

Louisville, KY-IN Nonattainment Area

**Final Area Designation for the
2015 Ozone National Ambient Air Quality Standards
Technical Support Document (TSD)**

I. Summary

This technical support document (TSD) describes the EPA's final designations for portions of the Louisville, Kentucky-Indiana area in Kentucky (KY) and Indiana (IN) as nonattainment for the 2015 ozone National Ambient Air Quality Standards (NAAQS).

On October 1, 2015, the EPA promulgated revised primary and secondary ozone NAAQS (80 FR 65292; October 26, 2015). The EPA strengthened both standards to a level of 0.070 parts per million (ppm). In accordance with section 107(d) of the Clean Air Act (CAA), whenever the EPA establishes a new or revised NAAQS, the EPA must promulgate designations for all areas of the country for that NAAQS.

Under section 107(d), states were required to submit area designation recommendations to the EPA for the 2015 ozone NAAQS no later than 1 year following promulgation of the standards, i.e., by October 1, 2016. Tribes were also invited to submit area designation recommendations. On September 30, 2016, Kentucky recommended that the Kentucky portion of the Louisville, KY-IN Area identified in Table 1 be designated as attainment/unclassifiable for the 2015 ozone NAAQS based on air quality data from 2013-2015. On September 16, 2016, Indiana recommended that the Indiana portion of the Louisville, KY-IN Area identified in Table 1 be designated as attainment for the 2015 ozone NAAQS based on air quality data from 2013-2015. On November 6, 2017 (82 FR 5423), the EPA designated all of Kentucky except for counties in the Louisville/Jefferson County--Elizabethtown--Madison, KY-IN CSA and the Cincinnati-Wilmington-Maysville, OH-KY-IN CSA, and all of Indiana except for counties in the Louisville/Jefferson County--Elizabethtown--Madison, KY-IN CSA, the Chicago-Naperville, IL-IN-WI CSA, the Cincinnati-Wilmington-Maysville, OH-KY-IN CSA, and the South Bend-Elkhart-Mishawaka, IN-MI CSA as attainment/unclassifiable for the 2015 ozone NAAQS.

One monitor in Jefferson County, KY is violating the 2015 ozone NAAQS based on air quality data from 2014-2016. Therefore, the EPA is designating the Louisville, KY-IN Area as nonattainment. Table 1 identifies the counties that comprise the Louisville, KY-IN nonattainment area. The EPA based its designation on the EPA's technical analysis as described in this TSD.

Table 1. Louisville-KY-IN Recommended Nonattainment Area and the EPA’s Designated Nonattainment Area for the 2015 Ozone NAAQS

Area	States’ Recommended Nonattainment Counties	The EPA’s Nonattainment Counties
Louisville, KY-IN (KY)*	Kentucky did not recommend this area for nonattainment	Bullitt County Jefferson County Oldham County
Louisville, KY-IN (IN)*	Indiana did not recommend this area for nonattainment	Clark County Floyd County

*There are additional TSDs for the rest of the state/commonwealth for Kentucky and Indiana.

On November 6, 2017 (Published at 82 FR 5423), the EPA signed a notice designating most of the areas these states did not recommend for designation as nonattainment as attainment/unclassifiable.¹

II. Nonattainment Area Analyses and Boundary Determination

The EPA evaluated and determined the boundaries for each nonattainment area on a case-by-case basis, considering the specific facts and circumstances of the area. In accordance with the CAA section 107(d), the EPA is designating as nonattainment the areas with the monitor that is violating the 2015 ozone NAAQS and nearby areas with emissions sources (i.e., stationary, mobile, and/or area sources) that contribute to the violation. As described in the EPA’s designations guidance for the 2015 NAAQS (hereafter referred to as the “ozone designations guidance”² after identifying each monitor indicating a violation of the ozone NAAQS in an area, the EPA analyzed those nearby areas with emissions potentially contributing to the violating area. In guidance issued in February 2016, the EPA provided that using the Core Based Statistical Area (CBSA) or Combined Statistical Area (CSA)³ as a starting point for the contribution analysis is a reasonable approach to ensure that the nearby areas most likely to contribute

¹ In previous ozone designations and in the designation guidance for the 2015 ozone NAAQS, the EPA used the designation category label Unclassifiable/Attainment to identify both areas that were monitoring attainment and areas that did not have monitors but for which the EPA had reason to believe were likely attainment and were not contributing to a violation in a nearby area. The EPA is now reversing the order of the label to be Attainment/Unclassifiable so that the category is more clearly distinguished from the separate Unclassifiable category.

² The EPA issued guidance on February 25, 2016 that identified important factors that the EPA intends to evaluate in determining appropriate area designations and nonattainment boundaries for the 2015 ozone NAAQS. Available at <https://www.epa.gov/ozone-designations/epa-guidance-area-designations-2015-ozone-naaqs>

³ Lists of CBSAs and CSAs and their geographic components are provided at www.census.gov/population/www/metroareas/metrodef.html. The Office of Management and Budget (OMB) adopts standards for defining statistical areas. The statistical areas are delineated based on U.S. Census Bureau data. The lists are periodically updated by the OMB. The EPA used the most recent July 2015 update (OMB Bulletin No. 15-01), which is based on application of the 2010 OMB standards to the 2010 Census, 2006-2010 American Community Survey, as well as 2013 Population Estimates Program data.

to a violating area are evaluated. The area-specific analyses may support nonattainment boundaries that are smaller or larger than the CBSA or CSA.

On November 6, 2017, the EPA issued attainment/unclassifiable designations for approximately 85 percent of the United States and one unclassifiable area designation.⁴ At that time, consistent with statements in the designations guidance regarding the scope of the area the EPA would analyze in determining nonattainment boundaries, the EPA deferred designation for any counties in the larger of a CSA or CBSA where one or more counties in the CSA or CBSA was violating the standard and any counties with a violating monitor not located in a CSA or CBSA. In addition, the EPA deferred designation for any other counties adjacent to a county with a violating monitor. The EPA also deferred designation for any county that had incomplete monitoring data, any county in the larger of the CSA or CBSA where such a county was located, and any county located adjacent to a county with incomplete monitoring data.

The EPA is proceeding to complete the remaining designations consistent with the designations guidance (and the EPA's past practice) regarding the scope of the area the EPA would analyze in determining nonattainment boundaries for the ozone NAAQS as outlined above. For those deferred areas where one or more counties violating the ozone NAAQS or with incomplete data are located in a CSA or CBSA, in most cases the technical analysis for the nonattainment area includes any counties in the larger of the relevant CSA or CBSA. For counties with a violating monitor not located in a CSA or CBSA, the EPA explains in the 3.0 Technical Analysis section, its decision whether to consider in the five-factor analysis for each area any other adjacent counties for which the EPA previously deferred action. We are designating all counties not included in five-factor analyses for a specific nonattainment or unclassifiable area analyses, as attainment/unclassifiable. These deferred areas are identified in a separate document entitled "Designations for Deferred Counties and County Equivalents Not Addressed in the Technical Analyses." which is available in the docket.

⁴ Air Quality Designations for the 2015 Ozone National Ambient Air Quality Standards published on November 16, 2017(82 FR 54232).

Master Legend

Ozone monitoring site with 2014-2016 design value

- No valid value
- 0 - 0.070 parts per million (ppm)
- 0.071 and above

National Emissions Inventory (NEI) 2014 v1

- Large Point Sources (VOC or NO_x >= 100 gross tons)
- ★ Small Point Sources

Hysplit

Elevation (Meters)

- ~ 100
- ~ 500
- ~ 1,000



EPA's Final Nonattainment Area Boundary



Federal American Indian Reservations and Off Reservation Lands



State Boundaries



County Boundaries



CSAs - Combined Statistical Areas



CBSAs - Metropolitan Statistical Areas



CBSAs - Micropolitan Statistical Areas

NAAAs-8 Hour Ozone (1997 NAAQS)

- Maintenance (NAAQS revoked)
- Nonattainment (NAAQS revoked)

NAAAs-8 Hour Ozone (2008 NAAQS)

- Nonattainment
- Maintenance

County Population (2010)

- > 5,194,675 to 9,818,605
- > 2,035,210 to 5,194,675
- > 744,344 to 2,035,210
- > 220,000 to 744,344
- 0 to 220,000

Census Tracts Population (2012)

- 0 to 2,825
- > 2,825 to 4,481
- > 4,481 to 6,373
- > 6,373 to 10,145
- > 10,145 to 39,143

Vehicle Miles Traveled - 2014

- 0 - 36,071,088
- 36,071,088.01 - 52,484,020
- 52,484,020.01 - 88,659,368
- 88,659,368.01 - 204,018,496
- 204,018,496.01 - 5,247,588,352

Figures in the remainder of this document refer to the master legend above.

III. Technical Analysis for Louisville, KY-IN

This technical analysis identifies the area with a monitor that violates the 2015 ozone NAAQS. It also provides the EPA's evaluation of this area and any nearby areas to determine whether those nearby areas have emissions sources that potentially contribute to ambient ozone concentrations at the violating monitor in the area, based on the weight-of-evidence of the five factors recommended in the EPA's ozone designations guidance and any other relevant information. In developing this technical analysis, the EPA

used the latest data and information available to the EPA (and to the states and tribes through the Ozone Designations Mapping Tool and the EPA Ozone Designations Guidance and Data web page)⁵. In addition, the EPA considered any additional data or information provided to the EPA by states or tribes.

The area of analysis for the Louisville, KY-IN area included the Louisville/Jefferson County--Elizabethtown--Madison, KY-IN CSA. The Louisville/Jefferson County--Elizabethtown--Madison, KY-IN CSA is comprised of the following counties: Bullitt County (KY); Hardin County (KY); Henry County (KY); Jefferson County (KY); Larue County (KY); Meade County (KY); Nelson County (KY); Oldham County (KY); Shelby County (KY); Spencer County (KY); Trimble County (KY); Clark County (IN); Floyd County (IN); Harrison County (IN); Jefferson County (IN); Scott County (IN); and Washington County (IN). The EPA applied the five factors recommended in its guidance to the area of analysis to determine the nonattainment area boundary.

The five factors recommended in the EPA's guidance are:

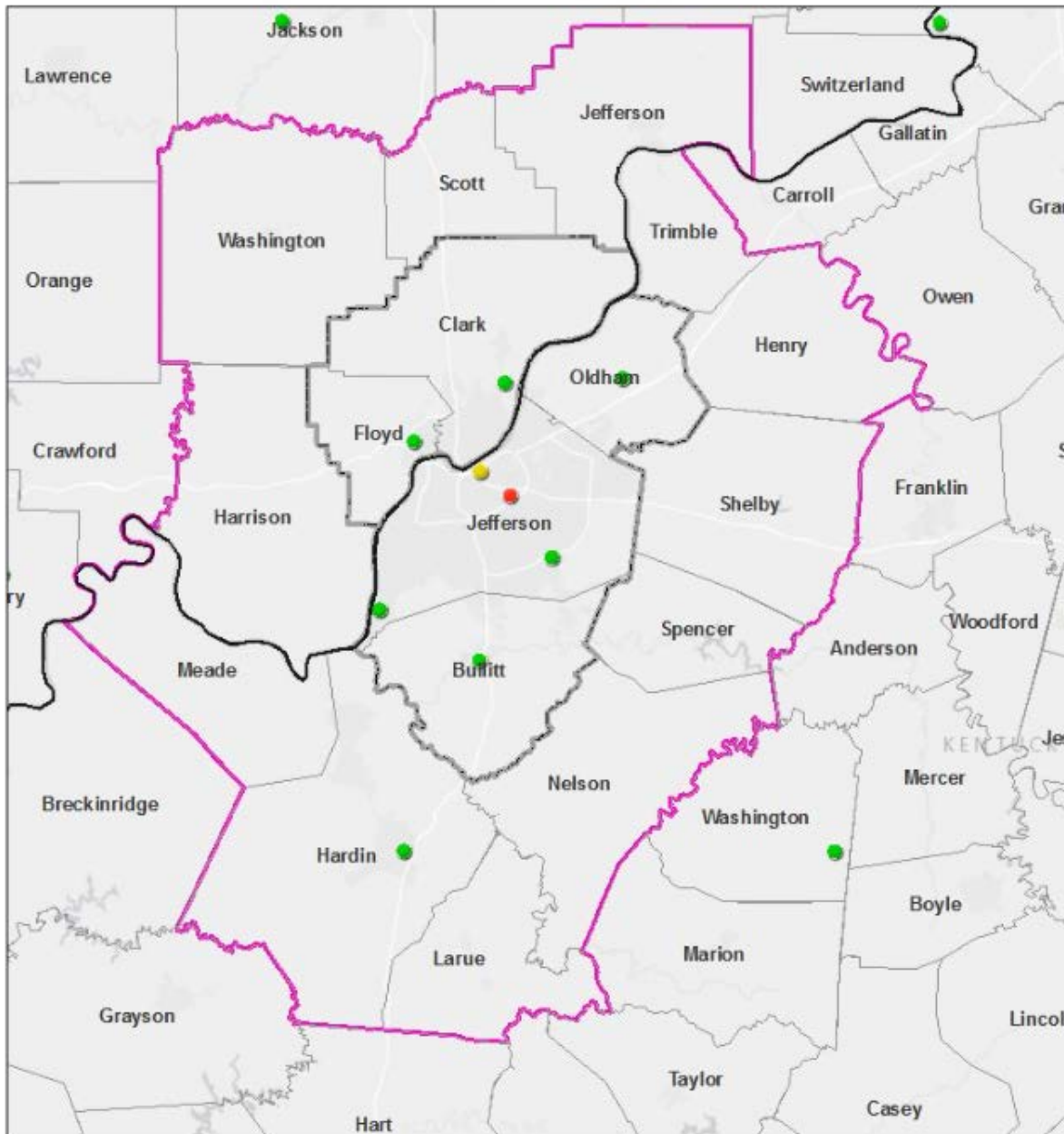
1. Air Quality Data (including the design value calculated for each Federal Reference Method (FRM) or Federal Equivalent Method (FEM) monitor);
2. Emissions and Emissions-Related Data (including locations of sources, population, amount of emissions, and urban growth patterns);
3. Meteorology (weather/transport patterns);
4. Geography/Topography (including mountain ranges or other physical features that may influence the fate and transport of emissions and ozone concentrations); and
5. Jurisdictional Boundaries (e.g., counties, air districts, existing nonattainment areas, areas of Indian country, Metropolitan Planning Organizations (MPOs)).

Figure 1 is a map of the EPA's nonattainment boundary for the Louisville, KY-IN area. The map shows the location of the ambient air quality monitors, county, and other jurisdictional boundaries.

For purposes of the 1997 ozone NAAQS, portions of this area were designated nonattainment. This boundary is also shown in Figure 1. The boundary for the nonattainment area for the 1997 ozone NAAQS included the entire counties of Bullitt (KY), Jefferson (KY), Oldham (KY), Clark (IN), and Floyd (IN). The boundary for the 2015 ozone NAAQS is the same as the boundary for the 1997 ozone NAAQS. The entire area was designated unclassifiable/attainment for the 2008 ozone NAAQS.

⁵ The EPA's Ozone Designations Guidance and Data web page can be found at <https://www.epa.gov/ozone-designations/ozone-designations-guidance-and-data>.

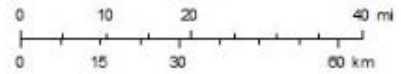
Figure 1. The EPA's Nonattainment Boundaries for the Louisville, KY-IN Area



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- | | |
|-----------------------------|----------------------------------|
| State Boundaries | Ozone 2016 Site Level DVs |
| USA_Countries | ● No valid value |
| Louisville_Area_of_Analysis | ● 0 - 0.070 |
| Louisville NAAKY Portion | ● 0.071 and above |
| Louisville NAAIN Portion | |



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 Map Service - USEPA Office of Environmental Information (OEI), Data: U.S. EPA Office of Air and Radiation (OAR) - Office of Air Quality

The EPA must designate as nonattainment any area that violates the NAAQS and any nearby areas that contribute to the violation in the violating area. Jefferson County, Kentucky has a monitor in violation of the 2015 ozone NAAQS, therefore this county is included in the final nonattainment area. The EPA determined that Bullitt County (KY), Oldham County (KY), Clark County (IN), and Floyd County (IN) contribute to the violating area. The following sections describe the five factor analysis. While the factors are presented individually, they are not independent. The five factor analysis process carefully considers the interconnections among the different factors and the dependence of each factor on one or more of the others, such as the interaction between emissions and meteorology for the area being evaluated.

IV. Factor Assessment

Factor 1: Air Quality Data

The EPA considered 8-hour ozone design values in parts per million (ppm) for air quality monitors in the Louisville, KY-IN area based on data for the 2014-2016 period (i.e., the 2016 design value, or DV). This is the most recent three-year period with fully-certified air quality data. The design value is the 3-year average of the annual 4th highest daily maximum 8-hour average ozone concentration.⁶ The 2015 NAAQS are met when the design value is 0.070 ppm or less. Only ozone measurement data collected in accordance with the quality assurance (QA) requirements using approved (FRM/FEM) monitors are used for NAAQS compliance determinations.⁷ The EPA uses FRM/FEM measurement data residing in the EPA's Air Quality System (AQS) database to calculate the ozone design values. Individual violations of the 2015 ozone NAAQS that the EPA determines have been caused by an exceptional event that meets the administrative and technical criteria in the Exceptional Events Rule⁸ are not included in these calculations. Whenever several monitors are located in a county (or designated nonattainment area), the design value for the county or area is determined by the monitor with the highest valid design value. The presence of one or more violating monitors (i.e. monitors with design values greater than 0.070 ppm) in a county or other geographic area forms the basis for designating that county or area as nonattainment. The remaining four factors are then used as the technical basis for determining the spatial extent of the designated nonattainment area surrounding the violating monitor (s) based on a consideration of what nearby areas are contributing to a violation of the NAAQS.

The EPA identified monitors where the most recent design values violate the NAAQS, and examined historical ozone air quality measurement data (including previous design values) to understand the nature of the ozone ambient air quality problem in the area. Eligible monitors for providing design value data generally include State and Local Air Monitoring Stations that are operated in accordance with 40 CFR part 58, appendices A, C, D and E and operating with an FRM or FEM monitor. These requirements must be met in order to be acceptable for comparison to the 2015 ozone NAAQS for designation purposes. All data from Special Purpose Monitors using an FRM or FEM are eligible for comparison to the NAAQS,

⁶ The specific methodology for calculating the ozone design values, including computational formulas and data completeness requirements, is described in 40 CFR part 50, appendix U.

⁷ The QA requirements for ozone monitoring data are specified in 40 CFR part 58, appendix A. The performance test requirements for candidate FEMs are provided in 40 CFR part 53, subpart B.

⁸ The EPA finalized the rule on the Treatment of Data Influenced by Exceptional Events (81 FR 68513) and the guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events in September of 2016. For more information, see <https://www.epa.gov/air-quality-analysis/exceptional-events-rule-and-guidance>.

subject to the requirements given in the March 28, 2016 Revision to Ambient Monitoring Quality Assurance and Other Requirements Rule (81 FR 17248).

The 2014-2016 design values for counties in the area of analysis are shown in Table 2.

Table 2. Air Quality Data (all values in ppm)^a.

County, State	State Recommended Nonattainment?	AQS Site ID	2014-2016 DV	2014 4 th highest daily max value	2015 4 th highest daily max value	2016 4 th highest daily max value
Jefferson, KY	No	21-111-0067	0.074	0.070	0.076	0.076
		21-111-0051	0.069	0.069	0.069	0.070
		21-111-0027	0.069	0.065	0.071	0.073
Bullitt, KY	No	21-029-0006	0.066	0.065	0.067	0.067
Hardin, KY	No	21-093-0006	0.065	0.062	0.066	0.068
Larue, KY	No	No monitor	N/A			
Meade, KY	No	No monitor	N/A			
Nelson, KY	No	No monitor	N/A			
Oldham, KY	No	21-185-0004	0.070	0.068	0.073	0.069
Trimble, KY	No	No monitor	N/A			
Henry, KY	No	No monitor	N/A			
Shelby, KY	No	No monitor	N/A			
Spencer, KY	No	No monitor	N/A			
Clark, IN	No	18-019-0008	0.070	0.066	0.074	0.072
Floyd, IN	No	18-043-1004	0.069	0.068	0.067	0.073
Harrison, IN	No	No monitor	N/A			
Jefferson, IN	No	No monitor	N/A			
Scott, IN	No	No monitor	N/A			
Washington, IN	No	No monitor	N/A			

^aThe highest design value in each county is indicated in bold type.

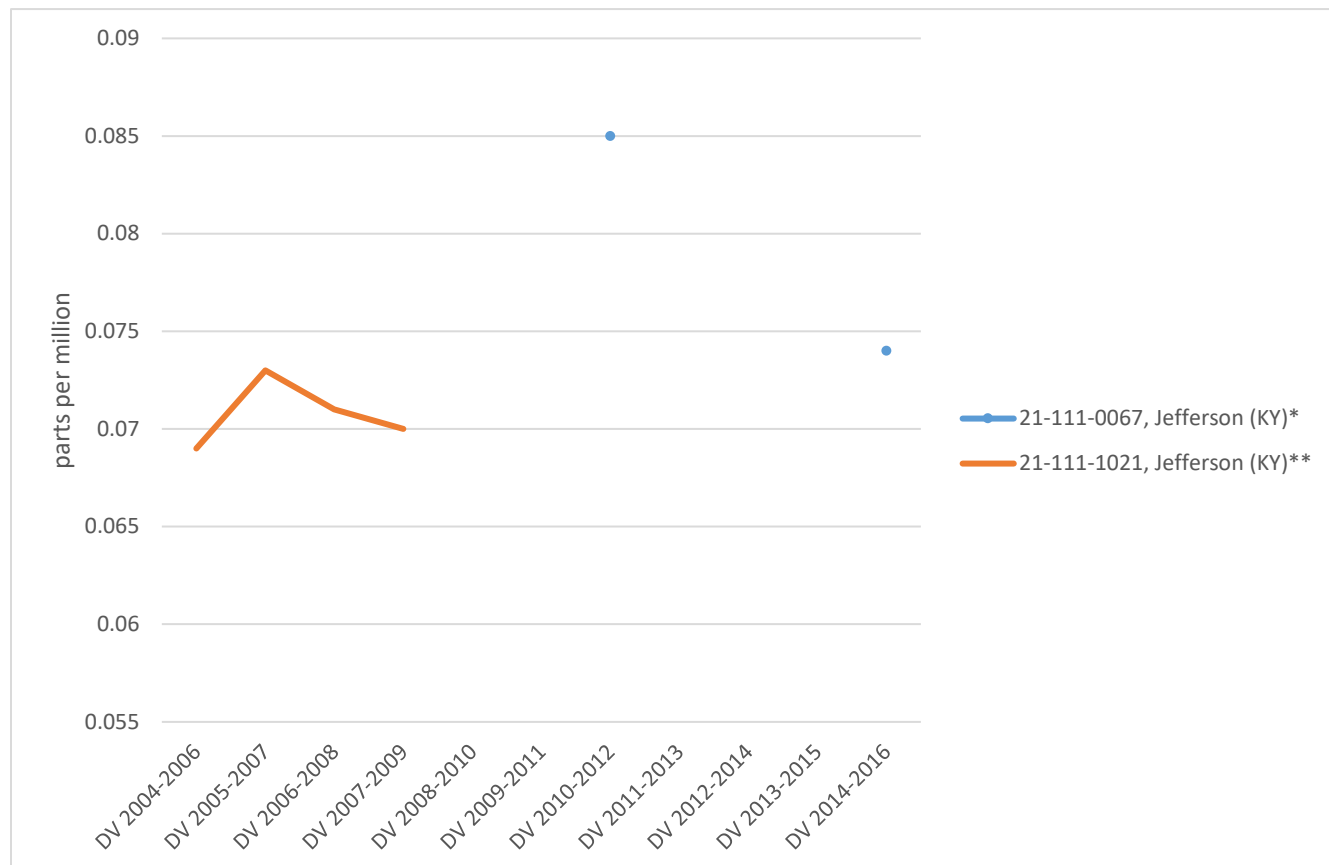
N/A means that the monitor did not meet the completeness criteria described in 40 CFR, part 50, Appendix U, or no data exists for the county.

Jefferson County, KY shows a violation of the 2015 ozone NAAQS, therefore this county is included in the final nonattainment area. A county (or partial county) must also be designated nonattainment if it contributes to a violation in a nearby area.

Figure 1, shown previously, identifies the Louisville, KY-IN final nonattainment area and the violating monitors. Table 2 identifies the design values for all monitors in the area of analysis and Figure 2 shows the historical trend of design values for the violating monitors. As indicated on the map, there is one violating monitor that is located near the city of Louisville in Jefferson County, Kentucky. To the north, south, and west of the violating monitor, there are eight monitors in the area of analysis that show compliance with the 2015 ozone NAAQS for the 2014-2016 time period. Air quality has generally

improved in the Louisville area since 2004. However, many of the monitors' 2014-2016 design values show a slight increase in measured ozone concentrations as compared to the 2013-2015 design values, and one monitor is now violating based on 2014-2016 data.

Figure 2. Three-Year Design Values for Violating Monitors. (2007-2016).



* The Cannons Lane NCore monitoring site (AQS ID 21-111-0067) collected valid design values during 2014-2016 and 2010-2012, but did not collect valid design values during any of the rolling three-year periods in between. Data collected by the monitor from January to October 2013 were invalidated due to quality assurance findings in Technical Systems Audits conducted by Kentucky and the EPA. As a result, the monitor did not produce valid design values for the 2011-2013, 2012-2014, or 2013-2015 periods.

** Monitor 21-111-1021 located in Jefferson County, KY was discontinued in December 2009. The EPA concurred with the termination of the 21-111-1021 site and relocation to the Ncore site (21-111-0067) on November 4, 2008.

The Commonwealth of Kentucky in its September 30, 2016, recommendation and the State of Indiana in its September 16, 2016, recommendation based analyses on 2013-2015 ozone data. Since this data no longer covers the most recent 3-year period with quality-assured, state-certified data and have been supplanted by the more current 2014-2016 ozone data, the EPA is not relying on the older ozone data upon which the states of Kentucky and Indiana based their 2016 recommendations. The EPA is instead relying on the 2014-2016 data for purposes of determining the appropriate designation and the boundaries of the area.

Factor 2: Emissions and Emissions-Related Data

The EPA evaluated ozone precursor emissions of nitrogen oxides (NOx) and volatile organic compounds (VOC) and other emissions-related data that provide information on areas contributing to violating monitors.

Emissions Data

The EPA reviewed data from the 2014 National Emissions Inventory (NEI). For each county in the area of analysis, the EPA examined the magnitude of large sources (NOx or VOC emissions greater than 100 tons per year (tpy)) and small point sources and the magnitude of county-level emissions reported in the NEI. These county-level emissions represent the sum of emissions from the following general source categories: point sources, non-point (i.e., area) sources, non-road mobile, on-road mobile, and fires. Emissions levels from sources in a nearby area indicate the potential for the area to contribute to monitored violations.

Table 3 provides a county-level emissions summary of NOx and VOC (given in tons per year (tpy)) emissions for the area of analysis considered for inclusion in the Louisville, KY-IN nonattainment area.

Table 3. Total County-Level NO_x and VOC Emissions.*

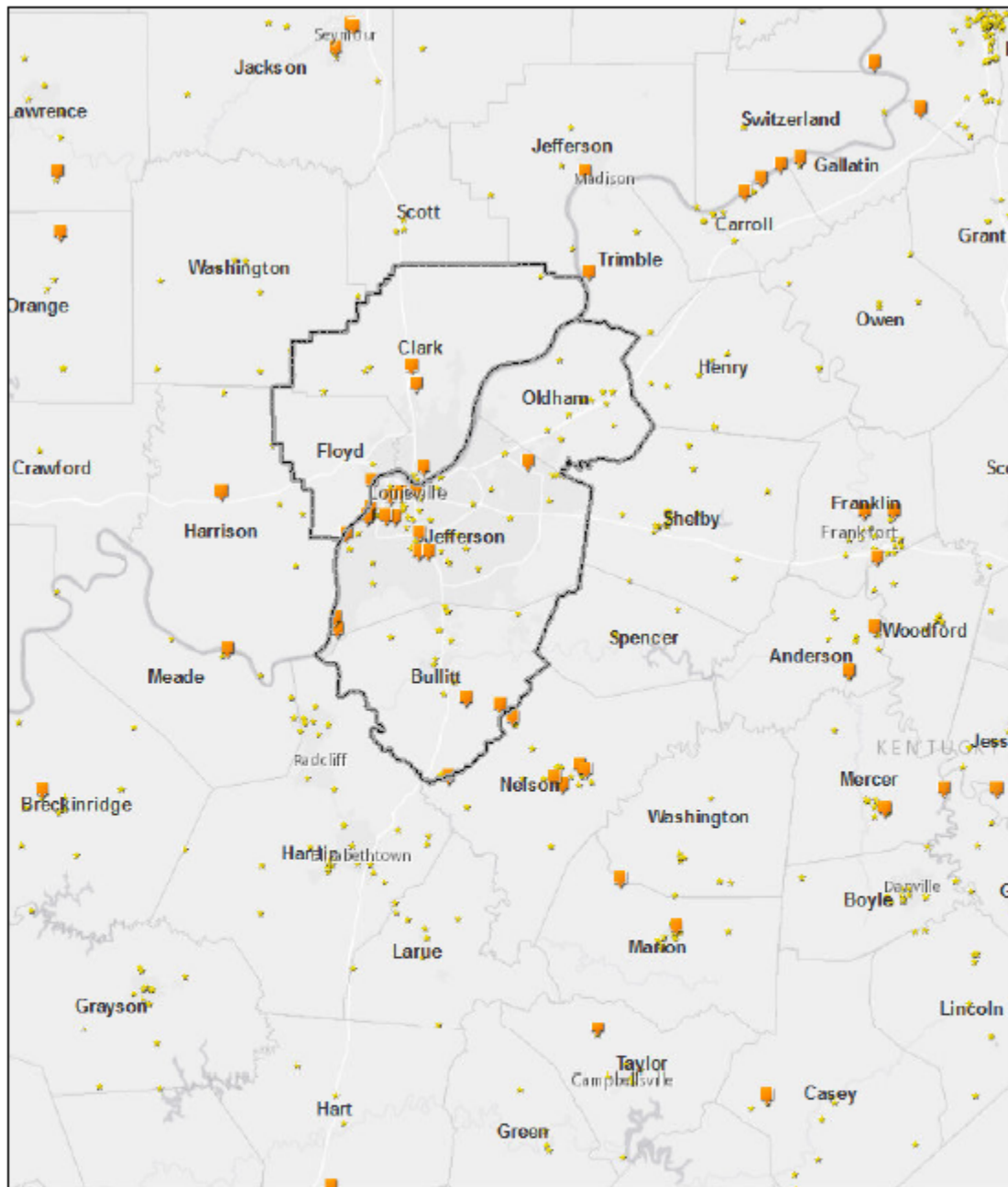
County	State Recommended Nonattainment?	Total NOx (tpy)	Total VOC (tpy)
Bullitt, KY	No	3,039	6,466
Henry, KY	No	1,076	588
Hardin, KY	No	3,960	4,128
Jefferson, KY	No	35,713	27,579
Larue, KY	No	642	481
Meade, KY	No	1,628	1,300
Nelson, KY	No	1,239	9,335
Oldham, KY	No	1940	1,301
Shelby, KY	No	2,511	2,097
Spencer, KY	No	325	427
Trimble, KY	No	4,223	429
Clark, IN	No	4,157	4,253
Floyd, IN	No	3,686	2,572

County	State Recommended Nonattainment?	Total NOx (tpy)	Total VOC (tpy)
Harrison, IN	No	1,774	1,701
Jefferson, IN	No	10,114	3,396
Scott, IN	No	839	1,155
Washington, IN	No	845	1,555
Area wide:		77,711	68,763

* Based on the 2014 NEI.

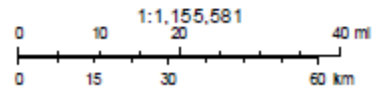
In addition to reviewing county-wide emissions of NOx and VOC in the area of analysis, the EPA also reviewed emissions from large point sources. The location of these sources, together with the other factors, can help inform nonattainment boundaries. The EPA further reviewed the location of small point sources, which appear concentrated in Bullitt (KY), Hardin (KY), Jefferson (KY), Nelson (KY), and Oldham (KY). The locations of the large and small point sources are shown in Figure 3 below. The nonattainment boundary is also shown.

Figure 3. Point Sources in the Area of Analysis.



November 1, 2017

- USA_Counties
- Louisville NAAKY Portion
- Louisville NAAIN Portion
- + Large Point Sources (VOC GT 100 or NOx GT 100)
- * Small Point Sources



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In summary, the EPA's analysis of relevant county-level emissions and the geographic locations of the relevant emission showed that Jefferson County, KY has relatively large emissions of NOx as compared to the other counties within the CSA, containing approximately 46 percent of the NOx emissions for the area of analysis. Jefferson County, IN had the second largest NOx emissions, with approximately 13 percent of the NOx emissions for the area of analysis. Five counties had total NOx emissions within a similar range of 3,000 to 4,500 tpy, and together comprise approximately 24.5 percent of the total NOx emissions for the area of analysis: Bullitt (KY); Hardin (KY); Trimble (KY); Clark (IN); and Floyd (IN). The remaining counties – Henry (KY); Larue (KY); Meade (KY); Nelson (KY); Oldham (KY); Shelby (KY); Spencer (KY); Harrison (IN); Scott (IN); and Washington (IN) – had NOx emissions of less than 2,000 tpy (and most had less than 1,000 tpy).

Jefferson County (KY) had the largest emissions of VOCs, with approximately 40 percent of total VOC emissions in the area of analysis. Four counties – Bullitt (KY), Hardin (KY), Nelson (KY) and Clark (IN) – had VOC emissions between 4,100 tons and 9,500 tons, and together contain approximately 35 percent of total VOC emissions in the area of analysis. Eight additional counties – Meade (KY), Oldham (KY), Shelby (KY), Floyd (IN), Harrison (IN), Jefferson (IN), Scott (IN), and Washington (IN) – had VOC emissions between 1,100 and 3,400 tons, and together contain approximately 21 percent of total VOC emissions in the area of analysis. The remainder of the counties reported total VOC emissions in a range of 400 to less than 600 tons: Henry (KY); Larue (KY); Spencer (KY); and Trimble (KY).

Emissions of both NOx and VOC in Jefferson County, KY are greater than the emissions for any of the other counties. Six counties – Bullitt (KY); Hardin (KY); Trimble (KY); Clark (IN); Floyd (IN); and Jefferson (IN) – have higher levels of NOx emissions as compared to the remaining counties in the Louisville CSA. Bullitt (KY), Hardin (KY), Nelson (KY) and Clark (IN) have relatively higher VOC emissions than the remaining counties in the Louisville CSA. Further discussion of the impact of the emissions in the area of analysis can be found in Factor 3.

Population density and degree of urbanization

In this part of the factor analysis, the 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 emissions of NOx and VOC from on-road and non-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 NOx and VOC emissions that may contribute to violations of the NAAQS. Table 4 shows the population, population density, and population growth information for each county in the area of analysis. Figure 4 shows the population density by county in the area of analysis, and Figure 5 shows the population density by census tract.

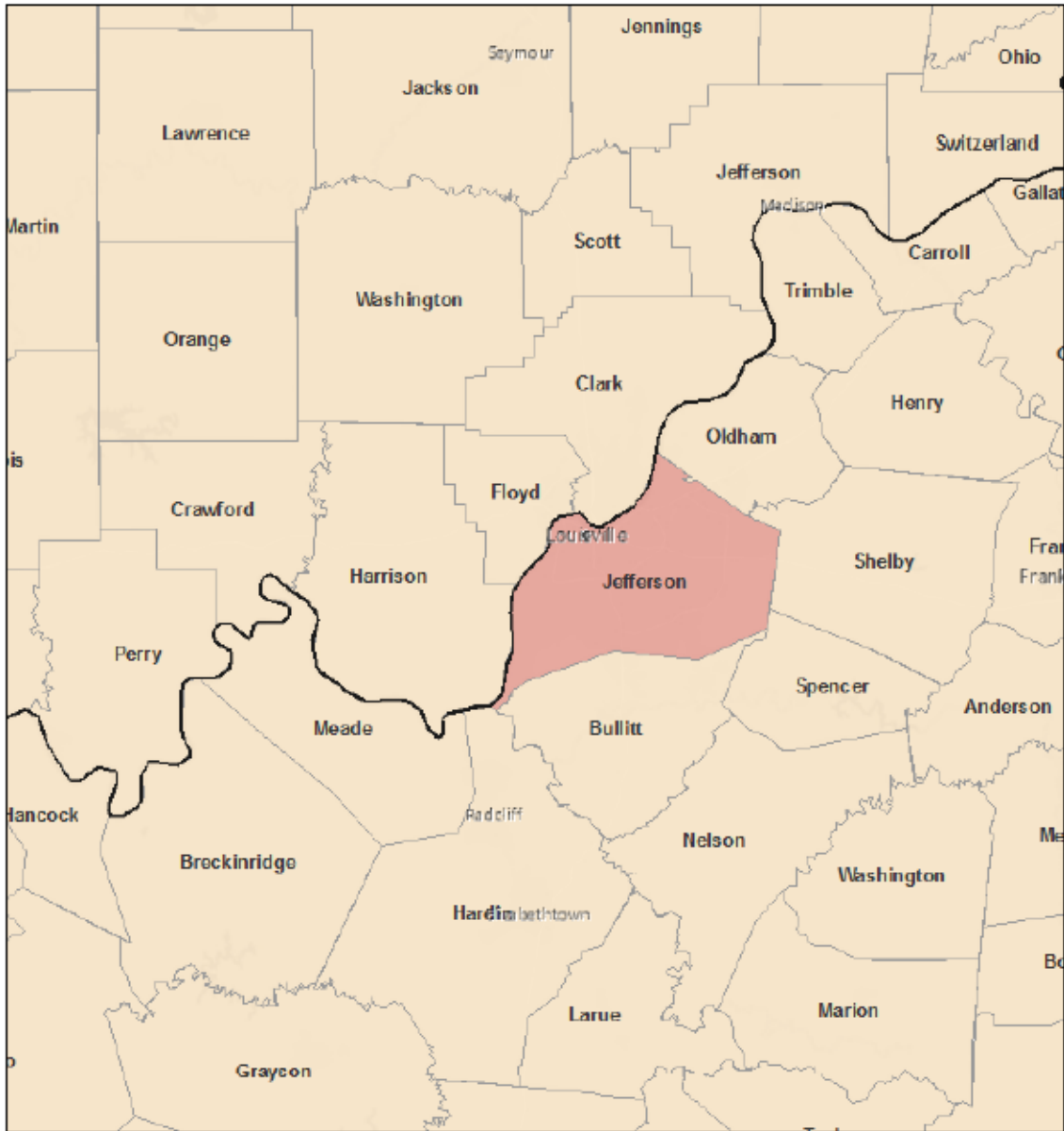
Table 4. Population and Growth.

County	State Recommended Nonattainment ?	2010 Population	2015 Population	2015 Population Density (per sq. mi.)	Absolute change in population (2010-2015)	Population % change (2010-2015)
Jefferson, KY	No	741,096	763,623	2007	22,527	3%
Clark, IN	No	110,232	115,371	309	5,139	5%
Hardin, KY	No	105,543	106,439	171	896	1%
Bullitt, KY	No	74,319	78,702	265	4,383	6%
Floyd, IN	No	74,578	76,778	519	2,200	3%
Oldham, KY	No	60,316	64,875	347	4,559	8%
Shelby, KY	No	42,074	45,632	120	3,558	8%
Nelson, KY	No	43,437	45,126	108	1,689	4%
Harrison, IN	No	39,364	39,578	82	214	1%
Jefferson, IN	No	32,428	32,416	90	-12	0%
Meade, KY	No	28,602	27,924	91	-678	-2%
Washington, IN	No	28,262	27,827	54	-435	-2%
Scott, IN	No	24,181	23,744	125	-437	-2%
Spencer, KY	No	17,061	17,894	96	833	5%
Henry, KY	No	15,416	15,620	55	204	1%
Larue, KY	No	14,193	14,241	54	48	0%
Trimble, KY	No	8,809	8,769	58	-40	0%
Area wide:		1,459,911	1,504,559	4,551	44,648	3%

* For state recommended partial counties, the emissions shown are for the entire county.

Source: U.S. Census Bureau population estimates for 2010 and 2015. www.census.gov/data.html.

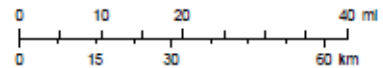
Figure 4. County-Level Population.



November 2, 2017

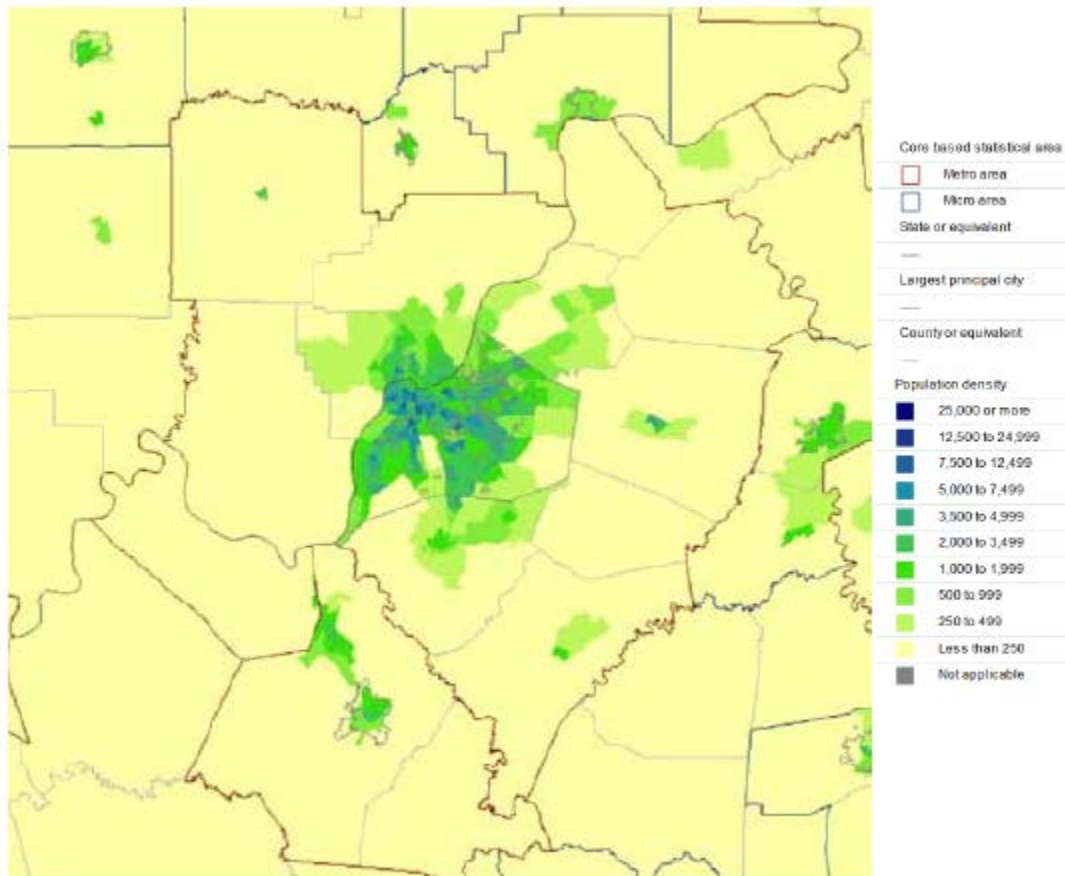
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- State Boundaries
- USA_Counties
- USA_Counties
 - 0 to 220,000
 - > 220,000 to 744,344



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Figure 5: Census Tract Level Population Density



Figures 4 and 5 show population patterns within the area of analysis. Figure 4 illustrates the relatively large population density contained in Jefferson County (KY), as compared to the population density of the surrounding counties in the area of analysis. However, Figure 5 – depicting population density at the census tract level – shows that population is centered around an urban core, which also corresponds with the violating monitor location (compare Figure 1 and Figure 5). The urban core extends beyond Jefferson County (KY) into the surrounding counties of Bullitt (KY), Oldham (KY), Clark (IN) and Floyd (IN). At the same time, the urbanized area does not extend to other counties, such as Shelby (KY), Spencer (KY) and Harrison (IN).

Population growth in the area of analysis was only 3 percent. The largest changes in population growth were in Bullitt (KY), Oldham (KY), Shelby (KY) and Clark (IN), which had small total population increases of between 3,500 and 5,200 persons when compared to Jefferson’s (KY) population increase of over 22,500 persons. While Spencer (KY) had a similar percent change, its population is lower than the listed four counties and the total increase in population was less than 900.

Traffic and Vehicle Miles Travelled (VMT)

The EPA evaluated the commuting patterns of residents, as well as the total VMT for each county in the area of analysis. In combination with the population/population density data and the location of main transportation arteries, 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 high VMT and/or high number of commuters indicates the presence of motor vehicle emissions that may contribute to violations of the NAAQS. Rapid population or VMT growth in a county on the urban perimeter may signify increasing integration with the core urban area, and thus could indicate that the associated area source and mobile source emissions may be appropriate to include in the nonattainment area. In addition to VMT, the EPA evaluated worker data collected by the U.S. Census Bureau⁹ for the counties in the area of analysis. Table 5 shows the traffic and commuting pattern data, including total VMT for each county in the area of analysis, number of residents who work in each county, number of residents that work in counties with the violating monitor, and the percent of residents working in counties with the violating monitor. The data in Table 5 are 2014 data.

Table 5. Traffic and Commuting Patterns.

County	State Recommended Nonattainment?	2014 Total VMT (Million Miles)	Number of County Residents Who Work	Number Commuting to or Within Counties with Violating Monitor(s)	Percentage Commuting to or Within Counties with Violating Monitor(s)
Jefferson, KY	No	7,574	348,166	284,137	81.6%
Clark, IN	No	1,544	57,972	17,443	30.1%
Hardin, KY	No	1,342	39,569	8,002	20.2%
Bullitt, KY	No	954	39,866	23,946	60.1%
Floyd, IN	No	874	38,310	12,281	32.1%
Shelby, KY	No	705	20,202	7,724	38.2%
Oldham, KY	No	566	29,084	16,940	58.2%
Harrison, IN	No	485	17,958	4,264	23.7%
Nelson, KY	No	479	20,850	5,208	25.0%
Scott, IN	No	334	9,573	845	8.8%
Jefferson, IN	No	317	13,771	208	1.5%
Washington, IN	No	269	12,221	1,103	9.0%
Henry, KY	No	265	6,967	2,100	30.1%

⁹ The worker data can be accessed at: <http://onthemap.ces.census.gov/>.

County	State Recommended Nonattainment?	2014 Total VMT (Million Miles)	Number of County Residents Who Work	Number Commuting to or Within Counties with Violating Monitor(s)	Percentage Commuting to or Within Counties with Violating Monitor(s)
Meade, KY	No	233	10,890	3,554	32.6%
Larue, KY	No	172	5,960	945	15.9%
Spencer, KY	No	122	8,781	4,904	55.8%
Trimble, KY	No	76	3,758	832	22.1%
Total		16,313	683,908	394,436	57.7%

* For state recommended partial counties, the data provided are for the entire county. Counties with a monitor(s) violating the NAAQS are indicated in bold.

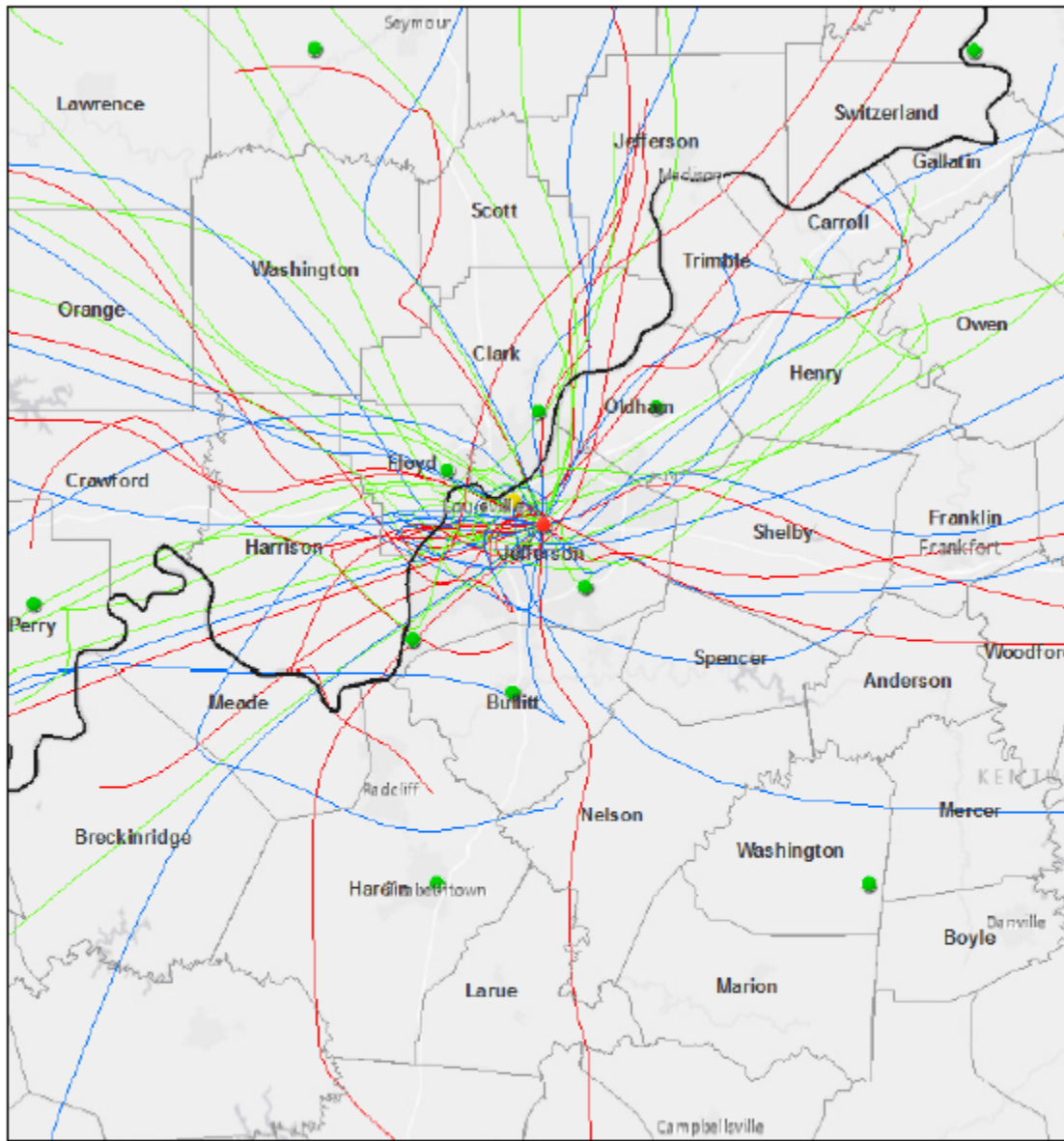
To show traffic and commuting patterns, Figure 6 overlays twelve-kilometer gridded VMT from the 2014 NEI with a map of the transportation arteries.

(IN); together, these counties each have more than 12,200 residents commuting into Jefferson County, KY which, combined, makes up approximately 18 percent of the area of analysis residents commuting into Jefferson County, KY. Hardin County (KY) has the third highest VMT in the area of analysis; however, the percentage commuting to Jefferson County (KY) is 20.2 percent of Hardin's workers and the absolute number of commuters is approximately 8,000 persons, or 2 percent of total commuters in the area of analysis that commute into Jefferson County, KY. Shelby County (KY) has 38 percent of its workforce that commutes into Jefferson County, KY, however, the absolute number of Shelby County residents commuting into Jefferson County, KY is less than 7,800 persons, or 2 percent of total commuters in the area of analysis that commute into Jefferson County, KY; further, Figure 6 illustrates that the vehicle miles follow a similar pattern to the population density, discussed earlier. While over 23 percent of Harrison County (IN) workers commute into Jefferson County, KY, this translates into only 4,264 commuters into Jefferson County, KY or 1 percent of total commuters in the area of analysis that commute into Jefferson County, KY. Similarly, while Henry County (KY), Meade (KY), Nelson (KY), and Spencer County (KY) have relatively high percentages of residents that commute to Jefferson County, KY for work as compared to the other counties in the area of analysis, these counties between 0.6 percent and 1.5 percent of total commuters in the area of analysis that commute into Jefferson County, KY. They also have very low VMT relative to the area of analysis. The remaining counties – Larue (KY), Trimble (KY), Jefferson (IN), Scott (IN), and Washington (IN) – have both relatively lower VMT and commuters, as compared to the rest of the area of analysis.

Factor 3: Meteorology

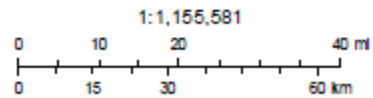
Evaluation of meteorological data helps to assess the fate and transport of emissions contributing to ozone concentrations and to identify areas potentially contributing to the monitored violations. Results of meteorological data analysis may inform the determination of nonattainment area boundaries. In order to determine how meteorological conditions, including, but not limited to, weather, transport patterns, and stagnation conditions, could affect the fate and transport of ozone and precursor emissions from sources in the area, the EPA evaluated 2014-2016 HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) trajectories at 100, 500, and 1000 meters above ground level (AGL) that illustrate the three-dimensional paths traveled by air parcels to a violating monitor. Figure 7 shows the 24-hour HYSPLIT back trajectories for each exceedance day (i.e., daily maximum 8 hour values that exceed the 2015 ozone NAAQS) for the violating monitor.

Figure 7. 2014- 2016 HYSPLIT Back Trajectories for Violating Monitor(s).



November 2, 2017

- State Boundaries
- USA_Counties
- Ozone 2016 Site Level DVs
- + No valid value
- + 0 - 0.070
- 0.071 and above
- Louisville_Jefferson_County_KY_IN_211110067
- 100
- 500
- 1,000



Map Service: USEPA Office of Environmental Information (OEI). Data: U.S. EPA Office of Air and Radiation (OAR) - Office of Air Quality

EPA Office of Environmental Information (OEI). Data: USEPA Office of Environmental Information (OEI), US Census Bureau | Source: U.S. Census Bureau | Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community | Esri, HERE, Garmin, NGA, USGS, NPS | Esri, HERE, NPS |

The 2014-2016 HYSPLIT back trajectories displayed in Figure 7 show that transport winds blew predominantly from the west, northwest, and northeast directions during times when the violating monitor in the Louisville area measured exceedances of the 2015 Ozone NAAQS. More limited, but not

insignificant, windflows were from the east at times of violation. These back trajectories show that winds blew predominately over the following counties on days when the violating monitor measured exceedances: Jefferson (KY); Oldham (KY); Clark (IN); Floyd (IN); and Harrison (IN).

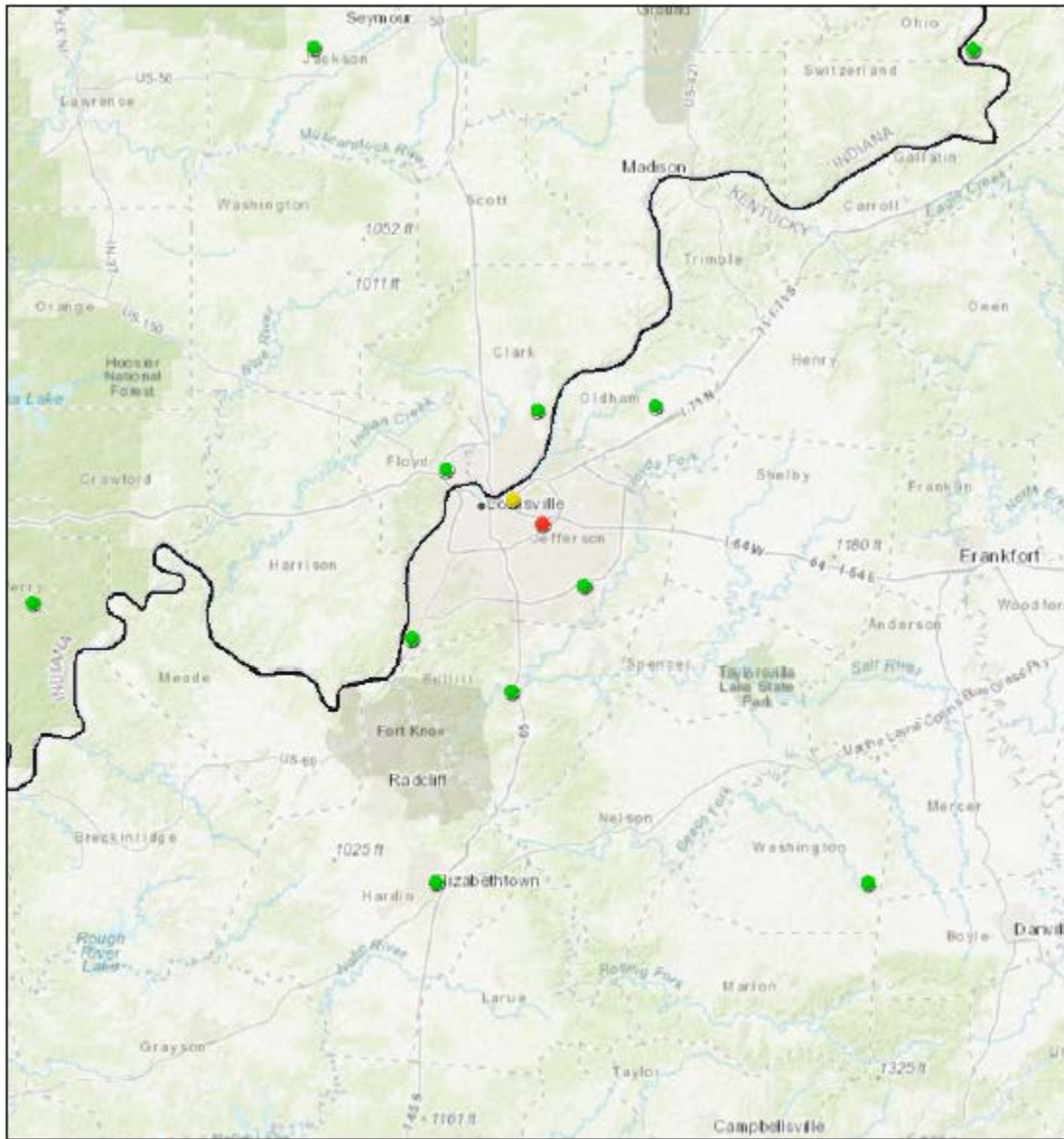
Factor 4: Geography/topography

Consideration of geography or topography can provide additional information relevant to defining nonattainment area boundaries. Analyses should examine the physical features of the land that might define the airshed. Mountains or other physical features may influence the fate and transport of emissions as well as the formation and distribution of ozone concentrations. The absence of any such geographic or topographic features may also be a relevant consideration in selecting boundaries for a given area.

The EPA used geography/topography analysis to evaluate the physical features of the land that might affect the airshed and, therefore, the distribution of ozone over the area. Figure 10 illustrates the topographical features in the area of analysis.

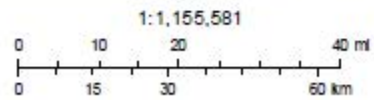
The Louisville, KY-IN area does not have any geographical or topographical features significantly limiting air pollution transport within its air shed.

Figure 10. Topographic Illustration of the Physical Features.



November 2, 2017

- State Boundaries
- Ozone 2016 Site Level DVs**
- + No valid value
- + 0 - 0.070
- + 0.071 and above



Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeBCO, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), Swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
 Map Service: USEPA Office of Environmental Information (OEI) Data: U.S.

Web AppBuilder for ArcGIS
 USEPA Office of Environmental Information (OEI) Data: USEPA Office of Environmental Information (OEI), US Census Bureau | Source: U.S. Census Bureau | Esri, HERE, Garmin, FAO, USGS, NOAA, EPA, NPS

Factor 5: Jurisdictional boundaries

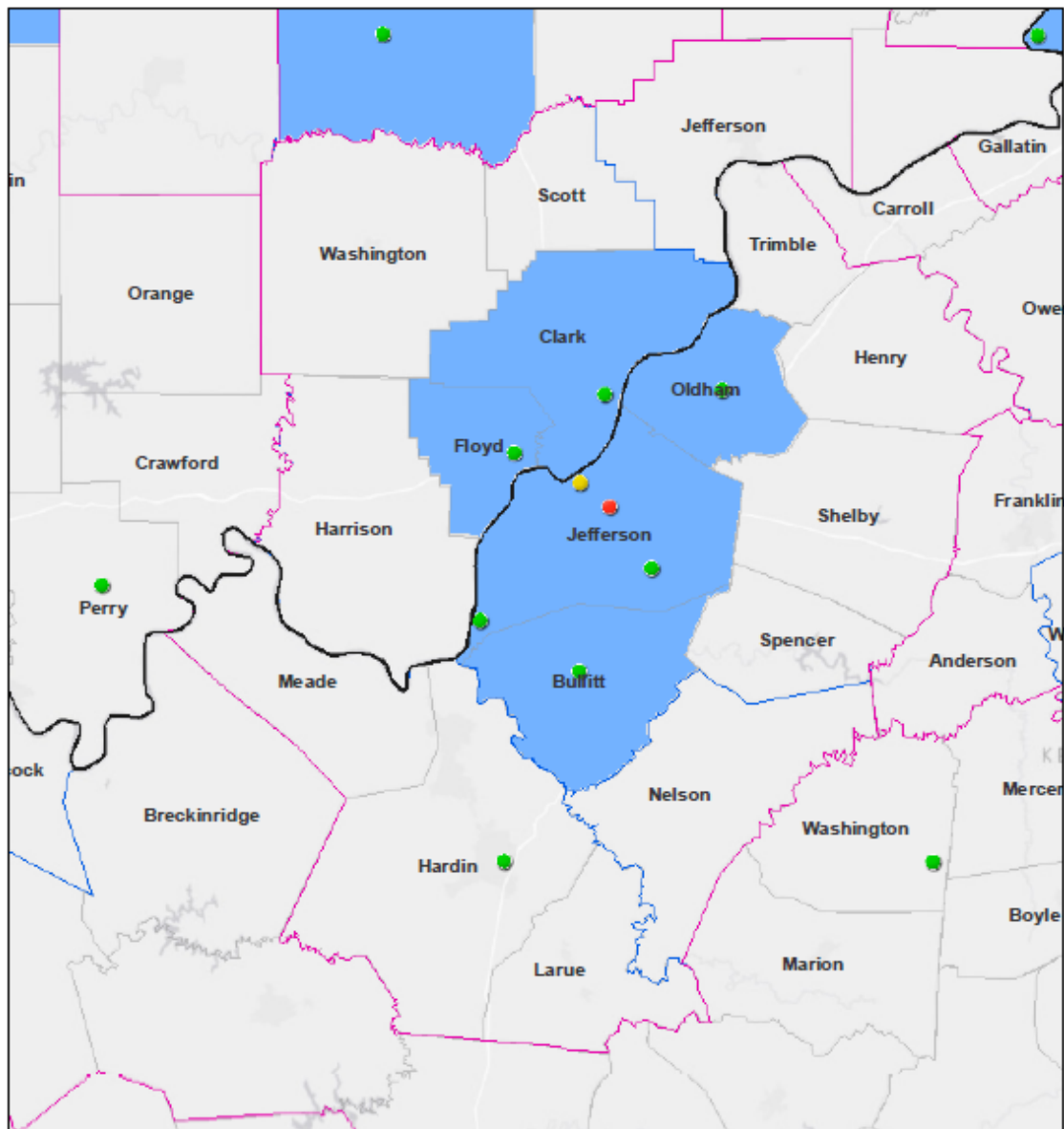
Once the geographic extent of the violating area and the nearby area contributing to violations is determined, the EPA considered existing jurisdictional boundaries for the purposes of providing a clearly defined legal boundary to carry out the air quality planning and enforcement functions for nonattainment areas. In defining the boundaries of the Louisville, KY-IN nonattainment area, the EPA considered existing jurisdictional boundaries, which can provide easily identifiable and recognized boundaries for purposes of implementing the NAAQS. Examples of jurisdictional boundaries include, but are not limited to: counties, air districts, areas of Indian country, metropolitan planning organizations, and existing nonattainment areas. If an existing jurisdictional boundary is used to help define the nonattainment area, it must encompass all of the area that has been identified as meeting the nonattainment definition. Where existing jurisdictional boundaries are not adequate or appropriate to describe the nonattainment area, the EPA considered other clearly defined and permanent landmarks or geographic coordinates for purposes of identifying the boundaries of the final designated areas.

The Louisville, KY-IN area has a previously established nonattainment boundary associated with the 1997 ozone NAAQS, including Bullitt (KY), Jefferson (KY), Oldham (KY), Clark (IN) and Floyd (IN) counties. For the 1979 1-hour ozone NAAQS, the nonattainment area had the same boundary, except that only a portions of Bullitt (KY) and Oldham (KY) counties were included.

In addition, there is a designated MPO for the Louisville urbanized area (Kentuckiana Regional Planning and Development Agency (KIPDA)) which includes the entirety of Jefferson County (KY), Bullitt County (KY), Oldham County (KY), Clark County (IN) and Floyd County, and portions of Shelby County (KY) and Harrison County (IN).¹¹

¹¹ http://www.kipda.org/files/PDF/Transportation_Division/FCR/Louisville_CR_Report_only.pdf

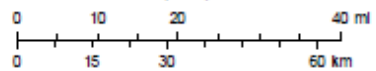
Figure 11. Jurisdictional Boundaries.



November 8, 2017

1:1,155,581

- State Boundaries
- CSAs - Combined Statistical Areas
- CBSAs - Metropolitan Statistical Areas
- USA_Countries
- Ozone 2016 Site Level DVs
 - + No valid value
- Ozone 1997 NAAQS NAA State Level
 - Maintenance (NAAQS revoked)
 - Nonattainment (NAAQS revoked)
- 0 - 0.070
- 0.071 and above



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 Map Service: USEPA Office of Environmental Information (OEI). Data: U.S. EPA Office of Air and Radiation (OAR) - Office of Air Quality
 U.S. EPA Office of Air and Radiation (OAR) - Office of Air Quality Planning

Standards (DAQPS) | U.S. Census Bureau | Map Service: USEPA Office of Environmental Information (OEI). Data: USEPA Office of Environmental Information (OEI), US Census Bureau | Source: U.S. Census Bureau | Web AppBuilder for ArcGIS

V. Conclusion for Louisville, KY-IN Area

Based on the assessment of factors described above, the EPA has concluded that the following counties meet the CAA criteria for inclusion in the Louisville, KY-IN nonattainment area: Bullitt County (KY), Jefferson County (KY), Oldham County (KY), Clark County (IN), and Floyd County (IN). These are the same counties that are included in the Louisville, KY-IN nonattainment area for the 1997 ozone NAAQS.

Jefferson County (KY) is included in the nonattainment area because the air quality monitor in Jefferson County, KY indicates a violation of the 2015 ozone NAAQS based on the 2016 design values. In addition, we note that Jefferson County, KY includes the bulk of the population within the CSA, and both NO_x and VOC emissions from Jefferson County, KY account for a large portion of the total emissions in the area of analysis.

Bullitt County (KY), Oldham County (KY), Clark County (IN), and Floyd County (IN) are counties adjacent to Jefferson County, KY, none of which has a violating monitor, but contribute to the ozone concentrations in violation of the 2015 ozone NAAQS. Bullitt County (KY) ranked high within the area of analysis on NO_x and VOC emissions, population, population density, VMT, number commuting into Jefferson and percent of workers commuting into Jefferson County, KY; and Bullitt County (KY) has been included as part of the previous nonattainment boundaries and is part of the KIPDA planning area. Oldham County (KY) ranked high within the area of analysis in population, population density, VMT, number commuting into Jefferson and percent of workers commuting into Jefferson County, KY; meteorological data suggested inclusion of Oldham County (KY); and Oldham County (KY) has been included as part of the previous nonattainment boundaries and is part of the KIPDA planning area. Clark County (IN) ranked high within the area of analysis on NO_x and VOC emissions, population, population density, VMT, number commuting into Jefferson and percent of workers commuting into Jefferson County, KY; meteorological data suggested inclusion of Clark County (IN); and Clark County (IN) has been included as part of the previous nonattainment boundaries and is part of the KIPDA planning area. Floyd County (IN) ranked high within the area of analysis on NO_x emissions, population, population density, VMT, number commuting into Jefferson and percent of workers commuting into Jefferson County, KY; meteorological data suggested inclusion of Floyd County (IN); and Floyd County (IN) has been included as part of the previous nonattainment boundaries and is part of the KIPDA planning area.

The EPA is not including the remaining analyzed counties within the nonattainment boundary of the Louisville, KY-IN nonattainment area. The EPA is not including Shelby County (KY) for the following reasons: first, emissions related data show that – compared to the other counties in the area of analysis – Shelby County (KY) has relatively low NO_x emissions, number of persons commuting into Jefferson County (KY), population, and relatively low population density that is not tied to the urbanized area of Louisville, KY; second, there are few jurisdictional ties to Jefferson County (KY), with only 4 square miles included in the KIPDA planning area; third, the meteorological data did not suggest inclusion of Shelby County (KY). The EPA is not including Harrison County (IN) in the nonattainment area for the following reasons: first, emissions related data show that Harrison County has relatively low NO_x emissions, low VMT, commuters into Jefferson County (KY), population, and population density as compared to other counties within the area of analysis; second, there are few jurisdictional ties to Jefferson County (KY) with only 0.1 square mile included in the KIPDA planning area; third, though meteorological analysis shows back trajectories over Harrison County (IN) from the violating monitor, a

weight of evidence approach must minimize the impact of trajectories when emissions under the trajectories are low. The EPA is not including Hardin County (KY) in the nonattainment area for the following reasons: first, emissions related data show that Hardin County has relatively low commuters into Jefferson County (KY), population density, population change and the census tract information shows a separation from the urban core of Jefferson County (KY); second, there are few jurisdictional ties to Jefferson County (KY); and third, the meteorological data did not suggest inclusion of Hardin County (KY). The EPA is not including Jefferson County (IN) in the nonattainment area for the following reasons: first, Jefferson County (IN) has low population, low population density, and low population growth, as well as low VMT and low commuter links to Jefferson County (KY); second, there are few jurisdictional ties to Jefferson County (KY); and third, the meteorological data did not suggest inclusion of Jefferson County (IN). Relevant to all of these counties, geography did not play a significant role in the evaluation as there were no features significantly limiting air pollution transport within the Jefferson County (KY) air shed.

The remaining counties – Henry (KY), Larue (KY), Meade (KY), Nelson (KY), Spencer (KY), Trimble (KY), Scott (IN), and Washington (IN) – ranked near the bottom of all counties in the area of analysis for most of the factors considered – relatively low NO_x or VOC emissions, population, population density, VMT, number of workers commuting into Jefferson County (KY), and few jurisdictional ties to Jefferson County (KY). While the HYSPLIT does show that some trajectories pass through these counties on the days on which the area exceeded the NAAQS, the other factors indicate that emissions from these counties likely had limited effect.