west virginia department of environmental protection

Appendix I:
Analysis Downwind Air Quality Context

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Promoting a healthy environment.

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Downwind Air Quality Context

Introduction

As noted in Alpine's June 2018 "Good Neighbor" Modeling[1], West Virginia is projected to be "linked" to the only downwind 2023 nonattainment receptor (Harford, MD) and three maintenance receptors (Gloucester, NJ; Richmond, NY; and Philadelphia, PA) in the nested Mid-Atlantic 4-km region. The Harford County, Maryland monitor is located in the Baltimore, MD Nonattainment Area; the Gloucester, NJ and Philadelphia, PA monitors are located in the Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE Nonattainment Area; and the Richmond, NY monitor is located in the New York-Northern New Jersey-Long Island, NY-NJ-CT Nonattainment Area.

Table 1 shows Alpine's Mid-Atlantic nested 4-km "Good Neighbor" Modeling results, with respect to West Virginia's contribution to the nonattainment and maintenance receptors and the in-state contribution (contribution of the state to its own nonattainment and maintenance monitors).

Table 1
West Virginia Contribution to Nonattainment and Maintenance Receptors identified in Alpine's Nested Mid-Atlantic 4-km Region based on the "Good Neighbor" Modeling Results[2]

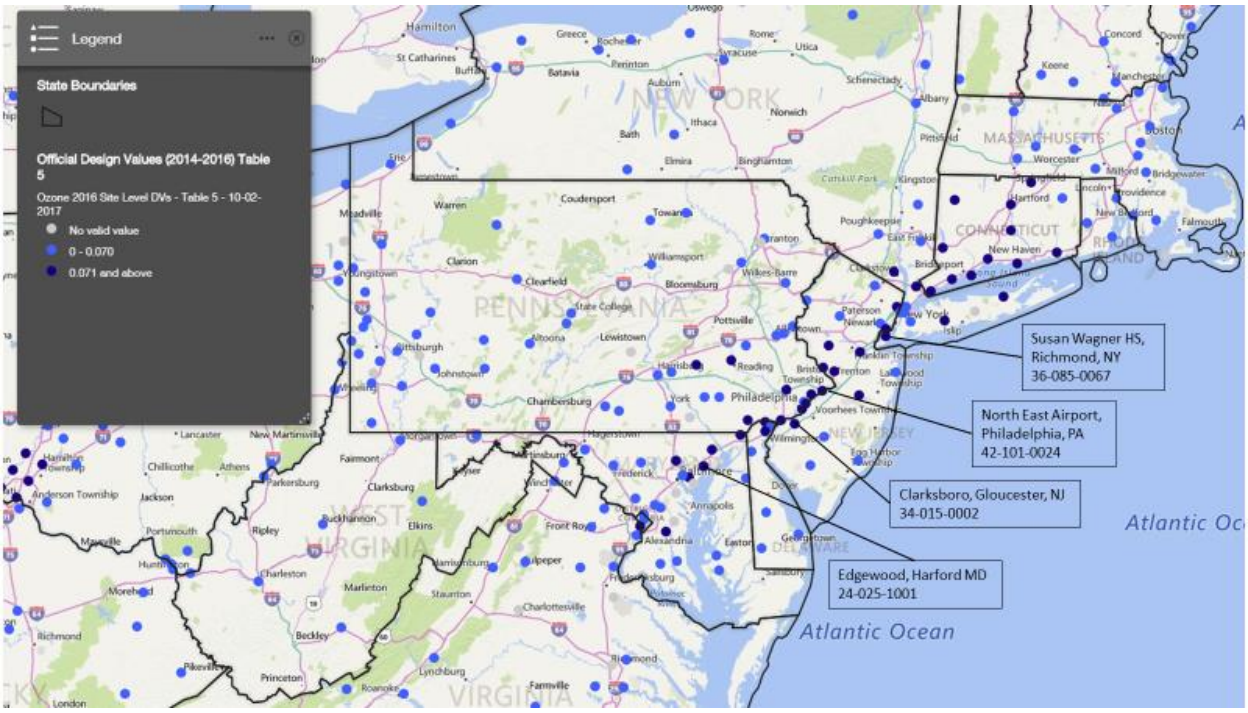
Monitor ID	State	County	2011 DVb	2023 DVf (Avg)	2023 DVf (Max)	In-State Contribution (ppb)	WV Contribution (ppb)
Nonattainment Receptor							
240251001	Maryland	Harford	90.0	71.1	73.5	23.97	2.52
Maintenance Receptors							
90010017	Connecticut	Fairfield	80.3	69.2	71.5	6.36	0.52
90013007	Connecticut	Fairfield	84.3	69.7	73.6	5.19	0.44
90019003	Connecticut	Fairfield	83.6	69.9	72.7	4.97	0.53
90099002	Connecticut	New Haven	85.7	70.3	73.0	9.60	0.35
90110124	Connecticut	New London	80.3	68.2	71.3	9.89	0.32
340150002	New Jersey	Gloucester	84.3	68.8	71.0	4.51	1.63
360850067	New York	Richmond	81.3	69.6	71.0	3.19	0.71
361030002	New York	Suffolk	83.3	70.7	72.1	10.10	0.65
421020024	Pennsylvania	Philadelphia	83.3	68.0	71.0	14.70	1.21

Note: a value of 70.9 ppb (or less) is considered to be in attainment of the 2015 ozone NAAQS, and a value of 71.0 ppb (or higher) is considered to be in violation of the 2015 ozone NAAQS.
Contributions shown in RED identify monitors to which WV is "linked."

[1] Alpine Geophysics, LLC, "Good Neighbor" Modeling Technical Support Document for 8-Hour Ozone State Implementation Plans, Final Technical Support Document, June 2018. (http://www.midwestozonegroup.com/files/FinalTSD-OzoneModelingSupportingGNSIPObligationsJune2018.pdf)
[2] Id., p. 35.

The projected 2023 nonattainment monitor and the three 2023 projected maintenance monitors to which West Virginia is "linked" are identified in Figure 1, which shows the ozone monitoring sites, color coded by their 2014-2016 ozone design values. As shown in Figure 1, the monitors in the Northeast that exceed the 2015 ozone NAAQS are located along the Interstate 95 (I-95) Corridor.

Figure 1. Ozone Monitoring Sites, 2014-2016 Design Values[3]



West Virginia conducted analyses of the Baltimore, MD area, the Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE area, and the New York-Northern New Jersey-Long Island, NY-NJ-CT area. The Baltimore area includes the City of Baltimore, and Anne Arundel, Baltimore, Carroll, Harford, and Howard Counties. The Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE area includes five counties in Pennsylvania – Bucks, Chester, Delaware, Montgomery and Philadelphia; nine counties in New Jersey – Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Mercer, Ocean and Salem; one county in Maryland – Cecil; and one county in Delaware – New Castle. The New York-Northern New Jersey-Long Island, NY-NJ-CT area includes nine counties in New York – Bronx, Kings, Nassau, New York, Queens, Richmond, Rockland, Suffolk and Westchester; 12 counties in New Jersey – Bergen, Essex, Hudson, Hunterdon, Middlesex, Monmouth, Morris, Passaic, Somerset, Sussex, Union and Warren; and two counties in Connecticut – Fairfield and Middlesex. [4]

[3] Ozone Designations Mapping Tool – Official Design Values. https://epa.maps.arcgis.com/apps/webappviewer/index.html?id=6a89e7170dd147b1852ec11ccb3880e8

[4] 83FR25776, 04JUN2018

Projected Nonattainment Area: Baltimore, MD

Projected Nonattainment Monitor: Edgewood, Harford, Maryland (24-025-1001)

The Baltimore, MD nonattainment area consists of the Baltimore-Columbia-Towson, MD Core Based Statistical Area (CBSA). A CBSA consists of the counties or equivalent entities associated with at least one core (urbanized area or urban cluster) of at least 10,000 population, plus adjacent counties having a high degree of social and economic integration with the core as measured through commuting ties with the counties associated with the core. The general concept of a CBSA is that of a core area containing a substantial population nucleus, together with adjacent communities having a high degree of economic and social integration with that core. The term "core based statistical area" became effective in 2003 and refers collectively to metropolitan statistical areas and micropolitan statistical areas[5]. Figure 2 shows the Baltimore-Columbia-Towson, MD CBSA.

Figure 2. Baltimore-Columbia-Towson, MD CBSA[6]

As noted by Maryland DEP, in their Ambient Air Monitoring Network Plan for Calendar Year 2018[7],

[5] https://www.census.gov/geo/reference/gtc/gtc_cbsa.html
[6] EPA Ozone Designation Mapping Tool
[7] http://www.mde.state.md.us/programs/Air/AirQualityMonitoring/Documents/MDNetworkPlanCY2018.pdf

Within an O_3 network, at least one O_3 site for each MSA [Metropolitan Statistical Area] must be designed to record the maximum concentration for that particular metropolitan area. More than one maximum concentration site may be necessary in some areas. Since O_3 requires appreciable formation time, the mixing of reactants and products occurs over large volumes of air, and this reduces the importance of monitoring small-scale spatial variability. The appropriate spatial scales for O_3 sites are neighborhood, urban, and regional.

The prospective maximum concentration monitor site should be selected in a direction from the city that is most likely to observe the highest O_3 concentrations, more specifically, downwind during periods of photochemical activity. For the Baltimore-Columbia-Towson, MD MSA, Essex, Edgewood, and Aldino are assigned this designation.

The Essex, Edgewood and Aldino monitors are identified in Figure 2.

Air Quality Data

There are seven monitors located in the Baltimore, MD Nonattainment Area. The 3-year design values for the 2006-2008 period through the 2015-2017 period are shown in Table 2 and Figure 3, below. The Edgewood monitor, the only monitor outside of California projected to be in nonattainment in 2023, is highlighted in yellow in Table 2.

Table 2. 3-Year Ozone Design Values (ppm) at Monitors in Baltimore, MD Nonattainment Area

AQS Site ID	Local Site Name	2006-2008	2007-2009	2008-2010	2009-2011	2010-2012	2011-2013	2012-2014	2013-2015	2014-2016	2015-2017
240030014	Davidsonville	0.087	0.080	0.079	0.081	0.087	0.081	0.074	0.069		
240051007	Padonia	0.080	0.075	0.077	0.077	0.082	0.078	0.072	0.071	0.072	
240053001	Essex	0.085	0.078	0.078	0.080	0.084	0.078	0.072	0.069	0.072	0.073
240130001	South Carroll	0.083	0.078	0.076	0.076	0.079	0.074	0.069	0.067	0.068	0.069
240251001	**Edgewood**	**0.091**	**0.087**	**0.089**	**0.092**	**0.093**	**0.085**	**0.075**	**0.071**	**0.072**	**0.075**
240259001	Aldino	0.089	0.082	0.078	0.078	0.082	0.078	0.073	0.070	0.073	0.073
245100054	Furley		0.067	0.067	0.074	0.075	0.072	0.064		0.066	0.069

Figure 3. 3-Year Ozone Design Values (ppm) at Monitors in Baltimore, MD Nonattainment Area

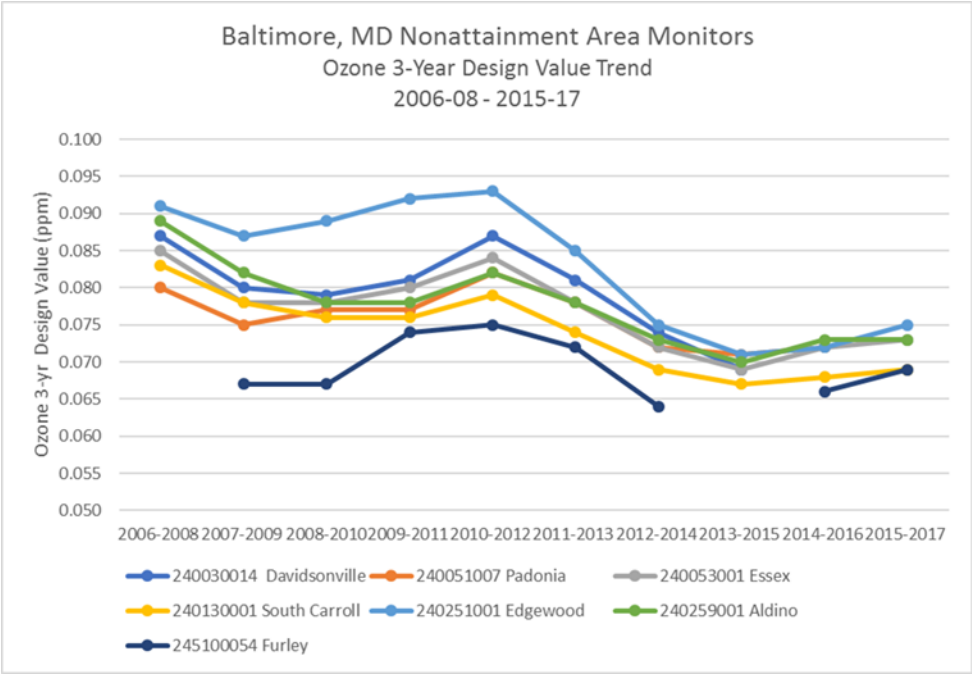


Table 3 shows the distance between the Edgewood monitor and the other monitors in the nonattainment area. The large differences in ozone concentrations between nearby monitors is indicative of strong local contributions.

Table 3. Distance Between Edgewood and Other Monitors in the Baltimore Nonattainment Area

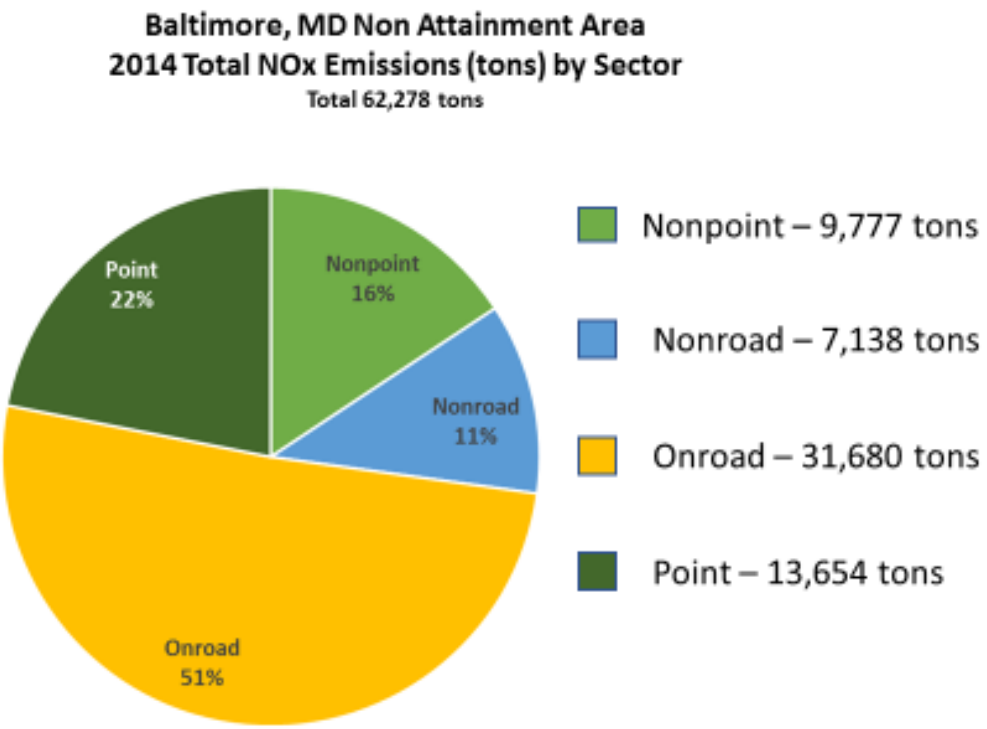
AQS Site ID	Local Site Name	Latitude	Longitude	Distance to Edgewood Monitor (miles)
240030014	Davidsonville	38.9025	-76.653056	39.93
240051007	Padonia	39.460478	-76.633543	18.30
240053001	Essex	39.310833	-76.474444	11.71
240130001	South Carroll	39.444294	-77.042252	39.85
240251001	**Edgewood**	**39.410191**	**-76.296946**	**0.00**
240259001	Aldino	39.563333	-76.203889	11.69
245100054	Furley	39.328807	-76.553075	14.79

As shown in Figure 3 and Table 2, the Edgewood monitor had the highest design value for nine of the past ten years, with design values consistently higher than other monitors in the area. This is indicative of a strong local influence.

Emissions Data

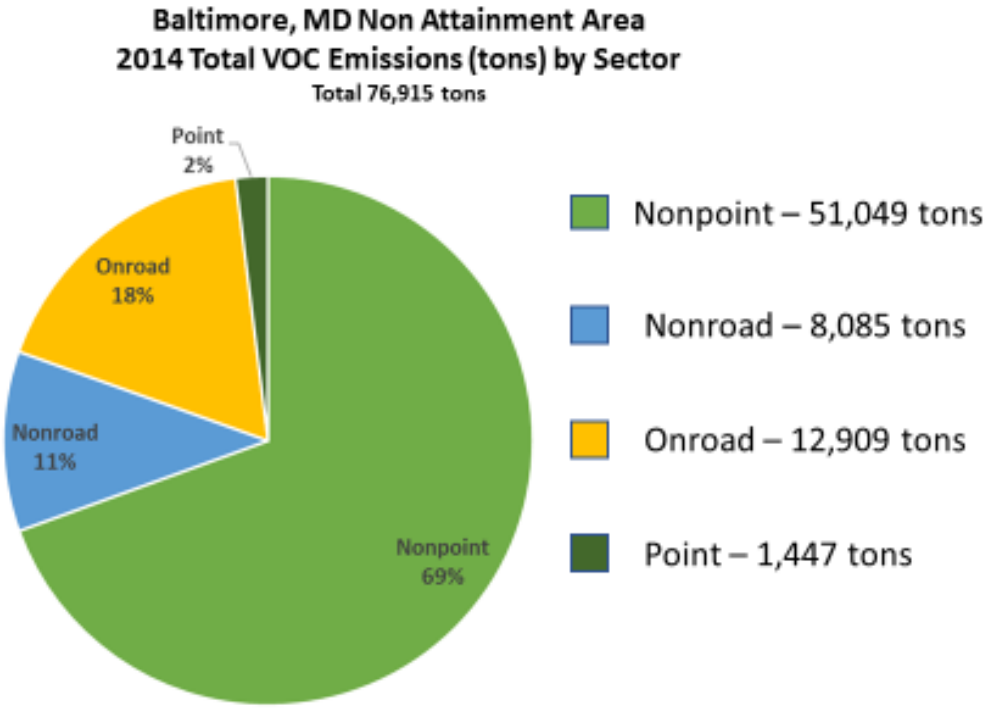
The 2014 National Emissions Inventory (NEI) data for NO_x and VOC, the precursors for ozone, are shown in Figures 4 and 5, respectively, for the Baltimore nonattainment area. As shown in Figure 4 below, for NO_x emissions in the area, Onroad sources accounted for 51 percent, Point sources accounted for 22 percent, Nonpoint sources accounted for 16 percent and Nonroad sources accounted for 11 percent. As shown in Figure 5, below, for VOC emissions, Nonpoint sources accounted for 69 percent, Onroad sources accounted for 18 percent, Nonroad sources accounted for 11 percent and Point sources accounted for 2 percent.

Figure 4. Baltimore, MD Nonattainment Area NO_x Emissions[8]



[8] EPA Ozone Designation Mapping Tool

Figure 5. Baltimore, MD Nonattainment Area VOC Emissions[9]



It is apparent that Onroad sources are the dominant contributor to NO_x in the Baltimore Area, and Nonpoint sources are the dominant contributor to VOC emissions in the area.

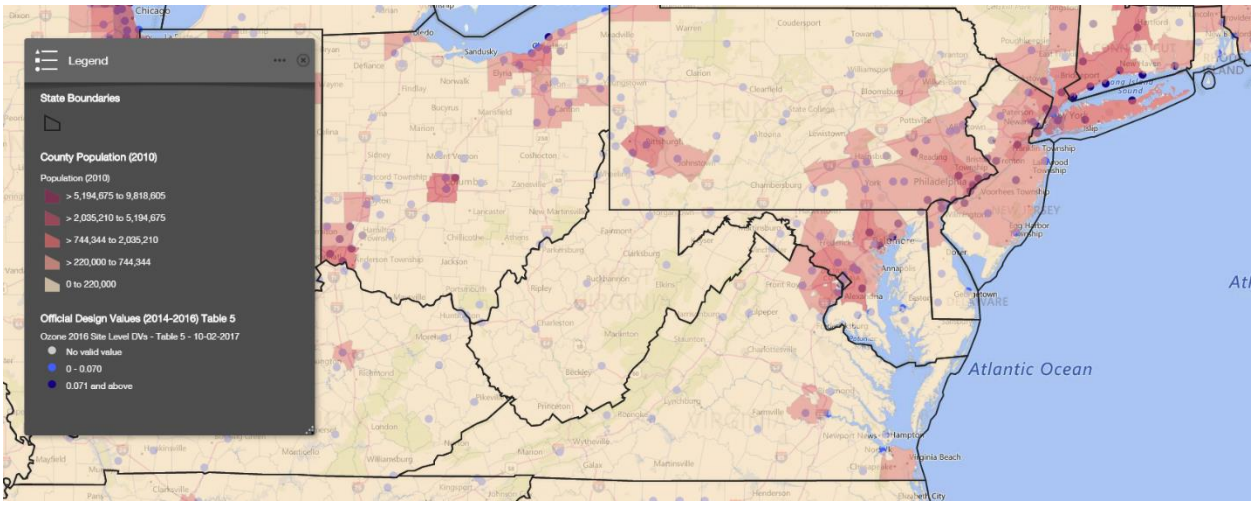
Population

As EPA noted in the *Baltimore, MD and Washington, DC-MD-VA Nonattainment Areas Final Areas Designations for the 2015 Ozone National Air Quality Standards Technical Support Document (TSD)*, the nonattainment area has a total population of 2,748,503 people. The areas included in the Baltimore CBSA have a wide diversity of population densities, ranging from 131 people per square mile (Queen Anne's, MD) to 7,682 people per square mile (Baltimore City, MD). Those living in Harford and Baltimore Counties account for almost 40 percent of the population residing within the Baltimore CBSA. This population is in close proximity to the Edgewood, Harford County monitor. [10] Figure 6 shows the population density in the northeast.

[9] EPA Ozone Designation Mapping Tool

[10] EPA, *Baltimore, MD and Washington, DC-MD-VA Nonattainment Areas Final Areas Designations for the 2015 Ozone National Air Quality Standards Technical Support Document (TSD), p. 20.* https://www.regulations.gov/searchResults?rpp=25&po=0&s=EPA-HQ-OAR-2017-0548-0410&fp=true&ns=true

Figure 6. County Level Population[11]



Traffic and Vehicle Miles Traveled

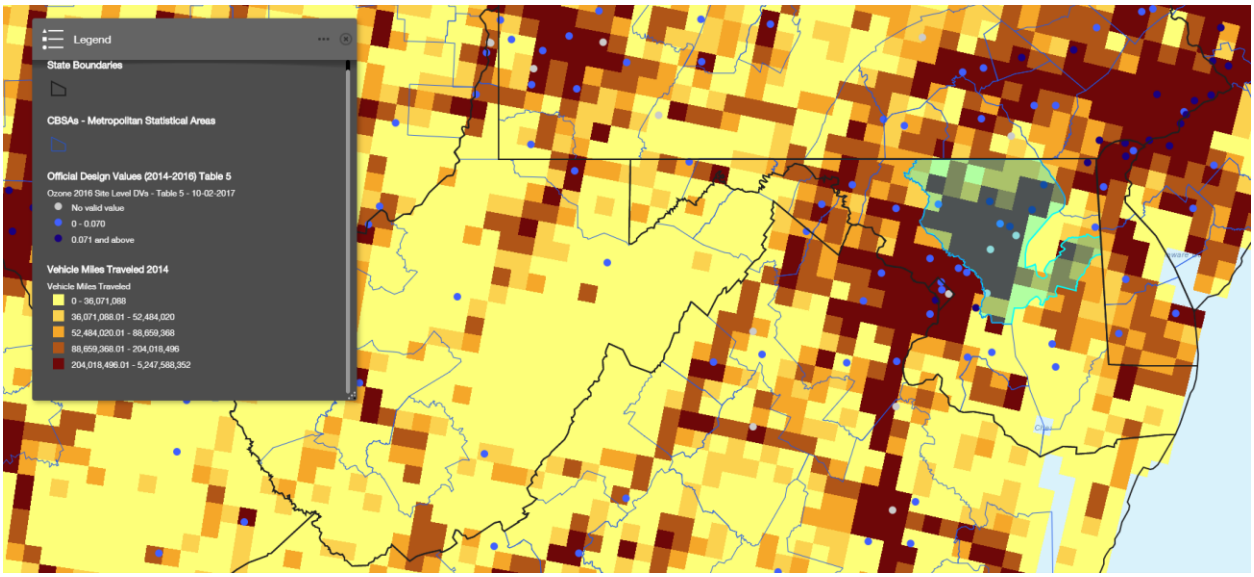
As EPA noted in the *Baltimore, MD and Washington, DC-MD-VA Nonattainment Areas Final Areas Designations for the 2015 Ozone National Air Quality Standards Technical Support Document (TSD),* generally a county with high VMT and/or a high number of commuters is an integral part of an urban area and indicates the presence of motor vehicle emissions which may contribute to a violation of the NAAQS.[12] Figure 7 shows the VMT for the Baltimore nonattainment area and surrounding areas.

As noted earlier, the monitors in the northeast that are not meeting the 2015 Ozone NAAQS are located along the I-95 corridor, in areas with high population density and large VMT, as shown in Figures 6 and 7. The VMT data, in conjunction with the emissions data, indicate that Mobile source emissions are a significant contributor to the ozone problem in the Baltimore area.

[11] EPA Ozone Designation Mapping Tool

[12] EPA, *Baltimore, MD and Washington, DC-MD-VA Nonattainment Areas Final Areas Designations for the 2015 Ozone National Air Quality Standards Technical Support Document (TSD), p. 21.* *https://www.regulations.gov/searchResults?rpp=25&po=0&s=EPA-HQ-OAR-2017-0548-0410&fp=true&ns=true*

Figure 7. Vehicle Miles Traveled in the Baltimore Nonattainment Area and Surrounding Areas[13]



Meteorology

As EPA noted in the Baltimore Area TSD, the evaluation of meteorological data is a helpful tool in the assessment of the fate and transport of emissions contributing to ozone concentration and identifying potential contributors to ozone concentrations. To determine how meteorological conditions including, but not limited to, weather, transport pattern, and stagnation conditions, could affect the fate and transport of ozone precursor emissions from sources in the area, EPA used HYSPLIT (Hybrid Single-Particle Lagrangian Integrated Trajectory) trajectories at 100, 500 and 1,000 meters above ground level (AGL) to illustrate the 3-dimensional paths traveled by air parcels to a monitor.[14]

Figures 8 and 9 show the HYSPLIT back trajectories for each day the maximum 8-hour ozone concentration exceeded the 2015 ozone NAAQS (ozone exceedance day) for the Edgewood monitor for 2015 and 2016, respectively. Figure 10 shows the HYSPLIT back trajectories for 2015 and 2016 for each ozone exceedance day at the Edgewood monitor and the gridded VMT for 2014. These figures show the Baltimore and Washington, DC area contribute heavily to the Harford County monitor, with strong influences from the I-95 corridor.

[13] EPA Ozone Designation Mapping Tool
[14] EPA, *Baltimore, MD and Washington, DC-MD-VA Nonattainment Areas Final Areas Designations for the 2015 Ozone National Air Quality Standards Technical Support Document (TSD), p. 24.* https://www.regulations.gov/searchResults?rpp=25&po=0&s=EPA-HQ-OAR-2017-0548-0410&fp=true&ns=true

Figure 8. 2015 HYSPLIT Back Trajectories: Edgewood, Harford Co., MD Monitor (240251001)[15]

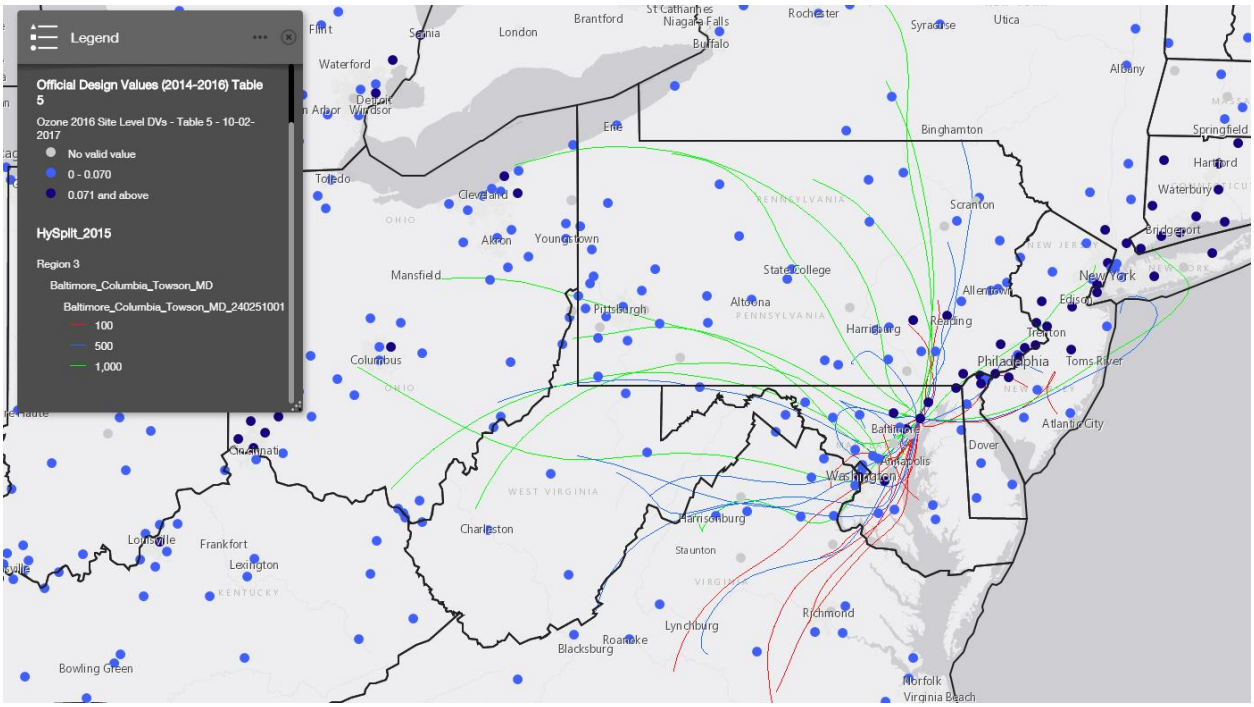
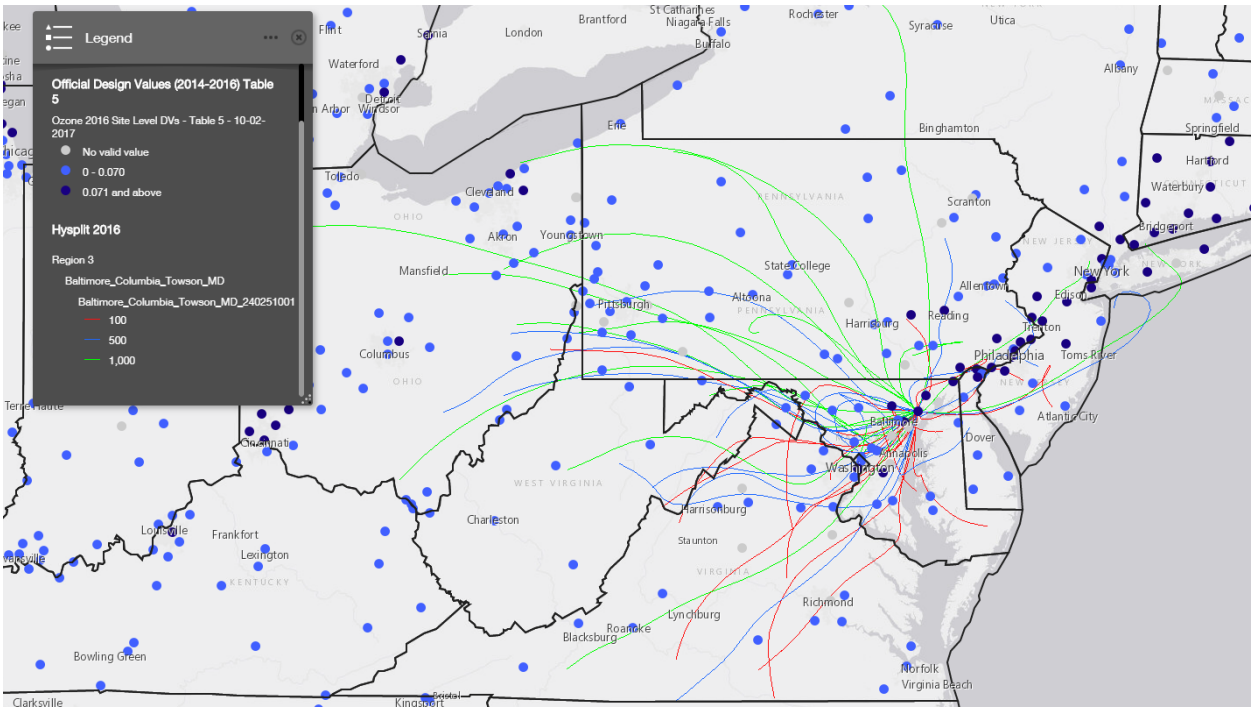
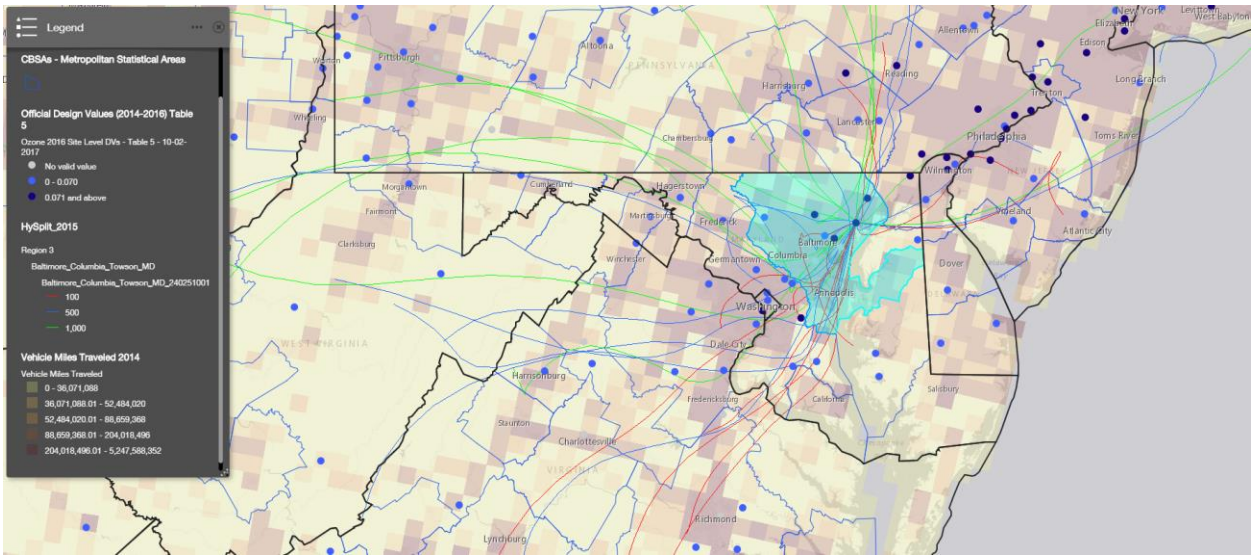


Figure 9. 2016 HYSPLIT Back Trajectories: Edgewood, Harford Co., MD Monitor (240251001)[16]



[15] EPA Ozone Designation Mapping Tool
[16] EPA Ozone Designation Mapping Tool

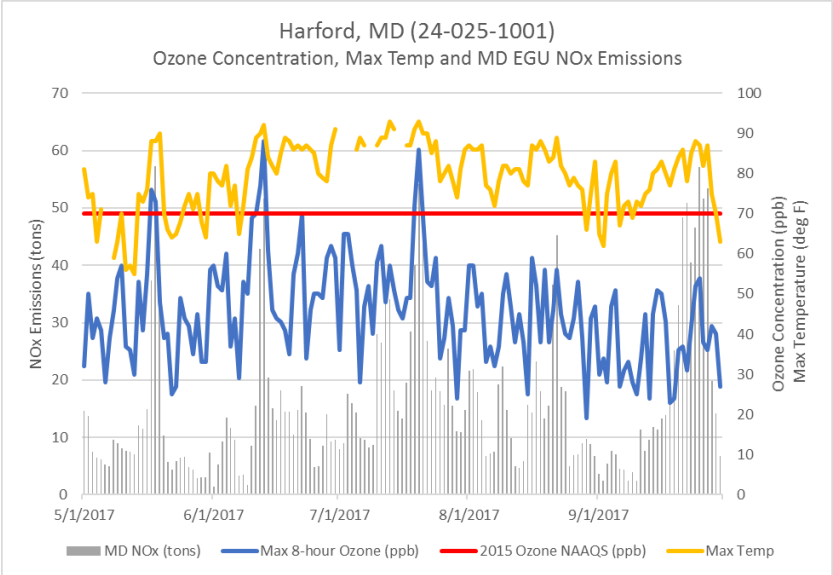
Figure 10. 2015 and 2016 HYSPLIT Back Trajectories for the Edgewood, Harford Co., MD Monitor and 2014 VMT[17]



WVDAQ analyzed the daily emissions from large electric generating units (EGUs) in Maryland, maximum daily temperature, and daily maximum 8-hour ozone concentrations at the Edgewood, Harford County, MD Monitor (240251001). The agency analyzed the 2017 ozone season Air Markets Program Data (AMPD) for Maryland. The AMPD for 2017 was selected for analysis because it reflects the first ozone season during which the CSAPR Update was implemented. Daily data for the 2017 ozone season for all sources subject to the CSAPR NO_x Ozone Season Group 2 program was downloaded from the AMPD website.[18] Daily ozone data was downloaded from EPA's Outdoor Air Quality data website.[19] Maximum daily temperature data for the Phillips Army Airfield, in the Baltimore area was downloaded from Weather Underground's Historical Weather website.[20] Figure 11 clearly shows a strong correlation between EGU emissions, maximum temperature and the maximum 8-hour ozone concentrations at the Edgewood, Harford County, MD monitor.

[17] EPA Ozone Designation Mapping Tool
[18] https://www.epa.gov/airmarkets
[19] https://www.epa.gov/outdoor-air-quality-data/download-daily-data
[20] http://api.wunderground.com/history/

Figure 11. Daily Ozone Concentration at the Edgewood, Harford Co., MD Monitor and Maximum Temperature and Maryland EGU Emissions



Conclusion

In the Alpine 2018 TSD, the results of the nested 4-km modeling project a 2023 average design value of 71.1 ppb for the Harford, MD receptor. Maryland has a projected contribution to the Harford, MD monitor of 23.97 ppb (33.7%), and the following states are projected to have a significant contribution: Virginia/DC, 3.92 ppb (5.5%); Ohio, 3.02 ppb (4.2%); Pennsylvania, 2.70 ppb (3.8%); West Virginia, 2.52 ppb (3.5%); Kentucky, 2.07 ppb (2.9%); Indiana, 1.81 ppb (2.5%); Illinois, 1.05 ppb (1.5%); and Texas, 0.90 ppb (1.3%). Boundary conditions account for 11.34 ppb (15.9%).[21]

It is clear the ozone concentrations at the Edgewood, Harford Co., MD monitor are strongly influenced by the large contribution from mobile sources along the I-95 corridor, the large population in the area, and the nearby Washington, DC-MD-VA Nonattainment Area.

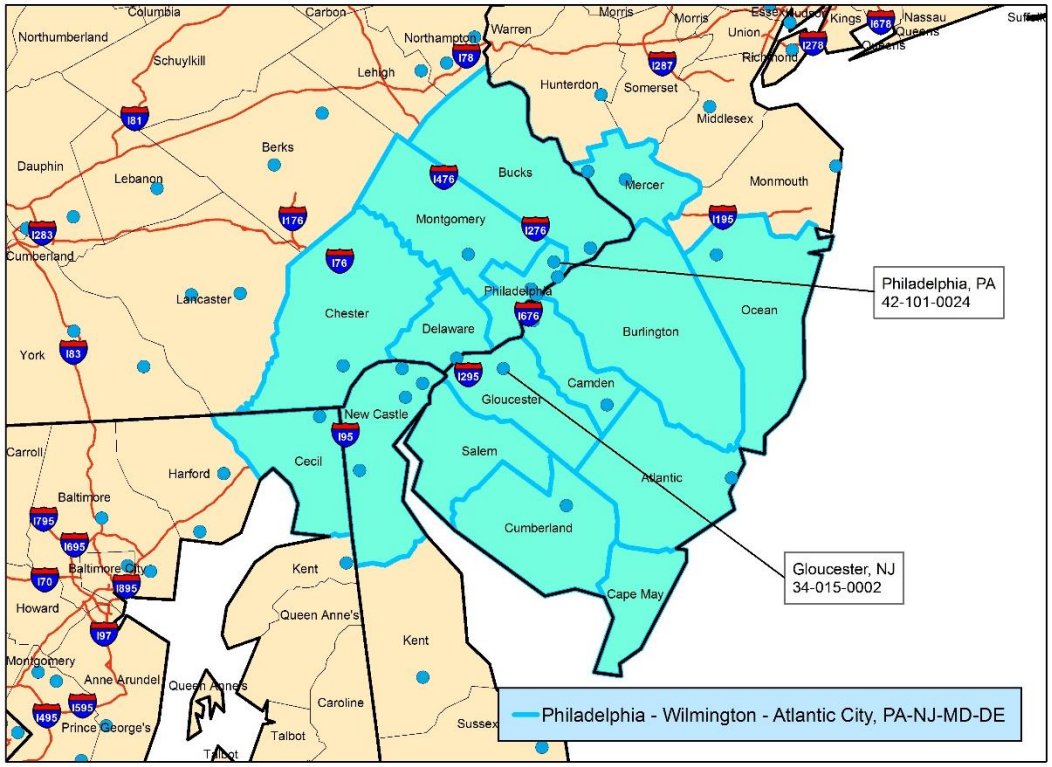
[21] Alpine Geophysics, June 2018, p. 35.

Projected Maintenance Area: Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE

Projected Maintenance Monitors: Philadelphia, PA (421010024), Gloucester, NJ (340150002)

The Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE area includes five counties in Pennsylvania – Bucks, Chester, Delaware, Montgomery and Philadelphia; nine counties in New Jersey – Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Mercer, Ocean and Salem; one county in Maryland – Cecil; and one county in Delaware – New Castle. Figure 12 shows the Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE Nonattainment Area.

Figure 12. Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE Nonattainment Area



Air Quality Data

There have been 22 ozone monitors located in the Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE area, with the number varying over the years. Currently there are 19 monitors. The 3-year design values for the 2006-2008 period through the 2015-2017 period are shown in Table 4 and Figure 13. The two monitors that are projected to be maintenance monitors in 2023 are highlighted in yellow in Table 4.

Table 4. 3-Year Ozone Design Values (ppm) at Monitors in the Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE Nonattainment Area

State	AQS Site ID	County	2006 - 2008	2007 - 2009	2008 - 2010	2009 - 2011	2010 - 2012	2011 - 2013	2012 - 2014	2013 - 2015	2014 - 2016	2015 - 2017
DE	100031007	New Castle	0.080	0.075	0.075	0.075	0.080	0.074	0.071	0.066	0.068	0.067
DE	100031010	New Castle	0.083	0.078	0.076	0.075	0.078	0.073	0.071		0.074	0.074
DE	100031013	New Castle	0.078	0.074	0.075	0.077	0.080	0.076	0.071	0.068	0.070	0.071
DE	100032004	New Castle						0.075	0.071		0.071	0.072
MD	240150003	Cecil	0.090	0.084	0.080	0.081	0.086	0.082	0.077	0.073	0.074	0.074
NJ	340010006	Atlantic		0.073	0.074	0.074	0.076	0.073	0.069	0.066	0.064	0.064
NJ	340070002	Camden							0.073	0.070	0.074	0.077
NJ	340070003	Camden	0.087									
NJ	340071001	Camden	0.086	0.081	0.080	0.080	0.087	0.081	0.076	0.069	0.068	0.068
NJ	340110007	Cumberland	0.081	0.078	0.076	0.071	0.075	0.070	0.070	0.065	0.067	0.066
NJ	**340150002**	**Gloucester**	**0.087**	**0.083**	**0.081**	**0.082**	**0.087**	**0.084**	**0.076**	**0.073**	**0.073**	**0.074**
NJ	340210005	Mercer	0.087	0.081	0.078	0.078	0.081	0.076	0.073	0.071	0.071	0.071
NJ	340219991	Mercer						0.076	0.073	0.071	0.073	0.073
NJ	340290006	Ocean	0.087	0.080	0.081	0.081	0.085	0.080	0.075	0.072	0.072	0.073
PA	420170012	Bucks	0.092	0.088	0.083	0.080	0.083	0.078	0.075	0.075	0.077	0.080
PA	420290100	Chester	0.082	0.077	0.076	0.074	0.079	0.076	0.073	0.069	0.071	0.073
PA	420450002	Delaware	0.083	0.077	0.074	0.073	0.078	0.076	0.074	0.072	0.072	0.071
PA	420910013	Montgomery	0.084	0.079	0.078	0.077	0.078	0.074	0.072	0.071	0.070	
PA	421010004	Philadelphia	0.067	0.064	0.066	0.068	0.070	0.060	0.056	0.054	0.061	
PA	**421010024**	**Philadelphia**	**0.089**	**0.084**	**0.082**	**0.083**	**0.087**	**0.080**	**0.075**	**0.073**	**0.077**	**0.078**
PA	421010048	Philadelphia									0.074	0.076
PA	421011002	Philadelphia						0.080				

Figure 13. 3-Year Ozone Design Values (ppm) at Monitors in the Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE Nonattainment Area

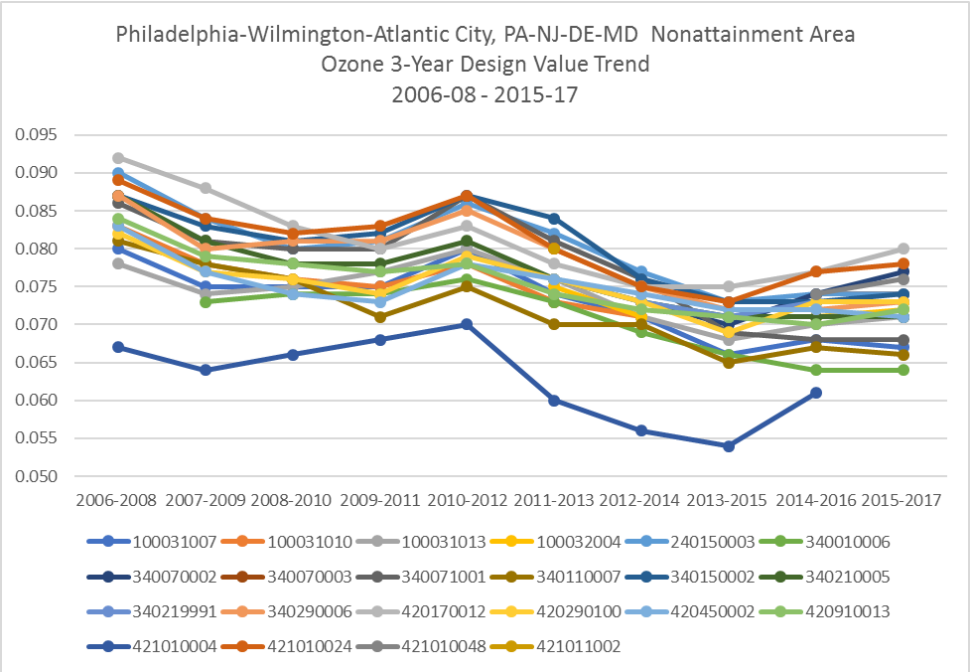


Table 5 shows the distance between the Gloucester, NJ and Philadelphia, PA monitors that are projected to be maintenance monitors in 2023 and the other monitors in the Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE Nonattainment Area.

Table 5. Distance Between Gloucester, NJ (340150002) and Philadelphia, PA (421010024) Monitors and Other Monitors in the Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE Nonattainment Area

State	AQS Site ID	County	Latitude	Longitude	Distance to Gloucester, NJ Monitor [340150002] (miles)	Distance to Philadelphia, PA Monitor [421010024] (miles)
DE	100031007	New Castle	39.5513	-75.732	32.56	52.69
DE	100031010	New Castle	39.817222	-75.563889	18.71	34.28
DE	100031013	New Castle	39.773889	-75.496389	15.20	33.10
DE	100032004	New Castle	39.739444	-75.558056	18.85	37.14
MD	240150003	Cecil	39.701444	-75.860051	35.09	51.89
NJ	340010006	Atlantic	39.464872	-74.448736	46.77	51.77
NJ	340070002	Camden	39.934446	-75.125291	10.35	11.50
NJ	340070003	Camden	39.923042	-75.097617	10.43	11.52
NJ	340071001	Camden	39.68425	-74.861491	20.28	28.24
NJ	340110007	Cumberland	39.422273	-75.025204	27.95	45.20
NJ	**340150002**	**Gloucester**	**39.800339**	**-75.212119**	**0.00**	**21.28**
NJ	340210005	Mercer	40.283092	-74.742644	41.58	20.15
NJ	340219991	Mercer	40.3125	-74.8729	39.67	17.89
NJ	340290006	Ocean	40.06483	-74.44405	44.61	30.04
PA	420170012	Bucks	40.107222	-74.882222	27.48	7.18
PA	420290100	Chester	39.834461	-75.768242	29.61	43.40
PA	420450002	Delaware	39.835556	-75.3725	8.85	25.33
PA	420910013	Montgomery	40.112222	-75.309167	22.15	15.90
PA	421010004	Philadelphia	40.008889	-75.09778	15.63	6.51
PA	**421010024**	**Philadelphia**	**40.076389**	**-75.011944**	**21.82**	**0.00**
PA	421010048	Philadelphia	39.991389	-75.080833	14.92	6.91
PA	421011002	Philadelphia	40.035985	-75.002405	19.71	2.84

The large differences in ozone concentrations between nearby monitors is indicative of strong local influence at the monitors with high concentrations. For example, the 2013-2015 and 2014-2016 design values for the Philadelphia monitor 421010004 were 0.054 and 0.061 ppm, respectively, while the 2013-2015 and 2014-2016 design values for monitor 421010024, the projected 2023 maintenance monitor, were 0.073 and 0.077 ppm, respectively. These monitors are located just 6.51 miles apart.

Emissions Data

The 2014 NEI data for NO_x and VOC is shown in Figures 14 and 15, respectively, for the Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE Nonattainment Area. As shown in Figure 14 below, for NO_x emissions in the area, Onroad sources accounted for 46 percent, Nonpoint sources accounted for 27 percent, Point sources accounted for 14 percent, and Nonroad sources accounted for 13 percent. As shown in Figure 15 below, for VOC emissions, Nonpoint sources accounted for 72 percent, Onroad sources accounted for 14 percent, Nonroad sources accounted for 11 percent and Point sources accounted for just 3 percent.

Figure 14. Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE Nonattainment Area NO_x Emissions

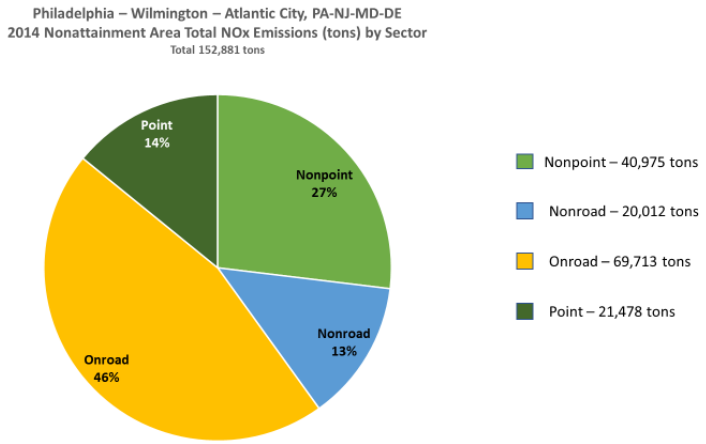
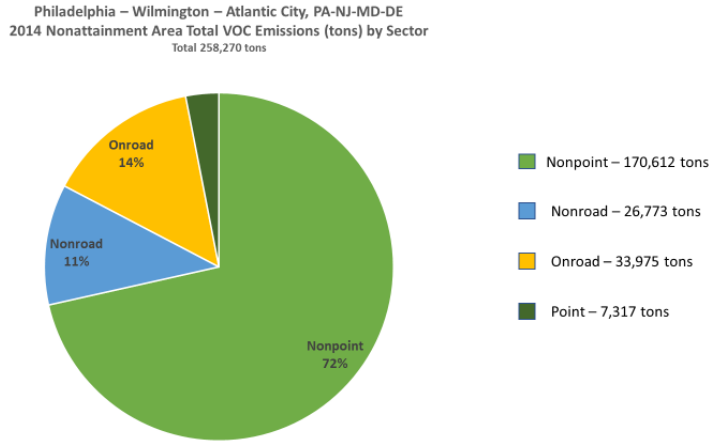


Figure 15. Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE Nonattainment Area VOC Emissions



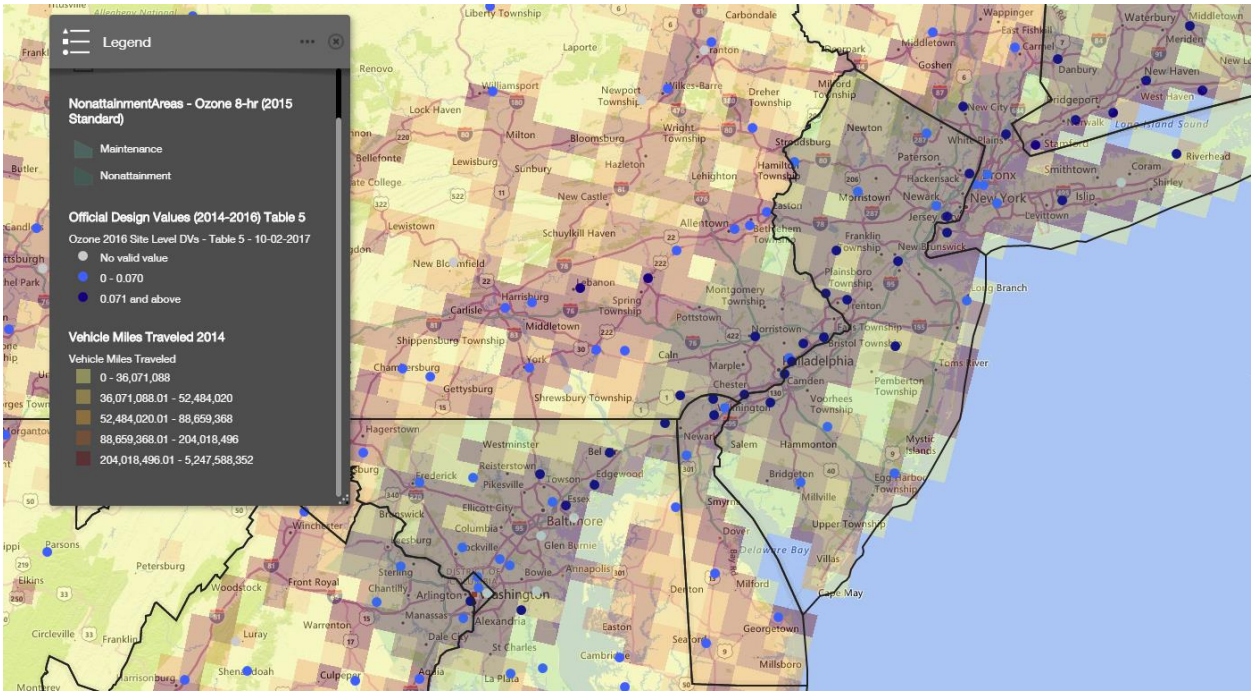
Population

As EPA noted in the *Philadelphia-Wilmington-Atlantic City, PA-NJ -MD-DE Nonattainment Area Final Area Designations for the 2015 Ozone National Ambient Air Quality Standards Technical Support Document (TSD)*, the nonattainment area had a total population in 2015 of 8,143,598 people. Philadelphia and Montgomery Counties, PA have the highest populations in the nonattainment area with 19 percent and 10 percent, respectively. Kent County, DE, Cecil County, MD, and Cape May, Cumberland and Salem Counties, NJ have the lowest populations, with less than two percent each. Population density for the area is shown in Figure 6, above.

Traffic and Vehicle Miles Traveled

As noted earlier, generally a county with high VMT and/or a high number of commuters is an integral part of an urban area and indicates the presence of motor vehicle emissions which may contribute to a violation of the NAAQS. Figure 16 shows the VMT for the Philadelphia-Wilmington-Atlantic City, PA-NJ -MD-DE Nonattainment Area.

Figure 16. Vehicle Miles Traveled in the Philadelphia-Wilmington-Atlantic City, PA-NJ -MD-DE Nonattainment Area and Surrounding Areas.



Meteorology

Figures 17 and 18 show the HYSPLIT back trajectories for each ozone exceedance day at the Philadelphia, PA monitor (421010024) in 2015 and 2016. Figures 19 and 20 show the HYSPLIT back trajectories for each ozone exceedance day at the Gloucester, NJ monitor (340150002) in 2015 and 2016, Figure 21 shows the HYSPLIT back trajectories for 2015 and 2016 for both the Philadelphia, PA monitor and the Gloucester, NJ monitor, and the gridded VMT for 2014.

Figure 17. 2015 HYSPLIT Back Trajectories, Philadelphia, PA Monitor (421010024)

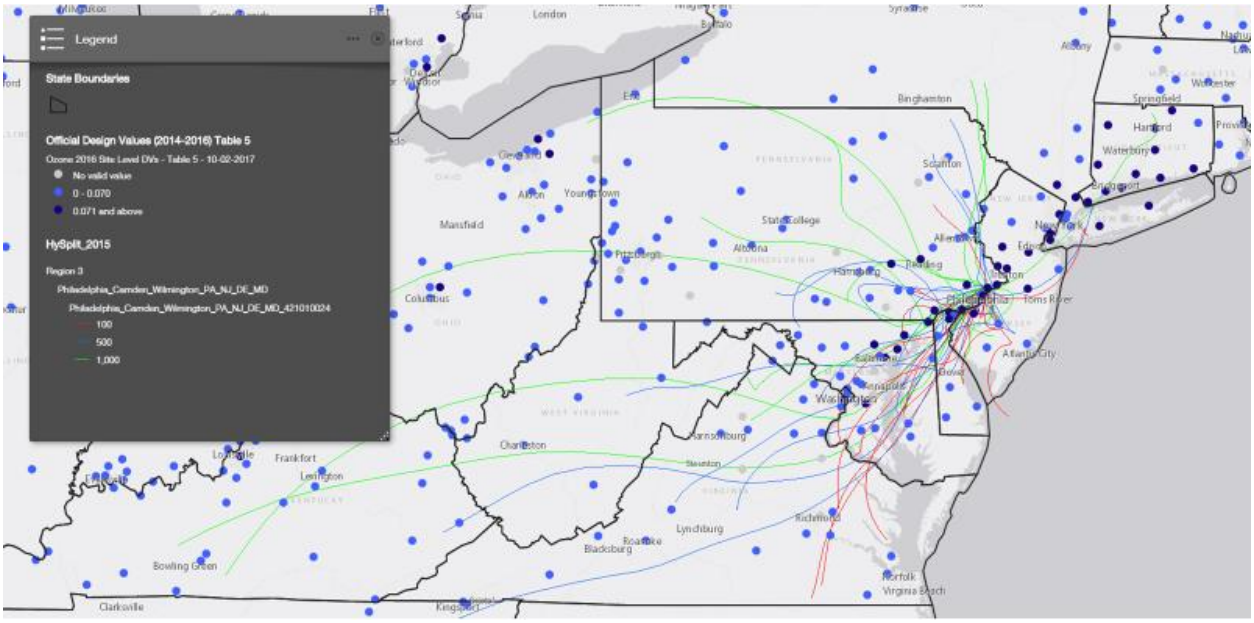


Figure 18. 2016 HYSPLIT Back Trajectories, Philadelphia, PA Monitor (421010024)

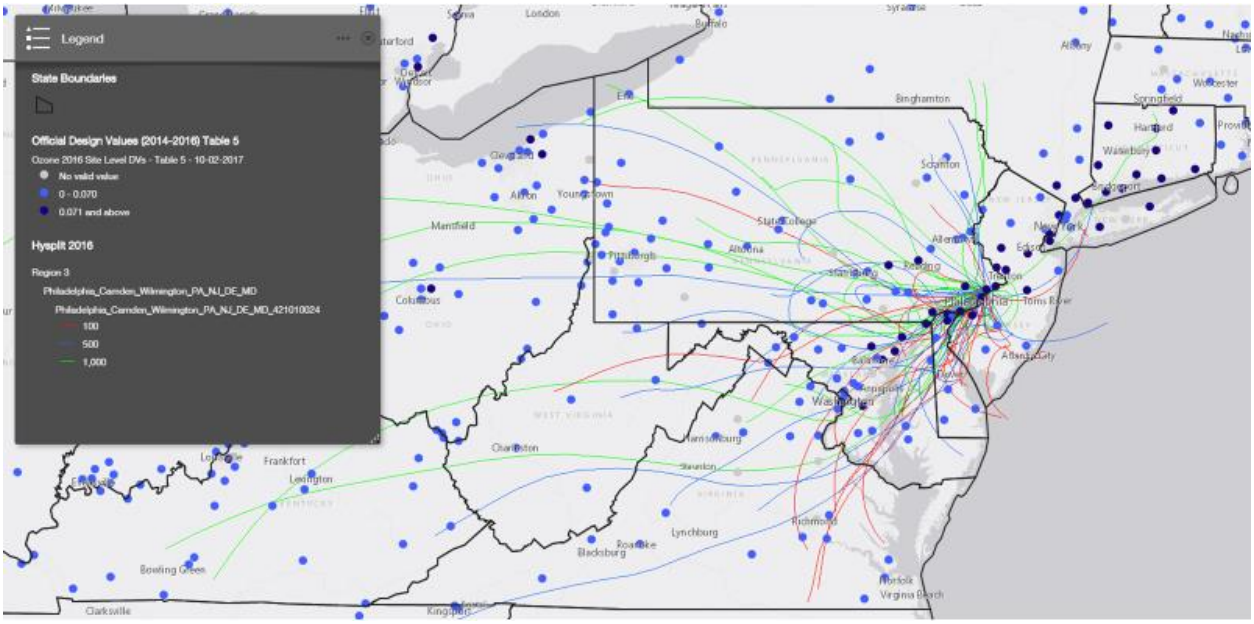


Figure 19. 2015 HYSPLIT Back Trajectories, Gloucester, NJ Monitor (340150002)

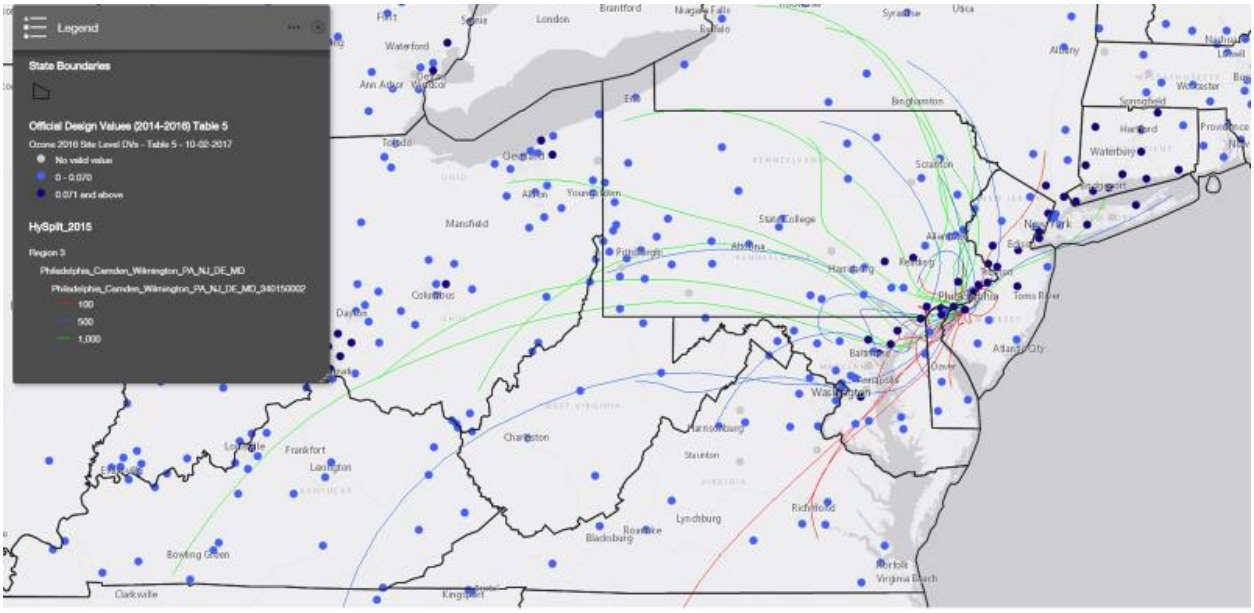


Figure 20. 2016 HYSPLIT Back Trajectories, Gloucester, NJ Monitor (340150002)

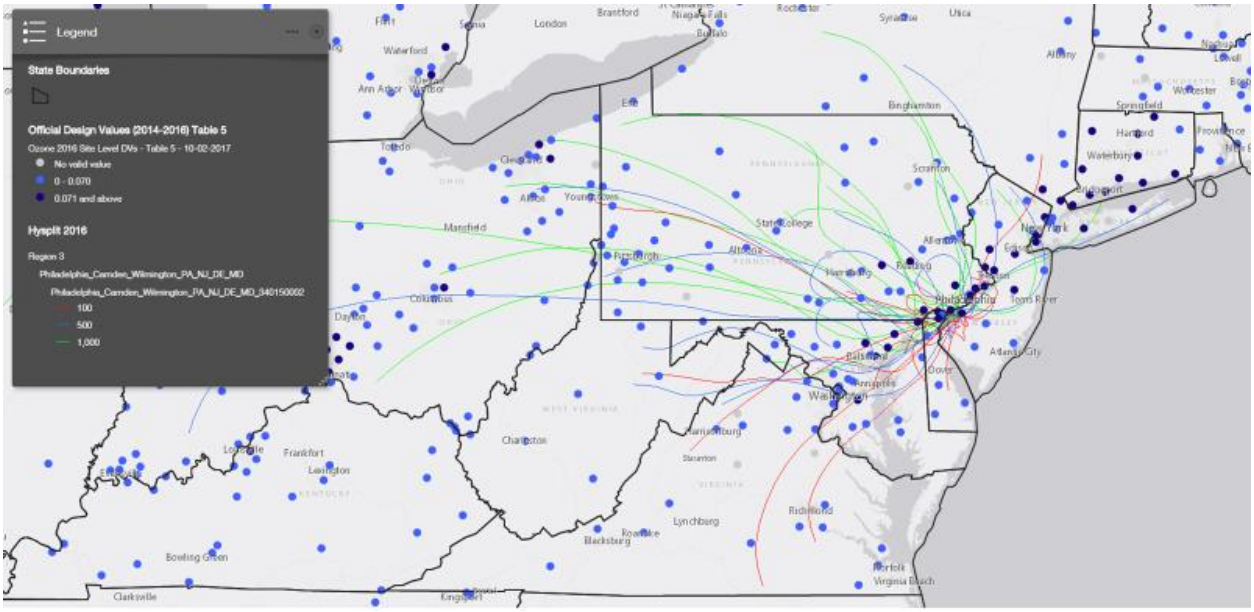
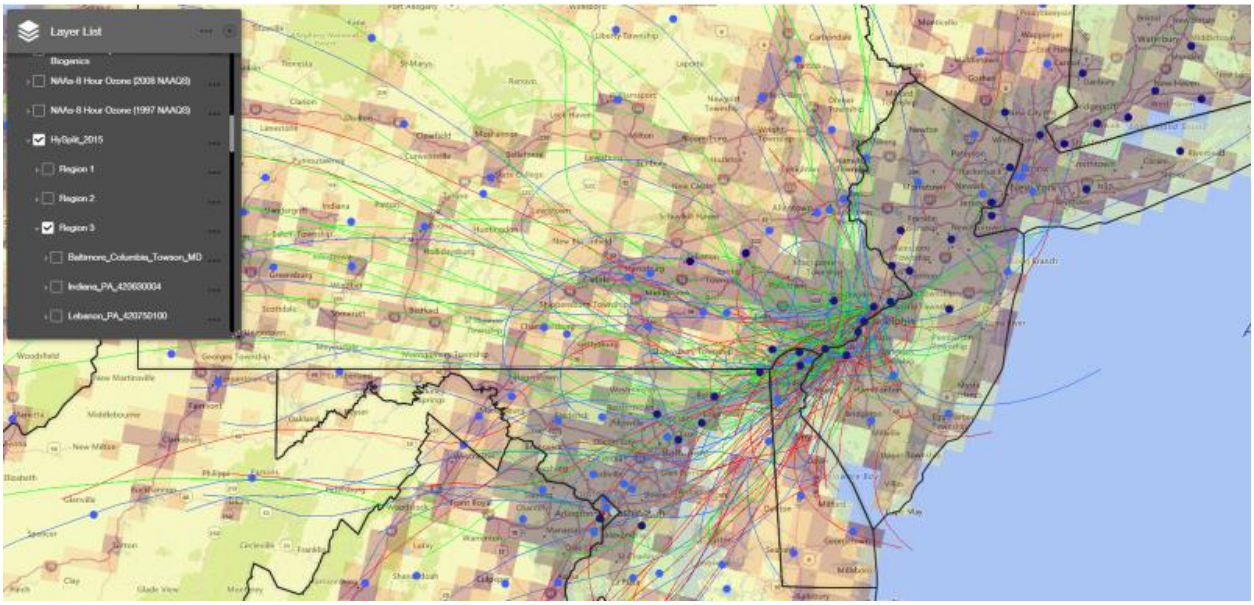


Figure 21. 2015 and 2016 HYSPLIT Back Trajectories for the Philadelphia, PA (421010024) and Gloucester, NJ (340150002) Monitors and 2014 VMT



These figures show the Baltimore, MD, and Washington, DC areas contribute heavily to the Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE Nonattainment Area, with a strong influenced from the I-95 corridor, with its heavy traffic.

WVDAQ analyzed the daily emissions from large EGUs in Pennsylvania and New Jersey, the maximum daily temperature, and daily maximum 8-hour ozone concentrations at the Philadelphia, PA (421010024) and Gloucester, NJ (340150002) monitors. West Virginia analyzed the 2017 ozone season AMPD for Pennsylvania and New Jersey. The 2017 ozone season was selected for analysis because if reflects the first ozone season during which the CSAPR Update was in effect. Daily data for the 2017 ozone season for all sources subject to the CSAPR NO_x Ozone Season Group 2 program was downloaded from the AMPD website.[22] Daily ozone data was downloaded from EPA's Outdoor Air Quality data website.[23] Maximum daily temperature data for the North East Airport, in Philadelphia, the location of monitor 421010024 was downloaded from Weather Underground's Historical Weather website, and temperature data from the Philadelphia International Airport, the closest airport to the Gloucester, NJ monitor (340150002) was also downloaded.[24] Figures 22 and 23 show the maximum daily temperature, daily maximum 8-hour ozone concentration and the state's daily EGU NO_x emissions. The figures clearly show a strong correlation between EGU emissions, maximum temperature and the maximum 8-hour ozone concentrations at the monitors.

[22] https://www.epa.gov/airmarkets
[23] https://www.epa.gov/outdoor-air-quality-data/download-daily-data
[24] http://api.wunderground.com/history/

Figure 22. Daily Ozone Concentration at the Philadelphia, PA (421010024) Monitor, Maximum Temperature and Pennsylvania EGU NO_x Emissions

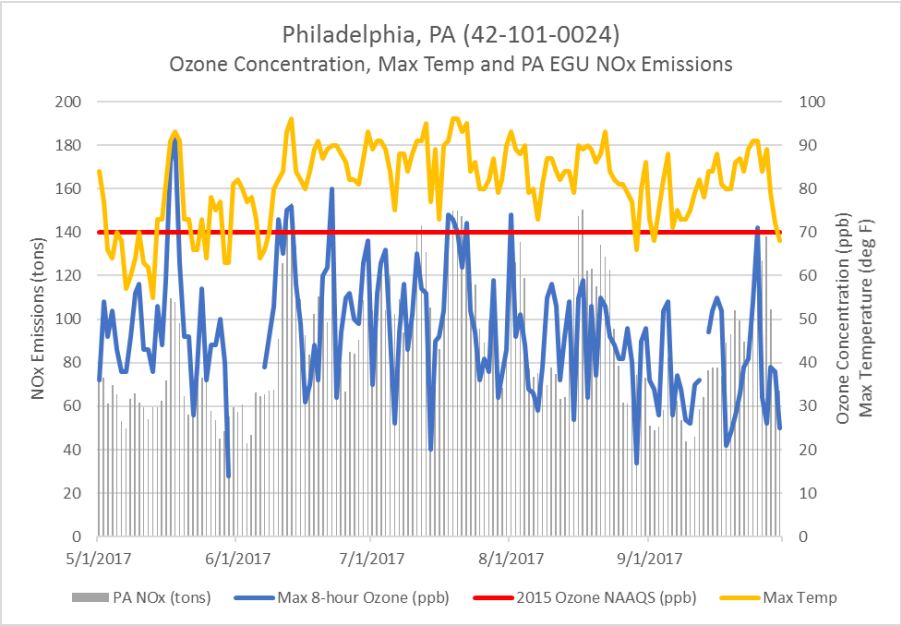
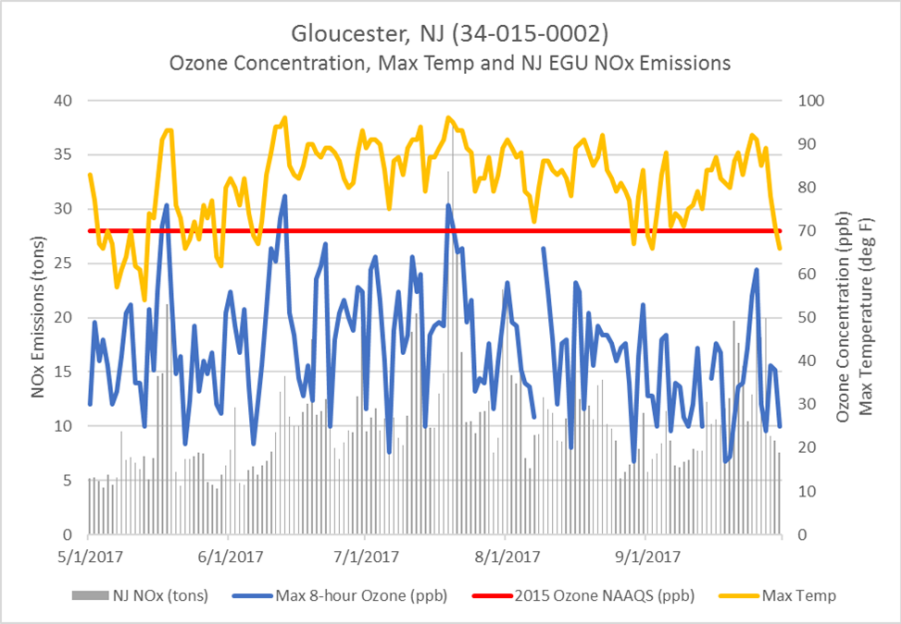


Figure 23. Daily Ozone Concentration at the Gloucester, NJ (340150002) Monitor, Maximum Temperature and New Jersey EGU NO_x Emissions



Conclusion

The Alpine 2018 nested 4-km modeling projects 2023 average design values of 68.0 and 68.8 ppb for the Philadelphia, PA and Gloucester, NJ monitors, respectively. The Alpine modeling also projects a maximum design values of 71.0 ppb for both the Philadelphia, PA and Gloucester, NJ monitors.

For the Philadelphia monitor, Pennsylvania has a projected contribution of 14.70 ppb (21.62%), and the following states are projected to have a significant contribution: Ohio, 4.05 ppb (5.96%); New Jersey, 2.44 ppb (3.59%); Indiana, 2.05 ppb (3.01%); Illinois, 1.75 ppb (2.57%); Maryland, 1.69 ppb (2.49%); Kentucky, 1.53 ppb (2.25%); West Virginia, 1.21 ppb (1.78%), and Texas, 1.19 ppb (1.75%). Boundary conditions account for 15.31 ppb (22.51%).

For the Gloucester monitor, New Jersey has a projected contribution of 4.51 ppb (6.56%), and the following states are projected to have a significant contribution: Pennsylvania, 8.29 ppb (12.05%); Delaware, 4.67 ppb (6.79%); Ohio, 4.07 ppb (5.92%); Maryland, 3.89 ppb (5.65%); Indiana, 1.98 ppb (2.88%); Kentucky, 1.69 ppb (2.46%); West Virginia, 1.63 ppb (2.37%); Illinois, 1.54 ppb (2.24%); Virginia/DC, 1.45 ppb (2.11%); and Texas, 1.06 ppb (1.54%). Boundary conditions account for 13.77 ppb (20.01%).

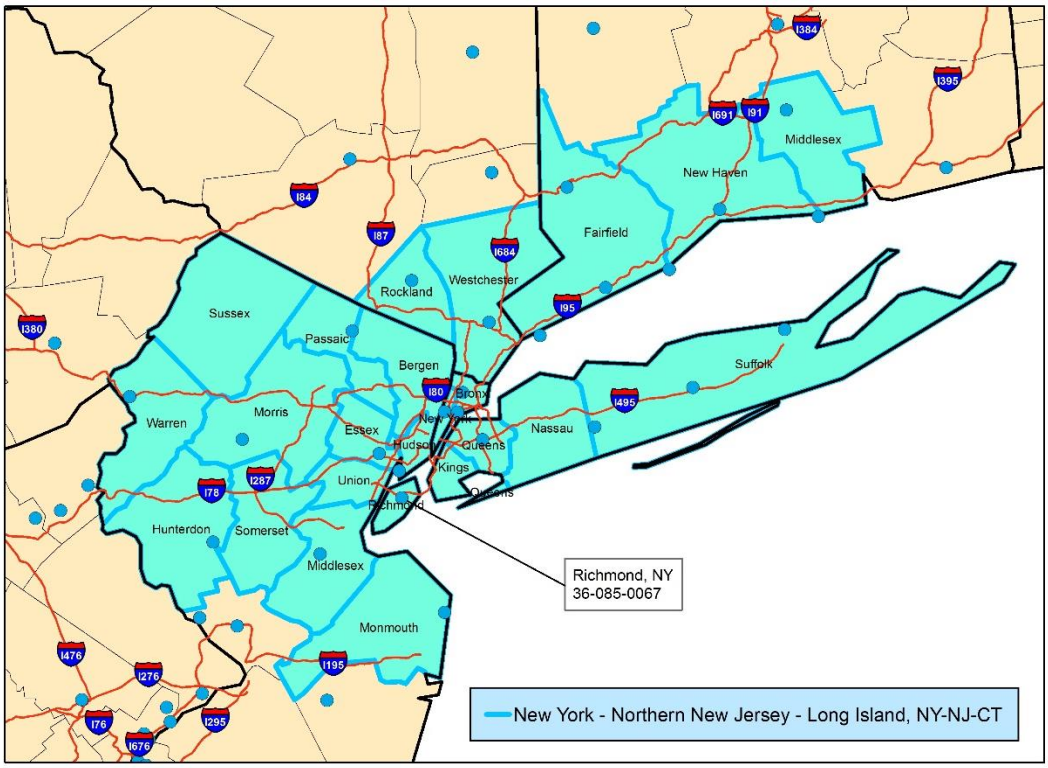
It is clear the ozone concentrations at the Philadelphia, PA and Gloucester, NJ monitors are strongly influenced by the large contribution from mobile sources along the I-95 corridor, the large population in the area, and the nearby Baltimore and Washington, DC-MD-VA nonattainment areas.

Projected Maintenance Area: New York-Northern New Jersey-Long Island, NY-NJ-CT

Projected Maintenance Monitor: Richmond, NY (360850067)

The New York-Northern New Jersey-Long Island, NY-NJ-CT area includes nine counties in New York – Bronx, Kings, Nassau, New York, Queens, Richmond, Rockland, Suffolk and Westchester; 12 counties in New Jersey – Bergen, Essex, Hudson, Hunterdon, Middlesex, Monmouth, Morris, Passaic, Somerset, Sussex, Union and Warren; and two counties in Connecticut – Fairfield and Middlesex. [25] Figure 24 show the New York-Northern New Jersey-Long Island, NY-NJ-CT Nonattainment Area.

Figure 24. New York-Northern New Jersey-Long Island, NY-NJ-CT Nonattainment Area



[25] 83FR25776, 04JUN2018

Air Quality Data

There have been 26 ozone monitors located in the New York-Northern New Jersey-Long Island, NY-NJ-CT area, with the number varying over the years. Currently there are 26 monitors. The 3-year design values for the 2006-2008 period through the 2015-2017 period are shown in Table 6 and Figure 25. The Richmond monitor that is projected to be a maintenance monitors in 2023 is highlighted in yellow in Table 6.

Table 6. 3-Year Ozone Design Values (ppm) at Monitors in the New York-Northern New Jersey-Long Island, NY-NJ-CT Nonattainment Area

State	AQS Site ID	County	2006 - 2008	2007 - 2009	2008 - 2010	2009 - 2011	2010 - 2012	2011 - 2013	2012 - 2014	2013 - 2015	2014 - 2016	2015 - 2017
CT	090010017	Fairfield	0.089	0.080	0.078	0.076	0.082	0.083	0.082	0.081	0.080	0.079
CT	090011123	Fairfield	0.088	0.084	0.081	0.080	0.083	0.081	0.078	0.076	0.078	0.077
CT	090013007	Fairfield	0.088	0.081	0.076	0.079	0.085	0.089	0.084	0.083	0.081	0.083
CT	090019003	Fairfield	0.087	0.082	0.080	0.079	0.085	0.087	0.085	0.084	0.083	0.083
CT	090070007	Middlesex	0.088	0.081	0.077	0.077	0.080	0.081	0.081	0.080	0.079	0.079
CT	090090027	New Haven	0.078	0.072	0.067	0.069	0.076	0.078	0.076	0.076	0.076	0.077
CT	090099002	New Haven	0.088	0.081	0.076	0.081	0.087	0.089	0.081	0.078	0.076	0.082
NJ	340030006	Bergen			0.076	0.076	0.078	0.077	0.074	0.074	0.074	0.074
NJ	340130003	Essex				0.076	0.082	0.076	0.072	0.069	0.070	0.068
NJ	340170006	Hudson	0.086	0.080	0.077	0.076	0.078	0.072		0.071	0.072	0.070
NJ	340190001	Hunterdon	0.086	0.081	0.078	0.077	0.080	0.077	0.072	0.070	0.070	0.072
NJ	340230011	Middlesex	0.088	0.080	0.078	0.080	0.085	0.079	0.074	0.072	0.074	0.075
NJ	340250005	Monmouth	0.086	0.081	0.080	0.079	0.083	0.078	0.072	0.070	0.069	0.068
NJ	340273001	Morris	0.086	0.079	0.075	0.075	0.078	0.075	0.072	0.070	0.068	0.069
NJ	340315001	Passaic	0.079	0.076	0.074	0.073	0.075	0.072	0.069	0.069	0.068	0.068
NJ	340410007	Warren						0.066	0.063	0.062	0.063	0.067
NY	360050110	Bronx	0.074	0.072						0.068	0.067	0.070
NY	360050133	Bronx	0.076	0.073	0.072	0.072	0.076	0.074	0.071	0.070	0.070	0.070
NY	360610135	New York		0.076	0.073	0.072	0.076	0.072	0.067	0.066	0.069	0.074
NY	360810124	Queens	0.077	0.074	0.074	0.075	0.080	0.079	0.072	0.069	0.069	0.076
NY	**360850067**	**Richmond**	**0.079**	**0.074**	**0.075**	**0.083**	**0.083**	**0.078**	**0.073**	**0.074**	**0.076**	**0.072**
NY	360870005	Rockland				0.071	0.076	0.074	0.072	0.071	0.072	0.076
NY	361030002	Suffolk	0.085	0.081	0.082	0.084	0.085	0.081	0.073	0.072	0.072	0.076
NY	361030004	Suffolk	0.089	0.079	0.076	0.075	0.079	0.080	0.075	0.072	0.072	0.076
NY	361030009	Suffolk	0.086	0.080	0.079	0.078	0.080	0.078	0.071			0.069
NY	361192004	Westchester	0.086	0.083	0.077	0.075	0.076	0.075	0.075	0.073	0.074	0.073

Figure 25. 3-Year Ozone Design Values (ppm) at Monitors in the New York-Northern New Jersey-Long Island, NY-NJ-CT Nonattainment Area

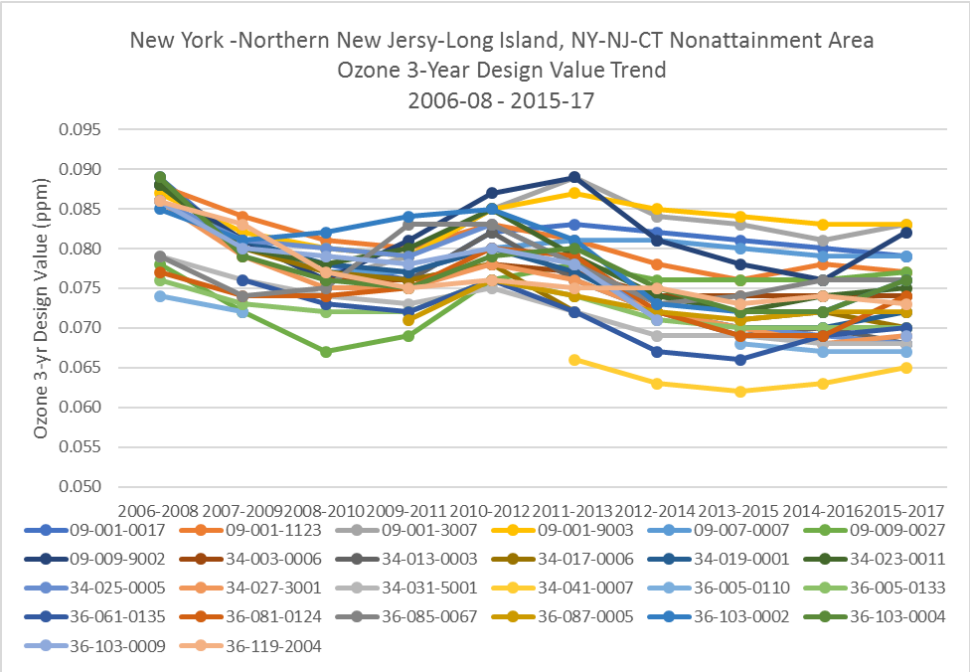


Table 7 shows the distance between the Richmond, NY monitor that is projected to be a maintenance monitor in 2023 and the other monitors in the New York-Northern New Jersey-Long Island, NY-NJ-CT Nonattainment Area.

Table 7. Distance Between the Richmond, NY Monitor and Other Monitors in the New York-Northern New Jersey-Long Island, NY-NJ-CT Nonattainment Area

State	AQS Site ID	County	Latitude	Longitude	Distance to Richmond, NY Monitor [360850067] (miles)
CT	090010017	Fairfield	41.004657	-73.585128	39.91
CT	090011123	Fairfield	41.399167	-73.443056	65.88
CT	090013007	Fairfield	41.1525	-73.103056	65.78
CT	090019003	Fairfield	41.118333	-73.336667	54.75
CT	090070007	Middlesex	41.552196	-72.630015	102.10
CT	090090027	New Haven	41.3014	-72.902871	80.25
CT	090099002	New Haven	41.256788	-72.55327	93.88
NJ	340030006	Bergen	40.870436	-73.991994	20.16
NJ	340130003	Essex	40.720989	-74.192892	9.29
NJ	340170006	Hudson	40.67025	-74.126081	5.09
NJ	340190001	Hunterdon	40.515262	-74.806671	36.21
NJ	340230011	Middlesex	40.462182	-74.429439	18.48
NJ	340250005	Monmouth	40.277647	-74.0051	22.93
NJ	340273001	Morris	40.787628	-74.676301	31.74
NJ	340315001	Passaic	41.058617	-74.255544	32.64
NJ	340410007	Warren	40.92458	-75.067815	54.28
NY	360050110	Bronx	40.816	-73.902	19.14
NY	360050133	Bronx	40.8679	-73.87809	22.78
NY	360610135	New York	40.81976	-73.94825	17.99
NY	360810124	Queens	40.73614	-73.82153	18.61
NY	**360850067**	**Richmond**	**40.59664**	**-74.12525**	**0.00**
NY	360870005	Rockland	41.18208	-74.02819	40.77
NY	361030002	Suffolk	40.74529	-73.41919	38.40
NY	361030004	Suffolk	40.96078	-72.71238	78.08
NY	361030009	Suffolk	40.82799	-73.05754	58.16
NY	361192004	Westchester	41.05192	-73.76366	36.70

The 3-year design values for the monitors in the area varied between a low of 68 ppb, and a high of 83 ppb for the 2015-2017 period. This variation of 15 ppb within the area is indicative of strong local influences.

Emissions Data

The New York-Northern New Jersey-Long Island, NY-NJ-CT Nonattainment Area 2014 NEI data for NO_x and VOC is shown in Figures 26 and 27, respectively. As shown in Figure 26, the NO_x emissions in the area are primarily due to mobile sources (62%), with onroad emissions accounting for 45 percent and nonroad emissions accounting for an additional 17 percent, the remaining 38 percent is due to nonpoint (26%) and point (12%) source emissions.

Figure 26. New York-Northern New Jersey-Long Island, NY-NJ-CT Nonattainment Area NO_x Emissions

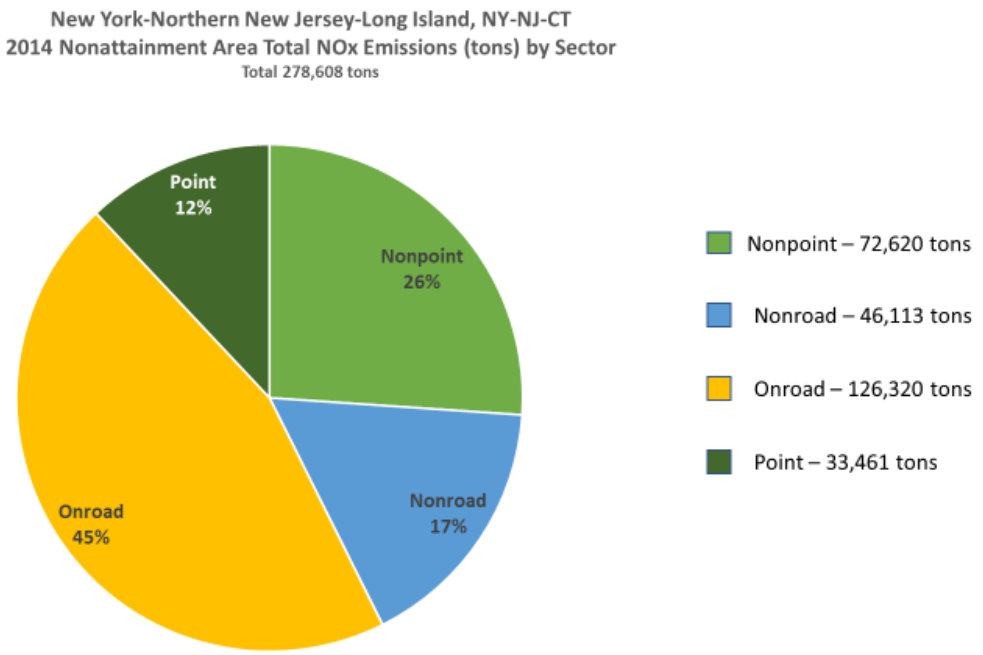
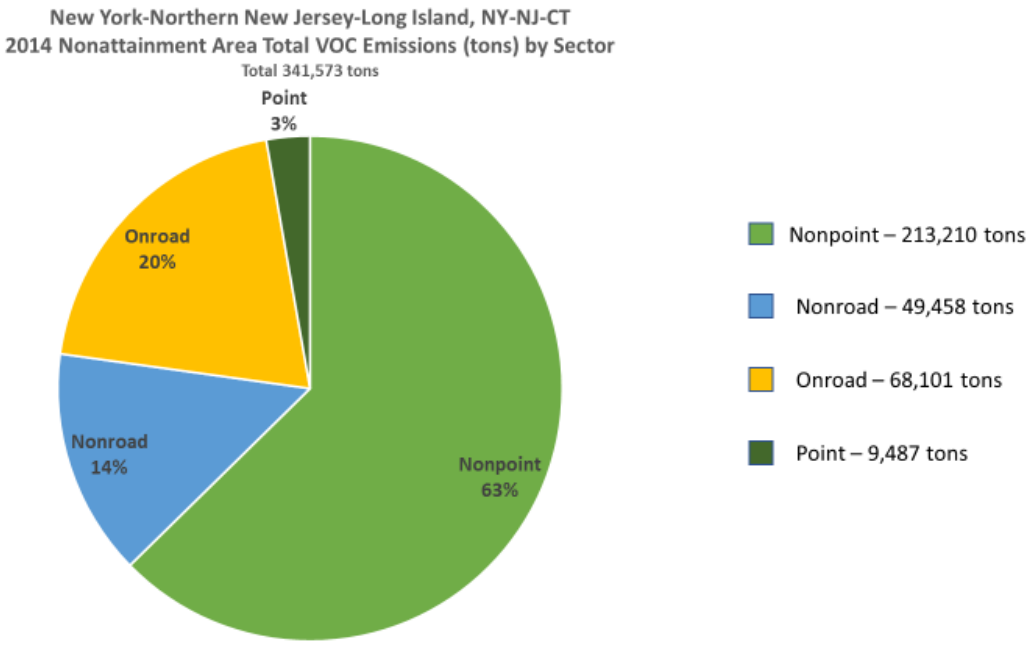


Figure 27. New York-Northern New Jersey-Long Island, NY-NJ-CT Nonattainment Area VOC Emissions



It is clear that mobile sources are the dominant contributor to NO_x emissions in the New York-Northern New Jersey-Long Island, NY-NJ-CT nonattainment area, accounting for 62 percent. Nonpoint sources are the dominant contributor to VOC emissions in the area, accounting for 63 percent.

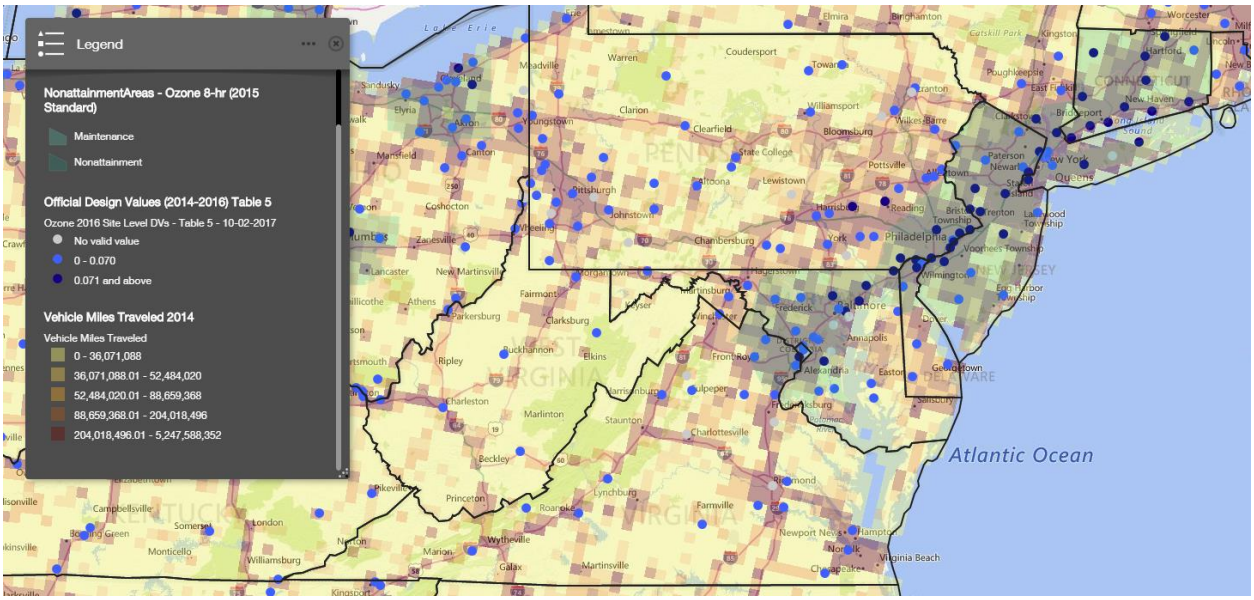
Population

As EPA noted in the *New York-Northern New Jersey-Long Island, NY-NJ-CT Nonattainment Area Final Area Designations for the 2015 Ozone National Ambient Air Quality Standards Technical Support Document (TSD)*, the New York Metro Area is a highly populated area with a total population in 2015 of 23,887,759 people. Kings and Queens Counties in New York have the highest population density, as well as the highest population, with 11.0 and 9.7 percent, respectively. Population density is shown in Figure 6 above.

Traffic and Vehicle Miles Traveled

As noted earlier, generally a county with high VMT and/or a high number of commuters is an integral part of an urban area and indicates the presence of motor vehicle emissions which may contribute to a violation of the NAAQS. Figure 28 shows the VMT for the New York-Northern New Jersey-Long Island, NY-NJ-CT Nonattainment Area and surrounding areas.

Figure 28. Vehicle Miles Traveled in the New York-Northern New Jersey-Long Island, NY-NJ-CT Nonattainment Area and Surrounding Areas.



Meteorology

Figures 29 and 30 show the HYSPLIT back trajectories for each ozone exceedance day at the Richmond, NY monitor (360850067) in 2015 and 2016. Figure 31 shows the HYSPLIT back trajectories for 2015 and 2016 for the Richmond, NY monitor, and the gridded VMT for 2014.

Figure 29. 2015 HYSPLIT Back Trajectories: Richmond, NY Monitor (360850067)

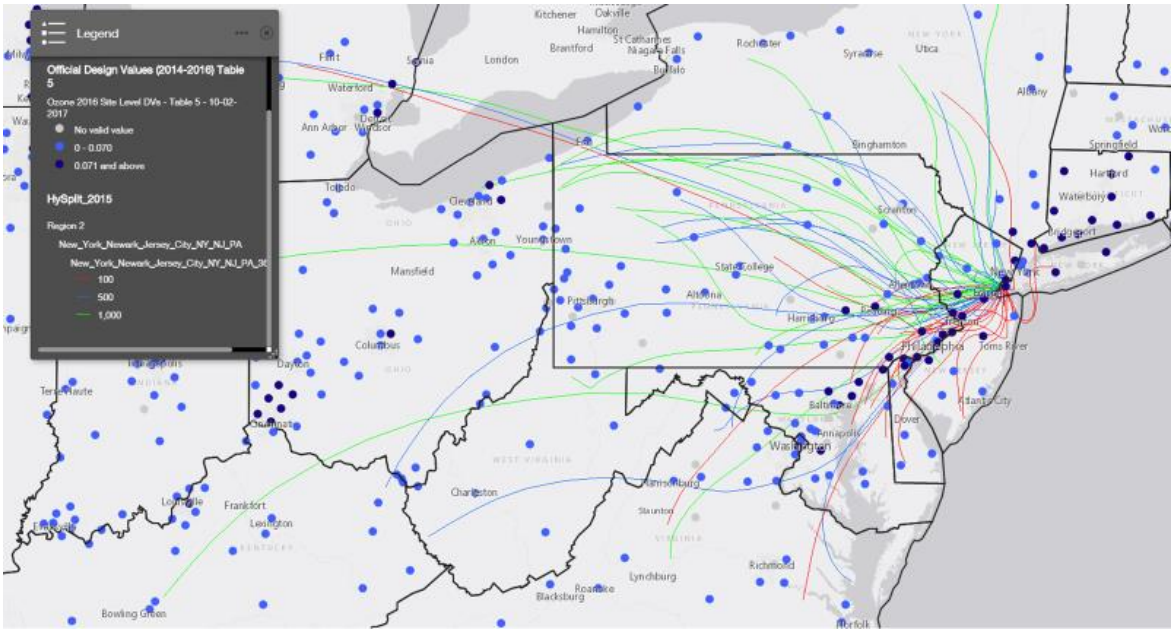


Figure 30. 2016 HYSPLIT Back Trajectories: Richmond, NY Monitor (360850067)

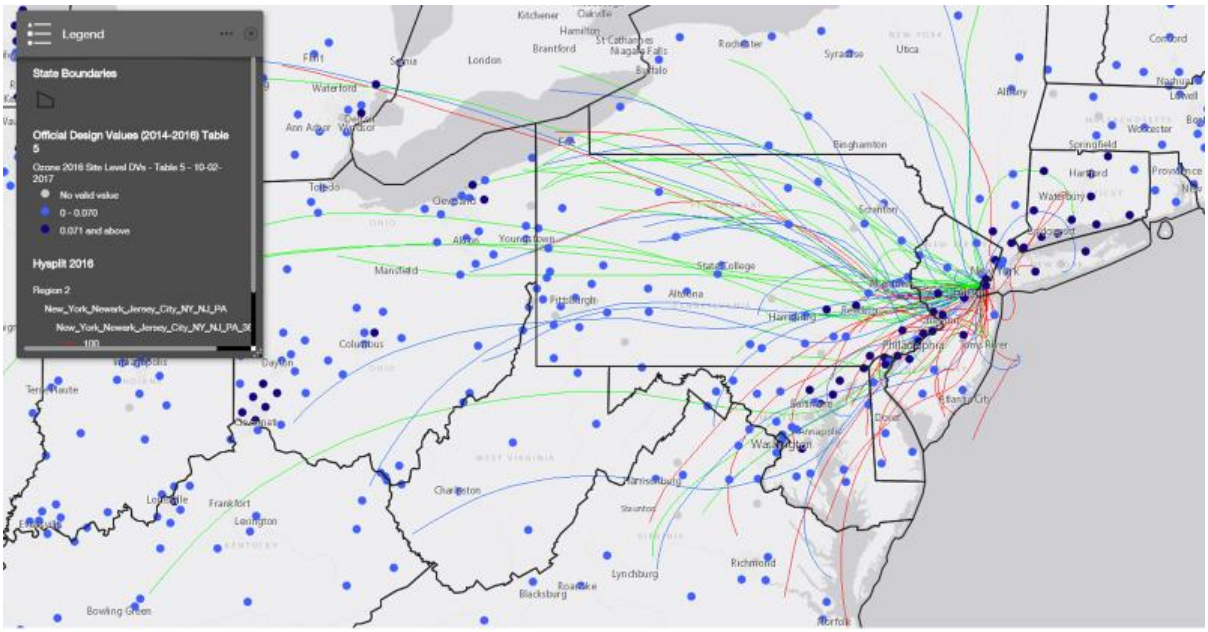
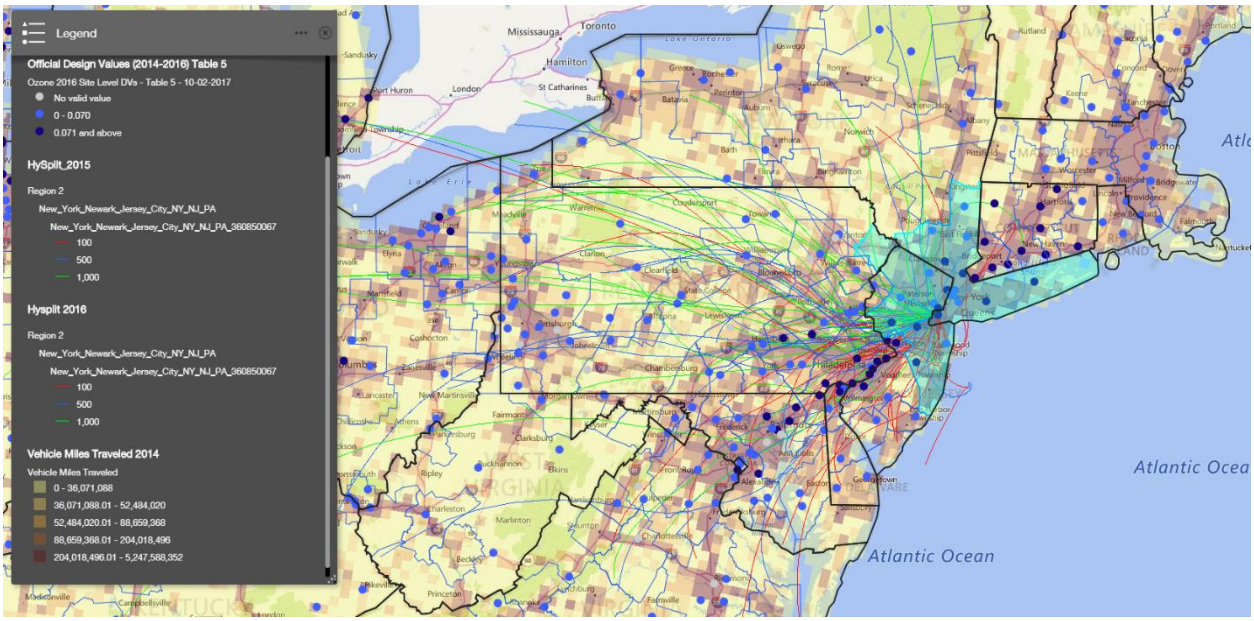


Figure 31. 2015 and 2016 HYSPLIT Back Trajectories for the Richmond, NY Monitor (360850067) and 2014 VMT



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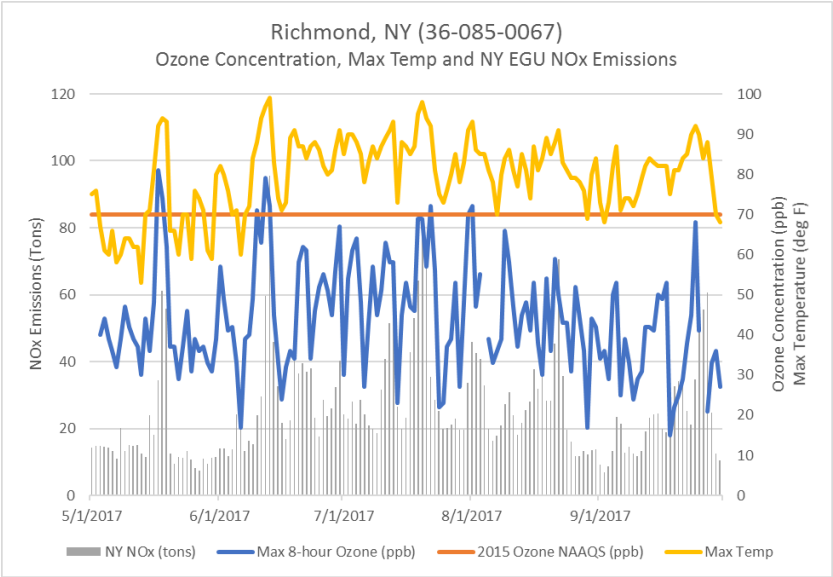
WVDAQ analyzed the daily emissions from large EGUs in New York, the maximum daily temperature, and daily maximum 8-hour ozone concentrations at the Richmond, NY (360850067) monitor. West Virginia analyzed the 2017 ozone season AMPD for New York. The 2017 ozone season was selected for analysis because if reflects the first ozone season during which the CSAPR Update was in effect. Daily data for the 2017 ozone season for all sources subject to the CSAPR NO_x Ozone Season Group 2 program was downloaded from the AMPD website.[26] Daily ozone data was downloaded from EPA's Outdoor Air Quality data website.[27] Maximum daily temperature data for the Newark New Jersey Airport, the closest airport to the Richmond, NY monitor, was downloaded from Weather Underground's Historical Weather website.[28] Figure 32 shows the maximum daily temperature, daily maximum 8-hour ozone concentration and the state's daily EGU NO_x emissions. The figure clearly shows a strong correlation between EGU emissions, maximum temperature and the maximum 8-hour ozone concentrations at the monitor.

[26] https://www.epa.gov/airmarkets
[27] https://www.epa.gov/outdoor-air-quality-data/download-daily-data
[28] http://api.wunderground.com/history/

Figure 32. Daily Ozone Concentration at the Richmond, NY (360850067) Monitor, Maximum Temperature and New York EGU NO_x Emissions



Conclusion

The Richmond, NY monitor is located on Staten Island, separated from New Jersey by the Arthur Kill and the Kill Van Kull, and from the rest of New York by New York Bay. The Arthur Kill, also known as the Staten Island Sound, is a tidal strait and a kill between Staten Island, a borough of New York City, and Union and Middlesex Counties in northern New Jersey. It is a major navigational channel of the Port of New York and New Jersey in the United States. The Kill Van Kull is a tidal strait between Staten Island, New York and Bayonne, New Jersey. It is approximately 3 miles (4.8 km) long and 1,000 feet (305 m) wide and connects Newark Bay with Upper New York Bay. It is spanned by the Bayonne Bridge and is one of the most heavily travelled waterways in the Port of New York and New Jersey.[29]

In the Alpine 2018 TSD, the results of the nested 4-km modeling project attainment of the 2015 Ozone NAAQS with a 2023 average design value of 69.6 ppb at the Richmond, NY monitor. The area is projected to be a maintenance area due to a projected maximum 2023 design value of 71.0 ppb at the Richmond, NY monitor. New York has a projected contribution of 3.19 ppb (4.58%), and the following states are projected to have a significant contribution: New Jersey, 11.59 ppb (16.65%); Pennsylvania, 5.73 ppb (8.23%); Ohio, 2.97 ppb (4.27%); Maryland, 1.39 ppb (2.00%); Illinois, 1.34 ppb (1.93%); Indiana, 1.29 ppb (1.85%); Virginia/DC, 1.18 ppb (1.70%); Michigan, 1.15 ppb (1.65%); Kentucky, 0.93 ppb (1.34%); Texas, 0.89 ppb (1.28%); and West Virginia, 0.71 ppb (1.02%). Boundary conditions account for 14.54 ppb (20.89%).

[29] https://en.wikipedia.org/wiki/Staten_Island

It is clear that the ozone concentrations at the Richmond, NY monitor are strongly influenced by the large contribution from mobile sources along the I-95 corridor, in the metro area and the heavily traveled waterways in the Port of New York and New Jersey, the large population in the area and the nearby Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE, Baltimore, MD and Washington, DC-MD-VA Nonattainment Areas.