# Technical Support Document:

# Chapter 15
# Proposed Round 3 Area Designations for the 2010 1-Hour $SO_2$ Primary National Ambient Air Quality Standard for Kentucky

## 1. Summary

Pursuant to section 107(d) of the Clean Air Act (CAA), the U.S. Environmental Protection Agency (the EPA, we, or us) must designate areas as either "nonattainment," "attainment," or "unclassifiable" for the 2010 1-hour sulfur dioxide (SO2) primary national ambient air quality standard (NAAQS) (2010 $SO_2$ NAAQS). The CAA defines a nonattainment area as an area that does not meet the NAAQS or that contributes to a nearby area that does not meet the NAAQS. An attainment area is defined by the CAA as any area that meets the NAAQS and does not contribute to a nearby area that does not meet the NAAQS. Unclassifiable areas are defined by the CAA as those that cannot be classified on the basis of available information as meeting or not meeting the NAAQS. In this action, the EPA has defined a nonattainment area as an area that the EPA has determined violates the 2010 $SO_2$ NAAQS or contributes to a violation in a nearby area, based on the most recent 3 years of air quality monitoring data, appropriate dispersion modeling analysis, and any other relevant information. An unclassifiable/attainment area is defined by EPA as an area that either: (1) based on available information including (but not limited to) appropriate modeling analyses and/or monitoring data, the EPA has determined (i) meets the 2010 $SO_2$ NAAQS, and (ii) does not contribute to ambient air quality in a nearby area that does not meet the NAAQS; or (2) was not required to be characterized under 40 CFR 51.1203(c) or (d) and the EPA does not have available information including (but not limited to) appropriate modeling analyses and/or monitoring data that suggests that the area may (i) not be meeting the NAAQS, or (ii) contribute to ambient air quality in a nearby area that does not meet the NAAQS[1]An unclassifiable area is defined by the EPA as an area that either: (1) was required to be characterized by the state under 40 CFR 51.1203(c) or (d), has not been previously designated, and on the basis of available information cannot be classified as either: (i) meeting or not meeting the 2010 $SO_2$ NAAQS, or (ii) contributing or not contributing to ambient air quality in a nearby area that does not meet the NAAQS; or (2) was not required to be characterized under 40 CFR 51.1203(c) or (d) and the EPA does have available information including (but not limited to) appropriate modeling analyses and/or monitoring data that suggests that the area may (i) not be meeting the NAAQS, or (ii) contribute to ambient air quality in a nearby area that does not meet the NAAQS.

This technical support document (TSD) addresses designations for nearly all remaining undesignated areas in Kentucky for the 2010 $SO_2$ NAAQS. In previous final actions, the EPA

[1] The term "attainment area" is not used in this document because the EPA uses that term only to refer to a previous nonattainment area that has been redesignated to attainment as a result of the EPA's approval of a state-submitted maintenance plan.

has issued designations for the 2010 $SO_2$ NAAQS for selected areas of the country.[2] The EPA is under a December 31, 2017, deadline to designate the areas addressed in this TSD as required by the U.S. District Court for the Northern District of California.[3] We are referring to the set of designations being finalized by the December 31, 2017 deadline as "Round 3" of the designations process for the 2010 $SO_2$ NAAQS. After the Round 3 designations are completed, the only remaining undesignated areas will be those where a state has installed and timely begun operating a new $SO_2$ monitoring network meeting the EPA specifications referenced in the EPA's $SO_2$ Data Requirements Rule (DRR) (80 FR 51052).

Kentucky submitted its first recommendation regarding designations for the 2010 1-hour $SO_2$ NAAQS on June 2, 2011. In this letter, the Commonwealth recommended that Jefferson County be designated nonattainment, and that all other areas be designated as unclassifiable/attainment. The Commonwealth submitted updated recommendations on December 20, 2011, and then January 15, 2013 for a more specific nonattainment area within a portion of Jefferson County. Kentucky also submitted additional information to the EPA with updated recommendations on September 16, 2015, ahead of the July 2, 2016, deadline to designate certain areas as part of the Round 2 designations. Kentucky submitted one more set of updated recommendations on January 6, 2017. In our intended designations, we have considered all the submissions from the state, except where a recommendation in a later submission regarding a particular area indicates that it replaces an earlier recommendation for that area we have considered the recommendation in the later submission.

For the areas in Kentucky that are part of the Round 3 designations process, Table 1 identifies the EPA's intended designations and the counties or portions of counties to which they would apply. It also lists Kentucky's current recommendations. The EPA's final designation for these areas will be based on an assessment and characterization of air quality through ambient air quality data, air dispersion modeling, other evidence and supporting information, or a combination of the above, and could change based on changes to this information (or the availability of new information) that alters EPA's assessment and characterization of air quality.

**Table 1. Summary of the EPA's Intended Designations and the Designation Recommendations by Kentucky**

| Area/County | Kentucky's Recommended Area Definition | Kentucky's Recommended Designation | The EPA's Intended Area Definition | The EPA's Intended Designation |
|---|---|---|---|---|
| Boone County Area | Boone County | Attainment | Same as State's Recommendation | Unclassifiable/ Attainment |
| Carroll County Area | Carroll County | Attainment | Same as State's Recommendation | Unclassifiable/ Attainment |

[2] A total of 94 areas throughout the U.S. were previously designated in actions published on August 5, 2013 (78 FR 47191), July 12, 2016 (81 FR 45039), and December 13, 2016 (81 FR 89870).
[3] *Sierra Club v. McCarthy*, No. 3-13-cv-3953 (SI) (N.D. Cal. Mar. 2, 2015).

| Area/County | Kentucky's Recommended Area Definition | Kentucky's Recommended Designation | The EPA's Intended Area Definition | The EPA's Intended Designation |
|---|---|---|---|---|
| Davies County Area | Davies County | Attainment | Same as State's Recommendation | Unclassifiable/ Attainment |
| Hancock County Area | Hancock County | Attainment | Same as State's Recommendation | Unclassifiable/ Attainment |
| Henderson County Area | Henderson County | Attainment | Henderson County (p) | Unclassifiable |
| Mason County Area | Mason County | Attainment | Same as State's Recommendation | Unclassifiable/ Attainment |
| McCracken County Area | McCracken County | Attainment | Same as State's Recommendation | Unclassifiable/ Attainment |
| Muhlenberg County Area | Muhlenberg County | Attainment | Same as State's Recommendation | Unclassifiable/ Attainment |
| Trimble County Area | Trimble County | Attainment | Same as State's Recommendation | Unclassifiable/ Attainment |
| Rest of the State* | Rest of the State | Attainment | Same as State's recommendation | Unclassifiable/ Attainment |

* Except for areas that are associated with sources for which Kentucky elected to install and began timely operation of a new $SO_2$ monitoring network meeting the EPA specifications referenced in the EPA's $SO_2$ DRR (*see* Table 2), the EPA intends to designate the remaining undesignated counties (or portions of counties) in Kentucky as "unclassifiable/attainment." These areas that we intend to designate as unclassifiable/attainment (those to which this row of this table is applicable) are identified more specifically in Section 11 of this TSD.

Areas for which Kentucky elected to install and began timely operation of a new, approved $SO_2$ monitoring network are listed in Table 2. The EPA is required to designate these areas, pursuant to a court ordered schedule, by December 31, 2020. Table 2 also lists the $SO_2$ emissions sources around which each new, approved monitoring network has been established.

**Table 2 – Undesignated Areas Which the EPA Is Not Addressing in this Round of Designations (and Associated Source or Sources)**

| Area | Source(s) |
|---|---|
| Henderson (p) and Webster Counties | Century Aluminum Sebree, LLC, Big Rivers Electric Corporation's (BREC's) Robert A. Reid Station/Henderson Municipal Power and Light (HMP&L) Station 2, and BREC's Green Station Landfill |

Areas that the EPA previously designated unclassifiable in Round 1 (*see* 78 FR 47191) and Round 2 (*see* 81 FR 45039 and 81 FR 89870) are not affected by the designations in Round 3 unless otherwise noted.

# 2. General Approach and Schedule

Updated designations guidance documents were issued by the EPA through a July 22, 2016, memorandum and a March 20, 2015, memorandum from Stephen D. Page, Director, U.S. EPA, Office of Air Quality Planning and Standards, to Air Division Directors, U.S. EPA Regions I-X. These memoranda supersede earlier designation guidance for the 2010 $SO_2$ NAAQS, issued on March 24, 2011, and identify factors that the EPA intends to evaluate in determining whether areas are in violation of the 2010 $SO_2$ NAAQS. The documents also contain the factors that the EPA intends to evaluate in determining the boundaries for designated areas. These factors include: 1) air quality characterization via ambient monitoring or dispersion modeling results; 2) emissions-related data; 3) meteorology; 4) geography and topography; and 5) jurisdictional boundaries.

To assist states and other interested parties in their efforts to characterize air quality through air dispersion modeling for sources that emit $SO_2$, the EPA released its most recent version of a draft document titled, "$SO_2$ NAAQS Designations Modeling Technical Assistance Document" (Modeling TAD) in August 2016.[4]

Readers of this chapter of this TSD should refer to the additional general information for the EPA's Round 3 area designations in Chapter 1 (Background and History of the Intended Round 3 Area Designations for the 2010 1-Hour SO2 Primary National Ambient Air Quality Standard) and Chapter 2 (Intended Round 3 Area Designations for the 2010 1-Hour SO2 Primary National Ambient Air Quality Standard for States with Sources Not Required to be Characterized).

As specified by the March 2, 2015, court order, the EPA is required to designate by December 31, 2017, all "remaining undesignated areas in which, by January 1, 2017, states have not installed and begun operating a new $SO_2$ monitoring network meeting the EPA specifications referenced in the EPA's" DRR. The EPA will therefore designate by December 31, 2017, areas of the country that are not, pursuant to the DRR, timely operating the EPA-approved and valid

[2] https://www.epa.gov/sites/production/files/2016-06/documents/so2modelingtad.pdf. In addition to this TAD on modeling, the EPA also has released a technical assistance document addressing $SO_2$ monitoring network design, to advise states that have elected to install and begin operation of a new $SO_2$ monitoring network. See Draft $SO_2$ NAAQS Designations Source-Oriented Monitoring Technical Assistance Document, February 2016, https://www.epa.gov/sites/production/files/2016-06/documents/so2monitoringtad.pdf.

monitoring networks. The areas to be designated by December 31, 2017, include the areas associated with nine sources in Kentucky meeting DRR emissions criteria that states have chosen to be characterized using air dispersion modeling, the areas associated with three sources in Kentucky for which air agencies imposed emissions limitations on sources to restrict their $SO_2$ emissions to less than 2,000 tpy, sources that met the DRR requirements by demonstrating shut down of the source (one of which is in Kentucky), areas for which the states chose monitoring for the DRR but did not timely meet the approval and operating deadline (none of which are in Kentucky), and other areas not specifically required to be characterized by the Commonwealth under the DRR.

Because many of the intended designations have been informed by available modeling analyses, this preliminary TSD is structured based on the availability of such modeling information. There is a section for each county for which modeling information is available. For some counties, multiple portions of the county have modeling information available and the section on the county is divided accordingly. The remaining to-be-designated counties are then addressed together in Section 11.

The EPA does not plan to revise this TSD after consideration of state and public comment on our intended designation. A separate TSD will be prepared as necessary to document how we have addressed such comments in the final designations.

The following are definitions of important terms used in this document:

1) 2010 $SO_2$ NAAQS – The primary NAAQS for $SO_2$ promulgated in 2010. This NAAQS is 75 parts per billion (ppb), based on the 3-year average of the 99$^{th}$ percentile of the annual distribution of daily maximum 1-hour average concentrations. See 40 CFR 50.17.
2) Design Value - a statistic computed according to the data handling procedures of the NAAQS (in 40 CFR part 50 Appendix T) that, by comparison to the level of the NAAQS, indicates whether the area is violating the NAAQS.
3) Designated nonattainment area – an area that, based on available information including (but not limited to) appropriate modeling analyses and/or monitoring data, the EPA has determined either: (1) does not meet the 2010 $SO_2$ NAAQS, or (2) contributes to ambient air quality in a nearby area that does not meet the NAAQS.
4) Designated unclassifiable/attainment area an area that either: (1) based on available information including (but not limited to) appropriate modeling analyses and/or monitoring data, the EPA has determined (i) meets the 2010 $SO_2$ NAAQS, and (ii) does not contribute to ambient air quality in a nearby area that does not meet the NAAQS; or (2) was not required to be characterized under 40 CFR 51.1203(c) or (d) and the EPA does not have available information including (but not limited to) appropriate modeling analyses and/or monitoring data that suggests that the area may (i) not be meeting the NAAQS, or (ii) contribute to ambient air quality in a nearby area that does not meet the NAAQS..[5]
5) Designated unclassifiable area – an area that either: (1) was required to be characterized by the state under 40 CFR 51.1203(c) or (d), has not been previously designated, and on

[5] The term "designated attainment area" is not used in this document because the EPA uses that term only to refer to a previous nonattainment area that has been redesignated to attainment as a result of the EPA's approval of a state-submitted maintenance plan.

the basis of available information cannot be classified as either: (i) meeting or not meeting the 2010 $SO_2$ NAAQS, or (ii) contributing or not contributing to ambient air quality in a nearby area that does not meet the NAAQS; or (2) was not required to be characterized under 40 CFR 51.1203(c) or (d) and the EPA does have available information including (but not limited to) appropriate modeling analyses and/or monitoring data that suggests that the area may (i) not be meeting the NAAQS, or (ii) contribute to ambient air quality in a nearby area that does not meet the NAAQS.

6) Modeled violation – a violation of the $SO_2$ NAAQS demonstrated by air dispersion modeling.
7) Recommended attainment area – an area that a state, territory, or tribe has recommended that the EPA designate as attainment.
8) Recommended nonattainment area – an area that a state, territory, or tribe has recommended that the EPA designate as nonattainment.
9) Recommended unclassifiable area – an area that a state, territory, or tribe has recommended that the EPA designate as unclassifiable.
10) Recommended unclassifiable/attainment area – an area that a state, territory, or tribe has recommended that the EPA designate as unclassifiable/attainment.
11) Violating monitor – an ambient air monitor meeting 40 CFR parts 50, 53, and 58 requirements whose valid design value exceeds 75 ppb, based on data analysis conducted in accordance with Appendix T of 40 CFR part 50.
12) We, our, and us – these refer to the EPA.

# 3. Technical Analysis for the Boone County Area

## 3.1. Introduction

The EPA must designate the Boone County area by December 31, 2017, because the area has not been previously designated and Kentucky has not installed and timely begun operation of a new, approved $SO_2$ monitoring network meeting the EPA specifications referenced in the EPA's $SO_2$ DRR for any sources of $SO_2$ emissions in Boone County. The DRR source, Duke Energy's East Bend Generating Station, is by the Ohio River, which is the border between Kentucky and Indiana. Boone County also borders Ohio. Therefore, the area of analysis, and the modeling receptors, cross the Kentucky state boundaries into neighboring states.

## 3.2. Air Quality Monitoring Data for the Boone County Area

This factor considers the $SO_2$ air quality monitoring data in the area of Boone County. Kentucky provided the values of the 99$^{th}$ percentile of the $SO_2$ monitors in Kentucky. Kentucky stated in its June 2, 2011 recommendation that "the average of the 99$^{th}$ percentile at all monitors is below the standard of 75 ppb in all locations except Jefferson County. The rest of the areas in Kentucky comply with the standard and should be designated as attainment/unclassifiable for the $SO_2$ standard."

The EPA reviewed the available air quality monitoring data in the AQS database and found no nearby data for Boone County. The closest monitor is over 35 km from East Bend, two counties east of Boone in Campbell County. In reviewing the available air quality monitoring data in AQS, the EPA determined that there is no relevant data in AQS collected in or near Boone County that could inform the intended designation action. The most recent $SO_2$ design values for all areas of the country are available at https://www.epa.gov/air-trends/air-quality-design-values.

## 3.3. Air Quality Modeling Analysis for the Boone County Area Addressing Duke Energy's East Bend Generating Station (East Bend)

### *3.3.1. Introduction*

This section 3.3 presents all the available air quality modeling information for a portion of Boone County that includes Duke Energy's East Bend Generating Station (East Bend). (This portion of Boone County will often be referred to as "the Boone County area" within this section 3.3.). This area contains one DRR source, the East Bend facility, around which Kentucky is required by the DRR to characterize $SO_2$ air quality, or alternatively establish an $SO_2$ emissions limitation of less than 2,000 tons per year (tpy). Kentucky's modeling demonstration for the Boone County area also includes nearby sources in a neighboring county and across the state border in Ohio. These are DRR sources thought to impact the Boone County area. All DRR sources evaluated for this area of analysis are listed below:

- The East Bend facility emitted 2,000 tons or more annually. Specifically, East Bend emitted 2,103 tons of $SO_2$ in 2014. The East Bend facility emitted 2,656 tons in 2015 and 2,681 tons in 2016. This source meets the DRR criteria and thus is on the $SO_2$ DRR Source list, and Kentucky has chosen to characterize it via modeling.

- Kentucky Utilities Company's Ghent Station facility emitted 2,000 tons or more annually (14,851 tons in 2014) and is also on the $SO_2$ DRR Source list. This source was included by Kentucky in characterizing the Boone County area; however, the area around this facility (in Carroll County) is discussed again explicitly in another section of this TSD chapter.

- Dynegy's Miami Fort Generating Station, formerly Duke Energy's Miami Fort Generating Station facility emitted 2,000 tons or more annually (28,474 tons in 2014) is located in Ohio and on the $SO_2$ DRR Source list. This source was included by Kentucky in characterizing the Boone County area; however, the area around this source (in Hamilton County, Ohio) is discussed again explicitly in the Ohio TSD chapter.

Because we have available results of air quality modeling in which these sources are modeled together, the area around this group of sources is being addressed in this section with consideration given to the impacts of all these sources.

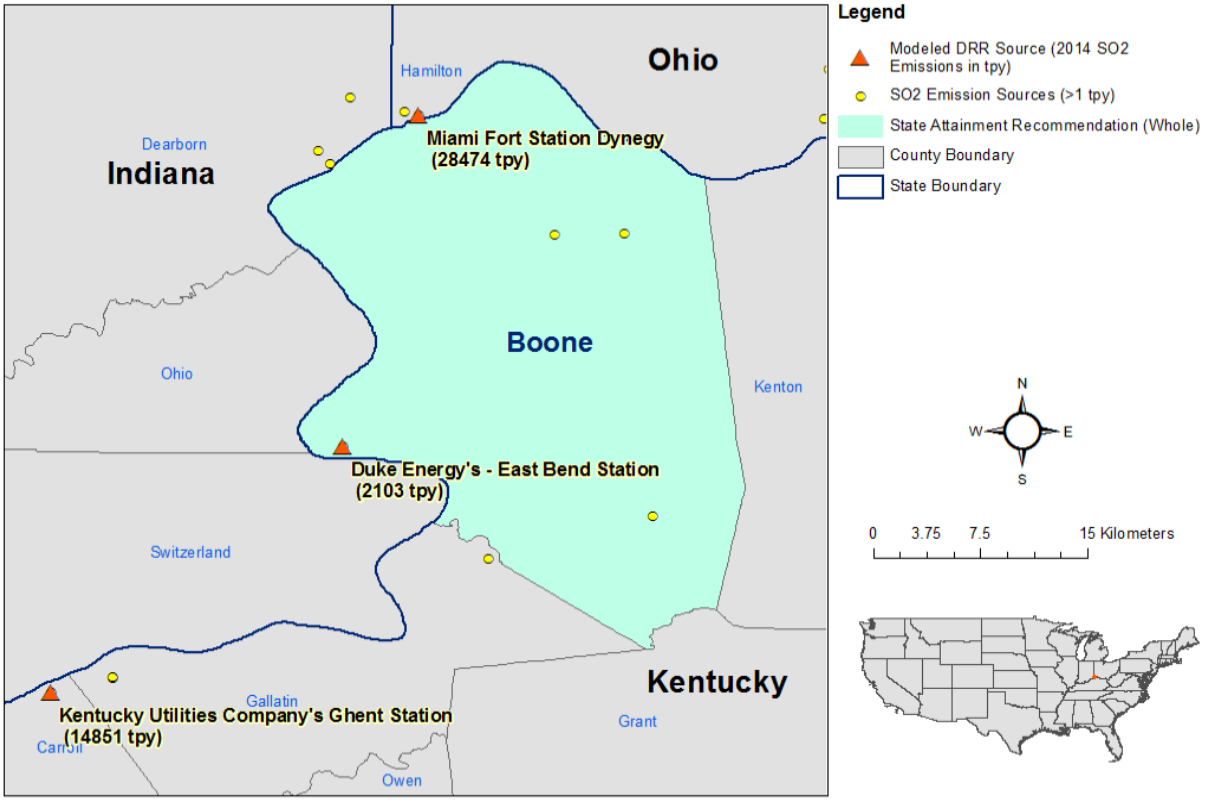
In its submission, Kentucky recommended that an area that includes the area surrounding the East Bend facility, specifically Boone County, be designated attainment based on an assessment and characterization of air quality impacts from these facilities and other nearby sources that may have a potential impact in the area where the 2010 $SO_2$ NAAQS may be exceeded. This assessment and characterization was performed using air dispersion modeling software, i.e., AERMOD, analyzing actual emissions. After careful review of the Commonwealth's assessment, supporting documentation, and all available data, the EPA agrees with the Commonwealth's recommendation for the area, and intends to designate the area as unclassifiable/attainment. Our reasoning for this conclusion is explained in a later section of this TSD, after all the available information is presented.

The area that the Commonwealth has assessed via air quality modeling is located in the southwest corner of Boone County, centered on the eastern bank of the Ohio River bordering Indiana. As seen in Figure 1 below, the East Bend facility is located in Boone County, Kentucky, approximately 21 kilometers (km) southwest of the city of Cincinnati, Ohio, and on the Ohio River, bordering Indiana. The Ghent Station facility is located in the northeast corner of Carroll County, Kentucky, approximately 23.5 km southwest of the East Bend facility. This source is also located along the eastern bank of the Ohio River, bordering Indiana. The Miami Fort Station facility is located across the Ohio River in the southwest portion of Hamilton County, Ohio, approximately 23 km north of East Bend. Miami Fort sits along the northern bank of the Ohio River, across the borders of Indiana and Kentucky. Also included in the figure are other nearby emitters of $SO_2$.[6]

[6] All other $SO_2$ emitters of 1 tpy or more (based on information in the emissions inventory data from the Commonwealth of Kentucky and the States of Ohio and Indiana) are shown in Figure 1.

Also included in the figure is the Commonwealth's recommended area for the attainment designation. The EPA's intended unclassifiable/attainment designation boundary for the Boone County area is not shown in this figure, but is shown in a figure in the section below that summarizes our intended designation.

**Figure 1. Map of the Boone County Area Addressing East Bend Facility.**




The discussion and analysis that follows below will reference the Modeling TAD and the factors for evaluation contained in the EPA's July 22, 2016, guidance and March 20, 2015, guidance, as appropriate.

For this area, the EPA received and considered two modeling assessments from the Commonwealth and one assessment from the State of Ohio. The assessment from Ohio does not explicitly model East Bend, and simply shows the impacts of Miami Fort out to 50 km in each direction. Because the Ohio modeling assessment does not include East Bend, the EPA will not refer to it in this section on Boone County.[7] More information on Ohio's assessment of the Adams County area is available in the Ohio chapter of this TSD. To avoid confusion in referring to these assessments, the following table indicates when they were received from the

[7] Ohio's modeling report for Miami Fort shows impacts below the NAAQS in Boone County. However, Kentucky explicitly included Miami Fort in the modeling assessment for characterizing the area around East Bend. Therefore, the EPA will refer to Kentucky's modeling assessments of the Boone County area in this section of the TSD only.

Commonwealth, provides identifiers for the assessment that are used in the discussion of the assessment that follows, and identifies any distinguishing features of the modeling assessment.

**Table 2 – Modeling Assessments for the Boone County Area**

| Assessment Submitted by | Date of the Assessment | Identifier Used in this TSD | Distinguishing or Otherwise Key Features |
|---|---|---|---|
| Kentucky | November 22, 2016* | November 22, 2016 Modeling Report or Modeling Report | First formal modeling report received |
| Kentucky | June 6, 2017** | June 6, 2017 Revised Modeling Report | Revised modeling assessment |

*This modeling report, dated November 22, 2016, was submitted to the EPA on January 6, 2017.

**The revised modeling report and revised modeling files were sent to the EPA by Kentucky on June 6, 2017.

### *3.3.2. Modeling Analysis Provided by the Commonwealth*

#### *3.3.2.1. Differences Between and Relevance of the Modeling Assessments Submitted by the Commonwealth*

Revised modeling was submitted by the Commonwealth on June 6, 2017. There were three differences between this modeling submittal and the previous submittal dated November 22, 2016. The first difference is the receptor grid that was used. The June 6, 2017, Revised Modeling Assessment included receptors over the entire East Bend property to address EPA's comment that the final modeling report should clearly demonstrate that the general public does not have access to all areas within the facility fenceline. Additionally, the EPA indicated that if the maximum predicted $SO_2$ concentrations do not occur within the 100-m receptor grid, additional receptors will need to be modeled to ensure that maximum impacts are resolved to the nearest 100 m. The June 6, 2017 Revised Modeling Assessment addresses this comment, and the receptor grid in the area where the maximum concentration occurs was revised to 100-m grid spacing. The second difference between the previous modeling submittal and the revised submittal is the characterization of the nearby Ghent Station facility, including the emissions used and the stack configuration of the units there. The June 6, 2017, Revised Modeling Report addresses the EPA's comment on discrepancies noted in the hourly emissions data and stack configurations that were modeled for Ghent Station initially. The emissions from units 2 and 3 were modeled as one stack in the revised modeling submittal. The third difference is in the processing of the meteorological data. The June 6, 2017, Revised Modeling Assessment addresses the EPA's comments on AERMET and AERMINUTE processing. AERMET processing was rerun in the revised modeling assessment with the THRESH_1MIN set to 0.5 m/s. Additionally, AERMINUTE was rerun using a more recent version (version 14337).

#### *3.3.2.2. Model Selection and Modeling Components*

The EPA's Modeling TAD notes that for area designations under the 2010 $SO_2$ NAAQS, the AERMOD modeling system should be used, unless use of an alternative model can be justified. The AERMOD modeling system contains the following components:

- AERMOD: the dispersion model
- AERMAP: the terrain processor for AERMOD
- AERMET: the meteorological data processor for AERMOD
- BPIPPRM: the building input processor
- AERMINUTE: a pre-processor to AERMET incorporating 1-minute automated surface observation system (ASOS) wind data
- AERSURFACE: the surface characteristics processor for AERMET
- AERSCREEN: a screening version of AERMOD

The Commonwealth used AERMOD version 15181 using all regulatory default options. AERMOD version 16216r has since become the regulatory model version. There were no updates from 15181 to 16216r that would significantly affect the concentrations predicted here. A discussion of the Commonwealth's approach to the individual components is provided in the corresponding discussion that follows, as appropriate.

The current version of AERMOD, version 16216r, includes updates to 40 CFR part 51, Appendix W, "Guideline of Air Quality Models," published on January 17, 2017 (82 FR 5203). This version of AERMOD also includes fixes to bugs that were inadvertently included in version 16216. Kentucky chose not to use the latest version of AERMOD because the Commonwealth is using the regulatory default settings for version 15181 available at the time of its modeling preparation and is not making use of any previously un-approved alternative modeling options included in version 16216r and the update to Appendix W.

#### *3.3.2.3. Modeling Parameter: Rural or Urban Dispersion*

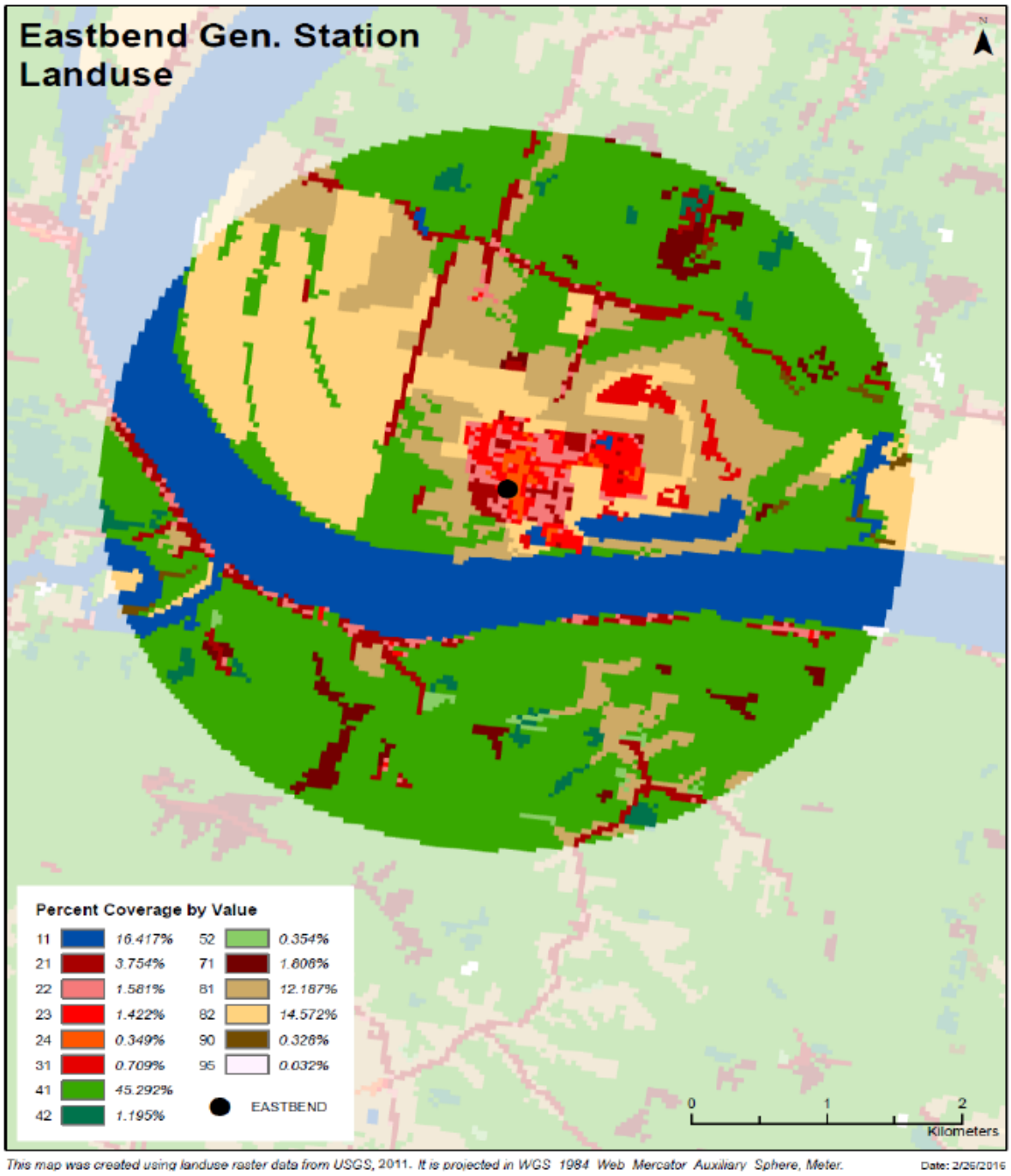
For any dispersion modeling exercise, the "urban" or "rural" determination of a source is important in determining the boundary layer characteristics that affect the model's prediction of downwind concentrations. For $SO_2$ modeling, the urban/rural determination is important because AERMOD invokes a 4-hour half-life for urban $SO_2$ sources. Section 6.3 of the Modeling TAD details the procedures used to determine if a source is urban or rural based on land use or population density. The EPA's recommended procedure for characterizing an area by prevalent land use is based on evaluating the dispersion environment within 3 km of the facility. According to the EPA's modeling guidelines, rural dispersion coefficients are to be used in the dispersion modeling analysis if more than 50 percent of the area within a 3 km radius of the facility is classified as rural. Conversely, if more than 50 percent of the area is urban, urban dispersion coefficients should be used in the modeling analysis.

Following the EPA's guidance, the 2011 land cover was obtained from United States Geological Survey (USGS) by the Commonwealth. A 3 km radius around the East Bend facility was downloaded. The 2011 land cover classification and corresponding Auer's land use categories are shown in Table 3. Figure 2 shows land cover within the 3 km radius and the tabulated percent of area for each category within the figure key. Therefore, for the purpose of performing the modeling for the area of analysis, the Commonwealth determined that it was most appropriate to run the model with rural dispersion coefficients or in rural mode. The EPA agrees with the Commonwealth that the results of this analysis show that the area is clearly rural.

**Table 3 – Categories for Determination of the Urban or Rural Modeling Parameter by Auer's Method with 2011 Land Use Information.**

| 2011 NLCD Land Cover Classification | | Auer Land-Use Classification | | Modeling TAD Rural or Urban |
|---|---|---|---|---|
| 11 | Open Water | A5 | Water Surfaces | Rural |
| 12 | Perennial Ice/Snow | A5 | Water Surfaces | Rural |
| 21 | Developed, Open Space | A1 | Metropolitan Natural | Rural |
| 22 | Developed, Low Intensity | R1 | Common Residential | Rural |
| 23 | Developed, Medium Intensity | I1, I2, C1, R2, R3 | Industrial/Commercial/Compact Residential | Urban |
| 24 | Developed, High Intensity | I1, I2, C1, R2, R3 | Industrial/Commercial/Compact Residential | Urban |
| 31 | Barren Land | A3 | Undeveloped (Grasses/Shrub) | Rural |
| 41 | Deciduous Forest | A4 | Undeveloped (Wooded) | Rural |
| 42 | Evergreen Forest | A4 | Undeveloped (Wooded) | Rural |
| 43 | Mixed Forest | A4 | Undeveloped (Wooded) | Rural |
| 52 | Shrub/Scrub | A3 | Undeveloped (Grasses/Shrub) | Rural |
| 71 | Grassland/Herbaceous | A3 | Undeveloped (Grasses/Shrub) | Rural |
| 81 | Pasture/Hay | A2 | Agriculture | Rural |
| 82 | Cultivated Crops | A2 | Agriculture | Rural |
| 90 | Wooded Wetlands | A4 | Undeveloped (Wooded) | Rural |
| 95 | Emergent Herbaceous Wetlands | A3 | Undeveloped (Grasses/Shrub) | Rural |

**Figure 2: Land Use Map for Area Within 3km of the East Bend Facility. Source: "Duke Energy East Bend Generating Station, Modeling Report for 1-hour $SO_2$ National Ambient Air Quality Standard (NAAQS)," prepared by Duke Energy for Kentucky, November 22, 2016.**



*3.3.2.4. Modeling Parameter: Area of Analysis (Receptor Grid)*

The TAD recommends that the first step towards characterization of air quality in the area around a source or group of sources is to determine the extent of the area of analysis and the spacing of the receptor grid. Considerations presented in the Modeling TAD include but are not limited to: the location of the $SO_2$ emission sources or facilities considered for modeling; the extent of concentration gradients due to the influence of nearby sources; and sufficient receptor coverage and density to adequately capture and resolve the model predicted maximum $SO_2$ concentrations.

The sources of $SO_2$ emissions subject to the DRR in this area are described in the introduction to this section. For the Boone County area, the Commonwealth has included two other emitters of $SO_2$ within 50 km of East Bend in any direction. The Commonwealth determined that this was the appropriate distance to adequately characterize air quality through modeling to include the potential extent of any $SO_2$ NAAQS exceedances in the area of analysis and any potential impact on $SO_2$ air quality from other sources in nearby areas. In addition to East Bend, the other emitters of $SO_2$ included in the area of analysis are: Kentucky Utilities Company's Ghent Station in Carroll County, Kentucky and Dynegy's Miami Fort Generating Station in Hamilton County, Ohio. No other sources beyond 50 km were determined by the Commonwealth to have the potential to cause concentration gradient impacts within the area of analysis. For a detailed analysis of nearby sources that were considered for the final modeling see Section 3.3.2.5

The grid receptor spacing for the area of analysis chosen by the Commonwealth is as follows:

- Receptors along the fence line every 50 meters (m)
- Receptors every 100 m from fence line to 3 km
- Receptors every 250 m from 3 km to 5 km
- Receptors every 500 m from 5 km to 10 km
- Receptors every 1,000 m from 10 km to 20 km
- Receptors every 2,000 m from 20 km to 50 km

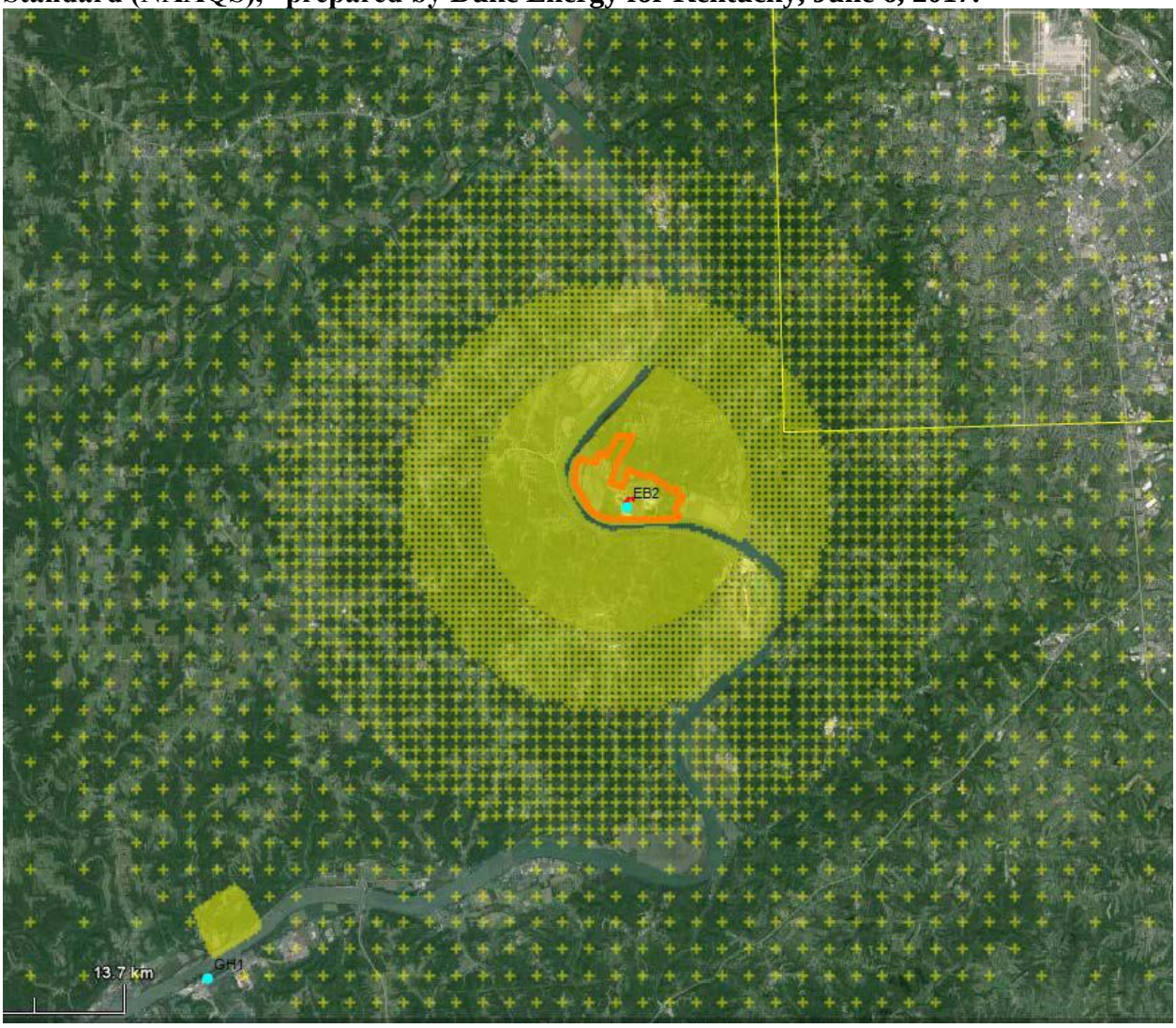
The receptor network contained 13,966 receptors, and the network covered the entirety of Boone, Kenton, Gallatin, and Carroll Counties in Kentucky, almost the entirety of Campbell and Grant Counties in Kentucky, extending into the northern and central portion of Owen County, the northern portion of Henry County, the northeastern portion of Trimble County, and the northwestern portion of Pendleton County in Kentucky. The modeling domain also covered all but the northeastern portion of Hamilton County, Ohio, the entirety of Dearborn, Ohio, and Switzerland Counties in Indiana, most of Ripley County, Indiana, the eastern half of Jefferson County, Indiana, and the southernmost portions of Franklin County, Indiana, and Butler County, Ohio, and one receptor in Clermont County, Ohio.

Figure 3, included in Kentucky's recommendation, shows the Commonwealth's chosen area of analysis surrounding the East Bend facility, as well as the receptor grid for the area of analysis.

Consistent with the Modeling TAD, the Commonwealth placed receptors for the purposes of this designation effort in locations that would be considered ambient air relative to each modeled facility. The June 6, 2017, Modeling Report indicates that Kentucky excluded receptors over the

Ohio River because it would not be feasible to place a monitor over bodies of water as seen in Figure 3. East Bend does not maintain a continuous fence around its property boundaries. In response to comments from the EPA, the Commonwealth added receptors on the East Bend property. Another comment that the EPA made for the modeling protocol and in response to the November 22, 2016, Modeling Report was that if maximum $SO_2$ concentrations do not occur within the 100-m receptor grid, additional receptors will need to be modeled to ensure that maximum impacts are resolved to the nearest 100 m. The maximum concentration occurred in the 1,000 m grid of the original modeling. The June 6, 2017, Revised Modeling included additional receptors to resolve the maximum concentration to the nearest 100 m.

**Figure 3: Receptor Grid for the Boone County Area. Source: "Duke Energy East Bend Generating Station, Modeling Report for 1-hour $SO_2$ National Ambient Air Quality Standard (NAAQS)," prepared by Duke Energy for Kentucky, June 6, 2017.**




The EPA agrees with the Commonwealth on the final receptor grid, which is consistent with the Modeling TAD. Initial concerns about whether the property had a fence or physical barrier and whether the area around the maximum concentration was modeled at 100-m spacing were

resolved with the submission of the revised modeling on June 6, 2017. The final receptor grid, therefore, can be expected to adequately characterize $SO_2$ impacts from the East Bend facility and the other facilities included in the analysis.

#### *3.3.2.5. Modeling Parameter: Source Characterization*

Section 6 of the Modeling TAD offers recommendations on source characterization including source types, use of accurate stack parameters, inclusion of building dimensions for building downwash (if warranted), and the use of actual stack heights with actual emissions or following good engineering practices (GEP) policy with allowable emissions.

East Bend consists of one generating unit (EU02). This generating unit utilizes a pulverized coal fired boiler with a maximum nominal heat input rating of 6,313 MMBtu/hr. The coal fired boiler is equipped with multiple emissions control devices. This unit is the only source of $SO_2$ emissions above 100 tpy in the entirety of Boone County. The June 6, 2017, Modeling Report indicates that:

> Other intermittent sources of $SO_2$ emissions include a 285 HP Fire Pump engine (EU-016) and an 1100 HP emergency generator (EU-013). Both these engines run on ultra-low sulfur diesel fuel. These engines are operated as emergency engines under the RICE MACT 40 CFR Part 63 Subpart ZZZZ. The operation of these engines are limited to less than 100 hours per year for maintenance and readiness checks. There are no limits on operation during emergency.

These intermittent sources were not included in the modeling analysis with the rationale that "The emergency engines do not operate enough and do not have large enough emissions of $SO_2$ to contribute to the annual distribution of daily maximum 1-hour $SO_2$ concentrations. The Modeling TAD[8] indicates that these types of intermittently operated sources can be excluded from the modeling demonstration because the EPA believes the most appropriate data to use for comparison to the 1-hour $SO_2$ NAAQS are based on emissions scenarios that are continuous enough or frequent enough to contribute significantly to the annual distribution of maximum daily 1-hour concentrations. Moreover, the modeled background concentrations should be representative of any potential impacts from these types of intermittently operated sources

The Commonwealth evaluated potential nearby source contributions to $SO_2$ impacts in the Boone County area by screening potential contribution in a "Q/d" (emissions/distance) analysis. The Commonwealth identified all of the $SO_2$ sources that emit greater that 100 tpy of actual emissions located within 50 km of East Bend. The following sources emitted greater than 100 tpy in 2014, but were not included in the modeling analysis due to having a Q/d < 20: Darling Ingredients Inc. (104.10 tpy; 43.3 km from East Bend), Rock-Tenn Converting Company (179.41 tpy; 46.4 km from East Bend), E.I. Du Pont Fort Hill Plant (152.90 tpy; 23.7 km from East Bend), and Anchor Glass Container Corporation (154.64 tpy; 24.5 km from East Bend). Due to their low levels of emissions and distance from East Bend, we agree that these sources did not need to be explicitly modeled and any potential impacts are represented by the

[8] The Modeling TAD references the March 1, 2011 memorandum entitled "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour $NO_2$ National Ambient Air Quality Standard," in considering intermittent sources.

background ambient monitor. Section 3.3.2.9 provides more details about Kentucky's decision to use the Northern Kentucky University (NKU) monitor for background. The emissions from point sources near East Bend that were not explicitly modeled are lower than the emissions from point sources located near the NKU monitor. Additionally, the NKU monitor is located in the Greater Cincinnati urbanized area, so is impacted by a larger amount of nonpoint $SO_2$ emissions sources.

Kentucky's Q/d calculations also showed that the following two sources would result in Q/d >20: Dynegy's Miami Fort Generating Station; and Kentucky Utilities Company's Ghent Station. See Attachment A of the June 6, 2017, Modeling Report for more information. Therefore, the $SO_2$ emissions from these sources were also included in the modeling analysis. DTE Electric Company's St. Bernard facility in Cincinnati, Ohio, was also identified in Attachment A of the June 6, 2017, Modeling Report as having a Q/d>20. This source was excluded from the modeling because the coal fired unit has been converted to natural gas.9 There are two additional sources that are within the 50 km radius, but were not included in the final modeling: Tanners Creek Station in Dearborn County, Indiana, and Duke Energy's Beckjord Station in Clermont County, Ohio. The Final Modeling Report indicates that the units at Tanners Creek Station have retired and were not considered in the modeling analysis. The Tanners Creek units 1-4 were permanently and enforceably shut down to comply with the Mercury and Air Toxics Rule, meaning the allowable emissions are now zero tpy for this facility.10 The EPA's Clean Air Markets Division (CAMD) air program data shows emissions of 18,091 tons for 2014 and 7,650 tons for 2015, but no emissions beyond May of 2015 for any of units 1-4.11 Beckjord Station ceased operation in 2014. The Beckjord shut down is permanent and enforceable.12 The EPA agrees with the Commonwealth's assessment of the nearby sources.

An equally important consideration in the decision to not explicitly model any other sources in the area of analysis is the representativeness of the background concentration data from the Northern Kentucky University monitor used in this analysis. The Commonwealth concluded that the impact of the onsite and offsite sources not explicitly included in the modeling will be captured by the background monitor. The Commonwealth considered three total monitors for this purpose: the Northern Kentucky University, Colerain, and Taft monitors are located 35 km, 37 km, and 37 km from the East Bend facility, respectively. Kentucky decided against using the Colerain monitor because it is located near and showed impacts from several large sources, including Miami Fort, which is explicitly included in the modeling demonstration. Kentucky decided not to use the Taft monitor due to impacts from several larger sources. Because the

[9] For more information, see Appendix R to Ohio's January 13, 2017 updated recommendation for $SO_2$ designations available at: https://www.epa.gov/so2-pollution/so2-data-requirements-rule-january-13-2017-state-submittals-ohio.
[10] An October 19, 2015, permit revision revoked the permit for the purposes of the Acid Rain Program and pollutant transport rules to remove the operating status of units 1-4, and a January 29, 2016 permit action revised the status of the source, reflecting the June 1, 2015 retirements of units 1-4.
[11] Emissions information is available at: https://ampd.epa.gov/ampd/.
[12] The Walter C. Beckjord facility was determined to contribute to violations in the Campbell-Clermont, Kentucky-Ohio multi-state nonattainment area and ceased operation in 2014. Upon notification to Ohio that the source had shut down, the State ceased the facility's authorization to operate unless it obtains a new permit (See 81 FR 47144 at 47147). The Ohio (81 FR 83158) and Kentucky (82 FR 13227) portions of the Campbell-Clermont, Kentucky-Ohio multi-state nonattainment area have since been redesignated to attainment.

Northern Kentucky University monitor is the closest monitor to East Bend, and because the Commonwealth reasonably concluded that the monitor would best represent background concentrations in the area of analysis, the EPA concurs with this determination. See Section 3.3.2.9 of this TSD for additional discussion of the background data used for this modeling assessment.

The Commonwealth characterized these sources within the area of analysis in accordance with the best practices outlined in the Modeling TAD. Specifically, the Commonwealth used actual stack heights in conjunction with actual emissions. The Commonwealth also adequately characterized East Bend's building layout and location, as well as the stack parameters, e.g., exit temperature, exit velocity, location, and diameter. Where appropriate, the AERMOD component BPIPPRM was used to assist in addressing building downwash.

For Miami Fort, the stack exit velocities and stack temperatures were held constant. Hourly stack exit velocities and stack temperatures from the continuous emissions monitoring systems (CEMS) data should be used if the data are available. Kentucky made use of CEMS data for exit velocities and stack temperatures for Ghent in the modeling demonstration.

The EPA agrees with Kentucky's method for characterizing the area. The assessment of nearby sources within 50 km of East Bend justifies the explicit modeling of the three DRR sources. The Northern Kentucky University background monitor, discussed in Section 3.3.2.9, will capture any impacts from sources in the area not explicitly modeled. The use of actual stack heights, and actual stack temperatures and exit velocities wherever available, is appropriate given the use of actual emissions. Building downwash is also appropriately accounted for.

#### *3.3.2.6. Modeling Parameter: Emissions*

The EPA's Modeling TAD notes that for the purpose of modeling to characterize air quality for use in designations, the recommended approach is to use the most recent 3 years of actual emissions data and concurrent meteorological data. However, the TAD also indicates that it would be acceptable to use allowable emissions in the form of the most recently permitted (referred to as potential to emit [PTE] or allowable) emissions rate that is federally enforceable and effective.

The EPA believes that CEMS data provide acceptable historical emissions information, when they are available. These data are available for many electric generating units. In the absence of CEMS data, the EPA's Modeling TAD highly encourages the use of AERMOD's hourly varying emissions keyword HOUREMIS, or through the use of AERMOD's variable emissions factors keyword EMISFACT. When choosing one of these methods, the EPA recommends using detailed throughput, operating schedules, and emissions information from the impacted source(s).

In certain instances, states and other interested parties may find that it is more advantageous or simpler to use PTE rates as part of their modeling runs. For example, where a facility has recently adopted a new federally enforceable emissions limit or implemented other federally enforceable mechanisms and control technologies to limit $SO_2$ emissions to a level that indicates compliance with the NAAQS, the state may choose to model PTE rates. These new limits or

conditions may be used in the application of AERMOD for the purposes of modeling for designations, even if the source has not been subject to these limits for the entirety of the most recent 3 calendar years. In these cases, the Modeling TAD notes that a state should be able to find the necessary emissions information for designations-related modeling in the existing $SO_2$ emissions inventories used for permitting or SIP planning demonstrations. In the event that these short-term emissions are not readily available, they may be calculated using the methodology in Table 8-1 of Appendix W to 40 CFR Part 51 titled, "Guideline on Air Quality Models."

As previously noted, the Commonwealth included East Bend and two other emitters of $SO_2$ within 50 km in the area of analysis. The Commonwealth has chosen to model these facilities using actual emissions. The facilities in the Commonwealth's modeling analysis and their associated annual actual $SO_2$ emissions between 2012 and 2014 are summarized below.

For East Bend, Miami Fort, and Ghent Stations, the Commonwealth provided annual actual $SO_2$ emissions between 2012 and 2014. This information is summarized in Table 4. A description of how the Commonwealth obtained hourly emission rates is given below this table.

**Table 4. Actual $SO_2$ Emissions Between 2012 – 2014 from Facilities in the Boone County Area**

| Facility Name | $SO_2$ Emissions (tpy) | | |
|---|---|---|---|
| | 2012 | 2013 | 2014 |
| East Bend | 1,495 | 2,196 | 2,100 |
| Ghent Station | 10,772 | 12,863 | 15,409 |
| Miami Fort* | 10,616 | 11,886 | 9,613 |
| Total Emissions from All Modeled Facilities in the Commonwealth's Area of Analysis | 22,883 | 26,945 | 27,122 |

*Miami Fort's unit 6 permanently shut down on June 1, 2015, to comply with MATS, and is therefore not included in the modeling analysis. Units 7 and 8 at this facility are included.[13]

For East Bend, Miami Fort and Ghent Stations, the actual hourly emissions data were obtained from CEMS. The hourly $SO_2$ emissions for these units were retrieved from the EPA's Clean Air Markets Division air program data and used in the modeling analysis.[14] Initially, there was a discrepancy between hourly emissions provided for Ghent and those in the EPA's CAMD data. In response to the EPA comments, Kentucky provided updated emissions information for Ghent.

The EPA agrees with Kentucky's use of past actual emissions for East Bend, Ghent Station, and for units 7 and 8 of Miami Fort. The EPA also agrees with the use of 2012 – 2014 emissions rather than the most recent set of emissions from the three sources modeled. According to the Clean Air Markets Division air program data, the emissions at East Bend increased in 2015 (2,656 tons) relative to the 2012 – 2014 data modeled. However, emissions decreased at Ghent Station in 2015 (10,703 tons) and at Miami Fort for units 7 and 8 in 2015 (7,482 tons). As shown

[13] For more information, see Appendix T to Ohio's January 13, 2017 updated recommendation for $SO_2$ designations available at: https://www.epa.gov/so2-pollution/so2-data-requirements-rule-january-13-2017-state-submittals.
[14] Information available at: https://ampd.epa.gov/ampd/.

in Section 3.3.2.10, maximum predicted concentrations occur near Ghent Station. Thus, the use of 2012 – 2014 emissions, while showing lower overall emissions from East Bend, is likely more representative in estimating $SO_2$ impacts from the much larger Ghent Station and Miami Fort facilities. The EPA believes this set of parameters provides representation of any possible $SO_2$ impacts in the area.

#### *3.3.2.7. Modeling Parameter: Meteorology and Surface Characteristics*

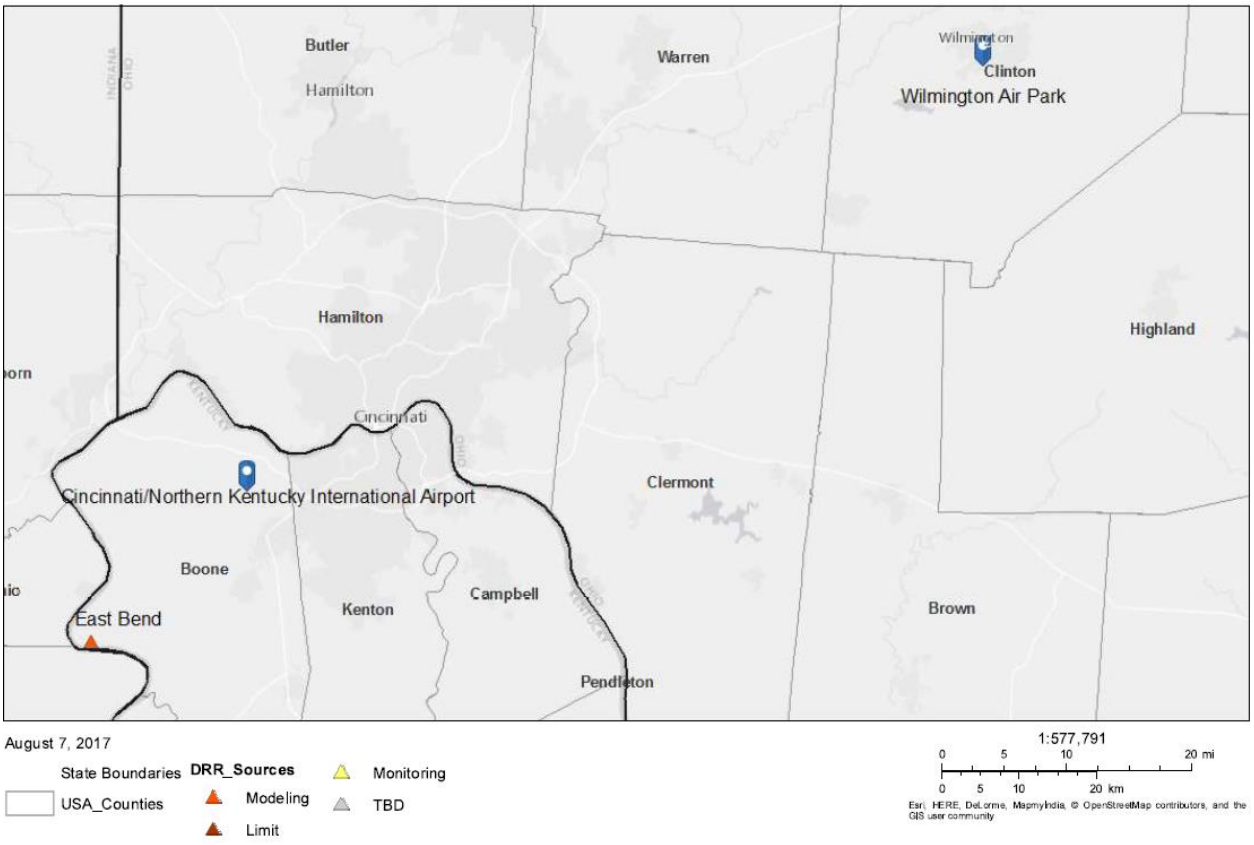
As noted in the Modeling TAD, the most recent 3 years of meteorological data (concurrent with the most recent 3 years of emissions data) should be used in designations efforts. The selection of data should be based on spatial and climatological (temporal) representativeness. The representativeness of the data is determined based on: 1) the proximity of the meteorological monitoring site to the area under consideration, 2) the complexity of terrain, 3) the exposure of the meteorological site, and 4) the period of time during which data are collected. Sources of meteorological data include National Weather Service (NWS) stations, site-specific or onsite data, and other sources such as universities, Federal Aviation Administration (FAA), and military stations.

For the area of analysis for the Boone County area, the Commonwealth selected the surface meteorology from the Cincinnati/Northern Kentucky International Airport NWS station in Covington, Kentucky, located at 35.04 N, 84.67 W, 21 km to the northeast of the source, and coincident upper air observations from a different NWS station, Wilmington Air Park, in Wilmington, Ohio, located at 39.42 N, 83.82 W, as best representative of meteorological conditions within the area of analysis.

The Commonwealth used AERSURFACE version 13016 using data from the Covington, Kentucky NWS station to estimate the surface characteristics (albedo, Bowen ratio, and surface roughness [$z_o$]) of the area of analysis. Albedo is the fraction of solar energy reflected from the earth back into space, the Bowen ratio is the method generally used to calculate heat lost or heat gained in a substance, and the surface roughness is sometimes referred to as "zo" The state estimated surface roughness values for 12 spatial sectors out to 1 km at a seasonal temporal resolution for dry, wet, and average conditions. The monthly surface moisture at the NWS site was categorized as dry, wet, or average by comparing the precipitation total for the month to the $30^{th}$ percentile of the historic precipitation data. If the monthly precipitation was less than or equal to the $30^{th}$ percentile, the dry Bowen Ratio was used; if the monthly precipitation was between the $30^{th}$ and $70^{th}$ percentile, then the average Bowen Ratio was used; if the monthly precipitation was greater than the $70^{th}$ percentile, then the wet Bowen Ratio was used.

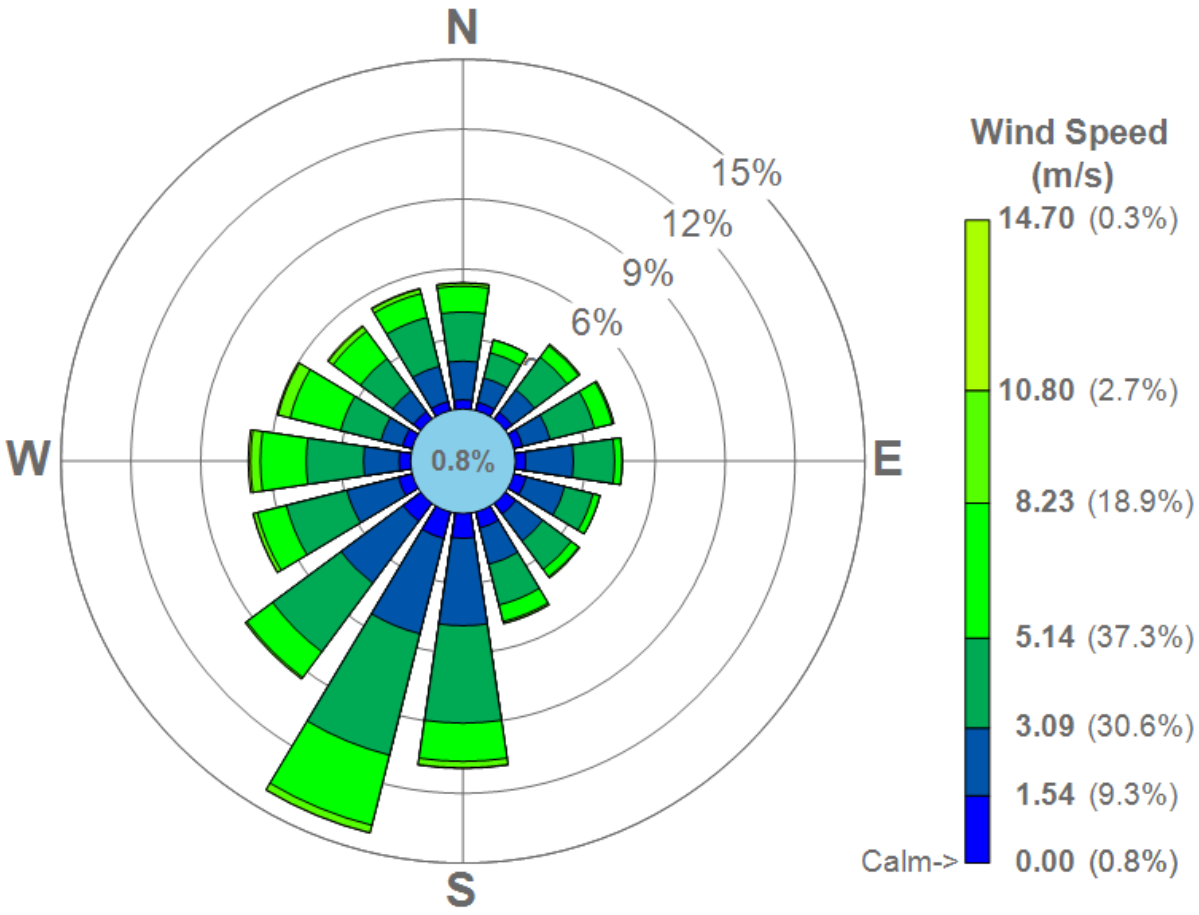
In the figure below, generated by the EPA, the locations of these NWS stations is shown relative to the area of analysis.

**Figure 4. Area of Analysis and the NWS stations in the Boone County Area**




As part of its recommendation, the Commonwealth provided the 3-year surface wind rose for the Covington, Kentucky, NWS site. In Figure 5, the frequency and magnitude of wind speed and direction are defined in terms of from where the wind is blowing. Analysis of the NWS data indicate winds predominately blow from the south, approximately 11 percent of the time, and southwest, approximately 24 percent of the time. To a lesser extent, winds can be observed blowing from all other directions with relative equal frequency.

**Figure 5: Covington, Kentucky NWS Cumulative Annual Wind Rose for Years 2012 - 2014**




Meteorological data from the above surface and upper air NWS stations were used in generating AERMOD-ready files with the AERMET processor. The output meteorological data created by the AERMET processor is suitable for being applied with AERMOD input files for AERMOD modeling runs. The Commonwealth followed the methodology and settings presented in Sections 3.1.2 and 3.1.3 of the AERMOD Implementation Guide (AIG) in the processing of the raw meteorological data into an AERMOD-ready format, and used AERSURFACE to best represent surface characteristics.

Hourly surface meteorological data records are read by AERMET, and include all the necessary elements for data processing. However, wind data taken at hourly intervals may not always portray wind conditions for the entire hour, which can be variable in nature. Hourly wind data may also be overly prone to indicate calm conditions, which are not modeled by AERMOD. In order to better represent actual wind conditions at the meteorological tower, wind data of 1-minute duration was provided from the first NWS station mentioned above, but in a different

formatted file to be processed by a separate preprocessor, AERMINUTE. These data were subsequently integrated into the AERMET processing to produce final hourly wind records of AERMOD-ready meteorological data that better estimate actual hourly average conditions and that are less prone to over-report calm wind conditions. This allows AERMOD to apply more hours of meteorology to modeled inputs, and therefore produce a more complete set of concentration estimates. As a guard against excessively high concentrations that could be produced by AERMOD in very light wind conditions, the Commonwealth set a minimum threshold of 0.5 meters per second (m/s) in processing meteorological data for use in AERMOD. In setting this threshold, no wind speeds lower than this value would be used for determining concentrations. This threshold was specifically applied to the 1-minute wind data. In addition, the "Ice-Free Winds Group" AERMINUTE option was selected for processing. The ice-free date was set at 4/24/2007 for the Cincinnati/Northern Kentucky International Airport NWS station.

The EPA believes the meteorology and surface characteristics used in the Commonwealth's modeling are acceptable. The meteorology made use of NWS data for surface and upper air data. The EPA believes that the meteorological data reasonably shows that impacts from East Bend and other sources included are expected to most frequently occur generally northeast of the facility, but that impacts could be seen in other directions as well. The surface characteristics were evaluated for the NWS site. Kentucky followed the EPA guidance in developing its modeling parameters.

#### *3.3.2.8. Modeling Parameter: Geography, Topography (Mountain Ranges or Other Air Basin Boundaries) and Terrain*

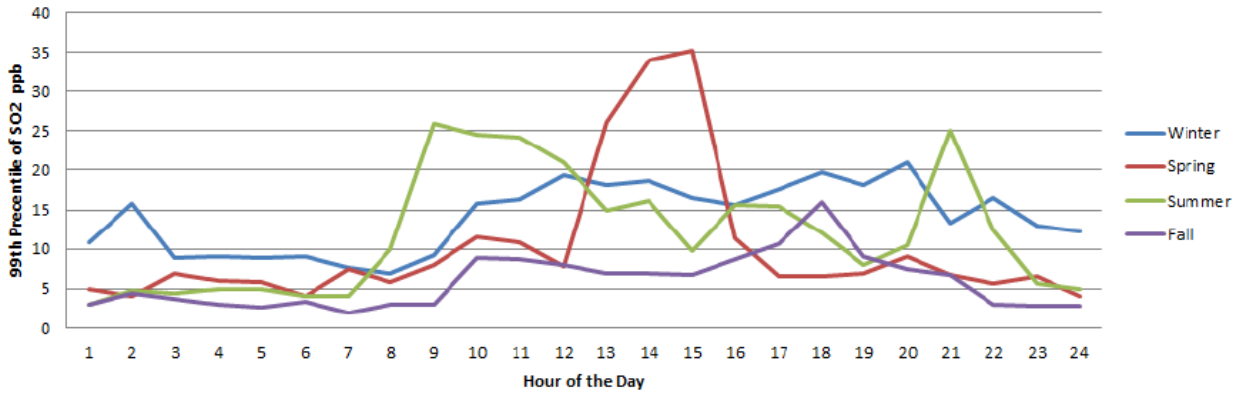
The terrain in the area of analysis is best described as gently rolling. To account for these small terrain changes, the AERMAP terrain program within AERMOD was used to specify terrain elevations for all the receptors. The source of the elevation data incorporated into the model is from the USGS National Elevation Database (NED).

The EPA confirmed that the Boone County area has no complex terrain considerations, and accordingly, the facility's characteristics can adequately represent the area and the modeling domain. We also agree with the Commonwealth's use of AERMAP version 11103 to obtain the elevations of sources, buildings, and receptors.

*3.3.2.9. Modeling Parameter: Background Concentrations of $SO_2$*

The Modeling TAD offers two mechanisms for characterizing background concentrations of $SO_2$ that are ultimately added to the modeled design values: 1) a "tier 1" approach, based on a monitored design value, or 2) a temporally varying "tier 2" approach, based on the 99$^{th}$ percentile monitored concentrations by hour of day and season or month. For this area of analysis, the Commonwealth elected to use a "tier 2" approach. Data were obtained from 2013-2015 for the Air Quality System (AQS) Site: 21-037-3002 (Northern Kentucky University, or NKU). The monitor is located approximately 35 km from East Bend, and was selected as best representative of background for the area of analysis based on its nearby sources. A 90-degree sector upwind from the monitor is excluded from the background concentrations to exclude the impacts from a nearby facility, Beckjord Station, which has since ceased operation. The background concentrations for this area of analysis were determined by the Commonwealth to vary from 5.24 micrograms per cubic meter ($\mu g/m^3$), equivalent to 2.0 ppb when expressed in two significant figures,[15] to 91.67 $\mu g/m^3$ (35 ppb), depending on the season, with an average value of 28.81 $\mu g/m^3$ (11 ppb). The Commonwealth chose to use 2013 – 2015 data for the background concentrations even though this does not align with the time period assessed for the actual emissions (2012 – 2014) because Kentucky wanted to make the most cautious estimate of potential $SO_2$ impacts. The NKU monitor showed higher concentrations, when subtracting impacts from Beckjord, in the 2013 – 2015 period. Figure 6 below shows how the $SO_2$ concentration at the NKU site varies by season.

**Figure 6: Northern Kentucky University Monitoring Site Seasonally Varying Background Concentration. Source: "Duke Energy East Bend Generating Station, Modeling Report for 1-hour $SO_2$ National Ambient Air Quality Standard (NAAQS)," prepared by Duke Energy for Kentucky, November 22, 2016.**




The NKU monitor was selected as the background monitor, since the monitor is located closest to East Bend and the monitor is less impacted by multiple nearby sources from different directions than two other monitors evaluated as possible sources of background data. The

[15] The $SO_2$ NAAQS level is expressed in ppb but AERMOD gives results in $\mu g/m^3$. The conversion factor for $SO_2$ (at the standard conditions applied in the ambient $SO_2$ reference method) is 1ppb = approximately 2.619 $\mu g/m^3$.

Commonwealth considered the Colerain and Taft monitors as well. However, because these monitors were slightly further from the East Bend facility and were significantly impacted by other nearby DRR sources, Kentucky decided to use the NKU monitor as best representative of the background concentrations in the area of analysis. The most significant impact on the NKU monitor is from Beckjord which ceased operation in 2014. The Beckjord shut down is permanent and enforceable.[16] The EPA agrees with the selection of the NKU monitor as best representative of background concentrations in the Boone County area. Kentucky also followed the Modeling TAD in its selection of the seasonal varying background concentration.

#### *3.3.2.10. Summary of Modeling Inputs and Results*

The AERMOD modeling input parameters for the Boone County area of analysis are summarized below in Table 5.

[16] The Walter C. Beckjord facility was determined to contribute to violations in the Campbell-Clermont, Kentucky-Ohio multi-state nonattainment area and ceased operation in 2014. Upon notification to Ohio that the source had shut down, the State ceased the facility's authorization to operate unless it obtains a new permit (*See* 81 FR 47144 at 47147). The Ohio (81 FR 83158) and Kentucky (82 FR 13227) portions of the Campbell-Clermont, Kentucky-Ohio multi-state nonattainment area have since been redesignated to attainment.

**Table 5: Summary of AERMOD Modeling Input Parameters for the Area of Analysis for the Boone County Area**

| Input Parameter | Value |
|---|---|
| AERMOD Version | 15181 (regulatory default) |
| Dispersion Characteristics | Rural |
| Modeled Sources | 3 |
| Modeled Stacks | 6 |
| Modeled Structures | 19 |
| Modeled Fencelines | 0 |
| Total receptors | 13,966 |
| Emissions Type | Actual |
| Emissions Years | 2012-2014 |
| Meteorology Years | 2012-2014 |
| NWS Station for Surface Meteorology | Covington, KY |
| NWS Station Upper Air Meteorology | Wilmington, OH |
| NWS Station for Calculating Surface Characteristics | Covington, KY |
| Methodology for Calculating Background $SO_2$ Concentration | Tier 2 approach using AQS site: 21-037-3002 for 2013-2015 |
| Calculated Background $SO_2$ Concentration | 5.24 – 91.67 $\mu g/m^3$ |

The results presented below in Table 6 show the magnitude and geographic location of the highest predicted modeled concentration based on the input parameters.

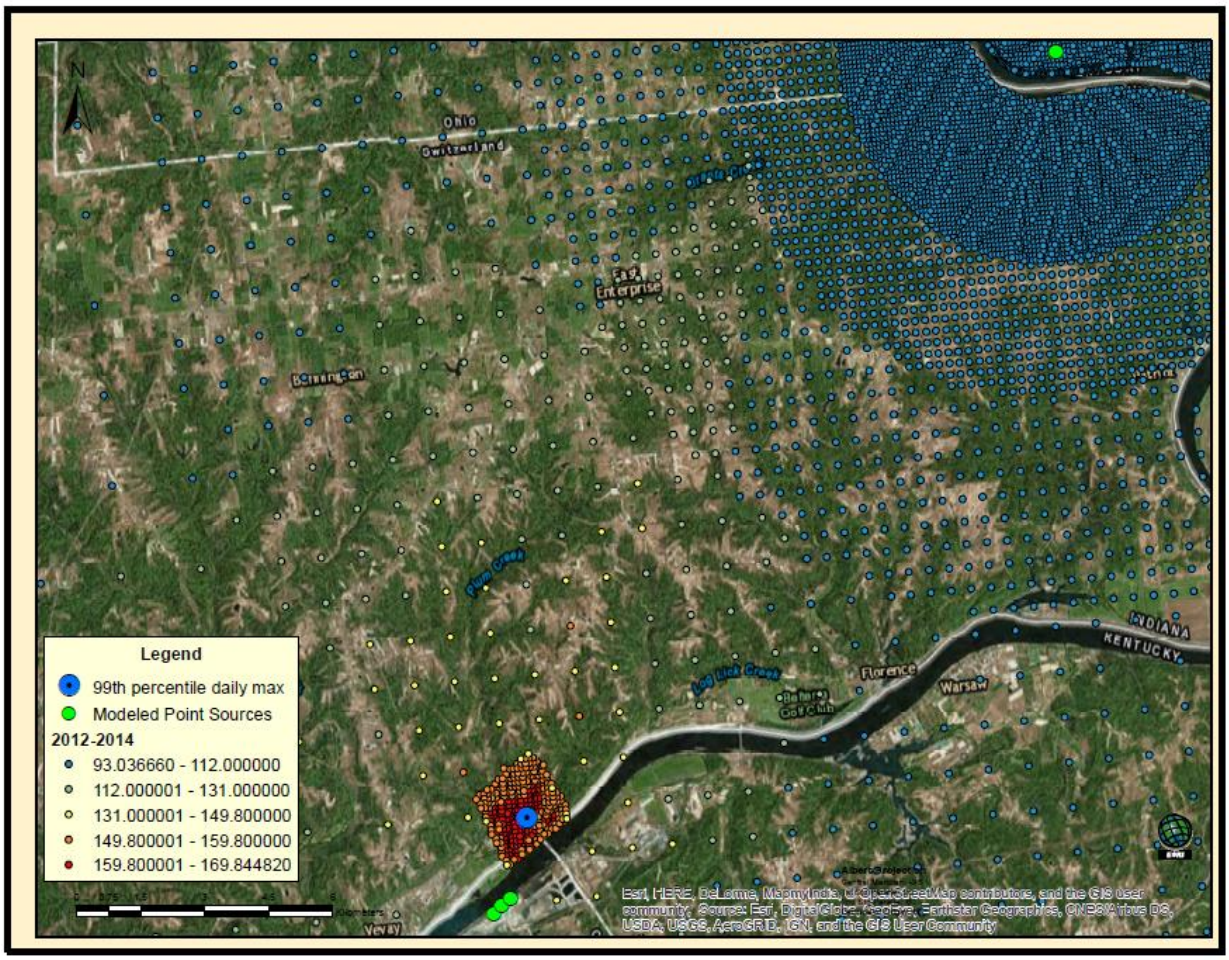
**Table 6. Maximum Predicted 99th Percentile Daily Maximum 1-Hour $SO_2$ Concentrations Averaged Over Three Years for the Area of Analysis for the Boone County Area**

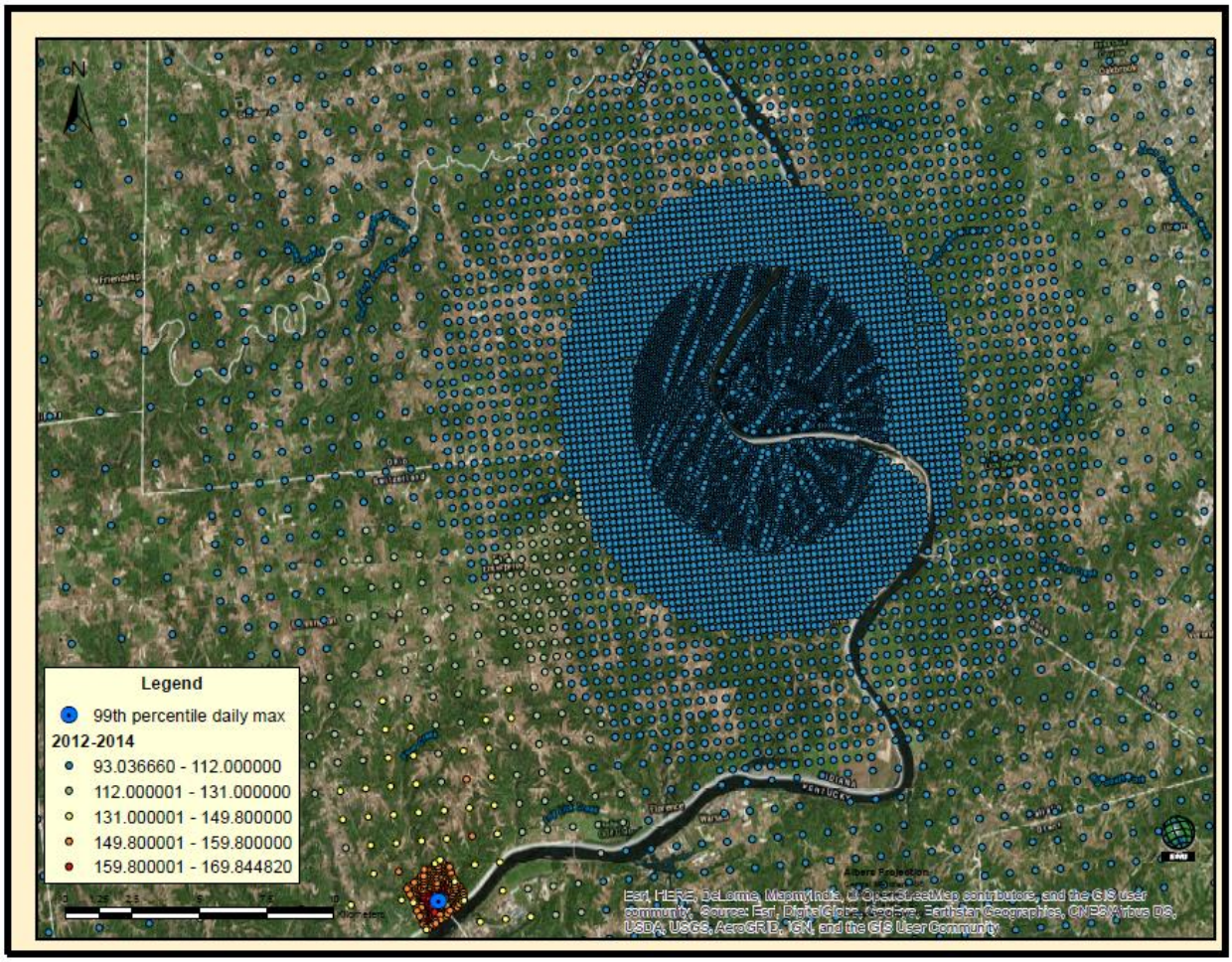
| | | Receptor Location [UTM zone 16] | | 99th percentile daily maximum 1-hour $SO_2$ Concentration (µg/m3) | |
|---|---|---|---|---|---|
| **Averaging Period** | **Data Period** | **UTM Easting (m)** | **UTM Northing (m)** | **Modeled concentration (including background)** | **NAAQS Level** |
| 99th Percentile 1-Hour Average | 2012-2014 | 671385.6 | 4292586.6 | 170 | 196.4* |

*Equivalent to the 2010 $SO_2$ NAAQS of 75 ppb using a 2.619 $\mu g/m^3$ conversion factor

The Commonwealth's modeling indicates that the highest predicted 99$^{th}$ percentile daily maximum 1-hour concentration within the chosen modeling domain is 170 µg/m$^3$, equivalent to 65 ppb. This modeled concentration included the background concentration of $SO_2$, and is based on actual emissions from the facilities. Figure 7a and 7b below were generated by the EPA using the model output files provided by Kentucky, and indicates that the predicted value occurred approximately 22 km southwest of East Bend and approximately 2 km north-northeast of Ghent Station across the Ohio River in Vevay, Indiana, in Switzerland County. The Commonwealth's receptor grid is also shown in the figure.

**Figure7a and 7b: Maximum Predicted 99$^{th}$ Percentile Daily Maximum 1-Hour $SO_2$ Concentrations Averaged Over Three Years for the Area of Analysis for the Boone County Area**






The modeling submitted by the Commonwealth does not indicate that the 1-hour $SO_2$ NAAQS is violated at the receptor with the highest modeled concentration.

#### *3.3.2.11. The EPA's Assessment of the Modeling Information Provided by the Commonwealth*

The EPA agrees with Kentucky's modeling to characterize $SO_2$ impacts in the Boone County area. The Commonwealth chose to model three DRR sources in the area, and the EPA agrees with this decision, as supported by the June 6, 2017, Modeling Report evaluating nearby sources within 50 km of East Bend. The EPA believes the modeling domain is appropriate to capture predicted maximum impacts in the Boone County area. Kentucky's selection of meteorology and surface characteristics for the area are also appropriate to make a valid modeling demonstration. The Commonwealth adequately represented the topography of the area with the model and its preprocessors. The Commonwealth chose to model emissions from East Bend, Ghent Station, and Miami Fort Generating Station during 2012 – 2014, rather than using the most recent available emissions. This departure from the Modeling TAD is acceptable because larger Ghent Station and Miami Fort Generating Station each show decreased emissions after this period, and decreases in emissions from these sources are larger than the increases seen at East Bend.

Therefore, modeling these sources together over the 2012 – 2014 period likely provides for a reliable estimate of potential $SO_2$ impacts in the area. The Commonwealth chose to use actual emissions to reflect normal operation of the sources. We believe these decisions are appropriate for the purpose of this modeling demonstration. We have also confirmed that Kentucky selected its seasonal varying background concentrations from the NKU monitor consistent with the Modeling TAD.

The Commonwealth made use of AERMOD version 15181, the most recent version available at the time the modeling was conducted. The EPA agrees that this model version is appropriate to characterize the area because the Commonwealth made use of default regulatory options available at the time and followed the Modeling TAD.

## 3.4. Emissions and Emissions-Related Data, Meteorology, Geography, and Topography for the Boone County Area

These factors have been incorporated into the air quality modeling efforts and results discussed above. The EPA is giving consideration to these factors by considering whether they were properly incorporated and by considering the air quality concentrations predicted by the modeling.

## 3.5. Jurisdictional Boundaries in the Boone County Area

Existing jurisdictional boundaries are considered for the purpose of informing the EPA's designation action for Boone County. Our goal is to base designations on clearly defined legal boundaries, and to have these boundaries align with existing administrative boundaries when reasonable.

The modeling domain extends from East Bend at a radius of 50 km, and so covers the entirety of Boone, Kenton, Gallatin, and Carrol Counties in Kentucky. This modeling domain also extends into most of Campbell and Grant Counties, the northern portions of Harrison, Owen, and Henry Counties, and the northeastern portion of Trimble County in Kentucky. The 50 km by 50 km modeling domain crosses the state boundary over the Ohio River into portions of Indiana and Ohio. As noted above, the modeling domain covers most of Hamilton County, Ohio, the entirety of Dearborn and Switzerland Counties in Indiana, most of Ripley County, Indiana, the eastern half of Jefferson County, Indiana, the southernmost portions of Franklin County, Indiana, and Butler County, Ohio.

## 3.6. The EPA's Assessment of the Available Information for the Boone County Area

The EPA intends to designate the Boone County area, including the entire County boundary, as unclassifiable/attainment. We believe that Kentucky's modeling analysis supports the conclusion that there are no expected violations of the 2010 $SO_2$ NAAQS in the area. There is no current monitoring data available for the area, so the modeling serves to reflect the air quality expected in the years modeled.

Based on the air quality characterization conducted within the Boone County area of analysis in accordance with the EPA's Modeling TAD, the Commonwealth concluded that the area should be designated as attainment. This recommendation is based on Kentucky's assessment that emissions from the East Bend facility could interact with those from the Ghent Station and Miami Fort Generating Station facilities and together impact the area, and the inclusion of these three DRR sources in the modeling demonstration. East Bend is the only Boone County source that emitted over 100 tons in 2014. Ghent Station and Miami Fort Generating Station are the only other sources within the 50 km by 50 km area of analysis to emit over 100 tons in 2014.

Kentucky evaluated possible contributions from these sources and other sources within 50 km of East Bend to $SO_2$ impacts in the Boone County area. Based on Kentucky's Q/d analysis, Kentucky decided in the Modeling Report to include possible contributions from nearby Ghent Station and Miami Fort Generating station by modeling actual emissions. Kentucky then added a reasonable value for background concentrations of $SO_2$ by including the 2013 – 2015 seasonal varying concentrations from the NKU monitor in Campbell County. The EPA agrees with the technical explanation for the Commonwealth's treatment of nearby $SO_2$ sources included in the June 6, 2017, Modeling Report. We believe the modeling of the sources included adequately represents the Boone County area. The EPA has reason to believe there are no additional sources in areas adjacent to our intended area that are likely to cause or contribute to a violation of the NAAQS in the area of analysis. In addition, based on the available information for the remaining areas in Kentucky and neighboring Indiana and Ohio, including monitoring and modeling, there are no current $SO_2$ nonattainment areas near Boone County, Kentucky or in nearby counties in Ohio or Indiana, and no expected nonattainment areas for this third round of designations. In addition, there are no nearby Round 4 areas being characterized by December 31, 2020 based on a newly deployed $SO_2$ monitor. Therefore, the Boone County area is not expected to contribute to ambient air quality in a nearby area that does not meet the NAAQS.

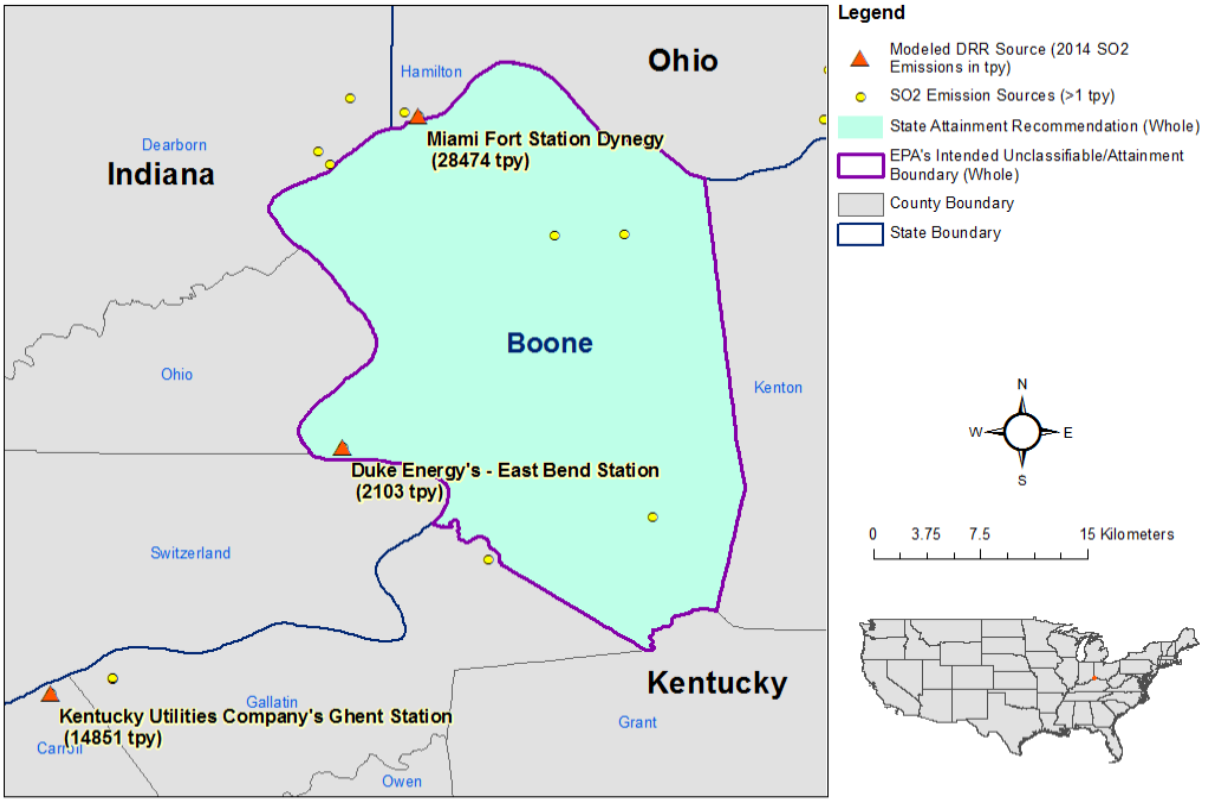
After careful evaluation of the Commonwealth's recommendation and supporting information, as well as all available relevant information, the EPA intends to designate the area around East Bend as unclassifiable/attainment for the 2010 $SO_2$ NAAQS. Specifically, the boundaries are comprised of the entirety of Boone County. There are no remaining portions of Boone County that remain to be characterized in the EPA's Round 4 of designations in 2020, nor are there any other portions of the County that have a separate area of analysis for Round 3.

The EPA believes that our intended unclassifiable/attainment area, bounded by the entirety of Boone County, will have clearly defined legal boundaries, and we intend to find these boundaries to be a suitable basis for defining our intended unclassifiable/attainment area.

## 3.7. Summary of Our Intended Designation for the Boone County Area

After careful evaluation of the Commonwealth's recommendation and supporting information, as well as all available relevant information, the EPA intends to designate the Boone County area as unclassifiable/attainment for the 2010 $SO_2$ NAAQS because the EPA has determined the area meets the 2010 $SO_2$ NAAQS and does not contribute to ambient air quality in a nearby area that does not meet the NAAQS. Specifically, the boundaries are comprised of the entirety of Boone County. Figure 8 shows the boundary of this intended designated area.

**Figure 8. Boundary of the Intended Boone County Unclassifiable/Attainment Area**




At this time, our intended designations for the Commonwealth only apply to this area and the other areas presented in this technical support document. The EPA intends in a separate action to evaluate and designate all remaining undesignated areas in Kentucky by December 31, 2020.

# 4. Technical Analysis for the Carroll County Area

## 4.1. Introduction

The EPA must designate the Carroll County area by December 31, 2017, because the area has not been previously designated and Kentucky has not installed and begun timely operation of a new, approved $SO_2$ monitoring network meeting the EPA specifications referenced in the EPA's $SO_2$ DRR for any sources of $SO_2$ emissions in Carroll County. The DRR source, Kentucky Utilities Company's Ghent Station, is by the Ohio River, which is the border between Kentucky and Indiana. Therefore, the area of analysis, and the modeling receptors, cross the Kentucky state boundary into neighboring Indiana.

## 4.2. Air Quality Monitoring Data for the Carroll County Area

This factor considers the $SO_2$ air quality monitoring data in the area of Carroll County. Kentucky provided the values of the 99$^{th}$ percentile of the $SO_2$ monitors in Kentucky. Kentucky stated in its June 2, 2011 recommendation that "the average of the 99$^{th}$ percentile at all monitors is below the standard of 75 ppb in all locations except Jefferson County…The rest of the areas in Kentucky comply with the standard and should be designated as attainment/unclassifiable for the $SO_2$ standard."

The EPA reviewed the available air quality monitoring data in the AQS database and found no nearby data for Carroll County. The closest monitor is over 57 km from Ghent Station, four counties northeast of Carroll in Campbell County. In reviewing the available air quality monitoring data in AQS, the EPA determined that there is no relevant data in AQS collected in or near Carroll County that could inform the intended designation action. The most recent $SO_2$ design values for all areas of the country are available at https://www.epa.gov/air-trends/air-quality-design-values.

## 4.3. Air Quality Modeling Analysis for the Carroll County Area Addressing Kentucky Utilities Company's Ghent Generating Station (Ghent Station)

### *4.3.1. Introduction*

This section 4.3 presents all the available air quality modeling information for a portion of Carroll County that includes Kentucky Utilities Company's Ghent Station. (This portion of Carroll County will often be referred to as "the Carroll County area" within this section 4.3.) This area contains one DRR source, the Ghent Station facility, around which Kentucky is required by the DRR to characterize $SO_2$ air quality, or alternatively establish an $SO_2$ emissions limitation of less than 2,000 tpy. Kentucky's modeling demonstration for the Carroll County area also includes nearby sources in nearby counties and across the state border in Indiana. These are DRR sources thought to impact the Carroll County area. All DRR sources evaluated for this area of analysis are listed below:

- The Ghent Station facility emitted 2,000 tons or more annually. Specifically, Ghent emitted 14,851 tons of $SO_2$ in 2014. This source meets the DRR criteria and thus is on the $SO_2$ DRR Source list, and Kentucky has chosen to characterize it via modeling.

- Louisville Gas & Electric's (LG&E's) Trimble County Station and Duke Energy's East Bend Generating Station emitted 2,000 tons or more annually and are also on the $SO_2$ DRR Source list, emitting 3,056 tons and 2,103 tons in 2014, respectively. However, the Trimble County Station in Trimble County and East Bend Station in Boone County are discussed again explicitly in other sections of this TSD chapter.

- Indiana Kentucky Electric Corporation's Clifty Creek Station emitted 2,000 tons or more annually (3,731 tons in 2014), and this source, located in Jefferson County, Indiana, is on the DRR source list. This source was included by Kentucky in characterizing the Carroll County area; however, the area around this source (in Jefferson County, Indiana) was subject to the Round 2 $SO_2$ designation process, and the EPA designated a portion of Jefferson County, Indiana, unclassifiable/attainment. Therefore, this source is not explicitly discussed in the Indiana chapter of this TSD.

Because we have available results of air quality modeling in which these sources are modeled together, the area around this group of sources is being addressed in this section with consideration given to the impacts of all these sources.

In its submission, Kentucky recommended that an area that includes the area surrounding the Ghent facility, specifically all of Carroll and Gallatin Counties in Kentucky, be designated as attainment based on an assessment and characterization of air quality impacts from these facilities and other nearby sources that may have a potential impact in the area where the 2010 $SO_2$ NAAQS may be exceeded. This assessment and characterization was performed using air dispersion modeling software, i.e., AERMOD, analyzing actual emissions. After careful review of the Commonwealth's assessment, supporting documentation, and all available data, the EPA intends to designate the area as unclassifiable/attainment. Our reasoning for this conclusion is explained in a later section of this TSD, after all the available information is presented.

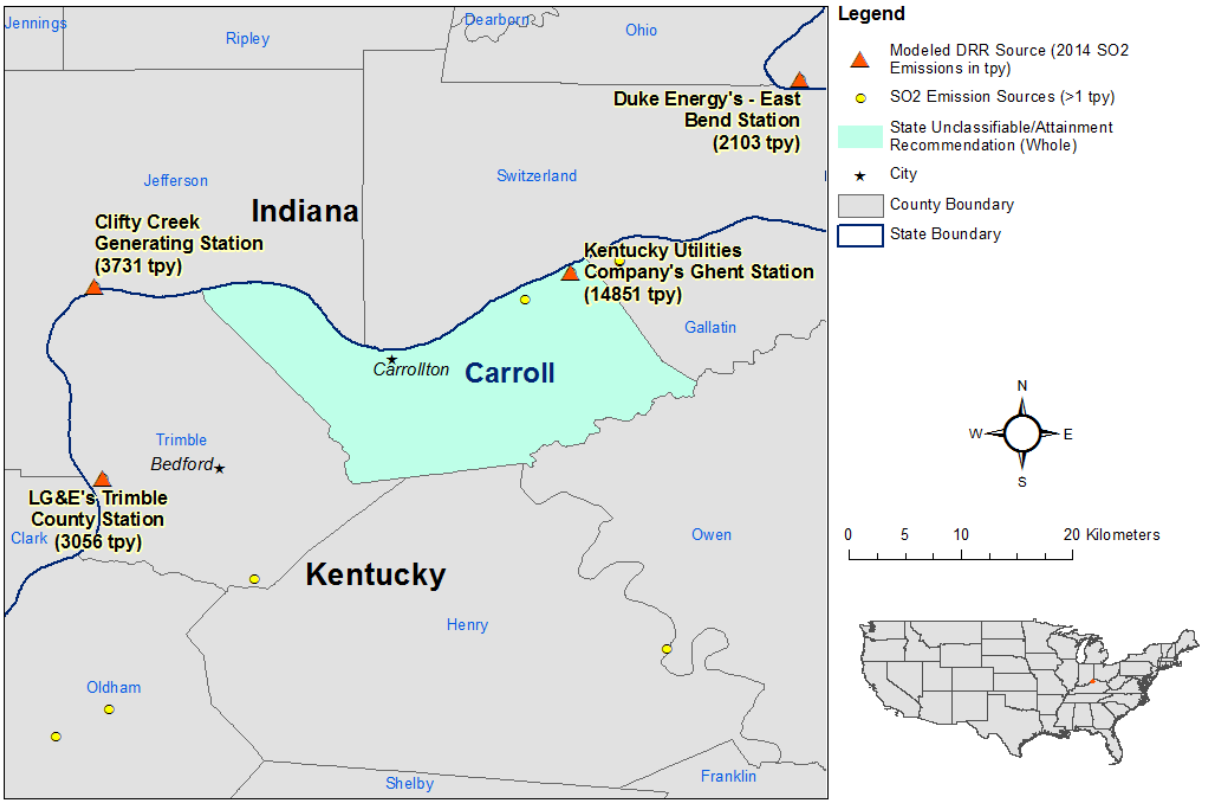
The area that the Commonwealth has assessed via air quality modeling is located in the northeast portion of Carroll County, on the southern bank of the Ohio River, which borders Switzerland County, Indiana. This source is also near the border of Gallatin County, Kentucky.

As seen in Figure 9 below, the Ghent Station facility is located adjacent to the Ohio River on U.S. Route 42, in Ghent, Kentucky, just northeast of Carrollton, Kentucky. LG&E Trimble County Station is located approximately 37 km to the southwest of Ghent Station in Trimble County, Kentucky. Duke Energy's East Bend Station is located approximately 24 km to the northeast of Ghent Station in Boone County, Kentucky, approximately 21 km southwest of the city of Cincinnati, Ohio. Indiana-Kentucky Electric Corporation's Clifty Creek Station is located approximately 33 km to the west of the Ghent facility along the northern bank of the Ohio River in Jefferson County, Indiana. Dynegy's Miami Fort Generating Station is located approximately 46 km to the north northeast of the Ghent facility in Hamilton County, Ohio. Clifty Creek and Miami Fort are DRR sources listed by Indiana and Ohio, respectively. Also included in the

figure is the Commonwealth's recommended area for the attainment designation. The EPA's intended unclassifiable/attainment designation boundary for the Carroll County area is not shown in this figure, but is shown in a figure in the section below that summarizes our intended designation.

Also included in Figure 9 are other nearby emitters of $SO_2$.[17] These are sources that were considered for inclusion in the modeling analysis, including Nucor Steel and Harsco Metals in Gallatin County, Kentucky.

**Figure 9. Map of the Carroll County Area Addressing Ghent Station**




The discussion and analysis that follows below will reference the Modeling TAD and the factors for evaluation contained in the EPA's July 22, 2016, guidance and March 20, 2015, guidance, as appropriate.

For this area, the EPA received and considered two modeling assessments from the Commonwealth and no assessments from other parties. To avoid confusion in referring to these assessments, the following table indicates when they were received, provides identifiers for the assessments that are used in the discussion of the assessments that follows, and identifies any distinguishing features of the modeling assessments.

[17] All other $SO_2$ emitters of 1 tpy or more (based on information in the emissions inventory data from the Commonwealth of Kentucky and the States of Ohio and Indiana) are shown in Figure 9.

**Table 7. Modeling Assessment for the Carroll County Area**

| Assessment Submitted by | Date of the Assessment | Identifier Used in this TSD | Distinguishing or Otherwise Key Features |
|---|---|---|---|
| Kentucky* | April 29, 2016 | April 29, 2016 Modeling Report | First formal modeling report received |
| Kentucky | November 11, 2016 | November 11, 2016 Memorandum | Additional justification for nearby sources |
| Kentucky*** | March 31, 2017 | March 31, 2017 Revised Modeling Report | Revised modeling assessment |

*Kentucky forwarded the protocol, assessment, and additional information from Kentucky Utilities Company, prepared by Trinity Consultants Company. The Modeling Report was forwarded to the EPA by Kentucky on January 6, 2017.
**This additional justification on nearby sources included and excluded from the modeling protocol was developed by Ghent Station for Kentucky.
***Kentucky forwarded the modeling report and modeling files from Kentucky Utilities Company, prepared by Trinity Consultants Company. These files were forwarded on April 10, 2017.

### *4.3.2. Modeling Analysis Provided by the Commonwealth*

#### *4.3.2.1. Differences Between and Relevance of the Modeling Assessments Submitted by the Commonwealth*

Revised modeling was submitted by the Commonwealth on April 10, 2017. There were four differences between this modeling submittal and the previous submittal dated April 29, 2016. The first difference is the version of the AERMOD model that was used. In the initial submittal, AERMOD version 15181 was used which was the most current regulatory version of the model available at the time. In the revised submittal, the Commonwealth used AERMOD version 16216r which includes updates to 40 CFR part 51, Appendix W, "Guideline of Air Quality Models," published on January 17, 2017 (82 FR 5203). This is the current regulatory version of the AERMOD Model. The second difference is the version of AERMET that was used. The April 10, 2017, Revised Modeling Report made use of Ohio's preprocessed meteorological data, which was processed using the current version of AERMET, version 16216. The third difference between the previous modeling submittal and the revised submittal is the emission rates used in the modeling of the background source Clifty Creek which is located approximately 33 km west of the Ghent facility. In the original modeling submittal, the Commonwealth used annualized 2014 emissions to model Clifty Creek for the entire 2012-2014 period to reflect the installation of $SO_2$ control technology in 2013. In the revised modeling submittal, the Commonwealth used the current federally enforceable limit (PTE) to model the Clifty Creek facility for all years

modeled (2012-2014). The fourth difference is in the receptor grid. The revised modeling submittal included additional receptors were included around the Clifty Creek facility to resolve the location of the maximum concentration to 100 m spacing.

#### *4.3.2.2. Model Selection and Modeling Components*

The EPA's Modeling TAD notes that for area designations under the 2010 $SO_2$ NAAQS, the AERMOD modeling system should be used, unless use of an alternative model can be justified. The AERMOD modeling system contains the following components:

- AERMOD: the dispersion model
- AERMAP: the terrain processor for AERMOD
- AERMET: the meteorological data processor for AERMOD
- BPIPPRM: the building input processor
- AERMINUTE: a pre-processor to AERMET incorporating 1-minute automated surface observation system (ASOS) wind data
- AERSURFACE: the surface characteristics processor for AERMET
- AERSCREEN: a screening version of AERMOD

The Commonwealth originally used AERMOD version 15181 using default options. However, with the updated April 10, 2017 modeling, the state made use of AERMOD version 16216r. The Commonwealth did not make use of any previously un-approved modeling options in using the updated model version. A discussion of the Commonwealth's approach to the individual components is provided in the corresponding discussion that follows, as appropriate.

The current version of AERMOD, version 16216r, includes updates to 40 CFR part 51, Appendix W, "Guideline of Air Quality Models," published on January 17, 2017 (82 FR 5203). This version of AERMOD also includes fixes to bugs that were inadvertently included in version 16216. Kentucky in its final April 10, 2017, Modeling Report used AERMOD version 16216r with all regulatory default settings.

#### *4.3.2.3. Modeling Parameter: Rural or Urban Dispersion*

For any dispersion modeling exercise, the "urban" or "rural" determination of a source is important in determining the boundary layer characteristics that affect the model's prediction of downwind concentrations. For $SO_2$ modeling, the urban/rural determination is important because AERMOD invokes a 4-hour half-life for urban $SO_2$ sources. Section 6.3 of the Modeling TAD details the procedures used to determine if a source is urban or rural based on land use or population density. The EPA's recommended procedure for characterizing an area by prevalent land use is based on evaluating the dispersion environment within 3 km of the facility. According to the EPA's modeling guidelines, rural dispersion coefficients are to be used in the dispersion modeling analysis if more than 50 percent of the area within a 3 km radius of the facility is classified as rural. Conversely, if more than 50 percent of the area is urban, urban dispersion coefficients should be used in the modeling analysis.
The Commonwealth used the Auer land use methodology as discussed in the modeling TAD and examined the various land use within 3 km of Ghent Station to quantify the percentage of area in various land use categories. Following this guidance, 2011 land use data (the most recent available data) were obtained from the U.S. Geological Survey through ArcGIS and a 3 km

radius circle inscribed electronically around Ghent Station was prepared. All data were georeferenced and tabulated using the categories shown in Table 3 in Section 3.2.2 for urban and rural designation. Figure 10 shows the layout of the land use and Table 8 shows the results of the land use categorization process. The area is predominantly rural (91 percent). Therefore, for the purpose of performing the modeling for the area of analysis, the Commonwealth determined that it was most appropriate to run the model with rural dispersion coefficients or in rural mode, and the EPA concurs with this assessment.

**Figure 10: Land Use Map for Area Within 3km of the Ghent Station facility. Source: "Air Dispersion Modeling Report: Ghent Station, Kentucky $SO_2$ Designation Analysis Under the Data Requirements Rule," prepared by Ghent Station, April 29, 2016.**

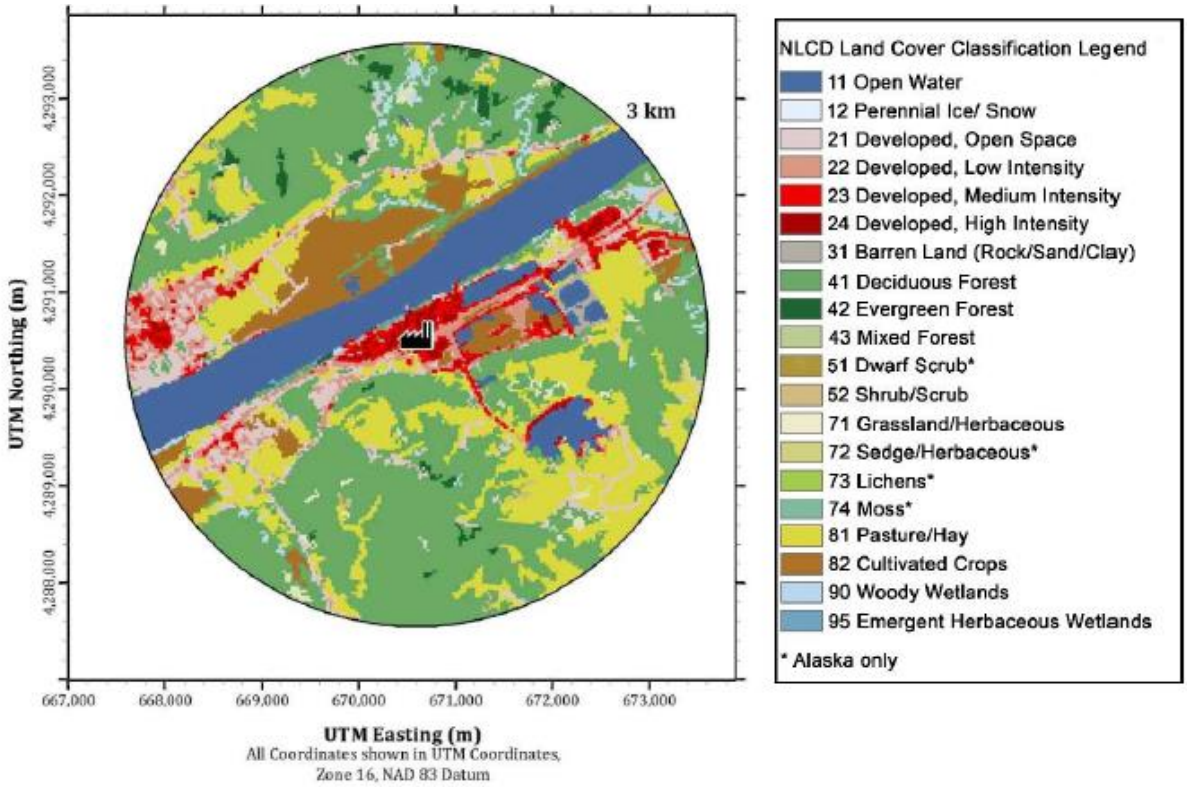


**Table 8 – Determination of the Urban or Rural Modeling Parameter for the Carroll County Area by Auer's Method with 2011 Land Use Information**

| Category ID | Category Description | Percent |
|---|---|---|
| 11 | Open Water | 12.6% |
| 21 | Developed, Open Space | 6.9% |
| 22 | Developed, Low Intensity | 4.7% |
| 23 | Developed, Medium Intensity | 2.9% |
| 24 | Developed, High Intensity | 1.4% |
| 31 | Barren Land | 0.4% |
| 41 | Deciduous Forest | 40.7% |
| 42 | Evergreen Forest | 1.3% |
| 43 | Mixed Forest | 0.0% |
| 52 | Shrub/Scrub | 0.3% |
| 71 | Grassland/Herbaceous | 0.9% |
| 81 | Pasture/Hay | 19.3% |
| 82 | Cultivated Crops | 7.1% |
| 90 | Woody Wetlands | 1.3% |
| 95 | Emergent Herbaceous Wetlands | 0.1% |
| | Total | 100% |
| | Urban | 9.0% |
| | Rural | 91.0% |

#### *4.3.2.4. Modeling Parameter: Area of Analysis (Receptor Grid)*

The TAD recommends that the first step towards characterization of air quality in the area around a source or group of sources is to determine the extent of the area of analysis and the spacing of the receptor grid. Considerations presented in the Modeling TAD include but are not limited to: the location of the $SO_2$ emission sources or facilities considered for modeling; the extent of concentration gradients due to the influence of nearby sources; and sufficient receptor coverage and density to adequately capture and resolve the model predicted maximum $SO_2$ concentrations.

The sources of $SO_2$ emissions subject to the DRR in this area are described in the introduction to this section. For the Carroll County area, the Commonwealth has included three other emitters of $SO_2$ within 50 km of Ghent Station in any direction. The Commonwealth determined that this was the appropriate distance to adequately characterize air quality through modeling to include the potential extent of any $SO_2$ NAAQS exceedances in the area of analysis and any potential impact on $SO_2$ air quality from other sources in nearby areas. In addition to Ghent Station, the other emitters of $SO_2$ included in the area of analysis are: LG&E's Trimble County Station, Duke Energy's East Bend facility and Indiana-Kentucky Electric Corporation's Clifty Creek Station. No other sources beyond 50 km were determined by the Commonwealth to have the potential to cause concentration gradient impacts within the area of analysis.

The grid receptor spacing for the area of analysis chosen by the Commonwealth is as follows:

- Receptors along the fence line every 50 m

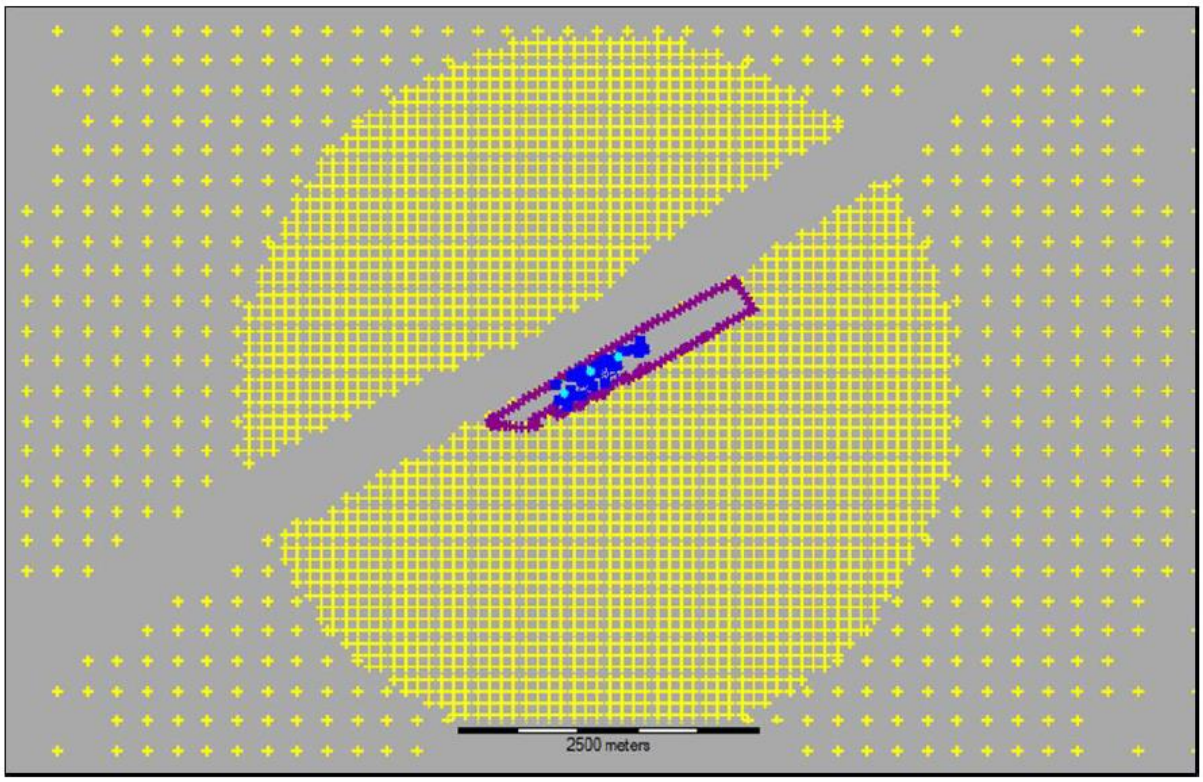
- Receptors every 100 m from fence line to 3 km
- Receptors every 250 m from 3 km to 5 km
- Receptors every 500 m from 5 km to 10 km
- Receptors every 1,000 m from 10 km to 20 km
- Receptors every 2,000 m from 20 km to 50 km

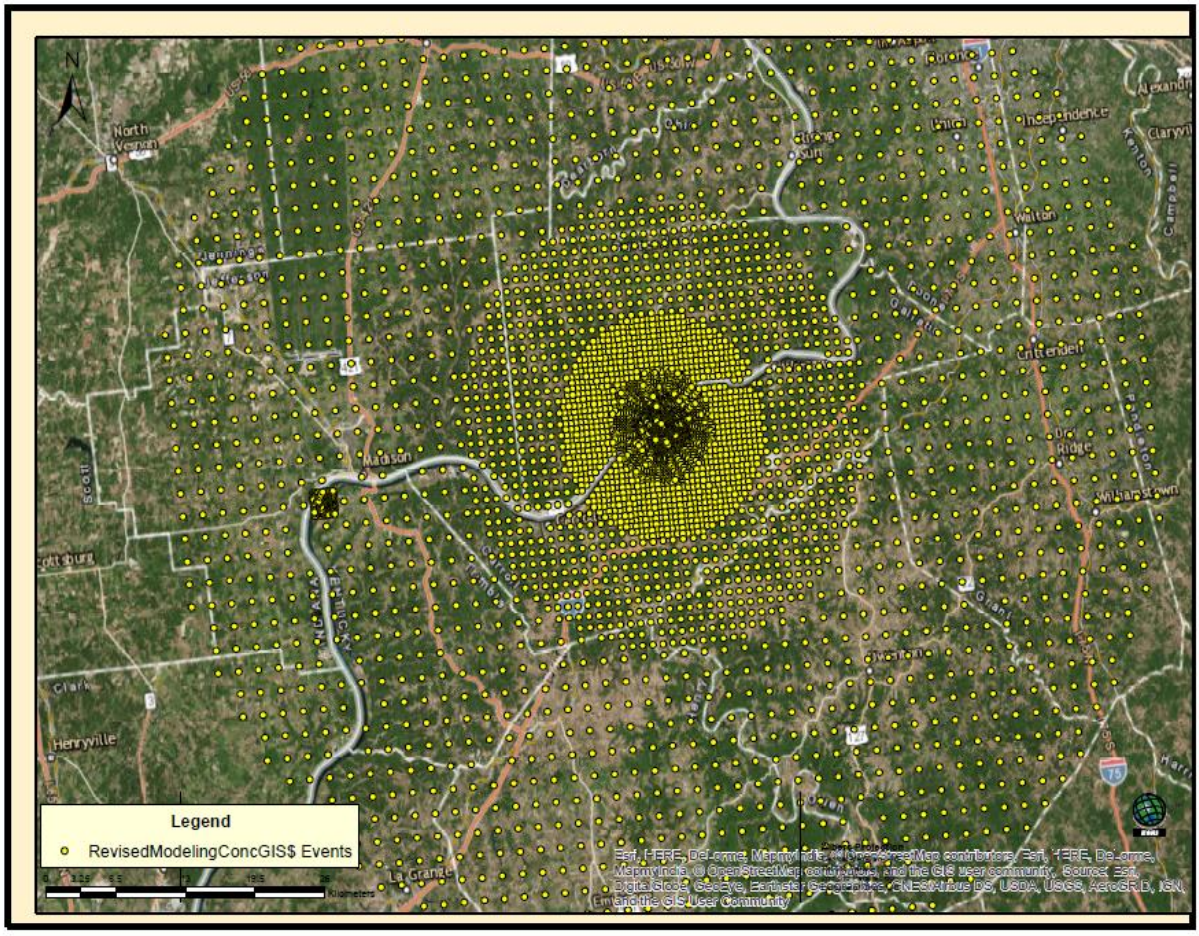
The receptor network contained 7,264 receptors, and the network covered the entirety of Carroll, Gallatin, Trimble, and Henry Counties in Kentucky, most of Boone, Grant, and Owen Counties in Kentucky, extending into the northern portions of Shelby and Franklin Counties, the northeastern portion of Oldham County, the northwestern portion of Pendleton County, and the western half of Kenton County in Kentucky. The modeling domain also covered the entirety of Switzerland and Ohio Counties in Indiana, most of Jefferson County, and the southern portion of Ripley and Dearborn Counties in Indiana, extending into the eastern portions of Scott, Clark, and Jennings Counties in Indiana, and the southwestern portion of Hamilton County, Ohio.

Figures 11a, included in the Commonwealth's recommendation, and 11b generated by the EPA, show the Commonwealth's chosen area of analysis surrounding the Ghent facility, as well as the receptor grid for the area of analysis.

Consistent with the Modeling TAD, the Commonwealth placed receptors for the purposes of this designation effort in locations that would be considered ambient air relative to each modeled facility, including other facilities' property with the exceptions of locations described in Section 4.2 of the Modeling TAD as not being feasible locations for placing a monitor. As can be seen, receptors in the Ohio River have been excluded from the modeling analysis because these would not be feasible locations to place a monitor. The Commonwealth also did not place receptors in other locations that it considered to not be ambient air relative to the Ghent Station facility. The Commonwealth did not include receptors within the fence line of the Ghent Station facility. According to the April 29, 2016, Modeling Report: "[t]he fence line consists of a metal fence topped with barbed wire on three sides and a berm along the western shoreline of the property along the Ohio River which acts as a physical barrier restricting the general public from access to KU property." Additional receptors were included around the Clifty Creek facility in the revised modeling assessment to resolve the location of the maximum concentration to 100-m spacing.

**Figure 11a and 11b: Receptor Grid for the Carroll County Area**






The EPA agrees with the Commonwealth on the final receptor grid, which is consistent with the Modeling TAD. The final receptor grid, therefore, can be expected to adequately characterize $SO_2$ impacts from the Ghent Station facility and the other facilities included in the analysis. Additionally, the modeling shows that the highest impacts are located west of the Ghent Station facility and south of the Clifty Creek Station facility on the south side of the Ohio River in Kentucky, approximately 34 km west of Ghent Station. The highest impacts from the Ghent Station facility alone occur approximately 3 km southwest of the Ghent facility.

#### *4.3.2.5. Modeling Parameter: Source Characterization*

Section 6 of the Modeling TAD offers recommendations on source characterization including source types, use of accurate stack parameters, inclusion of building dimensions for building downwash (if warranted), and the use of actual stack heights with actual emissions or following GEP policy with allowable emissions.

Ghent Station has four major sources of $SO_2$ emissions which emit through three stacks. These units are all coal-fired units. The March 31, 2017, Modeling Report asserts that $SO_2$ emissions from onsite emergency and auxiliary units are negligible "given the relatively small horsepower rating/limit of the engines and the very low sulfur content of the fuels used. In addition, these smaller sources are used on a short-term intermittent basis at the facility (operate fewer than 500

hours per year) and thus, do not contribute to the annual distribution of daily maximum 1-hour $SO_2$ concentrations." The Modeling TAD[18] indicates that these types of intermittently operated sources can be excluded from the modeling demonstration because the EPA believes the most appropriate data to use for comparison to the 1-hour $SO_2$ NAAQS are based on emissions scenarios that are continuous enough or frequent enough to contribute significantly to the annual distribution of maximum daily 1-hour concentrations. Moreover, the modeled background concentrations should be representative of any potential impacts from these types of intermittently operated sources.

The Trimble County Station facility was included in the modeling due to its location, which is predominantly upwind relative to Ghent Station. Therefore, winds would be expected to frequently carry emissions from Trimble County Station toward Ghent Station. The Clifty Creek Station is located approximately 4 km closer to Ghent Station than Trimble County Station and has a comparable magnitude of emissions. Therefore, the Commonwealth chose to include Clifty Creek Station in its analysis. East Bend sources were included in the modeling due to the close proximity to Ghent Station.

Two additional sources were considered within the 50 km radius, but were not included in the final modeling: Tanners Creek Station in Dearborn County, Indiana, and Miami Fort Station in Hamilton County, Ohio. The Final Modeling Report indicates that Tanners Creek Station shut down in 2014 and was not considered in the modeling analysis. The Tanners Creek units 1-4 were permanently and enforceably shut down to comply with the Mercury and Air Toxics Rule, meaning the allowable emissions are now zero tpy for this facility.[19] The EPA's Clean Air Markets Division (CAMD) air program data shows emissions of 18,091 tons for 2014 and 7,650 tons for 2015, but no emissions beyond May of 2015 for any of units 1-4.[20] Miami Fort Station and a nearby cluster of smaller sources were also considered for inclusion in the modeling. Miami Fort Station is approximately 46 km north northeast of Ghent Station. This cluster of sources is located approximately 30 km northwest of the Northern Kentucky University $SO_2$ monitor which was used as the background monitor. Based on the wind rose plot, the cluster of sources should impact the monitor with higher frequency and greater magnitudes than those impacts from the other facilities modeled in the vicinity of Ghent Station. Therefore, Miami Fort Station was excluded from the modeling analysis and is accounted for in the background concentration.

The Commonwealth characterized Ghent Station, LG&E's Trimble County Station, Duke Energy's East Bend facility, and Indiana-Kentucky Electric Corporation's Clifty Creek Station within the area of analysis in accordance with the best practices outlined in the Modeling TAD. Specifically, the Commonwealth used actual stack heights in conjunction with actual emissions for Ghent Station, LG&E's Trimble County Station, and Duke Energy's East Bend facility. The

[18] The Modeling TAD references the March 1, 2011 memorandum entitled "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour $NO_2$ National Ambient Air Quality Standard," in considering intermittent sources.
[19] An October 19, 2015, permit revision revoked the permit for the purposes of the Acid Rain Program and pollutant transport rules to remove the operating status of units 1-4, and a January 29, 2016 permit action revised the status of the source, reflecting the June 1, 2015 retirements of units 1-4.
[20] Emissions information is available at: https://ampd.epa.gov/ampd/.

Commonwealth used allowable emissions for Clifty Creek, and used stack heights determined in accordance with the EPA's GEP policy. The Commonwealth also adequately characterized the source's building layout and location, as well as the stack parameters, e.g., exit temperature, exit velocity, location, and diameter. Where appropriate, the AERMOD component BPIPPRM was used to assist in addressing building downwash.

The EPA agrees with Kentucky's method for characterizing the area. The assessment of nearby sources within 50 km of Ghent Station justifies the explicit modeling of the four DRR sources with potential impacts in the area. The Northern Kentucky University background monitor, discussed in Section 4.3.2.9, will provide representative impacts from sources in the area not explicitly modeled. The use of actual stack heights is appropriate given the use of actual emissions. Building downwash is also appropriately accounted for.

#### *4.3.2.6. Modeling Parameter: Emissions*

The EPA's Modeling TAD notes that for the purpose of modeling to characterize air quality for use in designations, the recommended approach is to use the most recent 3 years of actual emissions data and concurrent meteorological data. However, the TAD also indicates that it would be acceptable to use allowable emissions in the form of the most recently permitted (referred to as PTE or allowable) emissions rate that is federally enforceable and effective.

The EPA believes that CEMS data provide acceptable historical emissions information, when they are available. These data are available for many electric generating units. In the absence of CEMS data, the EPA's Modeling TAD highly encourages the use of AERMOD's hourly varying emissions keyword HOUREMIS, or through the use of AERMOD's variable emissions factors keyword EMISFACT. When choosing one of these methods, the EPA recommends using detailed throughput, operating schedules, and emissions information from the impacted source (s).

In certain instances, states and other interested parties may find that it is more advantageous or simpler to use PTE rates as part of their modeling runs. For example, where a facility has recently adopted a new federally enforceable emissions limit or implemented other federally enforceable mechanisms and control technologies to limit $SO_2$ emissions to a level that indicates compliance with the NAAQS, the state may choose to model PTE rates. These new limits or conditions may be used in the application of AERMOD for the purposes of modeling for designations, even if the source has not been subject to these limits for the entirety of the most recent 3 calendar years. In these cases, the Modeling TAD notes that a state should be able to find the necessary emissions information for designations-related modeling in the existing $SO_2$ emissions inventories used for permitting or SIP planning demonstrations. In the event that these short-term emissions are not readily available, they may be calculated using the methodology in Table 8-1 of Appendix W to 40 CFR Part 51 titled, "Guideline on Air Quality Models."

As previously noted, the Commonwealth included Ghent Station and three other emitters of $SO_2$ within 50 km in the area of analysis. The Commonwealth has chosen to model these facilities using a hybrid approach, where emissions from certain facilities are expressed as actual emissions, and those from other facilities are expressed as PTE rates. The facilities in the

Commonwealth's modeling analysis and their associated annual actual $SO_2$ emissions between 2012 and 2014 or PTE rates are summarized below.

For Ghent, Trimble County, and East Bend Stations, the Commonwealth provided annual actual $SO_2$ emissions between 2012 and 2014. East Bend Station provided actual hourly data for only the primary boiler (Source ID: D_2, or EU02 as referred to in Section 3 of this document). For the two other units at East Bend Station (Source ID: D_16 & D_13), annualized emissions were calculated using 2014 actual emissions. This information is summarized in Table 9. A description of how the Commonwealth obtained hourly emission rates is given below this table.

**Table 9. Actual $SO_2$ Emissions Between 2012 – 2014 from Facilities in the Area of Analysis for the Carroll County Area**

| | $SO_2$ Emissions (tpy) | | |
|---|---|---|---|
| **Facility Name** | **2012** | **2013** | **2014** |
| Ghent Station | 10,772 | 13,422 | 14,851 |
| Trimble County Station | 2,896 | 3,521 | 3,056 |
| East Bend Station (Source ID: D_2) | 1,497 | 2,198 | 2,103 |
| East Bend Station (Source ID: D_16) | Assumed 2014 | Assumed 2014 | 0.00431 |
| East Bend Station (Source ID: D_13) | Assumed 2014 | Assumed 2014 | 0.00001 |
| Total Emissions from All Facilities in the Area of Analysis Modeled Based on Actual Emissions | 15,115 | 19,141 | 20,010 |

For Ghent, Trimble County, and East Bend Stations, the actual hourly emissions data were obtained from CEMS emission data from 2012-2014 from CAMD data. CAMD annual emissions for Ghent Station, Trimble County Station, and Unit D_2 of East Bend Station were compared to the hourly emissions file used in the AERMOD modeling run. The CAMD annual emissions values for these sources match the summed hourly emissions values from AERMOD for each of these sources.

Two units at East Bend Station do not have CEMS data: Source ID: D_16 & D_13. For these units, an annualized emissions value was calculated from the 2014 actual emissions. These units are intermittent sources of $SO_2$ emissions: D_16 is a 285 HP Fire Pump engine and D_13 is an 1100 HP emergency generator, both of which run on low sulfur diesel fuel.

For Clifty Creek, the Commonwealth provided PTE values. This information is summarized in Table 10.

**Table 10. $SO_2$ Emissions based on PTE from Facilities in the Area of Analysis for the Carroll County Area**

| Facility Name | $SO_2$ Emissions (tpy, based on PTE) |
|---|---|
| Clifty Creek Station | 11,495 |
| Total Emissions from Facilities in the Area of Analysis Modeled Based on PTE | 11,495 |

The EPA derived the tons per year value shown in the table above by multiplying the current PTE for the facility (2,624.5 pounds per hour on a 720-hour [30-day] average basis) by 8,760 hours per year converted to tons. The EPA policy is that for cases involving longer term (e.g. 30-day) average emission limits, modeling of allowable emissions should reflect an upward-adjusted value that represents the one-hour emission limit that would be at least comparably stringent. Accordingly, the value that the Commonwealth modeled is approximately 78 percent higher than the 720-hour average limit.

The EPA agrees with Kentucky's use of past actual emissions for Ghent Station, Trimble County Station, and the main emitting unit at East Bend. We also agree with the use of 2012 – 2014 emissions rather than the most recent set of emissions from Ghent Station. According to CAMD air program data, the emissions decreased at Ghent Station in 2015 (10,703 tons) relative to the 2012 – 2014 period used. The emissions at East Bend increased in 2015 (2,656 tons) relative to the 2012 – 2014 data modeled, but these increases were generally less than the decreased emissions at the central facility (Ghent Station). In addition, East Bend is located over 20 km from Ghent Station which likely further lessens the likelihood of any impacts from the modest increases in emissions from East Bend affecting reliability of the modeling. The emissions at Trimble County also increased in 2015 (3,274 tons). As with East Bend, Trimble County is located over 30 km from Ghent Station which likely further lessens the likelihood of any impacts from the modest increases in emissions from Trimble County affecting reliability of the modeling. Thus, the use of 2012 – 2014 emissions is representative in estimating $SO_2$ impacts from Ghent Station. The EPA believes this set of parameters likely provides for a reliable representation of any possible $SO_2$ impacts in the area, assuming the meteorology does not significantly change.

The emissions data utilized in the modeling for Clifty Creek Station was updated in the revised modeling submitted in April 2017, to account for EPA's comments on using the annualized 2014 emissions data. This approach is now consistent with the $SO_2$ Modeling TAD and the EPA agrees with using PTE values for Clifty Creek.

#### *4.3.2.7. Modeling Parameter: Meteorology and Surface Characteristics*

As noted in the Modeling TAD, the most recent 3 years of meteorological data (concurrent with the most recent 3 years of emissions data) should be used in designations efforts. The selection of data should be based on spatial and climatological (temporal) representativeness. The representativeness of the data is determined based on: 1) the proximity of the meteorological monitoring site to the area under consideration, 2) the complexity of terrain, 3) the exposure of the meteorological site, and 4) the period of time during which data are collected. Sources of

meteorological data include NWS stations, site-specific or onsite data, and other sources such as universities, FAA, and military stations.

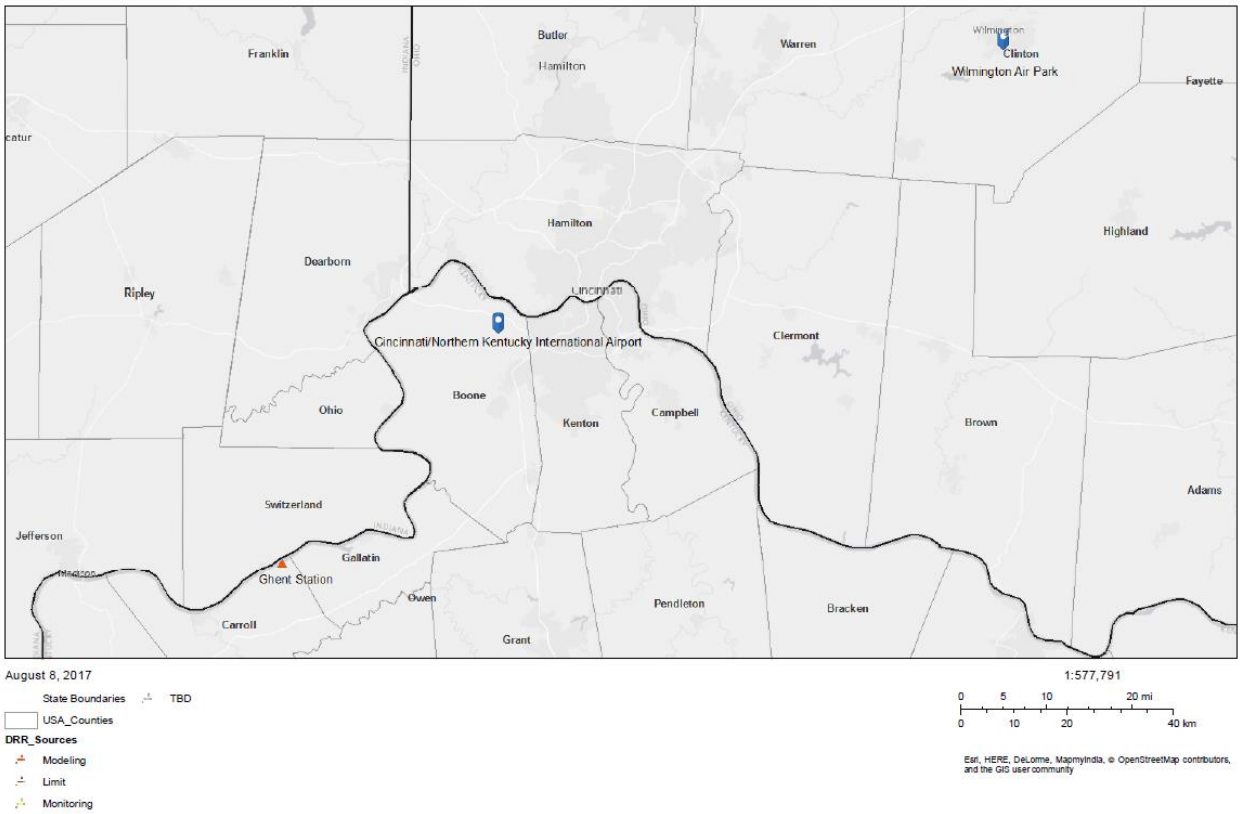
For the area of analysis for the Carroll County area, the Commonwealth selected the surface meteorology from the Cincinnati/Northern Kentucky International Airport NWS station in Covington, Kentucky, located at 39.05 N, 84.67 W, 45.6 km to the northeast of the source, and coincident upper air observations from the Wilmington Air Park Airport NWS station in Wilmington, Ohio, located at 39.42 N, 83.82 W, as best representative of meteorological conditions within the area of analysis.

The Commonwealth used met files developed by the Ohio Environmental Protection Agency and available on the State's website.[21] The information obtained from Ohio's archives included preprocessed data. AERSURFACE version 13016 using data from the Covington, Kentucky NWS station to estimate the surface characteristics (albedo, Bowen ratio, and surface roughness [$z_o$]) of the area of analysis. Albedo is the fraction of solar energy reflected from the earth back into space, the Bowen ratio is the method generally used to calculate heat lost or heat gained in a substance, and the surface roughness is sometimes referred to as "zo" The state estimated surface roughness values for 12 spatial sectors out to 1 km at a monthly temporal resolution. Monthly Bowen ratios were determined from the most recent 30-year precipitation normal for the surface station.

In the figure below, generated by the EPA, the locations of these NWS stations are shown relative to the area of analysis.

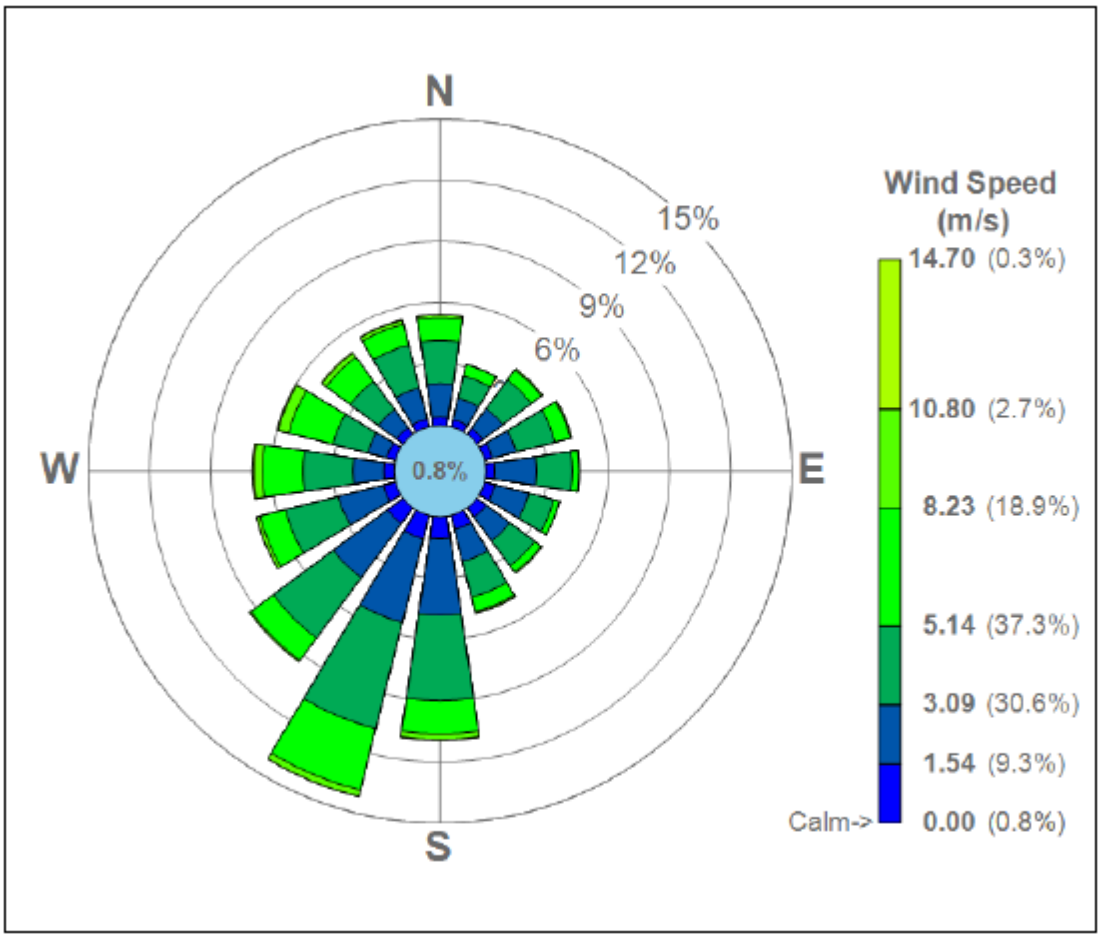
[21] http://www.epa.state.oh.us/dapc/model/modeling/metfiles.aspx

**Figure 12. Area of Analysis and the NWS stations in the Carroll County Area**




As part of its recommendation, the Commonwealth provided the 3-year surface wind rose for the Covington, KY NWS site. In Figure 13, the frequency and magnitude of wind speed and direction are defined in terms of from where the wind is blowing. Analysis of the NWS data indicate winds predominantly blow from the south and southwest directions, approximately 10 percent and 25 percent of the time, respectively. To a lesser extent, winds can be observed blowing from all other directions with relative equal frequency. The Commonwealth determined that Trimble County Station is predominantly upwind of Ghent Station, East Bend is not generally upwind of the source, and that Miami Fort Station would impact the monitor selected for background concentrations more than the area surrounding the source.

**Figure 13: Covington, KY NWS Cumulative Annual Wind Rose for Years 2012 – 2014**




Meteorological data from the above surface and upper air NWS stations were used in generating AERMOD-ready files with the AERMET processor. The output meteorological data created by the AERMET processor is suitable for being applied with AERMOD input files for AERMOD modeling runs. The Commonwealth acquired data from the Ohio Environmental Protection Agency's archives.[22] The Ohio state agency followed the methodology and settings as outlined in a recent U.S. EPA memorandum [Fox, Tyler. 2013. "Use of ASOS Meteorological Data in AERMOD Dispersion Modeling"] in the processing of the raw meteorological data into an AERMOD-ready format, and used AERSURFACE to best represent surface characteristics.

Hourly surface meteorological data records are read by AERMET, and include all the necessary elements for data processing. However, wind data taken at hourly intervals may not always portray wind conditions for the entire hour, which can be variable in nature. Hourly wind data may also be overly prone to indicate calm conditions, which are not modeled by AERMOD. In order to better represent actual wind conditions at the meteorological tower, wind data of 1-

[22] The Modeling Report for Kentucky's Ghent Station made use of preprocessed data made available by the Ohio Environmental Protection Agency at: http://www.epa.state.oh.us/dapc/model/modeling/metfiles.aspx.

minute duration was provided from the first NWS station mentioned above, but in a different formatted file to be processed by a separate preprocessor, AERMINUTE. These data were subsequently integrated into the AERMET processing to produce final hourly wind records of AERMOD-ready meteorological data that better estimate actual hourly average conditions and that are less prone to over-report calm wind conditions. This allows AERMOD to apply more hours of meteorology to modeled inputs, and therefore produce a more complete set of concentration estimates. As a guard against excessively high concentrations that could be produced by AERMOD in very light wind conditions, Ohio set a minimum threshold of 0.5 m/s in processing meteorological data for use in AERMOD. In setting this threshold, no wind speeds lower than this value would be used for determining concentrations. This threshold was specifically applied to the 1-minute wind data. The March 31, 2017, Revised Modeling Report made use of Ohio's preprocessed meteorological data, which was processed using the current version of AERMET, version 16216.

The EPA believes the surface and upper air meteorological data and surface characteristics used in the Commonwealth's modeling are acceptable. The EPA believes that the meteorological data reasonably shows that impacts from Ghent Station and other sources included are expected to occur most frequently generally northeast of the facility, but that impacts could be seen in other directions as well. The surface characteristics were evaluated for the NWS site. Kentucky followed the EPA guidance in developing its modeling parameters.

#### *4.3.2.8. Modeling Parameter: Geography, Topography (Mountain Ranges or Other Air Basin Boundaries) and Terrain*

The terrain in the area of analysis is best described as moderately hilly. To account for these terrain changes, the AERMAP terrain program within AERMOD was used to specify terrain elevations for all the receptors. The source of the elevation data incorporated into the model is from the USGS 1 arc-second NED.

The EPA confirmed that the Carroll County area has moderately complex terrain considerations, and accordingly, the terrain elevations are important in representing the area and the modeling domain. We also agree with the Commonwealth's use of AERMAP version 11103 to obtain the elevations of sources, buildings, and receptors.

#### *4.3.2.9. Modeling Parameter: Background Concentrations of $SO_2$*

The Modeling TAD offers two mechanisms for characterizing background concentrations of $SO_2$ that are ultimately added to the modeled design values: 1) a "tier 1" approach, based on a monitored design value, or 2) a temporally varying "tier 2" approach, based on the $99^{th}$ percentile monitored concentrations by hour of day and season or month. For this area of analysis, the Commonwealth elected to use a "tier 2" approach. Data were obtained from 2012-2014 for AQS Site: 21-037-3002 (Northern Kentucky University – NKU). These data were used to generate an annually distributed temporally (by hour of day) varying background based on the 99th percentile monitored concentrations. A 90-degree sector upwind from the monitor is excluded from the background concentrations to exclude the impacts from a nearby facility, Beckjord

Station, which has since ceased operation. The background concentrations for this area of analysis were determined by the Commonwealth to vary from 12.18 μg/m$^3$, equivalent to 4.7 ppb when expressed in 2 significant figures,[23] to 51.33 μg/m$^3$ (19.6 ppb), with an average value of 27.12 μg/m$^3$ (10.4 ppb). The Commonwealth chose to use 2012 – 2014 for this assessment to align the actual background with the actual emissions used in the modeling assessment. Table 11 lists the background values used in the modeling analysis.

**Table 11. 2012-2014 Three Year Average 99th Percentile $SO_2$ Concentrations by Hour of Day at the Northern Kentucky University Monitor with 90-Degree Exclusion Toward Beckjord Station**

| Hour of Day | Hourly Background $SO_2$ Concentrations at NKU Monitor (μg/m$^3$) |
|---|---|
| 1 | 16.53 |
| 2 | 14.79 |
| 3 | 13.05 |
| 4 | 13.92 |
| 5 | 13.92 |
| 6 | 12.18 |
| 7 | 17.4 |
| 8 | 19.14 |
| 9 | 25.23 |
| 10 | 38.28 |
| 11 | 39.15 |
| 12 | 51.33 |
| 13 | 43.5 |
| 14 | 40.89 |
| 15 | 44.37 |
| 16 | 38.28 |
| 17 | 44.37 |
| 18 | 33.93 |
| 19 | 22.62 |
| 20 | 25.23 |
| 21 | 24.36 |
| 22 | 21.75 |
| 23 | 18.27 |
| 24 | 18.27 |

[23] The $SO_2$ NAAQS level is expressed in ppb but AERMOD gives results in μg/m$^3$. The conversion factor for $SO_2$ (at the standard conditions applied in the ambient $SO_2$ reference method) is 1ppb = approximately 2.619 μg/m$^3$.

The EPA agrees that Kentucky adequately accounted for background in accordance with the Modeling TAD. The Commonwealth made use of the nearest $SO_2$ monitor, excluding data during times in which the wind direction most aligned with the Beckjord Station facility, which has since shut down permanently and enforceably and would no longer impact the Carroll County area.[24]

#### *4.3.2.10. Summary of Modeling Inputs and Results*

The AERMOD modeling input parameters for the Carroll County area of analysis are summarized below in Table 12.

**Table 12: Summary of AERMOD Modeling Input Parameters for the Area of Analysis for the Carroll County Area**

| Input Parameter | Value |
|---|---|
| AERMOD Version | 16216r (regulatory default) |
| Dispersion Characteristics | Rural |
| Modeled Sources | 4 |
| Modeled Stacks | 17 |
| Modeled Structures | 131 |
| Modeled Fencelines | 1 |
| Total receptors | 7,264 |
| Emissions Type | Mix of Actual and PTE |
| Emissions Years | 2012-2014 actuals; 2 units at East Bend used annualized emissions calculated from 2014 actual emissions; PTE used for Clifty Creek |
| Meteorology Years | 2012-2014 |
| NWS Station for Surface Meteorology | Covington, Kentucky airport |
| NWS Station Upper Air Meteorology | Wilmington, Ohio airport |
| NWS Station for Calculating Surface Characteristics | Covington, KY |
| Methodology for Calculating Background $SO_2$ Concentration | Tier 2 approach using AQS site: 21-037-3002 for 2012-2014 |
| Calculated Background $SO_2$ Concentration | 12.18 - 51.33µg/$m^3$ |

[24] See footnote #13 in Section 3 of this TSD for more information.

The results presented below in Table 13 show the magnitude and geographic location of the highest predicted modeled concentration based on the input parameters.

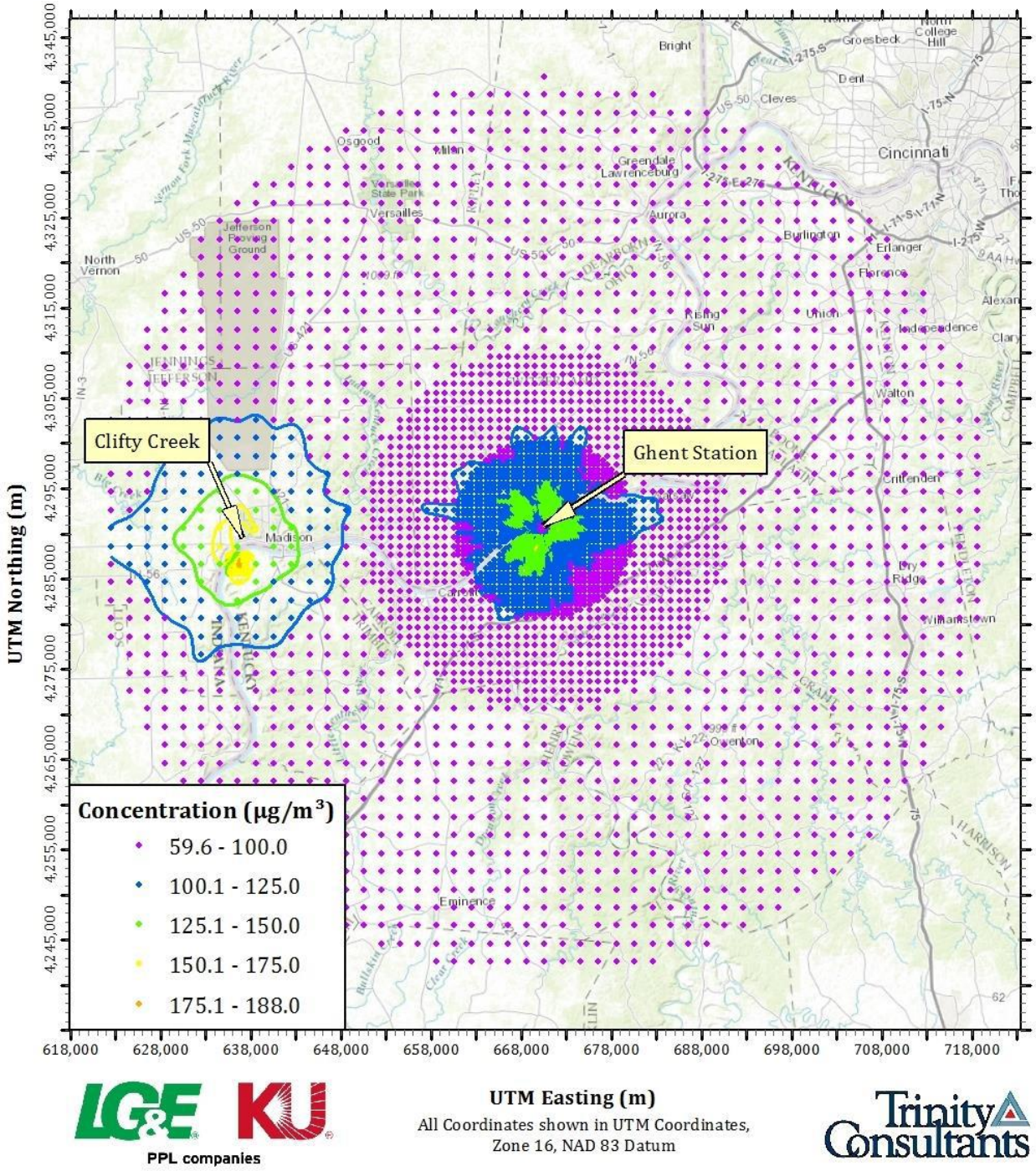
**Table 13. Maximum Predicted 99th Percentile Daily Maximum 1-Hour $SO_2$ Concentrations Averaged Over Three Years for the Area of Analysis for the Carroll County Area**

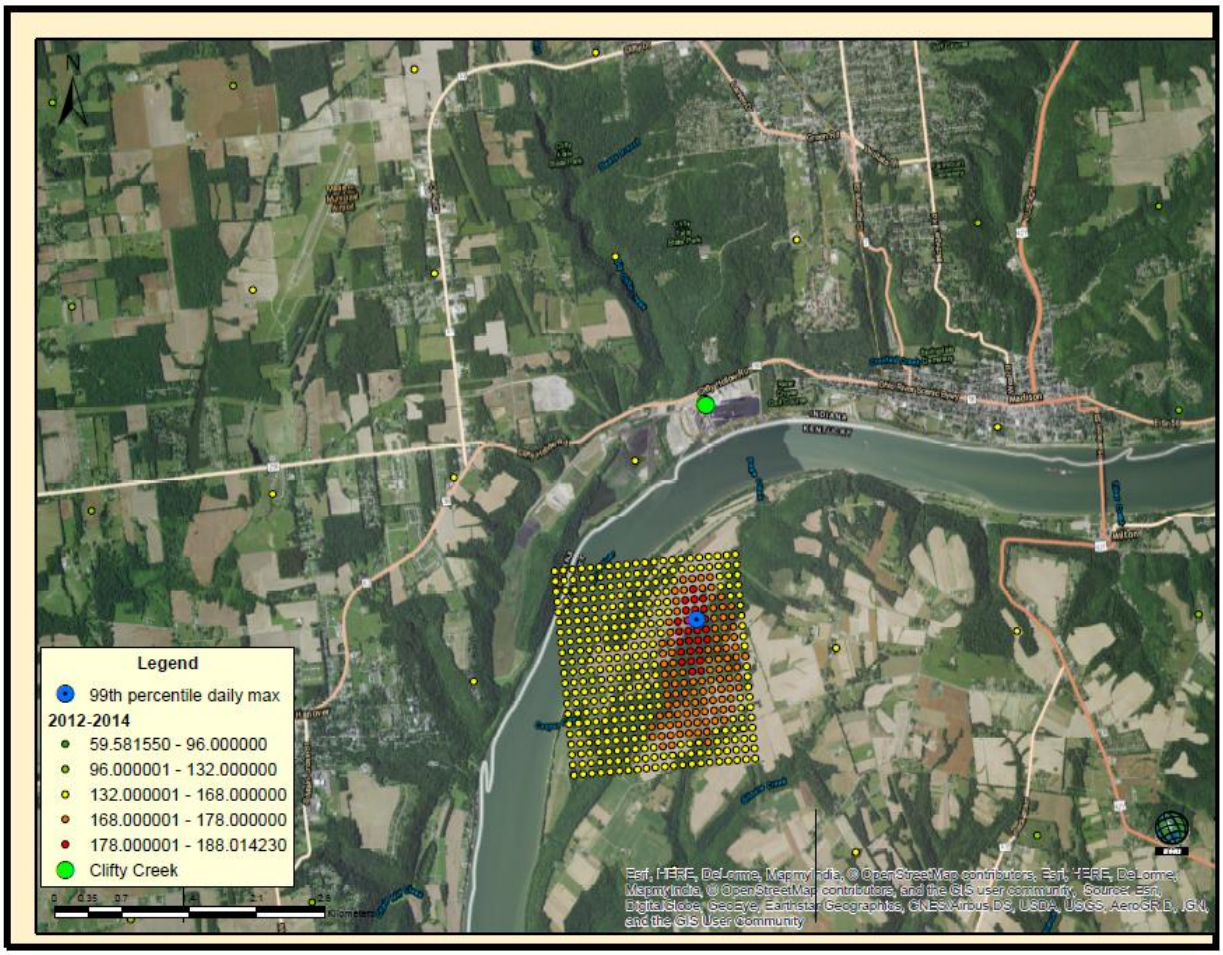
| Averaging Period | Data Period | Receptor Location [UTM zone 16] | | 99th percentile daily maximum 1-hour $SO_2$ Concentration ($\mu g/m^3$) | |
|---|---|---|---|---|---|
| | | UTM Easting (m) | UTM Northing (m) | Modeled concentration (including background) | NAAQS Level |
| 99th Percentile 1-Hour Average | 2012-2014 | 637,097 | 4,286,960 | 188.0 | 196.4* |

*Equivalent to the 2010 $SO_2$ NAAQS of 75 ppb using a 2.619 $\mu g/m^3$ conversion factor

The Commonwealth's modeling indicates that the highest predicted 99th percentile daily maximum 1-hour concentration within the chosen modeling domain is 188.0 $\mu g/m^3$, equivalent to 71.8 ppb. This modeled concentration included the background concentration of $SO_2$, and is based on actual emissions from the facilities. Figure 14a below was included as part of the Commonwealth's recommendation, and indicates that the highest impacts are located west of the Ghent Station and south of the Clifty Creek Station on the south side of the Ohio River in Kentucky, approximately 34 km west of Ghent Station. Figure 14b, generated by the EPA, highlights on the area of maximum concentration around the Clifty Creek facility. The Commonwealth's receptor grid is also shown in the figures.

**Figure 14a and 14b: Maximum Predicted 99th Percentile Daily Maximum 1-Hour $SO_2$ Concentrations Averaged Over Three Years for the Area of Analysis for the Carroll County Area**






The modeling submitted by the Commonwealth does not indicate that the 1-hour $SO_2$ NAAQS is violated at the receptor with the highest modeled concentration.

#### *4.3.2.11. The EPA's Assessment of the Modeling Information Provided by the Commonwealth*

The EPA agrees with Kentucky's modeling to characterize $SO_2$ impacts in the Carroll County area. The Commonwealth chose to model four DRR sources in the area, and the EPA agrees with this decision, as supported by the March 31, 2017, Modeling Report evaluating nearby sources within 50 km of Ghent Station, and the November 11, 2016, Memorandum clarifying sources excluded from the final modeling. The EPA believes the modeling domain is appropriate to capture predicted maximum impacts in the Carroll County area. Kentucky's selection of meteorological data for the area are also appropriate to make a valid modeling demonstration. The Commonwealth adequately represented the topography of the area with the model and its preprocessors. The Commonwealth chose to model emissions from Ghent Station, East Bend, and Trimble County Station during 2012 – 2014, rather than using the most recent available emissions. This departure from the Modeling TAD is acceptable because Ghent Station shows decreased emissions after this period, and the decreases in emissions from these sources are larger than the increases seen at East Bend and Trimble County Station. Also, East Bend and

Trimble County are both located over 20 km from Ghent. Therefore, modeling these sources together over the 2012 – 2014 period provides for a reliable estimate of potential $SO_2$ impacts in the area. The Commonwealth chose to use actual emissions to reflect normal operation of the sources. Clifty Creek emissions were represented by the current federally enforceable 720 hour rolling average, equivalent maximum hourly rate of 4,670[25] lb/hr. The decision was made to represent these emissions in terms of the current federally enforceable limit to be consistent with the DRR modeling performed by IDEM. We believe these decisions are appropriate for the purpose of this modeling demonstration. We have also confirmed that Kentucky selected its hourly varying background concentrations from the NKU monitor consistent with the Modeling TAD.

The Commonwealth made use of AERMOD version 16216r, the current version of the model. The EPA agrees that this model version is appropriate to characterize the area because the Commonwealth made use of default regulatory options available at the time and followed the Modeling TAD.

## 4.4. Emissions and Emissions-Related Data, Meteorology, Geography, and Topography for the Carroll County Area

These factors have been incorporated into the air quality modeling efforts and results discussed above. The EPA is giving consideration to these factors by considering whether they were properly incorporated and by considering the air quality concentrations predicted by the modeling.

[25] The PTE for the facility is 2,624.5 pounds per hour on a 720-hour (30-day) average basis. The EPA policy is that for cases involving longer term (e.g. 30-day) average emission limits, modeling of allowable emissions should reflect an upward-adjusted value that represents the one-hour emission limit that would be at least comparably stringent. Accordingly, the value that the Commonwealth modeled is approximately 78 percent higher than the 720-hour average limit.

## 4.5. Jurisdictional Boundaries in the Carroll County Area

Existing jurisdictional boundaries are considered for the purpose of informing the EPA's designation action for Carroll County. Our goal is to base designations on clearly defined legal boundaries, and to have these boundaries align with existing administrative boundaries when reasonable.

The modeling domain extends from Ghent Station at a radius of 50 km, and so covers the entirety of Carroll, Gallatin, Trimble, and Henry Counties in Kentucky, most of Boone, Grant, and Owen Counties in Kentucky, extending into the northern portions of Shelby and Franklin Counties, the northeastern portion of Oldham County, the northwestern portion of Pendleton County, and the western half of Kenton County in Kentucky. The modeling domain also covered the entirety of Switzerland and Ohio Counties in Indiana, most of Jefferson County, and the southern portion of Ripley and Dearborn Counties in Indiana, extending into the eastern portions of Scott, Clark, and Jennings Counties in Indiana, and the southwestern portion of Hamilton County, Ohio.

## 4.6. The EPA's Assessment of the Available Information for the Carroll County Area

The EPA intends to designate the Carroll County area, including the entire County boundary, as unclassifiable/attainment. We believe that Kentucky's modeling analysis supports the conclusion that there are no expected violations of the 2010 $SO_2$ NAAQS in the area. There is no current monitoring data available for the area, so the modeling serves to reflect the air quality expected in the years modeled.

Based on the air quality characterization conducted within the Carroll County area of analysis in accordance with the EPA's Modeling TAD, the Commonwealth concluded that the area should be designated as attainment. This recommendation is based on Kentucky's assessment that emissions from the Ghent Station facility could interact with those from the Trimble County Station, East Bend, and Clifty Creek Station facilities and together impact the area, and the inclusion of these four DRR sources in the modeling demonstration. Ghent Station is the only Carroll County source that emitted over 100 tons in 2014. East Bend, Trimble County Station, Clifty Creek Station, and Miami Fort Generating Station are the only other sources within the 50 km area of analysis to emit over 100 tons in 2014.

Kentucky evaluated possible contributions from these sources and other sources within 50 km of Ghent Station to $SO_2$ impacts in the Carroll County area. Based on Kentucky's Q/d analysis, Kentucky decided in the March 31, 2017, Modeling Report to include possible contributions from nearby Trimble County Station and East Bend by modeling actual emissions. Clifty Creek emissions were represented by the current federally enforceable 720 hour rolling average, equivalent maximum hourly rate of 4,670 lb/hr. The Commonwealth excluded Miami Fort based on its distance and its likelihood of being accounted for in the background concentration at the NKU monitor. Kentucky then added a reasonable value for background concentrations of $SO_2$ by including the 2012 – 2014 hourly varying concentrations from the NKU monitor in Campbell

County. The EPA agrees with the technical explanation for the Commonwealth's treatment of nearby $SO_2$ sources included in the March 31, 2017, Modeling Report. We believe the modeling of the sources included adequately represents the Carroll County area. The EPA has reason to believe there are no additional sources in areas adjacent to our intended area that are likely to cause or contribute to a violation of the NAAQS in the area of analysis. In addition, based on the available information for the remaining areas in Kentucky and neighboring Indiana and Ohio, including monitoring and modeling, there are no current $SO_2$ nonattainment areas near Carroll County, Kentucky or in nearby counties in Ohio or Indiana, and no expected nonattainment areas for this third round of designations. In addition, there are no nearby Round 4 areas being characterized by December 31, 2020 based on a newly deployed $SO_2$ monitor. Therefore, the Carroll County area is not expected to contribute to ambient air quality in a nearby area that does not meet the NAAQS.

After careful evaluation of the Commonwealth's recommendation and supporting information, as well as all available relevant information, the EPA intends to designate the area around Ghent Station as unclassifiable/attainment for the 2010 $SO_2$ NAAQS. Specifically, the boundaries are comprised of the entirety of Carroll County. There are no remaining portions of Carroll County that remain to be characterized in the EPA's Round 4 of designations in 2020, nor are there any other portions of the County that have a separate area of analysis for Round 3.

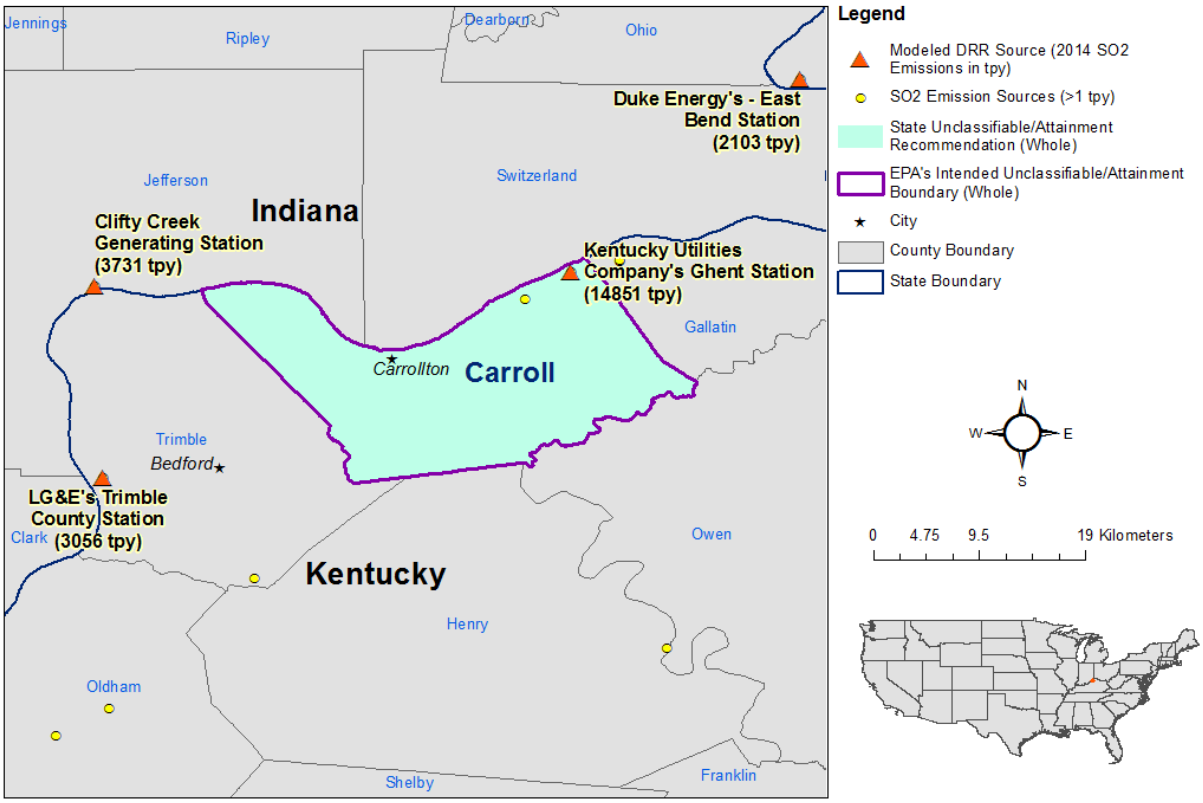
The EPA believes that our intended unclassifiable/attainment area, bounded by the entirety of Carroll County, will have clearly defined legal boundaries, and we intend to find these boundaries to be a suitable basis for defining our intended unclassifiable/attainment area.

## 4.7. Summary of Our Intended Designation for the Carroll County Area

After careful evaluation of the Commonwealth's recommendation and supporting information, as well as all available relevant information, the EPA intends to designate the Carroll County area as unclassifiable/attainment for the 2010 $SO_2$ NAAQS because the EPA has determined the area meets the 2010 $SO_2$ NAAQS and does not contribute to ambient air quality in a nearby area that does not meet the NAAQS. Specifically, the boundaries are comprised of the entirety of Carroll County.

Figure 15 shows the boundary of this intended designated area.

**Figure 15. Boundary of the Intended Unclassifiable/Attainment Carroll County Area**




At this time, our intended designations for the Commonwealth only apply to this area and the other areas presented in this technical support document. The EPA intends in a separate action to evaluate and designate all remaining undesignated areas in Kentucky by December 31, 2020.

# 5. Technical Analysis for the Daviess County Area

## 5.1. Introduction

The EPA must designate the Daviess County area by December 31, 2017, because the area has not been previously designated and Kentucky has not installed and begun timely operation of a new, approved $SO_2$ monitoring network meeting the EPA specifications referenced in the EPA's $SO_2$ DRR for any sources of $SO_2$ emissions in in Daviess County. The DRR source, Owensboro Municipal Utilities' Elmer Smith Station, is located near the Ohio River, which is the border between Kentucky and Indiana. Therefore, the area of analysis, and the modeling receptors, cross the Kentucky state boundary into neighboring Indiana.

## 5.2. Air Quality Monitoring Data for the Daviess County Area

This factor considers the $SO_2$ air quality monitoring data in the area of Daviess County. Kentucky provided the values of the 99$^{th}$ percentile of the $SO_2$ monitors in Kentucky. Kentucky stated in its June 2, 2011 letter that "the average of the 99$^{th}$ percentile at all monitors is below the standard of 75 ppb in all locations except Jefferson County…The rest of the areas in Kentucky comply with the standard and should be designated as attainment/unclassifiable for the $SO_2$ standard."

The EPA reviewed the available air quality monitoring data in the AQS database and found the following nearby data:

- The Owensboro Primary $SO_2$ monitor (AQS ID: 21-059-0005) is located at 37.780776, -87.075307 in Daviess County, 1.5 miles southwest of Elmer Smith Station. Data collected by this monitor is comparable to the NAAQS, and indicates that the most recent $SO_2$ levels are below the 1-hr NAAQS. The most recent three years of quality-assured, certified data from this monitor (2014-2016) is missing one quarter of complete data in 2015; the data indicate an incomplete 1-hr $SO_2$ design value of 33 ppb. This incomplete, invalid design value is unable to support a designation in the area around the monitor. This monitor was not located to characterize the maximum 1-hr $SO_2$ concentrations of Elmer Smith Station. Kentucky provided an air quality modeling analysis to characterize the maximum 1-hr $SO_2$ concentrations in the area (see Section 5.3 below).

In reviewing the available air quality monitoring data in AQS, the EPA determined that other than the data described above, there is no additional relevant data in AQS collected in or near Daviess County that could inform the intended designation action. The most recent $SO_2$ design values for all areas of the country are available at https://www.epa.gov/air-trends/air-quality-design-values.

## 5.3. Air Quality Modeling Analysis for the Daviess County Area Addressing Owensboro Municipal Utilities' Elmer Smith Station

### *5.3.1. Introduction*

This section 5.3 presents all the available air quality modeling information for a portion of Daviess County that includes Owensboro Municipal Utilities' (OMU) Elmer Smith Station. (This portion of Daviess County will often be referred to as "the Daviess County area" within this Section 5.3.) This area contains one DRR source, the Elmer Smith facility, around which Kentucky is required by the DRR to characterize $SO_2$ air quality, or alternatively establish an $SO_2$ emissions limitation of less than 2,000 tpy. Kentucky's modeling demonstration for the Daviess County area also includes nearby sources in nearby counties and across the state border in Indiana. These are DRR sources and other sources thought to impact the Daviess County area. All DRR sources and other sources modeled for this area of analysis are listed below:

- The Elmer Smith Station facility emitted 2,000 tons or more annually. Specifically, Elmer Smith emitted 5,741 tons of $SO_2$ in 2014 and 3,902 tons in 2015. This source meets the DRR criteria and thus is on the $SO_2$ DRR Source list, and Kentucky has chosen to characterize it via modeling.

- The Indiana-Michigan Power AEP – Rockport Station and the Alcoa Warrick Power Plant facilities both emitted 2,000 tons or more annually and both facilities are on the $SO_2$ DRR Source list. Indiana-Michigan AEP – Rockport Station emitted 54,980 tons of $SO_2$ in 2014 and Alcoa Warrick Power emitted 4,993 tons in 2014. These two sources are further discussed again explicitly in Indiana chapter of this TSD.

- The Owensboro Grain Company emitted 438 tons of $SO_2$ in 2014 and is not on the $SO_2$ DRR Source list. However, the Commonwealth of Kentucky determined that this source should be explicitly included in the modeling analysis to best predict total modeled $SO_2$ concentrations in the Daviess County area.

- Century Aluminum, Hawesville, Kentucky emitted 2,000 tons or more annually. Specifically, Century Aluminum emitted 2,224 tons of $SO_2$ in 2014 and 1,604 tons in 2015. This source meets the DRR criteria and thus is on the $SO_2$ DRR Source list, and Kentucky has chosen to characterize it via modeling to help characterize the Daviess County area; however, this source is discussed again explicitly in another section of this TSD chapter.

- Big Rivers Electric Corporation – Coleman Station emitted 923 tons of $SO_2$ in 2014 and is not on the DRR Source list. However, the Commonwealth of Kentucky determined that this source should be explicitly included in the modeling analysis to best predict total modeled $SO_2$ concentrations in the Daviess County area.

- Sigeco Culley Station emitted 1,896 tons of $SO_2$ in 2014 and is not on the DRR Source list. However, the Commonwealth of Kentucky determined that this source should be

explicitly included in the modeling analysis to best predict total modeled $SO_2$ concentrations in the Daviess County area.

Because we have available results of air quality modeling in which these sources are modeled together, the area around this group of sources is being addressed in this section with consideration given to the impacts of all these sources.

In its submission, Kentucky recommended that an area including the area surrounding the Elmer Smith facility, specifically Daviess County, be designated attainment based on an assessment and characterization of air quality impacts from the facilities listed above and other nearby sources that may have a potential impact in the area where the 2010 $SO_2$ NAAQS may be exceeded. This assessment and characterization was performed using air dispersion modeling software, i.e., AERMOD, analyzing actual emissions. After careful review of the Commonwealth's assessment, supporting documentation, and all available data, the EPA intends to designate the area as unclassifiable/attainment. Our reasoning for this conclusion is explained in a later section of this TSD, after all the available information is presented.

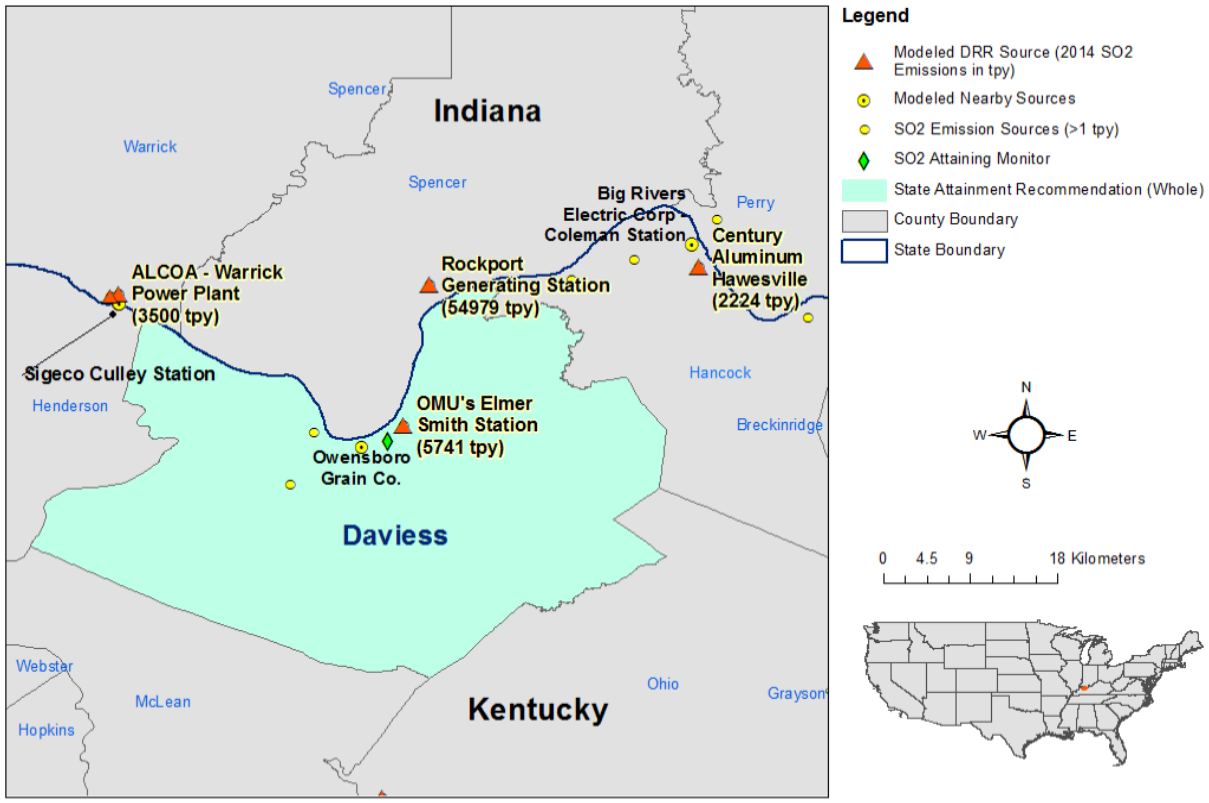
The area that the Commonwealth has assessed via air quality modeling is located in Daviess County, Kentucky adjacent to the Ohio River just northeast of Owensboro, Kentucky. The area of analysis also includes Spencer County, Indiana.

As seen in Figure 16 below, the Elmer Smith Station facility is located in Daviess County adjacent to the Ohio River on State Route 144 approximately 3 miles (5 km) northeast of the city center of Owensboro, Kentucky. Two additional DRR-subject sources were included in this modeling grouping. Indiana-Michigan Power AEP – Rockport Station near Rockport in Spencer County, Indiana, was included in the modeling along with the Alcoa Warrick Power Plant in Warrick County, Indiana. Also included in Figure 16 are other nearby emitters of $SO_2$.[26]

Also included in the figure is the Commonwealth's recommended area for the attainment designation. The EPA's intended unclassifiable/attainment designation boundary for the Daviess County area is not shown in this figure, but is shown in a figure in the section below that summarizes our intended designation.

[26] All other $SO_2$ emitters of 1 tpy or more (based on information in the inventory data provided by the states of Kentucky and Indiana) are shown in Figure 16.

**Figure 16. Map of the Daviess County Area Addressing Elmer Smith**




The discussion and analysis that follows below will reference the Modeling TAD and the factors for evaluation contained in the EPA's July 22, 2016, guidance and March 20, 2015, guidance, as appropriate.

For this area, the EPA received and considered two modeling assessments from the Commonwealth. To avoid confusion in referring to these assessments, the following table indicates when they were received, provides identifiers for the assessments that are used in the discussion of the assessments that follows, and identifies any distinguishing features of the modeling assessments.

**Table 14 – Modeling Assessments for the Daviess County Area**

| Assessment Submitted by | Date of the Assessment | Identifier Used in this TSD | Distinguishing or Otherwise Key Features |
|---|---|---|---|
| Kentucky | April 28, 2016* | April 28, 2016, Kentucky Modeling Report | First formal modeling report received |
| Kentucky | May 24, 2017 | May 24, 2017, Kentucky Modeling Report | Revision to reflect the EPA concerns |

*This modeling report, dated April 28, 2016, was submitted to the EPA on January 6, 2017.

### *5.3.2. Modeling Analysis Provided by the Commonwealth*

#### *5.3.2.1. Differences Between and Relevance of the Modeling Assessments Submitted by the Commonwealth*

Revised modeling was submitted by the Commonwealth on May 24, 2017. There were several differences between the most recent modeling submittal, dated May 24, 2017, and the previous submittal, dated April 28, 2016. The first difference is the version of the AERMOD model that was used. In the initial submittal, AERMOD version 15181 was used which was the most current regulatory version of the model available at the time. In the revised submittal, the Commonwealth used AERMOD version 16216r which includes updates to 40 CFR part 51, Appendix W, "Guideline of Air Quality Models," published on January 17, 2017 (82 FR 5203). This is the current regulatory version of the AERMOD Model.

The second difference between the previous modeling submittal and the revised submittal is the emission rates used in the modeling of OMU Elmer Smith as well as the background sources Indiana-Michigan AEP Rockport Station and ALCOA Warrick Power. In the original modeling submittal, the Commonwealth used 2012-2014 actual hourly emissions from CAMD to model these facilities. In the revised modeling submittal, the Commonwealth used 2014-2016 actual hourly emissions from CAMD to model these facilities.

The third difference between the previous modeling submittal and the revised submittal is the inclusion of three additional facilities in the modeling including Century Aluminum Hawesville, Big River Electric Coleman Station, and Sigeco Culley Station in the modeling. In the original modeling submittal, these facilities were not included in the modeling. The revised modeling submittal included emissions from these facilities.

The fourth difference between the previous modeling submittal and the revised submittal is the background concentrations used in the analysis. The original modeling submittal utilized background $SO_2$ concentrations from the Baskett monitor located in Henderson County, Kentucky, for the 2012-2014 period. The revised modeling utilized background concentrations

from the same monitor but updated the period of time used to correspond to the actual hourly emissions and meteorological data used which was for the 2014-2016 period.

The fifth and final difference between the previous modeling submittal and the revised submittal is the meteorological data used in the modeling. The original modeling utilized surface meteorological data from Evansville, Indiana, and upper air meteorological data from Lincoln Logan County Airport near Lincoln, Illinois for the 2012-2014 period. The revised modeling utilized meteorological data from the same stations but was updated to utilize data from the 2014-2016 period. The remainder of this Section will only address the most recent May 24, 2017, submittal from the Commonwealth.

#### *5.3.2.2. Model Selection and Modeling Components*

The EPA's Modeling TAD notes that for area designations under the 2010 $SO_2$ NAAQS, the AERMOD modeling system should be used, unless use of an alternative model can be justified. The AERMOD modeling system contains the following components:

- AERMOD: the dispersion model
- AERMAP: the terrain processor for AERMOD
- AERMET: the meteorological data processor for AERMOD
- BPIPPRM: the building input processor
- AERMINUTE: a pre-processor to AERMET incorporating 1-minute automated surface observation system (ASOS) wind data
- AERSURFACE: the surface characteristics processor for AERMET
- AERSCREEN: a screening version of AERMOD

The Commonwealth originally used AERMOD version 15181. However, with the updated May 24, 2017 modeling, the state made use of AERMOD version 16216r. A discussion of the Commonwealth's approach to the individual components is provided in the corresponding discussion that follows, as appropriate.

The current version of AERMOD, version 16216r, includes updates to 40 CFR part 51, Appendix W, "Guideline of Air Quality Models," published on January 17, 2017 (82 FR 5203). This version of AERMOD also includes fixes to bugs that were inadvertently included in version 16216. Kentucky in its final May 24, 2017, Modeling Report used AERMOD version 16216r with all regulatory default settings.

#### *5.3.2.3. Modeling Parameter: Rural or Urban Dispersion*

For any dispersion modeling exercise, the "urban" or "rural" determination of a source is important in determining the boundary layer characteristics that affect the model's prediction of downwind concentrations. For $SO_2$ modeling, the urban/rural determination is important because AERMOD invokes a 4-hour half-life for urban $SO_2$ sources. Section 6.3 of the Modeling TAD details the procedures used to determine if a source is urban or rural based on land use or population density. The EPA's recommended procedure for characterizing an area by prevalent land use is based on evaluating the dispersion environment within 3 km of the facility. According to the EPA's modeling guidelines, rural dispersion coefficients are to be used in the dispersion modeling analysis if more than 50 percent of the area within a 3 km radius of the facility is classified as rural. Conversely, if more than 50 percent of the area is urban, urban dispersion

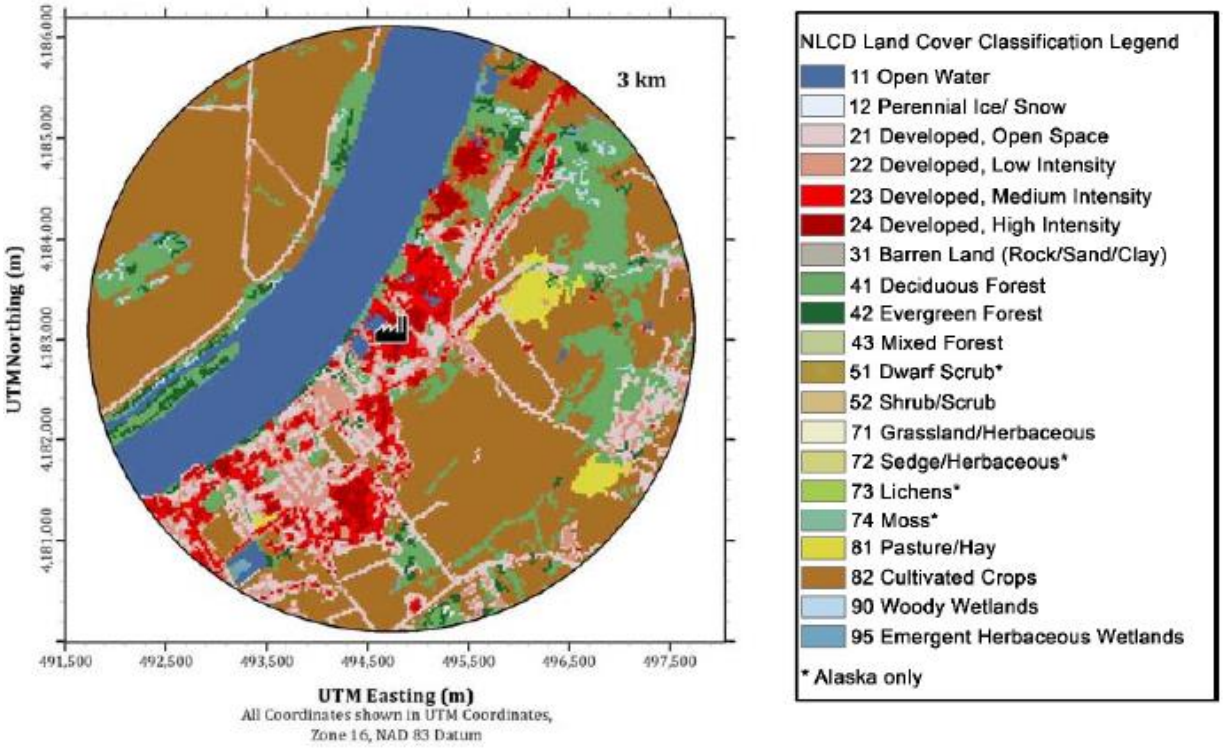
coefficients should be used in the modeling analysis. For the purpose of performing the modeling for the area of analysis, the Commonwealth determined that it was most appropriate to run the model in rural mode.

The Commonwealth used the Auer land use methodology as discussed in the modeling TAD and examined the various land use within 3 km of Elmer Smith to quantify the percentage of area in various land use categories. Following this guidance, 2011 land use data (the most recently available at the time of the modeling assessment) were obtained from the USGS through ArcGIS, and a 3 km radius circle inscribed electronically around the Elmer Smith facility was prepared. All data were georeferenced and tabulated using the categories shown in Table 15 for urban and rural designation. Figure 17 shows the layout of the land use and Table 15 shows the results of the land use categorization process. The analysis concluded that the area is predominantly rural (86.4 percent). Therefore, for the purpose of performing the modeling for the area of analysis, it is most appropriate to run the model with rural dispersion coefficients or in rural mode and the EPA concurs with this assessment.

**Table 15 – Determination of the Urban or Rural Modeling Parameter for the Daviess County Area by Auer's Method with 2011 Land Use Information**

| Category ID | Category Description | Percent |
|---|---|---|
| 11 | Open Water | 17.3% |
| 21 | Developed, Open Space | 9.2% |
| 22 | Developed, Low Intensity | 6.3% |
| 23 | Developed, Medium Intensity | 4.8% |
| 24 | Developed, High Intensity | 2.5% |
| 31 | Barren Land | 0.0% |
| 41 | Deciduous Forest | 12.1% |
| 42 | Evergreen Forest | 2.1% |
| 43 | Mixed Forest | 0.0% |
| 52 | Shrub/Scrub | 0.0% |
| 71 | Grassland/Herbaceous | 0.0% |
| 81 | Pasture/Hay | 1.6% |
| 82 | Cultivated Crops | 42.7% |
| 90 | Woody Wetlands | 0.6% |
| 95 | Emergent Herbaceous Wetlands | 0.5% |
| | Total | 100% |
| | Urban | 13.6% |
| | Rural | 86.4% |

**Figure 17: Land Use Map for Area Within 3km of the Elmer Smith facility. Source: "Air Dispersion Modeling Report: Elmer Smith Station, Owensboro, Kentucky $SO_2$ Designation Analysis Data Requirements Rule, Revision 1," prepared by Elmer Smith Station, April 28, 2016.**




*5.3.2.4. Modeling Parameter: Area of Analysis (Receptor Grid)*

The TAD recommends that the first step towards characterization of air quality in the area around a source or group of sources is to determine the extent of the area of analysis and the spacing of the receptor grid. Considerations presented in the Modeling TAD include but are not limited to: the location of the $SO_2$ emission sources or facilities considered for modeling; the extent of concentration gradients due to the influence of nearby sources; and sufficient receptor coverage and density to adequately capture and resolve the model predicted maximum $SO_2$ concentrations.

The sources of $SO_2$ emissions subject to the DRR in this area are described in the introduction to this section. For the Daviess County area, the Commonwealth has included six other emitters of $SO_2$ within 50 km of Elmer Smith in any direction. The Commonwealth determined that this was the appropriate distance to adequately characterize air quality through modeling to include the potential extent of any $SO_2$ NAAQS exceedances in the area of analysis and any potential impact on $SO_2$ air quality from other sources in nearby areas. In addition to Elmer Smith, the other emitters of $SO_2$ included in the area of analysis are: Owensboro Grain Company, Indiana-Michigan Power AEP – Rockport Station, Century Aluminum – Hawesville, Big Rivers Electric Corporation – Coleman Station, Sigeco Culley Station, and Alcoa Warrick Power Plant. No other sources beyond 50 km were determined by the Commonwealth to have the potential to cause concentration gradient impacts within the area of analysis. For a detailed analysis of nearby sources that were considered for the final modeling see Section 5.3.2.5.

The grid receptor spacing for the area of analysis chosen by the Commonwealth is as follows:

- Receptors along the fence line every 50 m
- Receptors every 100 m from fence line to 3 km
- Receptors every 250 m from 3 km to 5 km
- Receptors every 500 m from 5 km to 10 km
- Receptors every 1,000 m from 10 km to 20 km
- Receptors every 2,000 m from 20 km to 50 km

The receptor network contained 6,519 receptors, and the network covered Daviess, Hancock, McLean, northern Muhlenberg, northeast Hopkins, northeast Webster, western Breckinridge, and most of Ohio counties in Kentucky and Spencer, Warrick, eastern Vanderburgh, and southwestern Perry counties in Indiana.

Figure 18, included in the Commonwealth's recommendation, shows the Commonwealth's chosen area of analysis surrounding the Elmer Smith facility, as well as the receptor grid for the area of analysis. Figure 19 is zoomed in to depict receptors near the Elmer Smith Station immediate area.

Consistent with the Modeling TAD, the Commonwealth placed receptors for the purposes of this designation effort in locations that would be considered ambient air relative to the Elmer Smith facility, including other facilities' property with the exceptions of locations described in Section 4.2 of the Modeling TAD as not being feasible locations for placing a monitor. As can be seen in Figures 18 and 19, receptors in the Ohio River were excluded from the analysis because it would not be feasible to place a monitor over water. The Commonwealth also excluded receptors within the Elmer Smith fenceline because the Commonwealth asserted that these areas are not accessible by the general public and are not considered to be ambient air. All receptors extend from the Elmer Smith fenceline outward. As shown in Figure 22 of this TSD, the maximum concentrations were predicted to occur approximately 500 m south of the Elmer Smith fenceline.

**Figure 18: Receptor Grid for the Daviess County Area. Source: "Air Dispersion Modeling Report: Elmer Smith Station, Owensboro, Kentucky $SO_2$ Designation Analysis Data Requirements Rule, Revision 1," prepared by Elmer Smith Station, April 28, 2016.**

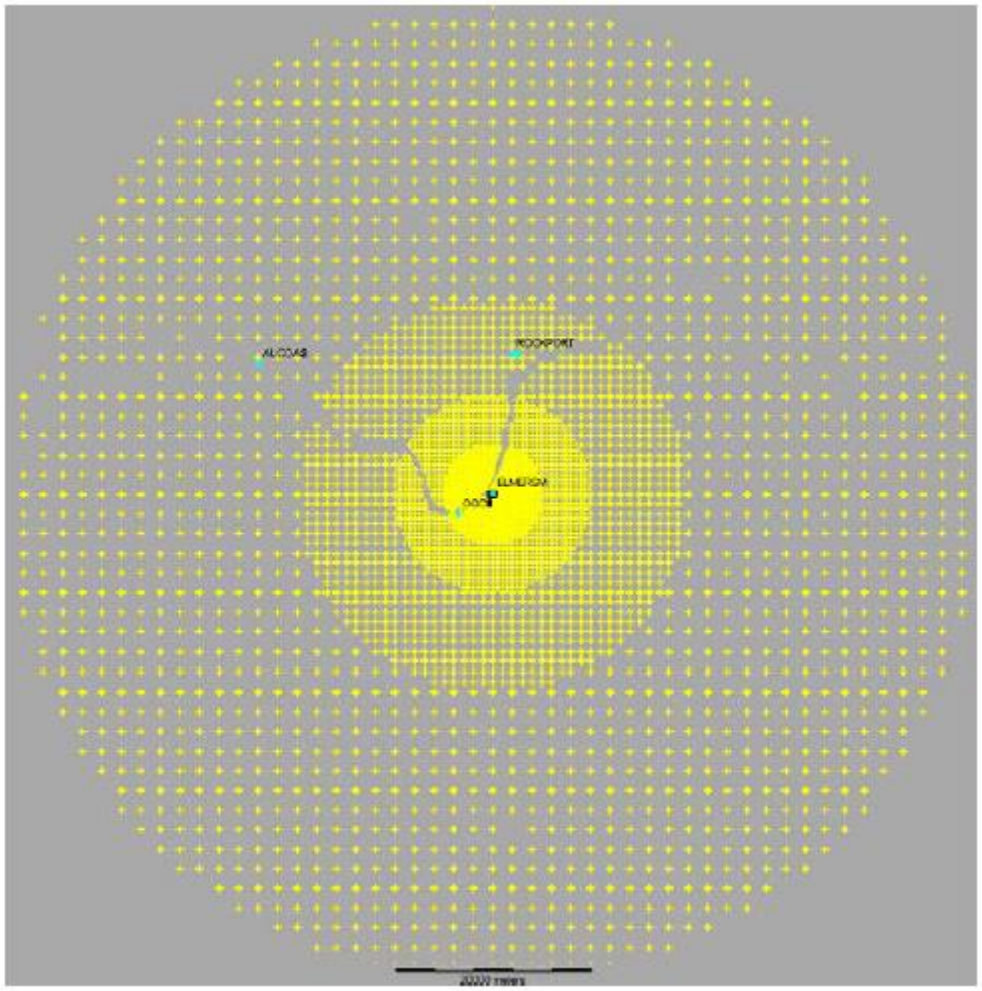


**Figure 19: Receptor Grid for the Daviess County Area. Source, Zoomed in Around the Elmer Smith Station area: "Air Dispersion Modeling Report: Elmer Smith Station, Owensboro, Kentucky $SO_2$ Designation Analysis Data Requirements Rule, Revision 1," prepared by Elmer Smith Station, April 28, 2016.**

The EPA agrees with the receptor grid used by the Commonwealth of Kentucky for this analysis. The EPA also agrees with those areas excluded from the receptor grid because either it was infeasible to place a monitor in those areas or those areas did not represent ambient air relative to the Elmer Smith Station facility. The receptor grid, therefore, can be expected to adequately characterize $SO_2$ impacts from Elmer Smith Station and the other nearby sources included in the modeling analysis.

#### *5.3.2.5. Modeling Parameter: Source Characterization*

Section 6 of the Modeling TAD offers recommendations on source characterization including source types, use of accurate stack parameters, inclusion of building dimensions for building downwash (if warranted), and the use of actual stack heights with actual emissions or following GEP policy with allowable emissions.

The January 6, 2017, Modeling Report describes the emissions sources as follows:

> The Elmer Smith Station has two major sources of $SO_2$ emissions which emit through a common stack. Unit #1 is an indirect heat exchanger which is coal-fired, equipped with over-fire air, electrostatic precipitator, selective catalytic

> reduction and flue gas desulfurization. Unit #2 is a coal-fired dry bottom indirect heat exchanger equipped with an electrostatic precipitator, low NOx burners and separated over-fire air, selective non-catalytic reduction and flue gas desulfurization. Units 1 and 2 exhaust through a common stack CS002. In addition, actual $SO_2$ emissions from the diesel fuel-fired emergency engine and the auxiliary heat exchanger are negligible given the relatively small horsepower rating of the engine and the very low sulfur content of the fuel used and the less number of hours operated. Consistent with the U.S. EPA's guidance for treatment of intermittently operated source like emergency engines and auxiliary heat exchanger in 1-hr $SO_2$ and $NO_2$ NAAQS demonstrations, these two units were excluded from the modeled source inventory.

The EPA agrees with the exclusion of the intermittent sources from this analysis.

The Commonwealth identified all of the $SO_2$ sources that emit greater that 100 tpy of actual emissions located within 50 km of OMU Elmer Smith. The following sources emitted greater than 100 tpy in 2014, but were not included in the modeling analysis: Century Aluminum Sebree (4,739 tpy; ~42 km), Robert A. Reid Station/Henderson Municipal Power and Light (HMP&L) Station 2/ Green Station Landfill - Big Rivers Electric Corporation (12,202 tpy; ~43km), and Robert D. Green Station - Big Rivers Electric Corporation (3,999 tpy, ~43 km). These sources were excluded from the modeling given the distance of these sources from OMU Elmer Smith (~42-43 km) and the location of the regional background monitor at Baskett. The impacts from these sources were assumed to be included in the background concentrations used in the modeling. The Baskett monitor is approximately 25 km from this cluster of sources. Additional sources that emitted greater than 100 tpy in 2014 and were not included in the modeling analysis are as follows: Green River Station - Kentucky Utilities Company (21,967.19 tpy; 48 km and Big Rivers Electric Corp - Wilson Station (6,900.89 tpy; 38 km). Green River Station was shut down in September 2015 and is no longer a source of $SO_2$ emissions. Wilson Station was not included in the modeling analysis due to the source taking a new lower sulfur limit and that given the distance from the Wilson Station to OMU Elmer Smith, the impacts were assumed to be included in the background concentrations. Due to the distance of these sources from OMU Elmer Smith, we agree that these sources did not need to be explicitly modeled and any potential impacts are represented by the background ambient monitor. Section 5.3.2.9 provides more details about Kentucky's decision to use the Baskett monitor for background.

The Alcoa Warrick Power Plant facility emitted 4,993 tons of $SO_2$ in 2014 according to the Indiana Department of Environmental Management (IDEM) inventory, as confirmed with information submitted to EPA's Emissions Inventory System (EIS) and reported in the 2014 National Emissions Inventory (NEI), version 1. and is located approximately 27 km to the northwest of Elmer Smith Station. Alcoa Warrick Power Plant was included in the AERMOD dispersion modeling analysis because emissions were substantially greater than "20D."[27] Alcoa Warrick

[27] The "20D" method was one method used to assess whether candidate sources within 50km of Elmer Smith should be included in the analysis. Using this method, if the emissions from a candidate source are greater than 20D (20 times the distance in km of the candidate source to Elmer Smith Station) then the source is retained for further consideration for potential inclusion in the modeling analysis. This analysis is sometimes referred to as Q/d (indicating emissions over distance).

Operations is located adjacent to the Alcoa Warrick Power Plant and emitted 3,500 tons of $SO_2$ in 2014 according to the 2014 NEI. This source was not included in the modeling submitted by the Commonwealth. The modeling report submitted by the Commonwealth indicates that this source has shut down, however, this shutdown has not been made permanent. As described in the paragraph below, non-inclusion of Alcoa Warrick Operations is not expected to affect the conclusion of this modeling analysis which is that the 1-hour $SO_2$ NAAQS is attained in the area around OMU Elmer Smith.

Alcoa Warrick Operations and Alcoa Warrick Power Plant are both located approximately 27 km northwest of Elmer Smith in southern Warrick County, Indiana. AERMOD modeling results indicate that the Alcoa Warrick Power Plant contributed less than 0.1 $\mu g/m^3$ to maximum impacts in the vicinity of OMU Elmer Smith from all sources combined. Alcoa Warrick Operations emitted less in 2014 (3,500 tpy) than the Alcoa Warrick Power Plant (4,993 tpy). These two facilities are less than 1 km apart. The Alcoa Warrick Power Plant has taller stacks (380-500 feet) than Warrick Operations (50-200 feet). Also, Warrick Operations consists of potlines and some stacks with temperatures (~170F) slightly warmer than the Alcoa Power sources (~128F). Based on the overall stack characteristics for the two facilities, the highest concentrations from Warrick Operations are expected to be a shorter distance downwind than the highest concentrations from Alcoa Power. Therefore, it can be expected that if Alcoa Warrick Operations were included in the modeling, it would have impacts similar to the impacts predicted from Alcoa Power and the combined impact of the two facilities would be approximately 1 $\mu g/m^3$ or less. Even if Warrick Operations had an impact 10 times the impact of Alcoa Power, the combined impact from the two facilities would still be less than 1 $\mu g/m^3$ at the point of maximum impact from all sources. In addition, as shown in Section 5.3.2.10 of this TSD, the maximum modeled impact from all sources combined is 140 $\mu g/m^3$ which is well below the 1-hour $SO_2$ NAAQS. Therefore, inclusion of Alcoa Warrick Operations in the modeling analysis would likely result in only a small increase in predicted concentrations in the vicinity of OMU Elmer Smith, and the EPA concurs with the non-inclusion of Alcoa Warrick Operations in this modeling analysis. Non-inclusion of Alcoa Warrick Operations is not expected to affect the conclusion of this modeling analysis which is that the 1-hour $SO_2$ NAAQS is attained in the area around OMU Elmer Smith.

The Owensboro Grain Company (OGC) is located approximately 4 km southwest of Elmer Smith Station and had 2014 $SO_2$ emissions of 438 tons, as confirmed with the 2014 NEI, version 1. OGC was included in the full AERMOD modeling of Elmer Smith because its emissions were greater than "20D" and due to the proximity of the source to Elmer Smith Station.

The Rockport Station had IDEM-reported $SO_2$ emissions of 54,979 in 2014, as confirmed with the 2014 NEI, version 1. This source is located 14 km north of Elmer Smith Station. The Rockport Station was included in the full AERMOD modeling of Elmer Smith because the emissions were greater than "20D."

Sigeco Culley Station is located 27 km northwest of Elmer Smith Station and had $SO_2$ emissions of 1,647 tons in 2014 as confirmed with the 2014 NEI, version 1. Sigeco Culley was included in the full AERMOD modeling of Elmer Smith because its emissions were greater than "20D".

Century Aluminum Hawesville is located 29 km northeast of Elmer Smith Station and had $SO_2$ emissions of 2,224 tons in 2014 as confirmed with the 2014 NEI, version 1. Century Aluminum was included in the full AERMOD modeling of Elmer Smith because its emissions were greater than "20D". Big Rivers Electric Corporation – Coleman Station is located adjacent to Century Aluminum Hawesville and had $SO_2$ emissions of 923 tons in 2014 as confirmed by data from the Clean Air Markets Division[28]. This facility was included in the modeling by the Commonwealth because of the potential of combined impacts with the nearby Century Aluminum Hawesville facility.

The Commonwealth characterized these sources within the area of analysis in accordance with the best practices outlined in the Modeling TAD. Specifically, the Commonwealth used actual stack heights in conjunction with actual emissions. The Commonwealth also adequately characterized the source's building layout and location, as well as the stack parameters, e.g., exit temperature, exit velocity, location, and diameter. Where appropriate, the AERMOD component BPIPPRM was used to assist in addressing building downwash.

The EPA concurs with this portion of the modeling analysis including the nearby sources included in the analysis, use of actual emissions and stack heights, and the use of BPIPPRM to simulate the effects of building downwash from buildings at the Elmer Smith Station facility.

#### *5.3.2.6. Modeling Parameter: Emissions*

The EPA's Modeling TAD notes that for the purpose of modeling to characterize air quality for use in designations, the recommended approach is to use the most recent 3 years of actual emissions data and concurrent meteorological data. However, the TAD also indicates that it would be acceptable to use allowable emissions in the form of the most recently permitted (referred to as PTE or allowable) emissions rate that is federally enforceable and effective.

The EPA believes that CEMS data provide acceptable historical emissions information, when they are available. These data are available for many electric generating units. In the absence of CEMS data, the EPA's Modeling TAD highly encourages the use of AERMOD's hourly varying emissions keyword HOUREMIS, or through the use of AERMOD's variable emissions factors keyword EMISFACT. When choosing one of these methods, the EPA recommends using detailed throughput, operating schedules, and emissions information from the impacted source(s).

In certain instances, states and other interested parties may find that it is more advantageous or simpler to use PTE rates as part of their modeling runs. For example, where a facility has recently adopted a new federally enforceable emissions limit or implemented other federally enforceable mechanisms and control technologies to limit $SO_2$ emissions to a level that indicates compliance with the NAAQS, the state may choose to model PTE rates. These new limits or conditions may be used in the application of AERMOD for the purposes of modeling for designations, even if the source has not been subject to these limits for the entirety of the most recent 3 calendar years. In these cases, the Modeling TAD notes that a state should be able to find the necessary emissions information for designations-related modeling in the existing $SO_2$ emissions inventories used for permitting or SIP planning demonstrations. In the event that these

[28] https://www.epa.gov/airmarkets

short-term emissions are not readily available, they may be calculated using the methodology in Table 8-1 of Appendix W to 40 CFR Part 51 titled, "Guideline on Air Quality Models."

As previously noted, the Commonwealth included Elmer Smith and six other emitters of $SO_2$ within 50 km in the area of analysis. The Commonwealth has chosen to model these facilities using actual emissions. The facilities in the Commonwealth's modeling analysis and their associated annual actual $SO_2$ emissions between 2014 and 2016 are summarized below.

For Elmer Smith, Alcoa Warrick Power Plant, Owensboro Grain Company, Sigeco Culley Station, Century Aluminum Hawesville, Big Rivers Electric Corporation – Coleman Station, and Indiana Michigan Power Rockport Station, annual actual $SO_2$ emissions between 2014 and 2016 are provided below. This information is summarized in Table 16. A description of how the Commonwealth obtained hourly emission rates is given below this table.

**Table 16. Actual $SO_2$ Emissions Between 2014 – 2016 from Facilities in the Area of Analysis for the Daviess County Area**

| | **$SO_2$ Emissions (tpy)** | | |
|---|---|---|---|
| **Facility Name** | **2014** | **2015** | **2016** |
| Elmer Smith | 5,741 | 3,902 | 2,449 |
| Alcoa Warrick Power Plant | 4,993 | 2,907 | 3,542 |
| Rockport Station | 54,979 | 29,889 | 24,341 |
| Owensboro Grain Company | 438 | 476 | Not Yet Available |
| Sigeco Culley Station | 1,896 | 1,513 | 1,311 |
| Century Aluminum Hawesville | 2,224 | 1,604 | 507 |
| Big Rivers Electric – Coleman Station | 923 | 0 | 0 |
| Total Emissions from All Facilities in the Area of Analysis Modeled Based on Actual Emissions | 71,194 | 40,291 | Not Yet Available |

For Elmer Smith, Alcoa Warrick Power Plant, Sigeco Culley Station, Big Rivers Electric Corporation – Coleman Station, and Rockport Station, the actual hourly emissions data were obtained from CEMS and were modeled with appropriate hourly varying emissions. For Owensboro Grain Company, the actual emissions data were determined by the Commonwealth based on 2015 emissions data reported to the Commonwealth of Kentucky.

For Century Aluminum Hawesville, the actual hourly emissions data for 13 of the 16 units (Source IDs: 41B_1, 84B_1, 89_1, 85A, 85B, 86A, 86B, 87A, 87B, 88A, 88B, 90A, 90B) were obtained from use of the monthly production logs in tandem with test-derived emission factors for each emission unit to discern representative monthly emission rates. Century Aluminum Hawesville used annualized emissions for 3 of the 16 smaller $SO_2$ united (Source IDs: 64_1, 113_1 and 114_1) due to their expected insignificant variation from hour to hour.

The EPA concurs with the emissions data used in the modeling analysis for the Elmer Smith Station area and believes that this analysis provides an adequate estimate of $SO_2$ concentrations in the area. The EPA has compared the sum of the hourly $SO_2$ emissions modeled for Elmer Smith, Alcoa Warrick Power Plant, Sigeco Culley Station, Big Rivers Electric Corporation –

Coleman Station, and Rockport Station for each year modeled and determined that these values equal the yearly values reported to the Clean Air Markets Division. The EPA concurs with the use of actual emissions data from the 2014-2016 period. This component of the modeling analysis was performed in a manner consistent with the $SO_2$ Modeling TAD.

#### *5.3.2.7. Modeling Parameter: Meteorology and Surface Characteristics*

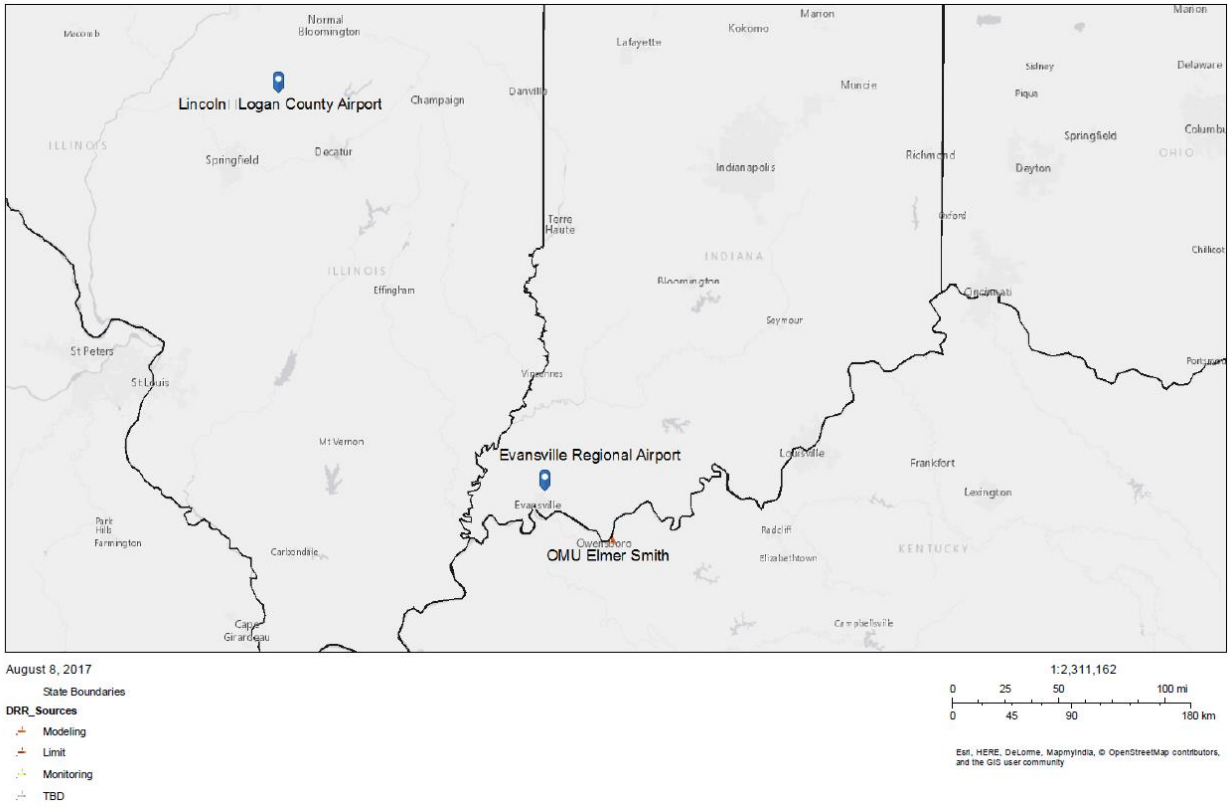
As noted in the Modeling TAD, the most recent 3 years of meteorological data (concurrent with the most recent 3 years of emissions data) should be used in designations efforts. The selection of data should be based on spatial and climatological (temporal) representativeness. The representativeness of the data is determined based on: 1) the proximity of the meteorological monitoring site to the area under consideration, 2) the complexity of terrain, 3) the exposure of the meteorological site, and 4) the period of time during which data are collected. Sources of meteorological data include NWS stations, site-specific or onsite data, and other sources such as universities, FAA, and military stations.

For the area of analysis for the Daviess County area, the Commonwealth selected the surface meteorology from the Evansville Regional Airport NWS station in Evansville, Indiana, located at 38.044 N, 87.521 W, 49 km from the source, and coincident upper air observations from a different NWS station, Lincoln-Logan County Airport, in Lincoln, IL, located at 40.09 N, 89.20 W, 327 km to the northwest of the source as best representative of meteorological conditions within the area of analysis.

The Commonwealth used AERSURFACE version 13016 using data from the Evansville NWS site to estimate the surface characteristics (albedo, Bowen ratio, and surface roughness [$z_o$]) of the area of analysis. Albedo is the fraction of solar energy reflected from the earth back into space, the Bowen ratio is the method generally used to calculate heat lost or heat gained in a substance, and the surface roughness is sometimes referred to as “zo” The state estimated surface roughness values for 12 spatial sectors out to 1 km at a seasonal temporal resolution for dry, wet, and average conditions.

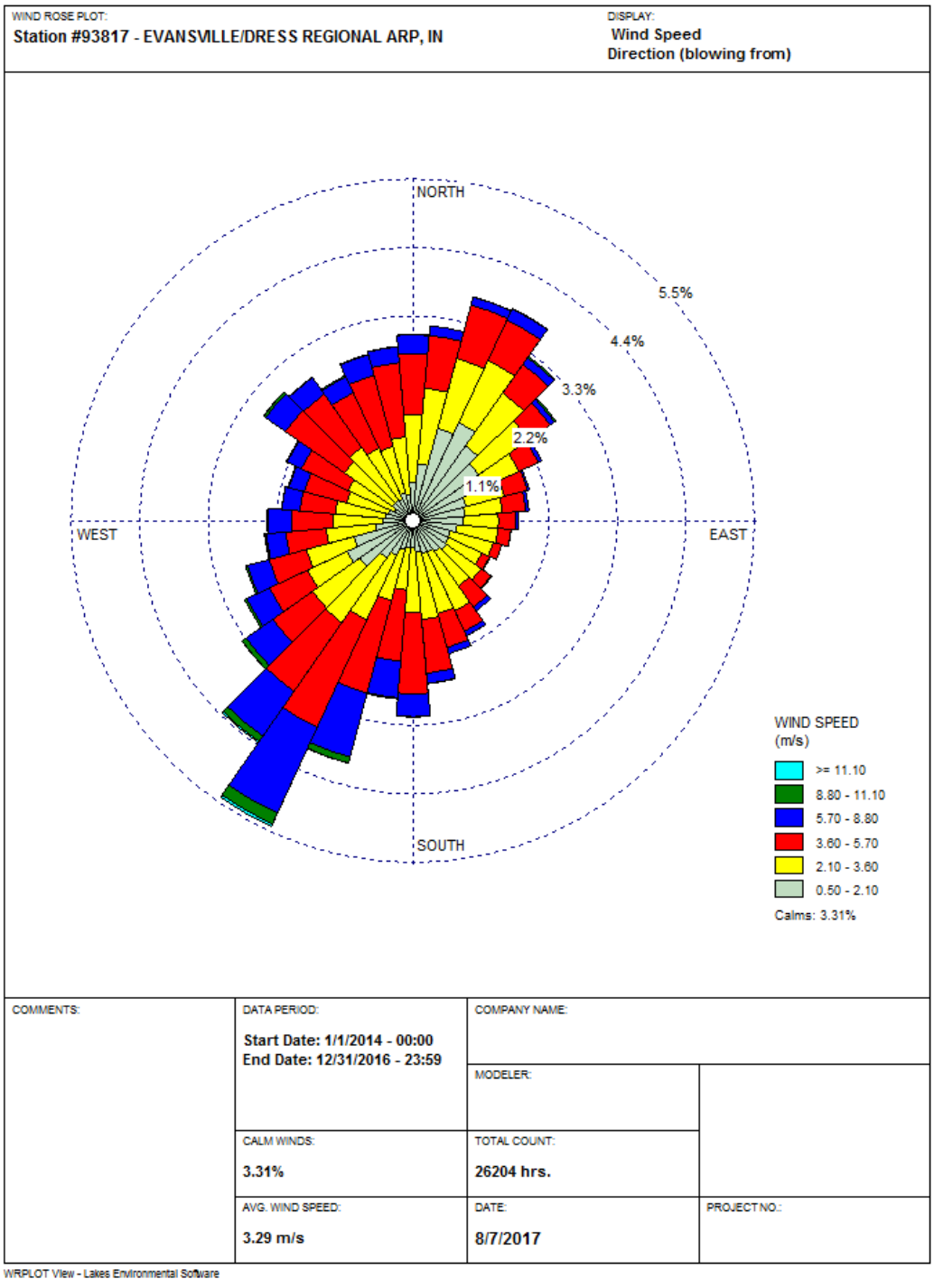
In the figure below, generated by the EPA, the locations of these NWS stations is shown relative to the area of analysis.

**Figure 20. Area of Analysis and the NWS stations in the Daviess County Area**




The EPA generated a wind rose for the Evansville, Indiana, airport for the 2014-2016 period. In Figure 21, the frequency and magnitude of wind speed and direction are defined in terms of from where the wind is blowing. This wind rose indicates that the predominant wind direction in the Evansville area is from the southwest.

**Figure 21: Evansville NWS Cumulative Annual Wind Rose for Years 2014 - 2016**




Meteorological data from the above surface and upper air NWS stations were used in generating AERMOD-ready files with the AERMET processor. The output meteorological data created by the AERMET processor is suitable for being applied with AERMOD input files for AERMOD

modeling runs. The Commonwealth followed the methodology and settings presented in Section 7 of the $SO_2$ Modeling TAD in the processing of the raw meteorological data into an AERMOD-ready format, and used AERSURFACE to best represent surface characteristics.

Hourly surface meteorological data records are read by AERMET, and include all the necessary elements for data processing. However, wind data taken at hourly intervals may not always portray wind conditions for the entire hour, which can be variable in nature. Hourly wind data may also be overly prone to indicate calm conditions, which are not modeled by AERMOD. In order to better represent actual wind conditions at the meteorological tower, wind data of 1-minute duration was provided from the Evansville NWS station mentioned above, but in a different formatted file to be processed by a separate preprocessor, AERMINUTE. These data were subsequently integrated into the AERMET processing to produce final hourly wind records of AERMOD-ready meteorological data that better estimate actual hourly average conditions and that are less prone to over-report calm wind conditions. This allows AERMOD to apply more hours of meteorology to modeled inputs, and therefore produce a more complete set of concentration estimates. As a guard against excessively high concentrations that could be produced by AERMOD in very light wind conditions, the Commonwealth set a minimum threshold of 0.5 m/s in processing meteorological data for use in AERMOD. In setting this threshold, no wind speeds lower than this value would be used for determining concentrations. This threshold was specifically applied to the 1-minute wind data. In addition, the "Ice-Free Winds Group" AERMINUTE option was selected due to the fact that a sonic anemometer has been installed at KEVV (the Evansville NWS station) on September 26, 2006.

The EPA believes that the surface and upper air meteorological data selected by the Commonwealth of Kentucky for use in this modeling analysis is acceptable and was processed in a manner consistent with the $SO_2$ modeling TAD. The EPA believes that the meteorological data shows that impacts from Elmer Smith Station and other sources included are reasonably expected to most frequently occur generally northeast of each respective facility, but that impacts could be seen in other directions as well.

#### *5.3.2.8. Modeling Parameter: Geography, Topography (Mountain Ranges or Other Air Basin Boundaries) and Terrain*

The terrain in the area of analysis is best described as rolling. To account for these terrain changes, the AERMAP (version 11103) terrain program within AERMOD was used to specify terrain elevations for all the receptors. The source of the elevation data incorporated into the model is from the USGS NED.

The EPA concurs with the use of AERMAP version 11103 to resolve terrain elevations of sources, buildings and receptors in the area of analysis. The EPA concurs with this component of the Commonwealth's modeling.

#### *5.3.2.9. Modeling Parameter: Background Concentrations of $SO_2$*

The Modeling TAD offers two mechanisms for characterizing background concentrations of $SO_2$ that are ultimately added to the modeled design values: 1) a "tier 1" approach, based on a monitored design value, or 2) a temporally varying "tier 2" approach, based on the 99$^{th}$ percentile monitored concentrations by hour of day and season or month. For this area of analysis, the Commonwealth elected to use a "tier 2" approach. Data were obtained from 2014-2016 for AQS Site: 21-101-0014 (Baskett fire house located in Kentucky, southeast of Evansville, IN). These data were used to generate temporally varying background concentrations based on the 99th percentile monitored concentrations by hour of day and month in this analysis. A 90-degree sector east exclusion zone was used to exclude impacts from the Alcoa Warrick Power Plant, Sigeco Culley Station, and Indiana-Michigan Power Rockport facilities, which were included in the modeling. The background concentrations for this area of analysis were determined by the Commonwealth to vary from 1.74 μg/m$^3$, equivalent to 0.7 ppb when expressed in 2 significant figures,[29] to 40.9 μg/m$^3$ (15.6 ppb), with an average value of 13.6 μg/m$^3$ (5.2 ppb).

The EPA concurs with the background concentrations used in the analysis including the described 90-degree exclusion zone. Even with the exclusion zone, the resulting background concentrations from the Baskett monitor are expected to be similar to background concentrations at OMU Elmer Smith. This component of the modeling analysis has been performed in a manner consistent with the $SO_2$ Modeling TAD.

#### *5.3.2.10. Summary of Modeling Inputs and Results*

The AERMOD modeling input parameters for the Daviess County area of analysis are summarized below in Table 17.

[29] The $SO_2$ NAAQS level is expressed in ppb but AERMOD gives results in μg/m$^3$. The conversion factor for $SO_2$ (at the standard conditions applied in the ambient $SO_2$ reference method) is 1ppb = approximately 2.619 μg/m$^3$.

**Table 17: Summary of AERMOD Modeling Input Parameters for the Area of Analysis for the Daviess County Area**

| Input Parameter | Value |
|---|---|
| AERMOD Version | 16216r |
| Dispersion Characteristics | Rural |
| Modeled Sources | 7 |
| Modeled Stacks | 22 |
| Modeled Structures | 22 |
| Modeled Fencelines | 1 |
| Total receptors | 6,519 |
| Emissions Type | Actuals |
| Emissions Years | 2014-2016 |
| Meteorology Years | 2014-2016 |
| NWS Station for Surface Meteorology | Evansville, IN |
| NWS Station Upper Air Meteorology | Lincoln, IL |
| NWS Station for Calculating Surface Characteristics | Evansville, IN |
| Methodology for Calculating Background $SO_2$ Concentration | Tier 2 approach using AQS site: 21-101-0014 for 2014-2016 |
| Calculated Background $SO_2$ Concentration | 1.74 – 40.9 $\mu g/m^3$ |

The results presented below in Table 18 show the magnitude and geographic location of the highest predicted modeled concentration based on the input parameters.

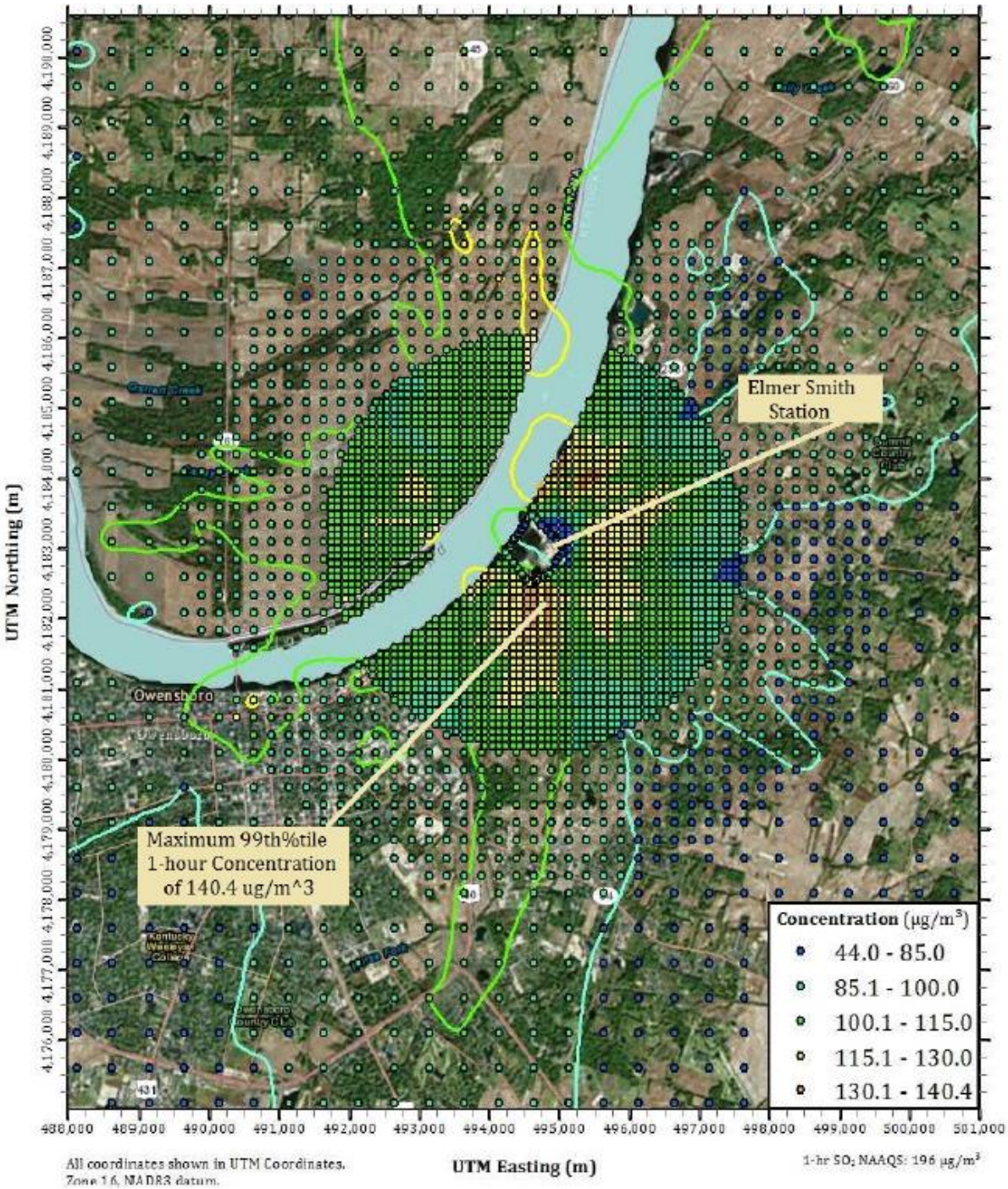
**Table 18. Maximum Predicted 99th Percentile Daily Maximum 1-Hour $SO_2$ Concentrations Averaged Over Three Years for the Area of Analysis for the Daviess County Area**

| Averaging Period | Data Period | Receptor Location [UTM zone 16] | | 99th percentile daily maximum 1-hour $SO_2$ Concentration ($\mu g/m^3$) | |
|---|---|---|---|---|---|
| | | UTM Easting (m) | UTM Northing (m) | Modeled concentration (including background) | NAAQS Level |
| 99th Percentile 1-Hour Average | 2014-2016 | 494,641 | 4,182,186 | 140.4 | 196.4* |

*Equivalent to the 2010 $SO_2$ NAAQS of 75 ppb using a 2.619 $\mu g/m^3$ conversion factor

The Commonwealth's modeling indicates that the highest predicted 99th percentile daily maximum 1-hour concentration within the chosen modeling domain is 140.4 $\mu g/m^3$, equivalent to 53.6 ppb. This modeled concentration included the background concentration of $SO_2$, and is based on actual emissions from the facilities. Figure 22 below was included as part of the Commonwealth's recommendation, and indicates that the predicted value occurred just south (~500 meters) of Elmer Smith Station. The Commonwealth's receptor grid is also shown in the figure.

**Figure 22: Maximum Predicted 99th Percentile Daily Maximum 1-Hour $SO_2$ Concentrations Averaged Over Three Years for the Area of Analysis for the Daviess County Area. Source: "Air Dispersion Modeling Report: Elmer Smith Station, Owensboro, Kentucky $SO_2$ Designation Analysis Data Requirements Rule, Revision 1," prepared by Trinity Consultants for Elmer Smith Station, May 24, 2017.**



The EPA's review of this modeling analysis concludes that the modeling was performed in a manner consistent with the $SO_2$ Modeling TAD. The modeling submitted by the Commonwealth does not indicate that the 1-hour $SO_2$ NAAQS is violated at the receptor with the highest modeled concentration.

#### *5.3.2.11. The EPA's Assessment of the Modeling Information Provided by the Commonwealth*

The EPA has reviewed the modeling analysis performed by the Commonwealth of Kentucky for Elmer Smith Station and other sources in the area and concurs that the modeling was performed in a manner consistent with the modeling TAD. The EPA also agrees that the maximum concentrations predicted by AERMOD are below the 1-hour $SO_2$ NAAQS. The Commonwealth chose to model four DRR sources in the area and three non-DRR sources, and the EPA agrees with this decision, as supported by the May 24, 2017, Modeling Report evaluating nearby sources within 50 km of Elmer Smith Station. As discussed in Section 5.3.2.5, Kentucky chose not to model the Alcoa Warrick Operations facility, an aluminum smelting facility, because the source had ceased smelting operations by March of 2016. However, the source has not shut down the smelting operations in a permanent and enforceable manner. The Alcoa Warrick Operations facility could therefore begin operating again. The Alcoa Warrick Power Plant, located adjacent to Alcoa Warrick Operations and shows similar emissions over the same time period. This facility was shown in the May 24, 2017, Modeling Report to contribute only 0.03 – 0.08 $\mu g/m^3$ $SO_2$ at the top 10 fourth-highest modeled receptors in the Daviess County area. Based on the overall stack characteristics for the two facilities, the highest concentrations from Warrick Operations are expected to be a shorter distance downwind than the highest concentrations from Alcoa Power. Therefore, it can be reasonably expected that if Alcoa Warrick Operations were included in the modeling, it would have impacts similar to the impacts predicted from Alcoa Warrick Power, and the combined impact of the two facilities would be approximately 1 $\mu g/m^3$ or less. Therefore, inclusion of Alcoa Warrick Operations in the modeling analysis would likely result in only a small increase in predicted concentrations in the vicinity of Elmer Smith. The EPA concurs with the non-inclusion of Alcoa Warrick Operations in this modeling analysis.

The EPA believes the modeling domain is appropriate to capture predicted maximum impacts in the Daviess County area. Kentucky's selection of meteorology and surface characteristics for the area are also appropriate to make a valid modeling demonstration. The Commonwealth adequately represented the topography of the area with the model and its preprocessors. The Commonwealth chose to model emissions from Elmer Smith Station, Alcoa Warrick Power Plant, Rockport Station, Sigeco Culley Station, Century Aluminum Hawesville, Big Rivers Electric Corporation – Coleman Station, and Owensboro Grain Company during 2014 – 2016, which is the most recently available emissions. The Commonwealth chose to use actual emissions to reflect normal operation of the sources. We believe these decisions are appropriate for the purpose of this modeling demonstration. The EPA has also confirmed that Kentucky selected its monthly/hourly varying background concentrations from the Baskett fire house monitor in a manner consistent with the Modeling TAD.

The Commonwealth made use of AERMOD version 16216r, the most recent regulatory version of the model.

## 5.4. Emissions and Emissions-Related Data, Meteorology, Geography, and Topography for the Daviess County Area

These factors have been incorporated into the air quality modeling efforts and results discussed above. The EPA is giving consideration to these factors by considering whether they were properly incorporated and by considering the air quality concentrations predicted by the modeling.

## 5.5. Jurisdictional Boundaries in the Daviess County Area

Existing jurisdictional boundaries are considered for the purpose of informing the EPA's designation action for Daviess County. Our goal is to base designations on clearly defined legal boundaries, and to have these boundaries align with existing administrative boundaries when reasonable.

The modeling domain extends to a square of 50 km by 50 km, and so covers the entirety of Daviess, Hancock, McLean, northern Muhlenberg, northeast Hopkins, northeast Webster, western Breckinridge, and most of Ohio counties in Kentucky. The 50 km by 50 km modeling domain crosses the state boundary over the Ohio River into portions of Indiana. As noted above, the modeling domain covers Spencer, Warrick, eastern Vanderburgh, and southwestern Perry counties in Indiana.

## 5.6. The EPA's Assessment of the Available Information for the Daviess County Area

The EPA intends to designate the Daviess County area, including the entire County boundary, as unclassifiable/attainment. We believe that Kentucky's modeling analysis supports the conclusion that there are no expected violations of the 2010 $SO_2$ NAAQS in the area. There is no current, complete monitoring data available for the area, so the modeling serves to reflect the air quality expected in the years modeled. The Owensboro monitor (AQS ID: 21-059-0005) in the area, located 1.5 km from Elmer Smith Station, has one quarter of incomplete data in 2015, meaning the 2015 and 2016 DVs are incomplete. This monitor cannot be relied upon for designations, and the Commonwealth did not assert that the monitor is sited in the area of maximum expected concentration.

Based on the air quality characterization conducted within the Daviess County area of analysis in accordance with the EPA's Modeling TAD, the Commonwealth concluded that the area should be designated as attainment. This recommendation is based on Kentucky's assessment that emissions from the Elmer Smith Station facility could interact with those from the Alcoa Warrick Power Plant, Rockport Station, Sigeco Culley Station, Century Aluminum Hawesville,

Big Rivers Electric Corporation – Coleman Station, and Owensboro Grain Company facilities and together impact the area, and the inclusion of these four DRR sources and two other sources in the modeling demonstration. Elmer Smith Station and Owensboro Grain Company are the only Daviess County sources that emitted over 100 tons in 2014. Alcoa Warrick Power Plant, Sigeco Culley Station, Century Aluminum Hawesville, Big Rivers Electric Corporation – Coleman Station, and Rockport Station are the only other sources in the 50 km area of analysis thought to impact the Daviess County area.

Kentucky evaluated possible contributions from these sources and other sources within 50 km of Elmer Smith Station to $SO_2$ impacts in the Daviess County area. Based on Kentucky's 20D analysis, Kentucky decided in the Modeling Report to include possible contributions from nearby Alcoa Warrick Power Plant, Rockport Station, Sigeco Culley Station, Century Aluminum Hawesville, Big Rivers Electric Corporation – Coleman Station, and Owensboro Grain Company by modeling actual emissions. The Alcoa Warrick Operations facility was not permanently and enforceably shut down. However, given the relative distance of this source from the Elmer Smith facility (27 km) and the relatively low impacts from nearby Alcoa Warrick Power Plant in the Daviess County area of analysis, the EPA does not expect that including Alcoa Warrick Operations in the modeling analysis would significantly increase predicted concentrations in the Daviess County area.

Kentucky then added a reasonable value for background concentrations of $SO_2$ by including the 2014 – 2016 monthly/hourly varying concentrations from the Baskett monitor in Henderson County. The EPA agrees with the technical explanation for the Commonwealth's treatment of nearby $SO_2$ sources included in the May 24, 2017, Modeling Report. We believe the modeling of the sources included adequately represents the Daviess County area. Based on the evaluation of sources within 50 km of OMU Elmer Smith (Section 5.3.2.5 of this TSD) the EPA has reason to believe there are no additional sources in areas adjacent to our intended area around Elmer Smith Station that are likely to cause or contribute to a violation of the NAAQS in the area of analysis. The EPA considered the impacts shown from nearby Alcoa Warrick Power Plant in the Daviess County area (0.03 – 0.08 $\mu g/m^3$). In addition, based on the available information for the remaining areas in Kentucky and neighboring Indiana, including monitoring and modeling, there are no current $SO_2$ nonattainment areas near Daviess County. The EPA intends to designate a portion of Warrick County, Indiana, as nonattainment based on third party modeling received for the A.B. Brown facility which included the Warrick County, Indiana and Henderson County, Kentucky (*S*ee the Indiana chapter of this TSD for more information). Additionally, the modeling assessment for the Warrick County, Indiana, and Henderson County, Kentucky, area indicates violations of the 1-hour $SO_2$ NAAQS in Henderson County, Kentucky, across the river from the Alcoa Warrick facilities. The EPA has concerns with the modeling demonstration for the Warrick County area, and accordingly intends to designate a portion of Henderson County, Kentucky as unclassifiable (*S*ee the Henderson County area section of this chapter of the TSD for more information). The EPA extracted the impacts (from model output files) from the Elmer Smith facility to receptors within 5 km of Warrick Operations including portions of Henderson County, Kentucky, and Warrick County, Indiana. The 1-hour $SO_2$ concentration gradients from Elmer Smith in the area are approximately 0.001 $\mu g/m^3/m$. Therefore, the Elmer Smith facility does not cause significant concentration gradients in the relevant portions of Henderson County, Kentucky or Warrick County, Indiana. Thus, the Daviess County area is not expected to contribute to ambient air quality in a nearby area that may not meet the NAAQS.

After careful evaluation of the Commonwealth's recommendation and supporting information, as well as all available relevant information, the EPA intends to designate the area around Elmer Smith Station as unclassifiable/attainment for the 2010 $SO_2$ NAAQS. Specifically, the boundaries are comprised of the entirety of Daviess County. There are no remaining portions of Daviess County that remain to be characterized in the EPA's Round 4 of designations in 2020, nor are there any other portions of the County that have a separate area of analysis for Round 3.

The EPA believes that our intended unclassifiable/attainment area, bounded by the entirety of Daviess County, will have clearly defined legal boundaries, and we intend to find these boundaries to be a suitable basis for defining our intended unclassifiable/attainment area.

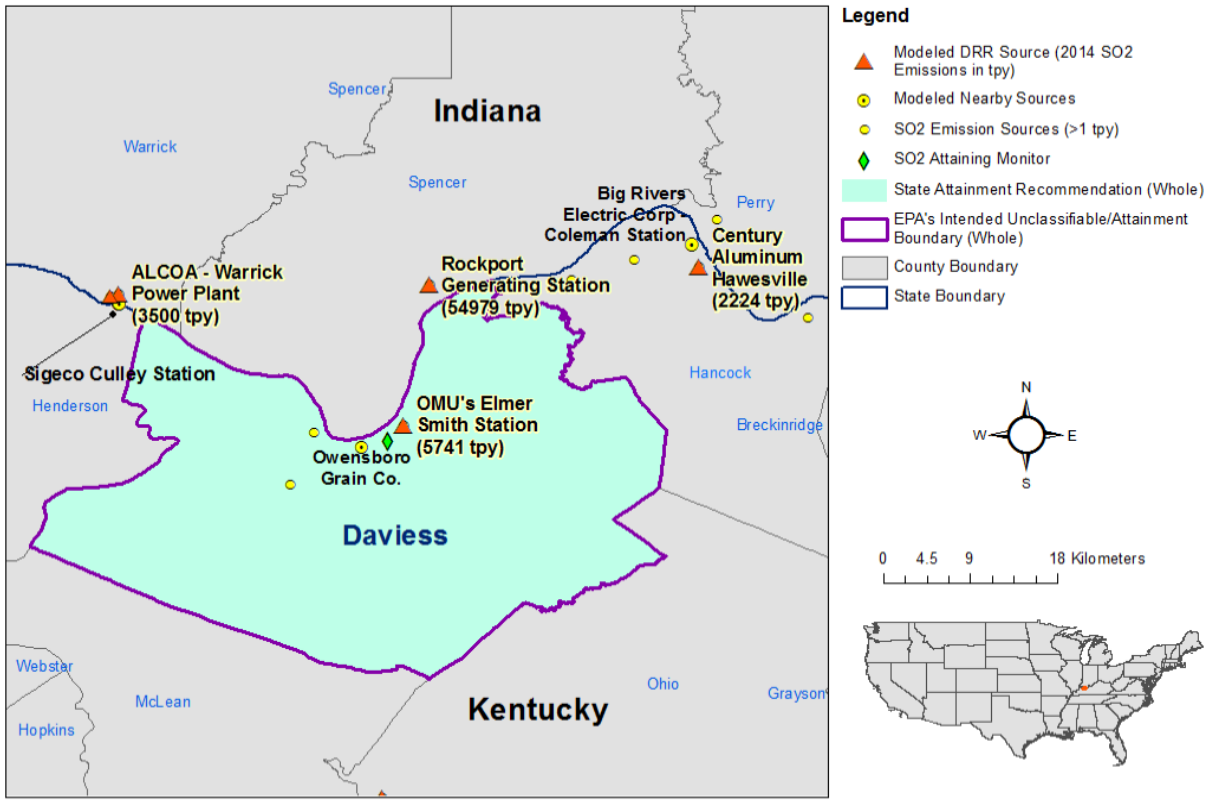
## 5.7. Summary of Our Intended Designation for the Daviess County Area

After careful evaluation of the Commonwealth's recommendation and supporting information, as well as all available relevant information, the EPA intends to designate the Daviess County area as unclassifiable/attainment for the 2010 $SO_2$ NAAQS because the EPA has determined the area

meets the 2010 $SO_2$ NAAQS and does not contribute to ambient air quality in a nearby area that does not meet the NAAQS. Specifically, the boundaries are comprised of the entirety of Daviess County.

Figure 23 shows the boundary of this intended designated area.

**Figure 23. Boundary of the Intended Daviess County Unclassifiable/Attainment Area**




At this time, our intended designations for the Commonwealth only apply to this area and the other areas presented in this technical support document. The EPA intends in a separate action to evaluate and designate all remaining undesignated areas in Kentucky by December 31, 2020.

# 6. Technical Analysis for the Hancock County Area

## 6.1. Introduction

The EPA must designate the Hancock County area by December 31, 2017, because the area has not been previously designated and Kentucky has not installed and begun timely operation of a new, approved $SO_2$ monitoring network meeting the EPA specifications referenced in the EPA's $SO_2$ DRR for any sources of $SO_2$ emissions in Hancock County. The DRR source, Century Aluminum's Hawesville facility, is located near the Ohio River, which is the border between Kentucky and Indiana. Therefore, the area of analysis, and the modeling receptors, cross the Kentucky state boundary into neighboring Indiana.

## 6.2. Air Quality Monitoring Data for the Hancock County Area

This factor considers the $SO_2$ air quality monitoring data in the area of Hancock County. Kentucky provided the values of the 99$^{th}$ percentile of the $SO_2$ monitors in Kentucky. Kentucky stated "the average of the 99$^{th}$ percentile at all monitors is below the standard of 75 ppb in all locations except Jefferson County. The rest of the areas in Kentucky comply with the standard and should be designated as attainment/unclassifiable for the $SO_2$ standard."[30]

The EPA reviewed the available air quality monitoring data in the AQS database and found the following nearby data:

- The Owensboro Primary $SO_2$ monitor (AQS ID: 21-059-0005) is located at 37.780776, -87.075307 in nearby Daviess County, approximately 19 miles southwest of Century Aluminum Hawesville. Data collected by this monitor is comparable to the NAAQS, and indicates that the most recent $SO_2$ levels are below the 1-hr NAAQS. The most recent three years of quality-assured, certified data from this monitor (2014-2016) is missing one quarter of complete data in 2015; however, the data do indicate an incomplete 1-hr $SO_2$ design value of 33 ppb. This incomplete, invalid design value is unable to support a designation in the area around the monitor. This monitor was not located to characterize the maximum 1-hr $SO_2$ concentrations of Elmer Smith in Daviess County, nor for Century Aluminum Hawesville in the Hancock County area. Kentucky provided an air quality modeling analysis to characterize the maximum 1-hr $SO_2$ concentrations in the Hancock County area (see Section 6.3 below).

In reviewing the available air quality monitoring data in AQS, the EPA determined that other than the data described above, there is no additional relevant data in AQS collected in or near Hancock County that could inform the intended designation action. The most recent $SO_2$ design values for all areas of the country are available at https://www.epa.gov/air-trends/air-quality-design-values.

[30] The EPA designated a portion of Jefferson County, Kentucky nonattainment for the 1-hour $SO_2$ NAAQS. This nonattainment area is comprised of the Watson Lane monitor (AQS) and the Louisville Gas & Electric Mill Creek Generating Station.

## 6.3. Air Quality Modeling Analysis for the Hancock County Area Addressing Century Aluminum Hawesville

### *6.3.1. Introduction*

This section 6.3 presents all the available air quality modeling information for a portion of Hancock County that includes Century Aluminum Hawesville. (This portion of Hancock County will often be referred to as "the Hancock County area" within this section 6.3.) This area contains one DRR source, the Century Aluminum Hawesville facility, around which Kentucky is required by the DRR to characterize $SO_2$ air quality, or alternatively establish an $SO_2$ emissions limitation of less than 2,000 tpy. Kentucky's modeling demonstration for the Hancock County area also includes nearby sources in nearby counties and across the state border in Indiana. These are DRR sources thought to impact the Hancock County area. All DRR sources evaluated for this area of analysis are listed below:

- The Century Aluminum Hawesville facility emitted 2,000 tons or more annually. Specifically, Century Aluminum emitted 2,224 tons of $SO_2$ in 2014 and 1,604 tons in 2015. This source meets the DRR criteria and thus is on the $SO_2$ DRR Source list, and Kentucky has chosen to characterize it via modeling.

- The Southeastern Indiana Gas & Electric Company's Culley Station emitted 1,647 tons of $SO_2$ in 2014 is not on the $SO_2$ DRR Source list but was included in the modeling analysis by the Commonwealth of Kentucky because of the potential of this source to have an impact on $SO_2$ concentrations in the area around Century Aluminum Hawesville due to its emissions and proximity to Century Aluminum.

- The Indiana-Michigan Power American Electric Power's Rockport Station facility, emitted 2,000 tons or more annually and is also on the $SO_2$ DRR Source list. Rockport Station emitted 54,979 tons of $SO_2$ in 2014 and was included in the modeling due to its potential to impact the Hancock County area. This source was included by Kentucky in characterizing the Hancock County area; however, the area around this source (in Spencer County, Indiana) is discussed again explicitly in the Indiana TSD chapter.

- Owensboro Municipal Utilities' Elmer Smith Station emitted 2,000 tons or more annually and is also on the $SO_2$ DRR Source list. This source was included by Kentucky in characterizing the Hancock County area; however, the area around this source is discussed again explicitly in another section of this TSD chapter.

- The Alcoa Warrick Power Plant, emitted 2,000 tons or more annually and is also on the $SO_2$ DRR Source list. Alcoa Warrick Power Plant emitted 3,500 tons of $SO_2$ in 2014 and was included in the modeling due to its potential to impact the Hancock County area. This source was included by Kentucky in characterizing the Hancock County area; however, the area around this source (in Warrick County, Indiana) is discussed again explicitly in the Indiana TSD chapter.

- Big Rivers Electric Corporation – Coleman Station is located just north of Century Aluminum and emitted 923 tons of $SO_2$ in 2014 and is not on the DRR Source list. However, the Commonwealth of Kentucky determined that this source should be explicitly included in the modeling analysis to best predict total modeled $SO_2$ concentrations in the Hancock County area.

Because we have available results of air quality modeling in which these sources are modeled together, the area around this group of sources is being addressed in this section with consideration given to the impacts of all these sources.

In its submission, Kentucky recommended that an area that includes the area surrounding the Century Aluminum facility, specifically Hancock County, be designated as attainment based on an assessment and characterization of air quality impacts from these facilities and other nearby sources that may have a potential impact in the area where the 2010 $SO_2$ NAAQS may be exceeded. This assessment and characterization was performed using air dispersion modeling software, i.e., AERMOD, analyzing actual emissions. After careful review of the Commonwealth's assessment, supporting documentation, and all available data, the EPA intends to designate the area as unclassifiable/attainment. Our reasoning for this conclusion is explained in a later section of this TSD, after all the available information is presented.

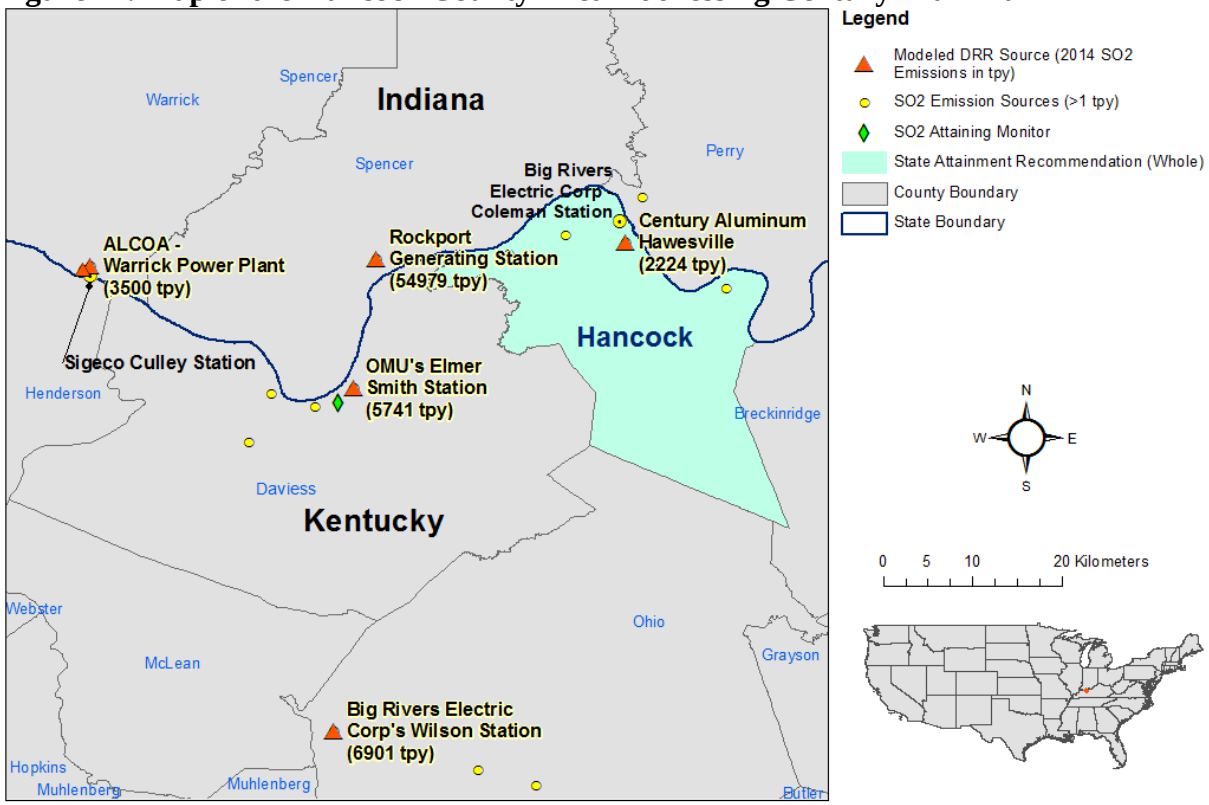
The area that the Commonwealth has assessed via air quality modeling is located in Hancock County Kentucky near the city of Hawesville.

As seen in Figure 24 below, the Century Aluminum facility is located across the Ohio River from Tell City, Indiana, on KY 271 N, 3.5 miles north northwest of the city center of Hawesville, Kentucky, and 22 miles northeast of Owensboro, in the Ohio River Valley within Hancock County, Kentucky. Three additional DRR-subject sources were included in this modeling grouping. Rockport Station near Rockport in Spencer County, Indiana, was included in the modeling along with the Alcoa Warrick Power Plant in Warrick County, Indiana, and Elmer Smith Station in nearby Daviess County, Kentucky. Included in Figure 24 are other nearby emitters of $SO_2$.[31] These are Alcoa Warrick Operations,[32] BREC Coleman Station, SIGECO Culley Station, and Owensboro Grain Company. The EPA's intended unclassifiable/attainment designation boundary for the Hancock County area is not shown in this figure, but is shown in a figure in the section below that summarizes our intended designation.

[31] All other $SO_2$ emitters of 1 tpy or more (based on information from the states of Kentucky and Indiana) are shown in Figure 24.

[32] Alcoa Warrick Operations, an aluminum smelting plant, suspended smelting operations by March 31, 2016. This change in operations is not permanent and enforceable.

**Figure 24. Map of the Hancock County Area Addressing Century Aluminum**




The discussion and analysis that follows below will reference the Modeling TAD and the factors for evaluation contained in the EPA's July 22, 2016, guidance and March 20, 2015, guidance, as appropriate.

For this area, the EPA received and considered two modeling assessments from the Commonwealth and no assessments from other parties. To avoid confusion in referring to these assessments, the following table lists them, indicates when they were received, provides an identifier for the assessment that is used in the discussion of the assessments that follow, and identifies any distinguishing features of the modeling assessments.

**Table 19. Modeling Assessments for the Hancock County Area**

| Assessment Submitted by | Date of the Assessment | Identifier Used in this TSD | Distinguishing or Otherwise Key Features |
|---|---|---|---|
| Kentucky | June 8, 2016* | June 8, 2016 Kentucky Modeling Analysis | First formal modeling report received |
| Kentucky | June 5, 2017 | June 5, 2017 Kentucky Modeling Analysis | Revision to reflect the EPA concerns |

*This modeling report, dated June 8, 2016, was submitted to the EPA on January 6, 2017.

### *6.3.2. Modeling Analysis Provided by the Commonwealth*

#### *6.3.2.1. Differences Between and Relevance of the Modeling Assessments Submitted by the Commonwealth*

Revised modeling was submitted by the Commonwealth on June 5, 2017. There were several differences between the most recent modeling submittal, dated June 5, 2017, and the previous submittal, dated June 8, 2016. The first difference is the version of the AERMOD model that was used. In the initial submittal, AERMOD version 15181 was used which was the most current regulatory version of the model available at the time. In the revised submittal, the Commonwealth used AERMOD version 16216r which includes updates to 40 CFR part 51, Appendix W, "Guideline of Air Quality Models," published on January 17, 2017 (82 FR 5203). This is the current regulatory version of the AERMOD Model.

The second difference between the previous modeling submittal and the revised submittal is the emission rates used in the modeling of the background sources included in the modeling, including Indiana-Michigan AEP Rockport Station, Sigeco Culley, OMU Elmer Smith Station, and ALCOA Warrick Power. In the original modeling submittal, the Commonwealth used 2012-2014 actual hourly CAMD emissions data to model these facilities. In the revised modeling submittal, the Commonwealth used 2014-2016 actual hourly CAMD emissions data to model these facilities.

The third difference between the previous modeling submittal and the revised submittal is the inclusion of the nearby Big Rivers Electric Coleman Station in the modeling. In the original submittal, this facility was not included in the modeling. The revised modeling submittal included emissions from this facility using 2014-2016 actual hourly CAMD emissions data.

The fourth difference between the previous modeling submittal and the revised submittal is the background concentrations used in the analysis. The original modeling submittal utilized background $SO_2$ concentrations from the Baskett monitor located in Henderson County, Kentucky, for the 2012-2014 period. The revised modeling utilized the same monitor but

updated the period of time used to correspond to the actual hourly emissions and meteorological data used which was for the 2014-2016 period.

The fifth difference between the previous modeling submittal and the revised submittal is the meteorological data used in the modeling. The original modeling utilized surface meteorological data from Evansville, Indiana, and upper air meteorological data from Lincoln Logan County Airport near Lincoln, Illinois, for the 2012-2014 period. The revised modeling utilized meteorological data from the same stations but was updated to utilize data from the 2014-2016 period.

The sixth and final difference between the previous modeling submittal and the revised submittal is the emission rates used for 13 of the 16 sources at Century Aluminum Hawesville. The original modeling utilized actual hourly emissions data for several units (Source IDs: 41B_1, 84B_1, 89_1, 85A, 85B, 86A, 86B, 87A, 87B, 88A, 88B, 90A, 90B) based on monthly production logs for 2012-2014 in tandem with test-derived emission factors for each emission unit to discern representative monthly emission rates. These 13 sources are primarily associated with the potlines and anode bake furnaces at the facility. The revised modeling utilized actual hourly emissions for these 13 sources based on updated monthly production logs for 2014-2016.

The remainder of this Section will only address the most recent June 5, 2017, submittal from the Commonwealth.

#### *6.3.2.2. Model Selection and Modeling Components*

The EPA's Modeling TAD notes that for area designations under the 2010 $SO_2$ NAAQS, the AERMOD modeling system should be used, unless use of an alternative model can be justified. The AERMOD modeling system contains the following components:

- AERMOD: the dispersion model
- AERMAP: the terrain processor for AERMOD
- AERMET: the meteorological data processor for AERMOD
- BPIPPRM: the building input processor
- AERMINUTE: a pre-processor to AERMET incorporating 1-minute automated surface observation system (ASOS) wind data
- AERSURFACE: the surface characteristics processor for AERMET
- AERSCREEN: a screening version of AERMOD

The Commonwealth originally used AERMOD version 15181 with default options. However, with the updated June 5, 2017 modeling, the state made use of AERMOD version 16216r. A discussion of the Commonwealth's approach to the individual components is provided in the corresponding discussion that follows, as appropriate.

The current version of AERMOD, version 16216r, includes updates to 40 CFR part 51, Appendix W, "Guideline of Air Quality Models," published on January 17, 2017 (82 FR 5203). This version of AERMOD also includes fixes to bugs that were inadvertently included in version 16216. Kentucky in its final June 5, 2017, Modeling Report used AERMOD version 16216r with all regulatory default settings.

#### *6.3.2.3. Modeling Parameter: Rural or Urban Dispersion*

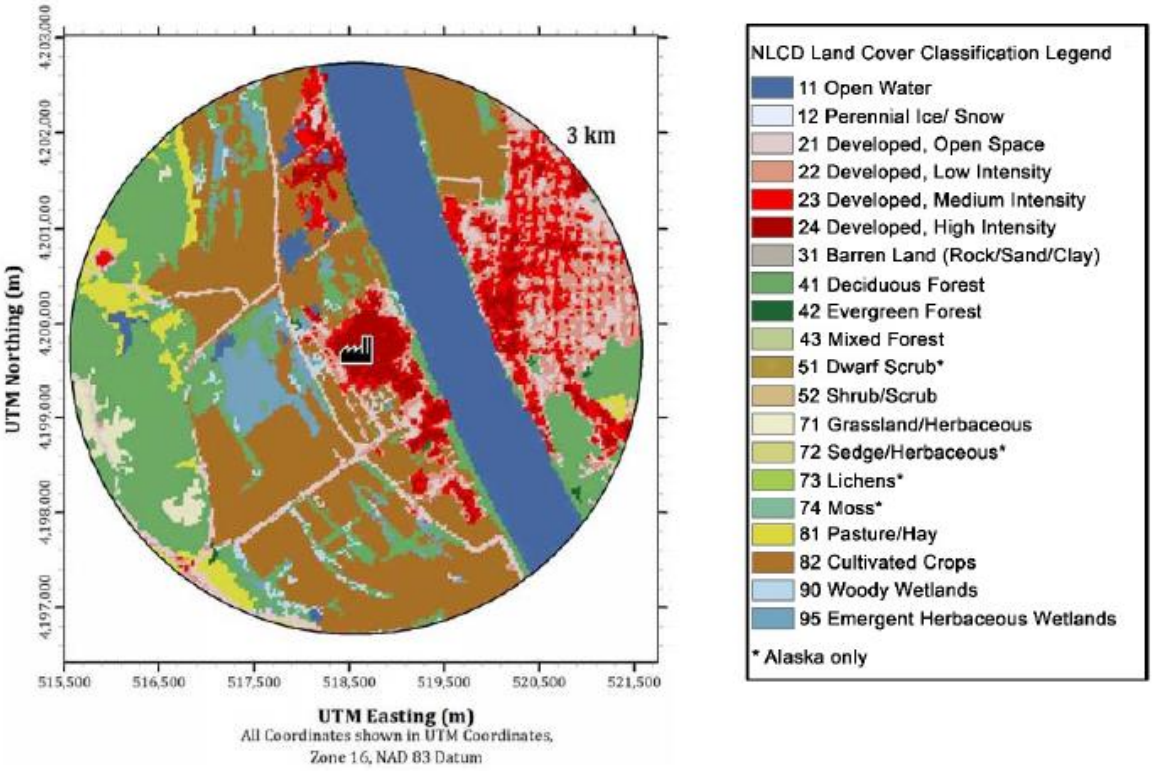
For any dispersion modeling exercise, the "urban" or "rural" determination of a source is important in determining the boundary layer characteristics that affect the model's prediction of downwind concentrations. For $SO_2$ modeling, the urban/rural determination is important because AERMOD invokes a 4-hour half-life for urban $SO_2$ sources. Section 6.3 of the Modeling TAD details the procedures used to determine if a source is urban or rural based on land use or population density. The EPA's recommended procedure for characterizing an area by prevalent land use is based on evaluating the dispersion environment within 3 km of the facility. According to the EPA's modeling guidelines, rural dispersion coefficients are to be used in the dispersion modeling analysis if more than 50 percent of the area within a 3 km radius of the facility is classified as rural. Conversely, if more than 50 percent of the area is urban, urban dispersion coefficients should be used in the modeling analysis.

The Commonwealth used the Auer land use methodology as discussed in the modeling TAD and examined the various land use within 3 km of Century Aluminum to quantify the percentage of area in various land use categories. Following this guidance, 2011 land use data (the most recently available data at the time of the assessment) were obtained from the U.S. Geological Survey through ArcGIS and a 3 km radius circle inscribed electronically around the Century Aluminum facility was generated. Figure 25 shows the layout of the land use and Table 20 shows the results of the land use categorization process. The area is predominantly rural (89.3 percent). Therefore, for the purpose of performing the modeling for the area of analysis, the Commonwealth determined that it was most appropriate to run the model with rural dispersion coefficients, and the EPA concurs with this assessment.

**Table 20. Determination of the Urban or Rural Modeling Parameter for the Hancock County Area by Auer's Method with 2011 Land Use Information**

| Category ID | Category Description | Percent |
|---|---|---|
| 11 | Open Water | 16.3% |
| 21 | Developed, Open Space | 6.5% |
| 22 | Developed, Low Intensity | 7.4% |
| 23 | Developed, Medium Intensity | 6.6% |
| 24 | Developed, High Intensity | 4.1% |
| 31 | Barren Land | 0.0% |
| 41 | Deciduous Forest | 20.3% |
| 42 | Evergreen Forest | 0.2% |
| 43 | Mixed Forest | 0.0% |
| 52 | Shrub/Scrub | 0.0% |
| 71 | Grassland/Herbaceous | 1.3% |
| 81 | Pasture/Hay | 2.9% |
| 82 | Cultivated Crops | 29.8% |
| 90 | Woody Wetlands | 1.2% |
| 95 | Emergent Herbaceous Wetlands | 3.4% |
| | Total | 100% |
| | Urban | 10.7% |
| | Rural | 89.3% |

**Figure 25: Land Use Map for Area Within 3km of the Century Aluminum Hawesville facility. Source: "Air Dispersion Modeling Report for Century Aluminum of Kentucky, Hawesville, Kentucky, $SO_2$ Designation Analysis Under the Data Requirements Rule, Revision 1," prepared by Century Aluminum Hawesville, June 5, 2017.**




*6.3.2.4. Modeling Parameter: Area of Analysis (Receptor Grid)*

The TAD recommends that the first step towards characterization of air quality in the area around a source or group of sources is to determine the extent of the area of analysis and the spacing of the receptor grid. Considerations presented in the Modeling TAD include but are not limited to: the location of the $SO_2$ emission sources or facilities considered for modeling; the extent of concentration gradients due to the influence of nearby sources; and sufficient receptor coverage and density to adequately capture and resolve the model predicted maximum $SO_2$ concentrations.

The sources of $SO_2$ emissions subject to the DRR in this area are described in the introduction to this section. For the Hancock County area, the Commonwealth has included five other emitters of $SO_2$ within 50 km of Century Aluminum in any direction. The Commonwealth determined that this was the appropriate distance to adequately characterize air quality through modeling to include the potential extent of any $SO_2$ NAAQS exceedances in the area of analysis and any potential impact on $SO_2$ air quality from other sources in nearby areas. In addition to Century Aluminum Hawesville, the other emitters of $SO_2$ included in the area of analysis are: Owensboro Municipal Utilities' Elmer Smith Station, Alcoa Warrick Power Plant, Culley Station, Big Rivers Electric Corporation – Coleman Station, and Rockport Station. No other sources beyond 50 km were determined by the Commonwealth to have the potential to cause concentration gradient

impacts within the area of analysis. For a detailed analysis of nearby sources that were considered for the final modeling see Section 6.3.2.5.

The grid receptor spacing for the area of analysis chosen by the Commonwealth is as follows:

- Receptors along the fence line every 50 m
- Receptors every 100 m from fence line to 3 km
- Receptors every 250 m from 3 km to 5 km
- Receptors every 500 m from 5 km to 10 km
- Receptors every 1,000 m from 10 km to 20 km
- Receptors every 2,000 m from 20 km to 50 km

The receptor network contained 6,641 receptors, and the network covered Hancock, most of Breckinridge, northern Ohio, northwestern Meade, and much of Daviess counties in Kentucky and Perry, Spencer, southeastern Warrick, southern Dubois, and southwestern Crawford counties in Indiana.

Figure 26 and 27, included in the Commonwealth's recommendation, shows the Commonwealth's chosen area of analysis surrounding the Century Aluminum Hawesville facility, as well as the receptor grid for the area of analysis.

Consistent with the Modeling TAD, the state placed receptors for the purposes of this designation effort in locations that would be considered ambient air relative to Century Aluminum Hawesville. Receptors at locations on other facilities' property were not removed from the analysis. Also, receptors at locations over water (including the Ohio River) were removed from the analysis as described in Section 4.2 of the Modeling TAD because these are not feasible locations for placing a monitor. As can be seen in Figure 26, receptors in the Ohio River and within the Century Aluminum fenceline have been excluded from consideration in the modeling. Also, receptors were placed along the fenceline of the Century Aluminum facility. In addition, receptors were placed at a 50-m spacing along a rail right of way that runs through the property of Century Aluminum, consistent with recommendations for fence lines. This can be seen in Figure 27.

**Figure 26: Receptor Grid for the Hancock County Area. Source: "Air Dispersion Modeling Report for Century Aluminum of Kentucky, Hawesville, Kentucky, $SO_2$ Designation Analysis Under the Data Requirements Rule, Revision 2," prepared by Century Aluminum Hawesville, June 5, 2017.**

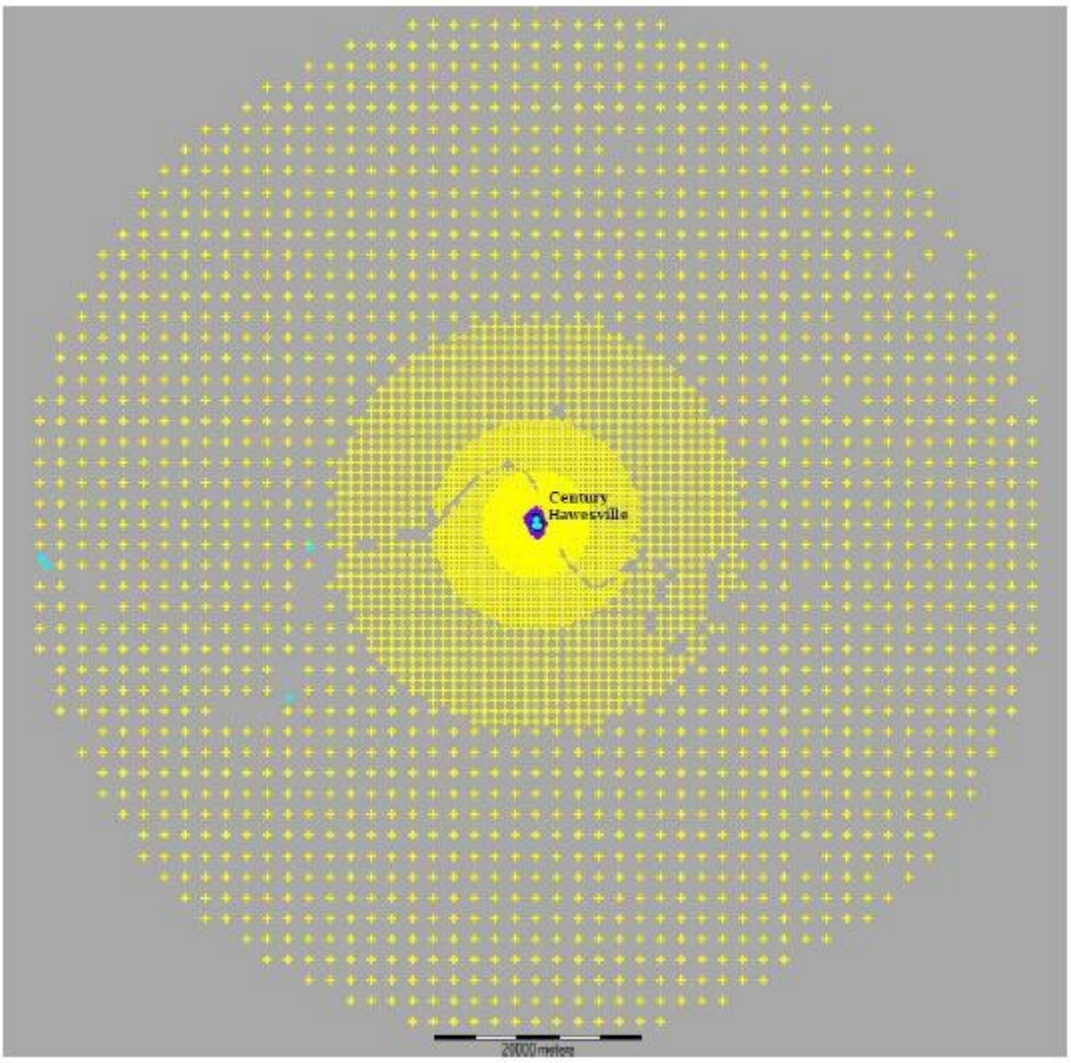
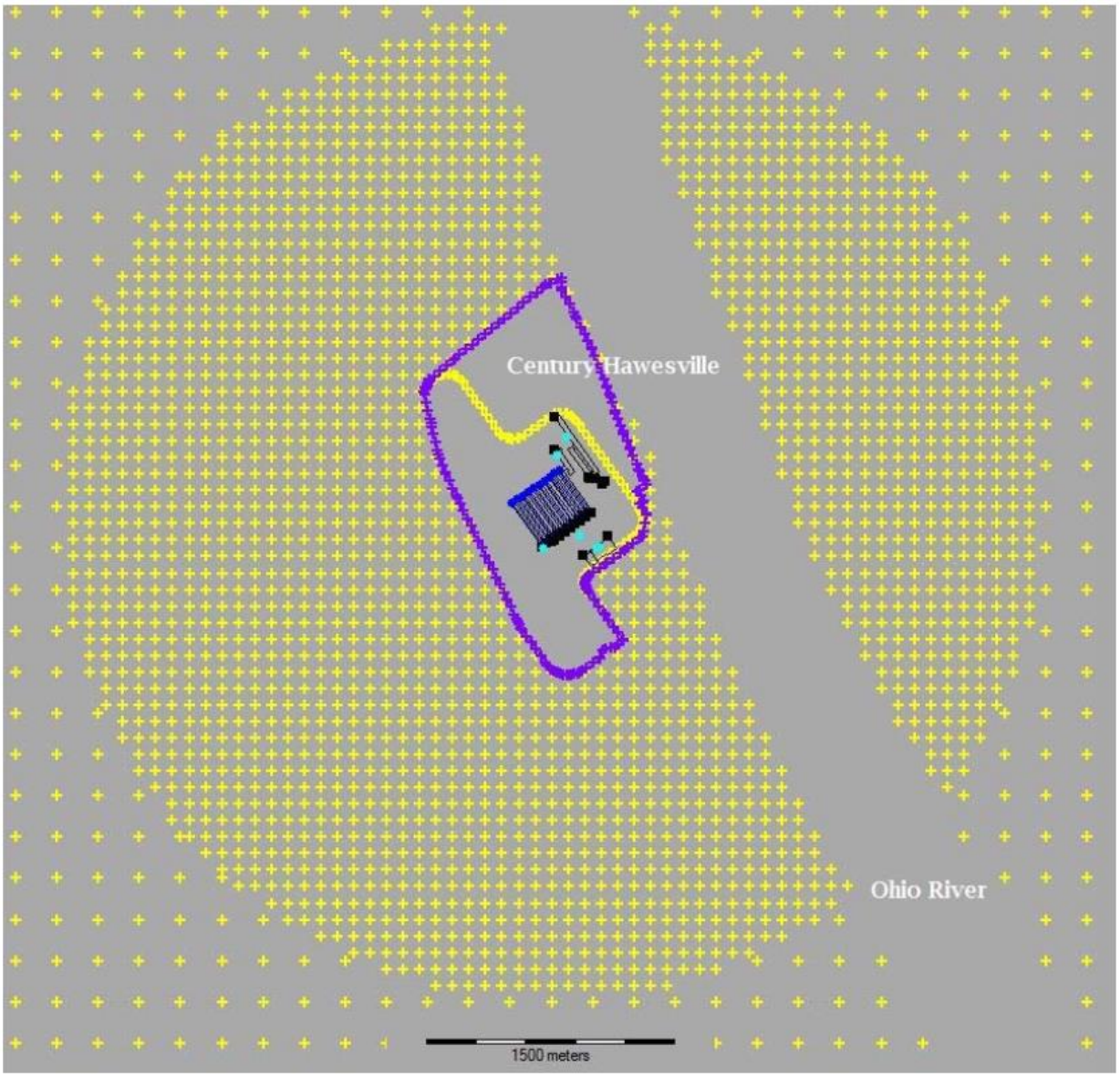


**Figure 27: Innermost Portion of the Receptor Grid for the Hancock County Area. Source: "Air Dispersion Modeling Report for Century Aluminum of Kentucky, Hawesville, Kentucky, $SO_2$ Designation Analysis Under the Data Requirements Rule, Revision 2," prepared by Century Aluminum Hawesville, June 5, 2017.**




The EPA concurs with the receptor grid used by the Commonwealth of Kentucky, including those receptors that were excluded from the modeling analysis because they were either located within the fenced portion of Century Aluminum Hawesville or they were located over water (the Ohio River). As shown in Section 6.3.2.10 of this TSD, maximum predicted $SO_2$ concentrations occur approximately 2 km west of the facility which is well away from the plant property boundaries. This component of the modeling analysis has been performed in a manner consistent with the $SO_2$ Modeling TAD.

#### *6.3.2.5. Modeling Parameter: Source Characterization*

Section 6 of the Modeling TAD offers recommendations on source characterization including source types, use of accurate stack parameters, inclusion of building dimensions for building downwash (if warranted), and the use of actual stack heights with actual emissions or following GEP policy with allowable emissions.

Century Aluminum's major sources of $SO_2$ emissions are the Potlines and Anode Bake Furnaces, each of which were modeled. The June 5, 2017, Modeling Report describes the emissions sources as follows:

> Each Potline (1-4) releases fugitive emissions through the roof vent of its own respective building. In addition, the captured Potline (1-4) emissions are all routed to a single control system (consisting of a multiclone, [electrostatic precipitator] (ESP) and wet scrubber in series) and released through a stack. While Potline 5 also releases fugitive emissions through the roof vent of its building, captured Potline 5 emissions are routed to a separate dry alumina scrubber and emissions are then released through a dedicated stack for Potline 5. The Anode Bake Furnaces release $SO_2$ from natural gas combustion and the processing of green anodes. These emissions are routed to a dry alumina scrubber and then in turn are also emitted through a dedicated stack. The $SO_2$ emission units at the facility included in the modeling analysis are the following:
>
> 1. Potlines 1-5 (EU84b, 85-90)
> 2. Anode Bake Furnace #1, #2, #3 (EU41b)
> 3. Aluminum Spray Furnace (EU64)
> 4. Casthouse Tilting Furnaces (EU113, 114)

The potlines were modeled as buoyant line sources. All other sources listed above were modeled as point sources. The remaining sources of $SO_2$ emissions are considered insignificant activities[33] and/or are intermittent sources and thus, do not normally contribute to the annual distribution of daily maximum 1-hour $SO_2$ concentrations. The sources intentionally excluded from the modeling analysis are the following:

1. Heater Hot Oil System (EU31)
2. Fire Pump Engine (EU137)
3. Admin Emergency Generator Engine (EU138)

The Commonwealth identified all of the SO2 sources that emit greater that 100 tpy of actual emissions located within 50 km of Century Aluminum Hawesville. The following source emitted greater than 100 tpy in 2014, but was not included in the modeling analysis due to having a Q/d < 20: Owensboro Grain Company (437.6 tpy; 33 km). Due to the low level of emissions and distance from Century Aluminum Hawesville, we agree that this source did not need to be explicitly modeled and any potential impacts are represented by the background ambient monitor. Section 6.3.2.9 provides more details about Kentucky's decision to use the Baskett monitor for background.

[33] Section C, V-08-012 R3 Air Quality Permit issued under 401 KAR 52:020.

Using the 20D[34] method, Owensboro Municipal Utilities' Elmer Smith Station, American Electric Power's Rockport Station, Southeastern Indiana Gas & Electric Company's Culley Station, and Alcoa Warrick Power Plant were included by the Commonwealth in the modeling due to their Q/d ratio being greater than 20. In addition, Big Rivers Electric Corporation – Coleman Station emitted 923 tons in 2014 before it shut down in May of that year but was included in the modeling due to its close proximity to Century Aluminum and the potential for the source to impact $SO_2$ concentrations in the immediate area around Century Aluminum. Alcoa Warrick Operations is located about 47 km west of Century Aluminum adjacent to the Alcoa Warrick Power Plant and emitted 3,500 tons of $SO_2$ in 2014 according to the 2014 NEI. This source was not included in the modeling submitted by the Commonwealth. The modeling report submitted by the Commonwealth indicates that this source has shut down, however, this shutdown has not been made permanent. As described in the paragraph below, non-inclusion of Alcoa Warrick Operations is not expected to affect the conclusion of this modeling analysis which is that the 1-hour $SO_2$ NAAQS is attained in the area around Century Aluminum Hawesville.

Alcoa Warrick Operations and Alcoa Warrick Power Plant are located some 47 km west of Century Aluminum Hawesville in southern Warrick County, Indiana. These sources are located adjacent to each other and near the outer range of the nominal 50 km distance considered applicable for Gaussian dispersion models such as AERMOD. AERMOD modeling results indicate that the Alcoa Warrick Power Plant contributed substantially less than 0.1 $\mu g/m^3$ to maximum impacts in the vicinity of Century Aluminum from all sources combined. Alcoa Warrick Operations emitted less in 2014 (3,500) than the Alcoa Warrick Power Plant (4,993). These two facilities are less than 1 km apart. The Alcoa Warrick Power Plant has taller stacks (380-500 feet) than Warrick Operations (50-200 feet). Also, Warrick Operations consists of potlines and some stacks with temperatures (~170F) slightly warmer than the Alcoa Power sources (~128F). Based on the overall stack characteristics for the two facilities, the highest concentrations from Warrick Operations are expected to occur a shorter distance downwind than the highest concentrations from Alcoa Power. Based on all of these factors, it can be reasonably expected that if Alcoa Warrick Operations were included in the modeling, it would have impacts similar to the impacts predicted from Alcoa Power. Further, it can also be reasonably expected that the combined impact of the two facilities would also be substantially less than 1 $\mu g/m^3$. Even if Warrick Operations had an impact 10 times the impact of Alcoa Power, the combined impact from the two facilities would still be less than 1 $\mu g/m^3$ at the point of maximum impact from all sources. In addition, as shown in Section 5.3.2.10 of this TSD, the maximum modeled impact from all sources combined is 140 $\mu g/m^3$ which is well below the 1-hour $SO_2$ NAAQS. Therefore, inclusion of Alcoa Warrick Operations in the modeling analysis would likely result in only a small increase in predicted concentrations in the vicinity of Century Aluminum and the EPA concurs with the non-inclusion of Alcoa Warrick Operations in this modeling analysis.

[34] The "20D" method was one method used to assess whether candidate sources within 50km of Century Aluminum should be included in the analysis. Using this method, if the emissions from a candidate source are greater than 20D (20 times the distance in km of the candidate source to Century Aluminum) then the source is retained for further consideration for potential inclusion in the modeling analysis. This analysis is sometimes referred to as Q/d (indicated emissions over distance).

Non-inclusion of Alcoa Warrick Operations is not expected to affect the conclusion of this modeling analysis which is that the 1-hour $SO_2$ NAAQS is attained in the area around Century Aluminum Hawesville.

The Commonwealth characterized these sources within the area of analysis in accordance with the best practices outlined in the Modeling TAD. Specifically, the Commonwealth used actual stack heights in conjunction with actual emissions. The state also adequately characterized the sources' building layouts and locations, as well as the stack parameters, e.g., exit temperature, exit velocity, location, and diameter. Where appropriate, the AERMOD component BPIPPRM was used to assist in addressing building downwash.

This component of the modeling analysis was performed in a manner consistent with the $SO_2$ Modeling TAD. Specifically, actual emissions and stack heights were used for all sources included in the modeling analysis. Also, potential building downwash resulting from structures at Century Aluminum was properly accounted for.

#### *6.3.2.6. Modeling Parameter: Emissions*

The EPA's Modeling TAD notes that for the purpose of modeling to characterize air quality for use in designations, the recommended approach is to use the most recent 3 years of actual emissions data and concurrent meteorological data. However, the TAD also indicates that it would be acceptable to use allowable emissions in the form of the most recently permitted (referred to as PTE or allowable) emissions rate that is federally enforceable and effective.

The EPA believes that CEMS data provide acceptable historical emissions information, when they are available. These data are available for many electric generating units. In the absence of CEMS data, the EPA's Modeling TAD highly encourages the use of AERMOD's hourly varying emissions keyword HOUREMIS, or through the use of AERMOD's variable emissions factors keyword EMISFACT. When choosing one of these methods, the EPA recommends using detailed throughput, operating schedules, and emissions information from the impacted source(s).

In certain instances, states and other interested parties may find that it is more advantageous or simpler to use PTE rates as part of their modeling runs. Specifically, a facility that has recently adopted a new federally-enforceable emissions limit or implemented other federally-enforceable mechanisms and control technologies to limit $SO_2$ emissions to a level that indicates compliance with the NAAQS. These new limits or conditions may be used in the application of AERMOD for the purposes of modeling for designations, even if the source has not been subject to these limits for the entirety of the most recent 3 calendar years. In these cases, the Modeling TAD notes that a state should be able to find the necessary emissions information for designations-related modeling in the existing $SO_2$ emissions inventories used for permitting or SIP planning demonstrations. In the event that these short-term emissions are not readily available, they may be calculated using the methodology in Table 8-1 of Appendix W to 40 CFR Part 51 titled, "Guideline on Air Quality Models."

As previously noted, the Commonwealth included Century Aluminum and five other emitters of $SO_2$ within 50 km in the area of analysis. The Commonwealth has chosen to model these

facilities using actual emissions. The facilities in the Commonwealth's modeling analysis and their associated annual actual $SO_2$ emissions between 2014 and 2016 are summarized below.

For Century Aluminum, Elmer Smith Station, Big Rivers Electric Corporation – Coleman Station, Rockport Station, Culley Station, and Alcoa Warrick Power Plant, the Commonwealth provided annual actual $SO_2$ emissions between 2014 and 2016. This information is summarized in Table 21. A description of how the state obtained hourly emission rates is given below this table.

**Table 21. Actual $SO_2$ Emissions Between 2014 – 2016 from Facilities in the Area of Analysis for the Hancock County Area**

| | $SO_2$ Emissions (tpy) | | |
|---|---|---|---|
| **Facility Name** | **2014** | **2015** | **2016** |
| Century Aluminum Hawesville | 2,227 | 1,618 | 507 |
| Alcoa Warrick Power Plant | 4,993 | 2,907 | 3,542 |
| Rockport Station | 54,979 | 29,889 | 24,341 |
| Culley Station | 1,896 | 1,513 | 1,311 |
| Elmer Smith Station | 5,741 | 3,902 | 2,449 |
| BREC – Coleman Station | 923 | 0 | 0 |
| Total Emissions from All Facilities in the Area of Analysis Modeled Based on Actual Emissions | 70,759 | 39,829 | 32,150 |

For Elmer Smith Station, Rockport Station, Culley Station, Big Rivers Electric Corporation – Coleman Station, and Alcoa Warrick Power Plant, the actual hourly emissions data were obtained from 2014-2016 CAMD CEMS data.[35] The EPA has compared the sum of the hourly $SO_2$ emissions modeled for Elmer Smith, Alcoa Warrick Power Plant, Culley Station, Big Rivers Electric Corporation – Coleman Station, and Rockport Station for each year modeled and determined that these values equal the yearly values reported to the Clean Air Markets Division.

For Century Aluminum Hawesville, the actual hourly emissions data for 13 of the 16 sources (Source IDs: 41B_1, 84B_1, 89_1, 85A, 85B, 86A, 86B, 87A, 87B, 88A, 88B, 90A, 90B) were obtained from use of the monthly production logs in tandem with test-derived emission factors for each emission unit to discern representative monthly emission rates. Century Aluminum Hawesville used annualized emissions for 3 of the 16 smaller $SO_2$ sources (Source IDs: 64_1, 113_1 and 114_1) due to their expected insignificant variation from hour to hour.

The EPA agrees with the use of hourly emissions data based on monthly production logs for the primary Century Aluminum $SO_2$ sources and the use of hourly emissions data based on CEMS data for modeling the other five nearby facilities included in the modeling. The most recently available emissions data was used for predicting $SO_2$ impacts from Century Aluminum Hawesville and the other sources impacting the Hancock County area, and the EPA agrees with the use of 2014 – 2016 actual emissions. This component of the modeling analysis was

[35] Information available at: https://ampd.epa.gov/ampd/.

performed in a manner consistent with the $SO_2$ Modeling TAD for all sources included in the modeling.

#### *6.3.2.7. Modeling Parameter: Meteorology and Surface Characteristics*

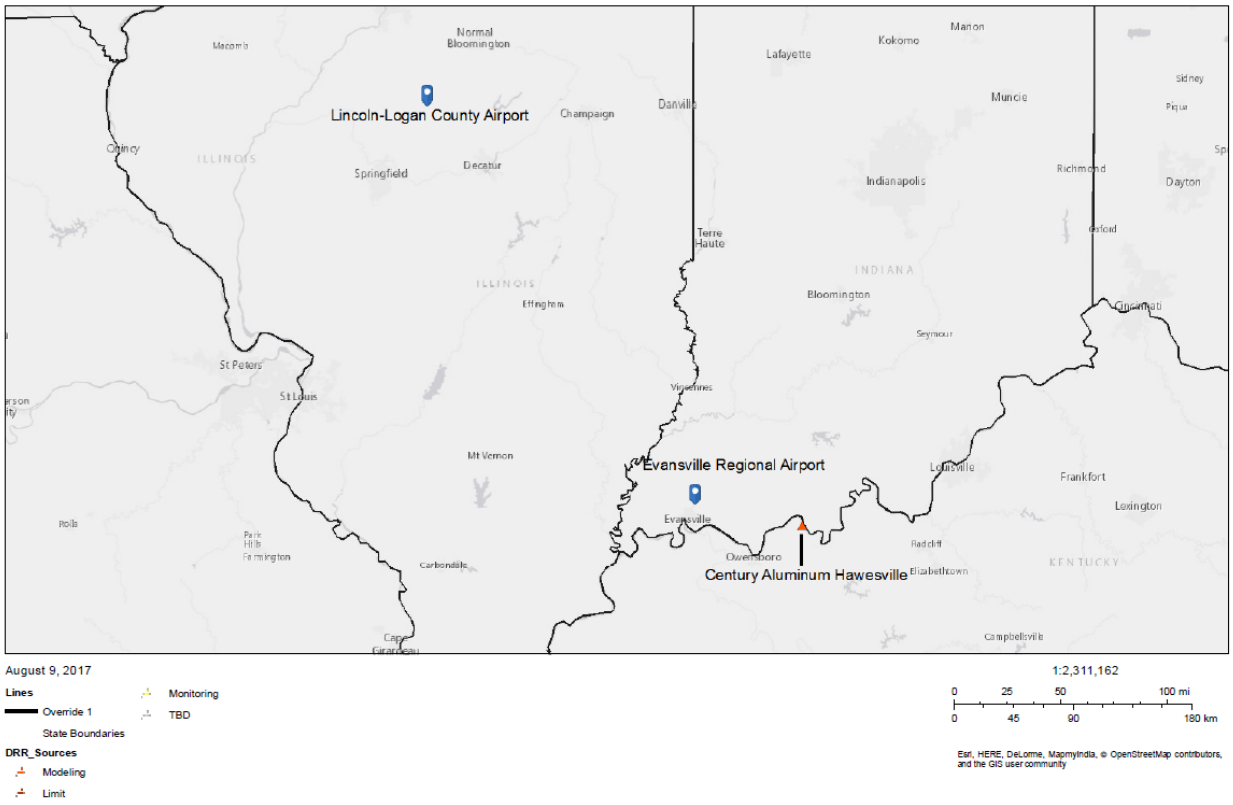
As noted in the Modeling TAD, the most recent 3 years of meteorological data (concurrent with the most recent 3 years of emissions data) should be used in designations efforts. The selection of data should be based on spatial and climatological (temporal) representativeness. The representativeness of the data is determined based on: 1) the proximity of the meteorological monitoring site to the area under consideration, 2) the complexity of terrain, 3) the exposure of the meteorological site, and 4) the period of time during which data are collected. Sources of meteorological data include NWS stations, site-specific or onsite data, and other sources such as universities, FAA, and military stations.

For the area of analysis for the Hancock County area, the Commonwealth selected the surface meteorology from the Evansville Regional Airport NWS station in Evansville, IN, located at 38.044 N, 87.521 W), 65.2 km from the source, and coincident upper air observations from a different NWS station, Lincoln-Logan County Airport, located in Lincoln, IL, located at 40.09 N, 89.20 W, 328 km to the northwest of the source as best representative of meteorological conditions within the area of analysis.

The Commonwealth used AERSURFACE version 13016 using data from the Evansville NWS site to estimate the surface characteristics (albedo, Bowen ratio, and surface roughness [$z_o$]) of the area of analysis. Albedo is the fraction of solar energy reflected from the earth back into space, the Bowen ratio is the method generally used to calculate heat lost or heat gained in a substance, and the surface roughness is sometimes referred to as “zo” The state estimated surface roughness values for 12 spatial sectors out to 1-3 km at a seasonal temporal resolution for dry, wet, and average conditions.

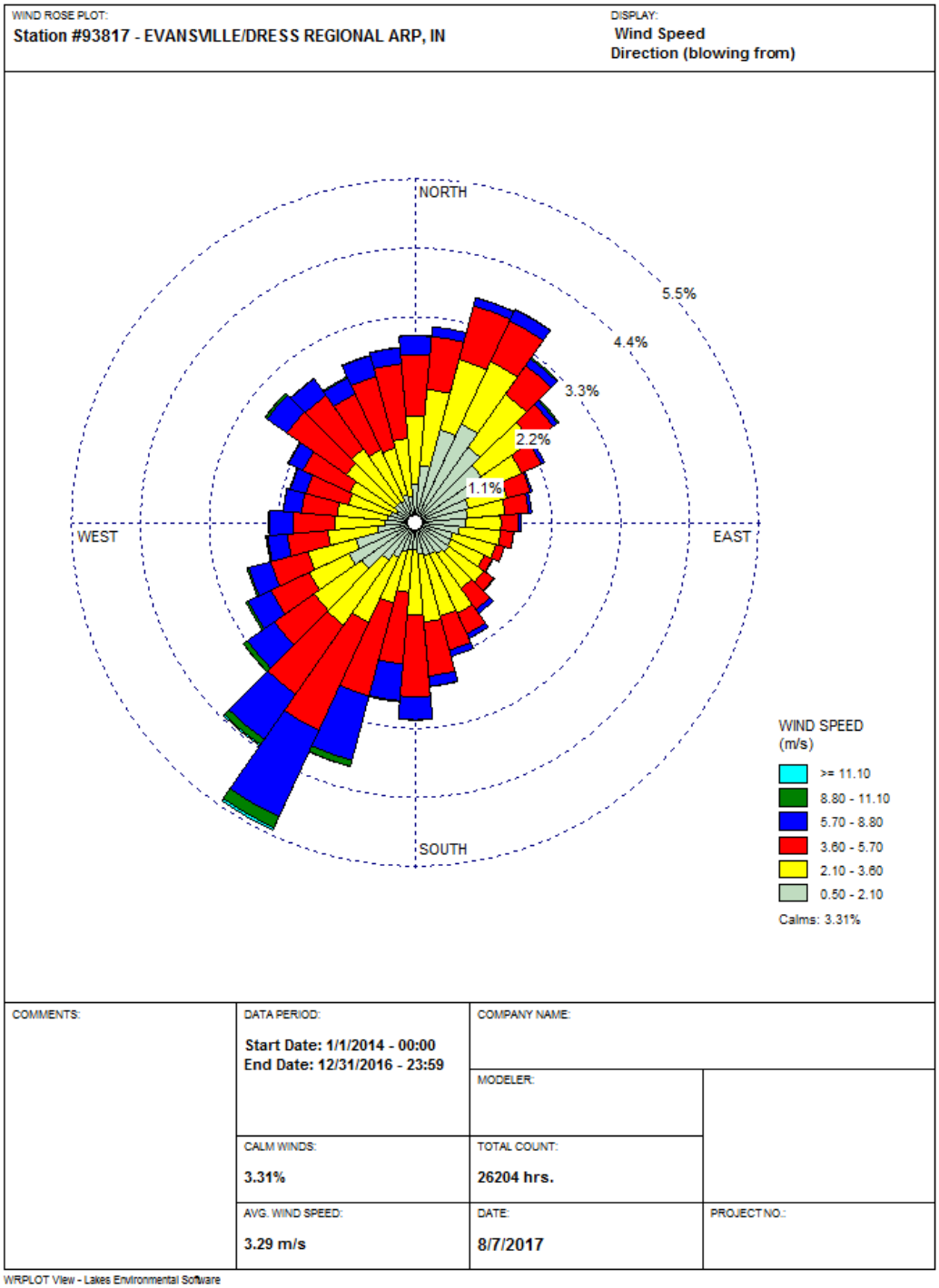
In the figure below, generated by the EPA, the location of these NWS stations is shown relative to the area of analysis.

**Figure 28. Area of Analysis and the NWS stations in the Hancock County Area**




The EPA generated a wind rose for the Evansville, Indiana, airport for the 2014-2016 period. In Figure 29, the frequency and magnitude of wind speed and direction are defined in terms of from where the wind is blowing. Analysis of the NWS data indicate winds predominantly blow from the southwest direction.

**Figure 29: Evansville NWS Cumulative Annual Wind Rose for Years 2014-2016**



Meteorological data from the above surface and upper air NWS stations were used in generating AERMOD-ready files with the AERMET processor. The output meteorological data created by the AERMET processor is suitable for being applied with AERMOD input files for AERMOD modeling runs. The Commonwealth followed the methodology and settings presented in Section 7 of the $SO_2$ Modeling TAD in the processing of the raw meteorological data into an AERMOD-ready format, and used AERSURFACE to best represent surface characteristics.

Hourly surface meteorological data records are read by AERMET, and include all the necessary elements for data processing. However, wind data taken at hourly intervals may not always portray wind conditions for the entire hour, which can be variable in nature. Hourly wind data may also be overly prone to indicate calm conditions, which are not modeled by AERMOD. In order to better represent actual wind conditions at the meteorological tower, wind data of 1-minute duration was provided from Evansville, IN, but in a different formatted file to be processed by a separate preprocessor, AERMINUTE. These data were subsequently integrated into the AERMET processing to produce final hourly wind records of AERMOD-ready meteorological data that better estimate actual hourly average conditions and that are less prone to over-report calm wind conditions. This allows AERMOD to apply more hours of meteorology to modeled inputs, and therefore produce a more complete set of concentration estimates. As a guard against excessively high concentrations that could be produced by AERMOD in very light wind conditions, the state set a minimum threshold of 0.5 m/s in processing meteorological data for use in AERMOD. In setting this threshold, no wind speeds lower than this value would be used for determining concentrations. This threshold was specifically applied to the 1-minute wind data. In addition, the "Ice-Free Winds Group" AERMINUTE option was selected due to the fact that a sonic anemometer has been installed at KEVV on September 26, 2006.

The EPA believes that the wind rose indicates that impacts from Century Aluminum and other sources included in the analysis are reasonably expected to most frequently occur generally northeast of each respective facility, but that impacts could be seen in other directions as well. The EPA believes that the surface and upper air meteorological data selected by the Commonwealth of Kentucky for use in this modeling analysis is acceptable and was processed in a manner consistent with the $SO_2$ modeling TAD.

#### *6.3.2.8. Modeling Parameter: Geography, Topography (Mountain Ranges or Other Air Basin Boundaries) and Terrain*

The terrain in the area of analysis is best described as complex to gently rolling. To account for these terrain changes, the AERMAP terrain program (version 11103) within AERMOD was used to specify terrain elevations for all the receptors. The source of the elevation data incorporated into the model is from the USGS NED.

The EPA believes that the terrain in the area of analysis is accounted for in a manner consistent with the $SO_2$ modeling TAD. The stated application of the AERMAP pre-processor should adequately resolve any variations in terrain the area.

#### *6.3.2.9. Modeling Parameter: Background Concentrations of $SO_2$*

The Modeling TAD offers two mechanisms for characterizing background concentrations of $SO_2$ that are ultimately added to the modeled design values: 1) a "tier 1" approach, based on a monitored design value, or 2) a temporally varying "tier 2" approach, based on the 99$^{th}$ percentile monitored concentrations by hour of day and season or month. For this area of analysis, the Commonwealth elected to use a "tier 2" approach. Data were obtained from 2014-2016 for AQS Site: 21-101-0014 (Baskett fire house located in Kentucky, southeast of Evansville, IN). These data were used to generate temporally varying background based on the 99th percentile monitored concentrations by hour of day and month in this analysis. A 90-degree sector east exclusion zone was used to exclude impacts from the facilities already being explicitly modeled. The background concentrations for this area of analysis were determined by the state to vary from 1.74 μg/m$^3$, equivalent to 0.7 ppb when expressed in two significant figures,[36] to 40.9 μg/m$^3$ (15.2 ppb), with an average value of 13.6 μg/m$^3$ (5.2 ppb).

The EPA agrees that the background monitor used in this analysis was selected in a manner consistent with the $SO_2$ modeling TAD. Also, the $SO_2$ concentration data from the background monitor was processed and hourly background concentration values by month were derived in a manner consistent with the $SO_2$ modeling TAD. The EPA also agrees with the 90-degree exclusion zone applied to the monitoring data to exclude the effect of sources explicitly modeled. Even with the exclusion zone, the resulting background concentrations from the Baskett monitor are expected to be similar to background concentrations at Century.

#### *6.3.2.10. Summary of Modeling Inputs and Results*

The AERMOD modeling input parameters for the Hancock County area of analysis are summarized below in Table 22.

[36] The $SO_2$ NAAQS level is expressed in ppb but AERMOD gives results in μg/m$^3$. The conversion factor for $SO_2$ (at the standard conditions applied in the ambient $SO_2$ reference method) is 1ppb = approximately 2.619 μg/m$^3$.

**Table 22: Summary of AERMOD Modeling Input Parameters for the Area of Analysis for the Hancock County Area**

| Input Parameter | Value |
|---|---|
| AERMOD Version | 16216r (regulatory default) |
| Dispersion Characteristics | Rural |
| Modeled Sources | 6 |
| Modeled Stacks | 18 |
| Modeled Structures | 28 |
| Modeled Fencelines | 1 |
| Total receptors | 6,641 |
| Emissions Type | Actuals |
| Emissions Years | 2014-2016 |
| Meteorology Years | 2014-2016 |
| NWS Station for Surface Meteorology | Evansville, IN |
| NWS Station Upper Air Meteorology | Lincoln, IL |
| NWS Station for Calculating Surface Characteristics | Evansville, IN |
| Methodology for Calculating Background $SO_2$ Concentration | Tier 2 approach using AQS site: 21-101-0014 for 2014-2016 |
| Calculated Background $SO_2$ Concentration | 1.74 – 40.9 μg/m3 |

The results presented below in Table 23 show the magnitude and geographic location of the highest predicted modeled concentration based on the input parameters.

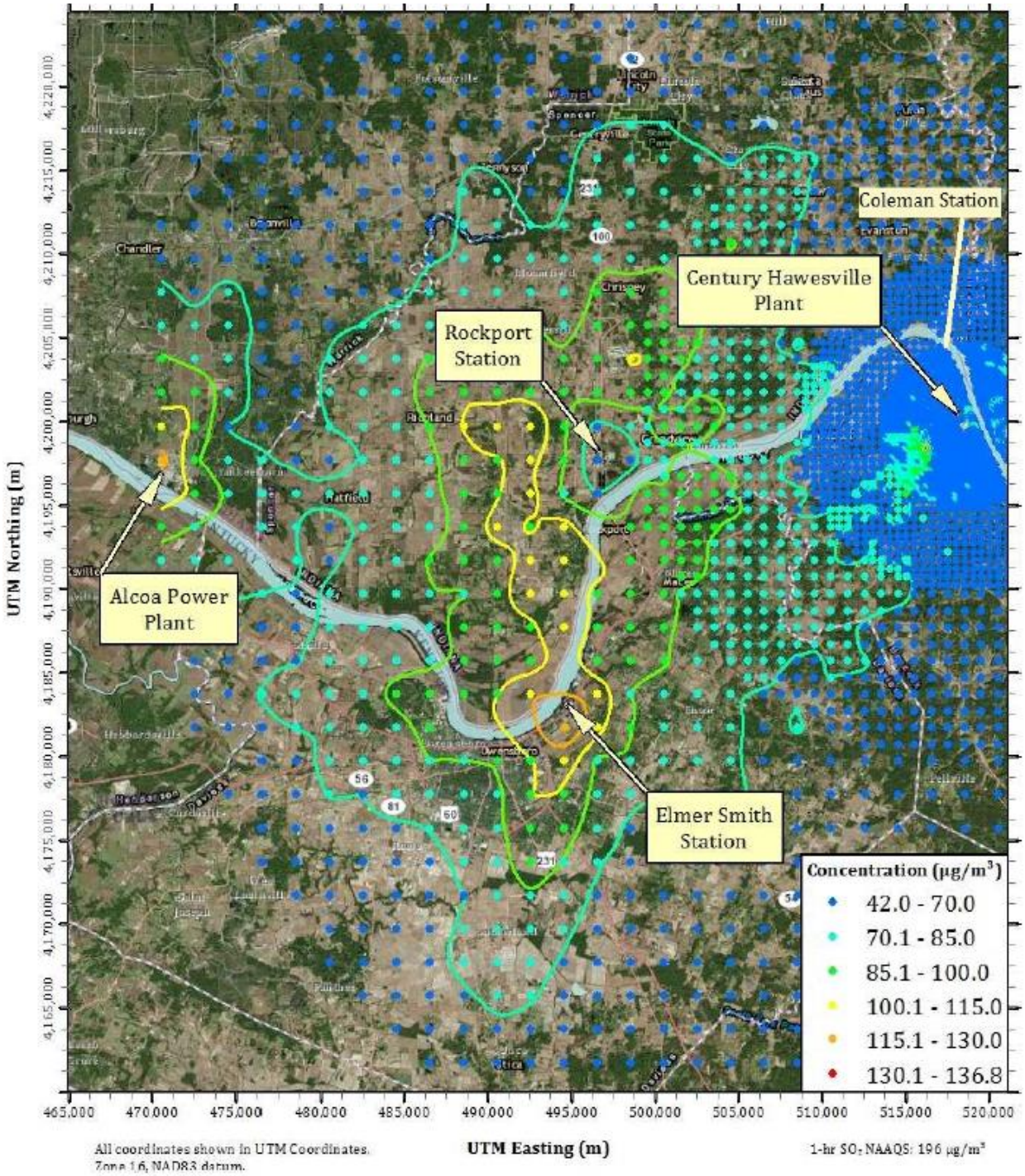
**Table 23. Maximum Predicted 99th Percentile Daily Maximum 1-Hour $SO_2$ Concentrations Averaged Over Three Years for the Area of Analysis for the Hancock County Area**

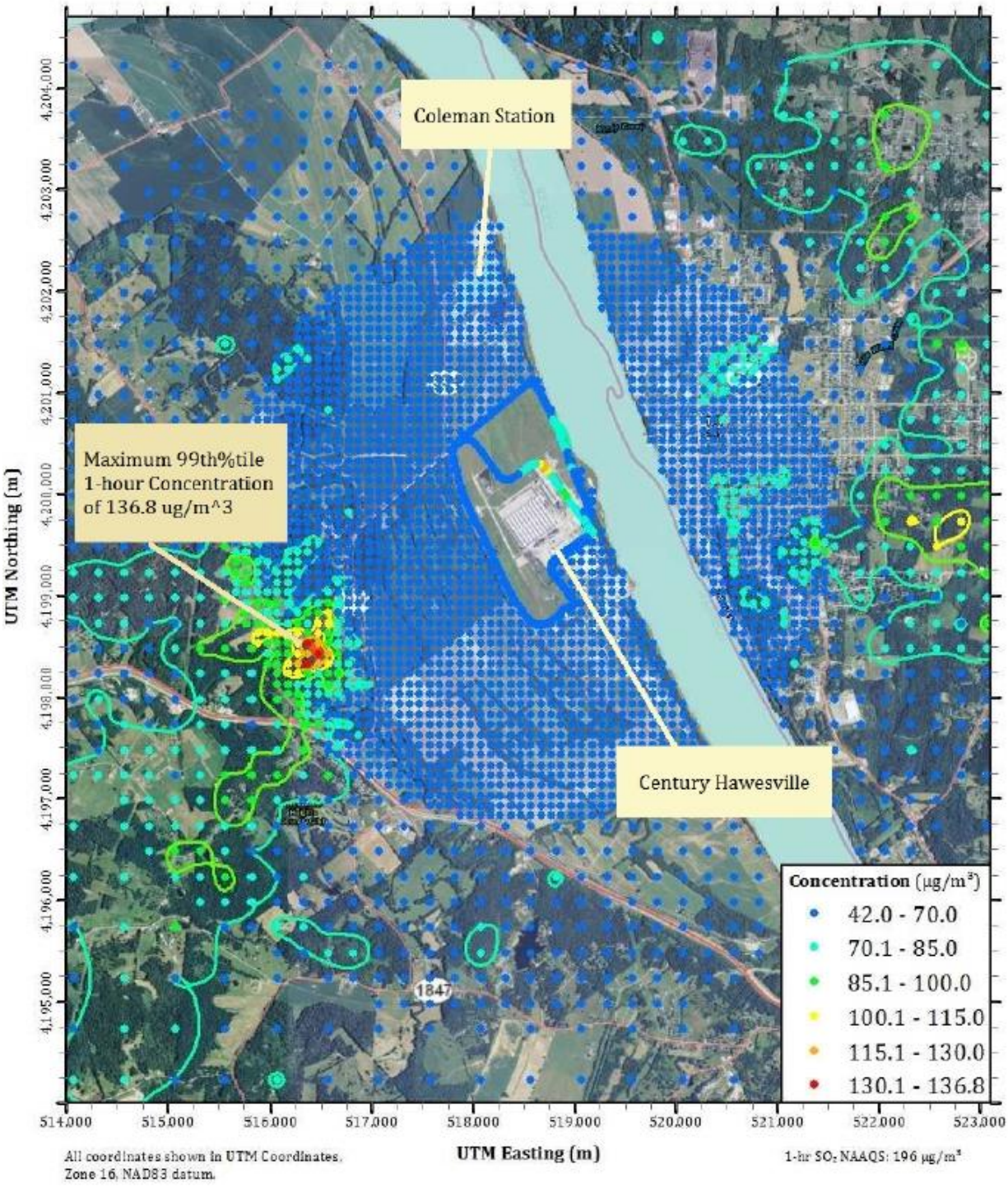
| Averaging Period | Data Period | Receptor Location [UTM zone 16] | | 99th percentile daily maximum 1-hour $SO_2$ Concentration ($\mu g/m^3$) | |
|---|---|---|---|---|---|
| | | UTM Easting (m) | UTM Northing (m) | Modeled concentration (including background) | NAAQS Level |
| 99th Percentile 1-Hour Average | 2014-2016 | 516,369 | 4,198,325 | 136.8 | 196.4* |

*Equivalent to the 2010 $SO_2$ NAAQS of 75 ppb using a 2.619 $\mu g/m^3$ conversion factor

The Commonwealth's modeling indicates that the highest predicted 99th percentile daily maximum 1-hour concentration within the chosen modeling domain is 136.8 $\mu g/m^3$, equivalent to 52.2 ppb. This modeled concentration included the background concentration of $SO_2$, and is based on actual emissions from the facilities. Figures 30a and 30b below were included as part of the state's recommendation, and indicate that the predicted value occurred approximately 2 km west of Century Aluminum. The Commonwealth's receptor grid is also shown in these figures.

**Figure 30a and 30b: Maximum Predicted 99th Percentile Daily Maximum 1-Hour $SO_2$ Concentrations Averaged Over Three Years for the Area of Analysis for the Hancock County Area. Source: "Air Dispersion Modeling Report for Century Aluminum of Kentucky, Hawesville, Kentucky, SO2 Designation Analysis Under the Data Requirements Rule, Revision 12," prepared by Trinity Consultants for Kentucky and Century Aluminum Hawesville, June 5, 2017June 8, 2016.**






The modeling submitted by the Commonwealth does not indicate that the 1-hour $SO_2$ NAAQS is violated at the receptor with the highest modeled concentration.

#### *6.3.2.11. The EPA's Assessment of the Modeling Information Provided by the Commonwealth*

The EPA has reviewed the modeling analysis performed by the Commonwealth of Kentucky for Century Aluminum Hawesville and other sources in the area and concurs that the modeling was performed in a manner consistent with the $SO_2$ Modeling TAD. Besides Century Aluminum Hawesville, the Commonwealth chose to model five other sources of $SO_2$ in the area. The EPA agrees that the receptor grid used is appropriate to capture maximum predicted impacts in the Hancock County area. The surface and upper air meteorological data selected for use in this analysis is appropriate. The Commonwealth chose to model emissions from Century Aluminum and the other sources included in the analysis from the most recent period available which is the 2014-2016 period. This should provide for a reliable estimate of $SO_2$ impacts in the area. As discussed in Section 6.3.2.5, Kentucky chose not to model the Alcoa Warrick Operations facility, an aluminum smelting facility, because the source had ceased smelting operations by March of 2016. However, the source has not shut down the smelting operations in a permanent and enforceable manner. The Alcoa Warrick Operations facility could therefore begin operating again. The Alcoa Warrick Power Plant, located adjacent to Alcoa Warrick Operations and shows similar emissions over the same time period. This facility was shown in the May 24, 2017, Modeling Report to contribute only 1E-05 – 6E-05 $\mu g/m^3$ $SO_2$ at the top 10 fourth-highest modeled receptors in the Daviess County area. Based on the overall stack characteristics for the two facilities, the highest concentrations from Warrick Operations are expected to be a shorter distance downwind than the highest concentrations from Alcoa Power. Therefore, it can be reasonably expected that if Alcoa Warrick Operations were included in the modeling, it would have impacts similar to the impacts predicted from Alcoa Warrick Power, and the combined impact of the two facilities would be much less than 1 $\mu g/m^3$. Therefore, inclusion of Alcoa Warrick Operations in the modeling analysis would likely result in only a small increase in predicted concentrations in the vicinity of Century Aluminum Hawesville. The EPA concurs with the non-inclusion of Alcoa Warrick Operations in this modeling analysis.

For the largest sources of $SO_2$ at the Century Aluminum facility, the Commonwealth chose to develop monthly emission rates from monthly production logs and test-derived emission factors. This is an acceptable approximation of actual emissions for units without CEMS. The EPA has also confirmed that Kentucky selected its monthly/hourly varying background concentrations from the Baskett fire house monitor in a manner consistent with the Modeling TAD. The Commonwealth made use of the most recent version of AERMOD (version 16216r). Thus, the EPA agrees that all components of this modeling assessment were performed in a manner consistent with the $SO_2$ Modeling TAD and that the maximum concentrations predicted by AERMOD are below the 1-hour $SO_2$ NAAQS.

## 6.4. Emissions and Emissions-Related Data, Meteorology, Geography, and Topography for the Hancock County Area

These factors have been incorporated into the air quality modeling efforts and results discussed above. The EPA is giving consideration to these factors by considering whether they were properly incorporated and by considering the air quality concentrations predicted by the modeling.

## 6.5. Jurisdictional Boundaries in the Hancock County Area

Existing jurisdictional boundaries are considered for the purpose of informing the EPA's designation action for Hancock County. Our goal is to base designations on clearly defined legal boundaries, and to have these boundaries align with existing administrative boundaries when reasonable.

The modeling domain extends from Century Aluminum Hawesville at a radius of 50 km, and so covers the entirety of Hancock, most of Breckinridge, northern Ohio, northwestern Meade, and much of Daviess Counties in Kentucky. The modeled receptors also covered Perry, Spencer, southeastern Warrick, southern Dubois, and southwestern Crawford Counties in Indiana.

## 6.6. The EPA's Assessment of the Available Information for the Hancock County Area

The EPA intends to designate the Hancock County area, including the entire County boundary, as unclassifiable/attainment. We believe that Kentucky's modeling analysis supports the conclusion that there are no expected violations of the 2010 $SO_2$ NAAQS in the area. There is no current, complete monitoring data available for the area, so the modeling serves to reflect the air quality expected in the years modeled. The Owensboro monitor (AQS ID: 21-059-0005) in the nearby Daviess County area, located 1.5 km from Elmer Smith Station and 31 km from Century Aluminum Hawesville, has one quarter of incomplete data in 2015, meaning the 2015 and 2016 DVs are incomplete and have not been shown to be located in the area of maximum concentration for Century Aluminum or Elmer Smith and thus cannot be relied on for designations. There are no other existing monitors to help characterize the air quality in the Hancock County area.

Based on the air quality characterization conducted within the Hancock County area of analysis in accordance with the EPA's Modeling TAD, the Commonwealth concluded that the area should be designated as attainment. This recommendation is based on Kentucky's assessment that emissions from the Century Aluminum Hawesville facility could interact with those from the Alcoa Warrick Power Plant, Rockport Station, Culley Station, Big Rivers Electric Corporation – Coleman Station, and Elmer Smith Station facilities and together impact the area, and the inclusion of these four DRR sources in the modeling demonstration. Century Aluminum Hawesville and Big Rivers Electric Corporation's Coleman Station are the only Hancock County

sources that emitted over 100 tons in 2014, and Coleman Station ceased operations in May of 2014. Elmer Smith Station, Alcoa Warrick Power Plant, Culley Station, and Rockport Station are the only other sources in the 50 km area of analysis thought to impact the Hancock County area.

Kentucky evaluated possible contributions from these sources and other sources within 50 km of Century Aluminum to $SO_2$ impacts in the Hancock County area. Based on Kentucky's 20D analysis, Kentucky decided in the Modeling Report to include possible contributions from nearby Alcoa Warrick Power Plant, Rockport Station, Culley Station, and Elmer Smith Station by modeling actual emissions. In addition, Big Rivers Electric Corporation – Coleman Station was included in the modeling due to its close proximity to Century Aluminum and the potential for the source to impact $SO_2$ concentrations in the immediate area around Century Aluminum. The Commonwealth excluded Alcoa Warrick Operations because this source was temporarily not operating and based on expected minimal impacts from this facility on maximum $SO_2$ concentrations in the vicinity of Century Aluminum. The Alcoa Power Plant facility is located immediately adjacent to Warrick Operations with $SO_2$ emissions greater than Warrick Operations and was included in the modeling, showing impacts of less than 1 $\mu g/m^3$ to maximum impacts in the vicinity of Century Aluminum from all sources combined. The Alcoa Warrick Operations facility was not permanently and enforceably shut down. However, given the relative distance of this source from the Century Aluminum Hawesville facility (48 km) and the very low impacts from nearby Alcoa Warrick Power Plant in the Hancock County area of analysis, the EPA does not expect that including Alcoa Warrick Operations in the modeling analysis would significantly increase predicted concentrations in the Hancock County area.

Kentucky then added a reasonable value for background concentrations of $SO_2$ by including the 2014 – 2016 monthly/hourly varying concentrations from the Baskett monitor in Henderson County. The EPA agrees with the technical explanation for the Commonwealth's treatment of nearby $SO_2$ sources included in the June 5, 2017, Modeling Report. We believe the modeling of the sources included adequately represents the Hancock County area. The EPA has reason to believe there are no additional sources in areas adjacent to our intended area that are likely to cause or contribute to a violation of the NAAQS in the area of analysis. The EPA considered the low impacts shown from nearby Alcoa Warrick Power Plant in the Daviess County area (1E-05 – 6E-05 $\mu g/m^3$). In addition, based on the available information for the remaining areas in Kentucky and neighboring Indiana, including monitoring and modeling, there are no current $SO_2$ nonattainment areas near Hancock County. The EPA intends to designate a portion of Warrick County, Indiana, as nonattainment based on third party modeling received for the A.B. Brown facility which included the Warrick County, Indiana and Henderson County, Kentucky (See the Indiana chapter of this TSD for more information). Additionally, the modeling assessment for the Warrick County, Indiana, and Henderson County, Kentucky, area indicates violations of the 1-hour $SO_2$ NAAQS in Henderson County, Kentucky, across the river from the Alcoa Warrick facilities. The EPA has concerns with the modeling demonstration for the Warrick County area, and accordingly intends to designate a portion of Henderson County, Kentucky as unclassifiable (See the Henderson County area section of this chapter of the TSD for more information). The EPA extracted the impacts (from model output files) from the Century Aluminum Hawesville facility to receptors within 5 km of Warrick Operations including portions of Henderson County, Kentucky, and Warrick County, Indiana. The 1-hour $SO_2$ impacts from Century Aluminum in the area ranged from 5 to 7 $\mu g/m^3$ (1.9 ppb – 2.7 ppb). Therefore, the Century Aluminum Hawesville

facility does not cause significant concentration gradients in the relevant portions of Henderson County, Kentucky or Warrick County, Indiana. Thus, the Hancock County area is not expected to contribute to ambient air quality in a nearby area that may not meet the NAAQS.

After careful evaluation of the Commonwealth's recommendation and supporting information, as well as all available relevant information, the EPA intends to designate the area around Century Aluminum Hawesville as unclassifiable/attainment for the 2010 $SO_2$ NAAQS. Specifically, the boundaries are comprised of the entirety of Hancock County. There are no remaining portions of Hancock County that remain to be characterized in the EPA's Round 4 of designations in 2020, nor are there any other portions of the County that have a separate area of analysis for Round 3.

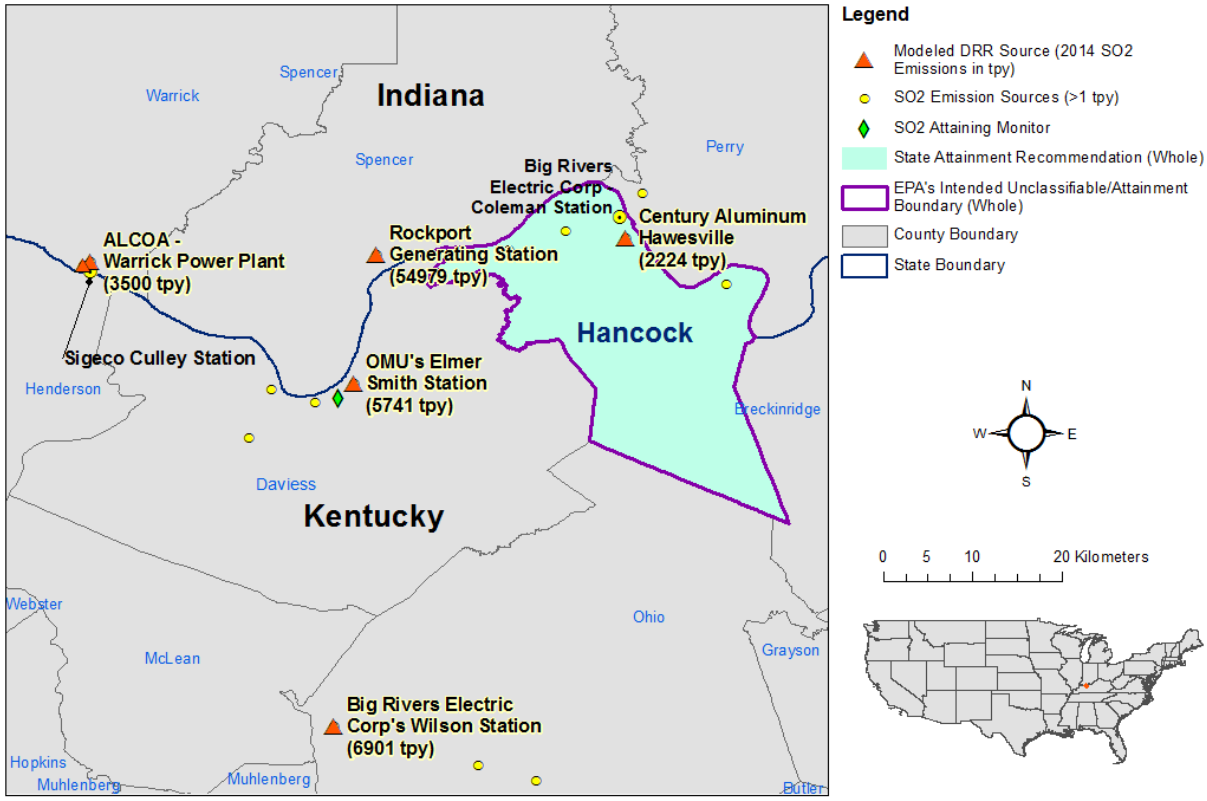
The EPA believes that our intended unclassifiable/attainment area, bounded by the entirety of Hancock County, will have clearly defined legal boundaries, and we intend to find these boundaries to be a suitable basis for defining our intended unclassifiable/attainment area.

## 6.7. Summary of Our Intended Designation for the Hancock County Area

After careful evaluation of the state's recommendation and supporting information, as well as all available relevant information, the EPA intends to designate the Hancock County area as unclassifiable/attainment for the 2010 $SO_2$ NAAQS because the EPA has determined the area meets the 2010 $SO_2$ NAAQS and does not contribute to ambient air quality in a nearby area that does not meet the NAAQS. Specifically, the boundaries are comprised of the entirety of Hancock County.

Figure 31 shows the boundary of this intended designated area.

**Figure 31. Boundary of the Intended Hancock County Unclassifiable/Attainment Area**




At this time, our intended designations for the state only apply to this area and the other areas presented in this technical support document. The EPA intends in a separate action to evaluate and designate all remaining undesignated areas in Kentucky by December 31, 2020.

# 7. Technical Analysis for the Mason County Area

## 7.1. Introduction

The EPA must designate the Mason County area by December 31, 2017, because the area has not been previously designated and Kentucky has not installed and begun timely operation of a new, approved $SO_2$ monitoring network meeting the EPA specifications referenced in the EPA's $SO_2$ DRR for any sources of $SO_2$ emissions in Mason County. The DRR source, East Kentucky Power Cooperative's Spurlock Station, is by the Ohio River, which is the border between Kentucky and Ohio. Therefore, the area of analysis, and the modeling receptors, cross the Kentucky state boundary into neighboring Ohio.

## 7.2. Air Quality Monitoring Data for the Mason County Area

This factor considers the $SO_2$ air quality monitoring data in the area of Mason County. Kentucky provided the values of the 99$^{th}$ percentile of the $SO_2$ monitors in Kentucky. Kentucky stated "the average of the 99$^{th}$ percentile at all monitors is below the standard of 75 ppb in all locations except Jefferson County.[37] The rest of the areas in Kentucky comply with the standard and should be designated as attainment/unclassifiable for the $SO_2$ standard."

The EPA reviewed the available air quality monitoring data in the AQS database and found the following nearby data:

- The ADAMHOS (West Union) $SO_2$ monitor (AQS ID: 39-001-0001) is located at 38.794667, -83.533988 in nearby Adams County, Ohio, 16.5 miles northeast of the Spurlock Power Station. Data collected by this monitor is comparable to the NAAQS, and indicates that the most recent $SO_2$ levels are below the 1-hr NAAQS. The most recent three years of complete, quality-assured, certified data from this monitor (2014-2016) indicate a 1-hr $SO_2$ design value of 24 ppb. However, this monitor was not located to characterize the maximum 1-hr $SO_2$ concentrations of East Kentucky Power Cooperative's Hugh L. Spurlock Station. Kentucky provided an air quality modeling analysis to characterize the maximum 1-hr $SO_2$ concentrations in the area (see Section 7.3 below).

In reviewing the available air quality monitoring data in AQS, the EPA determined that other than the data described above, there is no additional relevant data in AQS collected in or near Mason County that could inform the intended designation action. The most recent $SO_2$ design values for all areas of the country are available at https://www.epa.gov/air-trends/air-quality-design-values.

[37] The EPA designated a portion of Jefferson County, Kentucky nonattainment for the 1-hour $SO_2$ NAAQS. This nonattainment area is comprised of the Watson Lane monitor (AQS 21-111-0051) and the Louisville Gas & Electric Mill Creek Generating Station.

## 7.3. Air Quality Modeling Analysis for the Mason County Area Addressing East Kentucky Power Cooperative's Hugh L. Spurlock Generating Station (Spurlock Station)

### *7.3.1. Introduction*

This section 4.3 presents all the available air quality modeling information for a portion of Mason County that includes East Kentucky Power Cooperative's Hugh L. Spurlock Generating Station (Spurlock Station) (This portion of Mason County will often be referred to as "the Mason County area" within this section 7.3.) This area contains one DRR source, the Spurlock Station facility, around which Kentucky is required by the DRR to characterize $SO_2$ air quality, or alternatively establish an $SO_2$ emissions limitation of less than 2,000 tpy. Kentucky's modeling demonstration for the Mason County area also includes nearby sources across the state border in Ohio. These are DRR sources thought to impact the Mason County area. All DRR sources evaluated for this area of analysis are listed below:

- The Spurlock Station facility emitted 2,000 tons or more annually. Specifically, Spurlock Station emitted 4,689 tons of $SO_2$ in 2014 and 2,961 tons in 2015. This source meets the DRR criteria and thus is on the $SO_2$ DRR Source list, and Kentucky has chosen to characterize it via modeling.

- The AES-DP&L's Stuart Station (Stuart Station) and AES-DP&L's Killen Station (Killen Station) facilities both emitted 2,000 tons or more annually, and both sources are on the $SO_2$ DRR Source list. Stuart Station emitted 10,852 tons in 2014 and Killen Station emitted 13,096 tons in 2014. These sources were included by Kentucky in characterizing the Mason County area; however, the area around these sources (in Adams County, Ohio) is discussed again explicitly in the Ohio TSD chapter.

In its submission, Kentucky recommended that an area that includes the area surrounding the Spurlock Station facility, specifically Mason County, be designated as attainment based on an assessment and characterization of air quality impacts from these facilities and other nearby sources that may have a potential impact in the area where the 2010 $SO_2$ NAAQS may be exceeded. This assessment and characterization was performed using air dispersion modeling software, i.e., AERMOD, analyzing actual emissions. After careful review of the state's assessment, supporting documentation, and all available data, the EPA intends to designate the area as unclassifiable/attainment. Our reasoning for this conclusion is explained in a later section of this TSD, after all the available information is presented.

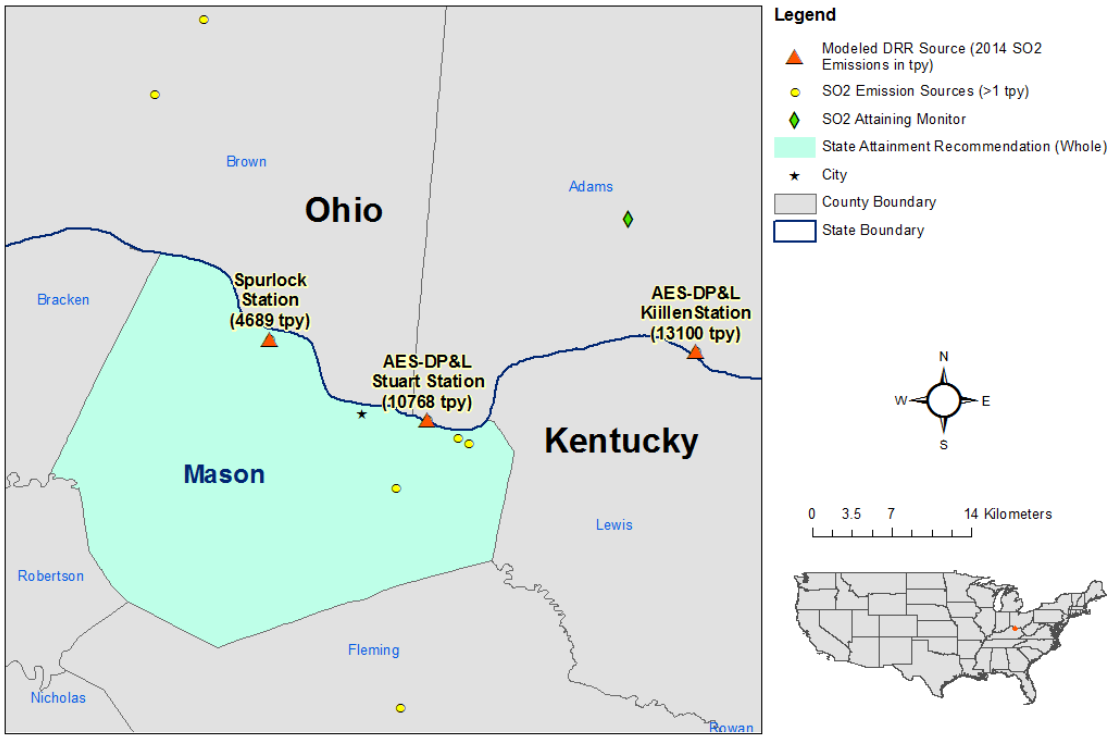
The area that the Commonwealth has assessed via air quality modeling is located in Mason County, Kentucky, just northwest of the city of Maysville, just south of the Ohio River.

As seen in Figure 32 below, the Spurlock Station facility is located in Mason County, adjacent to the Ohio River on West 2nd Street, 8.8 km northwest of the city center of Maysville, Kentucky. Also included in the figure is the Commonwealth's recommended area for the attainment designation. The EPA's intended unclassifiable/attainment designation boundary for the Mason

County area is not shown in this figure, but is shown in a figure in the section below that summarizes our intended designation.

Included in Figure 32 are other nearby emitters of $SO_2$.[38] The other DRR sources included in the modeling analysis are shown in Figure 32 including Stuart Station which is located in nearby Adams County, Ohio, along the northern bank of the Ohio River, southeast of Spurlock Station; and Killen Station which is located in nearby Adams County, Ohio, along the northern bank of the Ohio River, directly east of Spurlock Station.

**Figure 32. Map of the Mason County Area Addressing Spurlock Station**




The discussion and analysis that follows below will reference the Modeling TAD and the factors for evaluation contained in the EPA's July 22, 2016, guidance and March 20, 2015, guidance, as appropriate.

For this area, the EPA received and considered one modeling assessment from the Commonwealth and one assessment from the State of Ohio. The assessment from Ohio includes Spurlock Station. Because this modeling assessment was meant to satisfy the DRR for Ohio, EPA will not refer to it in this section on Mason County.[39] More information on Ohio's assessment of the Adams County area is available in the Ohio chapter of this TSD. To avoid

[38] All other $SO_2$ emitters of 1 tpy or more (based on information in the Kentucky, Ohio, and Indiana emissions inventory are shown in Figure 32.

[39] Ohio's modeling report for Adams County and the two DRR sources (Stuart Station and Killen Station) shows impacts below the NAAQS in Mason County. However, Kentucky explicitly included these two Ohio DRR sources in the modeling assessment for characterizing the area around Spurlock Station. Therefore, the EPA will refer to Kentucky's modeling assessments of the Mason County area in this section of the TSD only.

confusion in referring to these assessments, the following table lists them, indicates when they were received from the Commonwealth, provides an identifier for the assessment that is used in the discussion of the assessments that follow, and identifies any distinguishing features of the modeling assessments.

**Table 24 – Modeling Assessments for the Mason County Area**

| Assessment Submitted by | Date of the Assessment | Identifier Used in this TSD | Distinguishing or Otherwise Key Features |
|---|---|---|---|
| Commonwealth of Kentucky | April 29, 2016* | April 29, 2016 Modeling Report | Only formal modeling report received. |

*This modeling report, date April 29, 2016, was submitted to the EPA on January 6, 2017.

### *7.3.2. Modeling Analysis Provided by the Commonwealth*

#### *7.3.2.1. Model Selection and Modeling Components*

The EPA's Modeling TAD notes that for area designations under the 2010 $SO_2$ NAAQS, the AERMOD modeling system should be used, unless use of an alternative model can be justified. The AERMOD modeling system contains the following components:

- AERMOD: the dispersion model
- AERMAP: the terrain processor for AERMOD
- AERMET: the meteorological data processor for AERMOD
- BPIPPRM: the building input processor
- AERMINUTE: a pre-processor to AERMET incorporating 1-minute automated surface observation system (ASOS) wind data
- AERSURFACE: the surface characteristics processor for AERMET
- AERSCREEN: a screening version of AERMOD

The State used AERMOD version 15181, using all regulatory default options. AERMOD version 16216r has since become the regulatory model version. There were no updates from 15181 to 16216r that would significantly affect the concentrations predicted here. A discussion of the Commonwealth's approach to the individual components is provided in the corresponding discussion that follows, as appropriate. The current version of AERMOD, version 16216r, includes updates to 40 CFR part 51, Appendix W, "Guideline of Air Quality Models," published on January 17, 2017 (82 FR 5203). This version of AERMOD also includes fixes to bugs that were inadvertently included in version 16216. Kentucky chose not to use the latest version of AERMOD because the state is using the regulatory default settings for version 15181 available at the time of its modeling preparation and is not making use of any previously unapproved alternative modeling options included in version 16216r and the update to Appendix W.

#### *7.3.2.2. Modeling Parameter: Rural or Urban Dispersion*

For any dispersion modeling exercise, the "urban" or "rural" determination of a source is important in determining the boundary layer characteristics that affect the model's prediction of

downwind concentrations. For $SO_2$ modeling, the urban/rural determination is important because AERMOD invokes a 4-hour half-life for urban $SO_2$ sources. Section 6.3 of the Modeling TAD details the procedures used to determine if a source is urban or rural based on land use or population density. The EPA's recommended procedure for characterizing an area by prevalent land use is based on evaluating the dispersion environment within 3 km of the facility. According to the EPA's modeling guidelines, rural dispersion coefficients are to be used in the dispersion modeling analysis if more than 50 percent of the area within a 3 km radius of the facility is classified as rural. Conversely, if more than 50 percent of the area is urban, urban dispersion coefficients should be used in the modeling analysis.

The Commonwealth used the Auer land use methodology as discussed in the modeling TAD and examined the various land use within 3 km of Spurlock Station to quantify the percentage of area in various land use categories. Following this guidance, 2011 land use data (the most recently available at the time of the assessment) were obtained from the U.S. Geological Survey through ArcGIS and a 3 km radius circle inscribed electronically around the Spurlock Station was generated. Figure 33 shows the layout of the land use and Table 25 shows the results of the land use categorization process. The area is predominantly rural (93.4 percent), therefore, for the purpose of performing the modeling for the area of analysis, the Commonwealth determined that it was most appropriate to run the model with rural dispersion coefficients, and the EPA concurs with this assessment.

**Figure 33. Land Use Map for Area Within 3km of the Spurlock Station facility. Source: "Air Dispersion Modeling Report, Spurlock Station in Maysville, Kentucky, $SO_2$ NAAQS Designation Modeling Analysis Under the Data Requirements Rule, Revision 1," prepared by East Kentucky Power Cooperative, April 29, 2016.**

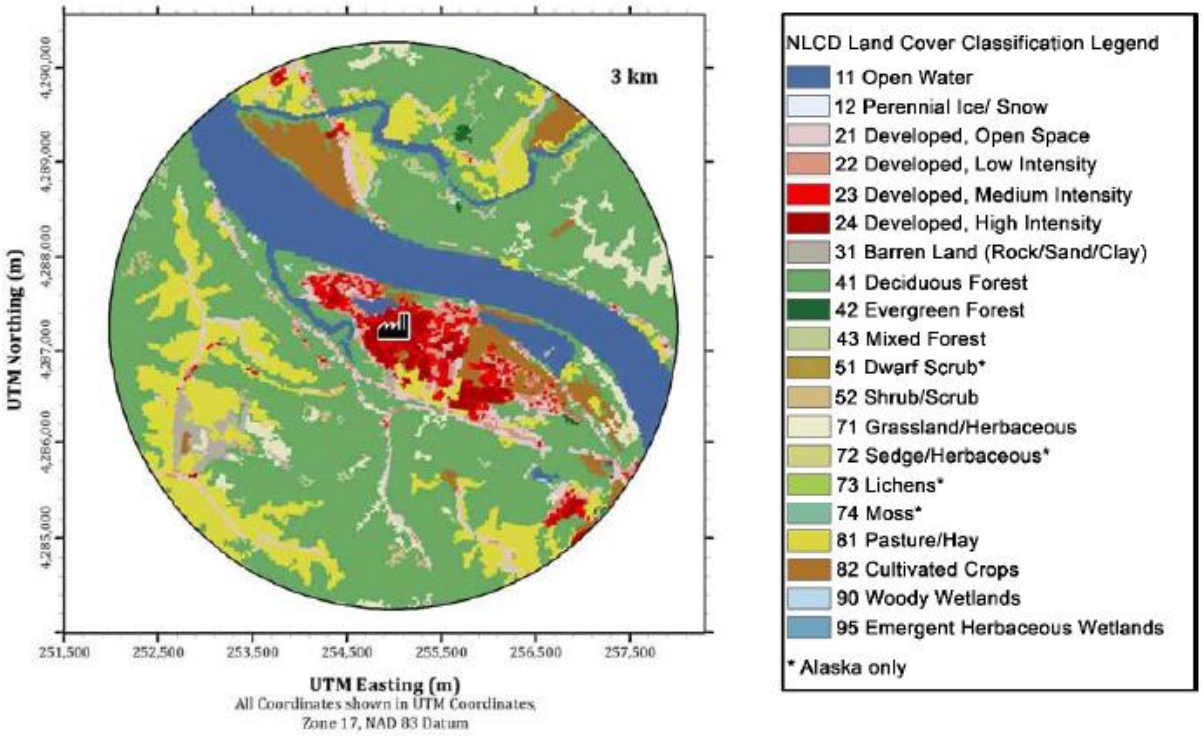


**Table 25 – Determination of the Urban or Rural Modeling Parameter for the Mason County Area by Auer's Method with 2011 Land Use Information**

| Category ID | Category Description | Percent |
|---|---|---|
| 11 | Open Water | 14.8% |
| 21 | Developed, Open Space | 4.4% |
| 22 | Developed, Low Intensity | 2.5% |
| 23 | Developed, Medium Intensity | 2.2% |
| 24 | Developed, High Intensity | 2.0% |
| 31 | Barren Land | 1.1% |
| 41 | Deciduous Forest | 49.7% |
| 42 | Evergreen Forest | 0.2% |
| 43 | Mixed Forest | 0.7% |
| 52 | Shrub/Scrub | 0.5% |
| 71 | Grassland/Herbaceous | 3.3% |
| 81 | Pasture/Hay | 13.9% |
| 82 | Cultivated Crops | 4.7% |
| 90 | Woody Wetlands | 0.0% |
| 95 | Emergent Herbaceous Wetlands | 0.0% |
| | Total | 100% |
| | Urban | 6.6% |
| | Rural | 93.4% |

The EPA agrees with the Commonwealth's assessment that the area around the Spurlock Station is predominantly rural and that AERMOD should be utilized with the rural option. This component of the modeling analysis was performed in a manner consistent with the $SO_2$ Modeling TAD.

#### *7.3.2.3. Modeling Parameter: Area of Analysis (Receptor Grid)*

The TAD recommends that the first step towards characterization of air quality in the area around a source or group of sources is to determine the extent of the area of analysis and the spacing of the receptor grid. Considerations presented in the Modeling TAD include but are not limited to: the location of the $SO_2$ emission sources or facilities considered for modeling; the extent of concentration gradients due to the influence of nearby sources; and sufficient receptor coverage and density to adequately capture and resolve the model predicted maximum $SO_2$ concentrations.

The source of $SO_2$ emissions subject to the DRR in this area is described in the introduction to this section. For the Mason County area, the Commonwealth has included two other emitters of $SO_2$ within 50 km of Spurlock Station in any direction. The Commonwealth determined that this was the appropriate distance to adequately characterize air quality through modeling to include the potential extent of any $SO_2$ NAAQS exceedances in the area of analysis and any potential impact on $SO_2$ air quality from other sources in nearby areas. In addition to Spurlock Station, the other emitters of $SO_2$ included in the area of analysis are Stuart Station and Killen Station. No

other sources beyond 50 km were determined by the Commonwealth to have the potential to cause concentration gradient impacts within the area of analysis.

The grid receptor spacing for the area of analysis chosen by the Commonwealth is as follows:

- Receptors along the fenceline every 50 m
- Receptors every 100 m from fence line to 3 km
- Receptors every 250 m from 3 km to 5 km
- Receptors every 500 m from 5 km to 10 km
- Receptors every 1,000 m from 10 km to 20 km
- Receptors every 2,000 m from 20 km to 50 km

Additionally, to ensure that maximum impacts were identified, a 100-meter receptor grid was placed around the maximum predicted $SO_2$ concentrations as needed.

The receptor network contained 7,236 receptors, and the network covered Mason, Fleming, Robertson, Nicholas, Bracken, eastern Harrison, eastern Pendleton, and southeastern Campbell counties and most of Lewis County in northern Kentucky, and southern Clermont, southwestern Highland, western Scioto counties, and most of Brown and Adams counties in southern Ohio.

Figures 34 and 35, included in the Commonwealth's recommendation, show the Commonwealth's chosen area of analysis surrounding the Spurlock Station facility, as well as the receptor grid for the area of analysis.

Consistent with the Modeling TAD, the Commonwealth placed receptors for the purposes of this designation effort in locations that would be considered ambient air relative to the Spurlock Station fenceline. Receptors from the modeling domain that fell within the boundaries of other facilities included in the modeling analysis were not removed. Receptors in the Ohio River have been excluded from consideration in the modeling because it is not possible to place a monitor over these areas, as per the modeling TAD. Receptors within the fenceline of Spurlock Station were excluded by the Commonwealth except for a line of receptors that runs across the property from east southeast to west northwest representing a rail right-of-way that was modeled because the area along the tracks could be considered as ambient air. The modeling report from the Commonwealth indicates that all fencing is intact and prevents the public from accessing the property. In addition, all roadways are gated with limited access through guarded entryways.

**Figure 34: Receptor Grid for the Mason County Area. Source: "Air Dispersion Modeling Report, Spurlock Station in Maysville, Kentucky, $SO_2$ NAAQS Designation Modeling Analysis Under the Data Requirements Rule, Revision 1," prepared by East Kentucky Power Cooperative, April 29, 2016.**

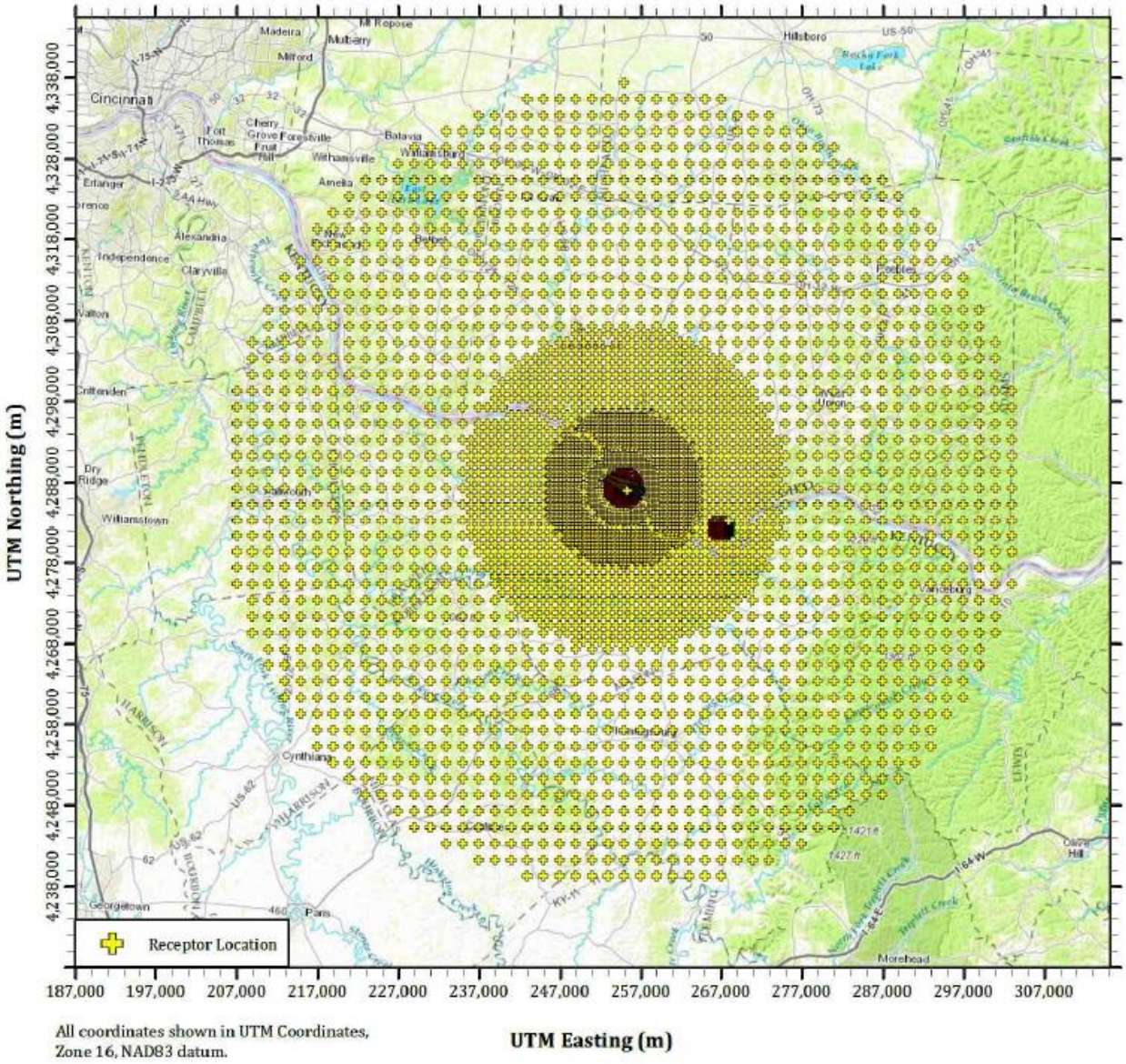
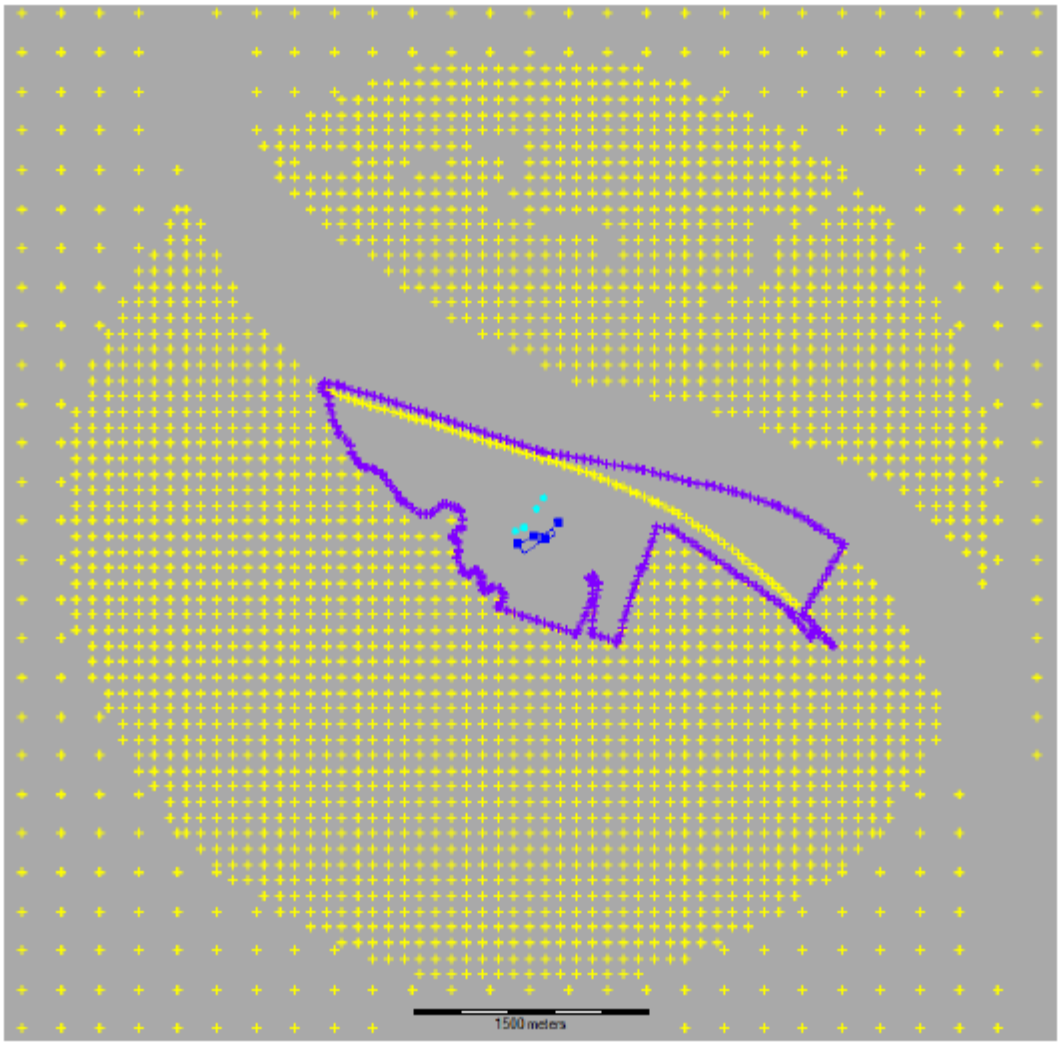


**Figure 35: Innermost Portion of the Receptor Grid for the Mason County Area with 100-Meter Spacing at the Area with the Highest Concentration. Source: "Air Dispersion Modeling Report, Spurlock Station in Maysville, Kentucky, $SO_2$ NAAQS Designation Modeling Analysis Under the Data Requirements Rule, Revision 1," prepared by East Kentucky Power Cooperative, April 29, 2016.**




The EPA agrees with the receptor grid used in this analysis, including the exclusion of receptors located within the fenceline of Spurlock Station and the exclusion of receptors that were located within the Ohio River or any other bodies of water within the modeling domain. This component of the modeling analysis was performed in a manner consistent with the $SO_2$ Modeling TAD.

#### *7.3.2.4. Modeling Parameter: Source Characterization*

Section 6 of the Modeling TAD offers recommendations on source characterization including source types, use of accurate stack parameters, inclusion of building dimensions for building downwash (if warranted), and the use of actual stack heights with actual emissions or following GEP policy with allowable emissions.

The Spurlock Station has four larger and four smaller units emitting $SO_2$. Each unit has a dedicated stack for a total of nine stacks, four of which are associated with the coal-fired units and are large individual stacks and five of which are typical small stacks for the emergency generators. The Spurlock Station units are identified below along with any $SO_2$ control devices or other operational systems:

1. Unit 1, coal-fired Indirect Heat Exchanger with scrubber,
2. Unit 2, coal-fired Indirect Heat Exchanger with scrubber,
3. Unit 3, coal-fired Circulating Fluidized Bed with scrubber,
4. Unit 4, coal-fired Circulating Fluidized Bed with scrubber,
5. Diesel-fired emergency generator,
6. Diesel-fired emergency generator,
7. Diesel-fired emergency generator,
8. Diesel-fired emergency generator and
9. Fire pump engine.

All units listed above from Spurlock Station were included in the modeling with the exception of the fire pump engine which was excluded from the modeling in a manner consistent with the $SO_2$ Modeling TAD due to a low number of hours of operation per year (approximately 36.6 hours from December 2012 – March 2016).

Using the 20D method, Stuart Station and Killen Station both emitted greater than 2,000 tons of $SO_2$ and were included for modeling due to their Q/d analysis being substantially greater than 20. The Stuart Station is located about 18 km east southeast of Spurlock Station and the Killen Station is located about 29 km to the east of Spurlock Station.

The Commonwealth characterized these sources within the area of analysis in accordance with the best practices outlined in the Modeling TAD. Specifically, the Commonwealth used actual stack heights in conjunction with actual emissions. The Commonwealth also adequately characterized the source's building layout and location, as well as the stack parameters, e.g., exit temperature, exit velocity, location, and diameter. Where appropriate, the AERMOD component BPIPPRM was used to assist in addressing building downwash.

The EPA agrees with this aspect of the modeling analysis, including the use of actual emissions and stack heights for all three facilities modeled and the parameterization of building downwash from structures and emissions at Spurlock Station. This component of the modeling analysis was performed in a manner consistent with the $SO_2$ Modeling TAD.

#### *7.3.2.5. Modeling Parameter: Emissions*

The EPA's Modeling TAD notes that for the purpose of modeling to characterize air quality for use in designations, the recommended approach is to use the most recent 3 years of actual emissions data and concurrent meteorological data. However, the TAD also indicates that it would be acceptable to use allowable emissions in the form of the most recently permitted (referred to as PTE or allowable) emissions rate that is federally enforceable and effective.

The EPA believes that CEMS data provide acceptable historical emissions information, when they are available. These data are available for many electric generating units. In the absence of CEMS data, the EPA's Modeling TAD highly encourages the use of AERMOD's hourly varying emissions keyword HOUREMIS, or through the use of AERMOD's variable emissions factors keyword EMISFACT. When choosing one of these methods, the EPA recommends using detailed throughput, operating schedules, and emissions information from the impacted source(s).

In certain instances, states and other interested parties may find that it is more advantageous or simpler to use PTE rates as part of their modeling runs. For example, where a facility has recently adopted a new federally enforceable emissions limit or implemented other federally enforceable mechanisms and control technologies to limit $SO_2$ emissions to a level that indicates compliance with the NAAQS, the state may choose to model PTE rates. These new limits or conditions may be used in the application of AERMOD for the purposes of modeling for designations, even if the source has not been subject to these limits for the entirety of the most recent 3 calendar years. In these cases, the Modeling TAD notes that a state should be able to find the necessary emissions information for designations-related modeling in the existing $SO_2$ emissions inventories used for permitting or SIP planning demonstrations. In the event that these short-term emissions are not readily available, they may be calculated using the methodology in Table 8-1 of Appendix W to 40 CFR Part 51 titled, "Guideline on Air Quality Models."

As previously noted, the Commonwealth included Spurlock Station and two other emitters of $SO_2$ within 50 km in the area of analysis. For this area of analysis, the Commonwealth has opted to use actual emissions for all facilities included in the modeling analysis. The facilities in the Commonwealth's modeling analysis and their associated actual emission rates are summarized below.

For Spurlock, Killen, and Stuart Stations, the Commonwealth provided annual actual $SO_2$ emissions between 2012 and 2014. Spurlock Station provided actual hourly emissions for 4 of their larger modeled units (Source ID: SPUR1 – 4). This information is summarized in Table 26. A description of how the Commonwealth obtained hourly emission rates is given below this table.

**Table 26. Actual $SO_2$ Emissions Between 2012 – 2014 from Facilities in the Area of Analysis for the Mason County Area**

| | **$SO_2$ Emissions (tpy)** | | |
|---|---|---|---|
| **Facility Name** | **2012** | **2013** | **2014** |
| Spurlock Station (Units 1-4) | 5,131 | 4,469 | 4,689 |
| Killen Station | 5,362 | 7,885 | 13,096 |
| Stuart Station | 8,864 | 11,542 | 10,852 |
| Total Emissions from All Facilities in the Area of Analysis Modeled Based on Actual Emissions | 19,357 | 23,896 | 28,637 |

For Spurlock, Killen and Stuart Stations, the actual hourly emissions data were obtained from CEMS. Spurlock Station also used other parametric monitoring data in the form of hourly $SO_2$ emission rates and boiler heat input rates when constructing actual hourly emissions. This

method was used only to fill in gaps in CEMS data. CAMD annual emissions for Spurlock Station were compared to the hourly emissions file used in the AERMOD modeling run and found to be equal to the CAMD annual emissions values.

For Spurlock Station, the state also provided emissions values for their four emergency generators (Source ID: EMERGEN1-4). This information is summarized in Table 27. A description of how the Commonwealth obtained hourly emission rates is given below this table.

**Table 27. $SO_2$ Emissions for Intermittently Operated Units from Facilities in the Area of Analysis for the Mason County Area Based on Assumed Continuous Operation**

| Facility Name | $SO_2$ Emissions (tpy, based on stack testing) |
|---|---|
| Spurlock Station – Emergency Generator 1 | 1.1 |
| Spurlock Station – Emergency Generator 2 | 0.9 |
| Spurlock Station – Emergency Generator 3 | 1.3 |
| Spurlock Station – Emergency Generator 4 | 1.5 |
| Total Emissions from Facilities in the Area of Analysis Modeled Based on Stack Testing | 4.8 |

The emissions values shown in the table above are based on the assumption that the four sources would emit at the level of their stack test value for all hours of the three years modeled. Emissions were assumed to be the same in each modeled year.

The EPA concurs with the use of actual hourly emissions data for the three facilities included in the modeling. The EPA has compared the sum of the hourly emissions modeled for Spurlock Station, Killen Station, and Stuart Station for each year modeled and determined that these values equal yearly values reported to the Clean Air Markets Division. Also, $SO_2$ emissions at Spurlock Station, Killen Station, and Stuart Station in 2015 were less than or equivalent to emissions from the 2012-2014 period modeled. Therefore, the period modeled should be sufficient for estimating $SO_2$ impacts, and the EPA concurs with use of actual emissions data from the 2012-2014 period. Four emergency sources at Spurlock Station were also included in the modeling analysis for all hours of the three years modeled at the level of their stack testing emission rates. This is a cautious approach for approximating impacts from these intermittently operated emergency generators. This component of the modeling analysis was performed in a manner consistent with the $SO_2$ Modeling TAD.

#### *7.3.2.6. Modeling Parameter: Meteorology and Surface Characteristics*

As noted in the Modeling TAD, the most recent 3 years of meteorological data (concurrent with the most recent 3 years of emissions data) should be used in designations efforts. The selection of data should be based on spatial and climatological (temporal) representativeness. The representativeness of the data is determined based on: 1) the proximity of the meteorological monitoring site to the area under consideration, 2) the complexity of terrain, 3) the exposure of the meteorological site, and 4) the period of time during which data are collected. Sources of

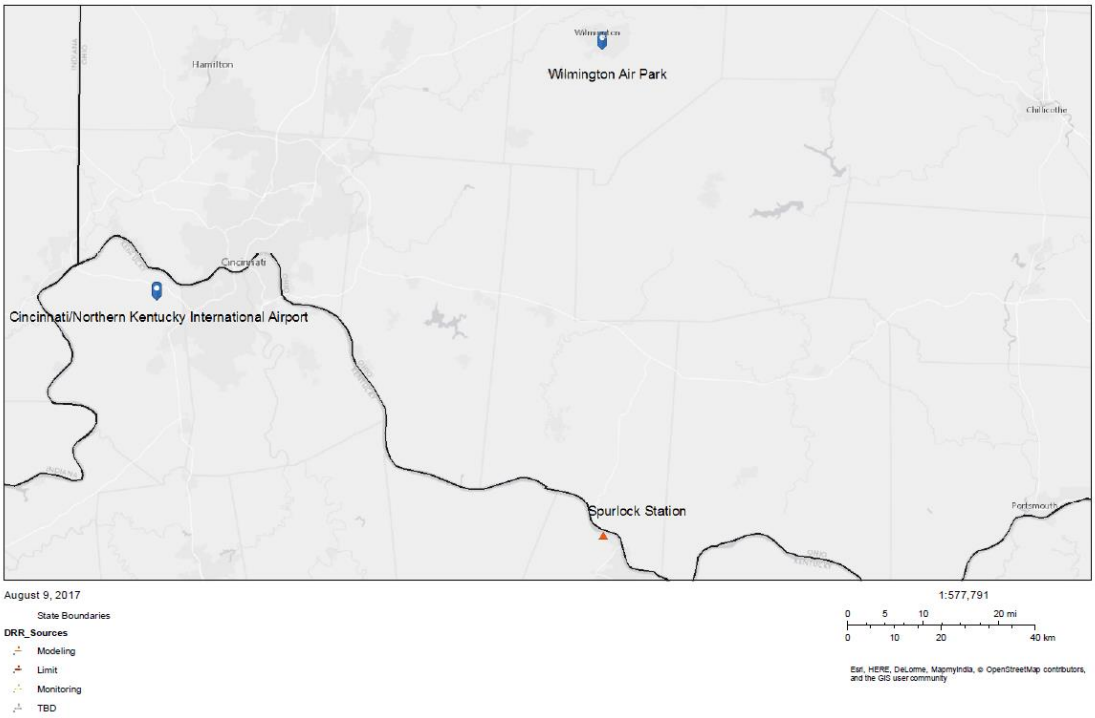
meteorological data include NWS stations, site-specific or onsite data, and other sources such as universities, FAA, and military stations.

For the area of analysis for the Mason County area, the state selected the surface meteorology from the Cincinnati/Northern Kentucky International Airport NWS station in Covington, Kentucky, located at 39.02 N, 84.67 W, 83.4 km to the northwest of the source, and coincident upper air observations from the Wilmington Air Park Airport NWS station in Wilmington, Ohio, located at 39.25 N, 83.47 W, 81.9 km north of Spurlock Station, as best representative of meteorological conditions within the area of analysis.

The Commonwealth used AERSURFACE version 13016 using data from the Cincinnati/Northern Kentucky International Airport NWS station to estimate the surface characteristics (albedo, Bowen ratio, and surface roughness [$z_o$]) of the area of analysis. Albedo is the fraction of solar energy reflected from the earth back into space, the Bowen ratio is the method generally used to calculate heat lost or heat gained in a substance, and the surface roughness is sometimes referred to as "zo" The state estimated surface roughness values for 12 spatial sectors out to 1-3 km at a seasonal temporal resolution for dry, wet, and average conditions.

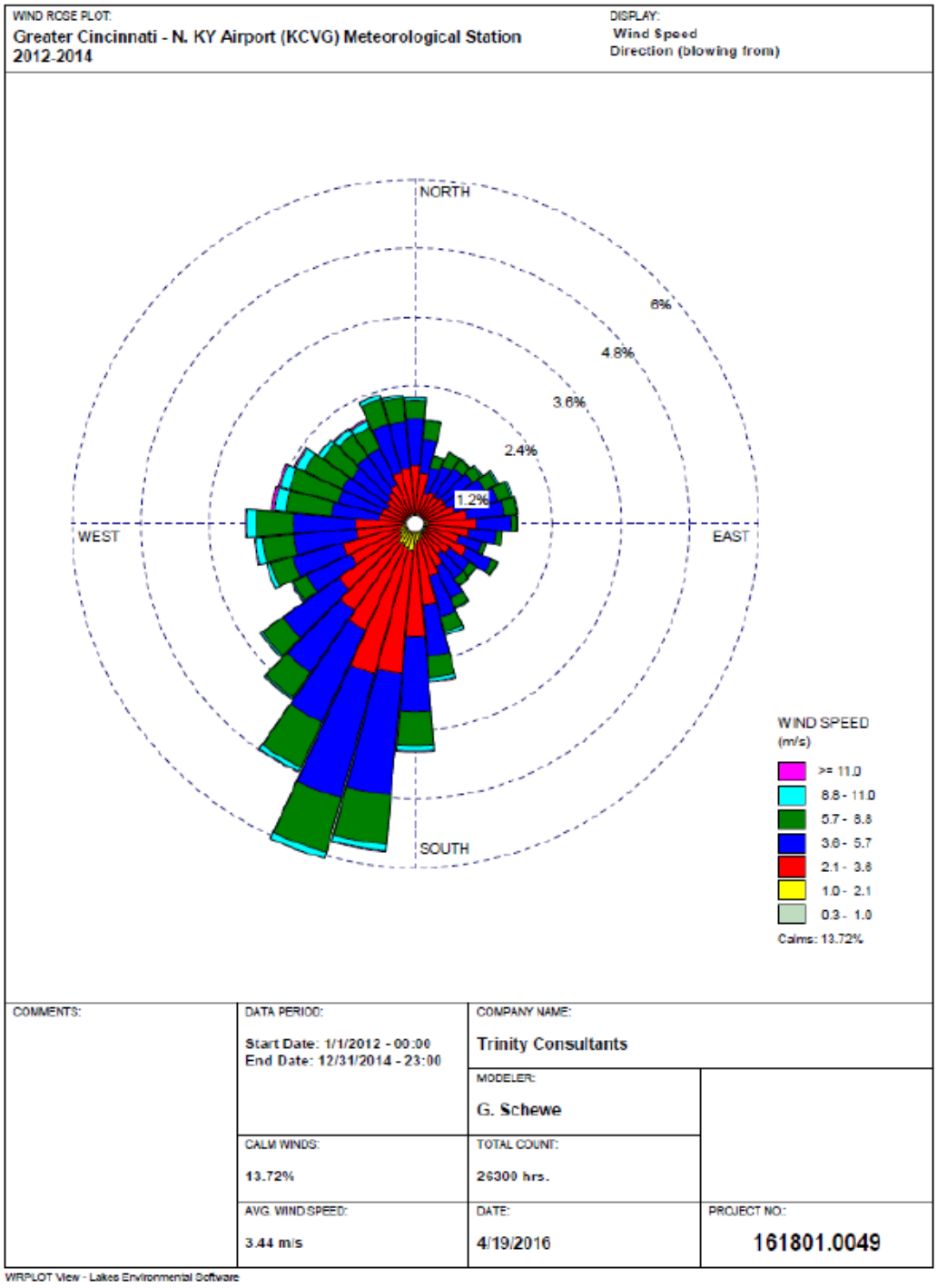
In the figure below, generated by the EPA, the locations of these NWS stations is shown relative to the area of analysis.

**Figure 36. Area of Analysis and the NWS stations in the Mason County Area**



As part of its recommendation, the Commonwealth provided the 3-year surface wind rose for the Hebron, Kentucky NWS site. In Figure 37, the frequency and magnitude of wind speed and direction are defined in terms of from where the wind is blowing. Analysis of the NWS data indicate winds predominately blow from the south (approximately 4 percent of the time) and southwest (approximately 20.3 percent of the time) directions. To a lesser extent, winds can be observed blowing from all other directions with relative equal frequency.

**Figure 37: Covington, Kentucky Cumulative Annual Wind Rose for Years 2012 – 2014**




Meteorological data from the above surface and upper air NWS stations were used in generating AERMOD-ready files with the AERMET processor. The output meteorological data created by the AERMET processor is suitable for being applied with AERMOD input files for AERMOD modeling runs. The Commonwealth followed the methodology and settings presented in Section

7 of the $SO_2$ Modeling TAD in the processing of the raw meteorological data into an AERMOD-ready format, and used AERSURFACE to best represent surface characteristics.

Hourly surface meteorological data records are read by AERMET, and include all the necessary elements for data processing. However, wind data taken at hourly intervals may not always portray wind conditions for the entire hour, which can be variable in nature. Hourly wind data may also be overly prone to indicate calm conditions, which are not modeled by AERMOD. In order to better represent actual wind conditions at the meteorological tower, wind data of 1-minute duration was provided from the Covington, Kentucky, NWS station mentioned above, but in a different formatted file to be processed by a separate preprocessor, AERMINUTE. These data were subsequently integrated into the AERMET processing to produce final hourly wind records of AERMOD-ready meteorological data that better estimate actual hourly average conditions and that are less prone to over-report calm wind conditions. This allows AERMOD to apply more hours of meteorology to modeled inputs, and therefore produce a more complete set of concentration estimates. As a guard against excessively high concentrations that could be produced by AERMOD in very light wind conditions, the state set a minimum threshold of 0.5 m/s in processing meteorological data for use in AERMOD. In setting this threshold, no wind speeds lower than this value would be used for determining concentrations. This threshold was specifically applied to the 1-minute wind data. The "Ice-Free Winds Group" AERMINUTE option was selected due to the fact that a sonic anemometer has been installed at Cincinnati/Northern Kentucky International Airport on April 24, 2007.

The EPA agrees with the processing and use of surface data from the Cincinnati/Northern Kentucky airport and upper air data from the Wilmington, Ohio, airport in this modeling analysis. This component of the modeling analysis was performed in a manner consistent with the $SO_2$ Modeling TAD.

#### *7.3.2.7. Modeling Parameter: Geography, Topography (Mountain Ranges or Other Air Basin Boundaries) and Terrain*

The terrain in the area of analysis is best described as moderately hilly. To account for these terrain changes, the AERMAP terrain program within AERMOD was used to specify terrain elevations for all the receptors. The source of the elevation data incorporated into the model is from the USGS 1 arc-second NED.

The EPA concurs with this component of the Commonwealth's modeling. This component of the modeling analysis was performed in a manner consistent with the $SO_2$ Modeling TAD.

#### *7.3.2.8. Modeling Parameter: Background Concentrations of $SO_2$*

The Modeling TAD offers two mechanisms for characterizing background concentrations of $SO_2$ that are ultimately added to the modeled design values: 1) a "tier 1" approach, based on a monitored design value, or 2) a temporally varying "tier 2" approach, based on the $99^{th}$ percentile monitored concentrations by hour of day and season or month. For this area of analysis, the

Commonwealth elected to use a "tier 2" approach. Data were obtained from 2012-2014 for AQS Site: 39-001-0001 (West Union monitor) located in Adams County, Ohio, approximately 27 km northeast of Spurlock Station. These data were used to generate temporally varying background based on the 99th percentile monitored concentrations by hour of day in this analysis. The hourly average background concentrations for this area of analysis were determined by the state to vary from 14.79 μg/m$^3$, equivalent to 5.7 ppb when expressed in two significant figures,[40] to 45.24 μg/m$^3$ (17.3 ppb), with an average value of 25.57 μg/m$^3$ (9.8 ppb).

**Table 28. 2012-2014 3-Year Average 99th Percentile $SO_2$ Concentrations by Hour of Day at the West Union Monitor**

| Hour of Day | Hourly Background $SO_2$ Concentrations at West Union Monitor (μg/m$^3$) |
|---|---|
| 1 | 20.88 |
| 2 | 20.45 |
| 3 | 20.01 |
| 4 | 20.01 |
| 5 | 17.40 |
| 6 | 14.79 |
| 7 | 17.40 |
| 8 | 16.53 |
| 9 | 20.88 |
| 10 | 25.23 |
| 11 | 36.54 |
| 12 | 45.24 |
| 13 | 31.32 |
| 14 | 28.71 |
| 15 | 26.97 |
| 16 | 28.71 |
| 17 | 29.58 |
| 18 | 38.28 |
| 19 | 29.58 |
| 20 | 28.71 |
| 21 | 26.10 |
| 22 | 25.23 |
| 23 | 24.36 |
| 24 | 20.88 |

The EPA concurs with the background monitor selected and the processing of this data into hourly background values to be used in the modeling analysis. This component of the modeling analysis was performed in a manner consistent with the $SO_2$ Modeling TAD.

[40] The $SO_2$ NAAQS level is expressed in ppb but AERMOD gives results in μg/m$^3$. The conversion factor for $SO_2$ (at the standard conditions applied in the ambient $SO_2$ reference method) is 1ppb = approximately 2.619 μg/m$^3$.

*7.3.2.9. Summary of Modeling Inputs and Results*

The AERMOD modeling input parameters for the Mason County area of analysis are summarized below in Table 29.

**Table 29: Summary of AERMOD Modeling Input Parameters for the Area of Analysis for the Mason County Area**

| Input Parameter | Value |
|---|---|
| AERMOD Version | 15181 (regulatory default) |
| Dispersion Characteristics | Rural |
| Modeled Sources | 3 |
| Modeled Stacks | 20 |
| Modeled Structures | 22 |
| Modeled Fencelines | 1 |
| Total receptors | 7,236 |
| Emissions Type | Actuals |
| Emissions Years | 2012-2014 |
| Meteorology Years | 2012-2014 |
| NWS Station for Surface Meteorology | Cincinnati/Northern Kentucky International Airport |
| NWS Station Upper Air Meteorology | Wilmington, OH |
| NWS Station for Calculating Surface Characteristics | Cincinnati/Northern Kentucky International Airport |
| Methodology for Calculating Background $SO_2$ Concentration | Tier 2 approach using AQS site: 39-001-0001 for 2012-2014 |
| Calculated Background $SO_2$ Concentration | 14.79 - 45.24 $\mu g/m^3$ |

The results presented below in Table 30 show the magnitude and geographic location of the highest predicted modeled concentration based on the input parameters.

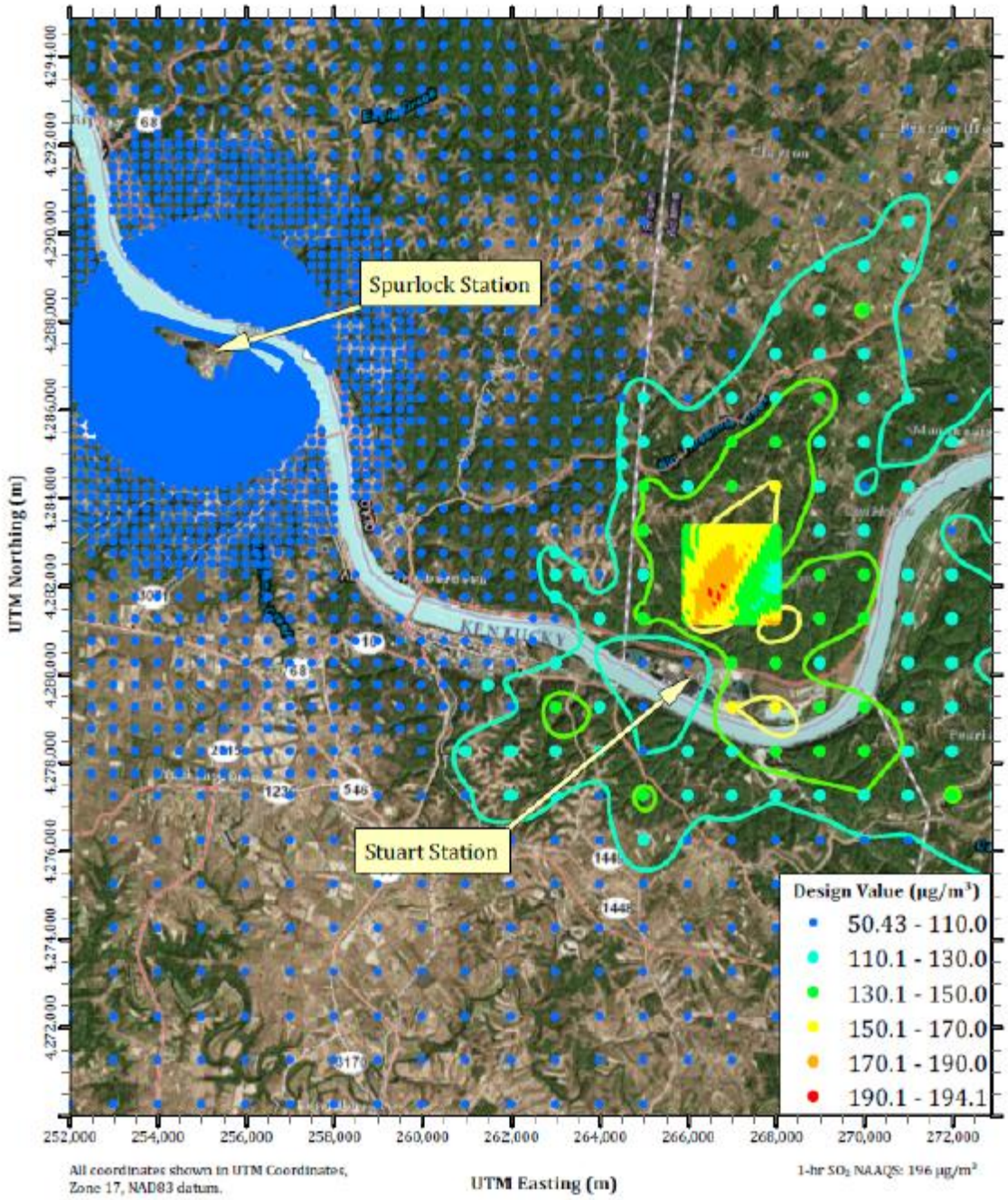
**Table 30. Maximum Predicted 99th Percentile Daily Maximum 1-Hour $SO_2$ Concentrations Averaged Over Three Years for the Area of Analysis for the Mason County Area**

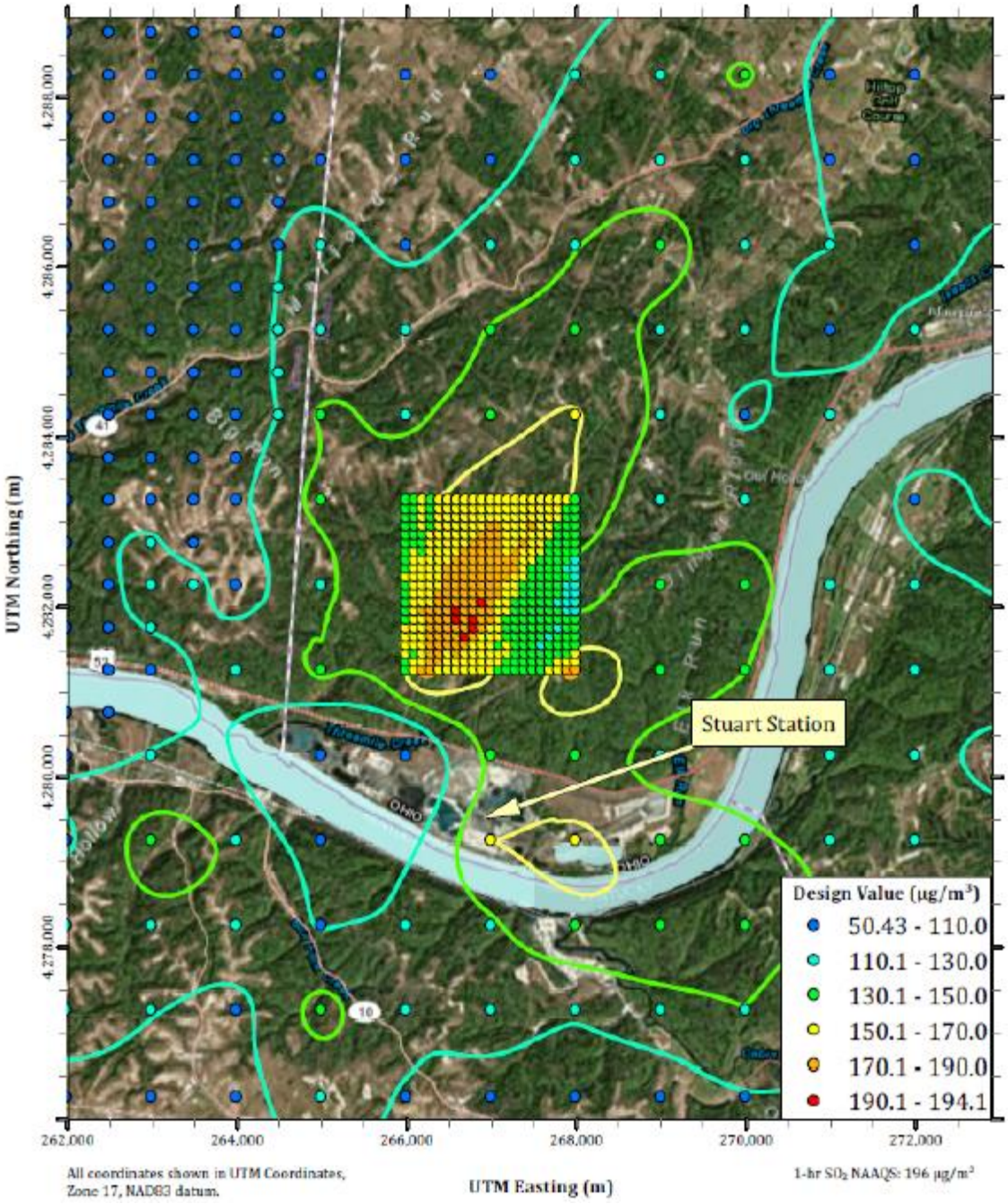
| Averaging Period | Data Period | Receptor Location [UTM zone 17] | | 99th percentile daily maximum 1-hour $SO_2$ Concentration ($\mu g/m^3$) | |
|---|---|---|---|---|---|
| | | UTM Easting (m) | UTM Northing (m) | Modeled concentration (including background) | NAAQS Level |
| 99th Percentile 1-Hour Average | 2012-2014 | 266,685 | 4,281,664 | 194.1 | 196.4* |

*Equivalent to the 2010 $SO_2$ NAAQS of 75 ppb using a 2.619 $\mu g/m^3$ conversion factor

The Commonwealth's modeling indicates that the highest predicted 99th percentile daily maximum 1-hour concentration within the chosen modeling domain is 194.1 $\mu g/m^3$, equivalent to 74.1 ppb. This modeled concentration included the background concentration of $SO_2$, and is based on actual emissions from the facilities. Figures 38a and 38b below were included as part of the state's recommendation, and indicate that the predicted value occurred approximately 12 km southeast of Spurlock Station near Stuart Station which was also included in the modeling analysis. The initial modeling indicated that the maximum concentration did not occur within the fine receptor grid near Spurlock Station. Accordingly, the Commonwealth remodeled with a 100-meter spacing near the area of predicted maximum concentration. The Commonwealth's receptor grid is also shown in the figures.

**Figure 38a and 38b: Maximum Predicted 99th Percentile Daily Maximum 1-Hour $SO_2$ Concentrations Averaged Over Three Years for the Area of Analysis for the Mason County Area. Source: "Air Dispersion Modeling Report, Spurlock Station in Maysville, Kentucky, $SO_2$ NAAQS Designation Modeling Analysis Under the Data Requirements Rule, Revision 1," prepared by East Kentucky Power Cooperative, April 29, 2016.**






The modeling submitted by the state does not indicate that the 1-hour $SO_2$ NAAQS is violated at the receptor with the highest modeled concentration.

### *7.3.2.10. The EPA's Assessment of the Modeling Information Provided by the Commonwealth*

The EPA has reviewed the modeling analysis submitted by the Commonwealth of Kentucky and concurs that the modeling assessment for the Mason County area is consistent with the $SO_2$

Modeling TAD. The EPA agrees with the inclusion of two other DRR source in the modeling analysis. The EPA believes the modeling domain used is sufficient to resolve predicted maximum impacts in the Mason County area. The Commonwealth's selected surface and upper air meteorological data are appropriate to make a valid modeling demonstration. The Commonwealth adequately represented the topography of the area with the model and its preprocessors. The Commonwealth chose to model emissions from Spurlock Station, Killen Station, and Stuart Station using the 2012-2014 period rather than using the most recently available emissions. This departure from the $SO_2$ Modeling TAD is acceptable because 2015 emissions from the three facilities were equivalent to or less than emissions from the 2012-2014 period modeled. The EPA also agrees that the $SO_2$ background monitor selected for use in this analysis and the background concentrations used are consistent with the $SO_2$ Modeling TAD. In general, all input data was prepared and the modeling was performed in a manner consistent with the $SO_2$ Modeling TAD. The EPA also concurs with the conclusion of this analysis which is that the maximum $SO_2$ concentrations predicted in the area are less than the NAAQS.

The Commonwealth made use of AERMOD version 15181, the most recent version available at the time the modeling was conducted. The EPA agrees that this model version is appropriate to characterize the area because the state made use of default regulatory options available at the time and followed the Modeling TAD.

## 7.4. Emissions and Emissions-Related Data, Meteorology, Geography, and Topography for the Mason County Area

These factors have been incorporated into the air quality modeling efforts and results discussed above. The EPA is giving consideration to these factors by considering whether they were properly incorporated and by considering the air quality concentrations predicted by the modeling.

## 7.5. Jurisdictional Boundaries in the Mason County Area

Existing jurisdictional boundaries are considered for the purpose of informing the EPA's designation action for city/county/parish. Our goal is to base designations on clearly defined legal boundaries, and to have these boundaries align with existing administrative boundaries when reasonable.

The modeling domain extends from Spurlock Station at a radius of 50 km, and so covers the entirety of Mason, Fleming, Robertson, Nicholas, and Bracken counties, eastern Harrison, eastern Pendleton, and southeastern Campbell counties, and most of Lewis County in northern Kentucky. The modeled receptors also covered southern Clermont, southwestern Highland, western Scioto counties, and most of Brown and Adams counties in southern Ohio.

## 7.6. The EPA's Assessment of the Available Information for the Mason County Area

The EPA intends to designate the Mason County area, including the entire County boundary, as unclassifiable/attainment. We believe that Kentucky's modeling analysis supports the conclusion that there are no expected violations of the 2010 $SO_2$ NAAQS in the area. There is no current, complete monitoring data available for the area, so the modeling serves to reflect the air quality expected in the years modeled.

Based on the air quality characterization conducted within the Mason County area of analysis in accordance with the EPA's Modeling TAD, the Commonwealth concluded that the area should be designated as attainment. This recommendation is based on Kentucky's assessment that emissions from the Spurlock Station facility could interact with those from the Killen Station and Stuart Station facilities and together impact the area, and the inclusion of these three DRR sources in the modeling demonstration. Spurlock Station and Carmeuse Lime & Stone are the only Mason County sources that emitted over 100 tons in 2014, and Carmeuse Lime & Stone was excluded because of the low likelihood of impacting the area based on the Q/d analysis. Killen Station and Stuart Station are the only other sources in the 50 km area of analysis thought to impact the Mason County area.

Kentucky evaluated possible contributions from these sources and other sources within 50 km of Elmer Smith Station to $SO_2$ impacts in the Mason County area. Based on a 20D analysis, Kentucky decided in the Modeling Report to include possible contributions from nearby Killen Station and Stuart Station by modeling actual emissions. Dynegy's Beckjord Station emitted over 2,000 tons in 2014, but was excluded because it has permanently shut down. Carmeuse Lime in Campbell County, Kentucky, was excluded due to Kentucky concluding that the source had a low likelihood to impact the area of analysis as supported by the Q/d analysis. Kentucky then added a reasonable value for background concentrations of $SO_2$ by including the 2012 – 2014 monthly/hourly varying concentrations from the West Union monitor in Adams County, Ohio. The EPA agrees with the technical explanation for the Commonwealth's treatment of nearby $SO_2$ sources included in the April 29, 2016, Modeling Report. We believe the modeling of the sources included adequately represents the Mason County area. The EPA has reason to believe there are no additional sources in areas adjacent to our intended area that are likely to cause or contribute to a violation of the NAAQS in the area of analysis. In addition, based on the available information for the remaining areas in Kentucky and neighboring Ohio, including monitoring and modeling, there are no current $SO_2$ nonattainment areas near Mason County, Kentucky or in nearby counties in Ohio, and no expected nonattainment areas for this third round of designations. Therefore, the Mason County area is not expected to contribute to ambient air quality in a nearby area that does not meet the NAAQS.

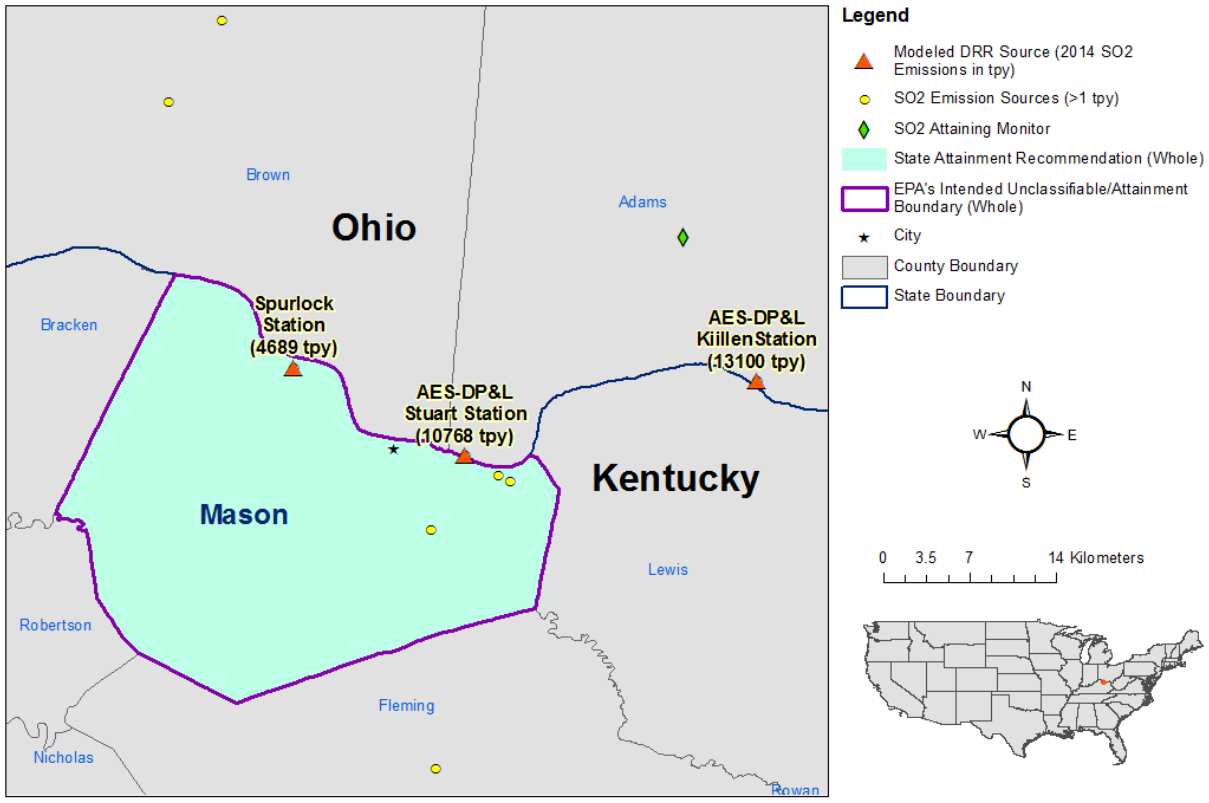
After careful evaluation of the Commonwealth's recommendation and supporting information, as well as all available relevant information, the EPA intends to designate the area around Spurlock Station as unclassifiable/attainment for the 2010 $SO_2$ NAAQS. Specifically, the boundaries are comprised of the entirety of Mason County. There are no remaining portions of Mason County that remain to be characterized in the EPA's Round 4 of designations in 2020, nor are there any other portions of the County that have a separate area of analysis for Round 3.

The EPA believes that our intended unclassifiable/attainment area, bounded by the entirety of Mason County, will have clearly defined legal boundaries, and we intend to find these boundaries to be a suitable basis for defining our intended unclassifiable/attainment area.

## 7.7. Summary of Our Intended Designation for the Mason County Area

After careful evaluation of the state's recommendation and supporting information, as well as all available relevant information, the EPA intends to designate the Mason County area as unclassifiable/attainment for the 2010 $SO_2$ NAAQS because the EPA has determined the area meets the 2010 $SO_2$ NAAQS and does not contribute to ambient air quality in a nearby area that does not meet the NAAQS. Specifically, the boundaries are comprised of the entirety of Mason County. Figure 39 shows the boundary of this intended designated area.

**Figure 39. Boundary of the Intended Mason County Unclassifiable/Attainment Area**




At this time, our intended designations for the state only apply to this area and the other areas presented in this technical support document. The EPA intends in a separate action to evaluate and designate all remaining undesignated areas in Kentucky by December 31, 2020.

# 8. Technical Analysis for the McCracken County Area

## 8.1. Introduction

The EPA must designate the McCracken County area by December 31, 2017, because the area has not been previously designated and Kentucky has not installed and begun timely operation of a new, approved $SO_2$ monitoring network meeting the EPA specifications referenced in the EPA's $SO_2$ DRR for any sources of $SO_2$ emissions in McCracken County. The DRR source, Tennessee Valley Authority's Shawnee Fossil Plant, is by the Ohio River, which is the border between Kentucky and Illinois. McCracken County is also near Missouri. Therefore, the area of analysis, and the modeling receptors, cross the Kentucky state boundaries into neighboring states.

## 8.2. Air Quality Monitoring Data for the McCracken County Area

This factor considers the $SO_2$ air quality monitoring data in the area of McCracken County. Kentucky provided the values of the 99$^{th}$ percentile of the $SO_2$ monitors in Kentucky. Kentucky stated "the average of the 99$^{th}$ percentile at all monitors is below the standard of 75 ppb in all locations except Jefferson County."

The EPA reviewed the available air quality monitoring data in the AQS database and found the following nearby data:

- The Jackson Purchase-Paducah Primary $SO_2$ monitor (AQS ID: 21-145-1024) is located at 37.05822, -88.57251 in McCracken County, 13 miles southeast of the Shawnee Fossil Plant. Data collected by this monitor is comparable to the NAAQS, and indicates that the most recent $SO_2$ levels are below the 1-hr NAAQS. The most recent three years of complete, quality-assured, certified data from this monitor (2014-2016) indicate a 1-hr $SO_2$ design value of 17 ppb. However, this monitor was not located to characterize the maximum 1-hr $SO_2$ concentrations of Shawnee Fossil Plant. Kentucky provided an air quality modeling analysis to characterize the maximum 1-hr $SO_2$ concentrations in the area (see Section 8.3 below).

In reviewing the available air quality monitoring data in AQS, the EPA determined that other than the data described above, there is no additional relevant data in AQS collected in or near McCracken County that could inform the intended designation action. The most recent $SO_2$ design values for all areas of the country are available at https://www.epa.gov/air-trends/air-quality-design-values.

## 8.3. Air Quality Modeling Analysis for the McCracken County Area Addressing Shawnee Fossil Plant

### *8.3.1. Introduction*

This section 8.3 presents all the available air quality modeling information for a portion of McCracken County that includes Tennessee Valley Authority's Shawnee Fossil Plant. (This portion of McCracken County will often be referred to as "the McCracken County area" within this section 8.3). This area contains one DRR source, the Shawnee Fossil Plant facility, around which Kentucky is required by the DRR to characterize $SO_2$ air quality, or alternatively establish an $SO_2$ emissions limitation of less than 2,000 tpy. Kentucky's modeling demonstration for the McCracken County area also includes nearby sources across the state border in Illinois. These are DRR sources and other smaller sources thought to impact the McCracken County area. All DRR sources and other sources modeled for this area of analysis are listed below:

- The Shawnee facility emitted 2,000 tons or more annually. Specifically, Shawnee emitted 29,835 tons of $SO_2$ in 2014 and 24,302 tons in 2015. This source meets the DRR criteria and thus is on the $SO_2$ DRR Source list, and Kentucky has chosen to characterize it via modeling.

- The Electric Energy Inc. - Joppa Steam (Joppa Steam) facility emitted 2,000 tons or more in 2014 and is on the DRR source list. The Joppa facility emitted 18,287 tons in 2014, and Kentucky decided to include this source in the modeling due to its potential to impact the area of analysis.

- The Honeywell International Inc. (Honeywell International) and Lafarge Midwest Inc. – Portland (Lafarge Midwest) facilities in Massac, Illinois are not on the $SO_2$ DRR Source list. Honeywell International and Lafarge Midwest emitted 144 tons and 490 tons in 2014, respectively. However, the Commonwealth of Kentucky determined that these sources should be explicitly included in the modeling analysis to best predict total modeled $SO_2$ concentrations in the McCracken County area.

Because we have available results of air quality modeling in which these sources are modeled together, the area around this group of sources is being addressed in this section with consideration given to the impacts of all these sources.

In its submission, Kentucky recommended that an area that includes the area surrounding the Shawnee facility, specifically McCracken County, be designated as attainment based on an assessment and characterization of air quality impacts from these facilities and other nearby sources that may have a potential impact in the area where the 2010 $SO_2$ NAAQS may be exceeded. This assessment and characterization was performed using air dispersion modeling software, i.e., AERMOD, analyzing actual emissions. After careful review of the Commonwealth's assessment, supporting documentation, and all available data, the EPA intends to designate the area as unclassifiable/attainment. Our reasoning for this conclusion is explained in a later section of this TSD, after all the available information is presented.

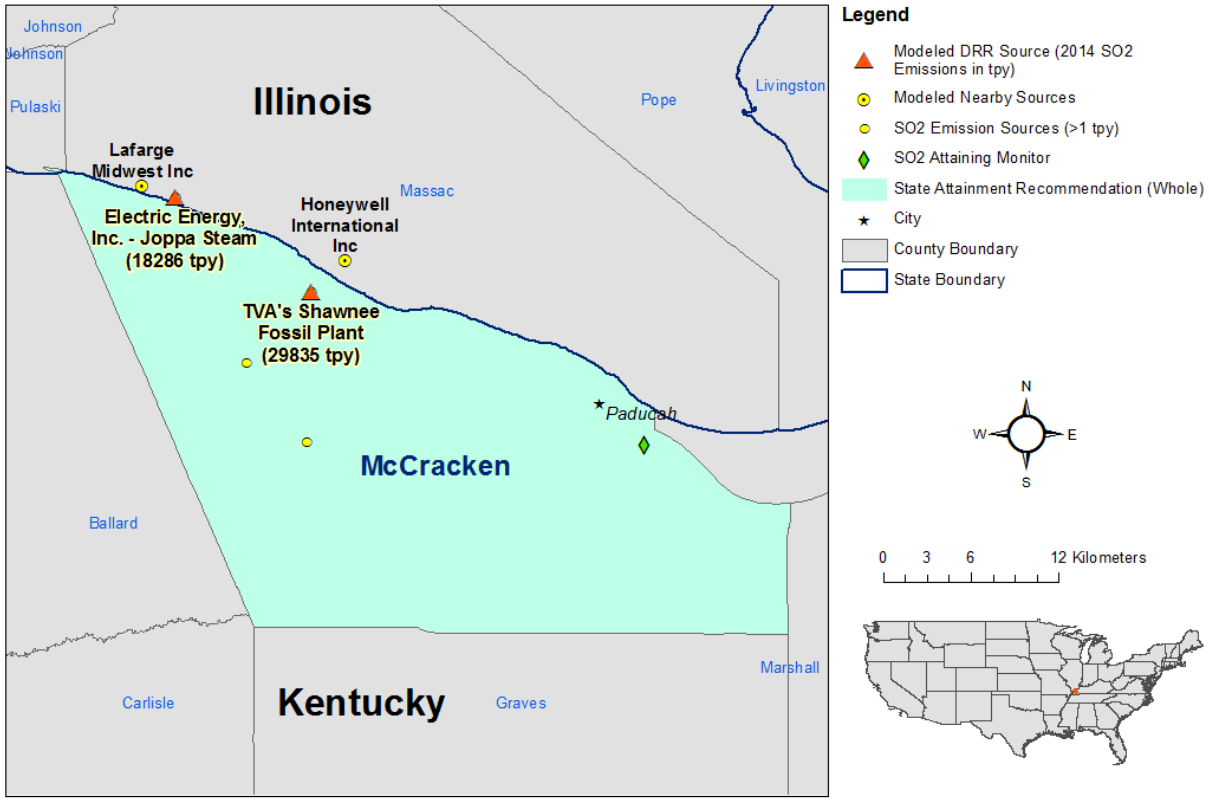
The area that the Commonwealth has assessed via air quality modeling is located in McCracken County, just south of the Ohio River, east of I-24, extending into Illinois.

As seen in Figure 40 below, the Shawnee Fossil Plant facility is located on the southern bank of the Ohio River in West Paducah, Kentucky, approximately 13 miles northwest of the mouth of the Tennessee River at Paducah, Kentucky. The Joppa Steam facility is located on the northern bank of the Ohio River in Joppa, Illinois, approximately 9.7 km northwest of the Shawnee Fossil Plant. Also included in Figure 40 are other nearby emitters of $SO_2$.[41] These are Honeywell International and Lafarge Midwest. Honeywell is located across the Ohio River in Massac County, Illinois, approximately 2.7 km north northeast of Shawnee Fossil Plant. Lafarge Midwest is also located in Massac County, Illinois along the northern bank of the Ohio River, approximately 9.8 km northwest of Shawnee Fossil Plant.

Also included in the figure is the Commonwealth's recommended area for the attainment designation. The EPA's intended unclassifiable/attainment designation boundary for the McCracken County area is not shown in this figure, but is shown in a figure in the section below that summarizes our intended designation.

[41] All other $SO_2$ emitters of 1 tpy or more (based on information in the inventory of sources provided by the Commonwealth of Kentucky and the States of Illinois and Missouri) are shown in Figure 40.

**Figure 40. Map of the McCracken County Area Addressing Shawnee Fossil Plant**




The discussion and analysis that follows below will reference the Modeling TAD and the factors for evaluation contained in the EPA's July 22, 2016, guidance and March 20, 2015, guidance, as appropriate.

For this area, the EPA received and considered one modeling assessment, including one assessment from the Commonwealth and no assessments from other parties. To avoid confusion in referring to these assessments, the following table lists them, indicates when they were received, provides an identifier for the assessment that is used in the discussion of the assessments that follow, and identifies any distinguishing features of the modeling assessments.

**Table 31 – Modeling Assessments for the McCracken County Area**

| Assessment Submitted by | Date of the Assessment | Identifier Used in this TSD | Distinguishing or Otherwise Key Features |
|---|---|---|---|
| Commonwealth of Kentucky | July 7, 2016* | July 7, 2016 Modeling Report | Only formal modeling report received. |

* This modeling report, date July 7, 2016, was submitted to the EPA on January 6, 2017.

### *8.3.2. Modeling Analysis Provided by the Commonwealth*

#### *8.3.2.1. Model Selection and Modeling Components*

The EPA's Modeling TAD notes that for area designations under the 2010 $SO_2$ NAAQS, the AERMOD modeling system should be used, unless use of an alternative model can be justified. The AERMOD modeling system contains the following components:

- AERMOD: the dispersion model
- AERMAP: the terrain processor for AERMOD
- AERMET: the meteorological data processor for AERMOD
- BPIPPRM: the building input processor
- AERMINUTE: a pre-processor to AERMET incorporating 1-minute automated surface observation system (ASOS) wind data
- AERSURFACE: the surface characteristics processor for AERMET
- AERSCREEN: a screening version of AERMOD

The Commonwealth used AERMOD version 15181, using all regulatory default options. AERMOD version 16216r has since become the regulatory model version. There were no updates from 15181 to 16216r that would significantly affect the concentrations predicted here. A discussion of the Commonwealth's approach to the individual components is provided in the corresponding discussion that follows, as appropriate.

The current version of AERMOD, version 16216r, includes updates to 40 CFR part 51, Appendix W, "Guideline of Air Quality Models," published on January 17, 2017 (82 FR 5203). This version of AERMOD also includes fixes to bugs that were inadvertently included in version 16216. Kentucky chose not to use the latest version of AERMOD because the state is using the regulatory default settings for version 15181 available at the time of its modeling preparation and is not making use of any previously unapproved alternative modeling options included in version 16216r and the update to Appendix W.

#### *8.3.2.2. Modeling Parameter: Rural or Urban Dispersion*

For any dispersion modeling exercise, the "urban" or "rural" determination of a source is important in determining the boundary layer characteristics that affect the model's prediction of downwind concentrations. For $SO_2$ modeling, the urban/rural determination is important because AERMOD invokes a 4-hour half-life for urban $SO_2$ sources. Section 6.3 of the Modeling TAD details the procedures used to determine if a source is urban or rural based on land use or population density. The EPA's recommended procedure for characterizing an area by prevalent land use is based on evaluating the dispersion environment within 3 km of the facility. According to the EPA's modeling guidelines, rural dispersion coefficients are to be used in the dispersion modeling analysis if more than 50 percent of the area within a 3 km radius of the facility is classified as rural. Conversely, if more than 50 percent of the area is urban, urban dispersion coefficients should be used in the modeling analysis.

The Commonwealth used the Auer land use methodology and examined the various land use within 3 km of Shawnee to quantify the percentage of area in various land use categories. The data source for the land cover was the 2011 National Land Cover Database (NLCD). Figure 41 shows the layout of the land use and Table 32 shows the results of the land use categorization

process. The area is about 98 percent rural. Therefore, for the purpose of performing the modeling for the area of analysis, the state determined that it was most appropriate to run the model with rural dispersion coefficients, and the EPA concurs with this assessment.

**Figure 41. Land Use Map for Area Within 3km of the Shawnee Fossil Plant Facility. Source: "Shawnee Fossil Plant: Modeling Results, 1-Hour $SO_2$ NAAQS Designation, Paducah, Kentucky," prepared by Tennessee Valley Authority for Kentucky, July 7, 2016.**

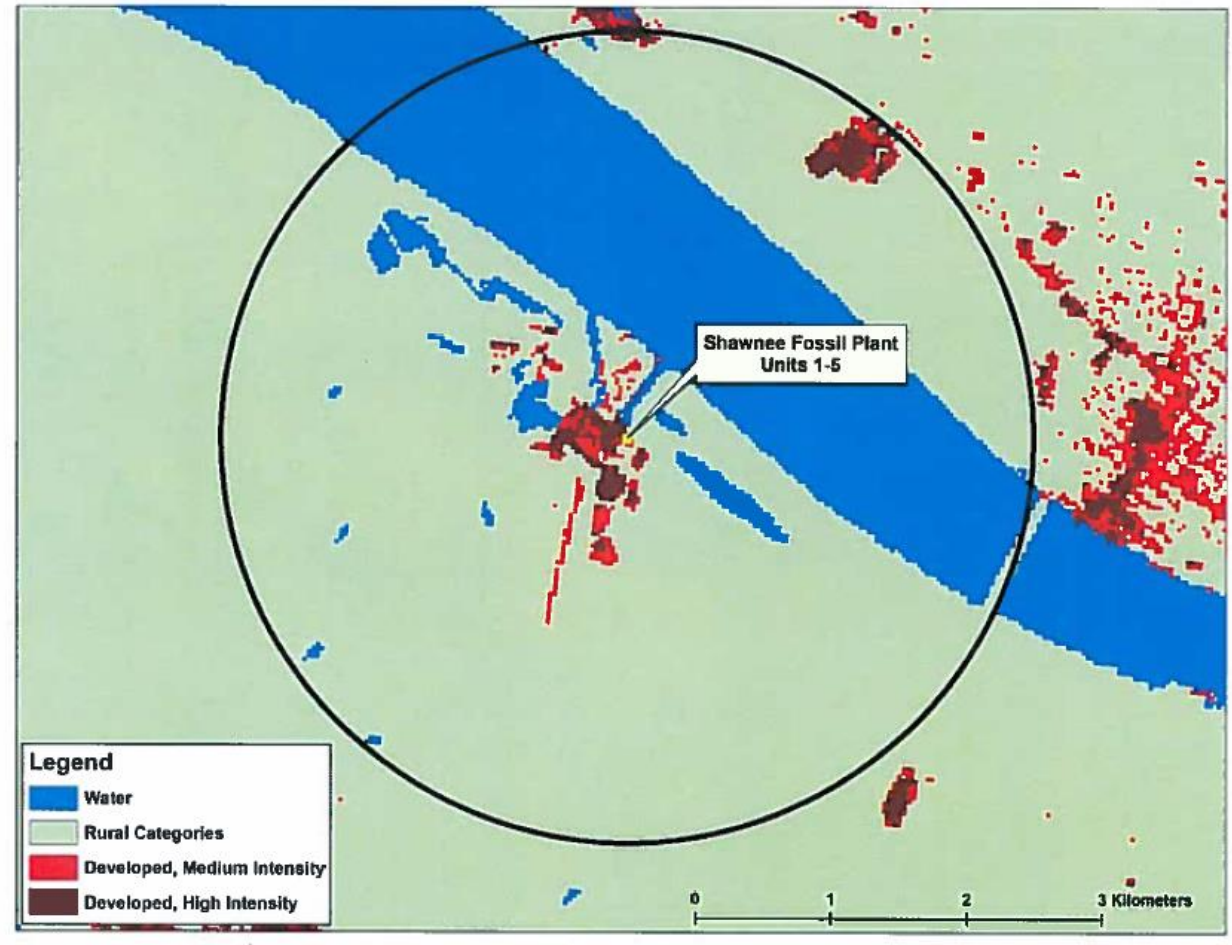


**Table 32 – Determination of the Urban or Rural Modeling Parameter for the McCracken County Area by Auer's Method with 2011 Land Use Information**

| Category ID | Category Description | Auer's Class | Percent |
|---|---|---|---|
| 23 | Developed, Medium Intensity | Urban | 1.24% |
| 24 | Developed, High Intensity | Urban | 1.21% |
| 11 | Open Water | Rural | 25.48% |
| 21 | Developed, Open Space | Rural | 4.11% |
| 22 | Developed, Low Intensity | Rural | 1.00% |
| 31 | Barren Land | Rural | 1.47% |
| 41 | Deciduous Forest | Rural | 26.59% |
| 42 | Evergreen Forest | Rural | 0.46% |
| 71 | Grassland/Herbaceous | Rural | 0.38% |
| 81 | Pasture/Hay | Rural | 0.33% |
| 82 | Cultivated Crop | Rural | 24.22% |
| 90 | Wood Wetlands | Rural | 10.58% |
| 95 | Emergent Herbaceous Wetlands | Rural | 3.03% |
| | | Total | 100% |
| | | Urban | 2.45% |
| | | Rural | 97.55% |

*8.3.2.3. Modeling Parameter: Area of Analysis (Receptor Grid)*

The TAD recommends that the first step towards characterization of air quality in the area around a source or group of sources is to determine the extent of the area of analysis and the spacing of the receptor grid. Considerations presented in the Modeling TAD include but are not limited to: the location of the $SO_2$ emission sources or facilities considered for modeling; the extent of concentration gradients due to the influence of nearby sources; and sufficient receptor coverage and density to adequately capture and resolve the model predicted maximum $SO_2$ concentrations.

The sources of $SO_2$ emissions subject to the DRR in this area are described in the introduction to this section. For the McCracken County area, the Commonwealth has included three other emitters of $SO_2$ within 50 km of Shawnee Fossil Plant in any direction. The Commonwealth determined that this was the appropriate distance to adequately characterize air quality through modeling to include the potential extent of any $SO_2$ NAAQS exceedances in the area of analysis and any potential impact on $SO_2$ air quality from other sources in nearby areas. In addition to Shawnee Fossil Plant, the other emitters of $SO_2$ included in the area of analysis are: Honeywell International, Lafarge Midwest, and Joppa Steam. No other sources beyond 50 km were determined by the Commonwealth to have the potential to cause concentration gradient impacts within the area of analysis.

The Commonwealth included two overlapping receptor grids to help characterize the McCracken County area. One grid is centered around the Shawnee Fossil Plant facility, and the other is centered around the Joppa Steam facility in Illinois. The grid centered around Joppa Steam is

nested within the main grid centered around Shawnee Fossil Plant. The grid receptor spacing for the area of analysis chosen by the Commonwealth is as follows:

**Table 33 – Description of Receptor Grid Spacing for the McCracken County Area**

| Source | Receptor Spacing (m) | Grid Size (km) | Grid Origin (km south and west of site) |
|---|---|---|---|
| Shawnee Fossil Plant | 100 | 6 x 6 | 3 |
| | 250 | 10 x 10 | 5 |
| | 500 | 40 x 40 | 20 |
| Joppa Steam | 100 | 6 x 6 | 3 |
| | 250 | 10 x 10 | 5 |

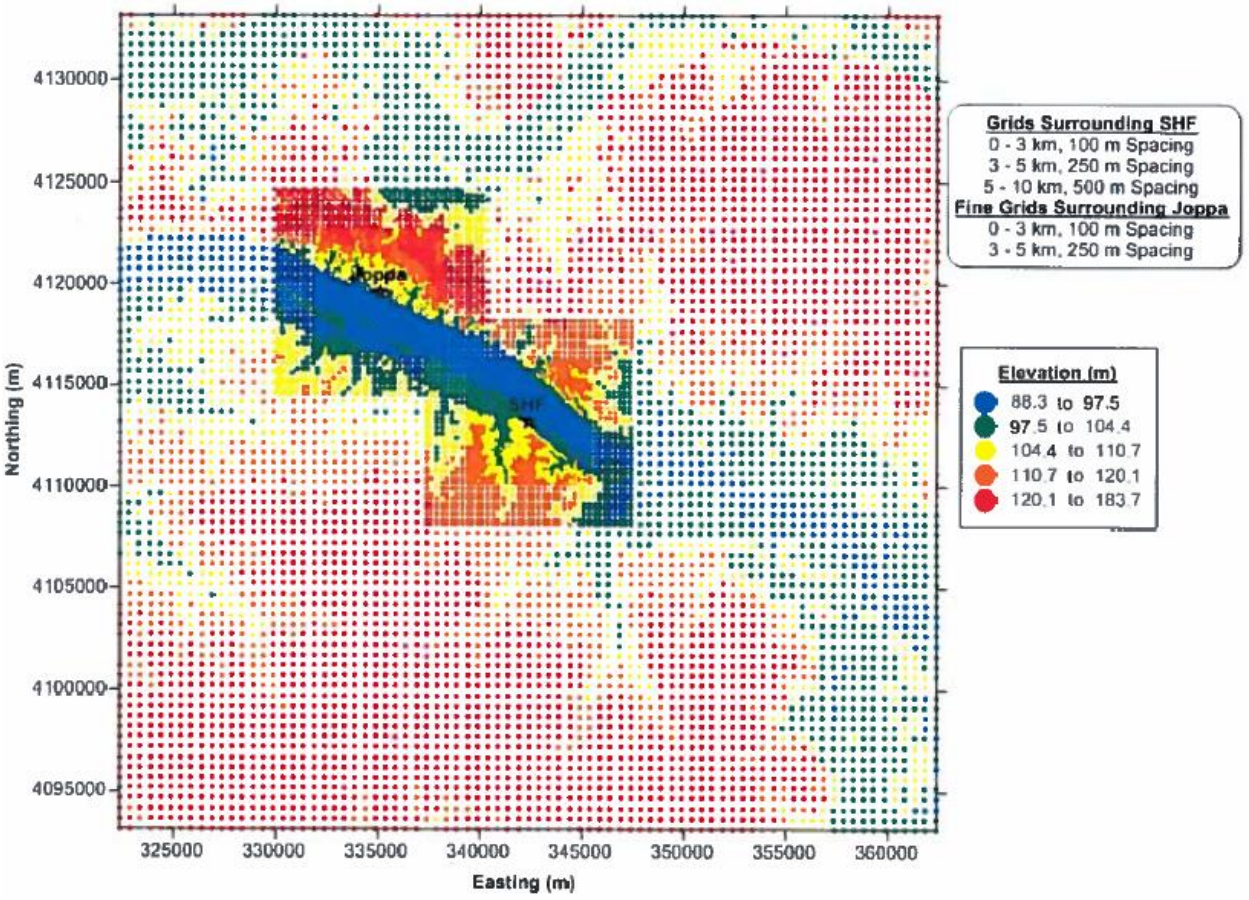
Denser spacing was done around both the Shawnee Fossil Plant and Joppa Steam facilities as described in Table 33.

The receptor network contained 15,738 receptors, and the network covered all of McCracken and Ballard Counties, most of Carlisle County, the northern portion of Graves County, the northwestern portion of Marshall County, and the western half of Livingston County in Kentucky. The grid also extends across the Ohio River and covers all of Massac County, most of Pulaski County, the southern portions of Johnson and Pope Counties, southeastern and northeastern portions of Alexander County, and the southeastern portion of Union County in Illinois. Finally, the eastern portion of Mississippi County, Missouri, is covered by the coarse grid.

Figure42, included in the Commonwealth's recommendation, shows the Commonwealth's chosen area of analysis surrounding the Shawnee Fossil Plant facility, as well as the receptor grid for the area of analysis and the elevation for each receptor.

Consistent with the Modeling TAD, the Commonwealth placed receptors for the purposes of this designation effort in locations that would be considered ambient air relative to each modeled facility, including other facilities' property, and in areas described in Section 4.2 of the Modeling TAD as not being feasible locations for placing a monitor. The Commonwealth included receptors over the Ohio River even though it is not feasible to place a monitor over water. The Commonwealth chose to include these receptors to provide for a cautious analysis of $SO_2$ impacts in the area of analysis. The Commonwealth did not place receptors in other locations that it considered to not be ambient air relative to each modeled facility. Receptors within the fenceline of Shawnee Fossil Plant were the only receptors excluded.

**Figure 42: Receptor Grid for the McCracken County Area, Including Receptor Elevations. Source: "Shawnee Fossil Plant: Modeling Results, 1-Hour $SO_2$ NAAQS Designation, Paducah, Kentucky," prepared by Tennessee Valley Authority for Kentucky, July 7, 2016.**




The EPA agrees with the receptor grid used in this analysis, including the exclusion of receptors located within the fenceline of Shawnee Fossil Plant. The DRR modeling report states that a permanent fence surrounds the property. The EPA agrees that the inclusion of receptors located within the Ohio River or any other bodies of water within the modeling domain provided for a more cautious approach to estimating $SO_2$ impacts in the McCracken County area. This component of the modeling analysis was performed in a manner consistent with the $SO_2$ Modeling TAD.

#### *8.3.2.4. Modeling Parameter: Source Characterization*

Section 6 of the Modeling TAD offers recommendations on source characterization including source types, use of accurate stack parameters, inclusion of building dimensions for building downwash (if warranted), and the use of actual stack heights with actual emissions or following GEP policy with allowable emissions.

Shawnee Fossil Plant has 10 units that emit $SO_2$, nine coal-fired boilers that exit through two stacks. The July 7, 2016, Modeling Report asserts that the coal blend is low sulfur (less than 2 percent by weight) and that boilers 1 – 4 will have operational scrubbers by December 31, 2017.

Shawnee Fossil Plant also has one diesel emergency generator, but this is permitted to operate only 100 hours per year and was therefore excluded from the modeling. The Modeling TAD[42] indicates that these types of intermittently operated sources can be excluded from the modeling demonstration.

The Joppa Steam facility was included in the modeling due to its potential to impact the area of analysis. Joppa Steam has six main boilers, with three stacks each handling emissions from two boilers. The other sources included in the modeling analysis are Honeywell International and Lafarge Midwest, each of which are major sources in Massac County, Illinois. Honeywell International is a chemical facility with natural gas boilers and onsite incinerators, and $SO_2$ emissions are emitted through one stack. Lafarge Midwest's Portland facility is a Portland cement plant with two stacks that emit $SO_2$. Both sources were included based on their proximity to the McCracken County area and their potential to impact the area.

The Commonwealth conducted a Q/d (indicating emissions/distance) analysis for sources within 75 km of Shawnee Fossil Plant. Kentucky looked to include any sources within 10 km of Shawnee Fossil Plant that emitted at least 1 tpy, then any sources between 10 and 50 km that were thought to have the potential to impact the area of analysis (generally sources with a Q/d greater than 20). Sources excluded that showed a Q/d greater than 20 were excluded because of more current emissions information about source PTE. Based on this analysis, the following sources were excluded from the modeling:

- Bunge North America, located 39 km from SFP was excluded based on a Q/d of .5.
- CC Metals and Alloys, located 39 km southwest of SFP was excluded from explicit modeling on the basis that the impact of this source is accounted for in the background concentration. The background monitor (Paducah KY – See Section 8.3.2.8) is located 21 km southwest of SFP which is between SFP and CC Metals and Alloys.
- Fluor Federal Services, Inc., located 6 km from SFP was excluded because their three coal-fired boilers were removed from service on 1-31-2016 and replaced with five natural gas-fired boilers. Reference Kentucky Division for Air Quality Permit V-14-012-R1.
- ISP Chemicals, LLC – located 39 km from SFP was excluded because they retired their coal fired boiler in September of 2014 and replaced it with three natural gas-fired boilers. Reference Kentucky Division for Air Quality Permit V-12-039-R1.
- Mounds Production Company, LLC – located 38 km from SFP was excluded based on a Q/d of .2.
- Vienna Correction Center (IL) – located 28 km from SFP was excluded based on a Q/d of 7.
- Wickliffe Paper Company – located 35 km from SFP was excluded based on a Q/d of 16.

In addition, based on the same analysis, the following sources located within 50 km of SFP were included in the modeling:

[42] The Modeling TAD references the March 1, 2011 memorandum entitled "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour $NO_2$ National Ambient Air Quality Standard," in considering intermittent sources.

- Honeywell International - located 2.7 km from Shawnee Fossil Plant (SFP)
- LaFarge Midwest Inc., Portland Cement – located 12 km from SFP
- Electric Energy Inc., Joppa – located 10 km from SFP

The Commonwealth characterized these sources within the area of analysis in accordance with the best practices outlined in the Modeling TAD. Specifically, the Commonwealth used actual stack heights in conjunction with actual emissions. The Commonwealth also adequately characterized the sources' building layouts and locations, as well as the stack parameters, e.g., exit temperature, exit velocity, location, and diameter. Where appropriate, the AERMOD component BPIPPRM was used to assist in addressing building downwash. For the Shawnee Fossil Plant facility, CEMS did not collect temperature data. The July 7, 2016, Modeling Report provided a comparison of the stack temperatures used in the 2014 title V permit renewal application with process-measured temperatures. The Commonwealth relies on the title V constant values for stack exit temperatures at this facility because of the minor differences seen between averaged measured stack temperatures and the title V assumed temperatures.

The EPA agrees with this aspect of the modeling analysis, including the use of actual emissions and stack heights for all three facilities modeled and the inclusion of building downwash from structures and emissions at Shawnee Fossil Plant. We also agree that the July 7, 2016, Modeling Report provides reasonable justification for the use of constant exit temperatures for the Shawnee Fossil Plant. The EPA agrees with the Commonwealth's conclusions regarding which sources should be included directly or excluded. This component of the modeling analysis was performed generally in a manner consistent with the $SO_2$ Modeling TAD, and with adequate technical justification where departing from the Modeling TAD.

#### *8.3.2.5. Modeling Parameter: Emissions*

The EPA's Modeling TAD notes that for the purpose of modeling to characterize air quality for use in designations, the recommended approach is to use the most recent 3 years of actual emissions data and concurrent meteorological data. However, the TAD also indicates that it would be acceptable to use allowable emissions in the form of the most recently permitted (referred to as PTE or allowable) emissions rate that is federally enforceable and effective.

The EPA believes that CEMS data provide acceptable historical emissions information, when they are available. These data are available for many electric generating units. In the absence of CEMS data, the EPA's Modeling TAD highly encourages the use of AERMOD's hourly varying emissions keyword HOUREMIS, or through the use of AERMOD's variable emissions factors keyword EMISFACT. When choosing one of these methods, the EPA recommends using detailed throughput, operating schedules, and emissions information from the impacted source(s).

In certain instances, states and other interested parties may find that it is more advantageous or simpler to use PTE rates as part of their modeling runs. For example, where a facility has recently adopted a new federally enforceable emissions limit or implemented other federally enforceable mechanisms and control technologies to limit $SO_2$ emissions to a level that indicates compliance with the NAAQS, the state may choose to model PTE rates. These new limits or conditions may be used in the application of AERMOD for the purposes of modeling for

designations, even if the source has not been subject to these limits for the entirety of the most recent 3 calendar years. In these cases, the Modeling TAD notes that a state should be able to find the necessary emissions information for designations-related modeling in the existing $SO_2$ emissions inventories used for permitting or SIP planning demonstrations. In the event that these short-term emissions are not readily available, they may be calculated using the methodology in Table 8-1 of Appendix W to 40 CFR Part 51 titled, "Guideline on Air Quality Models."

As previously noted, the Commonwealth included Shawnee Fossil Plant and three other emitters of $SO_2$ within 50 km in the area of analysis. The Commonwealth has chosen to model these facilities using actual emissions. The facilities in the Commonwealth's modeling analysis and their associated annual actual $SO_2$ emissions between 2012 and 2014 are summarized below.

For Shawnee Fossil Plant, Honeywell International, Lafarge Midwest, and Joppa Steam, the Commonwealth provided annual actual $SO_2$ emissions between 2012 and 2014. This information is summarized in Table 34. A description of how the Commonwealth obtained hourly emission rates is given below this table.

**Table 34. Actual $SO_2$ Emissions Between 2012 – 2014 from Facilities in the McCracken County Area**

| | **$SO_2$ Emissions (tpy)** | | |
|---|---|---|---|
| **Facility Name** | **2012** | **2013** | **2014** |
| Shawnee Fossil Plant | 27,115 | 27,211 | 29,835 |
| Honeywell International | 163 | 59 | 144 |
| Lafarge Midwest | 494 | 551 | 490 |
| Joppa Steam | 16,991 | 16,543 | 18,281 |
| Total Emissions from All Modeled Facilities in the State's Area of Analysis | 44,763 | 44,364 | 48,750 |

For Shawnee Fossil Plant and Joppa Steam, the actual hourly emissions data were obtained from CEMS.

For Honeywell International and Lafarge Midwest, the actual hourly emissions data were obtained from "emissions inventory furnished by [Illinois Environmental Protection Agency] IEPA."

The EPA agrees with the use of hourly emissions data obtained from CEMS for Shawnee Fossil Plant and Joppa Steam. The EPA also agrees with the detailed emissions inventory provided by IEPA for Honeywell International and Lafarge Midwest. $SO_2$ emissions from Shawnee Fossil Plant were less in 2015 (24,302 tons) than in the years modeled (2012-2014). Moreover, Joppa Steam and Lafarge Midwest also show decreased emissions after this period, and Honeywell International shows emissions comparable to 2012-2014 in 2015 (147 tons). Therefore, the use of 2012-2014 emissions should slightly overestimate $SO_2$ impacts relative to the use of 2015 emissions from Shawnee Fossil Plant and the other sources impacting the McCracken County area. Therefore, the EPA agrees with the use of 2012 – 2014 actual emissions. This component of the modeling analysis was performed in a manner consistent with the $SO_2$ Modeling TAD.

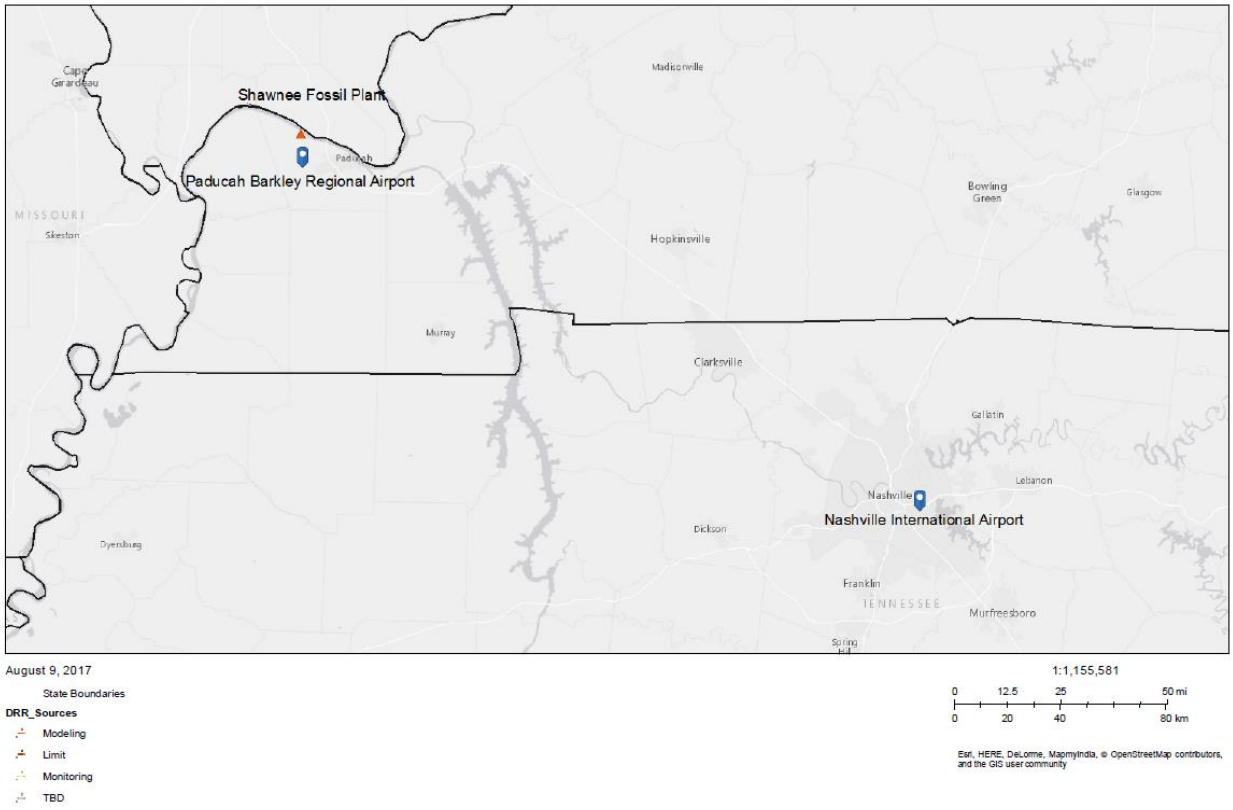
#### *8.3.2.6. Modeling Parameter: Meteorology and Surface Characteristics*

As noted in the Modeling TAD, the most recent 3 years of meteorological data (concurrent with the most recent 3 years of emissions data) should be used in designations efforts. The selection of data should be based on spatial and climatological (temporal) representativeness. The representativeness of the data is determined based on: 1) the proximity of the meteorological monitoring site to the area under consideration, 2) the complexity of terrain, 3) the exposure of the meteorological site, and 4) the period of time during which data are collected. Sources of meteorological data include NWS stations, site-specific or onsite data, and other sources such as universities, FAA, and military stations.

For the area of analysis for the McCracken County area, the Commonwealth selected the surface meteorology from the NWS station at the Paducah Barkley Regional Airport (PAH) located in Paducah, Kentucky, located at 37.06 N, 88.77 W, approximately 10 km south of Shawnee Fossil Plant, and coincident upper air observations from a different NWS station, at Nashville International Airport (BNA) in Nashville, Tennessee, located at 36.126 N, 86.677 W, approximately 219 km east southeast of Shawnee Fossil Plant as best representative of meteorological conditions within the area of analysis.

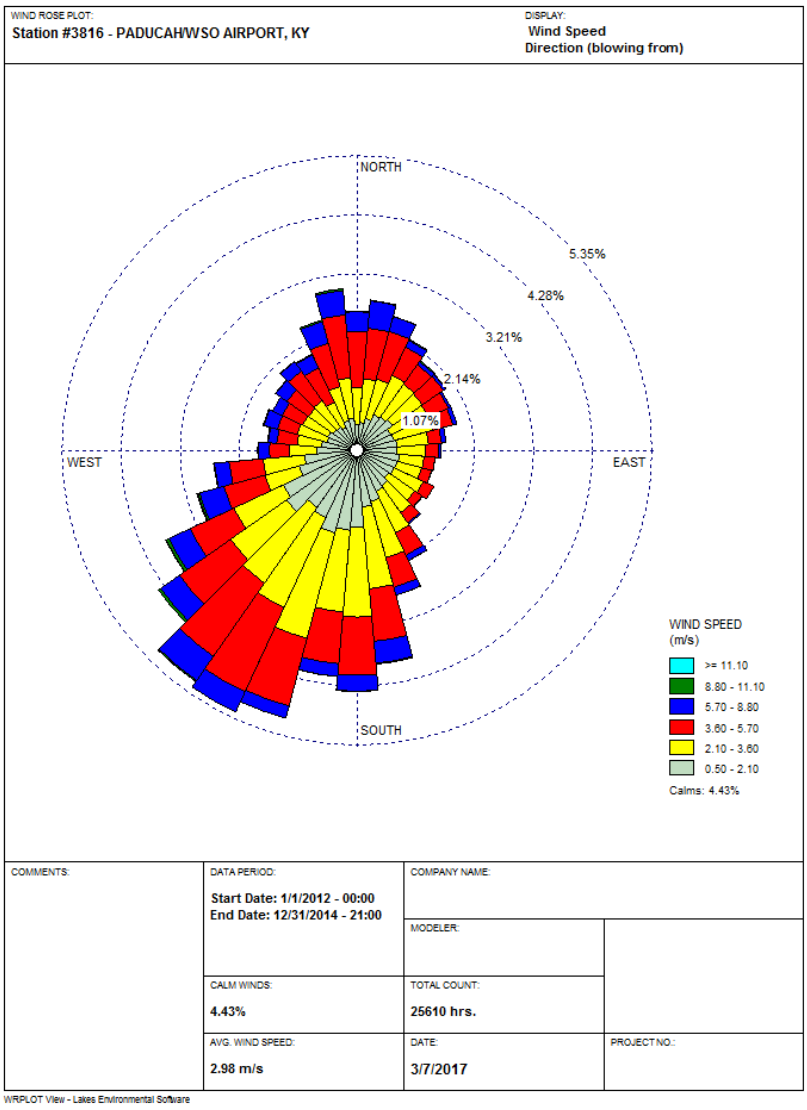
The Commonwealth used AERSURFACE version 13016 using data from the NWS station at the Paducah Barkley Regional Airport to estimate the surface characteristics (albedo, Bowen ratio, and surface roughness [$z_o$]) of the area of analysis. Albedo is the fraction of solar energy reflected from the earth back into space, the Bowen ratio is the method generally used to calculate heat lost or heat gained in a substance, and the surface roughness is sometimes referred to as “zo” The state estimated surface roughness values for 12 spatial sectors out to 1 km at a monthly temporal resolution for dry, wet, and average conditions.
In the figure below, generated by the EPA, the locations of these NWS stations are shown relative to the area of analysis.

**Figure 43. Area of Analysis and the NWS stations in the McCracken County Area**




The EPA generated a wind rose for the Paducah, Kentucky, airport for the 2012-2014 period. In Figure 44, the frequency and magnitude of wind speed and direction are defined in terms of from where the wind is blowing. Analysis of the NWS data indicate winds predominantly blow from the south (approximately 4.3-12 percent of the time) and southwest (approximately 20-24 percent of the time) directions.

**Figure 44: Paducah, Kentucky Cumulative Annual Wind Rose for Years 2012 – 2014**




Meteorological data from the above surface and upper air NWS stations were used in generating AERMOD-ready files with the AERMET processor. The output meteorological data created by the AERMET processor is suitable for being applied with AERMOD input files for AERMOD modeling runs. The Commonwealth followed the methodology and settings presented in Section 7 of the $SO_2$ Modeling TAD in the processing of the raw meteorological data into an AERMOD-ready format, and used AERSURFACE to best represent surface characteristics.

The Modeling Report indicates that: "[t]wo sets of meteorology were modeled, with one set using the onsite surface characteristics and another set using the surface characteristics of the NWS station." AERMOD results indicated that use of Paducah NWS data and surface characteristics from the same NWS station resulted in the highest predicted 1-hour $SO_2$ concentrations as reported in Section 8.3.2.9 of this TSD.

Hourly surface meteorological data records are read by AERMET, and include all the necessary elements for data processing. However, wind data taken at hourly intervals may not always portray wind conditions for the entire hour, which can be variable in nature. Hourly wind data may also be overly prone to indicate calm conditions, which are not modeled by AERMOD. In order to better represent actual wind conditions at the meteorological tower, wind data of 1-minute duration was provided from the Paducah Regional Airport, but in a different formatted file to be processed by a separate preprocessor, AERMINUTE. These data were subsequently integrated into the AERMET processing to produce final hourly wind records of AERMOD-ready meteorological data that better estimate actual hourly average conditions and that are less prone to over-report calm wind conditions. This allows AERMOD to apply more hours of meteorology to modeled inputs, and therefore produce a more complete set of concentration estimates. The Commonwealth did not set a minimum wind speed threshold in processing meteorological data for use in AERMOD, as is allowed in the Modeling TAD. Setting this threshold can guard against excessively high concentrations that could be produced by AERMOD in very light wind conditions. By not excluding any wind speeds, the modeling conducted over-predicts $SO_2$ impacts.

The EPA agrees with the processing and use of surface data from the Paducah airport and upper air data from the Nashville, Tennessee, airport in this modeling analysis. The EPA also agrees with the evaluation of onsite surface characteristics for separate modeling runs. This component of the modeling analysis was performed in a manner consistent with the $SO_2$ Modeling TAD.

#### *8.3.2.7. Modeling Parameter: Geography, Topography (Mountain Ranges or Other Air Basin Boundaries) and Terrain*

The terrain in the area of analysis is best described as gently rolling. To account for these terrain changes, the AERMAP terrain program within AERMOD was used to specify terrain elevations for all the receptors. See Figure 42 above with the elevation of each receptor plotted. The source of the elevation data incorporated into the model is from the USGS NED.

The EPA believes that the terrain in the area of analysis is accounted for in a manner consistent with the $SO_2$ modeling TAD. The stated application of the AERMAP pre-processor should adequately resolve any variations in terrain the area.

#### *8.3.2.8. Modeling Parameter: Background Concentrations of $SO_2$*

The Modeling TAD offers two mechanisms for characterizing background concentrations of $SO_2$ that are ultimately added to the modeled design values: 1) a "tier 1" approach, based on a monitored design value, or 2) a temporally varying "tier 2" approach, based on the 99$^{th}$ percentile monitored concentrations by hour of day and season or month. For this area of analysis, the Commonwealth elected to use a "tier 2" approach. Data was obtained from 2012-2014 for AQS Site: 21-145-1024 (Powell Street monitor) located in McCracken County, Kentucky, approximately 13 miles southeast of Shawnee Fossil Plant. These data were used to generate

temporally varying background based on the 99th percentile monitored concentrations for each hour of day by season in this analysis. The background concentrations for this area of analysis were determined by the state to vary from 2.6 μg/m$^3$, equivalent to 1.0 ppb when expressed in two significant figures,[43] to 34.1 μg/m$^3$ (13 ppb), with an average value of 13.6 μg/m$^3$ (5.2 ppb).

**Table 35. 2012-2014 Seasonal Hourly Concentrations at the Powell Street Monitor (ppb)**

| Hour | Winter | Spring | Summer | Fall |
|---|---|---|---|---|
| 0 | 4.7 | 3.0 | 2.3 | 2.0 |
| 1 | 5.0 | 4.0 | 1.3 | 1.7 |
| 2 | 4.7 | 2.0 | 1.3 | 2.3 |
| 3 | 6.0 | 3.0 | 1.0 | 1.7 |
| 4 | 4.7 | 3.0 | 1.3 | 2.0 |
| 5 | 4.0 | 2.0 | 2.0 | 2.0 |
| 6 | 3.7 | 2.0 | 2.7 | 2.7 |
| 7 | 4.0 | 3.7 | 4.0 | 4.3 |
| 8 | 5.3 | 4.0 | 6.7 | 4.7 |
| 9 | 7.0 | 5.0 | 6.3 | 6.7 |
| 10 | 8.0 | 12.0 | 5.7 | 9.7 |
| 11 | 7.3 | 9.3 | 11.0 | 8.3 |
| 12 | 10.0 | 10.7 | 11.3 | 11.0 |
| 13 | 11.3 | 6.7 | 8.3 | 9.3 |
| 14 | 8.3 | 5.0 | 9.3 | 13.0 |
| 15 | 7.3 | 6.3 | 8.0 | 10.7 |
| 16 | 10.0 | 6.7 | 9.0 | 8.0 |
| 17 | 10.7 | 4.7 | 7.3 | 6.3 |
| 18 | 7.3 | 3.7 | 7.0 | 3.3 |
| 19 | 5.3 | 2.0 | 5.0 | 2.3 |
| 20 | 4.0 | 1.0 | 2.7 | 2.3 |
| 21 | 4.3 | 1.3 | 2.0 | 2.7 |
| 22 | 4.3 | 2.0 | 1.7 | 2.3 |
| 23 | 4.0 | 2.3 | 2.0 | 2.0 |

The EPA concurs with the background monitor selected and the processing of this data into hourly, seasonally varying background values to be used in the modeling analysis. This component of the modeling analysis was performed in a manner consistent with the $SO_2$ Modeling TAD.

#### *8.3.2.9. Summary of Modeling Inputs and Results*

The AERMOD modeling input parameters for the McCracken County area of analysis are summarized below in Table 36.

[43] The $SO_2$ NAAQS level is expressed in ppb but AERMOD gives results in μg/m$^3$. The conversion factor for $SO_2$ (at the standard conditions applied in the ambient $SO_2$ reference method) is 1ppb = approximately 2.619 μg/m$^3$.

**Table 36: Summary of AERMOD Modeling Input Parameters for the Area of Analysis for the McCracken County Area**

| Input Parameter | Value |
|---|---|
| AERMOD Version | 15181 (regulatory default) |
| Dispersion Characteristics | Rural |
| Modeled Sources | 4 |
| Modeled Stacks | 8 |
| Modeled Structures | 71 |
| Modeled Fencelines | 1 |
| Total receptors | 15,738 |
| Emissions Type | Actual |
| Emissions Years | 2012-2014 |
| Meteorology Years | 2012-2014 |
| NWS Station for Surface Meteorology | Paducah, KY |
| NWS Station Upper Air Meteorology | Nashville, TN |
| NWS Station for Calculating Surface Characteristics | Paducah, KY and Onsite |
| Methodology for Calculating Background $SO_2$ Concentration | Tier 2 approach using AQS site: 21-145-1024 for 2012-2014 |
| Calculated Background $SO_2$ Concentration | 2.6 – 34.1 $\mu g/m^3$ |

The results presented below in Table 37 show the magnitude and geographic location of the highest predicted modeled concentration based on the input parameters.

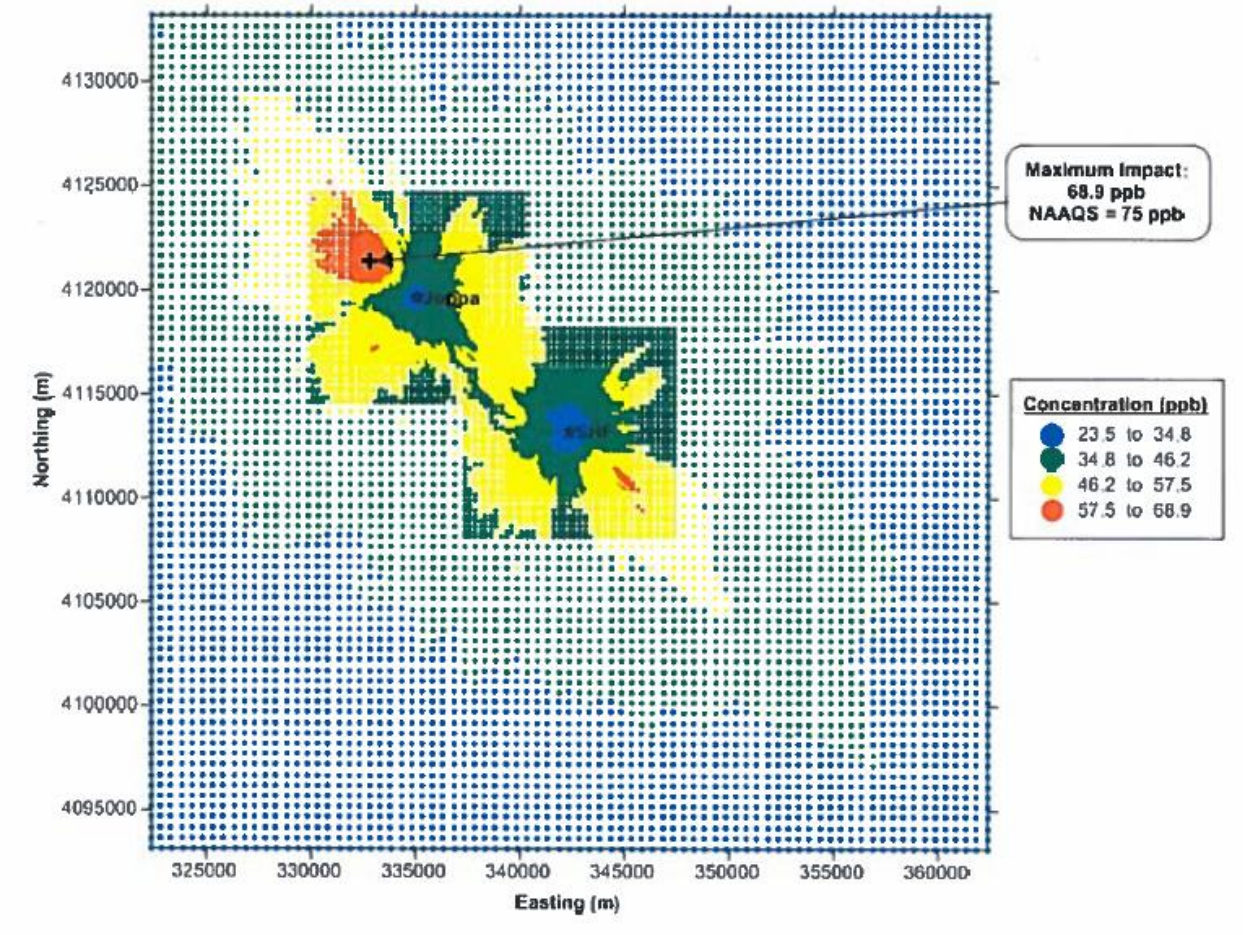
**Table 37. Maximum Predicted 99th Percentile Daily Maximum 1-Hour $SO_2$ Concentrations Averaged Over Three Years for the Area of Analysis for the McCracken County Area**

| Averaging Period | Data Period | Receptor Location [UTM zone 16] | | 99th percentile daily maximum 1-hour $SO_2$ Concentration ($\mu g/m^3$) | |
|---|---|---|---|---|---|
| | | UTM Easting (m) | UTM Northing (m) | Modeled concentration (including background) | NAAQS Level |
| 99th Percentile 1-Hour Average with NWS site Surface Characteristics | 2012-2014 | 332767 | 4121413 | 180.5 | 196.4* |
| 99th Percentile 1-Hour Average with Onsite Surface Characteristics | 2012-2014 | 332367 | 4120913 | 170.5 | 196.4* |

*Equivalent to the 2010 $SO_2$ NAAQS of 75 ppb using a 2.619 $\mu g/m^3$ conversion factor.

As indicated above, the Commonwealth performed modeling with two sets of surface characteristics: one with onsite information and one with information for the Paducah airport NWS site. The Commonwealth's modeling indicates that the highest predicted 99th percentile daily maximum 1-hour concentration within the chosen modeling domain for the Paducah airport NWS site's set of surface characteristics is 180.5 $\mu g/m^3$, equivalent to 68.9 ppb. The highest predicted 99th percentile daily maximum 1-hour concentration within the chosen modeling domain for the onsite surface characteristics is 170.5 $\mu g/m^3$, equivalent to 65.1 ppb. These modeled concentrations included the background concentrations of $SO_2$, and are based on actual emissions from the facilities. Figure 45 below shows the highest modeled concentrations, based on modeling conducted with NWS site surface characteristics, and was included as part of the Commonwealth's recommendation. This figure indicates that the predicted value occurred 12.66 km from Shawnee Fossil Plant, within the 100-meter spaced receptor grid northwest of Joppa, Illinois. The Commonwealth's receptor grid is also shown in the figure.

**Figure 45: Maximum Predicted 99th Percentile Daily Maximum 1-Hour $SO_2$ Concentrations Averaged Over Three Years for the Area of Analysis for the McCracken County Area. Source: "Shawnee Fossil Plant: Modeling Results, 1-Hour $SO_2$ NAAQS Designation, Paducah, Kentucky," prepared by Tennessee Valley Authority for Kentucky, July 7, 2016.**




The modeling submitted by the state does not indicate that the 1-hour $SO_2$ NAAQS is violated at the receptor with the highest modeled concentration.

*8.3.2.10. The EPA's Assessment of the Modeling Information Provided by the Commonwealth*

The EPA has reviewed the modeling analysis performed by the Commonwealth of Kentucky for Shawnee Fossil Plant and other sources in the area and concurs that the modeling was performed in a manner consistent with the Modeling TAD. The EPA also agrees that the maximum concentrations predicted by AERMOD are below the 1-hour $SO_2$ NAAQS. The Commonwealth chose to model two DRR sources in the area and two non-DRR sources, and the EPA agrees with this decision, as supported by the July 7, 2016, Modeling Report evaluating nearby sources within 50 km of Shawnee Fossil Plant. The EPA believes the modeling domain is appropriate to

capture predicted maximum impacts in the McCracken County area. Kentucky's selection of meteorology and surface characteristics for the area are also appropriate to make a valid modeling demonstration. The Commonwealth adequately represented the topography of the area with the model and its preprocessors. The Commonwealth chose to model emissions from Shawnee Fossil Plant, Joppa Steam, Honeywell International, and Lafarge Midwest during 2012 – 2014, rather than using the most recent available emissions. This departure from the Modeling TAD is acceptable because Shawnee Fossil Plant shows decreased emissions after this period, Joppa Steam also shows significant decreases in $SO_2$ emissions after this period, and Lafarge Midwest showed decreased emissions in 2015. Therefore, modeling these sources together over the 2012 – 2014 period likely provides for an overestimate of $SO_2$ impacts in the area relative to 2015. The Commonwealth chose to use actual emissions to reflect normal operation of the sources. The EPA believes these decisions are appropriate for the purpose of this modeling analysis. The EPA has also confirmed that Kentucky selected its seasonal/hourly varying background concentrations from the Powell Street monitor consistent with the Modeling TAD.

The Commonwealth made use of AERMOD version 15181, the most recent version available at the time the modeling was conducted. The EPA agrees that this model version is appropriate to characterize the area because the state made use of default regulatory options available at the time and followed the Modeling TAD wherever possible.

## 8.4. Emissions and Emissions-Related Data, Meteorology, Geography, and Topography for the McCracken County Area

These factors have been incorporated into the air quality modeling efforts and results discussed above. The EPA is giving consideration to these factors by considering whether they were properly incorporated and by considering the air quality concentrations predicted by the modeling.

## 8.5. Jurisdictional Boundaries in the McCracken County Area

Existing jurisdictional boundaries are considered for the purpose of informing the EPA's designation action for the McCracken County area. Our goal is to base designations on clearly defined legal boundaries, and to have these boundaries align with existing administrative boundaries when reasonable.

The modeling domain extends from Shawnee Fossil Plant at a radius of 50 km, and so covers the entirety of all of McCracken and Ballard Counties, most of Carlisle County, the northern portion of Graves County, the northwestern portion of Marshall County, and the western half of Livingston County in Kentucky. The modeled receptors also covered all of Massac County, most of Pulaski County, the southern portions of Johnson and Pope Counties, southeastern and northeastern portions of Alexander County, and the southeastern portion of Union County in Illinois, and the eastern portion of Mississippi County, Missouri.

## 8.6. The EPA's Assessment of the Available Information for the McCracken County Area

The EPA intends to designate the McCracken County area, including the entire County boundary, as unclassifiable/attainment. We believe that Kentucky's modeling analysis, and the monitoring data in the area, support the conclusion that there are no expected violations of the 2010 $SO_2$ NAAQS in the area. The 2014 – 2016 DV for the Powell Street monitor (AQS ID: 21-145-1024) is 17 ppb, which is below the NAAQS of 75 ppb, but the existing monitor is approximately 21 km from the Shawnee Fossil Plant facility. Kentucky did not assert that this existing monitor is located in the area of maximum concentration for the area, so it cannot be relied upon for designations, and the Commonwealth provided a modeling analysis to assess the air quality.

Based on the air quality characterization conducted within the McCracken County area of analysis in accordance with the EPA's Modeling TAD, the Commonwealth concluded that the area should be designated as attainment. This recommendation is based on Kentucky's assessment that emissions from the Shawnee Fossil Plant facility could interact with those from the Joppa Steam, Honeywell International, and Lafarge Midwest facilities and together impact the area, and the inclusion of these sources in the modeling analysis. Shawnee Fossil Plant and Fluor Federal Services, Inc. are the only McCracken County sources that emitted over 100 tons in 2014, and nearby ISP Chemicals, Inc. also showed the potential to impact the area. Both Fluor Federal Services, Inc. and ISP Chemicals, Inc. were excluded because the sources converted coal-fired boilers to natural gas and so significantly reduced their PTE. Joppa Steam, Honeywell International, and Lafarge Midwest are the only other sources in the 50 km area of analysis thought to impact the McCracken County area.

Kentucky evaluated possible contributions from these sources and other sources within 50 km of Shawnee Fossil Plant to $SO_2$ impacts in the McCracken County area. Based on a Q/d analysis, Kentucky decided in the Modeling Report to include possible contributions from nearby Joppa Steam, Honeywell International, and Lafarge Midwest by modeling actual emissions. Kentucky then added a reasonable value for background concentrations of $SO_2$ by including the 2012 – 2014 seasonal, hourly varying concentrations from the Powell Street monitor in the same county. The EPA agrees with the technical explanation for the Commonwealth's treatment of nearby $SO_2$ sources included in the July 7, 2016, Modeling Report. We believe the modeling of the sources included adequately represents the McCracken County area. Based on the analysis of potential source impacts in Section 8.3.2.4 of this TSD, the EPA has reason to believe there are no additional sources in areas adjacent to our intended area that are likely to cause or contribute to a violation of the NAAQS in the area of analysis. In addition, based on the available information for the remaining areas in Kentucky and neighboring Illinois and Missouri, including monitoring and modeling, there are no current $SO_2$ nonattainment areas near McCracken County, Kentucky or in nearby counties in Illinois or Missouri, and no expected nonattainment areas for this third round of designations. In addition, there are no nearby Round 4 areas being characterized by December 31, 2020 based on a newly deployed $SO_2$ monitor.

Therefore, the McCracken County area is not expected to contribute to ambient air quality in a nearby area that does not meet the NAAQS.

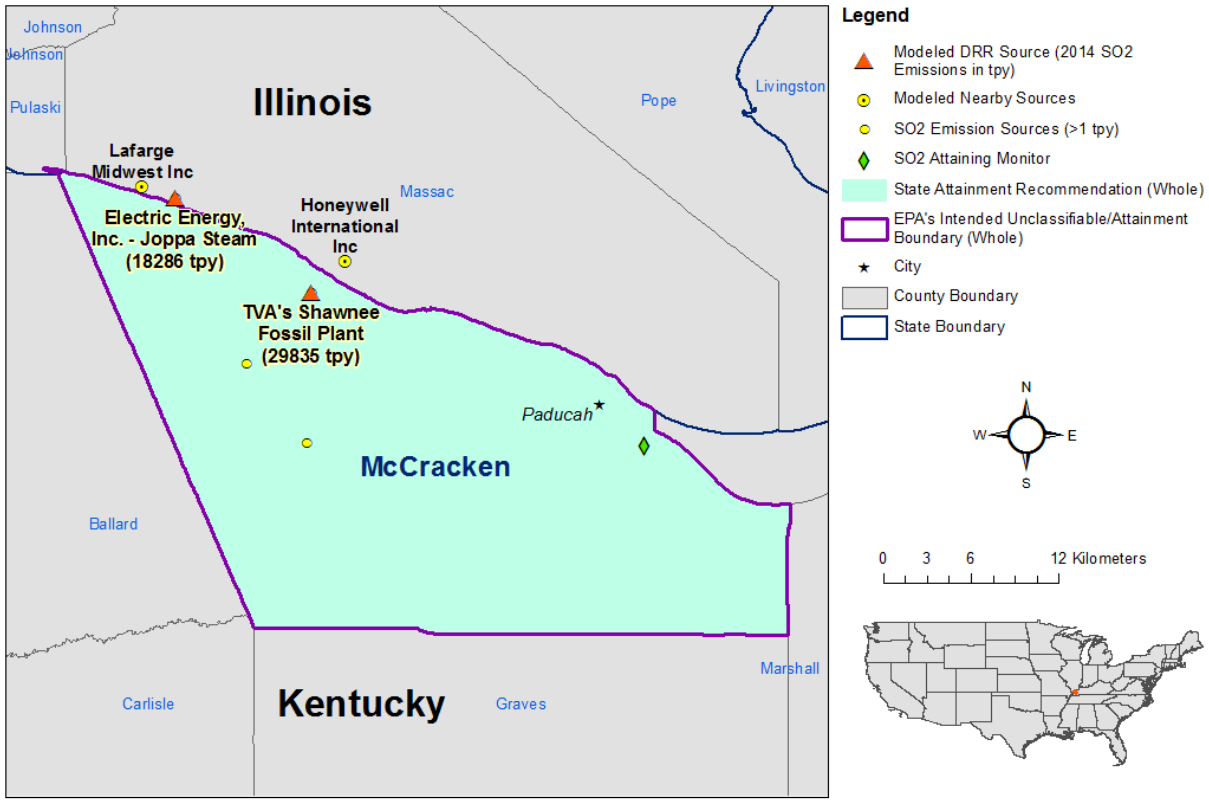
After careful evaluation of the Commonwealth's recommendation and supporting information, as well as all available relevant information, the EPA intends to designate the area around Shawnee Fossil Plant as unclassifiable/attainment for the 2010 $SO_2$ NAAQS. Specifically, the boundaries are comprised of the entirety of McCracken County. There are no remaining portions of McCracken County that remain to be characterized in the EPA's Round 4 of designations in 2020, nor are there any other portions of the County that have a separate area of analysis for Round 3.

The EPA believes that our intended unclassifiable/attainment area, bounded by the entirety of McCracken County, will have clearly defined legal boundaries, and we intend to find these boundaries to be a suitable basis for defining our intended unclassifiable/attainment area.

## 8.7. Summary of Our Intended Designation for the McCracken County Area

After careful evaluation of the state's recommendation and supporting information, as well as all available relevant information, the EPA intends to designate the McCracken County area as unclassifiable/attainment for the 2010 $SO_2$ NAAQS because the EPA has determined the area meets the 2010 $SO_2$ NAAQS and does not contribute to ambient air quality in a nearby area that does not meet the NAAQS. Specifically, the boundaries are comprised of the entirety of McCracken County. Figure 46 shows the boundary of this intended designated area.

**Figure 46. Boundary of the Intended McCracken County Unclassifiable/Attainment Area**




At this time, our intended designations for the state only apply to this area and the other areas presented in this technical support document. The EPA intends in a separate action to evaluate and designate all remaining undesignated areas in Kentucky by December 31, 2020.

# 9. Technical Analysis for the Muhlenberg County Area

## 9.1. Introduction

The EPA must designate the Muhlenberg County area by December 31, 2017, because the area has not been previously designated and Kentucky has not installed and begun timely operation of a new, approved $SO_2$ monitoring network meeting the EPA specifications referenced in the EPA's $SO_2$ DRR for any sources of $SO_2$ emissions in Muhlenberg County.

## 9.2. Air Quality Monitoring Data for the Muhlenberg County Area

This factor considers the $SO_2$ air quality monitoring data in the area of Muhlenberg County. Kentucky provided the values of the 99$^{th}$ percentile of the $SO_2$ monitors in Kentucky. Kentucky stated in its June 2, 2011 recommendation that "the average of the 99$^{th}$ percentile at all monitors is below the standard of 75 ppb in all locations except Jefferson County…The rest of the areas in Kentucky comply with the standard and should be designated as attainment/unclassifiable for the $SO_2$ standard."

The EPA reviewed the available air quality monitoring data in the AQS database and found no nearby data for Muhlenberg County. The closest monitor is over 75 km from Tennessee Valley Authority's Paradise Fossil Plant, two counties east of Muhlenberg County in Edmonson County. In reviewing the available air quality monitoring data in AQS, the EPA determined that there is no relevant data in AQS collected in or near Muhlenberg County that could inform the intended designation action. The most recent $SO_2$ design values for all areas of the country are available at https://www.epa.gov/air-trends/air-quality-design-values.

## 9.3. Air Quality Modeling Analysis for the Muhlenberg County Area Addressing Tennessee Valley Authority's Paradise Fossil Plant

### *9.3.1. Introduction*

This section 9.3 presents all the available air quality modeling information for a portion of Muhlenberg County that includes Tennessee Valley Authority's Paradise Fossil Plant. (This portion of Muhlenberg County will often be referred to as "the Muhlenberg County area" within this section 9.3.) This area contains the following $SO_2$ sources around which Kentucky is required by the DRR to characterize $SO_2$ air quality, or alternatively to establish an $SO_2$ emissions limitation of less than 2,000 tpy:

- The Paradise Fossil Plant facility emitted 2,000 tons or more annually. Specifically, Paradise emitted 19,655 tons of $SO_2$ in 2014 and 15,318 tons in 2015. This source meets the DRR criteria and thus is on the $SO_2$ DRR Source list, and Kentucky has chosen to characterize it via modeling.

- The Big Rivers Electric Corporation's Wilson Station emitted 2,000 tons or more annually and is on the $SO_2$ DRR Source list. Wilson was subject to the Round 2 $SO_2$

designation process, and the EPA designated Ohio County, Kentucky as unclassifiable. Therefore, this source is not explicitly discussed again in another section of this TSD.

Because the EPA has available results of air quality modeling in which these sources are modeled together, the area around this group of sources is being addressed in this section with consideration given to the impacts of all these sources.

In its submission, Kentucky recommended that an area that includes the area surrounding the Paradise Fossil Plant facility, specifically Muhlenberg County, be designated as attainment based on an assessment and characterization of air quality impacts from these facilities and other nearby sources that may have a potential impact in the area where the 2010 $SO_2$ NAAQS may be exceeded. This assessment and characterization was performed using air dispersion modeling software, i.e., AERMOD, analyzing a mixture of actual and allowable emissions. After careful review of the Commonwealth's assessment, supporting documentation, and all available data, the EPA intends to designate the area as unclassifiable/attainment. Our reasoning for this conclusion is explained in a later section of this TSD, after all the available information is presented.

The area that the Commonwealth has assessed via air quality modeling is located in the eastern portion of the Commonwealth, centered near the eastern border of Muhlenberg County, covering portions of the Green River, near Ohio and Butler Counties.

As seen in Figure 47 below, the Paradise Fossil Plant facility is located on the western bank of the Green River in Muhlenberg County, bordering Ohio County, approximately 8 km (5 miles) northeast of Drakesboro, Kentucky. The Wilson Station facility is located approximately 23 km north northwest of Paradise Fossil Plant in Ohio County in Centertown, Kentucky, just east of the Green River.

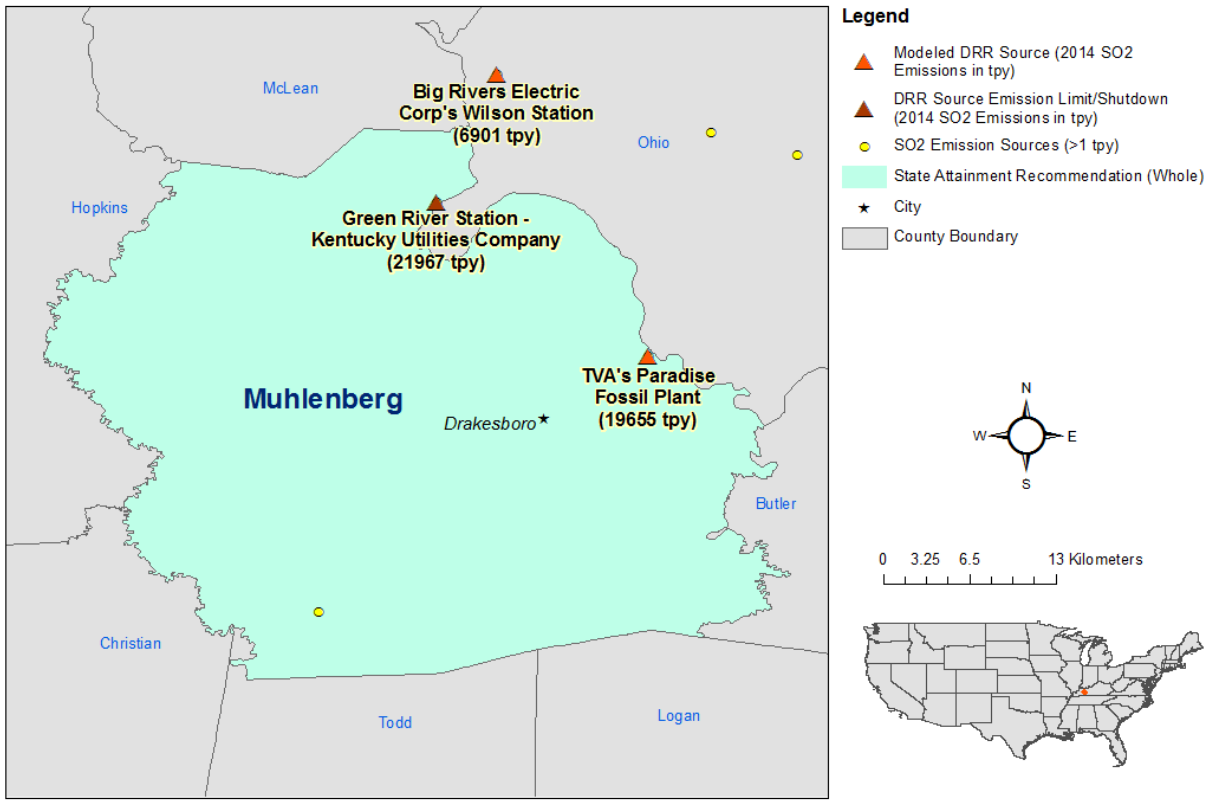
Included in Figure 47 are other nearby emitters of $SO_2$.[44] Also included in Figure 47 is the location of Wilson Station and the Kentucky Utilities Company's Green River Station facility, whose coal-fired units have shut down permanently to comply with the Mercury and Air Toxics Rule. Green River Station is located 23 km north-northwest of Paradise Fossil Plant in Muhlenberg County on the western bank of the Green River. All units at Green River Generating Station have been retired as of October 2015. For more information, see the September 25, 2015, letter from Kentucky Utilities Company to Kentucky accompanied by the latest title V permit for the facility, which shows the Mercury and Air Toxics Rule standard at 40 CFR 63, subpart UUUUU as an applicable requirement, included in the January 6, 2017, submittal to EPA.[45] The EPA confirmed that no emissions were reported to EPA's CAMD beginning in October 2015 for any federal programs for which Units 3 and 4 would have been subject. Additionally, on October 30, 2015, the EPA received retired unit exemption forms officially retiring the units from participation in CAMD federal programs for which the units were subject on. Other than Wilson Station and Green River Station, there are no other sources within 50 km of Paradise Fossil Plant that emitted 100 tons or more in 2014.

[44] All other $SO_2$ emitters of 1 tpy or more (based on information in the Kentucky, Ohio, and Indiana emissions inventory are shown in Figure 47.

[45] This information is available at: https://www.epa.gov/so2-pollution/so2-data-requirements-rule-january-13-2017-state-submittals-kentucky.

Also included in Figure 47 is the Commonwealth's recommended area for the attainment designation. The EPA's intended unclassifiable/attainment designation boundary for the Muhlenberg County area is not shown in this figure, but is shown in a figure in the section below that summarizes our intended designation.

**Figure 47. Map of the Muhlenberg County Area Addressing Paradise Fossil Plant**




The discussion and analysis that follows below will reference the Modeling TAD and the factors for evaluation contained in the EPA's July 22, 2016, guidance and March 20, 2015, guidance, as appropriate.

For this area, the EPA received and considered one modeling assessment, including one assessment from the Commonwealth and no assessments from other parties. To avoid confusion in referring to these assessments, the following table lists them, indicates when they were received, provides an identifier for the assessment that is used in the discussion of the assessments that follow, and identifies any distinguishing features of the modeling assessments.

**Table 38 – Modeling Assessments for the Muhlenberg County Area**

| Assessment Submitted by | Date of the Assessment | Identifier Used in this TSD | Distinguishing or Otherwise Key Features |
|---|---|---|---|
| Commonwealth of Kentucky | June 23, 2016* | June 23, 2016 Modeling Report | Only formal modeling report received. |

*This modeling assessment, dated June 23, 2016, was submitted to the EPA on January 6, 2017

### *9.3.2. Modeling Analysis Provided by the Commonwealth*

#### *9.3.2.1. Model Selection and Modeling Components*

The EPA's Modeling TAD notes that for area designations under the 2010 $SO_2$ NAAQS, the AERMOD modeling system should be used, unless use of an alternative model can be justified. The AERMOD modeling system contains the following components:

- AERMOD: the dispersion model
- AERMAP: the terrain processor for AERMOD
- AERMET: the meteorological data processor for AERMOD
- BPIPPRM: the building input processor
- AERMINUTE: a pre-processor to AERMET incorporating 1-minute automated surface observation system (ASOS) wind data
- AERSURFACE: the surface characteristics processor for AERMET
- AERSCREEN: a screening version of AERMOD

The Commonwealth used AERMOD version 15181, using all regulatory default options. AERMOD version 16216r has since become the regulatory model version. There were no updates from 15181 to 16216r that would significantly affect the concentrations predicted here. A discussion of the Commonwealth's approach to the individual components is provided in the corresponding discussion that follows, as appropriate.

The current version of AERMOD, version 16216r, includes updates to 40 CFR part 51, Appendix W, "Guideline of Air Quality Models," published on January 17, 2017 (82 FR 5203). This version of AERMOD also includes fixes to bugs that were inadvertently included in version 16216. Kentucky chose not to use the latest version of AERMOD because the state is using the regulatory default settings for version 15181 available at the time of its modeling preparation and is not making use of any previously unapproved alternative modeling options included in version 16216r and the update to Appendix W.

#### *9.3.2.2. Modeling Parameter: Rural or Urban Dispersion*

For any dispersion modeling exercise, the "urban" or "rural" determination of a source is important in determining the boundary layer characteristics that affect the model's prediction of downwind concentrations. For $SO_2$ modeling, the urban/rural determination is important because AERMOD invokes a 4-hour half-life for urban $SO_2$ sources. Section 6.3 of the Modeling TAD details the procedures used to determine if a source is urban or rural based on land use or population density. The EPA's recommended procedure for characterizing an area by prevalent land use is based on evaluating the dispersion environment within 3 km of the facility. According to the EPA's modeling guidelines, rural dispersion coefficients are to be used in the dispersion

modeling analysis if more than 50 percent of the area within a 3 km radius of the facility is classified as rural. Conversely, if more than 50 percent of the area is urban, urban dispersion coefficients should be used in the modeling analysis.

The Commonwealth used the Auer land use methodology and examined the various land use within 3 km of Paradise to quantify the percentage of area in various land use categories. The data source for the land cover was the 2011 National Land Cover Database (NLCD). Figure 48 shows the layout of the land use and Table 39 shows the results of the land use categorization process. The area is predominantly rural (95 percent). Therefore, for the purpose of performing the modeling for the area of analysis, the Commonwealth determined that it was most appropriate to run the model with rural dispersion coefficients, and the EPA concurs with this assessment.

**Figure 48. Land Use Map for Area Within 3km of the Paradise Fossil Plant Facility. Source: "Paradise Fossil Plant: Modeling Results, 1-Hour $SO_2$ NAAQS Designation, Paducah, Kentucky," prepared by Tennessee Valley Authority for Kentucky, June 23, 2016.**

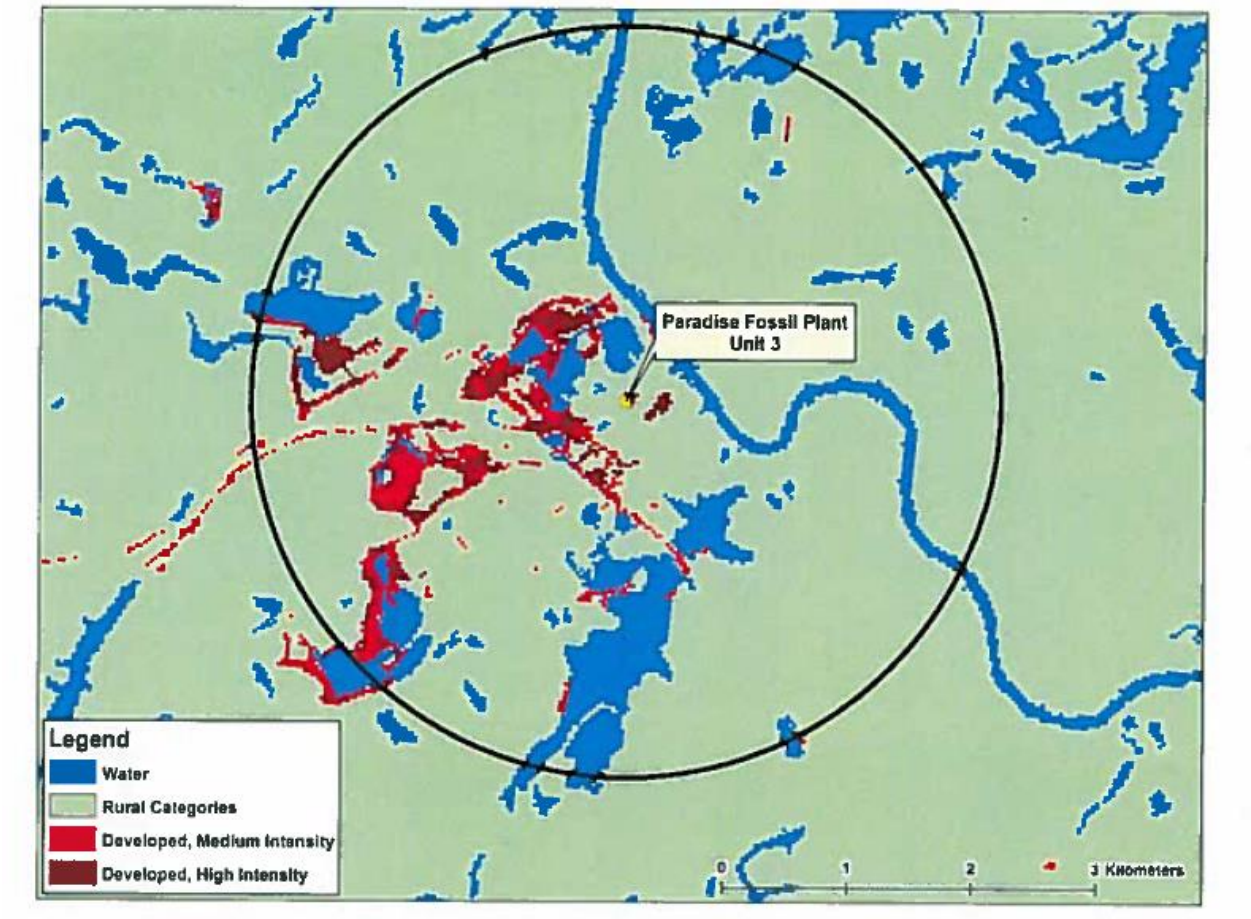


**Table 39 – Determination of the Urban or Rural Modeling Parameter for the Muhlenberg County Area by Auer's Method with 2011 Land Use Information**

| Category ID | Category Description | Auer's Class | Percent |
|---|---|---|---|
| 23 | Developed, Medium Intensity | Urban | 3.42% |
| 24 | Developed, High Intensity | Urban | 1.57% |
| 11 | Open Water | Rural | 13.05% |
| 21 | Developed, Open Space | Rural | 2.78% |
| 22 | Developed, Low Intensity | Rural | 2.59% |
| 31 | Barren Land | Rural | 2.54% |
| 41 | Deciduous Forest | Rural | 24.47% |
| 42 | Evergreen Forest | Rural | 4.75% |
| 43 | Mixed Forest | Rural | 0.02% |
| 52 | Shrub/Scrub | Rural | 0.04% |
| 71 | Grassland/Herbaceous | Rural | 17.45% |
| 81 | Pasture/Hay | Rural | 0.63% |
| 82 | Cultivated Crop | Rural | 19.70% |
| 90 | Wood Wetlands | Rural | 3.03% |
| 95 | Emergent Herbaceous Wetlands | Rural | 3.98% |
| | | Total | 100% |
| | | Urban | 4.99% |
| | | Rural | 95.01% |

#### *9.3.2.3. Modeling Parameter: Area of Analysis (Receptor Grid)*

The TAD recommends that the first step towards characterization of air quality in the area around a source or group of sources is to determine the extent of the area of analysis and the spacing of the receptor grid. Considerations presented in the Modeling TAD include but are not limited to: the location of the $SO_2$ emission sources or facilities considered for modeling; the extent of concentration gradients due to the influence of nearby sources; and sufficient receptor coverage and density to adequately capture and resolve the model predicted maximum $SO_2$ concentrations.

The sources of $SO_2$ emissions subject to the DRR in this area are described in the introduction to this section. For the Muhlenberg County area, the Commonwealth has included one other emitter of $SO_2$ within 50 km of Paradise Fossil Plant in any direction. The Commonwealth determined that this was the appropriate distance to adequately characterize air quality through modeling to include the potential extent of any $SO_2$ NAAQS exceedances in the area of analysis and any potential impact on $SO_2$ air quality from other sources in nearby areas. In addition to Paradise Fossil Plant, the other emitter of $SO_2$ included in the area of analysis is Big Rivers Electric Corporation's Wilson Station. No other sources beyond 50 km were determined by the Commonwealth to have the potential to cause concentration gradient impacts within the area of analysis.

The Commonwealth included two overlapping receptor grids to help characterize the Muhlenberg County area. One grid is centered around the Paradise Fossil Plant facility, and the other is centered around the Wilson Station facility in Ohio County. The grid centered around Wilson Station is nested within the main grid centered around Shawnee Fossil Plant. The grid receptor spacing for the area of analysis chosen by the Commonwealth is as follows:

**Table 40 – Description of Receptor Grid Spacing for the Muhlenberg County Area**

| Source | Receptor Spacing (m) | Grid Size (km) | Grid Origin (km south and west of site) |
|---|---|---|---|
| Paradise Fossil Plant | 100 | 6 x 6 | 3 |
| | 250 | 10 x 10 | 5 |
| | 500 | 40 x 40 | 20 |
| Wilson Station | 100 | 6 x 6 | 3 |
| | 250 | 10 x 10 | 5 |

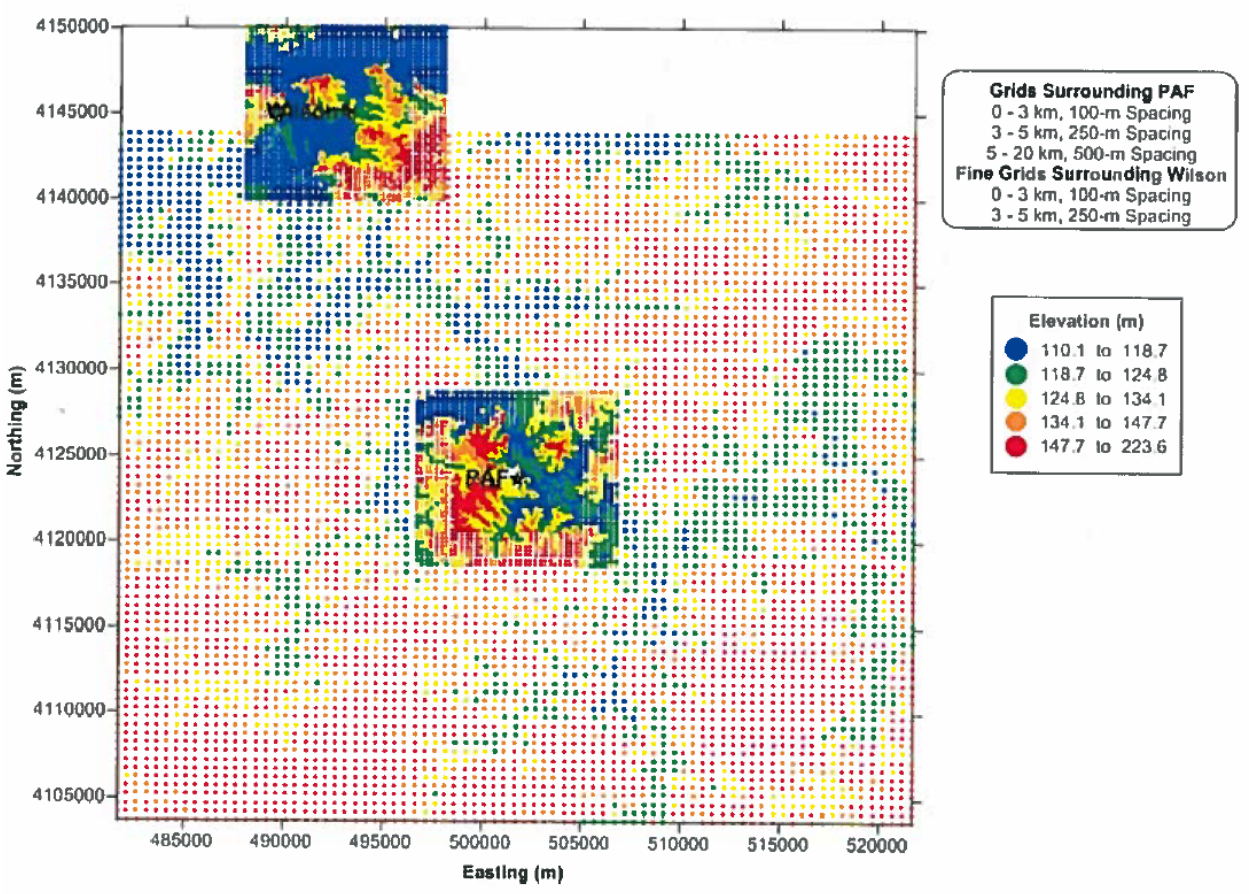
Denser spacing was done around both Paradise and Wilson facilities as described in Table 40.

The receptor network contained 15,725 receptors, and the network covered the entirety of Muhlenberg County, the eastern portion of Hopkins County, the northeastern portion of Christian County, the northern portions of Todd and Logan Counties, the northwestern portion of Warren County, all but the eastern portion of Butler County, most of Ohio County, the southernmost portion of Daviess County, most of McClean County, and a small portion of Webster County in Kentucky. This receptor network did not extend into portions of other states.

Figure 49, included in the state's recommendation, shows the state's chosen area of analysis surrounding the Paradise Fossil Plant, as well as the receptor grid for the area of analysis.

Consistent with the Modeling TAD, the Commonwealth placed receptors for the purposes of this designation effort in locations that would be considered ambient air relative to each modeled facility, including other facilities' property. The Commonwealth included receptors over the Green River even though over water is a location that meets the exceptions described in Section 4.2 of the Modeling TAD as not being feasible locations for placing a monitor. The Commonwealth chose to include these receptors to provide for a more complete analysis of $SO_2$ impacts in the area. The maximum concentration receptor is not within the Green River, nor other bodies of water. The Commonwealth did not place receptors in other locations that it considered to not be ambient air relative to each modeled facility. Receptors within the fenceline of Paradise Fossil Plant were excluded as the Commonwealth asserted that the facility is surrounded by a permanent fence.

**Figure 49: Receptor Grid for the Muhlenberg County Area, Including Receptor Elevations. Source: "Paradise Fossil Plant: Modeling Results, 1-Hour $SO_2$ NAAQS Designation, Paducah, Kentucky," prepared by Tennessee Valley Authority for Kentucky, June 23, 2016.**




The EPA agrees with the receptor grid used in this analysis, including the exclusion of receptors located within the fenceline of Paradise Fossil Plant. The DRR modeling report states that a permanent fence surrounds the property. The EPA agrees that the inclusion of receptors located within the Green River or any other bodies of water within the modeling domain provided for a more cautious approach to estimating $SO_2$ impacts in the Muhlenberg County area. This component of the modeling analysis was performed in a manner consistent with the $SO_2$ Modeling TAD.

#### *9.3.2.4. Modeling Parameter: Source Characterization*

Section 6 of the Modeling TAD offers recommendations on source characterization including source types, use of accurate stack parameters, inclusion of building dimensions for building downwash (if warranted), and the use of actual stack heights with actual emissions or following GEP policy with allowable emissions.

The Paradise Fossil Plant facility includes three coal-fired electric generating units (EGUs), eight oil-fired heating boilers, and three emergency diesel engines. The ancillary combustion sources – the oil fired heating boilers and emergency diesel engines – were excluded from the modeling due to having very small emissions and were not expected to impact modeled concentrations. Historic $SO_2$ emissions from these insignificant $SO_2$ sources are shown in the table below.

**Table 41. Emissions from Excluded Intermittent Sources**

| Year | Oil Heating Boilers 1-8 (tpy) | Diesel Engines 1-3 (tpy) |
|---|---|---|
| 2012 | 0.005 | Unavailable |
| 2013 | 0.0002 | 0.000006 |
| 2014 | 0.002 | 0.000007 |

Any potential impacts from these sources, though minimal, is expected to be captured by the Mammoth Cave background monitor (See Section 9.3.2.8).

Included in the modeling are the three coal-fired EGUs (PAF1-PAF3). PAF1 and PAF2 were retired under a U.S. EPA Administrative Compliance Order (ACO[46]), on April 15, 2017. PAF1 and PAF2 will be replaced with a natural gas fired three-on-one combined cycle plant, which is under construction. The June 23, 2016, Modeling Report notes that: "[d]uring the period from April 16, 2016, to April 15, 2017, PAF1 and PAF2 may be operated only as needed to maintain transmission system reliability, maintain required reserve margin, and startup PAF3 until new auxiliary boilers are commercially available." The EPA's CAMD information indicates that PAF1 did not operate past January 2017 and PAF2 did not operate past December 2016. Moreover, on July 24, 2017, the EPA received retired unit exemption forms officially retiring the units from participation in CAMD federal programs for which the units were subject.

Only one of the two units will be available at a given time unless unusually high system power demands require both to operate to ensure reliability of the transmission system. Therefore, the modeling analysis reflects operation of only one of the units at any given time. The units are identical, using the same emission controls and fuel. Therefore, PAF2 was modeled to represent emissions from either PAF1 or PAF2.

The Modeling Report goes on to note that: "because PAF1 and PAF2 will retire by April 15, 2017 under the federally enforceable ACO, PAF2 was modeled using allowable emissions for the period from January 1 through April 15 for each of the three years (2012-2014), and emissions for the period from April 16 through December 31 were set to zero." This approach for addressing emissions from PAF1 and PAF2 is inconsistent with the $SO_2$ Modeling TAD. However, because PAF1 and PAF2 both retired well before now, the current allowable $SO_2$ emission rate for these units is effectively zero. Nevertheless, the modeling that has been performed for Paradise includes unit PAF2 as described in the paragraphs above. Even though this modeling may not properly address emissions from PAF1 and PAF2 if these units were still in operation, it would have been acceptable for the Commonwealth to have excluded PAF1 and PAF2 from the modeling. Because PAF2 was included in the modeling as described in the

[46] U.S. EPA Administrative Compliance Order AED-CAA-113(a)-2016-0003, effective April 16, 2016.

paragraphs above, the modeling should provide an overestimate of $SO_2$ concentrations in the area of analysis.

PAF3 demonstrates compliance with the Mercury and Air Toxics Standards (MATS) acid gas limit using the surrogate $SO_2$ 30-day rolling average emission limit of 0.20 pounds per million BTU (lb/MMBtu). Thus, allowable emissions for PAF3 were modeled at an hourly emission rate equivalent to this MATS limit. The equivalent hourly rate (3,206 lb/hr) was determined by statistically analyzing the historic $SO_2$ emissions variability from PAF3 using the method described in USEPA's Guidance for 1-hour $SO_2$ Nonattainment Area SIP Submissions. This emission rate was modeled for PAF3 for the entire three-year period. Allowable emissions for PAF2 and PAF3 were modeled for three scenarios (100 percent load, 75 percent load, and 50 percent load) to ensure that the worst-case scenario was captured.

The 30-day rolling limit of equivalent stringency to the value modeled for PAF3 was computed in the following manner. First, the critical emission value (CEV), or the hourly value modeled was 3,206 lb/hr for PAF3. Then the ratio of the 99$^{th}$ percentile of 30-day rolling average emissions to the 99$^{th}$ percentile of 1-hour emissions was determined to be 0.712. Finally, the 30-day limit was determined by adjusting the CEV to a 30-day limit with this ratio, and the resultant limit was determined to be 2,282 lb/hr (3,206 x .712 = 2,282).

Using the Q/d method, Wilson Station emitted greater than 2,000 tons of $SO_2$ and was included in the modeling due to the Q/d ratio being greater than 20. The Wilson Station facility is located approximately 23 km from the Paradise Fossil Plant facility. This facility was included in the modeled using hourly varying emissions and flow rates from CEMS data obtained from the Clean Air Markets Division. Because Wilson Station was modeled using actual emissions, actual stack heights were used. There are no sources within 10 km of Paradise with emissions greater than 1 tpy. Other than Wilson Station, there is one other facility within 50 km with a Q/d value greater than 20: The Kentucky Utilities Company Green River Station. This facility officially shut down operations in late 2015. Therefore, this source was not included in the modeling.

With the exception of the cautious inclusion of PAF2 in the modeling as discussed above, the Commonwealth characterized these sources within the area of analysis in accordance with the best practices outlined in the Modeling TAD. The Commonwealth followed the EPA's GEP policy in conjunction with allowable emissions limits. The Commonwealth also adequately characterized the source's building layout and location, as well as the stack parameters, e.g., exit temperature, exit velocity, location, and diameter. Where appropriate, the AERMOD component BPIPPRM was used to assist in addressing building downwash. For the Paradise Fossil Plant facility, CEMS did not collect temperature data. The June 23, 2016, Modeling Report provided a comparison of the stack temperatures used in the 2012 title V permit renewal application with process-measured temperatures. This comparison concluded that there was less than a two percent difference between the modeled and measured stack exit temperatures indicating that the modeled stack exit temperatures are representative of actual temperatures during full load operation during 2012-14. Therefore, the Commonwealth relies on the title V constant values for stack exit temperatures at this facility because of the minor differences seen between averaged measured stack temperatures and the title V assumed temperatures. Temperature data was also unavailable for the Wilson Station facility. The Modeling Report indicates that temperatures

measured during stack testing were assumed to apply for all periods of operation for the modeling assessment.

The EPA agrees with this aspect of the modeling analysis, including the use of allowable emissions, GEP stack heights, and the inclusion of building downwash from structures at Paradise Fossil Plant. We also agree that the June 23, 2016, Modeling Report provides reasonable justification for the use of constant exit temperatures for the Paradise Fossil Plant. The EPA agrees with the Commonwealth's conclusions regarding which sources should be included directly or excluded. This component of the modeling analysis was performed generally in a manner consistent with the $SO_2$ Modeling TAD, and with adequate technical justification where departing from the Modeling TAD. The EPA also agrees with the inclusion of PAF2 in the modeling. Even though this unit has shut down under the conditions of an EPA ACO, it was included in the modeling which should provide for a cautious estimate of $SO_2$ concentrations in the area. The EPA concurs with the inclusion in the modeling of Wilson Station using actual hourly emissions and actual stack heights.

#### *9.3.2.5. Modeling Parameter: Emissions*

The EPA's Modeling TAD notes that for the purpose of modeling to characterize air quality for use in designations, the recommended approach is to use the most recent 3 years of actual emissions data and concurrent meteorological data. However, the TAD also indicates that it would be acceptable to use allowable emissions in the form of the most recently permitted (referred to as PTE or allowable) emissions rate that is federally enforceable and effective.

The EPA believes that CEMS data provide acceptable historical emissions information, when they are available. These data are available for many electric generating units. In the absence of CEMS data, the EPA's Modeling TAD highly encourages the use of AERMOD's hourly varying emissions keyword HOUREMIS, or through the use of AERMOD's variable emissions factors keyword EMISFACT. When choosing one of these methods, the EPA recommends using detailed throughput, operating schedules, and emissions information from the impacted source(s).

In certain instances, states and other interested parties may find that it is more advantageous or simpler to use PTE rates as part of their modeling runs. For example, where a facility has recently adopted a new federally enforceable emissions limit or implemented other federally enforceable mechanisms and control technologies to limit $SO_2$ emissions to a level that indicates compliance with the NAAQS, the state may choose to model PTE rates. These new limits or conditions may be used in the application of AERMOD for the purposes of modeling for designations, even if the source has not been subject to these limits for the entirety of the most recent 3 calendar years. In these cases, the Modeling TAD notes that a state should be able to find the necessary emissions information for designations-related modeling in the existing $SO_2$ emissions inventories used for permitting or SIP planning demonstrations. In the event that these short-term emissions are not readily available, they may be calculated using the methodology in Table 8-1 of Appendix W to 40 CFR Part 51 titled, "Guideline on Air Quality Models."

As previously noted, the Commonwealth included the Paradise Fossil Plant facility and one other emitter of $SO_2$ within 50 km in the area of analysis. For this area of analysis, the Commonwealth

has opted to use a hybrid approach, where a certain subset of emissions from certain facilities are expressed as actual emissions, and those from other facilities are expressed as PTE rates. The facilities in the state's modeling analysis and their associated actual or PTE rates are summarized below.

For Wilson Station, the Commonwealth provided annual actual $SO_2$ emissions between 2012 and 2014. This information is summarized in Table 42. A description of how the Commonwealth obtained hourly emission rates is given below this table.

**Table 42. Actual $SO_2$ Emissions Between 2012 – 2014 from Facilities in the Area of Analysis for the Muhlenberg County Area**

| Facility Name | $SO_2$ Emissions (tpy) | | |
|---|---|---|---|
| | 2012 | 2013 | 2014 |
| Wilson Station | 7,387 | 7,607 | 6,901 |
| Total Emissions from All Facilities in the Area of Analysis Modeled Based on Actual Emissions | 7,387 | 7,607 | 6,901 |

For Wilson Station, the actual hourly emissions data were obtained from CEMS data obtained from the Clean Air Markets Division Air Markets Program Data website.[47]

For the Paradise Fossil Plant facility, the Commonwealth provided PTE values. This information is summarized in Table 43. A description of how the Commonwealth obtained hourly emission rates is given below this table.

**Table 43. $SO_2$ Emissions based on PTE from Facilities in the Area of Analysis for the Muhlenberg County Area**

| Facility Name | $SO_2$ Emissions (tpy, based on PTE) |
|---|---|
| Paradise Fossil Plant (100% load scenario; first 105 days) | 19,326 |
| Paradise Fossil Plant (75% load scenario; first 105 days) | 15,861 |
| Paradise Fossil Plant (50% load scenario; first 105 days) | 12,339 |
| Paradise Fossil Plant (100% load scenario; rest of year) | 14,031 |
| Paradise Fossil Plant (75% load scenario; rest of year) | 10,565 |
| Paradise Fossil Plant (50% load scenario; rest of year) | 7,044 |
| Total Emissions from Facilities in the Area of Analysis Modeled Based on PTE (Maximum or 100% load scenario and first 105 days of the year) | 19,326 |

The PTE in tpy for Paradise Fossil Plant sources was determined by the Commonwealth based on the retirement of PAF1 and PAF2. As noted above, these units retired on April 15, 2017, as prescribed in the ACO. Accordingly, the Modeling Report shows that emissions for any period of time after April 15, 2017, emissions are assumed to be zero tons, which was the "future

[47] Information available at: https://ampd.epa.gov/ampd/.

allowable" limit at the time the modeling analysis was performed, as PAF1 and PAF2 shut down on April 15, 2017. This PTE of zero tons is permanent and federally enforceable. The ACO led to the permanent retirement of these units by April 15, 2017, and more recently the EPA received retired unit exemption forms for federal programs reporting under the EPA's CAMD on July 24, 2017. However, for January 1 through April 15 of each year, the first 105 days of each modeled year, the current allowable emissions at the time of the modeling analysis are assumed. Kentucky indicates that the reason the shut-down of PAF1 and PAF2 was not accounted for during the entirety of the years modeled was because the units had not ceased operation permanently by January 13, 2017. This approach for addressing emissions from PAF1 and PAF2 is inconsistent with the $SO_2$ Modeling TAD. However, and as previously noted, because the Commonwealth would have been justified to not include PAF1 and PAF2 in the modeling because they were shut down on April 15, 2017, and because PAF2 was included in the modeling as described in the paragraphs above, the modeling should provide a conservative estimate of $SO_2$ concentrations in the area of analysis. For PAF3, the current allowable emission limit for compliance with MATS was modeled. This limit is a 30-day rolling average limit of 0.20 lb/MMBtu, so the EPA's Nonattainment Guidance for modeling a higher effective 1-hour limit to determine compliance with the 1-hour NAAQS was followed.[48] The emission limit for PAF3 was modeled with the allowable limit for PAF2 for a 100 percent load scenario, a 75 percent load scenario, and a 50 percent scenario to ensure that the maximum possible impacts are captured.

The EPA agrees with the use of PTE emissions for PAF3 at Paradise Fossil Plant, and with the modeling of previous PTE emissions for PAF2 to represent possible impacts from PAF1 and PAF2 for the first 105 days of the year and the future allowable limit of zero for the remainder of each year to reflect the shutdown of these units after April 15, 2017. We also agree with the hourly emissions data obtained from CEMS for Wilson Station. The EPA has compared the sum of the hourly emissions modeled for Wilson Station for each year modeled and determined that these values are equal to those reported to the Clean Air Markets Division. Also, $SO_2$ emissions at Wilson Station in 2015 were less than or equivalent to emissions from the 2012-2014 period modeled. Therefore, the period modeled likely slightly overestimates $SO_2$ impacts relative to 2015, and the EPA concurs with use of actual emissions data from the 2012-2014 period. The EPA also agrees with the exclusion of eight oil-fired heating units and three emergency generators at Paradise Fossil Plant due to the low predicted emissions and the intermittent nature of operation. This component of the modeling analysis was generally performed in a manner consistent with the $SO_2$ Modeling TAD.

#### *9.3.2.6. Modeling Parameter: Meteorology and Surface Characteristics*

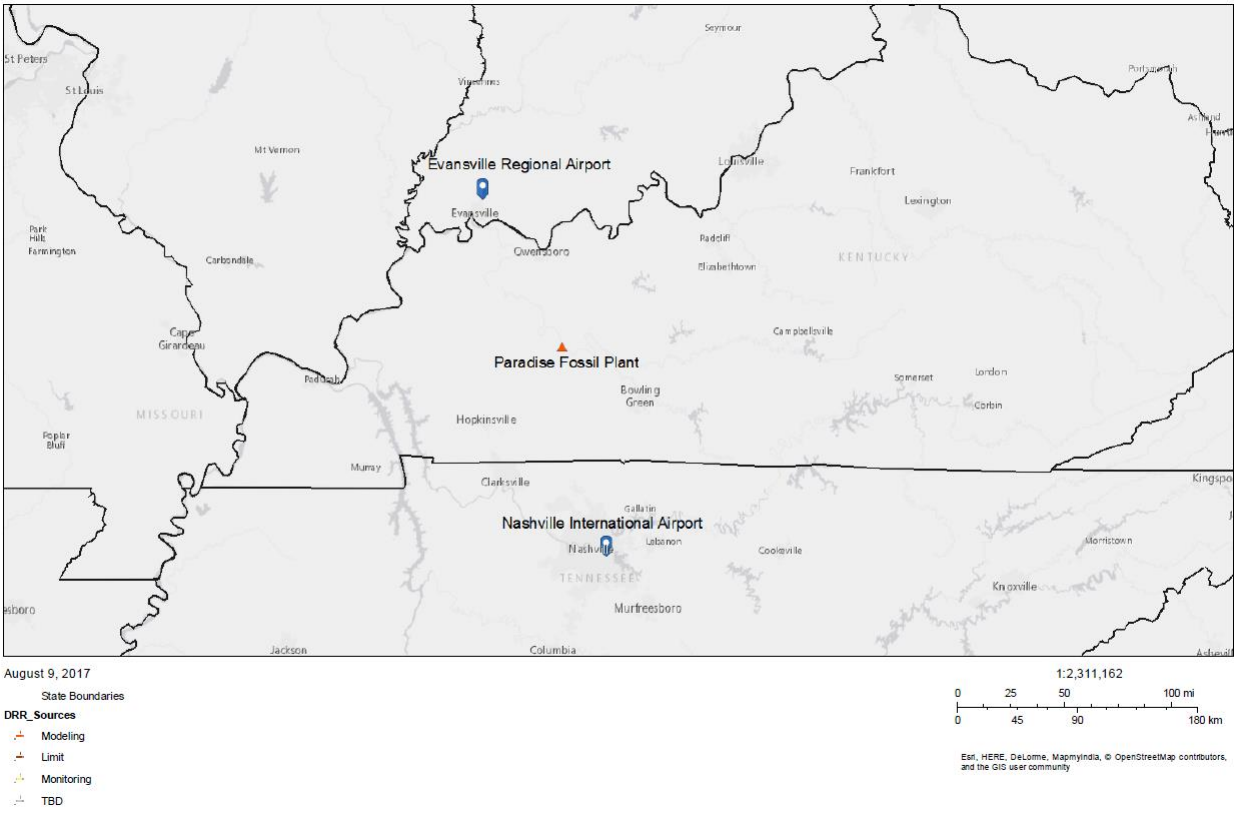
As noted in the Modeling TAD, the most recent 3 years of meteorological data (concurrent with the most recent 3 years of emissions data) should be used in designations efforts. The selection of data should be based on spatial and climatological (temporal) representativeness. The representativeness of the data is determined based on: 1) the proximity of the meteorological monitoring site to the area under consideration, 2) the complexity of terrain, 3) the exposure of the meteorological site, and 4) the period of time during which data are collected. Sources of meteorological data include NWS stations, site-specific or onsite data, and other sources such as universities, FAA, and military stations.

[48] "Guidance for 1-Hour $SO_2$ Nonattainment Area SIP Submissions," (Nonattainment Guidance), April 23, 2014.

For the area of analysis for the Muhlenberg County area, the state selected the surface meteorology from the Evansville Regional Airport NWS station in Evansville, Indiana, located at 38.044 N, 87.521 W, approximately 100 km northwest of Paradise Fossil Plant, and coincident upper air observations from a different NWS station, at Nashville International Airport (BNA) in Nashville, Tennessee, located at 36.126 N, 86.677 W, approximately 128 km south southeast of Paradise Fossil Plant, as best representative of meteorological conditions within the area of analysis.

The Commonwealth used AERSURFACE version 13016 using data from the NWS station at the Evansville Regional Airport to estimate the surface (albedo, Bowen ratio, and surface roughness [$z_o$]) of the area of analysis. Albedo is the fraction of solar energy reflected from the earth back into space, the Bowen ratio is the method generally used to calculate heat lost or heat gained in a substance, and the surface roughness is sometimes referred to as "zo" The Commonwealth estimated surface roughness values for 12 spatial sectors out to 1 km at a monthly temporal resolution for dry, wet, and average conditions. In the figure below, generated by the EPA, the locations of these NWS stations is shown relative to the area of analysis.

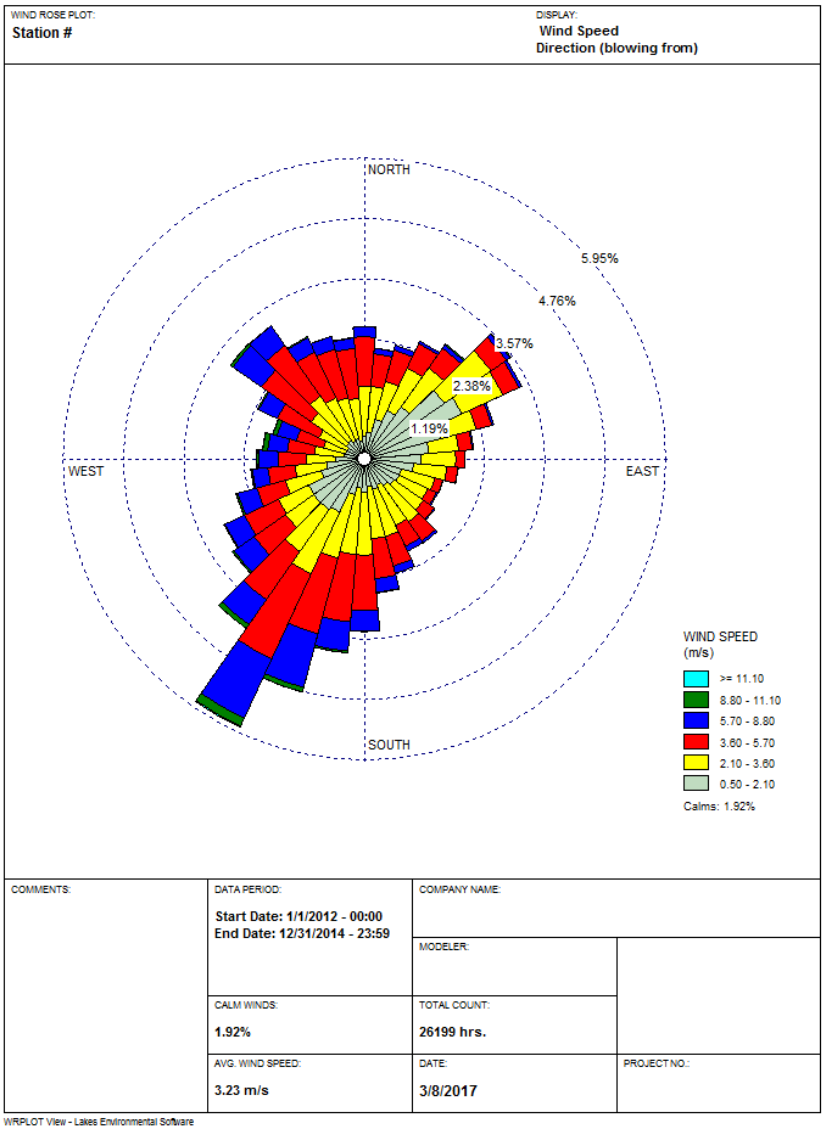
**Figure 50. Area of Analysis and the NWS stations in the Muhlenberg County Area**




The EPA generated a wind rose for the Evansville, Indiana, airport for the 2012-2014 period. In Figure 51, the frequency and magnitude of wind speed and direction are defined in terms of from

where the wind is blowing. Analysis of the NWS data indicate winds predominantly blow from the southwest direction, approximately 18 percent of the time.

**Figure 51: Evansville, NWS Cumulative Annual Wind Rose for Years 2012-2014**




Meteorological data from the above surface and upper air NWS stations were used in generating AERMOD-ready files with the AERMET processor. The output meteorological data created by the AERMET processor is suitable for being applied with AERMOD input files for AERMOD modeling runs. The Commonwealth followed the methodology and settings presented in Section 7 of the $SO_2$ Modeling TAD in the processing of the raw meteorological data into an AERMOD-ready format, and used AERSURFACE to best represent surface characteristics.

The Modeling Report indicates that: "[t]wo sets of meteorology were modeled, with one set using the onsite surface characteristics and another set using the surface characteristics of the NWS station."

Hourly surface meteorological data records are read by AERMET, and include all the necessary elements for data processing. However, wind data taken at hourly intervals may not always portray wind conditions for the entire hour, which can be variable in nature. Hourly wind data may also be overly prone to indicate calm conditions, which are not modeled by AERMOD. In order to better represent actual wind conditions at the meteorological tower, wind data of 1-minute duration was provided from the first NWS station mentioned above, but in a different formatted file to be processed by a separate preprocessor, AERMINUTE. These data were subsequently integrated into the AERMET processing to produce final hourly wind records of AERMOD-ready meteorological data that better estimate actual hourly average conditions and that are less prone to over-report calm wind conditions. This allows AERMOD to apply more hours of meteorology to modeled inputs, and therefore produce a more complete set of concentration estimates. The Commonwealth did not set a minimum wind speed threshold of 0.5 m/s in processing meteorological data for use in AERMOD, as is allowed in the Modeling TAD. Setting this threshold can guard against excessively high concentrations that could be produced by AERMOD in very light wind conditions. By not excluding any wind speeds, the modeling conducted conservatively predicts $SO_2$ impacts.

The EPA agrees with the processing and use of surface data from the Evansville airport and upper air data from the Nashville, Tennessee, airport in this modeling analysis. We also agree with the evaluation of onsite surface characteristics for separate modeling runs. This component of the modeling analysis was performed in a manner consistent with the $SO_2$ Modeling TAD.

#### *9.3.2.7. Modeling Parameter: Geography, Topography (Mountain Ranges or Other Air Basin Boundaries) and Terrain*

The terrain in the area of analysis is best described as hilly. To account for these terrain changes, the AERMAP terrain program within AERMOD was used to specify terrain elevations for all the receptors. See Figure 49 above with the elevation of each receptor plotted. The source of the elevation data incorporated into the model is from the USGS NED.

The EPA believes that the terrain in the area of analysis is accounted for in a manner consistent with the $SO_2$ modeling TAD. The stated application of the AERMAP pre-processor should adequately resolve any variations in terrain the area.

#### *9.3.2.8. Modeling Parameter: Background Concentrations of $SO_2$*

The Modeling TAD offers two mechanisms for characterizing background concentrations of $SO_2$ that are ultimately added to the modeled design values: 1) a "tier 1" approach, based on a monitored design value, or 2) a temporally varying "tier 2" approach, based on the $99^{th}$ percentile monitored concentrations by hour of day and season or month. For this area of analysis, the

Commonwealth elected to use a "tier 2" approach. Data was obtained from 2012-2014 for AQS Site: 21-061-0501 (Mammoth Cave National Park) located in Mammoth Cave, Kentucky, approximately 75 km (47 miles) east of Paradise Fossil Plant. These data were used to generate temporally varying background based on the 99th percentile monitored concentrations for each hour of day by season in this analysis. The background concentrations for this area of analysis were determined by the Commonwealth to vary from 3.41 $\mu g/m^3$, equivalent to 1.3 ppb when expressed in 2 significant figures,[49] to 18.9 $\mu g/m^3$ (7.2 ppb), with an average value of 9.43 $\mu g/m^3$ (3.6 ppb).

**Table 44. 2012-2014 Seasonal Hourly Concentrations at the Mammoth Cave Monitor (ppb)**

| Hour | Winter | Spring | Summer | Fall |
|---|---|---|---|---|
| 0 | 4.6 | 2.6 | 1.5 | 3.4 |
| 1 | 2.6 | 1.6 | 2.7 | 2.7 |
| 2 | 5.1 | 1.8 | 1.5 | 1.9 |
| 3 | 3.9 | 2.2 | 1.7 | 2.4 |
| 4 | 3.9 | 2.6 | 1.3 | 2.8 |
| 5 | 4.5 | 3.1 | 1.6 | 3.0 |
| 6 | 4.6 | 3.1 | 1.7 | 3.1 |
| 7 | 5.5 | 3.5 | 2.9 | 3.9 |
| 8 | 5.2 | 3.4 | 4.2 | 4.5 |
| 9 | 7.2 | 4.2 | 4.3 | 4.8 |
| 10 | 6.6 | 3.6 | 3.0 | 5.0 |
| 11 | 5.6 | 3.4 | 3.0 | 5.3 |
| 12 | 5.8 | 2.6 | 2.7 | 5.1 |
| 13 | 5.3 | 2.5 | 2.7 | 3.9 |
| 14 | 5.7 | 2.6 | 2.7 | 4.0 |
| 15 | 6.4 | 2.6 | 2.1 | 3.5 |
| 16 | 5.9 | 3.1 | 2.4 | 4.8 |
| 17 | 5.1 | 3.0 | 2.7 | 4.4 |
| 18 | 5.6 | 2.7 | 2.6 | 3.6 |
| 19 | 5.2 | 2.5 | 2.6 | 3.9 |
| 20 | 4.9 | 2.6 | 2.2 | 3.4 |
| 21 | 5.8 | 2.8 | 1.9 | 3.3 |
| 22 | 5.7 | 2.9 | 1.7 | 3.6 |
| 23 | 6.3 | 2.9 | 1.5 | 3.8 |

[49] The $SO_2$ NAAQS level is expressed in ppb but AERMOD gives results in $\mu g/m^3$. The conversion factor for $SO_2$ (at the standard conditions applied in the ambient $SO_2$ reference method) is 1ppb = approximately 2.619 $\mu g/m^3$.

The EPA concurs with the background monitor selected and the processing of this data into hourly, seasonally varying background values to be used in the modeling analysis. This component of the modeling analysis was performed in a manner consistent with the $SO_2$ Modeling TAD.

#### *9.3.2.9. Summary of Modeling Inputs and Results*

The AERMOD modeling input parameters for the Muhlenberg County area of analysis are summarized below in Table 45.

**Table 45: Summary of AERMOD Modeling Input Parameters for the Area of Analysis for the Muhlenberg County Area**

| Input Parameter | Value |
|---|---|
| AERMOD Version | 15181 (regulatory default) |
| Dispersion Characteristics | Rural |
| Modeled Sources | 2 |
| Modeled Stacks | 3 |
| Modeled Structures | 35 |
| Modeled Fencelines | 1 |
| Total receptors | 15,725 |
| Emissions Type | Mixed/Hybrid |
| Emissions Years | 2012 – 2014 Actuals; |
| Meteorology Years | 2012-2014 |
| NWS Station for Surface Meteorology | Evansville, IN |
| NWS Station Upper Air Meteorology | Nashville, TN |
| NWS Station for Calculating Surface Characteristics | Evansville, IN and On-Site |
| Methodology for Calculating Background $SO_2$ Concentration | Tier 2 approach using AQS site: 21-061-0501for 2012-2014 |
| Calculated Background $SO_2$ Concentration | 3.4 – 18.9 $\mu g/m^3$ |

The results presented below in Table 46 show the magnitude and geographic location of the highest predicted modeled concentration based on the input parameters.

**Table 46. Maximum Predicted 99th Percentile Daily Maximum 1-Hour $SO_2$ Concentrations Averaged Over Three Years for the Area of Analysis for the Muhlenberg County Area**

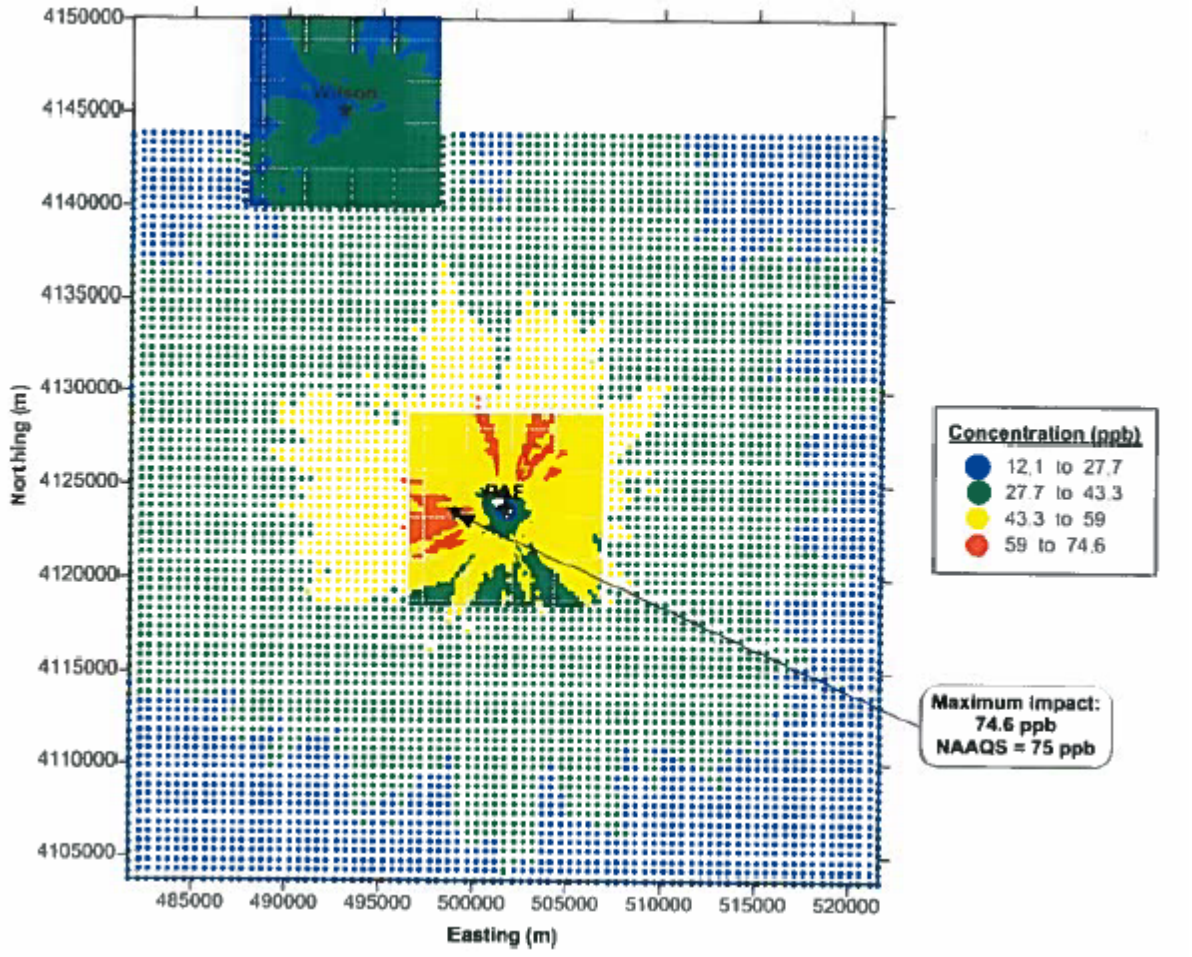
| Averaging Period | Data Period | Receptor Location [UTM zone 16] | | 99th percentile daily maximum 1-hour $SO_2$ Concentration ($\mu g/m^3$) | |
|---|---|---|---|---|---|
| | | UTM Easting (m) | UTM Northing (m) | Modeled concentration (including background) | NAAQS Level |
| 99th Percentile 1-Hour Average with NWS site Surface Characteristics at 100% Load | 2012-2014 | 499001 | 4123598 | 195.4 | 196.4* |
| 99th Percentile 1-Hour Average with Onsite Surface Characteristics at 100% Load | 2012-2014 | 498701 | 4122898 | 177.0 | 196.4* |
| 99th Percentile 1-Hour Average with NWS site Surface Characteristics at 75% Load | 2012-2014 | 499201 | 4123598 | 190.9 | 196.4* |
| 99th Percentile 1-Hour Average with Onsite Surface Characteristics at 75% Load | 2012-2014 | 502501 | 4124998 | 175.5 | 196.4* |
| 99th Percentile 1-Hour Average with NWS site Surface Characteristics at 50% Load | 2012-2014 | 498701 | 4123398 | 186.2 | 196.4* |
| 99th Percentile 1-Hour Average with Onsite Surface Characteristics at 50% Load | 2012-2014 | 502501 | 4124898 | 177.0 | 196.4* |

*Equivalent to the 2010 $SO_2$ NAAQS of 75 ppb using a 2.619 $\mu g/m^3$ conversion factor

As indicated above, the Commonwealth performed modeling with two sets of surface characteristics: one with onsite information and one with information for the Evansville airport

NWS site. The Commonwealth also included model runs for 100 percent load, 75 percent load, and 50 percent load for the PAF3 unit's PTE limit to ensure the maximum possible $SO_2$ impacts were captured in the analysis. The Commonwealth's modeling indicates that the highest predicted 99$^{th}$ percentile daily maximum 1-hour concentration within the chosen modeling domain for the Evansville airport NWS site's set of surface characteristics and assuming 100 percent load is 195.4 μg/m$^3$, equivalent to 74.6 ppb. The highest predicted 99$^{th}$ percentile daily maximum 1-hour concentration within the chosen modeling domain for the onsite surface characteristics at 100 percent load is 170.5 μg/m$^3$, equivalent to 67.6 ppb. These modeled concentrations included the background concentrations of $SO_2$, and are based on a mixture of actual and PTE emissions from the facilities. Figure 52 below shows the highest modeled concentrations, based on modeling conducted with NWS site surface characteristics at 100 percent load, and was included as part of the Commonwealth's recommendation. This figure indicates that the highest predicted value occurred 2.7 km directly east from Paradise Fossil Plant, within the 100-m spaced receptor grid. The Commonwealth's receptor grid is also shown in the figure.

**Figure 52: Maximum Predicted 99th Percentile Daily Maximum 1-Hour $SO_2$ Concentrations Averaged Over Three Years for the Area of Analysis for the Muhlenberg County Area. Source: "Paradise Fossil Plant: Modeling Results, 1-Hour $SO_2$ NAAQS Designation, Paducah, Kentucky," prepared by Tennessee Valley Authority for Kentucky, June 23, 2016.**




The modeling submitted by the Commonwealth does not indicate that the 1-hour $SO_2$ NAAQS is violated at the receptor with the highest modeled concentration.

#### *9.3.2.10. The EPA's Assessment of the Modeling Information Provided by the Commonwealth*

The EPA has reviewed the modeling analysis performed by the Commonwealth of Kentucky for Paradise Fossil Plant and other sources in the area and concurs that the modeling was performed in a manner consistent with the modeling TAD. The EPA also agrees that the maximum concentrations predicted by AERMOD are below the 1-hour $SO_2$ NAAQS. The Commonwealth chose to model two DRR sources in the area and no other sources, and the EPA agrees with this decision, as supported by the June 23, 2016, Modeling Report evaluating nearby sources within 50 km of Paradise Fossil Plant. The EPA believes the modeling domain is appropriate to capture

predicted maximum impacts in the Muhlenberg County area. Kentucky's selection of meteorology and surface characteristics for the area are also appropriate to make a valid modeling demonstration. The Commonwealth adequately represented the topography of the area with the model and its preprocessors. The Commonwealth chose to model actual emissions from nearby Wilson Station during 2012 – 2014, rather than using the most recent available emissions. This departure from the Modeling TAD is acceptable because Wilson Station shows decreased emissions after this period. Therefore, modeling these sources together over the 2012 – 2014 period provides for a conservative estimate of $SO_2$ impacts in the area. The Commonwealth chose to use actual emissions to reflect normal operation of the source.

Kentucky chose to model PTE for the primary source in the area, Paradise Fossil Plant. The PTE at Paradise Fossil Plant was accounted for with the MATS limit for unit PAF3, and by including current PTE for the first 105 days of each year and the future allowable PTE of zero emissions for the remainder of the year for unit PAF2. The Commonwealth chose to model emissions from Paradise Fossil Plant in this way to reflect the restricted operation of units PAF1 and PAF2 and the shut-down of these units after April 15, 2017. We believe these decisions are appropriate for the purpose of this modeling analysis. However, and as previously noted, because the Commonwealth would have been justified to not include PAF1 and PAF2 in the modeling because they were shut down on April 15, 2017, and because PAF2 was included in the modeling as described in the paragraphs above, the modeling should provide a conservative estimate of $SO_2$ concentrations in the area of analysis. We have also confirmed that Kentucky selected its seasonal/hourly varying background concentrations from the Mammoth Cave monitor consistent with the Modeling TAD.

The Commonwealth made use of AERMOD version 15181, the most recent version available at the time the modeling was conducted. The EPA agrees that this model version is appropriate to characterize the area because the state made use of default regulatory options available at the time and followed the Modeling TAD.

## 9.4. Emissions and Emissions-Related Data, Meteorology, Geography, and Topography for the Muhlenberg County Area

These factors have been incorporated into the air quality modeling efforts and results discussed above. The EPA is giving consideration to these factors by considering whether they were properly incorporated and by considering the air quality concentrations predicted by the modeling.

## 9.5. Jurisdictional Boundaries in the Muhlenberg County Area

Existing jurisdictional boundaries are considered for the purpose of informing the EPA's designation action for the Muhlenberg County area. Our goal is to base designations on clearly

defined legal boundaries, and to have these boundaries align with existing administrative boundaries when reasonable.

The modeling domain extends from Paradise Fossil Plant at a radius of 50 km, and so covers the entirety of Muhlenberg County, the eastern portion of Hopkins County, the northeastern portion of Christian County, the northern portions of Todd and Logan Counties, the northwestern portion of Warren County, all but the eastern portion of Butler County, most of Ohio County, the southernmost portion of Daviess County, most of McClean County, and a small portion of Webster County in Kentucky. This receptor network did not extend into portions of other states.

## 9.6. The EPA's Assessment of the Available Information for the Muhlenberg County Area

The EPA intends to designate the Muhlenberg County area, including the entire County boundary, as unclassifiable/attainment. We believe that Kentucky's modeling analysis supports the conclusion that there are no expected violations of the 2010 $SO_2$ NAAQS in the area. There is no current monitoring data available for the area, so the modeling serves to reflect the air quality expected in the years modeled.

Based on the air quality characterization conducted within the Muhlenberg County area of analysis in accordance with the EPA's Modeling TAD, the Commonwealth concluded that the area should be designated as attainment. This recommendation is based on Kentucky's assessment that emissions from the Paradise Fossil Plant facility could interact with those from the Wilson Station facility and together significantly impact the area, and the inclusion of these sources in the modeling analysis. Paradise Fossil Plant and Green River Station are the only Muhlenberg County sources that emitted over 100 tons in 2014, and Green River Station was excluded because the source has since permanently shut down. Wilson Station is the only other source in the 50 km area of analysis thought to impact the Muhlenberg County area.

Kentucky evaluated possible contributions from these sources and other potential sources within 50 km of Paradise Fossil Plant to $SO_2$ impacts in the Muhlenberg County area. Based on a Q/d analysis, Kentucky decided in the Modeling Report to include possible contributions from nearby Wilson Station by modeling actual emissions. Kentucky accounted for emissions from Paradise Fossil Plant with allowable emissions to reflect the reductions in $SO_2$ emissions relative to the 2012 – 2014 period that are were in effect from April 16, 2016, through April 15, 2017, and the shutdown of units PAF1 and PAF2 after April 15, 2017, as prescribed in the ACO. Kentucky then added a reasonable value for background concentrations of $SO_2$ by including the 2012 – 2014 seasonal, hourly varying concentrations from the Mammoth Cave monitor. The EPA agrees with the technical explanation for the Commonwealth's treatment of nearby $SO_2$ sources included in the June 23, 2016, Modeling Report. We believe the modeling of the sources included adequately represents the Muhlenberg County area. Based on the analysis of potential source impacts in Section 8.3.2.4 of this TSD, the EPA has reason to believe there are no additional sources in areas adjacent to our intended area that are likely to cause or contribute to a violation of the NAAQS in the area of analysis. In addition, based on the available information for the remaining areas in Kentucky, including monitoring and modeling, there are no current $SO_2$ nonattainment areas near Muhlenberg County, Kentucky, and no expected nonattainment areas for this third round of designations. In addition, there are no nearby Round 4 areas being characterized by December 31, 2020 based on a newly deployed $SO_2$ monitor. Therefore, the Muhlenberg County area is not expected to contribute to ambient air quality in a nearby area that does not meet the NAAQS.

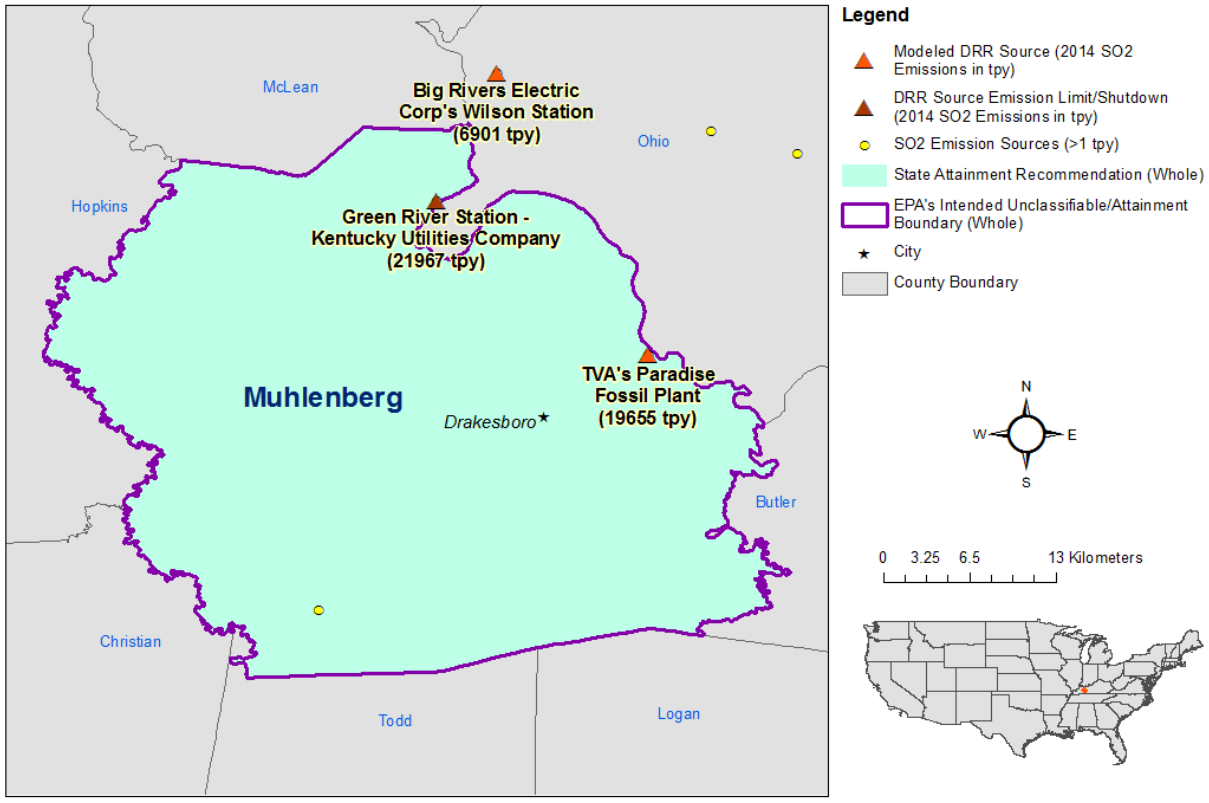
After careful evaluation of the Commonwealth's recommendation and supporting information, as well as all available relevant information, the EPA intends to designate the area around Paradise Fossil Plant as unclassifiable/attainment for the 2010 $SO_2$ NAAQS. Specifically, the boundaries are comprised of the entirety of Muhlenberg County. There are no remaining portions of Muhlenberg County that remain to be characterized in the EPA's Round 4 of designations in 2020, nor are there any other portions of the County that have a separate area of analysis for Round 3.

The EPA believes that our intended unclassifiable/attainment area, bounded by the entirety of Muhlenberg County, will have clearly defined legal boundaries, and we intend to find these boundaries to be a suitable basis for defining our intended unclassifiable/attainment area.

## 9.7. Summary of Our Intended Designation for the Muhlenberg County Area

After careful evaluation of the state's recommendation and supporting information, as well as all available relevant information, the EPA intends to designate the Muhlenberg County area as unclassifiable/attainment for the 2010 $SO_2$ NAAQS because the EPA has determined the area meets the 2010 $SO_2$ NAAQS and does not contribute to ambient air quality in a nearby area that does not meet the NAAQS. Specifically, the boundaries are comprised of the entirety of Muhlenberg County. Figure 53 shows the boundary of this intended designated area.

**Figure 53. Boundary of the Intended Muhlenberg County Unclassifiable/Attainment Area**




At this time, our intended designations for the state only apply to this area and the other areas presented in this technical support document. The EPA intends in a separate action to evaluate and designate all remaining undesignated areas in Kentucky by December 31, 2020.

# 10. Technical Analysis for the Trimble County Area

## 10.1. Introduction

The EPA must designate the Trimble County area by December 31, 2017, because the area has not been previously designated and Kentucky has not installed and begun timely operation of a new, approved $SO_2$ monitoring network meeting the EPA specifications referenced in the EPA's $SO_2$ DRR for any sources of $SO_2$ emissions in Trimble County.

## 10.2. Air Quality Monitoring Data for the Trimble County Area

This factor considers the $SO_2$ air quality monitoring data in the area of Trimble County. Kentucky provided the values of the 99$^{th}$ percentile of the $SO_2$ monitors in Kentucky. Kentucky stated in its June 2, 2011 recommendation that "the average of the 99$^{th}$ percentile at all monitors is below the standard of 75 ppb in all locations except Jefferson County…The rest of the areas in Kentucky comply with the standard and should be designated as attainment/unclassifiable for the $SO_2$ standard."

The EPA reviewed the available air quality monitoring data in the AQS database and found no nearby data for Trimble County. The closest monitor is over 43 km from Louisville Gas & Electric – Kentucky Utilities Trimble County Generating Station, two counties south of Trimble County in Jefferson County. In reviewing the available air quality monitoring data in AQS, the EPA determined that there is no relevant data in AQS collected in or near Carroll County that could inform the intended designation action. The most recent $SO_2$ design values for all areas of the country are available at https://www.epa.gov/air-trends/air-quality-design-values.

## 10.3. Air Quality Modeling Analysis for the Trimble County Area Addressing Louisville Gas & Electric – Kentucky Utilities' (LG&E-KU) Trimble County Generating Station (Trimble County Station)

### *10.3.1. Introduction*

This section 10.3 presents all the available air quality modeling information for a portion of Trimble County that includes Louisville Gas & Electric – Kentucky Utilities (LG&E-KU) Trimble County Generating Station (Trimble Station). (This portion of Trimble County will often be referred to as "the Trimble County area" within this section 10.3). This area contains one DRR source, the Trimble Station facility, around which Kentucky is required by the DRR to characterize $SO_2$ air quality, or alternatively to establish an $SO_2$ emissions limitation of less than 2,000 tpy. Kentucky's modeling demonstration for the Trimble County area also includes nearby sources in nearby counties and across the state border in Indiana. These are DRR sources thought to impact the Trimble County area. All DRR sources evaluated for this area of analysis are listed below:

- The Trimble Station facility emitted 2,000 tons or more annually. Specifically, Trimble Station emitted 3,056 tons in 2014 and 3,272 tons in 2015. This source meets the DRR criteria and thus is on the $SO_2$ DRR Source list, and Kentucky has chosen to characterize it via modeling.

- Kentucky Utilities Company's Ghent Station (Ghent Station) emitted 2,000 tons or more annually and is also on the $SO_2$ DRR Source list; however, this facility is discussed explicitly in another County modeling section of this TSD chapter. This source emitted 14,851 tons of $SO_2$ in 2014 and 10,703 tons in 2015.

- Indiana-Kentucky Electric Corporation's Clifty Creek Station (Clifty Creek Station) is on the $SO_2$ DRR Source list and was included in the modeling analysis. This source emitted 3,731 tons of $SO_2$ in 2014 and 4,444 tons in 2015. This source was subject to the Round 2 $SO_2$ designations process, and the EPA designated a portion of Jefferson County, Indiana unclassifiable/attainment.

Because we have available results of air quality modeling in which these sources are modeled together, the area around this group of sources is being addressed in this section with consideration given to the impacts of all these sources.

In its submission, the Commonwealth of Kentucky recommended that an area that includes the area surrounding the Trimble Station facility, specifically Trimble County, be designated as attainment based on an assessment and characterization of air quality impacts from these facilities and other nearby sources that may have a potential impact in the area where the 2010 $SO_2$ NAAQS may be exceeded. This assessment and characterization was performed using air dispersion modeling software, i.e., AERMOD, analyzing actual emissions. After careful review of the Commonwealth's assessment, supporting documentation, and all available data, the EPA intends to designate the area as unclassifiable/attainment. Our reasoning for this conclusion is explained in a later section of this TSD, after all the available information is presented.

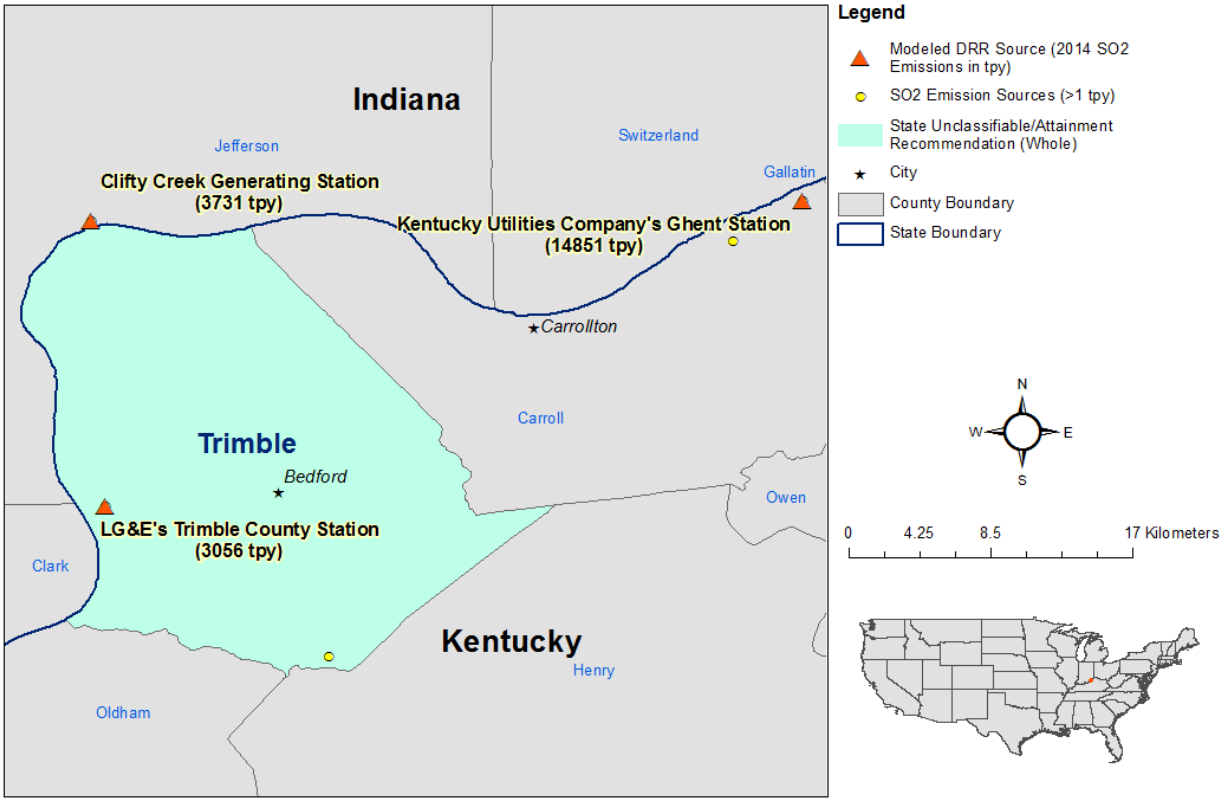
The area that the Commonwealth has assessed via air quality modeling is located in Trimble County, Kentucky, just west of Bedford, centered near the Ohio River, which is the border between Kentucky and Indiana in this area.

As seen in Figure 54 below, the Trimble County Station facility is located approximately 48 km northeast of Louisville and 8 km west of Bedford, Kentucky, in Trimble County on a strip of land between the Ohio River and KY Highway 1838. Also included in the figure is the Ghent Station facility, located adjacent to the Ohio River on U.S. Route 42, in Ghent, Kentucky, just northeast of Carrollton, Kentucky. Clifty Creek Station is located approximately 17 km to the north of the Trimble County Station along the northern bank of the Ohio River in Jefferson County, Indiana. Figure 54 depicts other nearby emitters of $SO_2$.[50].

[50] All other $SO_2$ emitters of 1 tpy or more (based on information in the emissions inventories from the states of Kentucky, Indiana and Ohio are shown in Figure 54.

Also included in Figure 54 is the Commonwealth's recommended area for the attainment designation. The EPA's intended unclassifiable/attainment designation boundary for the Trimble County area is not shown in this figure, but is shown in a figure in the section below that summarizes our intended designation.

**Figure 54. Map of the Trimble County Area Addressing Trimble Station.**




The discussion and analysis that follows below will reference the Modeling TAD and the factors for evaluation contained in the EPA's July 22, 2016, guidance and March 20, 2015, guidance, as appropriate.

For this area, the EPA received and considered two modeling assessments from the Commonwealth and no assessments from other parties. To avoid confusion in referring to these assessments, the following table lists them, indicates when they were received, provides an identifier for the assessment that is used in the discussion of the assessments that follow, and identifies any distinguishing features of the modeling assessments.

**Table 47 – Modeling Assessments for the Trimble County Area**

| Assessment Submitted by | Date of the Assessment | Identifier Used in this TSD | Distinguishing or Otherwise Key Features |
|---|---|---|---|
| Commonwealth of Kentucky | April 29, 2016* | April 29, 2016Modeling Report or Kentucky Modeling Report | First formal modeling report received |
| Commonwealth of Kentucky | March 31, 2017 | March 31, 2017 Modeling Report or Kentucky Modeling Report | Revision to reflect EPA concerns |

*This modeling assessment, dated April 29, 2016, was submitted to the EPA on January 6, 2017.

### *10.3.2. Modeling Analysis Provided by the Commonwealth*

#### *10.3.2.1. Differences Between and Relevance of the Modeling Assessments Submitted by the Commonwealth*

Revised modeling was submitted by the Commonwealth on March 31, 2017. There were two differences between this modeling submittal and the previous submittal dated April 29, 2016. The first difference is the version of the AERMOD model that was used. In the initial submittal, AERMOD version 15181 was used which was the most current regulatory version of the model available at the time. In the revised submittal, the Commonwealth used AERMOD version 16216r which includes updates to 40 CFR part 51, Appendix W, "Guideline of Air Quality Models," published on January 17, 2017 (82 FR 5203). This is the current regulatory version of the AERMOD Model. The second difference between the previous modeling submittal and the revised submittal is the emission rates used in the modeling of the background source Clifty Creek which is located 17 km north of LGE Trimble. In the original modeling submittal, the Commonwealth used annualized 2014 emissions to model Clifty Creek for the entire 2012-2014 period to reflect the installation of $SO_2$ control technology in 2013. In the revised modeling submittal, the Commonwealth used the current federally enforceable limit to model the Clifty Creek facility for all years modeled (2012-2014). The remainder of this Section will only address the most recent March 31, 2017, submittal from the Commonwealth.

#### *10.3.2.2. Model Selection and Modeling Components*

The EPA's Modeling TAD notes that for area designations under the 2010 $SO_2$ NAAQS, the AERMOD modeling system should be used, unless use of an alternative model can be justified. The AERMOD modeling system contains the following components:

- AERMOD: the dispersion model
- AERMAP: the terrain processor for AERMOD
- AERMET: the meteorological data processor for AERMOD
- BPIPPRM: the building input processor
- AERMINUTE: a pre-processor to AERMET incorporating 1-minute automated surface observation system (ASOS) wind data
- AERSURFACE: the surface characteristics processor for AERMET

- AERSCREEN: a screening version of AERMOD

The Commonwealth originally used AERMOD version 15181, using regulatory default options. However, with the updated March 31, 2017 modeling, the state made use of AERMOD version 16216r. A discussion of the Commonwealth's approach to the individual components is provided in the corresponding discussion that follows, as appropriate.

The current version of AERMOD, version 16216r, includes updates to 40 CFR part 51, Appendix W, "Guideline of Air Quality Models," published on January 17, 2017 (82 FR 5203). This version of AERMOD also includes fixes to bugs that were inadvertently included in version 16216. Kentucky in its final March 31, 2017, Modeling Report used AERMOD version 16216r with all regulatory default settings.

#### *10.3.2.3. Modeling Parameter: Rural or Urban Dispersion*

For any dispersion modeling exercise, the "urban" or "rural" determination of a source is important in determining the boundary layer characteristics that affect the model's prediction of downwind concentrations. For $SO_2$ modeling, the urban/rural determination is important because AERMOD invokes a 4-hour half-life for urban $SO_2$ sources. Section 6.3 of the Modeling TAD details the procedures used to determine if a source is urban or rural based on land use or population density. The EPA's recommended procedure for characterizing an area by prevalent land use is based on evaluating the dispersion environment within 3 km of the facility. According to the EPA's modeling guidelines, rural dispersion coefficients are to be used in the dispersion modeling analysis if more than 50 percent of the area within a 3 km radius of the facility is classified as rural. Conversely, if more than 50 percent of the area is urban, urban dispersion coefficients should be used in the modeling analysis.

The Commonwealth used the Auer land use methodology as discussed in the modeling TAD and examined the various land use within 3 km of Trimble Station to quantify the percentage of area in various land use categories. Following this guidance, 2011 land use data (the most recently available at the time of the assessment) were obtained from the U.S. Geological Survey through ArcGIS and a 3 km radius circle inscribed electronically around Trimble Station. Figure 55 shows the layout of the land use and Table 48 shows the results of the land use categorization process. The area is 97.6 percent rural, therefore, for the purpose of performing the modeling for the area of analysis, the Commonwealth determined that it was most appropriate to run the model with rural dispersion coefficients or in rural mode, and the EPA concurs with this assessment.

**Figure 55. Land Use Map for Area Within 3km of the Trimble County Station Facility. Source: "Air Dispersion Modeling Report: Trimble County Station, Kentucky $SO_2$ Designation Analysis Under the Data Requirements Rule, Revision 2," prepared by LG&E and KU Energy, LLC, March 31, 2017.**

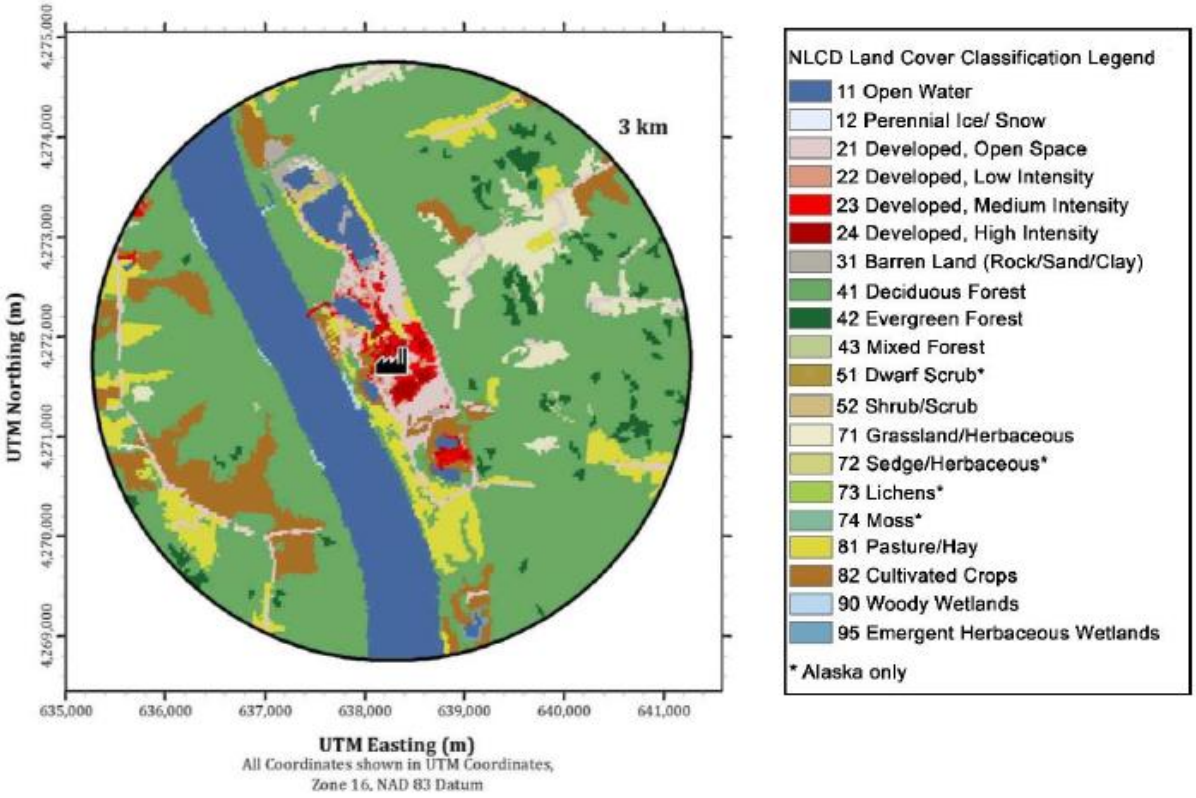


**Table 48 – Determination of the Urban or Rural Modeling Parameter for the Trimble County Area by Auer's Method with 2011 Land Use Information**

| Category ID | Category Description | Percent |
|---|---|---|
| 11 | Open Water | 15.2% |
| 21 | Developed, Open Space | 4.1% |
| 22 | Developed, Low Intensity | 0.9% |
| 23 | Developed, Medium Intensity | 1.0% |
| 24 | Developed, High Intensity | 0.6% |
| 31 | Barren Land | 0.6% |
| 41 | Deciduous Forest | 56.6% |
| 42 | Evergreen Forest | 2.3% |
| 43 | Mixed Forest | 0.2% |
| 52 | Shrub/Scrub | 0.2% |
| 71 | Grassland/Herbaceous | 3.8% |
| 81 | Pasture/Hay | 6.6% |
| 82 | Cultivated Crops | 7.7% |
| 90 | Woody Wetlands | 0.1% |
| 95 | Emergent Herbaceous Wetlands | 0.1% |
| | Total | 100% |
| | Urban | 2.4% |
| | Rural | 97.6% |

#### *10.3.2.4. Modeling Parameter: Area of Analysis (Receptor Grid)*

The TAD recommends that the first step towards characterization of air quality in the area around a source or group of sources is to determine the extent of the area of analysis and the spacing of the receptor grid. Considerations presented in the Modeling TAD include but are not limited to: the location of the $SO_2$ emission sources or facilities considered for modeling; the extent of concentration gradients due to the influence of nearby sources; and sufficient receptor coverage and density to adequately capture and resolve the model predicted maximum $SO_2$ concentrations.

The sources of $SO_2$ emissions subject to the DRR in this area are described in the introduction to this section. For the Trimble County area, the Commonwealth has included two other emitters of $SO_2$ within 50 km of Trimble Station in any direction. The Commonwealth determined that this was the appropriate distance to adequately characterize air quality through modeling to include the potential extent of any $SO_2$ NAAQS exceedances in the area of analysis and any potential impact on $SO_2$ air quality from other sources in nearby areas. In addition to Trimble Station, the other emitters of $SO_2$ included in the area of analysis are: Ghent Station and Clifty Creek Station. No other sources beyond 50 km were determined by the Commonwealth to have the potential to cause concentration gradient impacts within the area of analysis.

The grid receptor spacing for the area of analysis chosen by the Commonwealth is as follows:

- Receptors along the fenceline every 50 m

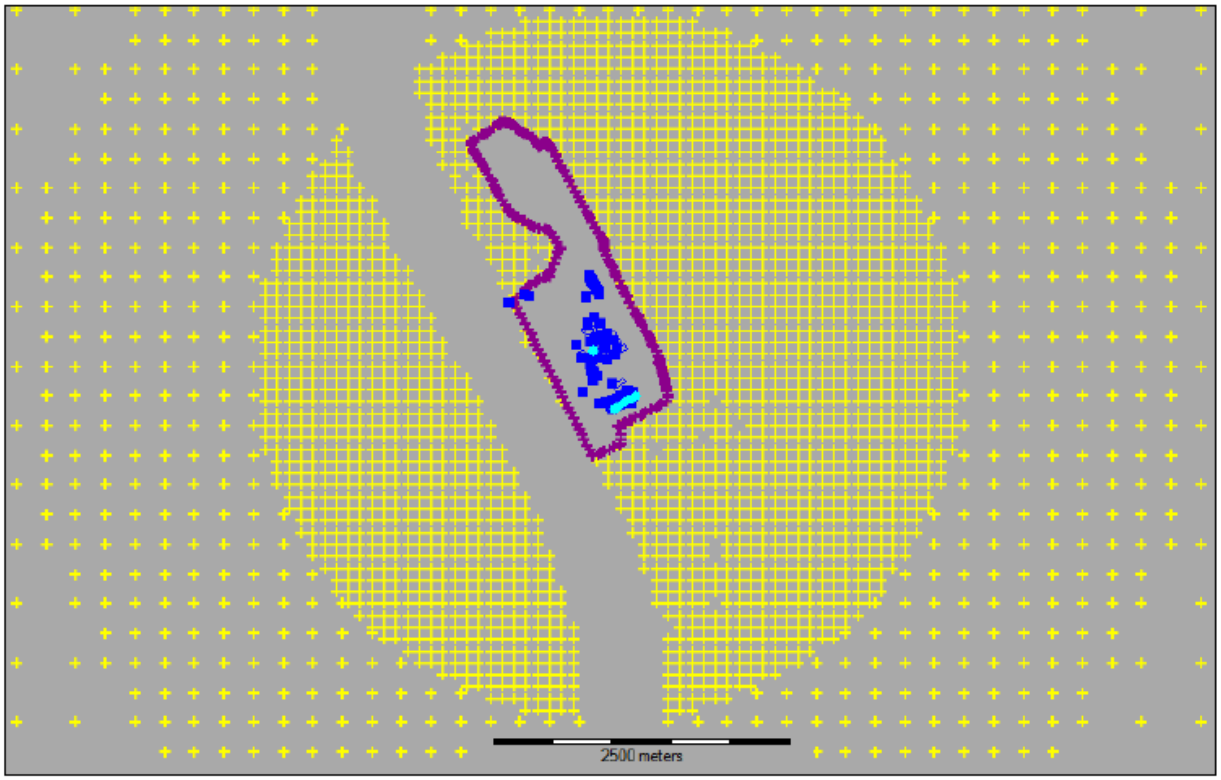
- Receptors every 100 m from fence line to 3 km
- Receptors every 250 m from 3 km to 5 km
- Receptors every 500 m from 5 km to 10 km
- Receptors every 1,000 m from 10 km to 20 km
- Receptors every 2,000 m from 20 km to 50 km

The receptor network contained 7,204 receptors, and the network covered Trimble, Carroll, Henry, Oldham, northern Shelby, western Gallatin, northwestern Owen, and northern Jefferson counties in northern Kentucky, and Jefferson, Clark, Scott, eastern Washington, southern Jennings, southeastern Jackson, southern Ripley, southwestern Dearborn, western Ohio, and western Switzerland counties in southern Indiana.

Figure 56, included in the Commonwealth's recommendation, shows the Commonwealth's chosen area of analysis surrounding Trimble Station, as well as the receptor grid for the area of analysis.

Consistent with the Modeling TAD, the Commonwealth placed receptors for the purposes of this designation effort in locations that would be considered ambient air relative to Trimble Generating Station with the exceptions of locations described in Section 4.2 of the Modeling TAD as not being feasible locations for placing a monitor. Receptors that may have fallen on the plant properties of other facilities included in the modeling were not excluded from the analysis. Receptors in the Ohio River and within the Trimble Station fenceline have been excluded from the modeling analysis. The Modeling Report indicates: "[a] metal fence with barbed wire topping restricts public access along the north, south, and east edges of Trimble County Station. The Ohio River along with a significant berm restrict public access along the west edge of Trimble County Station. Together these physical barriers act as the modeling boundary, referred to as the fence line." In addition, the maximum 1-hour $SO_2$ concentration is predicted to occur several km north of the LGE Trimble facility.

**Figure 56: Receptor Grid for the Trimble County Area. Source: "Air Dispersion Modeling Report: Trimble County Station, Kentucky $SO_2$ Designation Analysis Under the Data Requirements Rule, Revision 2," prepared by LG&E and KU Energy, LLC, March 31, 2017.**




The EPA concurs with the receptor grid used in this modeling analysis including the exclusion of receptors located within the fenceline of Trimble Station and over the Ohio River. The receptor grid should be acceptable for assessing $SO_2$ concentrations within the area of analysis. The receptor grid is consistent with the $SO_2$ modeling TAD.

#### *10.3.2.5. Modeling Parameter: Source Characterization*

Section 6 of the Modeling TAD offers recommendations on source characterization including source types, use of accurate stack parameters, inclusion of building dimensions for building downwash (if warranted), and the use of actual stack heights with actual emissions or following GEP policy with allowable emissions.

The Trimble County Station has multiple major sources of $SO_2$ emissions including Units 1 and 2 (two coal fired indirect heat exchangers), and Turbines 5 through 10 (six natural gas-fired combustion turbines). Unit 1 and Unit 2 have a single common stack with three flues. Unit 1 exhausts through one out of the three flues whereas Unit 2 exhausts through the other two flues ("2A" and "2B"). Turbines 5-10 exhaust through a stack dedicated to each unit.

Other sources of $SO_2$ emissions include five diesel fired emergency generator engines, one limited use auxiliary boiler, and one diesel fired emergency firewater pump engine. These units are intermittent (operate fewer than 500 hours per year) and thus, do not contribute to the annual distribution of daily maximum 1-hour $SO_2$ concentrations. Consistent with U.S. EPA's guidance for treatment of intermittently operated sources like emergency engines in 1-hr $SO_2$ and $NO_2$ NAAQS demonstrations, LG&E-KU has excluded these engines from the modeled source inventory and the EPA concurs with this assessment. Historic $SO_2$ emissions from these insignificant $SO_2$ sources are shown in the table below.

**Table 49. Emissions from Excluded Intermittent Sources**

| Year | Limited Use Auxiliary Boiler (tpy) | Diesel Fire Pump (tpy) | Diesel Engines 1-5 (tpy) |
|---|---|---|---|
| 2012 | 0.012 | Unavailable | 0.0011 |
| 2013 | 0.018 | Unavailable | 0 |
| 2014 | 0.002 | Unavailable | 0.0036 |

Any potential impacts from these sources, though minimal, is expected to be captured by the Green Valley Elementary School background monitor (See Section 10.3.2.9).

The Commonwealth considered sources within 50 km of LGE Trimble for potential inclusion in the modeling analysis. The Commonwealth used the 20D method as well as consideration of the proximity of the candidate sources to the background monitor in the deliberation of whether the source should be included.

Ghent Station is located approximately 37 km northeast of Trimble Station. Given the emissions magnitude of Ghent Station and the probable small contribution from Ghent Station to the background monitor concentration due to the distance between Ghent Station and the background monitor (approximately 84 km), Ghent Station was included in the modeling analysis.

There are several other relatively smaller $SO_2$ sources located in close proximity to Ghent Station that were considered for potential inclusion in the modeling analysis including Nucor Steel Gallatin and Harsco Metals. Since the release height for Ghent Station is much higher than the release height for Nucor Steel Gallatin and Harsco Metals, little plume interaction is expected between Ghent Station and the other nearby sources. The combined emissions from Nucor Steel Gallatin and Harsco Metals is 34 tpy. The Q/d value for Nucor Steel Gallatin and Harsco Metals combined is less than 1. Therefore, Nucor Steel Gallatin and Harsco Metals were excluded from the modeling analysis.

The Clifty Creek Station is located only 17 km north of Trimble County Station. Given the proximity between Clifty Creek Station and Trimble County Station and the potential for Clifty Creek to impact $SO_2$ concentrations in the area around the Trimble County Station, Clifty Creek Station was included in the refined modeling analysis.

No other sources within 50 km of LG&E-KU Trimble were included in the modeling analysis by the Commonwealth. The background monitor used for this modeling analysis is the New Albany-Green Valley Elementary School monitor located just north of Louisville, Kentucky (see Section 10.3.2.9 of this TSD). The 2014 NEI indicates that there are much greater $SO_2$ emissions within 20 km of this monitor than there are within the same distance of LG&E-KU Trimble. Therefore, this background monitor should sufficiently account for any impacts from facilities within 50 km of LG&E-KU Trimble that were not explicitly modeled.

The Commonwealth characterized these sources within the area of analysis in accordance with the best practices outlined in the Modeling TAD. Specifically, the Commonwealth used actual stack heights in conjunction with actual emissions for LG&E-KU Trimble Station and KU Ghent Station. The Commonwealth utilized PTE emissions and stack heights consistent with the GEP policy for Clifty Creek. The Commonwealth also adequately characterized the source's building layout and location, as well as the stack parameters, e.g., exit temperature, exit velocity, location, and diameter. Where appropriate, the AERMOD component BPIPPRM was used to assist in addressing building downwash.

The EPA concurs with this component of the modeling analysis including the nearby sources included in the modeling analysis, the intermittent sources excluded at Trimble Station and parameterization of building downwash from structures located on Trimble Station property. This portion of the modeling was performed in a manner consistent with the $SO_2$ Modeling TAD.

#### *10.3.2.6. Modeling Parameter: Emissions*

The EPA's Modeling TAD notes that for the purpose of modeling to characterize air quality for use in designations, the recommended approach is to use the most recent 3 years of actual emissions data and concurrent meteorological data. However, the TAD also indicates that it would be acceptable to use allowable emissions in the form of the most recently permitted (referred to as PTE or allowable) emissions rate that is federally enforceable and effective.

The EPA believes that CEMS data provide acceptable historical emissions information, when they are available. These data are available for many electric generating units. In the absence of CEMS data, the EPA's Modeling TAD highly encourages the use of AERMOD's hourly varying emissions keyword HOUREMIS, or through the use of AERMOD's variable emissions factors keyword EMISFACT. When choosing one of these methods, the EPA recommends using detailed throughput, operating schedules, and emissions information from the impacted source(s).

In certain instances, states and other interested parties may find that it is more advantageous or simpler to use PTE rates as part of their modeling runs. For example, where a facility has recently adopted a new federally enforceable emissions limit or implemented other federally enforceable mechanisms and control technologies to limit SO2 emissions to a level that indicates compliance with the NAAQS, the state may choose to model PTE rates. These new limits or conditions may be used in the application of AERMOD for the purposes of modeling for designations, even if the source has not been subject to these limits for the entirety of the most recent 3 calendar years. In these cases, the Modeling TAD notes that a state should be able to find the necessary emissions information for designations-related modeling in the existing $SO_2$

emissions inventories used for permitting or SIP planning demonstrations. In the event that these short-term emissions are not readily available, they may be calculated using the methodology in Table 8-1 of Appendix W to 40 CFR Part 51 titled, "Guideline on Air Quality Models."

As previously noted, the Commonwealth included Trimble Station and two other emitters of $SO_2$ within 50 km in the area of analysis. The Commonwealth has chosen to model Trimble Station and KU Ghent using actual emissions. The Clifty Creek facility was modeled using current PTE emissions. The facilities in the Commonwealth's modeling analysis and their associated annual actual $SO_2$ emissions between 2012 and 2014 are summarized below.

For Trimble, Ghent, and Clifty Creek Stations, the Commonwealth provided annual actual $SO_2$ emissions between 2012 and 2014. This information is summarized in Table 50. A description of how the Commonwealth obtained hourly emission rates is given below this table.

**Table 50. Actual $SO_2$ Emissions Between 2012 – 2014 from Facilities in the Trimble County Area**

| Facility Name | $SO_2$ Emissions (tpy) | | |
|---|---|---|---|
| | 2012 | 2013 | 2014 |
| Trimble County Station | 2,896 | 3,521 | 3,056 |
| Ghent Station | 10,772 | 13,422 | 14,852 |
| Total Emissions from All Modeled Facilities in the Commonwealth's Area of Analysis | 13,618 | 16,943 | 17,908 |

For Trimble County and Ghent Station, the actual hourly emissions data were obtained from CEMS. The EPA has compared the sum of the hourly emissions modeled for these two facilities for each year modeled and determined that these values equal the yearly values reported to the Clean Air Markets Division.

For Clifty Creek Station, the current federally enforceable PTE was utilized in the modeling for all years modeled (2012-2014). The PTE for Clifty Creek Station is shown in the table below

**Table 51. PTE $SO_2$ Emissions for Facilities in the Trimble County Area**

| Facility Name | PTE $SO_2$ Emissions (tpy) |
|---|---|
| Clifty Creek | 11,495 |
| Total PTE Emissions from All Modeled Facilities in the Commonwealth's Area of Analysis | 11,495 |

The EPA derived the tons per year value shown in the table above by multiplying the current PTE for the facility (2,624.5 pounds per hour on a 720-hour (30-day) average basis) by 8,760 hours per year converted to tons. EPA policy is that for cases involving longer term (e.g. 30-day) average emission limits, modeling of allowable emissions should reflect an upward-adjusted

value that represents the one-hour emission limit that would be at least comparably stringent. Accordingly, the value that the Commonwealth modeled is approximately 78 percent higher than the 720-hour average limit.

The EPA agrees with the emissions data used in this modeling analysis for Trimble County Station, Clift Creek Station, and Ghent Station. This component of the modeling was performed in a manner consistent with the $SO_2$ Modeling TAD.

#### *10.3.2.7. Modeling Parameter: Meteorology and Surface Characteristics*

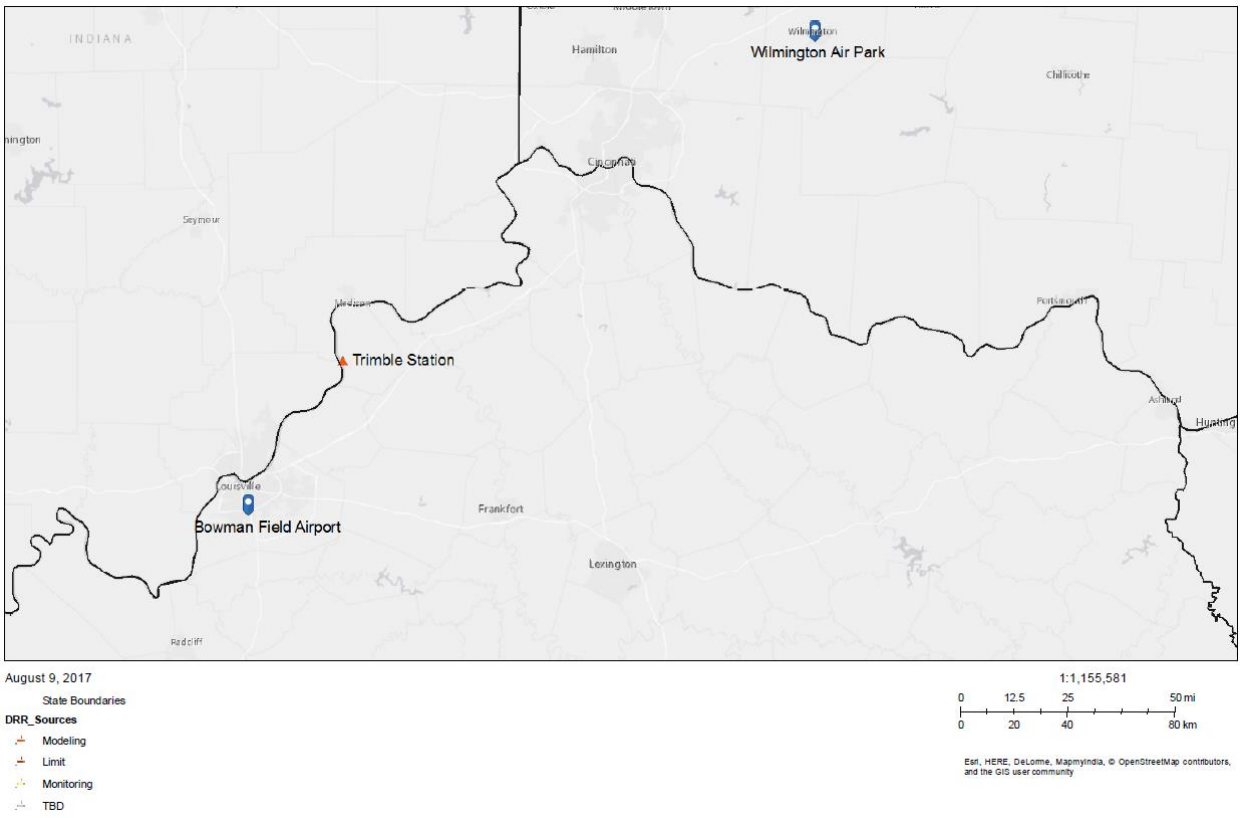
As noted in the Modeling TAD, the most recent 3 years of meteorological data (concurrent with the most recent 3 years of emissions data) should be used in designations efforts. The selection of data should be based on spatial and climatological (temporal) representativeness. The representativeness of the data is determined based on: 1) the proximity of the meteorological monitoring site to the area under consideration, 2) the complexity of terrain, 3) the exposure of the meteorological site, and 4) the period of time during which data are collected. Sources of meteorological data include NWS stations, site-specific or onsite data, and other sources such as universities, FAA, and military stations.

For the area of analysis for the Trimble County area, the Commonwealth selected the surface meteorology from the NWS station at Bowman Field Airport in Louisville, Kentucky, located at 38.228 N, 85.664 W, 45 km to the southwest of the source, and coincident upper air observations from a different NWS station at Wilmington Air Park Airport, located in Wilmington, Ohio, located at 39.25 N, 83.47 W, 166 km away from the source as best representative of meteorological conditions within the area of analysis.

The Commonwealth used AERSURFACE version 13016 using data from Bowman Field Airport to estimate the surface characteristics (albedo, Bowen ratio, and surface roughness [$z_o$]) of the area of analysis. Albedo is the fraction of solar energy reflected from the earth back into space, the Bowen ratio is the method generally used to calculate heat lost or heat gained in a substance, and the surface roughness is sometimes referred to as “zo” The Commonwealth estimated surface roughness values for 12 spatial sectors out to 1-3 km at a seasonal temporal resolution for dry, wet, and average conditions.

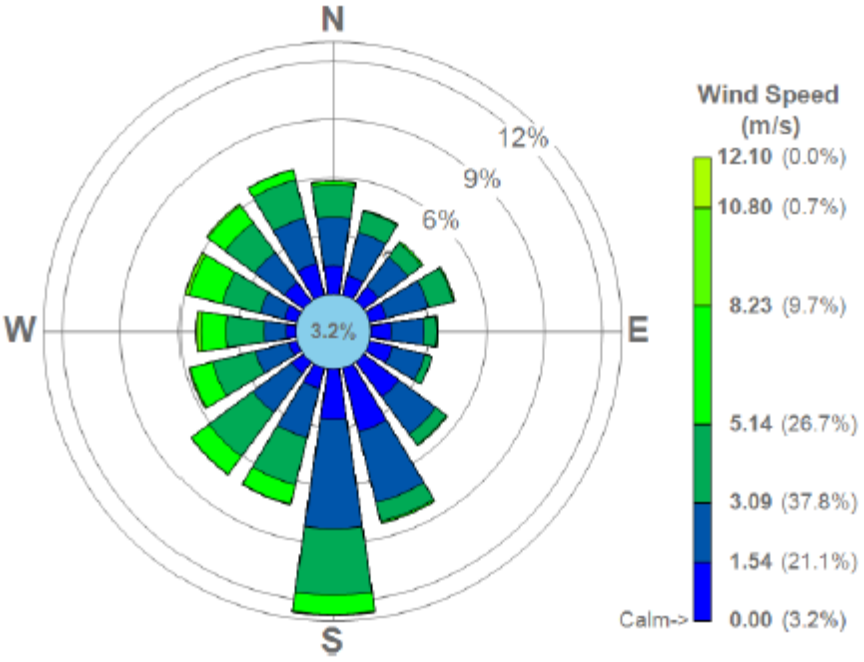
In the figure below, generated by the EPA, the locations of these NWS stations is shown relative to the area of analysis.

**Figure 57. Area of Analysis and the NWS stations in the Trimble County Area**




As part of its recommendation, the Commonwealth provided the 3-year surface wind rose for the Bowman Field NWS station. In Figure 58, the frequency and magnitude of wind speed and direction are defined in terms of from where the wind is blowing. Analysis of the NWS data indicate winds predominately blow from the southern directions. To a lesser extent, winds can be observed blowing from all other directions with relative equal frequency.

**Figure 58: Bowman Field NWS Cumulative Annual Wind Rose for Years 2012 - 2014**




Meteorological data from the above surface and upper air NWS stations were used in generating AERMOD-ready files with the AERMET processor. The output meteorological data created by the AERMET processor is suitable for being applied with AERMOD input files for AERMOD modeling runs. The Commonwealth followed the methodology and settings presented in Section 7 of the $SO_2$ Modeling TAD in the processing of the raw meteorological data into an AERMOD-ready format, and used AERSURFACE to best represent surface characteristics.

Hourly surface meteorological data records are read by AERMET, and include all the necessary elements for data processing. However, wind data taken at hourly intervals may not always portray wind conditions for the entire hour, which can be variable in nature. Hourly wind data may also be overly prone to indicate calm conditions, which are not modeled by AERMOD. In order to better represent actual wind conditions at the meteorological tower, wind data of 1-minute duration was provided from Bowman Field Airport, but in a different formatted file to be processed by a separate preprocessor, AERMINUTE. These data were subsequently integrated into the AERMET processing to produce final hourly wind records of AERMOD-ready meteorological data that better estimate actual hourly average conditions and that are less prone to over-report calm wind conditions. This allows AERMOD to apply more hours of meteorology to modeled inputs, and therefore produce a more complete set of concentration estimates. As a guard against excessively high concentrations that could be produced by AERMOD in very light wind conditions, the Commonwealth set a minimum threshold of 0.5 m/s in processing meteorological data for use in AERMOD. In setting this threshold, no wind speeds lower than this value would be used for determining concentrations. This threshold was specifically applied to the 1-minute wind data. The "Ice-Free Winds Group" AERMINUTE option was selected due to the fact that a sonic anemometer has been installed at KLOU on May 23, 2007.

The EPA concurs with this component of the modeling analysis including the surface and upper air meteorological stations used is the analysis and the processing of this data. The EPA also concurs with the use of data from the nearby Louisville International Airport to represent moisture conditions at Bowman Field Airport. This component of the modeling analysis has been performed in a manner consistent with the $SO_2$ Modeling TAD.

#### *10.3.2.8. Modeling Parameter: Geography, Topography (Mountain Ranges or Other Air Basin Boundaries) and Terrain*

The terrain in the area of analysis is best described as moderately hilly. To account for these terrain changes, the AERMAP (version 11103) terrain program within AERMOD was used to specify terrain elevations for all the receptors. The source of the elevation data incorporated into the model is from the USGS 1 arc-second National Elevation Data (NED).

The EPA concurs with this component of the modeling analysis.

#### *10.3.2.9. Modeling Parameter: Background Concentrations of $SO_2$*

The Modeling TAD offers two mechanisms for characterizing background concentrations of $SO_2$ that are ultimately added to the modeled design values: 1) a "tier 1" approach, based on a monitored design value, or 2) a temporally varying "tier 2" approach, based on the 99$^{th}$ percentile monitored concentrations by hour of day and season or month. For this area of analysis, the Commonwealth elected to use a "tier 2" approach. Data was obtained from 2012-2014 for AQS Site: 18-043-1004 (New Albany-Green Valley Elementary School monitor). These data were used to generate an annually distributed temporally (by hour of day) varying background based on the 99th percentile monitored concentrations. The background concentrations for this area of analysis were determined by the state to vary from 12.27 μg/m$^3$, equivalent to 4.7 ppb when expressed in 2 significant figures,[51] to 52.72 μg/m$^3$ (20.1 ppb), with an average value of 33.16 μg/m$^3$ (12.7 ppb).

**Table 52. 2012-2014 3-Year Average 99$^{th}$ Percentile $SO_2$ Concentrations by Hour of Day at the Green Valley Elementary School Monitor**

| Hour of Day | Hourly Background SO2 Concentrations at Green Valley Elementary School Monitor (μg/m$^3$) |
|---|---|
| 1 | 22.79 |
| 2 | 20.10 |
| 3 | 16.01 |
| 4 | 15.92 |
| 5 | 16.62 |
| 6 | 12.27 |
| 7 | 16.27 |
| 8 | 17.40 |
| 9 | 30.28 |
| 10 | 42.02 |
| 11 | 47.50 |
| 12 | 51.77 |
| 13 | 50.11 |
| 14 | 52.72 |
| 15 | 45.94 |
| 16 | 44.46 |
| 17 | 43.50 |
| 18 | 37.50 |
| 19 | 46.72 |
| 20 | 35.50 |
| 21 | 33.06 |
| 22 | 32.71 |
| 23 | 35.06 |
| 24 | 29.49 |

[51] The $SO_2$ NAAQS level is expressed in ppb but AERMOD gives results in μg/m$^3$. The conversion factor for $SO_2$ (at the standard conditions applied in the ambient $SO_2$ reference method) is 1ppb = approximately 2.619 μg/m$^3$.

The EPA concurs with this component of the modeling analysis including the background monitor used and the processing of the data to develop annual hourly background $SO_2$ concentrations. This component of the modeling analysis has been performed in a manner consistent with the $SO_2$ Modeling TAD.

#### *10.3.2.10. Summary of Modeling Inputs and Results*

The AERMOD modeling input parameters for the Trimble County area of analysis are summarized below in Table 53.

**Table 53: Summary of AERMOD Modeling Input Parameters for the Area of Analysis for the Trimble County Area**

| Input Parameter | Value |
|---|---|
| AERMOD Version | 16216r (regulatory default) |
| Dispersion Characteristics | Rural |
| Modeled Sources | 3 |
| Modeled Stacks | 14 |
| Modeled Structures | 131 |
| Modeled Fencelines | 1 |
| Total receptors | 7,204 |
| Emissions Type | Actual and PTE |
| Emissions Years | 2012-2014 |
| Meteorology Years | 2012-2014 |
| NWS Station for Surface Meteorology | Bowman Airport, KY |
| NWS Station Upper Air Meteorology | Wilmington, OH |
| NWS Station for Calculating Surface Characteristics | Bowman Airport, KY |
| Methodology for Calculating Background $SO_2$ Concentration | Tier 2 approach using AQS site: 18-043-1004 for 2012-2014 |
| Calculated Background $SO_2$ Concentration | 12.27 – 52.72 $\mu g/m^3$ |

The results presented below in Table 54 show the magnitude and geographic location of the highest predicted modeled concentration based on the input parameters.

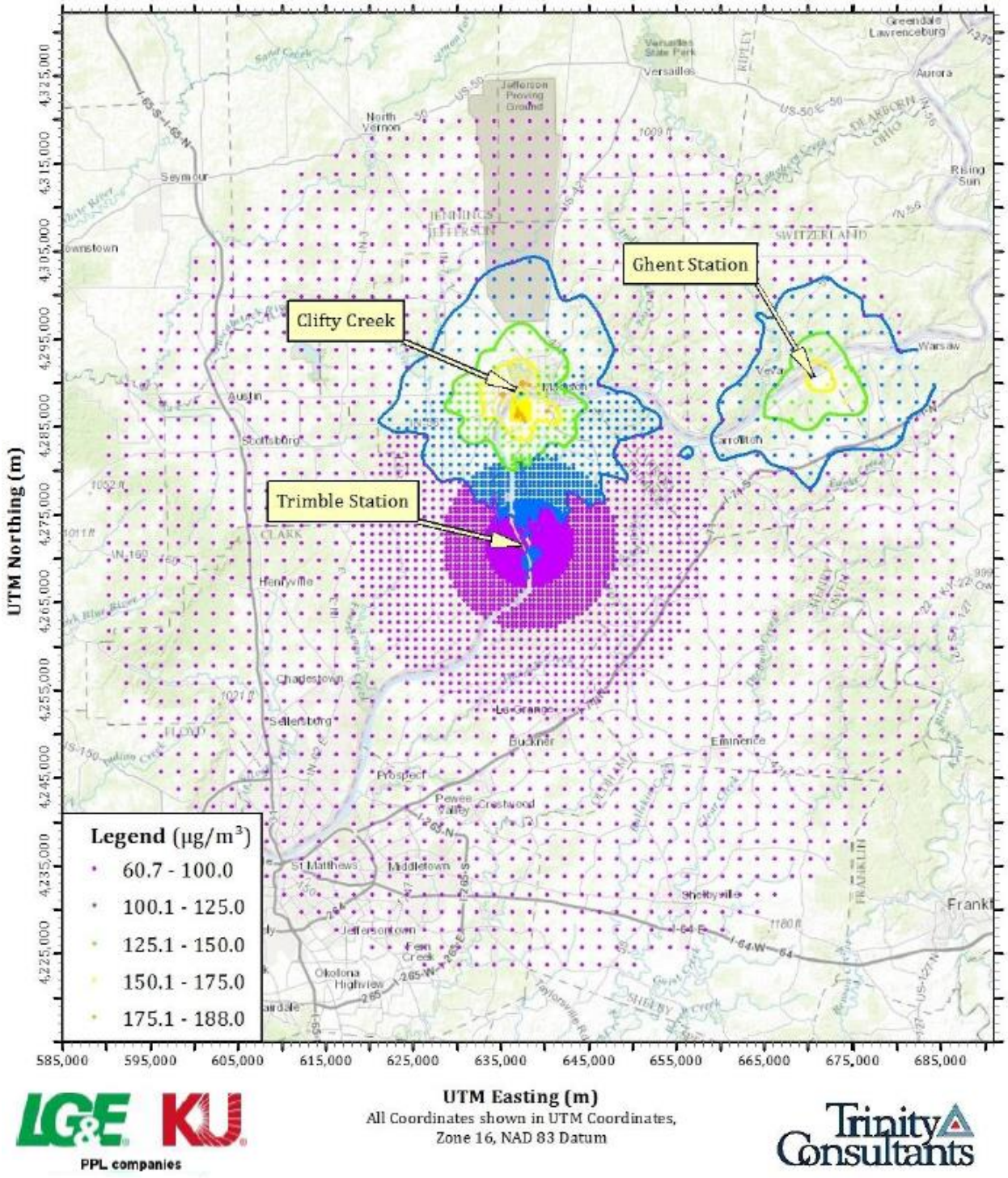
**Table 54. Maximum Predicted 99th Percentile Daily Maximum 1-Hour $SO_2$ Concentrations Averaged Over Three Years for the Area of Analysis for the Trimble County Area**

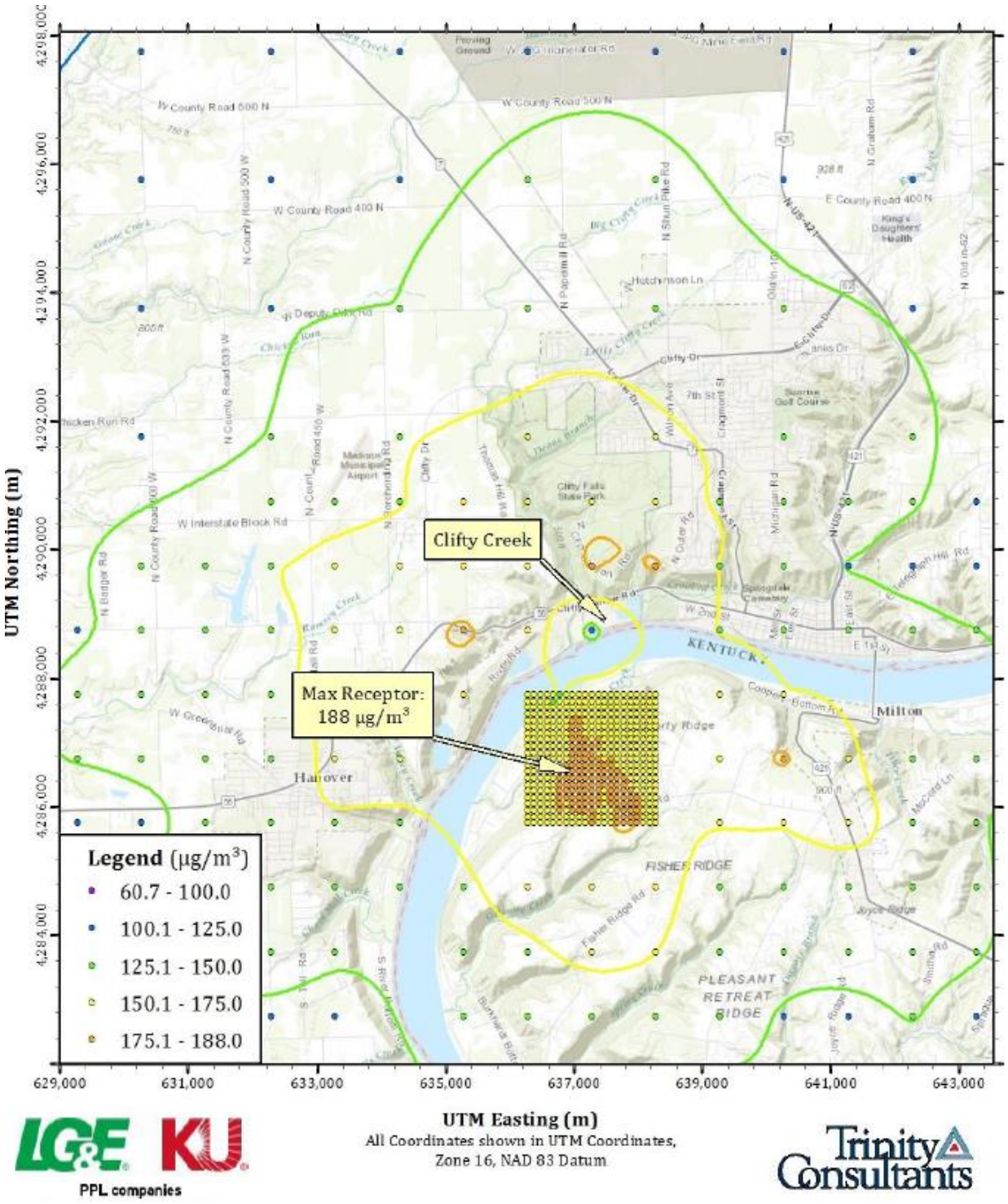
| Averaging Period | Data Period | Receptor Location [UTM zone 16] | | 99th percentile daily maximum 1-hour $SO_2$ Concentration (μg/m$^3$) | |
|---|---|---|---|---|---|
| | | UTM Easting (m) | UTM Northing (m) | Modeled concentration (including background) | NAAQS Level |
| 99th Percentile 1-Hour Average | 2012-2014 | 636,969 | 4,286,533 | 188 | 196.4* |

*Equivalent to the 2010 $SO_2$ NAAQS of 75 ppb using a 2.619 μg/m$^3$ conversion factor

The Commonwealth's modeling indicates that the highest predicted 99th percentile daily maximum 1-hour concentration within the chosen modeling domain is 188 μg/m$^3$, equivalent to 71.8 ppb. This modeled concentration included the background concentration of $SO_2$, and is based on actual emissions from the LGE Trimble and KU Ghent facilities and PTE from Clifty Creek. Figures 59a and 59b below were included as part of the Commonwealth's recommendation, and indicate that the predicted value occurred well north (greater than 10 km) of Trimble Station near Clifty Creek. The Commonwealth's receptor grid is also shown in the figures.

**Figure 59a and 59b: Maximum Predicted 99th Percentile Daily Maximum 1-Hour $SO_2$ Concentrations Averaged Over Three Years for the Area of Analysis for the Trimble County Area. Source: "Air Dispersion Modeling Report: Trimble County Station, Kentucky $SO_2$ Designation Analysis Under the Data Requirements Rule, Revision 2," prepared by LG&E and KU Energy, LLC, March 31, 2017.**






The modeling submitted by the Commonwealth does not indicate that the 1-hour $SO_2$ NAAQS is violated at the receptor with the highest modeled concentration.

#### *10.3.2.11. The EPA's Assessment of the Modeling Information Provided by the Commonwealth*

The EPA concurs with the modeling used to assess $SO_2$ concentrations in the Trimble County area of Kentucky. The Commonwealth chose to model two other DRR sources of $SO_2$ in the area of analysis including one source subject to the Round 2 designations. The EPA agrees with the inclusion of these sources in the modeling. The Commonwealth chose to model the Trimble and KU Ghent facilities utilizing actual hourly emissions for the 2012-2014 period. The Commonwealth chose to represent Clifty Creek Station emissions in terms of the currently federally enforceable PTE. The EPA concurs with the emissions data utilized in the modeling. The EPA believes the modeling domain is appropriate to capture predicted maximum impacts in the Trimble County Area. Kentucky's selection of surface and upper air meteorological stations are appropriate. The Commonwealth adequately represented the topography of the area with the model and its pre-processors. The EPA has also confirmed that Kentucky selected its annual hourly varying background $SO_2$ concentrations from the Green Valley Elementary School monitor in a manner consistent with the $SO_2$ Modeling TAD. This modeling analysis has been performed in a manner consistent with the $SO_2$ modeling TAD.

## 10.4. Emissions and Emissions-Related Data, Meteorology, Geography, and Topography for the Trimble County Area

These factors have been incorporated into the air quality modeling efforts and results discussed above. The EPA is giving consideration to these factors by considering whether they were properly incorporated and by considering the air quality concentrations predicted by the modeling.

## 10.5. Jurisdictional Boundaries in the Trimble County Area

Existing jurisdictional boundaries are considered for the purpose of informing the EPA's designation action for the Trimble County area. Our goal is to base designations on clearly defined legal boundaries, and to have these boundaries align with existing administrative boundaries when reasonable.

The modeling domain extends from Trimble County Station at a radius of 50 km, and so covers the entirety of Trimble, Carroll, Henry, Oldham, northern Shelby, western Gallatin, northwestern Owen, and northern Jefferson counties in northern Kentucky, and Jefferson, Clark, Scott, eastern Washington, southern Jennings, southeastern Jackson, southern Ripley, southwestern Dearborn, western Ohio, and Switzerland counties in southern Indiana.

## 10.6. The EPA's Assessment of the Available Information for the Trimble County Area

The EPA intends to designate the Trimble County area, including the entire County boundary, as unclassifiable/attainment. We believe that Kentucky's modeling analysis supports the conclusion that there are no expected violations of the 2010 $SO_2$ NAAQS in the area. There is no current monitoring data available for the area, so the modeling serves to reflect the air quality expected in the years modeled.

Based on the air quality characterization conducted within the Trimble County area of analysis in accordance with the EPA's Modeling TAD, the Commonwealth concluded that the area should be designated as attainment. This recommendation is based on Kentucky's assessment that emissions from the Trimble County Station facility could interact with those from the Ghent Station, and Clifty Creek Station facilities and together impact the area, and the inclusion of these three DRR sources in the modeling demonstration. Trimble County Station is the only Trimble County source that emitted over 100 tons in 2014. Ghent Station and Clifty Creek Station are the only other sources within the 50 km area of analysis believed to impact the area.

Kentucky evaluated possible contributions from these sources and other sources within 50 km of Trimble County Station to $SO_2$ impacts in the Trimble County area. Based on Kentucky's Q/d analysis, Kentucky decided in the Modeling Report to include possible contributions from nearby Ghent Station by modeling actual emissions and the Clifty Creek Station by modeling PTE emissions. The Commonwealth excluded smaller sources clustered around Ghent Station based on their distance and small emissions. Any regional sources near the Green Valley Elementary School monitor were assumed to be adequately accounted for in the background concentrations. Kentucky then added a reasonable value for background concentrations of $SO_2$ by including the 2012 – 2014 hourly varying concentrations from the Green Valley Elementary School monitor in Floyd County, Indiana. The EPA agrees with the technical explanation for the Commonwealth's treatment of nearby $SO_2$ sources included in the March 31, 2017, Modeling Report. We believe the modeling of the sources included adequately represents the Trimble County area. The EPA has reason to believe there are no additional sources in areas adjacent to our intended area that are likely to cause or contribute to a violation of the NAAQS in the area of analysis. In addition, based on the available information for the remaining areas in Kentucky and neighboring Indiana and Ohio, including monitoring and modeling, there are no current $SO_2$ nonattainment areas near Trimble County, Kentucky or in nearby counties in Ohio or Indiana, and no expected nonattainment areas for this third round of designations. In addition, there are no nearby Round 4 areas being characterized by December 31, 2020 based on a newly deployed $SO_2$ monitor. Therefore, the Trimble County area is not expected to contribute to ambient air quality in a nearby area that does not meet the NAAQS.

After careful evaluation of the Commonwealth's recommendation and supporting information, as well as all available relevant information, the EPA intends to designate the area around Trimble County Station as unclassifiable/attainment for the 2010 $SO_2$ NAAQS. Specifically, the boundaries are comprised of the entirety of Trimble County. There are no remaining portions of Trimble County that remain to be characterized in the EPA's Round 4 of designations in 2020, nor are there any other portions of the County that have a separate area of analysis for Round 3.

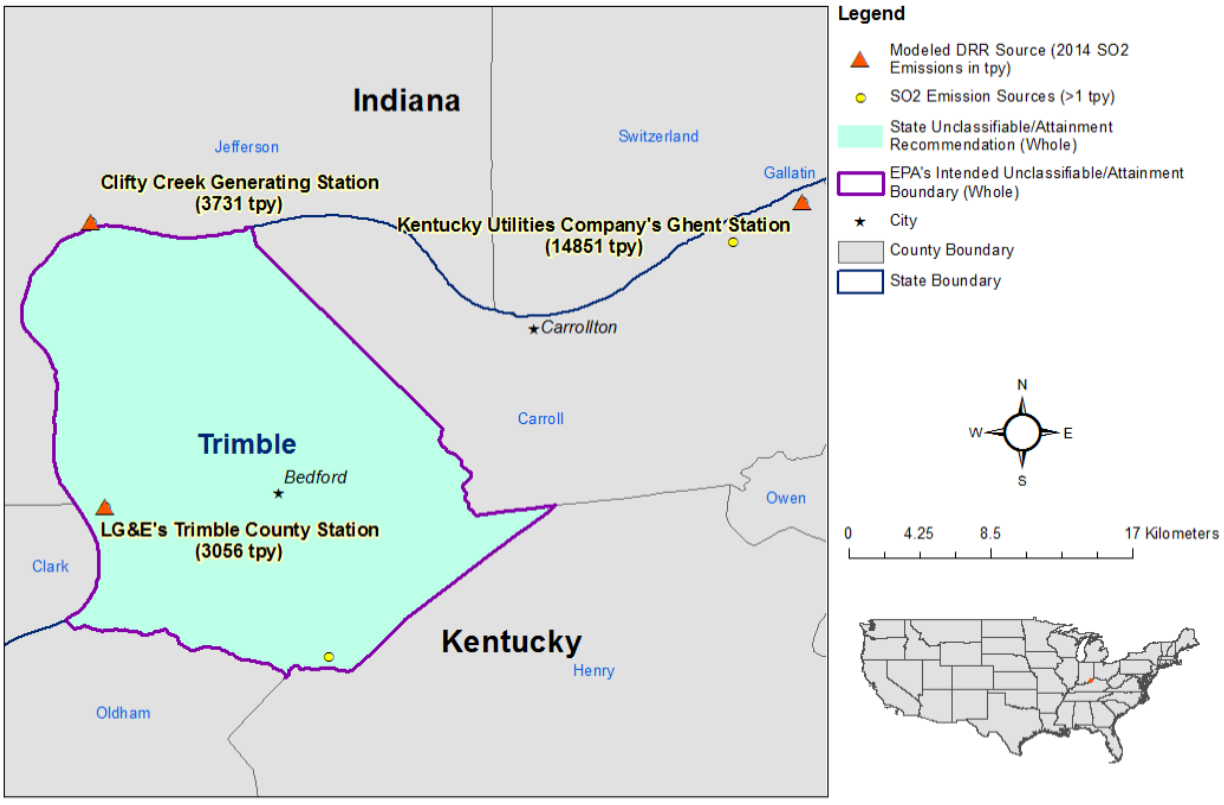
The EPA believes that our intended unclassifiable/attainment area, bounded by the entirety of Trimble County, will have clearly defined legal boundaries, and we intend to find these boundaries to be a suitable basis for defining our intended unclassifiable/attainment area.

## 10.7. Summary of Our Intended Designation for the Trimble County Area

After careful evaluation of the Commonwealth's recommendation and supporting information, as well as all available relevant information, the EPA intends to designate the Trimble County area as unclassifiable/attainment for the 2010 $SO_2$ NAAQS because the EPA has determined the area meets the 2010 $SO_2$ NAAQS and does not contribute to ambient air quality in a nearby area that does not meet the NAAQS. Specifically, the boundaries are comprised of the entirety of Trimble County.

Figure 60 shows the boundary of this intended designated area.

**Figure 60. Boundary of the Intended Trimble County Unclassifiable/Attainment Area**




At this time, our intended designations for the Commonwealth only apply to this area and the other areas presented in this technical support document. The EPA intends in a separate action to evaluate and designate all remaining undesignated areas in Kentucky by December 31, 2020.

# 11. Technical Analysis for the Henderson County Area

## 11.1. Introduction

The EPA must designate the Henderson County area by December 31, 2020, because the area has not been previously designated and Kentucky has installed and begun timely operation of a new, approved $SO_2$ monitoring network meeting the EPA specifications referenced in the EPA's $SO_2$ DRR for any sources of $SO_2$ emissions in Henderson County. The DRR source, Century Aluminum Sebree, LLC, is located near DRR sources in Webster County, Big Rivers Electric Corporation's (BREC's) Robert A. Reid Station/Henderson Municipal Power and Light (HMP&L) Station 2, and BREC's Green Station Landfill, is by the Green River, which is on the border between Henderson and McClean Counties and Webster and McClean Counties in this part of Kentucky. Because the Commonwealth has deployed an approved $SO_2$ monitoring network, Webster County and a portion of Henderson County will be designated by December 31, 2020, based on the available monitoring data that will be available at that time.

A separate portion of Henderson County borders the Ohio River, which constitutes the state border between Indiana and Kentucky in this part of the Commonwealth. Across the Ohio River in Warrick County, Indiana are two DRR sources, Alcoa Warrick Power Plant and Alcoa Warrick Operations. Indiana's January 13, 2017, submittal did not include modeling of this area, and instead included a review of monitoring data in the area. Additional information in the EPA's possession is a modeling analysis provided by a third party during Round 2 of designations under the 2010 $SO_2$ NAAQS. Although this modeling was submitted as a comment on the intended designation of the area near the A.B. Brown plant in Posey County, the modeling also included the emissions of the Alcoa facilities and estimated concentrations near these facilities in Warrick County. Therefore, the area of analysis, and the modeling receptors, from the A.B. Brown modeling assessment cross the Indiana state boundaries into Henderson County, Kentucky. The A.B. Brown modeling assessment, which shows impacts from the Warrick County DRR sources, is discussed in the Indiana chapter of this TSD.

## 11.2. Air Quality Monitoring Data for the Henderson County Area

This factor considers the $SO_2$ air quality monitoring data in the area of Henderson County. Kentucky provided the values of the $99^{th}$ percentile of the $SO_2$ monitors in Kentucky. Kentucky stated "the average of the $99^{th}$ percentile at all monitors is below the standard of 75 ppb in all locations except Jefferson County."

The EPA reviewed the available air quality monitoring data in the AQS database and found the following nearby data:

- The Baskett $SO_2$ monitor (AQS ID: 21-101-0014) is located at 37.871200, -87.463750 in Henderson County, 24 km north northeast of Century Aluminum Sebree, and approximately 12.6 km from the Alcoa Warrick facilities in Indiana. Data collected by

this monitor is comparable to the NAAQS, and indicates that the most recent $SO_2$ levels are below the 1-hr NAAQS. The most recent three years of complete, quality-assured, certified data from this monitor (2014-2016) indicate a 1-hr $SO_2$ design value of 21 ppb. However, this monitor was not located to characterize the maximum 1-hr $SO_2$ concentrations of Century Aluminum Sebree, nor the much closer DRR sources across the Ohio River in Warrick County, Indiana. The EPA has a modeling assessment of the area (see the Indiana chapter of this TSD).

In reviewing the available air quality monitoring data in AQS, the EPA determined that other than the data described above, there is no additional relevant data in AQS collected in or near Henderson County that could inform the intended designation action. The most recent $SO_2$ design values for all areas of the country are available at https://www.epa.gov/air-trends/air-quality-design-values.

## 11.3. Air Quality Modeling Analysis for the Henderson County Area Addressing DRR Sources in Warrick County, Indiana

### *11.3.1. Introduction*

The EPA received no air quality modeling information assessing sources in Henderson County, Kentucky. However, the EPA received modeling information assessing DRR sources in Warrick County, Indiana, across the Ohio River from Henderson County, Kentucky. As noted above, Indiana sought to characterize air quality using the limited monitoring data in the area, and did not provide modeling for the Warrick County area. The EPA has modeling information addressing this area that was submitted by a third party during Round 2 of $SO_2$ designations. This modeling appears to shows potential impacts in portions of Henderson County, Kentucky. The EPA believes that there is uncertainty with the modeling information with respect to the portion of the modeled impacts in the Henderson County area. For more information on this modeling assessment and its predicted impacts in Indiana, including the EPA's intended nonattainment designation for a portion of Warrick County, see the Indiana chapter of this TSD.

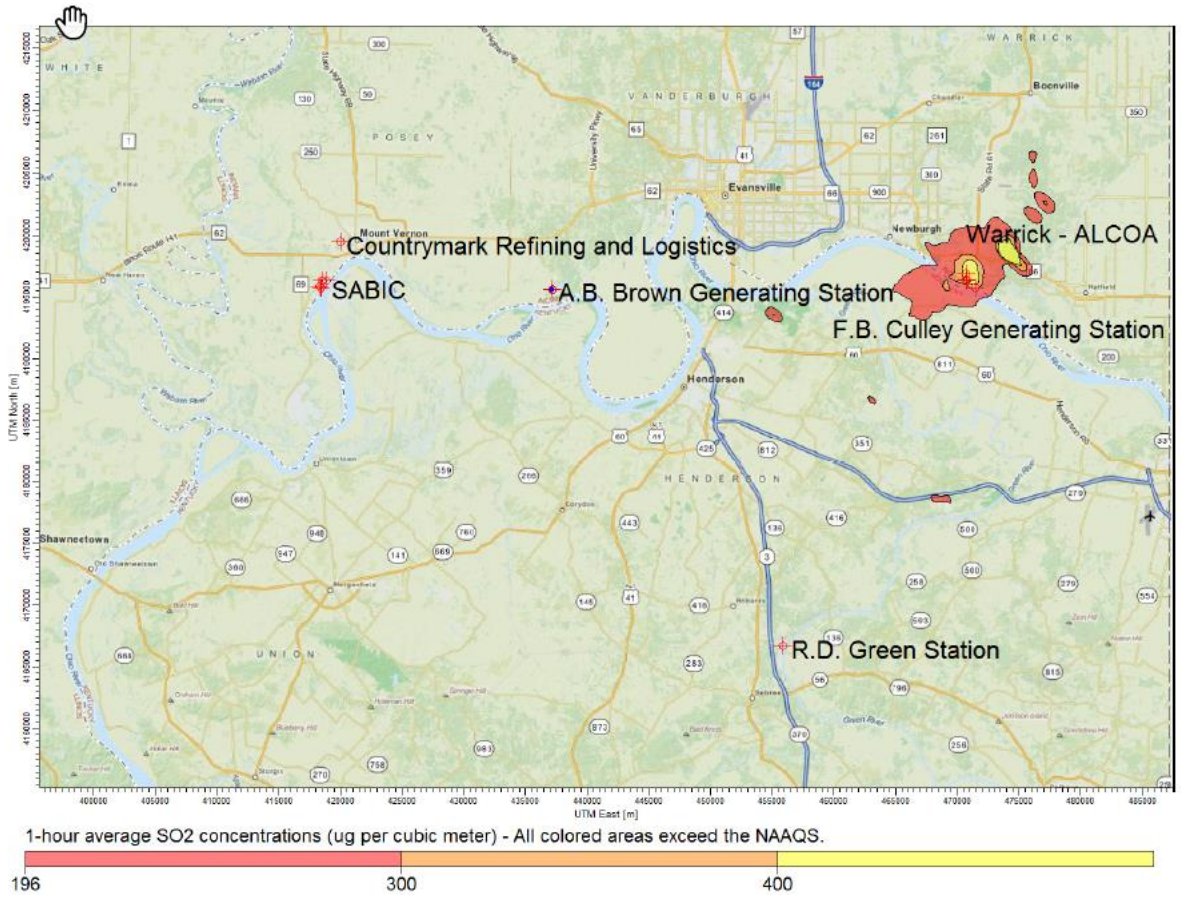
#### *11.3.1.1. The EPA's Assessment of the Modeling Information Provided by a Third Party in Henderson County, Kentucky*

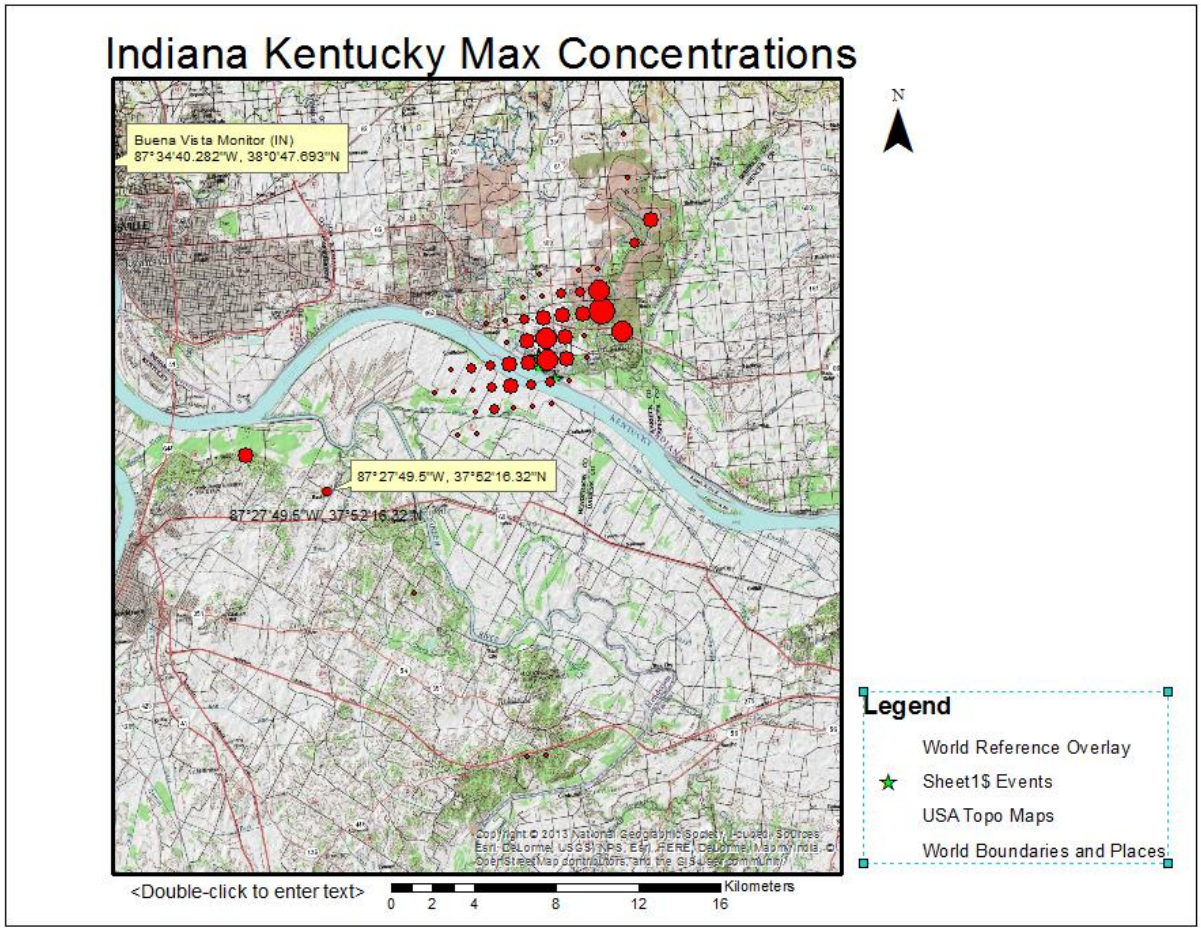
The modeling submitted by a third party indicates that the 1-hour $SO_2$ NAAQS is violated at numerous receptors surrounding the Alcoa facilities in Warrick County, Indiana, and a small portion of Henderson County, Kentucky. The modeling results indicate the area in which a NAAQS violation was modeled, information that is relevant to the selection of the boundaries of the area that will be designated. Figure 61a shows the results of this modeling. In particular, this modeling indicates that a portion of the potential violations are estimated to be occurring in the northeastern portion of Henderson County, just across the river from the Alcoa facilities. Figure 61b goes on to indicate exactly where the modeled receptors showing impacts from the Warrick County facilities are predicted to occur in Henderson County, specifically the following census block groups within the county: 211010207013, 211010207014, 211010207024, and

211010208004. A small portion of Henderson County, Kentucky represented by block group 211010207013 extends across the Ohio River to a small open area along the northern river bank.

The EPA believes that there are aspects of the modeling assessment that cause uncertainty as to the precise nature and location of the portion of the modeled potential violations in Henderson County, Kentucky. It is not clear whether the modeling performed by the Sierra Club was specifically configured to fully characterize more extended impacts from the Alcoa facilities; however, we have concluded that the extent of receptors is adequate to determine if violations are occurring in the area surrounding the Alcoa facilities. As stated above, the primary facility in the modeling analysis was the A.B. Brown facility in Posey County, Indiana, and the Alcoa facilities were included as additional sources that could contribute to the modeled concentrations in the areas potentially impacted by those sources. As such, a number of conservative, simplifying assumptions were made by Sierra Club for characterizing the Alcoa sources and emissions, potentially leading to uncertainties in the modeled footprint. Related to Henderson County, we note that Sierra Club's assessment assumes that the emissions from a number of the Alcoa co-located potline stacks are merged. As explained in more detail in the Indiana chapter of this TSD, this assumption could potentially affect the predicted plume rise and thus the modeled output concentrations, potentially leading to modeled underestimation of downwash near the Alcoa facilities and overestimation of concentrations as distance increases from the stacks. Although, due to the magnitude of modeled violations, it is unlikely that changes in these modeling assumptions would affect the model results enough to not indicate violations of the standard in the vicinity of Alcoa, this possible underestimation of downwash forms the basis of the uncertainty in the more distant model estimated concentrations in Henderson County, Kentucky.

**Figure 61a and 61b: Predicted 99th Percentile Daily Maximum 1-Hour $SO_2$ Concentrations Averaged Over Three Years for the Area of A.B. Brown Analysis**






## 11.4. Emissions and Emissions-Related Data, Meteorology, Geography, and Topography for the Henderson County Area

The EPA, in order to determine the boundary of the area to be designated, is assessing these factors. The EPA evaluated whether any nearby sources contributed to the modeled violations so as to warrant including the associated source area in the nonattainment area. In interpreting section 107(d)(1)(A), the criteria for "nearby" vary by pollutant, reflecting varying degrees to which distant sources influence pollutant concentrations. Unlike pollutants that are formed by atmospheric chemical reactions, for which pollutant concentrations generally reflect the combination of impacts from numerous sources spread over broad areas, $SO_2$ concentrations at any particular location tend to be dominated by impacts from sources within a modest distance. In the case of the violations within and near Warrick County, Indiana, the violations are modeled within a few km of the three sources in the area, i.e. the two Alcoa facilities and Sigeco Culley Newburgh, a power plant, and these sources appear to have a dominant impact on these concentrations. Table 55 lists sources emitting over 100 tons of $SO_2$ per year within 50 km of the Alcoa facilities.

**Table 55. Facilities Emitting at least 100 tons of $SO_2$ Per Year Within 50 km of the Alcoa Facilities**

| Facility Name | County | 2014 $SO_2$ Emissions (tpy) | Distance from Alcoa (km) |
|---|---|---|---|
| Owensboro Grain | Daviess, KY | 438 | 25 |
| Rockport Station | Spencer, IN | 54,979 | 26 |
| Owensboro Muni – Elmer Smith Station | Daviess, KY | 5,741 | 27 |
| Century Aluminum Sebree | Henderson, KY | 4,739 | 31 |
| Big River/Robert D. Green Station | Webster, KY | 3,999 | 33 |
| Big River/Robert A. Reid Station | Webster, KY | 12,202 | 33 |
| A.B. Brown Station | Posey, IN | 8,080 | 34 |
| Big River/Coleman Station | Hancock, KY | 923 | 47 |
| Century Aluminum | Hancock, KY | 2,224 | 48 |

These sources are all at considerable distance from the Alcoa facilities. Furthermore, given that the estimated violations in and near Warrick County are limited to an area quite near to the Alcoa facilities (as commonly occurs for $SO_2$), it appears unlikely that the sources in Table 55 have substantial impacts on $SO_2$ concentrations in the Alcoa facilities area. Therefore, the EPA believes that the sources in Table 55 should not be considered nearby contributors to the estimated violations within and near Warrick County. That is, the only sources that warrant being considered nearby contributors to the violations, namely the two Alcoa facilities and Culley, are within the area estimated to be violating the standard. As a result, the area defined above as including the area that contains the violations within and near Warrick County also includes all the nearby sources likely to be contributing to these violations.

Additionally, there are no sources located in the portion of Henderson County where impacts were modeled.

Any meteorology influences in the area have been incorporated into the Sierra Club's modeling which uses surface-level meteorology from the Evansville, Indiana Airport, NWS site. The Evansville site is the closest and most representative site in the area of the Alcoa facility.

The geography of this northeastern portion of Henderson County shows that the area is situated on the southern bank of the Ohio River. This area is not highly residential. The terrain in the area of analysis extending into Henderson County is best described as gently rolling. The terrain is relatively flat, with a few hills in Henderson County to the south of this area.

## 11.5. Jurisdictional Boundaries in the Henderson County Area

Existing jurisdictional boundary is considered for the purpose of informing the EPA's designation action for the Henderson County area. Our goal is to base designations on clearly

defined legal boundaries, and to have these boundaries align with existing administrative boundaries when reasonable.

The modeled violations are shown to occur near the southern bank of the Ohio River out to Hebbardsville, Kentucky near the Audubon Parkway. Because there are no Kentucky sources in this area, nor are there any Kentucky sources near enough to cause impacts in this area, the EPA intends to designate only the portion of Henderson County around which modeled violations were predicted.

## 11.6. The EPA's Assessment of the Available Information for the Henderson County Area

The EPA intends to designate the Henderson County area, consisting of the portion of Henderson County contained within census block groups 211010207013, 211010207014, 211010207024, and 211010208004, as unclassifiable. We believe that the third party modeling analysis received for the A.B. Brown facility shows modeled violations of the 2010 $SO_2$ NAAQS in the area, but that features of the modeling assessment cause significant uncertainty as to the precise nature and location of any modeled violations in the Henderson County, Kentucky area. Therefore, the EPA is uncertain regarding a portion of the footprint of the modeling results, and is unable based on available information to determine whether the Henderson County area is meeting or not meeting the NAAQS.

Moreover, there are no sources in this area within Henderson County, Kentucky, and no nearby sources in other parts of Henderson County or other parts of Kentucky thought to contribute to the estimated violations within and near Henderson County. There are no complex considerations with the geography or topography of the area.

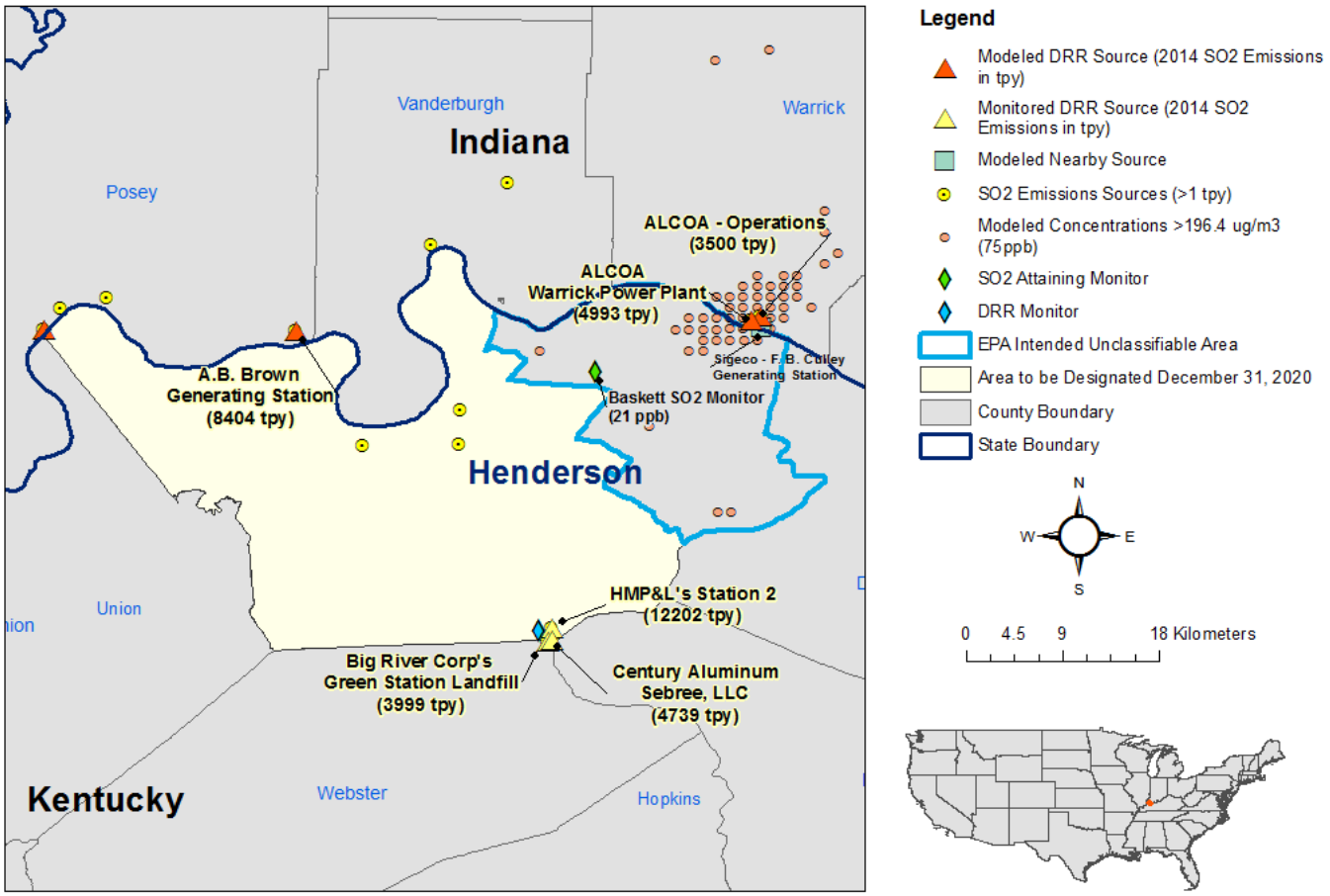
After careful evaluation of the Commonwealth's recommendation and supporting information, as well as all available relevant information, the EPA intends to designate the area showing air quality impacts from the Indiana facilities as unclassifiable for the 2010 $SO_2$ NAAQS. Specifically, the boundary is comprised of the portion of Henderson County contained within census block groups 211010207013, 211010207014, 211010207024, and 211010208004. There are no other portions of the County that have a separate area of analysis for Round 3, and the remainder of Henderson County will be characterized in the EPA's Round 4 of designations in 2020.

The EPA believes that our intended unclassifiable area, the Henderson County area, bounded by census block groups 211010207013, 211010207014, 211010207024, and 211010208004, will have clearly defined legal boundaries, and we intend to find these boundaries to be a suitable basis for defining our intended unclassifiable area.

## 11.7. Summary of Our Intended Designation for the Henderson County Area

After careful evaluation of the Commonwealth's recommendation and supporting information, as well as all available relevant information, the EPA intends to designate the Henderson County area as unclassifiable for the 2010 $SO_2$ NAAQS because it cannot be classified on the basis of available information as meeting or not meeting the NAAQS. Specifically, the boundary is comprised of the portion of Henderson County contained within census block groups 211010207013, 211010207014, 211010207024, and 211010208004. Figure 62 shows the boundary of this intended designated area. At this time, our intended designations for the Commonwealth only apply to this area and the other areas presented in this technical support document. The EPA intends in a separate action to evaluate and designate all remaining undesignated areas in Kentucky by December 31, 2020.

**Figure 62. Boundary of the Intended Henderson County Partial Unclassifiable Area**



# 12. Technical Analysis for Remaining Areas in Kentucky

## 12.1. Introduction

In its June 2, 2011, recommendations and subsequent January 6, 2017, DRR submission, the Commonwealth recommended the entire state be designated attainment. This does not include the areas listed in Table 2 for which the EPA intends to designate by December 31, 2020. This assessment and characterization is based an analysis of emissions and air quality monitoring data in the counties and surrounding areas. After careful review of the Commonwealth's assessment, supporting documentation, and all available data, the EPA intends to designate the remaining counties in the Commonwealth as unclassifiable/attainment because the remaining areas in the state were not required to be characterized under 40 CFR 51.1203(c) and EPA does not have available information including (but not limited to) appropriate modeling analyses and/or monitoring data that suggests that the area may (i) not be meeting the NAAQS, or (ii) contribute to ambient air quality in a nearby area that does not meet the NAAQS.[52] Therefore, the EPA is designating the remaining counties in Table 56 in the Commonwealth as unclassifiable/attainment.[53]

Kentucky installed and began operation of a new, approved $SO_2$ monitoring network by January 1, 2017 for only three DRR sources (see Table 2). Accordingly, the EPA must designate the remaining counties by December 31, 2017. The EPA is designating the counties and portions of counties in Table 56 in the Commonwealth as "unclassifiable/attainment."

**Table 56. Counties and Portions of Counties that the EPA Intends to Designate Unclassifiable/Attainment**

| County or Partial County (p) | Kentucky's Recommended Area Definition | Kentucky's Recommended Designation | The EPA's Intended Area Definition | The EPA's Intended Designation |
|---|---|---|---|---|
| Adair County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Allen County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Anderson County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |

[52] The EPA designated a portion of Jefferson County, Kentucky nonattainment for the 1-hour $SO_2$ NAAQS in August 2013(round 1 $SO_2$ designations). This nonattainment area is comprised of the Watson Lane monitor (AQS 21-111-0051) and the Louisville Gas & Electric Mill Creek Generating Station.

[53] This table excludes those counties that were designated unclassifiable in Round 2. These counties, Ohio and Pulaski Counties, were designated unclassifiable due to insufficient information to determine if the D.B. Wilson and John S. Cooper (which are also DRR sources) were violating the 1-hour $SO_2$ NAAS. Additionally, the EPA intends to designate the rest of Campbell County and Jefferson County unclassifiable/attainment by December 31, 2017. Portions of these two counties were designated nonattainment in August 2013 for the 1st round of $SO_2$ designations based on violating air quality data. However, on May 10, 2017 (82 FR 13227) the Campbell County, KY, portion of the multistate area Campbell-Clermont County, KY-IN, area was redesignated to attainment.

| County or Partial County (p) | Kentucky's Recommended Area Definition | Kentucky's Recommended Designation | The EPA's Intended Area Definition | The EPA's Intended Designation |
|---|---|---|---|---|
| Ballard County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Barren County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Bath County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Bell County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Bourbon County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Boyd County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Boyle County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Bracken County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Breathitt County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Breckinridge County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Bullitt County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Butler County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Caldwell County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Calloway County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Campbell County (p)* | Remainder of county** | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Carlisle County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Carter County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Casey County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Christian County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Clark County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Clay County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |

| County or Partial County (p) | Kentucky's Recommended Area Definition | Kentucky's Recommended Designation | The EPA's Intended Area Definition | The EPA's Intended Designation |
|---|---|---|---|---|
| Clinton County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Crittenden County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Cumberland County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Edmonson County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Elliott County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Estill County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Fayette County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Fleming County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Floyd County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Franklin County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Fulton County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Gallatin County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Garrard County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Grant County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Graves County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Grayson County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Green County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Greenup County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Hardin County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Harlan County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Harrison County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |

| County or Partial County (p) | Kentucky's Recommended Area Definition | Kentucky's Recommended Designation | The EPA's Intended Area Definition | The EPA's Intended Designation |
|---|---|---|---|---|
| Hart County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Henry County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Hickman County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Hopkins County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Jackson County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Jefferson County (p)* | Remainder of county** | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Jessamine County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Johnson County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Kenton County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Knott County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Knox County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| LaRue County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Laurel County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Lawrence County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Lee County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Leslie County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Letcher County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Lewis County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Lincoln County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Livingston County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Logan County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |

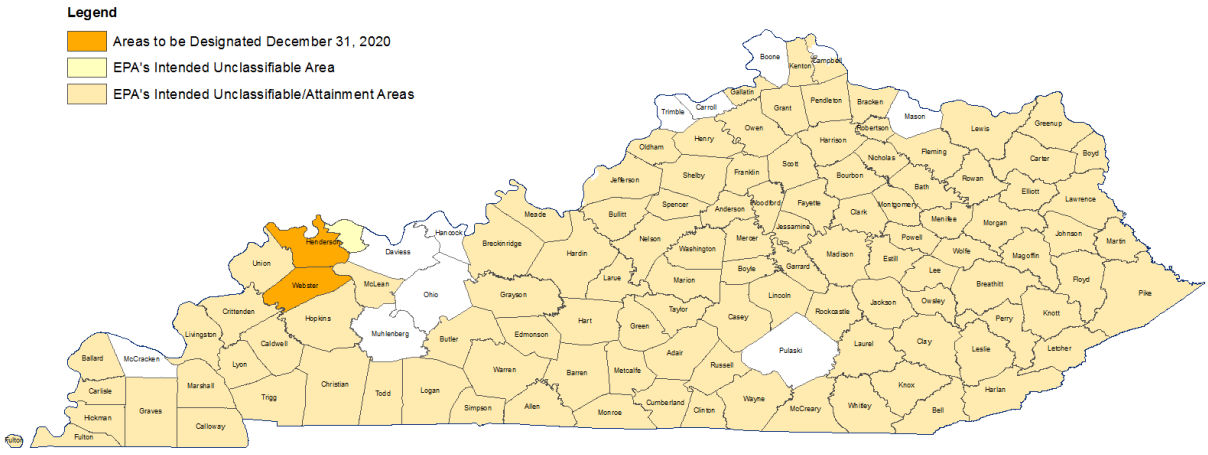
| County or Partial County (p) | Kentucky's Recommended Area Definition | Kentucky's Recommended Designation | The EPA's Intended Area Definition | The EPA's Intended Designation |
|---|---|---|---|---|
| Lyon County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Madison County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Magoffin County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Marion County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Marshall County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Martin County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| McClean County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| McCreary County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Meade County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Menifee County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Mercer County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Metcalfe County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Monroe County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Montgomery County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Morgan County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Nelson County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Nicholas County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Oldham County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Owen County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Owsley County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Pendleton County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |

| County or Partial County (p) | Kentucky's Recommended Area Definition | Kentucky's Recommended Designation | The EPA's Intended Area Definition | The EPA's Intended Designation |
|---|---|---|---|---|
| Perry County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Pike County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Powell County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Robertson County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Rockcastle County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Rowan County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Russell County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Scott County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Shelby County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Simpson County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Spencer County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Taylor County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Todd County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Trigg County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Union County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Warren County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Washington County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Wayne County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Whitley County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Wolfe County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |
| Woodford County | Entire county | Unclassifiable/ attainment | Same as Commonwealth's | Unclassifiable/ attainment |

*Portions of Campbell County and Jefferson County were designated in the 2013 Round 1 designations. (See August 5, 2013, 78 FR 47191). The EPA has since finalized redesignation and maintenance plan for both the Ohio and Kentucky portions of this area on November 21, 2016 (81 FR 83158) and March 10, 2017 (82 FR 13227), respectively. This TSD is only addressing the remainder of each of these counties.
**The Commonwealth's June 2, 2011, recommendation to the EPA asked for all areas to be designated as attainment.

Table 56 also summarizes Kentucky's recommendations for these areas. Specifically, Kentucky recommended that all remaining counties in the Commonwealth be designated as unclassifiable/attainment, unclassifiable based on the lack of any information indicating a violation of the 2010 1-hour $SO_2$ NAAQS. After careful review of the Commonwealth's assessment, supporting documentation, and all available data, the EPA intends to designate the remaining areas in the County (listed above in Table 56) as unclassifiable/attainment. Figure 63 shows the locations of these areas within Kentucky.

**Figure 63. The EPA's Intended Unclassifiable/Attainment Designations for Counties in Kentucky Based on Available Information**




As referenced in the Introduction (see Table 2), the counties or portions of counties associated with sources for which Kentucky has installed and begun timely operation of a new, approved $SO_2$ monitoring network are required to be designated by December 31, 2020, but those counties or portions of counties are not being addressed at this time. Specifically, the portion of Henderson County not being designated in this Round 3 designation effort, and the entirety of Webster County are being addressed by December 31, 2020. Counties or portions of counties

previously designated unclassifiable in Round 1 (s*ee* 78 *Federal Register* 4719) and Round 2 (s*ee* 81 *Federal Register* 45039) will remain unchanged unless otherwise noted.

## 12.2. Air Quality Monitoring Data for the Remaining Areas in Kentucky

AQS monitors identified in Table 57 below, located in several of the remaining undesignated counties, have complete, valid data for 2013 - 2015 and 2014-2016 and these data indicate that there was no violation of the 2010 $SO_2$ NAAQS at the monitoring sites for those periods, however the EPA does not have any information that each monitor is located in maximum concentration for each respective area. Additionally, no DRR sources are located near these monitors, nor in these Counties and EPA has no available relevant air quality data for these areas.

**Table 57. Monitoring Data for Counties in Kentucky that the EPA Intends to Designate Unclassifiable/Attainment**

| County | AQS ID | Latitude | Longitude | 2013 – 2015 Design Value (ppb) | 2014-2016 Design Value(ppb) |
|---|---|---|---|---|---|
| Boyd | 21-019-0017 | 38.45934 | -82.64041 | 16 | 12 |
| Campbell* | 21-037-3002 | 39.021881 | -84.47445 | 50 | 30 |
| Edmonson | 21-061-0501 | 37.13179 | -86.142953 | 10 | 7 |
| Fayette | 21-067-0012 | 38.06503 | -84.49761 | 11 | 8 |
| Greenup | 21-089-0007 | 38.548136 | -82.731163 | 14 | 12 |
| Jessamine | 21-113-0001 | 37.89147 | -84.58825 | 14 | 10 |

*This monitor is referred to as the Northern Kentucky University monitor, and is addressed in several sections of this document for background concentrations. This monitor was also the driver for the 2013 designation of portions of Campbell County, Kentucky and Clermont County, Ohio as nonattainment.

## 12.3. Jurisdictional Boundaries in the Remaining Areas in Kentucky

Existing jurisdictional boundaries are considered for the purpose of informing the EPA's designation action for these remaining counties. Our goal is to base designations on clearly defined legal boundaries, and to have these boundaries align with existing administrative boundaries when reasonable.

Kentucky recommended that all areas in the Commonwealth be designated as attainment. The EPA intends to designate all remaining counties as unclassifiable/attainment individually based on the existing county boundaries.

## 12.4. The EPA's Assessment of the Available Information for the Remaining Areas in Kentucky

After careful evaluation of the Commonwealth's recommendation and supporting information, as well as all available relevant information, the EPA intends to designate the areas in the above Table 56 as unclassifiable/attainment for the 2010 $SO_2$ NAAQS. Our intended unclassifiable/attainment areas, bounded by existing county boundaries, will have clearly defined legal boundaries, and we intend to find these boundaries to be a suitable basis for defining our intended unclassifiable area.

There is no current monitoring data available for the vast majority of the remaining counties. Five of the 108 undesignated counties and partial counties in Kentucky had sufficient valid monitoring data, as indicated in Section 10.2, but have not been demonstrated to be located in maximum concentrations for their respective areas. The data for Boyd, Campbell, Edmonson, Fayette, and Jessamine Counties show DVs well below the NAAQS. Furthermore, these areas do not have any DRR sources. Therefore, this $SO_2$ data supports the EPA's intended unclassifiable/attainment designation for these counties. The data for McCracken County further supports the modeling demonstration done for the area surrounding TVA's Shawnee Fossil Plant, discussed in Section 8, on which the EPA is basing its intended unclassifiable/attainment designation.

Based on the any available information for the remaining counties, including the five counties with valid $SO_2$ data, the Commonwealth concluded that these counties should be designated as unclassifiable/attainment. This recommendation is based on Kentucky's assessment that no evidence of $SO_2$ impacts leading to violations of the 2010 $SO_2$ NAAQS is available. No remaining undesignated counties have DRR sources within their boundaries except for those which have imposed federally-enforceable limitations on PTE or have permanently shut down.

Not included in this section or previous sections of this document, are the areas already designated in Rounds 1 or 2 as well as those areas that will not be designated until Round 4. For the Commonwealth, the only areas that have been previously designated include all of Ohio and Pulaski Counties, designated Unclassifiable in Round 2, and portions of Campbell and Jefferson Counties in Round 1. The counties that will be designated by December 31, 2020, are listed in Table 2 and include portions of Henderson and Webster Counties.

The EPA agrees with the Commonwealth's recommendation for these remaining areas. We believe the available information supports our intended unclassifiable/attainment designation. In addition, based on the available information for the remaining areas in Kentucky and nearby Ohio, Indiana, Illinois, and Missouri, including monitoring and modeling, there are no current $SO_2$ nonattainment areas near these remaining counties in Kentucky, and no expected nonattainment areas for this third round of designations. Therefore, the remaining areas in Kentucky are not expected to contribute to ambient air quality in any nearby areas that do not meet the NAAQS.

## 12.5. Summary of Our Intended Designation for the Remaining Areas in Kentucky

After careful evaluation of the Commonwealth's recommendation and supporting information, as well as all available relevant information, the EPA intends to designate the remaining areas in Kentucky as unclassifiable/attainment for the 2010 1-hour NAAQS. Specifically, the boundaries are comprised of existing county boundaries. Figure 63 above shows the location of these areas within Kentucky and the EPA's intended boundary of intended remainder of Kentucky unclassifiable/attainment areas.

At this time, our intended designations for the Commonwealth only apply to these areas and the other areas presented in this technical support document. The EPA intends to evaluate and designate all remaining undesignated areas in Kentucky by December 31, 2020.