Technical Support Document:

Chapter 5
Final Round 4 Area Designations for the 2010 1-Hour SO_2 Primary National Ambient Air Quality Standard for Missouri

1. Summary

Pursuant to section 107(d) of the Clean Air Act (CAA), the U.S. Environmental Protection Agency (EPA, we, or us) must designate areas as either "nonattainment," "attainment," or "unclassifiable" for the 2010 1-hour sulfur dioxide (SO_2) primary national ambient air quality standard (NAAQS) (2010 SO_2 NAAQS). On or about August 13, 2020, EPA sent states our responses to certain designation recommendations for the 2010 SO_2 NAAQS. On August 21, 2020, EPA published a notice of availability (NOA) in the *Federal Register* (*see* 85 FR 51694), initiating a 30-day public comment period. The NOA and the technical support document (TSD) for EPA's intended designations provided background on the relevant CAA definitions and the history of the designations for this NAAQS. The TSD for EPA's intended designations also described Missouri's recommended designations and EPA's assessment of the available information.

This TSD for EPA's final Round 4 area designations for Missouri addresses any change in Missouri's recommended designations since EPA communicated its intended designations in August 2020 and provides our assessment of additional relevant information that was timely submitted by Missouri or other parties since the publication of the NOA. This TSD does not repeat information contained in the TSD for EPA's intended designations except as needed to explain our assessment of the newer information and to make clear the final action we are taking and its basis, but that information is incorporated as part of our final designations. If the assessment of the information that was already considered in the TSD for EPA's intended designations has changed based on new timely information and we are finalizing a designation based on such change in our assessment, this TSD also explains that change. For areas of Missouri that are not explicitly addressed in this chapter, we are finalizing the designations described in our 120-day letters and Chapter 2 of the TSD for EPA's intended Round 4 area designations as explained in those documents.

In a letter dated October 16, 2020, Missouri responded to EPA's intended designations by providing additional information including additional technical information to support its April 30, 2020, recommendation. EPA also received public comments regarding the intended designation for the New Madrid County, Missouri, area. These comments are addressed in the Response to Comments document associated with this final action.

Table 1 identifies Missouri's current designation recommendations, EPA's final Round 4 designations, and the areas in Missouri to which those designations apply. Chapter 1 of this TSD for EPA's final designations explains the definitions we are applying in the final designations process.

Table 1. Summary of EPA's Final Designations and the Designation Recommendations by Missouri

Area/County	Missouri's Recommended Area Definition	Missouri's Recommended Designation	EPA's Intended Designation	EPA's Final Area Definition	EPA's Final Designation
New Madrid County, MO	Area encompassing the property boundaries of these two facilities - The portion of New Madrid County bounded by the Mississippi River to the east and the lines connecting the following coordinates: Zone 16 Universal Transverse Mercator (UTM) coordinates (272016.6, 4042423.62), (268791.92, 4042564.43), (268957.29, 4045213.47), and (270362.07, 4045125.75)	Nonattainment	Nonattainment	Area bounded by: • East: Missouri/ Kentucky and Missouri/ Tennessee State lines. • North: County Highway 406 East to Levee Road, following Levee Road North to County Highway 406, then extending directly East to the Missouri/ Kentucky State line. • West: County Highway 403 • South: County Highway 408 East to the intersection with County Highway 431, then extending directly East to the Missouri/ Tennessee State line	Nonattainment
Remaining portion of New Madrid County, MO	Remainder of New Madrid County	Attainment/ Unclassifiable	Attainment/ Unclassifiable	Remainder of New Madrid County	Attainment/ Unclassifiable

Area/County	Missouri's Recommended Area Definition	Missouri's Recommended Designation	EPA's Intended Designation	EPA's Final Area Definition	EPA's Final Designation
Iron County, MO*	Iron County, MO	Attainment/ Unclassifiable	Attainment/ Unclassifiable	Same as State's Recommendation	Attainment/ Unclassifiable

* EPA addresses this area in Chapter 2 with all other areas which EPA is designating "attainment/unclassifiable" or "unclassifiable."

Areas that EPA previously designated in Round 1 (*see* 78 FR 47191), Round 2 (*see* 81 FR 45039 and 81 FR 89870), and Round 3 (*see* 83 FR 1098 and 83 FR 14597) are not affected by the designations in Round 4.

2. Technical Analysis for the New Madrid County, Missouri Area

2.1. Introduction

EPA must designate the New Madrid County, Missouri area by December 31, 2020, because the area has not been previously designated, and Missouri installed and began operating new EPA-approved monitors pursuant to EPA's SO_2 Data Requirements Rule (DRR).[1] This section presents all the available air quality information for the portion of New Madrid County that includes the following SO_2 sources around which the DRR required the state to characterize air quality:

- The Associated Electric Cooperative Inc. (AECI) New Madrid facility operates two coal-fired boilers for the generation of electric power. AECI New Madrid emits more than 2,000 tons of SO_2 annually. Specifically, AECI New Madrid emitted 16,774 tons of SO_2 in 2014. This source meets the DRR criteria and thus is on the SO_2 DRR Source list, and Missouri has chosen to characterize it via monitoring.

- The Magnitude 7 Metals (M7M) facility is a primary aluminum reduction plant that uses electrolysis to form aluminum. The facility emits more than 2,000 tons of SO_2 annually. Specifically, the facility emitted 5,323 tons of SO_2 in 2014. This source meets the DRR criteria and is on the SO_2 DRR Source list, and Missouri has chosen to characterize it via monitoring.

As seen in Figure 1 and Figure 2 below, the AECI New Madrid and M7M facilities sit adjacent to one another and are located in southeast Missouri along the Mississippi River. They are approximately 200 km to the south of St. Louis, Missouri and approximately 3 km to the east of the nearest city, Marston, Missouri. The locations of the three SO_2 monitors are provided in Figure 2. Site #1 is located just to the north of the M7M facility on the property of AECI New Madrid. Site #2 is also located on AECI New Madrid's property to the southeast of the M7M

[1] *See* 80 FR 51052 (August 21, 2015), codified at 40 CFR part 51 subpart BB.

fenceline. Site #3 is located at the M7M entrance on the west side of the facility. These three monitors were sited to characterize the air quality in the area around both sources in the New Madrid County area which Missouri selected to characterize via monitoring under the DRR.

Figure 1. Map of the New Madrid County, Missouri Area Addressing the AECI New Madrid and M7M DRR sources.

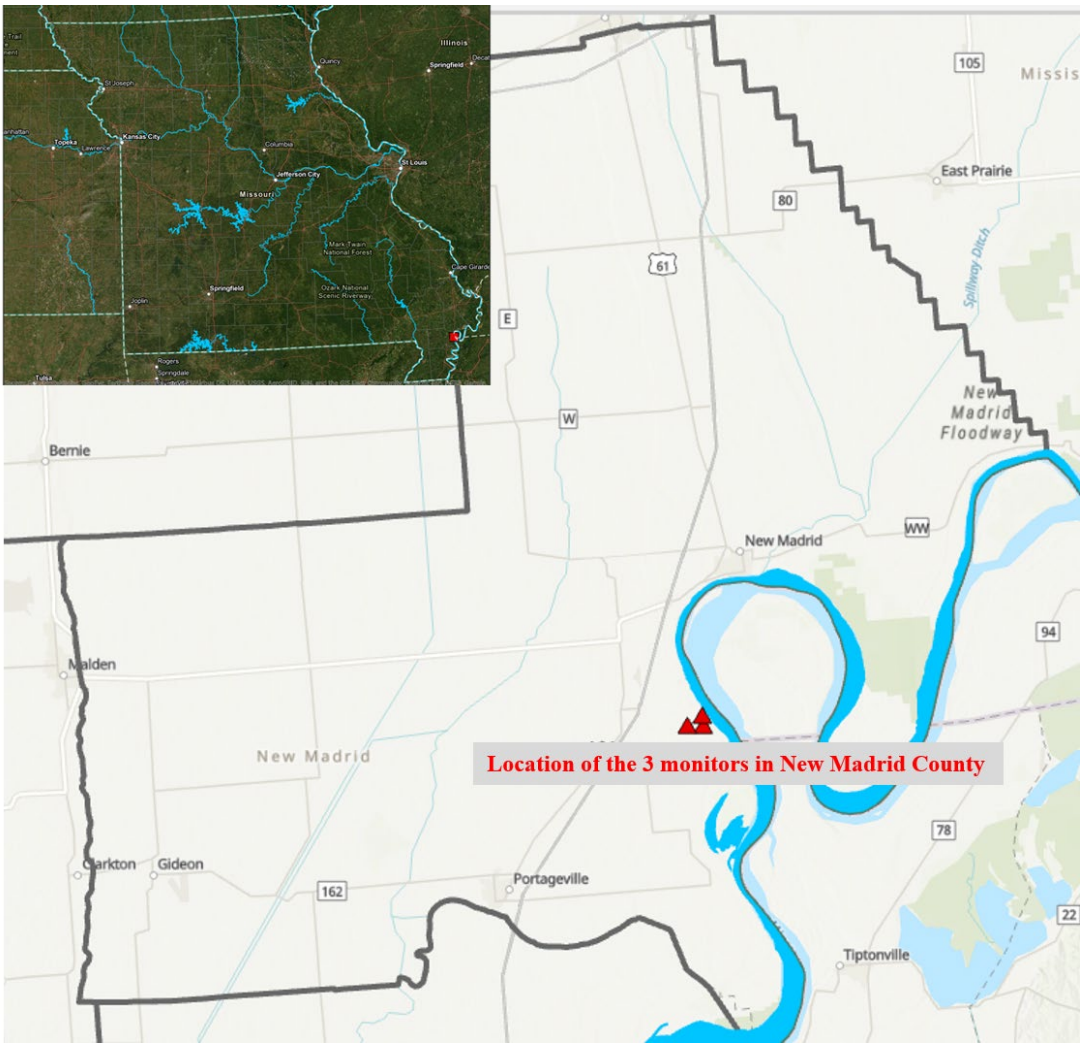
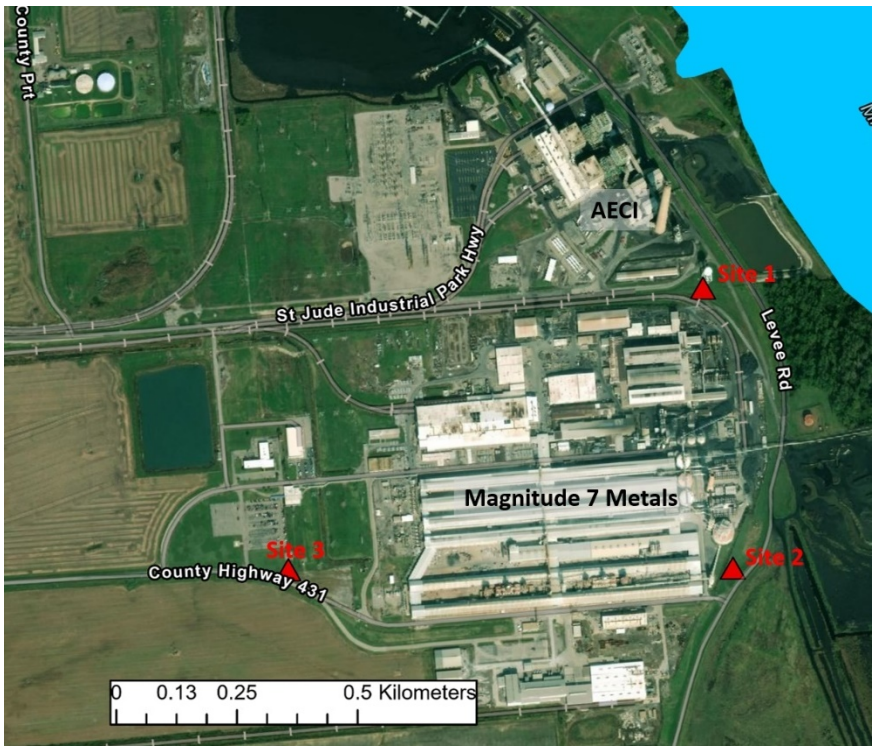


Figure 2. Map of the AECI New Madrid and M7M DRR sources and SO_2 monitor locations.



2.2. Summary of Information Reviewed in the TSD for the Intended Round 4 Area Designations

In its April 30, 2020, recommendation letter, Missouri recommended a portion of New Madrid County be designated as nonattainment for the 2010 SO_2 NAAQS, based on monitored air quality from 2017-2019. Specifically, the state's recommended boundaries consisted of:

- the portion of New Madrid County bounded by the Mississippi River to the east and lines connecting the following: Zone 16 Universal Transverse Mercator (UTM) coordinates (272016.6, 4042423.62) (268791.92, 4042564.43) (268957.29, 4045213.47) and (270362.07, 4045125.75).

EPA's intended designation agreed with Missouri's recommendation as to the designation category, and EPA intended to designate a portion of New Madrid County, Missouri, as described in the intended designations TSD, as nonattainment for the 2010 SO_2 NAAQS based upon currently available monitoring information for the 2017-2019 period. Our intended boundaries were different than the State's recommended boundaries.

Two monitors in the New Madrid County area are violating the 2010 SO_2 NAAQS based on the 2017-2019 design values. On April 30, 2020, Missouri submitted air dispersion modeling to demonstrate the extent of the NAAQS violations and to establish a nonattainment boundary. The State considered different modeling scenarios that included different emissions inputs at M7M,

in particular for the emissions at the two currently operating carbon bakes and two currently operating potlines. The State based its modeling scenario that was used to inform its boundary recommendation on AERMOD's ability to match the maximum monitored concentrations, in particular the Site #1 monitor. Site #1 is located less than 0.1 km from the carbon bake #1 stacks. EPA further evaluated the State's chosen modeling scenario, utilizing quantile-quantile (q-q) plots to compare the model predictions to monitor concentrations. Figures 10 and 11 from the intended designations TSD for Missouri provided the q-q plots for Site #1 and Site #2, respectively. The plots were based on monitor and modeled data from a 12-month period (September 2018 through August 2019).

The q-q plot at Site #1 showed the model could replicate the maximum concentrations, and as discussed in the intended designations TSD, this formed the basis for the State's chosen modeled emissions and source characterization at M7M. However, the q-q plots at Site #1 also showed that beyond the model replication of the maximum monitor concentration, the model severely underpredicted monitor concentrations exceeding the 1-hour SO_2 NAAQS. This model underprediction was even more pronounced at Site #2.

This q-q model evaluation indicates a consistent model underprediction in the State's chosen modeling scenario at the two nearby monitors that are in violation of the NAAQS. The model underprediction is likely due to a combination of factors, with uncertainties in the modeled emissions and source characterization (i.e., what is the best way to represent the 64 short stacks of carbon bake #2) as primary concerns. The q-q plots showed the difficulty of properly representing the M7M source characterization and operations within AERMOD. Because of these uncertainties at M7M, EPA was not able to rely solely on the State's modeling demonstration to inform the extent of the nonattainment boundary around the AECI and M7M facilities.

2.3. Air Quality Monitoring Data for the New Madrid County, Missouri Area

In the TSD for the intended area designations, EPA considered design values for air quality monitors in the New Madrid County, Missouri area. Specifically, EPA determined that two monitors, the Site #1 AECI Water Tower monitor (AQS ID# 29-143-9001) and Site #2 East Graveyard monitor (AQS ID# 29-143-9002), violated the 2010 SO_2 NAAQS with 2017-2019 design values of 202 and 268 ppb, respectively. EPA has no new quality assured monitoring information that warrants revising our prior analysis of available monitoring data.

2.4. Assessment of New Technical Information for the New Madrid County, Missouri Area Addressing Magnitude 7 Metals and AECI New Madrid

On October 16, 2020, Missouri submitted new modeling analyzing air quality in the area surrounding Magnitude 7 Metals and AECI in the New Madrid County area to support the State's April 30, 2020, recommended nonattainment area boundary. This assessment and characterization were performed using air dispersion modeling software, i.e., AERMOD, analyzing actual emissions. After careful review of the State's October 2020 and April 2020

modeling assessments, supporting documentation, and all available information to inform the nonattainment area boundary, EPA is finalizing the nonattainment area boundary as intended. Our reasoning for this conclusion is explained in a later section of this TSD, after all the available information is presented.

The discussion and analysis that follows below will reference the "SO_2 NAAQS Designations Modeling Technical Assistance Document" (Modeling TAD) and the factors for evaluation contained in EPA's September 5, 2019, guidance, July 22, 2016, guidance and March 20, 2015, guidance, as appropriate.[2]

2.4.1. Modeling Analysis Provided by the State

2.4.1.1.Differences Between and Relevance of the Modeling Assessments Submitted by the State

In its October 16, 2020, submittal, the State provided an AERMOD model performance evaluation (MPE) for the New Madrid area of analysis for three separate modeling scenarios, utilizing model output and the monitoring data for all three monitoring sites. The goal of the MPE was to support the State's original nonattainment area modeling and boundary recommendation as submitted by the State on April 30, 2020. Table 2 provides a brief overview of the three MPE modeling scenarios. A detailed summary of the inputs to the three MPE modeling scenarios provided in the State's October 16, 2020, submittal can be found in Section 2.4.1.6 of this document.

In all three of these MPE scenarios, the State used actual monitoring data from the three ambient air monitors around M7M and AECI to evaluate model performance. As shown in Figure 2 and described in Section 2.1, the three monitors are the Water Tower (Site #1) site located just to the north of the M7M facility on the property of AECI New Madrid, the Graveyard (Site #2) site located on AECI New Madrid's property to the southeast of the M7M fenceline, and the West Entrance (Site #3) site located at the M7M entrance on the west side of the facility.

[2] https://www.epa.gov/sites/production/files/2016-04/documents/so2modelingtad.pdf.

Table 2. The three MPE Modeling Scenarios provided by Missouri in its October 16, 2020 Submission.

MPE Model Scenario	Dataset used to estimate modeled hourly emissions	Meteorological Time Period Modeled and Monitored Value Comparison Period
1	12-month emissions from 12-month mass balance compliance worksheet covering the period of September 2018 through August 2019.	2019
2	Monthly emissions from mass balance compliance worksheets for October, November and December 2018.	October – December, 2018
3	MPE Scenario 1 emissions with substituted fugitive emissions as further explained in Section 2.4.1.6 of this TSD.	2019

The State looked at four metrics in its MPE, which are further described in Section 2.4.1.6. Based on the metrics, the State designed a scoring system that gave a passing score if the modeling scenario was deemed acceptable for a specific metric. Overall, the three MPE scenarios evaluate the modeling inputs used for both Scenario #2 and Scenario #6 from the previous modeling (April 30, 2020) and a new modeling scenario (October 16, 2020). EPA's final TSD evaluates all three MPE scenarios, and thus evaluates the State's Scenario #2 (MPE Scenario #2) and Scenario #6 (MPE Scenario #1) from its April 30, 2020 modeling submittal, in addition to the new modeling scenario (MPE Scenario #3) used to support its boundary recommendation in the following sections.

2.4.1.2.Model Selection and Modeling Components

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 19191, the most recent version at the time the modeling was submitted to EPA. A discussion of the State's approach to the individual components is provided in the corresponding discussion that follows, as appropriate.

2.4.1.3.Modeling Parameter: Rural or Urban Dispersion

For any dispersion modeling exercise, the determination of whether a source area is "urban" or "rural" 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 area is urban or rural based on land use or population density.

For the purpose of performing the modeling for the area of analysis, the State determined that it was most appropriate to run the model in rural mode. The Guideline on Air Quality Models, Appendix W section 7.2.1.1(b) instructs users to define the urban or rural classification of the area considering land use and population density. The land use procedure in Appendix W section 7.2.1.1(b)(i) classifies urban areas based on industrial, commercial, and residential land use over 50% within a 3 km radius of the source. The population density (section 7.2.1.1(b)(ii)) threshold of the 3 km radius surrounding each facility is compared to the urban threshold of 750 people per square kilometer. Both the land use and population density guidelines in Appendix W were used to assess the urban characteristics of the area and it was determined to be rural. EPA agrees with the State for this component of the State's modeling.

2.4.1.4.Modeling Parameter: Area of Analysis (Receptor Grid)

The Modeling 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 significant 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 New Madrid County area, the State evaluated seven other sources of SO_2 within 25 km of AECI New Madrid and M7M. The State noted that none of these seven sources emitted more than 1 ton per year of SO_2 during the 2016-2018 timeframe and were therefore not included as explicitly modeled sources in the State's modeling demonstration. The State determined that this 25 km distance 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. No other sources beyond 25 km were determined by the State to have the potential to cause significant concentration gradients within the area of analysis.

As part of State's MPE analysis submitted on October 16, 2020, the State placed discrete receptors at the locations of the three monitors in the area in order to evaluate model performance. No other modeled receptors were placed in the grid. EPA finds the placement of the three discrete receptors adequate to address model to monitor comparisons in the New Madrid area of analysis.

For the overall assessment of air quality to inform the nonattainment area boundary in the New Madrid area of analysis, the grid receptor spacing chosen by the State is as follows:

- Modeled receptors were placed in New Madrid County outward up to 6 km from the M7M facility. The State deemed this 6 km extent sufficient to encompass all violations associated with the actual operations of AECI New Madrid and M7M. Receptors located over water (i.e. the Mississippi River) or in other states were not included in the modeling analysis. The State used grid spacing of 50 meters along the fencelines of AECI New Madrid and M7M and 100 meter spacing throughout the rest of the modeling domain.

The receptor network contained 4,517 receptors, and the network covered the southeastern portion of New Madrid County, Missouri to the Mississippi River. Figures 3 and 4, included in the State's recommendation, show the State's chosen area of analysis surrounding the AECI New Madrid and M7M facilities, as well as the receptor grid for the area of analysis.

Because two monitors, which are the two ambient monitors showing violations of the NAAQS, are located on the AECI New Madrid facility's property, the State placed receptors within the AECI New Madrid property, while excluding receptors on M7M's property. Therefore, the State's modeling contains an evaluation of M7M's impact on AECI New Madrid property, but does not contain the relative impacts that AECI New Madrid would have on M7M's property. While the area within the M7M property would be ambient relative to the impacts from AECI New Madrid, EPA agrees with the State's assertion in the October 2020 submittal that it would have no impact on the nonattainment boundary as both properties are already included in the nonattainment area boundary.

In addition, the State removed receptors from the Mississippi River on the basis that it would be unfeasible to place an air quality monitor on the River and asserts that this is consistent with EPA's prior guidance. Prior EPA guidance, specifically documents titled, "SO_2 NAAQS Designations Modeling Technical Assistance Document" (SO_2 NAAQS Designations Modeling TAD) and "SO_2 NAAQS Designations Source-Oriented Monitoring Technical Assistance Document" (SO_2 NAAQS Designations Monitoring TAD),[3] allow for exclusion of receptors over bodies of water when the modeling is used for purposes of siting a monitor or modeling for designations purposes when monitors are not available. However, for the purposes of informing a nonattainment boundary, the SO_2 Modeling TAD may be a resource, but additional consideration should be given to any area that may be experiencing violations in the ambient air, regardless of whether that area includes a water body or whether or not an ambient monitor could be feasibly placed there. For example, EPA previously included portions of water bodies in SO_2 nonattainment areas when that area is experiencing air quality violations, including in both

[3] *See* SO_2 NAAQS Designations Source-Oriented Monitoring Technical Assistance Document (February 2016), available at https://www.epa.gov/sites/production/files/2016-06/documents/so2monitoringtad.pdf, and SO_2 NAAQS Designations Modeling Technical Assistance Document (August 2016), available at https://www.epa.gov/sites/production/files/2016-06/documents/so2modelingtad.pdf.

Round 1 nonattainment areas in Missouri.[4] Additionally, in this Round 4 of designations for the 2010 SO_2 NAAQS, EPA is finalizing a nonattainment area boundary in Whatcom County, Washington, which includes a portion of the Strait of Georgia (see the intended and final designations TSDs for Washington). As discussed above, in this case, the Missouri portion of the Mississippi River adjacent to M7M and AECI is within 0.25 km of the modeled NAAQS violations on the edge of the State's receptor grid, therefore that portion of the river is likely similarly experiencing violations. Additionally, as that portion of the river is undesignated, for the reasons outlined above, it is best represented with the same designation classification as the immediately adjacent area that is being designated nonattainment.

The State also excluded receptors over previously designated areas in the bordering states of Kentucky and Tennessee, which are located within 1 to 6 km of AECI New Madrid and M7M.[5]

[4] For example, in Round 1 of designations for the 2010 SO_2 NAAQS, EPA included the portion of the Missouri River located in Jackson County, as part of the Jackson County nonattainment area. Also, in Round 1, EPA included the Missouri portion of the Mississippi River in the Jefferson County nonattainment area. See the Final Round 1 designations TSD for Missouri here: https://www.epa.gov/sites/production/files/2016-03/documents/mo-tsd.pdf

[5] *See* 83 FR 1098 (January 9, 2018).

Figure 3. Area of Analysis for the New Madrid County Area. Image courtesy of Missouri.

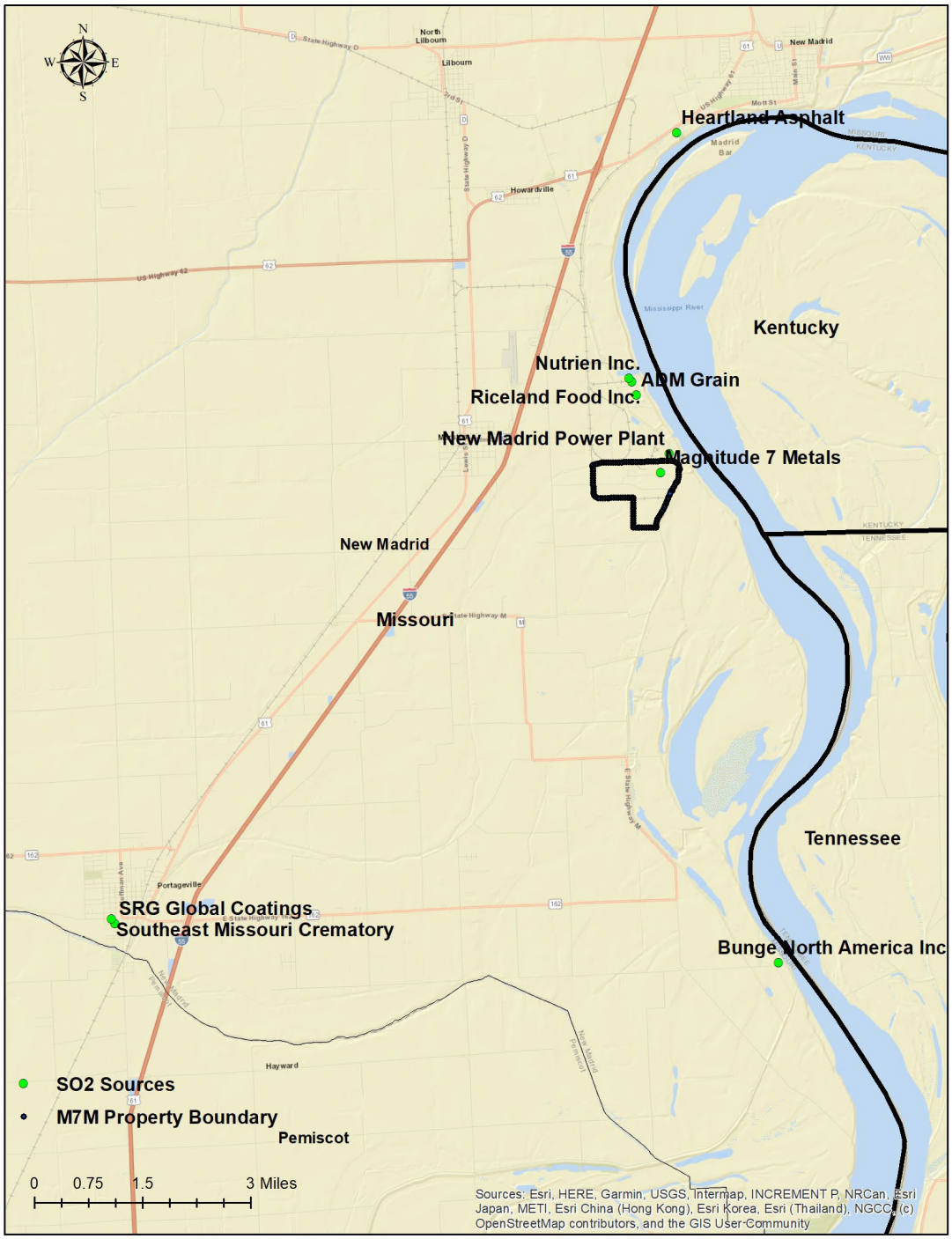
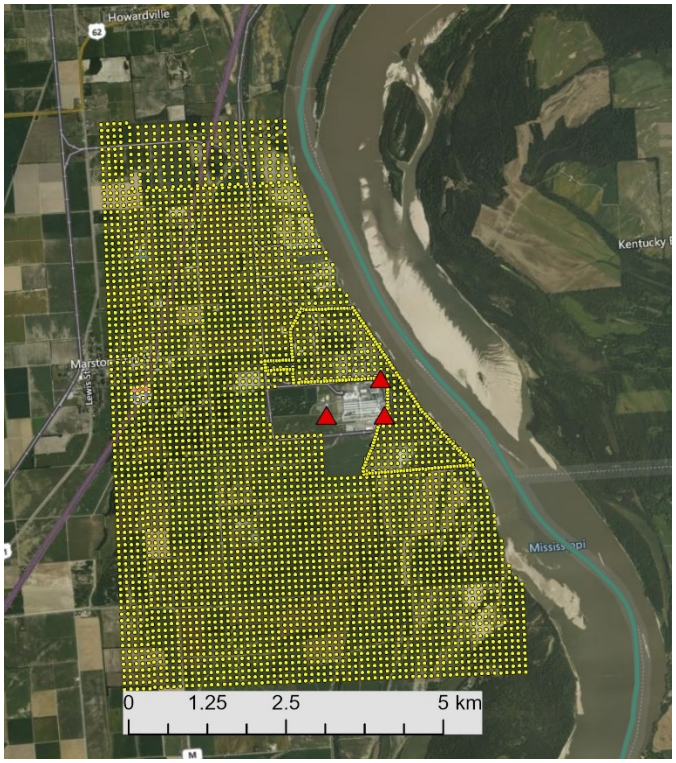


Figure 4. Receptor Grid for the New Madrid County Area. Receptors are shown as yellow dots and monitor locations as red triangles.



EPA finds that the modeled receptor grid is sufficient to address modeled impacts in New Madrid County, except for the exclusion of receptors over the Mississippi River. As previously mentioned, the State excluded over water receptors following the recommendations of the SO_2 Modeling TAD. However, EPA's September 2019 memorandum states that the SO_2 Modeling TAD can be used as a helpful tool for evaluating the extent of monitored and modeled NAAQS violations, but other circumstances specific to a particular area should be considered. With monitored violations located within 0.25 km of the Mississippi River, as noted in the intended designations TSD, EPA found that receptors needed to be placed on the portion of the Mississippi River that resides in the undesignated New Madrid County to fully evaluate potential impacts in the county. As described above, these receptors are being used to determine the extent of the nonattainment area boundary and not being used to establish if the area is initially violating, which is already known based on the violating monitors, and therefore over water receptors are appropriate. Additionally, EPA must designate the entirety of the undesignated New Madrid County, including the portion of the Mississippi River adjacent to the nonattainment area. Because of the immediately adjacent violations, EPA finds this portion of the river is best represented by the adjacent nonattainment area status as opposed to the remainder of the county which EPA is designating as attainment/unclassifiable.

2.4.1.5.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.

The State explicitly modeled AECI New Madrid and M7M and no other sources for the New Madrid area of analysis. The AECI New Madrid units were modeled using actual stack heights and actual hourly emissions. The two units at AECI New Madrid emit from a single 243-meter stack. For the AECI New Madrid facility, the State adequately characterized the source's building layout and location. Where appropriate, the AERMOD component BPIPPRM was used to assist in addressing building downwash.

M7M was modeled using estimates of actual emissions for the known SO_2 emission points, except for MPE Scenario #3 which substituted modeled volume sources for a fraction of stack emissions in an attempt to characterize fugitive emission releases associated with potential leaks from the fluoride scrubber control systems at M7M, which is further discussed below.

MPE Scenario #1 and #2 Characterization

SO_2 emissions at M7M are due to three emission source types. The first type of source are three on-site carbon bake furnaces. The carbon bake furnaces produce block anodes, with the sulfur in the raw coke and pitch material producing emissions of SO_2 during the baking process. M7M carbon bake #1 is not currently operating, although permitted to, and has not operated during the 2017-2019 timeframe. Carbon bake #2 and carbon bake #3 have been operating since the facility restarted in August of 2018. Emissions from carbon bake #3 are routed to an individual 23-meter stack, and this 23-meter actual stack height was used in the modeling.

Carbon bake #2 emissions are routed to four fluoride scrubbers that can ultimately emit to 64 individual hinged rain capped stacks that are designed to open when operating. Each of the four scrubbers have a group of 16 individual stacks and each group of stacks are 4.5 meters apart. Each stack is approximately 0.3 meter in diameter and 15 meters in height. The 16 stacks above each fluoride scrubber are 0.152 meters apart.

To best represent the actual operations of carbon bake #2 in its boundary recommendation analysis, the State performed modeling scenarios that included modeling carbon bake #2 as operating with 64 stacks, 48 stacks, 32 stacks, and one single stack. The State modeled the hinged rain cap stacks using the capped stack option (i.e., POINTCAP) in AERMOD, based on pictures of the hinged cap not completely opening during operation. The modeled stack parameters of exit temperature and velocity were based on actual stack tests performed at the facility in January and February of 2019. The State ultimately modeled the 64 stacks of carbon bake #2 emissions as 32 individual capped stacks, concluding that this modeled scenario was able to best match the maximum monitored SO_2 concentrations at monitoring Site #1. The State further justified modeling carbon bake #2 as 32 individual stacks based on information, provided by the M7M facility, that typically only two of the four carbon bake #2 scrubbers are in operation at the same time.

The second and third emission source types at M7M are from the pots that produce the aluminum through electrolysis. The pots are located in rectangular buildings known as potlines. Sulfur present in some of the aluminum oxide as well as sulfur still present in the carbon anode and cathode blocks oxidizes in the pots to form emissions of SO_2. The M7M facility has three potlines. Potlines #1 and #2 have been in operation since M7M restarted in the summer of 2018. Potline #3 is not currently operating, although permitted to, and has not operated in the 2017-2019 timeframe. Emissions from Potlines #1 and #2 are captured and routed to a 90-meter stack. The State modeled this actual stack height for Potlines #1 and #2. Emissions from the potlines that are not captured and routed to the stack are allowed to vent through the top of the potline building. These rooftop fugitive emissions were represented and modeled using EPA's buoyant line source (BLP) algorithm within AERMOD. Each potline building includes two buoyant line sources in the modeling analysis, which match the actual set-up for these buildings at the facility.

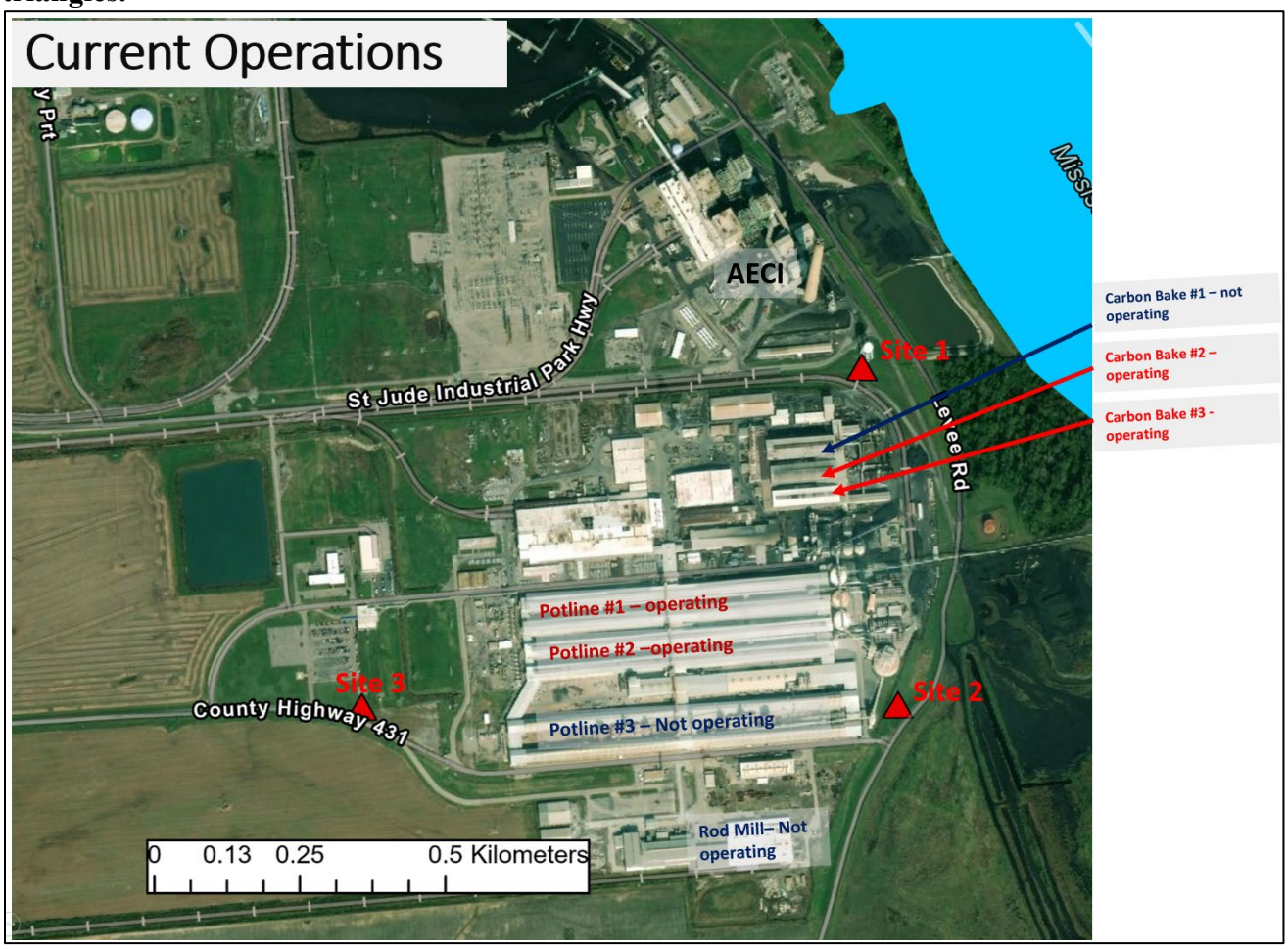
To provide a visual context to emission points modeled, Figure 5 shows the locations of the known emission sources (i.e. M7M carbon bakes and potlines, AECI New Madrid stack) for the New Madrid County area of analysis.

MPE Scenario #3 Characterization

For MPE Scenario #3, the State used the same source characterization as was used in MPE Scenarios #1 and #2, but included modeled volume sources to characterize fugitive emission releases possibly associated with two fluoride scrubber control systems at M7M. The modeled volume sources included two volumes sources near the carbon bake scrubber system and two volume sources near the potline scrubber system near the potline stack. The State notes that the inclusion of the volume sources was to characterize escaping SO_2 emissions from the carbon bake and potline fluoride scrubber structures where the external shell and ductwork are failing to fully direct process gas to the stack.[6]

[6] In the State's October 16, 2020, submittal, the State notes the failing status of the potline fluoride scrubber systems was found during a March 14, 2019, site visit to M7M. The State's site visit notes included the following recommendation, "*Completely replace the pot-line Fluoride scrubbers (external metal shell and ductwork). It seemed very apparent that these structures have failed almost completely to contain the process gas flow and direct it to the 100-meter stack. This failure is creating significant fugitive emissions that most likely are directed to monitoring site #2 when winds are just right (from the north).*" See page 6 of Missouri's October 16, 2020, submission.

Figure 5. Location of known SO_2 emission points at the AECI New Madrid (black label) and M7M facilities. Currently operating emission points at M7M are indicated with red text and non-operating sources are indicated by blue text. Monitor sites are denoted by red triangles.



For the M7M facility, the State adequately characterized the source's building layout and location. Where appropriate, the AERMOD component BPIPPRM was used to assist in addressing building downwash.

The State designed modeling scenarios based on actual emissions estimates from the carbon bake process and the potlines, which included a modeling scenario that attempts to characterize escaping SO_2 emissions from fluoride control systems. EPA understands and agrees with the State that the current operations at the carbon bakes and potlines at M7M are difficult to characterize within the AERMOD modeling system. While EPA finds merit in the State's assumptions used to characterize the current operations at M7M, EPA finds it is appropriate to emphasize the difficulty in representing the actual operating conditions of the carbon bake stacks and the fluoride control systems, which lead to uncertainties when representing these sources in the AERMOD modeling system, as described in Sections 2.4.1.6 and 2.4.1.11 of this TSD.

Overall, based on both the April 30, 2020 and October 16, 2020 modeling submittals, EPA continues to find that there is uncertainty in the characterization of M7M within the AERMOD modeling system, and thus there is uncertainty in knowing the exact geographic extent of the violations based on modeling alone. This uncertainty should be considered and factored in when interpreting the adequacy of the modeling results and further highlights that EPA cannot solely rely on the existing modeling record in its evaluation of the New Madrid area.

2.4.1.6.Modeling Parameter: Emissions

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.

EPA believes that continuous emissions monitoring systems (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, EPA's Modeling TAD highly encourages the use of AERMOD's hourly varying emissions keyword HOUREMIS, or the use of AERMOD's variable emissions factors keyword EMISFACT. When choosing one of these methods, EPA recommends using detailed throughput, operating schedules, and emissions information from the impacted source(s).

As previously noted, the State included the AECI New Madrid and M7M facilities and no other sources of SO_2 within 25 km in the area of analysis. The State has chosen to model these facilities using actual emissions. The facilities in the State's modeling analysis and their associated annual actual SO_2 emissions between 2017 and 2019 are summarized below.

For AECI New Madrid, the State provided annual actual SO_2 emissions between 2016 and 2018 in both the April 30, 2020 recommendation and the October 16, 2020 additional modeling. For M7M, there were no emissions reported for 2017 as the facility was not operating. Actual emissions from 2018 submitted to EPA's National Emissions Inventory (NEI) are summarized in Table 3. Actual annual emissions for 2019 for M7M were provided by the State upon EPA request. EPA retrieved AECI New Madrid annual emissions for 2019 as available in EPA's Clean Air Markets Division's Database.[7] A description of how the State obtained hourly emission rates is given below this table.

Table 3. Actual SO_2 Emissions Between 2017 – 2019 from Facilities in the New Madrid County Area

Facility Name	SO_2 Emissions (tpy)		
	2017	2018	2019
AECI New Madrid	13,548	14,866	13,252
Magnitude 7 Metals	0*	1,772	3,706
Total Emissions from All Modeled Facilities in the State's Area of Analysis	13,548	16,638	16,985

* Noranda Aluminum, now M7M, was idled in 2016. M7M restarted the plant operations in June of 2018.

[7] https://ampd.epa.gov/ampd/

For AECI New Madrid, the actual hourly emissions data were obtained from CEMS.

For M7M, the State's October 16, 2020, MPE submittal modeled three different scenarios with unique emissions inputs for the carbon bake emission and potline sources. The three MPE scenarios were designed to evaluate the model performance for modeled emission rates for the carbon bakes and potlines, and fugitive emissions related to fluoride scrubber operations. A summary of the three MPE scenarios is provided below and in Table 4:

1) MPE Scenario #1 evaluated the modeling scenario that the State used to inform its recommended nonattainment area for New Madrid County area that was submitted to EPA on April 30, 2020 (*i.e.*, Scenario #6 from the April 30, 2020 modeling assessment and as evaluated in EPA's intended designations TSD). The emissions from M7M in this MPE scenario are based on the facility's 12-month rolling compliance emissions report for September 2018 through August 2019. The 12-month emissions total for each emission source was divided by 8,760 hours and modeled continuously for all emission points at the facility. For this MPE, the State used just one full calendar year of meteorological data (2019).

2) MPE Scenario #2 includes emissions and meteorology only for the months of October, November, and December in 2018. In this MPE scenario, the emissions from M7M vary for each month based on the emissions reported in compliance monthly mass balance worksheets. This MPE scenario used the same inputs as Scenario #2 from the State's original April 30, 2020, modeling assessment for an abbreviated time period.

3) MPE Scenario #3 augments the MPE Scenario #1 described above. MPE Scenario #3 utilizes 2019 meteorological data, and emissions from M7M are based on the facility's 12-month rolling compliance emissions report for September 2018 through August 2019. However, in this third scenario the State added volume sources to characterize potential fugitive emission releases from the two fluoride scrubbers controlling emissions at the pot lines and carbon bakes. The State modeled a quarter of a percent of total emissions from the carbon bakes as a volume source to represent fugitive emissions from the carbon bake fluoride scrubbers. The State also modeled half a percent of total emissions from the pot lines as a volume source to represent fugitive emissions from the pot line fluoride scrubbers. These emission estimates and source characterizations reflect engineering judgement of fugitive emissions potentially occurring due to deteriorating control equipment, i.e. equipment with some leakage of emissions due to external corrosion, or other deterioration that makes the equipment less than airtight. It is not known how much or if such fugitive emissions are actually occurring.

Table 4. The three MPE Modeling Scenarios provided by Missouri in its October 16, 2020 Submission.

MPE Model Scenario	Dataset used to estimate modeled hourly emissions	Meteorological Time Period Modeled and Monitored Value Comparison Period
1	12-month emissions from 12-month mass balance compliance worksheet covering the period of September 2018 through August 2019.	2019
2	Monthly emissions from mass balance compliance worksheets for October, November and December 2018.	October – December, 2018
3	12-month emissions from 12-month mass balance compliance worksheet covering the period of September 2018 through August 2019. Additionally, the State substituted a quarter of a percent of total emissions from the carbon bake stacks as a volume source to represent fugitive emissions from the carbon bake fluoride scrubbers. The State also substituted half a percent of total emissions from the potlines stack as a volume source to represent fugitive emissions from the potline fluoride scrubbers.	2019

As mentioned in Section 2.4.1.1, the State looked at four metrics in its MPE. Based on these evaluation metrics, the State designed a scoring system that gave a passing score if the modeling scenario was deemed acceptable for a specific metric. The metrics along with the acceptable criteria and the State's scoring methodology is as follows:

- From EPA's 1992 "Protocol for Determining Best Performing Models," the State calculated the Fractional Bias (FB) using the highest 25 modeled and monitored concentrations.[8] The State considered FB ranges between -0.67 and +0.67 acceptable and if the modeling fell within that range, the modeling received a passing score (1).

- From EPA's 1992 "Protocol for Determining Best Performing Models," the State calculated the Robust Highest Concentration (RHC) statistic. The State considered RHC values within a factor of 2 (ratios between 0.5 and 2.0) as acceptable and if the modeling fell within that range, the modeling received a passing score (1).

- The State evaluated a Design Value (DV) test. To perform the DV test, the State calculated the ratio of the modeled 99th percentile to monitored 99th percentile at each monitor. The State considered DV test values within a factor of 2 (0.5 – 2.0) as acceptable and if the modeling fell within that range, the modeling received a passing score (1).

- The State produced quantile-quantile (q-q) plots of sorted and ranked modeled concentrations versus monitored concentrations. The q-q plots contain dashed lines

[8] https://www.epa.gov/sites/production/files/2020-10/documents/model_eval_protocol.pdf

indicating either over-prediction or under-prediction by a factor of 2. The State deemed the performance as acceptable, and the modeling received a passing score (1), if a large majority of the values plotted on the q-q plot fell within this factor of 2 range (i.e. between the dashed lines). In addition, the State gave the modeling a score of 0.5 under scenarios when roughly half of the values fell within the acceptable range.

The State used the above metrics and scoring to rank each modeling scenario at each of the three monitors. Overall, the State concluded that the results indicate that the model performance for MPE Scenario #3 and MPE Scenario #1 are acceptable, with MPE Scenario #3 the best performing modeling scenario, followed by MPE Scenario #1 and then MPE Scenario #2. The State concludes that the results of MPE Scenario #1 further support the State's modeling scenario (Scenario #6 from the April 30, 2020 submittal) used to establish their recommended nonattainment boundary. Further, the State uses MPE Scenario #3 to provide the basis of new modeling that supports the State's recommended nonattainment boundary.

Overall, the three MPE scenarios evaluate the modeling inputs used to support the State's modeling scenarios:

- MPE Scenario #1 evaluates and supports Scenario #6 from Missouri's April 30, 2020, modeling submission.
- MPE Scenario #2 evaluates and supports Scenario #2 from Missouri's April 30, 2020, modeling submission.
- MPE Scenario #3 evaluates and supports a new modeling scenario (October 16, 2020).

As part of its October 16, 2020 MPE submittal, the State evaluated multiple methods of estimating emissions information for M7M and input this information into AERMOD to be compared with the 2019 monitoring data (unless otherwise noted). As was highlighted in EPA's intended designations TSD, EPA notes that the emissions estimates vary widely by the data source and estimation methodology (one-month compliance worksheet, 12-month compliance worksheet, inclusion of assumed fugitive volume sources) which leads to uncertainty and low confidence in emission estimates to accurately represent the M7M's facility operations.

For instance, since the meteorological year of 2019 was used in all MPE scenarios (unless otherwise noted), it would be most relevant to use either monthly emissions estimates for the 12 individual months of 2019 or the 12-month compliance emissions estimate for 2019. In addition, while EPA acknowledges the State's attempt to characterize potentially faulty control equipment by including volume sources to account for some of the high monitored concentrations, there is large uncertainty in estimating the amount of fugitive emissions from these unconventional sources. The State estimated 0.25% and 0.50% of the emissions from the carbon bakes and potlines, respectively, are escaping as fugitive emissions due to ineffective scrubber controls but provides little additional detail as support for these precise estimates. The assumptions in the State's modeling do not capture, for instance, if the fugitive emissions vary in magnitude with the facility operations either temporally or spatially or in their release characteristics. Because of these continued uncertainties, EPA is unable to solely rely on the current modeling record in its evaluation of the New Madrid area of analysis.

2.4.1.7.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, for sources modeled with actual emissions) 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.

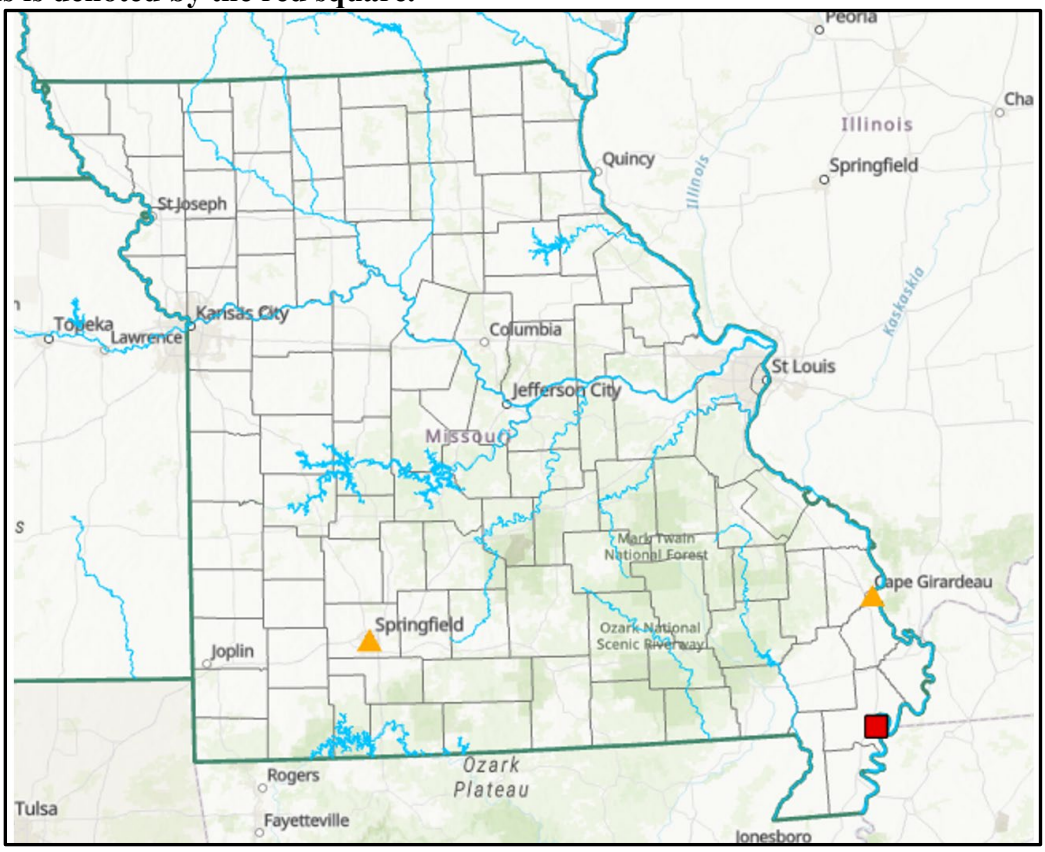
An on-site surface meteorological station is operated at Site #3 (West Entrance), collecting surface temperature and wind speed and wind direction. Site #3 can be seen in Figure 5. The State evaluated the quality of the meteorological data using a June 13, 2019, audit report and found that the anemometer did not meet EPA criteria for regulatory dispersion modeling when recording low wind speeds (< 1.5 m/s).[9] Because of this data quality issue, the State chose not to incorporate the on-site meteorology into its modeling analysis and chose to only evaluate NWS stations near the New Madrid area.

For the area of analysis for the New Madrid County area, the State selected the surface meteorology from the NWS station in Cape Girardeau, Missouri, located at latitude 37.2255, longitude - 89.5786, 79 km to the northeast of the source, along with and coincident upper air observations from the NWS station in Springfield, Missouri, located at latitude 37.24, longitude - 93.39, 209 km to the west of the source, as best representative of meteorological conditions within the area of analysis.

The State used AERSURFACE version 13016 using data from Cape Girardeau, Missouri NWS station to estimate the surface characteristics of the area of analysis. The State estimated surface characteristics at a seasonal temporal resolution. Surface roughness values were estimated for 12 spatial sectors out to 1 km. Surface roughness, also referred to as "Zo", is related to the height of obstacles to the wind flow, which is an important factor in determining the magnitude of mechanical turbulence and the stability of the boundary layer. The State also estimated values for albedo (the fraction of solar energy reflected from the earth back into space) and the Bowen ratio (the method generally used to calculate heat lost or heat gained in a substance) based whether conditions were wet, dry, or average. In Figure 6, generated by EPA, the locations of these NWS stations are shown relative to the area of analysis.

[9] "Audit Report for M7M SO2-MET on 13June2019.pdf" in the docket.

Figure 6. Area of Analysis and the NWS stations in the New Madrid County, Missouri Area. The locations of Cape Girardeau, Missouri (surface) and Springfield, Missouri (upper air) are denoted by orange triangles. The location of the New Madrid Area of Analysis is denoted by the red square.



The 3-year surface wind rose for the Cape Girardeau, Missouri NWS station is shown in Figure 7. In Figure 7, the frequency and magnitude of wind speed and direction are defined in terms of from where the wind is blowing. As shown in Figure 7, the New Madrid County area of analysis experienced winds from all directions throughout the years modeled, with a south-southwest wind being the most predominate wind direction. As previously mentioned, the on-site anemometer did not meet EPA criteria for regulatory dispersion modeling when recording low wind speeds (< 1.5 m/s).[10] However, for additional reference, EPA plotted a 3-year surface wind rose using wind direction data from the on-site meteorological station (Figure 8). While there are some directional component deviations between the on-site and Cape Girardeau, Missouri NWS data, overall, the on-site data shows south winds to predominate, similarly to the NWS data.

[10] For additional information, refer to the audit report in the docket for this designations action.

Figure 7. New Madrid County, Missouri Cumulative Annual Wind Rose for Years 2017 – 2019. Data from the Cape Girardeau, Missouri NWS station.

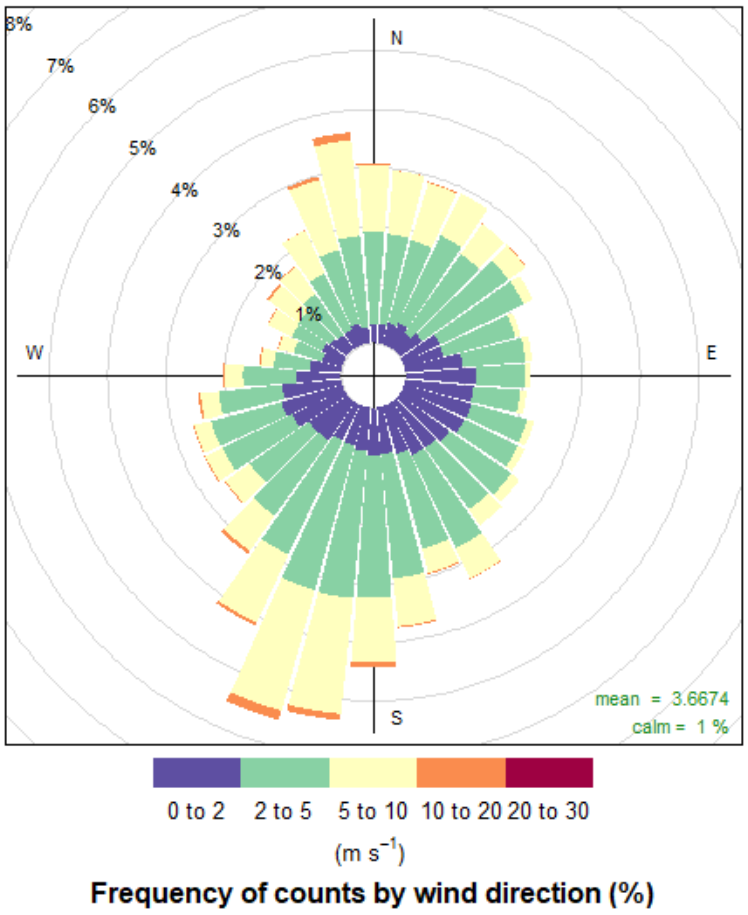
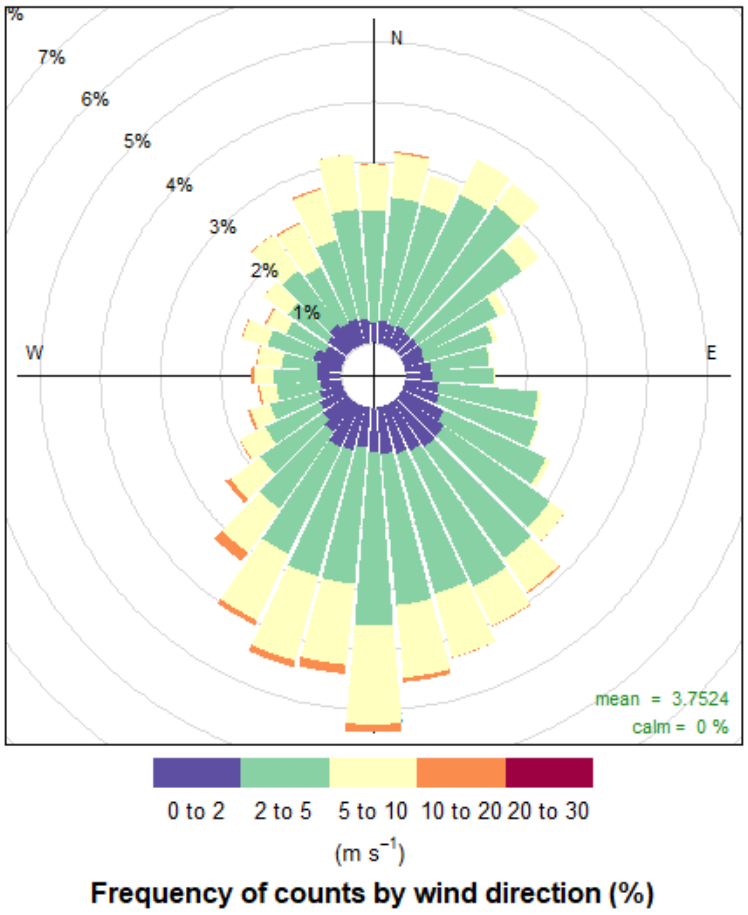


Figure 8. Cumulative Annual Wind Rose for Years 2017 – 2019 using data from the M7M on-site meteorological site.



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 State followed the methodology and settings presented in 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 Cape Girardeau, Missouri NWS station, which is the source of the surface meteorological data, 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. Per the AERMET User's Guide, the State set a minimum threshold of 0.5 meters per second 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.

EPA concludes the processing of meteorological data follows EPA guidance and is representative of meteorological conditions around the AECI New Madrid and M7M facility for purposes of modeling to inform the nonattainment boundary. Our assessment is based on the description and analysis the State provided which indicate the surface and upper air sites chosen were the best available for the State to use given the audit results and data quality issues at the on-site meteorological station. From the wind roses (Figures 7 and 8), EPA concludes hourly impacts will occur in all directions with predominant transport of emissions to the north-northeast based on higher frequency of south-southwest winds.

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

The terrain in the area of analysis is best described as relatively flat. To account for 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. EPA agrees with the State's treatment of terrain within AERMOD and finds it followed established guidance for terrain processing.

2.4.1.9.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 99th percentile monitored concentrations by hour of day and season or month. For this area of analysis, the State chose a tier 1 approach using the 3-year design value from 2016-2018 from the regional rural monitor located at Mark Twain State Park (AQS Site ID: 29-137-0001).[11] The background concentration for this area of analysis was determined by the State to be 13.1 micrograms per cubic meter ($\mu g/m^3$), equivalent to 5 ppb when expressed in two significant figures, and that value was incorporated into the final AERMOD results.

As mentioned in Section 2.4.1.4, the State evaluated other sources of SO_2 within the New Madrid County area of analysis. These seven other sources in New Madrid County each emitted less than 0.5 tons per year of SO_2 in 2016-2018. In its April 30, 2020, submission, the State noted, "Due to the low emissions from these sources, the air program elected to characterize the impact from these small sources through the development of a fixed background concentration to be used in the analysis and added to the SO_2 concentration impact from the two explicitly modeled sources."

[11] The most recent 3-year design value (2017-2019) at the Mark Twain State Park is 4 ppb.

EPA concludes that a background value of 5 ppb from the rural Mark Twain State Park monitor is acceptable for the New Madrid County area since there are no other large SO_2 sources within 40 km of the explicitly modeled AECI New Madrid and M7M facilities. Additionally, EPA agrees that the use of a fixed background concentration to characterize the impacts from the seven smaller sources in the county that were not explicitly modeled is reasonable in this case.

2.4.1.10. Summary of Modeling Inputs and Results

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

Table 5. Summary of AERMOD Modeling Input Parameters for the Area of Analysis for the New Madrid County Area

Input Parameter	Value
AERMOD Version	19191 (regulatory default)
Dispersion Characteristics	Rural
Modeled Sources	2
Modeled Stacks	35
Modeled Structures	77
Modeled Fencelines	2
Total receptors	4,520
Emissions Type	Actual
Emissions Years	2017-2019 CEMS for AECI New Madrid. A 12-month actual emissions estimate from a September 2018 – August 2019 compliance report for the M7M facility.
Meteorology Years	2017-2019
NWS Station for Surface Meteorology	Cape Girardeau, Missouri
NWS Station Upper Air Meteorology	Springfield, Missouri
NWS Station for Calculating Surface Characteristics	Cape Girardeau, Missouri
Methodology for Calculating Background SO_2 Concentration	Tier 1 based on design value, for 2016-2018, at Mark Twain State Park (AQS Site # 29-137-0001
Calculated Background SO_2 Concentration	5 ppb

The results presented below in Table 6 and Figure 9 show the geographic extent of the predicted modeled violations for the 3-year meteorological period of 2017-2019 based on the input parameters associated with MPE Scenario #3.

Table 6. Predicted 99th Percentile Daily Maximum 1-Hour SO_2 Concentration Averaged Over Three Years for the Area of Analysis for the New Madrid County, Missouri Area

		Receptor Location UTM zone 15		99th percentile daily maximum 1-hour SO_2 Design Value Concentration ($\mu g/m^3$)	
Averaging Period	Data Period	UTM	UTM	Modeled Design Value Concentration (including background)	NAAQS Level
99th Percentile 1-Hour Average	2017-2019	807996.20	4046399.30	1,418.68	196.4*

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

Figure 9 was included as part of the State's October 16, 2020, submittal and indicates that the predicted modeled violations are fully contained within the State's recommended nonattainment area boundary. EPA notes, that for MPE Scenario #3, violating receptors are found on the State's recommended southern boundary, and violating receptors occur within less than 100 meters of the northern boundary. In addition, modeled receptors are within 5% of the NAAQS beyond the State's recommended boundary. With the MPE Scenario #3 indicating monitor levels greater than the NAAQS are still underpredicted by the modeling, sometimes by over a factor of two, EPA finds the MPE provides justification for EPA's slightly expanded nonattainment boundary, providing an appropriate degree of confidence in the New Madrid area of analysis.

The State also provided information indicating the extent of violations predicted with MPE Scenario #2 (which was modeling Scenario #2 of the April 30, 2020 submittal) roughly matches EPA's intended nonattainment boundary. The State notes that this Scenario #2 largely overpredicted concentrations when compared with Scenario #6 of the April 30, 2020, submittal. However, EPA finds this indicative of the wide variation of model inputs and assumptions and these results support and provide justification for EPA's slightly expanded nonattainment boundary, given this uncertainty in a precise "modeled" boundary. The results from this scenario are shown in Figure 10. EPA's final nonattainment boundary is presented in Section 2.4.1.11 of this document, after all supporting information is presented.

Figure 9. Predicted 99th Percentile Daily Maximum 1-Hour SO_2 Concentrations greater than the NAAQS (196.4 µg/m3) Averaged Over Three Years for the Area of Analysis for the New Madrid County, Missouri Area. (Based on Scenario #3 Inputs) Image from Missouri's October 16, 2020 submittal.

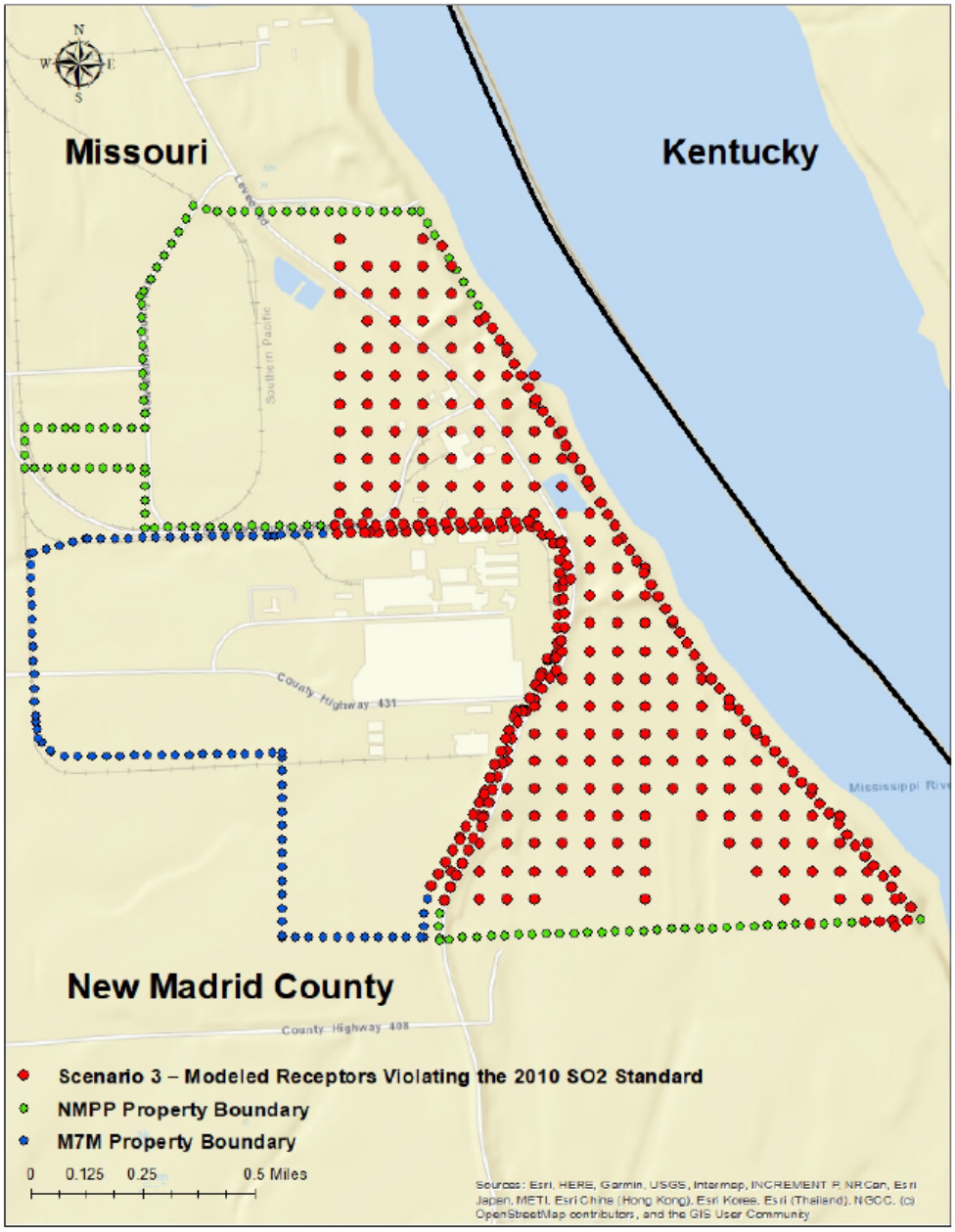
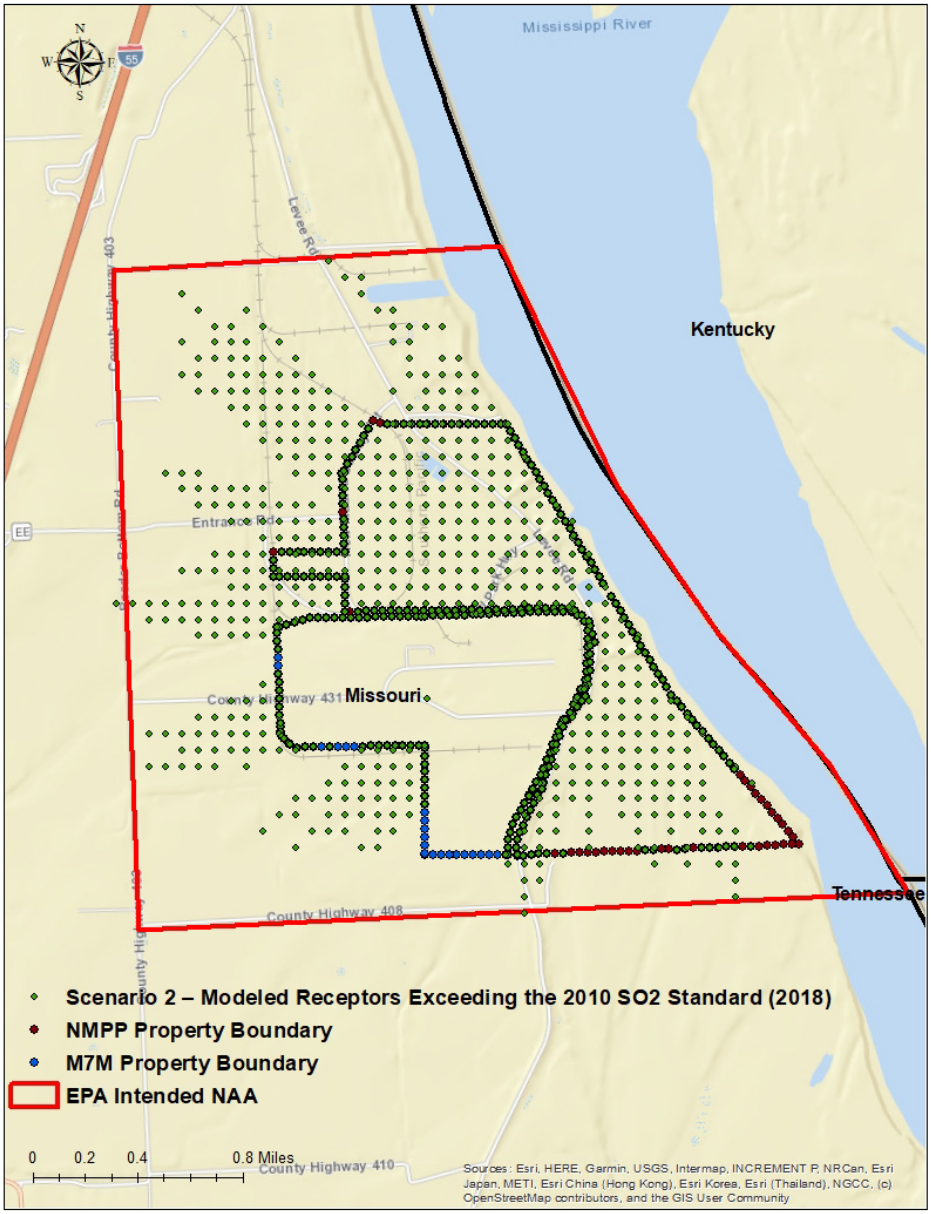


Figure 10. Predicted 99th Percentile Daily Maximum 1-Hour SO_2 Concentrations greater than the NAAQS (196.4 µg/m^3) Averaged Over Three Years for the Area of Analysis for the New Madrid County, Missouri Area (Based on Scenario #2 Inputs) Image from Missouri's October 16, 2020 submittal.



The modeling submitted by the State indicates that the 2010 1-hour SO_2 NAAQS is violated at the receptor with the highest modeled concentration, among others. The modeling results also include 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. When evaluating the suite of modeling scenarios, the modeled violations are located beyond the north, south and east fenceline of the M7M facility (Figure 9), and to the west and can extend up to 0.8 km beyond the M7M fenceline (Figure 10). Modeled violations occur up to the edge of the modeled receptor grid which ends at the bank of the Mississippi River.

2.4.1.11. EPA's Assessment of the Modeling Information Provided by the State

In its October 16, 2020, submittal, the State provided an MPE of three modeling scenarios with differing emission estimation methodology and/or data sources. The purpose of this MPE was to support the State's recommended boundary from its April 30, 2020 submittal. For all MPE scenarios, the State used the evaluation metrics of fractional bias, robust highest concentration, design value test, along with evaluating q-q plots to determine the adequacy of AERMOD to represent the current operations at M7M. The State deemed that the MPE Scenario #1 performed adequately enough at monitor Site #1 and Site #3 (while acknowledging poorer performance at Site #2) and this supports the modeling demonstration the State relied on in its boundary recommendation submitted to EPA on April 30, 2020. To address the model performance at Site #2, the State added volume sources to characterize suspected fugitive emission releases from the two fluoride scrubbers controlling emissions at the potlines and carbon bakes (MPE model Scenario #3). This improved the model performance metrics used by the State at Site #2. The State then modeled for the entire 2017-2019 time period using the same source inputs as MPE Scenario #3 and the results from that modeling showed violations were contained within the State's recommended boundary, although violations occurred on the boundary edge on portions of the southern boundary.

While EPA appreciates the State's efforts to evaluate AERMOD for actual operations of SO_2 emitting sources in the New Madrid County area of analysis, for the reasons outlined below, EPA cannot solely rely on the State's modeling submittal in establishing the nonattainment boundary in New Madrid County.

- EPA notes that the MPE metrics evaluate the highest (tail end) of the modeled and monitored concentrations. The q-q plots show that there are many occurrences in MPE Scenario #1 and MPE Scenario #3 where the model underpredicts monitored values much greater than the NAAQS at both Site #1 and Site #2. EPA notes that all monitored and modeled values above the NAAQS should be examined and considered for purposes of designations, not just the values on the tail end (high) distribution.
- Additionally, the MPE for Scenario #1 and Scenario #3 use emissions from a 12-month period covering September 2018 through August 2019, while using meteorological and monitor data from the entirety of 2019. Ideally, a model performance using emission estimates for the entirety of 2019 would have been included in the MPE to have a dataset based on concurrent emissions, meteorology, and monitoring data.
- With the monitored violations located within 0.25 km of the Mississippi River, as noted in the intended designations TSD, EPA determined modeled receptors needed to be placed on the Missouri portion of the Mississippi River that resides in New Madrid County. The lack of model receptors outside the State's recommended boundary leads to uncertainty in identifying the actual extent of violations.
- Lastly, the uncertainty in the estimation and characterization of the fugitive emissions at the fluoride scrubbers makes it difficult for EPA to rely on the MPE Scenario #3 and the subsequent 3-year modeling that used similar modeling inputs for the sole basis of establishing a nonattainment boundary. Specifically, as noted in the State's October 16, 2020, submittal, a recent site visit to M7M revealed that the fluoride scrubber systems for the potlines and carbon bakes are in disrepair and are likely failing to contain the process

gas and direct it to the stack(s). As noted earlier, there is considerable uncertainty in the quantification of these fugitive emissions as well as in characterizing the spatial and temporal variability of the emissions.

EPA agreed with the State that the likely primary cause of the monitored violations is due to low-height emissions releases (i.e., relatively short carbon bake stacks and possibly some fugitive emissions from failing control equipment), and that emissions from AECI New Madrid contribute to the violations. However, no reliable information was available to conclusively determine the full geographic extent of NAAQS violations in the area.

For these reasons, and with the additional consideration that the area has monitored 1-hour SO_2 concentrations greater than six times the level of the 2010 SO_2 NAAQS in 2018 and 2019, EPA was unable to rely solely on the State's modeling as a basis to establish the geographic extent of EPA's final nonattainment area boundary and, therefore, EPA's final boundary expands on the State's recommended boundary.[12] EPA finds that extending the nonattainment boundary provides a more representative area to capture the likely SO_2 impacts from AECI New Madrid and M7M within New Madrid County.

In its October 16, 2020, submittal, Missouri asserts that EPA partially relied on a recommendation from Appendix W to inform the intended nonattainment boundary. Specifically, the statement that magnitudes of concentration gradients will generally be greatest between the source and a distance 10x the stack height. The State suggests EPA look only at the stack height at M7M rather than AECI New Madrid when considering this recommendation. EPA is aware of this recommendation from Appendix W. However, EPA did not explicitly consider this recommendation when developing the intended nonattainment boundary.

2.5. Emissions and Emissions-Related Data, Meteorology, Geography, and Topography for the New Madrid County, Missouri Area

These factors have been incorporated into the air quality modeling efforts and results discussed above. 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.

2.6. Jurisdictional Boundaries in the New Madrid County, Missouri Area

EPA considers existing jurisdictional boundaries for the purposes of providing a clearly defined legal boundary for carrying out the air quality planning and enforcement functions for the area. Our goal is to base designations on clearly defined legal boundaries that align with existing administrative boundaries when reasonable. Existing jurisdictional boundaries used to define a

[12] EPA's assessment of the modeling for the New Madrid County area to inform our nonattainment boundary for 2010 SO_2 NAAQS designations does not imply that the modeling is appropriate for other purposes, such as new source review (NSR), interstate transport, or state implementation plan (SIP) demonstrations.

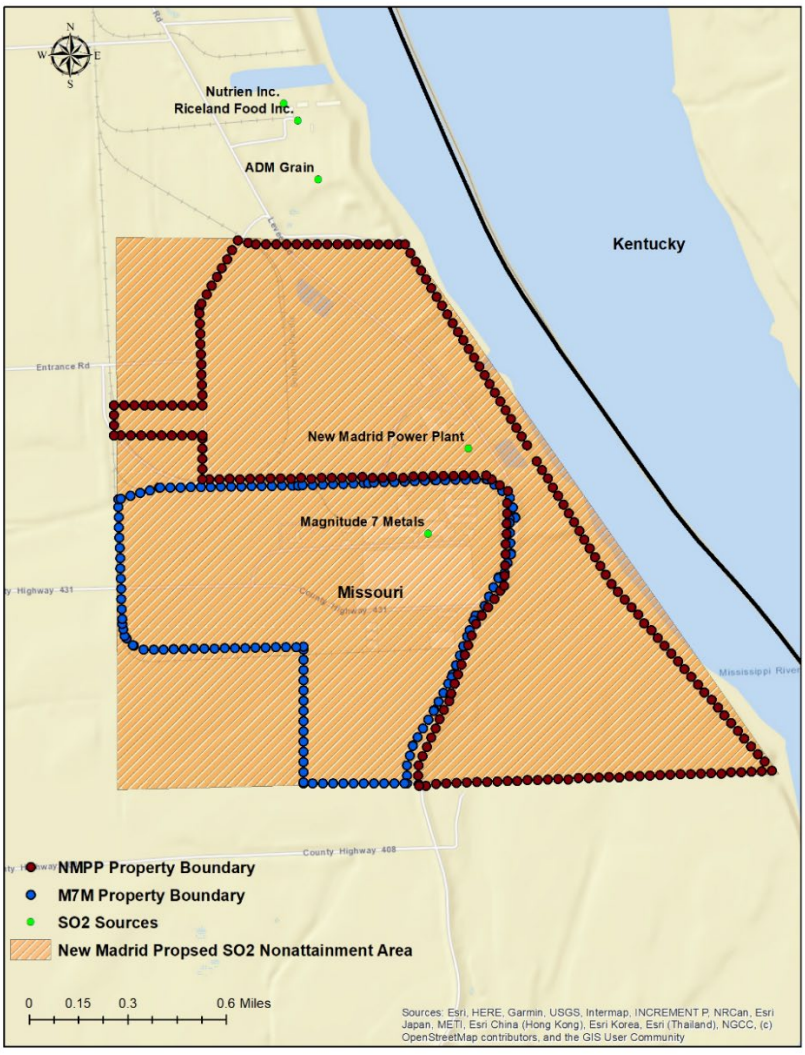
nonattainment area must encompass the area that has been identified as meeting the nonattainment definition.

The State's recommended nonattainment boundary for New Madrid County was designed from geographical coordinates. The State's recommended boundary is shown in Figure 11, and consists of:

- the Mississippi river on the east and the lines connecting the following coordinates: Zone 16 Universal Transverse Mercator (UTM) coordinates: (272016.6E, 4042423.62N), (268791.92E, 4042564.43N), (268957.29E, 4045213.47N), and (270362.07E, 4045125.75N).

The State's boundary encompasses a constructed polygon based on the property lines of AECI New Madrid and M7M. It extends approximately 1 km in the north-south direction and 1.5 km in the east-west direction.

Figure 11. Missouri's recommended nonattainment boundary for the New Madrid County Area of Analysis. Image courtesy of Missouri.



2.7. Other Information Relevant to the Designation of the New Madrid County, Missouri Area

EPA received comments from Sierra Club regarding the intended designation for the New Madrid County, Missouri area. These comments are addressed in the Response to Comment (RTC) document associated with this final action.

2.8. EPA's Assessment of the Available Information for the New Madrid County, Missouri Area

Two individual monitors in the New Madrid County area are violating the NAAQS based on the 2017-2019 design values. Missouri submitted air dispersion modeling to assess the extent of the NAAQS violations and to establish a recommended nonattainment boundary.

The State's recommended nonattainment boundary was based on the extent of modeled violations of the 2010 1-hour SO_2 NAAQS. The State developed modeling scenarios that used available information that represented the actual operations at AECI New Madrid and M7M. In EPA's intended designations TSD, we noted that due to uncertainties in the source characterization and emissions estimates along with the lack of receptors over the Mississippi River, EPA was unable to solely rely on the State's modeling to determine the geographic extent of violations to inform the nonattainment boundary.

In response to EPA's intended designations, the State provided a detailed model performance evaluation using the monitor data from the three sites located within the New Madrid County area of analysis and updated modeling to account for likely fugitive emissions associated with existing control devices. As described in earlier sections of this document, there are remaining uncertainties and difficulties associated with representing a facility like M7M in AERMOD and there are additional uncertainties introduced in the State's October 16, 2020, analysis related to the likely fugitive emissions escaping from the Flouride scrubber control systems and the characterization of those fugitive emissions. For these reasons and the reasons described in Section 2.4.1.11, EPA is unable to rely solely on the extent of the modeled violations that was used by the State to establish its recommended nonattainment boundary to inform EPA's final nonattainment boundary.

EPA acknowledges the efforts the State has put into evaluating the application of the AERMOD modeling system for this difficult to characterize source and in providing the MPE for characterization of M7M and AECI. EPA understands this work is important in better understanding the M7M facility impacts, and EPA does agree that the model performance improves with the modifications (*i.e.*, inclusion of fugitive emissions) and assumptions (*i.e.*, carbon bake stack characterization) the State has incorporated into the modeling. In particular, the fugitive emissions characterization assumption does seem to hold merit in this situation as described by the State, although there is still uncertainty in what emissions are actually occuring in terms of overall magnitude and temporal variability. Given the continued uncertainty in the emissions profile and characterization of emissions for this source, EPA continues to find a

slightly expanded boundary as proposed with our intended designations is appropriate. We are establishing this boundary by considering many factors, most notably monitoring data that indicates a large concentration gradient over short distances, modeling the State has submitted with fugitive emissions assumptions and associated performance evaluations, and known stack release characteristics from both AECI and M7M. These factors when considered together support a nonattainment boundary extent clearly smaller than the starting point of the full county, but larger than a boundary defined solely with modeling given the uncertainties discussed above. This slightly larger boundary offers an appropriate degree of confidence that the area of nonattainment has been captured, while not being so conservative that an unnecessarily large nonattainment boundary is selected. EPA finds the additional modeling the State has provided further justifies our final boundary and offers additional information on why a larger or smaller boundary than EPA selected is not warranted based on the current record.

EPA's nonattainment boundary includes the two principal SO_2 sources that contribute to SO_2 violations in New Madrid County. EPA's nonattainment boundary extends 2 km to 3 km to the north, west and south of the main emissions points at AECI New Madrid and M7M. Given that there is uncertainty in the geographic extent of the current NAAQS violations, EPA's boundary provides a high degree of confidence that it encompasses the area of New Madrid County where violations of the NAAQS are likely to occur. EPA's final nonattainment area is bounded by:

- East: Missouri/ Kentucky and Missouri/Tennessee State lines.
- North: County Highway 406 East to Levee Road, following Levee Road North to County Highway 406, then extending directly East to the Missouri/Kentucky State line.
- West: County Highway 403
- South: County Highway 408 East to the intersection with County Highway 431, then extending directly East to the Missouri/Tennessee State line

This area has clearly defined legal boundaries, and we find these boundaries to be a suitable basis for defining our final nonattainment area. EPA finds this nonattainment area captures the extent of NAAQS violations in the undesignated area and the sources causing them, the M7M and AECI New Madrid facilities.[13]

EPA has no evidence to suggest that violations are occurring in the remainder of New Madrid County or that there are sources outside the nonattainment area that are contributing to the violations in the nonattainment area. Specifically, the remainder of New Madrid County does not

[13] While there are three additional permitted SO_2 sources located inside EPA's final nonattainment boundary, EPA does not have evidence that these sources are contributing to the observed violations. Rather, for the reasons explained in this document, EPA expanded the nonattainment boundary to capture the full extent of violations in the undesignated area and the sources causing them, the M7M and AECI New Madrid facilities. These smaller sources are not included in the nonattainment area because they are necessarily contributing to the violations of the 2010 SO_2 NAAQS but rather the NAAQS violations themselves are likely occuring in the area of those sources. As discussed in Chapter 1 of this TSD, 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.

contain any sources that emitted greater than 0.5 tons per year of SO_2 in 2016-2018. For these reasons, EPA is designating the remainder of New Madrid County as attainment/unclassifiable.

2.9. Summary of EPA's Final Designation for the New Madrid County, Missouri Area

After careful evaluation of the State's recommendation and supporting information provided to EPA on April 30, 2020 and on October 16, 2020, as well as all timely available relevant information, EPA is designating a portion of New Madrid County, Missouri as nonattainment for the 2010 SO_2 NAAQS. Specifically, the boundaries are defined as the area bounded by:

- East: Missouri/ Kentucky and Missouri/Tennessee State lines.
- North: County Highway 406 East to Levee Road, following Levee Road North to County Highway 406, then extending directly East to the Missouri/Kentucky State line.
- West: County Highway 403
- South: County Highway 408 East to the intersection with County Highway 431, then extending directly East to the Missouri/Tennessee State line

Additionally, EPA is designating the remainder of New Madrid County, Missouri as attainment/unclassifiable.

Figure 12 shows the boundary of this final designated area and Figure 13 provides a more focused graphic of the final nonattainment area around AECI New Madrid and M7M compared with the State's recommended boundary.

Figure 12. Boundary of the New Madrid County, Missouri Final Nonattainment Area and Attainment/Unclassifiable Area

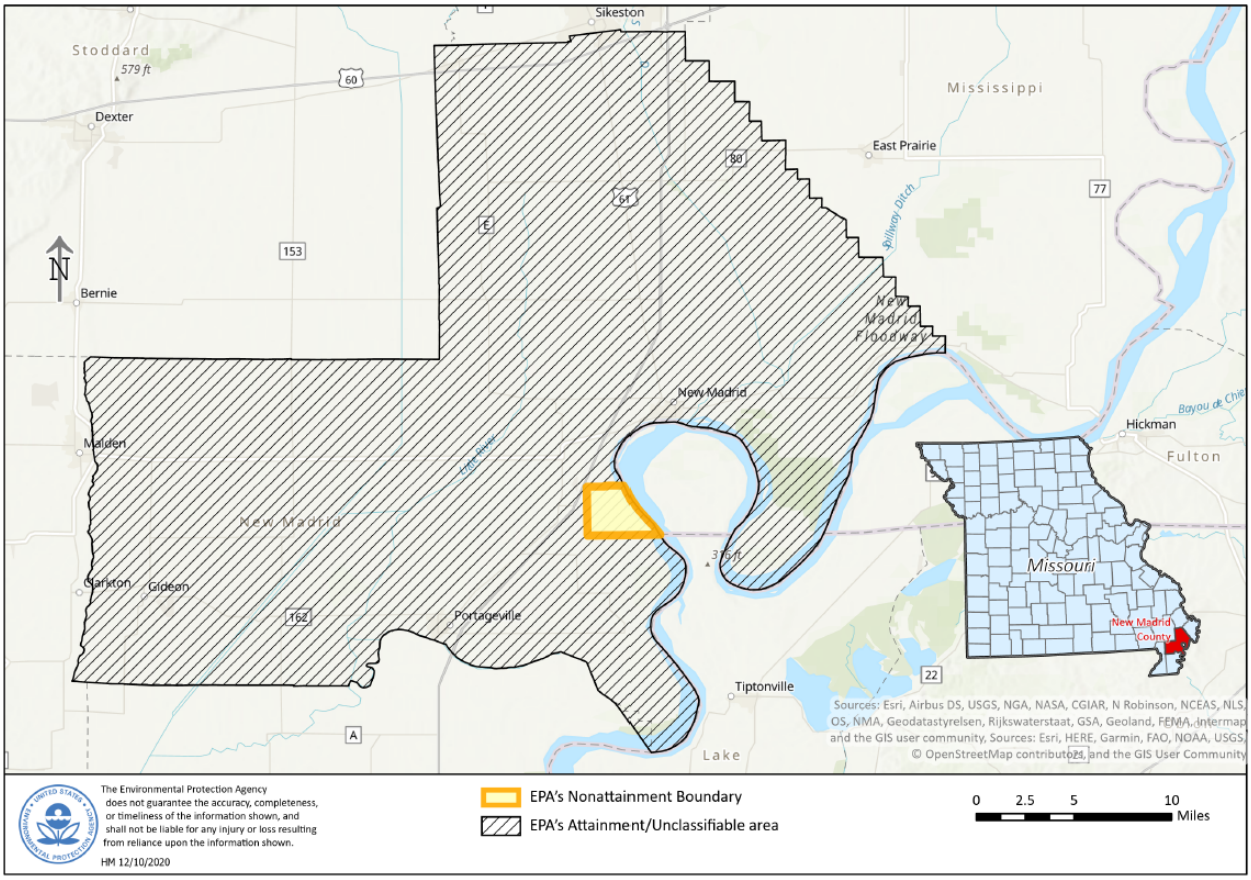


Figure 13. Boundary of the New Madrid County, Missouri Nonattainment Area. EPA's final nonattainment boundary is shown with the larger, orange polygon and the State's recommended nonattainment boundary is shown with the smaller, green polygon.