Technical Support Document:

Chapter 8
Intended Round 3 Area Designations for the 2010 1-Hour SO_2 Primary National Ambient Air Quality Standard for Connecticut

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 (SO_2) 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 the 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 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 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 all remaining undesignated areas in Connecticut for the 2010 SO_2 NAAQS. In previous final actions, the EPA has issued

[1] 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.

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 began timely operation of a new SO_2 monitoring network meeting EPA specifications referenced in EPA's SO_2 Data Requirements Rule (DRR). (80 FR 51052). The EPA is required to designate those remaining undesignated areas by December 31, 2020.

Connecticut submitted its first recommendation of "unclassifiable" statewide regarding designations for the 2010 1-hour SO_2 NAAQS on June 13, 2011. The state submitted an updated recommendation of "attainment" statewide with supporting air quality analyses on March 14, 2013. The state submitted an updated air quality analysis on December 8, 2016. 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 completely replaces an earlier recommendation for that area we have considered the recommendation in the later submission.

For the areas in Connecticut 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 Connecticut'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. Following the completion of these Round 3 designations, there will be no remaining undesignated areas in Connecticut to be addressed.

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

Area/County	Connecticut's Recommended Area Definition	Connecticut's Recommended Designation	EPA's Intended Area Definition	EPA's Intended Designation
Entire State of Connecticut	Entire State of Connecticut	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).

[*] The EPA intends to designate the entire state of Connecticut as "unclassifiable/attainment" based on modeling analyses submitted by Connecticut for all in-state sources with annual emissions greater than 100 tons. Justification for individual areas within the state of Connecticut is discussed in sections 3 through 6 of this TSD.

There are no areas for which Connecticut elected to install and began operation of a new, approved SO_2 monitoring network. The EPA is required to designate such areas, pursuant to a court ordered schedule, by December 31, 2020.

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. No areas in Connecticut were previously designated in Round 1 or Round 2.

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 SO_2 Primary National Ambient Air Quality Standard) and Chapter 2 (Intended Round 3 Area Designations for the 2010 1-Hour SO_2 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 EPA specifications

[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.

referenced in EPA's" SO_2 DRR. The EPA will therefore designate by December 31, 2017, areas of the country that are not, pursuant to the DRR, timely operating EPA-approved and valid monitoring networks. The areas to be designated by December 31, 2017, include the area associated with one source in Connecticut subject to the DRR that Connecticut has chosen to characterize using air dispersion modeling, and other areas not specifically required to be characterized by the state 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 6.

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 ppb, based on the 3-year average of the 99th 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) 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 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 Fairfield County Area

3.1. Introduction

The EPA must designate the Fairfield County, Connecticut, area by December 31, 2017, because the area has not been previously designated and Connecticut has not installed and begun timely operation of a new, approved SO_2 monitoring network to characterize air quality in the vicinity of any source in Fairfield County. Connecticut submitted three modeling analyses of Fairfield County, two in March 2013 to support the state's requested recommendation for attainment, and one in December 2016 for the state's one DRR source, Bridgeport Harbor Station. The March 2013 analyses included sources in both Fairfield and New Haven Counties. The discussion in this section describes the state's 2013 analysis only insofar as it relates to and supports the designation for Fairfield County. A later section will describe the same analysis as it relates and supports the designation for New Haven County. The December 2016 modeling analysis for Bridgeport Harbor Station is an update to one of the March 2013 analyses. As such, the EPA considers the newer analysis to supersede the older analysis for that source because it is most representative of current air quality. The March 2013 modeling analysis for Norwalk Power and the December 2016 modeling analysis for Bridgeport Harbor Station are each presented separately in the sections that follow. Then, the discussion later in this TSD will consider the aggregation of these results and explain how they relate to the intended designation for Fairfield County.

To its west, Fairfield County, Connecticut, borders Dutchess, Putnam, and Westchester Counties, New York. Furthermore, Fairfield County, Connecticut, is separated from Suffolk and Nassau Counties, New York, to the south by Long Island Sound.

3.2. Air Quality Monitoring Data for the Fairfield County Area

This factor considers the SO_2 air quality monitoring data in the area of Fairfield, Connecticut. The state included monitoring data from the following monitor:

- Air Quality System monitor 09-001-0012. This Edison School monitor is located at 115 Boston Terrace, Bridgeport, Connecticut, in Fairfield County, and is approximately 3.2 km to the northeast of Bridgeport Harbor Station. Data collected at this monitor indicates that the monitored SO_2 Design Value for the period from 2014 to 2016 is 6 parts per billion (ppb; equivalent to 15.7 micrograms per cubic meter, $\mu g/m^3$). The state intended all available data collected at this monitor to support and corroborate air dispersion modeling results; the discussion of these modeled results follows immediately below.

The EPA agrees that the Edison School monitor is the most representative source of available background SO_2 data for input into the air quality modeling. The EPA has no information indicating whether the Edison School monitor is located in the area of expected maximum SO_2 impacts for this area. The EPA has confirmed that there are no additional relevant data in the Air Quality System (AQS). For reference, see the annual air quality Design Values for SO_2 posted at

our Air Quality Design Values website, https://www.epa.gov/air-trends/air-quality-design-values.

3.3. Air Quality Modeling Analysis for the Fairfield County Area Addressing Bridgeport Harbor Station

3.3.1. Introduction

This section presents all the available air quality modeling information for a portion of Fairfield County that includes Bridgeport Harbor Station (Bridgeport Harbor). (This portion of Fairfield County will often be referred to as "the Bridgeport Harbor area" within this section). This area contains Bridgeport Harbor, the source around which Connecticut 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 tons per year. The Bridgeport Harbor facility does not emit 2,000 tons or more annually, but was added to the SO_2 DRR Source list by agreement between the EPA and the state.

In its March 2013 submission, Connecticut recommended that the entire state be designated attainment based on modeling analyses and Connecticut ambient monitoring data trends for SO_2. The modeling analyses included two sources, Bridgeport Harbor and Norwalk Power LLC (Norwalk Power), in Fairfield County. Connecticut submitted an assessment and characterization that relies principally on air quality modeling on December 8, 2016, for the area around Bridgeport Harbor to satisfy the requirements of the DRR. The EPA considers the December 2016 modeling to be more representative of current air quality than the March 2013 modeling for Bridgeport Harbor. Both the March 2013 and December 2016 assessments and characterizations were performed using air dispersion modeling software, i.e., AERMOD, analyzing actual emissions. The analysis of Norwalk Power will be addressed separately in a later section and considered in aggregation as they relate to the EPA's intended designation for Fairfield County. After careful review of the state's assessments, supporting documentation, and all available data, the EPA agrees with the state's recommendation for the area and intends to designate the area as unclassifiable/attainment. The EPA intends to include this unclassifiable/attainment area as part of the EPA's intended statewide unclassifiable/attainment area, as discussed in Section 7. Our reasoning for this conclusion is explained in a later section of this TSD, after all the available information is presented.

The area the state has assessed in December 2016 via air quality modeling is located in southeastern Fairfield County, including Bridgeport, Fairfield, Trumbull, and Stratford; and also in a small portion of Milford in New Haven County.

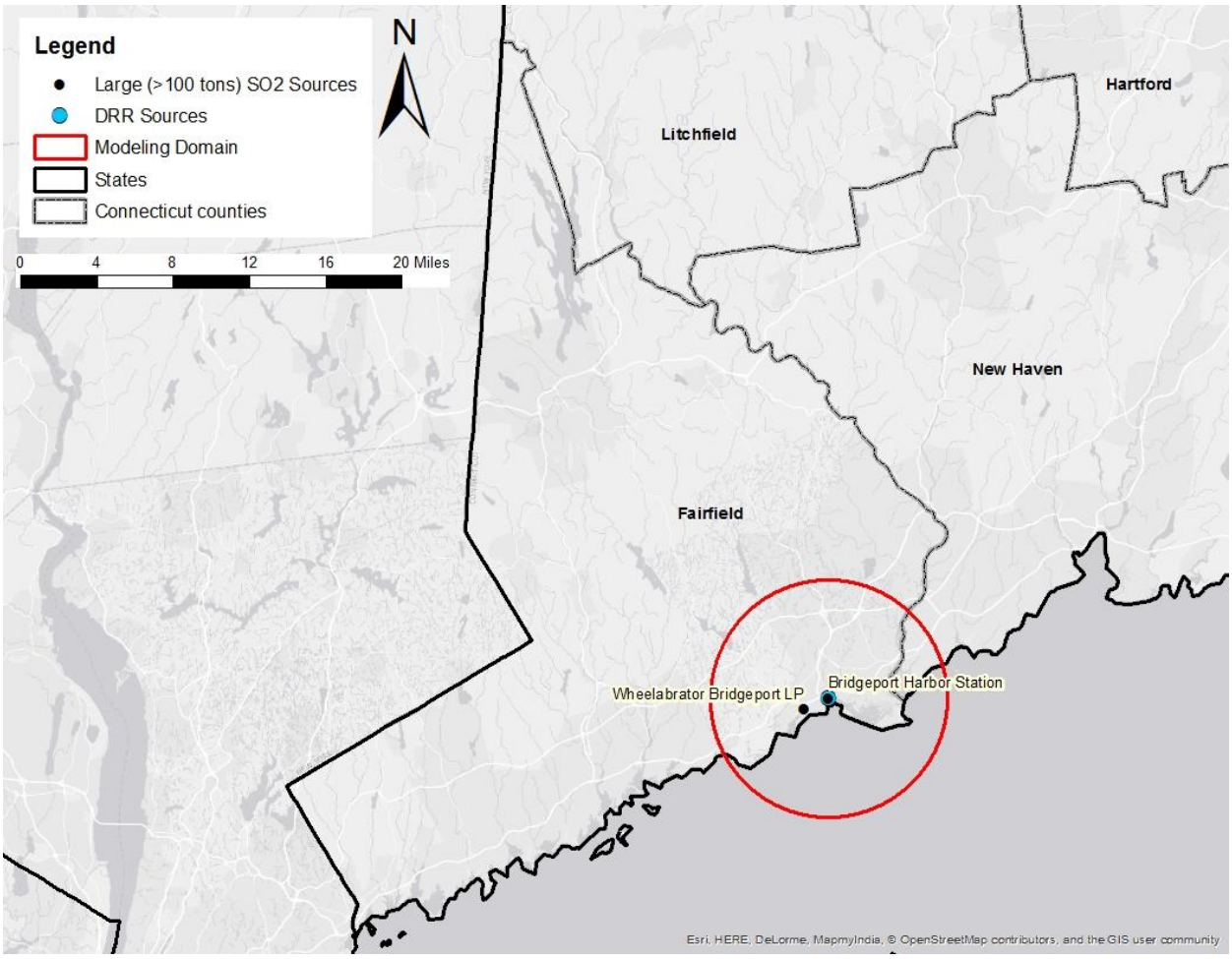
As seen in Figure 1 below, the Bridgeport Harbor facility is located near downtown Bridgeport at the inlet of the Pequannock River from the Bridgeport Harbor waterbody.[5] The Norwalk Power facility has shut down since the March 2013 modeling was conducted, so the location of the

[5] To avoid confusion between Bridgeport Harbor Station and the Bridgeport Harbor waterbody, the latter is always referred to in this TSD using the word "waterbody."

source is not indicated in Figure 1. Also included in the figure is one other nearby emitter of SO_2, which is Wheelabrator Bridgeport LP in Bridgeport, Connecticut.[6]

The state's 2013 recommended area for the attainment designation is statewide. The EPA's intended statewide unclassifiable/attainment designation boundary is not shown in Figure 1, but is shown in Figure 25 in Section 7 below, which summarizes our intended designation.

Figure 1. Map of the Fairfield County, Connecticut Area Addressing Bridgeport Harbor Station



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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.

[6] The one other SO_2 emitter of 100 tpy or more (based on information in the EPA's 2014 National Emissions Inventory version 1) is shown in Figure 1. There are no additional SO_2 emitters above this emission level in the vicinity of the named source.

3.3.2. Modeling Analysis Provided by the State

3.3.2.1. 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, the most up-to-date version at the time of submittal, 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 state's approach to the individual components is provided in the corresponding discussion that follows, as appropriate.

3.3.2.2. 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.

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 urban mode. The state conducted a land-use analysis for the 3 km area around the modeled source, consistent with Section 7.2.3 of the *Guideline on Air Quality Models*. The analysis showed 48% urban and 52% rural. However, due to the close proximity to Long Island Sound, an industrialized zone, and a major interstate highway system, the state characterized the area as urban. The state included the population of several urban centers across the modeling domain for a total population of 308,000.

Given the roughly even split between urban and rural land use based on the state's analysis, and the reasoning presented above regarding the characteristics of nearby features, the EPA agrees with Connecticut's selection of urban dispersion characteristics. Use of rural dispersion characteristics is likely to result in lower near-field impacts, so the use of urban dispersion characteristics for this site is likely a more conservative (i.e., unlikely to underpredict concentrations) modeling assumption.

3.3.2.3. 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 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 source of SO_2 emissions subject to the DRR in this area is described in the introduction to this section. For the Bridgeport Harbor area, the state did not include any other emitters of SO_2 in the December 2016 modeling domain around Bridgeport Harbor. The state determined that it was most appropriate to represent other sources of SO_2 in the monitored background to adequately characterize air quality through modeling to include the potential extent of any SO_2 NAAQS exceedances in the area of analysis. The EPA agrees with the state that the Bridgeport levels observed at the Edison monitor are appropriate for representing nearby sources in the monitored background level because the only non-DRR source with emissions greater than 100 tons per year in the area is upwind from the monitor.

The receptor placement for the area of analysis selected by the state is a nested Cartesian grid, as follows:

- 50-meter fence-line spacing around the property boundary
- 50-meter spacing from the fence-line to 500 meters from the fence-line
- a 4,800 meter by 5,000-meter area with 100-meter spacing centered over the facility
- an 11 km by 11 km area with 250-meter spacing centered over the facility
- a circular area with radius approximately 10 km centered on the facility with 500-meter spacing

The receptor network contained 5,593 receptors, and the network covered the southeastern portion of Fairfield County and a small portion in the west of New Haven County, as well as a portion of Long Island Sound. The extent of the modeling domain was consistent with neither the modeling protocol nor modeling report, which indicated that receptors would also be placed at 1 km resolution to a distance of 20 to 30 km from the source. The Modeling TAD indicates that the distance between the source and its maximum ground level concentration is generally 10 times the stack height in flat terrain. In this case, the distance would be around 1.5 km based on the 152 meter stack height. The modeled domain far exceeds this distance; therefore, the EPA believes that the modeling domain is sufficient to identify maximum impacts from Bridgeport Harbor within the area.

Figures 2 and 3, generated by the EPA based on modeling files submitted by the state, show the state's chosen area of analysis surrounding Bridgeport Harbor, 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 the modeled

facility. The state excluded receptors from locations on the facility property within the fenceline. The EPA reviewed aerial imagery to confirm that public access is precluded through physical barriers for such locations. The state opted to apply a regular grid of receptors without excluding receptor locations over water bodies, though Section 4.2 of the Modeling TAD allows removal of receptors in such locations.

Figure 2. Area of Analysis for the Bridgeport Harbor Area

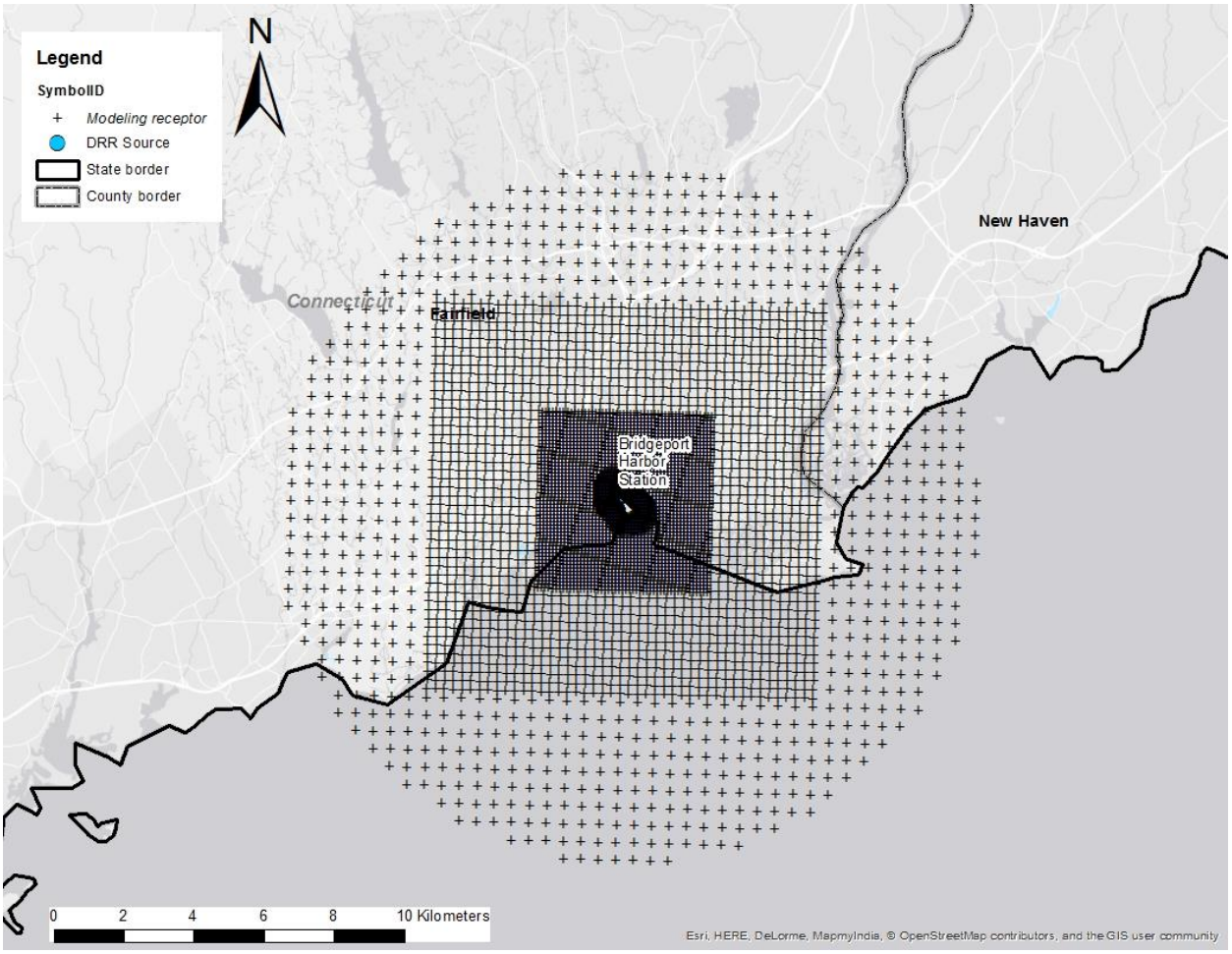

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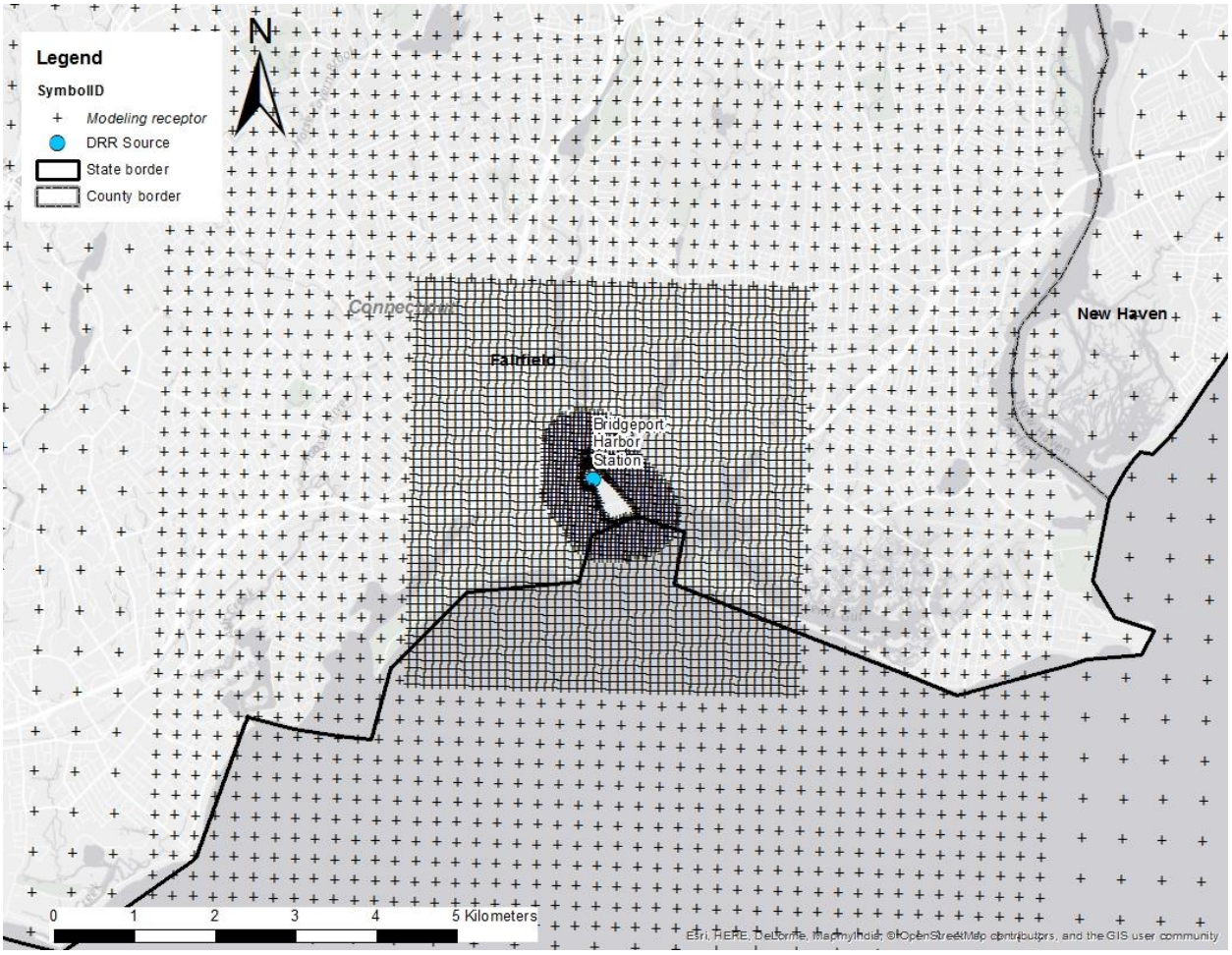
Figure 3. Near-field Receptor Grid for the Bridgeport Harbor Area



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The EPA finds that the modeling domain and placement of receptors are appropriate for adequately characterizing the area around Bridgeport Harbor.

3.3.2.4. 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 state explicitly included Bridgeport Harbor for modeling to address the requirement under the DRR to characterize air quality around all listed sources. Other sources in or near the area are adequately characterized by the monitored background levels included in the modeling. The EPA agrees with this assumption because there are no other DRR sources within the area and the only other source greater than 100 tons per year is upwind of the monitor location.

The state characterized this source within the area of analysis in accordance with the best practices outlined in the Modeling TAD. Specifically, the state used actual stack heights in conjunction with actual emissions. The source's building was not characterized because the actual stack height is in excess of good engineering practice height, and therefore, the structure is not expected to contribute to excessive ground-level concentrations through a building downwash effect. The EPA examined aerial imagery for this facility to confirm the conclusion that downwash is not expected to contribute to excessive ground-level concentrations. This topic is discussed further at the end of this section. The state adequately characterized the source's stack parameters, e.g., exit temperature, exit velocity, location, and diameter.

Based on comparisons between the modeling source characterization against publicly available information in permits, maps, and stack test data, the EPA concludes that the source characterization is appropriate.

3.3.2.5. 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 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, 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 state included Bridgeport Harbor in the area of analysis. The state has chosen to model this facility using actual emissions. The state provided annual actual SO_2

emissions between 2013 and 2015. This information is summarized in Table 2. A description of how the state obtained hourly emission rates is given below this table.

Table 2. Actual SO_2 Emissions Between 2013 – 2015 from Facilities in the Bridgeport Harbor Area

Facility Name	SO_2 Emissions (tpy)		
	2013	2014	2015
Bridgeport Harbor	782	922	707
Total Emissions from All Modeled Facilities in the State's Area of Analysis	782	922	707

For Bridgeport Harbor Unit 3, the actual hourly emissions data were obtained from continuous emissions monitoring systems (CEMS), and retrieved variable stack exhaust flow data from the EPA's Clean Air Markets Database (CAMD). The EPA has confirmed that the hourly varying emissions and annual emissions reported by the state align. The state used a uniform stack exhaust temperature for all hours because variable stack temperature data were not available. The state excluded emissions from Norwalk Power for January through March 2013, while the facility was still operating. Norwalk Power facility ceased operation in 2013, and this was made federally enforceable through the revocation of the facility's Title V operating permit on November 27, 2013.

Based on the available evidence, the EPA concurs with Connecticut in its selections of emissions parameters and emissions rates for the source included in the modeling.

3.3.2.6. Modeling Parameter: Meteorology and Surface Characteristics

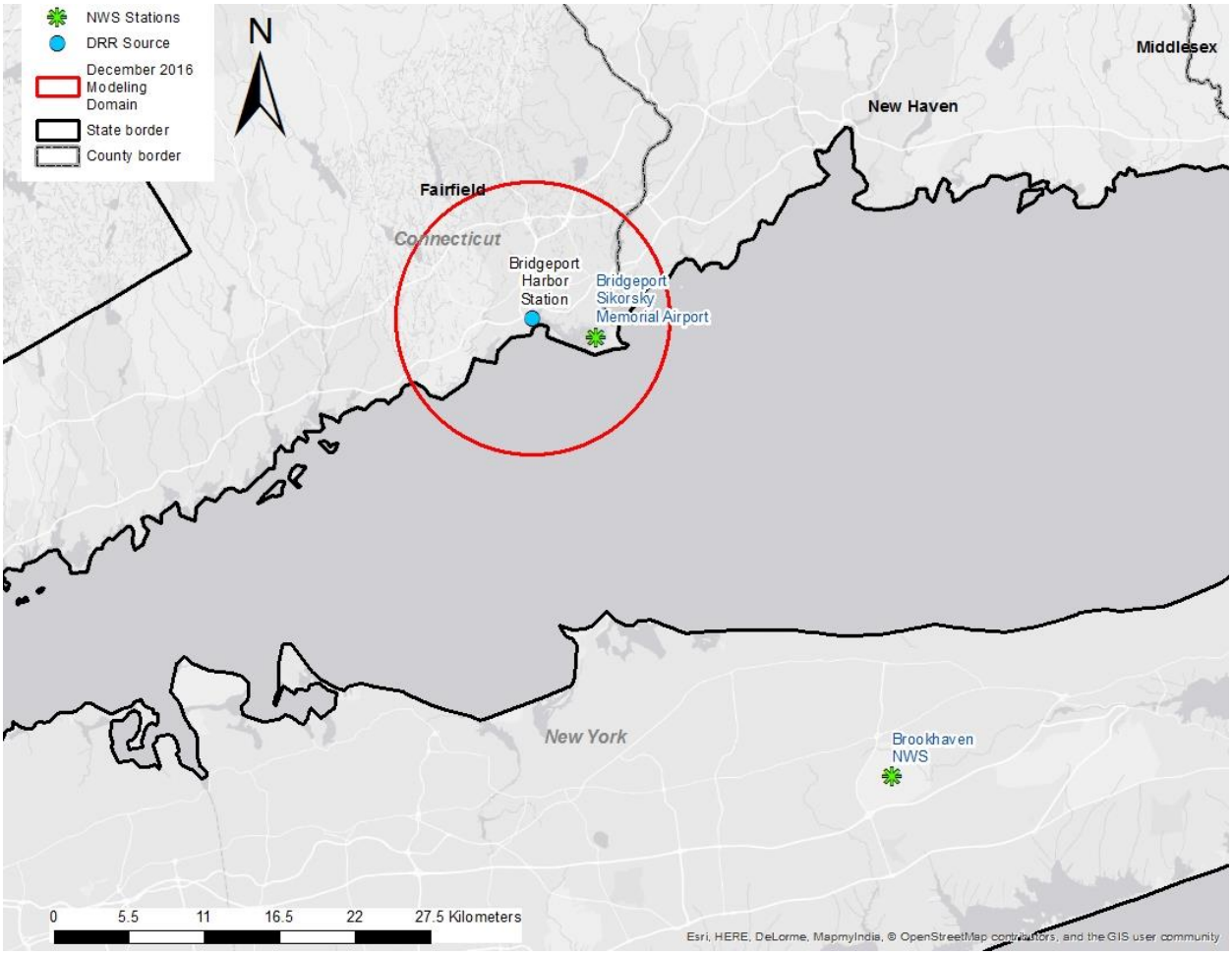
As noted in the Modeling TAD, the most recent 3 years of meteorological data (concurrent with the most recent 3 years of emissions data) should be used in designations efforts. The selection of data should be based on spatial and climatological (temporal) representativeness. The representativeness of 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 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 Bridgeport Harbor area, the state selected the surface meteorology from the NWS Automated Surface Observing Systems (ASOS) station at Sikorsky Airport in Stanford, Connecticut, 5.0 km to the east-northeast of the source, and coincident upper air observations from a different NWS station located in Brookhaven, New York, around 42 km to the southeast of the source, as best representative of meteorological conditions within the area of analysis.

The state used AERSURFACE version 13016 using land cover data from the 1992 National Land Cover Dataset representative of the Sikorsky Airport NWS station to estimate the surface characteristics (albedo, Bowen ration, and surface roughness (z_o)) of the area of analysis. The state estimated values for 12 spatial sectors out to 1 km at a monthly temporal resolution for average conditions.

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

Figure 4. Area of Analysis and the NWS stations in the Bridgeport Harbor Area



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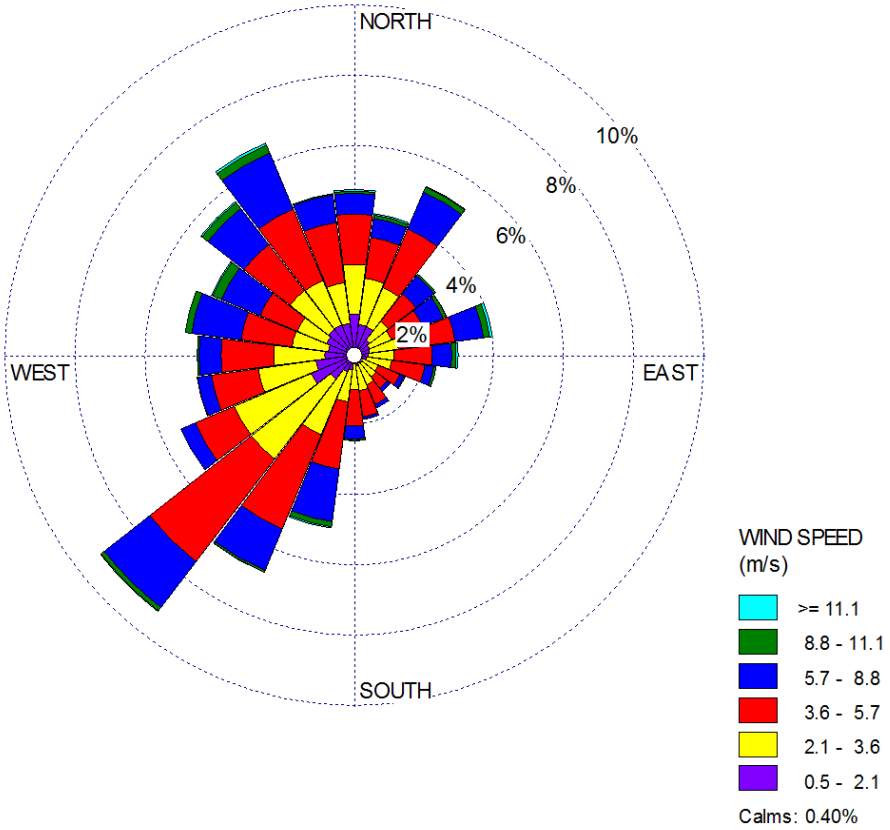
The EPA generated a wind rose for the 3-year surface data from the Sikorsky Airport ASOS station using the WRPLOT View™ software version 7.0 (Lakes Environmental). In Figure 5, the frequency and magnitude of wind speed and direction are defined in terms of from where the wind is blowing. During the 3-year period, the prevailing wind directions tended to be from the southwest and northeast, and from the northern quadrants; relatively few hours were from the southeast (i.e., the direction of the harbor relative to the source).

Figure 5. Fairfield County, Connecticut Cumulative Annual Wind Rose for Years 2013 – 2015



Meteorological data from the above surface and upper air NWS stations were used in generating AERMOD-ready files with the AERMET processor, version 15181. 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 AERMET version 15181 User's Guide and Addendum, as clarified in the March 8, 2013 memorandum from Tyler Fox "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-

minute duration was provided from the Sikorsky Airport ASOS station, but in a different formatted file to be processed by a separate preprocessor, AERMINUTE version 15272. 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 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.

The EPA concludes from the information at hand that the meteorological data were selected and treated appropriately and are suitable for the current assessment. The station used for surface meteorology in the development of meteorological inputs to AERMOD is located within the modeling domain, and is suitably representative of the meteorological conditions at Bridgeport Harbor.

3.3.2.7. 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 hills in the northern quadrants, and flat (water) in the southern quadrants. 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 US Geological Survey's National Elevation Dataset at 10-meter (1/3-arc second) resolution.

Based on the submission, the EPA concludes the state's approach in specifying terrain elevations is appropriate.

3.3.2.8. 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 99th percentile monitored concentrations by hour of day and season or month. For this area of analysis, the state

used the tier 2 approach described in the Modeling TAD and in the EPA's March 1, 2011, memorandum, "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 Ambient Air Quality Standard." Specifically, the state relied on the 99th percentile (by hour of day and season) based on data from the Edison School (AQS site number 09-001-0012) for 2013-2015. Using this approach, the state developed 96 individual values to represent 24-hourly values for each of four seasons. The range of background values included in the state's modeling is from 1.0 ppb, equivalent to 2.6 micrograms per cubic meter ($\mu g/m^3$)[7], to 8.7 ppb (22.8 $\mu g/m^3$), with an average value of 3.9 ppb (10.3 $\mu g/m^3$). The background concentrations for this area of analysis were determined by the state and are presented in Table 3.

Table 3. SO_2 Background Concentrations in the Bridgeport Harbor Area for 2013 – 2015 in ppb

Hour	Season			
	Winter	Spring	Summer	Fall
1	7.4	5.0	1.1	3.3
2	7.4	4.4	1.1	3.4
3	7.7	5.0	1.2	3.4
4	7.0	5.6	1.0	3.0
5	7.4	5.2	1.2	3.0
6	7.4	5.6	1.0	2.8
7	8.6	5.7	1.5	3.2
8	8.5	5.1	1.6	3.6
9	8.7	3.8	1.6	3.9
10	7.3	3.5	1.8	3.5
11	7.0	3.2	2.3	5.5
12	6.3	4.3	2.6	4.1
13	6.3	4.0	1.6	4.1
14	6.4	4.1	1.5	3.4
15	5.4	3.0	1.5	3.1
16	4.5	2.5	1.0	2.6
17	4.0	2.1	1.9	2.6
18	4.8	2.8	2.1	2.5
19	5.5	2.5	2.2	2.5
20	5.5	3.2	2.4	2.6
21	6.1	4.6	5.6	2.9
22	6.4	4.0	1.8	2.8
23	6.7	3.7	1.2	2.5
24	7.0	4.3	1.8	3.1

[7] 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 1 ppb = approximately 2.619 $\mu g/m^3$.

The EPA believes the background values used for the assessment of the Bridgeport Harbor area are appropriate, based on the data and reasoning provided by the state.

3.3.2.9. Summary of Modeling Inputs and Results

The AERMOD modeling input parameters for the Bridgeport Harbor area of analysis are summarized below in Table 4.

Table 4. Summary of AERMOD Modeling Input Parameters for the Area of Analysis for the Bridgeport Harbor area

Input Parameter	Value
AERMOD Version	15181 (regulatory default mode)
Dispersion Characteristics	Urban (Population: 308,000)
Modeled Sources	1
Modeled Stacks	1
Modeled Structures	0
Modeled Fencelines	1
Total receptors	5,593
Emissions Type	Actual
Emissions Years	2013-2015
Meteorology Years	2013-2015
NWS Station for Surface Meteorology	Sikorsky Airport ASOS
NWS Station Upper Air Meteorology	Brookhaven, New York NWS
NWS Station for Calculating Surface Characteristics	Sikorsky Airport ASOS
Methodology for Calculating Background SO_2 Concentration	AQS site number 09-001-0012, Tier 2, temporally varying by hour of day and season
Calculated Background SO_2 Concentration	1.0 to 8.7 ppb

The results presented below in Table 5 show the magnitude and geographic location of the highest predicted modeled concentration based on the input parameters.

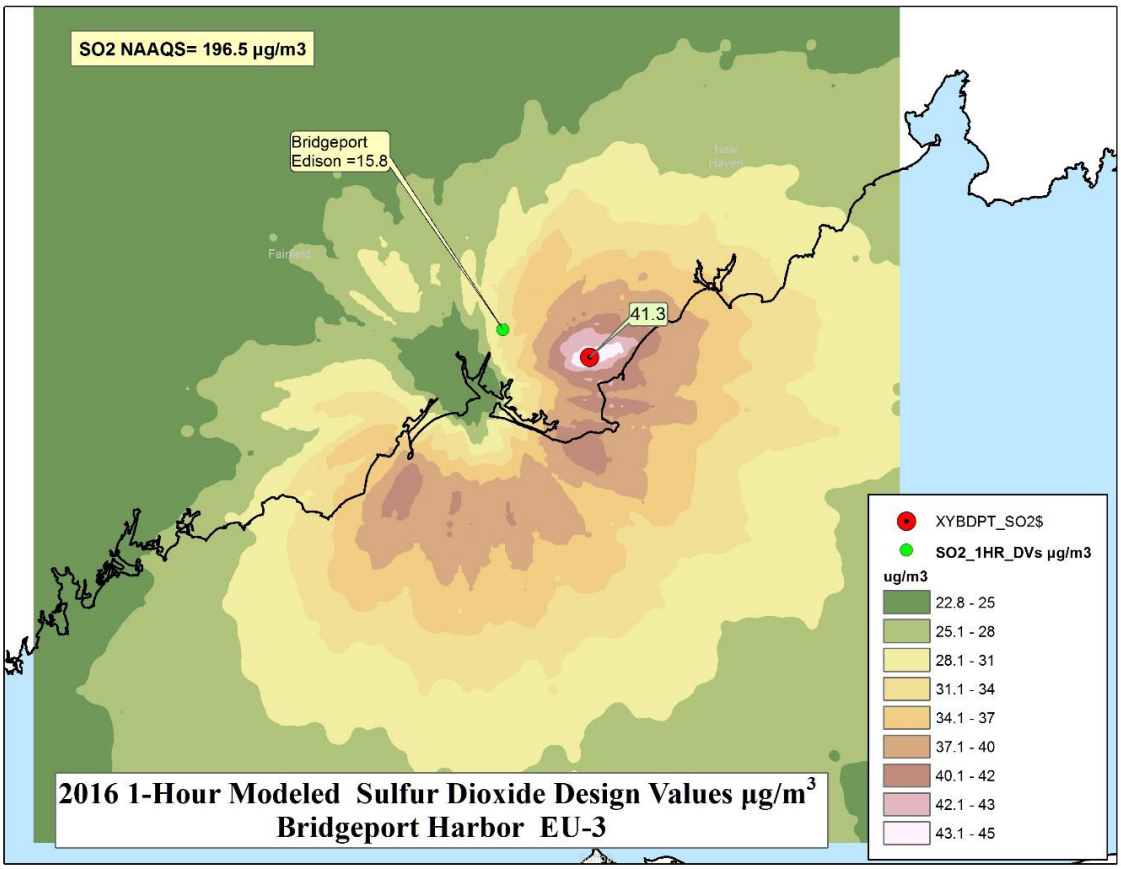
Table 5. Maximum Predicted 99th Percentile Daily Maximum 1-Hour SO_2 Concentrations Averaged Over Three Years for the Area of Analysis for the Bridgeport Harbor area

Averaging Period	Data Period	Receptor Location [UTM zone 18]		99th percentile daily maximum 1-hour SO_2 Concentration (µg/m³)	
		UTM-X (meters)	UTM-Y (meters)	Modeled concentration (including background)	NAAQS Level
99th Percentile 1-Hour Average	2013-2015	659,000	4,561,000	41.3	196.4*

*Equivalent to the 2010 SO_2 NAAQS of 75 ppb using a 2.619 µg/m³ conversion factor

The state's modeling indicates that the highest predicted 99th percentile daily maximum 1-hour concentration within the chosen modeling domain is 41.3 µg/m³, equivalent to 15.8 ppb. This modeled concentration included the background concentration of SO_2, and is based on actual emissions from the facility. Figure 6 below was included as part of the state's recommendation,

Figure 6. Predicted 99th Percentile Daily Maximum 1-Hour SO_2 Concentrations Averaged Over Three Years for the Area of Analysis for the Bridgeport Harbor Area



and indicates that the predicted value occurred in western Milford approximately 7.0 km to the east of Bridgeport Harbor.

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.

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

The modeling submitted by the state does not contain any significant departures from the Modeling TAD. As explained in the preceding sections, the EPA concurs with the state's selection of modeling components, including: urban operating mode; modeling domain and receptor placement; source characterization, including stack parameters; emissions parameters and rates; meteorological data and surface parameters; terrain elevations; and background concentrations. Connecticut did not characterize building downwash in its analysis of emissions from Bridgeport Harbor Station. Based on the modeled results which indicate that ambient levels resulting from Bridgeport Harbor do not approach the level of the standard, and the EPA's expectations for how the structure interacts with plume dispersion, the EPA does not expect that downwash for this specific case will cause or contribute to a violation of the NAAQS. Therefore, the EPA believes that the modeling submitted by the state is sufficient to base designations determinations on for the area.

3.4. Air Quality Modeling Analysis for the Fairfield County Area Addressing Norwalk Power

3.4.1. Introduction

This section presents all the available air quality modeling information for a portion of Fairfield County that includes Norwalk Power. (This portion of Fairfield County will often be referred to as "the Norwalk Power area" within this section). This area contains Norwalk Power, around which the state chose to characterize SO_2 air quality as part of its March 2013 recommendation, but which does not emit 2,000 tons or more annually and was not otherwise listed under the DRR.

In its March 2013 submission, Connecticut recommended that the entire state be designated attainment based on modeling analyses and Connecticut ambient monitoring data trends for SO_2. The modeling analyses included two sources, Bridgeport Harbor and Norwalk Power, in Fairfield County. Connecticut submitted an assessment and characterization that relies principally on air quality modeling on December 8, 2016, for the area around Bridgeport Harbor to satisfy the requirements of the DRR. The EPA considers the December 2016 modeling to be more representative of current air quality than the March 2013 modeling for Bridgeport Harbor. Both the March 2013 and December 2016 assessments and characterizations were performed using air dispersion modeling software, i.e., AERMOD, analyzing a mixture of actual and allowable emissions. The analysis of Bridgeport Harbor has been addressed separately in a previous section and considered in aggregation as they relate to the EPA's intended designation

for Fairfield County. After careful review of the state's assessments, supporting documentation, and all available data, the EPA intends to modify the state's recommendation and designate the area as unclassifiable/attainment as part of the EPA's intended statewide unclassifiable/attainment area, as discussed in Section 7. Our reasoning for this conclusion is explained in a later section of this TSD, after all the available information is presented.

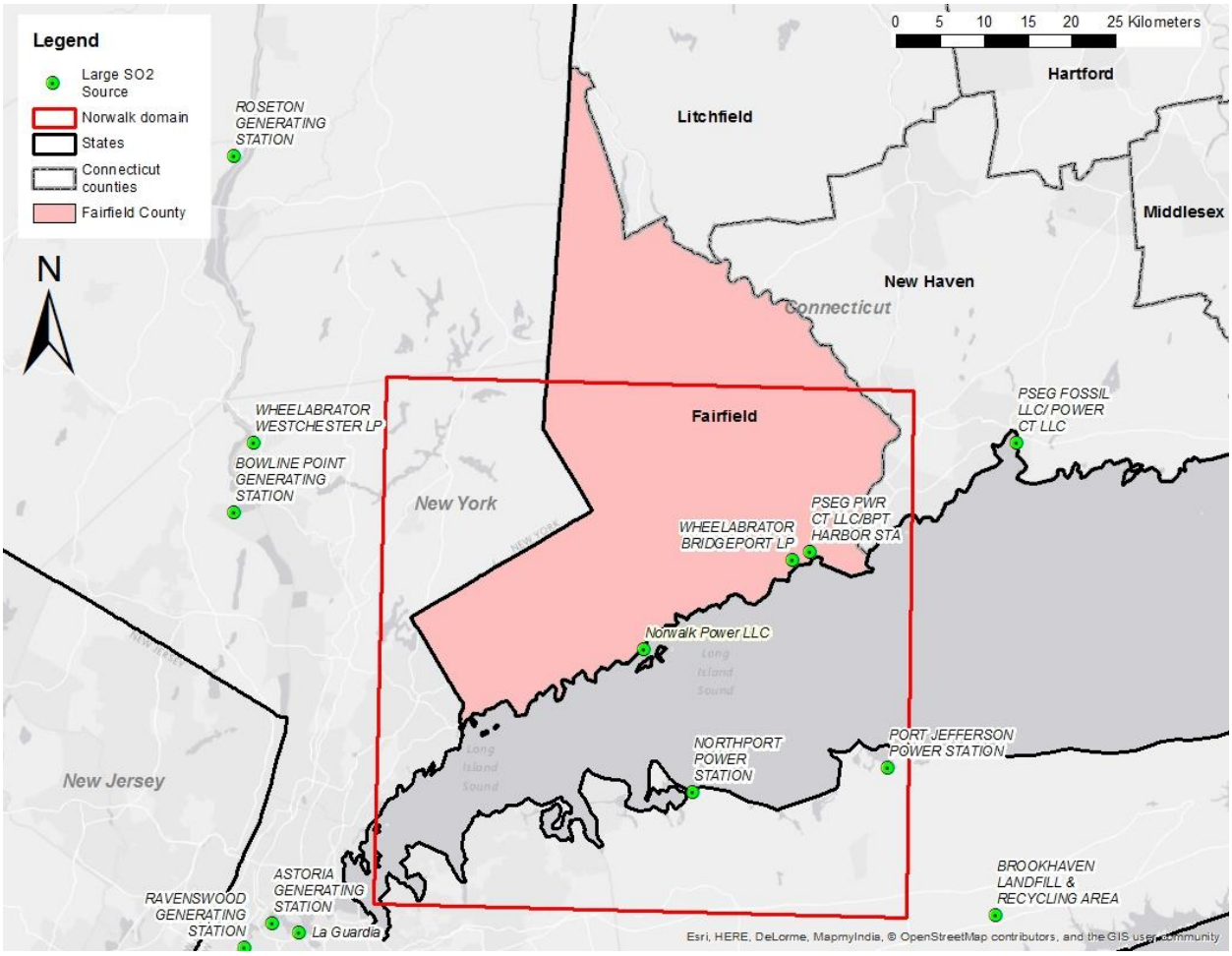
The March 2013 modeling assessed a 60 km square area centered on Norwalk Power that included most of Fairfield County and a small portion of New Haven County, Connecticut, as well as portions of Nassau, Suffolk, and Westchester Counties, New York.

As seen in Figure 7 below, the Norwalk Power facility was located at the tip of the southwestern peninsula comprising Norwalk Harbor in southwestern Connecticut. The Norwalk Power facility shut down in 2013 through the revocation of its Title V operating permit on November 27, 2013, which indicates that the shutdown is permanent and enforceable, since the 2013 modeling was conducted. Also included in the figure are the other facilities with emissions above 100 tpy SO_2 in the Norwalk Power modeling domain.[8]

The state's 2013 recommended area for the attainment designation is statewide. The EPA's intended statewide unclassifiable/attainment designation boundary is not shown in Figure 7, but is shown in Figure 25 in Section 7 below, which summarizes our intended designation.

[8] The two nearby SO_2 emitters of 100 tpy or more (based on information in the EPA's 2014 National Emissions Inventory version 1) are shown in Figure 7. These are Wheelabrator Bridgeport LP and Bridgeport Harbor.

Figure 7. Map of the Fairfield County, Connecticut Area Addressing Norwalk Power



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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.

3.4.2. Modeling Analysis Provided by the State

3.4.2.1. 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 12345 in regulatory default mode. This version is not the current regulatory version of the model. The EPA has reviewed changes in the model formulation that may affect the modeling results and determined that the version used by the state will not underestimate impacts for this particular modeling analysis. The EPA believes that the current analysis will result in higher concentrations than if it had been modeled with the current model version. Therefore, the analysis is conservative and appropriate for comparison against the NAAQS. This is discussed further in section 3.4.2.10 of this TSD. A discussion of the state's approach to the individual components is provided in the corresponding discussion that follows, as appropriate.

3.4.2.2. 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.

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 urban mode (as discussed in Section 3.4 above). The state selected the urban option for modeling dispersion from Norwalk Power with a surrounding population of 85,603.

As described in the previous analysis for Bridgeport Harbor, the EPA agrees with Connecticut's selection of urban dispersion characteristics for Sikorsky Airport.

3.4.2.3. 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 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.

For the Norwalk Power area, the state included Norwalk Power in the modeling. The state also included emissions from Bridgeport Harbor and New Haven Harbor in the modeling. Additional sources that were not modeled explicitly within the modeling domain include Northport Power Station in Northport, New York; Port Jefferson Power Station in Port Jefferson, New York; and

Wheelabrator Bridgeport LP, in Bridgeport, Connecticut. The EPA believes that these sources can be appropriately represented in the monitored background because they are remote from the area of expected maximum concentration and background levels did not screen out impacts from the direction of those sources.

The receptor placement for the area of analysis selected by the state is a nested Cartesian grid, as follows:

- A 10 km square area at 250-meter spacing centered on the source
- A 20 km square area at 500-meter spacing centered on the source
- A 60 km square area at 1,000-meter spacing centered on the source

The receptor network contained 6,201 unique receptors, and the network covered the southeastern portion of Fairfield County and a small portion in the west of New Haven County, as well as a portions of Long Island, Long Island Sound, and Westchester County. Fenceline receptors were not included in the modeling domain, but because modeling receptors were included within the fenceline on the facility property, and because the modeled maximum concentration was not near the fenceline, the model is expected to identify maximum impacts for the area.

Figures 8 and 9, generated by the EPA based on modeling files submitted by the state, show the state's chosen area of analysis surrounding Norwalk Power, as well as the receptor grid for the area of analysis.

The state placed receptors for the purposes of this designation effort throughout the domain, including in locations that may not be considered ambient air relative to the modeled facility. The state opted to apply a regular grid of receptors without excluding receptor locations over water bodies, though Section 4.2 of the Modeling TAD allows removal of receptors in such locations.

Figure 8. Area of Analysis for the Norwalk Power Area

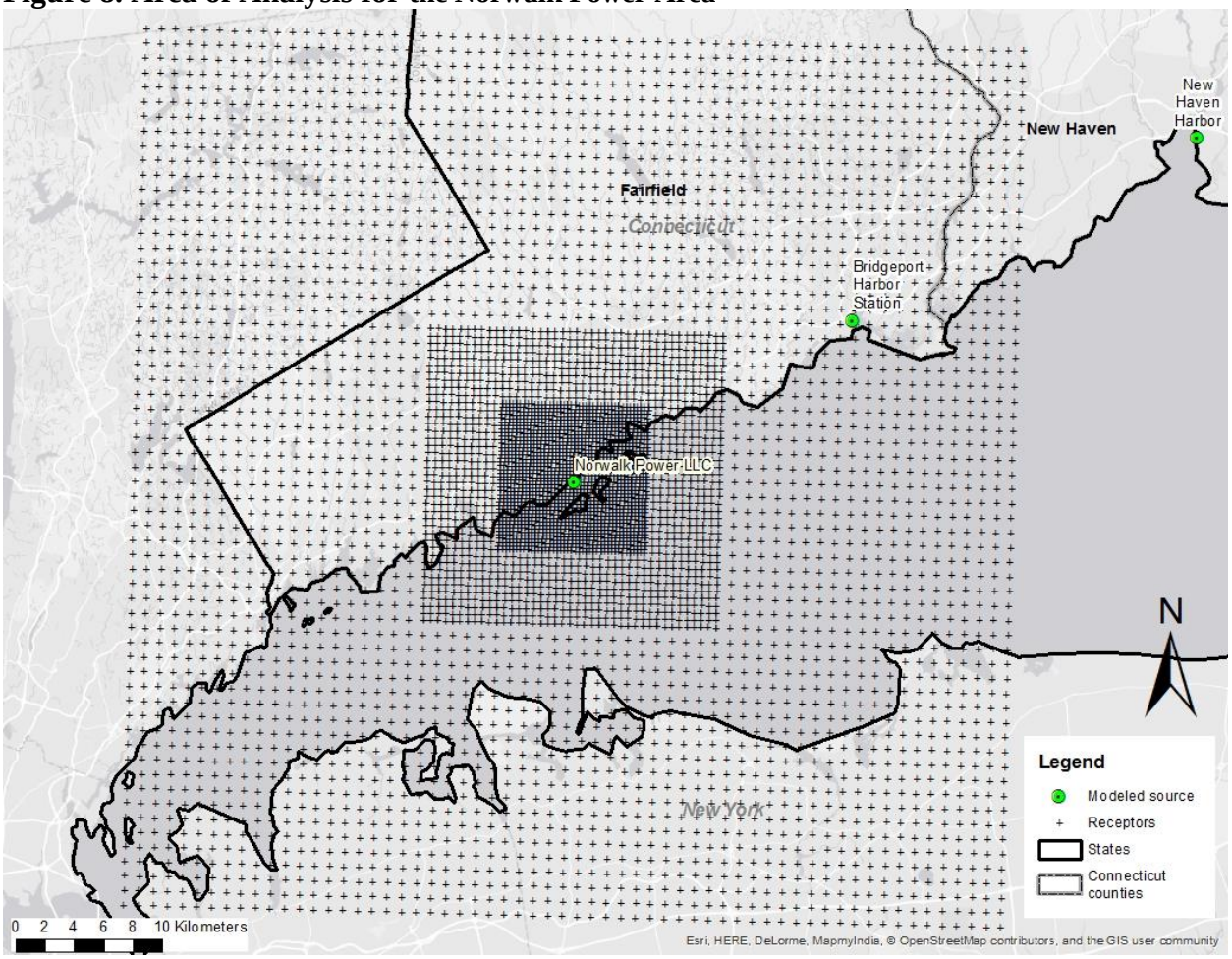

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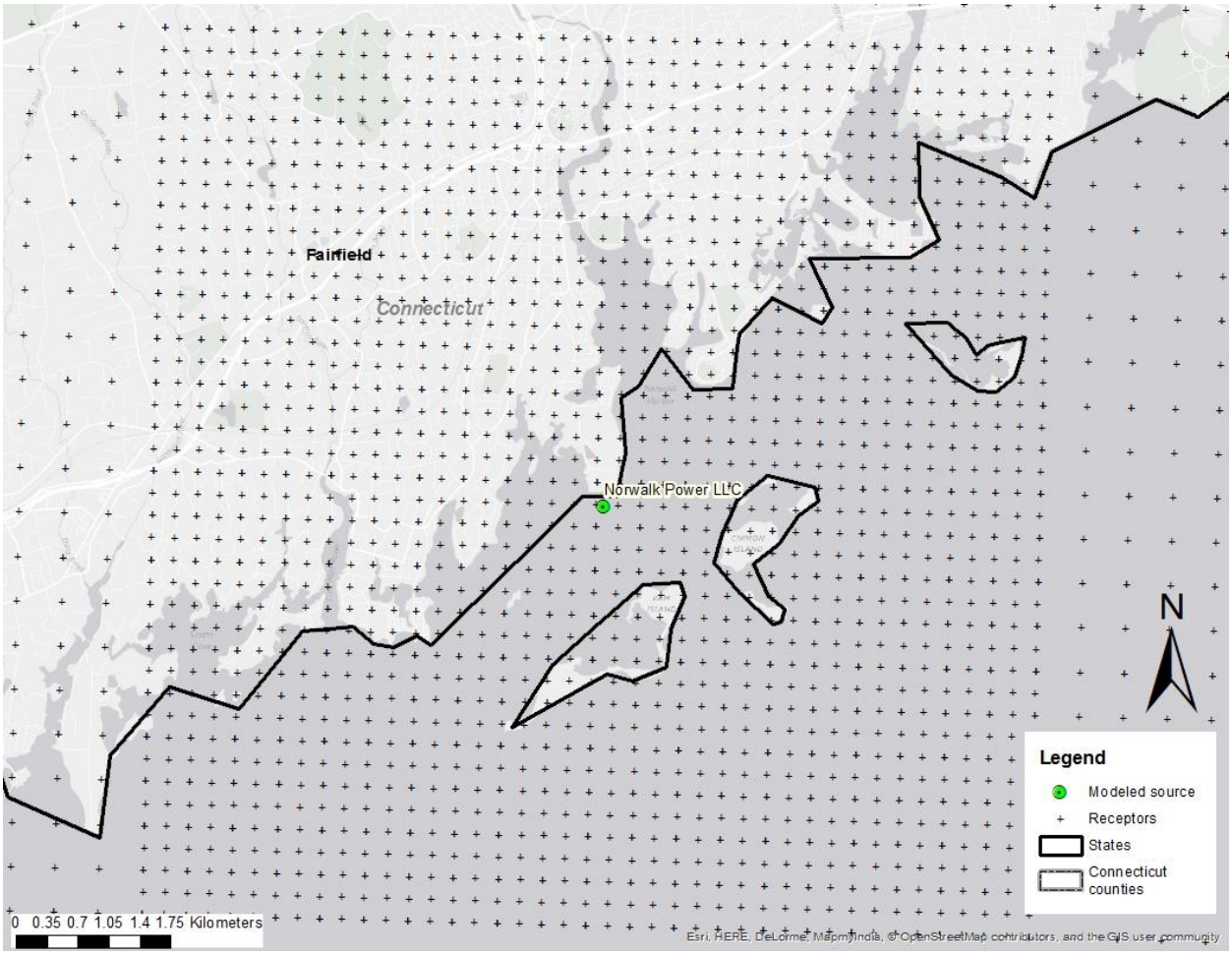
Figure 9. Near-field Receptor Grid for the Norwalk Power Area



The source of this map image is Esri, used by EPA with Esri's permission.

The EPA finds that the modeling domain and placement of receptors are appropriate for adequately characterizing the area around Norwalk Power.

3.4.2.4. 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 state explicitly included Norwalk Power for modeling to address all sources in the state with emissions greater than 100 tpy to support its attainment recommendation. The state also included Bridgeport Harbor and New Haven Harbor in the modeling. The state did not include sources outside of Connecticut in the modeling. Specifically, the state did not include Port Jefferson Power Station and Northport Power Station in Suffolk County, New York, both of which are

located within the state's modeling domain (see Figure 7). Northport Power Station is also a DRR source, and discussion of the area around that source is provided in the TSD Chapter for New York. The modeling domain for Northport Power Station extended 10 km from that source, and did not include areas in Connecticut. As discussed in the New York Chapter of the TSD, the area of maximum impact around Northport Power Station is located near that source, and not near Norwalk Power.

Port Jefferson Power Station emitted 367 tons of SO_2 in 2014, and though this source was not modeled, emissions from Port Jefferson Power Station are not expected to cause a concentration gradient in the area of maximum impact for Norwalk Power because of the relatively low emissions and distance between the sources.

The state characterized this source within the area of analysis in accordance with the best practices outlined in the Modeling TAD. Specifically, the state used actual stack heights in conjunction with actual emissions. The state followed the EPA's good engineering practices (GEP) policy in conjunction with allowable emissions limits, as applicable. The state also adequately characterized the source's stack parameters, e.g., exit temperature, exit velocity, location, and diameter. The state did not characterize the source's building layout and location.

The lack of structure information being included in the Norwalk Power analysis may lead to under-prediction of maximum impacts due to building downwash effects, which, though unlikely, has the potential to result in a violation of the standard. This element of the state's modeling is discussed further at the end of this section. Other elements of the source characterization appear to be appropriate. The state's exclusion of Northport and Port Jefferson Power Stations appear to be reasonable based on the analysis for Northport (as described in the New York Chapter of the TSD). Specifically, concentrations at the edge of the 10 km Northport modeling domain are very low and do not indicate a likelihood of contributions to impacts greater than the NAAQS more distant than 10 km, i.e., in areas that would have been affected by Norwalk Power.

3.4.2.5. 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 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, 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 state included Norwalk Power in the area of analysis. For this area of analysis, the state has opted to use a hybrid approach, where emissions from certain units are expressed as actual emissions, and those from other units are expressed as PTE rates. The emission units in the state's modeling analysis and their associated actual or PTE rates are summarized below.

For Norwalk Power Units 1 and 2, the state provided annual actual SO_2 emissions between 2007 and 2011. This information is summarized in Table 6. A description of how the state obtained hourly emission rates is given below this table.

Table 6. Actual SO_2 Emissions Between 2007 – 2011 from Units in the Norwalk Power Area

	SO_2 Emissions (tpy)				
Unit Name	**2007**	**2008**	**2009**	**2010**	**2011**
Bridgeport Harbor Unit 2	52	14	0	13	1
Bridgeport Harbor Unit 3	2,692	2,960	1,264	1,260	513
New Haven Harbor Unit 1	815	212	224	257	67
Norwalk Power Unit 1	218	205	32	64	23
Norwalk Power Unit 2	320	281	37	76	26
Total Emissions from All Modeled Facilities in the State's Area of Analysis*	4,097	3,673	1,558	1,669	630

*Annual emissions totals for all units may differ slightly from the sum of annual individual unit emissions due to rounding.

For Norwalk Power Units 1 and 2, the actual hourly emissions data were obtained from CEMs. Emissions used in the state's analysis are from 2007-2011 rather than the most recent 3 years as recommended in the Modeling TAD. To determine whether changes in emissions may have an effect on results, the EPA examined statewide and facility trends that may influence the modeling for this area of analysis. For the facility, SO_2 emissions declined from 538 tons in 2007, to 49 tons in 2011, to 33 tons in 2013, to 0 tons in both 2014 and 2015. (The source has been shut down). The EPA performed a similar analysis on emissions from Bridgeport Harbor and New Haven Harbor. For New Haven Harbor, SO_2 emissions declined from an average annual emissions of 315 tons between 2007 and 2011 to 197 tons between 2013 and 2015; the maximum annual emissions for the prior period was 815 tons in 2007 and 299 tons in 2014 for the current period. For Bridgeport Harbor, SO_2 emissions declined from an average annual emissions of 1,754 tons between 2007 and 2011 to 803 tons between 2013 and 2015; the maximum annual emissions for the prior period was 2,975 tons in 2008 and 922 tons in 2014 for the current period. Statewide emissions have similarly declined from the period of analysis (2007-2011), during which an annual average of 18,307 tons were emitted statewide, to the 2013-2015 period, during which an annual average of 12,523 tons were emitted statewide. Based on this information, the EPA concludes that the trend in facility and statewide emissions has decreased over time, and the state's use of older emissions data will not underestimate impacts from the facility.

For other units at Norwalk Power and New Haven Harbor, the state provided PTE values. This information is summarized in Table 7. A description of how the state obtained hourly emission rates is given below this table.

Table 7. SO_2 Emissions based on PTE from Units in the Area of Analysis for the Norwalk Power Area

Unit Name	SO_2 Emissions (tpy, based on PTE)
Norwalk Power Unit 3B	18.8
Norwalk Power Unit 2T	279.8
New Haven Harbor Unit 2	360.1
New Haven Harbor Combustion Turbines	12.5
Total Emissions from Units in the Area of Analysis Modeled Based on PTE	671.2

The PTE in tons per year for units at Norwalk Power and New Haven Harbor was determined by the state based on permitted emission and/or operation limits. Emissions were assumed to be the same in each modeled year.

Based on the available evidence, the EPA concurs with Connecticut in its selections of emissions parameters and emissions rates for the sources included in the modeling.

3.4.2.6. Modeling Parameter: Meteorology and Surface Characteristics

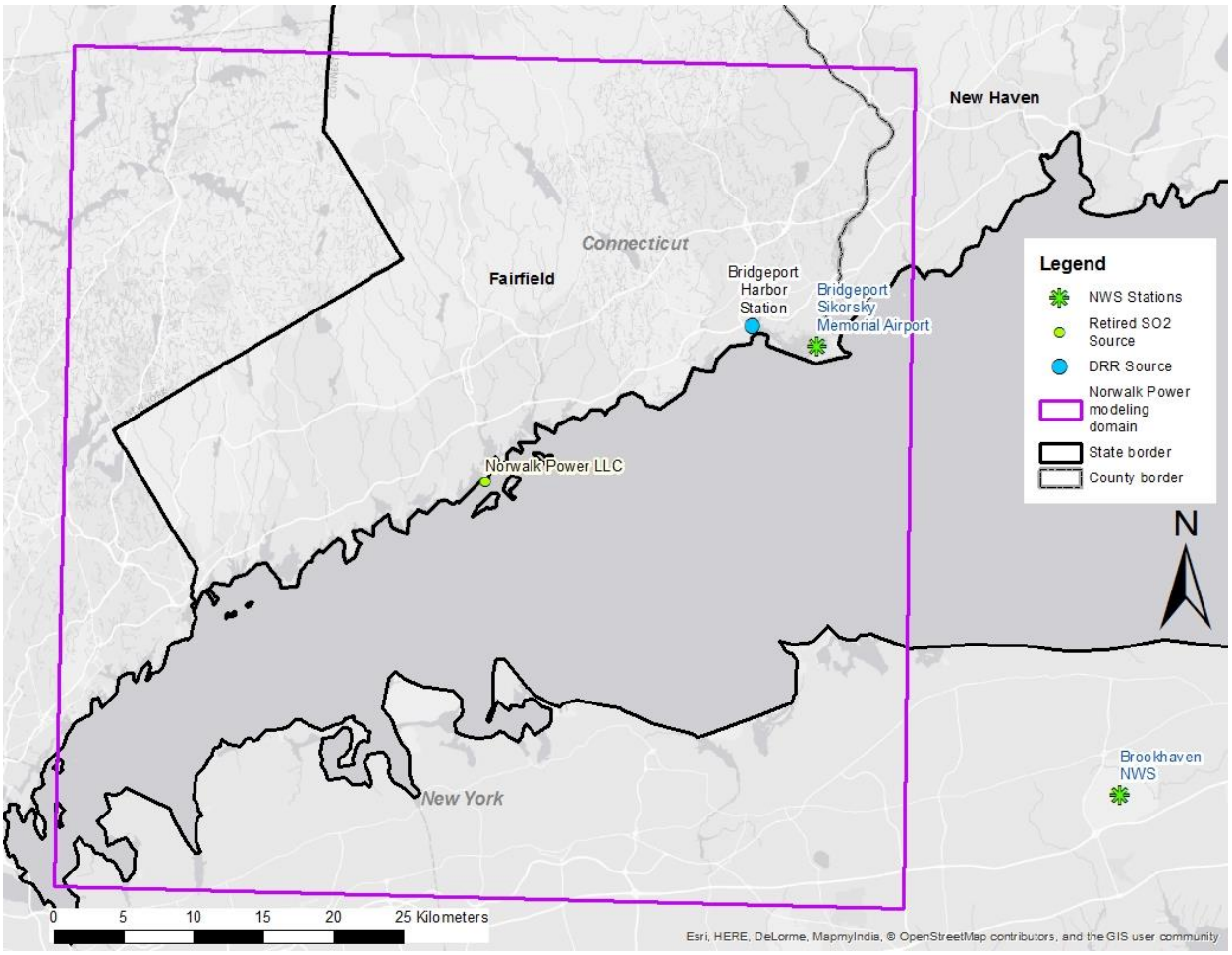
As noted in the Modeling TAD, at least the most recent 3 years of meteorological data (concurrent with the most recent 3 years of emissions data) should be used in designations efforts. The selection of data should be based on spatial and climatological (temporal) representativeness. The representativeness 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 Norwalk Power area, the state selected the surface meteorology for a 5-year period from the NWS Automated Surface Observing Systems (ASOS) station at Sikorsky Airport in Stanford, Connecticut, about 26.5 km to the east-northeast of the source, and coincident upper air observations from a different NWS station located in Brookhaven, New York as best representative of meteorological conditions within the area of analysis.

The state used AERSURFACE version 08009 using land cover data from the 1992 National Land Cover Dataset representative of the Sikorsky Airport NWS station to estimate the surface characteristics (albedo, Bowen ration, and surface roughness (z_o)) of the area of analysis. The state estimated values for 12 spatial sectors out to 1 km at a monthly temporal resolution for average conditions. The EPA compared the version 08009 formulation to version 13016 to identify updates that may have resulted in changes for this analysis and concluded that only minor differences are expected to result from this change in this case.

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

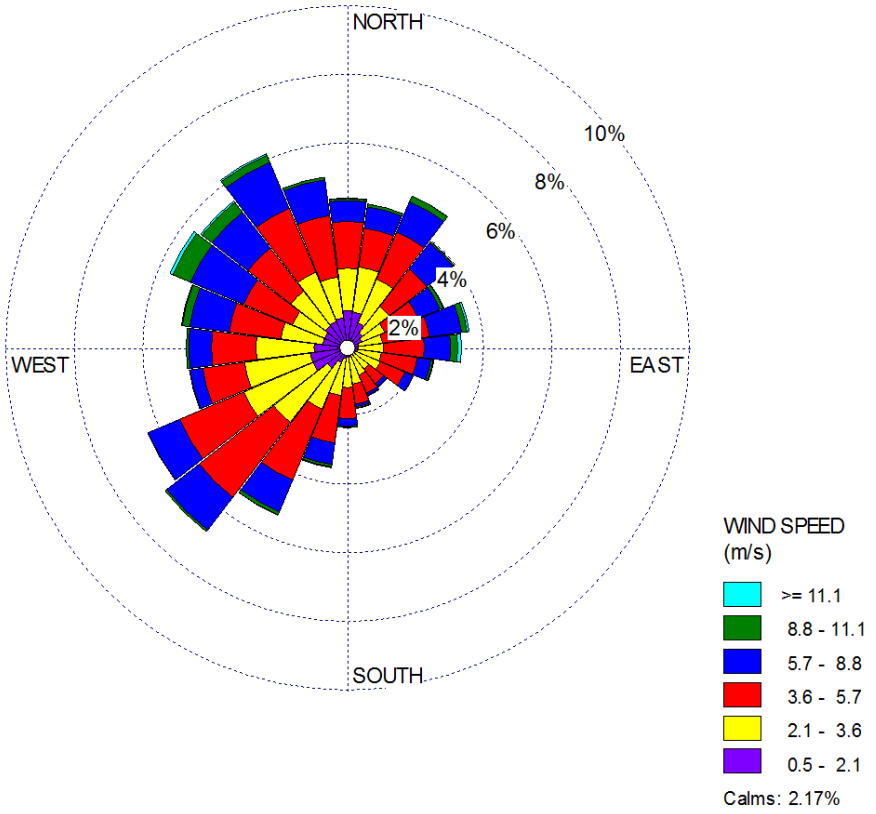
Figure 10. Area of Analysis and the NWS stations in the Norwalk Power Area



The source of this map image is Esri, used by EPA with Esri's permission.

The EPA generated a wind rose for the 5-year surface data from the Sikorsky Airport ASOS station using the WRPLOT View™ software version 7.0 (Lakes Environmental). In Figure 11, the frequency and magnitude of wind speed and direction are defined in terms of from where the wind is blowing. During the 5-year period, the prevailing wind directions tended to be from the southwest and northeast, and from the northern quadrants; relatively few hours were from the southeast (i.e., the direction of the harbor relative to the source).

Figure 11. Fairfield County, Connecticut Cumulative Annual Wind Rose for Years 2007 – 2011



Meteorological data from the above surface and upper air NWS stations were used in generating AERMOD-ready files with the AERMET processor, version 12345. 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 AERMET version 12345 User's Guide and Addendum 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 Sikorsky Airport ASOS station, but in a different formatted file to be processed by a separate preprocessor, AERMINUTE version 11325. 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 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.

The EPA notes several inconsistencies with the Modeling TAD in the state's selection of meteorological data and processing. Specifically, in our Modeling TAD, the EPA recommended the use of the most recent model version and meteorological datasets. However, the state's analysis uses older model versions with out-of-date meteorological data. The following discussion indicates how the EPA assessed these inconsistencies with the Modeling TAD and the resolution of that assessment.

- The EPA has compared the meteorological data submitted by the state to the most recent three years for the same area. The two wind roses included in the previous sections (i.e., Figures 5 and 11) serve as a basis for making this comparison for wind speed and direction. The EPA has assessed the pattern of winds from these datasets. The patterns are nearly identical, with approximately the same proportion of hours with winds from each direction and speed category. Furthermore, the EPA has compared the temperature, cloud cover, relative humidity, and atmospheric pressure profiles from 2007-2011 and 2013-2015, and found minimal differences between the parameter profiles for each time period.
- The EPA has compared the meteorological data submitted by the state using AERMET version 12345 to the same data as processed with AERMET version 16216. The EPA considered hourly differences in various output variables, specifically sensible heat flux, surface friction velocity, convective velocity scale, potential temperature gradient above the mixing height, and convectively and mechanically driven mixing height. In our review, the EPA found no or minimal differences for the vast majority of hours in the analysis.
- The EPA examined model change bulletins for AERMET for all versions between 12345 and 16216, specifically bulletins for versions 13350, 14134, 15181, and 16216. No changes are expected to cause substantial differences in the AERMET outputs using the state's selected input options and data.

The EPA concludes from the information at hand that the meteorological data were selected and treated appropriately and are suitable for the current assessment, despite any inconsistencies with the Modeling TAD, as discussed above. The station used for surface meteorology in the development of meteorological inputs to AERMOD is located within the modeling domain, and is suitably representative of the meteorological conditions at Norwalk Power.

3.4.2.7. 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 hills in the northern quadrants, and flat (water) in the southern quadrants. 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 US Geological Survey's National Elevation Dataset at 30-meter (1-arc second) resolution.

Based on the submission, the EPA concludes the state's approach in specifying terrain elevations is appropriate.

3.4.2.8. 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 99th percentile monitored concentrations by hour of day and season or month. For this area of analysis, the state used the tier 2 approach described in the Modeling TAD and in the EPA's March 1, 2011 memo, "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 Ambient Air Quality Standard." Specifically, the state relied on the 99th percentile (by hour of day and season) based on data from the Edison School (AQS site number 09-001-0012) for 2009-2011. Using this approach, the state developed 96 individual values to represent 24-hourly values for each of four seasons. The range of background values included in the state's modeling is from 3.7 ppb (9.7 $\mu g/m^3$) to 26.9 ppb (70.5 $\mu g/m^3$), with an average value of 12.3 ppb (32.3 $\mu g/m^3$).[9] The background concentrations for this area of analysis were determined by the state and are presented in Table 8.

[9] 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 1 ppb = approximately 2.619 $\mu g/m^3$.

Table 8. SO_2 Background Concentrations in the Norwalk Power Area for 2009 – 2011

Hour	Season			
	Winter	Spring	Summer	Fall
1	12.2	7.9	7.6	4.6
2	11.7	6.8	7.1	7.6
3	13.1	4.9	5.4	8.0
4	14.0	4.8	4.1	7.5
5	13.9	8.1	3.7	6.2
6	14.1	8.7	4.8	5.9
7	16.4	8.0	5.4	5.3
8	16.0	10.0	7.4	9.2
9	16.9	12.1	12.8	10.3
10	17.2	12.0	12.8	11.8
11	14.7	19.3	14.8	12.9
12	14.0	17.1	23.2	16.0
13	14.1	19.5	20.9	16.8
14	20.8	16.4	26.1	12.9
15	19.8	19.0	20.1	12.9
16	23.4	16.2	18.3	10.7
17	21.4	16.2	20.2	11.3
18	11.6	15.4	26.9	9.6
19	12.1	13.1	14.1	11.1
20	11.9	9.8	10.3	13.9
21	11.1	9.1	14.1	12.9
22	10.2	9.4	12.5	8.6
23	10.5	7.6	11.0	7.2
24	11.3	7.6	10.0	4.5

The EPA believes the background values used for the assessment of the Norwalk Power area are appropriate, based on the data and reasoning provided by the state.

3.4.2.9. Summary of Modeling Inputs and Results

The AERMOD modeling input parameters for the Norwalk Power area of analysis are summarized below in Table 9.

Table 9. Summary of AERMOD Modeling Input Parameters for the Area of Analysis for the Norwalk Power area

Input Parameter	Value
AERMOD Version	12345
Dispersion Characteristics	Urban (Population: 85,603)
Modeled Sources	4
Modeled Stacks	3
Modeled Structures	0
Modeled Fencelines	0
Total receptors	6,201
Emissions Type	Hybrid (both actual and PTE)
Emissions Years	2007-2011
Meteorology Years	2007-2011
NWS Station for Surface Meteorology	Sikorsky Airport ASOS
NWS Station Upper Air Meteorology	Brookhaven, New York NWS
NWS Station for Calculating Surface Characteristics	Sikorsky Airport ASOS
Methodology for Calculating Background SO_2 Concentration	AQS site number 09-001-0012, Tier 2, temporally varying by hour of day and season
Calculated Background SO_2 Concentration	3.7 to 26.9 ppb

The results presented below in Table 10 show the magnitude and geographic location of the highest predicted modeled concentration based on the input parameters.

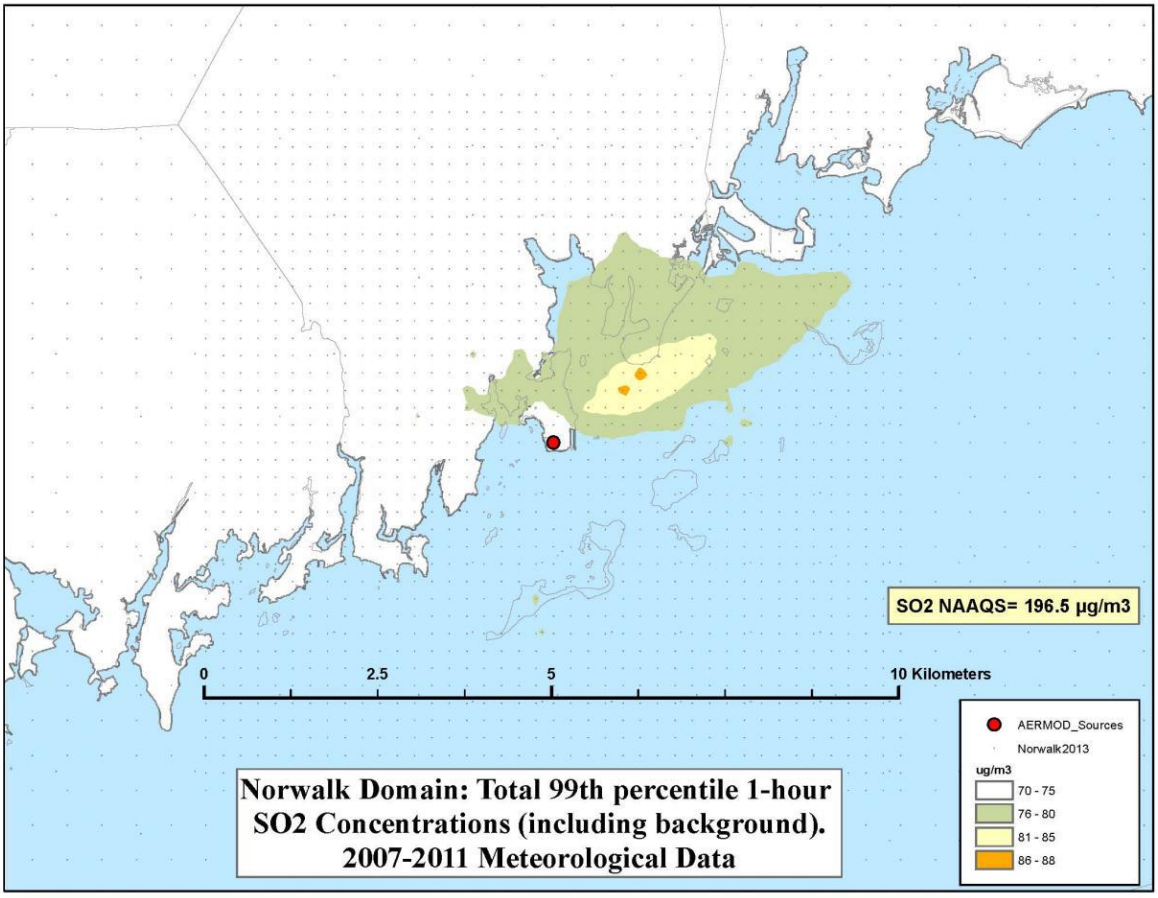
Table 10. Maximum Predicted 99th Percentile Daily Maximum 1-Hour SO_2 Concentrations Averaged Over Five Years for the Area of Analysis for the Norwalk Power area

Averaging Period	Data Period	Receptor Location [UTM zone 18]		99th percentile daily maximum 1-hour SO_2 Concentration ($\mu g/m^3$)	
		UTM-X (meters)	UTM-Y (meters)	Modeled concentration (including background)	NAAQS Level
99th Percentile 1-Hour Average	2007-2011	634,744	4,549,016	88.1	196.4*

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

The state's modeling indicates that the highest predicted 99th percentile daily maximum 1-hour concentration within the chosen modeling domain is 88.1 $\mu g/m^3$, equivalent to 33.6 ppb. This modeled concentration included the background concentration of SO_2, and is based on a mix of actual and allowable emissions from the facilities. Figure 12 below was included as part of the state's recommendation, and indicates that the predicted value occurred around 1 km to the northeast of Norwalk Power over water. The state's receptor grid is also shown in the figure.

Figure 12. Predicted 99th Percentile Daily Maximum 1-Hour SO_2 Concentrations Averaged Over Five Years for the Area of Analysis for the Norwalk Power Area



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.

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

The modeling submitted by the state was performed prior to the EPA releasing our Modeling TAD. Therefore, there are some deviations from the Modeling TAD in the state's modeling analysis. As discussed in previous sections, the state's modeling relies on outdated versions of various components of the modeling system. The versions used by the state in some cases are no longer considered the regulatory version of the model. To account for these differences, the EPA has conducted an assessment of the differences in the modeling from the elements described in the Modeling TAD.

- The EPA has compared the meteorological data submitted by the state to the most recent three years for the same area. The two wind roses included in the previous sections (i.e., Figures 5 and 11) serve as a basis for making this comparison for wind speed and

direction. The EPA has assessed the pattern of winds from these datasets. The patterns are nearly identical, with approximately the same proportion of hours with winds from each direction and speed category. Furthermore, the EPA has compared the temperature, cloud cover, relative humidity, and atmospheric pressure profiles from 2007-2011 and 2013-2015, and found minimal differences between the parameter profiles for each time period.

- The EPA has compared the meteorological data submitted by the state using AERMET version 12345 to the same data as processed with AERMET version 16216. Specifically, the EPA considered hourly differences in various output variables, specifically sensible heat flux, surface friction velocity, convective velocity scale, potential temperature gradient above the mixing height, and convectively and mechanically driven mixing height. In our review, the EPA found no or minimal differences for the vast majority of hours in the analysis.
- The EPA examined model change bulletins for AERMET for all versions between 12345 and 16216, specifically bulletins for versions 13350, 14134, 15181, and 16216. No changes are expected to cause substantial differences in the AERMET outputs using the state's selected input options and data.
- To determine whether changes in emissions may have an effect on results, the EPA examined statewide and facility trends that may influence the modeling for this area of analysis. For the facility, SO_2 emissions declined from 560 tons in 2007, to 49 tons in 2011, to 33 tons in 2013, to 0 tons in both 2014 and 2015. (The source has been shut down.) The EPA performed a similar analysis on emissions from Bridgeport Harbor and New Haven Harbor. For New Haven Harbor, SO_2 emissions declined from an average annual emissions of 315 tons between 2007 and 2011 to 197 tons between 2013 and 2015; the maximum annual emissions for the prior period was 815 tons in 2007 and 299 tons in 2014 for the current period. For Bridgeport Harbor, SO_2 emissions declined from an average annual emissions of 1,756 tons between 2007 and 2011 to 803 tons between 2013 and 2015; the maximum annual emissions for the prior period was 2,975 tons in 2008 and 922 tons in 2014 for the current period. Statewide emissions have similarly declined from the period of analysis (2007-2011), during which an annual average of 18,307 tons were emitted statewide, to the 2013-2015 period, during which an annual average of 12,523 tons were emitted statewide.
- The EPA examined model change bulletins for AERMOD for all versions between 12345 and 16216r, specifically bulletins for versions 13350, 14134, 15181, and 16216. The model change bulletins indicate that the model version used by the state will result in higher concentrations than the current regulatory version. Specifically, version 15181 included a bug fix for tall stacks in urban areas; the sources in Connecticut using the urban option with AERMOD version 12345 will potentially have higher concentrations than those using model versions with the bug fix.

Based on this assessment, the EPA concludes that the state's analysis has the capability to demonstrate that no violations of the NAAQS have occurred.

As explained in the preceding sections, and in the context of the preceding discussion regarding the use of outdated modeling components, the EPA concurs with the state's selection of modeling components, including: urban operating mode; modeling domain and receptor placement; source characterization, including stack parameters; emissions parameters and rates; meteorological data and surface parameters; terrain elevations; and background concentrations. Connecticut did not characterize building downwash in its analysis of emissions from Norwalk Power. Based on the modeled results which indicate that ambient levels resulting from Norwalk Power do not approach the level of the standard, and the EPA's expectations for how the structure interacts with plume dispersion, the EPA does not expect that downwash for this specific case will cause or contribute to a violation of the NAAQS. Therefore, the EPA believes that the modeling submitted by the state is sufficient to base designations determinations on for this area.

3.5. Jurisdictional Boundaries in the Fairfield County Area

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

In 2013, the state recommended an attainment designation for the entire state of Connecticut, including Fairfield County, based on modeling for all sources with annual emissions greater than 100 tons SO_2 in the state that showed attainment of the 1-hour SO_2 NAAQS. In that 2013 analysis, the state included both Bridgeport Harbor and Norwalk Power, both within Fairfield County. This recommendation was reaffirmed in December 2016 based the results updated modeling for Bridgeport Harbor, as described in the previous sections. Based on version 1 of the 2014 National Emissions Inventory (NEI), there are no SO_2 sources within 10 km outside the boundaries of Fairfield County with annual emissions greater than 100 tons. One additional source, Wheelabrator Bridgeport LP, in Fairfield County within the state's modeling domain had annual SO_2 emissions greater than 100 tons, specifically 116 tons, though the source was not included in modeling inputs. The EPA agrees with the state that emissions from Bridgeport Harbor will dominate in the Fairfield County area (especially since Norwalk Power has closed), and inclusion of that source provides for a reasonable basis for designating the area.

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

The EPA is basing our intended designation for Fairfield County, Connecticut, primarily on the modeling assessment provided by the state in December 2016, and supported by the 2013 modeling assessment for Norwalk Power. The EPA finds that these analyses taken together serve as a suitable basis for assessing the SO_2 attainment status of the Fairfield County area. Furthermore, ambient air monitoring data collected at the Edison School site in Fairfield County indicates that no violation of the NAAQS has occurred. These monitoring data were available to

EPA for consideration in the designations process; however, since it is unclear if these monitors are located in areas of maximum concentration, it is unclear if the data are representative of the area's actual air quality.

State modeling from 2013 is also available for New Haven County, and is discussed in a different section of this TSD. Based on version 1 of the 2014 National Emissions Inventory (NEI), there is one additional SO_2 source, Wheelabrator Bridgeport LP, within the state's modeling domain, but no sources within 10 km outside the boundaries of Fairfield County with annual emissions greater than 100 tons. The EPA has no information indicating the presence of a violation near the border of Fairfield County. Discussion of a nearby source, Northport Power Station in Suffolk County, New York, is included in the TSD Chapter for New York. As described in that TSD Chapter, modeling provided to the EPA by New York State does not indicate that the 1-hour SO_2 is violated near Northport Power Station. The New York modeling did not include Connecticut sources, nor did the Connecticut modeling include New York sources. Modeling of each area indicated that the areas of maximum concentration resulting from the respective sources were relatively close to the source. Furthermore, the New York sources are not expected to cause a concentration gradient near the Fairfield County, Connecticut sources, and any contributions from New York sources are expected to be fully captured in the monitored background levels used in the modeling. Therefore, the EPA agrees that no New York sources were erroneously left out of the modeling for Fairfield County, Connecticut.

There are no areas within or near Fairfield County that are intended to remain undesignated after Round 3 designations are completed, and that would therefore occur in a later action.

The EPA believes that our intended unclassifiable/attainment area, bounded by the jurisdictional boundaries of Fairfield 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. The EPA intends to include this unclassifiable/attainment area as part of the EPA's intended statewide unclassifiable/attainment area, as discussed in Section 7.

3.7. Summary of Our Intended Designation for the Fairfield 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 Fairfield County, Connecticut, area as unclassifiable/attainment for the 2010 SO_2 NAAQS, as part of the EPA's intended statewide unclassifiable/attainment area, as discussed in Section 7.

4. Technical Analysis for the New Haven County Area

4.1. Introduction

The EPA must designate the New Haven County, Connecticut, area by December 31, 2017, because the area has not been previously designated and Connecticut has not installed and begun timely operation of a new, approved SO_2 monitoring network to characterize air quality in the vicinity of any source in New Haven County. Connecticut submitted one modeling analysis of New Haven County in March 2013 to support the state's requested recommendation for attainment. The March 2013 analysis included sources in both Fairfield and New Haven Counties. The discussion in this section describes the state's 2013 analysis only insofar as it relates to and supports the designation for New Haven County. A previous section described the same analysis as it relates and supports the designation for Fairfield County. The March 2013 modeling analysis for New Haven is presented in the sections that follow. Then, the discussion later in this TSD will explain how it relates to the intended designation for New Haven County.

New Haven County, Connecticut, borders Fairfield, Litchfield, Hartford, and Middlesex Counties, Connecticut. Furthermore, New Haven County, Connecticut, is separated from Suffolk County, New York, to the south by Long Island Sound at a distance of 20 km or greater.

4.2. Air Quality Monitoring Data for the New Haven County Area

This factor considers the SO_2 air quality monitoring data in the area of New Haven County, Connecticut. The state included monitoring data from the following monitor:

- Air Quality System monitor 09-009-0027. The Criscuolo Park monitor is located at 9 James Street, New Haven, Connecticut, in New Haven County, and is approximately 2.0 km to the north of New Haven Harbor. Data collected at this monitor indicates that the monitored SO_2 Design Value for the period from 2009-2011, which coincides with the modeled period, is 36 ppb (equivalent to 94.3 $\mu g/m^3$). The most recent available design value at this site was for the period from 2014 to 2016 with a value of 9 ppb (23.6 $\mu g/m^3$). The state intended all available data collected at this monitor to support and corroborate air dispersion modeling results; the discussion of these modeled results follows immediately below.

The EPA agrees that the Criscuolo Park monitor is the most representative source of available background SO_2 data for input into the air quality modeling. Because the Criscuolo Park monitor is not located in the area of maximum concentration, the EPA finds that this monitoring data on its own is not sufficient to designate the New Haven County area. The EPA has confirmed that there are no additional relevant data in the Air Quality System (AQS). For reference, see the annual air quality Design Values for SO_2 posted at our Air Quality Design Values website, https://www.epa.gov/air-trends/air-quality-design-values.

4.3. Air Quality Modeling Analysis for the New Haven County Area Addressing New Haven Harbor

4.3.1. Introduction

This section presents all the available air quality modeling information for a portion of New Haven County that includes New Haven Harbor Generating Station (New Haven Harbor). (This portion of New Haven County will often be referred to as "the New Haven County area" within this section.) This area contains New Haven Harbor, around which the state chose to characterize SO_2 air quality as part of its March 2013 recommendation, but which does not emit 2,000 tons or more annually and was not otherwise listed under the DRR.

In its March 2013 submission, Connecticut recommended that the entire state be designated attainment based on modeling analyses and Connecticut ambient monitoring data trends for SO_2. The modeling analyses included one source, New Haven Harbor, in New Haven County. The state's assessment and characterization were performed using air dispersion modeling software, i.e., AERMOD, analyzing a mixture of actual and allowable emissions. After careful review of the state's assessments, supporting documentation, and all available data, the EPA intends to modify the state's recommendation and designate the area as unclassifiable/attainment as part of the EPA's intended statewide unclassifiable/attainment area, as discussed in Section 7. Our reasoning for this conclusion is explained in a later section of this TSD, after all the available information is presented.

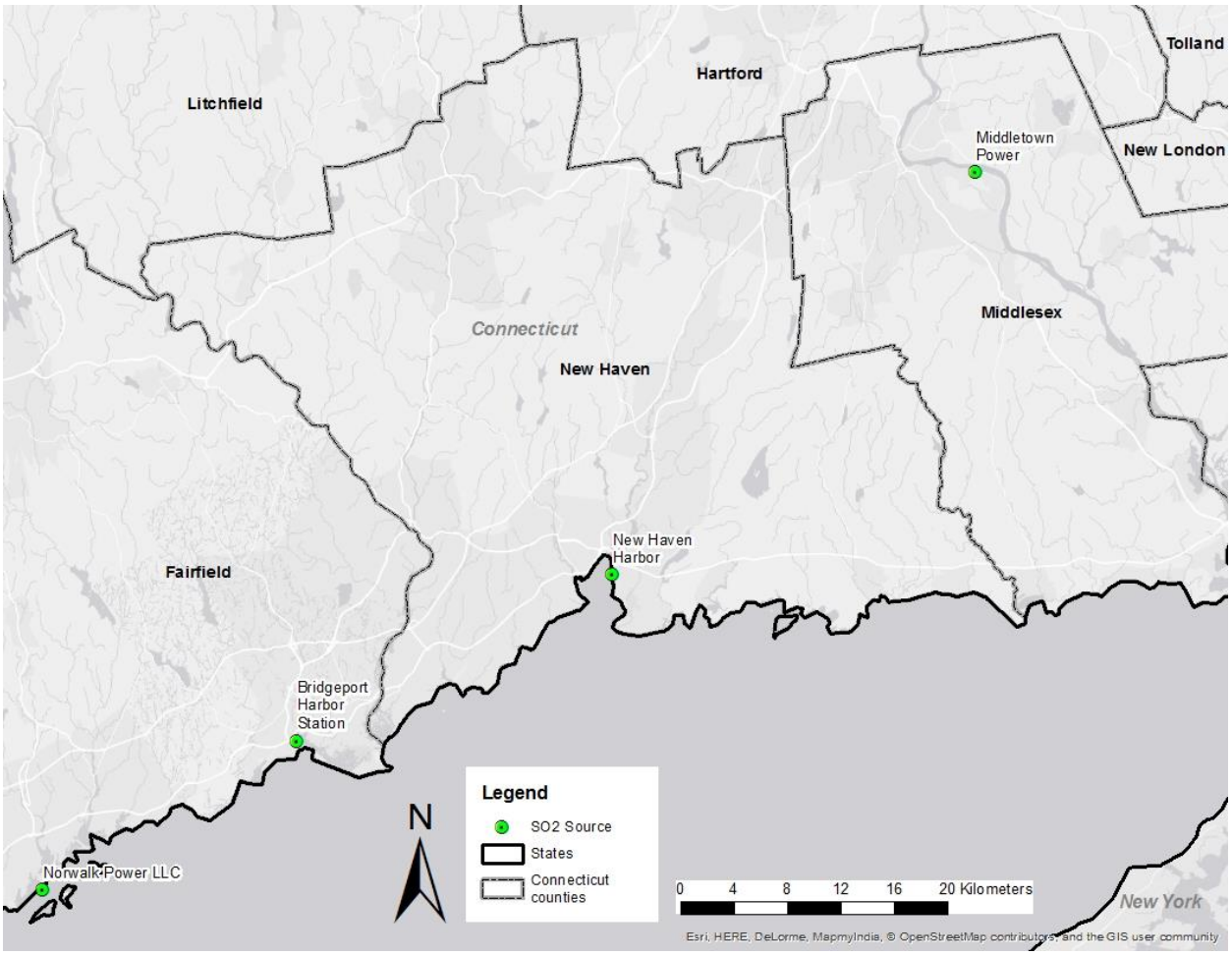
The March 2013 modeling assessed a 76 km (north-south) by 98 km (east-west) area centered on New Haven Harbor that including nearly the entirety of New Haven County, and also nearly the entirety of both Fairfield and Middlesex Counties, Connecticut.

As seen in Figure 13 below, the New Haven Harbor facility is located to the immediate east of the New Haven Harbor waterbody, immediately to the north of East Shore Park. Also included in the figure are the other facilities with emissions above 100 tpy SO_2 in the New Haven Harbor modeling domain.[10]

The state's 2013 recommended area for the attainment designation is statewide. The EPA's intended unclassifiable/attainment designation boundary for the New Haven County, Connecticut, area is not shown in Figure 13, but is shown in Figure 25 in Section 7 below, which summarizes our intended designation. The EPA intends to include this unclassifiable/attainment area as part of the EPA's intended statewide unclassifiable/attainment area, as discussed in Section 7.

[10] The nearby SO_2 emitters of 100 tpy or more (based on information in the EPA's 2014 version 1 National Emissions Inventory) are shown in Figure 13.

Figure 13. Map of the New Haven County, Connecticut Area Addressing New Haven Harbor



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.

4.3.2. Modeling Analysis Provided by the State

4.3.2.1. 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 12345 in default mode. The EPA has reviewed changes in the model formulation that may affect the modeling results and determined that the version used by the state will not underestimate impacts for this particular modeling analysis. The EPA believes that the current analysis will result in higher concentrations than if it had been modeled with the current model version. Therefore, the analysis is conservative and appropriate for comparison against the NAAQS. This is discussed further in section 4.3.2.10 of this TSD. A discussion of the state's approach to the individual components is provided in the corresponding discussion that follows, as appropriate.

4.3.2.2. 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.

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 urban mode (as discussed in Section 3.4 above). The state selected the urban option for modeling dispersion from New Haven Harbor with a surrounding population of 129,779.

As described in the previous analysis for Fairfield County, the EPA agrees with Connecticut's selection of urban dispersion characteristics for Sikorsky Airport.

4.3.2.3. 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 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.

For the New Haven Harbor area, the state included New Haven Harbor in the modeling. The state also included emissions from Bridgeport Harbor and Norwalk Power in the modeling.

The receptor placement for the area of analysis selected by the state is a nested Cartesian grid, as follows:

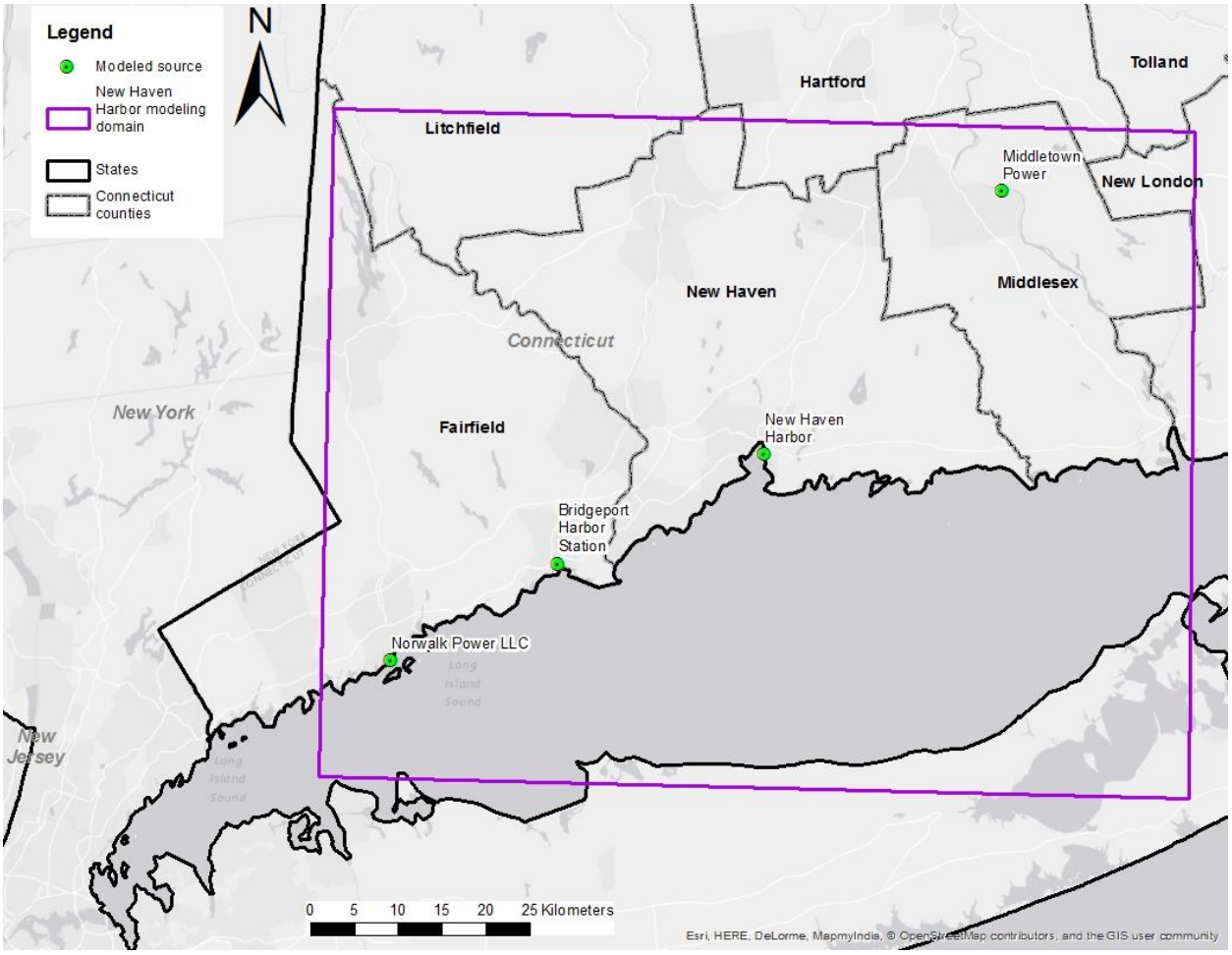
- A 10 km square area at 250-meter spacing centered on the source
- A 76 km (north-south) by 98 km (east-west) area at 2,000-meter spacing centered on the source

The receptor network contained 3,631 receptors, and the network covered the entirety of New Haven County, as well as the majority of Fairfield and Middlesex Counties. Fenceline receptors were not included in the modeling domain, but because modeling receptors were included within the fenceline on the facility property, and because the modeled maximum concentration was not near the fenceline, the model is expected to identify maximum impacts for the area.

Figures 14 and 15, generated by the EPA based on modeling files submitted by the state, show the state's chosen area of analysis surrounding New Haven Harbor, as well as the receptor grid for the area of analysis.

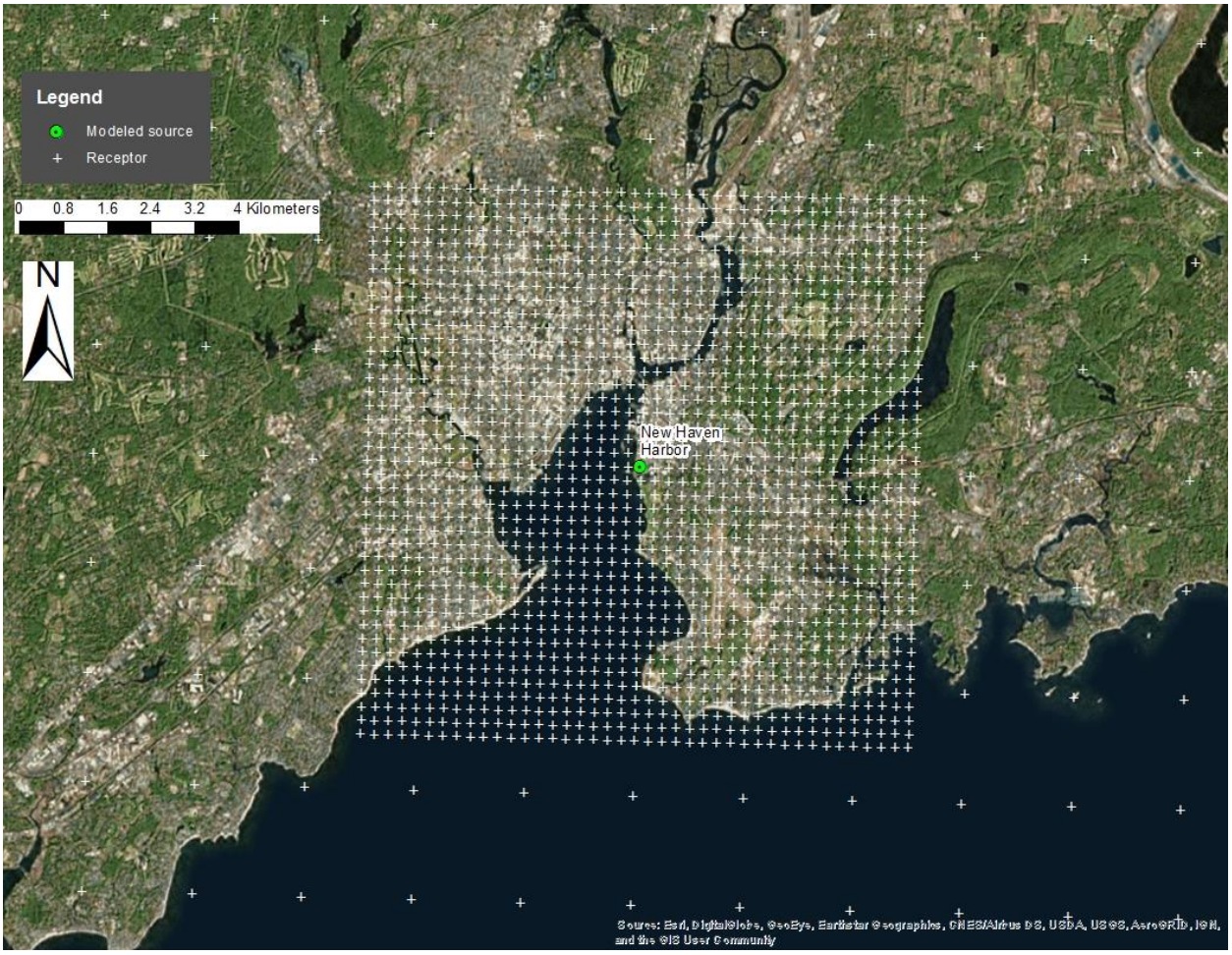
The state placed receptors for the purposes of this designation effort throughout the domain, including in locations that may not be considered ambient air relative to the modeled facility. The state opted to apply a regular grid of receptors without excluding receptor locations over water bodies, though Section 4.2 of the Modeling TAD allows removal of receptors in such locations.

Figure 14. Area of Analysis for the New Haven Harbor Area



The source of this map image is Esri, used by EPA with Esri's permission.

Figure 15. Receptor Grid for the New Haven Harbor Area



The source of this map image is Esri, used by EPA with Esri's permission.

The EPA finds that the modeling domain and placement of receptors are appropriate for adequately characterizing the area around New Haven Harbor.

4.3.2.4. 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 state explicitly included New Haven Harbor for modeling to address all sources in the state with emissions greater than 100 tpy to support its attainment recommendation. The state also included Bridgeport Harbor and Norwalk Power in the modeling. During the period modeled, Wheelabrator Bridgeport did not emit more than 100 tons SO_2 per year.

The state characterized this source within the area of analysis in accordance with the best practices outlined in the Modeling TAD. Specifically, the state used actual stack heights in conjunction with actual emissions. The state followed the EPA's good engineering practices (GEP) policy in conjunction with allowable emissions limits, as applicable. The state 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.

Based on comparisons between the modeling source characterization against publicly available information in permits and maps, the EPA concludes that the source characterization is appropriate.

4.3.2.5. 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 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, 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 state included New Haven Harbor in the area of analysis. For this area of analysis, the state has opted to use a hybrid approach, where emissions from certain units are expressed as actual emissions, and those from other units are expressed as PTE rates. The emission units in the state's modeling analysis and their associated actual or PTE rates are summarized below.

For New Haven Unit 1, the state provided annual actual SO_2 emissions between 2007 and 2011. This information is summarized in Table 6 in a previous section. A description of how the state obtained hourly emission rates is given below this table.

For New Haven Harbor Unit 1, the actual hourly emissions data were obtained from CEMs. Emissions used in the state's analysis are from 2007-2011 rather than the most recent 3 years as recommended in the Modeling TAD. To determine whether changes in emissions may have an effect on results, the EPA examined statewide and facility trends that may influence the modeling for this area of analysis. For the facility, SO_2 emissions declined from an average annual emissions of 315 tons between 2007 and 2011 to 197 tons between 2013 and 2015. The maximum annual emissions for the prior period was 815 tons in 2007 and 299 tons in 2014 for the current period. The EPA performed a similar analysis on emissions from Norwalk Power and Bridgeport Harbor. For Norwalk Power, SO_2 emissions declined from 560 tons in 2007, to 49 tons in 2011, to 33 tons in 2013, to 0 tons in both 2014 and 2015. (The source has been shut down.) For Bridgeport Harbor, SO_2 emissions declined from an average annual emissions of 1,756 tons between 2007 and 2011 to 803 tons between 2013 and 2015; the maximum annual emissions for the prior period was 2,975 tons in 2008 and 922 tons in 2014 for the current period. Statewide emissions have similarly declined from the period of analysis (2007-2011), during which an annual average of 18,307 tons were emitted statewide, to the 2013-2015 period, during which an annual average of 12,523 tons were emitted statewide. Based on this information, the EPA concludes that the trend in facility and statewide emissions has decreased over time, and the state's use of older emissions data will not underestimate impacts from the facility.

For other units at Norwalk Power and New Haven Harbor, the state provided PTE values. This information is presented in Table 7 in a previous section. The PTE in tons per year for units at Norwalk Power and New Haven Harbor was determined by the state based on permitted emission and/or operation limits. The emission rates used for New Haven Harbor Unit 2 are 82.2 lb/hr, which is higher than the currently permitted emission rate of 46.06 lb/hr, and 0.95 lb/hr for three combustion turbines, consistent with the federally enforceable permitted rates (as confirmed in the state's Title V operating permit 117-0265-TV). Because the emission rate for Unit 2 is higher than currently allowed, the resulting modeled concentrations will be higher than current impacts will be in reality, and the modeling can still serve to demonstrate attainment of the NAAQS. Rates for units at Norwalk Power are consistent with those described in the previous section. Emissions were assumed to be the same in each modeled year.

Based on the available evidence, the EPA concurs with Connecticut in its selections of emissions parameters and emissions rates for the sources included in the modeling.

4.3.2.6. Modeling Parameter: Meteorology and Surface Characteristics

As noted in the Modeling TAD, at least 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

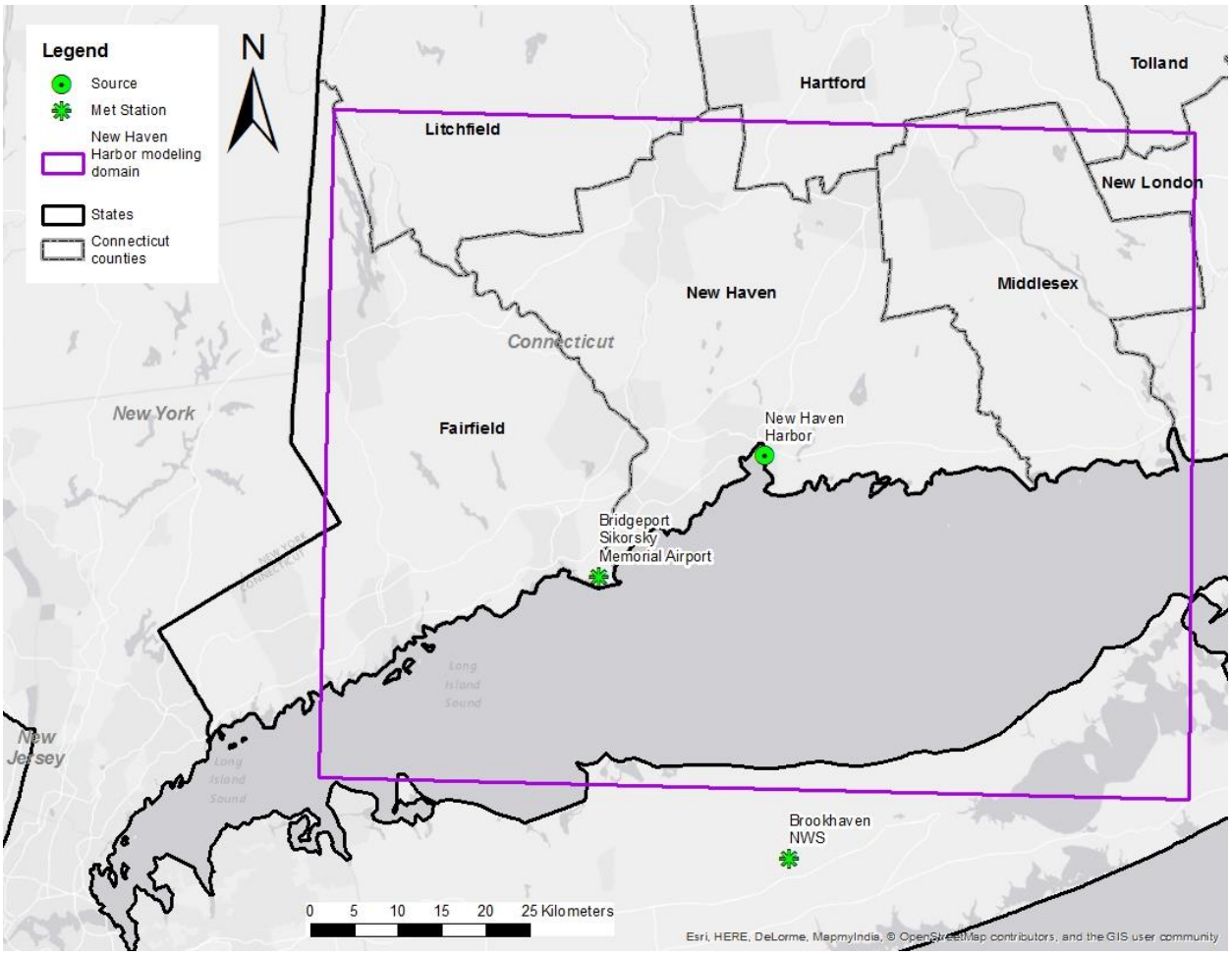
the meteorological monitoring site to the area under consideration, 2) the complexity of terrain, 3) the exposure of the meteorological site, and 4) the period of time during which data are collected. Sources of meteorological data include National Weather Service (NWS) stations, site-specific or onsite data, and other sources such as universities, Federal Aviation Administration (FAA), and military stations.

For the area of analysis for the New Haven Harbor area, the state selected the surface meteorology for a 5-year period from the NWS Automated Surface Observing Systems (ASOS) station at Sikorsky Airport in Stanford, Connecticut, about 23 km to the southwest of the source, and coincident upper air observations from a different NWS station located in Brookhaven, New York as best representative of meteorological conditions within the area of analysis.

The state used AERSURFACE version 08009 using land cover data from the 1992 National Land Cover Dataset representative of the Sikorsky Airport NWS station to estimate the surface characteristics (albedo, Bowen ration, and surface roughness (z_o)) of the area of analysis. The state estimated values for 12 spatial sectors out to 1 km at a monthly temporal resolution for average conditions.

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

Figure 16. Area of Analysis and the NWS stations in the New Haven Harbor Area



The source of this map image is Esri, used by EPA with Esri's permission.

The EPA generated a wind rose for the 5-year surface data from the Sikorsky Airport ASOS station using the WRPLOT View™ software version 7.0 (Lakes Environmental). Please refer to Figure 11 from the previous section, which uses the same meteorology. The frequency and magnitude of wind speed and direction are defined in terms of from where the wind is blowing. During the 5-year period, the prevailing wind directions tended to be from the southwest and northeast, and from the northern quadrants; relatively few hours were from the southeast.

Meteorological data from the above surface and upper air NWS stations were used in generating AERMOD-ready files with the AERMET processor, version 12345. 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 AERMET version 12345 User's Guide and Addendum 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 Sikorsky Airport ASOS station, but in a different formatted file to be processed by a separate preprocessor, AERMINUTE version 11325. 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 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.

The EPA notes several inconsistencies with the Modeling TAD in the state's selection of meteorological data and processing. Specifically, in our Modeling TAD, the EPA recommended the use of the most recent model version and meteorological datasets. However, the state's analysis uses older model versions with out-of-date meteorological data. The following discussion indicates how the EPA assessed these inconsistencies with the Modeling TAD and the resolution of that assessment.

- The EPA has compared the meteorological data submitted by the state to the most recent three years for the same area. The two wind roses included in the previous sections (i.e., Figures 5 and 11) serve as a basis for making this comparison for wind speed and direction. The EPA has assessed the pattern of winds from these datasets. The patterns are nearly identical, with approximately the same proportion of hours with winds from each direction and speed category. Furthermore, the EPA has compared the temperature, cloud cover, relative humidity, and atmospheric pressure profiles from 2007-2011 and 2013-2015, and found minimal differences between the parameter profiles for each time period.
- The EPA has compared the meteorological data submitted by the state using AERMET version 12345 to the same data as processed with AERMET version 16216. Specifically, the EPA considered hourly differences in various output variables, specifically sensible heat flux, surface friction velocity, convective velocity scale, potential temperature gradient above the mixing height, and convectively and mechanically driven mixing height. In our review, the EPA found no or minimal differences for the vast majority of hours in the analysis.
- The EPA examined model change bulletins for AERMET for all versions between 12345 and 16216, specifically bulletins for versions 13350, 14134, 15181, and 16216. No changes are expected to cause substantial differences in the AERMET outputs using the state's selected input options and data.

The EPA concludes from the information at hand that the meteorological data were selected and treated appropriately and are suitable for the current assessment, despite any inconsistencies with the Modeling TAD, as discussed above. The station used for surface meteorology in the development of meteorological inputs to AERMOD is located within the modeling domain, and is suitably representative of the meteorological conditions at New Haven Harbor.

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

The terrain in the area of analysis starts at nearly sea level at the center, with rising elevations to the west, east, and north, with areas of steep and rocky terrain, but mostly gently rolling hills. The area in the southern portion of the domain is Long Island Sound (i.e., water at sea level). 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 US Geological Survey's National Elevation Dataset at 30-meter (1-arc second) resolution.

Based on the submission, the EPA concludes the state's approach in specifying terrain elevations is appropriate.

4.3.2.8. 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 99th percentile monitored concentrations by hour of day and season or month. For this area of analysis, the state used the tier 2 approach described in the Modeling TAD and in the EPA's March 1, 2011 memo, "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 Ambient Air Quality Standard." Specifically, the state relied on the 99th percentile (by hour of day and season) based on data from the Criscuolo Park monitor (AQS site number 09-009-0027) for 2009-2011. Using this approach, the state developed 96 individual values to represent 24-hourly values for each of four seasons. The background concentrations for this area of analysis were determined by the state, but the state did not provide information about the values used in this tier 2 approach and the EPA could not verify the background levels. Therefore, to ensure that background levels were adequately included, the EPA applied the comparable tier 1 value of 36 ppb (94.3 $\mu g/m^3$) to the state's reported results.

The EPA believes the background values used for the assessment of the New Haven County area, if used in conjunction with the tier 1, are appropriate, based on the data and reasoning provided by the state and augmented as described above.

4.3.2.9. Summary of Modeling Inputs and Results

The AERMOD modeling input parameters for the New Haven County area of analysis are summarized below in Table 11.

Table 11. Summary of AERMOD Modeling Input Parameters for the Area of Analysis for the New Haven County area

Input Parameter	Value
AERMOD Version	12345
Dispersion Characteristics	Urban (Population: 129,779)
Modeled Sources	3
Modeled Stacks	3
Modeled Structures	2
Modeled Fencelines	0
Total receptors	3,631
Emissions Type	Hybrid (both actual and PTE)
Emissions Years	2007-2011
Meteorology Years	2007-2011
NWS Station for Surface Meteorology	Sikorsky Airport ASOS
NWS Station Upper Air Meteorology	Brookhaven, New York NWS
NWS Station for Calculating Surface Characteristics	Sikorsky Airport ASOS
Methodology for Calculating Background SO_2 Concentration	AQS site number 09-009-0027, Tier 2, temporally varying by hour of day and season
Calculated Background SO_2 Concentration	Tier 1 value is 36 ppb

The results presented below in Table 12 show the magnitude and geographic location of the highest predicted modeled concentration based on the input parameters. The EPA applied the Tier 1 background value in addition to the total value presented by the state as a conservative measure to ensure that the background was properly accounted for.

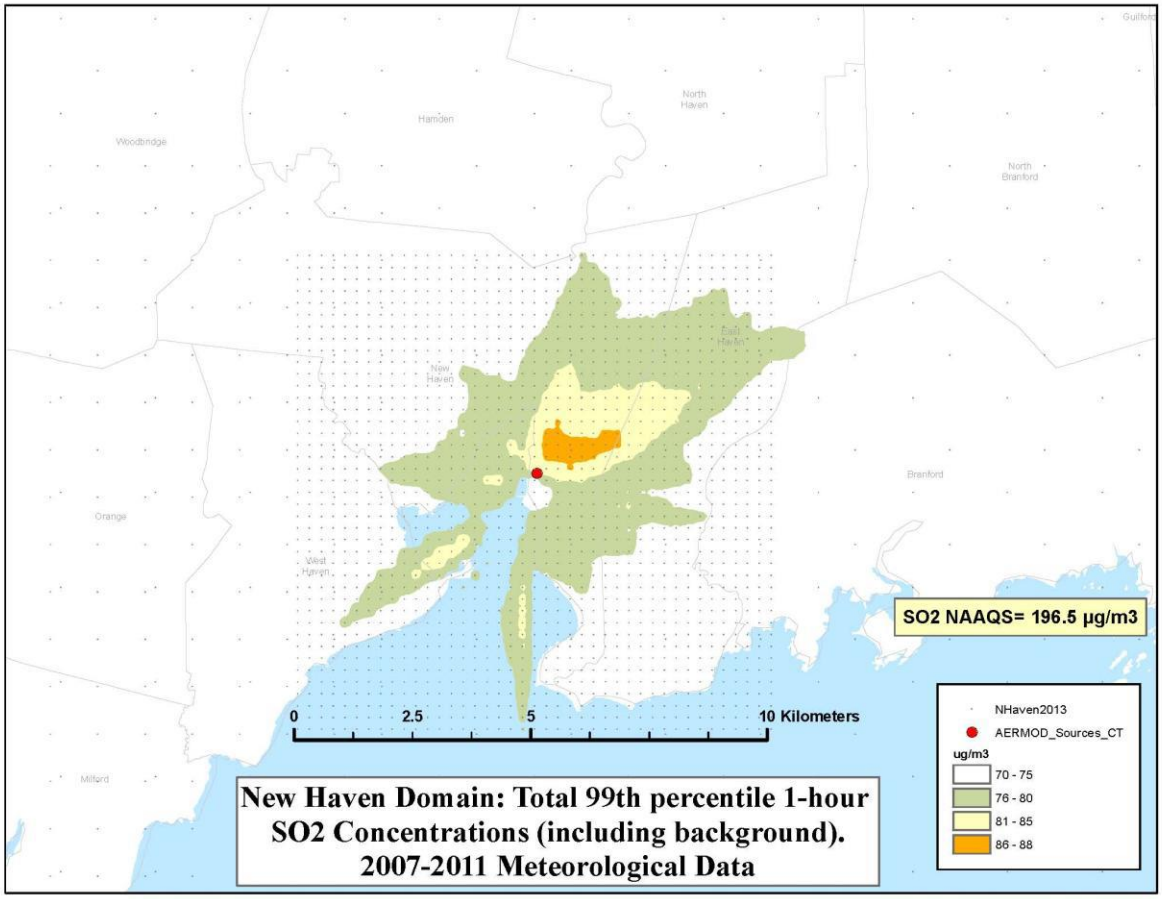
Table 12. Maximum Predicted 99th Percentile Daily Maximum 1-Hour SO_2 Concentrations Averaged Over Five Years for the Area of Analysis for the New Haven County area

Averaging Period	Data Period	Receptor Location [UTM zone 18]		99th percentile daily maximum 1-hour SO_2 Concentration ($\mu g/m^3$)	
		UTM-X (meters)	UTM-Y (meters)	Modeled concentration (including background)	NAAQS Level
99th Percentile 1-Hour Average	2007-2011	675,805	4,573,389	181.8*	196.4†

* Includes the state's reported maximum concentration of 87.5 $\mu g/m^3$ including tier 2 background value and tier 1 background value. This double counts background values as an additional check to ensure that the background values are entirely accounted for.
† Equivalent to the 2010 SO_2 NAAQS of 75 ppb using a 2.619 $\mu g/m^3$ conversion factor

The state's modeling indicates that the highest predicted 99th percentile daily maximum 1-hour concentration within the chosen modeling domain is 87.5 $\mu g/m^3$, equivalent to 33.4 ppb. As an additional check, the EPA has also accounted for background concentration by adding the tier 1 value of 36 ppb, which leads to a value of 69.4 ppb. The state's modeled concentration included the background concentration of SO_2, and is based on a mix of actual and allowable emissions from the facilities. Figure 17 below was included as part of the state's recommendation, and indicates that the state's predicted value occurred in an area around 2.5 km to the northeast of New Haven Harbor. The state's receptor grid is also shown in the figure.

Figure 17. Predicted 99th Percentile Daily Maximum 1-Hour SO_2 Concentrations Averaged Over Five Years for the Area of Analysis for the New Haven Harbor Area



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.

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

The modeling submitted by the state was performed prior to the EPA releasing our Modeling TAD. Therefore, there are some deviations from the Modeling TAD in the state's modeling analysis. As discussed in previous sections, the state's modeling relies on outdated versions of various components of the modeling system. The versions used by the state in some cases are no longer considered the regulatory version of the model. To account for these differences, the EPA has conducted an assessment of the differences in the modeling from the elements described in the Modeling TAD.

- The EPA has compared the meteorological data submitted by the state to the most recent three years for the same area. The two wind roses included in the previous sections (i.e., Figures 5 and 11) serve as a basis for making this comparison for wind speed and

direction. The EPA has assessed the pattern of winds from these datasets. The patterns are nearly identical, with approximately the same proportion of hours with winds from each direction and speed category. Furthermore, the EPA has compared the temperature, cloud cover, relative humidity, and atmospheric pressure profiles from 2007-2011 and 2013-2015, and found minimal differences between the parameter profiles for each time period.

- The EPA has compared the meteorological data submitted by the state using AERMET version 12345 to the same data as processed with AERMET version 16216. Specifically, the EPA considered hourly differences in various output variables, specifically sensible heat flux, surface friction velocity, convective velocity scale, potential temperature gradient above the mixing height, and convectively and mechanically driven mixing height. In our review, the EPA found no or minimal differences for the vast majority of hours in the analysis.
- The EPA examined model change bulletins for AERMET for all versions between 12345 and 16216, specifically bulletins for versions 13350, 14134, 15181, and 16216. No changes are expected to cause substantial differences in the AERMET outputs using the state's selected input options and data.
- To determine whether changes in emissions may have an effect on results, the EPA examined statewide and facility trends that may influence the modeling for this area of analysis. For the facility, SO_2 emissions declined from an average annual emissions of 315 tons between 2007 and 2011 to 197 tons between 2013 and 2015. The maximum annual emissions for the prior period was 815 tons in 2007 and 299 tons in 2014 for the current period. The EPA performed a similar analysis on emissions from Norwalk Power and Bridgeport Harbor. For Norwalk Power, SO_2 emissions declined from 560 tons in 2007, to 49 tons in 2011, to 33 tons in 2013, to 0 tons in both 2014 and 2015. (The source has been shut down.) For Bridgeport Harbor, SO_2 emissions declined from an average annual emissions of 1,756 tons between 2007 and 2011 to 803 tons between 2013 and 2015; the maximum annual emissions for the prior period was 2,975 tons in 2008 and 922 tons in 2014 for the current period. Statewide emissions have similarly declined from the period of analysis (2007-2011), during which an annual average of 18,307 tons were emitted statewide, to the 2013-2015 period, during which an annual average of 12,523 tons were emitted statewide.
- The EPA examined model change bulletins for AERMOD for all versions between 12345 and 16216r, specifically bulletins for versions 13350, 14134, 15181, and 16216. The model change bulletins indicate that the model version used by the state will result in higher concentrations than the current regulatory version. Specifically, version 15181 included a bug fix for tall stacks in urban areas; the sources in Connecticut using the urban option with AERMOD version 12345 will potentially have higher concentrations than those using model versions with the bug fix.

Based on this assessment, the EPA concludes that the state's analysis has the capability to demonstrate that no violations of the NAAQS have occurred.

As explained in the preceding sections, and in the context of the preceding discussion regarding the use of outdated modeling components, the EPA concurs with the state's selection of modeling components, including: urban operating mode; modeling domain and receptor placement; source characterization, including stack parameters; emissions parameters and rates; meteorological data and surface parameters; terrain elevations; and background concentrations. Therefore, the EPA believes that the modeling submitted by the state is sufficient to base designations determinations on for this area.

4.4. Jurisdictional Boundaries in the New Haven County Area

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

In 2013, the state recommended an attainment designation for the entire state of Connecticut, including New Haven County, based on modeling for all sources with annual emissions greater than 100 tons SO_2 in the state that showed attainment of the 1-hour SO_2 NAAQS. In that 2013 analysis, the state included New Haven Harbor within New Haven County. Based on version 1 of the 2014 NEI, there are no SO_2 sources within 10 km outside the boundaries of New Haven County with annual emissions greater than 100 tons except for Bridgeport Harbor and Wheelabrator Bridgeport LP, which have been discussed in the previous section addressing Fairfield County. The EPA agrees with the state that emissions from New Haven Harbor will dominate in the New Haven County area, except for the portion of the county included in the Bridgeport Harbor analysis, and inclusion of the New Haven Harbor source provides for a reasonable basis for designating the area.

4.5. The EPA's Assessment of the Available Information for the New Haven County Area

The EPA is basing our intended designation for New Haven County, Connecticut, primarily on the modeling assessment provided by the state in 2013. The EPA finds this analysis serve as a suitable basis for assessing the SO_2 attainment status of the New Haven County area. Furthermore, ambient air monitoring data collected at the Criscuolo Park site in New Haven County indicates that no violation of the NAAQS has occurred. These data were available to EPA for consideration in the designations process, however, since it is unclear if these monitors are located in areas of maximum concentration, it is unclear if the data are representative of the area's actual air quality.

State modeling is also available for Fairfield County and Middlesex County, both of which border New Haven County, and these analyses are discussed in different sections of this TSD. Based on version 1 of the 2014 NEI, there are no SO_2 sources within 10 km outside the boundaries of New Haven County with annual emissions greater than 100 tons except for

Bridgeport Harbor and Wheelabrator Bridgeport LP, which have been discussed in the previous section addressing Fairfield County. The EPA has no information indicating the presence of a violation near any border of New Haven County.

There are no areas within or near New Haven County that are intended to remain undesignated until after Round 3 designations are completed, and that would therefore occur in a later action.

The EPA believes that our intended statewide unclassifiable/attainment area 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. The EPA intends to include this unclassifiable/attainment area as part of the EPA's intended statewide unclassifiable/attainment area, as discussed in Section 7.

4.6. Summary of Our Intended Designation for the New Haven 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 New Haven County, Connecticut, area as unclassifiable/attainment for the 2010 SO_2 NAAQS, as part of the EPA's intended statewide unclassifiable/attainment area, as discussed in Section 7.

5. Technical Analysis for the Middlesex County Area

5.1. Introduction

The EPA must designate the Middlesex County, Connecticut, area by December 31, 2017, because the area has not been previously designated and Connecticut has not installed and begun timely operation of a new, approved SO_2 monitoring network to characterize air quality in the vicinity of any source in Middlesex County. Connecticut submitted one modeling analysis of Middlesex County in March 2013 to support the state's requested recommendation for attainment. The March 2013 modeling analysis for Middlesex County is presented in the sections that follow. Then, the discussion later in this TSD will explain how it relates to the intended designation for Middlesex County.

Middlesex County, Connecticut, borders New Haven, Hartford, and New London Counties, Connecticut. Furthermore, Middlesex, Connecticut, is separated from Suffolk County, New York, to the south by Long Island Sound at a distance of greater than 10 km.

5.2. Air Quality Monitoring Data for the Middlesex County Area

This factor considers the SO_2 air quality monitoring data in the area of Middlesex County, Connecticut. The state included monitoring data from the following monitor:

- Air Quality System monitor 09-003-1003. The East Hartford McAuliffe Park monitor is located at Remington Road, Hartford, Connecticut, in Hartford County, which is approximately 26 km to the north of Middletown Power. Data collected at this monitor indicates that the monitored SO_2 Design Value for the period from 2009-2011, which coincides with the modeled period, was 14 ppb (equivalent to 36.7 $\mu g/m^3$). The most recent available design value at this site was for the period from 2010-2012 with a value of 11 ppb (28.8 $\mu g/m^3$). The state intended all available data collected at this monitor to support and corroborate air dispersion modeling results; the discussion of these modeled results follows immediately below.

The EPA agrees that the McAuliffe Park monitor is the most representative source of available background SO_2 data for input into the air quality modeling. These data were available to EPA for consideration in the designations process, however, since it is unclear if these monitors are located in areas of maximum concentration, it is unclear if the data are representative of the area's actual air quality. The EPA has confirmed that there are no additional relevant data in the Air Quality System (AQS). For reference, see the annual air quality Design Values for SO_2 posted at our Air Quality Design Values website, https://www.epa.gov/air-trends/air-quality-design-values.

5.3. Air Quality Modeling Analysis for the Middlesex County Area Addressing Middletown Power

5.3.1. Introduction

This section presents all the available air quality modeling information for a portion of Middlesex County that includes Middletown Power LLC (Middletown Power). (This portion of Middlesex County will often be referred to as "the Middlesex County area" within this section.) This area contains Middletown Power, around which the state chose to characterize SO_2 air quality as part of its March 2013 recommendation, but which does not emit 2,000 tons or more annually and was not otherwise listed under the DRR.

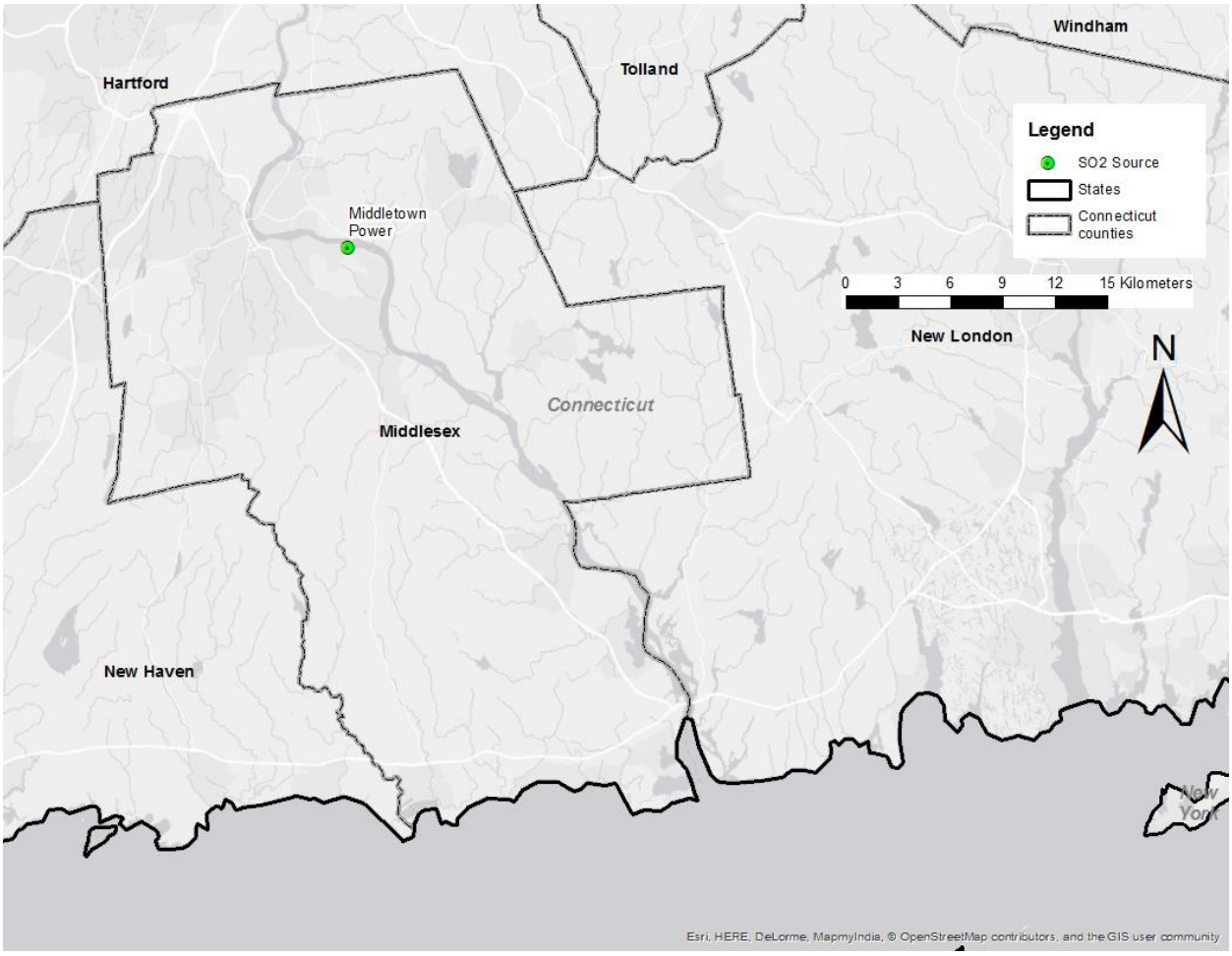
In its March 2013 submission, Connecticut recommended that the entire state be designated attainment based on modeling analyses and Connecticut ambient monitoring data trends for SO_2. The modeling analyses included one source, Middletown Power, in Middlesex County. The state's assessment and characterization were performed using air dispersion modeling software, i.e., AERMOD, analyzing a mixture of actual and allowable emissions. After careful review of the state's assessments, supporting documentation, and all available data, the EPA intends to modify the state's recommendation and designate the area as unclassifiable/attainment as part of the EPA's intended statewide unclassifiable/attainment area, as discussed in Section 7. Our reasoning for this conclusion is explained in a later section of this TSD, after all the available information is presented.

The March 2013 modeling assessed an area extending 50 km around Middletown Power area that including the entirety of Middlesex County, nearly the entirety of Hartford, New Haven, and Tolland Counties, the majority of New London and Windham Counties, and large portions of Litchfield County.

As seen in Figure 18 below, the Middletown Power facility is located immediately to the south of the Connecticut River, about 5 km to the east of downtown Middletown, Connecticut.[11]

The state's 2013 recommended area for the attainment designation is statewide. The EPA's intended unclassifiable/attainment designation boundary for the Middlesex County, Connecticut, area is not shown in Figure 18, but is shown in Figure 25 in Section 7 below, which summarizes our intended designation.

Figure 18. Map of the Middlesex County, Connecticut Area Addressing Middletown Power



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.

[11] There are no other nearby SO_2 emitters of 100 tpy or more (based on information in the EPA's 2014 version 1 National Emissions Inventory).

5.3.2. Modeling Analysis Provided by the State

5.3.2.1. 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 12345 in default mode. The EPA has reviewed changes in the model formulation that may affect the modeling results and determined that the version used by the state will not underestimate impacts for this particular modeling analysis. The EPA believes that the current analysis will result in higher concentrations than if it had been modeled with the current model version. Therefore, the analysis is conservative and appropriate for comparison against the NAAQS. This is discussed further in section 5.3.2.10 of this TSD. A discussion of the state's approach to the individual components is provided in the corresponding discussion that follows, as appropriate.

5.3.2.2. 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.

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 (as discussed in Section 3.4 above).

The EPA agrees with Connecticut's selection of rural dispersion characteristics for Middletown Power, given the land use characteristics for the area.

5.3.2.3. 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 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.

For the Middlesex County area, the state included Middletown Power in the modeling.

The receptor placement for the area of analysis selected by the state is a series of nested, square Cartesian grids centered on the source, as follows:

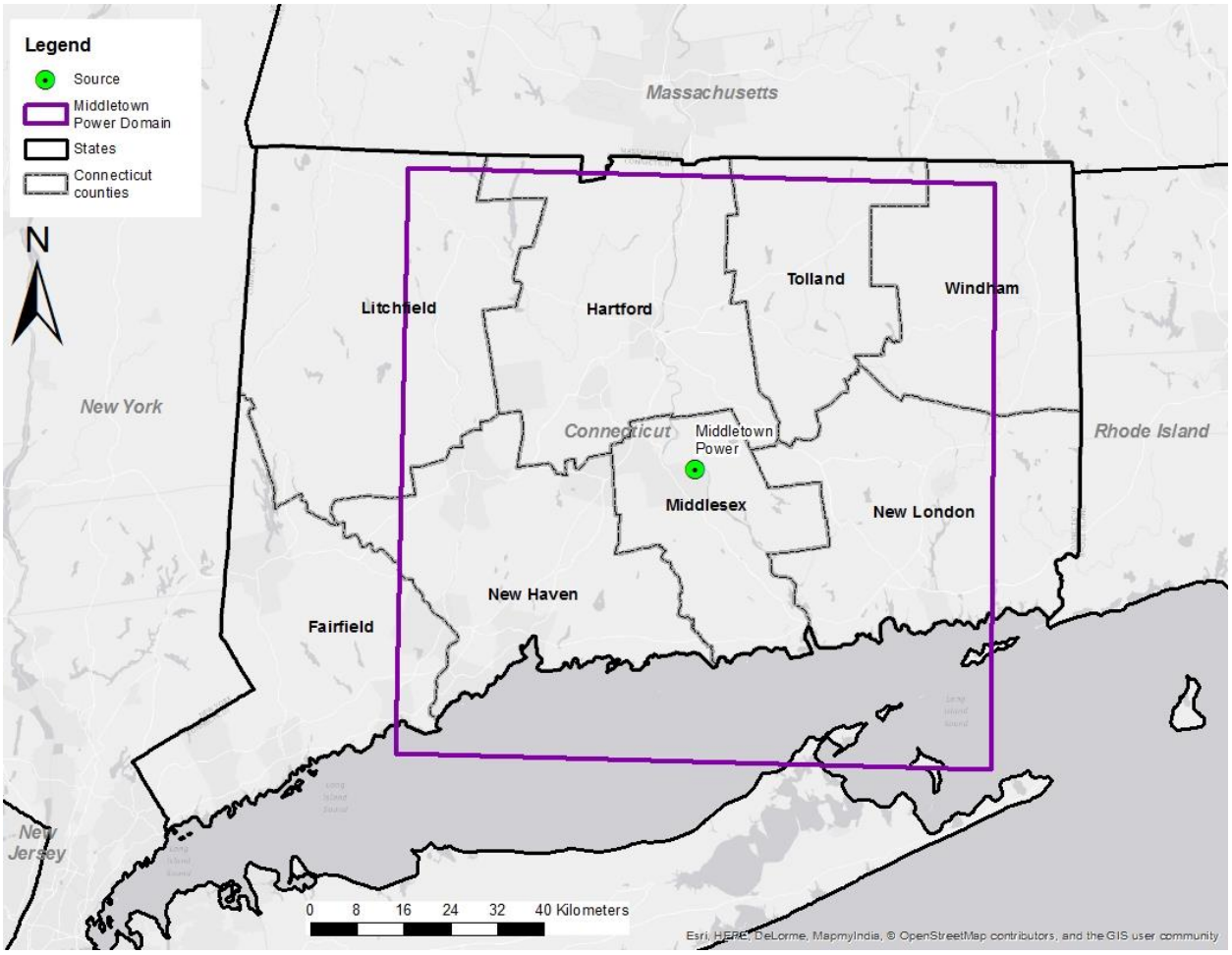
- Extending 5 km from the source at 250-meter spacing
- Extending 10 km from the source at 500-meter spacing
- Extending 20 km from the source at 1,000-meter spacing
- Extending 50 km from the source at 2,000-meter spacing

The receptor network contained 6,321 unique receptors, and the network covered the entirety of Middlesex County, nearly the entirety of Hartford, New Haven, and Tolland Counties, the majority of New London and Windham Counties, and large portions of Litchfield County. Fenceline receptors were not included in the modeling domain, but because modeling receptors were included within the fenceline on the facility property, and because the modeled maximum concentration was not near the fenceline, the model is expected to identify maximum impacts for the area.

Figures 19 and 20, generated by the EPA based on modeling files submitted by the state, show the state's chosen area of analysis surrounding Middletown Power, as well as the receptor grid for the area of analysis.

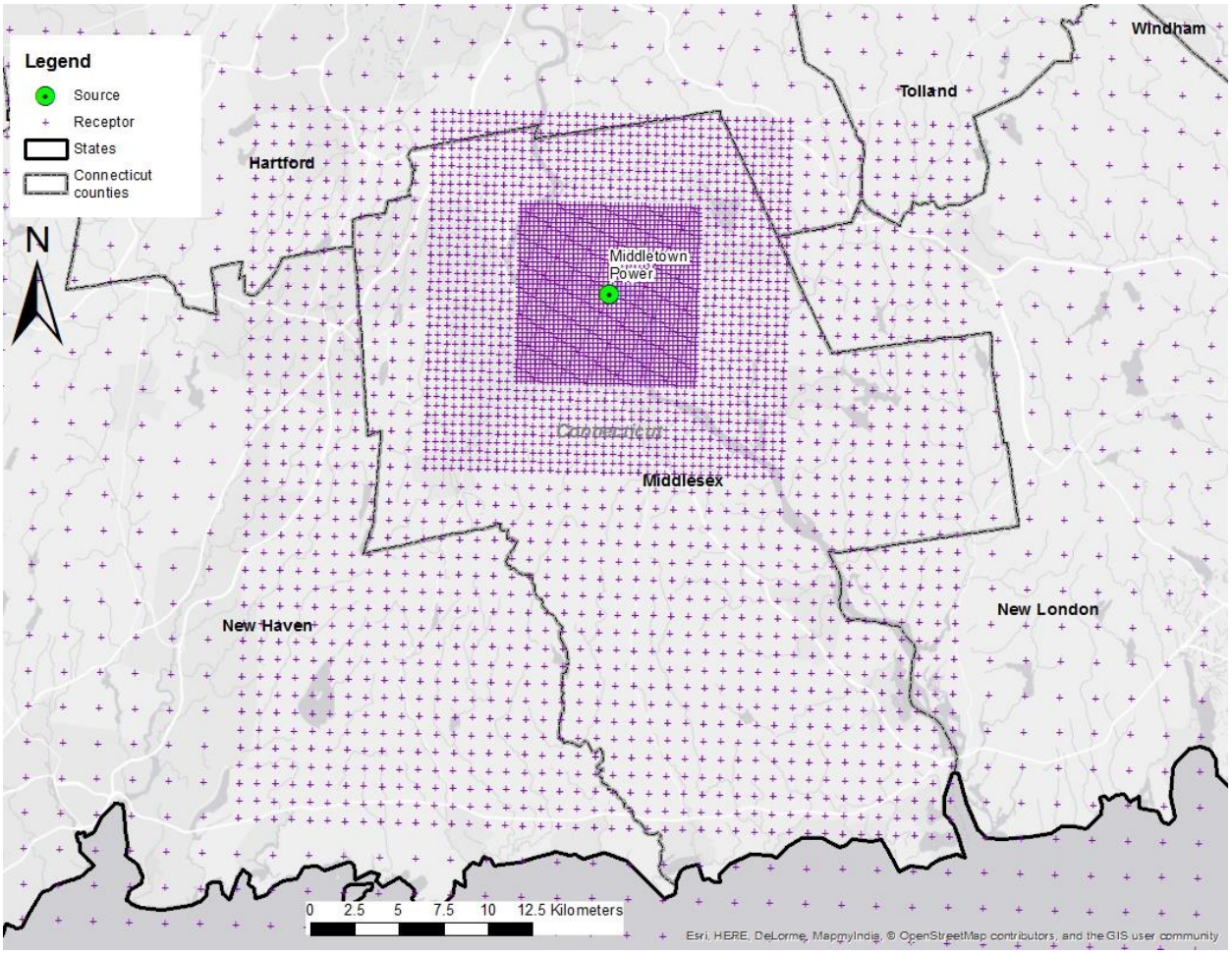
The state placed receptors for the purposes of this designation effort throughout the domain, including in locations that may not be considered ambient air relative to the modeled facility. The state opted to apply a regular grid of receptors without excluding receptor locations over water bodies, though Section 4.2 of the Modeling TAD allows removal of receptors in such locations.

Figure 19. Area of Analysis for the Middlesex County, Connecticut Area



The source of this map image is Esri, used by EPA with Esri's permission.

Figure 20. Near-field Receptor Grid for the Middlesex County, Connecticut Area



The source of this map image is Esri, used by EPA with Esri's permission.

The EPA finds that the modeling domain and placement of receptors are appropriate for adequately characterizing the Middlesex County, Connecticut, area.

5.3.2.4. 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 state explicitly included Middletown Power for modeling to address all sources in the state with emissions greater than 100 tpy to support its attainment recommendation. Other sources in or near the area are adequately characterized by the monitored background levels included in the modeling.

The state characterized this source within the area of analysis in accordance with the best practices outlined in the Modeling TAD. Specifically, the state used actual stack heights in conjunction with actual emissions. The state followed the EPA's good engineering practices (GEP) policy in conjunction with allowable emissions limits, as applicable. The state 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.

Based on comparisons between the modeling source characterization against publicly available information in permits and maps, the EPA concludes that the source characterization is appropriate.

5.3.2.5. 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 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, 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, 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 state included Middletown Power in the area of analysis. For this area of analysis, the state has opted to use a hybrid approach, where emissions from certain units are expressed as actual emissions, and those from other units are expressed as PTE rates. The emission units in the state's modeling analysis and their associated actual or PTE rates are summarized below.

For Middletown Power Units 2, 3, and 4, the state provided annual actual SO_2 emissions between 2007 and 2011. This information is summarized in Table 13. A description of how the state obtained hourly emission rates is given below this table.

Table 13. Actual SO_2 Emissions Between 2009 – 2011 from Units in the Middlesex County Area

Unit Name	SO_2 Emissions (tpy)				
	2007	2008	2009	2010	2011
Middletown Power Unit 2	79	37	26	15	10
Middletown Power Unit 3	33	69	39	16	7
Middletown Power Unit 4	55	97	51	132	53
Total Emissions from All Modeled Units in the State's Area of Analysis*	166	203	116	162	71

*Annual emissions totals for all units may differ slightly from the sum of annual individual unit emissions due to rounding.

For Middletown Power Units 2, 3, and 4, the actual hourly emissions data were obtained from CEMs. Emissions used in the state's analysis are from 2007-2011 rather than the most recent 3 years as recommended in the Modeling TAD. To determine whether changes in emissions may have an effect on results, the EPA examined statewide and facility trends that may influence the modeling for this area of analysis. For the facility, SO_2 emissions declined from an average annual emissions of 215 tons between 2007 and 2011 to 135 tons between 2013 and 2015. The maximum annual emissions for the prior period was 514 tons in 2007 and 170 tons in 2014 for the current period. Statewide emissions have similarly declined from the period of analysis (2007-2011), during which an annual average of 18,307 tons were emitted statewide, to the 2013-2015 period, during which an annual average of 12,523 tons were emitted statewide. Based on this information, the EPA concludes that the trend in facility and statewide emissions has decreased over time, and the state's use of older emissions data will not underestimate impacts from the facility.

For the remaining auxiliary units and combustion turbines at Middletown Power, the state provided PTE values because CEMs data was not available. This information is summarized in Table 14. A description of how the state obtained hourly emission rates is given below this table.

Table 14. SO_2 Emissions based on PTE from Units in the Area of Analysis for the Middlesex County Area

Unit Name	SO_2 Emissions (tpy, based on PTE)
Middletown Power Auxiliary Unit 4	33.3
Middletown Power Turbine (20 MW)	56.7
Middletown Power Four Combustion Turbines (50 MW)	16.8
Total Emissions from Units in the Area of Analysis Modeled Based on PTE	106.8

The PTE in tons per year for Middletown Power auxiliary units and turbines were determined by the state based on permitted emission and/or operation limits. Specifically, auxiliary Unit 4 is subject to statewide sulfur in residual fuel limits of 0.3% by weight that were approved into the state's SIP on July 10, 2014 (see 79 FR 39322) and a unit-specific emission limit of 36.5 lb SO_2/hr per NSR permit number 104-0002, the 20 MW turbine is subject to distillate fuel sulfur limits of 0.05% by weight as of July 1, 2014 (see 81 FR 33134) for an allowable rate of 10.6 lb/hr, and the four 50 MW combustion turbines are each subject to a separate federally enforceable NSR permit emission limit of 0.7 lb/hr, which is incorporated into the facility's title V operating permit. The federally enforceable rates for the turbine units are more stringent than the emission rates included in the modeling, so the EPA concludes that those units are adequately accounted for. However, the modeled rate for auxiliary Unit 4 was 7.6 lb/hr, which is 4.8 times lower than the actual federally enforceable emission limit of 36.5 lb/hr. This discrepancy will be discussed further later in this section. Emissions were assumed to be the same in each modeled year.

Based on the available evidence, with the exception of emissions for auxiliary Unit 4, for which a discrepancy of a factor of 4.8 was identified, the EPA concurs with Connecticut in its selections of emissions parameters and emissions rates for the sources included in the modeling. The discrepancy regarding emissions from auxiliary Unit 4 will be further addressed later in this section.

5.3.2.6. Modeling Parameter: Meteorology and Surface Characteristics

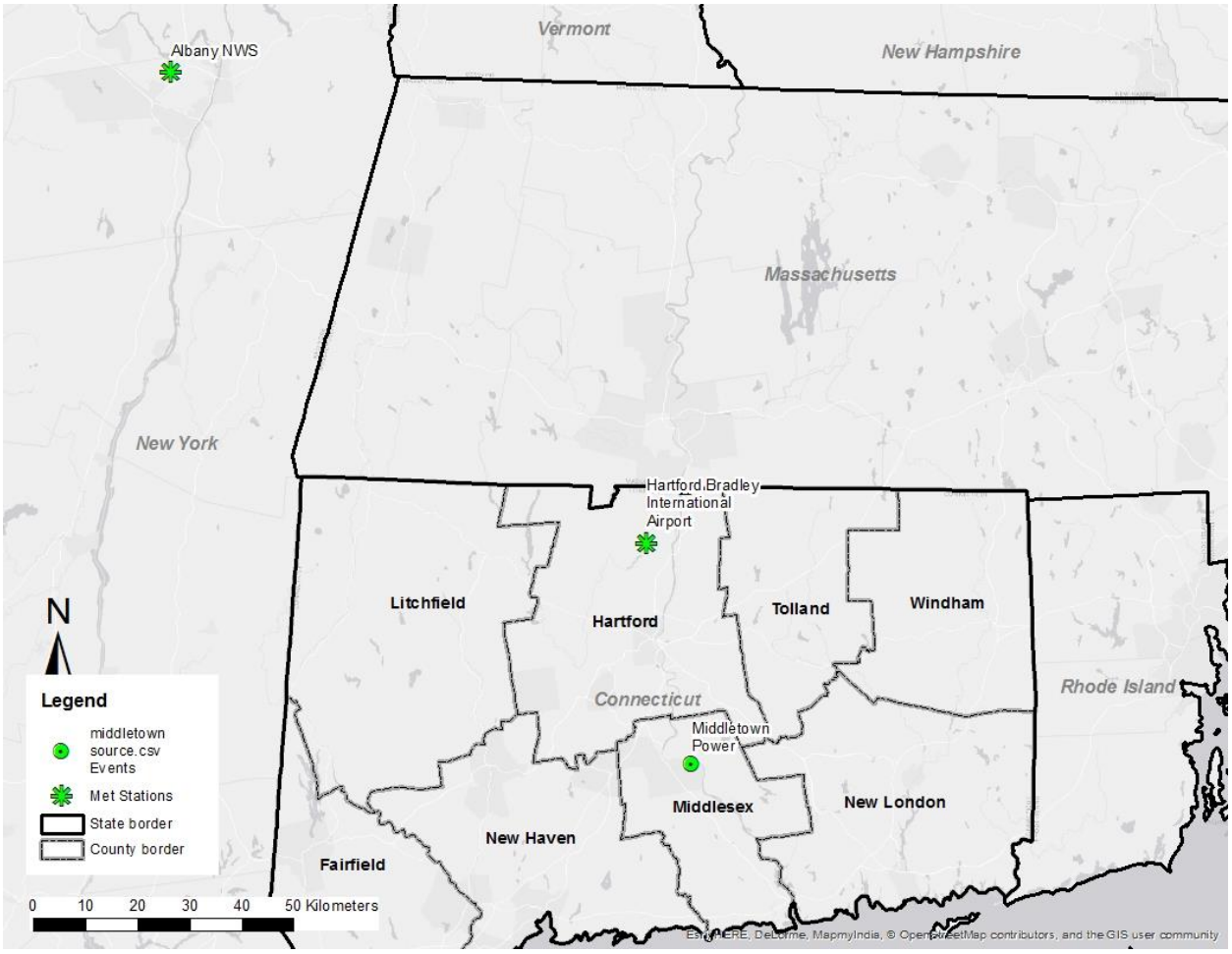
As noted in the Modeling TAD, at least the most recent 3 years of meteorological data (concurrent with the most recent 3 years of emissions data) should be used in designations efforts. The selection of data should be based on spatial and climatological (temporal) representativeness. The representativeness 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 Middlesex County area, the state selected the surface meteorology for a 5-year period from the NWS Automated Surface Observing Systems (ASOS) station at Bradley Airport in Windsor Locks, Connecticut, about 43 km to the north of the source, and coincident upper air observations from a different NWS station located in Albany, New York as best representative of meteorological conditions within the area of analysis.

The state used AERSURFACE version 08009 using land cover data from the 1992 National Land Cover Dataset representative of the Bradley Airport NWS station to estimate the surface characteristics (albedo, Bowen ration, and surface roughness (z_o)) of the area of analysis. The state estimated values for 12 spatial sectors out to 1 km at a monthly temporal resolution for average conditions.

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

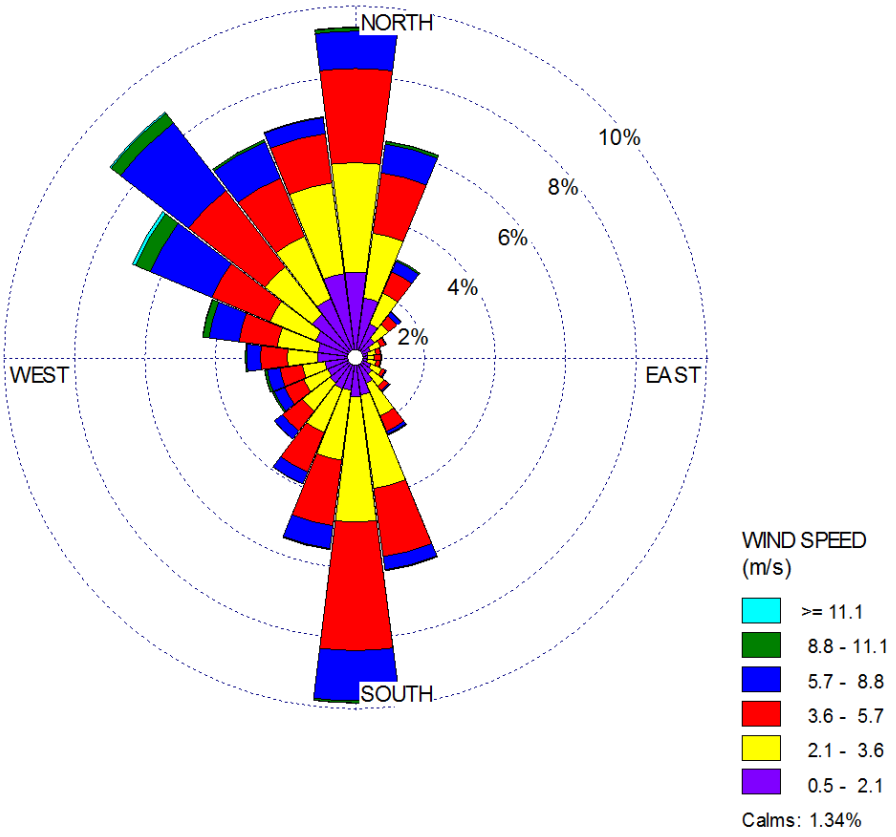
Figure 21. Area of Analysis and the NWS stations in the Middlesex County Area



The source of this map image is Esri, used by EPA with Esri's permission.

The EPA generated a wind rose for the 5-year surface data from the Bradley Airport ASOS station using the WRPLOT View™ software version 7.0 (Lakes Environmental). In Figure 22, the frequency and magnitude of wind speed and direction are defined in terms of from where the wind is blowing. During the 5-year period, the prevailing wind directions tended to be from the north to the northwest or from the south; relatively few hours were from the east or west.

Figure 22. Middlesex County, Connecticut Cumulative Annual Wind Rose for Years 2007 – 2011



Meteorological data from the above surface and upper air NWS stations were used in generating AERMOD-ready files with the AERMET processor, version 12345. 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 AERMET version 12345 User's Guide and Addendum in the processing of the raw meteorological data into an AERMOD-ready format, and used AERSURFACE to best represent surface characteristics.

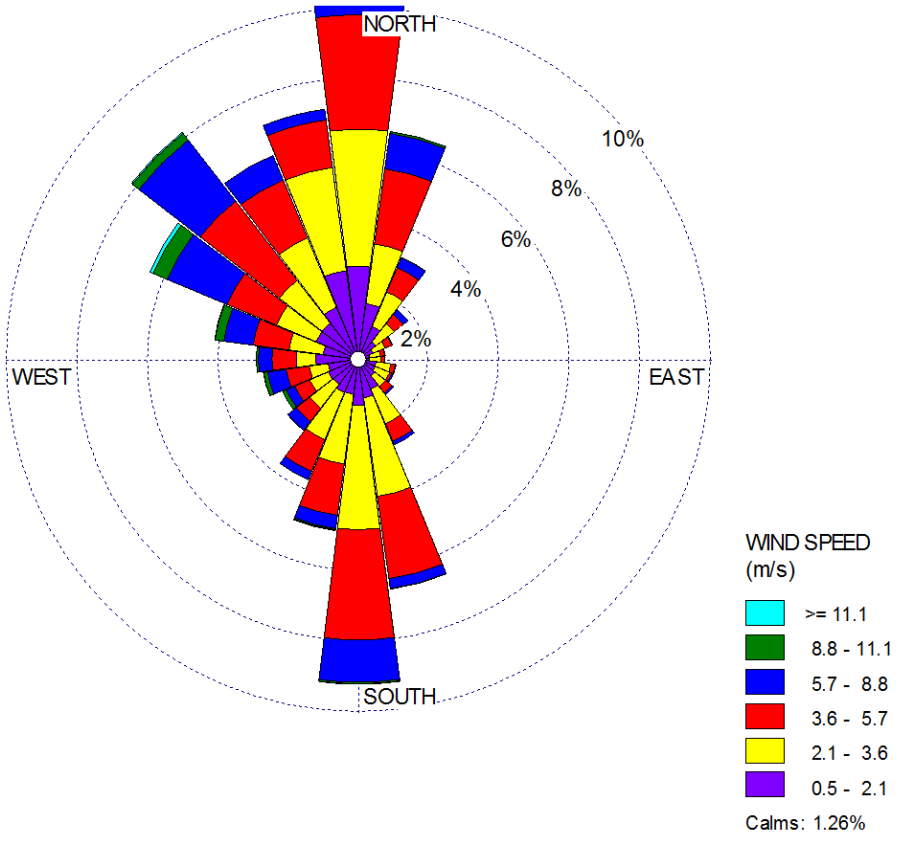
Hourly surface meteorological data records are read by AERMET, and include all the necessary elements for data processing. However, wind data taken at hourly intervals may not always portray wind conditions for the entire hour, which can be variable in nature. Hourly wind data may also be overly prone 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 Bradley Airport ASOS station, but in a different formatted file to be processed by a separate preprocessor, AERMINUTE version 11325. 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 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.

The EPA notes several inconsistencies with the Modeling TAD in the state's selection of meteorological data and processing. Specifically, in our Modeling TAD, the EPA recommended the use of the most recent model version and meteorological datasets. However, the state's analysis uses older model versions with out of date meteorological data. The following discussion indicates how the EPA assessed these inconsistencies with the Modeling TAD and the resolution of that assessment.

- The EPA has compared the meteorological data submitted by the state to the most recent three years for the same area. The EPA compared the original meteorological data submitted by the state using AERMET version 12345 against data processed using AERMET version 16216, the most current version. A wind rose based on the updated AERMET preprocessor is presented in Figure 23. The EPA has assessed the pattern of winds from these datasets. The patterns are nearly identical, with approximately the same proportion of hours with winds from each direction and speed category. Furthermore, the EPA has compared the temperature, cloud cover, relative humidity, and atmospheric pressure profiles from 2007-2011 and 2013-2015, and found minimal differences between the parameter profiles for each time period.
- The EPA has compared the meteorological data submitted by the state using AERMET version 12345 to the same data as processed with AERMET version 16216. Specifically, the EPA considered hourly differences in various output variables, specifically sensible heat flux, surface friction velocity, convective velocity scale, potential temperature gradient above the mixing height, and convectively and mechanically driven mixing height. In our review, the EPA found no or minimal differences for the vast majority of hours in the analysis.
- The EPA examined model change bulletins for AERMET for all versions between 12345 and 16216, specifically bulletins for versions 13350, 14134, 15181, and 16216. No

changes are expected to cause substantial differences in the AERMET outputs using the state's selected input options and data.

Figure 23. Middlesex County, Connecticut Cumulative Annual Wind Rose for Years 2009 – 2011 using AERMET version 16216



The EPA concludes from the information at hand that the meteorological data were selected and treated appropriately and are suitable for the current assessment, despite any inconsistencies with the Modeling TAD, as discussed above. The station used for surface meteorology in the development of meteorological inputs to AERMOD is located within the modeling domain, and is suitably representative of the meteorological conditions at Middletown Power.

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

The terrain in the area of analysis covers an area that includes gently rolling terrain to more complex, rocky terrain in the northeast portion of the domain, to flat terrain over Long Island Sound. 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 US Geological Survey's National Elevation Dataset at 30-meter (1-arc second) resolution.

Based on the submission, the EPA concludes the state's approach in specifying terrain elevations is appropriate.

5.3.2.8. 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 99th percentile monitored concentrations by hour of day and season or month. For this area of analysis, the state used the tier 2 approach described in the Modeling TAD and in the EPA's March 1, 2011 memo, "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 Ambient Air Quality Standard". Specifically, the state relied on the 99th percentile (by hour of day and season) based on data from the East Hartford McAuliffe Park monitor (AQS site number 09-003-1003) for 2009-2011. Using this approach, the state developed 96 individual values to represent 24-hourly values for each of four seasons. The range of background values included in the state's modeling is from 1.4 ppb (3.7 $\mu g/m^3$)[12], to 16.6 ppb (43.5 $\mu g/m^3$), with an average value of 7.2 ppb (18.9 $\mu g/m^3$). The background concentrations for this area of analysis were determined by the state and are presented in Table 15.

[12] 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 1 ppb = approximately 2.619 $\mu g/m^3$.

Table 15. SO_2 Background Concentrations in the Middlesex County Area for 2009 – 2011

Hour	Season			
	Winter	Spring	Summer	Fall
1	14.2	8.6	2.3	6.4
2	12.4	7.0	1.9	5.9
3	12.8	9.4	1.7	5.9
4	12.0	7.4	1.5	5.2
5	12.2	8.7	1.6	5.0
6	13.2	10.0	1.9	4.9
7	15.0	9.9	3.1	5.2
8	16.6	9.0	3.2	7.4
9	16.5	7.6	4.0	6.8
10	15.3	6.3	3.5	7.7
11	14.1	5.9	3.7	5.7
12	13.4	5.0	3.3	5.8
13	11.0	4.8	3.3	6.3
14	11.6	6.4	3.4	5.8
15	12.1	4.7	3.4	6.2
16	11.7	3.4	1.4	5.3
17	14.7	3.2	3.1	5.2
18	14.2	4.1	3.1	5.2
19	14.2	4.4	3.4	5.5
20	14.3	4.9	3.0	6.4
21	14.4	6.5	2.4	6.1
22	12.8	7.5	2.2	5.8
23	12.5	7.7	2.2	6.0
24	12.7	8.4	2.1	6.6

The EPA believes the background values used for the assessment of the Middlesex County area are appropriate, based on the data and reasoning provided by the state.

5.3.2.9. Summary of Modeling Inputs and Results

The AERMOD modeling input parameters for the Middlesex County area of analysis are summarized below in Table 16.

Table 16. Summary of AERMOD Modeling Input Parameters for the Area of Analysis for the Middlesex County area

Input Parameter	Value
AERMOD Version	12345
Dispersion Characteristics	Rural
Modeled Sources	9
Modeled Stacks	8
Modeled Structures	5
Modeled Fencelines	0
Total receptors	6,321
Emissions Type	Hybrid (both actual and PTE)
Emissions Years	2007-2011
Meteorology Years	2007-2011
NWS Station for Surface Meteorology	Bradley Airport ASOS
NWS Station Upper Air Meteorology	Albany, New York NWS
NWS Station for Calculating Surface Characteristics	Bradley Airport ASOS
Methodology for Calculating Background SO_2 Concentration	AQS site number 09-003-1003, Tier 2, temporally varying by hour of day and season
Calculated Background SO_2 Concentration	1.4 to 16.6 ppb

The results presented below in Table 17 show the magnitude and geographic location of the highest predicted modeled concentration based on the input parameters.

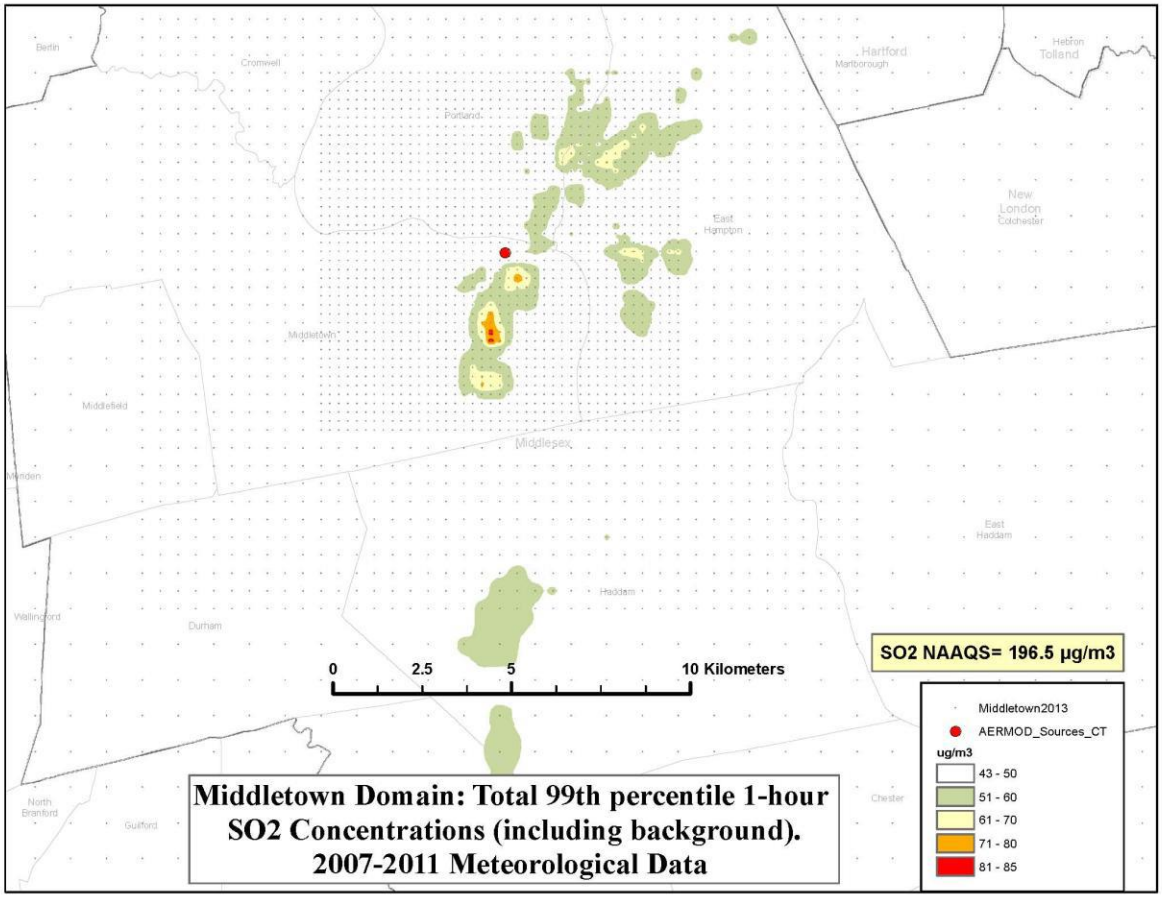
Table 17. Maximum Predicted 99th Percentile Daily Maximum 1-Hour SO_2 Concentrations Averaged Over Five Years for the Area of Analysis for the Middlesex County area

Averaging Period	Data Period	Receptor Location [UTM zone 18]		99th percentile daily maximum 1-hour SO_2 Concentration ($\mu g/m^3$)	
		UTM-X (meters)	UTM-Y (meters)	Modeled concentration (including background)	NAAQS Level
99th Percentile 1-Hour Average	2007-2011	701,504	4,600,627	89.7	196.4*

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

The state's modeling indicates that the highest predicted 99th percentile daily maximum 1-hour concentration within the chosen modeling domain is 89.7 $\mu g/m^3$, equivalent to 34.2 ppb. The state's modeled concentration included the background concentration of SO_2, and is based on a mix of actual and allowable emissions from the facility. Because the state's modeling assessment included a discrepancy of a factor of 4.8 for one emission unit, the EPA further examined the state's modeling results for that unit and applied the discrepancy factor to that unit's emissions to determine the unit's impacts, assuming that those impacts occurred at the location of the highest modeled concentration. Specifically, the modeled impacts from auxiliary Unit 4 are 0.30 $\mu g/m^3$. The EPA applied a scaling factor of 4.8 to those impacts to derive an impact level of 1.44 $\mu g/m^3$, and added the difference ($1.44 - 0.30 = 1.14$ $\mu g/m^3$) to the modeled results to determine the maximum impacts that could arise if the discrepancy had not been in the modeling. Therefore, the modeled impact is adjusted from 89.7 $\mu g/m^3$ to 90.9 $\mu g/m^3$. Figure 24 below was included as part of the state's recommendation, and indicates that the state's predicted value occurred approximately 2.6 km to the south southwest of the facility. The state's receptor grid is also shown in the figure.

Figure 24. Predicted 99th Percentile Daily Maximum 1-Hour SO_2 Concentrations Averaged Over Five Years for the Area of Analysis for the Middlesex County Area



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.

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

The modeling submitted by the state was performed prior to the EPA releasing our Modeling TAD. Therefore, there are some deviations from the Modeling TAD in the state's modeling analysis. As discussed in previous sections, the state's modeling relies on outdated versions of various components of the modeling system. The versions used by the state in some cases are no longer considered the regulatory version of the model. To account for these differences, the EPA has conducted an assessment of the differences in the modeling from the elements described in the Modeling TAD.

- The EPA has compared the meteorological data submitted by the state to the most recent three years for the same area. The two wind roses included in the previous sections (i.e., Figures 22 and 23) serve as a basis for making this comparison for wind speed and

direction. The EPA has assessed the pattern of winds from these datasets. The patterns are nearly identical, with approximately the same proportion of hours with winds from each direction and speed category. Furthermore, the EPA has compared the temperature, cloud cover, relative humidity, and atmospheric pressure profiles from 2007-2011 and 2013-2015, and found minimal differences between the parameter profiles for each time period.

- The EPA has compared the meteorological data submitted by the state using AERMET version 12345 to the same data as processed with AERMET version 16216. Specifically, the EPA considered hourly differences in various output variables, specifically sensible heat flux, surface friction velocity, convective velocity scale, potential temperature gradient above the mixing height, and convectively and mechanically driven mixing height. In our review, the EPA found no or minimal differences for the vast majority of hours in the analysis.
- The EPA examined model change bulletins for AERMET for all versions between 12345 and 16216, specifically bulletins for versions 13350, 14134, 15181, and 16216. No changes are expected to cause substantial differences in the AERMET outputs using the state's selected input options and data.
- To determine whether changes in emissions may have an effect on results, the EPA examined statewide and facility trends that may influence the modeling for this area of analysis. For the facility, SO_2 emissions declined from an average annual emissions of 215 tons between 2007 and 2011 to 135 tons between 2013 and 2015. The maximum annual emissions for the prior period was 514 tons in 2007 and 170 tons in 2014 for the current period. Statewide emissions have similarly declined from the period of analysis (2007-2011), during which an annual average of 18,307 tons were emitted statewide, to the 2013-2015 period, during which an annual average of 12,523 tons were emitted statewide.
- The EPA examined model change bulletins for AERMOD for all versions between 12345 and 16216r, specifically bulletins for versions 13350, 14134, 15181, and 16216. The model change bulletins indicate that the model version used by the state will result in higher concentrations than the current regulatory version. Specifically, version 15181 included a bug fix for tall stacks in urban areas; the sources in Connecticut using the urban option with AERMOD version 12345 will potentially have higher concentrations than those using model versions with the bug fix.
- Because the state's modeling assessment included a discrepancy of a factor of 4.8 for one emission unit, the EPA further examined the state's modeling results for that unit and applied the discrepancy factor to that unit's emissions to determine the unit's impacts, assuming that those impacts occurred at the location of the highest modeled concentration. Specifically, the modeled impacts from auxiliary Unit 4 are 0.30 $\mu g/m^3$. The EPA applied a scaling factor of 4.8 to those impacts to derive an impact level of 1.44 $\mu g/m^3$, and added the difference ($1.44 - 0.30 = 1.14$ $\mu g/m^3$) to the modeled results to determine the maximum impacts that could arise if the discrepancy had not been in the modeling. Therefore, the modeled impact is adjusted from 89.7 $\mu g/m^3$ to 90.9 $\mu g/m^3$, which does not indicate a violation of the NAAQS.

Based on this assessment, the EPA concludes that the state's analysis has the capability to demonstrate that no violations of the NAAQS have occurred.

As explained in the preceding sections, and in the context of the preceding discussion regarding the use of outdated modeling components, the EPA concurs with the state's selection of modeling components, including: urban operating mode; modeling domain and receptor placement; source characterization, including stack parameters; emissions parameters and rates; meteorological data and surface parameters; terrain elevations; and background concentrations. Therefore, the EPA believes that the modeling submitted by the state is sufficient to base designations determinations on for this area.

5.4. Jurisdictional Boundaries in the Middlesex County Area

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

In 2013, the state recommended an attainment designation for the entire state of Connecticut, including Middlesex County, based on modeling for all sources with annual emissions greater than 100 tons SO_2 in the state that showed attainment of the 1-hour SO_2 NAAQS. In that 2013 analysis, the state included Middletown Power within Middlesex County. Based on version 1 of the 2014 NEI, there are no SO_2 sources within 20 km outside the boundaries of Middlesex County with annual emissions greater than 100 tons. The EPA agrees with the state that emissions from Middletown Power will dominate in the Middlesex County area, and inclusion of the Middletown Power source provides for a reasonable basis for designating the area.

5.5. The EPA's Assessment of the Available Information for the Middlesex County Area

The EPA is basing our intended designation for Middlesex County, Connecticut, primarily on the modeling assessment provided by the state in 2013. The EPA finds this analysis serves as a suitable basis for assessing the SO_2 attainment status of the Middlesex County area.

State modeling is also available for New Haven County, which borders Middlesex County, and this analysis is discussed in a previous section of this TSD. Based on version 1 of the 2014 NEI, there are no SO_2 sources within 20 km outside the boundaries of Middlesex County with annual emissions greater than 100 tons. The EPA has no information indicating the presence of a violation near any border of Middlesex County.

There are no areas within or near Middlesex County that are intended to remain undesignated until after Round 3 designations are completed, and that would therefore occur in a later action.

The EPA believes that our intended statewide unclassifiable/attainment area 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. The EPA intends to include this unclassifiable/attainment area as part of the EPA's intended statewide unclassifiable/attainment area, as discussed in Section 7.

5.6. Summary of Our Intended Designation for the Middlesex County Area

After careful evaluation of the state's recommendation and supporting information, as well as all available relevant information, the EPA intends to modify the state's recommendation and designate the Middlesex County, Connecticut, area as unclassifiable/attainment for the 2010 SO_2 NAAQS, as part of the EPA's intended statewide unclassifiable/attainment area, as discussed in Section 7. A designation of "unclassifiable/attainment" for this statewide area indicates 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.

6. Technical Analysis for the Rest of Connecticut Areas

6.1. Introduction

The state has not installed and begun timely operation of a new, approved SO_2 monitoring network meeting EPA specifications referenced in EPA's SO2 DRR for any sources of SO_2 emissions in the counties identified in Table 18. Accordingly, the EPA must designate these counties by December 31, 2017. At this time, there are no air quality modeling results available to the EPA for these counties. In addition, there is no air quality monitoring data that indicate any violation of the 1-hour SO_2 NAAQS. The EPA is designating the counties in Table 18 in the state as "unclassifiable/attainment" based on the state's modeling analyses, which assessed air quality around all SO_2 emissions sources greater than 100 tons per year and characterized air quality in almost every area of the state, including large portions or nearly the entirety of all counties in the state. As described in the preceding sections, the EPA intends to find that these modeling analyses serve as a sufficient basis for designating areas around the modeled sources. Because the modeling domains in aggregate essentially cover the entire state of Connecticut (see Figures 8, 14, and 19), and because the state included all sources with annual emissions greater than 100 tons in its analyses, the EPA considers the aggregate analyses to be a sufficient basis to designate all other areas of Connecticut.

A designation of "unclassifiable/attainment" for this statewide area indicates 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.

Table 18. Counties that the EPA Intends to Designate Unclassifiable/Attainment as Part of the Intended Statewide Unclassifiable/Attainment Designation

County	Connecticut's Recommended Area Definition	Connecticut's Recommended Designation	EPA's Intended Area Definition	EPA's Intended Designation
Hartford	Entire state of Connecticut	Attainment	Same as State's Recommendation	Unclassifiable/ Attainment
Litchfield				
New London				
Tolland				
Windham				

Table 18 also summarizes Connecticut's recommendations for these areas. Specifically, the state recommended that the entire state of Connecticut be designated as attainment based on the modeling analyses for all sources greater than 100 tons per year and ambient monitoring data. In its recommendation, the state did not identify a preference for establishing a single area versus several areas. However, in conversations between the state and the EPA, the state did express a preference for a single statewide area. Based on the state's preference for a statewide designation, and because this is also a clearly defined legal boundary, , the EPA intends to designate Connecticut on a statewide basis. After careful review of the state's assessment, supporting documentation, and all available data, the EPA intends to modify the state's recommendation and designate the rest of Connecticut areas as unclassifiable/attainment as part of the EPA's intended statewide unclassifiable/attainment area, as discussed in Section 7.

As discussed in the Introduction, there are no counties associated with sources for which Connecticut has installed and begun timely operation of a new, approved SO_2 monitoring network are required to be designated by December 31, 2020, but are not being addressed at this time.

6.2. Air Quality Monitoring Data for the Litchfield County Area

AQS monitor 09-005-0005 located at Mohawk Mountain, Cornwall, in Litchfield County, Connecticut, has sufficient valid data for 2013-2015. These data indicate that there were no violations of the 2010 SO_2 NAAQS at the monitoring site in that period. These data were available to EPA for consideration in the designations process, however, since it is unclear if these monitors are located in areas of maximum concentration, it is unclear if the data are representative of the area's actual air quality.. Accordingly, the intended designation of unclassifiable/attainment for this area is appropriate.

For reference, see the annual posted air quality Design Values for SO_2 posted at our Air Quality Design Values website, https://www.epa.gov/air-trends/air-quality-design-values.

6.3. Jurisdictional Boundaries in the Rest of Connecticut Areas

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

6.4. The EPA's Assessment of the Available Information for the Rest of Connecticut Areas

Our intended unclassifiable/attainment area 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. The EPA intends to include this unclassifiable/attainment area as part of the EPA's intended statewide unclassifiable/attainment area, as discussed in Section 7.

State modeling is also available for areas bordering Litchfield County (modeling for Fairfield and New Haven Counties), Hartford County, (modeling for New Haven and Middlesex Counties), and New London County (modeling for Middlesex County), and these analyses are discussed in previous sections of this TSD. Based on version 1 of the 2014 NEI, there are no SO_2 sources within 10 km outside the boundaries of Hartford, Litchfield, New London, Tolland, and Windham Counties, Connecticut, with annual emissions greater than 100 tons. The EPA has no information indicating the presence of a violation near any border of these areas.

6.5. Summary of Our Intended Designation for the Rest of Connecticut Areas

After careful evaluation of the state's recommendation and supporting information, as well as all available relevant information, the EPA intends to designate the counties listed in Table 18, Hartford, Litchfield, New London, Tolland, and Windham Counties, Connecticut, as unclassifiable/attainment for the 2010 SO_2 NAAQS, as part of the EPA's intended statewide unclassifiable/attainment area, as discussed in Section 7.

A designation of "unclassifiable/attainment" for these areas indicates 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.

The locations of Hartford, Litchfield, New London, Tolland, and Windham Counties, which the EPA intends to be part of the statewide designation area as discussed in Section 7, are shown in Figure 25.

7. Technical Analysis for the Entire State of Connecticut

7.1. Introduction

The state has not installed and begun timely operation of a new, approved SO_2 monitoring network meeting EPA specifications referenced in EPA's SO_2 DRR for any sources of SO_2 emissions in Connecticut. Accordingly, the EPA must designate the entire state by December 31, 2017. The EPA has discussed the information available for each county in the state in the preceding sections. Air quality modeling results available to the EPA for all Connecticut counties, as described in the previous sections, indicates no violation of the 1-hour SO_2 NAAQS. In addition, there is no air quality monitoring data that indicate any violation of the 1-hour SO_2 NAAQS. The EPA intends to designate the entire state as "unclassifiable/attainment" based on the state's modeling analyses, which assessed air quality around most SO_2 emissions sources greater than 100 tons per year (with the sole exception of Wheelabrator Bridgeport, which emitted 116 tons in 2014) and characterized air quality in almost every area of the state, including large portions or nearly the entirety of all counties in the state. Because Wheelabrator Bridgeport is located near Bridgeport Harbor, which has been evaluated using modeling consistent with the Modeling TAD, and which was characterized appropriately in the monitored background, the EPA believes there is sufficient information to designate the Fairfield County area as unclassifiable/attainment, as described in Section 3. As described in the preceding sections, the EPA intends to find that these modeling analyses serve as a sufficient basis for designating areas around the modeled sources. Because the modeling domains in aggregate essentially cover the majority of the state of Connecticut (see Figures 8, 14, and 19), and because the state included all sources with annual emissions greater than 100 tons (except one, which has been discussed previously) in its analyses, the EPA considers the aggregate analyses to be a sufficient basis to designate all areas of Connecticut.

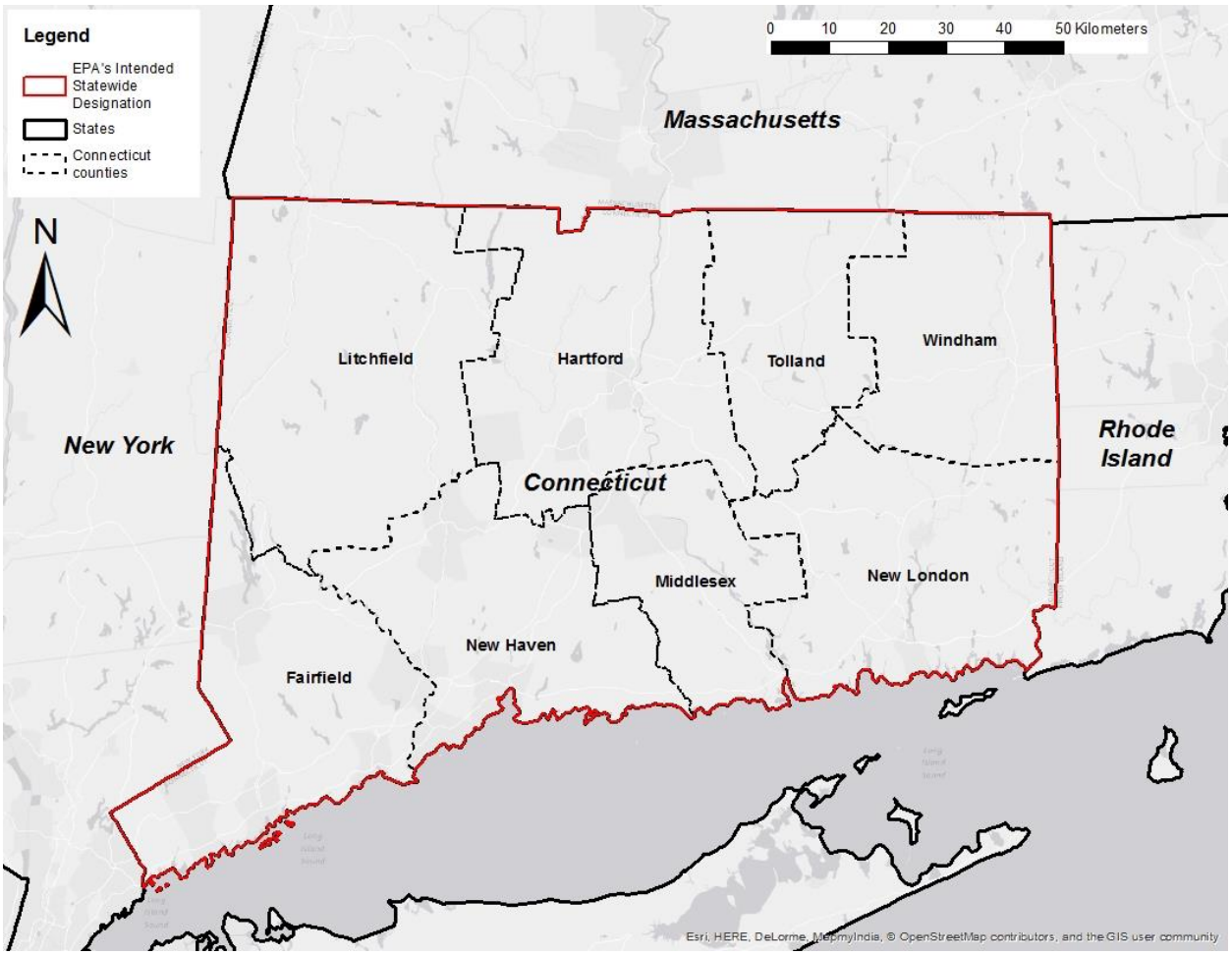
A designation of "unclassifiable/attainment" indicates an area that either: (1) was required to be characterized by the state under 40 CFR 51.1203(c) or (d), has not been previously designated, and on the basis of available information cannot be classified as either: (i) meeting or not meeting the 2010 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.

Table 19. Counties that the EPA Intends to Designate Unclassifiable/Attainment

County	Connecticut's Recommended Area Definition	Connecticut's Recommended Designation	EPA's Intended Area Definition	EPA's Intended Designation
Fairfield	Entire State of Connecticut	Attainment	Same as State's Recommendation	Unclassifiable/ Attainment
Hartford				
Litchfield				
Middlesex				
New London				
Tolland				
Windham				

Table 19 also summarizes Connecticut's recommendations for these areas. Specifically, the state recommended that the entire state of Connecticut be designated as attainment based on the modeling analyses for all sources greater than 100 tons per year and ambient monitoring data. In its recommendation, the state did not identify a preference for establishing a single area versus several areas. However, in conversations between the state and the EPA, the state did express a preference for a single statewide area. Based on the state's preference for a statewide designation, and because this is also a clearly defined legal boundary, the EPA intends to designate Connecticut on a statewide basis. After careful review of the state's assessment, supporting documentation, and all available data, the EPA intends to designate the entire state of Connecticut as unclassifiable/attainment. Figure 25 shows the EPA's intended statewide designation area.

Figure 25. The EPA's Intended Unclassifiable/Attainment Designation for the Entire State of Connecticut



The source of this map image is Esri, used by EPA with Esri's permission.

As discussed in the Introduction, there are no counties associated with sources for which Connecticut has installed and begun timely operation of a new, approved SO_2 monitoring network that are required to be designated by December 31, 2020, but are not being addressed at this time.

7.2. Jurisdictional Boundaries in the Entire State of Connecticut

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

7.3. The EPA's Assessment of the Available Information for the Entire State of Connecticut

Our intended unclassifiable/attainment area, bounded by the jurisdictional boundaries of the state of Connecticut 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.

The EPA has no information indicating the presence of a violation near any border of these areas. Furthermore, the area is not nearby or contributing to any area for which designations are being deferred until a later round of designations.

7.4. Summary of Our Intended Designation for the Entire State of Connecticut

After careful evaluation of the state's recommendation and supporting information, as well as all available relevant information, the EPA intends to designate the area in the above Table 19, the entire state of Connecticut, as unclassifiable/attainment for the 2010 SO_2 NAAQS. Specifically, the boundaries of this area are comprised of the Connecticut state boundaries.

Figure 25 above shows the EPA's intended statewide designation area.

For the entire state of Connecticut, the boundary of the unclassifiable/attainment area is the state boundary.

Following the completion of these Round 3 designations, there will be no remaining undesignated areas in Connecticut to be addressed.