Prepared for:
Mississippi Power Company

Modeling Report Daniel Steam Electric Generating Plant 1-hour SO_2 NAAQS Modeling

AECOM, Inc.
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1.0 Introduction

On June 2, 2010, the EPA issued final revisions (75 FR 35520) to the primary National Ambient Air Quality Standards (NAAQS) for sulfur dioxide (SO_2). In the final rule, the EPA established a new primary 1-hour standard for SO_2 set at a level of 75 parts per billion (ppb). Also in the revision, the EPA revoked the two existing primary NAAQS (the 24-hour and annual standards) which will become effective one year after the area is designated for the new 1-hour standard.

EPA is issuing area designations for the 1-hour SO_2 NAAQS in separate rounds. On August 10, 2015, as part of its implementation, the EPA issued the final Data Requirements Rule for the 2010 1-Hour Sulfur Dioxide Primary NAAQS[1] (e.g. "SO_2 Data Requirements Rule," or "DRR"). The DRR directs state and tribal air agencies to provide data to characterize air quality in the vicinity of sources of certain SO_2 emissions to identify maximum 1-hour SO_2 concentrations in ambient air. The air quality data provided pursuant to the DRR presumably will be used by the Mississippi Department of Environmental Quality (MDEQ) and EPA in future actions regarding area designations as the agencies continue implementing the SO_2 NAAQS.

In part, the DRR required air agencies to submit to EPA by January 15, 2016, a list identifying the sources in the state around which SO_2 air quality is to be characterized. This list must include sources located in areas that have not been designated nonattainment and have emissions greater than 2000 tons per year of SO_2 unless otherwise exempt (e.g. unit retirement, fuel switch, permit limits, etc.). The DRR sets forth two options air agencies may utilize to characterize air quality; by using either modeling of actual source emissions or by using ambient air quality monitors. For each source on the list, air agencies are required to identify the approach (ambient monitoring or modeling) it will use to characterize air quality in the vicinity of the source unless the source chooses to adopt emission limits.

In a letter to the EPA dated January 13, 2016, MDEQ identified the sources in Mississippi that have SO_2 emissions greater than 2000 tons per year for the most recent year for which emissions data are available (2014). MDEQ identified Mississippi Power Company's (Mississippi Power) Daniel Steam Electric Generating Plant (Plant Daniel) in Jackson County as a source on this source list. MDEQ requested that air quality in the vicinity of Plant Daniel be evaluated through modeling with respect to the 1-hour SO_2 NAAQS and the DRR. The DRR requires that for sources that choose to characterize air quality through modeling, a modeling protocol must be provided to the EPA by July 1, 2016.

EPA has issued[2] separate non-binding draft Technical Assistance Documents (TAD) for modeling and monitoring that set forth procedures for both pathways. The current version of the TADs (updated February 2016) reference other EPA modeling guidance documents, including the following clarification memos (1) the August 23, 2010 "*Applicability of Appendix W Modeling Guidance for the 1-hour SO_2 NAAQS*" and (2) the March 1, 2011 "*Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard*" (hereafter referred to as the "additional clarification memo"). In the March 1, 2011, clarification memo, EPA declares that the memo applies equally to the 1-hour SO_2 NAAQS even though it was prepared primarily for the 1-hour nitrogen dioxide (NO_2) NAAQS.

In order to comply with the requirements of the DRR, a dispersion modeling protocol was submitted to MDEQ in June 2016. EPA Region 4 provided comments on this draft protocol in July 2016. These comments are resolved in this final modeling report. In addition, modeling procedures are consistent with applicable guidance, including the August 2016 "SO_2 NAAQS Designations Modeling Technical Assistance Document"

[1] 80 FR 51052, August 21, 2015 Federal Register Notice. Docket ID No. EPA–HQ–OAR–2013–0711.

[2] EPA, 2014. Modeling and Monitoring Technical Assistance Documents. Available at https://www.epa.gov/sites/production/files/2016-06/documents/so2modelingtad.pdf and https://www.epa.gov/sites/production/files/2016-06/documents/so2monitoringtad.pdf

(TAD) issued by the USEPA (EPA 2016). The modeling approach is also consistent with the final Data Requirements Rule (DDR) for the 2010 1-hour SO_2 primary NAAQS (80 FR 51052, August 21, 2015). This report presents the modeling methods and assumptions, including model selection and options, meteorological data and source parameters used in the modeling analyses that characterize air quality in the vicinity of Plant Daniel.

This document consists of the following three additional sections:

Section 2 - Facility Description and Emission Sources

Section 3 - Modeling Approach

Section 4 - Analysis of Modeling Results.

2.0 Facility Description and Emission Sources

Plant Daniel is an electric power generation plant including two subcritical coal-fired boilers (Units 1-2) and two natural gas-fired combined cycle combustion turbines (Units 3A/3B and 4A/4B). Units 1 and 2 are both currently equipped with a wet flue gas desulfurization (FGD) system for control of SO_2 emissions. However, the FGD system did not come online until the end of 2015. Therefore, all the modeling is highly conservative as was conducted using uncontrolled SO_2 emission rates which are not reflective of current operations with the FGD system in place. Plant Daniel is located in Jackson County, MS near Escatawpa, MS. The location of Plant Daniel is shown in Figures 2-1 and 2-2.

During the period selected for modeling (2012-2014), Units 1-2 exhausted to a 350-foot common stack. Therefore, the modeling was performed using the physical stack data associated with this common stack as opposed to the scrubbed stack currently servicing Units 1-2.

Units 3A/3B-4A/4B exhaust through separate 121-foot stacks.

Since the modeling is being performed with actual hourly emissions from Units 1 and 2, the NAAQS modeling was performed with their actual stack height in accordance with recommendations in the DRR and TAD. Gas-fired allowable emission rates were used to model Units 3 and 4. However, these stacks are less than the Good Engineering Practice (GEP) stack height and as such will also be modeled with their actual physical stack height. Table 2-1 shows the physical stack parameters for Unit 1 and 2, the scrubber stack, and Units 3 and 4, the combustion turbine stacks.

Table 2-1 Units 1-4 Physical Stack Parameters

Unit	Description	Location (UTM Zone 16 NAD 1983)		Stack Base Elevation (feet)	Stack Height (feet)	Flue Diameter (feet)
		Easting (meters)	Northing (meters)			
Unit 1	Coal Boiler Stack	350610	3378843	23.0	350	34.1
Unit 2						
Unit 3A	Combined-Cycle Combustion Turbine Stacks[2]	350653	3378685	24.0	121	16.8
Unit 3B		350652	3378648	24.0	121	16.8
Unit 4A		350653	3378540	24.0	121	16.8
Unit 4B		350648	3378504	24.0	121	16.8

(1) See text for discussion
(2) Combustion turbine stacks were also modeled with a fixed exit velocity and stack temperature:
Unit 3A → Velocity = 87.6 ft/s, Temperature = 215.3 F
Unit 3B → Velocity = 85.6 ft/s, Temperature = 208.1 F
Unit 4A → Velocity = 86.0 ft/s, Temperature = 208.1 F
Unit 4B → Velocity = 85.6 ft/s, Temperature = 213.5 F

For Units 1 and 2, the emissions for modeling consisted of actual hourly emissions, temperatures, and flow rates for the most recent three calendar years (2012-2014). The hourly flue gas flow rates and temperature for each stack were determined from the individual unit's flue gas flow rate and temperature using the following approach:

$ACFM_T = ACFM_1 + ACFM_2$

$Temp_T = (Temp_1 \times SCFM_1 + Temp_2 \times SCFM_2) / (SCFM_T)$

Where:

$ACFM_T$ = Total flue gas flow rate in actual cubic feet per minute (ACFM) for the two units discharging from the same stack

$ACFM_1$, $ACMF_2$ = The flue gas flow rate from the two units discharging from the same stack

$SCFM_T$ = Total standard flue gas flow rate in actual cubic feet per minute (SCFM) for the two units discharging from the same stack

$SCFM_1$, $SCMF_2$ = The standard flue gas flow rate from the two units discharging from the same stack

$Temp_T$ = the flue gas flow-weighted temperature of the combined flue gases discharging from the stack

$Temp_1$, $Temp_2$ = The flue gas temperature from one of the units discharging from the same stack

There are no other large sources of SO_2 emissions at Plant Daniel and, as such, the modeling was limited to Units 1 through 4.

Figure 2-1 Location of Plant Daniel

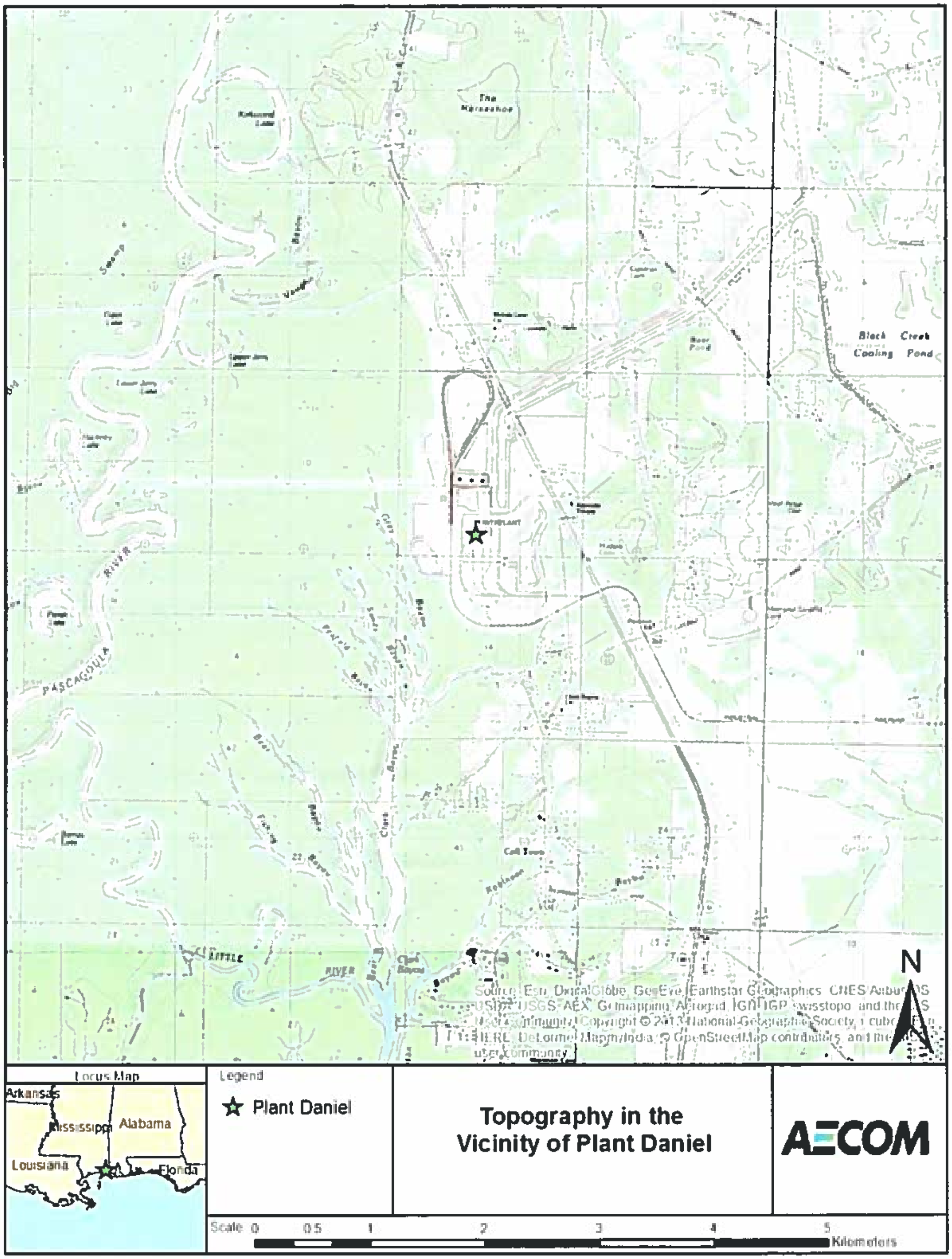
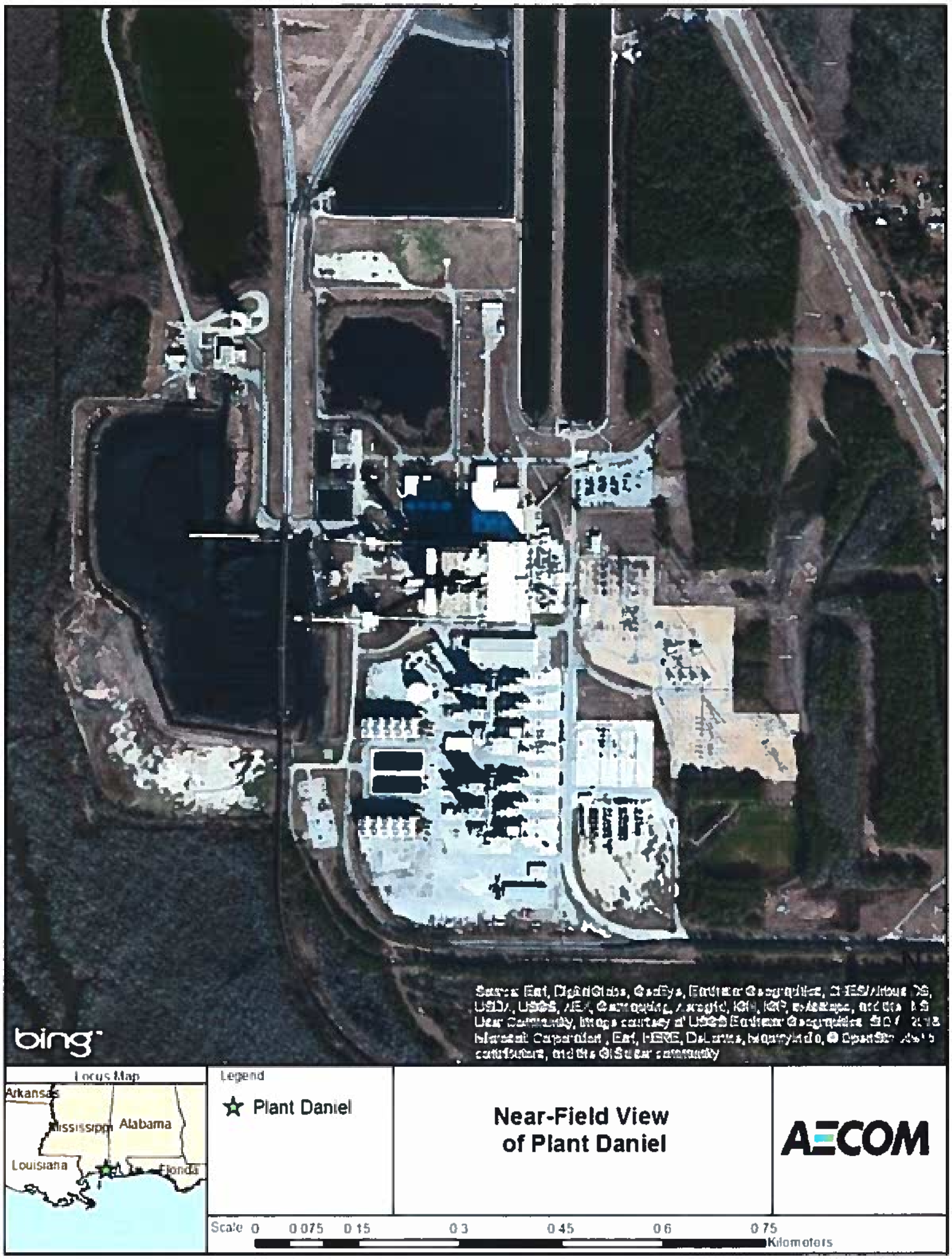


Figure 2-2 Near-Field View of Plant Daniel



3.0 Modeling Approach

3.1 Overview

This section presents the approach to the dispersion modeling analysis that was used for the 1-hour SO_2 NAAQS modeling for Plant Daniel. The modeling approach was consistent with the guidance provided in the DRR and TAD where applicable. The following sections address each relevant portion of the modeling approach, including model selection, building downwash, terrain, meteorology, and ambient air quality data.

3.2 Model Selection and Options

AERMOD is EPA's recommended refined dispersion model for simple and complex terrain for receptors within 50 kilometers (km) of a modeled source. AERMOD is also capable of producing the statistical output required for the 1-hour SO_2 NAAQS. As such, AERMOD Version 15181 (released June 30, 2015) was used for this analysis using default model options.

Figure 3-1 shows that the area surrounding Plant Daniel is predominantly rural. Therefore, the urban source options in AERMOD were not used.

3.3 Building Downwash

In accordance with the DRR and TAD, since actual hourly emissions are being used, the modeling analysis will be conducted with the actual physical stack height for all stacks. The effects of building downwash was incorporated into the modeling analysis. EPA's Building Profile Input Program software (BPIP PRIME Dated 04274) was used to calculate the direction-specific building dimensions for input to AERMOD.

Figure 3-2 shows the location of the modeled stack locations and buildings that were used as input to BPIP.

3.4 Terrain and Receptor Processing with AERMAP

EPA modeling guidelines require that the differences in terrain elevations between the stack base and model receptor locations be considered in the modeling analyses. There are three types of terrain:

- simple terrain – locations where the terrain elevation is at or below the exhaust height of the stacks to be modeled;
- intermediate terrain – locations where the terrain is between the top of the stack and the modeled exhaust "plume" centerline (this varies as a function of plume rise, which in turn, varies as a function of meteorological condition);
- complex terrain – locations where the terrain is above the plume centerline.

The area in the vicinity of Plant Daniel is characterized as simple terrain relative to the modeled stacks.

A comprehensive Cartesian receptor grid extending to approximately 20 km from Plant Daniel was used in the AERMOD modeling to assess ground-level SO_2 concentrations. The 20-km receptor grid was more than sufficient to resolve the maximum impacts and any potential significant impact area(s).

The Cartesian receptors grid consisted of the following receptor spacing:

- From the center of the plant out to a distance of 3,000 meters (m) at 100-m increments
- Beyond 3,000 m to 5,000 m at 200-m increments
- Beyond 5,000 m to 10,000 m at 500-m increments
- Beyond 10,000 m to 20,000 m at 1000-m increments.

- Receptors will also be placed at 25-m intervals along the ambient air boundary.

Based on the location of the modeled maximum design concentration determined with the aforementioned receptor grid, additional fine-grid receptors (100-m spacing) were added in the area of maximum impacts to ensure that the maximum design concentration occurred within 100-m resolution spaced receptors.

The AERMAP domain corresponds to a 5-km buffer beyond the receptor grid and provides sufficient resolution of the hill height scale required for each receptor. A 5-km buffer is sufficient as there are no significant terrain features just beyond this distance.

Terrain elevations from the National Elevation Dataset (NED) acquired from USGS[3] were processed with AERMAP (version 11103) to develop the receptor terrain elevations and corresponding hill height scale required by AERMOD. The NED file is referenced to Datum NAD 83 (note all receptors are referenced to NAD 83 UTM Zone 16). The NED files are included in the modeling archive CD (see Appendix A).

The extent of the receptor grid is shown in Figures 3-3 and 3-4.

Figure 3-3 also depicts the modeling ambient air boundary. The Plant Daniel ambient boundary is delineated by actual fence, except in a few areas. These areas are impenetrable by either a natural barrier or a man-made barrier. The non-fenced area on the eastern side of Plant Daniel is impenetrable due to the Plant Daniel canals. These canals have restricted access. The non-fenced areas on the western and southern sides of Plant Daniel are impenetrable due to natural barriers. These adjacent portions of the site are tidal marsh, which create a natural barrier and, thus, restrict access.

3.5 Meteorological Data for Modeling

No on-site meteorological data is available, so the application of a refined dispersion model requires multiple years of hourly meteorological data that are representative of the model application site. In addition to being representative, the data must meet quality and completeness requirements per EPA guidelines.

For this application, three years (2012-2014) of model-ready meteorological data was obtained from MDEQ's website[4]. Specifically, surface data from Trent Lott International Airport, MS along with upper air data from Slidell, LA. This data was processed by MDEQ using AERMET Version 15181 and provided in model-ready format for this application. The meteorological station information can be found in Table 3-1. The location of the meteorological station is shown in Figure 3-5.

Trent Lott International Airport is located in very close proximity to Plant Daniel (approximately 5 miles south-southeast of Plant Daniel). There were two potential alternative airports much further away (1) Mobile/Bates Field (located approximately 20 miles to the northeast of Plant Daniel) and (2) Gulfport-Biloxi International Airport (located approximately 30 miles to the west-southwest of Plant Daniel). As compared to Trent Lott International, both of these airports would be less representative due to proximity from Plant Daniel. Given its close proximity and similar proximity to the coastline, Trent Lott International is highly representative from a both a land use and wind pattern perspective.

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[3] http://viewer.nationalmap.gov/launch/

[4] http://www.deq.state.ms.us/MDEQ.nsf/page/epd_AERMET_Preprocessedmetdata?OpenDocument

Table 3-1 Meteorological Stations used for Modeling

Met Site	Latitude	Longitude	Base Elevation (ft)	Station Call Sign
Trent Lott International Airport, MS	30.464 N	88.532 W	9.8	KPQL
Slidell, LA	30.33 N	89.82 W	26.2	KSIL

3.6 Ambient Monitoring Data and Nearby Background Sources

As part of the 1-hour SO_2 NAAQS analysis, ambient background was added to the modeled concentrations. The ambient SO_2 background design concentration associated with the closest monitor in Pascagoula, MS (EPA AQS ID: 28-059-0006) for 2012-2014 is 27 ppb (70.7 $\mu g/m^3$).

For this application a refinement was made to the ambient background data. In accordance with Section 8.1 of the modeling TAD and consistent with USEPA guidance in the March 1, 2011 Clarification Memo[5], seasonal and hour of day background varying concentrations were used when pairing the modeled and monitored concentrations.

Three years (2012-2014) of hourly SO_2 monitoring data from the Pascagoula monitor were obtained and then used to calculate season and hour of day varying background concentrations in accordance with the USEPA guidance in the March 1, 2011 Clarification Memo. The resulting database included a range of valid observations from 81 to 92 per hour of day and season. These counts in valid observations resulted in the 99th percentile equaling the 2nd highest observations for each season and hour to be consistent with the USEPA March 1, 2011 Guidance. Table 3-2 shows the resultant seasonal and hour of day varying background included as input to AERMOD.

There are two additional nearby background SO_2 sources that could be considered as part of the analysis. These two sources are (1) Mississippi Phosphates Corporation and (2) Chevron Pascagoula Refinery. Both of these sources are located just over 20 kilometers almost due south of Plant Daniel (see Figure 3-6). According to the 2011 National Emissions Inventory these sources each had 1,331 and 772 TPY of SO_2 emissions respectively. At nearly 20 kilometers, the likelihood of these sources interacting with sources at Plant Daniel to cause a modeled exceedance of the 1-hour SO_2 NAAQS is extremely low.

These sources are also located in close proximity to the Pascagoula monitor that is being proposed as part of this analysis. A pollution rose for the Pascagoula monitor (2012-2014) is presented in Figure 3-7 using concurrent wind direction data from Trent Lott International Airport. The pollution rose clearly shows a strong influence of both Plant Daniel (as indicated by the higher concentrations observed with northerly winds) and Mississippi Phosphates Corporation/Chevron Pascagoula Refinery (as indicated by the higher concentrations observed with south easterly winds.

As such, for this modeling analysis, the ambient background from the Pascagoula monitor was used to represent the impact of both the regional ambient background and the impact of the two background sources (Mississippi Phosphates Corporation and Chevron Pascagoula Refinery). This methodology represents a conservative overall approach that is highly protective of air quality for the following reasons:

(1) The Pascagoula monitor is located within approximately 5 kilometers of both Mississippi Phosphates Corporation and Chevron Pascagoula Refinery. Being so close, the impact these sources have on

[5] http://www.epa.gov/ttn/scram/guidance/clarification/Additional_Clarifications_AppendixW_Hourly-NO2-NAAQS_FINAL_03-01-2011.pdf

this monitor are likely to be conservative at receptors that are further away and associated with the maximum modeled concentrations from Plant Danial.

(2) The background monitoring data (that includes influence from Mississippi Phosphates Corporation and Chevron Pascagoula Refinery) is added to the modeled concentration every hour of the modeling regardless of wind direction. This would be conservative as compared to removing influence from these sources in the monitoring data and modeling the sources directly because the combined impact from the background sources and Plant Daniel would only occur on an hourly bases for certain favorable wind directions.

(3) The Pascagoula monitor is double counting the impact from Plant Daniel and no monitoring data associated with the primary source being modeled was removed.

Table 3-2 Pascagoula Monitor – 2012-2014 Season and Hour of Day Ambient Background (μg/m^3)

Hour of Day	Season 1 (Dec-Jan-Feb)	Season 2 (Mar-Apr-May)	Season 3 (Jun-Jul-Aug)	Season 4 (Sep-Oct-Nov)
1	9.6	11.4	12.2	4.4
2	12.2	8.7	12.2	7.0
3	14.8	11.4	11.4	7.0
4	14.8	11.4	11.4	7.0
5	8.7	12.2	11.4	7.9
6	12.2	12.2	16.6	12.2
7	15.7	7.9	48.0	13.1
8	14.0	16.6	23.6	7.9
9	13.1	17.5	48.0	8.7
10	31.4	28.8	49.8	19.2
11	18.3	30.6	30.6	33.2
12	27.1	21.0	31.4	21.0
13	35.8	18.3	29.7	15.7
14	25.3	14.8	26.2	16.6
15	21.0	12.2	24.5	19.2
16	20.1	13.1	15.7	15.7
17	15.7	10.5	11.4	15.7
18	14.0	12.2	10.5	14.8
19	20.1	8.7	9.6	6.1
20	13.1	10.5	12.2	5.2
21	16.6	7.9	13.1	7.9
22	11.4	13.1	23.6	6.1
23	10.5	10.5	8.7	8.7
24	7.0	10.5	10.5	7.0

Figure 3-1 Land Use within 3 km of Plant Daniel – Aerial Photo

Figure 3-2 Plant Daniel Buildings and Stacks used for the BPIP Analysis

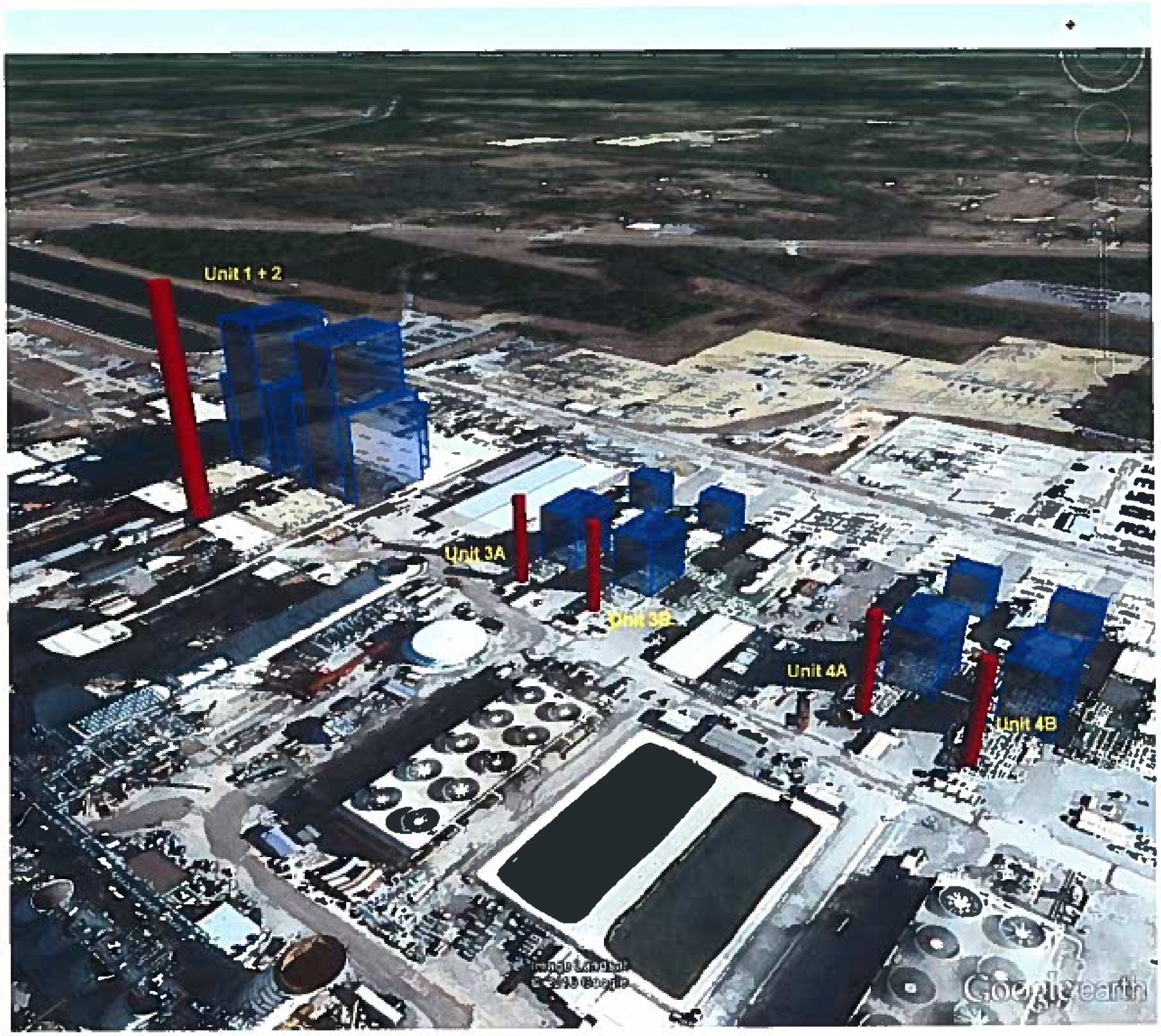


Figure 3-3 Near-field Receptor Grid for Plant Daniel

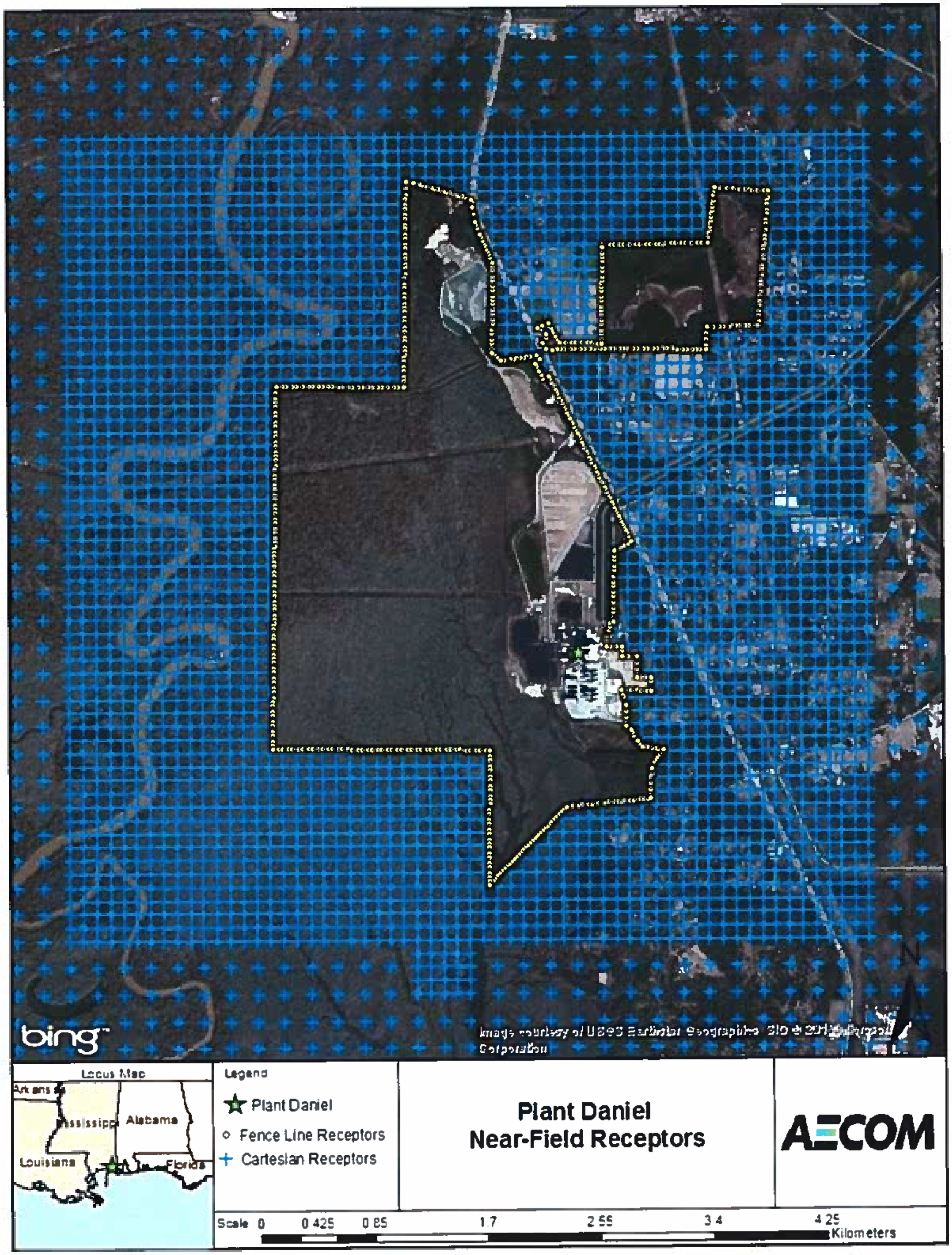


Figure 3-4 Extent of Entire Receptor Grid for Plant Daniel

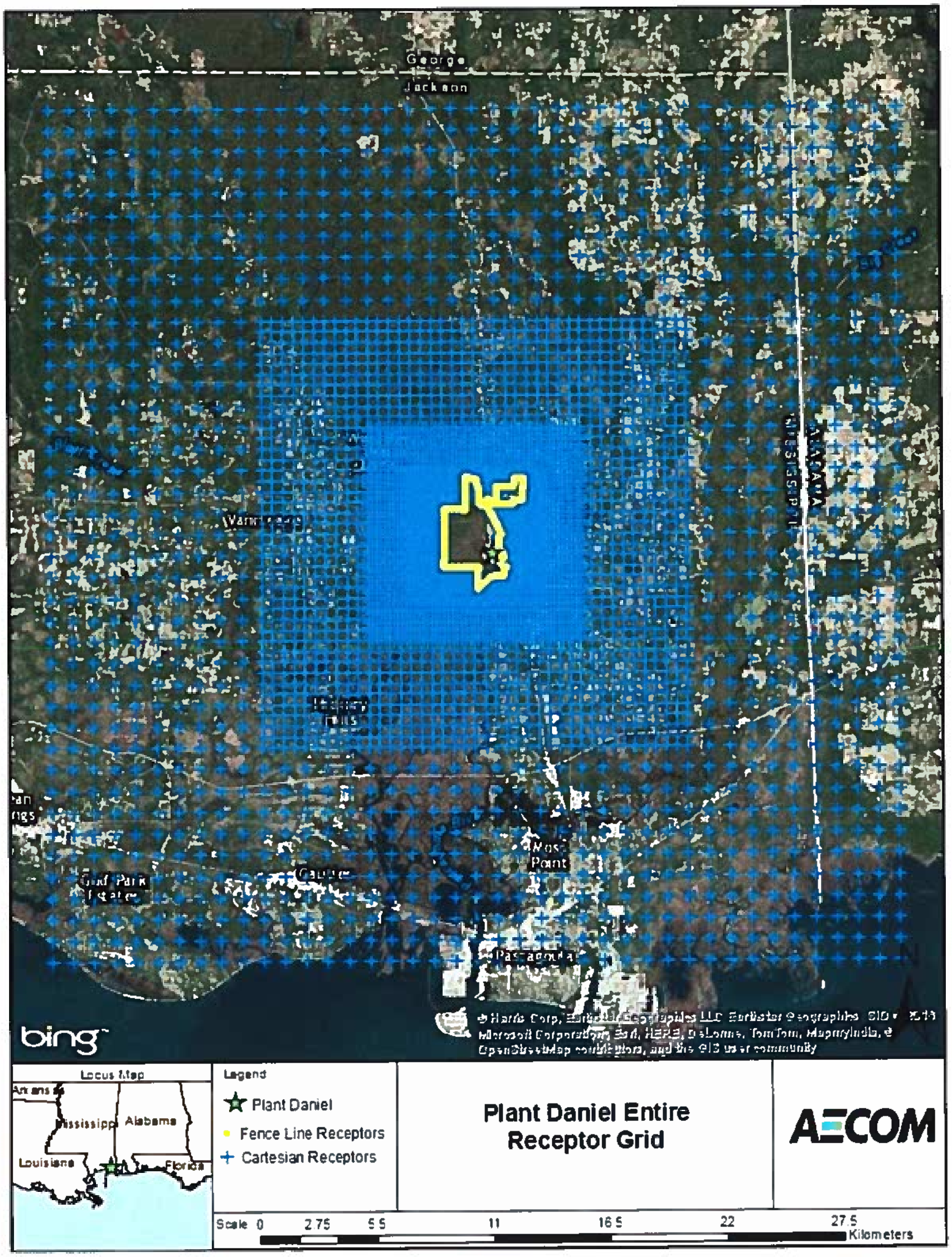


Figure 3-5 Location of Ambient SO_2 Monitor and Meteorological Sites Relative to Plant Daniel

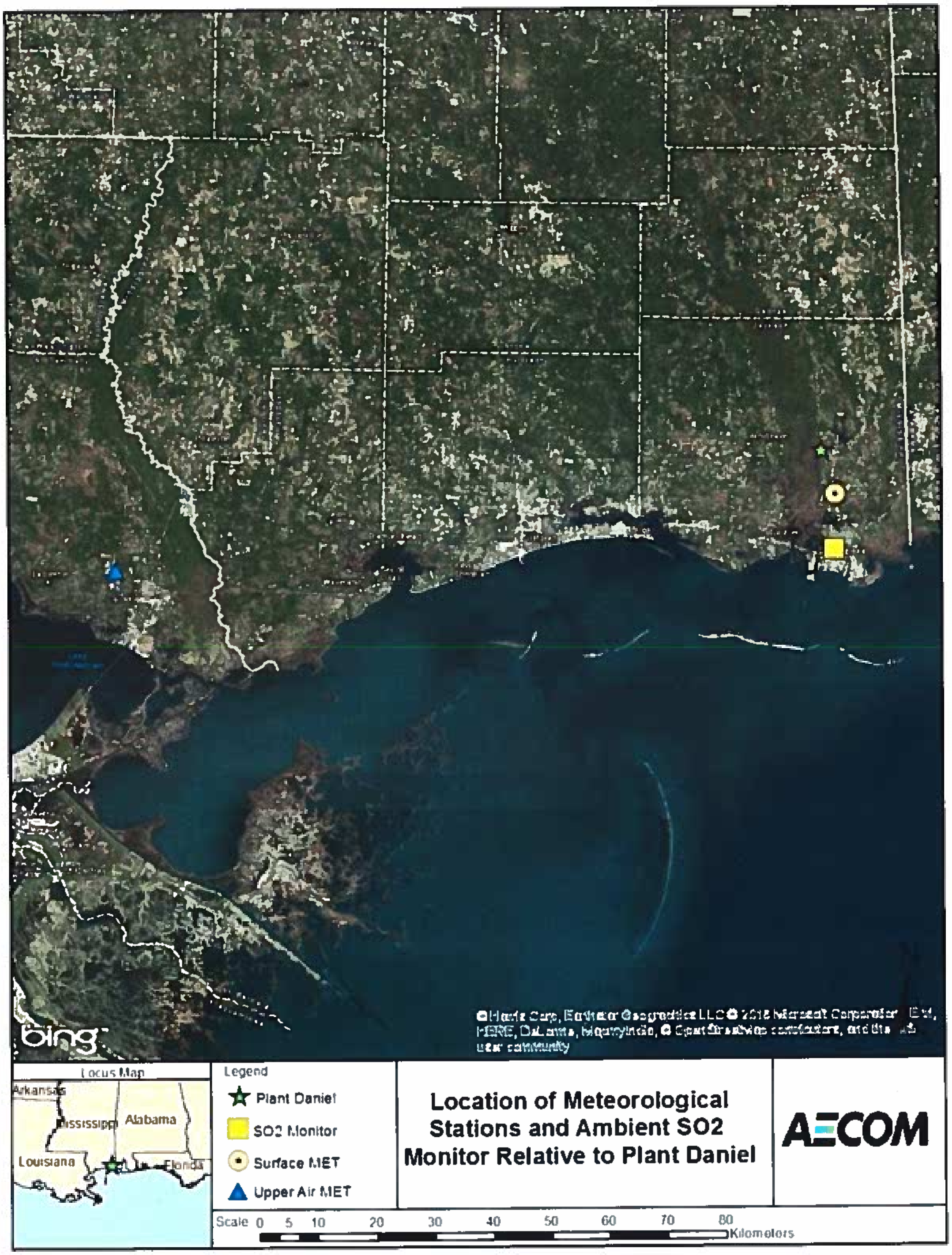


Figure 3-6 Location of Background Sources and the Pascagoula Monitor Relative to Plant Daniel

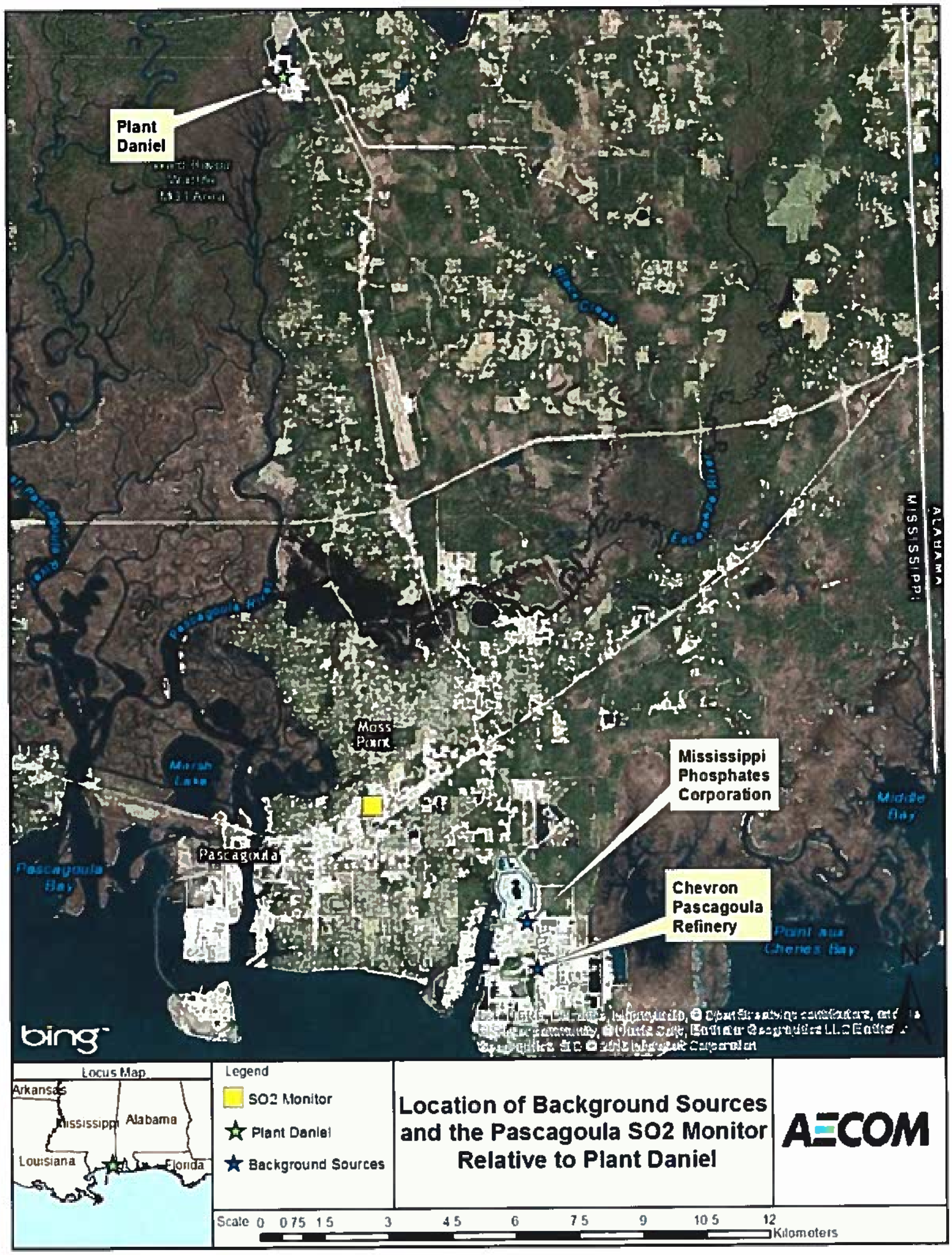
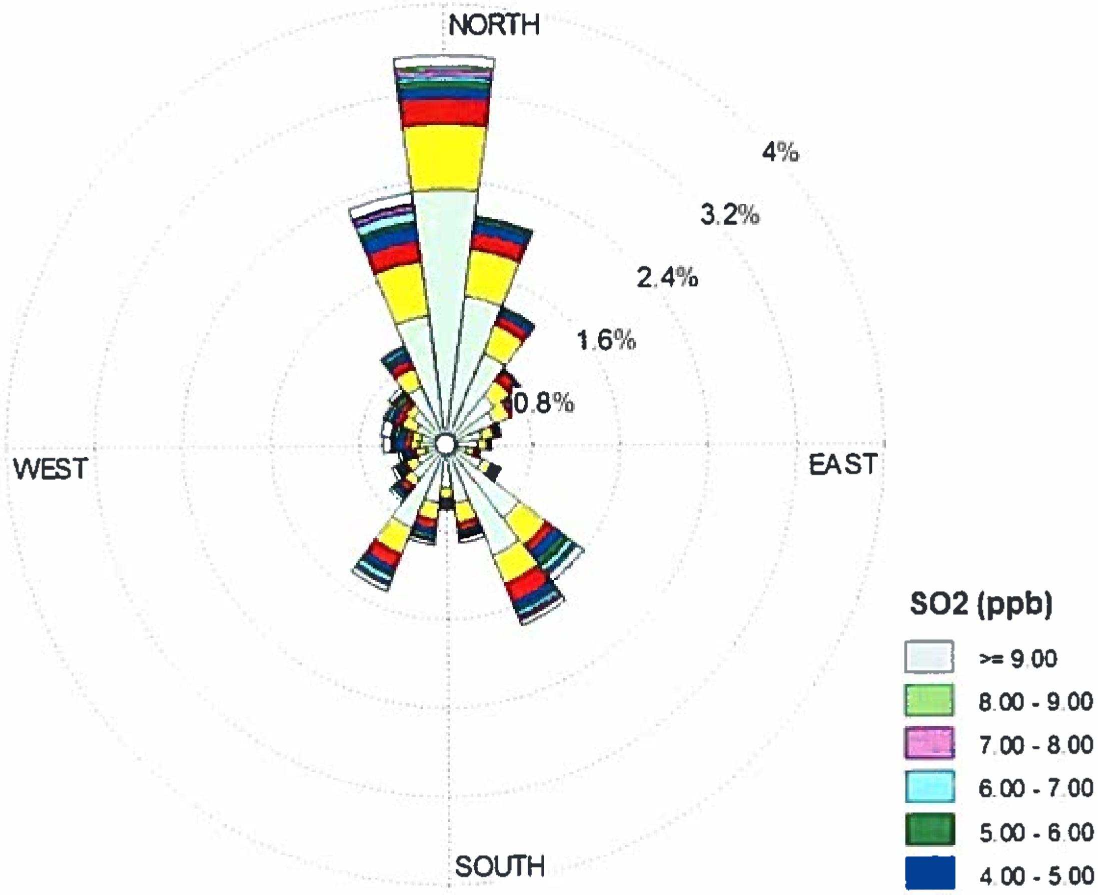


Figure 3-7 2012-2014 Pascagoula Monitor Pollution Rose



4.0 Analysis of Modeling Results

The modeling results for the 1-hour SO_2 NAAQS are presented in Table 4-1 and are based on modeled design concentration from Plant Daniel using actual hourly emissions from 2012-2014 and seasonal and hour of day varying background. The modeled design concentration was calculated by AERMOD and reflects the three-year average of the 99th percentile ranked peak daily 1-hour SO_2 concentration.

Table 4-1 compares the total concentration (modeled plus background) with the 1-hour SO_2 NAAQS of 196.5 $\mu g/m^3$. Figure 4-1 shows the location of the maximum modeled concentration, which is immediately south of the southern boundary of Plant Daniel. Refined-grid receptors were included in this area to ensure that the location of this maximum total design concentration was located in an area with 100-meter spaced receptor resolution.

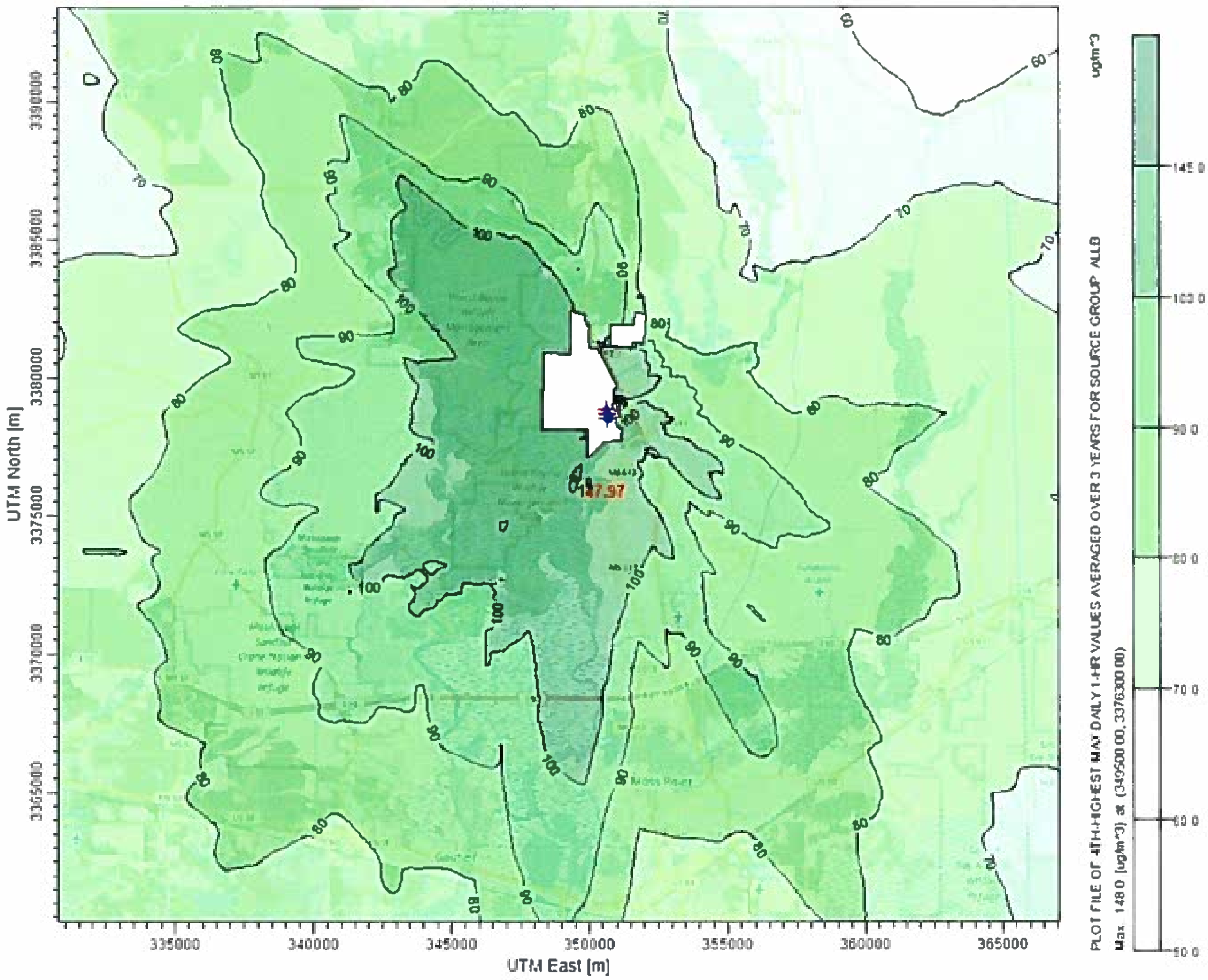
As shown in Table 4-1, the modeling results indicate that all areas surrounding the facility are in compliance with the applicable NAAQS standard and should be designated as attainment.

The modeling archive (included with this report as Appendix A) contains all the electronic files needed to review and produce the results contained in this report.

Table 4-1 Summary of 1-hour SO_2 NAAQS Analysis

Pollutant	Averaging Period	Model Design Concentration ($\mu g/m^3$)	Monitored Background Concentration ($\mu g/m^3$)	Total Concentration ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)	Below NAAQS (Y/N)?	Percent of NAAQS (%)
SO_2	1-hour	105.83	42.14	147.97	196.5	Y	75%

Figure 4-1 Isopleth Map of 1-hour SO_2 NAAQS Total Concentrations (Modeled + Background)



Appendix A

Electronic Modeling Archive