Lansing Smith Electric Generating Plant

Bay County, Florida

Evaluation of Compliance with the 1-hour NAAQS for SO_2

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1. Introduction

Wingra Engineering, S.C. was hired by the Sierra Club to conduct an air modeling impact analysis to help USEPA, state and local air agencies identify facilities that are likely causing exceedances of the 1-hour sulfur dioxide (SO_2) national ambient air quality standard (NAAQS). This document describes the results and procedures for an evaluation conducted for the Lansing Smith Electric Generating Plant (Lansing Smith) located in Bay County, Florida.

The dispersion modeling analysis predicted ambient air concentrations for comparison with the one hour SO_2 NAAQS. The modeling was performed using the most recent version of AERMOD, AERMET, and AERMINUTE, with data provided to the Sierra Club by regulatory air agencies and through other publicly-available sources as documented below. The analysis was conducted in adherence to all available USEPA guidance for evaluating source impacts on attainment of the 1-hour SO_2 NAAQS via aerial dispersion modeling, including the AERMOD Implementation Guide; USEPA's Applicability of Appendix W Modeling Guidance for the 1-hour SO_2 National Ambient Air Quality Standard, August 23, 2010; modeling guidance promulgated by USEPA in Appendix W to 40 CFR Part 51; ; USEPA's March 2011 Modeling Guidance for SO_2 NAAQS Designations;[1] and USEPA's December 2013 SO_2 NAAQS Designations Modeling Technical Assistance Document.[2]

2. Compliance with the 1-hour SO_2 NAAQS

2.1 1-hour SO_2 NAAQS

The 1-hour SO_2 NAAQS takes the form of a three-year average of the 99^{th}-percentile of the annual distribution of daily maximum 1-hour concentrations, which cannot exceed 75 ppb.[3] Compliance with this standard was verified using USEPA's AERMOD air dispersion model, which produces air concentrations in units of $\mu g/m^3$. The 1-hour SO_2 NAAQS of 75 ppb equals 196.2 $\mu g/m^3$, and this is the value used for determining whether modeled impacts exceed the NAAQS.[4] The 99^{th}-percentile of the annual distribution of daily maximum 1-hour concentrations corresponds to the fourth-highest value at each receptor for a given year.

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[1] http://www.epa.gov/scram001/so2_modeling_guidance.htm.
[2] http://epa.gov/oaqps001/sulfurdioxide/pdfs/SO2ModelingTAD.pdf.
[3] USEPA, Applicability of Appendix W Modeling Guidance for the 1-hour SO_2 National Ambient Air Quality Standard, August 23, 2010.
[4] The ppb to $\mu g/m^3$ conversion is found in the source code to AERMOD v. 14134, subroutine Modules. The conversion calculation is $75/0.3823 = 196.2\ \mu g/m^3$.

2.2 Modeling Results

Modeling results for Lansing Smith are summarized in Table 1. It was determined that based on current allowable emissions, the Lansing Smith could cause downwind SO_2 concentrations which exceed the 1-hour NAAQS.

For the modeling results presented in Table 1, the evaluated emission rates were the allowable - the peak emission rate from each unit as approved by the current air quality operation permit for the facility. A draft permit was released for public comment in December of 2014. The allowable emissions in the draft permit do not change the current limitations.

Air quality impacts in Florida are based on a background concentration of 57.2 µg/m3. This is the most recently available design value for Escambia County, Florida, from 2011-2013. See Section 5 for further discussion of the background concentration used for this modeling analysis.

Table 1 - SO_2 Modeling Results for Lansing Smith Modeling Analysis

Emission Rates	Averaging Period	99th Percentile 1-hour Daily Maximum (µg/m^3)				Complies with NAAQS?
		Impact	Background	Total	NAAQS	
Allowable	1-hour	780.3	57.2	837.5	196.2	No

The currently permitted emissions used for the modeling analysis are summarized in Table 2.

Table 2 - Modeled SO_2 Emissions from Lansing Smith [5]

Stack ID	Unit ID	Allowable Emissions 24-hour Average (lbs/hr)
S01	Unit 1	8,751.6
	Unit 2	10,107.9
Stack Total	All Units	18,859.5

Based on the modeling results, emission reductions from current rates considered necessary to achieve compliance with the 1-hour NAAQS were calculated and are presented in Table 3.

[5] Allowable emissions were taken from Florida DEP, Title V Air Operation Permit Renewal, Permit No. 0050014-018-AV, January 1, 2010. The allowable emissions with both units in operation are 4.5 lbs/mmbtu. A draft permit was released for public comment in December of 2014. The allowable emissions in the draft permit do not change the current limitations.

Table 3 - Required Emission Reductions for Compliance with the 1-hour NAAQS for SO_2

Acceptable Impact (NAAQS - Background) 99th Percentile 1-hour Daily Max (µg/m^3)	Required Total Facility Reduction Based on Allowable Emissions (%)	Required Total Facility Emission Rate (lbs/hr)	Required Total Facility 1-hour Average Emission Rate (lbs/mmbtu)
139.0	82%	3,359.6	0.80

Predicted exceedances of the 1-hour NAAQS for SO_2 based on allowable emissions extend throughout the region to a maximum distance of 50 kilometers.

Figure 1 presents a regional view of NAAQS exceedances based on allowable emissions.

Figure 2 presents a local view of NAAQS exceedances based on allowable emissions.

2.3 Conservative Modeling Assumptions

A dispersion modeling analysis requires the selection of numerous parameters which affect the predicted concentrations. For the enclosed analysis, several parameters were selected which under-predict facility impacts.

Assumptions used in this modeling analysis which likely under-estimate concentrations include the following:

- Allowable emissions are based on a limitation with an averaging period which is greater than the 1-hour average used for the SO_2 air quality standard. Emissions and impacts during any 1-hour period may be higher than assumed for the modeling analysis.
- No consideration of facility operation at less than 100% load. Stack parameters such as exit flow rate and temperature are typically lower at less than full load, reducing pollutant dispersion and increasing predicted air quality impacts.
- No consideration of building or structure downwash. These downwash effects typically increase predicted concentrations near the facility.
- No evaluation has been conducted to determine if the stack height exceeds Good Engineering Practice or GEP height. If the stack height exceeds GEP, the predicted concentrations will increase.
- No consideration of off-site sources. These other sources of SO_2 will increase the predicted impacts.

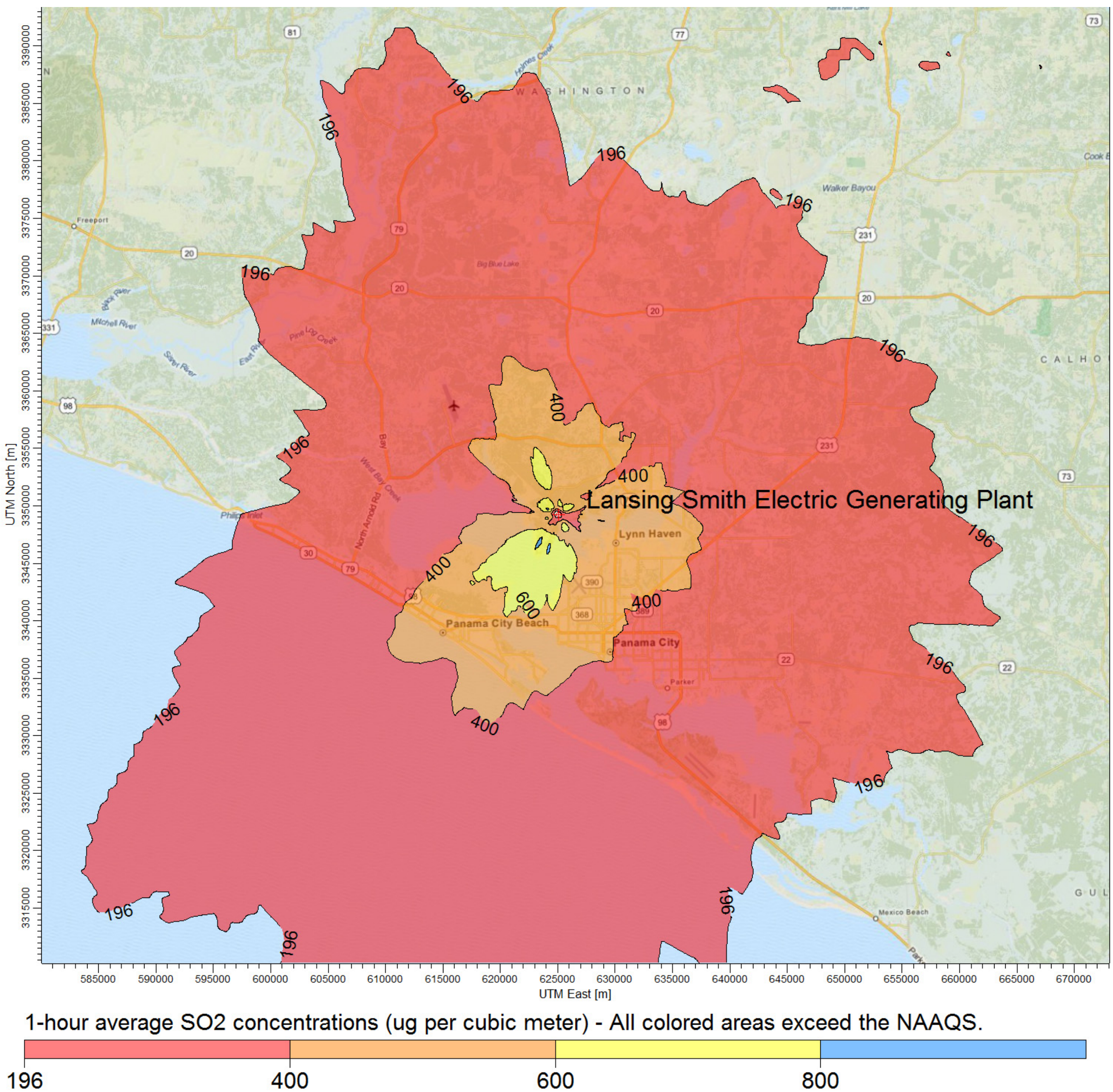

Figure 1 - Regional View of Lansing Smith Impacts Based on Allowable Emissions

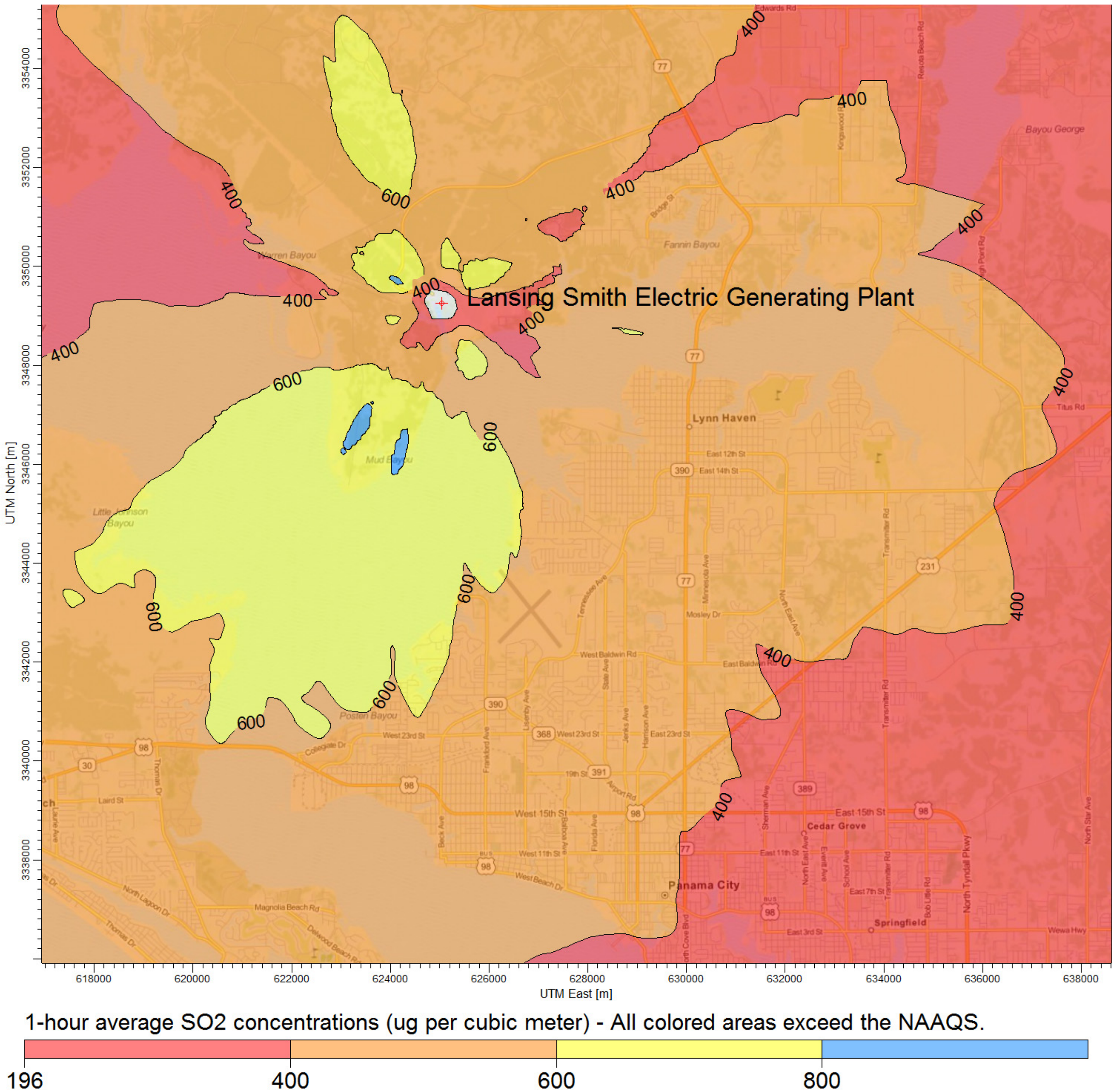

Figure 2 - Local View of Lansing Smith Impacts Based on Allowable Emissions

3. Modeling Methodology

3.1 Air Dispersion Model

The modeling analysis used USEPA's AERMOD program, v. 14134. AERMOD, as available from the Support Center for Regulatory Atmospheric Modeling (SCRAM) website, was used in conjunction with a third-party modeling software program, *AERMOD View*, sold by Lakes Environmental Software.

3.2 Control Options

The AERMOD model was run with the following control options:

- 1-hour average air concentrations
- Regulatory defaults
- Flagpole receptors

To reflect a representative inhalation level, a flagpole height of 1.5 meters was used for all modeled receptors. This parameter was added to the receptor file when running AERMAP, as described in Section 4.4.

An evaluation was conducted to determine if the modeled facility was located in a rural or urban setting using USEPA's methodology outlined in Section 7.2.3 of the Guideline on Air Quality Models.[6] For urban sources, the URBANOPT option is used in conjunction with the urban population from an appropriate nearby city and a default surface roughness of 1.0 meter. Methods described in Section 4.1 were used to determine whether rural or urban dispersion coefficients were appropriate for the modeling analysis.

3.3 Output Options

The AERMOD analysis was based on three years of recent meteorological data. The modeling analyses used one run with three years of sequential meteorological data from 2011-2013. Consistent with USEPA's Modeling Guidance for SO_2 NAAQS Designations, AERMOD provided a table of fourth-high 1-hour SO_2 impacts concentrations consistent with the form of the 1-hour SO_2 NAAQS.[7]

Please refer to Table 1 for the modeling results.

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[6] USEPA, Revision to the Guideline on Air Quality Models: Adoption of a Preferred General Purpose (Flat and Complex Terrain) Dispersion Model and Other Revisions, Appendix W to 40 CFR Part 51, November 9, 2005.
[7] USEPA, Area Designations for the 2010 Revised Primary Sulfur Dioxide National Ambient Air Quality Standards, Attachment 3, March 24, 2011, pp. 24-26.

4. Model Inputs

4.1 Geographical Inputs

The "ground floor" of all air dispersion modeling analyses is establishing a coordinate system for identifying the geographical location of emission sources and receptors. These geographical locations are used to determine local characteristics (such as land use and elevation), and also to ascertain source to receptor distances and relationships.

The Universal Transverse Mercator (UTM) NAD83 coordinate system was used for identifying the easting (x) and northing (y) coordinates of the modeled sources and receptors. Stack locations were obtained from facility permits and prior modeling files provided by the state regulatory agency. The stack locations were then verified using aerial photographs.

The facility was evaluated to determine if it should be modeled using the rural or urban dispersion coefficient option in AERMOD. A GIS was used to determine whether rural or urban dispersion coefficients apply to a site. Land use within a three-kilometer radius circle surrounding the facility was considered. USEPA guidance states that urban dispersion coefficients are used if more than 50% of the area within 3 kilometers has urban land uses. Otherwise, rural dispersion coefficients are appropriate.[8]

USEPA's AERSURFACE v. 13016 was used to develop the meteorological data for the modeling analysis. This model was also used to evaluate surrounding land use within 3 kilometers. Based on the output from the AERSURFACE, approximately 0.8% of surrounding land use around the modeled facility was of urban land use types including Type 21 – Low Intensity Residential, Type 22 – High Intensity Residential and Type 23 – Commercial / Industrial / Transportation.

This is less than the 50% value considered appropriate for the use of urban dispersion coefficients. Based on the AERSURFACE analysis, it was concluded that the rural option would be used for the modeling summarized in this report. Please refer to Section 4.5.3 for a discussion of the AERSURFACE analysis.

[8] USEPA, Revision to the Guideline on Air Quality Models: Adoption of a Preferred General Purpose (Flat and Complex Terrain) Dispersion Model and Other Revisions, Appendix W to 40 CFR Part 51, November 9, 2005, Section 7.2.3.

4.2 Emission Rates and Source Parameters

The modeling analyses only considered SO_2 emissions from the facility. Off-site sources were not considered. Concentrations were predicted for allowable emissions based on the current permit issued by the regulatory agency.

Stack parameters and emissions used for the modeling analysis are summarized in Table 4.

Table 4 – Facility Stack Parameters and Emissions [9]

Stack	S01
Description	Units 1 and 2
X Coord. [m]	625045
Y Coord. [m]	3349253
Base Elevation [m]	3.73
Release Height [m]	60.66
Gas Exit Temperature [°K]	399.817
Gas Exit Velocity [m/s]	31.302
Inside Diameter [m]	5.486
Allowable Emission Rate [g/s]	2,376

The above stack parameters and emissions were obtained from regulatory agency documents and databases identified in Section 2.2. The analysis was conducted based on 100% operating load using maximum exhaust flow rates and temperatures. Operation at less than full capacity loads was not considered. This assumption tends to under-predict impacts since stack parameters such as exit flow rate and temperature are typically lower at less than full load, reducing pollutant dispersion and increasing predicted air quality impacts. Stack location, height and diameter were verified using aerial photographs, and flue gas flow rate and temperature were verified using combustion calculations.

[9] Stack parameters were taken from Florida DEP, Title V Air Operation Permit Renewal, Permit No. 0050014-018-AV, January 1, 2010.

4.3 Building Dimensions and GEP

No building dimensions or prior downwash evaluations were available. Therefore this modeling analysis did not address the effects of downwash and this may under-predict impacts.

4.4 Receptors

For Lansing Smith, three receptor grids were employed:

1. A 100-meter Cartesian receptor grid centered on Lansing Smith and extending out 5 kilometers.
2. A 500-meter Cartesian receptor grid centered on Lansing Smith and extending out 10 kilometers.
3. A 1,000-meter Cartesian receptor grid centered on Lansing Smith and extending out 50 kilometers. 50 kilometers is the maximum distance accepted by USEPA for the use of the AERMOD dispersion model.[10]

A flagpole height of 1.5 meters was used for all these receptors.

Elevations from stacks and receptors were obtained from National Elevation Dataset (NED) GeoTiff data. GeoTiff is a binary file that includes data descriptors and geo-referencing information necessary for extracting terrain elevations. These elevations were extracted from 1 arc-second (30 meter) resolution NED files. The USEPA software program AERMAP v. 11103 is used for these tasks.

4.5 Meteorological Data

To improve the accuracy of the modeling analysis, recent meteorological data for the 2011-2013 period were prepared using the USEPA's program AERMET which creates the model-ready surface and profile data files required by AERMOD. Required data inputs to AERMET included surface meteorological measurements, twice-daily soundings of upper air measurements, and the micrometeorological parameters surface roughness, albedo, and Bowen ratio. One-minute ASOS data were available so USEPA methods were used to reduce calm and missing hours.[11] The USEPA software program AERMINUTE v. 11325 is used for these tasks.

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[10] USEPA, Revision to the Guideline on Air Quality Models: Adoption of a Preferred General Purpose (Flat and Complex Terrain) Dispersion Model and Other Revisions, Appendix W to 40 CFR Part 51, Section A.1.(1), November 9, 2005.

[11] USEPA, Area Designations for the 2010 Revised Primary Sulfur Dioxide National Ambient Air Quality Standards, Attachment 3, March 24, 2011, p. 19.

This section discusses how the meteorological data was prepared for use in the 1-hour SO_2 NAAQS modeling analyses. The USEPA software program AERMET v. 13350 is used for these tasks.

4.5.1 Surface Meteorology

Surface meteorology was obtained for Destin Airport located near the Lansing Smith. Integrated Surface Hourly (ISH) data for the 2011-2013 period were obtained from the National Climatic Data Center (NCDC). The ISH surface data was processed through AERMET Stage 1, which performs data extraction and quality control checks.

4.5.2 Upper Air Data

Upper-air data are collected by a "weather balloon" that is released twice per day at selected locations. As the balloon is released, it rises through the atmosphere, and radios the data back to the surface. The measuring and transmitting device is known as either a radiosonde, or rawinsonde. Data collected and radioed back include: air pressure, height, temperature, dew point, wind speed, and wind direction. The upper air data were processed through AERMET Stage 1, which performs data extraction and quality control checks.

For Lansing Smith, the concurrent 2011-2013 upper air data from twice-daily radiosonde measurements obtained at the most representative location were used. This location was the Tallahassee, Florida measurement station. These data are in Forecast Systems Laboratory (FSL) format and were downloaded in ASCII text format from NOAA's FSL website.[12] All reporting levels were downloaded and processed with AERMET.

4.5.3 AERSURFACE

AERSURFACE is a program that extracts surface roughness, albedo, and daytime Bowen ratio for an area surrounding a given location. AERSURFACE uses land use and land cover (LULC) data in the U.S. Geological Survey's 1992 National Land Cover Dataset to extract the necessary micrometeorological data. LULC data was used for processing meteorological data sets used as input to AERMOD.

AERSURFACE v. 13016 was used to develop surface roughness, albedo, and daytime Bowen ratio values in a region surrounding the meteorological data collection site. AERSURFACE was used to develop surface roughness in a one kilometer radius surrounding the data collection site. Bowen ratio and albedo was developed for a 10 kilometer by 10 kilometer area centered on the meteorological data collection site. These micrometeorological data were processed for seasonal

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[12] Available at: http://esrl.noaa.gov/raobs/

periods using 30-degree sectors. Seasonal moisture conditions were considered average with no months with continuous snow cover.

4.5.4 Data Review

Missing meteorological data were not filled as the data file met USEPA's 90% data completeness requirement.[13] The AERMOD output file shows there were 2.65% missing data.

To confirm the representativeness of the airport meteorological data, the surface characteristics of the airport data collection site and the modeled source location were compared. Since the Destin Airport is located close to Lansing Smith, this meteorological data set was considered appropriate for this modeling analysis. [14] Additionally, this weather station provided high quality surface measurements for the most recent 3-year time, and had similar land use, surface characteristics, terrain features and climate.

5. Background SO_2 Concentrations

Background concentrations were determined consistent with USEPA's Modeling Guidance for SO_2 NAAQS Designations.[15] To preserve the form of the 1-hour SO_2 standard, based on the 99th percentile of the annual distribution of daily maximum 1-hour concentrations averaged across the number of years modeled, the <u>background</u> fourth-highest daily maximum 1-hour SO_2 concentration was added to the <u>modeled</u> fourth-highest daily maximum 1-hour SO_2 concentration.[16] The background concentrations was based on the 2011-2013 design values measured by the ambient monitor located in Escambia County, Florida.[17]

This ambient monitor is the closet to Lansing Smith, in Bay County, Florida. Due to the distance between Lansing Smith and the Escambia County monitor, it is not expected that measurements would be influenced by emissions from the plant.

6. Reporting

All files from the programs used for this modeling analysis are available to regulatory agencies. These include analyses prepared with AERSURFACE, AERMET, AERMAP, and AERMOD.

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[13] USEPA, Meteorological Monitoring Guidance for Regulatory Modeling Applications, EPA-454/R-99-05, February 2000, Section 5.3.2, pp. 5-4 to 5-5.
[14] USEPA, AERMOD Implementation Guide, March 19, 2009, pp. 3-4.
[15] USEPA, Area Designations for the 2010 Revised Primary Sulfur Dioxide National Ambient Air Quality Standards, Attachment 3, March 24, 2011, pp. 20-23.
[16] USEPA, Applicability of Appendix W Modeling Guidance for the 1-hour SO_2 National Ambient Air Quality Standard, August 23, 2010, p. 3.
[17] http://www.epa.gov/airtrends/values.html