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April 5, 2012

VIA ELECTRONIC
AND FIRST-CLASS MAIL

Gwendolyn Keyes Fleming
Regional Administrator
United States Environmental Protection Agency
Region 4
Atlanta Federal Center
61 Forsyth Street
Atlanta, Georgia 30303-8960

Re: Tennessee's Attainment Designations for the 2008 Ozone NAAQS: Knoxville Metropolitan Area

Dear Administrator Fleming:

This firm represents the six East Tennessee Counties of Anderson, Blount, Cocke, Knox, Loudon, and Sevier ("Counties"). The Counties comprise a portion of the Knoxville-Sevierville-LaFollette Combined Statistical Area ("Knoxville CSA"). We write to urge the United States Environmental Protection Agency ("EPA") to designate all areas within the boundaries of the Counties attainment with respect to the 2008 National Ambient Air Quality Standards ("NAAQS") for ozone.

The Counties retained Waller Lansden and EnSafe, an environmental consulting firm, to perform a legal and technical analysis regarding EPA's pending attainment designation under the ozone NAAQS as it affects the Counties. Rick Bolton and John Shipp of EnSafe performed the technical analysis contained in this letter.

Our analysis addresses two main issues related to the designation of counties within the Knoxville CSA: First, what three-year period should be used to compute design values for each monitor in the Knoxville CSA, and second, based on those design values, which counties or portions of counties should be designated nonattainment with the 2008 ozone NAAQS. We conclude, as demonstrated below, that EPA should use the 2009 through 2011 data as a basis for making its ozone attainment designations, and that the design values do not support a nonattainment designation for the counties in which the monitors are located or adjacent counties. In the alternative, we believe that only the portion of Blount County that contains the Great Smoky Mountains National Park should be designated nonattainment, and the remainder of the Counties should be designated attainment with the 2008 ozone NAAQS.

I. APPROPRIATE THREE-YEAR PERIOD

A. Certification of 2011 Data

Normally, there is little question about what three-year period is to be used in the designation process. However, in this case there are two issues that have arisen regarding which period should be used. The first of those issues is that when EPA cancelled its reconsideration of the 2008 ozone NAAQS in September 2011, it indicated that it intended to use the 2008-2010 period for making the determinations, but EPA offered the states the opportunity to accelerate certification of the 2011 ozone season data and use the 2009-2011 period for calculating design values. (Memorandum from Gina McCarthy to EPA Air Pollution Directors, Regions 1-10, dated September 22, 2011.) On October 3, 2011 the Tennessee Department of Environment and Conservation ("TDEC") notified EPA Region IV that it was "working to get the 2011 data certified as quickly as possible" and planned to use the 2009-2011 three-year design values to revise its March 2009 designation recommendations, which it had made to EPA before the reconsideration had begun. (Email from Quincy Styke to EPA Region IV, dated October 3, 2011; *see* Letter from James H. Fyke to A. Stanley Meiburg, dated March 10, 2009.) Accordingly, on November 8, 2011, TDEC officially revised its recommendations based on "preliminary" 2009-2011 design values. (Letter from Robert J. Martineau, Jr., to Gwen Keyes Fleming, dated November 8, 2011.) We understand that EPA and TDEC are working to certify the data for the 2009-2011 period.

B. Data Completeness Related to Two Knox County Monitors

40 C.F.R. Part 50, Appendix P provides the data handling requirements for determining whether an ozone monitoring site meets the national 8-hour primary

and secondary ambient air quality standards for ozone. A monitoring site meets the standard "when the 3-year average of the annual fourth-highest daily maximum 8-hour average O_3 concentration is less than or equal to 0.075 ppm." (40 C.F.R. Part 50, Appendix P, § 2.3(a).) That average is based on three consecutive, *complete* years of air quality monitoring data. To satisfy the completion requirement, "daily maximum 8-hour average concentrations [must be] available for at least 90% of the days within the O_3 monitoring season, on average, for the 3-year period, with a minimum data completeness requirement in any one year of at least 75% of the days within the O_3 monitoring season." (*Id.*) However, if a site does not meet these completion percentages, its air quality monitoring data may nonetheless be considered in the designation decision. 40 C.F.R. Part 50, Appendix P, § 2.3(b) provides:

> When computing whether the minimum data completeness requirements have been met, meteorological or ambient data may be sufficient to demonstrate that meteorological conditions on missing days were not conducive to concentrations above the level of the standard. Missing days assumed less then [sic] the level of the standard are counted for the purpose of meeting the data completeness requirement, subject to the approval of the appropriate Regional Administrator.

EPA Region 1 ("Region 1") recently considered ambient and meteorological data for missing days in making ozone attainment designations in Eastern and Western Massachusetts.[1] By letter dated December 15, 2011, Region 1 accepted the Massachusetts Department of Environmental Protection's ("MDEP") request to allow missing ambient air ozone concentrations to be counted. Based on MDEP's missing data analysis, Region 1 agreed that the missing ozone data could be assumed to be less than the 1997 8-hour ozone standard. MDEP's "missing data package contain[ed] documentation and analysis showing that meteorological and ambient data conditions for the missing days were not conducive to forming elevated concentrations of ground-level ozone which would have exceeded the 1997 8-hour ozone standard. Specifically, the analysis examine[d] the temperature, cloud cover, and precipitation, as well as the ozone concentrations at surrounding monitors, for each missing day." (Letter from H. Curtis Spalding, EPA Region 1, to Nancy Seidman, Massachusetts Department of Environmental Protection, dated December 15, 2011.)

[1] *See* 77 Fed. Reg. 14,712 (Mar. 13, 2012); 77 Fed. Reg. 3,220 (Jan. 23, 2012).

MDEP conducted its analysis under 40 C.F.R. Part 50, Appendix I, § 2.3(b), which contains equivalent language to Appendix P, § 2.3(b).[2] The three monitors at issue had the following data completeness percentages for one year: 30%, 41%, and 69%. In addition, one monitor did not meet the 90% 3-year average data completeness requirements (its percentage was 80%). In Tennessee, two Knox County monitors have data completeness percentages of 56% and 73% for year 2011. One of these monitors did not meet the 3-year average requirement with a data completeness percentage of 83%.

This second issue related to what three-year period should be used in making the designations arose during the process of certifying the 2011 ozone data. At the two monitors located in Knox County, internal monitor temperature data were not available for a period of time at the beginning of the ozone season. Consequently, EPA has indicated it may not accept the ozone data from these two monitors for that period of time. The result of a decision not to accept those data is that, for the year 2011, neither of the Knox County monitors meets the data completeness requirement. If the 2011 ozone data for these two monitors is not determined to be complete, the three-year period that will be used by EPA to make the designations will be 2008-2010.

The completeness requirement for ozone monitors prescribes that each monitor must have daily maximum 8-hour average ozone concentrations available for at least 90% of the days within the ozone monitoring season, on average, for the 3-year period, with a minimum data completeness requirement for any one year of at least 75% of those days within the ozone monitoring season. (40 C.F.R. Part 50, Appendix P, § 2.3 (b).) However, as discussed above, 40 C.F.R. Part 50, Appendix P, § 2.3 (b) further provides that "meteorological or ambient data may be sufficient to demonstrate that meteorological conditions on missing days were not conducive to concentrations above the level of the standard."

Table 1 summarizes the data completeness data for the Knox County monitors for the 2009-2011 period based on the data in EPA's AirData database as of March 10, 2012:

[2] 40 C.F.R. Part 50, Appendix I, § 2.3(b) provides: "When computing whether the minimum data completeness requirements have been met, meteorological or ambient data may be sufficient to demonstrate that meteorological conditions on missing days were not conducive to concentrations above the level of the standard. Missing days assumed less than the level of the standard are counted for the purpose of meeting the data completeness requirement, subject to the approval of the appropriate Regional Administrator."

Table 1 2009-2011 Knox County Ozone Monitor Completeness Data Based on EPA's AirData Database as of March 10, 2012				
Monitor	**2009 Knox County Ozone Data Completeness (%)**	**2010 Knox County Ozone Data Completeness (%)**	**2011 Knox County Ozone Data Completeness (%)**	**3-Year Average* Knox County Ozone Data Completeness (%)**
Rutledge Pike (East Knox)	97	95	56	83
Mildred Drive (Spring Hill)	99	97	73	90

*2009-2011 3-year average.

Based on these data, neither monitor meets the minimum completeness requirements for the 2011 ozone season and, in addition, the Rutledge Pike monitor does not meet the three-year average completeness requirement.

To determine whether any of the missing days in 2011 (i.e., days with no internal temperature data) could be "counted for the purpose of meeting the data completeness requirement'" both "meteorological and ambient data" for the immediate vicinity of the two Knox County monitors were examined.

Internal temperature data was not available at the Rutledge Pike monitor from March 1, 2011 through June 13, 2011, and at the Mildred Drive monitor from March 1, 2011 through May 2, 2011. Table 2 shows the highest 8-hour daily maximum ozone concentration measured at any monitor in the Knoxville CSA (high elevation monitors and low elevation monitors) for each day during this timeframe, based on data in EPA's AirData database.

Table 2 Highest 8-Hour Maximum Ozone Measured in the Knoxville CSA and the Modeled 8-Hour Maximum Ozone for the Knoxville CSA, March 1, 2011 through June 13, 2011		
Date	**Highest 8-Hour Maximum Ozone Measured in Knoxville CSA (ppb)**	**Modeled 8-Hour Maximum Ozone for the Knoxville CSA (ppb)**
March 1, 2011	50	49

March 2, 2011	58	60
March 3, 2011	62	67
March 4, 2011	56	55
March 5, 2011	50	44
March 6, 2011	38	42
March 7, 2011	50	46
March 8, 2011	55	54
March 9, 2011	53	46
March 10, 2011	40	42
March 11, 2011	51	46
March 12, 2011	66	66
March 13, 2011	62	60
March 14, 2011	59	47
March 15, 2011	50	48
March 16, 2011	61	44
March 17, 2011	62	65
March 18, 2011	59	61
March 19, 2011	56	55
March 20, 2011	57	60
March 21, 2011	61	60
March 22, 2011	63	60
March 23, 2011	55	49
March 24, 2011	42	48
March 25, 2011	60	44
March 26, 2011	59	42
March 27, 2011	40	39
March 28, 2011	52	41
March 29, 2011	56	56
March 30, 2011	47	47
March 31, 2011	44	34
April 1, 2011	53	47
April 2, 2011	61	62
April 3, 2011	61	68
April 4, 2011	56	61
April 5, 2011	57	54
April 6, 2011	60	67
April 7, 2011	65	64
April 8, 2011	52	66
April 9, 2011	42	56

April 10, 2011	47	60
April 11, 2011	53	58
April 12, 2011	56	49
April 13, 2011	69	61
April 14, 2011	71	70
April 15, 2011	68	63
April 16, 2011	51	59
April 17, 2011	61	61
April 18, 2011	70	67
April 19, 2011	66	68
April 20, 2011	57	57
April 21, 2011	51	59
April 22, 2011	52	58
April 23, 2011	51	60
April 24, 2011	58	61
April 25, 2011	50	62
April 26, 2011	46	55
April 27, 2011	50	55
April 28, 2011	61	54
April 29, 2011	62	60
April 30, 2011	69	69
May 1, 2011	69	61
May 2, 2011	59	63
May 3, 2011	54	54
May 4, 2011	53	58
May 5, 2011	63	63
May 6, 2011	65	62
May 7, 2011	66	63
May 8, 2011	70	61
May 9, 2011	64	69
May 10, 2011	61	65
May 11, 2011	68	63
May 12, 2011	65	63
May 13, 2011	58	62
May 14, 2011	53	52
May 15, 2011	36	49
May 16, 2011	42	43
May 17, 2011	43	36
May 18, 2011	55	46

May 19, 2011	65	48
May 20, 2011	63	58
May 21, 2011	73	71
May 22, 2011	57	65
May 23, 2011	52	70
May 24, 2011	56	55
May 25, 2011	73	63
May 26, 2011	66	52
May 27, 2011	63	54
May 28, 2011	67	65
May 29, 2011	65	78
May 30, 2011	65	65
May 31, 2011	72	68
June 1, 2011	68	72
June 2, 2011	81	75
June 3, 2011	85	70
June 4, 2011	85	86
June 5, 2011	70	91
June 6, 2011	81	81
June 7, 2011	84	82
June 8, 2011	86	84
June 9, 2011	74	81
June 10, 2011	75	97
June 11, 2011	66	81
June 12, 2011	65	71
June 13, 2011	74	66

To be conservative, we assumed that if there was no ambient ozone measurement in the Knoxville CSA exceeding 90% of the standard (i.e., not greater than 67 ppb), then the ambient data for the vicinity of the Knox County monitors indicates that conditions were not "conducive to concentrations above the level of the standard." Based on that analysis, 57 of the 63 missing days between March 1, 2011 and May 2, 2011 at the Mildred Drive monitor could be included in the completeness calculation, and 82 of the 104 missing days at the Rutledge Pike monitor could be included. On none of the days in question at the Mildred Drive monitor was there an 8-hour maximum ozone level measured above the standard at any location in the state of Tennessee, and on only seven of the days in question at the Rutledge Pike monitor was ozone measured in the state to exceed the standard.

In addition to analyzing the ambient data for the Knoxville CSA, we performed an analysis of meteorological conditions for the period of time in question to determine whether or not they were "conducive to concentrations above the level of the standard." TDEC has developed predictive models based on regression analyses of historical ozone concentrations measured across the state with the meteorological conditions that existed at the time and location of those measurements. These predictive models have been fine-tuned over time and are now used quite effectively to forecast ozone concentrations at various places across the state a day ahead. The predictive model for the Knox County area is based on the preceding day's ozone level and the next day's predicted high and low ambient temperature, relative humidity, and wind speed.

For this analysis of meteorological conditions, TDEC staff input the actual previous day's ozone concentrations and the meteorological conditions that existed in the Knox County area on each of the days in question and ran the Knox County model. The resulting modeled ozone concentrations are listed in Table 2 above.

Taking the same conservative approach described above, we assumed that if the modeled ozone did not exceed 90% of the standard (i.e., was not greater than 67 ppb), then the meteorological conditions in the vicinity of the Knox County monitors indicate that conditions were not "conducive to concentrations above the level of the standard." In that case, 59 of the 63 missing days between March 1, 2011 and May 2, 2011 at the Mildred Drive monitor could be included in the completeness calculation, and 83 of the 104 missing days at the Rutledge Pike monitor could be included.

Based on the analysis of both ambient ozone levels and meteorological conditions, it appears that the majority of days in question at both of the Knox County monitors can be included in the data completeness calculations. Counting only the days when *neither* the ambient ozone data nor the modeled ozone concentration exceeded 90% of the level of the standard, there are 55 of the 63 days in question at the Mildred Drive monitor and 76 of the 105 days in question at the Rutledge Pike monitor that can be counted.

Table 3 summarizes the re-calculated data completeness for each of the Knox County monitors for the 2009-2011 period.

Table 3 2009-2011 Knox County Ozone Monitor Re-Calculated Completeness Data Based on Analysis of Ambient Ozone Data and Meteorological Conditions				
Monitor	**2009 Knox County Ozone Data Completeness (%)**	**2010 Knox County Ozone Data Completeness (%)**	**2011 Knox County Ozone Data Completeness (%)**	**3-Year Average* Knox County Ozone Data Completeness (%)**
Rutledge Pike (East Knox)	97	95	87	93
Mildred Drive (Spring Hill)	99	97	96	97

*2009-2011 3-year average.

Based on this analysis, we strongly recommend that Region IV use the re-calculated 2011 percent data completeness for the two Knox County ozone monitors and accept the 2011 ozone data for the Knoxville CSA as complete.

If the 2011 Knox County data are accepted as complete based on the foregoing analysis, the 2009-2011 3-year average can be used to make the attainment designations for the Knoxville CSA. According to the data currently in EPA's AirData database, Table 4 lists the 4th highest 8-hour daily maximums and the 3-year design values for the two Knox County monitors.

Table 4 2009-2011 Knox County 4th Highest 8-Hour Daily Maximums and 3-Year Design Values				
Monitor	**2009 4th Highest 8-Hour Daily Maximum (ppb)**	**2010 4th Highest 8-Hour Daily Maximum (ppb)**	**2011 4th Highest 8-Hour Daily Maximum (ppb)**	**3-Year Design Value* (ppb)**
Rutledge Pike (East Knox)	66	70	71	69
Mildred Drive (Spring Hill)	68	74	74	72

*2009-2011 3-year average.

However, during the time in question at the Rutledge Pike monitor, ozone measurements on two days exceeded the standard. These data are not currently included in EPA's AirData database. These two days were June 7 and 8, 2011, and the 8-hour maximums for those days were 79 ppb and 86 ppb, respectively. If these two days are factored in, the 4th highest 8-hour maximum for the Rutledge Pike monitor for 2011 becomes 74 ppb, rather than 71 ppb, and the 3-year design value becomes 70 ppb rather than 69 ppb.

II. COUNTY DESIGNATIONS

In November 2011 the State of Tennessee revised its March 2009 recommendations for the designation of counties in the state for attainment and nonattainment with the 2008 ozone NAAQS. (Letter from Robert J. Martineau, Jr., to Gwen Keyes Fleming, dated November 8, 2011.) In that letter, TDEC recommended that for the Knoxville area, the portions of Blount, Cocke, and Sevier counties within the boundaries of the Great Smoky Mountains National Park ("Park") be designated nonattainment and that the remaining portions of those counties, as well as the entireties of the other counties in the Knoxville CSA, be designated attainment. This recommendation was based on 2009-2011 preliminary design values. Subsequently, EPA informed the State of Tennessee that it intended to designate Anderson, Blount, Knox, Loudon, and Sevier Counties in their entireties and the portion of Cocke County within the Park boundary as nonattainment. (Letter from Gwendolyn Keyes Fleming to the Honorable Bill Haslam, dated December 8, 2011.) EPA agreed with the State's recommendation of attainment with regard to the remaining counties in the Knoxville CSA. EPA's decision was based on 2008-2010 design values and a technical analysis of five factors (i.e., an analysis of the so-called "nine factors").

As discussed in detail in the preceding section of this report, we strongly recommend that EPA accept the 2011 ozone data for the Knoxville CSA as complete, and that the 2009-2011 design values be used in making the designations with the 2008 ozone NAAQS. Accordingly, we have conducted a re-analysis of some of the factors EPA discussed in the attachment to its December 8, 2011 letter.

A. Factor 1: Air Quality Data

Figure 1 shows the locations of the nine ozone monitors in the Knoxville CSA and Table 5 presents the 2009 through 2011 4th highest 8-hour daily maximum ozone concentration as well as the 2009-2011 design values for each of the monitors.

Figure 1 – Knoxville CSA Ozone Monitor Locations.

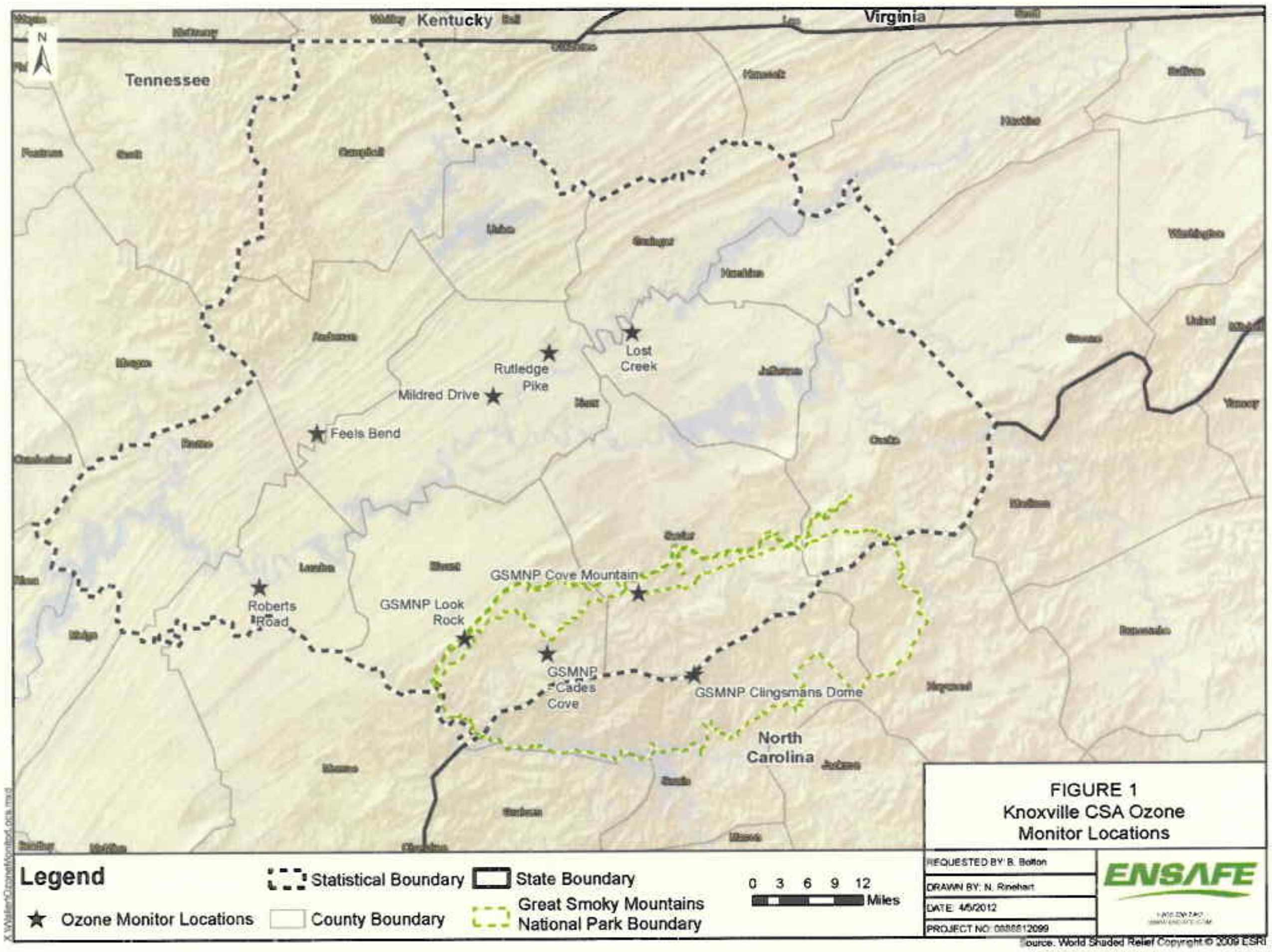


Table 5 2009-2011 Knoxville CSA 4th Highest 8-Hour Daily Maximums and Design Values					
Monitor	**County**	**2009 4th Highest 8-Hour Daily Maximum (ppb)**	**2010 4th Highest 8-Hour Daily Maximum (ppb)**	**2011 4th Highest 8-Hour Daily Maximum (ppb)**	**2009-2011 Design Value (ppb)**
Freels Bend	Anderson	65	73	74	70
Cades Cove	Blount	62	74	68	68
Look Rock	Blount	69	81	82	77
Lost Creek	Jefferson	68	77	73	72
Mildred Drive	Knox	68	74	74	72
Rutledge Pike	Knox	66	70	74	70
Roberts Road	Loudon	68	76	75	73
Clingmans Dome	Sevier	71	77	79	75
Cove Mountain	Sevier	70	78	77	75

For the 2009-2011 period only one monitor in the Knoxville CSA exceeded the 2008 zone NAAQS: the monitor located in Blount County at Look Rock. The monitors in all of the other counties in the Knoxville CSA attained the NAAQS for this period.

B. Factor 2: Emissions and Emissions-Related Data

According to the 2008 National Emissions Inventory ("NEI") Blount, Loudon, Sevier, and Cocke Counties made very small contributions to the area-wide emissions of NO_X and VOCs, and Anderson County made a very small contribution to VOC emissions. (*See* "Emissions and Emissions-Related Data" analysis contained in the attachment to EPA's December 8, 2011 letter to the State of Tennessee.) According to the 2008 NEI, NO_X emissions in Anderson County were 12,475 tons. Of that total, 8,622 tons were emitted by TVA's Bull Run Power Plant. In the "Conclusion" section to the "Technical Analysis for Knoxville-Sevierville-La Follette" section of EPA's attachment to its December 8, 2011 letter to the State of Tennessee, EPA points out that "while SCR controls were installed at the plant (i.e., Bull Run Power Plant), there has been a steady increase in NO_X emission levels since 2006." However, since 2008 NO_X emissions from Bull Run have declined significantly. Not only have the total annual and ozone season emissions declined, but the emission rates have significantly declined as well, indicating that the SCR at the plant is effectively controlling NO_X emissions. Figure 2 and Table 6 summarize the NO_X emissions from the Bull Run Plant.

Figure 2 – NOx Emissions - TVA's Bull Run Plant, Anderson Co., TN.

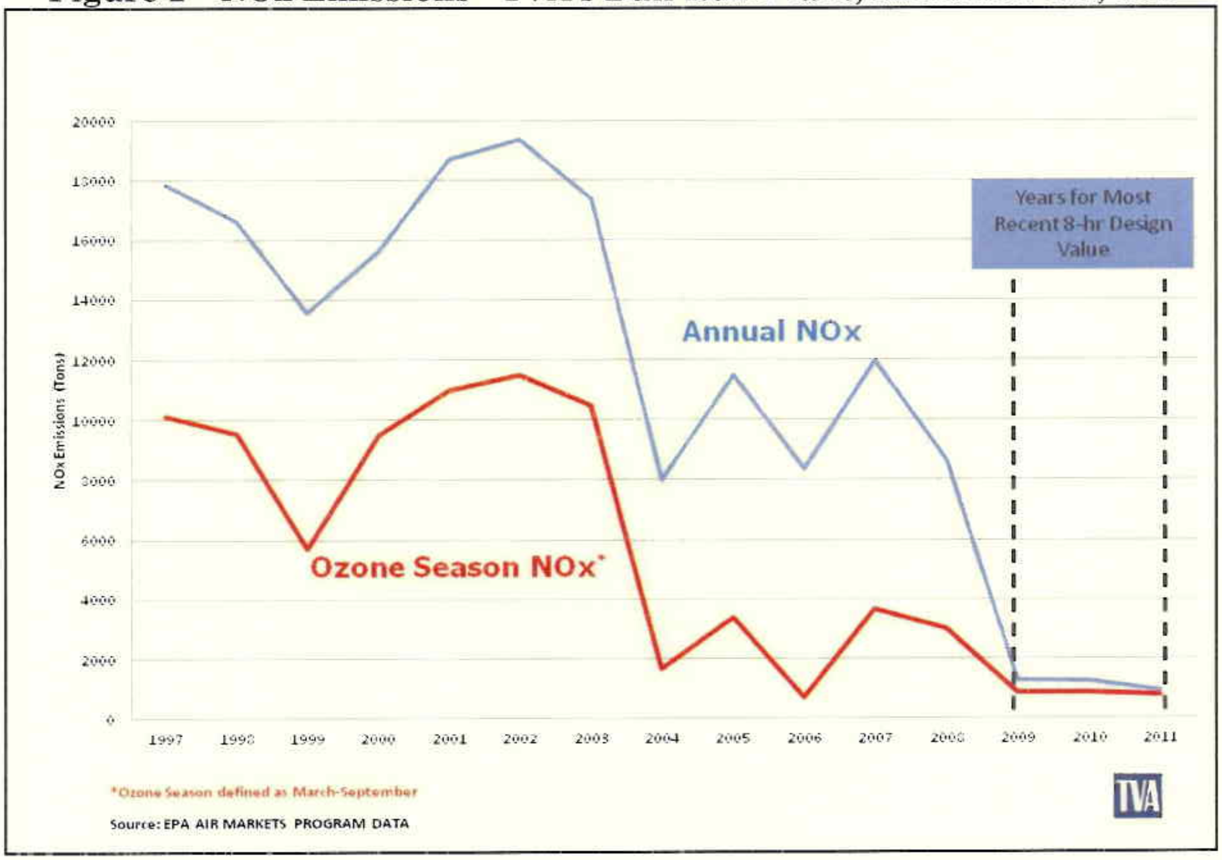


Table 6 Bull Run Power Plant NOx Emissions*				
Year	**Annual Emissions (TPY)**	**Annual Emission Rate (lbs/mmBTU)**	**Ozone Season Emissions (TPY)**	**Ozone Season Emission Rate (lbs/mmBTU)**
2008	8,622.3	0.372	2,983.8	0.244
2009	1,270.7	0.090	843.5	0.080
2010	1,221.0	0.074	829.5	0.069
2011	912.0	0.070	758.2	0.070

* Source: EPA Air Markets Program Data

C. Factor 3: Meteorology (Weather/Transport Patterns)

In EPA's attachment to its December 8, 2011 letter to the State of Tennessee, EPA mentions an analysis of wind direction and speed for the 2008-2010 ozone season (March through October) conducted to better understand the fate and transport of precursor emissions contributing to ozone formation. EPA's analysis of the National Weather Service data collected at Knoxville McGhee Tyson Airport indicated that southwest and west-southwest winds predominate along with a northern component.

Figure 3 – Wind Direction Percentage for Knoxville McGhee Tyson Airport, Ozone Season, 2009-2011.

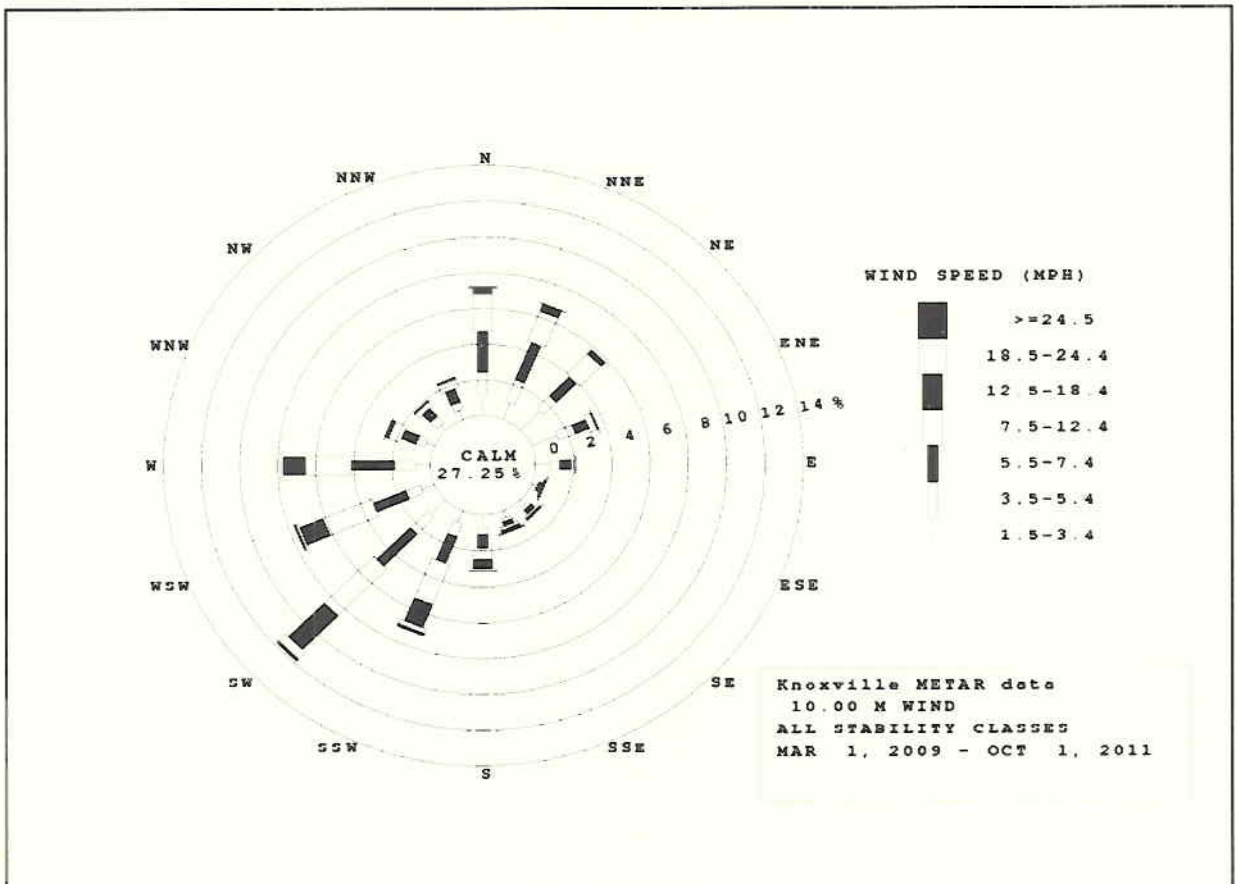


Figure 3 shows the results of a similar analysis for the 2009-2011 ozone seasons. Disregarding the calms, slightly over fifty percent of the time the wind was from the south to west quadrant. There are no significant point sources of NO_X

or VOC emissions in the counties EPA intends to designate nonattainment that are in the south to west quadrant from the Look Rock monitor. Again disregarding the calms, only about one-third of the time was the wind from the west to northeast, the direction from Look Rock in which most of the sources of NO_X and VOCs emissions are located, as well as the major population centers and transportation corridors.

D. Factor 4: Geography/Topography (Mountain Ranges or Other Air Basin Boundaries)

Section 107(d) of the Clean Air Act requires each state's governor to provide EPA a list of all areas, or portions thereof, in the state designated as nonattainment, attainment, or unclassifiable for the ozone national ambient air quality standard. (42 U.S.C. § 7407(d)(1).) EPA designation guidance provides that potential ozone nonattainment areas "should be evaluated on a case-by-case basis." (EPA Memorandum: Area Designations for the 2008 Revised Ozone National Ambient Air Quality Standards 1, dated December 4, 2008.) Further, EPA "recognizes that these area-specific analyses conducted by states, tribes, and/or EPA may support nonattainment area boundaries that are larger or smaller than the presumptive area starting point." (*Id.*) In this guidance document, EPA also provided a list of factors that the states could consider in making their nonattainment boundary recommendations. One of these factors is identified as "geography/topography (mountain ranges or other air basin boundaries)." (*Id.*, Attachment 2.)

EPA previously has considered the impact of high elevation areas when making nonattainment designations. In North Carolina, EPA agreed to designate only areas above 4,000 feet as the nonattainment area in the Plott Balsam Mountains because "the State submitted information indicating that the violations of the 8-hour ozone standard at the monitors located at the high elevations were due to long range transport and the area was not generating emissions that caused the violations." (Letter from Region 4 Administrator to Secretary of North Carolina Department of Environment & Natural Resources, Enclosure 2, dated December 3, 2003.)

In EPA's attachment to its December 8, 2011 letter to the State of Tennessee, EPA discusses a number of analyses it conducted based on the 2008-2010 ozone seasons. EPA concluded (1) the two high elevation monitors in Sevier County (Clingmans Dome at 6655 feet above mean sea level ("MSL"), and Cove Mountain at 4150 feet above MSL) are located at "a significantly higher elevation than the Knox County monitors" and thus "measure elevated ozone levels overnight due to regional transport of tropospheric ozone formed during the daytime"; (2) the urban monitor in Knox County (Mildred Drive) exhibits a diurnal pattern typical of urban sites and predominantly impacted by urban and nearby emissions; and (3) the monitor at Look Rock (the only monitor measuring a violation of the standard during the 2009-2011 ozone seasons) exhibited a diurnal pattern characterized by impacts from both urban and nearby emissions as well as regional tropospheric ozone formed during the day, in some cases at the same time.

In EPA's analysis it did not mention the characteristics of the diurnal patterns of the other monitors in the Knoxville CSA. Some of those monitors are located nearer local emission sources and at lower elevations (e.g., Rutledge Pike in Knox County, Freels Bend in Anderson County, Lost Creek Road in Jefferson County, and Roberts Road in Loudon County). EPA also did not mention the Cades Cove monitor located just nine miles from the Look Rock monitor in Blount County at an elevation of 1850 feet above MSL.

A detailed analysis of the diurnal patterns of all the monitors in the Knoxville CSA reveals that the characteristics of the Look Rock, Clingmans Dome, and Cove Mountain monitors are generally very similar, while all the other monitors in the Knoxville CSA exhibit diurnal patterns typical of urban sites, including the monitor located at Cades Cove. Figures 4 and 5 provide examples of the diurnal patterns at each monitor during high ozone episodes in the Knoxville CSA.

Figure 4 – Ozone Concentrations Across the Knoxville CSA, June 23-26, 2009.

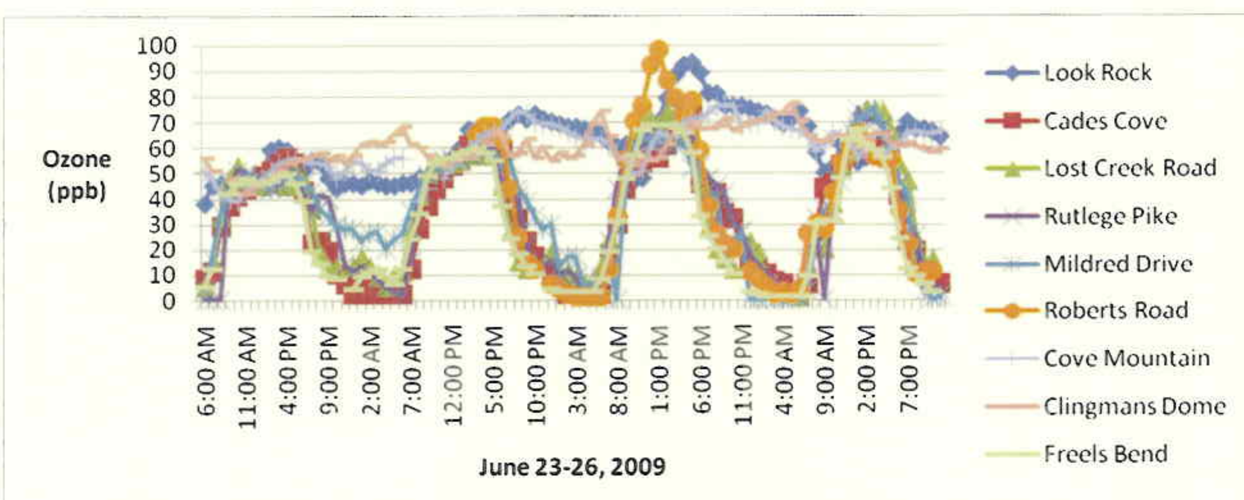
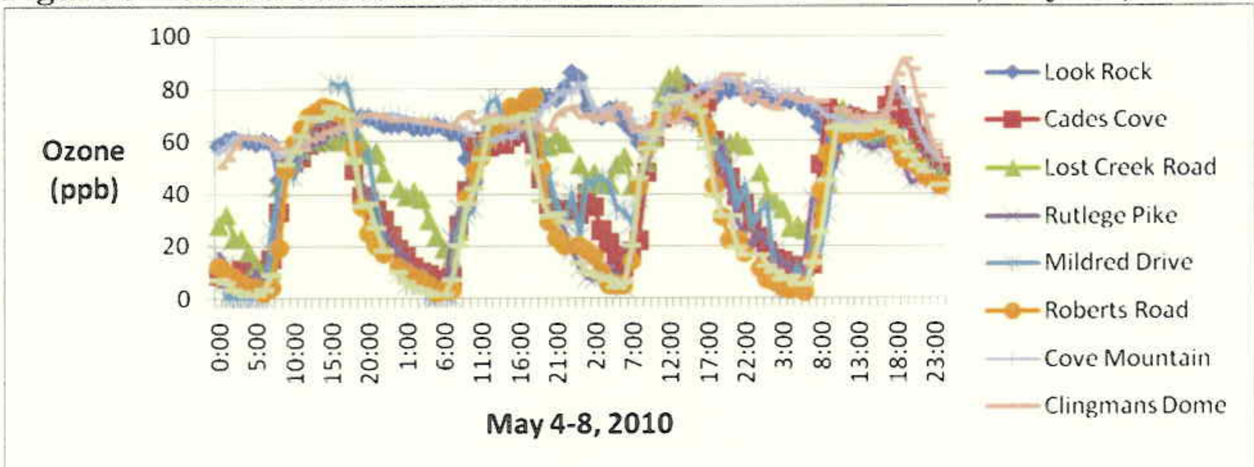


Figure 5 – Ozone Concentrations Across the Knoxville CSA, May 4-8, 2010.



Clearly, concentrations of ozone at the Look Rock monitor exhibit diurnal characteristics very similar to those at the Clingmans Dome and Cove Mountain monitors, which are remote, high elevation monitors and, as EPA suggests in its analysis, are typically predominantly influenced by regional transport of tropospheric ozone, rather than nearby emissions. Also of note is that the average 2009-2011 design value for the three high elevation monitors (Look Rock, Clingmans Dome, and Cove Mountain) is 75.7 ppb while the average for the remaining, lower elevation monitors is 70.8 ppb (*see* Table 5).

Because the Cades Cove monitor is located in very close proximity to the Look Rock monitor but at a lower elevation, we conducted a detailed analysis of back trajectories for the two sites on each day when the maximum 8-hour daily average ozone concentration at Look Rock exceeded 75 ppb. The back trajectories were computed using the National Oceanic and Atmospheric Administration's HYSPLIT model. Figures 5-10 are examples of typical pairs of back trajectories ending when the ozone concentration was at its maximum at Look Rock, and Figures 11-13 are composites of the back trajectories for each of the three years, 2009-2011.

Figure 6 – NOAA HYSPLIT Backyard Trajectory Ending at 2100 UTC 25 June 2009.

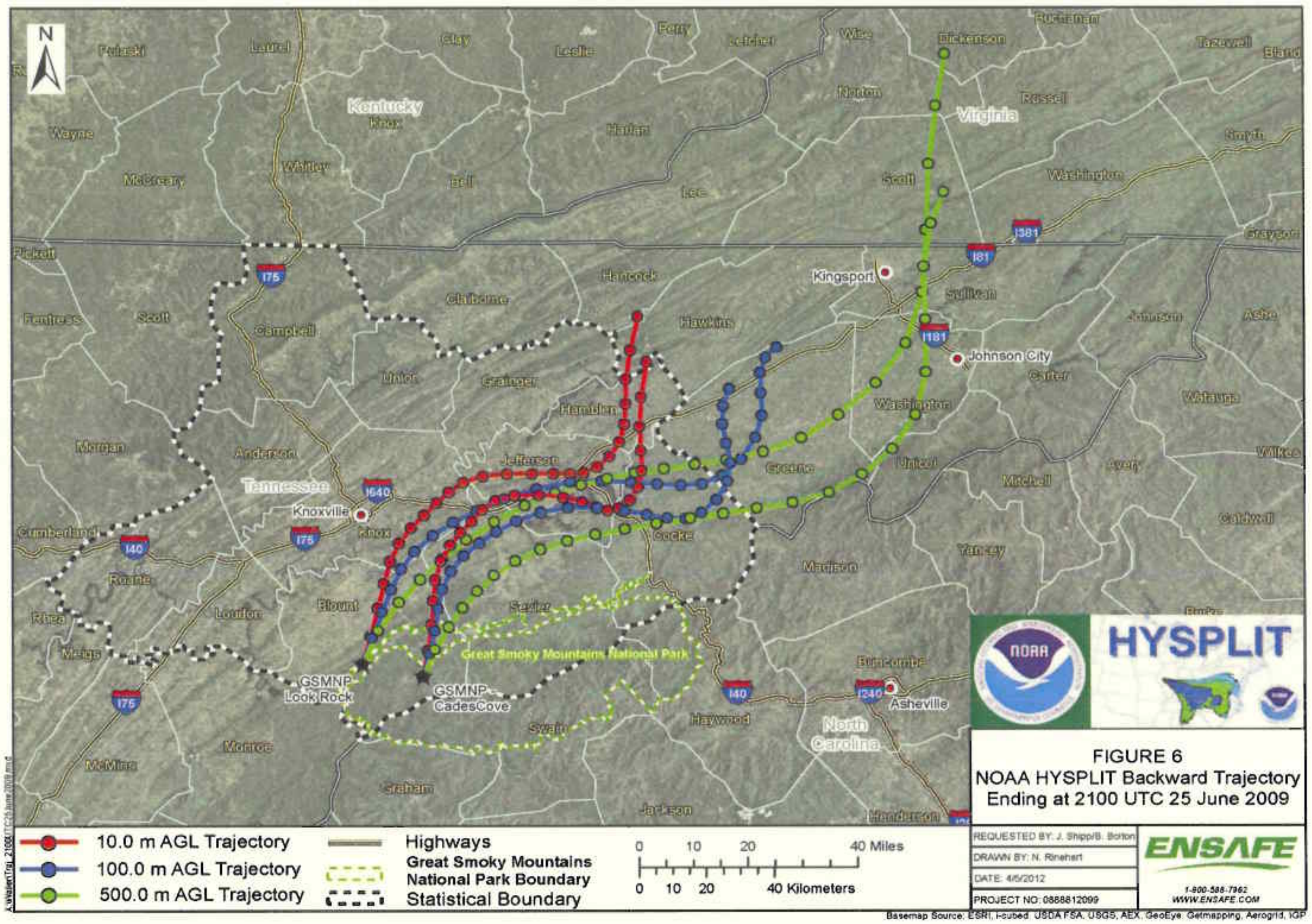


Figure 7 – NOAA HYSPLIT Backward Trajectory Ending at 2100 UTC 15 April 2010.

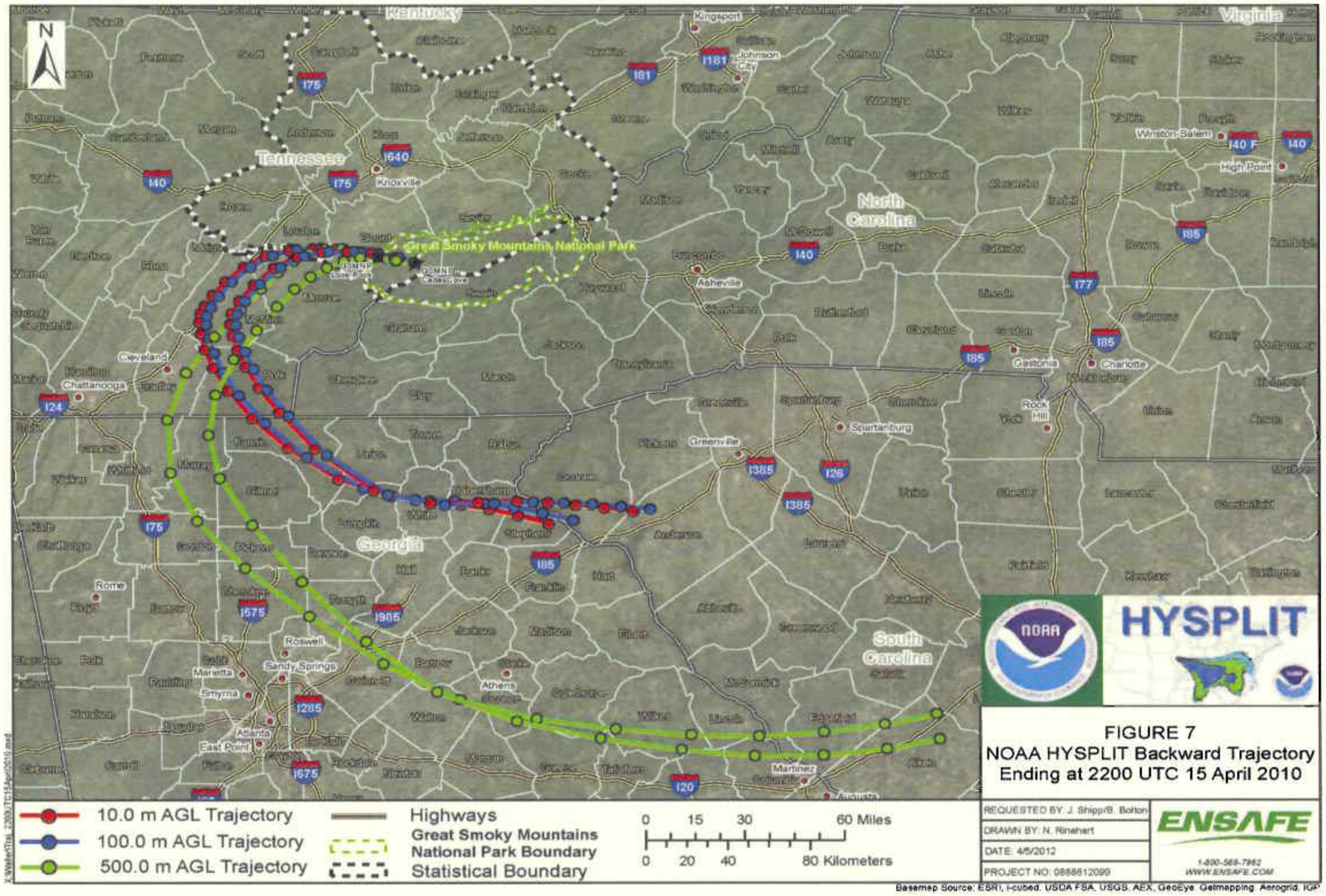


Figure 8 – NOAA HYSPLIT Backward Trajectory Ending at 2100 UTC 6 May 2010.

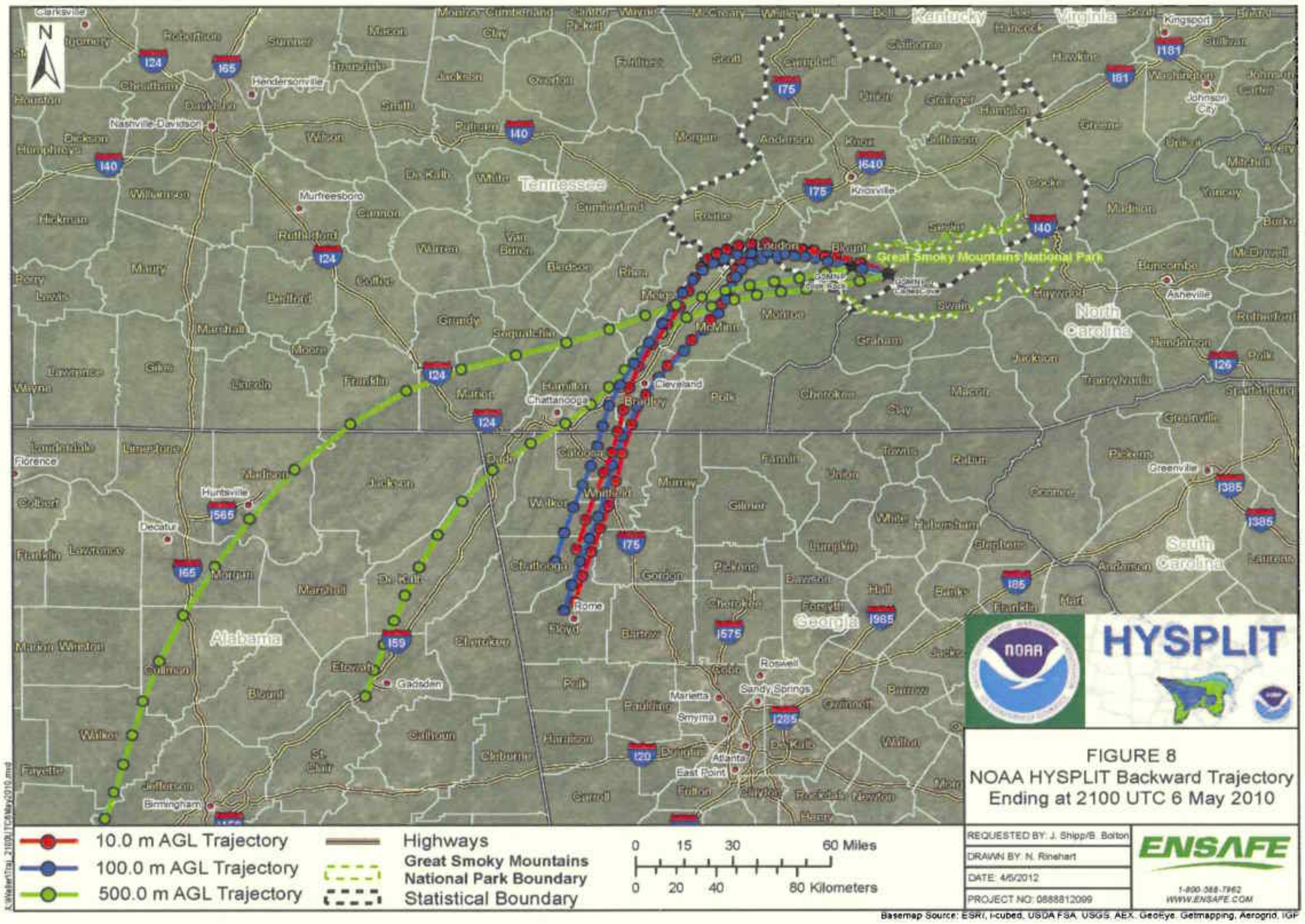


Figure 9 – NOAA HYSPLIT Backward Trajectory Ending at 2000 UTC 8 July 2010.

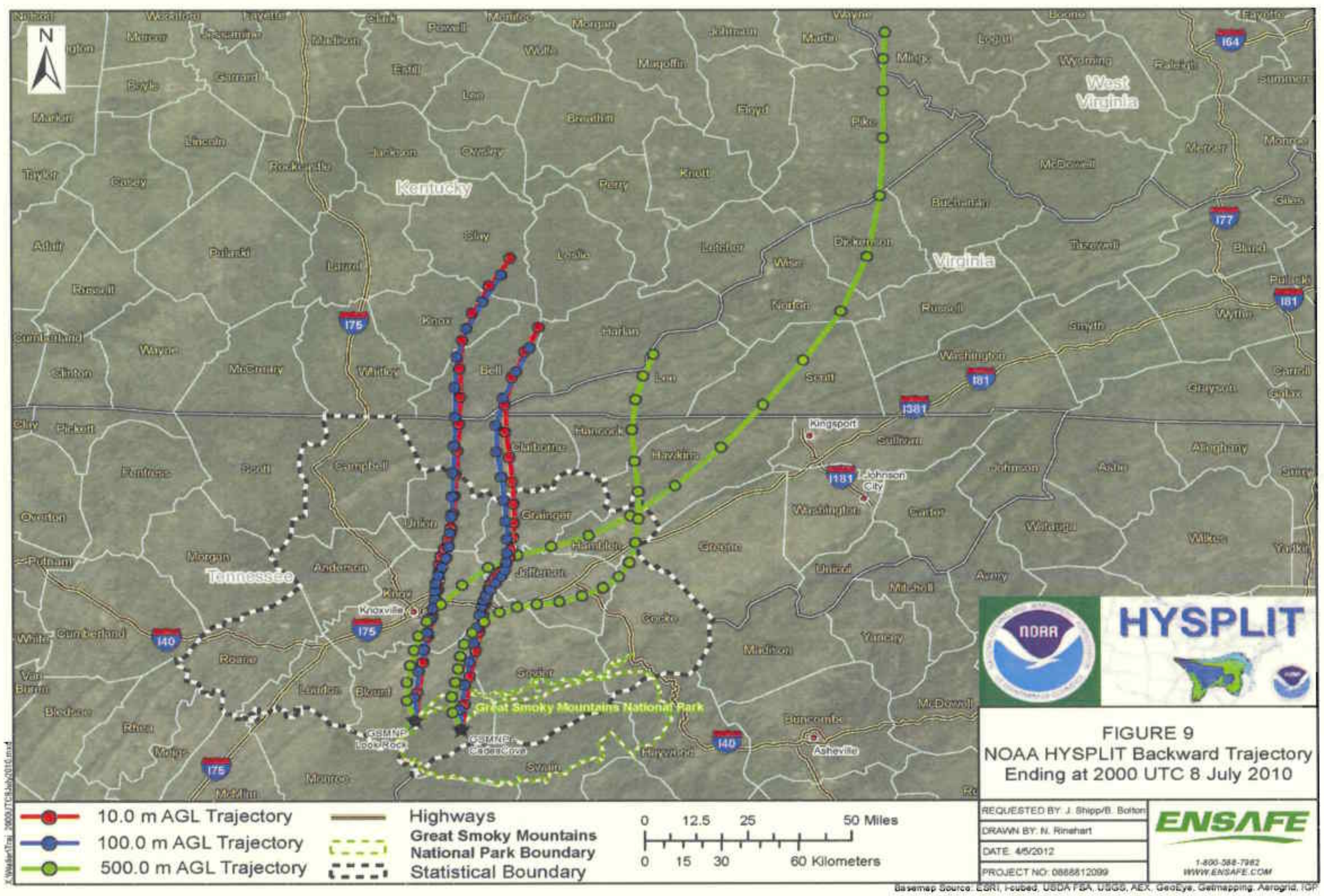


Figure 10 – NOAA HYSPLIT Backward Trajectory Ending at 1900 UTC 3 June 2011.

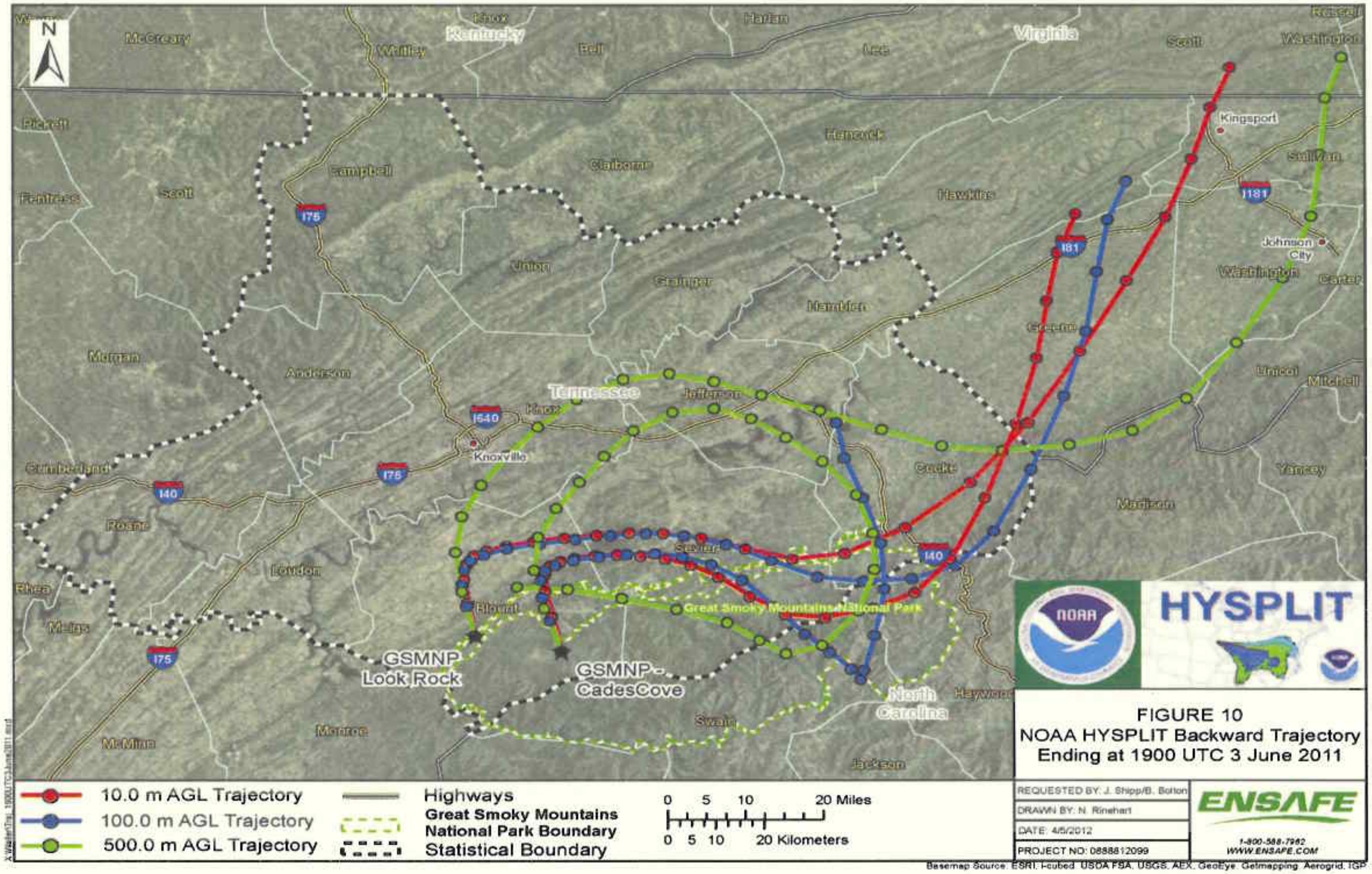


Figure 11 – NOAA HYSPLIT Backward Trajectory Ending at 2100 UTC 13 July 2011.

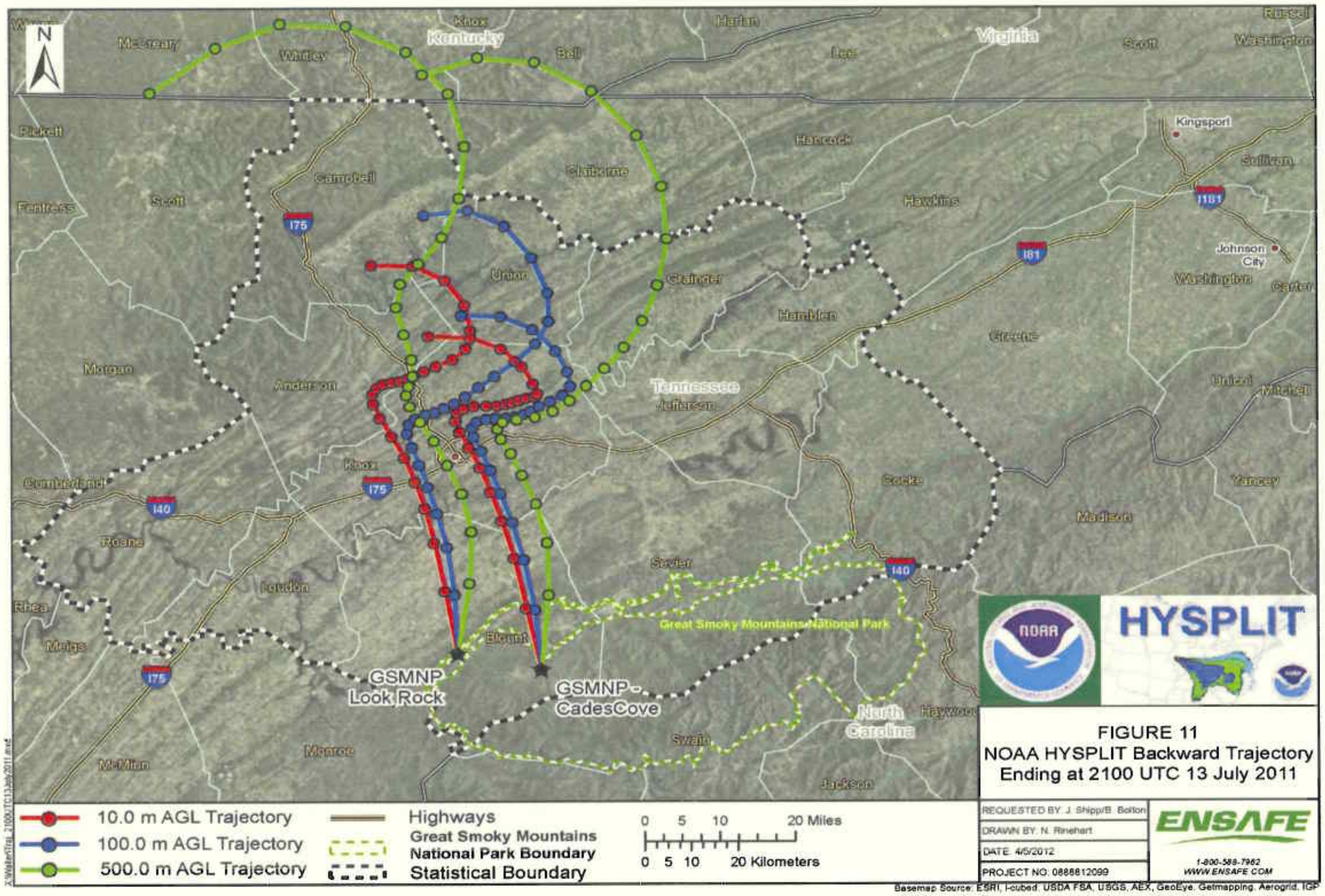


Figure 12 – NOAA HYSPLIT Model Composite Backward Trajectories for 2009.

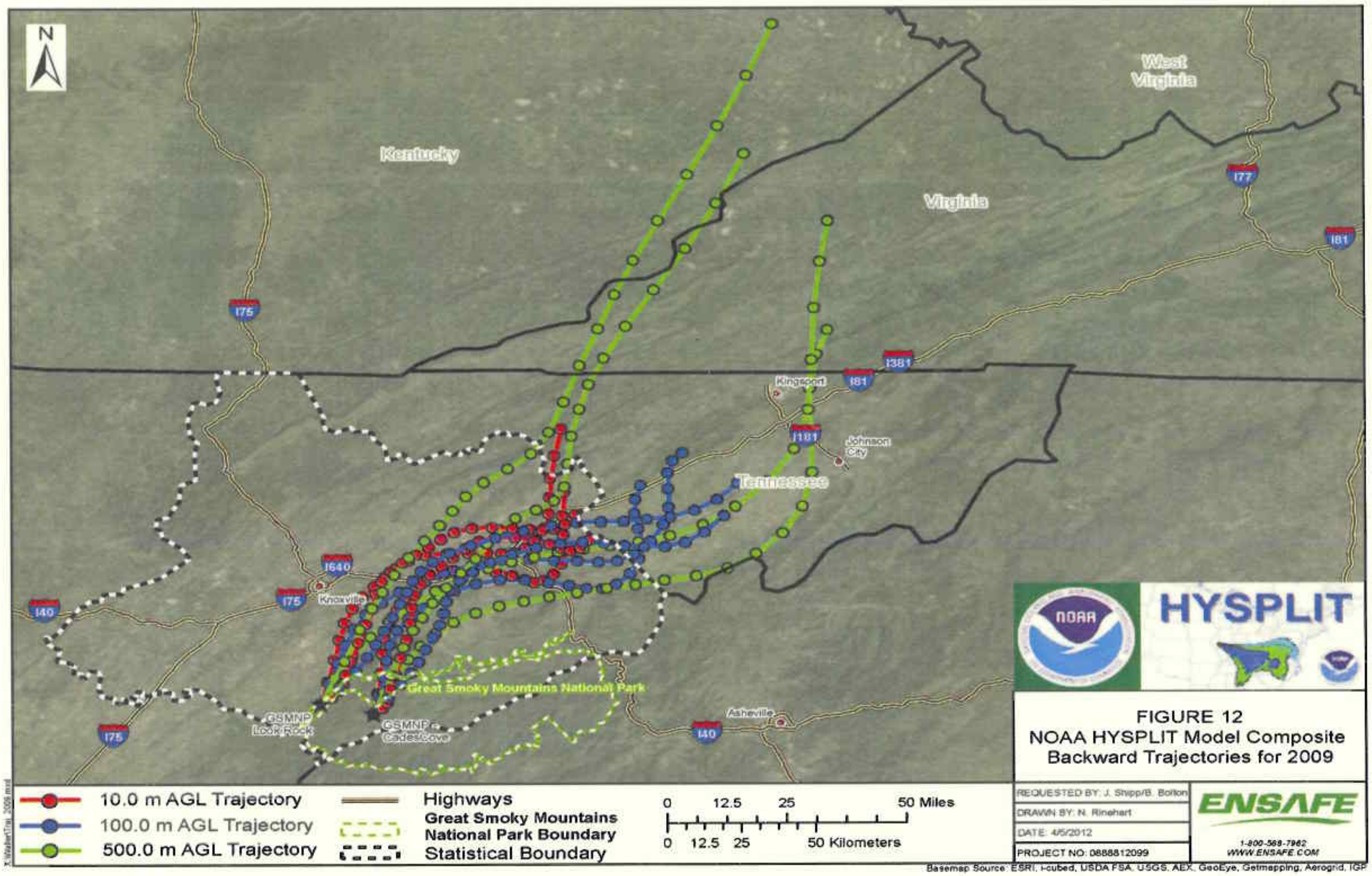


Figure 13 – NOAA HYSPLIT Model Composite Backward Trajectories for 2010.

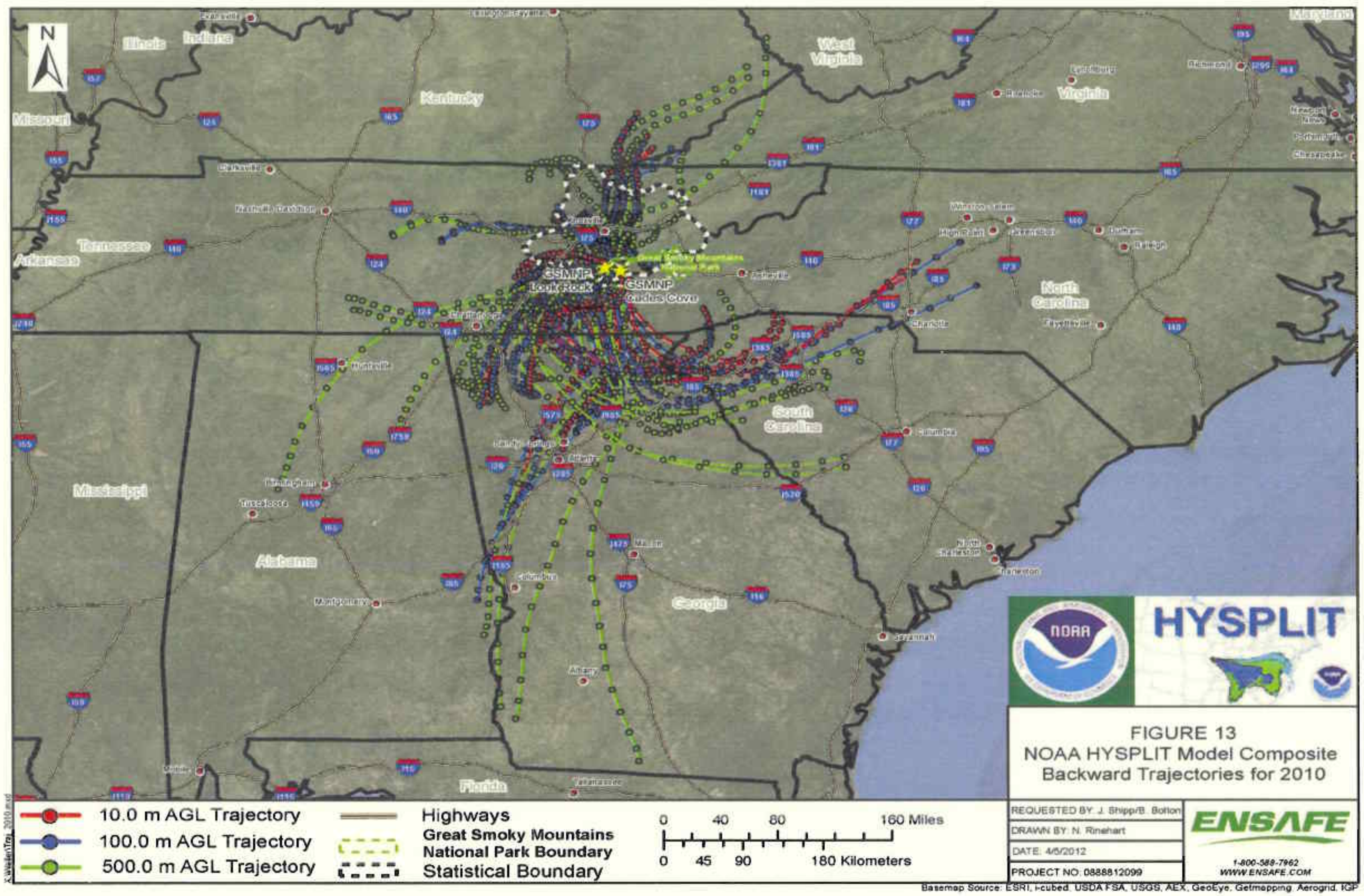
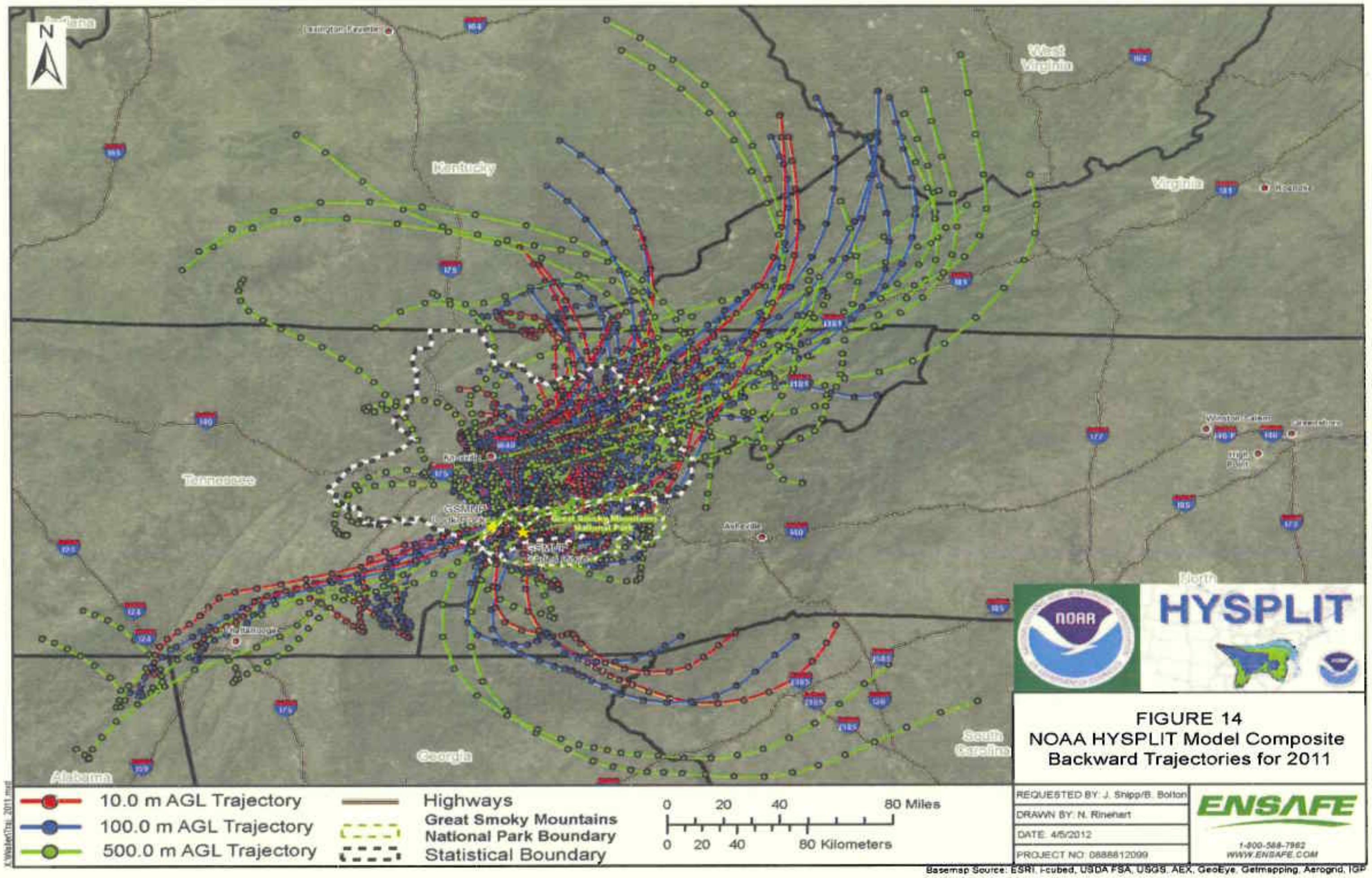
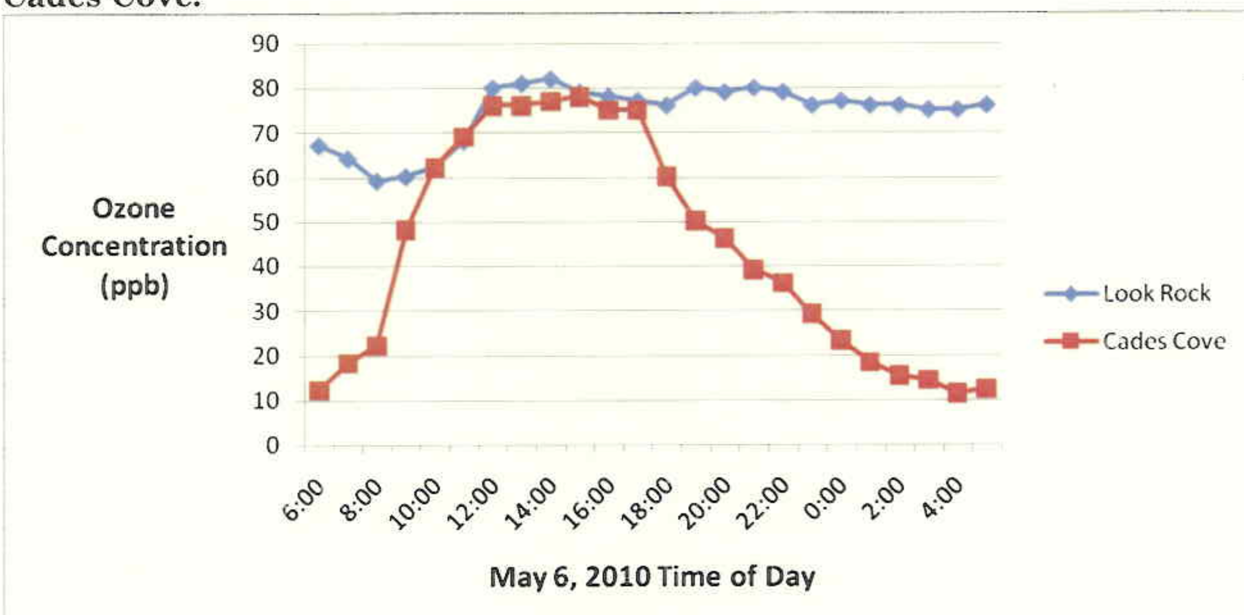


Figure 14 – NOAA HYSPLIT Model Composite Backward Trajectories for 2011.



As can be seen from these examples, based only on back trajectories, the two monitors should generally be expected to be impacted by emissions from the same general areas. However, as pointed out above, the Cades Cove monitor is not violating the 2008 ozone NAAQS. In fact it has the lowest 2009-2011 design value in the Knoxville CSA. As graphically shown in Figures 3 and 4 above, the Cades Cove monitor exhibits a diurnal ozone pattern similar to those of the other lower elevation monitors, while the Look Rock monitor exhibits a diurnal pattern similar to the other higher elevation monitors. The monitor at Look Rock is being significantly impacted by regional transport of tropospheric ozone during the nighttime hours. Figure 15 shows a typical comparison of the diurnal ozone patterns at Look Rock and Cades Cove.

Figure 15 – Comparison of Diurnal Ozone Patterns at Look Rock and Cades Cove.



The ozone concentration at Look Rock is already high early on the morning of May 6, 2010 (67 ppb), while the concentration at Cades Cove is very low (12 ppb) due to the overnight deposition and destruction of ozone. As ozone is formed during the day, concentrations increase dramatically at the Cades Cove monitor (to 78 ppb), while concentrations increase much less at Look Rock (to 82 ppb). However, with the coming of evening as the concentrations decline at Cades Cove, concentrations at Look Rock remain high as regional ozone is transported in and/or the nocturnal boundary layer isolates the higher elevations from the ozone destruction (titration) processes that occur at lower elevations. Consequently, the 8-hour average concentrations are higher at the higher elevations.

The data in Table 7 demonstrates the impact that higher overnight ozone concentrations have on the maximum 8-hour average concentration, and thus the ozone design value. At the Look Rock monitor the 8-hour average climbs above 75 ppb by 6 pm on May 6 and is still above 75 the next morning, while the 8-hour average at Cades Cove never exceeds 73 ppb.

Table 7
Diurnal Ozone Concentrations at Look Rock and Cades Cove
May 5-7, 2010

Time	Look Rock Ozone (ppb)	Cades Cove Ozone (ppb)	Look Rock Running 8-Hour Average (ppb)	Cades Cove Running 8-Hour Average (ppb)
2300	86	33		
0000	84	32		
0100	73	40		
0200	70	35		
0300	69	26		
0400	72	21		
0500	72	16		
0600	67	12	74	26
0700	64	18	71	25
0800	59	22	68	23
0900	60	48	66	24
1000	62	62	65	28
1100	68	69	65	33
1200	80	76	66	40
1300	81	76	67	47
1400	82	77	69	56
1500	79	78	71	63
1600	78	75	73	70
1700	77	75	75	73
1800	76	60	77	73
1900	80	50	79	70
2000	79	46	79	67

2100	80	39	78	62
2200	79	36	78	57
2300	76	29	78	51
0000	77	23	78	44
0100	76	18	77	37
0200	76	15	77	32
0300	75	14	77	27
0400	75	11	76	23
0500	76	12	76	19

The impact that this difference has over the course of all three ozone seasons (2009-2011) is illustrated by the data in Table 8. For each of the days during the three ozone seasons that the daily maximum 8-hour average ozone concentration at Look Rock exceeded 75 ppb, Table 8 lists the 6:00 AM ozone concentration for both Look Rock and Cades Cove, the maximum daytime hourly ozone concentration, and the daytime increase. The ozone concentration at Cades Cove was normally very low in the early morning, averaging only 9.0 ppb, while the early morning concentration at Look Rock was normally still high from the preceding day, averaging 64 ppb. Although daytime increases at Look Rock averaged less than the daytime increases at Cades Cove (20.4 versus 63.3 ppb), the resulting daytime ozone maximum hourly ozone concentration at Look Rock ended up much higher than Cades Cove and created an exceedance of the 8-hour ozone NAAQS. The exceedances of the 8-hour NAAQS were the result of the effects of the elevation of Look Rock.

Table 8
Early Morning Ozone Concentrations at Look Rock and Cades Cove With Daytime Increases

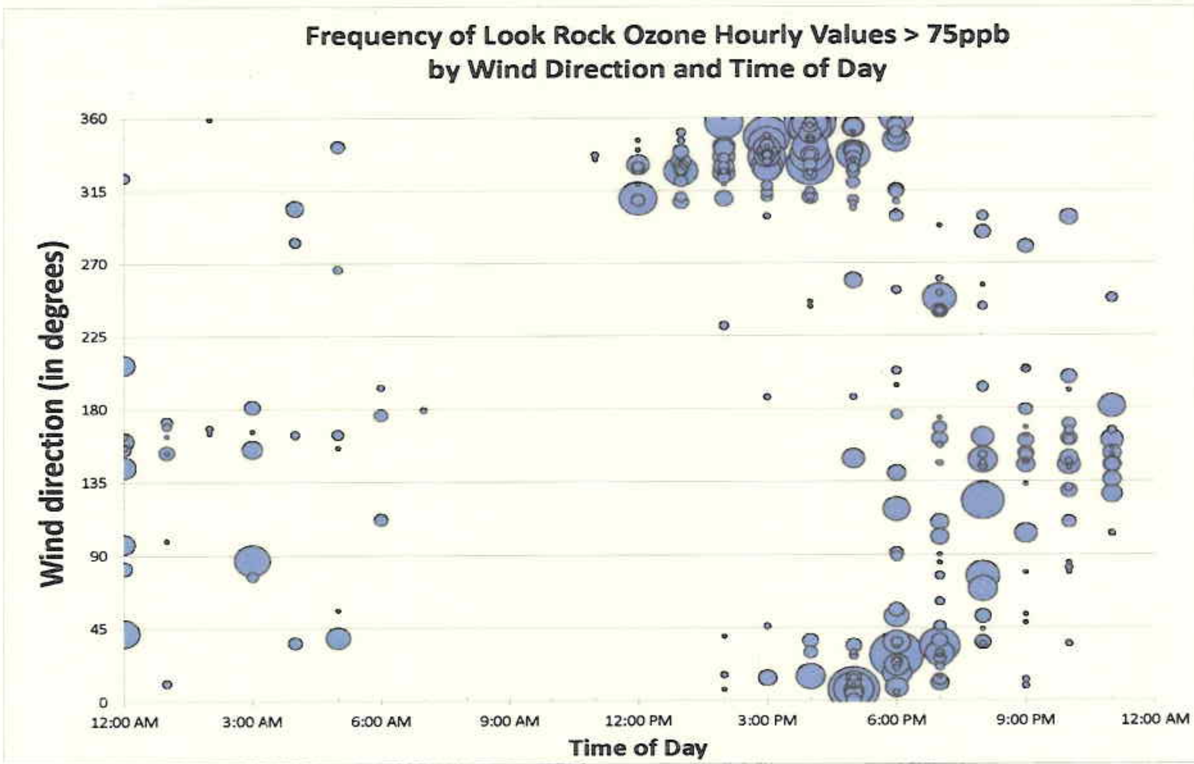
Date	Look Rock 6:00 AM Ozone (ppb)	Cades Cove 6:00 AM Ozone (ppb)	Look Rock Maximum Daytime Ozone (ppb)	Cades Cove Maximum Daytime Ozone (ppb)	Look Rock Daytime Ozone Increase (ppb)	Cades Cove Daytime Ozone Increase (ppb)
6/25/09	65	2	93	73	28	71
4/2/10	68	16	80	84	12	68
4/13/10	69	31	79	79	10	48
4/14/10	72	21	86	81	14	60
4/15/10	66	17	80	76	14	59
5/5/10	65	5	74	64	9	59

5/6/10	67	12	82	78	15	66
7/7/10	49	2	82	74	33	72
7/8/10	62	6	95	80	33	74
9/2/10	60	6	84	77	24	71
9/21/10	53	2	69	62	16	60
10/11/10	62	2	79	69	17	67
6/2/11	53	10	93	70	40	60
6/3/11	72	7	95	79	23	72
6/4/11	77	9	98	72	21	63
6/6/11	48	2	92	66	44	64
6/30/11	63	2	84	69	21	67
7/1/11	80	3	87	65	7	62
7/2/11	74	11	68	64	-6	53
7/13/11	65	31	91	71	26	40
8/3/11	68	5	82	68	14	63
8/12/11	53	1	82	71	29	70
9/2/11	60	3	85	71	25	68
Averages	64.0	9.0	84.3	72.3	20.4	63.3

In its attachment to its December 8, 2011 letter to the State of Tennessee, EPA discussed the frequency of ozone hourly values greater than 75 ppb by wind direction and time of day for the Look Rock site. In that discussion, EPA presented a graphic (*see* Figure 4 of the "Technical Analysis for Knoxville-Sevierville-La Follette," page 8) that showed that when hourly ozone concentrations exceed 75 ppb during the afternoon hours, the wind is predominantly from the north to northwest, while during the overnight hours the wind is predominantly from the southeast to south-southeast. Although in the text of the discussion of this graphic EPA made a misstatement and reversed these directions, it drew the conclusion that this difference is further evidence that "both downwind urban ozone formation from Knoxville Knox County and high elevation regional transport of ozone contribute to NAAQS violations."

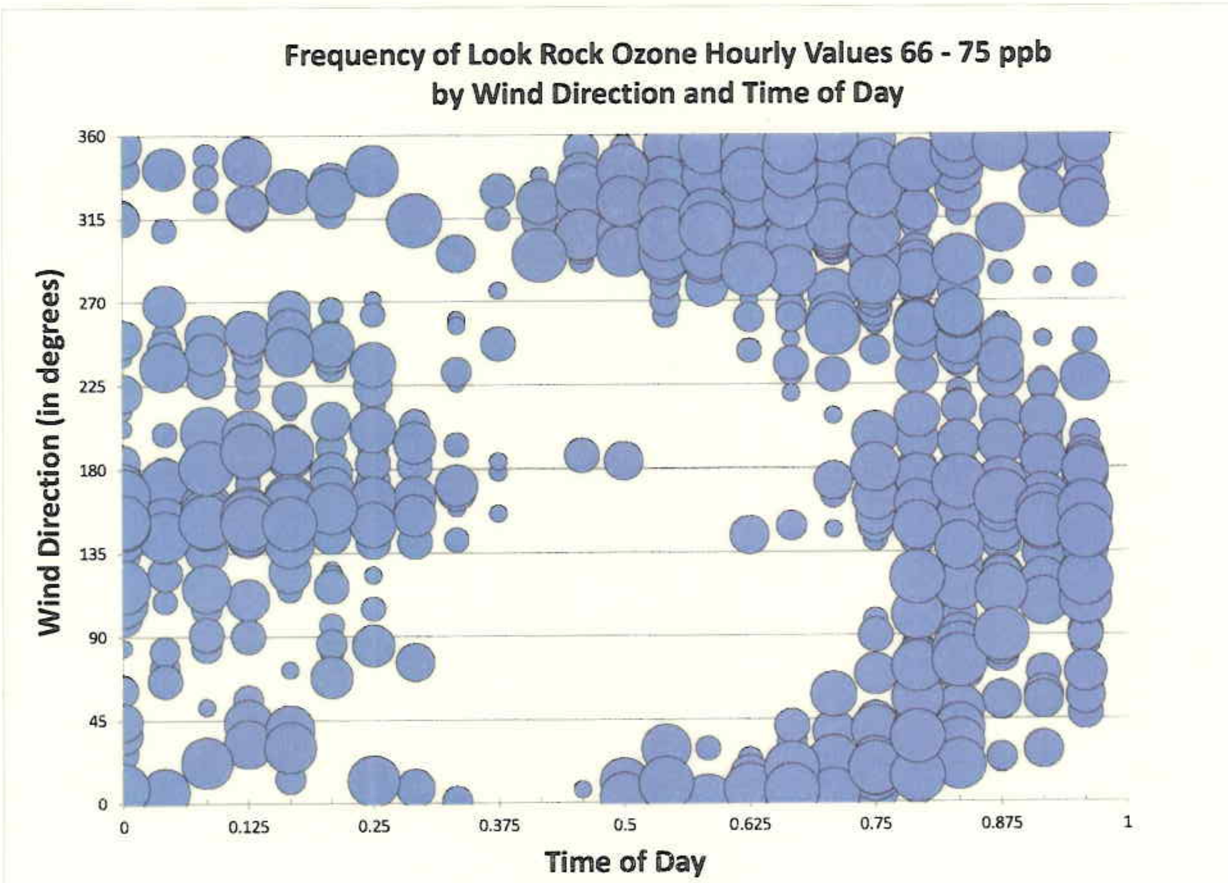
Although EPA does not state what data it used in its analysis, we assume it was either 2007-2010 or 2008-2010. Therefore, we repeated the analysis using the 2009-2011 ozone data for Look Rock. Figure 16 shows the results of that analysis.

Figure 16 – Frequency of Look Rock Ozone Hourly Values Greater Than 75 ppb by Wind Direction and Time of Day.



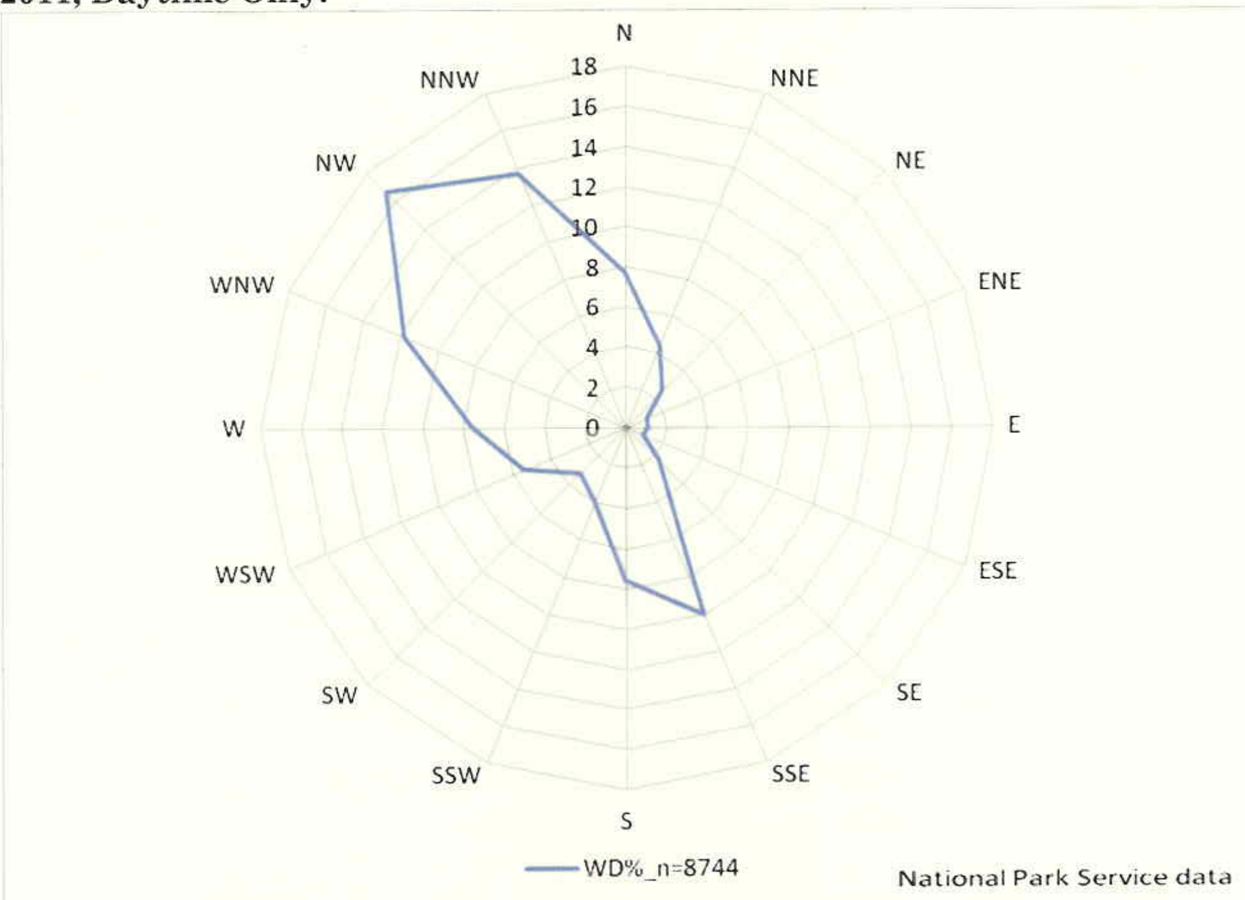
In addition to repeating EPA's analysis, we also looked at the wind direction by time of day for the hours when the ozone concentration at Look Rock was 66-75 ppb. That analysis is depicted in Figure 17.

Figure 17 – Frequency of Look Rock Ozone Hourly Values 66-75 ppb by Wind Direction and Time of Day.



We also constructed a wind rose based on CastNet data for the ozone seasons of 2009-2011. That wind rose is shown in Figure 18.

Figure 18 – Wind Direction Percentage for Look Rock, Ozone Season, 2009-2011, Daytime Only.



Based on all these analyses, we have concluded, as EPA did, that there appears to be a change in wind direction in the evening with the wind coming from the south-southeast when the ozone concentrations exceed 75 ppb. However, from the analyses shown in Figures 17 and 18, it appears that this same phenomenon not only also occurs when the ozone concentrations are 66-75 ppb, but also appears to occur almost every day. We believe this occurs due to the settling in the early evening of the nocturnal boundary layer to an elevation below the elevation of the Look Rock monitor and the subsequent rush of air down the slope to the north-northeast from the top of the ridge (causing the wind direction to change to "from" the south southeast). This behavior is typical of a high elevation site.

We draw two additional conclusions from the wind rose shown in Figure 18. First, examining the predominant wind directions measured at the Look Rock monitor (Figure 18) and comparing them to the predominant wind directions shown in Figure 2, which were measured at the Knoxville McGhee Tyson Airport, one finds that wind directions at Look Rock are markedly different. While the primary predominant wind direction measured at the Look Rock monitor was from the south-southeast with a secondary predominant direction being the northwest to north-northwest, as EPA points out in its analysis, the primary predominant wind direction for the Knoxville Airport is southwest to west-southwest with a secondary predominant direction of north to north-northeast.

The second conclusion we draw from the wind rose shown in Figure 18 is that there are no significant sources of emissions in any of the counties EPA intends to designate as nonattainment in the south-southeast direction from Look Rock and no major sources of emissions in the northwest direction from Look Rock, except the Bull Run Power Plant. As stated earlier (*see* Table 6), the Bull Run Power Plant has state-of-the-art NO_X controls (selective catalytic reduction) that are reducing emissions significantly. Consequently, there has been a dramatic decline in emissions and emission rate since 2008. The major urban centers and transportation corridors in the Knoxville CSA are located from north northwest to north northeast of the Look Rock monitor.

III. CONCLUSIONS

Based on the analyses we have conducted and the foregoing discussion, we draw the following conclusions.

The 2011 Knox County ozone data should be determined to be complete and should be certified.

Based on that certification, the 2009-2011 data should be used to compute the design values that are used to make attainment designations for the Knoxville CSA.

The urban areas and major transportation corridors in the Knoxville CSA are well surrounded by ozone monitors: Freels Bend in Anderson County to the west; Lost Creek Road in Jefferson County and Rutledge Pike in Knox County to the north; Clingmans Dome and Cove Mountain in Sevier County to the east; and Roberts Road in Loudon County and Cades Cove and Look Rock in Blount County to the south. In addition there is a monitor in the midst of that urban and transportation area: Mildred Drive in Knox County. (*See* Figure 1.)

Based on the 2009-2011 design values (see Table 5) there is only one monitor out of nine in the Knoxville CSA that measured an exceedance of the 2008 ozone NAAQS. That monitor was the Look Rock monitor in Blount County. The Look Rock monitor is a high elevation, ridge top monitor located at an elevation of approximately 2700 feet above MSL.

The Cades Cove monitor is located just nine miles from the Look Rock monitor in the same county. The Cades Cove monitor is located at an elevation of approximately 1850 feet above MSL. Both monitors are located in remote locations in the Great Smoky Mountains National Park. Both monitors have very similar back trajectories on every day when the maximum 8-hour ozone concentration at Look Rock exceeded 75 ppb.

Although the two Blount County monitors are located in close proximity and share the same back trajectories, their characteristics are very different entirely as a result of the elevation at which each monitor is located.

In the late afternoon as the sun begins to set, ozone concentrations at the Cades Cove monitor begin to rapidly decline due to surface deposition and ozone destruction. This results in a rapid lowering of the 8-hour average ozone concentration. At the Look Rock monitor, on the other hand, during the evening hours as the nocturnal boundary layer settles below the elevation of the monitor, the air around the monitor is cut off from the titration reactions that destroy ozone. Consequently, 8-hour average ozone concentrations remain higher, sometime resulting in exceedances of the NAAQS.

The diurnal ozone patterns at the Clingmans Dome and Cove Mountain monitors appear to be similar to Look Rock, while the diurnal patterns at the remainder of the monitors in the Knoxville CSA appear to be similar to Cades Cove.

The major urban areas and primary transportation corridors of the Knoxville CSA, as well as all but one of the major stationary sources of emissions are not located in either of the predominant wind directions from the Look Rock monitor, making it unlikely that they contribute significantly to ozone concentrations at Look Rock.

Eight of the nine monitors in the Knoxville CSA, located within and in a ring around the major urban areas and transportation corridors, did not measure an exceedance to the ozone NAAQS, and the one monitor that did measure an exceedance the 8-hour daily averages is clearly impacted by elevation; therefore, local emissions in the Knoxville CSA are not causing exceedances of the ozone NAAQS.

It is clear that the effect of elevation is the primary cause of the higher number of daily maximum 8-hour averages exceeding the NAAQS at the Look Rock monitor. It is not appropriate, as EPA suggests, to designate all of Anderson, Blount, Knox, Loudon, and Sevier Counties and a portion of Cocke County as nonattainment based only on a design value exceeding the NAAQS at one monitor that is so strongly influenced by elevation.

Therefore, we recommend that (1) all six Counties be designated attainment, or (2) alternatively, only the portion of Blount County within the boundaries of the Great Smoky Mountains National Park be designated nonattainment, and all other portions of the Knoxville CSA be designated attainment.

Very truly yours,

Michael K. Stagg

Michael K. Stagg

MKS/mw

cc: Tim Burchett, *Mayor, Knox County*
Estelle Herron, *Mayor, Loudon County*
Myron Iwanski, *Mayor, Anderson County*
Ed Mitchell, *Mayor, Blount County*
Vaughn Moore, *Mayor, Cocke County*
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