarksville, TN-KY nonattainment area, based upon currently available information. These counties are listed in the table below.

	State-Recommended Nonattainment Counties	EPA-Recommended Nonattainment Counties
Clarksville, TN-KY	Montgomery (unclassifiable)	Montgomery Humphreys (partial) Stewart (partial)

The following is a summary of the technical analysis for the Tennessee portion of the Clarksville, TN-KY area.

In general, the Clarksville, TN-KY area is a small metropolitan statistical area (MSA) with four counties. Montgomery county contains a monitor that is violating the $PM_{2.5}$ standard. Three other nearby counties are included in the nonattainment area on the basis of contributing emissions. Stewart county, also in the MSA, contains a power plant that has NO_X and SO_2 controls, yet still emits 35,000 tons of NO_X and 20,000 tons of SO_2 annually (based on 2006 emissions.) In addition, two non-MSA counties, Humphreys, TN, and Muhlenberg, KY, also have power plants. Humphreys' 2006 power plant emissions were approximately 20,000 tons of NO_X and 97,000 tons of SO_2, while Muhlenberg's 2006 power plant emissions were approximately 44,000 tons of NO_X and 98,000 tons of SO_2. (Note that these 2006 emissions levels vary to some degree from the 2005 emissions data presented in table 1.)

Factor 1: Emissions data

For this factor, EPA evaluated county level emission data for the following $PM_{2.5}$ components and precursor pollutants: "$PM_{2.5}$ emissions total," "$PM_{2.5}$ emissions carbon," "$PM_{2.5}$ emissions other," "SO_2," "NO_X," "VOCs," and "NH_3." "$PM_{2.5}$ emissions total" represents direct emissions of $PM_{2.5}$ and includes: "$PM_{2.5}$ emissions carbon," "$PM_{2.5}$ emissions other", primary sulfate (SO_4), and primary nitrate. (Although primary sulfate and primary nitrate, which are emitted directly from stacks rather than forming in atmospheric reactions with SO_2 and NO_X, are part of "$PM_{2.5}$ emissions total," they are not shown in Table 1 as separate items). "$PM_{2.5}$ emissions carbon" represents the sum of organic carbon (OC) and elemental carbon (EC) emissions, and "$PM_{2.5}$ emissions other" represents other inorganic particles (crustal). Emissions of SO_2 and NO_X, which are precursors of the secondary $PM_{2.5}$ components sulfate and nitrate, are also considered. VOCs (volatile organic compounds) and NH_3 (ammonia) are also potential $PM_{2.5}$ precursors and are included for consideration.

Emissions data were derived from the 2005 National Emissions Inventory (NEI), version 1. See http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html.

EPA also considered the Contributing Emissions Score (CES) for each county. The CES is a metric that takes into consideration emissions data, meteorological data, and air quality monitoring information to provide a relative ranking of counties in and near an area. Note that this metric is not the exclusive manner for considering data for these factors. A summary of the CES is included in attachment 2, and a more detailed description can be found at http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html#C.

Table 1 shows emissions of $PM_{2.5}$ and precursor pollutants components (given in tons per year) and the CES for violating and potentially contributing counties in Clarksville, TN-KY. Counties are listed in descending order by CES.

Table 1. $PM_{2.5}$ Related Emissions and Contributing Emissions Score

County	State Recom-mended Non-attain ment	CES	$PM_{2.5}$ emissions total (tpy)	$PM_{2.5}$ emissions carbon (tpy)	$PM_{2.5}$ emissions other (tpy)	SO_2 (tpy)	NO_X (tpy)	VOCs (tpy)	NH_3 (tpy)
Muhlenberg Co, KY	No	100	3,769	226	110	100,828	39,096	1,741	787
Humphreys Co, TN	No	92	6,359	368	249	77,765	23,238	5,458	730
Montgomery Co, TN	No	76	1,424	331	152	2,156	5,555	6,438	485
Stewart Co, TN	No	47	2,614	159	93	17,755	28,776	1,689	154
Dickson Co, TN	No	19	909	219	83	432	3,212	4,375	268
Robertson Co, TN	No	17	703	186	102	560	3,870	3,363	806
Cheatham	No	16	484	159	75	325	2,172	3,201	100

Co, TN									
Christian Co, KY	No	14	728	140	102	854	3,947	3,833	1,639
Trigg Co, KY	No	7	537	184	67	222	1,332	1,815	451

Based on emission levels and CES values, Montgomery, Stewart, and Humphreys Counties, Tennessee rank high for this factor and are candidates for a 24-hour $PM_{2.5}$ nonattainment designation. Other nearby Tennessee counties ranked low for this factor.

Factor 2: Air quality data

This factor considers the 24-hour $PM_{2.5}$ design values (in µg/m^3) for air quality monitors in counties in the Clarksville area based on data for the 2005-2007 period. A monitor's design value indicates whether that monitor attains a specified air quality standard. The 24-hour $PM_{2.5}$ standards are met when the 3-year average of a monitor's 98th percentile values are 35 µg/m^3 or less. A design value is only valid if minimum data completeness criteria are met.

The 24-hour $PM_{2.5}$ design values for counties in the Clarksville area with PM 2.5 monitors are shown in Table 2.

Table 2. Air Quality Data

County	State Recommended Nonattainment	24-hr $PM_{2.5}$ Design Values, 2004-2006 (µg/m^3)	24-hr $PM_{2.5}$ Design Values, 2005-2007 (µg/m^3)
Montgomery	No	34	38
Christian	No	30	33

Montgomery County shows a violation of the 24-hour $PM_{2.5}$ standard. Therefore, this county is included in the Clarksville nonattainment area. However, the absence of a violating monitor alone is not a sufficient reason to eliminate counties as candidates for nonattainment status. Each county has been evaluated based on the weight of evidence of the nine factors and other relevant information.

Under this factor, we also consider fine particle composition monitoring data. Air quality monitoring data on the composition of fine particle mass are available from the EPA Chemical Speciation Network and the IMPROVE monitoring network. Analysis of these data indicates that the days with the highest fine particle concentrations in the Clarksville region occur about 88% in the warm season and 12% in the cool season. In the warm season, the average chemical composition of the highest days is 72% sulfate, 24% carbon, 3% crustal, and 0% nitrate. In the cool season, the average chemical composition of the highest days is 34% sulfate, 34% nitrate, 29% carbon, and 3% crustal. These data indicate that sources of SO2, direct PM2.5, and NOx emissions contribute to violations in the area.

Note: Eligible monitors for providing design value data generally include State and Local Air Monitoring Stations (SLAMS) at population-oriented locations with an FRM monitor. All data from Special Purpose Monitors (SPM) using an FRM is eligible for comparison to the relevant NAAQS, subject to the requirements given in the October 17, 2006 Revision to Ambient Air Monitoring Regulations (71 FR 61236). All monitors used to provide data must meet the monitor siting and eligibility requirements given in 71 FR 61236 to 61328 in order to be acceptable for comparison to the 24-hr $PM_{2.5}$ NAAQS for designation purposes.

Factor 3: Population density and degree of urbanization (including commercial development)

Table 3 shows the 2005 population for each county in the Clarksville area, as well as the population density for each county in that area. Population data gives an indication of whether it is likely that population-based emissions might contribute to violations of the 24-hour $PM_{2.5}$ standards.

Based on this factor, Montgomery County, TN dominates the Clarksville area in terms of population and population density and warrants consideration in the Clarksville nonattainment area. Christian County, KY has the next highest population and density; however, Christian County has a monitor which shows attainment with the 24-hour $PM_{2.5}$ standards. Nearly 90 percent of the Clarksville MSA resides in Montgomery County, Tennessee and Christian County, Kentucky.

Table 3. Population

County	State Recommended Nonattainment	2005 Population	2005 Population Density (pop/sq mi)
Montgomery	No	146,845	270
Christian	No	69,735	96
Muhlenberg	No	31,562	66
Humphreys	No	18,208	33
Trigg	No	13,329	28
Stewart	No	12,975	26

Factor 4: Traffic and commuting patterns

This factor considers the number of commuters in each county who drive to another county within the Clarksville area, the percent of total commuters in each county who commute to other counties within the Clarksville area, as well as the total Vehicle Miles Traveled (VMT) for each county in thousands of miles (see Table 4). A county with numerous commuters is generally an integral part of an urban area and is likely contributing to fine particle concentrations in the area.

Table 4. Traffic and Commuting Patterns

County	State Recommended Non-attainment	2005 VMT (millions of miles)	Number Commuting to any violating counties	Percent Commuting to any violating counties	Number Commuting into and within the statistical area	Percent Commuting into and within the statistical area
Montgomery	No	1,343	40,570	62	56,550	87
Christian	No	1,002	2,080	6	31,190	95
Stewart	No	122	1,480	30	4,180	84
Trigg	No	262	140	3	5,010	93
Humphreys	No	341	50	1	120	2
Muhlenberg	No	311	20	0	230	2

The listing of counties on Table 5 reflects a ranking based on the number of people commuting to other counties. Montgomery County warrents consideration based on this and other factors (1, 2, and 3) and the CES.

Note: The 2005 VMT data used for table 5 and 6 of the 9-factor analysis has been derived using methodology similar to that described in "Documentation for the final 2002 Mobile National Emissions Inventory, Version 3, September 2007, prepared for the Emission Inventory Group, U.S. EPA. This document may be found at: atftp://ftp.epa.gov/EmisInventory/2002finalnei/documentation/mobile/2002_mobile_nei_version_3_report_092807.pdf
The 2005 VMT data were taken from documentation which is still draft, but which should be released in 2008.

Factor 5: Growth rates and patterns

This factor considers population growth for 2000-2005 and growth in vehicle miles traveled for 1996-2005 for counties in the Clarksville area, as well as patterns of population and VMT growth. A county with rapid population or VMT growth is generally an integral part of an urban area and likely to be contributing to fine particle concentrations in the area.

Table 5 below shows population, population growth, VMT and VMT growth for counties that are included in the Clarksville area. Counties are listed in descending order based on VMT growth between 1996 and 2005.

Table 5. Population and VMT Values and Percent Change.

Location	Population (2005)	Population Density (2005)	Population % change (2000 - 2005)	2005 VMT (millions of miles)	VMT % change (1996 to 2005)

Montgomery	146,845	270	9	1,343	20
Christian	69,735	96	(4)	1,002	18
Muhlenberg	31,562	66	(1)	311	29
Humphreys	18,208	33	2	341	43
Trigg	13,329	28	5	262	11
Stewart	12,975	26	4	122	21

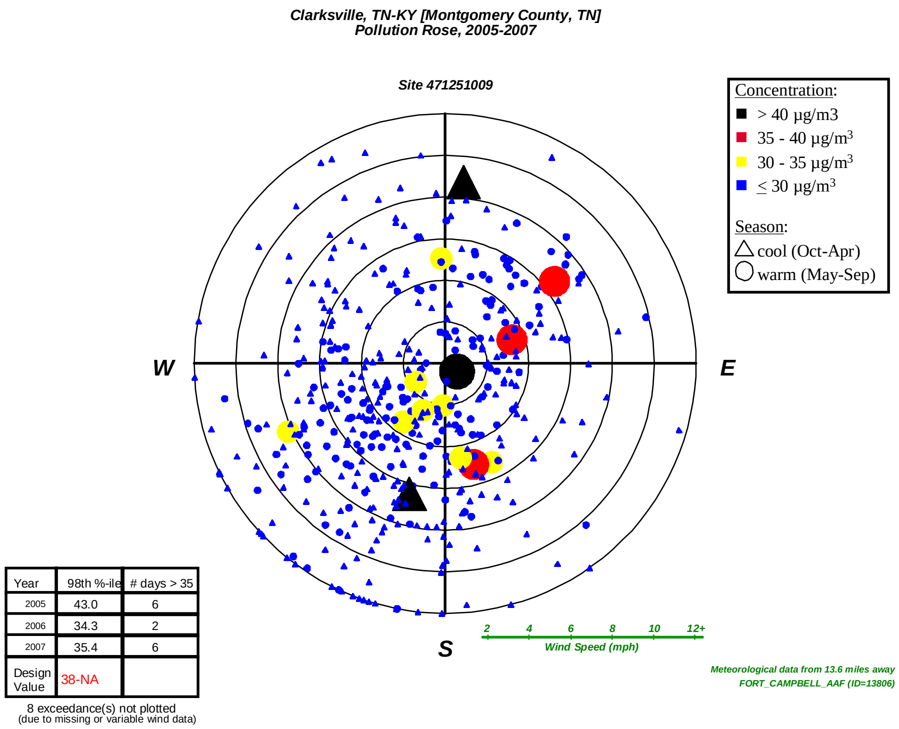
Montgomery County had relatively high population growth between 2000 and 2005, and warrants consideration based on this and other factors (1, 2, 3, and 4) and the CES.

Factor 6: Meteorology (weather/transport patterns)

For this factor, EPA considered data from National Weather Service instruments in the area. Wind direction and wind speed data for 2004-2006 were analyzed, with an emphasis on "high $PM_{2.5}$ days" for each of two seasons (an October-April "cold" season and a May-September "warm" season). These high days are defined as days where any FRM or FEM air quality monitors had 24-hour $PM_{2.5}$ concentrations above 95% on a frequency distribution curve of $PM_{2.5}$ 24-hour values.

For each air quality monitoring site, EPA developed a "pollution rose" to understand the prevailing wind direction and wind speed on the days with highest fine particle concentrations. The figure identifies 24-hour $PM_{2.5}$ values by color; days exceeding 35 ug/m3 are denoted with a red or black icon. A dot indicates the day occurred in the warm season; a triangle indicates the day occurred in the cool season. The center of the figure indicates the location of the air quality monitoring site, and the location of the icon in relation to the center indicates the direction from which the wind was blowing on that day. An icon that is close to the center indicates a low average wind speed on that day. Higher wind speeds are indicated when the icon is further away from the center.

Figure 2. Pollution rose for the Clarksville area.



As shown in the pollution rose in Figure 2, on high $PM_{2.5}$ days prevailing surface winds often come from the north or south. The pollution rose shows that 24-hour $PM_{2.5}$ concentrations are influenced by emissions from any direction at various times, but these data also suggest that emissions from some directions relative to the violation are more likely to contribute to the violation than emissions from other directions, specifically from the direction of Humphreys County, Tennessee, and Muhlenberg County, Kentucky.

Note: the meteorology factor is also considered in each county's Contributing Emissions Score because the method for deriving this metric included an analysis of trajectories of air masses for high $PM_{2.5}$ days.

Based on this factor and various others, Montgomery, Stewart, and Humphreys Counties in Tennessee warrant inclusion in the Clarksville nonattainment area.

Factor 7: Geography/topography (mountain ranges or other air basin boundaries)

The geography/topography analysis looks at physical features of the land that might have an effect on the air shed and, therefore, on the distribution of $PM_{2.5}$ over the Clarksville area.

The Clarksville, TN-KY area does not have any geographical or topographical barriers significantly limiting air-pollution transport within its air shed. Therefore, the absence of topographical and geographical barriers in this area supports our conclusion that emissions from Montgomery, Humphreys (partial), and Stewart (partial) Counties can be contributing to violations in the area.

Factor 8: Jurisdictional boundaries (e.g., existing PM and ozone areas)

The Clarksville area is not an existing area under the 1997 $PM_{2.5}$ standards, but is a maintenance area (Montgomery County only) for the 1-hour and 8-hour ozone standards. Therefore, based on this factor and others (1, 2, 3, 4, and 6) and the CES, Montgomery County warrants consideration in the Clarksville nonattainment area.

Factor 9: Level of control of emission sources

This factor considers emission controls currently implemented for major sources in the Clarksville area.

The emission estimates on Table 1 (under Factor 1) include any control strategies implemented by the states in the Clarksville area before 2005 that may influence emissions of any component of $PM_{2.5}$ emissions (i.e., total carbon, SO_2, NO_X, and crustal $PM_{2.5}$).

In considering county-level emissions, EPA used data from the 2005 National Emissions Inventory, the most updated version of the national inventory available at the beginning of the designations process in late 2007. However, EPA recognized that for certain counties, emissions may have changed since 2005. For example, certain power plants or large sources of emissions in or near this area may have installed emission controls or otherwise significantly reduced emissions since 2005. Some States provided updated information on emissions and emission controls in their comments to EPA. EPA considered such additional information in making final designation decisions.

With regard to nearby power plants, EPA considered information about whether a specific plant installed federally enforceable emission controls by December 2008 resulting in significant emissions reductions. A control requirement is considered to be federally-enforceable if it is required by a State regulation adopted in a State implementation plan, if it is included in a federally-enforceable Title V operating permit, or if it is required by a consent decree which also requires the controls to be included in federally enforceable permit upon termination of the consent decree. In making final decisions, EPA also considered whether a facility would continue to emit pollutants which contribute to $PM_{2.5}$ exceedances even after emission controls are operational.

It should be noted that there are several electric generating units (EGU) within the area. Specifically, they reside in Muhlenberg, Humphreys, and Stewart Counties. The control levels on these power plants can be seen in the table below, and represent moderate to heavy control on emissions from these plants.

County	Plant	Unit	Controls	Operating Date	2006 SO_2 (tons)	2006 NO_X (tons)
Stewart, TN	Cumberland	2	Cold-side ESP + SCR + Wet Scrubber	All by 2004	9,538	18,704
Stewart, TN	Cumberland	1	Cold-side ESP + SCR + Wet Scrubber	All by 2003	8,814	15,656
Humphreys, TN	Johnsonville	10	Cold-side ESP	No SCR or scrubber	10,369	2,159
Humphreys, TN	Johnsonville	8	Cold-side ESP	No SCR or scrubber	9,947	2,085
Humphreys, TN	Johnsonville	7	Cold-side ESP	No SCR or scrubber	9,179	1,915
Humphreys, TN	Johnsonville	3	Cold-side ESP + Cyclone	No SCR or scrubber	9,175	1,901
Humphreys, TN	Johnsonville	2	Cold-side ESP + Cyclone	No SCR or scrubber	8,961	1,854
Humphreys, TN	Johnsonville	1	Cold-side ESP + Cyclone + SNCR	No SCR or scrubber	8,920	1,861
Humphreys, TN	Johnsonville	6	Cold-side ESP + Cyclone	No SCR or scrubber	8,749	1,817
Humphreys, TN	Johnsonville	9	Cold-side ESP	No SCR or scrubber	7,986	1,670
Humphreys, TN	Johnsonville	4	Cold-side ESP + Cyclone	No SCR or scrubber	7,909	1,592
Humphreys, TN	Johnsonville	5	Cold-side ESP + Cyclone	No SCR or scrubber	5,597	1,293

Muhlenberg, KY	Paradise	3	Cold-side ESP + SCR + Wet Scrubber	All by 2006	52,974	16,837
Muhlenberg, KY	Paradise	2	SCR + Wet Scrubber, OFA	All by 2000	15,805	13,040
Muhlenberg, KY	Paradise	1	SCR + Wet Scrubber, OFA	All by 2001	15,146	13,145
Muhlenberg, KY	Green River	all		No SCR or scrubber	14,000	1,500

Legend	
ESP	Electrostatic Precipitator
OFA	Over Fired Air
SCR	Selective Catalytic Reduction

Based on emission control levels as well as other factors (1, 6) and CES values, parts of Stewart and Humphreys Counties, Tennessee warrant inclusion in the Clarksville 24-hour $PM_{2.5}$ nonattainment designation. Even with emission controls installed at the TVA Cumberland plant in Stewart county, the plant still emits a substantial level of emissions and contributes to fine particle concentrations at the nearby violating monitor. The Johnsonville plant in Humphreys county emits a substantial level of emissions from ten unscrubbed units and also contributes to fine particle concentrations at the nearby violating monitor.

Conclusion

EPA concludes that the appropriate nonattainment boundary for the Clarksville area includes Montgomery, Humphreys (partial), and Stewart (partial) Counties in Tennessee based on analysis of the above factors and other analytic tools. Specifically, a review of the emissions and meteorology factors indicate that the Cumberland plant in Stewart county and the Johnsonville plant in Humphreys county have high emissions that impact the violating monitor in Montgomery county. However, the factors do not support inclusion of the entire county in each case, so EPA has limited the nonattainment area to Montgomery county plus two partial counties in Tennessee and part of Muhlenberg county in Kentucky.

Additional information regarding responses to specific State comments can be found in EPA's Response to State Comments document at http://www.epa.gov/pmdesignations/2006standards/tech.htm.

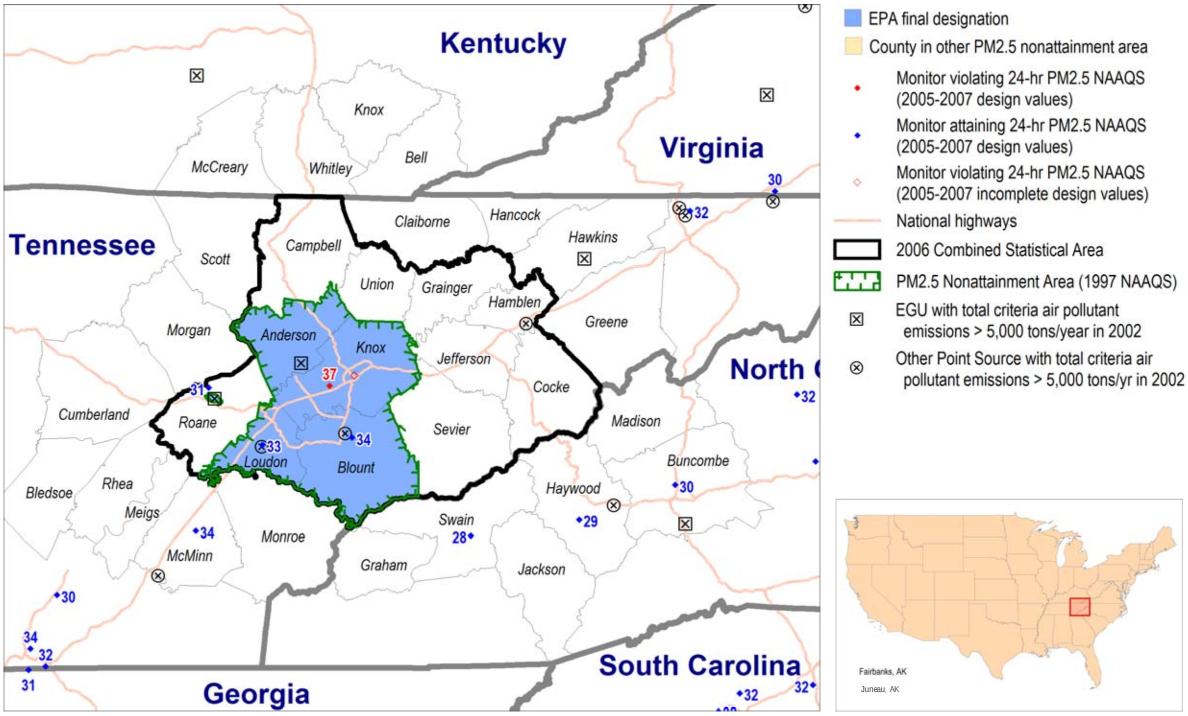
EPA Technical Analysis for Knoxville

Pursuant to section 107(d) of the Clean Air Act, EPA must designate as nonattainment those areas that violate the NAAQS and those nearby areas that contribute to violations. This technical analysis for Knoxville identifies the counties with monitors that violate the 24-hour $PM_{2.5}$ standard and evaluates nearby counties for contributions to fine particle concentrations in the area. EPA has evaluated these counties based on the weight of evidence of the following nine factors recommended in EPA guidance and any other relevant information:

- pollutant emissions
- air quality data
- population density and degree of urbanization
- traffic and commuting patterns
- growth
- meteorology
- geography and topography
- jurisdictional boundaries
- level of control of emissions sources

Figure 1 is a map of the counties in the area and other relevant information such as the locations and design values of air quality monitors, the metropolitan area boundary, and counties recommended as nonattainment by the State.

Figure 1. Knoxville-Sevierville-La Follette, TN CSA



For this area, EPA previously established $PM_{2.5}$ nonattainment boundaries for the 1997 $PM_{2.5}$ NAAQS that included 4 full and 1 partial counties (Knox, Blount, Loudon, Anderson, and part of Roane), with all being located in Tennessee. Data from 2005-2007 indicate that air quality monitors in Loudon and Knox Counties continue to violate the annual $PM_{2.5}$ standard of 15 ug/m^3 with design values of 15.7 ug/m^3.

In December, 2007, Federal Reference Method (FRM) monitors located in the State Tennessee recommended that Knoxville be designated as "attainment" for the 2006 24-hour $PM_{2.5}$ standard based on air quality data from 2004-2006. These . However, data for 2005-2007 indicate that a monitor in Knox County violates the 24-hour $PM_{2.5}$ standard with a value of 37 ug/m3. (Tennessee Department of Environment and Conservation (TDEC) letters dated December 13, 2007, June 10, 2008, and October 20, 2008)

In August 2008, EPA notified Tennessee of its intended designations. In this letter, EPA also requested that if the State wished to provide comments on EPA's intended designation, it should do so by October 20, 2008. EPA stated that it would consider any additional information (e.g., on power plants or partial county areas) provided by the State in making final decisions on the designations.

In October 2008, Tennessee provided additional information regarding the Knoxville area. The State accepted EPA's proposed boundary on the condition that EPA resolves all exceptional events claims prior to the final designation. See Attachment 3 in this document for further details on exceptional events in the Knoxville area.

Based on EPA's technical analysis described below, EPA has designated the same counties as previously designated for PM2.5 as nonattainment for the 24-hour $PM_{2.5}$ air-quality standard as part of the Knoxville nonattainment area, based upon currently available information. These counties are listed in the table below.

	State-Recommended Nonattainment Counties	EPA-Final Designated Nonattainment Counties
Knoxville, TN	None	Anderson Blount Knox Loudon Roane (partial)

The following is a summary of the technical analysis for the EPA Region 4 portion of the Knoxville Area.

The analysis of nine factors below indicates that the same five counties have the highest contributing emission scores in the area. The violating monitor is located in Knox County, the central county in the metropolitan area and the largest in terms of population and commuting. Roane and Anderson counties have large point sources and the highest emissions of SO_2 in the area, and they are identified as contributors to the high sulfate levels in the area. Loudon County and Blount County, both of which border Knox County, have moderate levels of SO_2 emissions and direct carbonaceous $PM_{2.5}$. Loudon and Blount also show some of the highest rates of population growth in the area.

Factor 1: Emissions data

For this factor, EPA evaluated county level emission data for the following $PM_{2.5}$ components and precursor pollutants: "$PM_{2.5}$ emissions total," "$PM_{2.5}$ emissions carbon," "$PM_{2.5}$ emissions other," "SO_2," "NO_X," "VOCs," and "NH_3." "$PM_{2.5}$ emissions total" represents direct emissions of $PM_{2.5}$ and includes: "$PM_{2.5}$ emissions carbon," "$PM_{2.5}$ emissions other", primary sulfate (SO_4), and primary nitrate. (Although primary sulfate and primary nitrate, which are emitted directly from stacks rather than forming in atmospheric reactions with SO_2 and NO_X, are part of "$PM_{2.5}$ emissions total," they are not shown in Table 1 as separate items). "$PM_{2.5}$ emissions carbon" represents the sum of organic carbon (OC) and elemental carbon (EC) emissions, and "$PM_{2.5}$ emissions other" represents other inorganic particles (crustal). Emissions of SO_2 and NO_X, which are precursors of the secondary $PM_{2.5}$ components sulfate and nitrate, are also considered. VOCs (volatile organic compounds) and NH_3 (ammonia) are also potential $PM_{2.5}$ precursors and are included for consideration.

Emissions data were derived from the 2005 National Emissions Inventory (NEI), version 1. See http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html

EPA also considered the Contributing Emissions Score (CES) for each county. The CES is a metric that takes into consideration emissions data, meteorological data, and air quality monitoring information to provide a relative ranking of counties in and near an area. Note that this metric is not the exclusive manner for considering data for these factors. A summary of the CES is included in attachment 2, and a more detailed description can be found at http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html#C.

Table 1 shows emissions of $PM_{2.5}$ and precursor pollutants components (given in tons per year) and the CES for violating and potentially contributing counties in the Knoxville area. Counties that are part of the Knoxville nonattainment area for the 1997 $PM_{2.5}$ NAAQS are shown in boldface.

Table 1. $PM_{2.5}$ Related Emissions and Contributing Emissions Score

County	State	State Recommended Nonattainment	CES Score	NO_X	SO_2	PM2_5	OC	EC
Roane Co	**TN**	**No**	**24**	**17759**	**56838**	**3447**	**196**	**131**
Anderson Co	**TN**	**No**	**41**	**16765**	**40905**	**2549**	**240**	**134**
Blount Co	**TN**	**No**	**35**	**4412**	**5126**	**2113**	**314**	**144**
Knox Co	**TN**	**No**	**100**	**21460**	**3289**	**1696**	**363**	**353**
Jefferson Co	TN	No	17	3787	375	1117	411	112
Loudon Co	**TN**	**No**	**22**	**6358**	**4647**	**809**	**198**	**100**
Sevier Co	TN	No	15	2877	294	716	309	90
Hamblen Co	TN	No	3	4947	6555	665	170	75
Union Co	TN	No	4	909	188	281	73	23
Grainger Co	TN	No	2	762	145	233	79	26

Table 1 indicates that Knox has the highest contributing emissions score, followed by Anderson, Blount, Roane and Loudon Counties. These are the same five counties that were designated as part of the Knoxville nonattainment area for violating the 1997 $PM_{2.5}$ standards. Roane and Anderson Counties have large point sources and the highest emissions of SO_2 in the area, and they are identified as contributors to the high sulfate levels in the area. Direct carbonaceous $PM_{2.5}$ contributing counties include Roane, Anderson, Blount, and Knox County. Jefferson and Sevier Counties have low emissions relative to the MSA.

Based on emission levels and CES values, Knox, Anderson, Blount, Roane and Loudon Counties, Tennessee are candidates for a 24-hour $PM_{2.5}$ nonattainment designation.

Factor 2: Air quality data

This factor considers the 24-hour $PM_{2.5}$ design values (in µg/m^3) for air quality monitors in counties in the Knoxville based on data for the 2005-2007 period. A monitor's design value indicates whether that monitor attains a specified air quality standard. The 24-hour $PM_{2.5}$ standards are met when the 3-year average of a monitor's 98th percentile values are 35 µg/m^3 or less. A design value is only valid if minimum data completeness criteria are met.

The 24-hour $PM_{2.5}$ design values for counties in the Knoxville Area are shown in Table 2.

Table 2. Air Quality Data

County	State	State Recommended Nonattainment	2004-2006 24-hr $PM_{2.5}$ Design Value (µg/m3)	2005-2007 24-hr $PM_{2.5}$ Design Value (µg/m3)
Blount	TN	No	30	34
Knox	TN	No	33	37
Loudon	TN	No	31	33
Roane	TN	No	30	31

Knox County shows a violation of the 24-hour $PM_{2.5}$ standard based on 2005-2007 data. Therefore, this county is included in the Knoxville nonattainment area. It should also be noted that Loudon County currently has a monitor that continues to violate the annual standard for $PM_{2.5}$. However, the absence of a violating monitor alone is not a sufficient reason to eliminate counties as candidates for nonattainment status. Each county has been evaluated based on the weight of evidence of the nine factors and other relevant information.

Note: Eligible monitors for providing design value data generally include State and Local Air Monitoring Stations (SLAMS) at population-oriented locations with a FRM. All data from Special Purpose Monitors (SPM) using an FRM is eligible for comparison to the relevant NAAQS, subject to the requirements given in the October 17, 2006 Revision to Ambient Air Monitoring Regulations (71 FR 61236). All monitors used to provide data must meet the monitor siting and eligibility requirements given in 71 FR 61236 to 61328 in order to be acceptable for comparison to the 24-hr $PM_{2.5}$ NAAQS for designation purposes.

Factor 3: Population density and degree of urbanization (including commercial development)

Table 3 shows the 2005 population for each county in the area being evaluated, as well as the population density for each county in that area. Population data gives an indication of whether it is likely that population-based emissions might contribute to violations of the 24-hour $PM_{2.5}$ standards.

From Table 3, it is shown that Knox County has the highest population and is the most densely populated county in the area. As such, Knox County is the largest contributor from a population perspective to the high levels of $PM_{2.5}$ in the Knoxville area. Blount, Sevier (which has low emissions relative to the MSA), and Anderson are moderately sized counties, with populations ranging from 70,000 to 115,000.

Table 3. Population

County	State	2000 Population	2005 Population	2000-2005 Population Growth	2005 Population Density (person/sq mi)
Knox Co	TN	382032	409116	6	778
Blount Co	TN	105823	115261	9	203
Sevier Co	TN	71170	79593	11	133
Anderson Co	TN	71330	71801	2	208
Hamblen Co	TN	58128	60017	3	341
Roane Co	TN	51910	52624	2	133
Jefferson Co	TN	44294	47913	8	152
Loudon Co	TN	39086	43242	11	174
Grainger Co	TN	20659	22109	7	73
Union Co	TN	17808	18660	6	75

Based on this factor, Knox County dominates the Knoxville area in terms of population and population density, followed by Blount and Anderson Counties, and all warrant consideration in the Knoxville nonattainment area.

Factor 4: Traffic and commuting patterns

This factor considers the number of commuters in each county who drive to another county within the Knoxville area, the percent of total commuters in each county who commute to other counties within the Knoxville area, as well as the total Vehicle Miles Traveled (VMT) for each county in millions of miles (see Table 4). A county with numerous commuters is generally an integral part of an urban area and is likely contributing to fine particle concentrations in the area.

Table 4. Traffic and Commuting Patterns

County	State Recommended nonattainment	2005 VMT (millions of miles)	Number Commuting to any violating counties	Percent Commuting to any violating counties	Number commuting into and within the statistical area	Percent commuting into and within the statistical area
Knox	**No**	6,139	158,290	86	180,970	98
Blount	**No**	1,236	13,610	28	47,610	97
Sevier	No	1,054	6,520	19	33,800	99
Anderson	**No**	774	8,120	27	30,020	98
Hamblen	No	624	890	3	25,700	96
Roane	**No**	577	3,180	14	20,710	93
Jefferson	No	777	4,380	22	19,710	98
Loudon	**No**	738	4,580	26	15,740	90
Grainger	No	223	2,070	24	8,200	94
Union	No	126	3,870	54	7,020	97

The counties that are in the nonattainment area for the 1997 $PM_{2.5}$ NAAQS are shown in boldface.

From Table 4, Knox County has the highest number of commuters and highest VMT of any county in the area. Most Knox County commuters stay in the county. The other counties with the highest number of commuters into Knox County are Blount, Sevier (which has low emissions relative to the MSA), Anderson, and Loudon. For all of these counties plus Union County, 80% or more of their commuters travel to other counties within the Knoxville metropolitan area.

Note: Note: The 2005 VMT data used for tables 4 and 5 of the technical analysis have been derived using methodology such as that described in "Documentation for the 2005 Mobile National Emissions Inventory, Version 2," December 2008, prepared for the Emission Inventory Group, U.S. EPA. This document may be found at: ftp://ftp.epa.gov/EmisInventory/2005_nei/mobile_sector/documentation/2005_mobile_nei_version_2_report.pdf.

Factor 5: Growth rates and patterns

This factor considers population growth for 2000-2005 and growth in vehicle miles traveled for 1996-2005 for counties in the Knoxville area, as well as patterns of population and VMT growth. A county with rapid population or VMT growth is generally an integral part of an urban area and likely to be contributing to fine particle concentrations in the area.

Table 5 below shows population, population growth, VMT and VMT growth for counties that are included in the Knoxville area. Counties are listed in descending order based on VMT growth between 1996 and 2005.

Table 5. Population and VMT Values and Percent Change

County	2005 Population	2005 Population Density (person/sq mi)	Population % change (2000	2005 VMT (millions of miles)	VMT % change (1996 to 2005)
Sevier	79,339	133	11	1,054	74
Knox	405,355	771	6	6,139	46
Jefferson	48,261	154	8	777	32
Grainger	22,188	73	7	223	28
Blount	115,616	204	9	1,236	26
Union	19,005	77	6	126	25
Loudon	43,411	176	11	738	22
Hamblen	60,191	343	3	624	13
Anderson	72,518	210	2	774	5
Roane	52,753	133	2	577	(12)

From Table 5, it is shown that Knox County dominates the area with respect to VMT. Additionally, the county has demonstrated a 46% increase in VMT over the 10 year period spanning from 1996 to 2005. Sevier County (which has low emissions relative to the MSA), is also a county identified through this factor, due to its high VMT growth rate, of 74%. Additionally, Sevier County has the second highest VMT in the area, although this number only represents about 17% of Knox County's VMT.

The counties with the highest rates of population growth from 2000-2005 (see table 3) are Loudon (11%), Sevier (11%), and Blount (9%).

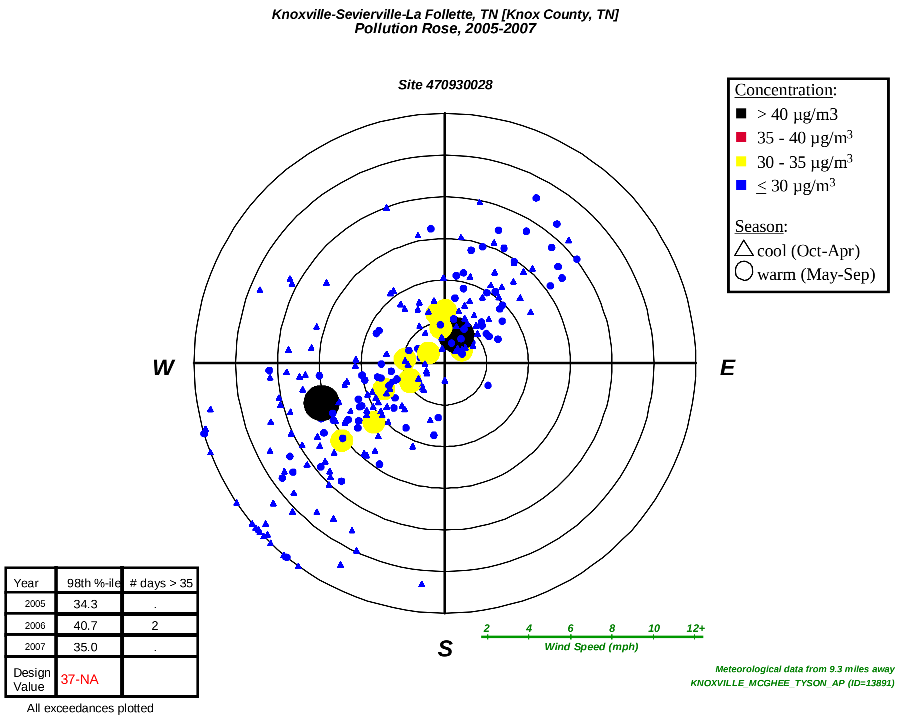
Knox and Blount Counties warrant consideration based on this and other factors (1 – 4 for Knox, 1, 3, and 4 for Blount) and the CES.

Factor 6: Meteorology (weather/transport patterns)

For this factor, EPA considered data from National Weather Service instruments in the area. Wind direction and wind speed data for 2004-2006 were analyzed, with an emphasis on “high $PM_{2.5}$ days” for each of two seasons (an October-April “cold” season and a May-September “warm” season). These high days are defined as days where any FRM or FEM air quality monitors had 24-hour $PM_{2.5}$ concentrations above 95% on a frequency distribution curve of $PM_{2.5}$ 24-hour values.

For each air quality monitoring site, EPA developed a “pollution rose” to understand the prevailing wind direction and wind speed on the days with highest fine particle concentrations. The figure identifies 24-hour $PM_{2.5}$ values by color; days exceeding 35 ug/m3 are denoted with a red or black icon. A dot indicates the day occurred in the warm season; a triangle indicates the day occurred in the cool season. The center of the figure indicates the location of the air quality monitoring site, and the location of the icon in relation to the center indicates the direction from which the wind was blowing on that day. An icon that is close to the center indicates a low average wind speed on that day. Higher wind speeds are indicated when the icon is further away from the center.

Figure 2. Pollution Rose for Knox County, TN



As shown in the pollution rose in Figure 2, on high $PM_{2.5}$ days prevailing surface winds typically come from the northeast and southwest. The pollution roses show that 24-hour $PM_{2.5}$ concentrations are influenced by emissions from any direction at various times, but these data also suggest that emissions from the direction of both Loudon and Roane Counties are more likely to contribute to the violation than emissions from other directions.

Note: the meteorology factor is also considered in each county's Contributing Emissions Score because the method for deriving this metric included an analysis of trajectories of air masses for high $PM_{2.5}$ days.

Factor 7: Geography/topography (mountain ranges or other air basin boundaries)

The geography/topography analysis looks at physical features of the land that might have an effect on the air shed and, therefore, on the distribution of $PM_{2.5}$ over the Knoxville area.

The Knoxville area does not have any geographical or topographical barriers significantly limiting air-pollution transport within its air shed. Therefore, this factor did not play a significant role in the decision-making process.

Factor 8: Jurisdictional boundaries (e.g., existing PM and ozone areas)

In evaluating the jurisdictional boundary factor, EPA gave special consideration to areas that were already designated nonattainment in 2005 for violating the 1997 fine particle standards. Analysis of chemical composition data in these areas indicates that the same components that make up most of the $PM_{2.5}$ mass in the area on an annual average basis (such as sulfate and direct $PM_{2.5}$ carbon in many eastern areas) also are key contributors to the $PM_{2.5}$ mass on days exceeding the 24-hour $PM_{2.5}$ standard. These data indicate that in many cities, the same source categories that contribute to violations of the annual standard also contribute to exceedances of the 24-hour standard.

Most areas that were originally designated nonattainment for the $PM_{2.5}$ standards still have not attained the standards. Thus, EPA has generally concluded that counties that were designated as having emissions sources contributing to fine particle concentrations which continue to exceed the 1997 standards (all areas violated the annual standard, two also violated the previous 24-hour standard) also contribute to fine particle concentrations on the highest days. For this reason, EPA believes that for most existing nonattainment areas, the nonattainment area for the 2006 24-hour standard should be the same. Consideration also should be given to existing boundaries and organizations as they may facilitate air quality planning and the implementation of control measures to attain the standard. Areas already designated as nonattainment represent important boundaries for state air quality planning.

From a EPA perspective, the major jurisdictional boundary in the Knoxville Area is the Knoxville MSA. This includes Anderson, Blount, Knox, Loudon, and Union County, Tennessee. Knox County is the only county with air-quality monitors that violate the 1997 $PM_{2.5}$ NAAQS.

Other jurisdictional boundaries, for the Knoxville Area, that should be considered are the 8-hour ozone nonattainment area, and the annual $PM_{2.5}$ nonattainment area. These boundaries are defined below:

8-hour Ozone Nonattainment Area:
Anderson, Blount, Knox, Loudon, Sevier, Jefferson, and Cocke County, Tennessee

Annual $PM_{2.5}$ Nonattainment Area:
Anderson, Blount, Knox, Loudon, and Roane (partial) County, Tennessee

Factor 9: Level of control of emission sources

This factor considers emission controls currently implemented for major sources in the Knoxville area.

The emission estimates on Table 1 (under Factor 1) include any control strategies implemented by the states in the Knoxville area before 2005 that may influence emissions of any component of $PM_{2.5}$ emissions (i.e., total carbon, SO_2, NO_X, and crustal $PM_{2.5}$). Anderson, Blount, Jefferson, Loudon, and Sevier County, are all subject to Prevention of Significant Deterioration (PSD) requirements, Reasonably Available Control Technology, Maximum Achievable Control Technology for Hazardous Air Pollutants, and New Source Performance Standards.

In considering county-level emissions, EPA used data from the 2005 National Emissions Inventory, the most updated version of the national inventory available at the beginning of the designations process in late 2007. However, EPA recognized that for certain counties, emissions may have changed since 2005. For example, certain power plants or large sources of emissions in or near this area may have installed emission controls or otherwise significantly reduced emissions since 2005. Some States provided updated information on emissions and emission controls in their comments to EPA. EPA considered such additional information in making final designation decisions.

With regard to nearby power plants, EPA considered information about whether a specific plant installed federally enforceable emission controls by December 2008 resulting in significant emissions reductions. A control requirement is considered to be federally-enforceable if it is required by a State regulation adopted in a State implementation plan, if it is included in a federally-enforceable Title V operating permit, or if it is required by a consent decree which also requires the controls to be included in federally enforceable permit upon termination of the consent decree. In making final decisions, EPA also considered whether a facility would continue to emit pollutants which contribute to $PM_{2.5}$ exceedances even after emission controls are operational.

In its October 20, 2008, letter to EPA, Tennessee provided updated information on power plant controls for Anderson and Roane Counties. The Tennessee Valley Authority – Bull Run Fossil Plant will have scrubbers online by the end of 2008, and in two phases, at the Kingston Fossil Plant in 2009 and 2010, respectively.

Although EPA agrees that these new and future emissions controls will have a positive impact on air quality in the Knoxville area, we do not agree that this information warrants the exclusion of Anderson and Roane Counties. While we agree that new scrubbers at both plants will provide for reductions in SO_2 emissions in 2009 and beyond, we asked for more information in order to consider new controls.

Specifically, EPA requested additional information on:

- the plant name, city, county, and township/tax district
- identification of emission units at the plant, fuel use, and megawatt capacity
- identification of emission units on which controls will be installed, and units on which controls will not be installed
- identification of the type of emission control that has been or will be installed on each unit, the date on which the control device became / will become operational,

and the emission reduction efficiency of the control device
- the estimated pollutant emissions for each unit before and after implementation of emission controls
- whether the requirement to operate the emission control device will be federally enforceable by December 2008, and the instrument by which federal enforceability will be ensured (e.g. through source-specific SIP revision, operating permit requirement, consent decree)

Without all of the information listed above, we are unable to consider the controls at the Bull Run Plant for this designation process. Regarding the Kingston Plant, any reductions in emissions achieved by controls installed in 2009 and 2010 are not considered timely for the purpose of these designations. EPA must consider current emissions and control levels when determining appropriate nonattainment boundaries.

Conclusion

EPA concludes that the appropriate nonattainment boundary for the Knoxville area includes Anderson, Blount, Knox, Loudon, and Roane (partial) Counties based on the above factors. Specifically, Knox County contains a violating monitor, has emissions that impact the violating monitor, and contributes to its own violating monitor due to population density and degree of urbanization, and traffic and commuting patterns. Anderson, Blount, and Loudon Counties have emissions that impact the violating monitor in Knox County, and contribute to the violating monitor due to population density and degree of urbanization, traffic and commuting patterns, growth rates and patterns, meteorology, and level of control of emission sources. Roane County has emissions that impact the violating monitor in Knox County, and contributes to the violating monitor primarily due to emissions from the Kingston Fossil Plant electrical generating unit and meteorology. However, Roane County did not rate highly based on other factors included in this analysis. Therefore, a partial boundary is appropriate for Roane County which captures the Kingston Plant emissions.

Additional information regarding responses to specific State comments can be found in EPA's Response to Comments document at
http://www.epa.gov/pmdesignations/2006standards/tech.htm.

Attachment 2

Description of the Contributing Emissions Score

The CES is a metric that takes into consideration emissions data, meteorological data, and air quality monitoring information to provide a relative ranking of counties in and near an area. Using this methodology, scores were developed for each county in and around the relevant metro area. The county with the highest contribution potential was assigned a score of 100, and other county scores were adjusted in relation to the highest county. The CES represents the relative maximum influence that emissions in that county have on a violating county. The CES, which reflects consideration of multiple factors, should be considered in evaluating the weight of evidence supporting designation decisions for each area.

The CES for each county was derived by incorporating the following significant information and variables that impact $PM_{2.5}$ transport:

- Major $PM_{2.5}$ components: total carbon (organic carbon (OC) and elemental carbon (EC)), SO_2, NO_X, and inorganic particles (crustal).
- $PM_{2.5}$ emissions for the highest (generally top 5%) $PM_{2.5}$ emission days (herein called "high days") for each of two seasons, cold (Oct-Apr) and warm (May-Sept)
- Meteorology on high days using the NOAA HYSPLIT model for determining trajectories of air masses for specified days
- The "urban increment" of a violating monitor, which is the urban $PM_{2.5}$ concentration that is in addition to a regional background $PM_{2.5}$ concentration, determined for each $PM_{2.5}$ component
- Distance from each potentially contributing county to a violating county or counties

A more detailed description of the CES can be found at http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html#C.

Attachment 3

$PM_{2.5}$ Exceptional Events Technical Support Document

U.S. Environmental Protection Agency Region 4

State of Tennessee

2007

2008 Technical Support Document for the State of Tennessee
Fine Particulate Matter Exceptional Event Demonstration

I. Introduction

A technical support document (TSD) has been prepared to discuss the rationale for concurrence or non-concurrence with requests to apply data flags on fine particulate matter ($PM_{2.5}$) concentrations that may have been impacted by exceptional events and that may have exceeded the National Ambient Air Quality Standards (NAAQS). The State of Tennessee (Tennessee) has identified several $PM_{2.5}$ concentrations that may have been impacted by wildfires that originated in southern Georgia and northern Florida during the 2007 monitoring cycle. Tennessee has prepared and submitted documentation to support requests for concurrence with exceptional event data flags in accordance with current federal regulations regarding exceptional events. Key excerpts from *Part 50 National Primary and Secondary Ambient Air Quality Standards* are provided in Section II. Any exceptional event flags that EPA Region 4 concurs with will be excluded from use in determinations of exceedances and National Ambient Air Quality Standards (NAAQS) violations.

II. Excerpts from Exceptional Event Regulations

<u>A. Definition of an Exception Event:</u> *According to §50.1(j): "Exceptional event means an event that affects air quality, is not reasonably controllable or preventable, is an event caused by human activity that is unlikely to recur at a particular location or a natural event, and is determined by the Administrator in accordance with 40 CFR 50.14 to be an exceptional event. It does not include stagnation of air masses or meteorological inversions, a meteorological event involving high temperatures or lack of precipitation, or air pollution relating to source noncompliance."*

<u>B. Definition of an Exceedance:</u> *Exceedance with respect to a national ambient air quality standard means one occurrence of a measured or modeled concentration that exceeds the specified concentration level of such standard for the averaging period specified by the standard.*

<u>C. Exclusion of Data:</u> *EPA shall exclude data from use in determinations of exceedances and NAAQS violations where a State demonstrates to EPA's satisfaction that emissions from fireworks displays caused a specific air pollution concentration in excess of one or more national ambient air quality standards at a particular air quality monitoring location and otherwise satisfies the requirements of this section. Such data will be treated in the same manner as exceptional events under this rule, provided a State demonstrates that such use of fireworks is significantly integral to traditional national, ethnic, or other cultural events including, but not limited to July Fourth celebrations which satisfy the requirements of this section."*

<u>D. Criteria for Exclusion:</u> *The demonstration to justify data exclusion shall provide evidence that*

(1) The event satisfies the criteria set forth in 40 CFR 50.1(j);
(2) There is a clear causal relationship between the measurement under consideration and the event that is claimed to have affected the air quality in the area;
(3) The event is associated with a measured concentration in excess of normal historical fluctuations, including background; and
(4) There would have been no exceedance or violation but for the event.

III. Evaluation of $PM_{2.5}$ Concentrations and Supporting Documentation

In order to meet criteria 1 and 2 listed in Section II of this document, Tennessee provided supporting documentation which included $PM_{2.5}$ speciation data, wind trajectories, meteorological data (including graphs, charts, and various satellite images), and statistical data. Each $PM_{2.5}$ 24-hr average concentration requested for exclusion was first evaluated against these criteria using a two-step analysis. This analysis was designed to compare the requested value to historical values observed at the site and determine whether the concentration was an exceedance of the 24-hr $PM_{2.5}$ NAAQS and whether any exceedances could have been caused by the flagged event.

Step 1: Monthly Average Comparison

Using 24-hr $PM_{2.5}$ data from AQS for 2004-2007, a comparison three-year monthly average was calculated. The three-year monthly average concentration was calculated excluding data from the year in which the data in question was collected. For example, a requested value in May 2006 was compared to the average of all the samples collected at the site during May 2004, May 2005, and May 2007. If the three-year average was greater than the annual $PM_{2.5}$ NAAQS (15.0 $\mu g/m^3$) and the requested value was less than the 24-hr $PM_{2.5}$ NAAQS (35 $\mu g/m^3$), then EPA concurrence was not given to the requested value. This is because in EPA's judgment there is insufficient evidence that "there would have been no exceedance or violation but for the event" as required by §50.14(c)(3)(iii)(D) because the normally expected concentration at the site (the three-year monthly mean concentration) is in excess of the NAAQS.

Step 2: Monthly 84^{th} Percentile Comparison

Using 24-hr $PM_{2.5}$ data from AQS for 2004-2007, a comparison three-year upper 84^{th} percentile was calculated for the month in which the requested value was collected. The three-year monthly 84^{th} percentile was calculated excluding data from the year in which the data in question was collected. For example, a requested value in May 2006 was compared to the upper 84^{th} percentile calculated from of all the samples collected at the site during May 2004, May 2005, and May 2007. The calculated three-year monthly upper 84^{th} percentile was considered to represent the range of normally expected high values at that site due to normal local and background sources If the requested value was below the calculated three-year monthly upper 84^{th} percentile, EPA concurrence was not given to the requested value. This is because in EPA's judgment that there is insufficient evidence to demonstrate that the NAAQS exceedance was caused by the suspected event as required by §50.14(c)(3)(iii)(D) and not by normal local and background sources at the site.

If a requested value did not meet the requirements described in one or more of the above steps and Tennessee did not submit compelling evidence to demonstrate that the event satisfied the exceptional event criteria, then EPA concurrence was not given to the exceptional event flag on the requested value. The values that did meet all of the conditions described above were then evaluated against the requirements of §50.14(c)(3)(iii).

Summary of maps and graphs used

Additional maps and graphs were generated by EPA to provide assistance in completing the review of the Tennessee submittal. The graphics provided in this document were not included in Tennessee's submittal. The additional maps and graphs have been included in this TSD as appropriate. Unless otherwise noted, these products were obtained from the DATAFED Data Views Catalog, which can be accessed at http://datafedwiki.wustl.edu/index.php/Data_Views_Catalog. This may include maps using data from AQS, the National Aeronautics and Space Administration (NASA), and the Navy Aerosol Analysis and Prediction System (NAAPS). Also, unless otherwise noted, all ambient air monitoring data used in this analysis was obtained from the EPA AQS database.

IV. Data Evaluation

The State of Tennessee identified forty-eight concentrations that were potentially impacted by wildfire smoke. In Tables 1 and 2, the observed concentrations, monthly averages, 84th and 95th percentiles, and results of the two-step analysis are provided, along with EPA's preliminary response to the submittal. Documentation submitted by Tennessee claims that smoke from wildfires in South Georgia and North Florida caused NAAQS exceedances at the sites listed in the tables.

Table 1 lists the concentrations that passed both steps of the initial analysis. Further analysis of available data and documentation was determined necessary for completing the review. The discussions that follow will demonstrate that the 24-hr average $PM_{2.5}$ concentrations listed in Table 1 meet or fail to meet the criteria described in the Exceptional Events Rule, §50.14.

Table 2, which is located in the Appendix, lists values that failed to pass both steps of the initial analysis. Also, the documentation submitted by Tennessee did not demonstrate a clear causal relationship between the measured concentration and the event, and did not demonstrate that there would have been no exceedance or violation but for the event. Due to these reasons, no further analysis of the data is Table 2 was deemed necessary. EPA concurrence was not given to these exceptional event flags.

Table 1. Concentrations that passed Steps 1 and 2.

Date	AQS ID	County	MSA	Observed Conc.	Monthly Average	84th Percentile	95th Percentile	Step 1	Step 2	EPA Concur
5/19/07	47-125-1009	Montgomery	Clarksville	52.6	12.1	15.3	21.1	PASS	PASS	NO
5/22/07	47-125-1009	Montgomery	Clarksville	20	12.1	15.3	21.1	PASS	PASS	NO
5/25/07	47-125-1009	Montgomery	Clarksville	17.5	12.1	15.3	21.1	PASS	PASS	NO
5/26/07	47-125-1009	Montgomery	Clarksville	20.2	12.1	15.3	21.1	PASS	PASS	NO
5/27/07	47-125-1009	Montgomery	Clarksville	32.4	12.1	15.3	21.1	PASS	PASS	NO
5/28/07	47-125-1009	Montgomery	Clarksville	35.3	12.1	15.3	21.1	PASS	PASS	NO
5/29/07	47-125-1009	Montgomery	Clarksville	22.4	12.1	15.3	21.1	PASS	PASS	NO
5/30/07	47-125-1009	Montgomery	Clarksville	35.7	12.1	15.3	21.1	PASS	PASS	YES
6/17/07	47-099-0002	Lawrence	Not in an MSA	24	14.9	21.5	25.3	PASS	PASS	NO
7/31/07	47-125-1009	Montgomery	Clarksville	39.1	19.2	24.5	32.3	PASS	PASS	NO
8/1/07	47-125-1009	Montgomery	Clarksville	38.7	19.3	27.8	35.4	PASS	PASS	NO
8/3/07	47-125-1009	Montgomery	Clarksville	38.4	19.3	27.8	31.6	PASS	PASS	NO
8/4/07	47-125-1009	Montgomery	Clarksville	43	19.3	27.8	35.4	PASS	PASS	NO

V. Discussion of Evidence

A. Event Description: Southern Georgia and North Florida Wildfires

The Bugaboo Scrub Fire (Figure 1a) was a wildfire that raged from April to June in 2007 and ultimately became the largest fire in the history of both Georgia and Florida. The Bugaboo Scrub Fire, which was not actually named until it had blazed for nearly a month, started in the Okefenokee Swamp, most of which is located in Georgia. It was previously known as the Sweat Farm Road Fire, which merged with the Big Turnaround Complex Fire shown in Figure 1b. Due to the amount of acreage consumed by these wildfires, large amounts of smoke persisted in the air from May through the first week of June. Wind transported much of this smoke throughout the southeastern region. The presence of particulate matter, a large constituent of smoke, was observed at many monitoring sites and in many cases caused very large increases in the measured 24-hour $PM_{2.5}$ mass concentrations.

Figure 1a. Bugaboo Scrub Fire, April 29, 2007.

Figure 1b. Sweat Farm Road Fire, April 28, 2007.

B. Causal Relationship between the Event and Air Quality

To evaluate the possible causal relationship of the wildfires on air quality in Montgomery (Clarksville) and Lawrence Counties, maps and wind trajectories were analyzed to assess the probability of smoke transport from the wildfires. Figure 3 illustrates spatially averaged $PM_{2.5}$ concentrations that were used to assess the possible impacts of smoke on air quality. Figure 4 illustrates backwards wind trajectories that passed through the suspected source region on each of the days under consideration. These trajectories support the possible transport of smoke through Lawrence County and Clarksville on some of these days. Figure 5 depicts the NASA OMI aerosol index observed on each of the days in question that exceeded the NAAQS 24 hr standard (35 ug/m^3).

Speciation data was collected at the Clarksville site (AQS ID 47-125-1009) on a 1 in 6 day sampling schedule. Because of this schedule, speciation data was limited and only available for May 30 and August 4. Federal reference method (FRM) mass, organic carbon, and sulfate mass are shown in the graph in Figure 10.

C. Comparison to Historical Levels

In order to further assess the impacts of the Georgia and Florida fires, the data in question was compared to historical levels observed at each site. Table 1 shows that all of the values that passed both steps of the initial analysis vary in terms of the levels above the 95th percentile calculated from data collected during the respective months for 2004-2006. May 19 and August 4 are considerably higher than the 95th percentiles, which strongly suggest that the data were influenced by an exceptional event. Figure 3 shows the spatially averaged 24-hr average $PM_{2.5}$ concentrations observed on each of the days in question. Figures 1 and 2 show the excess $PM_{2.5}$ concentrations observed above the 84th and 95th percentiles, respectively, on each of the days. These maps show 24-hr average $PM_{2.5}$ concentrations above the normal range of values observed in the Clarksville area historically during the respective months.

D. Demonstration of No Exceedance "But For" the Event

The values reported for May 22, 25, 26, 27, 29, and June 17 passed the initial screening tests, however, they do not exceed the 24-hour standard (35 ug/m3). Further, Table 1 shows that several values do not exceed the 95th percentiles. Without $PM_{2.5}$ speciation data available for any of these values, it is EPA's judgment that there is insufficient evidence to determine that "there would have been no exceedance or violation but for the event." Further, the information provided in Tennessee's submittal was inconclusive in demonstrating a causal relationship. EPA concurrence was not given for any of these days.

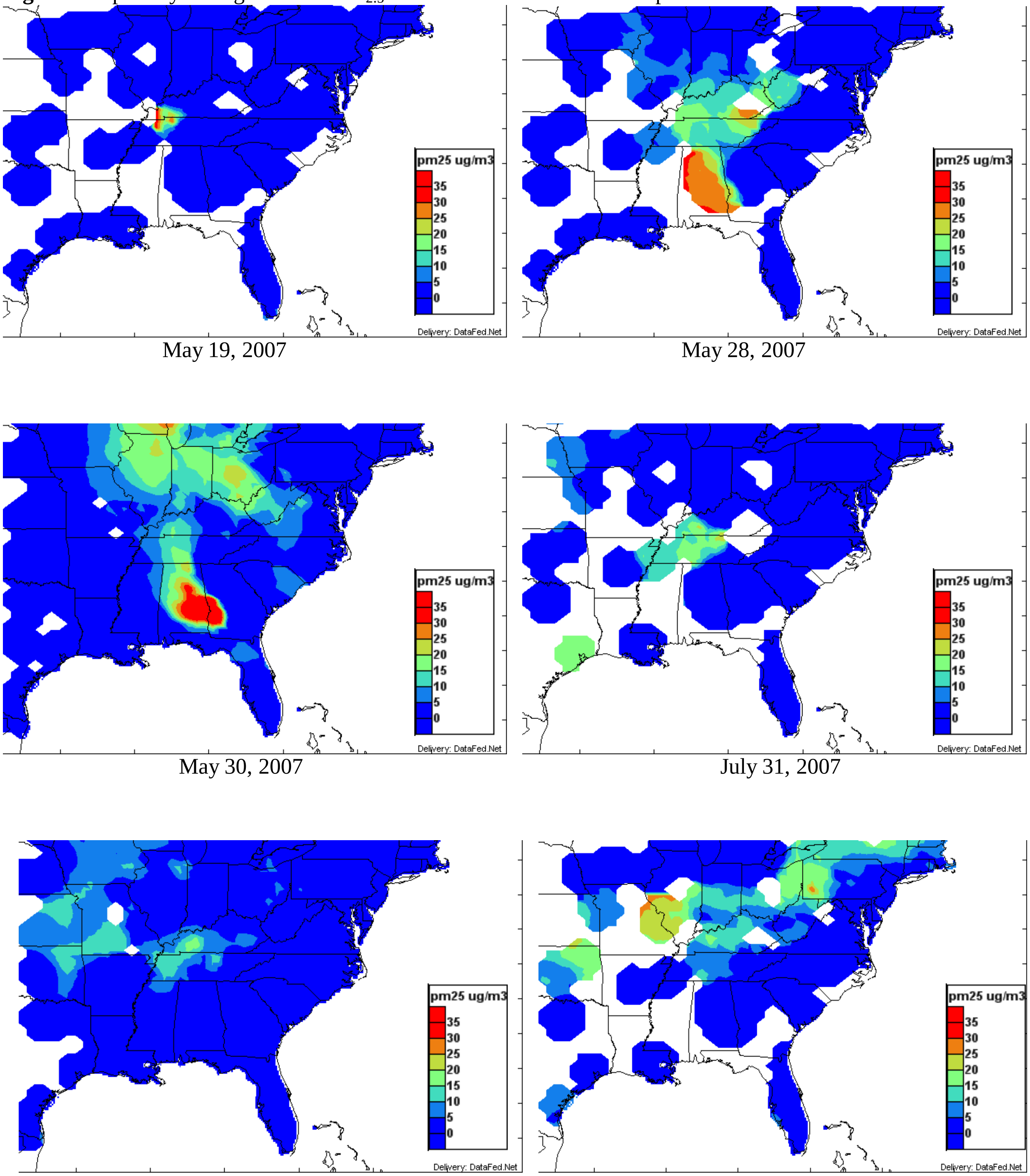
The values reported for May 19, 28, July 31, August 1, and August 3 exceed the 24-hour standard (35 ug/m^3); however, $PM_{2.5}$ speciation data was not available for these specific days. Without these data, determining an organic mass apportionment was not possible. A significantly high PM value was observed in Clarksville on May 19 of 56.2 ug/m^3. Although the value is significantly higher than the 95th percentile value (21.1 ug/m^3), an evaluation of the maps in Figures 3 and 4 suggests that the high value was not due to air mass movement from the wildfires but from a localized event or source. The lack of wind trajectories approaching and leaving the Clarksville area from the southern Georgia and north Florida areas on this day suggests possible stagnation of air in the area. For the other days, figures 3 and 4 also indicate high PM concentrations in the Clarksville area, although figure 5 indicates low aerosol levels in both source and impact areas. As with May 19, the lack of wind trajectories suggest localized sources. Without $PM_{2.5}$ speciation data, there is insufficient evidence to determine that "there would have been no exceedance or violation but for the event." EPA concurrence was not given for any of these days.

May 30 and August 4 both reported concentrations that were exceedances of the 24-hr $PM_{2.5}$ standard (35µg/m^3). The values for May 30 and August 4 were, respectively, in excess of the historical 95th percentile by 14.6 µg/m^3 and 7.6µg/m^3 for the Clarksville site in the months of May and August. This is an indication that these monitors may have been impacted by an exceptional event. $PM_{2.5}$ speciation data was available for both days which allowed for a more critical analysis of the components of the PM mass. Figures 6a through 9b show varying images of the national levels of organic carbon and sulfates measured on May 30 and August 4. While these images are helpful in providing an overall view, they are somewhat inconclusive for assessing specific areas.

Figure 10 shows the levels of $PM_{2.5}$ organic carbon and sulfate compounds compared to the total PM mass. For May 30, the graph shows that the organic carbon level is higher than sulfate, and may represent a greater portion of the PM mass. Figure 11 shows the adjusted $PM_{2.5}$ mass in relation to the NAAQS standards. Typically, these estimations would be made based on several years of historical data. Clarksville's calculations are based on one year of available speciation data from 2007. The data shows the impact that would be made on the PM mass if organic carbon and sulfates were removed from the mass. For May 30, the graph suggests that the removal of the organic carbon would reduce the PM mass significantly and well below the daily standard. The PM mass would remain high if sulfates were removed. Combined with other evidence that has been reviewed, the concentration for May 30 is likely to have been significantly impacted by wildfire smoke. EPA concurs with the data flag applied to this concentration.

For August 4, the removal of organic carbon from the PM mass does not appear to reduce the level of the PM mass significantly and suggests a greater impact from sulfates on this day. Additionally, there was not other significant evidence to suggest that August 4 may have been impacted by local wildfires but rather a potential localized sulfate event or other sulfate source. Thus, EPA does not concur with flagging the concentration measured on this day.

Figure 1. Spatially averaged excess $PM_{2.5}$ concentrations above the 84th percentile.



May 19, 2007

May 28, 2007

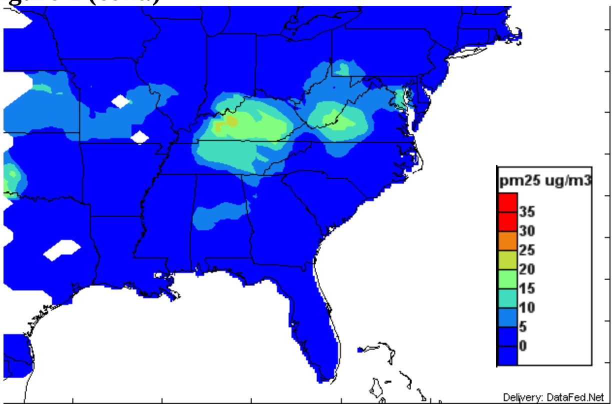
May 30, 2007

July 31, 2007

August 1, 2007

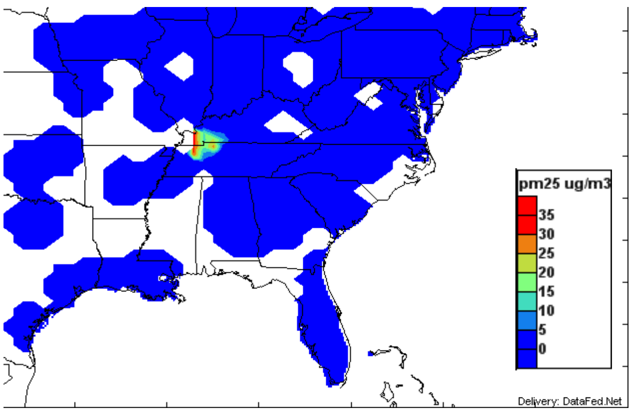
August 3, 2007

Figure 1 (cont.)

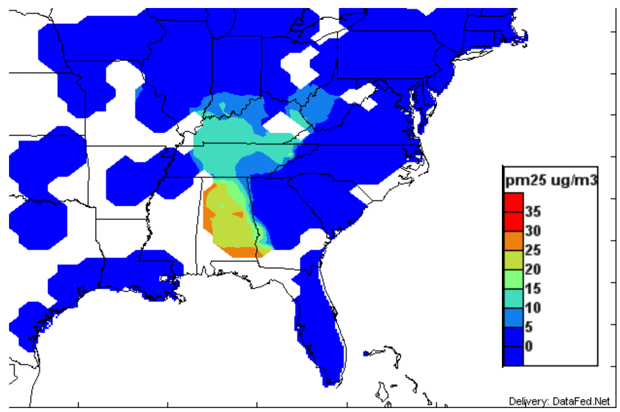


August 4, 2007

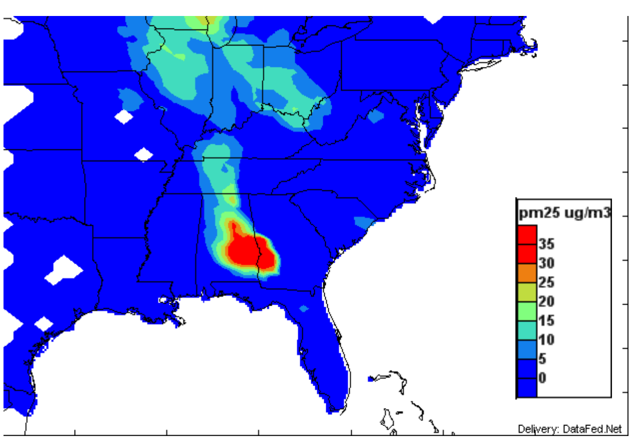
Figure 2. Spatially averaged excess $PM_{2.5}$ concentrations above the 95th percentile.



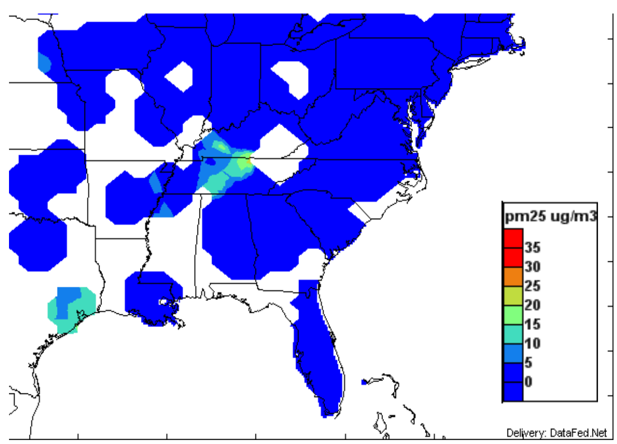
May 19, 2008



May 28, 2007

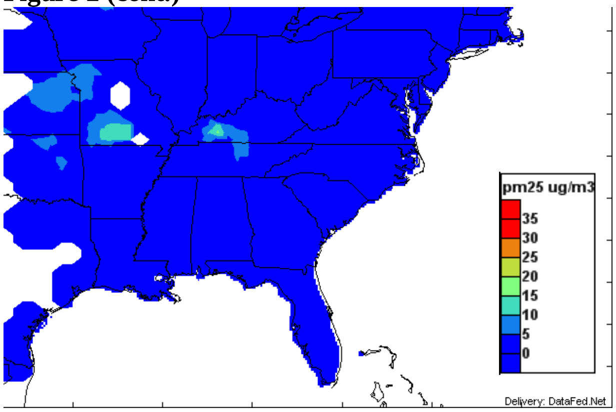


May 30, 2007

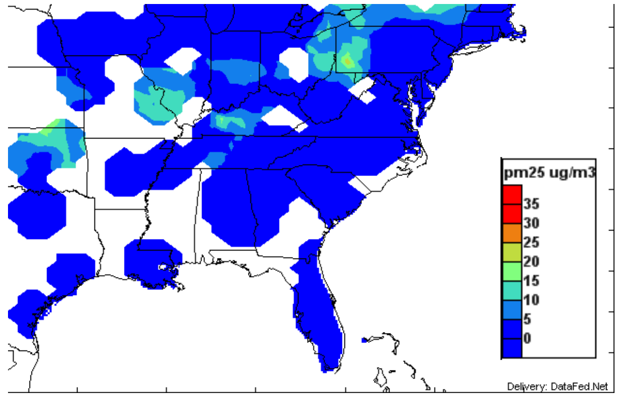


July 31, 2007

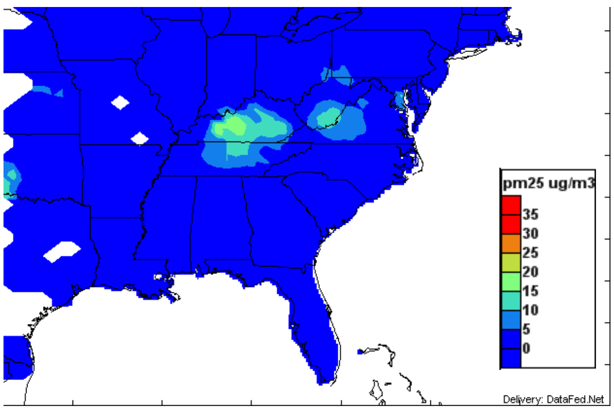
Figure 2 (cont.)



August 1, 2007

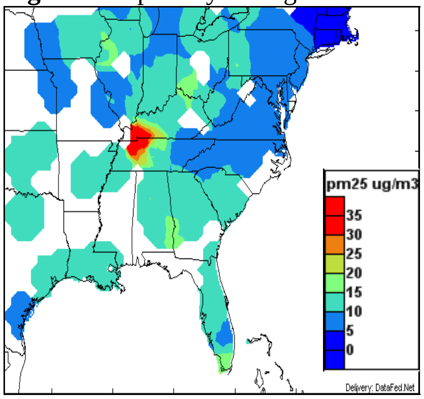


August 3, 2007

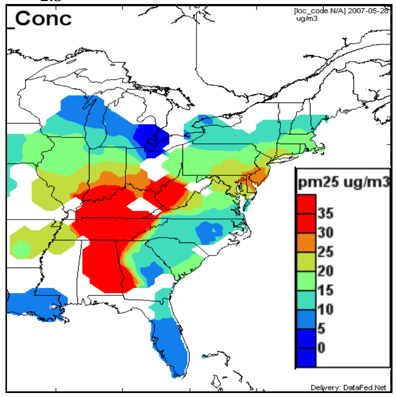


August 4, 2007

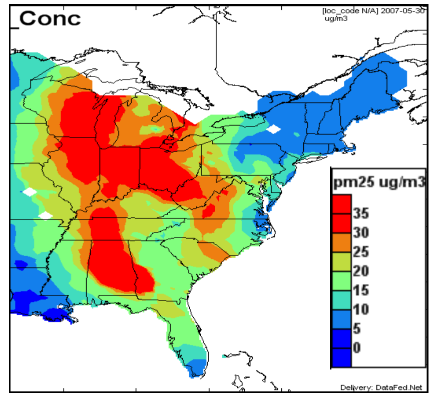
Figure 3: Spatially averaged observed $PM_{2.5}$ concentrations



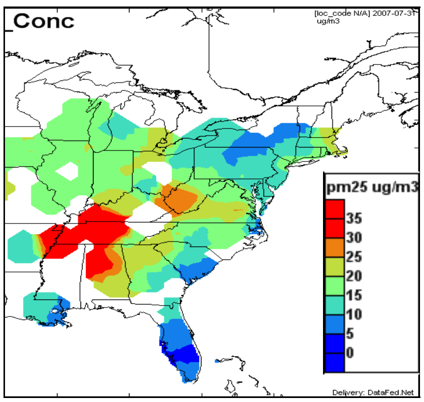
May 19, 2007



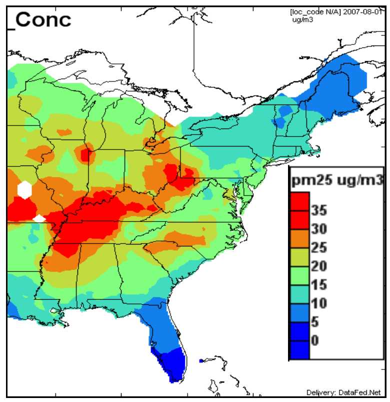
May 28, 2007



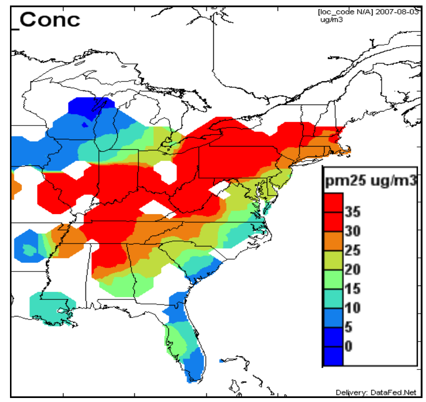
May 30, 2007



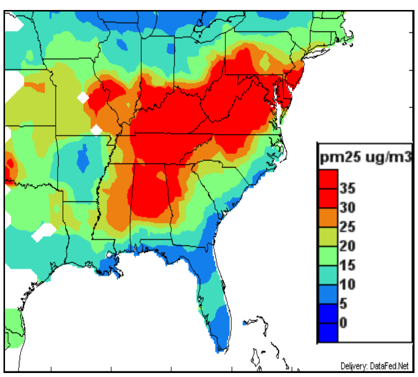
July 31, 2007



August 1, 2007

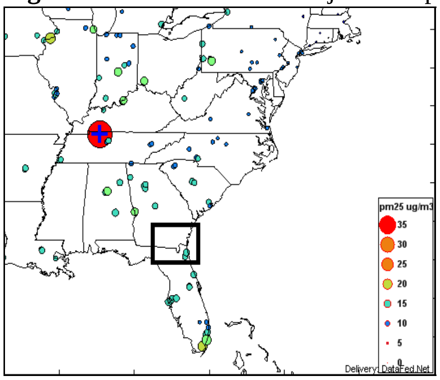


August 3, 2007

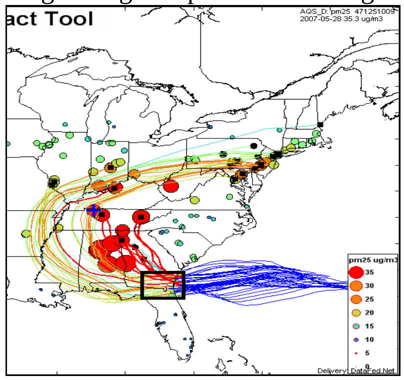


August 4, 2007

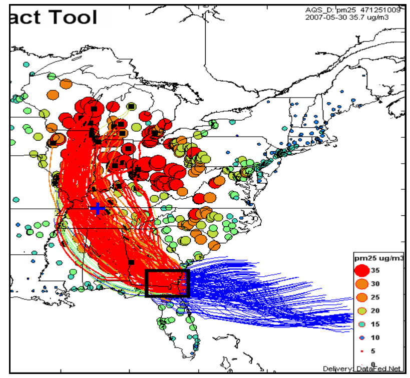
Figure 4: Backward wind trajectories passing through suspected source region.



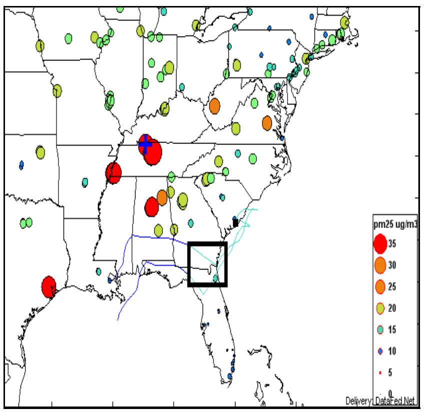
May 19, 2007



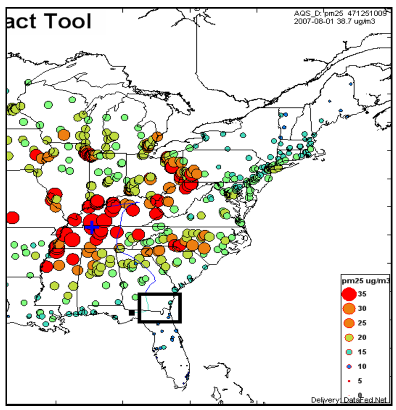
May 28, 2007



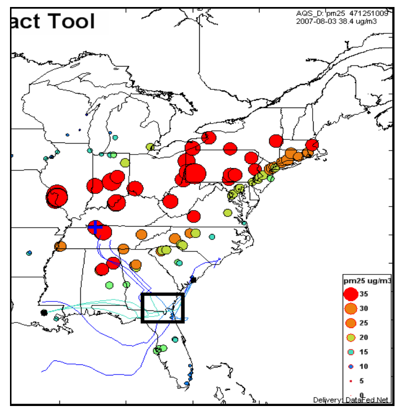
May 30, 2007



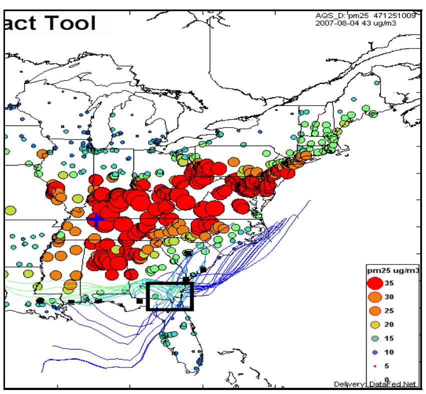
July 31, 2007



August 1, 2007

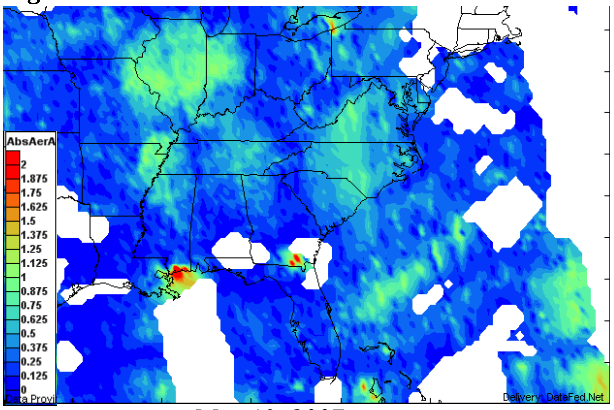


August 3, 2007

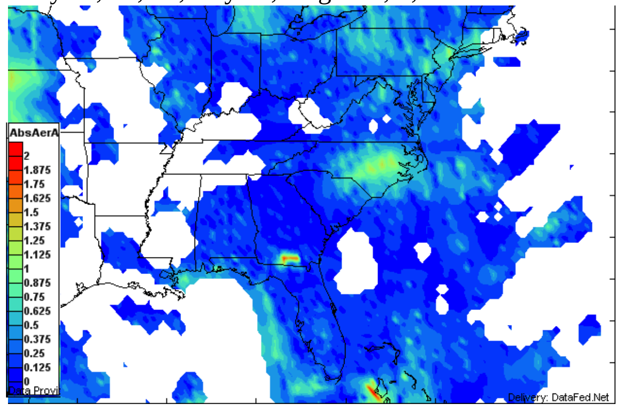


August 4, 2007

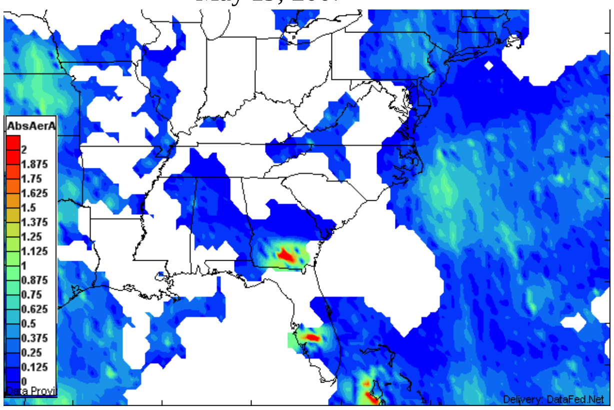
Figure 5. NASA OMI satellite aerosol concentrations for May 19, 28, 30; July 31; August 1, 3, and 4



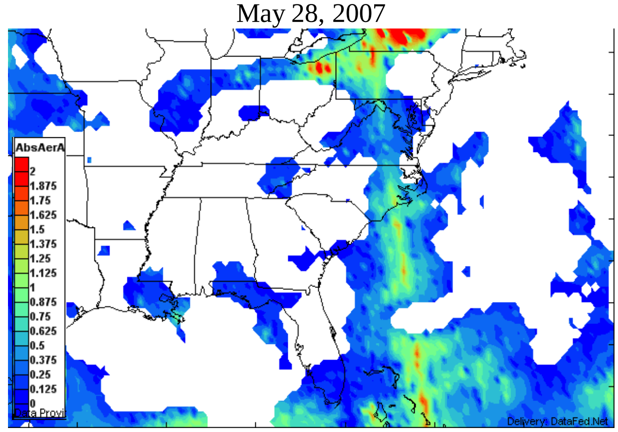
May 19, 2007



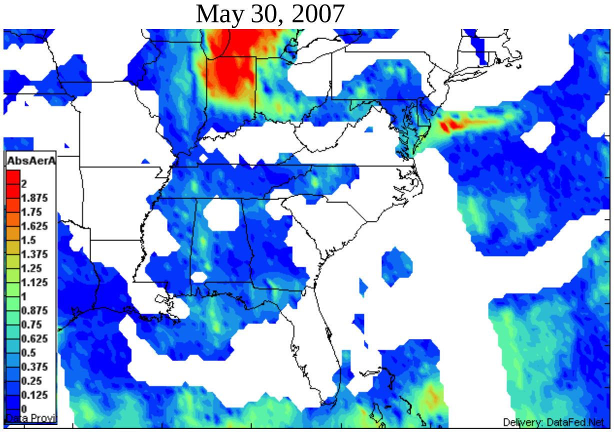
May 28, 2007



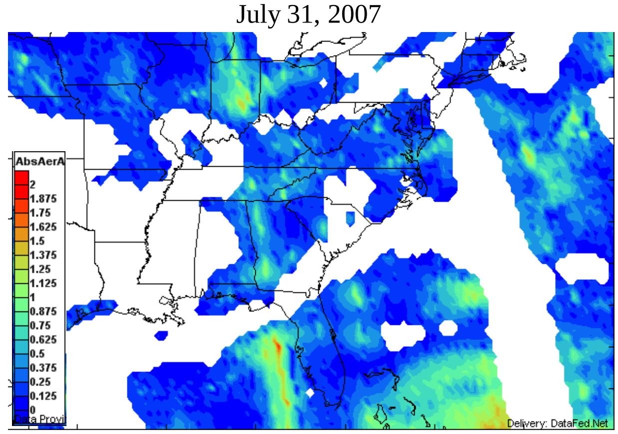
May 30, 2007



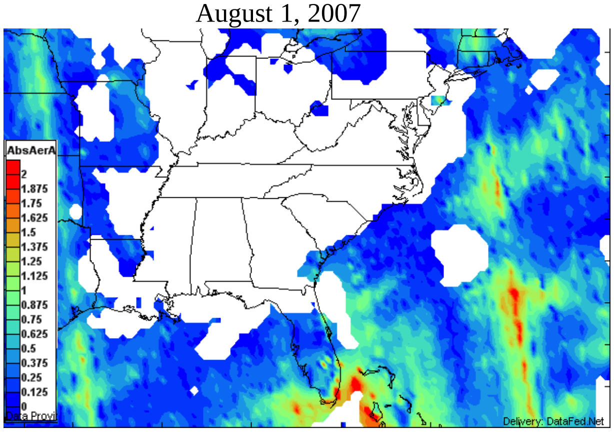
July 31, 2007



August 1, 2007



August 3, 2007



August 4, 2007

Figure 6a. National Sulfate Levels for May 30, 2007

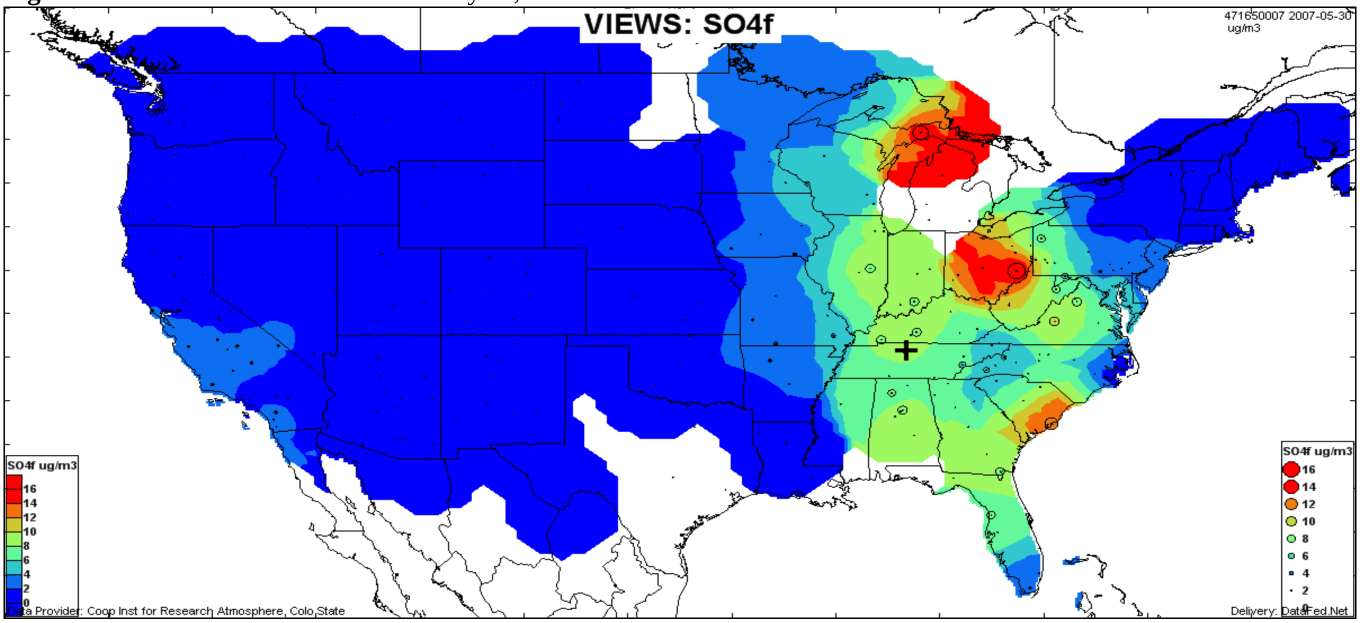


Figure 6b. National Organic Carbon Levels for May 30, 2007

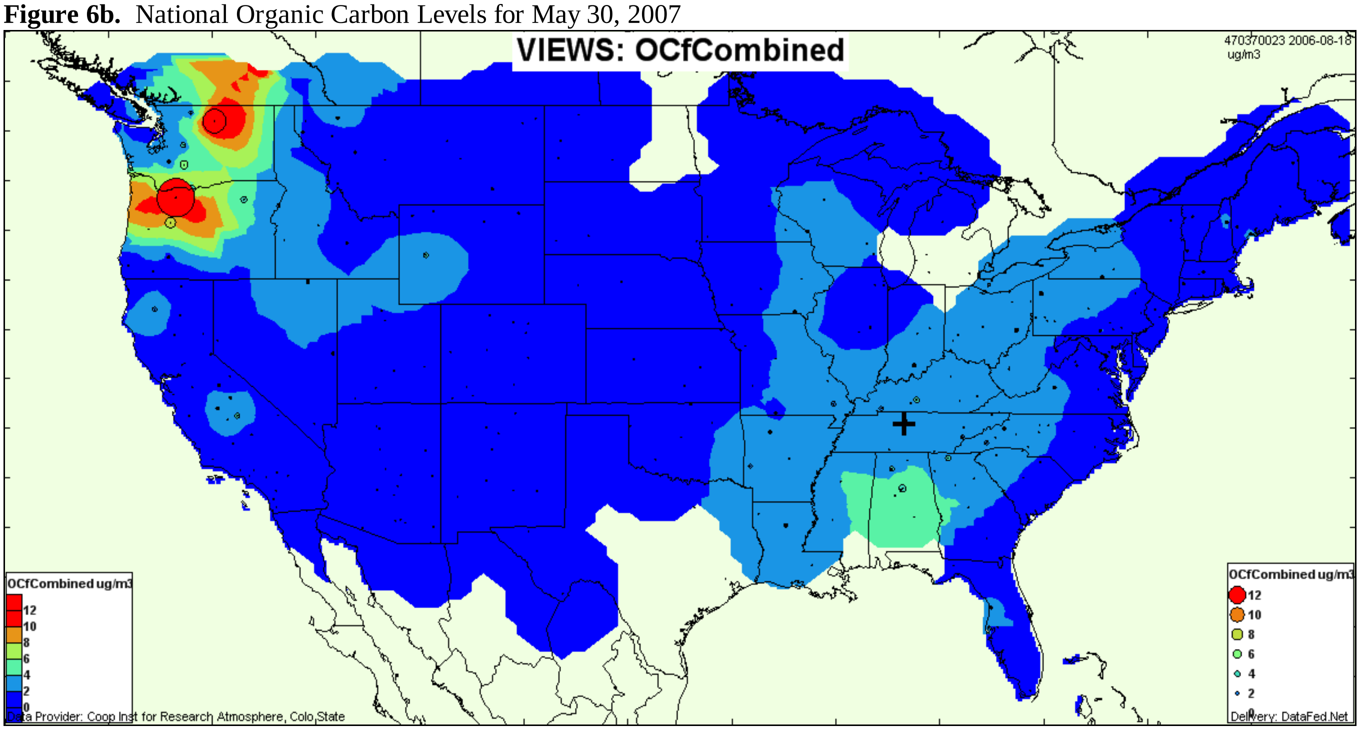


Figure 7a. National Sulfate Levels for August 4, 2007

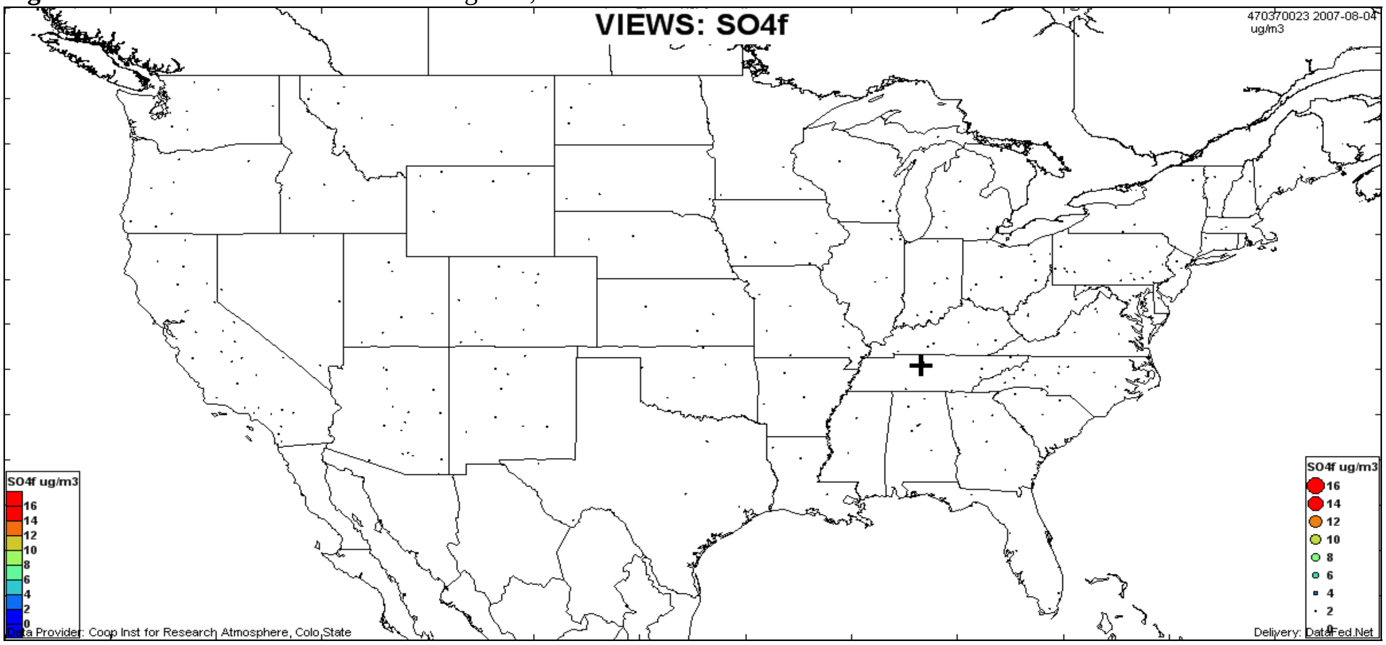


Figure 7b. National Organic Carbon Levels for August 4, 2007

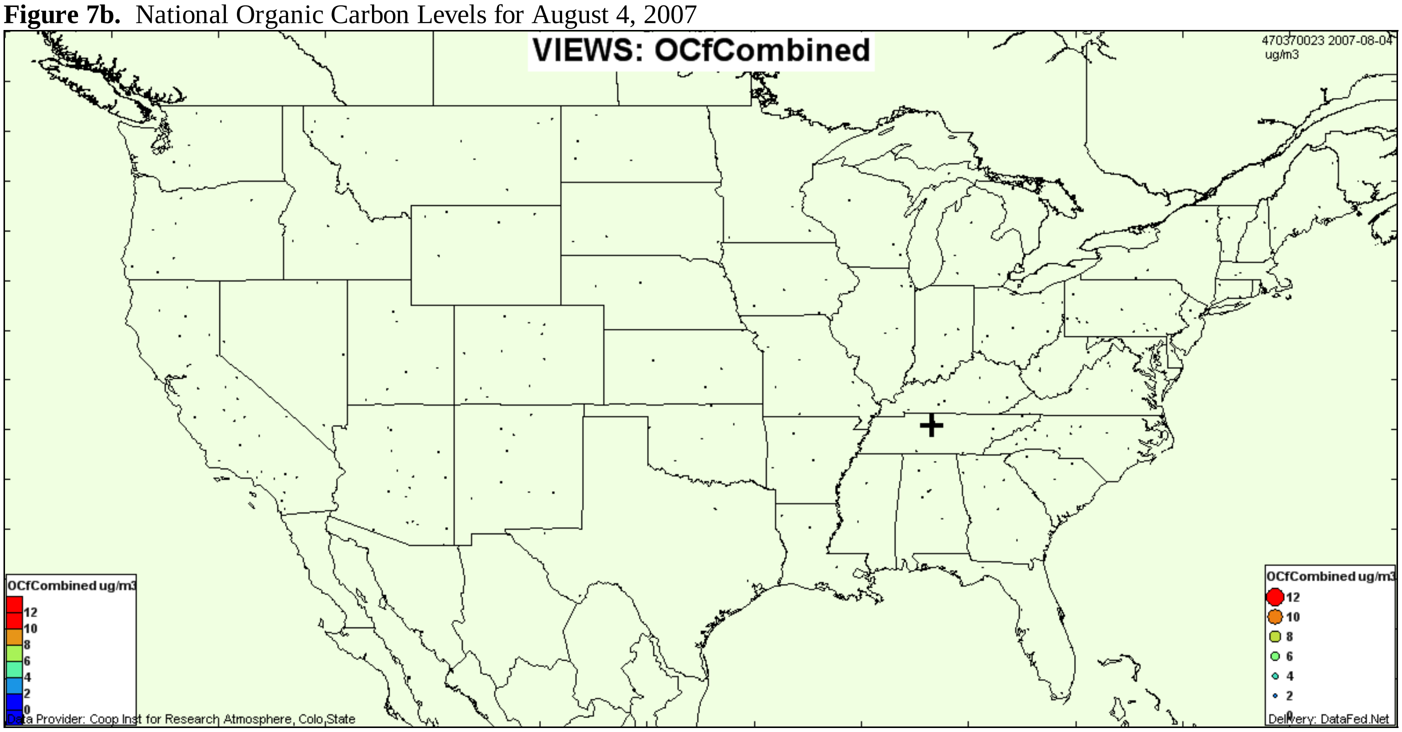


Figure 8a. NAAPS Sulfate Aerosol Maps for May 30, 2007

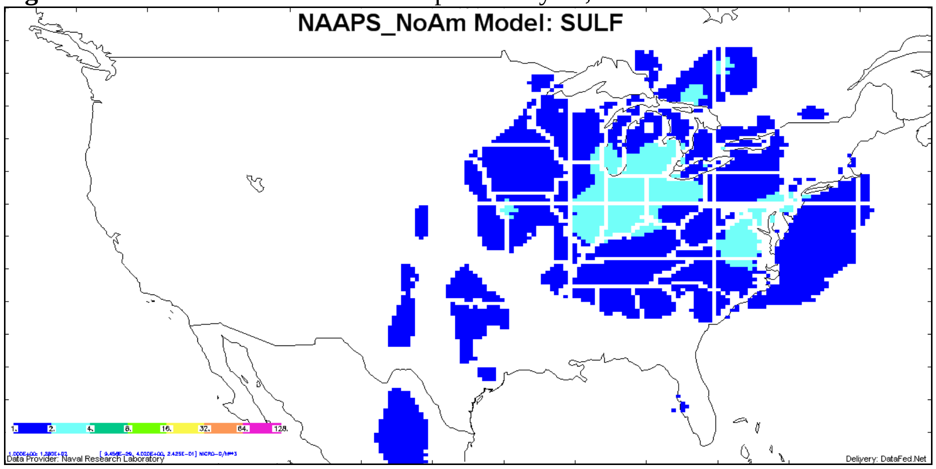


Figure 8b. NAAPS Organic Carbon Aerosol Maps for May 30, 2007

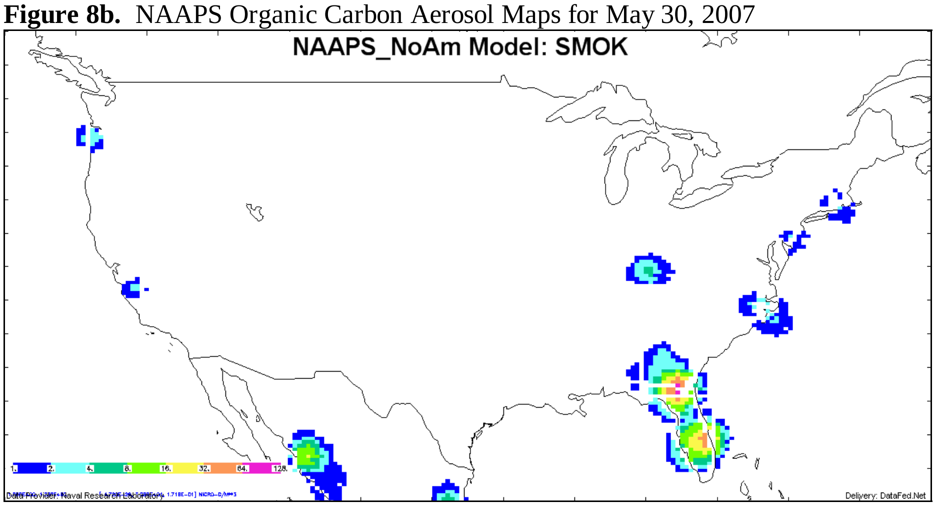


Figure 9a: NAAPS Sulfate Aerosol Maps for August 4, 2007

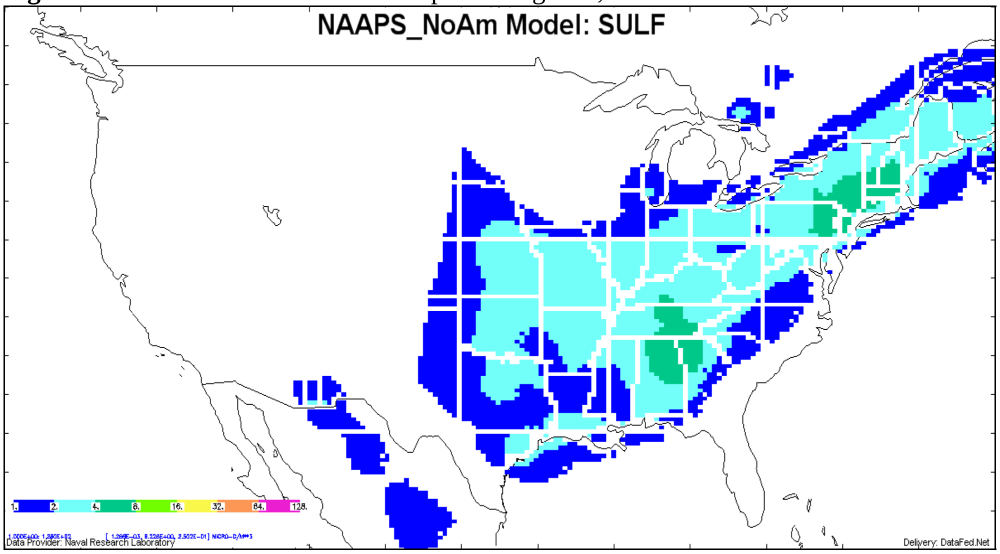


Figure 9b. NAAPS Organic Carbon Aerosol Maps for August 4, 2007

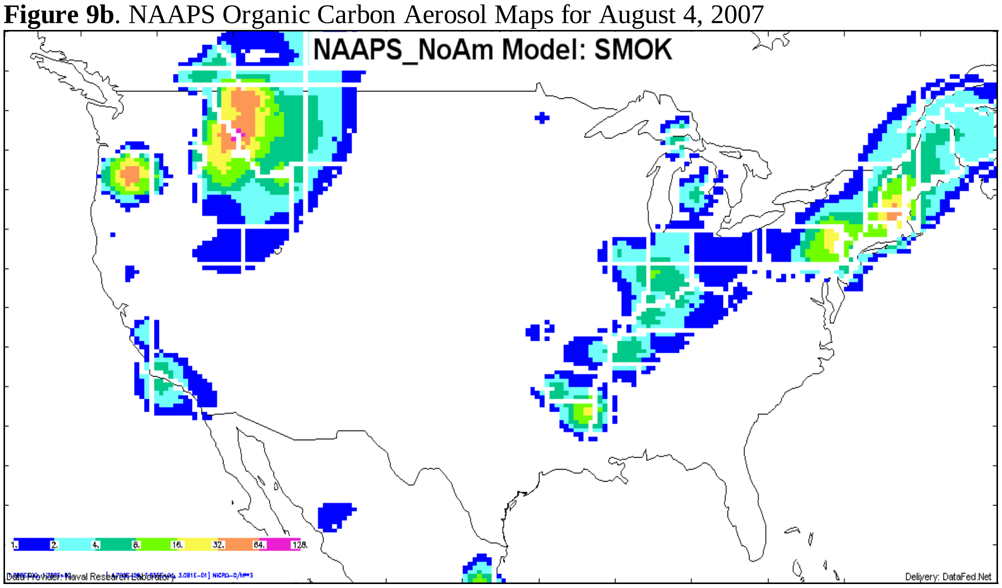


Figure 10. Clarksville $PM_{2.5}$ Organic Carbon and Sulfate Compared to Total $PM_{2.5}$

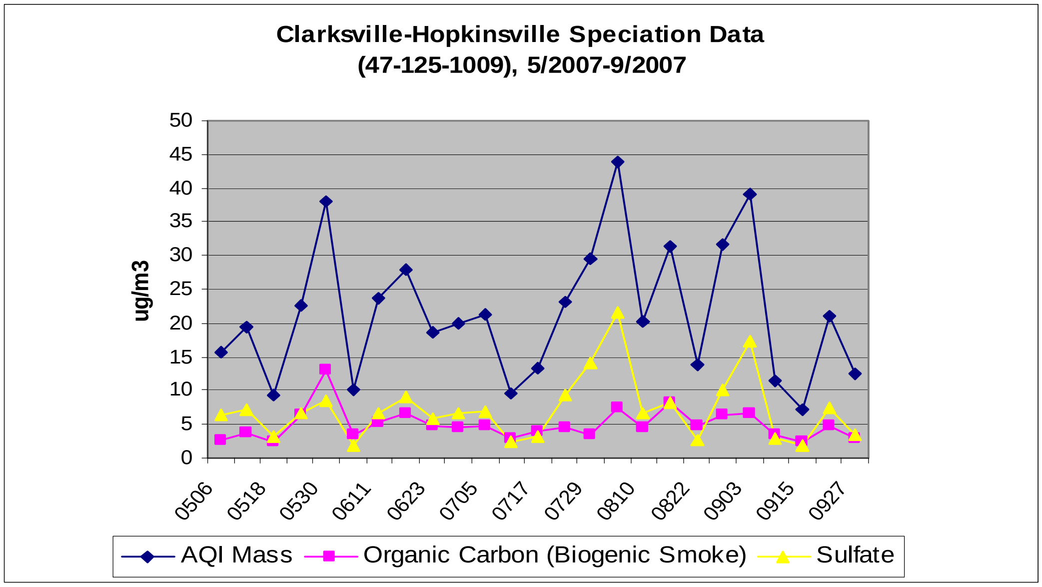
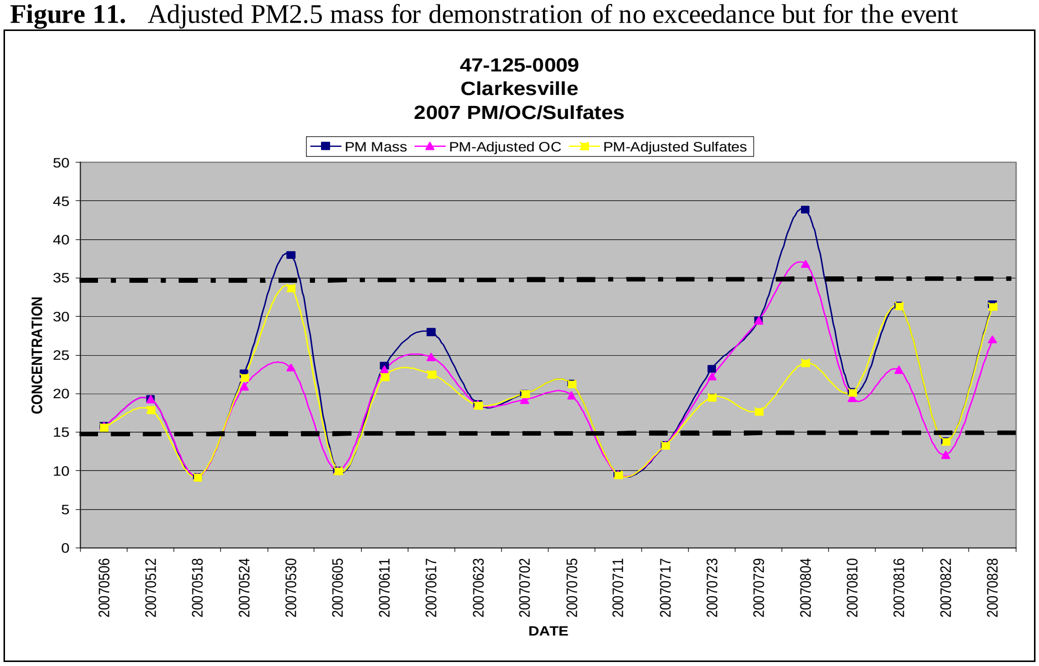


Figure 11. Adjusted PM2.5 mass for demonstration of no exceedance but for the event



APPENDIX

Table 2. Concentrations that failed Steps 1 and 2.

Date	AQS ID	County	MSA	Observed Conc.	Monthly Average	84th Percentile	95th Percentile	Step 1	Step 2	EPA Concur
5/20/07	47-125-1009	Montgomery	Clarksville	14.5	12.1	15.3	21.1	PASS	FAIL	NO
5/21/07	47-105-0108	Loudon	Knoxville	16.1	16.9	22.4	31.2	FAIL	FAIL	NO
5/21/07	47-125-1009	Montgomery	Clarksville	12.8	12.1	15.3	21.1	PASS	FAIL	NO
5/21/07	47-163-1007	Sullivan	Johnson City	15.2	14.9	20.0	25.2	PASS	FAIL	NO
6/1/07	47-125-1009	Montgomery	Clarksville	21	16.5	22.0	31.1	FAIL	FAIL	NO
6/2/07	47-125-1009	Montgomery	Clarksville	30.7	16.5	22.0	31.1	FAIL	PASS	NO
6/12/07	47-125-1009	Montgomery	Clarksville	22.6	16.5	22.0	31.1	FAIL	PASS	NO
6/13/07	47-125-1009	Montgomery	Clarksville	25.3	16.5	22.0	31.1	FAIL	PASS	NO
6/17/07	47-105-0108	Loudon	Knoxville	32.1	19.7	25.3	27.7	FAIL	PASS	NO
6/17/07	47-107-1002	McMinn	Not in an MSA	31.2	19.3	24.9	28.1	FAIL	PASS	NO
6/17/07	47-119-2007	Maury	Not in an MSA	24	16.2	20.5	28.2	FAIL	PASS	NO
6/17/07	47-125-1009	Montgomery	Clarksville	24.1	16.5	22.0	31.1	FAIL	PASS	NO
6/17/07	47-145-0004	Roane	Knoxville	25.6	18.2	22.7	25.4	FAIL	PASS	NO
6/17/07	47-163-1007	Sullivan	Johnson City	27.9	17.4	24.1	26.9	FAIL	PASS	NO
6/17/07	47-165-0007	Sumner	Nashville	23.6	17.4	25.5	30.4	FAIL	FAIL	NO
6/18/07	47-125-1009	Montgomery	Clarksville	18	16.5	22.0	31.1	FAIL	FAIL	NO
6/21/07	47-125-1009	Montgomery	Clarksville	17.6	16.5	22.0	31.1	FAIL	FAIL	NO
6/22/07	47-125-1009	Montgomery	Clarksville	18.3	16.5	22.0	31.1	FAIL	FAIL	NO
7/27/07	47-125-1009	Montgomery	Clarksville	26.2	19.2	24.5	32.3	FAIL	PASS	NO
7/28/07	47-125-1009	Montgomery	Clarksville	18.2	19.2	24.5	32.3	FAIL	FAIL	NO
7/29/07	47-125-1009	Montgomery	Clarksville	25.8	19.2	24.5	32.3	FAIL	PASS	NO
7/30/07	47-125-1009	Montgomery	Clarksville	30.8	19.2	24.5	32.3	FAIL	PASS	NO
8/2/07	47-125-1009	Montgomery	Clarksville	31.7	19.3	27.8	35.4	FAIL	PASS	NO
8/5/07	47-125-1009	Montgomery	Clarksville	33.2	19.3	27.8	35.4	FAIL	PASS	NO
8/6/07	47-125-1009	Montgomery	Clarksville	25.7	19.3	27.8	35.4	FAIL	FAIL	NO
8/7/07	47-125-1009	Montgomery	Clarksville	15.3	19.3	27.8	35.4	FAIL	FAIL	NO
8/8/07	47-125-1009	Montgomery	Clarksville	14.9	19.3	27.8	35.4	FAIL	FAIL	NO
8/31/07	47-125-1009	Montgomery	Clarksville	15.2	19.3	27.8	35.4	FAIL	FAIL	NO
9/1/07	47-125-1009	Montgomery	Clarksville	22.2	19.3	25.8	37.3	FAIL	FAIL	NO
9/2/07	47-125-1009	Montgomery	Clarksville	31.7	19.3	25.8	37.3	FAIL	PASS	NO
9/3/07	47-125-1009	Montgomery	Clarksville	35.1	19.3	25.8	37.3	FAIL	PASS	NO
9/4/07	47-125-1009	Montgomery	Clarksville	34.6	19.3	25.8	37.3	FAIL	PASS	NO
9/5/07	47-125-1009	Montgomery	Clarksville	33.2	19.3	25.8	37.3	FAIL	PASS	NO
9/6/07	47-125-1009	Montgomery	Clarksville	34.3	19.3	25.8	37.3	FAIL	PASS	NO
9/7/07	47-125-1009	Montgomery	Clarksville	13.8	19.3	25.8	37.3	FAIL	FAIL	NO