Pennsylvania
Area Designations for the
2008 Ozone National Ambient Air Quality Standards

The table below identifies the areas and associated counties or parts of counties in Pennsylvania that EPA is designating as nonattainment for the 2008 ozone national ambient air quality standards (2008 ozone NAAQS). In accordance with section 107(d) of the Clean Air Act, EPA must designate an area "nonattainment" if it is violating the 2008 ozone NAAQS or if it is contributing to a violation of the 2008 ozone NAAQS in a nearby area. The technical analyses supporting the boundaries for the individual nonattainment areas are provided below.

Nonattainment Areas in Pennsylvania

Area	Pennsylvania Recommended Nonattainment Counties	EPA's Designated Nonattainment Counties
Allentown-Bethlehem-Easton, PA	Lehigh	Carbon, Lehigh, Northampton
Lancaster, PA	Lancaster	Lancaster
Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE	Bucks, Montgomery, Philadelphia	Bucks, Chester, Delaware, Montgomery, Philadelphia
Pittsburgh-Beaver Valley, PA	Allegheny	Allegheny, Armstrong, Beaver, Butler, Fayette, Washington, Westmoreland
Reading, PA	Berks	Berks

The Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE Area is a multi-state nonattainment area. Table 1 in the Technical Analysis for the Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE Area, below, identifies the counties in the other states that EPA is designating as part of the nonattainment area.

EPA is designating the remaining counties in Pennsylvania that are not listed in the table above as "unclassifiable/attainment" for the 2008 ozone NAAQS. Note that Pike County, PA, which is being designated as "unclassifiable/attainment" for the 2008 ozone NAAQS, is part of the New York-Newark-Bridgeport, NY, NJ, CT, PA Combined Statistical Area. EPA considered Pike County in its five factor analysis for the New York- Newark- Bridgeport, NY, NJ, CT nonattainment area, and determined that the inclusion of Pike County in that nonattainment area was not warranted. Please refer to the Technical Analysis for the New York- Newark-Bridgeport, NY, NJ, CT for more information.

The analysis below provides the basis for nonattainment area boundaries. It relies on our analysis of whether and which monitors are violating the 2008 ozone NAAQS, based on certified air quality monitoring data from 2008-2010 and 2009-2011, and an evaluation of whether nearby areas are contributing to such violations. EPA has evaluated contributions from nearby areas based on a weight of evidence analysis considering the factors identified below. EPA issued guidance on December 4, 2008 that identified these factors as ones EPA would consider in

determining nonattainment area boundaries and recommended that states consider these factors in making their designation recommendations to EPA.[1]

1. Air quality data (including the design value calculated for each FRM or FEM monitor in the area);
2. Emissions and emissions-related data (including location of sources and population, amount of emissions and emissions controls, and urban growth patterns);
3. Meteorology (weather/transport patterns);
4. Geography and topography (mountain ranges or other basin boundaries);
5. Jurisdictional boundaries (e.g., counties, air districts, existing nonattainment areas, Indian country, metropolitan planning organizations (MPOs))

Ground-level ozone is not emitted directly into the air, but is created by chemical reactions between oxides of nitrogen (NOx) and volatile organic compounds (VOC) in the presence of sunlight. Because NOx and VOC emissions from a broad range of sources over a wide area typically contribute to violations of the ozone standards, EPA believes it is important to consider whether there are contributing emissions from a broad geographic area. Accordingly, EPA chose to examine the 5 factors with respect to the larger of the Combined Statistical Area (CSA) or Core Based Statistical Area (CBSA) within which is located the violating monitor(s).[2] All data and information used by EPA in this evaluation are the latest available to EPA and/or provided to EPA by states or tribes.

In EPA's designations guidance for the 2008 ozone NAAQS EPA recommended examining CSA/CBSAs because certain factors (such as population) used to establish CSAs and CBSAs are similar to the factors EPA is using in this technical analysis to determine if a nearby area is contributing to a violation of the 2008 ozone NAAQS. EPA used the same basic approach in the designation process for the 1997 ozone NAAQS. Where a violating monitor is not located in a CSA or CBSA, EPA's guidance recommended using the boundary of the county containing the violating monitor as the starting point for considering the nonattainment area's boundary.

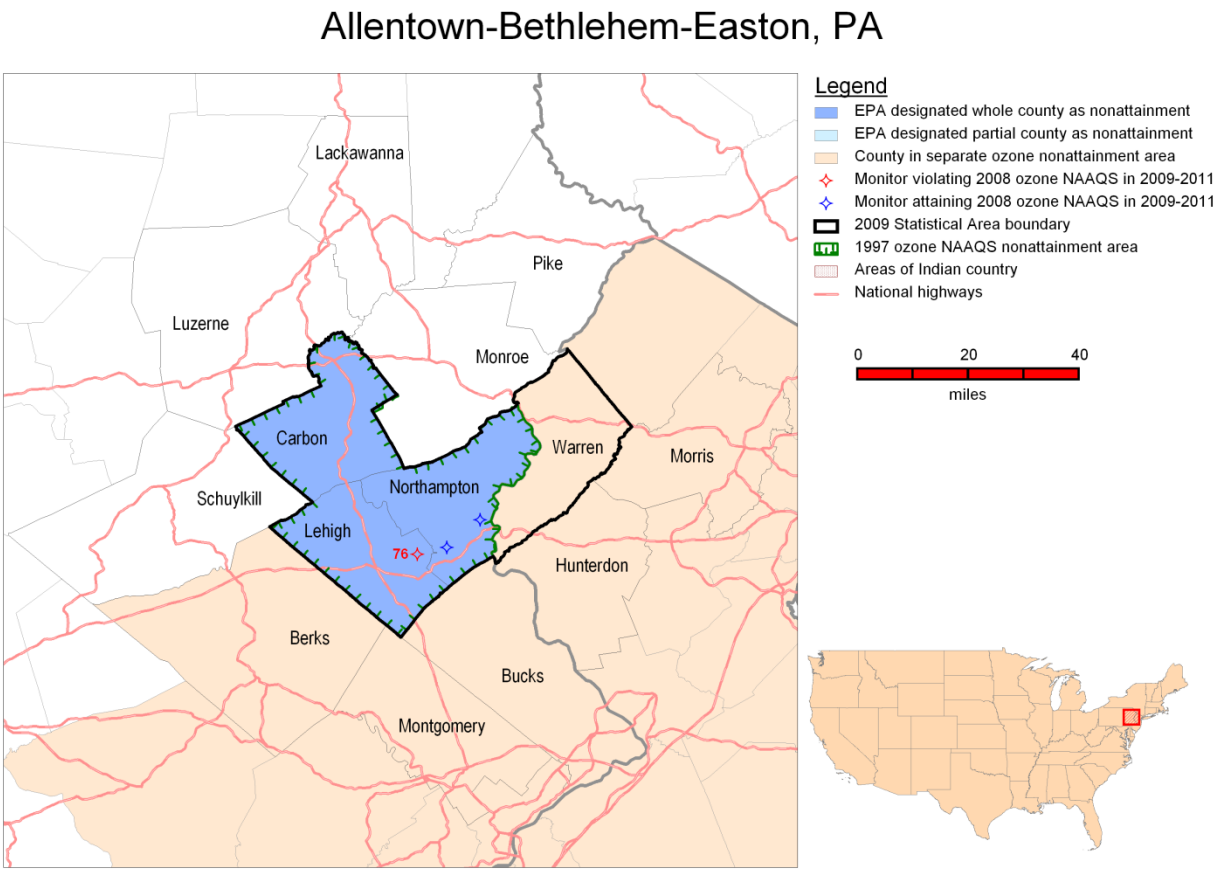
[1] The December 4, 2008 guidance memorandum "Area Designations for the 2008 Revised Ozone National Ambient Air Quality Standards" refers to 9 factors. In this technical support document we have grouped the emissions-related factors together under the heading of "Emissions and Emissions-Related Data," which results in 5 categories of factors.

[2] Lists of CBSAs and CSAs and their geographic components are provided at www.census.gov/population/www/metroareas/metrodef.html . The lists are periodically updated by the Office of Management and Budget. EPA used the most recent update, based on 2008 population estimates, issued on December 1, 2009 (OMB Bulletin No. 10-02).

Technical Analysis for the Allentown-Bethlehem-Easton Area

Figure 1 is a map of the Allentown-Bethlehem-Easton, PA nonattainment area (Allentown Area). The map provides other relevant information including the locations and design values of air quality monitors, county and other jurisdictional boundaries, census-defined metropolitan statistical area (MSA) boundary, existing maintenance area boundary for the 1997 ozone NAAQS, and EPA's nonattainment boundary for the 2008 ozone NAAQS.

Figure 1



For purposes of the 1997 ozone NAAQS, portions of this area were designated nonattainment. The boundary for the nonattainment area for the 1997 ozone NAAQS included the entire counties of Carbon, Lehigh, and Northampton Counties. Warren County, NJ, which is now part of the census-defined MSA, was designated nonattainment for the 1997 ozone NAAQS as part of the separate New York-Northern New Jersey-Long Island, NY-NJ-CT nonattainment area.

In March 2009, the Commonwealth of Pennsylvania recommended that the same three counties (Carbon, Lehigh, and Northampton) in Pennsylvania be designated as nonattainment in the Allentown-Bethlehem-Easton Area for the 2008 ozone NAAQS based on air quality data from 2006-2008. Pennsylvania provided an updated recommendation on November 22, 2011, based on more recent certified air quality data from 2009-2011. That recommendation was to designate only Lehigh County as nonattainment (as it has a violating monitor) and to designate

nearby Carbon and Northampton Counties as attainment. The same county, Lehigh County, is violating based on the 2008-2010 and 2009-2011 monitoring data. This data comes from FRM monitors or FEM monitors sited and operated in accordance with 40 CFR Part 58. (See the March 17, 2009 and November 22, 2011 letters from the Pennsylvania Department of Environmental Protection to EPA.)

In April 2009, the State of New Jersey recommended the same nonattainment boundary for the twelve New Jersey counties (including Warren County) for the 2008 ozone NAAQS as was the case for the 1997 ozone NAAQS (i.e., that Warren County be part of the New York-Northern New Jersey-Long Island, NY-NJ-CT nonattainment area). These data are from FRM monitors or FEM monitors sited and operated in accordance with 40 CFR Part 58. (See the April 1, 2009 letter from the New Jersey Department of Environmental Protection to EPA.)

After considering these recommendations and based on EPA's technical analysis described below, EPA is designating the Allentown Area as "nonattainment" and including three Pennsylvania counties, identified in Table 1, below, in the Allentown Area.

Table 1. States' Recommended and EPA's Designated Nonattainment Counties for Allentown-Bethlehem-Easton, PA.

Allentown-Bethlehem-Easton, PA	State-Recommended Nonattainment Counties	EPA Designated Nonattainment Counties
Pennsylvania	Lehigh	Carbon, Lehigh, Northampton
New Jersey	None	None

Factor Assessment

This factor assessment includes information on the counties in the Allentown-Bethlehem-Easton PA-NJ MSA and the surrounding Pennsylvania counties of Schuylkill, Luzerne, Lackawanna, and Monroe that are not already part of another nonattainment area for the 2008 ozone NAAQS.[3] EPA has determined that it is appropriate to place the nearby counties of Berks, Montgomery, and Bucks in Pennsylvania and Hunterdon and Morris in New Jersey, in separate nonattainment areas for the 2008 ozone NAAQS from the Allentown Area. See EPA's respective technical analyses for these adjacent nonattainment areas for EPA's rationale for our nonattainment designation for these counties. Therefore, EPA is not including Berks, Montgomery, and Bucks Counties, PA, or Hunterdon and Morris Counties, NJ in this analysis for the Allentown Area. To the extent that emissions from those counties may contribute to ozone concentrations in the Allentown Area, that contribution will be lessened by planning and emission control obligations for those separate nonattainment areas.

[3] Luzerne and Lackawanna Counties are part of the Scranton-Wilkes-Barre PA MSA.

Factor 1: Air Quality Data

For this factor, we considered 8-hour ozone design values (in parts per billion (ppb)) for air quality monitors in counties in the Allentown Area based on data for the 2008-2010 period (i.e., the 2010 design value, or DV), which are the most recent years with fully-certified air quality data. However, Pennsylvania submitted certified 2011 air quality data to EPA in November 2011. Therefore, for the Pennsylvania counties in this analysis, 2011 DVs are included and considered. A monitor's DV is the metric or statistic that indicates whether that monitor attains a specified air quality standard. The 2008 ozone NAAQS are met when the annual fourth-highest daily maximum 8-hour average concentration, averaged over 3 years is 0.075 ppm (75 ppb) or less. A DV is only valid if minimum data completeness criteria are met. See 40 CFR part 50 Appendix P. Where several monitors are located in a county (or a designated nonattainment area or maintenance area), the DV for the county or area is determined by the monitor with the highest level.

The 2010 and 2011 DVs for the ozone NAAQS for counties in the Allentown Area and nearby surrounding area are shown in Table 2. We did not include neighboring counties to the south of the area, which are included in separate nonattainment areas.

Table 2. Air Quality Data.

County	State Recommended Nonattainment?	2010 8-hour Ozone DV (ppb)	2011 8-hour Ozone DV (ppb)
Carbon, PA	No	--	--
Lehigh, PA	Yes	76	76
Northampton, PA	No	75	75
Warren, NJ	Yes, other area	--	--
Schuylkill, PA	No	--	--
Luzerne, PA	No	69	65
Lackawanna, PA	No	72	71
Monroe, PA	No	70	70

Notes: Counties with no ozone monitor are identified with "--" in the 2010 8-hour Ozone DV column.
2011 DVs are included for Pennsylvania counties because Pennsylvania submitted certified 2011 data to EPA in November 2011.

In accordance with section 107(d) of the Clean Air Act, EPA must designate an area "nonattainment" if it is violating the 2008 ozone NAAQS. Lehigh County shows a violation of the 2008 ozone NAAQS, therefore this county must be included in a nonattainment area. A county (or partial county) must also be designated nonattainment if it contributes to a violation in a nearby area. Each Pennsylvania county without a violating monitor that is located near Lehigh County has been evaluated based on the weight of evidence of the five factors and other relevant information to determine whether it contributes to the nearby violation.

Factor 2: Emissions and Emissions-Related Data

EPA evaluated emissions of ozone precursors (NO_x and VOC) and other emissions-related data that provide information on areas contributing to violating monitors.

Emissions Data

EPA evaluated county-level emission data for NO_x and VOC derived from the 2008 National Emissions Inventory (NEI), version 1.5. This is the most recently available NEI. (See http://www.epa.gov/ttn/chief/net/2008inventory.html) Significant emissions levels in a nearby area indicate the potential for the area to contribute to monitored violations. We also considered any additional information on changes to emissions levels that are not reflected in recent inventories. These changes include emissions reductions due to permanent and enforceable emissions controls that will be in place before final designations are issued and emissions increases due to new sources. However, EPA received no such additional information.

Table 3 shows emissions of NO_x and VOC (given in tons per year (tpy)) for violating and potentially contributing counties in the Allentown Area.

Table 3. Total 2008 NO_x and VOC Emissions.

County	State Recommended Nonattainment?	NO_x (tpy)	VOC (tpy)
Carbon, PA	No	3,302	3,452
Lehigh, PA	Yes	11,160	12,147
Northampton, PA	No	17,082	8,499
Warren, NJ	Yes, other area	4,483	3,925
Schuylkill, PA	No	6,554	5,922
Luzerne, PA	No	12,045	13,183
Lackawanna, PA	No	7,118	7,233
Monroe, PA	No	5,761	8,017

Of the counties in the Allentown-Bethlehem-Easton MSA, Northampton has the highest total NOx emissions, and Lehigh has the highest total VOC emissions. Lehigh also has high NOx emissions, and Northampton has relatively high VOC emissions. Carbon County and Warren County, by comparison, have much lower NOX and VOC emissions. Of the nearby counties outside this MSA, Luzerne has the highest NOx and VOC emissions. Monroe, Lackawanna, and Schuylkill Counties have lower emissions by comparison, than Lehigh and Northampton Counties.

Population density and degree of urbanization

EPA evaluated the population and vehicle use characteristics and trends of the area as indicators of the probable location and magnitude of non-point source emissions. These include ozone-creating emissions from on-road and off-road vehicles and engines, consumer products,

residential fuel combustion, and consumer services. Areas of dense population or commercial development are an indicator of area source and mobile source NO_x and VOC emissions that may contribute to ozone formation. Rapid population or VMT growth (see below) in a county on the urban perimeter signifies increasing integration with the core urban area, and indicates that the associated area source and mobile source emissions may be appropriate to include in the nonattainment area. Table 4 shows the population, population density, and population growth information for each county in the area.

Of the counties that are part of the Allentown-Bethlehem-Easton MSA, Lehigh and Northampton have the highest populations, with Carbon having the lowest population and population density (followed closely by Warren County). Lehigh County is also the fastest growing county and has the largest population change. Carbon, Lehigh, and Northampton Counties all experienced double digit population growth in the prior decade. Of the counties nearby to, but outside of this, MSA, Luzerne has the highest population, very nearly as large as Lehigh, distantly followed by Lackawanna.

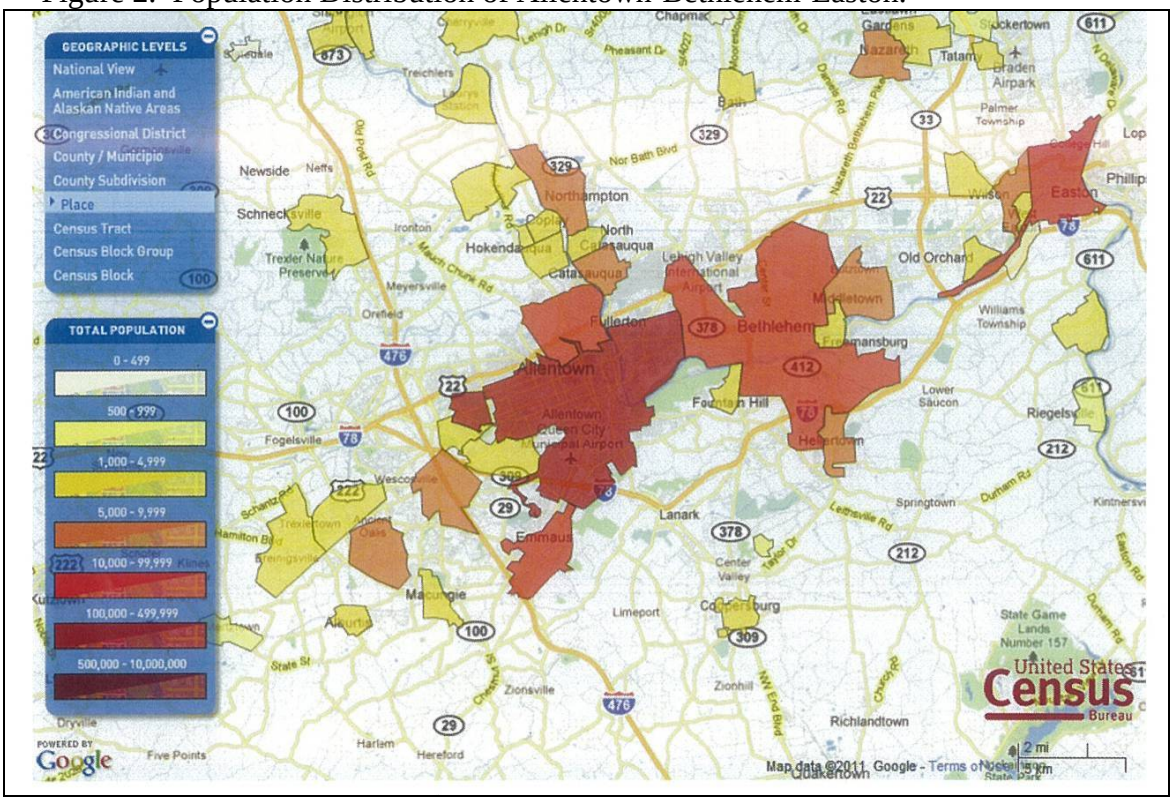
Table 4. Population and Growth

County	State Recommended Nonattainment?	2010 Population	2010 Population Density (1000 pop/sq mi)	Absolute change in population (2000-2010)	Population % change (2000-2010)
Carbon, PA	No	65,249	0.17	6,417	+11%
Lehigh, PA	Yes	349,497	1.00	36,843	+12%
Northampton, PA	No	297,735	0.79	30,295	+11%
Warren, NJ	Yes, other area	108,692	0.30	5,745	+6%
Schuylkill, PA	No	148,289	0.19	-1,798	-1.2%
Luzerne, PA	No	320,918	0.35	2,363	+0.7%
Lackawanna, PA	No	214,437	0.46	1,524	+0.7%
Monroe, PA	No	169,842	0.28	30,077	+22%

Sources: U.S. Census Bureau population estimates for 2010 as of August 4, 2011 (http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_PL_GCTPL2.STO5&prodType=table)

The counties neighboring the Allentown-Bethlehem-Easton MSA have comparatively low population growth, with the exception of Monroe County which grew more than 20%. These adjacent counties are comparatively sparsely populated, with population densities ranging from a high of 460 to a low of 190 persons per square mile. Figure 2 illustrates how the population centers of this area are clustered primarily in the urban centers, with very sparse populations in the surrounding communities.

Figure 2. Population Distribution of Allentown-Bethlehem-Easton.



Source: US Census (http://2010.census.gov/2010census/popmap/)

Traffic and VMT data

EPA evaluated the total Vehicle Miles Traveled (VMT) and the commuting patterns of residents for each county in the area of analysis. In combination with the population/population density data and the location of main transportation arteries (see Figure 1 above), this information helps identify the probable location of non-point source emissions. A county with high VMT and/or a high number of commuters is generally an integral part of an urban area and indicates the presence of motor vehicle emissions that may contribute to ozone formation. Rapid population or VMT growth in a county on the urban perimeter signifies increasing integration with the core urban area, and indicates that the associated area source and mobile source emissions may be appropriate to include in the nonattainment area. Table 5 shows traffic and commuting pattern data, including total 2008 VMT and VMT growth. Table 6 shows the number of commuters in each county who travel within that county or to another county in the area of analysis.

Table 5. Traffic and VMT Data.

County	State Recommended Nonattainment?	2008 VMT (million miles)	Percent VMT Growth (2002-2008)
Carbon, PA	No	740	0.8%
Lehigh, PA	Yes	2,893	2.9%
Northampton, PA	No	1,997	0.7%
Warren, NJ	No	1,530	1.1%
Luzerne, PA	No	2,963	4.2%
Lackawanna, PA	No	1,994	5.9%
Monroe, PA	No	1,621	2.5%
Schuylkill, PA	No	1,394	-3.4%

* MOBILE model VMTs are those inputs into the NEI version 1.5.

Table 6. County to County Worker Flow

Residence County → / **Workplace County ↓**	Carbon, PA	Lehigh, PA	Northampton, PA	Warren, NJ	Monroe, PA	Lackawanna, PA	Luzerne, PA	Schuylkill, PA
Carbon, PA	12,341	550	390	8	614	38	634	1,014
Lehigh, PA	4,663	110,302	30,180	602	1618	193	678	1,742
Northampton, PA	1,975	18,040	68,449	1,803	3,467	46	142	258
Warren, NJ	88	682	7,192	21,034	1,359	4	7	15
Monroe, PA	1,185	410	2,137	200	39,829	2,536	1,664	98
Lackawanna, PA	100	80	92	0	579	79,507	8,105	72
Luzerne, PA	2,224	207	97	12	639	6,847	120,645	3,588
Schuylkill, PA	1,435	268	61	0	31	76	1,179	43,979

Source: U.S. Census Bureau estimates for 2000 County-to-County Worker Flow (http://www.census.gov/hhes/commuting/data/commuting.html)

Of the counties in the Allentown-Bethlehem-Easton MSA, Lehigh County has the highest overall VMT, and the highest proportion commuting to violating counties, with most of that commuting occurring within Lehigh County (see Table 6). Northampton County has significant VMT, with a sizable portion commuting to Lehigh County (the location of the violating monitor). Warren County has lower overall VMT, and comparatively lower commuting contribution to Lehigh County (or any of the nearby counties). Carbon County, which is connected to Lehigh County through the major interstate 476 corridor, has relatively low VMT, but has the third most commuters into Lehigh County where the violating monitor is located. Of the counties outside the Allentown MSA, Luzerne has comparatively high overall VMT. However, Table 6 illustrates that the counties outside the Allentown MSA have very few commuters to the Allentown Area.

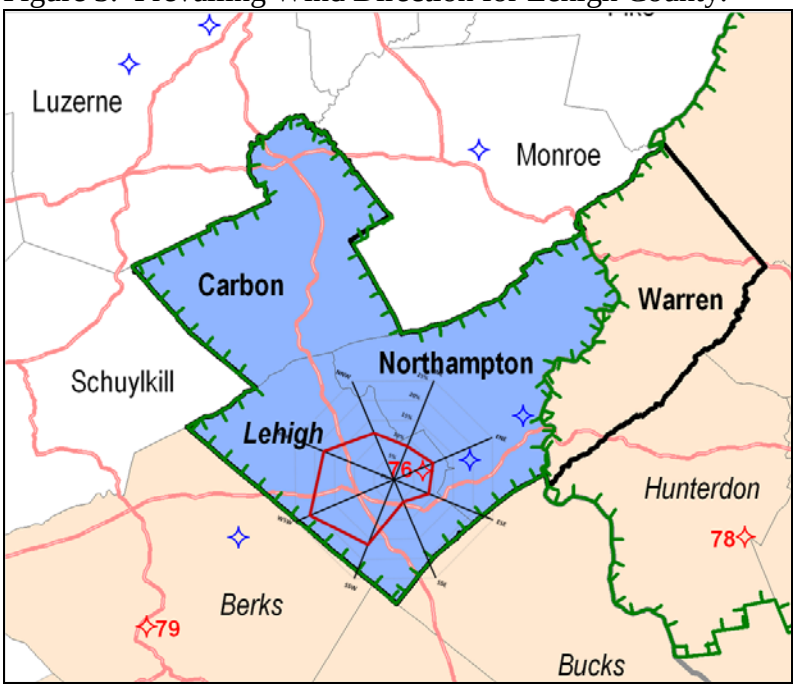
Factor 3: Meteorology (weather/transport patterns)

EPA evaluated any available meteorological data to help determine how meteorological

conditions, such as weather, transport patterns and stagnation conditions, would affect the fate and transport of precursor emissions contributing to ozone formation.

The prevailing winds during the summer ozone season for Lehigh County come predominately from the southwest, and to a lesser degree from the west and south. The violating monitor for this area is located close to the eastern edge of Lehigh County. On this basis, the neighboring Scranton-Wilkes-Barre area to the northeast is less likely to contribute to a violation of the Lehigh County monitor, particularly in light of the topography separation between the areas (i.e., the Blue Mountain Ridge). Based solely on historical prevailing winds, the violating monitor in Lehigh County is unlikely to be impacted by downwind contribution from Monroe County and Warren County.

Figure 3. Prevailing Wind Direction for Lehigh County.



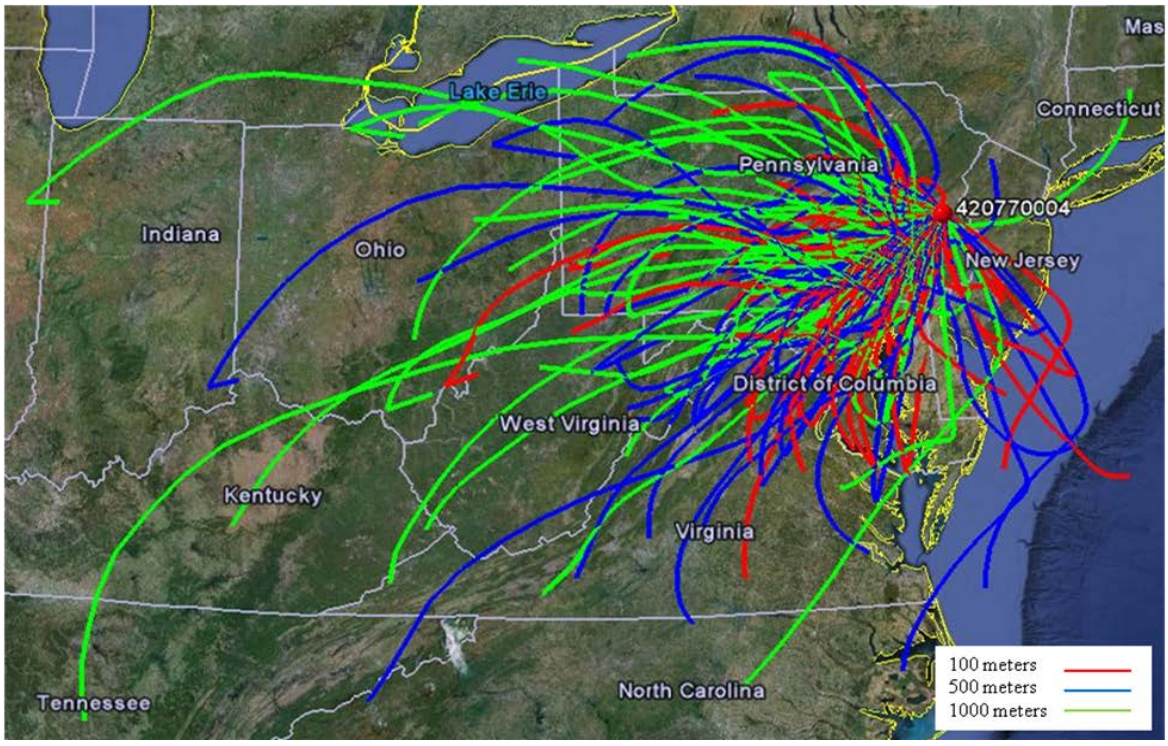
To further understand the meteorological transport conditions within the area around the Allentown Area, we also evaluated 24-hour back trajectories for the 2007-2011 time period, using the National Oceanic and Atmospheric Administration (NOAA) Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) model. The model uses the monitoring location as a starting point, and goes back in time using meteorological data to determine how a parcel of air would have traveled on a given day. EPA evaluated three separate elevations for each exceedance day to better characterize the wind pattern and pollution transport to the monitor. EPA used monitor 42-077-0004 in Lehigh County as the starting point for the HYSPLIT back trajectories, as it currently is the only violating monitor in the Allentown Area. Table 7 shows the exceedance days and corresponding recorded 8-hour ozone value. Note that there were no exceedance days in the Allentown Area in 2009. The air quality monitoring data and HYSPLIT results for those exceedance days are available in the docket for this action.

Table 7. 2007 to 2011 Exceedance-Day 8-Hour Ozone Values at Monitor 42-077-0004

Exceedance Day	8-hour average (ppm ozone)		Exceedance Day	8-hour average (ppm ozone)		Exceedance Day	8-hour average (ppm ozone)
5/15/2007	0.082		4/19/2008	0.085		8/10/2010	0.078
5/25/2007	0.08		5/30/2008	0.076		8/19/2010	0.08
5/31/2007	0.076		6/10/2008	0.079		9/1/2010	0.094
6/1/2007	0.076		6/13/2008	0.091		9/2/2010	0.092
6/19/2007	0.091		7/18/2008	0.083		9/7/2010	0.078
6/26/2007	0.079		7/20/2008	0.076		9/22/2010	0.079
6/27/2007	0.08		7/29/2008	0.078		9/24/2010	0.076
7/9/2007	0.087		9/4/2008	0.079		6/7/2011	0.079
8/2/2007	0.078		6/2/2010	0.077		6/8/2011	0.077
8/3/2007	0.079		6/26/2010	0.079		6/9/2011	0.079
9/21/2007	0.081		7/4/2010	0.083		7/6/2011	0.077
9/25/2007	0.078		7/6/2010	0.079		7/20/2011	0.084
4/18/2008	0.08		7/28/2010	0.077		7/21/2011	0.082

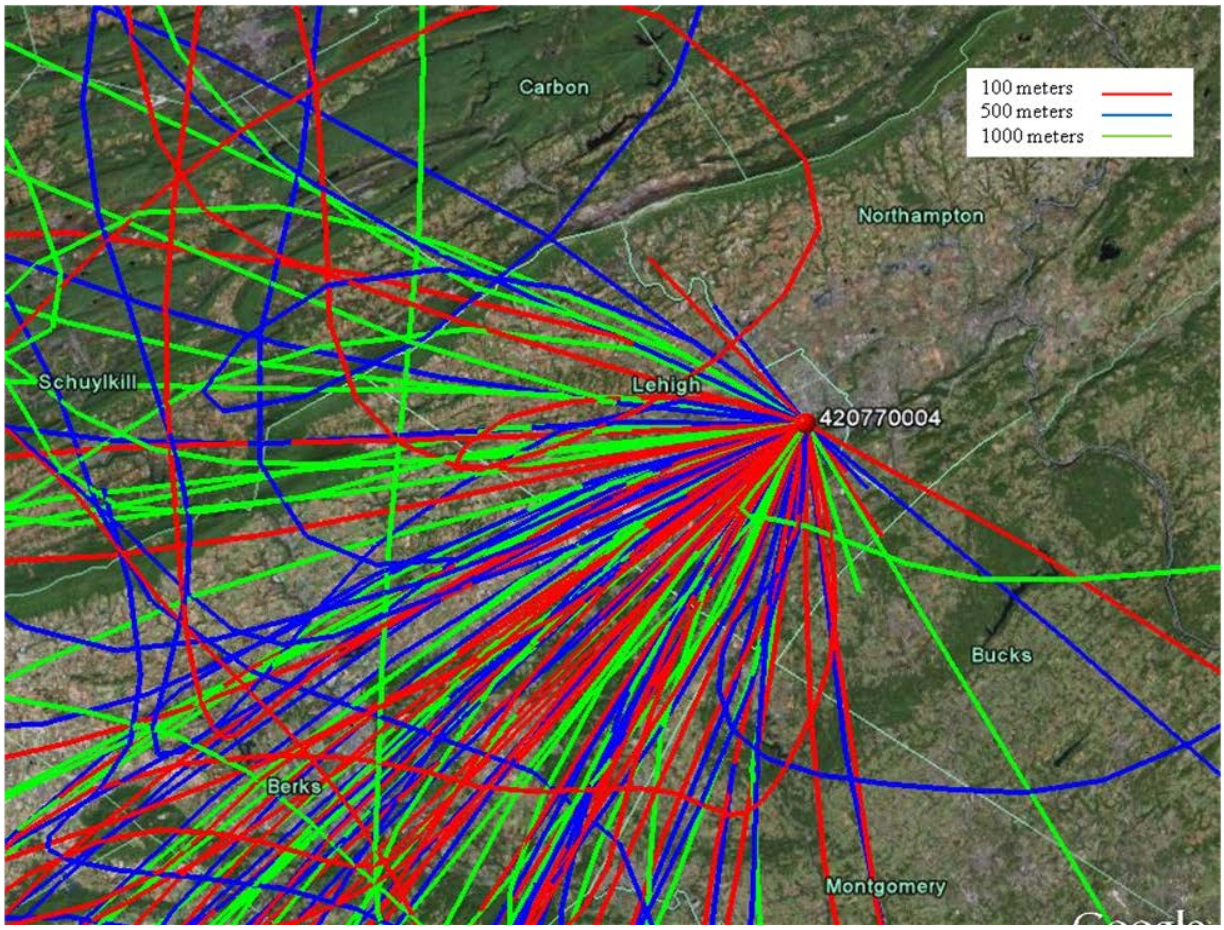
Figure 4 overlays HYSPLIT 24-hour back trajectories for all the 2007-2011 ozone exceedances at monitor 42-077-0004 on a Google Earth map of the northeastern United States. It gives an overview of long-range transport to the Allentown Area. As seen in Figure 4, the 24-hour back trajectories indicate regional transport from many directions and over several states.

Figure 4. NOAA HYSPLIT 24-Hour Back Trajectories for 2007-2011 Exceedances Days - Overview



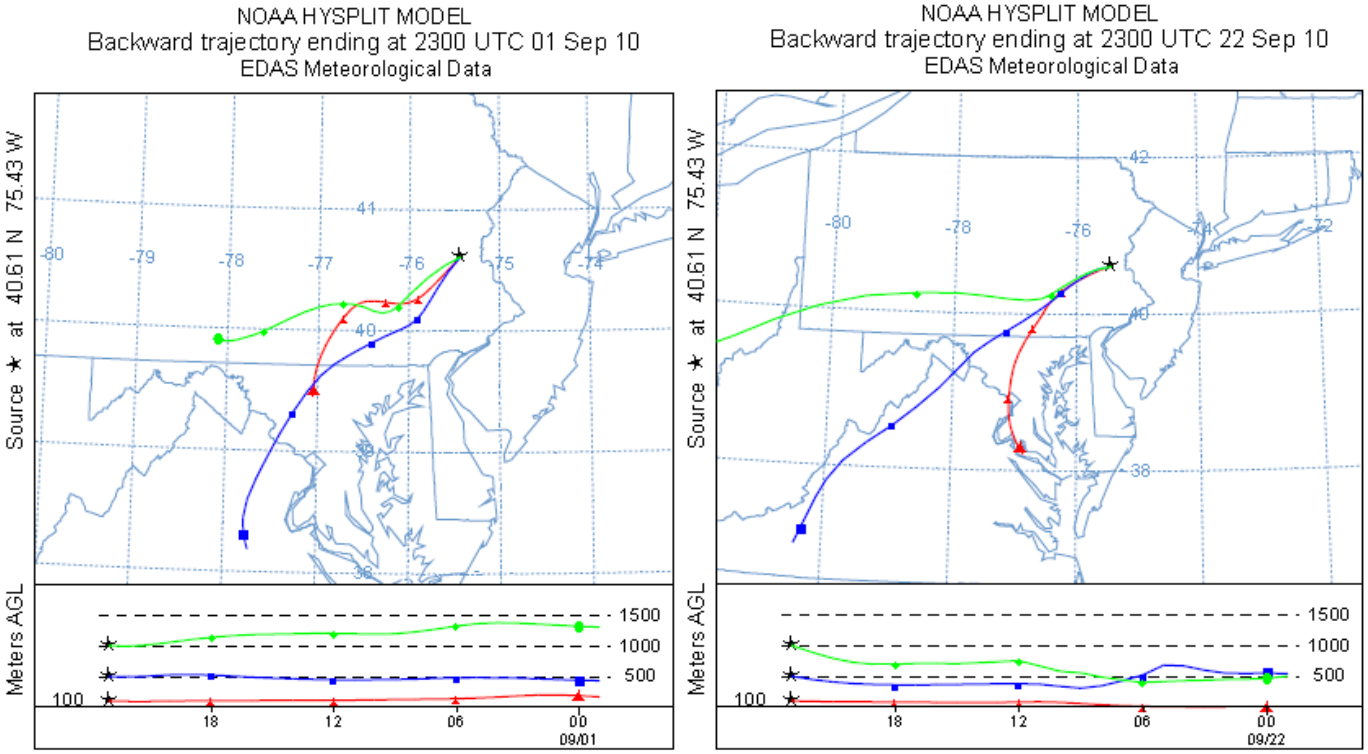
In Figure 5, below, EPA has zoomed in on these same 24-hour HYSPLIT back trajectories, showing more of the nearby transport on high ozone days. This zoomed in perspective shows that on exceedance days, winds are predominantly from the southwest. Figure 5 also shows a large percent of exceedance days with winds coming from the west and south, and, to a lesser extent from the northwest from the direction of Carbon County. This correlates reasonably well with the NWS 30-year average wind directions given above.

Figure 5. NOAA HYSPLIT 24-Hour Back Trajectories for 2007-2011 Exceedances Days - Zoom View

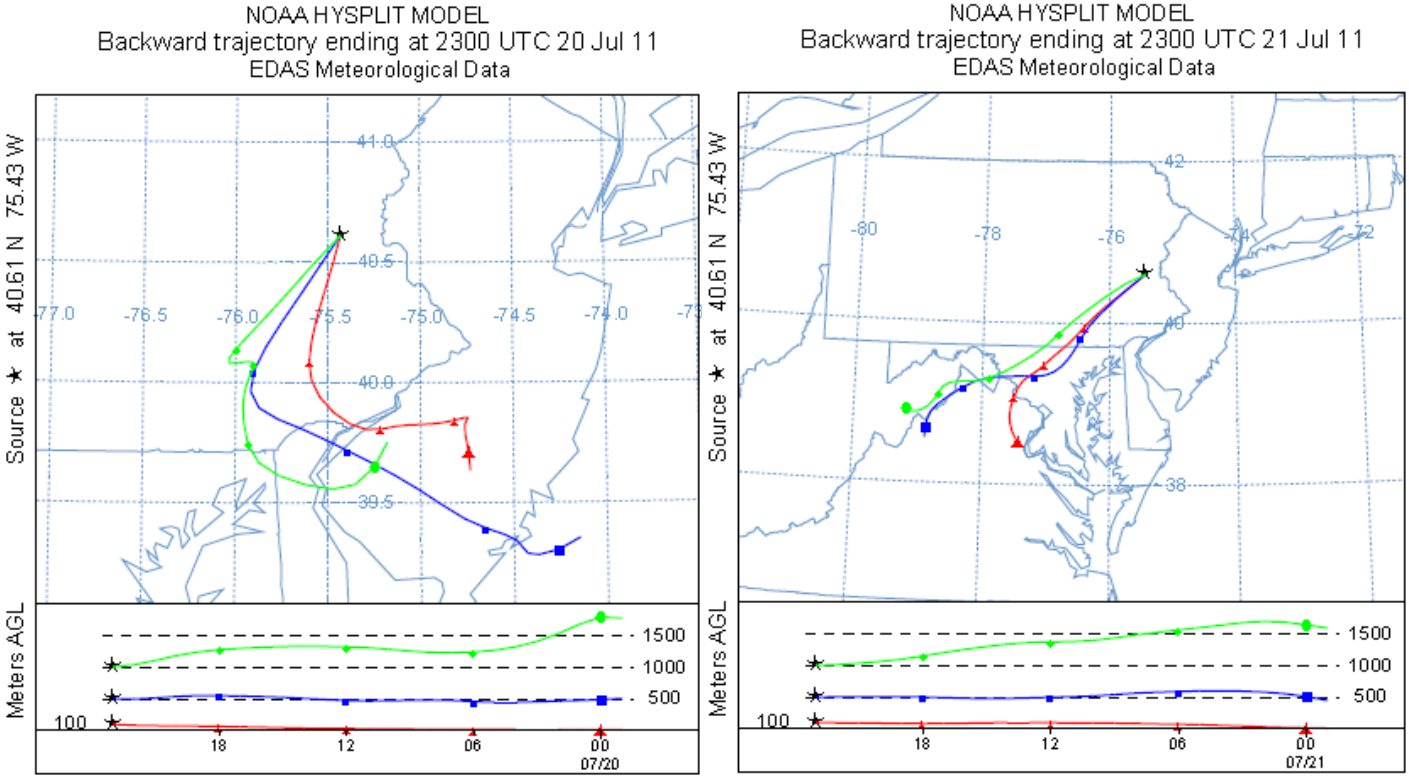


To further illustrate the local transport situation in the Allentown Area, EPA has selected specific trajectories for two "ozone episodes," which are periods when the ozone levels are high for consecutive days. As shown in Table 7, the 8-hour average ozone value at monitor 42-077-0004 was above the standard for two days in a row in 2010 (September 1-2) and 2011 (July 20-21). The September 2010 episode had the highest ozone values recorded in the 2007-2011 period, while the July 2011 episode was the most recent. Figures 6 through 9 show the back trajectories calculated for these episodes. They all demonstrate the dominant southwesterly air flow to monitor 42-077-0004. Figure 8 is exceptional, in that it shows that the winds on July 20, 2011 started to the southeast of monitor 42-077-0004 before turning to approach the Allentown Area from the south and southwest.

Figures 6 & 7, NOAA HYSPLIT 24-Hour Back Trajectories September 1-2, 2010



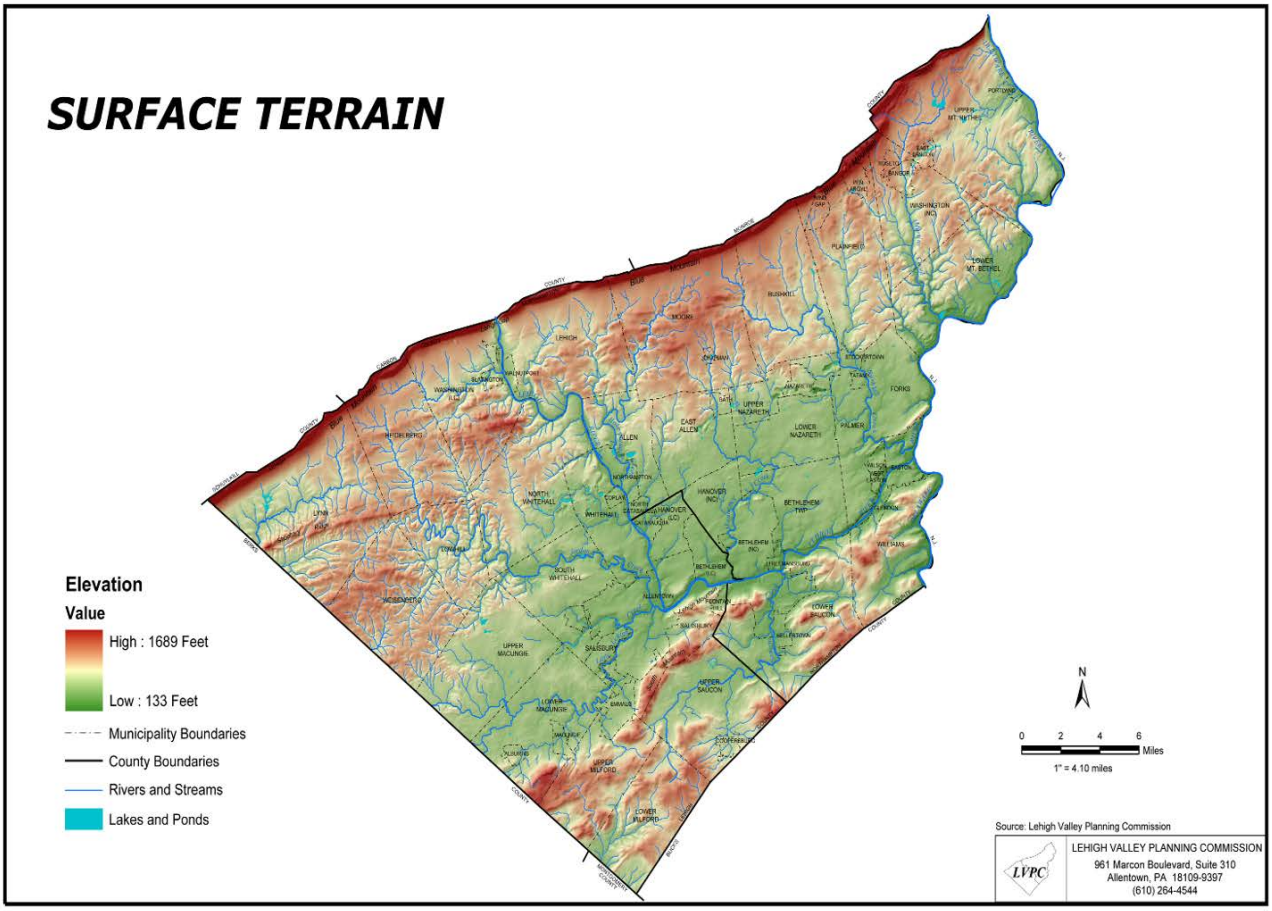
Figures 8 & 9, NOAA HYSPLIT 24-Hour Back Trajectories July 20-21, 2011



Factor 4: Geography/topography (mountain ranges or other air basin boundaries)

The geography/topography analysis evaluates the physical features of the land that might affect the airshed and, therefore, the distribution of ozone over the area. The Allentown Area has several geographical and topographical barriers that impact air pollution generation and transport within its air shed. The region is bounded on the north by Pocono Mountains, and in particular by the Blue Mountain Ridge that runs west-southwest to north-northeast, creating a significant physical barrier to air movement from north to south and south to north. The Lehigh River crosses the area flowing south from Carbon County, with a broad valley connecting Carbon County to both Lehigh and Northampton Counties, and serves as the border between Lehigh and Northampton Counties. The Delaware River divides Northampton and Warren Counties. Elevation changes run from lows of just over 100 feet above sea level to nearly 1600 feet on the Blue Ridge Mountain Ridge, with the elevation at the Lehigh Valley Airport near Allentown falling at approximately 300 feet. The area lies approximately 80 miles west of the Atlantic Ocean. Warren County is mountainous, with the Kittatinny Ridge bounding the county on the west. Warren County is also part of the Lehigh Valley on its southern edge, and the Kittatinny Valley in the northern part of the county.

Figure 10. Allentown-Bethlehem-Easton Topography (Northampton and Lehigh Counties).



Source: Lehigh Valley Planning Commission

Factor 5: Jurisdictional boundaries

Once the general areas to be included in the nonattainment area were determined, EPA considered existing jurisdictional boundaries for the purposes of providing a clearly defined legal boundary and carrying out the air quality planning and enforcement functions for nonattainment areas. Examples of jurisdictional boundaries include existing/prior nonattainment areas for ozone or other urban-scale pollutants, counties, air districts, townships, metropolitan planning organizations, state lines, Reservations, urban growth boundary, etc. Where existing jurisdictional boundaries are not adequate to describe the nonattainment area, other clearly defined and permanent landmarks or geographic coordinates are considered.

The Allentown Area has previously established nonattainment boundaries associated with the 1997 ozone NAAQS, with Carbon, Lehigh, and Northampton Counties forming the Allentown-Bethlehem-Easton nonattainment area. The Commonwealth initially recommended the same nonattainment area boundary for the 2008 ozone NAAQS in March 2009, but subsequently recommended that only Lehigh County be nonattainment in a November 2011 revised recommendation to EPA. Warren County, New Jersey was part of the separate New York-Northern New Jersey-Long Island, NY-NJ-CT nonattainment area under the 1997 ozone NAAQS, and New Jersey has recommended the same nonattainment boundary for the 2008 ozone NAAQS.

The counties comprising the Allentown Area historically have strong planning and economic ties. Maintaining the 1997 ozone NAAQS boundary promotes continuity of planning. Lehigh and Northampton counties comprise the metropolitan transportation planning organization. Carbon County is part of a five-county rural planning organization along with Monroe, Schuylkill, Wayne, and Pike Counties. The Pennsylvania Department of Transportation supports Carbon County with respect to air quality-related technical work, and Pennsylvania indicates that past inclusion of Carbon County in the nonattainment area has not proven problematic from a jurisdictional perspective.

Warren County, NJ is part of the Allentown-Bethlehem-Easton census-defined MSA, but is covered by a separate transportation planning organization, and has historically been part of a separate nonattainment area for ozone, as well as for particulate matter NAAQS. New Jersey has recommended it for inclusion under the 2008 NAAQS as part of the nearby New York-Northern New Jersey-Long Island, NY-NJ-CT area, which has a higher overall design value than it would if included in the Allentown Area.

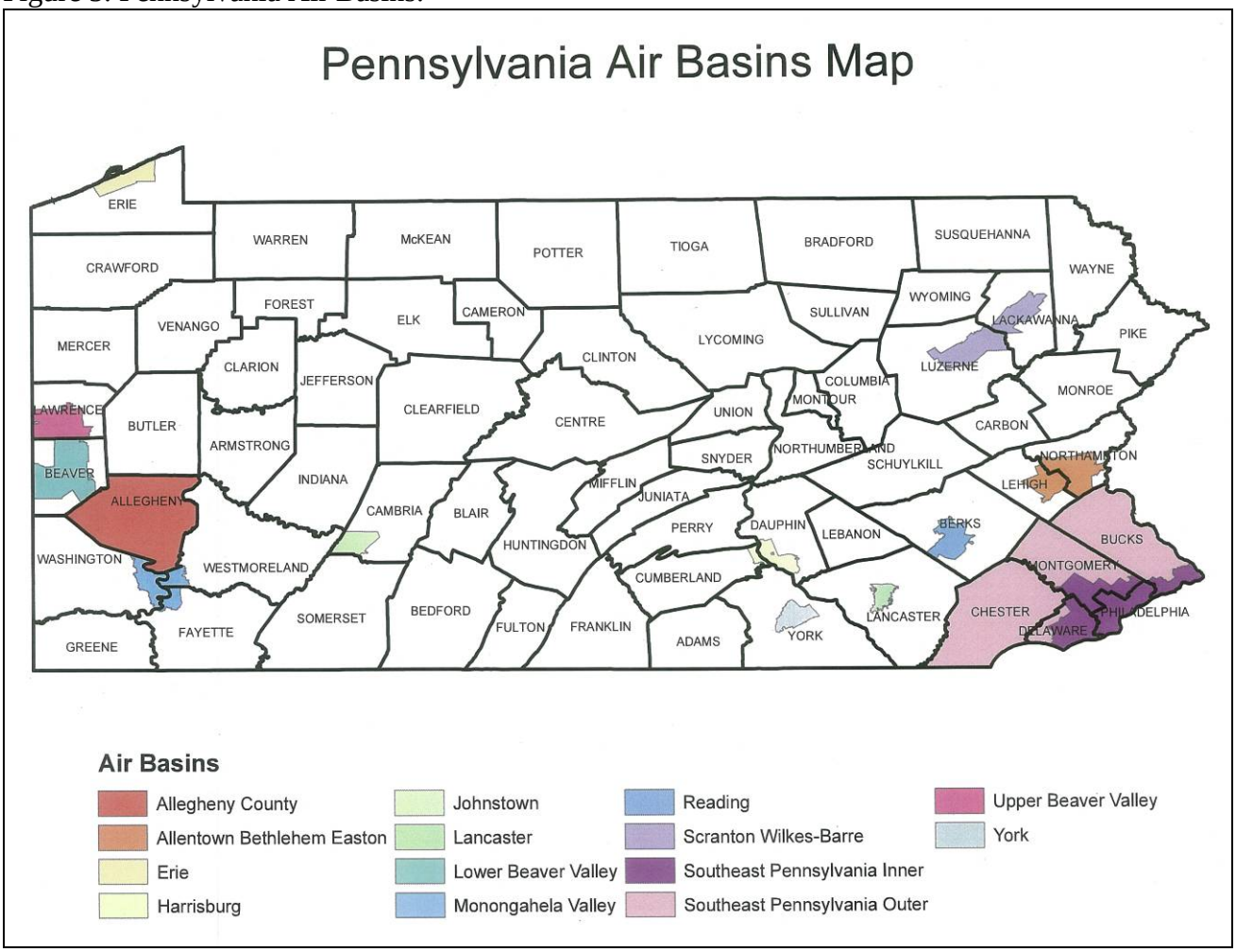
Luzerne and Lackawanna Counties are part of the Scranton-Wilkes-Barre, PA MSA, and have social and economic ties associated with that area. They also have a separate transportation planning agency from the Allentown Area. Scranton was nonattainment under the 1997 ozone NAAQS, but the area is currently monitoring attainment of the 2008 ozone NAAQS. The topography of the region separates Allentown-Bethlehem-Easton from this and other nearby areas to the west and north of the area.

Monroe County is part of the East Stroudsburg Micropolitan Statistical Area. Schuylkill County is part of the one-county Pottsville Micropolitan Statistical Area. Neither of these two counties

has strong economic or social ties to the Allentown Area.

The Allentown-Bethlehem-Easton Air Basin defined in 25 *Pa. Code* §121.1 covers portions of Lehigh and Northampton Counties (see Figure 5). Although these air basins were developed for purposes of the sulfur compound controls outlined in 25 *Pa. Code* § 123.22, they represent state-defined existing local boundaries for emission controls in certain areas of the Commonwealth.

Figure 5. Pennsylvania Air Basins.



Conclusion

Based on the assessment of factors described above, EPA has concluded that the following counties meet the CAA criteria for inclusion in the Allentown Area: Carbon, Lehigh, and Northampton. These are the same counties that are included in the Allentown nonattainment area for the 1997 ozone NAAQS.

The air quality monitor in Lehigh County indicates a violation of the 2008 ozone NAAQS based on the 2010 and 2011 DV, therefore this county is included in the nonattainment area. Carbon

and Northampton are nearby counties that do not have violating monitors, but EPA has concluded that these areas contribute to the ozone concentrations in violation of the 2008 ozone NAAQS through ozone precursor emissions. Northampton and Lehigh Counties have among the highest NOx and VOC emissions in the area. Lehigh and Northampton Counties contain the cities of Allentown, Bethlehem, and Easton, where the highest population concentrations in the area are located. Vehicle miles of travel are highest in Lehigh and Northampton Counties, and Lehigh County also has the highest percentage of commuters travelling to a county with a violating monitor. Carbon and Northampton Counties are in the Allentown-Bethlehem-Easton MSA, along with Lehigh County, and a significant number of commuters from both counties commute into Lehigh County.

In 2009, Pennsylvania recommended that the Allentown-Bethlehem-Easton nonattainment area maintain the same boundaries as were in place for the 1997 ozone NAAQS. In November 2011, Pennsylvania revised its recommendation to include only Lehigh County (the location of the violating monitor), setting aside past jurisdictional factors for inclusion of Carbon and Northampton counties as part of the nonattainment area. However, in Pennsylvania's February 28, 2012 response to EPA's December 9, 2011 "120-day letter", the Commonwealth concurred with EPA's recommendation to include Carbon and Northampton Counties, stating,

> "Although we recommended nonattainment boundaries only for counties with monitors violating the ozone standard, we recognize that use of the same nonattainment area boundaries, based primarily on the same MSA as for the 1997 and 2008 ozone standards, should preserve continuity of planning for both the DEP and the regional transportation planning agencies."

EPA's believes this jurisdictional argument is a prominent reason for designating nonattainment area boundary for the 2008 ozone NAAQS. New Jersey recommended inclusion of Warren County in the New York-Northern New Jersey-Long Island nonattainment area, as it was under the 1997 ozone NAAQS, rather than including Warren County in the Allentown Area. Although Warren County is part of the Allentown-Bethlehem-Easton CSA, there are strong jurisdictional arguments for maintaining the nonattainment boundaries of the 1997 ozone standard for the 2008 ozone standard. EPA has concluded that Warren County should be included in the New York-Northern New Jersey-Long Island, and not in the Allentown Area.

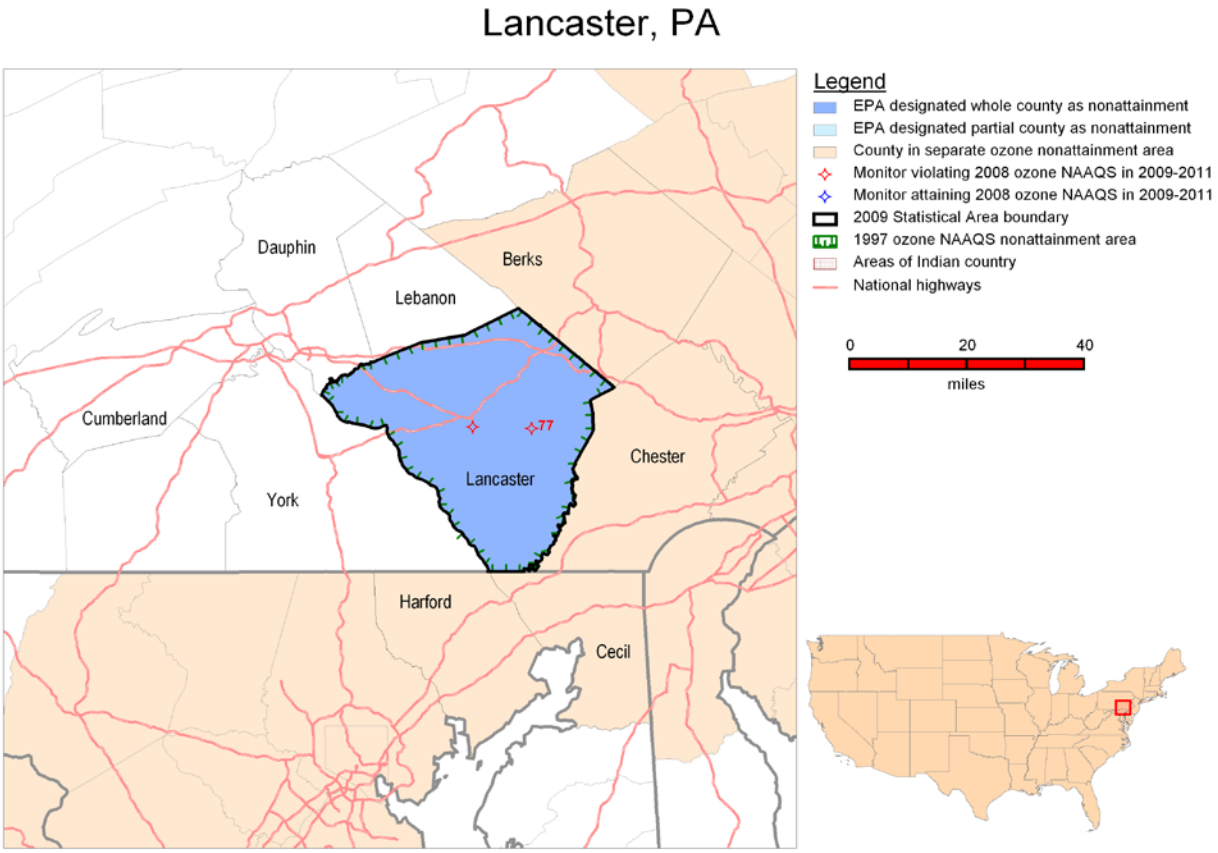
Prevailing winds and topography support exclusion of the Scranton-Wilkes-Barre area counties of Luzerne and Lackawanna, as well as the downwind counties of Monroe and Warren.

The adjacent counties to the Allentown Area eastern and southern boundary are being designated as part of separate nonattainment areas with equal or higher classification as this area. Finally, past ozone NAAQS boundaries and jurisdictional ties support keeping the prior nonattainment boundaries for Allentown Area, to include Carbon, Lehigh, and Northampton Counties.

Technical Analysis for the Lancaster Area

Figure 1 is a map of the Lancaster, PA nonattainment area (Lancaster Area). The map provides other relevant information including the locations and design values of air quality monitors, county and other jurisdictional boundaries, metropolitan statistical area boundary, existing maintenance area boundary for the 1997 ozone NAAQS, and EPA's nonattainment area boundary for the 2008 ozone NAAQS.

Figure 1



For purposes of the 1997 8-hour ozone NAAQS, this area was designated nonattainment. The boundary for the nonattainment area for the 1997 ozone NAAQS included the entire county of Lancaster.

In March 2009, the Commonwealth of Pennsylvania recommended that Lancaster County be designated as nonattainment as the Lancaster Area for the 2008 ozone NAAQS based on air quality data from 2006-2008, keeping the same boundaries as the 1997 ozone NAAQS nonattainment area. Pennsylvania provided an update to the original recommendation in November 2011 based on air quality data from 2009-2011. Based on this updated information, the Commonwealth once more recommended that Lancaster County be designated nonattainment under the 2008 ozone NAAQS. The 2008-2010 and 2009-2011 monitoring data both show that

the same county (Lancaster) is violating the 2008 ozone NAAQS. The recommendations are based on monitoring data from FRM monitors or FEM monitors sited and operated in accordance with 40 CFR Part 58. (See the March 17, 2009 and November 22, 2011 letters from the Pennsylvania Department of Environmental Protection to EPA.)

After considering these recommendations and based on EPA's technical analysis described below, EPA is designating Lancaster County, Pennsylvania (identified in Table 1 below) as "nonattainment" for the 2008 ozone NAAQS as a single-county nonattainment area.

Table 1. State's Recommended and EPA's Designated Nonattainment Counties for Lancaster.

Lancaster, PA	State-Recommended Nonattainment Counties	EPA's Designated Nonattainment Counties
Pennsylvania	Lancaster	Lancaster

Factor Assessment

EPA is including the nearby counties of Berks and Chester, Pennsylvania, and Cecil and Harford, Maryland as part of separate nonattainment areas for the 2008 ozone NAAQS from the Lancaster Area. Based on EPA's five-factor analyses, EPA has concluded that Berks County should be designated nonattainment as the Reading Area; Chester, and Cecil Counties should be designated nonattainment in the Philadelphia-Wilmington-Atlantic City Area; and Harford County should be designated nonattainment as part of the Baltimore Area. See EPA's respective technical analyses for these adjacent nonattainment areas for EPA's rationale for our nonattainment designation for these counties. Therefore, EPA is not including Berks, Chester, Cecil, and Harford Counties in this analysis for the Lancaster Area. To the extent that emissions from those counties may contribute ozone concentrations in the Lancaster Area, that contribution will be lessened by emission controls put in place in those separate nonattainment areas.

Factor 1: Air Quality Data

For this factor, we considered 8-hour ozone design values (in parts per billion (ppb)) for air quality monitors in counties in the Lancaster area MSA based on data for the 2008-2010 and 2009-2011 periods (i.e., the 2010 and 2011 design values, or DVs), which are the most recent years with fully-certified air quality data. A monitor's DV is the metric or statistic that indicates whether that monitor attains a specified air quality standard. The 2008 ozone NAAQS are met when the annual fourth-highest daily maximum 8-hour average concentration, averaged over 3 years is 0.075 ppm (75 ppb) or less. A DV is only valid if minimum data completeness criteria are met. See 40 CFR part 50 Appendix P. Where several monitors are located in a county (or a designated nonattainment area or maintenance area), the DV for the county or area is determined by the monitor with the highest level.

The 2010 DVs and 2011 DVs for the 2008 ozone NAAQS for counties in the Lancaster area and certain nearby surrounding counties are shown in Table 2.

Table 2. Air Quality Data.

County	State Recommended Nonattainment?	EPA Designated Nonattainment?	2008-2010 Design Value (ppb)	2009-2011 Design Value (ppb)
Lancaster, PA	Yes	Yes	77	77
York, PA	No	No	74	72
Lebanon, PA	No	No	--	--
Dauphin, PA	No	No	73	73

Note: Counties with no ozone monitor are identified with "--" in the 2010 and 2011 8-hour Ozone DV columns.

In accordance with section 107(d) of the Clean Air Act, EPA must designate an area "nonattainment" if it is violating the 2008 ozone NAAQS. Lancaster County shows a violation of the 2008 ozone NAAQS, therefore this county must be included in a nonattainment area. A county (or partial county) must also be designated nonattainment if it contributes to a violation in a nearby area. Each county without a violating monitor that is located near a county with a violating monitor has been evaluated based on the weight of evidence of the five factors to determine whether it contributes to the nearby violation.

Factor 2: Emissions and Emissions-Related Data

EPA evaluated emissions of ozone precursors (NO_x and VOC) and other emissions-related data that provide information on areas contributing to violating monitors.

Emissions Data

EPA evaluated county-level emission data for NO_x and VOC derived from the 2008 National Emissions Inventory (NEI), version 1.5. This is the most recently available NEI. (See http://www.epa.gov/ttn/chief/net/2008inventory.html) Significant emissions levels in a nearby area indicate the potential for the area to contribute to observed violations. We will also consider any additional information we receive on changes to emissions levels that are not reflected in recent inventories. These changes include emissions reductions due to permanent and enforceable emissions controls that will be in place before final designations are issued and emissions increases due to new sources.

Table 3 shows emissions of NO_x and VOC (given in tons per year) for violating and nearby potentially contributing counties in the Lancaster area.

Table 3. Total 2008 NO_x and VOC Emissions.

County	State Recommended Nonattainment?	EPA Designated Nonattainment?	NO_x (tpy)	VOC (tpy)
Lancaster, PA	Yes	Yes	18,217	22,877
York, PA	No	No	35,616	15,723
Lebanon, PA	No	No	6,166	5,367
Dauphin, PA	No	No	10,848	11,760

York County has much higher NOx emissions than the other nearby counties, having nearly as much total NOx emissions as all the other counties listed in Table 3. Lancaster has the highest VOC emissions, followed closely by York. Lebanon and Dauphin have comparatively lower emissions of both NOx and VOCs.

Population density and degree of urbanization

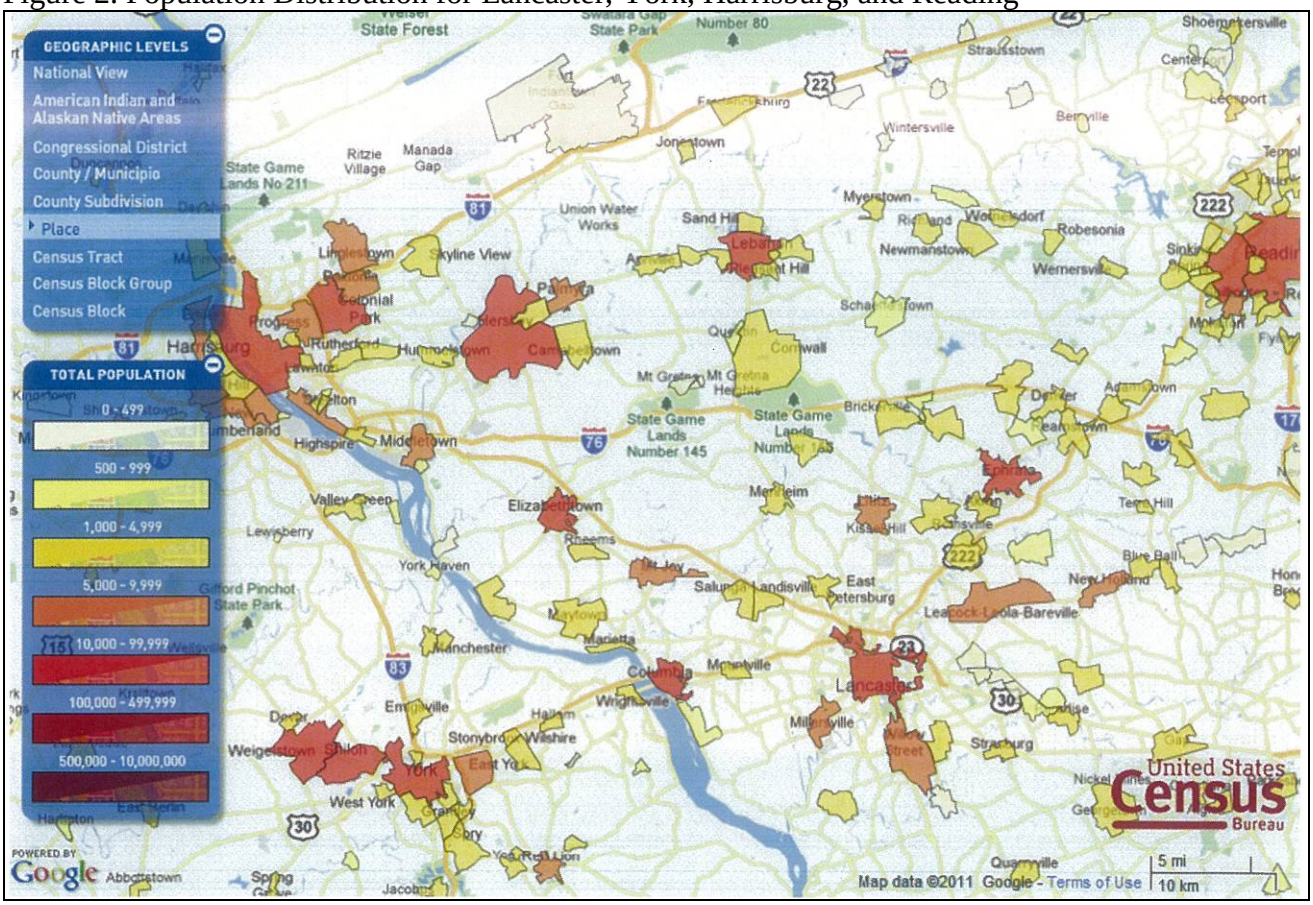
EPA evaluated the population and vehicle use characteristics and trends of the area as indicators of the probable location and magnitude of non-point source emissions. These include ozone-creating emissions from on-road and off-road vehicles and engines, consumer products, residential fuel combustion, and consumer services. Areas of dense population or commercial development are an indicator of area source and mobile source NO_x and VOC emissions that may contribute to ozone formation. Table 4 shows the population, population density, and population growth information for each county in the area.

Table 4. Population and Growth.

County	State Recommended Nonattainment?	EPA Designated Nonattainment?	2010 Population	2010 Population Density (1000 pop/sq mi	Absolute change in population (2000-2010)	Population % change (2000-2010)
Lancaster, PA	Yes	Yes	519,445	0.53	47,669	+10%
York, PA	No	No	434,972	0.48	52,263	+14%
Lebanon, PA	No	No	133,568	0.37	13,151	+11%
Dauphin, PA	No	No	268,100	0.48	16,303	+6%

Sources: U.S. Census Bureau population estimates for 2010 as of August 4, 2011 (http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_PL_GCTPL2.STO5&prodType=table)

Figure 2. Population Distribution for Lancaster, York, Harrisburg, and Reading



Source: US Census Bureau (http://2010.census.gov/2010census/popmap/)

Lancaster County has the highest population of any of the counties in the Lancaster and surrounding areas, followed by York County. Dauphin and Lebanon have much lower populations. All of these counties have similar population densities, ranging from 370 to 530 persons per square mile, however, the populations of the cities and towns are distributed unevenly between small, dense urban cores and outlying towns and rural areas. As can be seen in the Census map in Figure 2, the Cities of Lancaster, York (and to a lesser extent Reading and Harrisburg) all have small dense urban centers surrounded by sparsely populated areas with smaller towns interspersed.

Nearly all of the counties in Table 4 have experienced double digit growth between 2000 and 2010, but the overall population growth numbers for all four counties total just over a hundred thousand persons over the past decade.

Traffic and commuting patterns

EPA evaluated the total Vehicle Miles Traveled (VMT) in the area and VMT growth, as well as commuter movement within and between counties. This information, in combination with the population/population density data and the location of main transportation arteries (see Figure 1, above), helps in identifying the probable location of non-point source emissions. A county with high VMT and/or a high number of commuters is generally an integral part of an urban area and indicates the presence of motor vehicle emissions that may contribute to ozone formation. Rapid population or VMT growth in a county on the urban perimeter signifies increasing integration with the core urban area, and indicates that the associated area source and mobile source emissions may be appropriate to include in the nonattainment area. Table 5 shows traffic and commuting pattern data, including total 2008 VMT, growth in VMT for the period between 2002-2008, and the total vehicle miles traveled (VMT) for each county. Table 6 shows the number of commuters traveling within and between the counties in the area of analysis.

Table 5. Traffic and VMT data.

County	State Recommended Nonattainment?	EPA Designated Nonattainment?	2008 VMT* (million miles)	Percent VMT Growth 2002-2008
Lancaster, PA	Yes	Yes	4,245	9.0%
York, PA	No	No	3,275	6.1%
Lebanon, PA	No	No	1,210	4.5%
Dauphin, PA	No	No	3,062	2.0%

* MOBILE model VMTs are those inputs into the NEI version 1.5.

Table 6. County to County Worker Flow.

Residence County → / **Workplace County ↓**	Lancaster, PA	York, PA	Lebanon, PA	Dauphin, PA
Lancaster, PA	201,608	5,485	3,770	2,585
York, PA	4,018	142,104	266	2,365
Lebanon, PA	1,952	332	36,677	2,508
Dauphin, PA	6,927	9,848	12,853	93,958

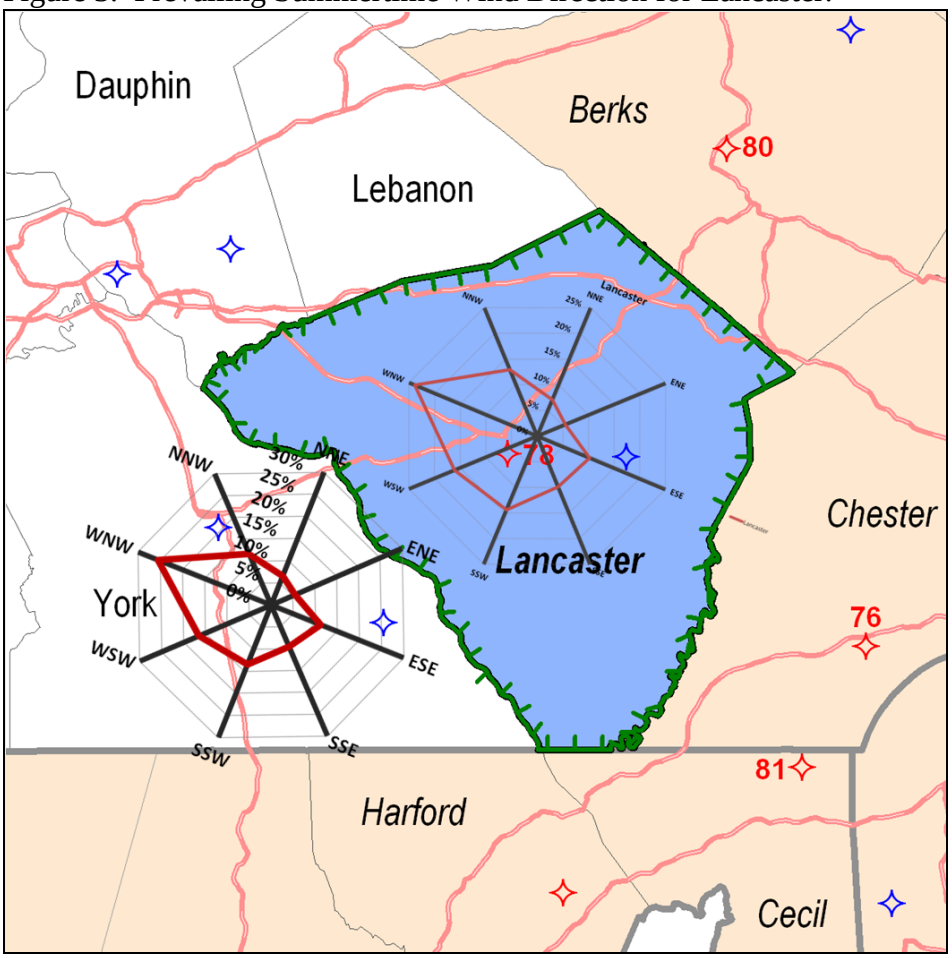
Source: U.S. Census Bureau estimates for 2000 County-to-County Worker Flow (http://www.census.gov/hhes/commuting/data/commuting.html

Lancaster County has the highest overall VMT and historical growth in VMT of the counties in the area of analysis, followed by York and Dauphin Counties. Table 6 shows the county-to-county commuter worker flow. Lancaster has the highest number of commuters, most of whom travel within Lancaster County, which has the only violating monitor in the area of analysis. Similarly, York County commuters travel predominantly inside York County, with only 10% travelling to any county with a violating monitor. Dauphin and Lebanon Counties also contribute very few commuters to Lancaster County, with most commuting inside their home county.

Factor 3: Meteorology (weather/transport patterns)

EPA evaluated certain available meteorological data to help determine how meteorological conditions, such as weather, transport patterns and stagnation conditions, would affect the fate and transport of precursor emissions contributing to ozone formation.

Figure 3. Prevailing Summertime Wind Direction for Lancaster.



The prevailing winds during the ozone season predominate from the west-northwest, indicating that emissions from the Harrisburg-Lebanon-Carlisle metropolitan area counties of Lebanon and Dauphin may have an impact on the Lancaster violating monitor. To a lesser extent, York County emissions may also contribute to the violating monitor, dependent upon the wind direction during an ozone episode. The emissions impact from Berks, Chester, Cecil, and even Harford Counties appear to be lower, on the basis of prevalent wind direction alone, than the counties to the west of Lancaster. Note that the counties of Chester, Berks, and Harford, MD are downwind (based on prevalent wind direction) of Lancaster and have higher 2010 DVs than the monitors in York, Cumberland, and Dauphin Counties, which are upwind of Lancaster.

To further understand the meteorological transport conditions within the regional area around Lancaster, we also evaluated 24-hour back trajectories for the 2007-2011 time period, using the National Oceanic and Atmospheric Administration (NOAA) Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) model. The model uses the monitoring location as a starting point, and goes back in time using meteorological data to determine how a parcel of air would have traveled on a given day. The current violating monitor, 42-071-0007, was used as the starting point for the analyses.

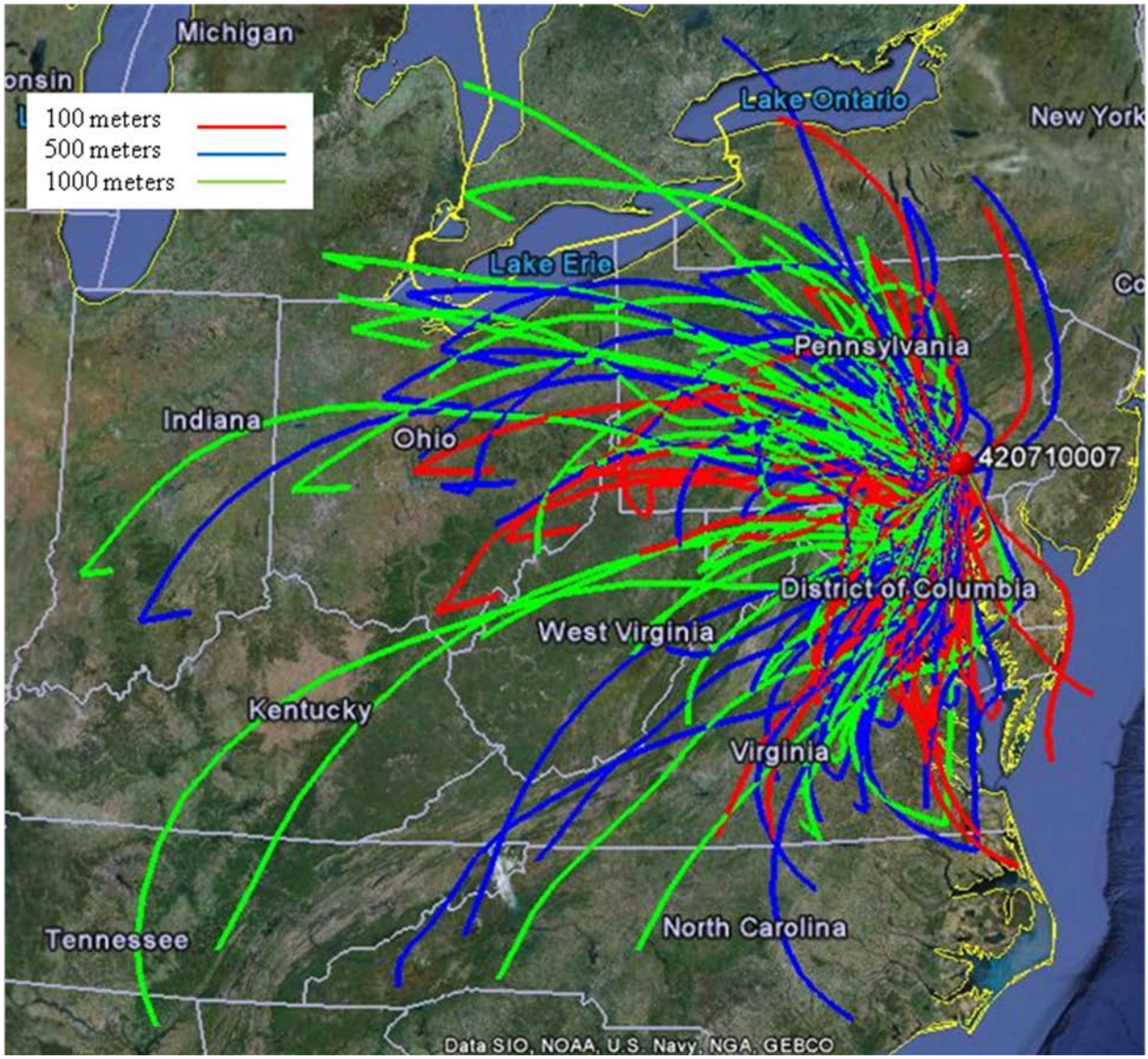
EPA evaluated three separate elevations for each exceedance day to better characterize the wind pattern and pollution transport to the monitor. EPA used HYSPILT to evaluated wind patterns at the violating monitor for all days where the 8-hour average was above the 0.075 ppm standard (exceedance days). The air quality monitoring data and HYSPLIT results for those exceedance days are available in the docket for this action. Table 7 lists the exceedance days and corresponding 8-hour average ozone values for each exceedance day.

Table 7. 2007 to 2011 Exceedance-Day 8-Hour Ozone Values

Exceedance Day	8-hour average (ppm ozone)		Exceedance Day	8-hour average (ppm ozone)
5/15/2007	0.079		7/15/2009	0.076
5/25/2007	0.085		5/1/2010	0.076
5/27/2007	0.077		6/22/2010	0.077
5/30/2007	0.082		6/26/2010	0.076
5/31/2007	0.083		7/4/2010	0.082
6/7/2007	0.082		7/5/2010	0.082
6/8/2007	0.079		7/6/2010	0.085
6/18/2007	0.092		8/10/2010	0.095
6/19/2007	0.077		8/19/2010	0.079
7/9/2007	0.082		8/29/2010	0.078
8/3/2007	0.081		8/31/2010	0.076
8/4/2007	0.077		9/1/2010	0.079
8/15/2007	0.076		9/2/2010	0.086
8/30/2007	0.076		5/31/2011	0.078
9/7/2007	0.077		6/8/2011	0.084
9/8/2007	0.077		6/9/2011	0.077
9/25/2007	0.083		7/2/2011	0.087
4/18/2008	0.078		7/5/2011	0.078
4/19/2008	0.083		7/22/2011	0.083
6/10/2008	0.076		7/23/2011	0.078
6/13/2008	0.080			
7/16/2008	0.082			
7/17/2008	0.081			
7/18/2008	0.080			
7/29/2008	0.076			

Figure 4 overlays HYSPLIT 24-hour back trajectories for all the 2007-2011 ozone exceedances at monitor 42-071-0007 on a Google Earth map of the northeastern United States. It gives an overview of long-range transport to the Lancaster Area. As seen in Figure 4, the 24-hour back trajectories indicate regional transport from many directions and over several states, but most of the winds come from the western half of the compass, including winds from the north, northwest, west, southwest, and south. Few trajectories are seen from the east, northeast, or southeast.

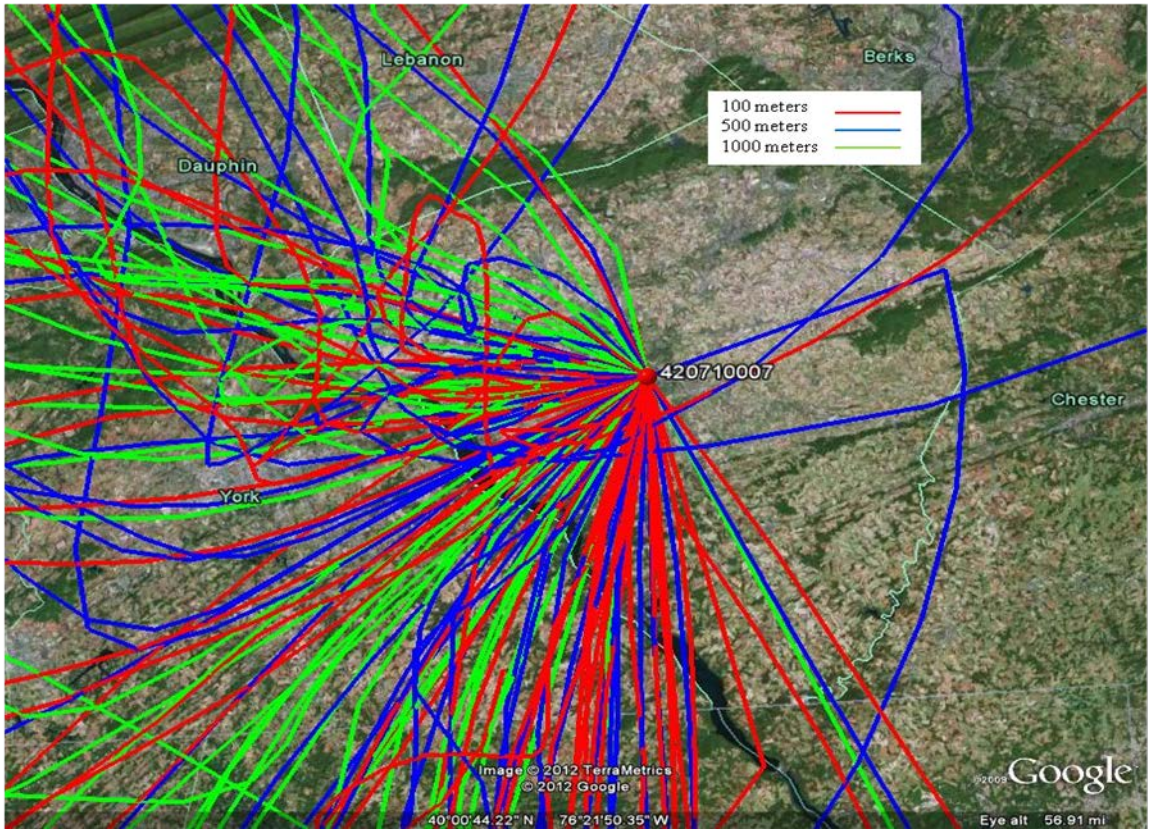
Figure 4. NOAA HYSPLIT 24-Hour Back Trajectories for 2006-2010 Exceedances Days - Overview



In Figure 5, below, EPA has zoomed in on these same 24-hour HYSPLIT back trajectories, showing more of the nearby transport on high ozone days. This zoomed in perspective shows prevailing winds from the south and southwest, and west with some trajectories from the northwest. Thus, on exceedance days, this analysis suggests that winds traveling to the Lancaster monitor are more likely to pass through York County, Pennsylvania than any other

county in the area of analysis. Figure 5 shows that a large number of trajectories pass through Harford County, Maryland, to the south of Lancaster County, which is part of the Baltimore nonattainment area. A smaller number of trajectories pass through Dauphin and Lebanon Counties, with only a few through Berks and Chester Counties.

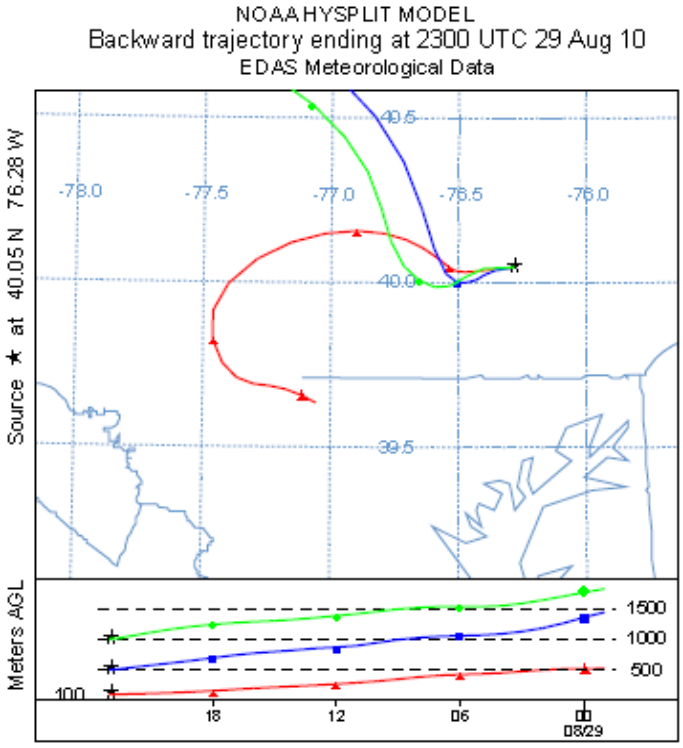
Figure 5. NOAA HYSPLIT 24-Hour Back Trajectories for 2006-2010 Exceedances Days - Zoom View

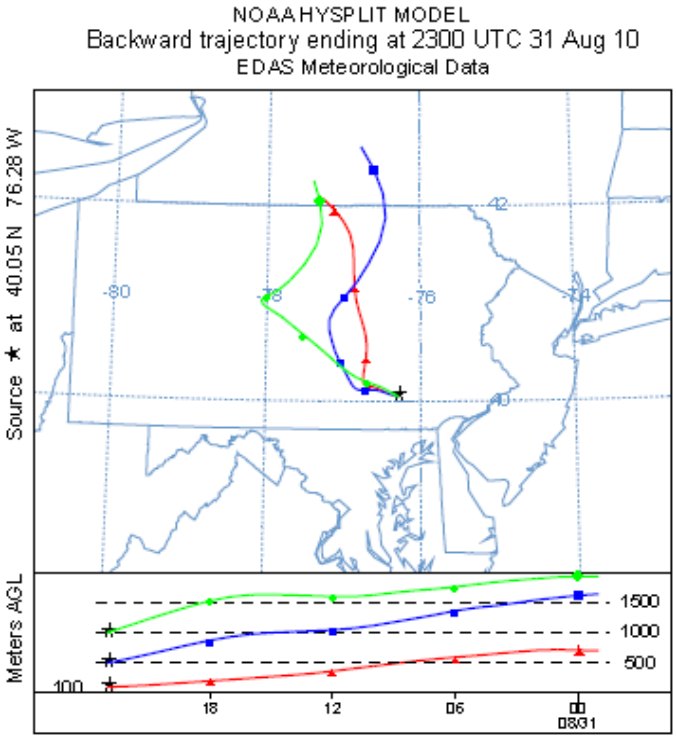


To further illustrate the local transport situation in the Lancaster Area, EPA has selected specific trajectories for an "ozone episode," which is a period when the ozone levels are high for several consecutive days. As shown in Table 7, the 8-hour average ozone value at monitor 42-071-0007 was above the standard for four days at the end of August and beginning of September in 2010, August 29 & 31 and September 1 & 2. Note that the 8-hour average ozone value on August 30 was below the standard. So, EPA did not perform a HYSPLIT analysis for that day.

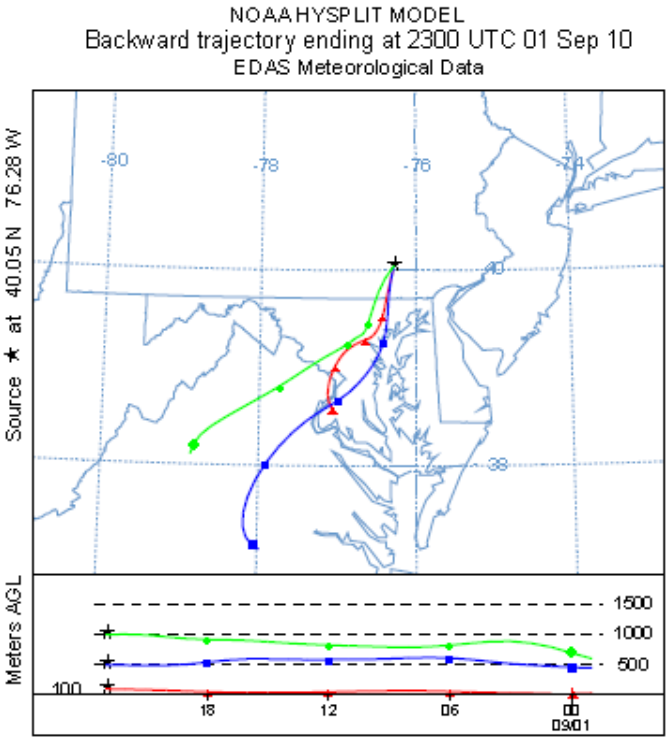
Figures 6 through 9 show the HYSPLIT back trajectories for the 2010 ozone episode. In the first two days of the episode (Figures 6 & 7), the winds come mainly from the north, through Dauphin and Cumberland Counties, and with some trajectories curving through York County on the way to the Lancaster Area. The exception is the low elevation trajectory on August 29, 2010 that starts to the southwest of Lancaster and curves through York County on its way toward the Lancaster monitor. In the last two days of the episode (Figures 8 & 9), the winds come from the south, through York County and Harford County, Maryland.

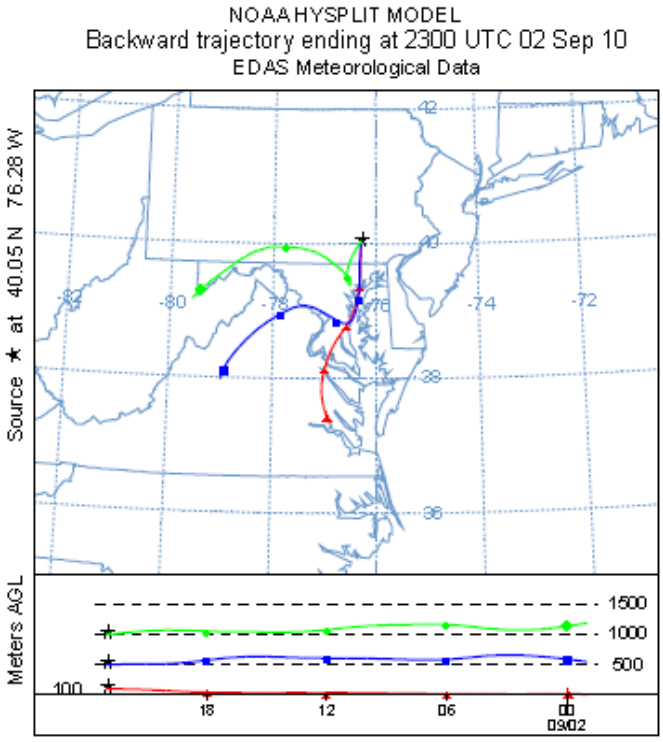
Figures 6 & 7, NOAA HYSPLIT 24-Hour Back Trajectories August 29 &31, 2010





Figures 8 & 9, NOAA HYSPLIT 24-Hour Back Trajectories September 1 & 2, 2010





Factor 4: Geography/topography (mountain ranges or other air basin boundaries)

The geography/topography analysis evaluates the physical features of the land that might affect the airshed and, therefore, the distribution of ozone over the area. The Lancaster Area does not have any geographical or topographical barriers significantly limiting air pollution transport to the area. Therefore, this factor did not play a significant role in this evaluation.

Factor 5: Jurisdictional boundaries

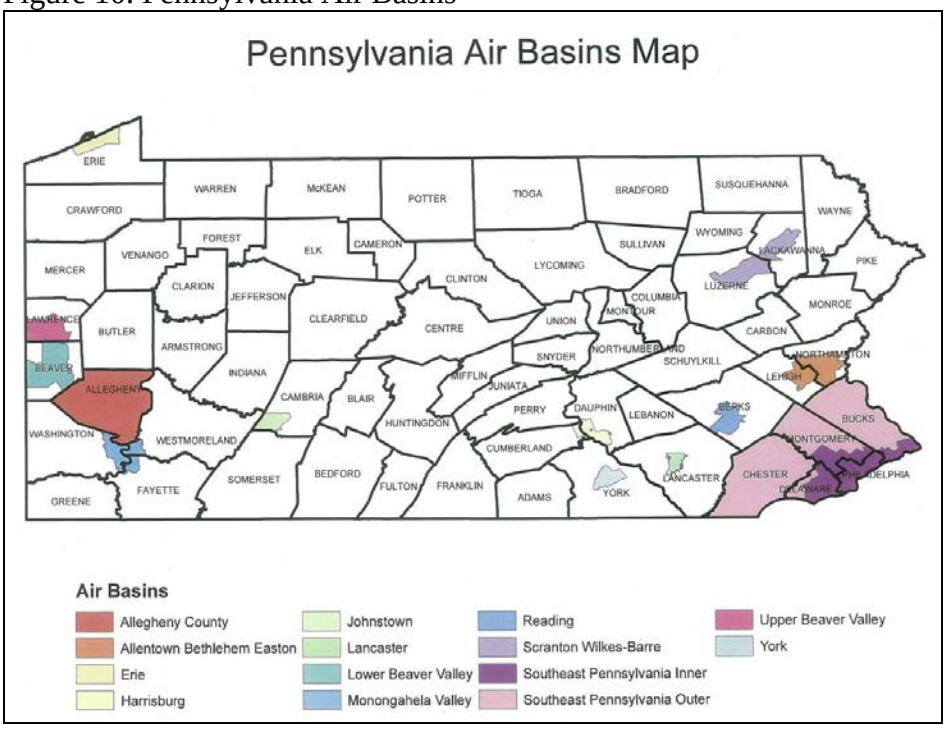
Once the general areas to be included in the nonattainment area were determined, EPA considered existing jurisdictional boundaries for the purposes of providing a clearly defined legal boundary and carrying out the air quality planning and enforcement functions for nonattainment areas. Examples of jurisdictional boundaries include existing/prior nonattainment areas for ozone or other urban-scale pollutants, counties, air districts, townships, metropolitan planning organizations, state lines, Reservations, urban growth boundary, etc. Where existing jurisdictional boundaries are not adequate to describe the nonattainment area, other clearly defined and permanent landmarks or geographic coordinates are used.

The single-county Lancaster MSA area has previously established nonattainment boundaries associated with the 1997 8-hour ozone NAAQS.

The Commonwealth has recommended the same boundary for the 2008 ozone NAAQS, with Lancaster County to be designated nonattainment as a single-county area for the 2008 ozone NAAQS. Lancaster County is a single-county metropolitan statistical area based on economic, political and commuting patterns. This area is served by a single-county transportation-planning agency.

The Lancaster Air Basin defined in 25 *Pa. Code* §121.1 covers portions of Lancaster County (see Figure 5). Although these air basins were developed for purposes of the sulfur compound controls outlined in 25 *Pa. Code* § 123.22, they represent state-defined existing local boundaries for emission controls in certain areas of the Commonwealth.

Figure 10. Pennsylvania Air Basins



Conclusion

Based on the assessment of factors described above, EPA has concluded that the following county meets the CAA criteria for inclusion in the Lancaster nonattainment area: Lancaster.

This is the same county that is included in the Lancaster nonattainment area for the 1997 ozone NAAQS. The air quality monitor in Lancaster County indicates violations of the 2008 ozone NAAQS based on the 2010 DVs, therefore this county must be included in the nonattainment area.

Chester, Harford, Cecil, and Berks are nearby counties that have violating monitors, but are part of separate nearby CSAs and are being designated nonattainment as part of separate areas. York, Cumberland, Dauphin, and Lebanon Counties do not have violating monitors, but EPA has concluded that these areas do not contribute to the ozone concentrations in violation of the 2008 ozone NAAQS in Lancaster County enough to warrant their inclusion in the Lancaster Area.

York County has the highest NOx emissions of the counties evaluated and has the second highest VOC emissions. York County has the second highest population and the largest population growth over the past decade. York County has the second highest VMT, but most York County commuters remain within York County and do not travel to Lancaster County (where the violating monitor is located). Meteorology indicates that emissions from York County may contribute to violations of the ozone standard as wind come predominantly from the west, southwest, and south on ozone exceedance days, and York County is to the west of Lancaster

County and its violating monitor. On ozone exceedance days, winds also come from the northwest, but at less frequency than winds from the west, southwest, and south. This indicates that Lebanon and Dauphin may contribute to violations in Lancaster, as these counties lie to the northwest of Lancaster. However, the magnitude of NOx and VOC emissions from those counties is comparatively smaller than Lancaster or York Counties.

Lancaster has the highest VMT of all the counties being compared here (followed by York), and has by far the highest number of commuters, most of whom commute within Lancaster County, where the violating monitor is located.

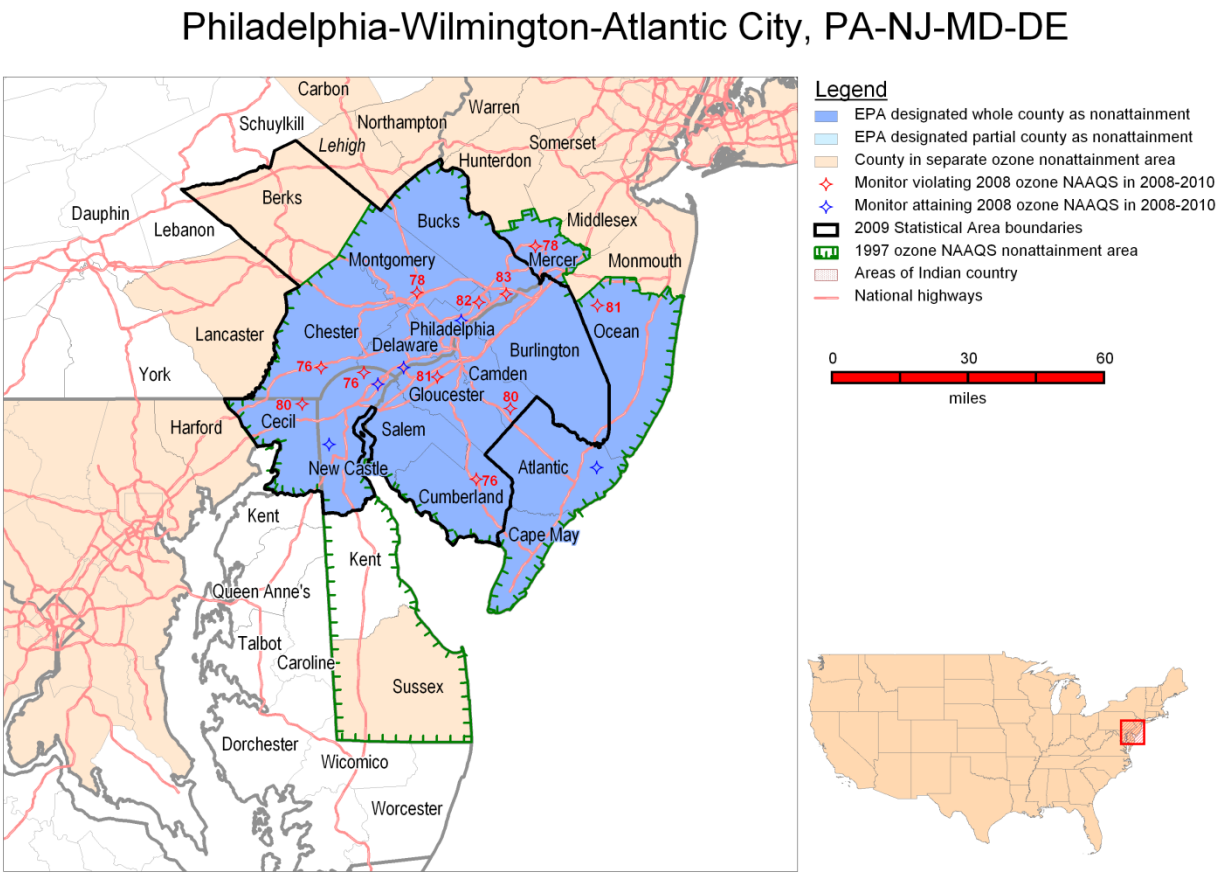
There are strong jurisdictional arguments for making Lancaster a single county nonattainment area. The county has is a single-county metropolitan statistical area based on economic, political and commuting patterns. Lancaster County was a single county nonattainment area under the 1997 ozone NAAQS, and the prior 1-hour ozone NAAQS. The area is served by a single-county transportation-planning agency, and has a unique political and cultural identity of its own.

The Commonwealth has recommended the same single-county boundary for the 2008 ozone NAAQS, with Lancaster County to be designated nonattainment for the 2008 ozone NAAQS. This area is served by a single-county transportation-planning agency. Designating it as a single-county nonattainment area maintains continuity of planning since the county has an approved maintenance plan for the 1997 ozone NAAQS.

Technical Analysis for the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD Area

Figure 1 is a map of the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD nonattainment area. The map provides other relevant information including the locations and 2010 design values of air quality monitors, county and other jurisdictional boundaries. The map shows the boundaries of the Philadelphia-Camden-Vineland, PA-NJ-DE-MD CSA, the existing nonattainment area boundary for the 1997 ozone NAAQS, and EPA's nonattainment boundary for the 2008 ozone NAAQS.

Figure 1.



For purposes of the 1997 8-hour ozone NAAQS, much of this area was designated nonattainment. The Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE nonattainment area at that time included the entire counties of Kent, New Castle, and Sussex in Delaware; Cecil in Maryland; Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Mercer, Ocean, and Salem in New Jersey; and Bucks, Chester, Delaware, Montgomery, and Philadelphia in Pennsylvania.

In March 2009, the State of Delaware recommended that no counties in Delaware be included in the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD area for the 2008 ozone NAAQS based on air quality data from 2006-2008. Instead, Delaware recommend a large, multi-state nonattainment area, covering the entire States of Delaware, Maryland, Michigan, New Jersey,

New York, North Carolina, Ohio, Pennsylvania, Virginia, and West Virginia, and the District of Columbia. Alternatively, Delaware recommended that the entire State of Delaware be designated as a stand-alone nonattainment area. In October 2011, Delaware updated its recommendations. In that letter, Delaware expanded its recommended large multi-state nonattainment area to include the States of Kentucky, Indiana, Illinois, Missouri, Tennessee, and Wisconsin. In addition, in its October 2011 letter, the State of Delaware specified that if EPA did not accept either of its designation options, then Kent County should not be designated nonattainment. This recommendation was based on 2008-2010 data and continues to be true based on preliminary 2009-2011 data. The data are from Federal Reference Method (FRM) monitors or Federal Equivalent Method (FEM) monitors sited and operated in accordance with 40 CFR Part 58. (See the March 18, 2009 letter from Governor Jack A. Markell to EPA, received on April 3, 2009; and the October 28, 2011 letter from the Delaware Department of Natural Resources and Environmental Control.)

In March 2009, the State of Maryland recommended that Cecil County be designated as nonattainment as part of the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD area for the 2008 ozone NAAQS based on air quality data from 2006-2008. This is the same Maryland County that was included in the Philadelphia-Wilmington-Atlantic City nonattainment area for the 1997 ozone NAAQS. This recommendation was based on data from FRM monitors or FEM monitors sited and operated in accordance with 40 CFR Part 58. (See the March 10, 2009 letter from Governor Martin O'Malley to EPA, received on March 16, 2009.) EPA has confirmed that the area is still nonattainment, based on the design value for 2010, which uses data from 2008 through 2010.

In April 2009, the State of New Jersey recommended that the same nine counties in New Jersey that were included in the Philadelphia-Wilmington-Atlantic City nonattainment area for the 1997 ozone NAAQS be designated as nonattainment in the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD area for the 2008 ozone NAAQS based on air quality data from 2006-2008. This recommendation was based on data from FRM monitors or FEM monitors sited and operated in accordance with 40 CFR Part 58. (See the April 1, 2009 letter from the New Jersey Department of Environmental Protection to EPA.) EPA has confirmed that the area is still nonattainment, based on the design value for 2010, which uses data from 2008 through 2010.

In March 2009, the Commonwealth of Pennsylvania recommended that the same five counties in Pennsylvania that were included in the Philadelphia-Wilmington-Atlantic City nonattainment area for the 1997 ozone NAAQS be designated as nonattainment in the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD for the 2008 ozone NAAQS based on air quality data from 2006-2008. Pennsylvania provided an update to the original recommendation in November 2011 based on air quality data from 2009-2011. That recommendation was to remove Chester and Delaware Counties from the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD, and designate those counties as attainment. This recommendation was based on data from FRM monitors or FEM monitors sited and operated in accordance with 40 CFR Part 58. (See the March 17, 2009 and November 22, 2011 letters from the Pennsylvania Department of Environmental Protection to EPA.)

After considering these recommendations and based on EPA's technical analysis described below, EPA is designating 16 counties in Delaware, Maryland, New Jersey, and Pennsylvania

(identified in Table 1 below) as "nonattainment" for the 2008 ozone NAAQS as the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD nonattainment area.

Table 1. State's Recommended and EPA's Designated Nonattainment Counties for the Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE Area.

Philadelphia	State-Recommended Nonattainment Counties	Counties Designated by EPA as Nonattainment
Delaware	None	New Castle
Maryland	Cecil	Cecil
New Jersey	Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Mercer, Ocean, and Salem	Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Mercer, Ocean, and Salem
Pennsylvania	Bucks, Montgomery, and Philadelphia	Bucks, Chester, Delaware, Montgomery, and Philadelphia

Factor Assessment

The counties evaluated in this analysis include all counties in the Philadelphia-Camden-Vineland, PA-NJ-MD-DE CSA plus the counties outside the CSA that were included in the Philadelphia-Wilmington-Atlantic City nonattainment area for the 1997 ozone NAAQS. A more detailed meteorological assessment is included in a factor assessment for New Jersey's request for Ocean and Mercer Counties is attached.

Factor 1: Air Quality Data

For this factor, we considered 8-hour ozone design values (in parts per billion (ppb)) for air quality monitors in counties in the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD area based on data for the 2008-2010 period (i.e., the 2010 design value, or DV), which are the most recent years with fully-certified air quality data for the entire area.

However, Pennsylvania submitted certified 2011 air quality data to EPA in November 2011. The only effect of using 2011 data is a slight change in the highest design value for the nonattainment area and the location of the highest design value. Since none of the other states in the nonattainment area submitted certified 2011 data to EPA while EPA was in the process of evaluating the states submittal, that is, though March 2011, EPA is using 2010 ozone data as the last year of data for evaluation of these requests. In ordinary circumstances, EPA does not use data from different years in different parts of nonattainment areas. The effects of using 2011 data from Pennsylvania are noted in Appendix C.

A monitor's DV is the metric or statistic that indicates whether that monitor attains a specified air quality standard. The 2008 ozone NAAQS are met when the annual fourth-highest daily maximum 8-hour average concentration, averaged over 3 years is 0.075 ppm or less. A DV is only valid if minimum data completeness criteria are met. See 40 CFR part 50 Appendix P. Where several monitors are located in a county (or a designated nonattainment area or maintenance area), the DV for the county or area is determined by the monitor with the highest level.

Note: Monitors that are eligible for providing design value data generally include State and Local Air Monitoring Stations (SLAMS) that are sited in accordance with 40 CFR Part 58, Appendix D (Section 4.1) and operating with a federal reference method (FRM) or federal equivalent method (FEM) monitor that meets the requirements of 40 CFR part 58, appendix A. All data from a special purpose monitor (SPM) using an FRM or FEM which has operated for more than 24 months is eligible for comparison to the NAAQS unless the monitoring agency demonstrates that the data came from a particular period during which the requirements of appendix A (quality assurance requirements) or appendix E (probe and monitoring path siting criteria) were not met.

The 2010 DVs for the ozone NAAQS for counties in the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD CSA and several nearby surrounding counties are shown in Table 2.

Table 2. Air Quality Data.

County	State Recommended Nonattainment?	2010 8-hour Ozone DV (ppb)
Atlantic, NJ	Yes	74
Berks, PA	Yes, other area	79
Bucks, PA	Yes	83
Burlington, NJ	Yes	--
Camden, NJ	Yes	80
Cape May, NJ	Yes	--
Cecil, MD	Yes	80
Chester, PA	No	76
Cumberland, NJ	Yes	76
Delaware, PA	No	74
Gloucester, NJ	Yes	81
Kent, DE	No	74
Mercer, NJ	Yes	78
Montgomery, PA	Yes	78
New Castle, DE	Yes, other area	76
Ocean, NJ	Yes	81
Philadelphia, PA	Yes	82
Salem, NJ	Yes	--
Sussex, DE	Yes, other area	77

Note: Counties with no ozone monitor are identified with "--" in the 2010 8-hour Ozone DV column.

In accordance with section 107(d) of the Clean Air Act, EPA must designate an area nonattainment if it is violating the 2008 ozone NAAQS. New Castle and Sussex Counties in Delaware; Cecil County, Maryland; Berks, Bucks, Montgomery, and Philadelphia Counties in Pennsylvania; and Camden, Cumberland, Gloucester, Mercer, and Ocean Counties in New Jersey show violations of the 2008 ozone NAAQS. Therefore, these counties must be included in a nonattainment area. A county (or partial county) must also be designated nonattainment if it contributes to a violation in a nearby area. Each county without a violating monitor that is

located near a county with a violating monitor has been evaluated based on the weight of evidence of the five factors and other relevant information to determine whether it contributes to the nearby violation.

Factor 2: Emissions and Emissions-Related Data

EPA evaluated emissions of ozone precursors (NO_x and VOC) and other emissions-related data that provide information on areas contributing to violating monitors.

Emissions Data

EPA evaluated county-level emission data for NO_x and VOC derived from the 2008 National Emissions Inventory (NEI), version 1.5. This is the most recently available NEI. (See http://www.epa.gov/ttn/chief/net/2008inventory.html) Significant emissions levels in a nearby area indicate the potential for the area to contribute to observed violations. We will also consider any additional information we receive on changes to emissions levels that are not reflected in recent inventories. These changes include emissions reductions due to permanent and enforceable emissions controls that will be in place before final designations are issued and emissions increases due to new sources.

Table 3 shows emissions of NO_x and VOC (given in tons per year) for counties in the area of analysis.

Table 3. Total 2008 NO_x and VOC Emissions.

County	State Recommended Nonattainment?	NO_x (tpy)	VOC (tpy)
Atlantic, NJ	Yes	6,143	10,713
Berks, PA	Yes, other area	18,908	15,918
Bucks, PA	Yes	17,736	21,160
Burlington, NJ	Yes	10,919	12,909
Camden, NJ	Yes	12,725	10,731
Cape May, NJ	Yes	6,407	7,774
Cecil, MD	Yes	4,763	3,715
Chester, PA	No	16,806	16,351
Cumberland, NJ	Yes	4,916	5,727
Delaware, PA	No	28,118	15,881
Gloucester, NJ	Yes	18,335	11,756
Kent, DE	No	7,667	5,381
Mercer, NJ	Yes	9,909	8,160
Montgomery, PA	Yes	22,741	26,372
New Castle, DE	Yes, other area	22,633	14,133
Ocean, NJ	Yes	9,909	19,572
Philadelphia, PA	Yes	33,176	32,021
Salem, NJ	Yes	6,106	3,308
Sussex, DE	Yes, other area	14,870	9,972

Philadelphia County, PA has the highest NOx and VOC emissions in the area of analysis. Other counties with comparatively high emissions are New Castle County in Delaware; Delaware and Montgomery Counties in Pennsylvania and Ocean and Burlington Counties in New Jersey. Counties with comparatively low emissions are Kent County, Delaware; Cecil County, Maryland; and Salem County in New Jersey.

Population density and degree of urbanization

EPA evaluated the population and vehicle use characteristics and trends of the area as indicators of the probable location and magnitude of non-point source emissions. These include ozone-creating emissions from on-road and off-road vehicles and engines, consumer products, residential fuel combustion, and consumer services. Areas of dense population or commercial development are an indicator of area source and mobile source NO_x and VOC emissions that may contribute to ozone formation. Table 4 shows the population, population density, and population growth information for each county in the area.

Table 4. Population and Growth.

County	State Recommended Nonattainment?	2010 Population	2010 Population Density (1000 pop/sq mi)	Absolute change in population (2000-2010)	Population % change (2000-2010)
Atlantic, NJ	Yes	274,549	0.45	21,569	+9%
Berks, PA	Yes, other area	411,442	0.48	36,945	+10%
Bucks, PA	Yes	625,249	1.01	25,841	+4%
Burlington, NJ	Yes	448,734	0.55	24,255	+6%
Camden, NJ	Yes	513,657	2.26	6,064	+1%
Cape May, NJ	Yes	97,265	0.34	(5,043)	-5%
Cecil, MD	Yes	101,108	0.27	14,643	+17%
Chester, PA	No	498,886	0.66	63,107	+14%
Cumberland, NJ	Yes	156,898	0.31	10,547	+7%
Delaware, PA	No	558,979	2.93	6,938	+1%
Gloucester, NJ	Yes	288,288	0.86	31,962	+12%
Kent, DE	No	162,310	0.27	35,200	+28%
Mercer, NJ	Yes	366,513	1.60	14,979	+4%
Montgomery, PA	Yes	799,874	1.64	48,936	+7%
New Castle, DE	Yes, other area	538,479	1.11	36,620	+7%
Ocean, NJ	Yes	576,567	0.76	62,913	+12%
Philadelphia, PA	Yes	1,526,006	10.71	12,194	+1%
Salem, NJ	Yes	66,083	0.19	1,867	+3%
Sussex, DE	Yes, other area	197,145	0.20	39,710	+25%

Sources: U.S. Census Bureau population estimates for 2010 as of August 4, 2011. (http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_PL_GCTPL2.STO5&prodType=table)

Philadelphia County, Pennsylvania has the highest population and population density in the area of analysis. Bucks, Chester, Montgomery, and Delaware Counties, in Pennsylvania; New Castle County in Delaware; and Ocean County in New Jersey also have comparatively large populations compared to Kent County, Delaware and Salem County in New Jersey with comparatively small populations and population densities. Most counties in the analysis have experienced some population growth.

Traffic and commuting patterns

EPA evaluated the total Vehicle Miles Traveled (VMT) for each county in the area. In combination with the population/population density data and the location of main transportation arteries (see Figure 1, above), this information helps identify the probable location of non-point source emissions. A county with high VMT is generally an integral part of an urban area and indicates the presence of motor vehicle emissions that may contribute to ozone formation. Rapid population or VMT growth in a county on the urban perimeter signifies increasing integration with the core urban area, and indicates that the associated area source and mobile source emissions may be appropriate to include in the nonattainment area. Table 5 shows total 2008 VMT for each county.

Table 5. Traffic (VMT) Data.

County	State Recommended Nonattainment?	2008 VMT* (million miles)
Atlantic, NJ	Yes	2,863
Berks, PA	Yes, other area	3,335
Bucks, PA	Yes	5,021
Burlington, NJ	Yes	4,524
Camden, NJ	Yes	3,923
Cape May, NJ	Yes	1,040
Cecil, MD	Yes	1,350
Chester, PA	No	4,410
Cumberland, NJ	Yes	1,163
Delaware, PA	No	3,782
Gloucester, NJ	Yes	2,645
Kent, DE	No	1,565
Mercer, NJ	Yes	3,306
Montgomery, PA	Yes	6,883
New Castle, DE	Yes, other area	5,266
Ocean, NJ	Yes	3,834
Philadelphia, PA	Yes	5,955
Salem, NJ	Yes	992
Sussex, DE	Yes, other area	2,122

* MOBILE model VMT are those inputs into the NEI version 1.5.

New Castle County, Delaware; and Bucks, Montgomery, and Philadelphia Counties in Pennsylvania; and Burlington County in New Jersey have the highest VMT in the area of analysis. Kent County, Delaware; Cecil County, Maryland; and several counties in New Jersey have relatively low VMT.

Table 6. County to County Worker Flow.

Residence County →	Kent, DE	New Castle, DE	Sussex, DE	Cecil, MD	Berks, PA	Bucks, PA	Chester, PA	Delaware, PA	Montgomery, PA	Philadelphia, PA
Workplace County ↓										
Kent, DE	47,455	3,927	5,704	186	157	18	131	112	41	65
New Castle, DE	6,058	209,742	1,119	14,059		493	12,976	9,002	1,201	1,856
Sussex, DE	3,779	319	52,073	33			29	15	6	39
Cecil, MD	243	3,379	42	18,446		18	557	192		52
Atlantic, NJ	11	142		31	4	172	73	231	181	831
Burlington, NJ	40	475	25	27	40	4,250	426	1,306	1,559	5,087
Camden, NJ	55	434	10	72	27	2,039	539	2,287	1,844	7,196
Cape May, NJ		27	20		13	54	81	118	95	324
Cumberland, NJ	26	164	5	19		42	24	103	66	140
Gloucester, NJ		750	19	82	16	362	411	1,251	405	1,502
Mercer, NJ	10	78	12	7	37	20,812	222	345	1,298	1,676
Ocean, NJ		13	30	8	5	220	23	10	13	86
Salem, NJ	32	1,841	11	139		37	155	245	59	84
Berks, PA		4	48	5	140,819	410	1,916	187	4,231	243
Bucks, PA	12	261	12	22	675	168,090	1,133	2,060	23,722	23,248
Chester, PA	37	4,738	33	941	5,596	3,036	137,678	18,504	25,006	7,810
Delaware, PA	125	8,150	61	373	505	2,754	17,870	137,988	11,758	21,802
Montgomery, PA	27	1,851	53	176	12,727	48,414	25,673	28,144	245,619	59,970
Philadelphia, PA	83	5,386	131	254	702	31,892	10,568	48,151	54,576	429,667

Source: US Census Bureau County-To-County Worker Flow Files
http://www.census.gov/population/www/cen2000/commuting/index.html

Bucks, Chester, Delaware, Montgomery, and Philadelphia Counties in Pennsylvania have the highest numbers of commuters to other counties in the Philadelphia-Camden-Vineland PA-NJ-MD-DE CSA. New Castle County, Delaware, Cecil County, Maryland, and Berks County, Pennsylvania have moderate numbers of commuters into other counties in the CSA. Sussex and Kent Counties in Delaware, which are not in the Philadelphia-Camden-Vineland PA-NJ-MD-DE CSA, have the fewest commuters into the CSA. More about Ocean and Mercer Counties in Appendix A.

Factor 3: Meteorology (weather/transport patterns)

EPA evaluated available meteorological data, consisting of 30-year average summertime wind directions from the National Weather Service, and trajectories on high ozone days to help determine how meteorological conditions, such as weather, transport patterns and stagnation conditions, would affect the fate and transport of precursor emissions contributing to ozone formation.

The highest ozone design values, over 80 ppb, are in Bucks and Philadelphia Counties, in

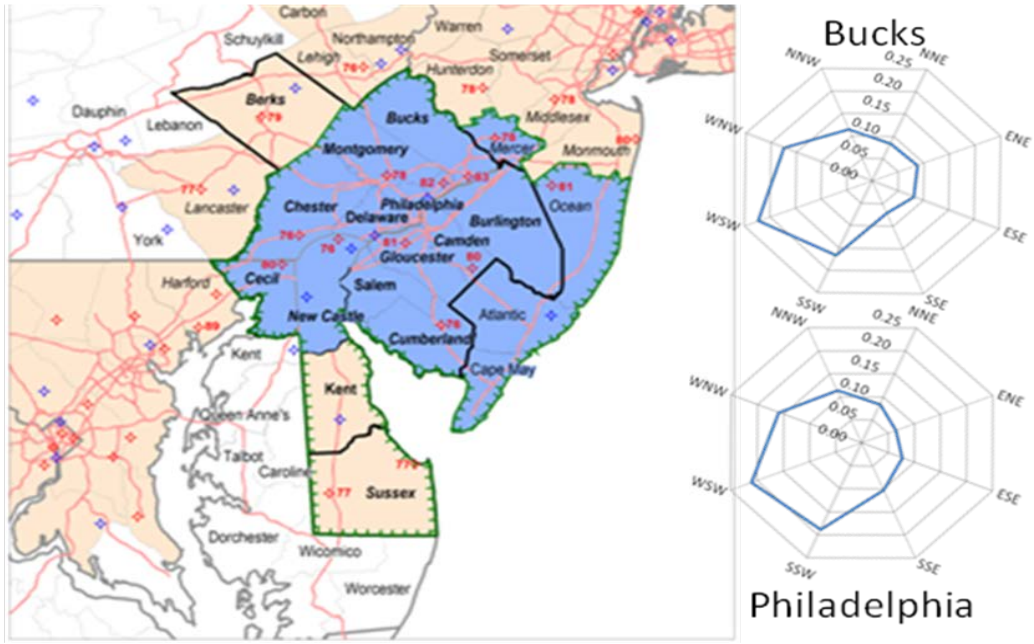
Pennsylvania, and Ocean County in New Jersey. Bucks County had the highest 2010 DV in the Philadelphia area, while Philadelphia County has the highest 2011 DV. Wind rose and trajectory analyses for Bucks and Philadelphia Counties provide data on the influence of weather on the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD nonattainment area in general. An analysis for Ocean County, the third highest site, is in Appendix A, where the wind and trajectories analyses are used to determine if Ocean (and nearby Mercer) Counties are better suited to be in the Philadelphia-Wilmington-Atlantic City area or the New York – Northern New Jersey-Long Island area.

The NWS 30-year average summertime wind directions are shown in Figure 2 for both Bucks and Philadelphia Counties. As can be seen from Figure 2, the winds during the ozone season come predominantly from the southwest. This indicates that emissions from Chester and Delaware Counties in Pennsylvania; New Castle County, Delaware; Cecil County, Maryland; and counties in southwest New Jersey contribute to the downwind violations in Bucks, Philadelphia and Ocean Counties during most of the ozone season. Considering prevailing wind patterns and the location of the highest violating monitors, Berks County, Pennsylvania and Kent and Sussex Counties in Delaware are less likely to contribute to downwind violations during most of the ozone season, and Ocean and Mercer are more likely to be affected by emissions in the core of the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD area than the core of the New York City area.

This is supported by two more detailed analyses for wind flows affecting monitors in Philadelphia and Bucks Counties (below) and Ocean and Mercer Counties (in Appendix A).

Detailed Analysis of Meteorological Transport Conditions for the Philadelphia Nonattainment Area

Figure 1. 30-Year Average Summertime Wind Directions in the Philadelphia Area



To further understand the meteorological transport conditions within the area around the Philadelphia area, we also evaluated 24-hour back trajectories for the 2007-2011 time period, using the National Oceanic and Atmospheric Administration (NOAA) Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) model. The model uses the monitoring location as a starting point, and goes back in time using meteorological data to determine how a parcel of air would have traveled on a given day. EPA evaluated three separate elevations for each exceedance day to better characterize the wind pattern and pollution transport to the monitor. EPA used monitor 42-101-0024 in Bucks County as the starting point for the HYSPLIT back trajectories, as it currently has the highest DV in the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD area. The air quality monitoring data and HYSPLIT results for those exceedance days are available in the docket for this action.

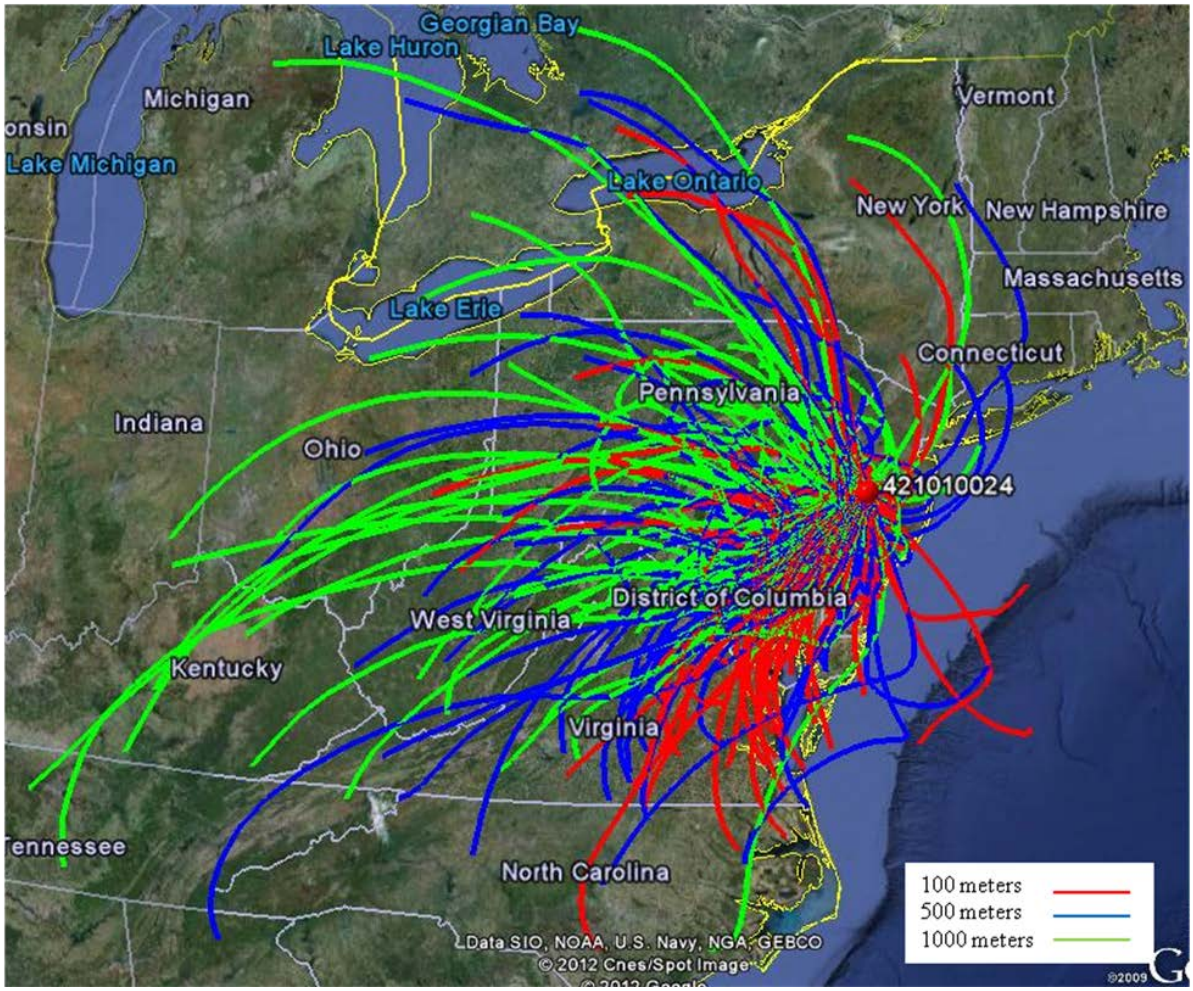
Table 1. 2007 to 2011 Exceedance-Day 8-Hour Ozone Values at Monitor 42-101-0024

Exceedance Day	8-hour average (ppm ozone)		Exceedance Day	8-hour average (ppm ozone)		Exceedance Day	8-hour average (ppm ozone)
5/29/2006	0.077		7/28/2007	0.079		6/26/2010	0.084
5/30/2006	0.086		8/2/2007	0.104		7/5/2010	0.082
6/1/2006	0.084		8/3/2007	0.082		7/6/2010	0.084
6/17/2006	0.082		8/4/2007	0.08		7/7/2010	0.077
6/18/2006	0.096		8/17/2007	0.079		7/16/2010	0.08
6/19/2006	0.077		8/29/2007	0.077		7/19/2010	0.076
6/22/2006	0.081		8/30/2007	0.087		7/23/2010	0.088
7/11/2006	0.078		9/21/2007	0.083		7/28/2010	0.076
7/17/2006	0.085		4/19/2008	0.087		8/10/2010	0.088
7/18/2006	0.087		6/7/2008	0.079		8/19/2010	0.094
7/19/2006	0.077		6/10/2008	0.099		8/20/2010	0.062
7/31/2006	0.079		6/13/2008	0.08		8/29/2010	0.076
8/1/2006	0.08		6/14/2008	0.082		8/30/2010	0.079
8/2/2006	0.077		6/21/2008	0.079		9/1/2010	0.092
8/3/2006	0.077		7/3/2008	0.083		9/22/2010	0.079
8/6/2006	0.077		7/11/2008	0.082		6/1/2011	0.094
5/15/2007	0.076		7/12/2008	0.077		6/7/2011	0.089
5/25/2007	0.084		7/17/2008	0.078		6/8/2011	0.092
5/27/2007	0.087		7/18/2008	0.088		6/9/2011	0.093
5/30/2007	0.076		7/22/2008	0.085		6/10/2011	0.081
5/31/2007	0.095		7/29/2008	0.08		7/6/2011	0.076
6/1/2007	0.079		7/30/2008	0.087		7/7/2011	0.082
6/8/2007	0.097		9/4/2008	0.079		7/10/2011	0.077
6/19/2007	0.087		8/15/2009	0.084		7/18/2011	0.087
6/26/2007	0.095		5/1/2010	0.078		7/21/2011	0.085
7/9/2007	0.106		6/2/2010	0.08		7/22/2011	0.086

Exceedance Day	8-hour average (ppm ozone)		Exceedance Day	8-hour average (ppm ozone)		Exceedance Day	8-hour average (ppm ozone)
7/14/2007	0.076		6/4/2010	0.079		7/29/2011	0.079
7/15/2007	0.076		6/19/2010	0.078			
7/17/2007	0.081		6/22/2010	0.082			

Figure 2 overlays HYSPLIT 24-hour back trajectories for all the 2007-2011 ozone exceedances at monitor 42-101-0024 on a Google Earth map of the northeastern United States. It gives an overview of long-range transport to the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD area. As seen in Figure 2, the 24-hour back trajectories indicate regional transport from many directions and over several states.

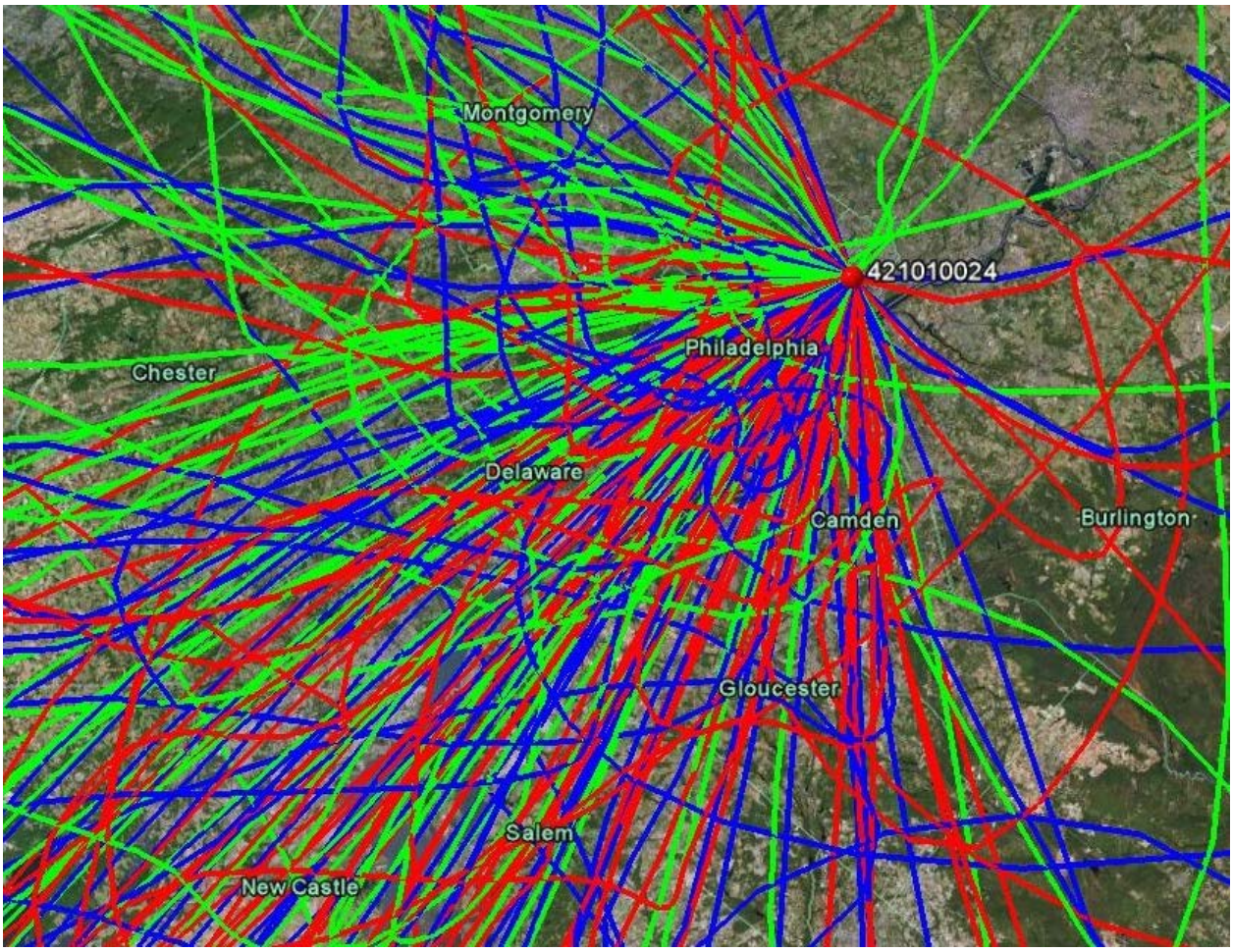
Figure 2. NOAA HYSPLIT 24-Hour Back Trajectories for 2007-2011 Exceedances Days - Overview



In Figure 3, below, these EPA has zoomed in on these same 24-hour HYSPLIT back trajectories, showing more of the nearby transport on high ozone days. This zoomed in perspective shows

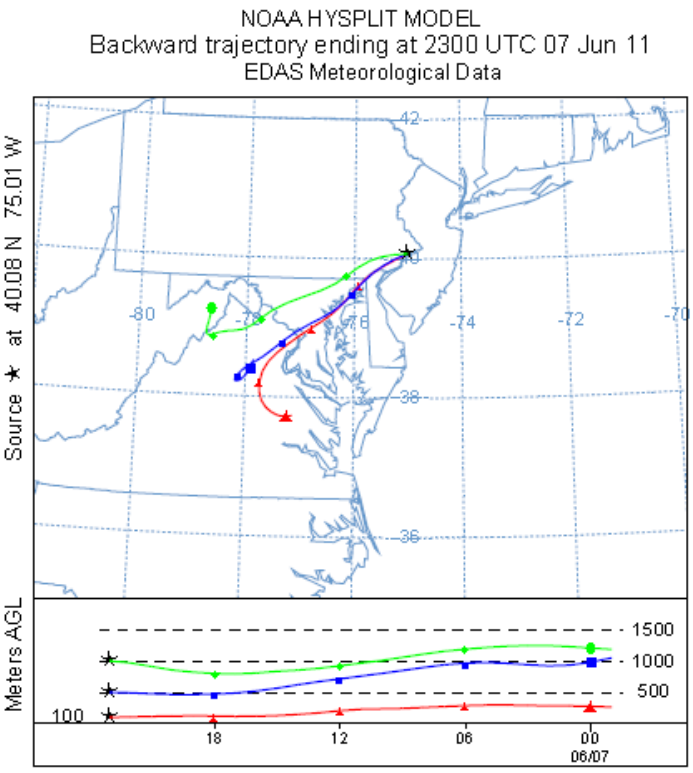
that on exceedance days, winds are predominantly from the south and southwest. This correlates reasonably well with the NWS 30-year average wind directly given above, which gave prevailing winds as from the west-southwest and south-southwest. Figure 3 also shows a large percent of exceedance days with winds coming from the northwest, and several exceedance days with winds coming from the east.

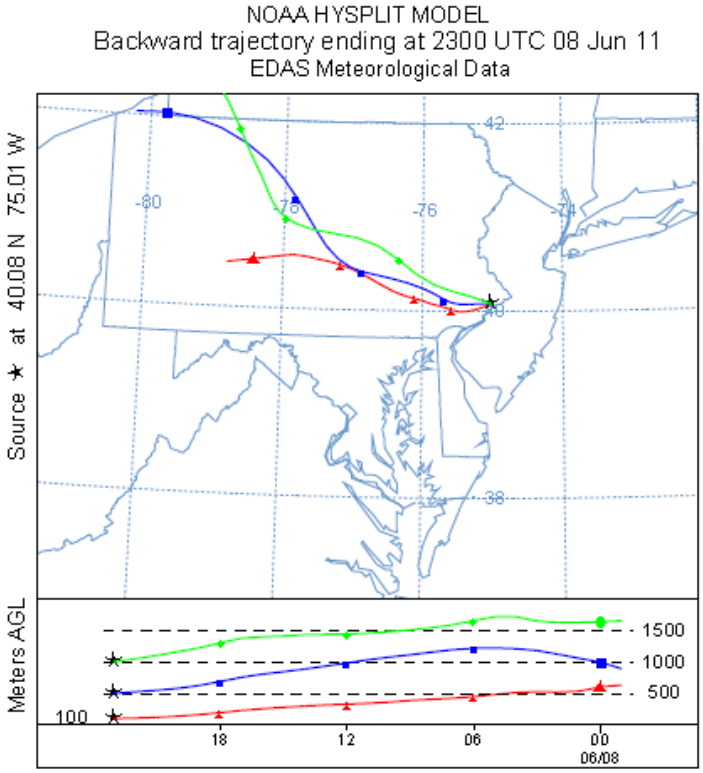
Figure 3. NOAA HYSPLIT 24-Hour Back Trajectories for 2006-2010 Exceedances Days - Zoom View

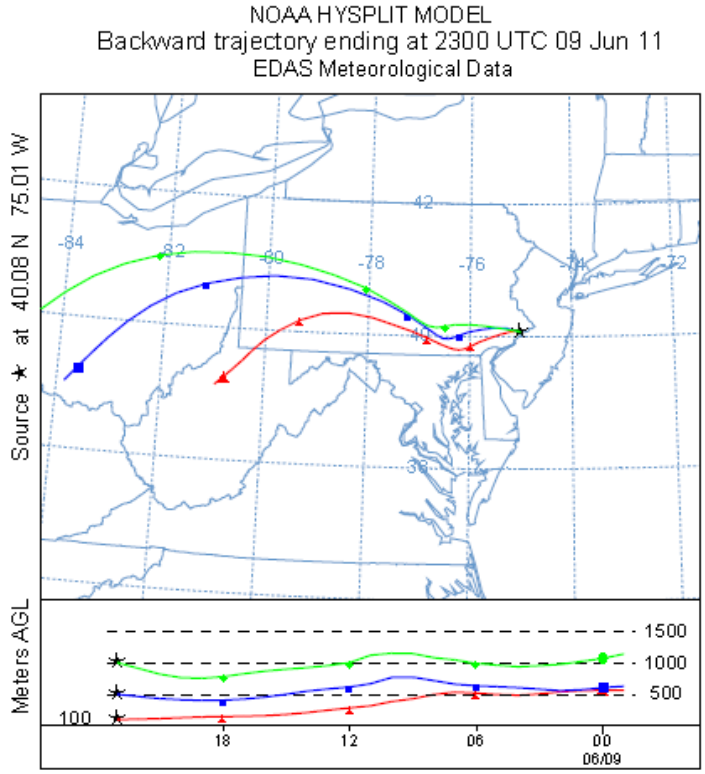


To further illustrate the local transport situation in the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD area, EPA has selected specific trajectories for two "ozone episodes," periods when the ozone levels are high for several consecutive days. As shown in Table 1, the 8-hour average ozone value at monitor 42-101-0024 was above the standard for three days in a row in 2011 (June 7-9) and 2007 (May 30-June 1). Figure 4 shows that at the start of the 2011 episode, winds came from the predominant southwesterly direction. Figures 5 and 6 show that during the second and third days of the 2011 episode, wins were mainly from the west. Figures 7 through 9 depict the HYSPLIT back trajectories for the 2007 episode. These figures show that the while winds can start out northwest of at monitor 42-101-0024, throughout most of the 2007 episode winds were from the southwest.

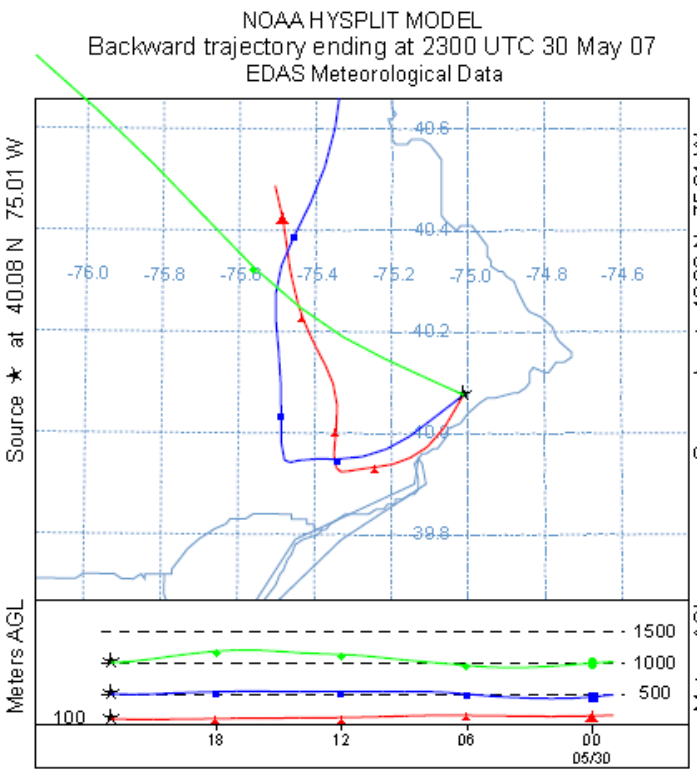
Figures 4, 5 & 6, NOAA HYSPLIT 24-Hour Back Trajectories June 7-9, 2011

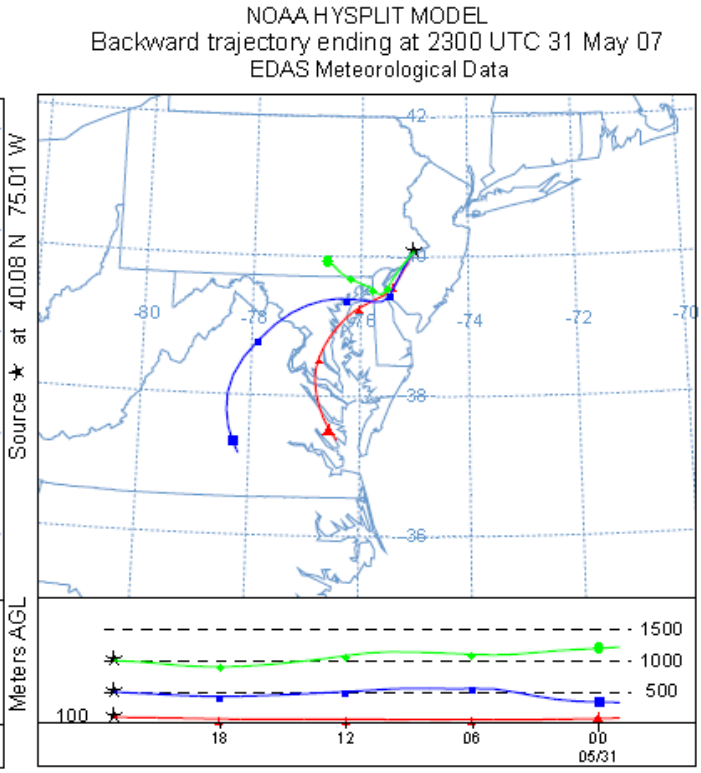


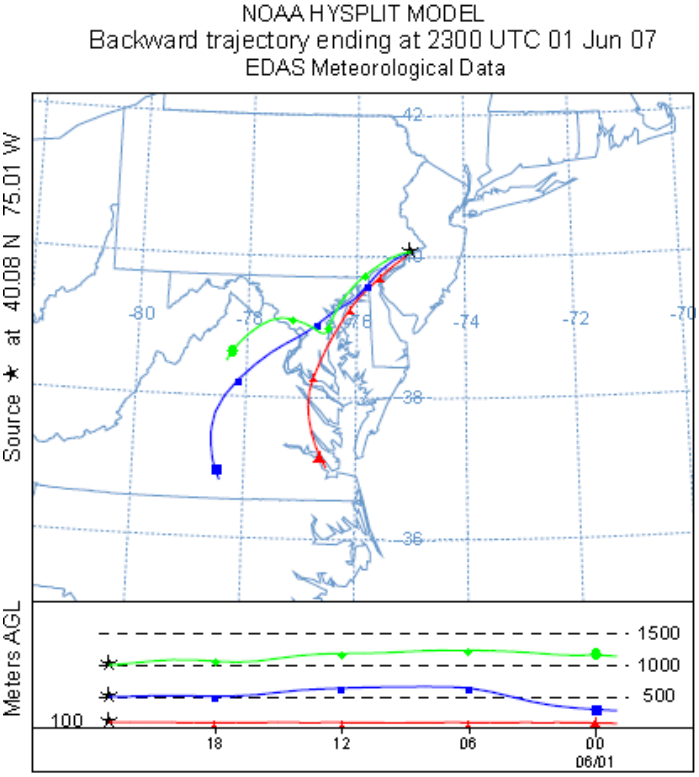




Figures 7, 8, & 9 NOAA HYSPLIT 24-Hour Back Trajectories May 30-June 1, 2007







Factor 4: Geography/topography (mountain ranges or other air basin boundaries)

The geography/topography analysis evaluates the physical features of the land that might affect the airshed and, therefore, the distribution of ozone over the area.

The Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD area does not have any geographical or topographical barriers significantly limiting air pollution transport within its air shed. Therefore, there are no barriers to contribution from upwind areas.

Factor 5: Jurisdictional boundaries

EPA considers existing jurisdictional boundaries for the purposes of providing a clearly defined legal boundary and so that areas designated nonattainment have the legal authority and cooperative planning necessary to carrying out the air quality planning and enforcement functions for nonattainment areas. Examples of jurisdictional boundaries include existing/prior nonattainment areas for ozone or other urban-scale pollutants, counties, air districts, townships, metropolitan planning organizations, state lines, urban growth boundary, etc. Where existing jurisdictional boundaries are not adequate to describe the nonattainment area, other clearly defined and permanent landmarks or geographic coordinates are used.

The major jurisdictional boundaries in the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD area are the state lines between Pennsylvania, Delaware, and New Jersey. Air-quality monitors that violate the 2008 8-hour ozone NAAQS in the Philadelphia Area are located in Delaware, Maryland, New Jersey, and Pennsylvania.

The Philadelphia-Camden-Vineland CSA consists of New Castle County, Delaware; Cecil County, Maryland; Burlington, Camden, Cumberland, Gloucester, and Salem Counties in New Jersey, and Berks, Bucks, Chester, Delaware, Montgomery, and Philadelphia Counties in Pennsylvania. All those counties, except for Berks County, Pennsylvania are included in the Philadelphia-Wilmington-Atlantic City nonattainment area for the 1997 8-hour ozone NAAQS. The nonattainment area also includes Kent and Sussex Counties, Delaware and Atlantic, Cape May, Mercer, and Ocean Counties, New Jersey.

Mercer and Ocean Counties, New Jersey are part of the New York-Newark-Bridgeport, NY-NJ-CT-PA CSA. Atlantic County makes up the Atlantic City-Hammonton, NJ MSA. Cape May County makes up the Ocean City, NJ MSA. In Delaware, Kent County, Delaware makes up the Dover MSA and Sussex County makes up the Seaford Micropolitan Statistical Area.

The Delaware Valley Regional Planning Commission (DVRPC), the metropolitan planning organization (MPO) in the Philadelphia Area, serves Bucks, Chester, Delaware, Montgomery, and Philadelphia Counties in Pennsylvania, and Burlington, Camden, Gloucester, and Mercer Counties in New Jersey. New Castle County, DE and Cecil County, Maryland are in a separate MPO, the Wilmington Area Planning Council (WILMAPCO).

Delaware

New Castle County has historically been part of the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD nonattainment area for ozone (1-hour and 8-hour) and fine particulate matter ($PM_{2.5}$). New Castle County is part of the Wilmington, DE-MD-NJ Metropolitan Division of the Philadelphia-Camden-Wilmington Metropolitan Statistical Area (MSA) in the Philadelphia-Camden-Vineland CSA. Being part of a statistical area indicates that counties are linked through employment and commuting. According to the Office of Management and Budget's "Standards for Defining Metropolitan and Micropolitan Statistical Areas," published in the Federal Register on December 27, 2000 (65 FR 82228), the "general concept of a Metropolitan Statistical Area or a Micropolitan Statistical Area is that of an area containing a recognized population nucleus and adjacent communities that have a high degree of integration with that nucleus." Delaware, Pennsylvania, Maryland and New Jersey have a long history of working cooperatively through the Ozone Transport Commission (OTC) and the Mid-Atlantic Northeast Visibility Union (MANE-VU) with ozone attainment planning. Furthermore, the two local MPOs, DVRPC and WILMAPCO, have worked together for decades.

Kent and Sussex Counties are less connected to the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD area. They are not part of the Philadelphia-Camden-Vineland CSA. Kent County makes up the Dover MSA, and Sussex County makes up the Seaford Micropolitan Statistical Area. The Dover/Kent County MPO is the planning organization for Kent County, Delaware. This MPO covers 20 municipalities including all of Smyrna, which is also in New Castle County and all of Milford, which is also in Sussex County. Planning for Sussex County is done by the Sussex County Planning and Zoning Commission While Kent County was part of the Philadelphia-Wilmington-Trenton nonattainment area for the 1-hour ozone NAAQS, Sussex County was a separate nonattainment area.

Maryland

Cecil County has historically been part of the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD nonattainment area for ozone (1-hour and 8-hour) and $PM_{2.5}$. Cecil County is part of the Wilmington, DE-MD-NJ Metropolitan Division of the Philadelphia-Camden-Wilmington MSA in the Philadelphia-Camden-Vineland CSA. Maryland, Delaware, Pennsylvania, and New Jersey have a long history of working cooperatively through the OTC and MANE-VU and with ozone attainment planning. Furthermore, the two local MPOs, DVRPC and WILMAPCO, have worked together for decades.

Pennsylvania

Bucks, Chester, Delaware, Montgomery, and Philadelphia Counties have historically been part of the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD nonattainment area for ozone (1-hour and 8-hour) and $PM_{2.5}$. These five counties are part of the Philadelphia, PA Metropolitan Division of the Philadelphia-Camden-Wilmington MSA in the Philadelphia-Camden-Vineland CSA. These counties are part of DVRPC, the main MPO for the Philadelphia Area.

Berks County is less connected to the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD nonattainment area. While it was added to the Philadelphia-Camden-Vineland CSA in December 2005, it's in a separate MSA, the Reading, PA MSA. Berks County has historically not been part of the Philadelphia nonattainment area for 8-hour ozone and $PM_{2.5}$, but has been designated separately as the Reading area. Berks County was designated

attainment/unclassifiable for 1-hour ozone. In addition, Berks County is covered by a separate MPO, the **Berks County Planning Commission.**

See Appendix B for EPA's response to comments on the boundaries of the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD area in Pennsylvania.

New Jersey

Southern New Jersey, from Mercer and Ocean Counties southward, are part of the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD ozone nonattainment area since EPA's previous eight-hour ozone standard designations in 2004, which were upheld by the US Court. Ocean County is part of the NYC transportation planning area and Mercer County is part of the Philadelphia planning area. We note that New Jersey's desire to continue to include Ocean and Mercer Counties in the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD area is important to this factor, since New Jersey has to balance inconveniences due to transportation planning areas that are different from the nonattainment areas with benefits of including Ocean and Mercer Counties in the Philadelphia nonattainment area.

New Jersey also requested that EPA designate all of the counties from New Jersey that were designated as nonattainment for Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD area for the 2008 ozone standard be designated as nonattainment for the 2011 ozone standard, even those counties that are not in the Philadelphia-Canden-Vineland CSA.

Conclusion

Based on the assessment of factors described above, and with additional details in the enclosed Appendices, EPA concluded that the following counties meet the CAA criteria for inclusion in the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD nonattainment area for the 2008 eight-hour ozone standard: New Castle County, Delaware; Cecil County, Maryland; Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Mercer, Ocean, and Salem Counties in New Jersey; and Bucks, Chester, Delaware, Montgomery, and Philadelphia Counties in Pennsylvania. The Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD nonattainment area for the 1997 8-hour ozone NAAQS included these same counties, plus Kent and Sussex Counties in Delaware.

New Castle County in Delaware; Cecil County in Maryland; Berks, Bucks, Montgomery and Philadelphia Counties in Pennsylvania and Camden, Cumberland, Gloucester, Mercer and Ocean Counties in New Jersey show violations of the 2008 ozone NAAQS based on 2010 design values. Maryland and Pennsylvania have requested that these violating counties in their respective States be included as part of the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD nonattainment area, which is consistent with their inclusion of that area for the 1-hour and 1997 8-hour NAAQS and the PM2.5 NAAQS. New Jersey requested that its violating counties listed above be included in the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD area, as

they were for the 1997 8-hour NAAQS. The factors above support inclusion of these counties and neighboring counties recommended by the states in that nonattainment area. Therefore, we will include them as part of the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD nonattainment area for the 2008 ozone NAAQS.

We have made a further analysis of the other counties in the area that Delaware and Pennsylvania did not include in their request for the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD nonattainment area, as well as further analysis of New Jersey's request for Ocean and Mercer Counties to be included in the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD area, summarized as follows.

New Castle County, Delaware has relatively high emissions, high population, and high VMT. Considering prevailing winds from the southwest, this county likely contributes to downwind violations of the ozone NAAQS in the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD Area. Furthermore, New Castle County is part of the Philadelphia-Wilmington-Atlantic City 8-hour ozone nonattainment area for the 1997 ozone standard and the Philadelphia-Camden-Vineland CSA. New Castle County has a moderate degree of commuting into the other counties in the CSA, including over 24,000 commuters into Cecil, Chester, Delaware, Montgomery, and Philadelphia Counties. Therefore, EPA will designate New Castle County as nonattainment as part of the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD Area.

Chester and Delaware Counties in Pennsylvania are part of the Philadelphia, PA Metropolitan Division of the Philadelphia-Camden-Wilmington MSA in the Philadelphia-Camden-Vineland CSA. These counties have been historically part of the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD nonattainment areas for ozone (8-hour and 1-hour) and $PM_{2.5}$ and are linked together with significant commuting throughout the 5 counties. These counties have relatively high populations and population densities. Delaware County has the second highest NOx emissions in the areas of analysis and among the highest VOC emissions. Taking into account the prevailing winds during the ozone season are predominantly from the southwest, emissions from Chester and Delaware Counties likely contribute to downwind violations in Bucks and Philadelphia Counties during most of the ozone season. Considering all these factors, EPA has concluded that Chester and Delaware Counties are included in the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD area.

In addition, monitors in **Sussex County, Delaware and Berks County, Pennsylvania** show violations of the 2008 ozone NAAQS and must be designated nonattainment. We believe that Sussex County, Delaware and Berks County, Pennsylvania should be designated as in separate nonattainment areas, and explained below.

Berks County, Pennsylvania has a violating monitor, but relatively moderate emissions, population, and VMT. There is some commuting from Berks County to the other counties in the Philadelphia Area, and Berks County is part of the Philadelphia-Camden-Vineland CSA. However, Berks County has historically been a separate ozone and PM2.5 nonattainment area. The County's MPO, the **Berks County Planning Commission,** is separate from the Philadelphia Area's MPO, DVRPC. Furthermore, meteorology indicates that on typical summer days when the violating monitors are experiencing exceedances of the ozone NAAQS, emissions from

Berks County are not upwind of those monitors in the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD Area and thus we believe emissions from Berks County do not significantly contribute to nonattainment at those monitors. Therefore, EPA has concluded that Berks County should not be included in the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD Area, and should be designated as nonattainment in a separate area[4].

Sussex County, Delaware has a monitor that is violating the 2008 ozone NAAQS. It has moderate emissions and population in the area as compared with the other counties in the area of analysis. It is not part of the Philadelphia-Camden-Vineland CSA. Furthermore, considering prevailing winds from the southwest and the location of the highest violating monitors in the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD Area, it is not likely that Sussex County is contributing significantly to the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD area. Therefore, EPA has concluded that Sussex County should not be included in the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD area, and should be designated as nonattainment in a separate area[5].

Kent County, Delaware has a monitor that meets the 2008 8-hour ozone NAAQS. This county has comparatively low emissions, population and VMT, and is not part of the Philadelphia-Camden-Vineland CSA. Therefore, EPA has concluded that Kent County should not be included in the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD area, and should be designated as unclassifiable/attainment.

Ocean and Mercer Counties are more affected by emissions from counties in the Philadelphia metropolitan area than emissions from counties in the New York City metropolitan area and EPA concludes that Ocean and Mercer Counties should be included in the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD area, as they were for the 1997 8-hour ozone NAAQS.

New Jersey requested all of the counties in the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD nonattainment area for the 1997 ozone NAAQS designations should be included in the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD nonattainment area for the 2008 ozone NAAQS designations. As noted in the beginning of this TSD, the issue placing Ocean and Mercer Counties in the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD area when they are in the New York CSA is decided on the basis of the factor analysis. However, the other counties recommended by New Jersey for inclusion in the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD area that were in the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD area for the 1997 ozone NAAQS designations are approved by EPA, since New Jersey's counties that are outside the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD CSA are not in a metropolitan area shared by another state. Thus, EPA concurs with New Jersey's recommendation for **Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, and Salem Counties** to be included in the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD nonattainment area for the 2008 ozone NAAQS.

[4] See EPA's Technical Analysis for the Reading Area, sent to the Commonwealth of Pennsylvania by EPA Region III.
[5] See EPA's Technical Analysis for the Seaford Area, sent to the State of Delaware by EPA Region III.

Appendix A.

Factor Analysis for New Jersey's Request to Include Ocean and Mercer Counties in the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD Nonattainment Area

New Jersey proposes that the entire state be designated as nonattainment for the 2008 ozone NAAQS[6], but requested that the boundary between the New York City nonattainment area and Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD (Philadelphia nonattainment area) be different from the CSA boundaries.

EPA has determined that several factors are relevant to determining if the boundaries of the New York City and Philadelphia areas proposed by the State of New Jersey are approvable. The following sections provide additional information, as available and relevant.

Factor 1: Air Quality Data

Air quality data is based on the 8-hour ozone design values (in ppb) for air quality monitors in New Jersey, based on data for the 2008-2010 period (i.e., the 2010 design value, or DV). These are the most recent years with fully-certified air quality data. A monitor's DV is the metric or statistic that indicates whether that monitor attains a specified air quality standard. The 2008 ozone NAAQS are met when the annual fourth-highest daily maximum 8-hour average concentration, averaged over 3 years is 0.075 ppm (75ppb) or less. A DV is only valid if minimum data completeness criteria are met. See 40 CFR part 50 Appendix P. Where several monitors are located in a county (or a designated nonattainment area or maintenance area), the DV for the county or area is determined by the monitor with the highest level.

The 2010 DVs for the ozone NAAQS for counties New Jersey are in Table 2.

Table 2. Air Quality Data.

County	State Recommended Nonattainment?	2010 8-hour Ozone DV (ppb)
Atlantic, NJ	Yes	74
Berks, PA	Yes, other area	79
Bucks, PA	Yes	83
Burlington, NJ	Yes	--
Camden, NJ	Yes	80
Cape May, NJ	Yes	--
Cecil, MD	Yes	80
Chester, PA	No	76
Cumberland, NJ	Yes	76

[6] New Jersey (as well as Maryland, Delaware and Connecticut) requested a large, regional nonattainment area, with local designations if EPA did not approve the larger area designation. See EPA's separate response to the states, elsewhere in these Technical Support Documents.

Delaware, PA	No	74
Gloucester, NJ	Yes	81
Kent, DE	No	74
Mercer, NJ	Yes	78
Montgomery, PA	Yes	78
New Castle, DE	Yes, other area	76
Ocean, NJ	Yes	81
Philadelphia, PA	Yes	82
Salem, NJ	Yes	--
Sussex, DE	Yes, other area	77

Note: Counties with no ozone monitor are identified with "--" in the 2010 8-hour Ozone DV column

The highest design value in NJ is 81ppb in Ocean and Gloucester Counties. The highest design value in the Philadelphia nonattainment area is 83ppb in Bucks Co., PA. The highest design value in the New York City nonattainment area is 84 ppb in Suffolk County, Long Island, NY. The elevated design values in Ocean County is a reason for including Ocean in the Philadelphia-Wilmington-Atlantic City nonattainment area, as other factors show its ozone is mostly from Philadelphia, not New York.

The air quality monitoring data are included in the docket for this action.

As shown in Figures 1 and 2, design values decrease further north and east from Ocean County, until the next set of peak design values occur downwind of New York City on Long Island and in Connecticut. This is an indication that Ocean County is affected strongly and mostly by sources to the south and west, which includes the Philadelphia area. This is typical of the northeastern United States, since most of peak ozone design values are found north and east of the centers of major urban areas.

Factor 2: Emissions and Emissions-Related Data

This factor does not provide much information related to New Jersey's request for Ocean and Mercer Counties to be included in the prospective Philadelphia nonattainment area.

Emissions Data

Not evaluated because New Jersey has proposed that every county in New Jersey is proposed to be nonattainment. There are no counties proposed to be attainment in New Jersey.

The only issue, whether Mercer and Ocean Counties should continue to be included with the Philadelphia area as opposed to the New York area, does not use this factor as a deciding factor. The question that needs a multi-factor analysis is about whose emissions affect Ocean and Mercer Counties the most, which is best determined by analysis of transport of ozone and ozone-forming emissions.

Population density and degree of urbanization

Not evaluated since the question is the impact of urban ozone on Ocean and Mercer County and less so about whether Ocean and Mercer Counties affect other areas.

Traffic and commuting patterns

EPA evaluated the commuting patterns of residents in the area. A neighboring county with high VMT and/or a high number of commuters coming into the county with a violating monitor is generally an integral part of an urban area and indicates the presence of motor vehicle emissions that may contribute to ozone formation. Rapid population or VMT growth in a county on the urban perimeter signifies increasing integration with the core urban area, and indicates that the associated area source and mobile source emissions may be appropriate to include in the nonattainment area. The attached spreadsheet shows traffic and commuting pattern data, including total 2008 VMT* and 10-year VMT growth, number of commuters in each county who drive to another county within the area, the percent of total commuters in each county who commute to other counties within the area**, and the total vehicle miles traveled (VMT) for each county.

* MOBILE model VMTs are those inputs into the NEI version 1.5.
** U.S. Census Bureau estimates for 2000 County-to-County Worker Flow http://www.census.gov/hhes/commuting/data/commuting.html.

The County-to-County Worker Flow data from 2000 was used in the previous 2004 analysis for the 1997 ozone standard.

Based on 2000 data, the 2004 analysis noted that more commuters either stay in Ocean County or Mercer Counties or go to the Philadelphia area than go to the New York City area.

The data are included in the docket for this action.

Commuting from Ocean and Mercer Counties into central Philadelphia is much lower than the counties with the highest numbers of commuters heading into Philadelphia. For Ocean County, most of the top-ranked counties for its commuters are in the New York-Newark-Bridgeport, NY-NJ-CT-PA CSA. Mercer County's second-ranked destination is New York County (Manhattan). However, the reason for including Ocean and Mercer Counties in the Philadelphia-Wilimington-Atlantic City nonattanment area is due to the impact that the Philadelphia area has on Ocean and Mercer Counties, not their impact on Philadelphia.

Factor 3: Meteorology (weather/transport patterns)

EPA evaluated available meteorological data to help determine how meteorological conditions, such as weather, transport patterns and stagnation conditions, would affect the fate and transport of precursor emissions contributing to ozone formation.

Wind rose for 1988-1992

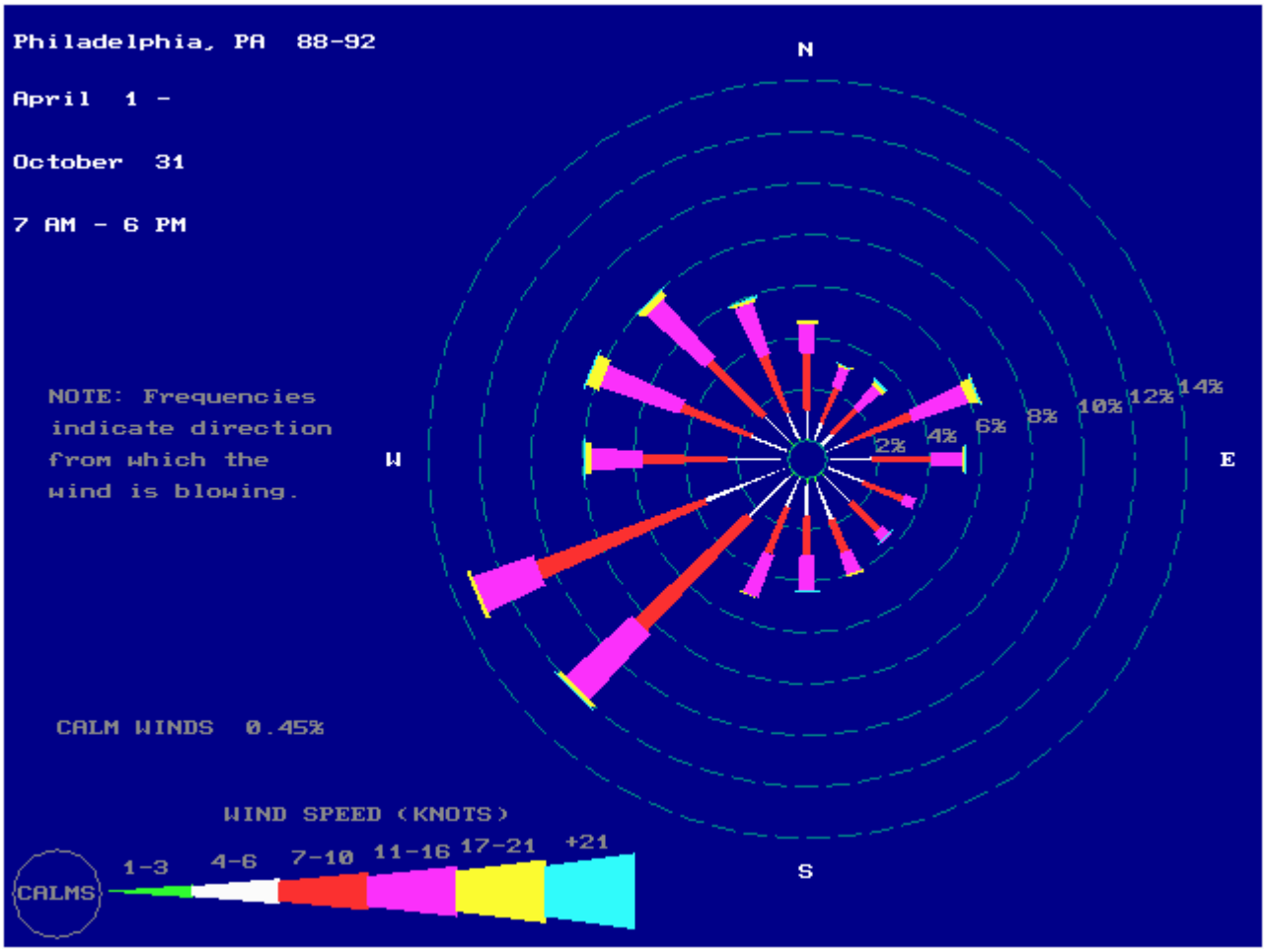


Figure 3-1. Daytime wind rose during ozone season, Philadelphia, PA.

The 1997 designation assessment showed, via wind roses (see above), trajectory analysis and contribution assessments, that Ocean County (and by extension, Mercer County) are downwind of the Philadelphia metropolitan area and are not as strongly affected by emissions from the New York City metropolitan area. More recent trajectory analyses continue to support New Jersey's request.

EPA produced trajectories from NOAA's HYSPLIT program for days when monitoring sites in Mercer and Ocean Counties had the highest ozone concentrations from 2008 through 2011. Trajectories were run backwards from the monitoring site with the arrival time at the monitoring site at 1400 local standard time. Three trajectories were run for each day – starting at different altitudes that are climatologically within the mixed layer during the afternoon, when peak ozone typically occurs and thermal mixing from sunshine is at a maximum. These trajectories predominantly come through eastern Pennsylvania and less frequently from southeastern New York. Thus, emissions from the Philadelphia metropolitan area are more likely to affect Ocean and Mercer Counties than the New York City metropolitan area.

In summary, these trajectories show when the air comes from on high ozone days at these monitoring sites in recent years.

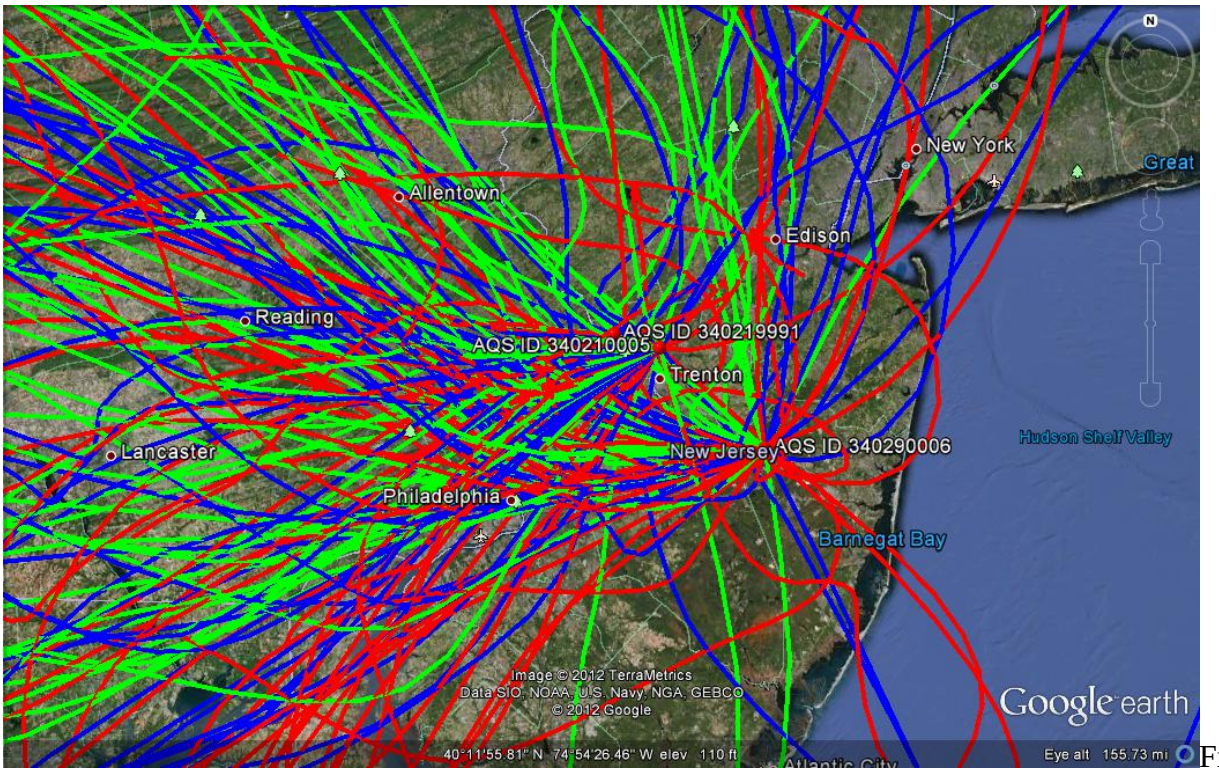


Figure 3-2. Trajectories for high ozone days at monitors in Ocean and Mercer Counties.

Figure 3-2, with all of the trajectories for the three monitoring sites in Ocean and Mercer Counties, is too busy to examine closely. However, it shows that the thicket of trajectories is thickest over eastern Pennsylvania, and markedly less so over New York. This is not surprising, since the basic conceptual model for ozone formation in the metropolises of the northeastern corridor of the United States is for ozone to form on sunny days with surface winds from the southwest and winds aloft from the west.

Here's the classic example of the conceptual model from the University of Maryland:

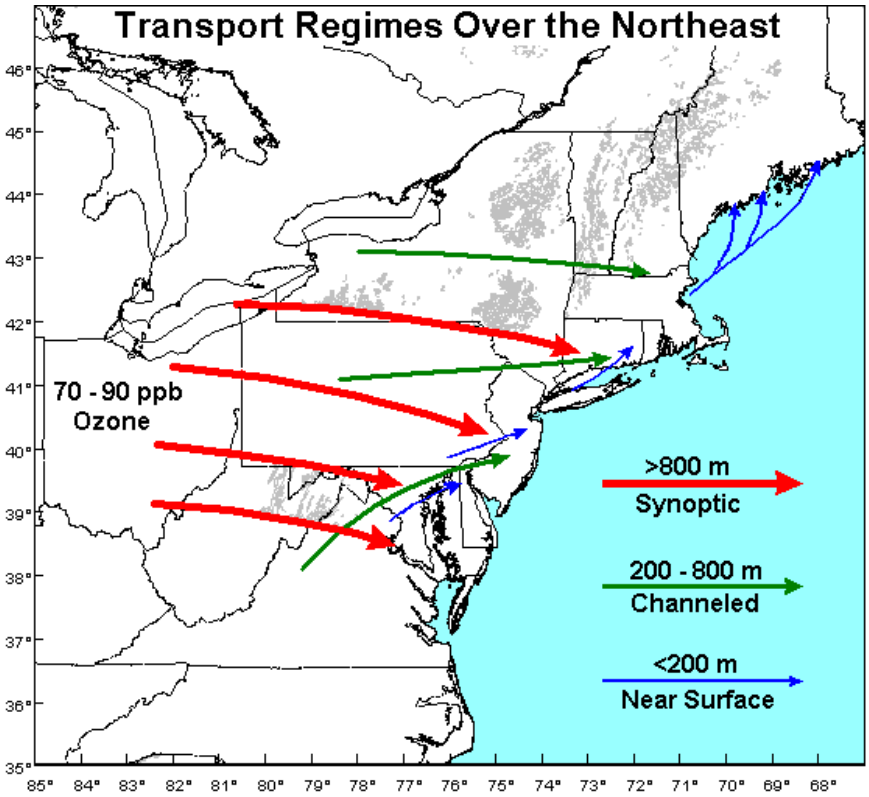


Figure 3-3. Conceptual model of ozone transport

Here are composite graphics of the trajectories for each site in Ocean and Mercer Counties, as well as for each of the three altitudes:

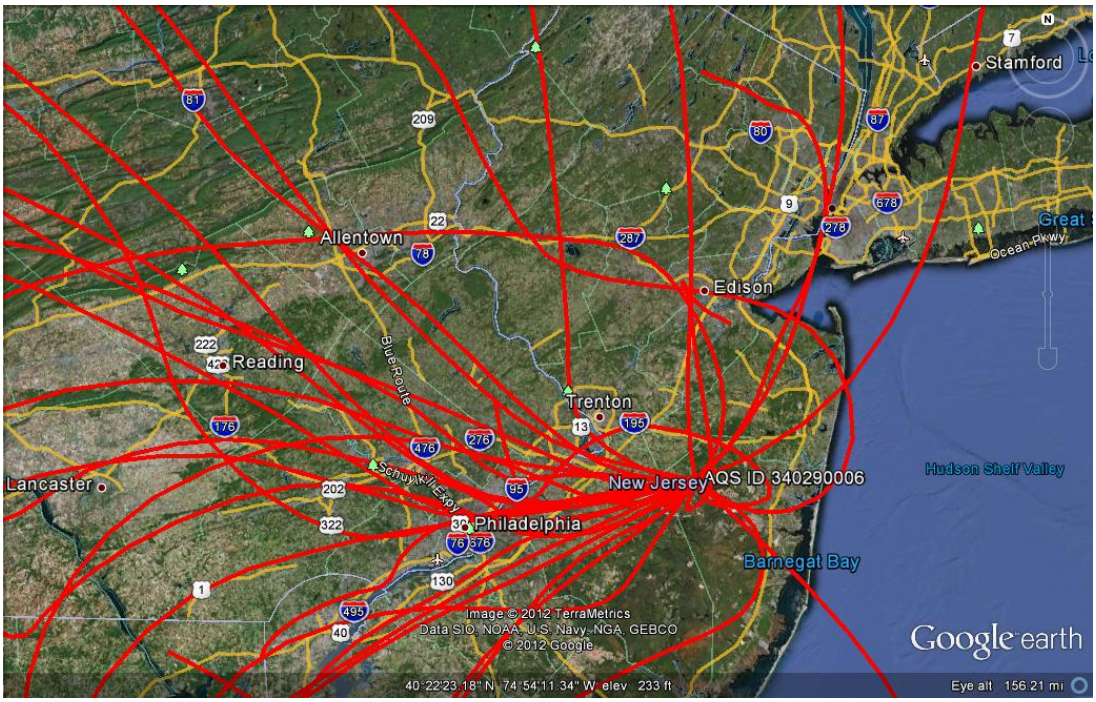


Figure 3-4. Trajectories to the ozone monitor in Ocean County, ending at 100 meters above ground level in mid-afternoon on high ozone days.

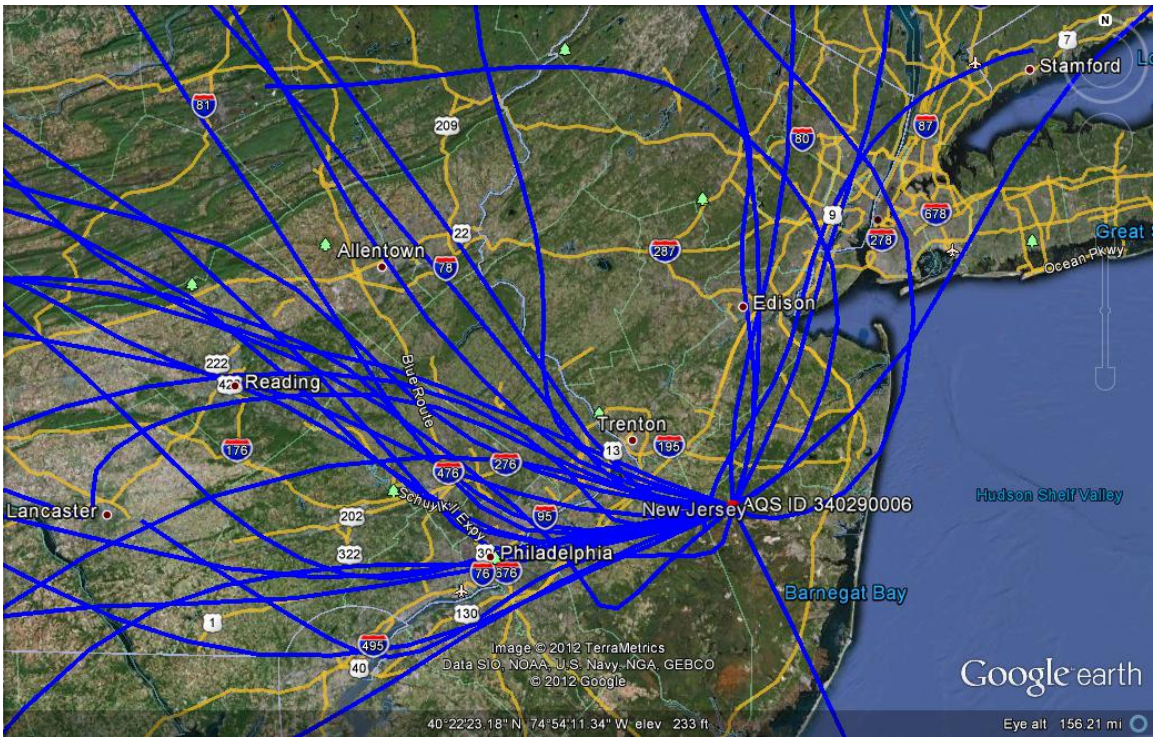


Figure 3-5. Trajectories to the ozone monitor in Ocean County, ending at 500 meters above ground level in mid-afternoon on high ozone days.

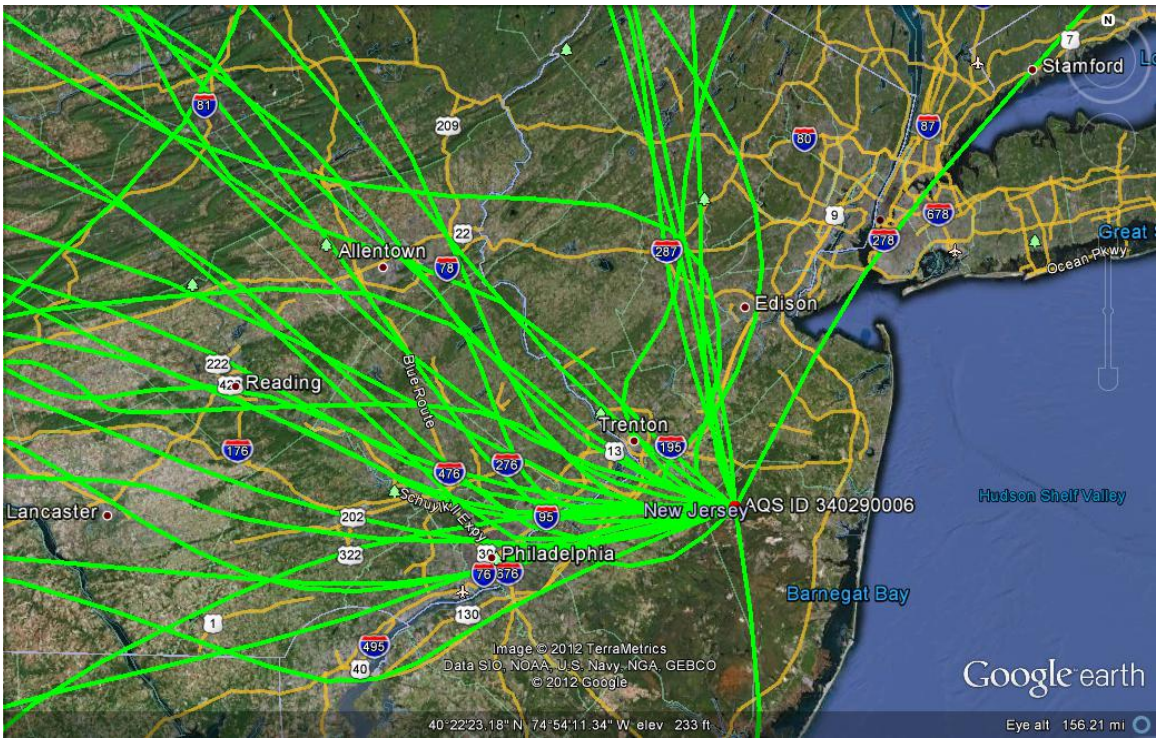


Figure 3-6. Trajectories to the ozone monitor in Ocean County, ending at 1000 meters above ground level in mid-afternoon on high ozone days.

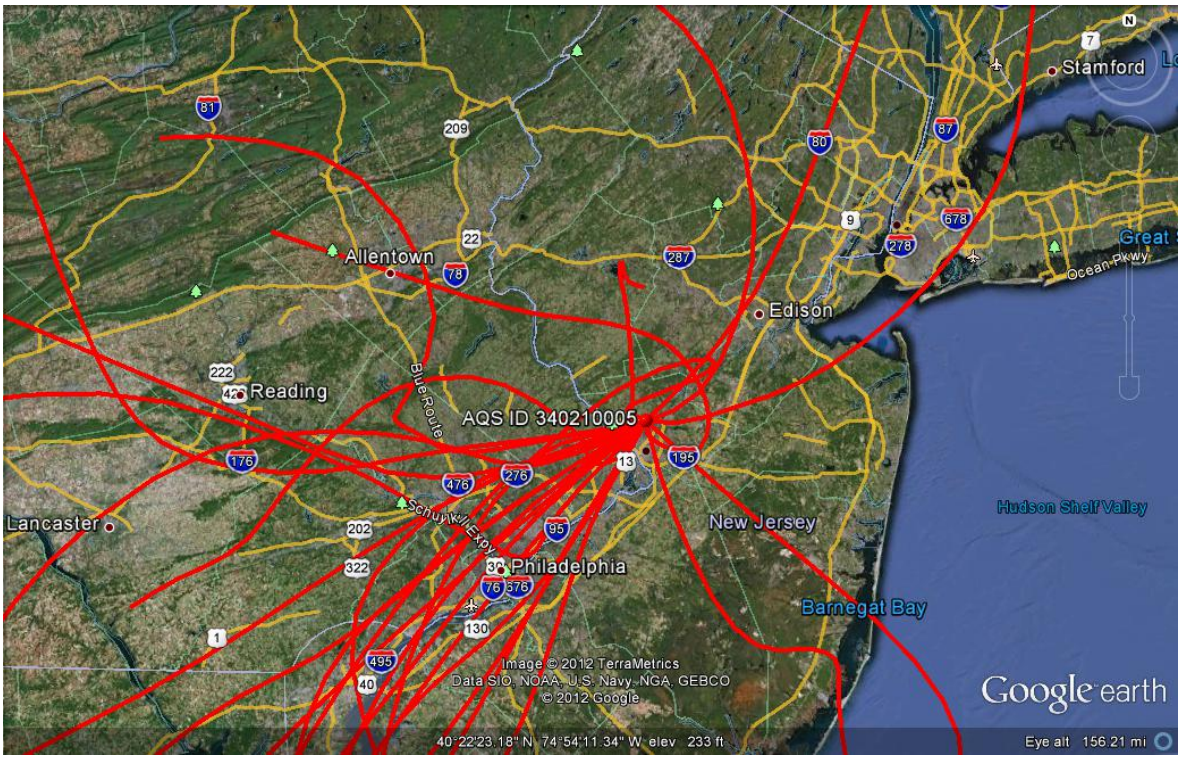


Figure 3-7. Trajectories to the Rider University ozone monitor in Mercer County, ending at 100 meters above ground level in mid-afternoon on high ozone days.

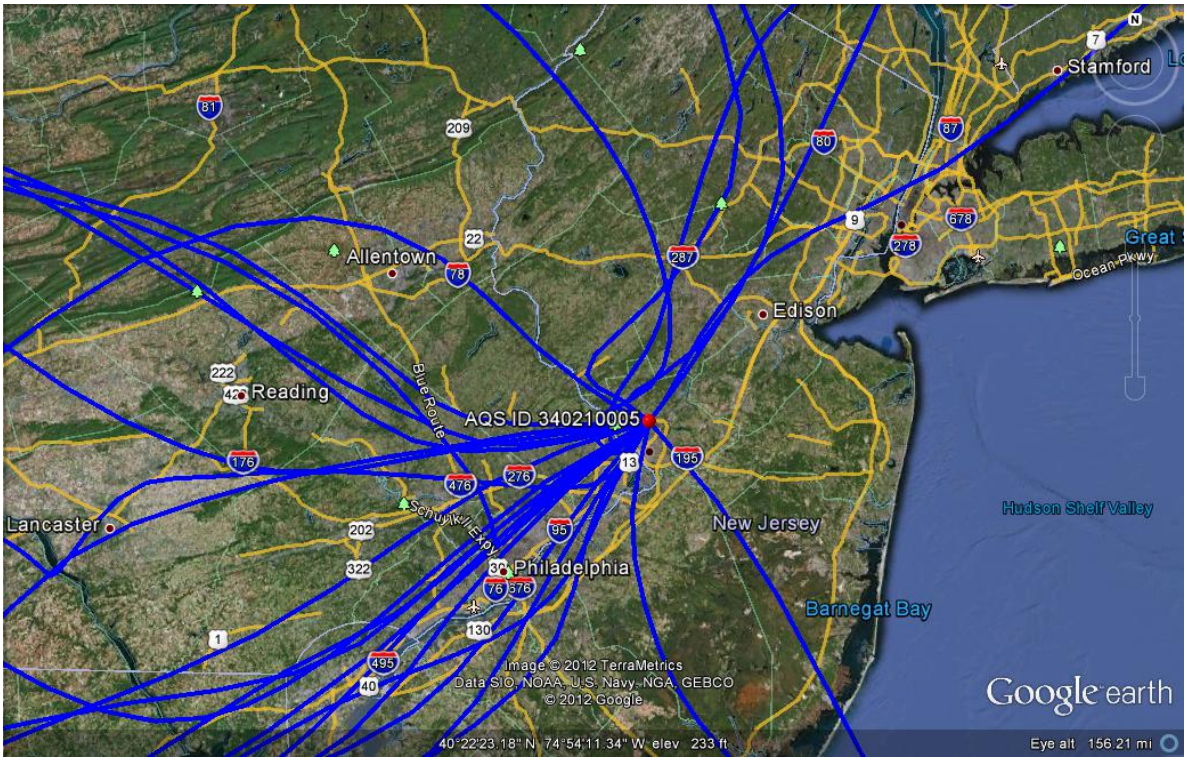


Figure 3-8. Trajectories to the Rider University ozone monitor in Mercer County, ending at 500 meters above ground level in mid-afternoon on high ozone days.

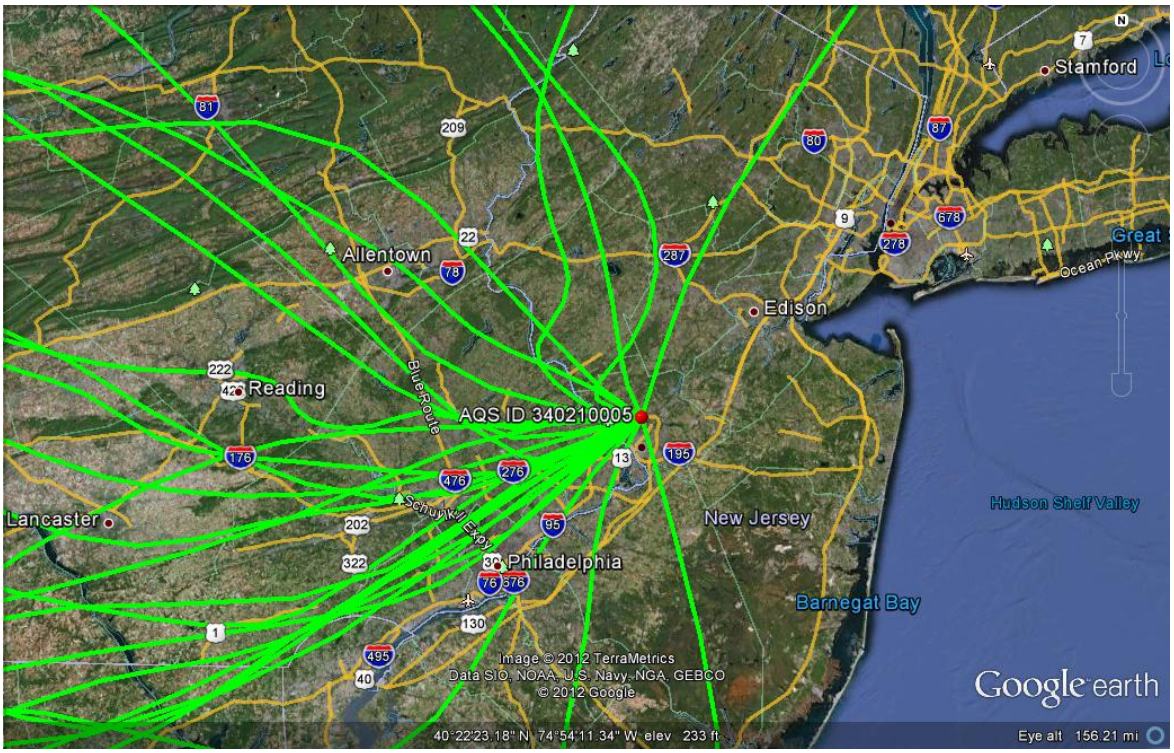


Figure 3-9. Trajectories to the Rider University ozone monitor in Mercer County, ending at 1000 meters above ground level in mid-afternoon on high ozone days.

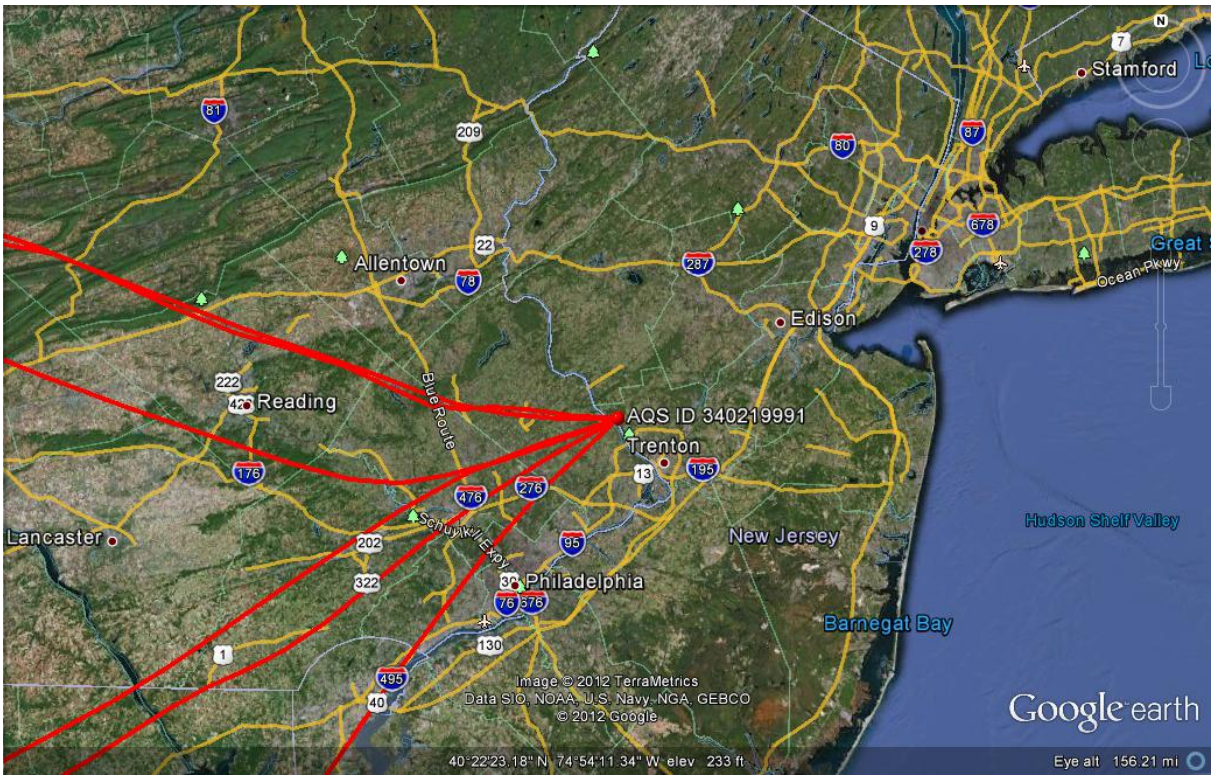


Figure 3-10. Trajectories to the Washington Crossing ozone monitor in Mercer County, ending at 100 meters above ground level in mid-afternoon on high ozone days.

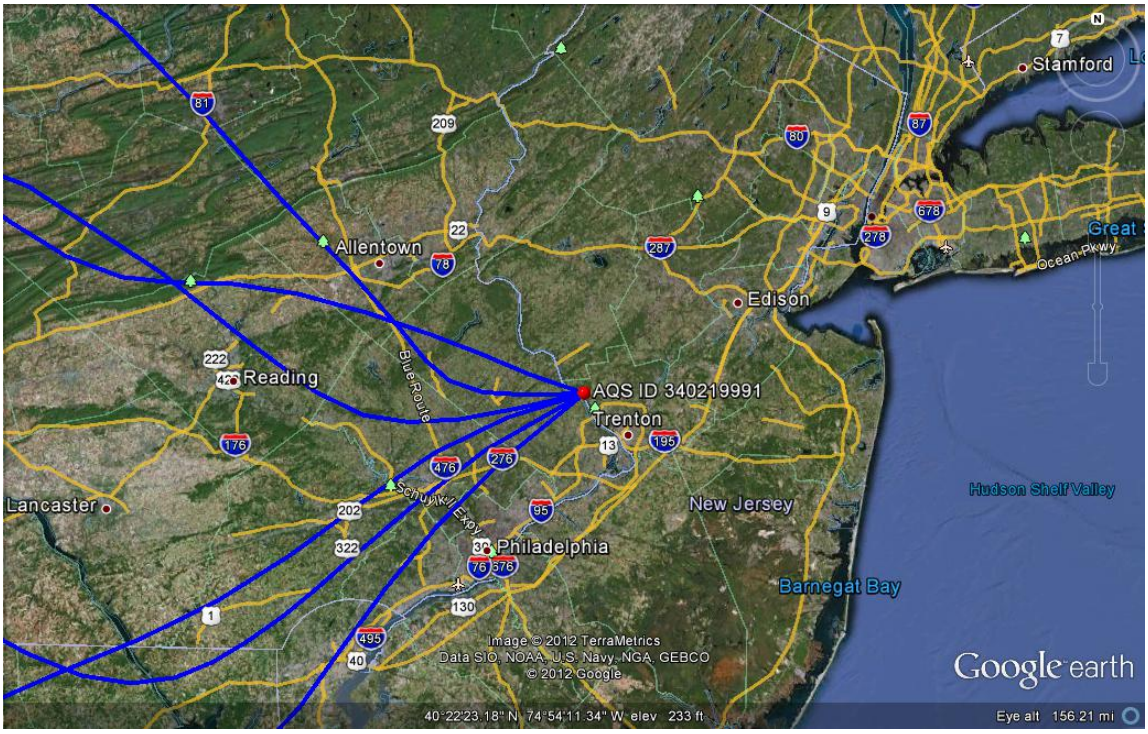


Figure 3-11. Trajectories to the Washington Crossing ozone monitor in Mercer County, ending at 500 meters above ground level in mid-afternoon on high ozone days.

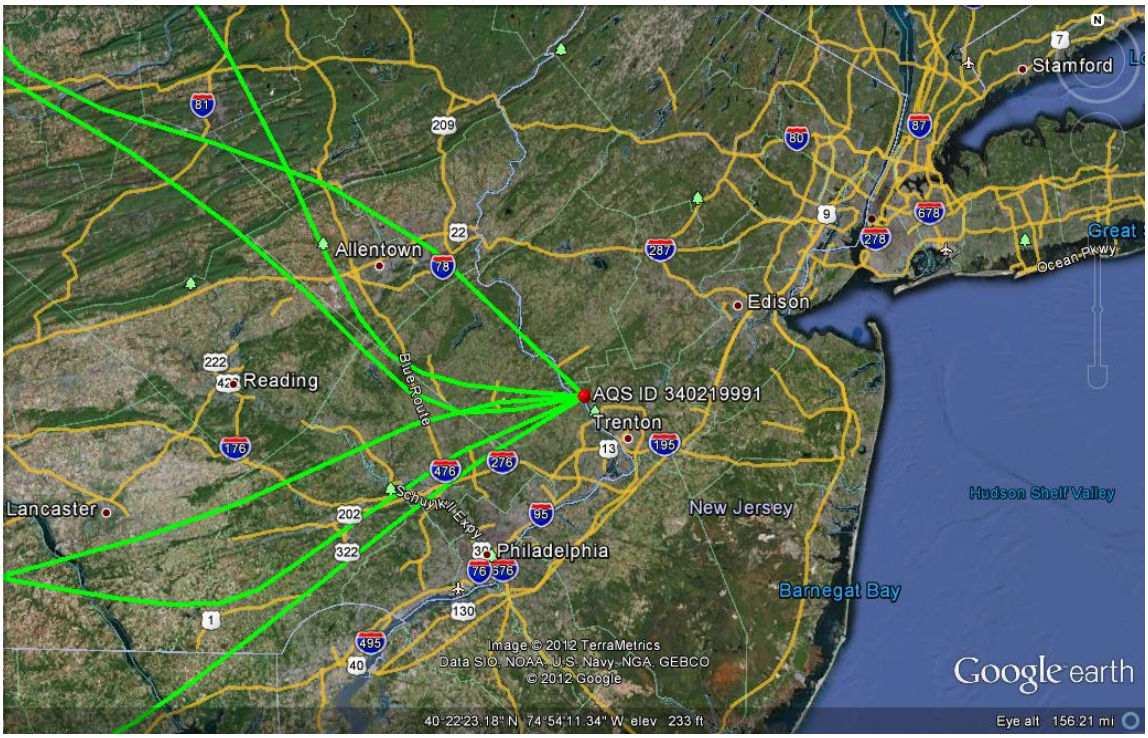


Figure 3-12. Trajectories to the Washington Crossing ozone monitor in Mercer County, ending at 1000 meters above ground level in mid-afternoon on high ozone days.

The original mapping file for the trajectory analysis is included in the docket for this action.

Factor 4: Geography/topography (mountain ranges or other air basin boundaries)

New Jersey's division of its nonattainment areas into two areas is not based on, nor affected by, topographic barriers.

Factor 5: Jurisdictional boundaries

Once the general areas to be included in the nonattainment area were determined, EPA considered existing jurisdictional boundaries for the purposes of providing a clearly defined legal boundary and carrying out the air quality planning and enforcement functions for nonattainment areas. Examples of jurisdictional boundaries include existing/prior nonattainment areas for ozone or other urban-scale pollutants, counties, air districts, townships, metropolitan planning organizations, state lines, Reservations, urban growth boundary, etc. Where existing jurisdictional boundaries are not adequate to describe the nonattainment area, other clearly defined and permanent landmarks or geographic coordinates were considered.

EPA approved the inclusion of Ocean and Mercer Counties into the Philadelphia nonattainment area for the 2004 ozone nonattainment designations.

Ocean County is in the New York City metropolitan transportation planning organization. Mercer County is in the Philadelphia metropolitan transportation planning organization. Since 2004, New Jersey has worked with Ocean County being within the Philadelphia nonattainment area and in the New York City-centered transportation planning organization. If New Jersey requests that Ocean County should be included with the Philadelphia nonattainment area despite the possible difficulties of this situation, this factor should not be a reason for declining New Jersey's request.

Summary

EPA has determined that ozone concentrations in Mercer and Ocean Counties are more strongly affected by emissions from the Philadelphia metro area in eastern Pennsylvania than the New York City metro area in southeastern New York. Ocean and Mercer Counties should be in the Philadelphia ozone nonattainment area as they were for designations for the previous 1997 eight-hour ozone standard.

EPA uses five types of factors when we consider how to determine the boundaries of a nonattainment area:

1. Air quality data (including the design value calculated for each FRM or FEM monitor in the area);

Both Ocean and Mercer Counties violate the air quality standard; with Ocean County having a higher design value than any monitors further downwind of Ocean County, except the peak monitors downwind of New York City.

2. Emissions and emissions-related data (including location of sources and population, amount of emissions and emissions controls, and urban growth patterns);
   This factor has a limited relevance to this issue, as the issue is whether the Ocean and Mercer Counties are more affected by the Philadelphia nonattainment area than the New York City area. However, one factor from the 2004 analysis noted that more commuters stay in Ocean County or go to the Philadelphia area than go to the New York City area.[7]
3. Meteorology (weather/transport patterns);
   The 2004 analyses of the evaluation of boundaries for the 1997 ozone NAAQS[8] show that Ocean County is much more likely to be impacted by winds from the Philadelphia area than winds from the New York City area. However, more recent wind rose data and trajectory analyses support New Jersey's recommendation that Mercer and Ocean County are affected more strongly by the Philadelphia area than the New York area.
4. Geography and topography (mountain ranges or other basin boundaries);
   Not much of a factor, since there are no major topographic features affecting conclusions from the wind flow analyses.
5. Jurisdictional boundaries (e.g., counties, air districts, existing nonattainment areas, Indian country, metropolitan planning organizations (MPOs))
   Ocean County is part of the NYC transportation planning area and Mercer County is part of the Philadelphia planning area. However, Ocean and Mercer Counties have been in the Philadelphia nonattainment area since 2004. New Jersey's desire to continue to include Ocean and Mercer Counties in the Philadelphia area prevails, since New Jersey has to deal with any inconveniences due to transportation planning areas that are different from the nonattainment areas.

EPA received no negative comments during the comment period about the assignment of Ocean and Mercer Counties to the Philadelphia nonattainment area.

[7] This factor uses Census Bureau data from 2000, which will be updated if newer data are available.
[8] http://www.epa.gov/ozonedesignations/1997standards/documents/tsd/ch3.pdf

Appendix B: Response to Comments on Berks County and the Philadelphia Nonattainment Area

In Pennsylvania's February 28, 2012 response to EPA's December 9, 2011 "120-day letter", the Commonwealth provided information to respond to public comments on EPA's preliminary recommendations. Comments were submitted to EPA, recommending that the agency include Reading (Berks County) in Philadelphia area because Reading is part of the Philadelphia-Camden-Vineland Consolidated Statistical Area (CSA). The Commonwealth disagreed with this suggestion and supported EPA's proposal to designate Berks County as a single county nonattainment area for the following reasons:

- The Commonwealth's recommendation and EPA's preliminary response are consistent with the Office of Management and Budget (OMB) definition. The OMB defines the Reading metropolitan statistical area as an area that consists of only Berks County. Although the OMB added Berks County to the Philadelphia CSA in 2006 because of increasing commuting ties to the larger area, Berks County traditionally has its own planning functions, including its own countywide transportation planning organization.
- EPA designated Berks County as a single-county nonattainment area for the 1-hour ozone standard, the 1997 8-hour ozone standard and the 1997 fine particulate matter standard.
- Analysis of the most current work destination data for Berks County' indicates that in 2009, 57.7 percent of the employment of Berks County residents was in Berks County.
- The Reading Air Basin, defined in 25 Pa. Code § 121,1 and codified in 40 CFR 52.2020, covers portions of Berks County and no other county.
- Based on the 2008 National Emissions Inventory shown below, VOC and NOx emissions (tons per year) in Berks County are low compared to emissions in the 5-county Philadelphia Area. The five Pennsylvania counties (Bucks, Chester, Delaware, Montgomery and Philadelphia) are part of a much larger CSA, which in turn is only part of the proposed four-state Philadelphia-Wilmington-Atlantic City nonattainment area. Therefore, the inclusion of Berks County in the Philadelphia-Wilmington-Atlantic City area is unlikely to have a significant effect on the area attaining the standard.

Appendix C. Ozone Design Values in Pennsylvania Calculated Including 2011 Ozone Data

Pennsylvania submitted certified ozone data for 2011 to EPA in November 2011. Since no other states in the Philadelphia Area submitted certified ozone data for 2011 during EPA's review process, EPA will not include Pennsylvania's 2011 ozone data in calculating design values for designations. The effect of using 2011 data from Pennsylvania is listed below for information purposes, with the 2011 design value being calculated with air quality data from 2009, 2010 and 2011.

County	State Recommended Nonattainment?	2010 8-hour Ozone DV (ppb)	2011 8-hour Ozone DV (ppb)
Atlantic, NJ	Yes	74	
Berks, PA	Yes, other area	79	77
Bucks, PA	Yes	83	80
Burlington, NJ	Yes	--	
Camden, NJ	Yes	80	
Cape May, NJ	Yes	--	
Cecil, MD	Yes	80	
Chester, PA	No	76	74
Cumberland, NJ	Yes	76	
Delaware, PA	No	74	73
Gloucester, NJ	Yes	81	
Kent, DE	No	74	
Mercer, NJ	Yes	78	
Montgomery, PA	Yes	78	77
New Castle, DE	Yes, other area	76	
Ocean, NJ	Yes	81	
Philadelphia, PA	Yes	82	83
Salem, NJ	Yes	--	
Sussex, DE	Yes, other area	77	

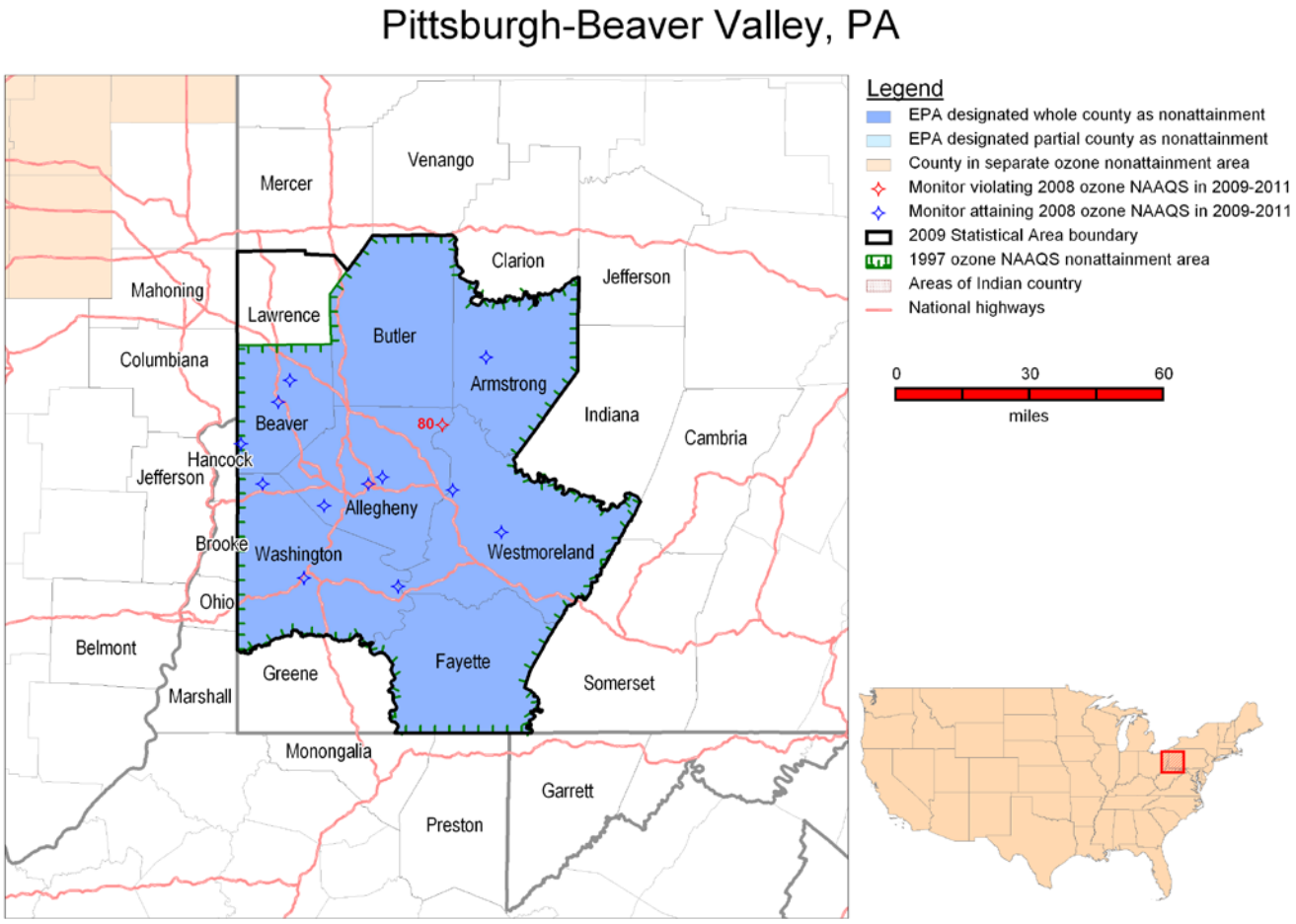
Notes: Counties with no ozone monitor are identified with "--" in the 2010 8-hour Ozone DV column.
2001 DVs are included for Pennsylvania counties because Pennsylvania submitted certified 2011 data to EPA in November 2011.

The highest ozone design values, over 80 ppb, are in Bucks and Philadelphia Counties, in Pennsylvania, and Ocean County in New Jersey. Buck County had the highest 2010 DV in the Philadelphia area, while Philadelphia County has the highest 2011 DV.

Technical Analysis for the Pittsburgh-Beaver Valley Area

Figure 1 is a map of the Pittsburgh-Beaver Valley, PA 2008 ozone nonattainment area. The map provides other relevant information including the locations and design values of air quality monitors, county and other jurisdictional boundaries, CSA/CBSA boundary, existing nonattainment or maintenance boundary for 1997 ozone NAAQS, and EPA's recommended boundaries.

Figure 1. Map of the Pittsburgh-Beaver Valley Area



For purposes of the 1997 8-hour ozone NAAQS, the Pittsburgh-Beaver Valley area was designated nonattainment. The boundary for the nonattainment area for the 1997 ozone NAAQS included the entire counties of Allegheny, Armstrong, Beaver, Butler, Fayette, Washington, and Westmoreland.

In March 2009, the Commonwealth of Pennsylvania recommended that the same counties be designated as "nonattainment" for the 2008 ozone NAAQS based on air quality data from 2006-2008. Pennsylvania updated its 2009 recommendation on November 22, 2011, based on newly available certified air quality data from 2009-2011. Pennsylvania's 2011 updated recommendation also revised the recommendation to limit the nonattainment area (for all areas

in the Commonwealth) to only the county with the violating monitor. In the case of Pittsburgh, the Commonwealth recommends nonattainment for only Allegheny County, which continues to violate the 2008 ozone NAAQS based on 2009-2011 preliminary monitoring data. The certified air quality data for 2009-2011 indicates that the monitor in Armstrong County that violated based on 2008-2010 data is no longer violating the 2008 NAAQS.

This monitoring data is from Federal Reference Method (FRM) monitors or Federal Equivalent Method (FEM) monitors sited and operated in accordance with 40 CFR Part 58 (see the March 17, 2009 and November 22, 2011 letters from the Pennsylvania Department of Environmental Protection to EPA.)

After considering these recommendations and based on EPA's technical analysis described below, EPA is designating seven counties in Pennsylvania (identified in Table 1 below) as "nonattainment" for the 2008 ozone NAAQS as part of the Pittsburgh-Beaver Valley nonattainment area.

Table 1. State's Recommended and EPA's Designated Nonattainment Counties for Pittsburgh-Beaver Valley.

Pittsburgh-Beaver Valley	State-Recommended Nonattainment Counties	EPA's Designated Nonattainment Counties
Pennsylvania	Allegheny	Allegheny Armstrong Beaver Butler Fayette Washington Westmoreland

Factor Assessment

Factor 1: Air Quality Data

For this factor, we considered 8-hour ozone design values (in parts per billion (ppb)) for air quality monitors in counties in the Pittsburgh-New Castle, PA CSA (or Pittsburgh CSA) based on the certified data for the 2008-2010 and 2009-2011 period (i.e., the 2010 and 2011 design values, or DVs), which are the most recent years with fully-certified air quality data. Note that the 2011 DV is used for Pittsburgh-Beaver Valley area because Pennsylvania submitted certified 2011 air quality data to EPA in November 2011. A monitor's DV is the metric or statistic that indicates whether that monitor attains a specified air quality standard. The 2008 ozone NAAQS are met when the annual fourth-highest daily maximum 8-hour average concentration, averaged over 3 years is 0.075 ppm (75 ppb) or less. A DV is only valid if minimum data completeness criteria are met. See 40 CFR part 50 Appendix P. Where several monitors are located in a county (or a designated nonattainment area or maintenance area), the DV for the county or area is determined by the monitor with the highest level.

The 2010 and 2011 DVs for the 2008 ozone NAAQS for counties in the Pittsburgh-New Castle,

PA CSA are shown in Table 2. Pennsylvania submitted a letter to revise its nonattainment area recommendations based on updated certified monitoring data for the three-year period 2009-2011. Based on the certified 2009-2011 monitoring data provided by Pennsylvania in its November 2011 revised recommendation, two of the three monitors that violated based on 2008-2010 data are attaining the 2008 ozone NAAQS (one of the monitors in Allegheny County and the monitor in Armstrong County).

Table 2. Air Quality Data

County	State Recommended Nonattainment?	EPA Designated Nonattainment?	2008-2010 8-hour Ozone DV (ppb)	2009-2011 8-hour Ozone DV (ppb)
Allegheny, PA	Yes	Yes	81	80
Armstrong, PA	No	Yes	76	73
Beaver, PA	No	Yes	73	72
Butler, PA	No	Yes	--	--
Fayette, PA	No	Yes	--	--
Lawrence, PA	No	No	66	66
Washington, PA	No	Yes	71	69
Westmoreland, PA	No	Yes	72	69

Note: Counties with no ozone monitor are identified with "--" in the 2010 and 2011 8-hour Ozone DV columns.

One monitor in Allegheny County and one monitor in Armstrong County showed a violation of the 2008 ozone NAAQS based on 2008-2010 data. Pennsylvania updated its recommendations using 2009-2011 monitoring data via a letter to EPA dated November 22, 2011. Based on this more recent data, only the Harrison monitor in Allegheny County shows a violation of the 2008 ozone NAAQS. Therefore Allegheny County must be included in the nonattainment area. However, a county (or partial county) must also be designated nonattainment if it contributes to a violation in a nearby area. Each county the lies within EPA's starting area of analysis (i.e., the Pittsburgh-New Castle Consolidated CSA) which is located nearby to a county with a violating monitor has been evaluated based on the weight of evidence of the five factors and other relevant information to determine whether it contributes to the nearby violation (even if that county does not have a violating monitor based on 2010 or 2011 DV).

Factor 2: Emissions and Emissions-Related Data

EPA evaluated emissions of ozone precursors (NO_x and VOC) and other emissions-related data that provide information on areas contributing to violating monitors.

Emissions Data

EPA evaluated county-level emission data for NO_x and VOC derived from the 2008 National Emissions Inventory (NEI), version 1.5. This is the most recently available NEI. (See http://www.epa.gov/ttn/chief/net/2008inventory.html) Significant emissions levels in a nearby area indicate the potential for the area to contribute to observed violations. For this factor, we also considered any additional information we received on changes to emissions levels that are

not reflected in recent inventories. These changes include emissions reductions due to permanent and enforceable emissions controls that will be in place before final designations are issued and emissions increases due to new sources. EPA received no such additional emissions data for the Pittsburgh-Beaver Valley area.

Table 3 shows emissions of NO_x and VOC (given in tons per year) for violating and potentially contributing counties in the Pittsburgh-New Castle CSA.

Table 3. Total 2008 NO_x and VOC Emissions

County	State Recommended Nonattainment?	EPA Designated Nonattainment?	NO_x (tpy)	VOC (tpy)
Allegheny, PA	Yes	Yes	52,399	37,506
Armstrong, PA	No	Yes	21,140	3,253
Beaver, PA	No	Yes	35,714	6,030
Butler, PA	No	Yes	7,789	7,856
Fayette, PA	No	Yes	4,639	6,149
Lawrence, PA	No	No	8,960	3,814
Washington, PA	No	Yes	14,304	7,256
Westmoreland, PA	No	Yes	14,827	13,548

Allegheny County has the highest NOx and VOC emissions in the area. Beaver and Armstrong Counties NOx emissions are somewhat higher than the remaining counties in the area, although Beaver County has fairly low VOC emissions. Westmoreland County has higher emissions than the remaining counties. Lawrence and Fayette Counties have relatively low emissions of NOx and VOC, by comparison to the other counties in the Pittsburgh CSA.

Population density and degree of urbanization

EPA evaluated the population and vehicle use characteristics and trends of the area as indicators of the probable location and magnitude of non-point source emissions. These include ozone-creating emissions from mobile sources, such as on-road and off-road vehicles and engines, and area sources, such as consumer products, residential fuel combustion, and consumer services. Areas of dense population or commercial development are an indicator of area source and mobile source NO_x and VOC emissions that may contribute to ozone formation. Rapid population or vehicle miles travelled (VMT) growth (see below) in a county on the urban perimeter signifies increasing integration with the core urban area, and indicates that the associated area source and mobile source emissions may be appropriate to include in the nonattainment area. Table 4 shows the population, population density, and population growth information for each county in the area.

Table 4. Population and Growth.

County	State Recommended Nonattainment?	2010 Population	2010 Population Density (1000 pop /sq mi)	Absolute change in population (2000-2010)	Population % change (2000-2010)
Allegheny, PA	Yes	1,223,348	1.64	(56,566)	-4%
Armstrong, PA	No	68,941	0.10	(3,374)	-5%
Beaver, PA	No	170,539	0.38	(10,576)	-6%
Butler, PA	No	183,862	0.23	9,343	+5%
Fayette, PA	No	136,606	0.17	(11,908)	-8%
Lawrence, PA	No	91,108	0.25	(3,514)	-4%
Washington, PA	No	207,820	0.24	4,873	+2%
Westmoreland, PA	No	365,169	0.35	(4,521)	-1%

Sources: U.S. Census Bureau population estimates for 2010 as of August 4, 2011 (http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_PL_GCTPL2.STO5&prodType=table) and U.S. Census Bureau GIS files for the county boundaries

Allegheny County has by far the largest overall 2010 population (and population density), with its population nearly totaling the combined population of the other seven counties in the CSA. All of the counties are relatively sparsely populated in comparison to Allegheny County, with Armstrong, Fayette, Butler, Washington, and Lawrence being the most sparsely populated (having population densities of less than 250 persons per square mile). In terms of population change, only Butler and Washington Counties have exhibited any population growth since 2000, with all remaining area counties exhibiting declining population.

Traffic and VMT data

EPA evaluated the total Vehicle Miles Traveled (VMT) for each county, as well as VMT growth. In combination with the population/population density data and the location of main transportation arteries (see above), this information helps identify the probable location of non-point source emissions. A county with high VMT and/or a high number of commuters is generally an integral part of an urban area and indicates the presence of motor vehicle emissions that may contribute to ozone formation. Rapid population or VMT growth in a county on the urban perimeter often signifies increasing integration with the core urban area, and indicates that the associated area source and mobile source emissions may be appropriate to include in the nonattainment area. Table 5 shows total 2008 VMT and 2002-2008 VMT growth for each county in the CSA.

Table 5. Traffic (VMT) Data

County	2008 VMT (million miles)	Percent VMT Growth (2002-2008)
Allegheny, PA	9,227	-0.6
Armstrong, PA	621	-1.0
Beaver, PA	1,434	-2.6
Butler, PA	1,747	2.8
Fayette, PA	1,062	5.7
Lawrence, PA	781	-0.6
Washington, PA	2,114	-7.2
Westmoreland, PA	3,430	-4.4

* MOBILE model VMTs are those inputs into the NEI version 1.5.

Table 6. County to County Worker Flow

Residence County → / **Workplace County ↓**	Allegheny	Armstrong	Beaver	Butler	Fayette	Washington	Westmoreland	Lawrence
Allegheny	536,655	4,582	23,946	21,403	5,151	27,645	43,536	2,043
Armstrong	635	16,279	14	1,013	25	22	2,197	12
Beaver	5,235	106	47,074	1,372	136	556	561	2,717
Butler	7,868	2,609	4,885	51,572	168	370	1,231	2,366
Fayette	732	12	28	35	35,915	1,317	2,391	25
Washington	9,211	68	467	267	25	53,268	3,473	53
Westmoreland	12,049	2,719	291	831	3,051	2,718	106,015	103
Lawrence	736	44	2,003	1013	8,985	69	165	27,536

Source: U.S. Census Bureau estimates for 2000 County-to-County Worker Flow (http://www.census.gov/hhes/commuting/data/commuting.html

Allegheny County has by far the highest VMT, totaling nearly the combined VMT of the next five highest counties VMT. Allegheny County also has by far the largest number of commuters travelling within its own borders to and is also a destination for a sizable number of commuters from other nearby counties. Fayette and Butler are the only counties in the area with appreciable VMT growth. Table 6 depicts commuter flow within and between the respective counties. It is clear from Table 6 that Allegheny County draws the greatest number of commuters from all counties, but also that most of the counties have at least some contribution to each other. Lawrence County is a notable exception, as it sends the fewest commuters to the county with the violating monitor (i.e., Allegheny County) of any of the counties in the area of analysis, and has the fewest overall commuters of any county in the area of analysis (except for Armstrong County).

Figure 2 is a map depicting the arterial highway network for the Pittsburgh CSA. Figure 3 depicts the key interstate and arterial highways, focusing on Allegheny County, which has the

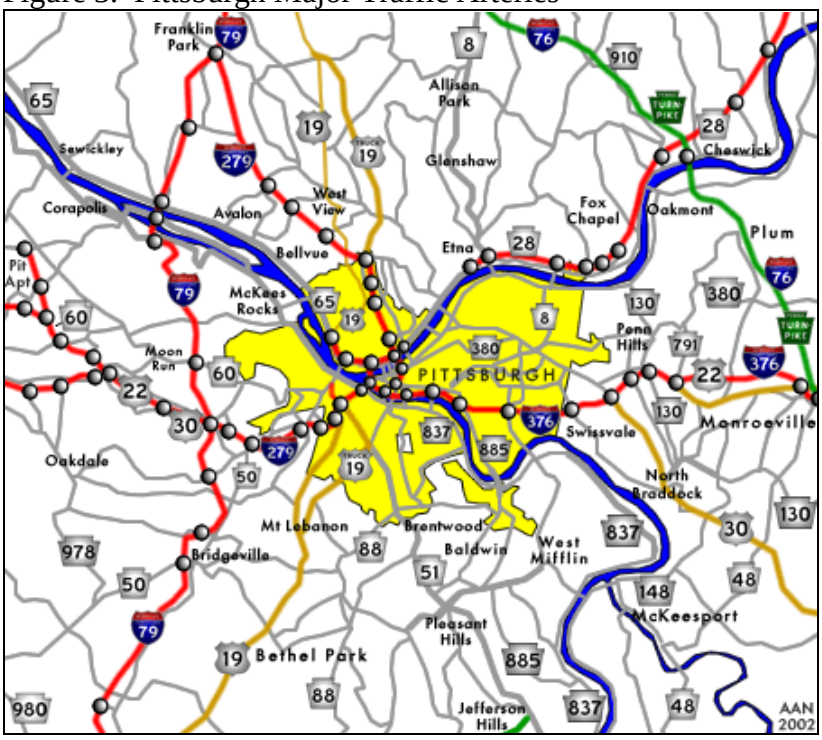
preponderance of the total area VMT and commuter traffic flow.

Figure 2. Southwestern Pennsylvania Major Road Network

Figures 2 and 3 depict the arterial highway network for Pittsburgh, with figure 3 focusing on Allegheny County and the City of Pittsburgh downtown area. The main interstates for the region are: Interstate 376 (the main east-west route), Interstate 279 (the main north-south artery extending from downtown Pittsburgh north to meet with I-79), and Interstate 579 (a short freeway spur from Interstate 279 south). I-79 skirts the Pittsburgh downtown district to the west (passing north-south through Butler, Allegheny, and Washington Counties before leaving Pittsburgh to West Virginia). The Pennsylvania Turnpike (Interstate 76) skirts the Pittsburgh downtown district to the North and East (passing through Westmoreland, Allegheny, Beaver, and Lawrence Counties before passing into Ohio).

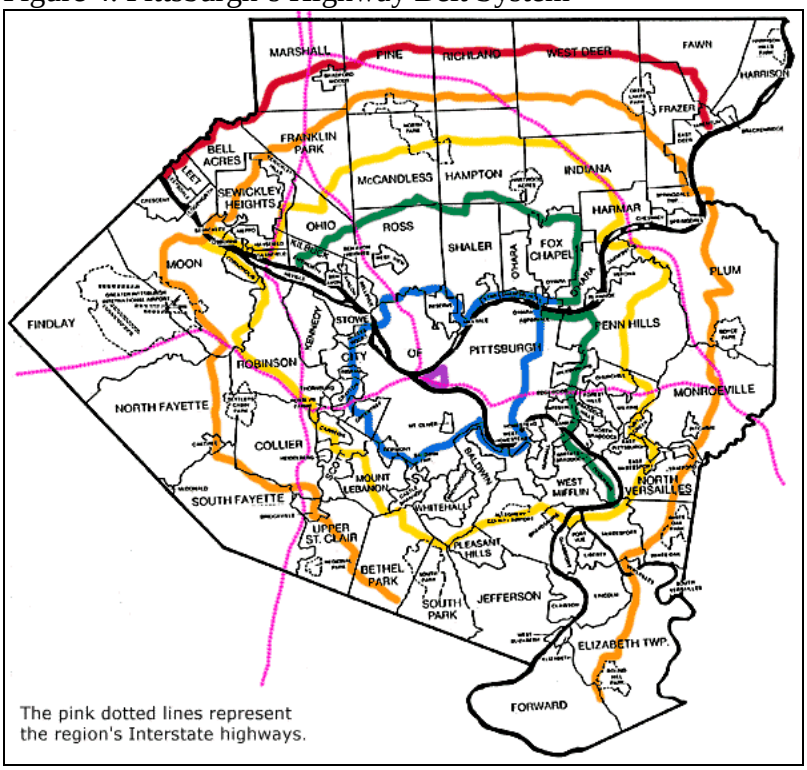
With most of these interstates looping outside the Pittsburgh downtown, Pittsburgh relies on an inner beltway system of smaller highways within Allegheny County. Figure 4 depicts the Beltway system of six color-coded loops surround the City of Pittsburgh and link the city and surrounding communities, highways, and airports.

Figure 3. Pittsburgh Major Traffic Arteries



Source: AA Roads (www.aaroads.com)

Figure 4. Pittsburgh's Highway Belt System



Source: Highway Route Markers of the United States (www.routemarkers.com)

From Table 6, it is clear that much of the total commuting for the area consists of Allegheny

commuters commuting within Allegheny County. The commuting totals from the remaining counties are much smaller in comparison (in spite of some of the large percentages of commuters), due to their lower VMT totals and lower population densities. The high percentage of commuters in Armstrong County traveling to a county with a violating monitor is a function of that county having been in violation of the 2008 ozone NAAQS prior to the 2009-2011 period. It is clear that the remaining Pittsburgh CSA counties have lower total commuters and smaller total VMT, and likely have a higher proportion of their VMT associated with the regional interstate highway network depicted in Figures 2 and 3 (although some of those may be regional commuters that are moving to the inner ring highways depicted in Figure 4).

Of all the Pittsburgh CSA counties, Lawrence and Armstrong have the lowest overall 2008 VMT, and Lawrence has the lowest number of commuters to a violating county, based on 2008 data.

Factor 3: Meteorology (weather/transport patterns)

EPA evaluated any available meteorological data to help determine how meteorological conditions, such as weather, transport patterns and stagnation conditions, would affect the fate and transport of precursor emissions contributing to ozone formation.

The highest ozone design value for the period 2008-2010 is 81 ppb in Allegheny County, followed by 76 ppb in Armstrong County. For the period 2009-2011, the highest ozone design value was 79 ppb in Allegheny County. The prevailing winds during the ozone season have strong westerly and southwesterly components. This indicates the potential contribution to violations from western Counties in the CSA and potentially from transport from areas in Ohio and West Virginia. However, a number of monitors in counties on both sides of the Pennsylvania-Ohio and Pennsylvania-West Virginia border are currently measuring attainment of the ozone standard.

To further understand the meteorological transport conditions within the regional area around Pittsburgh, we evaluated 24-hour back trajectories for the 2007 to 2011 time period, using the National Oceanic and Atmospheric Administration (NOAA) Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) model. The model uses the monitoring location as a starting point and, using meteorological data, evaluates how a parcel of air traveled over the prior day. EPA's HYSPLIT analysis evaluated three separate elevations for each exceedance day to better characterize the wind pattern and pollution transport to the monitor. The violating monitor in Harrison Township, Allegheny County (42-003-1005) was used as the starting point for the analyses.

EPA evaluated three separate elevations for each exceedance day to better characterize the wind pattern and pollution transport to the monitor. EPA used HYSPILT to evaluate wind patterns at the violating monitor for all days where the 8-hour average was above the 0.075 ppm standard (exceedance days). Table 7 lists the exceedance days and corresponding 8-hour average ozone values for each exceedance day. As seen in Table 7, the years 2007, 2008, and 2011 had more exceedances, likely due to in part to meteorology differences that made those years more

conducive for ozone formation than in 2009 and 2010.

Table 7. 2007 to 2011 Exceedance-Day 8-Hour Ozone Values – Harrison Monitor (Monitor # 42-003-1005)

Exceedance Day	8-hour average (ppm ozone)		Exceedance Day	8-hour average (ppm ozone)
2007			2009	
5/31/2007	0.077		5/15/2009	0.076
6/2/2007	0.076		5/21/2009	0.080
7/8/2007	0.076		5/22/2009	0.084
7/10/2007	0.080		5/23/2009	0.077
8/2/2007	0.099		6/25/2009	0.079
8/3/2007	0.086		8/16/2009	0.076
8/4/2007	0.082		2010	
8/12/2007	0.078		7/6/2010	0.083
8/28/2007	0.087		7/7/2010	0.077
8/29/2007	0.089		7/8/2010	0.105
9/5/2007	0.083		8/9/2010	0.078
9/6/2007	0.080		8/29/2010	0.086
9/22/2007	0.078		8/31/2010	0.092
2008			2011	
7/12/2008	0.076		6/6/2011	0.078
7/15/2008	0.076		6/8/2011	0.084
7/16/2008	0.091		6/9/2011	0.080
7/17/2008	0.083		6/18/2011	0.078
7/18/2008	0.082		6/30/2011	0.076
7/19/2008	0.088		7/6/2011	0.082
7/29/2008	0.086		7/22/2011	0.080
8/1/2008	0.081		8/18/2011	0.076
8/21/2008	0.084		9/2/2011	0.078
9/4/2008	0.085		9/3/2011	0.085

Figure 5 overlays HYSPLIT 24-hour back trajectories for all the 2007-2011 ozone exceedances at monitor 42-003-1005 on a Google Earth map of the northeastern United States. It gives an overview of long-range transport to the Pittsburgh area on the exceedance days for the period from 2007 to 2011. As seen in Figure 5, the 24-hour back trajectories indicate regional transport primarily from the western half of the compass, primarily from the west, northwest and southwest directions. Very few trajectories are seen from the eastern half of the compass (i.e., the east, northeast, or southeast directions), relative to the violating monitor in Allegheny County.

Figure 5. NOAA HYSPLIT 24-Hour Back Trajectories for 2006-2010 Exceedances Days - Overview

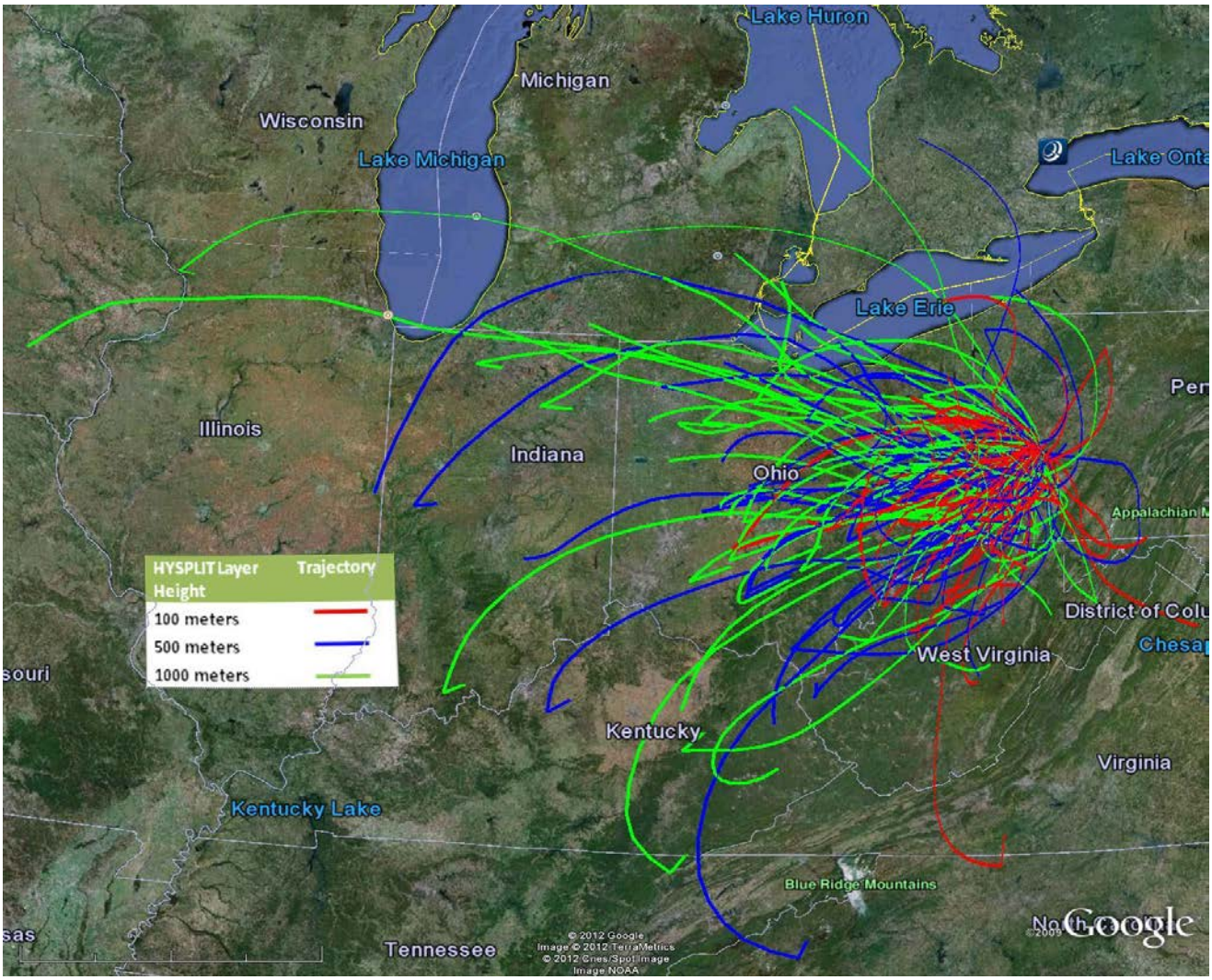
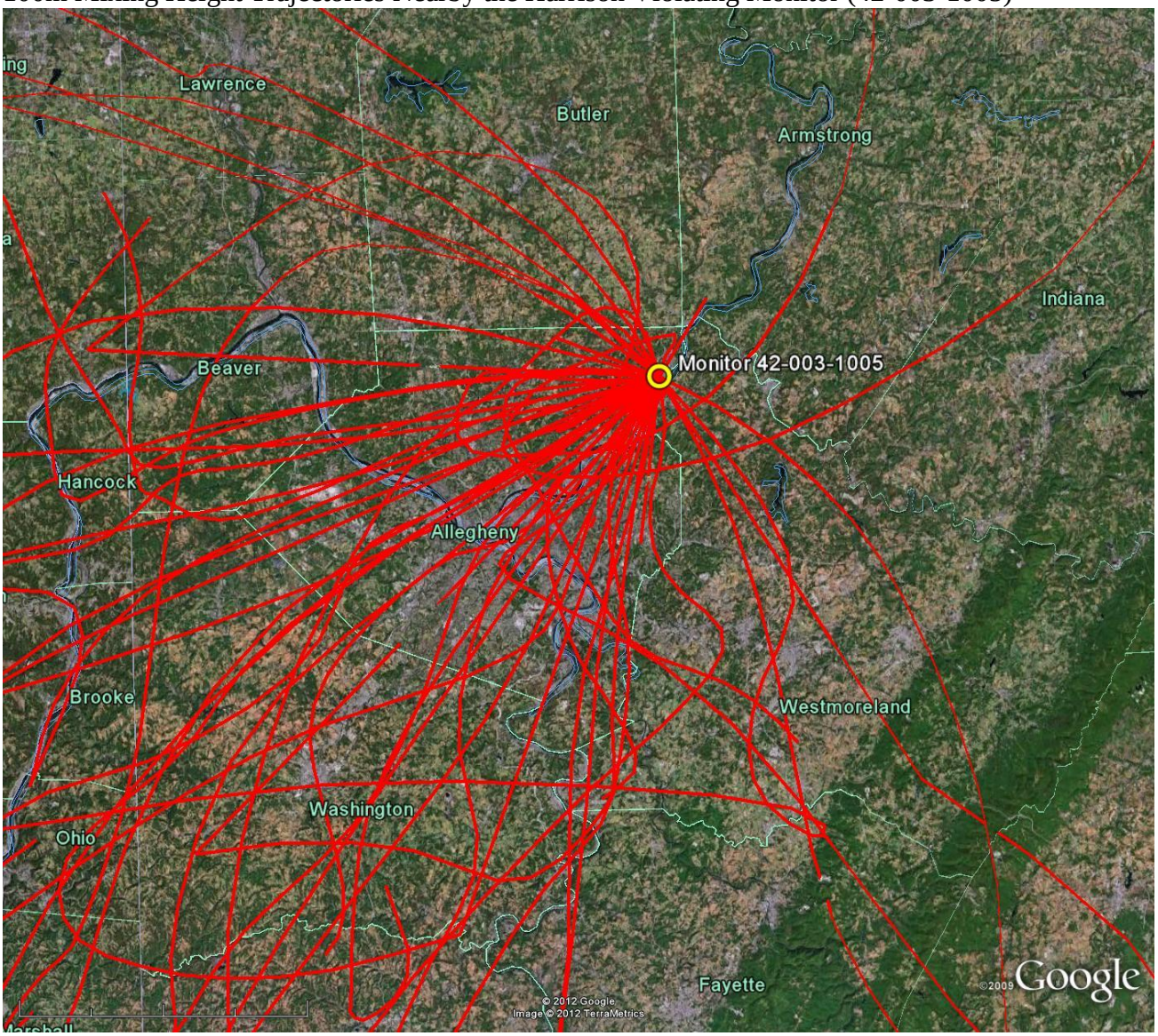


Figure 6, below, is a closer view of the same 24-hour HYSPLIT back trajectories, depicting a shorter timeframe of the back trajectories of transport on high ozone days. This zoomed in perspective shows prevailing winds from the western half of the compass, predominantly from the west and southwest, with some trajectories from north and northwest. Thus, on exceedance days, this analysis suggests that winds traveling to Harrison ozone monitor in Allegheny County are more likely to come from the Pennsylvania and Ohio Counties to the west, southwest and northwest than from any other Pennsylvania counties in the analysis. Figure 5 shows that a large number of trajectories (at the 100 meter modeled mixing height) pass through Allegheny, Washington, and Beaver Counties after passing over Brook, Ohio, Marshall, and Hancock Counties in Ohio. A smaller number of these nearby 100 meter level trajectories pass through Butler and Westmoreland. A very few pass over Fayette and Lawrence Counties. Armstrong and Indiana Counties each have only a single 100 meter trajectory passing over.

Figure 6. NOAA HYSPLIT Back Trajectories for 2006-2010 Exceedances Days – 100m Mixing Height Trajectories Nearby the Harrison Violating Monitor (42-003-1005)

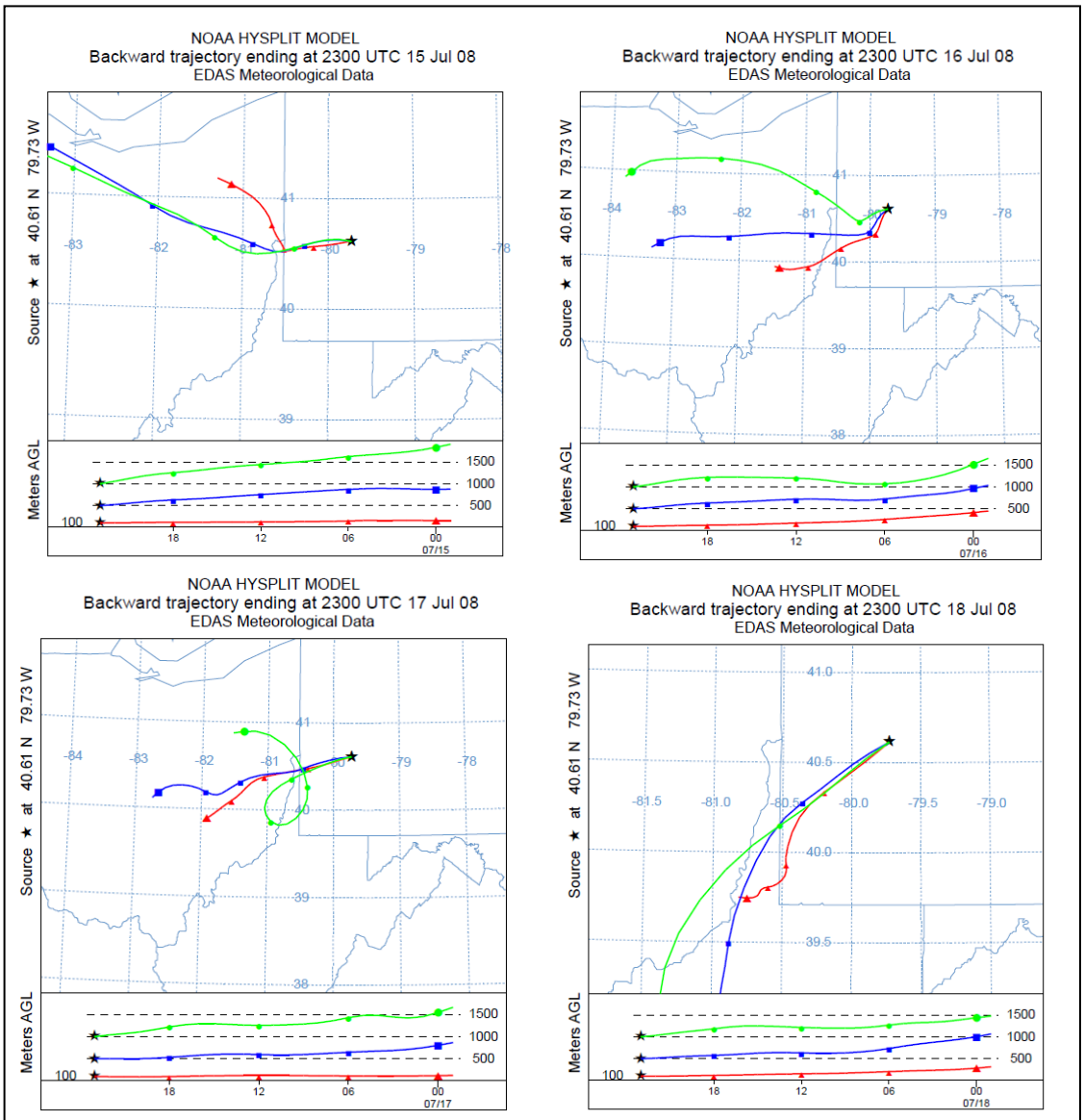


To further illustrate the local transport situation in the Pittsburgh area, EPA selected specific trajectories for an "ozone episode," which is a period when the ozone levels are high for several consecutive days. As shown in Table 7, the 8-hour average ozone value at monitor 42-003-1005 exceeded the 2008 ozone standard on five days between July 15th to July 19th in the summer of 2008.

Figure 7 and 8 show the HYPLIT back trajectories for the July 2008 episode. During this episode, the winds came mainly from the west and northwest and pass through Beaver and Washington Counties after passing through the West Virginia panhandle counties (Hancock, Brooke, Ohio, and Marshall.)

Other multi-day exceedance events in Pittsburgh over the five-year period between 2007 and 2011 include: August 2-4, 2007; May 21-23, 2009; and July 6-8, 2010. Although not presented here, HYSPLIT results for those days are similar in outcome to those for July 15-19, 2008 presented below in Figure 7. The HYSPLIT results for those exceedance days are available in the docket for this action.

Figure 7. NOAA HYSPLIT 24-Hour Back Trajectories July 15-19, 2008



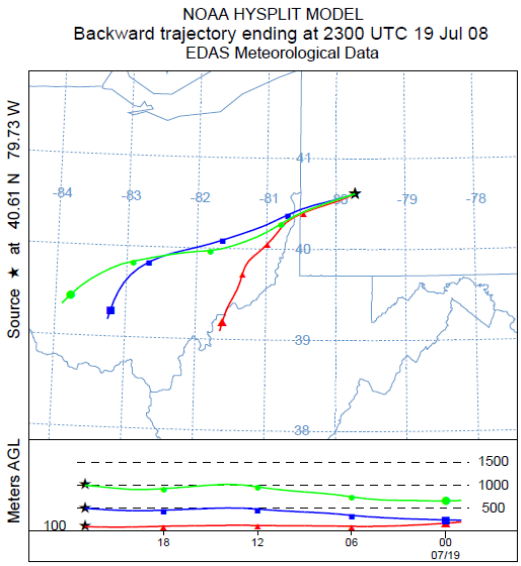
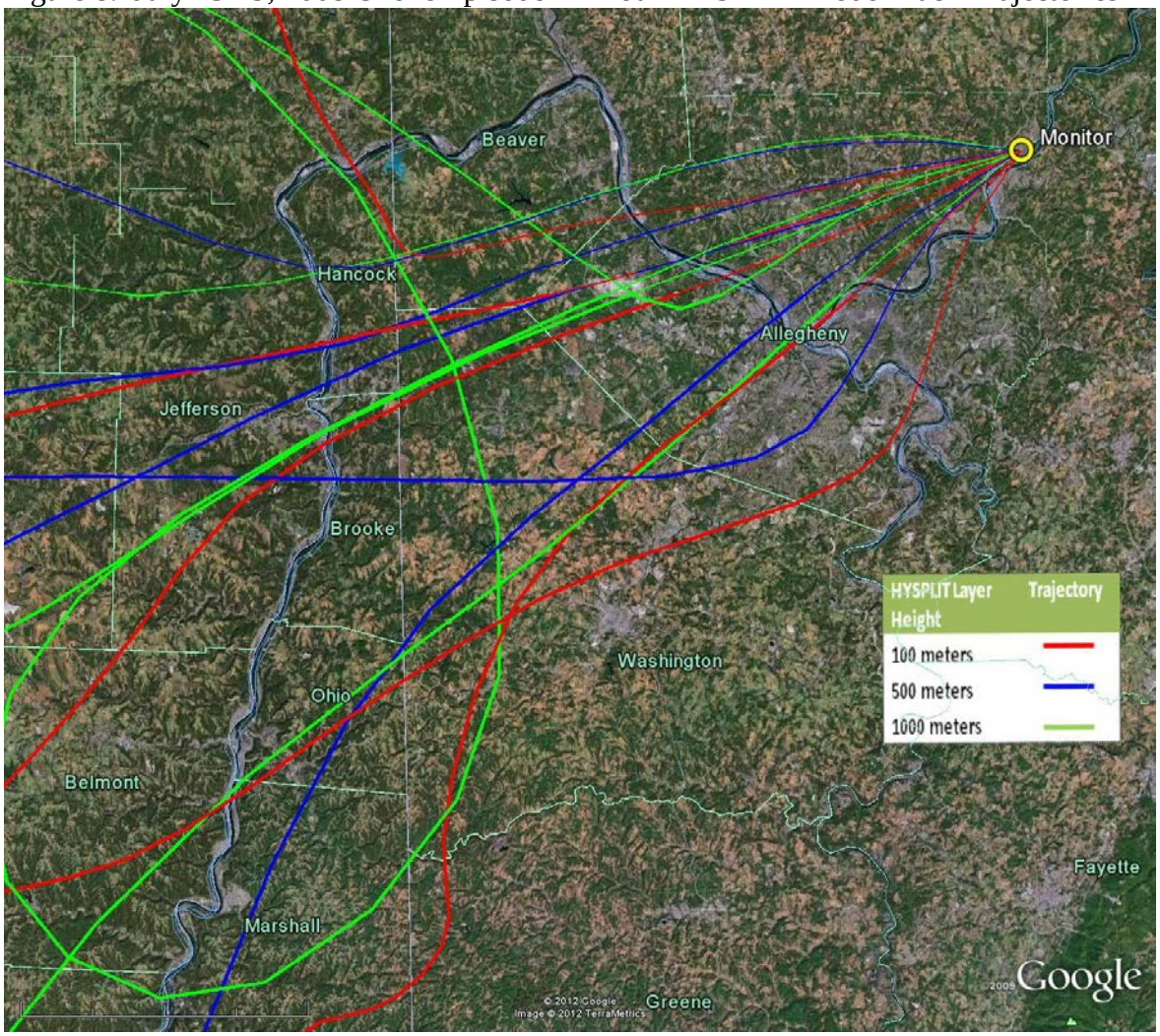


Figure 8. July 15-19, 2008 Ozone Episode 24-Hour HYSPLIT Model Back Trajectories



This data confirms that Washington and Beaver Counties (and Allegheny County, itself) are upwind of the violating monitor in Allegheny County. Therefore, emissions from Washington and Beaver Counties likely contribute to the ozone concentrations of the nearby monitor in Allegheny County, on these days. Similar results can be seen from HYSPLIT results from other exceedance days for the period from 2007-2011 (which are not presented here but are included in the docket). To a lesser degree (i.e., a lower frequency) the back trajectories for this July 2008 episode pass over Butler, Westmoreland, and Lawrence Counties upwind of the violating monitor. The nearby Counties of Fayette, Armstrong, and Indiana do not appear to be contributing significantly on these days on the basis of this HYSPLIT analysis in support of the meteorology factor.

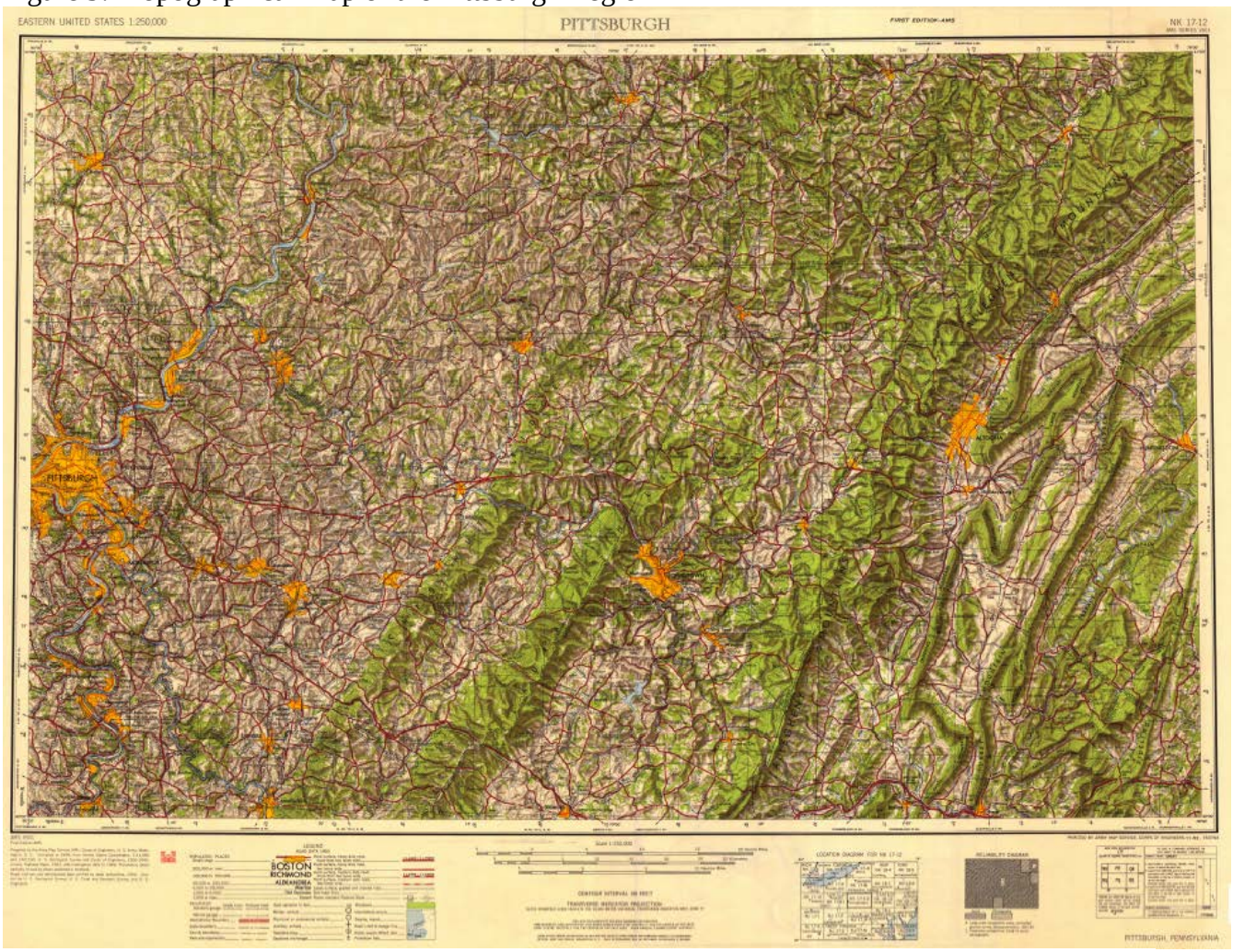
Factor 4: Geography/topography (mountain ranges or other air basin boundaries)

The geography/topography analysis evaluates the physical features of the land that might affect the airshed and, therefore, the distribution of ozone over the area.

Pittsburgh lies on the Appalachian Plateau extending westward from the Allegheny Front, which is an escarpment that makes the western part of Pennsylvania higher than the eastern part of the Commonwealth. The City of Pittsburgh itself is defined by the river valleys of the Allegheny, the Monongahela, and the Ohio.

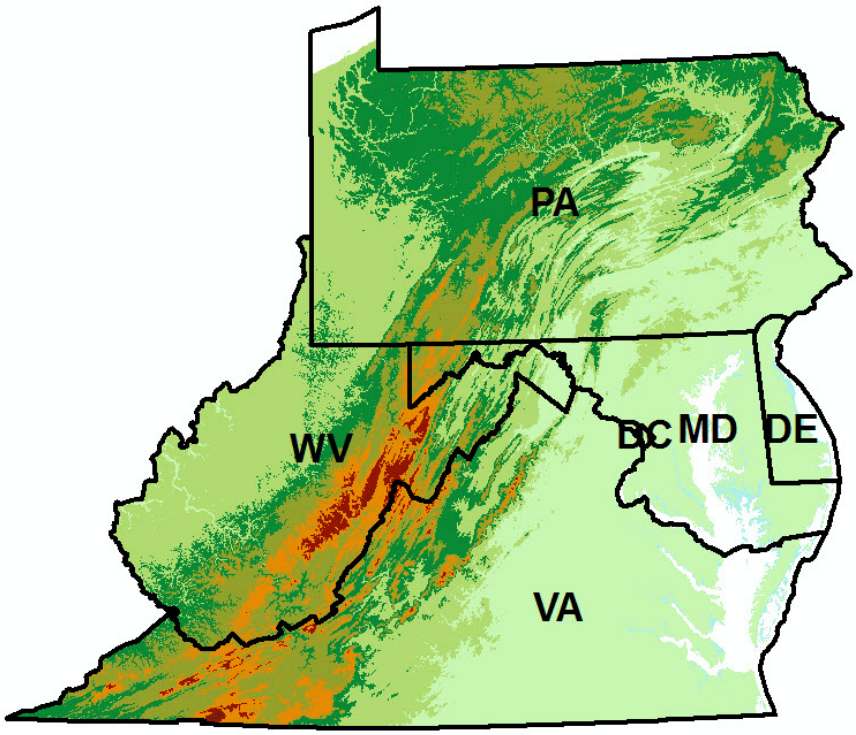
Elevations in the Pittsburgh region range from around 700 feet above sea level where the rivers meet, to 1,200 to 1,300 feet at the highest points, with dramatic hills and valleys often separating neighborhoods and communities. The highest land is at the prevailing level of the Appalachian Plateau, with the river valleys forming the low points, and varying slopes connecting it together. Figures 9 and 10 are maps showing the topography of the southwestern Pennsylvania and the broader Midatlantic U.S region.

Figure 9. Topographical Map of the Pittsburgh Region



Source: US Geologic Society, National Historic Map, Eastern United States

Figure 10. Topographic Map of the Midatlantic U.S.



This mountainous topography of the Appalachian Mountains may form a geographic or topographic barrier, limiting movement of air and air pollution within the airshed, perhaps impacting weather patterns as well as wind movements within and across the area, potentially creating inversions or other phenomenon that could affect wind trajectories and speeds, etc. It is possible that the mountain ridges running from southwest to northeast may block off certain low-level wind movements, limiting transport of ozone or ozone precursors from counties to the east and south of Pittsburgh. However, Pennsylvania did not submit data as part of its recommendations to EPA in 2009 or 2011 indicating that topography plays a significant role in distribution of ozone across the Pittsburgh-Beaver Valley area. Therefore, EPA did not rely heavily upon this factor in its designations decision.

Factor 5: Jurisdictional boundaries

Once the general areas to be included in the nonattainment area were determined, EPA considered existing jurisdictional boundaries for the purposes of providing a clearly defined legal boundary and carrying out the air quality planning and enforcement functions for nonattainment areas. Examples of jurisdictional boundaries include existing/prior nonattainment areas for ozone or other urban-scale pollutants, counties, air districts, townships, metropolitan planning organizations, state lines, Reservations, urban growth boundary, etc. Where existing jurisdictional boundaries are not adequate to describe the nonattainment area, other clearly defined and permanent landmarks or geographic coordinates were considered.

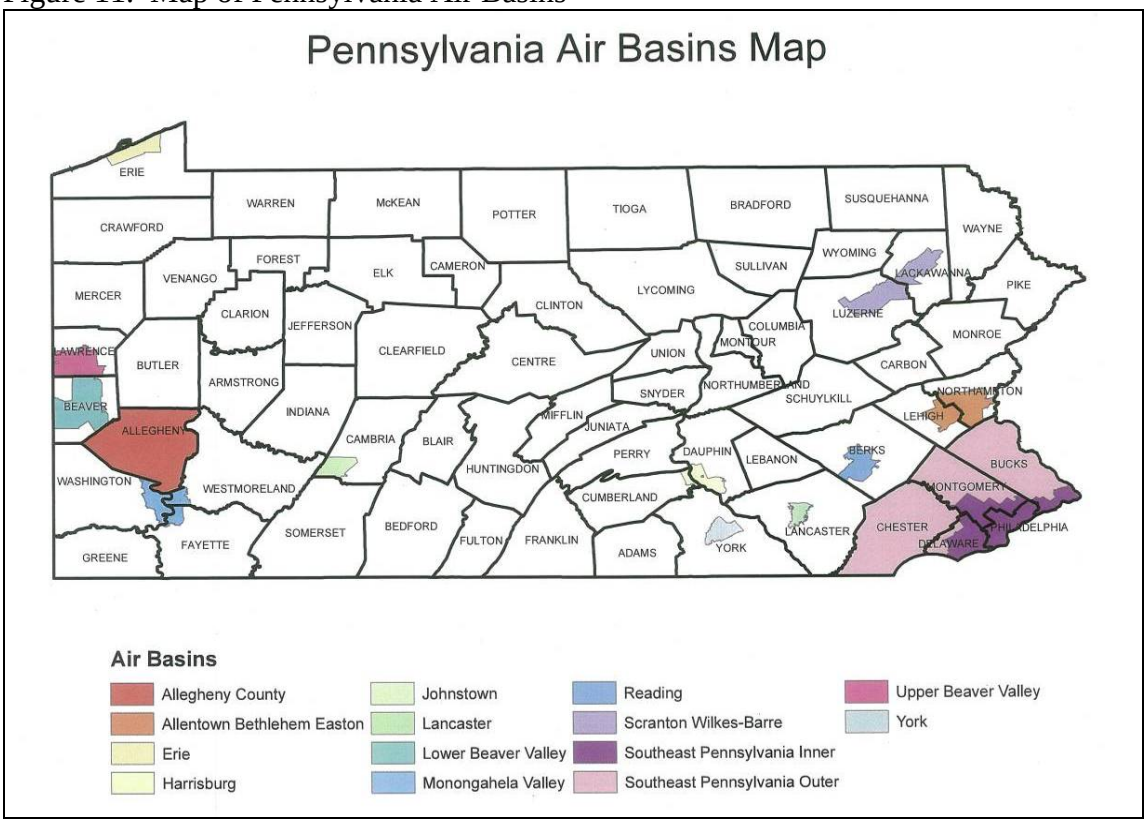
The Pittsburgh-Beaver Valley area has previously established nonattainment boundaries associated with both the 1-hour and 1997 8-hour ozone NAAQS. In its March 2009 recommendation to EPA, the Commonwealth recommended the same nonattainment area boundary for the 2008 ozone NAAQS. However, in a letter sent to EPA on November 22, 2011, Pennsylvania revised its recommendation to include as nonattainment only those counties having monitored violations of the 2008 ozone standard. In the case of the Pittsburgh-Beaver Valley area, Pennsylvania's November 2011 revised recommendation was that only Allegheny County be designated as nonattainment for the Pittsburgh area.

EPA relied on the Pittsburgh-New Castle CSA as its analytical starting point for determining nonattainment area boundaries. The Pittsburgh-New Castle CSA includes the 7-county Pittsburgh Metropolitan Statistical Area, as well as the one-county New Castle Micropolitan Statistical Area (comprised of Lawrence County).

As Pennsylvania indicated in its March 2009 recommendation to EPA, the counties in the Pittsburgh Metropolitan Statistical Area are part of one single transportation-planning agency as designated by the U.S. Department of Transportation (U.S. DOT) based on economic and commuting patterns. Retaining the existing boundary for this nonattainment area allows the area to benefit from continuity of planning between the 1997 and 2008 ozone standards. The 1997 Pittsburgh ozone nonattainment area had two emission control programs that pertain only to this area and not to surrounding counties: a requirement for cleaner gasoline during the ozone season and a requirement for gasoline pumps to control fumes when vehicles are refueling.

Finally, the area being designated by EPA as nonattainment includes three air basins (as defined in 25 *Pa.Code* § 121.1): the Lower Beaver Valley Air Basin, the Allegheny County Air Basin and the Monongahela Valley Air Basin. Figure 11 is a map denoting the locations of these air basins. They were developed for purposes of the sulfur compound controls outlined in 25 *Pa. Code* § 123.22, yet they represent existing local boundaries for emission controls in these areas of the Commonwealth.

Figure 11. Map of Pennsylvania Air Basins



In November 2011, Pennsylvania submitted a revised recommendation letter to EPA to alter its March 2009 recommendation to reflect only the county violating the 2008 ozone NAAQS (i.e. Allegheny County), dismissing its jurisdiction-based arguments set forth in the Commonwealth's prior March 2009 recommendation.

Pennsylvania did not recommend inclusion of Lawrence County in its March 2009 or November 2011 area recommendation letters to EPA. The Commonwealth reiterated its rationale for exclusion of Lawrence County from the nonattainment area in its February 28, 2012 response to EPA's December 9, 2011 120-day intended recommendation letter. That rationale was that Lawrence County has a monitor that is monitoring well below the 2008 ozone NAAQS, that the area has traditionally been a stand-alone planning area, and that the county's micropolitan statistical area status indicates a lower level of social and economic ties to the Pittsburgh metropolitan area counties than counties within the Pittsburgh metropolitan statistical area.

Conclusion

Based on the assessment of factors described above, EPA has concluded that the following counties meet the CAA criteria for inclusion in the Pittsburgh-Beaver Valley nonattainment area: Allegheny, Armstrong, Beaver, Butler, Fayette, Washington, and Westmoreland. EPA has concluded that the other county that was part of this analysis, Lawrence County, does not violate the NAAQS or appear to contribute significantly to the nearby ozone violation in Allegheny County.

On the basis of the factor discussion set forth in this document, there is cause to extend the nonattainment boundary beyond the county with a violating monitor, i.e., Allegheny County. With respect to emissions and emissions-related data, Armstrong, Beaver, Washington, and Westmoreland Counties have relatively high emissions. Although the area is facing low to negative population growth (with the exception of Butler and Washington Counties) and many of the counties are sparsely populated, Washington, Westmoreland, Beaver, Butler, and Fayette Counties continue to have populations over 100,000 persons. Westmoreland, Washington, Beaver, and Butler Counties have high VMT, even relative to more densely populated Allegheny County.

With respect to the meteorology factor, it is clear that Beaver and Washington Counties are upwind of the nearby violating monitor in Allegheny County on exceedance days over the past five years. Butler, Westmoreland, and Lawrence Counties appear to be upwind of the violating monitor, but on a less frequent basis and therefore likely contribute to ozone levels at the violating monitor, but to a lesser degree than Beaver and Washington Counties. Meteorology appears not to be a significant factor for contribution to the violating monitor in Allegheny County for Fayette and Armstrong Counties. Counties to the west of Pittsburgh (such as Indiana) appear to be downwind from the monitor, based on wind direction and HYSPLIT back trajectories, and therefore on the basis of the meteorology factor do not appear to contribute to nonattainment of that monitor.

With respect to jurisdictional boundaries, it is clear that the counties in the Pittsburgh Metropolitan Statistical Area are socially and economically intertwined. The Pittsburgh metropolitan area counties utilize a single transportation-planning agency, and have emission control programs unique from neighboring counties and metropolitan areas. Historically, this Pittsburgh metropolitan area has been the ozone nonattainment boundary.

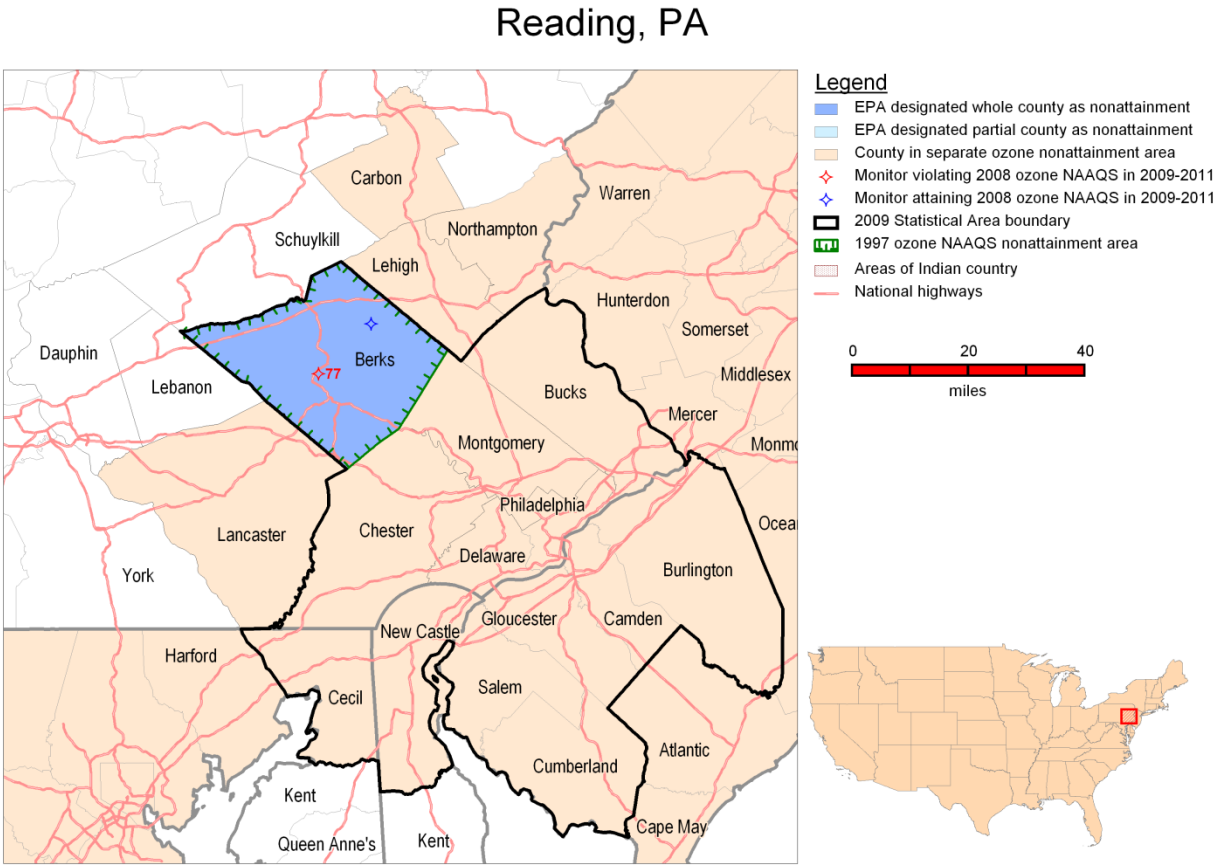
Based on this factor assessment, EPA has concluded that the Pittsburgh Metropolitan Statistical Area be the boundary for the 2008 nonattainment area, as it was for the 1997 ozone NAAQS nonattainment area, and to exclude the New Castle Micropolitan Statistical Area from the Pittsburgh-Beaver Valley nonattainment area. Based on the most recent 2009-2011 monitoring data, Allegheny County is the only county monitoring a violation of the 2008 NAAQS, so under the Clean Air Act that county must be designated nonattainment.

EPA disagrees with Pennsylvania's revised November 2011 recommendation to exclude the remaining Pittsburgh area counties from the nonattainment area. EPA agrees with Pennsylvania's original 2009 recommendation that the nearby counties in the Pittsburgh Metropolitan Statistical Area contribute to nonattainment of the 2008 ozone NAAQS and must also be designated nonattainment. EPA agrees with Pennsylvania's 2009 and revised 2011 recommendations that there is sufficient evidence on the basis of the above factor assessment to exclude Lawrence County from the EPA intended nonattainment area.
Therefore, EPA has concluded that the nonattainment area for 2008 ozone NAAQS for the Pittsburgh-Beaver Valley area be the same as the 7-county nonattainment area boundary under the prior 1997 ozone NAAQS.

Technical Analysis for the Reading Area

Figure 1 is a map of the Reading nonattainment area, Berks County, Pennsylvania. The map provides other relevant information including the locations and design values of air quality monitors, major transportation arteries, and county and other jurisdictional boundaries. This map shows the former Reading nonattainment area for the 1997 ozone NAAQS, now a maintenance area, which consists of Berks County, Pennsylvania. It also shows the Philadelphia-Camden-Vineland CSA.

Figure 1.



For purposes of the 1997 8-hour ozone NAAQS, the Reading Area was designated nonattainment. The boundary for the nonattainment area for the 1997 ozone NAAQS included the entire county of Berks in Pennsylvania.

In March 2009, the Commonwealth of Pennsylvania recommended that the same county, Berks, be designated as nonattainment in the Reading Area for the 2008 ozone NAAQS based on air quality data from 2006-2008. Pennsylvania provided an update to the original recommendation in November 2011 based on certified air quality data from 2009-2011. That recommendation update did not make any modification to the Reading area boundary, or nonattainment status. The recommendations are based on data from Federal Reference Method (FRM) monitors or Federal Equivalent Method (FEM) monitors sited and operated in accordance with 40 CFR Part

58. (See the March 17, 2009 and November 22, 2011 letters from the Pennsylvania Department of Environmental Protection to EPA.)

After considering these recommendations and based on EPA's technical analysis described below, EPA is designating Berks County, Pennsylvania as "nonattainment" for the 2008 ozone NAAQS and will describe it as the "Reading nonattainment area."

Table 1. State's Recommended and EPA's Designated Nonattainment Counties for Reading Area.

Reading, PA	State-Recommended Nonattainment Counties	EPA's Designated Nonattainment Counties
Pennsylvania	Berks	Berks

Factor Assessment

EPA has determined that it is appropriate to include Bucks, Chester, Montgomery, Lancaster, and Lehigh Counties in other separate nonattainment areas for the 2008 ozone NAAQS. Based on EPA's five-factor analyses, EPA has determined that Bucks, Chester, and Montgomery Counties should be designated as nonattainment in the Philadelphia-Wilmington-Atlantic City Area, Lancaster County should be designated as nonattainment in the Lancaster Area, and Lehigh County should be designated nonattainment as part of the Allentown-Bethlehem-Easton Area. See EPA's respective technical analyses for these adjacent nonattainment areas for EPA's rationale supporting our nonattainment designation for these counties. To the extent that emissions from the Bucks, Chester, Montgomery, Lancaster, and Lehigh Counties may contribute ozone concentrations in the Reading nonattainment area, that contribution will be lessened by emission controls put in place in those separate nonattainment areas. Therefore, EPA is not including Bucks, Chester, Montgomery, Lancaster, and Lehigh Counties in this analysis for the Reading nonattainment area.

Factor 1: Air Quality Data

For this factor, we considered 8-hour ozone design values (in parts per billion (ppb)) for air quality monitors in counties in the Reading area based on data for the 2008-2010 and 2009-2011 periods (i.e., the 2010 and 2011 design values, or DVs), which are the most recent years with fully-certified air quality data. Note that the 2011 DV is used for the Reading area because Pennsylvania submitted certified 2011 air quality data to EPA in November 2011. A monitor's DV is the metric or statistic that indicates whether that monitor attains a specified air quality standard. The 2008 ozone NAAQS are met when the annual fourth-highest daily maximum 8-hour average concentration, averaged over 3 years is 0.075 ppm or less (which is equal to 75 ppb or less). A DV is only valid if minimum data completeness criteria are met. See 40 CFR part 50 Appendix P. Where several monitors are located in a county (or a designated nonattainment area or maintenance area), the DV for the county or area is determined by the monitor with the highest DV.

Note: Monitors that are eligible for providing design value data generally include State and Local Air Monitoring Stations (SLAMS) that are sited in accordance with 40 CFR Part 58, Appendix D (Section 4.1) and operating with a federal reference method (FRM) or federal equivalent method (FEM) monitor that meets the requirements of 40 CFR part 58, appendix A. All data from a special purpose monitor (SPM) using an FRM or FEM which has operated for more than 24 months is eligible for comparison to the NAAQS unless the monitoring agency demonstrates that the data came from a particular period during which the requirements of appendix A (quality assurance requirements) or appendix E (probe and monitoring path siting criteria) were not met. The 2010 and 2011 DVs for the ozone NAAQS for Berks County and nearby surrounding counties are shown in Table 2.

Table 2. Air Quality Data.

County	State Recommended Nonattainment?	2008-2010 Design Value (ppb)	2009-2011 Design Value (ppb)
Berks, PA	Yes	79	77
Lebanon, PA	No	--	--
Schuylkill, PA	No	--	--

Note: Counties with no ozone monitor are identified with "--" in the Design Value columns.

In accordance with section 107(d) of the Clean Air Act, EPA must designate an area nonattainment if it is violating the 2008 ozone NAAQS. Berks County shows a violation of the 2008 ozone NAAQS, therefore this county must be included in a nonattainment area. Note that the absence of a violating monitor is not a sufficient reason to eliminate nearby counties as candidates for nonattainment status based upon contribution to violations in other nearby areas. Each county is being evaluated based on the weight of evidence of the five factors.

Factor 2: Emissions and Emissions-Related Data

EPA evaluated emissions of ozone precursors (NO_x and VOC) and other emissions-related data that provide information on areas potentially contributing to violating monitors.

Emissions Data

EPA evaluated county-level emission data for NO_x and VOC derived from the 2008 National Emissions Inventory (NEI), version 1.5. This is the most recently available NEI. (See http://www.epa.gov/ttn/chief/net/2008inventory.html) Significant emissions levels in a nearby area indicate the potential for the area to contribute to observed violations. For this factor, we also considered any additional information we received on changes to emissions levels that are not reflected in recent inventories. These changes include emissions reductions due to permanent and enforceable emissions controls that are in place before final designations are issued and emissions increases due to new sources. EPA received no such additional emissions data for the Reading area.

Table 3 shows emissions of NO_x and VOC (given in tons per year) **i**n potentially contributing counties in the Reading Area.

Table 3. Total 2008 NO_x and VOC Emissions.

County	State Recommended Nonattainment?	NO_x (tpy)	VOC (tpy)
Berks, PA	Yes	18,908	15,918
Lebanon, PA	No	6,166	5,367
Schuylkill, PA	No	6,554	5,922

Berks County has the highest NOx and VOC emissions in the area of analysis. In fact, the emissions from Berks County are nearly three times higher than the emissions in Lebanon and Schuylkill Counties. This indicates that the most likely source of ozone precursor emissions for the Reading area is Berks County, rather than Schuylkill and/or Lebanon Counties.

Population density and degree of urbanization

EPA evaluated the population and vehicle use characteristics and trends of the area as indicators of the probable location and magnitude of non-point source emissions. These include ozone-creating emissions from on-road and off-road vehicles and engines, consumer products, residential fuel combustion, and consumer services. Areas of dense population or commercial development are an indicator of area source and mobile source NO_x and VOC emissions that may contribute to ozone formation. Table 4 shows the population, population density, and population growth information for each county in the area of analysis.

Table 4. Population and Growth.

County	State Recommended Nonattainment?	2010 Population	2010 Population Density (1000 pop/sq mi)	Absolute change in population (2000-2010)	Population % change (2000-2010)
Berks, PA	Yes	411,442	0.48	36,945	+10%
Lebanon, PA	No	133,568	0.37	13,151	+11%
Schuylkill, PA	No	148,289	0.19	-1,798	-1.2%

Sources: U.S. Census Bureau population estimates for 2010 as of August 4, 2011 (http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_PL_GCTPL2.STO5&prodType=table).

Berks County has the highest population in the area of analysis. In fact, the population in Berks County is nearly three times higher than the populations of Lebanon and Schuylkill Counties. This indicates that non-point source emissions from Lebanon or Schuylkill Counties likely make up a small portion of the non-point source emissions in the area of analysis, relative to Berks County's non-point source emissions.

Traffic and commuting patterns

EPA evaluated the commuting patterns of residents in the area, as well as the total Vehicle Miles Traveled (VMT) for each county. In combination with the population/population density data and the location of main transportation arteries (see Figure 1, above), this information helps identify the probable location of non-point source emissions. A county with high VMT and/or a high number of commuters is generally an integral part of an urban area and indicates the presence of motor vehicle emissions that may contribute to ozone formation. Rapid population

or VMT growth in a county on the urban perimeter signifies increasing integration with the core urban area, and indicates that the associated area source and mobile source emissions may be appropriate to include in the nonattainment area. Table 5 shows the total vehicle miles traveled (VMT) for each county in 2008.

Table 5. Traffic (VMT) Data..

County	State Recommended Nonattainment?	2008 VMT* (million miles)
Berks, PA	Yes	3,335
Lebanon, PA	No	1,210
Schuylkill, PA	No	1,394

* MOBILE model VMTs are those inputs into the NEI version 1.5.

VMT in Berks County is more than twice as high as VMT in Lebanon and Schuylkill Counties. However, as shown in Table 6, below, Lebanon and Schuylkill Counties do have commuters into Berks County. Therefore, there is come contribution of VMT and mobile source emissions from Lebanon and Schuylkill Counties to Berks County.

Table 6. County to County Worker Flow.

Residence County → / **Workplace County ↓**	Berks, PA	Lebanon, PA	Schuylkill, PA
Berks, PA	140,819	2,799	5,790
Lebanon, PA	2,053	36,677	1,482
Schuylkill, PA	619	188	43,979

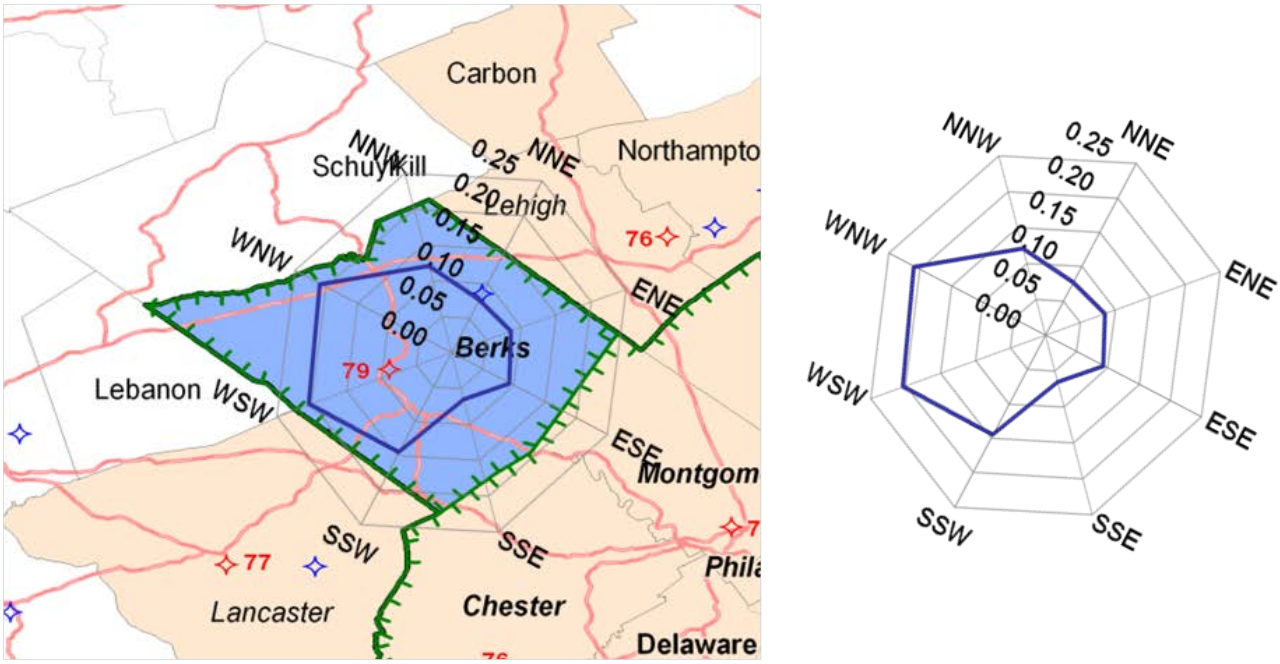
Source: US Census Bureau County-To-County Worker Flow Files
http://www.census.gov/population/www/cen2000/commuting/index.html

Factor 3: Meteorology (weather/transport patterns)

EPA evaluated available meteorological data, consisting of 30-year average summertime wind directions from the National Weather Service (NWS), to help determine how meteorological conditions, such as weather, transport patterns and stagnation conditions, would affect the fate and transport of precursor emissions contributing to ozone formation.

In the summertime, the predominant winds in Berks County come from the west, with the largest components from the west-southwest (20%) and west-northwest (20%). There is also a high frequency of winds from the south-southwest (15%). As shown in Figure 2, below, this indicates that Lebanon County is upwind of the violating monitor in Berks County. Therefore, emissions from Lebanon County likely contribute to ozone concentrations in Berks County. However, since emissions in Lebanon County are relatively low, the relative contribution to ozone concentrations in Berks County is also relatively low.

Figure 2. 30-Year Average Summertime Wind Directions in Berks County, Pennsylvania



To further understand the meteorological transport conditions within the regional area around Reading, we also evaluated 24-hour back trajectories for the 2006-2010 time period, using the National Oceanic and Atmospheric Administration (NOAA) Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) model. The model uses the monitoring location as a starting point, and goes back in time using meteorological data to determine how a parcel of air would have traveled on a given day. EPA evaluated three separate elevations for each exceedance day to better characterize the wind pattern and pollution transport to the monitor.

EPA used HYSPILT to evaluated wind patterns at the violating monitor for all days where the 8-hour average was above the 0.075 ppm standard (exceedance days). The current violating monitor, 42-011-0011, started operating in 2007. It replaced monitor 42-011-0010, which was discontinued at the end of 2006. Table 7 lists the exceedance days and corresponding 8-hour average ozone values for each exceedance day. The air quality monitoring data and HYSPLIT results for those exceedance days are available in the docket for this action.

As shown in Table 7, the years 2007, 2008, and 2010 had more meteorology that was conducive to ozone formation than the years 2006 and 2009.

Table 7. 2006 to 2010 Exceedance-Day 8-Hour Ozone Values at the Violating Reading Monitor

Exceedance Day	Monitor	8-hour average (ppm ozone)		Exceedance Day	Monitor	8-hour average (ppm ozone)
5/30/2006	42-011-0010	0.08		7/9/2007	42-011-0011	0.09
5/31/2006	42-011-0010	0.079		7/10/2007	42-011-0011	0.08
6/1/2006	42-011-0010	0.076		7/30/2007	42-011-0011	0.076
6/17/2006	42-011-0010	0.078		8/2/2007	42-011-0011	0.082

Exceedance Day	Monitor	8-hour average (ppm ozone)		Exceedance Day	Monitor	8-hour average (ppm ozone)
6/18/2006	42-011-0010	0.086		8/3/2007	42-011-0011	0.085
7/11/2006	42-011-0010	0.078		8/15/2007	42-011-0011	0.077
				8/30/2007	42-011-0011	0.078
				9/7/2007	42-011-0011	0.081
				9/21/2007	42-011-0011	0.076
				9/25/2007	42-011-0011	0.083
				4/18/2008	42-011-0011	0.078
				4/19/2008	42-011-0011	0.088
				5/30/2008	42-011-0011	0.077
				6/13/2008	42-011-0011	0.082
				7/16/2008	42-011-0011	0.077
				7/17/2008	42-011-0011	0.077
				7/18/2008	42-011-0011	0.083
				7/19/2008	42-011-0011	0.083
				7/20/2008	42-011-0011	0.078
				7/29/2008	42-011-0011	0.082
				7/30/2008	42-011-0011	0.077
				8/22/2008	42-011-0011	0.084
				9/4/2008	42-011-0011	0.079
				5/22/2009	42-011-0011	0.079
				5/21/2010	42-011-0011	0.076
				5/21/2010	42-011-0011	0.076
				5/27/2010	42-011-0011	0.079
				7/4/2010	42-011-0011	0.077
				7/8/2010	42-011-0011	0.087
				8/10/2010	42-011-0011	0.084
				9/1/2010	42-011-0011	0.087
				9/2/2010	42-011-0011	0.087

Figure 3 overlays HYSPLIT 24-hour back trajectories for all the 2006-2010 ozone exceedances at both Reading monitors on a Google Earth map of the northeastern United States. It gives an overview of long-range transport to the Reading area. As seen in Figure 3, the 24-hour back trajectories indicate regional transport from many directions and over several states.

In Figure 4, below, these EPA has zoomed in on these same 24-hour HYSPLIT back trajectories, showing more of the nearby transport on high ozone days. This zoomed in perspective shows prevailing winds from the southwest, along with winds from the west and south. This correlates reasonably well with the NWS 30-year average wind directly given above, which gave prevailing winds as from the west-southwest (20%), west-northwest (20%), and south-southwest (15%).

Figure 3. NOAA HYSPLIT 24-Hour Back Trajectories for 2006-2010 Exceedances Days - Overview

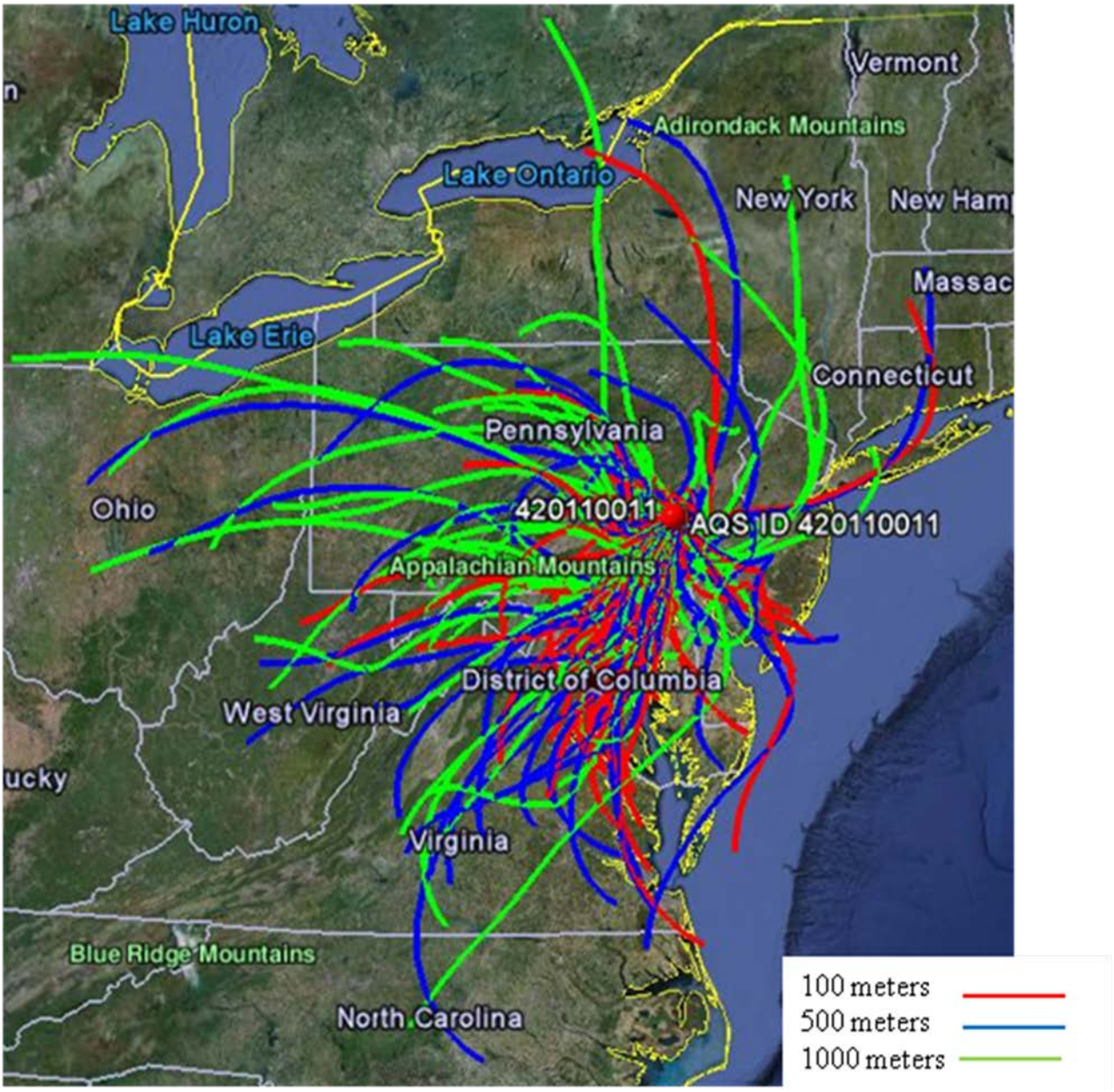
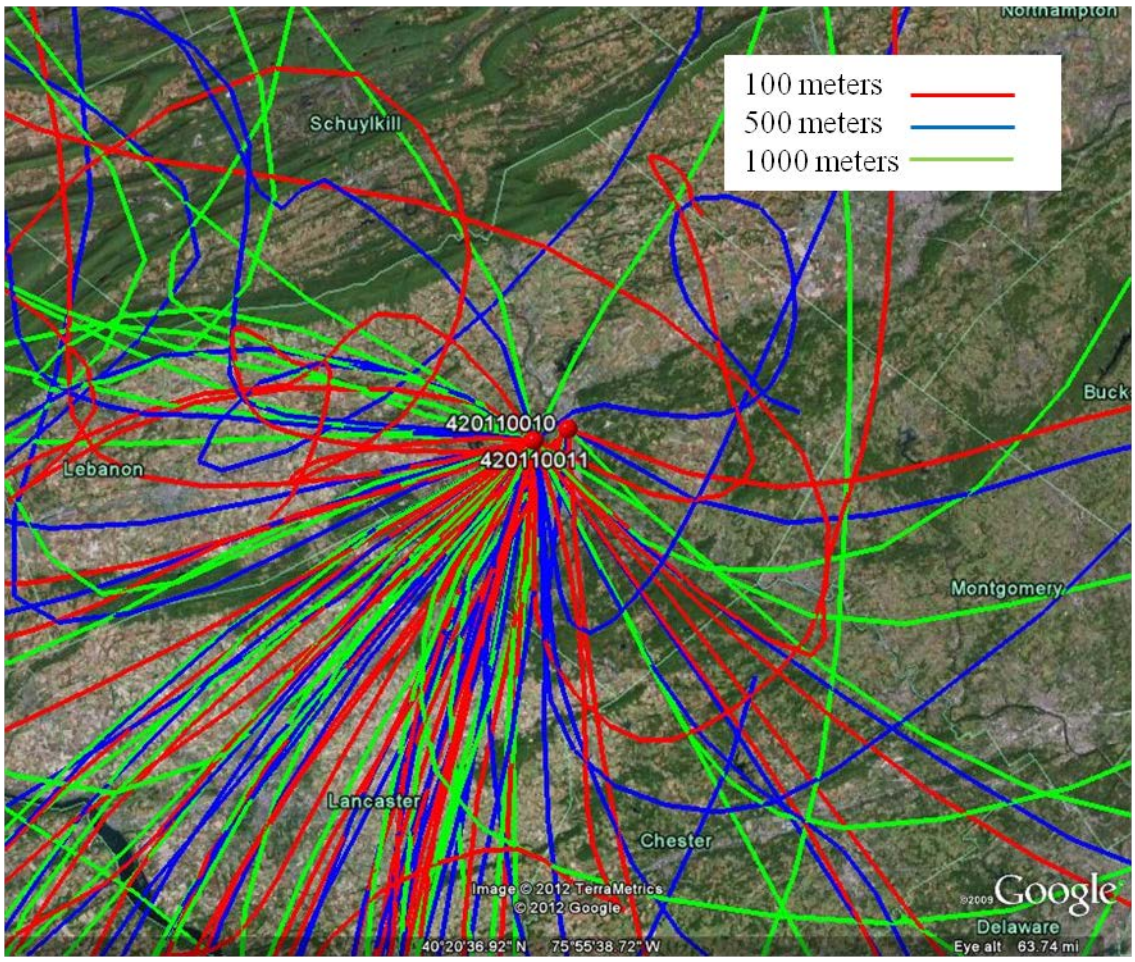
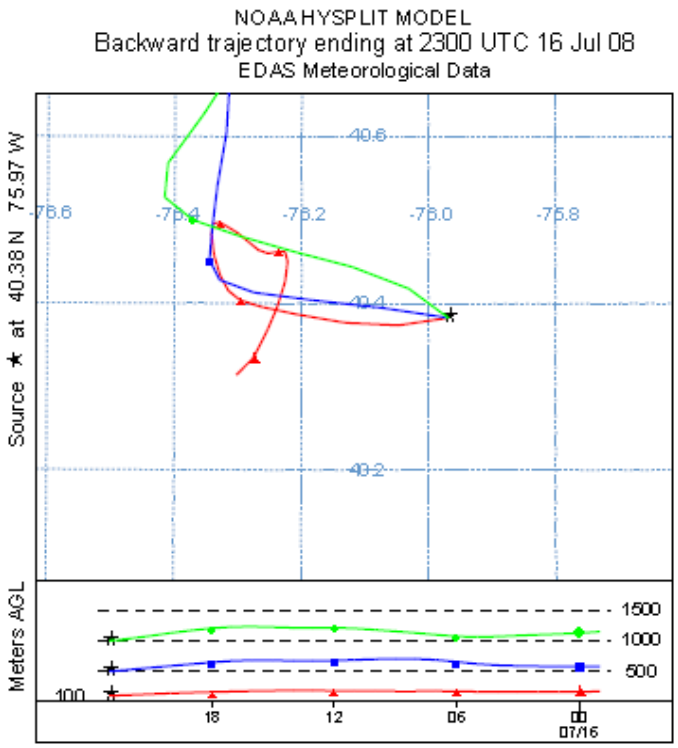


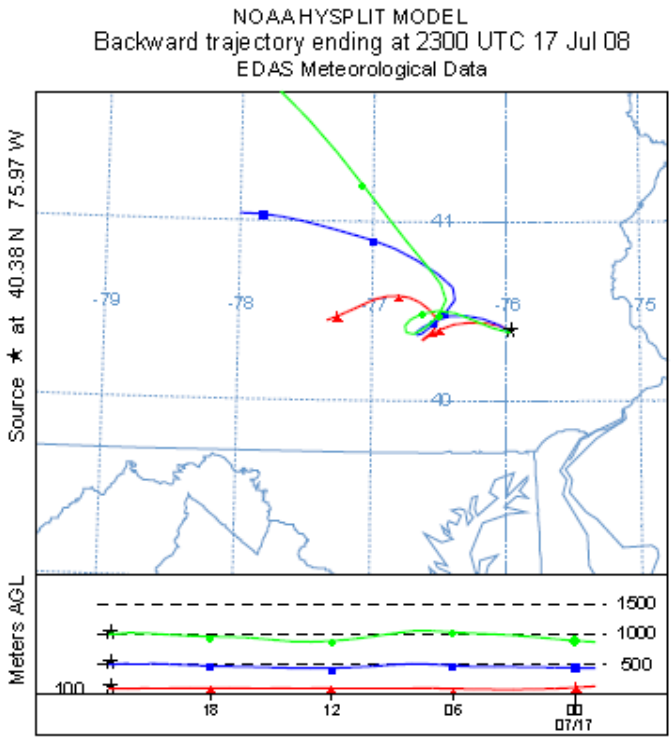
Figure 4. NOAA HYSPLIT 24-Hour Back Trajectories for 2006-2010 Exceedances Days - Zoom View



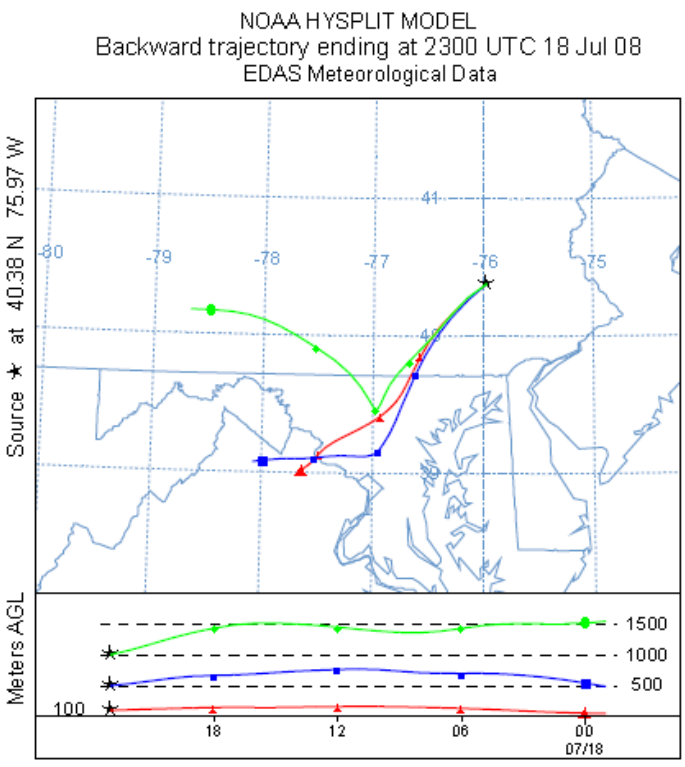
To further illuminate the local transport situation in the Reading area, EPA has selected specific trajectories for a particularly long "ozone episode" that occurred in 2008. As shown in Table 7, for five days in 2008, July 16-20, the 8-hour average ozone value at monitor 42-011-0011 was above the standard. As shown in Figures 7 through 9, during the first two days of the ozone episode, winds at higher elevations were coming from the north, then west. Also at the beginning of the episode, lower level winds (100 meters) changed directions several times, but came from the west to meet the monitor on the exceedance days. The last three days of the ozone episode demonstrated the more dominant wind pattern from the southwest. However, the 1000 meter trajectories reveal interesting shifts in wind direction between twenty-four and 12 hours prior to the exceedance.

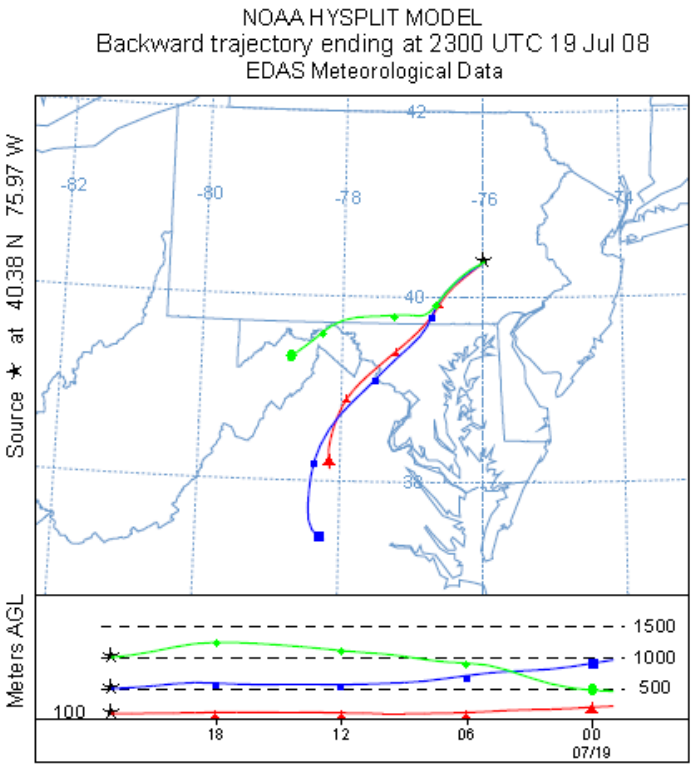
Figures 5 & 6, NOAA HYSPLIT 24-Hour Back Trajectories July 16 & 17, 2008



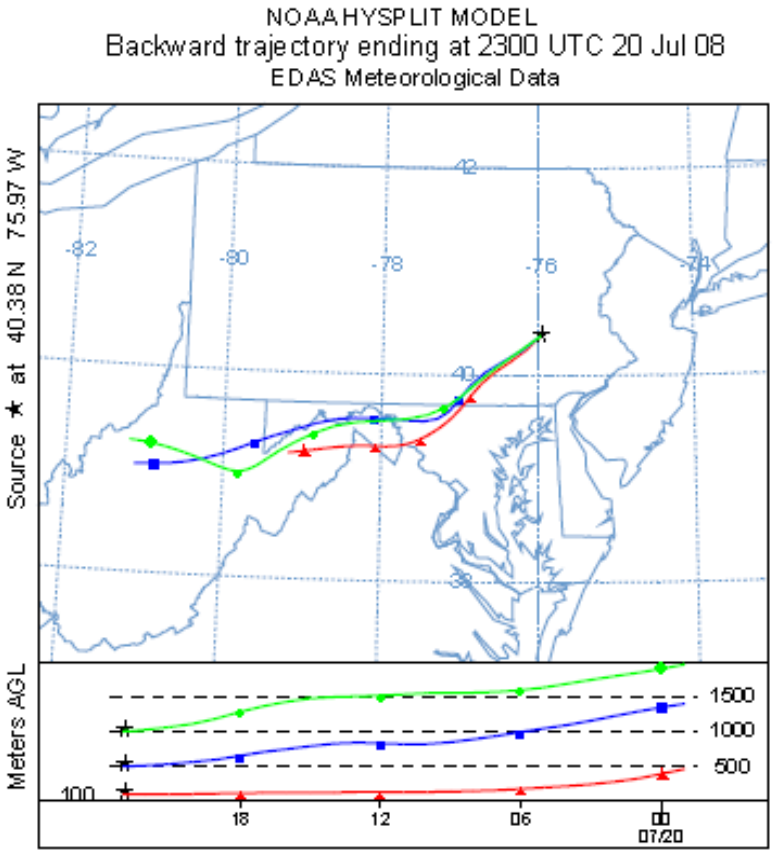


Figures 7 & 8, NOAA HYSPLIT 24-Hour Back Trajectories July 18 & 19, 2008





Figures 9, NOAA HYSPLIT 24-Hour Back Trajectories July 20, 2008



This data confirms that Lebanon and Lancaster Counties are upwind of the violating monitor in Berks County. Therefore, emissions from Lebanon and Lancaster Counties likely contribute to ozone concentrations in Berks County. However, since emissions in Lebanon County are relatively low, the contribution to ozone concentrations in Berks County is also relatively low. Furthermore, Lancaster County is designated nonattainment in the Lancaster area. To the extent that emissions from Lancaster County may contribute ozone concentrations in the Reading nonattainment area, that contribution will be lessened by emission controls put in place in that separate nonattainment area. This analysis also indicates that Schuylkill County is infrequently upwind of the violating monitor in Berks County on exceedance days.

Factor 4: Geography/topography (mountain ranges or other air basin boundaries)

The geography/topography analysis evaluates the physical features of the land that might affect the airshed and, therefore, the distribution of ozone over the area.

The Reading area does not have any geographical or topographical barriers significantly limiting air pollution transport within its air shed. Therefore, there are no barriers to contribution from

upwind areas.

Factor 5: Jurisdictional boundaries

EPA considers existing jurisdictional boundaries for the purposes of providing a clearly defined legal boundary and carrying out the air quality planning and enforcement functions for nonattainment areas. Examples of jurisdictional boundaries include existing/prior nonattainment areas for ozone or other urban-scale pollutants, counties, air districts, townships, metropolitan planning organizations, state lines, Reservations, urban growth boundary, etc. Where existing jurisdictional boundaries are not adequate to describe the nonattainment area, other clearly defined and permanent landmarks or geographic coordinates are used.

The three counties in the area of analysis are in the same state, but otherwise are not connected jurisdictionally. They are served by different **metropolitan planning organizations (MPOs); the Berks County Planning Commission, the** Lebanon County MPO, and the Schuylkill County Planning and Zoning Commission. They are historically in separate nonattainment areas for ozone and fine particulate matter ($PM_{2.5}$). Finally, they are in separate statistical areas, as defined by the US Census Bureau.

The Reading area has a previously-established nonattainment boundary associated with the 1997 8-hour ozone NAAQS, which is the single county of Berks. Pennsylvania has recommended the same boundary for the 2008 ozone NAAQS. The Reading area for the 1997 $PM_{2.5}$.NAAQS also consists of the single county of Berks. Lebanon and Schuylkill Counties have historically been included in nonattainment areas other than the Reading area for ozone and/or $PM_{2.5}$. Lebanon County is part of the Harrisburg area for ozone (1-hour and 8-hour) and $PM_{2.5}$. Schuylkill County was a single-county nonattainment area for the 1-hour ozone NAAQS, and was designated attainment/unclassifiable for the 1997 8-hour NAAQS and $PM_{2.5}$.

According to the Office of Management and Budget's "Standards for Defining Metropolitan and Micropolitan Statistical Areas," published in the Federal Register on December 27, 2000 (65 FR 82228), the "general concept of a Metropolitan Statistical Area or a Micropolitan Statistical Area is that of an area containing a recognized population nucleus and adjacent communities that have a high degree of integration with that nucleus." Being part of a statistical area indicates that counties are linked through employment and commuting. Conversely, being in separate statistical areas implies little interconnection. As stated above, Berks, Lebanon, and Schuylkill Counties are in separate statistical areas. Lebanon County makes up the Lebanon MSA, which is part of the Harrisburg-Carlisle-Lebanon, CSA. Schuylkill County makes up the Pottsville Micropolitan Statistical Area. Berks County makes up the Reading MSA, which is part of the Philadelphia-Camden-Vineland CSA. However, EPA is not including Berks County in the Philadelphia-Wilmington-Atlantic City Area for the 2008 ozone NAAQS, as supported by EPA's five-factor analysis for that area[9].

Furthermore, in Pennsylvania's February 28, 2012 response to EPA's December 9, 2011 "120-day letter", the Commonwealth provided information to respond to public comments on EPA's

[9] See EPA's Technical Analysis for the Philadelphia-Wilmington-Atlantic City nonattainment area.

preliminary recommendations. Comments were submitted to EPA recommending that the agency include Reading (Berks County) in the Philadelphia area because Reading is part of the Philadelphia-Camden-Vineland Consolidated Statistical Area (CSA). The Commonwealth disagrees with this suggestion and supports EPA's proposal to designate Berks County as a single county nonattainment area for the following reasons:

- The Commonwealth's recommendation and EPA's preliminary response are consistent with the Office of Management and Budget (OMB) definition. The OMB defines the Reading metropolitan statistical area as an area that consists of only Berks County. Although the 0MB added Berks County to the Philadelphia CSA in 2006 because of increasing commuting ties to the larger area, Berks County traditionally has its own planning functions, including its own countywide transportation planning organization.
- EPA designated Berks County as a single-county nonattainment area for the 1-hour ozone standard, the 1997 8-hour ozone standard and the 1997 fine particulate matter standard.
- Analysis of the most current work destination data for Berks County' indicates that in 2009, 57.7 percent of the employment of Berks County residents was in Berks County.
- The Reading Air Basin, defined in 25 Pa. Code § 121.1 and codified in 40 CFR 52.2020, covers portions of Berks County and no other county.

Conclusion

Based on the assessment of factors described above, EPA has concluded that the following counties meet the CAA criteria for inclusion in the Reading nonattainment area: Berks County. This is the same county that was included in the Reading nonattainment area for the 1997 ozone NAAQS (now the Reading maintenance area). An air quality monitor in Berks County is violating the 2008 ozone NAAQS based on the 2010 and 2011 DVs, therefore this county must be included in a nonattainment area. EPA has preliminarily concluded that Berks County should be included in the Reading Area.

EPA has concluded that the other counties in this analysis, Lebanon and Schuylkill Counties, do not contribute to ozone violations in Berks County. These counties do not have ozone monitors. These counties have relatively low emissions, populations, and VMT. Dominant ozone season winds in Berks County come from the west and west-southwest. Therefore, Lebanon County is upwind of the violating monitor in Berks County. However, since emissions in Lebanon County are relatively low, the contribution to ozone concentrations in Berks County from upwind emissions in Lebanon County is also relatively low. Furthermore, Lebanon and Schuylkill Counties are not linked jurisdictionally to the Reading area. They are served by different MPOs and they are in separate statistical areas. Therefore, Lebanon and Schuylkill Counties should not be included in the Reading nonattainment area.