1-HOUR SO_2 NAAQS DESIGNATION MODELING REPORT

South Mississippi Electric Power Association> R D Morrow, Sr. Generating Plant, Lamar County, MS

SOUTH MISSISSIPPI ELECTRIC POWER ASSOCIATION

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. EXECUTIVE SUMMARY

The South Mississippi Electric Power Association (SMEPA) owns and operates the R D Morrow, Sr. Generating Plant (Morrow Plant). SMEPA conducted sulfur dioxide (SO_2) designation modeling to determine whether the area around the Morrow Plant should be designated as attainment or non-attainment. SMEPA has submitted a SO_2 designation modeling protocol (See Appendix A) to the Mississippi Department of Environmental Quality (MDEQ) in June 2015 and was also approved by the U. S. Environmental Protection Agency (U. S. EPA) via conference call on July 09, 2015. SMEPA conducted the SO_2 designation modeling using the U.S. EPA's preferred air dispersion model for near-field regulatory applications, the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD). SMEPA used the following dispersion modeling methodology to determine the designation status of the area around the Morrow Plant:

- Used the most recent three (3) years of actual emissions (2012, 2013, and 2014);
- Used three (3) years of meteorological data (2012, 2013, and 2014);
- Used actual stack heights rather than limiting model stack heights to GEP height; and
- Included near-by sources from the regional inventories provided by the MDEQ.

SMEPA conducted the dispersion modeling in accordance with the modeling protocol approved by the U.S. EPA. Table 1-1 shows the dispersion modeling results and indicates the **area around the Morrow Plant should be classified as "attainment"** and SMEPA is not causing or contributing to any violations of the 1-hour SO_2 National Ambient Air Quality Standards (NAAQS). Detailed modeling procedure and analysis are discussed in the following sections.

Table 1-1. SO_2 Designation Modeling Results

Years	2012	2013	2014
4th Maximum Modeled Concentration [a], µg/m³	125.11	123.02	131.42
Design Value Concentration [b], µg/m³	115.17	123.02	95.89
4th Highest Averaged Concentration (2012-2014) [c], µg/m³ (ppb)	**111.36 (42.50)**		
Background Concentration[1], µg/m³ (ppb)	**36.65 (13.99)**		
NAAQS + Background, µg/m³ (ppb)	**148.01 (56.49)**		
NAAQS[2], µg/m³ (ppb)	**196.34 (75.00)**		
NAAQS Exceedance (Yes/No)	**No**		

[a] The maximum modeled concentration represents the 4th highest maximum concentration predicted for 2012, 2013, and 2014.

[b] Design value concentration is the modeled concentration in a receptor that yielded the design value of the NAAQS (average of 4th highest concentration for three years)

[c] 4th highest averaged concentration is the design value of the NAAQS (average of design value concentrations of three years)

[1] The background concentration was provided by the MDEQ obtained from the air monitoring station (Site ID: 280490020) at Jackson, MS

[2] SO_2 NAAQS of 75 ppb or 0.075 ppm was obtained from http://www.epa.gov/air/criteria.html. In accordance with the Primary National Ambient Air Quality Standard for Sulfur Dioxide (http://www.gpo.gov/fdsys/pkg/FR-2010-06-22/html/2010-13947.htm) final rule, Table B-1 footnote, ppm was converted to µg/m³ by multiplying by M/0.02447, where M is the molecular weight (64.06 lb/lbmol).

2. INTRODUCTION

The Morrow Plant is located in Lamar County, Mississippi, which is currently classified as attainment for all criteria pollutants[3]. The Plant is currently operating under the Title V Permit No. 1440-00021, issued by the MDEQ.

On June 2, 2010, the U.S. EPA revised the primary NAAQS for SO_2 by establishing a 1-hour standard at a level of 75 parts per billion (ppb)[4], which is equivalent to 196.34 $\mu g/m^3$. The form of the 1-hour SO_2 NAAQS standard is a 3- year average of the 99^{th} percentile of the annual distribution of daily maximum 1-hour average concentrations.

Following the U.S. EPA's May 2014 publication of the proposed Data Requirements Rule, the U.S. EPA was sued for "*failing to undertake a certain nondiscretionary duty under the Clean Air Act ("CAA"), 42 U.S.C. §§ 7401-7671q, and that such alleged failure is actionable under section 304(a)(2) of the CAA, 42 U.S.C. § 7604(a)(2)*". The lawsuit resulted in a Consent Decree that was entered on March 2, 2015 in the U.S. District Court for the Northern District of California[5]. As a result of the Consent Decree, an additional designation phase was added to the two designation phases that were already included in the U.S. EPA's May 2014 proposed Data Requirements Rule. The additional phase affects areas with stationary sources that meet specific emission criteria laid out in the Consent Decree. The U.S. EPA released a memorandum on March 20, 2015 (referred to herein as the 2015 SO_2 Area Designation Guidance) to the Regional Directors clarifying the path forward for states with sources affected by the decree.[6]

The Consent Decree requires the U.S. EPA to complete a round of SO_2 designations for the areas affected by the Consent Decree by July 2, 2016. The U.S. EPA is expected to release a final version of the Data Requirements Rule around September 2015. It is expected that the Data Requirements Rule will address all three remaining phases of the designation process.

The Morrow Plant meets the emission criteria laid out in the consent decree. The U.S. EPA has listed the Morrow Plant as a source exceeding the established threshold with actual annual emissions of 3,948 TPY and emission rate of 0.63 lbs/MMBTU based on 2012 emissions data.[7] Thus, the U.S. EPA is required to designate the area surrounding the Morrow Plant by July 2, 2016. Because the Consent Decree does not provide sufficient time to commission representative ambient air monitors, SMEPA has decided to utilize an air dispersion modeling analysis to determine attainment status. Therefore, in accordance with the EPA's May 2014 proposed Data Requirements Rule[8], an SO_2 designation for the area surrounding the Morrow Plant will be based on the predictions of the air dispersion modeling analysis presented in this modeling report. The U.S. EPA published a draft Technical Assistance Document (TAD) in December 2013 describing the approach that should be considered when conducting dispersion modeling in support of a 1-hour SO_2 NAAQS designation[9] (referred to herein as the 2013 SO_2 NAAQS Modeling TAD). To determine the attainment status, Trinity Consultants

[3] http://www.epa.gov/oaqps001/greenbk/ancl.html

[4] http://www.epa.gov/air/criteria.html. Final rule signed June 2, 2010

[5] http://www.epa.gov/so2designations/pdfs/201503FinalCourtOrder.pdf

[6] http://www.epa.gov/oaqps001/sulfurdioxide/pdfs/20150320SO2designations.pdf

[7] http://www.epa.gov/airquality/sulfurdioxide/designations/pdfs/sourceareas.pdf

[8] http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2013-0711-0001

[9] http://www.epa.gov/oaqps001/sulfurdioxide/pdfs/SO2ModelingTAD.pdf

(Trinity) conducted the dispersion modeling on behalf of SMEPA to predict the SO_2 concentrations in the area surrounding the Morrow Plant and the results are attached to this report. This modeling report includes the following:

- 1-Hour SO_2 Designation Modeling Procedure
- 1-Hour SO_2 Designation Modeling Results
- Electronic Files
- Appendix A – Modeling Protocol
- Appendix B – MDEQ Met Data Guidance
- Appendix C – Rain CII Carbon Hourly Emissions Calculations
- Appendix D – AERSURFACE Output
- Appendix E – SO_2 Monitor Values Report

3.1. MODEL SELECTION

Trinity performed 1-hour SO_2 modeling using EPA's preferred AERMOD Version 14134 using input files developed using Trinity's *BREEZE* Software. AERMOD is a steady-state Gaussian dispersion model based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain[10].

3.2. METEOROLOGICAL SITE SELECTION AND REPRESENTATIVENESS

SMEPA used the meteorological data collected at the Bobby L Chain Municipal Airport Station (WBAN: 13833). SMEPA believes that the meteorological data collected at this site is representative for the Morrow Plant based on the proximity, surface characteristics, and land use types. The Bobby L Chain Municipal Airport Station is approximately 9 miles from the center of the Morrow Plant. Terrain between the project site and the meteorological station is generally flat and there are no complex or elevated terrain features. A visual inspection of the terrain map indicated that the terrain features are similar for the meteorological station and the Morrow Plant. The terrain maps are shown in Figure 3-1 and Figure 3-2. Also, the surface characteristic comparison was conducted between the meteorological station and the Morrow Plant. Table 3-1 shows the surface characteristics (i.e., albedo, Bowen-ratio, and surface roughness) values of the meteorological station and the Morrow Plant. In accordance with U.S. EPA guidance, these values were determined using the latest version of the U.S. EPA AERSURFACE tool (version 13016) with a 1 km radius used to define surface roughness.[11] Please refer Appendix D for AERSURFACE output. The albedo and Bowen-ratio values were similar for both the meteorological station and the Morrow Plant. As a typical case, the difference in the surface roughness values between the meteorological station and the Morrow Plant is due the difference in the land use types. The meteorological station has varying land use types for each sector whereas the Morrow Plant has same land use type for each sector, mostly of mixed forest. The land use types around the meteorological station and the Morrow Plant within a 3-Km radius shown in Figure 3-3 and Figure 3-4. The surface characteristics used to process the meteorological data may result in a more conservative concentrations as a result of the smaller roughness lengths. The smaller roughness length in the pre-processed data would result in less turbulent conditions. The less turbulent condition would not facilitate good dispersion, thus resulting in higher impacts. Based on the proximity, topography, and surface characteristics analysis, SMEPA concludes that meteorological data collected at this meteorological station (KHBG) would be representative of the meteorological conditions at the Morrow Plant.

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[10] http://www.epa.gov/ttn/scram/dispersion_prefrec.htm#aermod

[11] U.S. Environmental Protection Agency. 2013. "AERSURFACE User's Guide." EPA-454/B-08-001, Revised 01/16/2013. Available Online: http://www.epa.gov/scram001/7thconf/aermod/aersurface_userguide.pdf

Table 3-1. Comparison of Surface Characteristics Values between Meteorological Station and Morrow Plant

Month	Sector	Surface Characteristics Analysis					
		Albedo		Bowen-Ratio		Surface Roughness	
		Met Station	Morrow Plant	Met Station	Morrow Plant	Met Station	Morrow Plant
1	1	0.15	0.14	0.63	0.79	0.037	0.309
2	1	0.15	0.14	0.63	0.79	0.037	0.309
3	1	0.14	0.14	0.48	0.60	0.051	0.370
4	1	0.14	0.14	0.48	0.60	0.051	0.370
5	1	0.15	0.15	0.34	0.34	0.068	0.460
6	1	0.15	0.15	0.34	0.34	0.068	0.460
7	1	0.15	0.15	0.34	0.34	0.068	0.460
8	1	0.15	0.15	0.34	0.34	0.068	0.460
9	1	0.15	0.15	0.34	0.34	0.068	0.460
10	1	0.15	0.15	0.63	0.79	0.058	0.455
11	1	0.15	0.15	0.63	0.79	0.058	0.455
12	1	0.15	0.14	0.63	0.79	0.037	0.309

Figure 3-1. Terrain Map around the Bobby L Chain Municipal Airport Station within Approximately 3 Km Radius

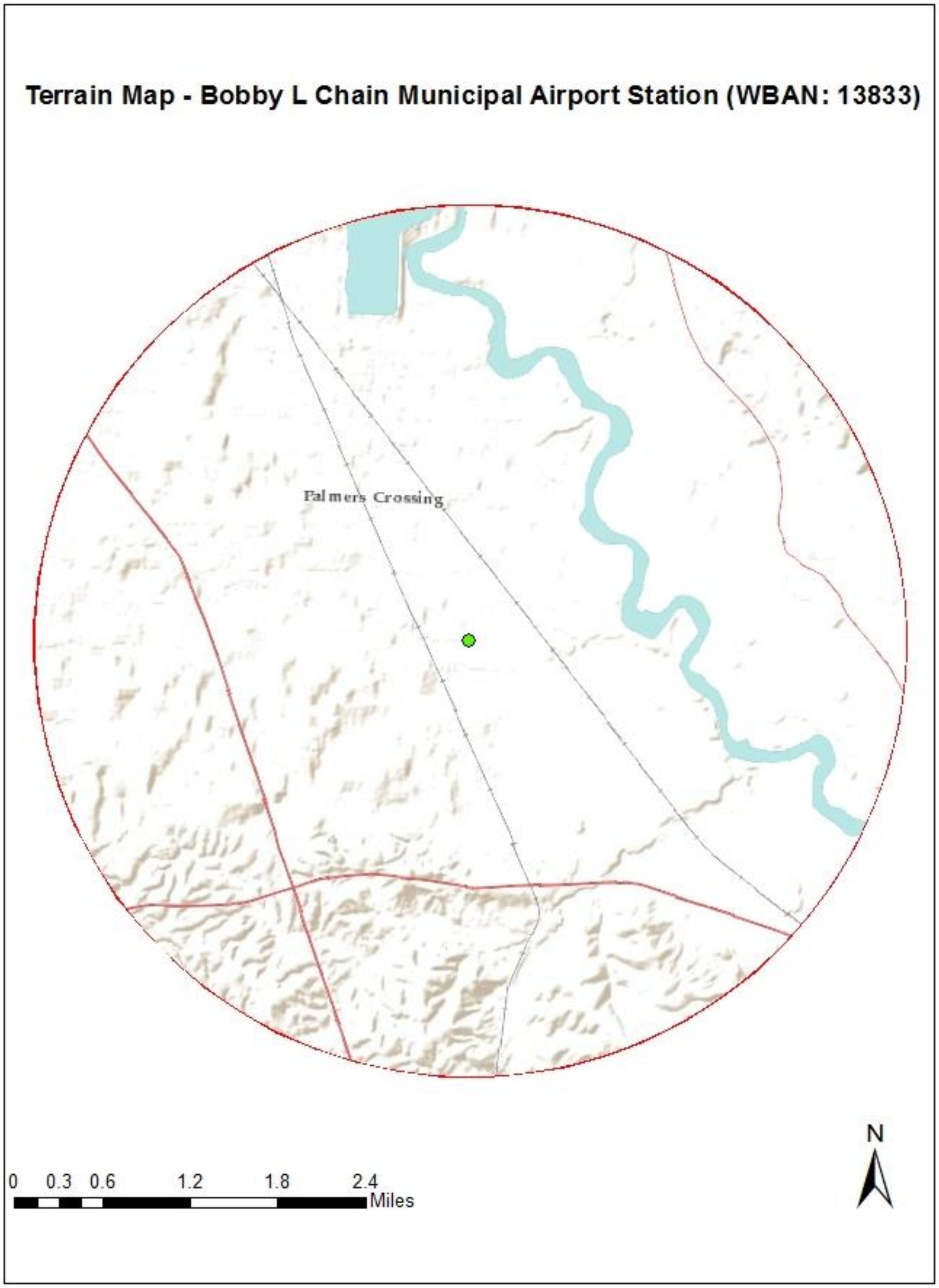


Figure 3-2. Terrain Features around the Morrow Plant within Approximately 3 Km Radius

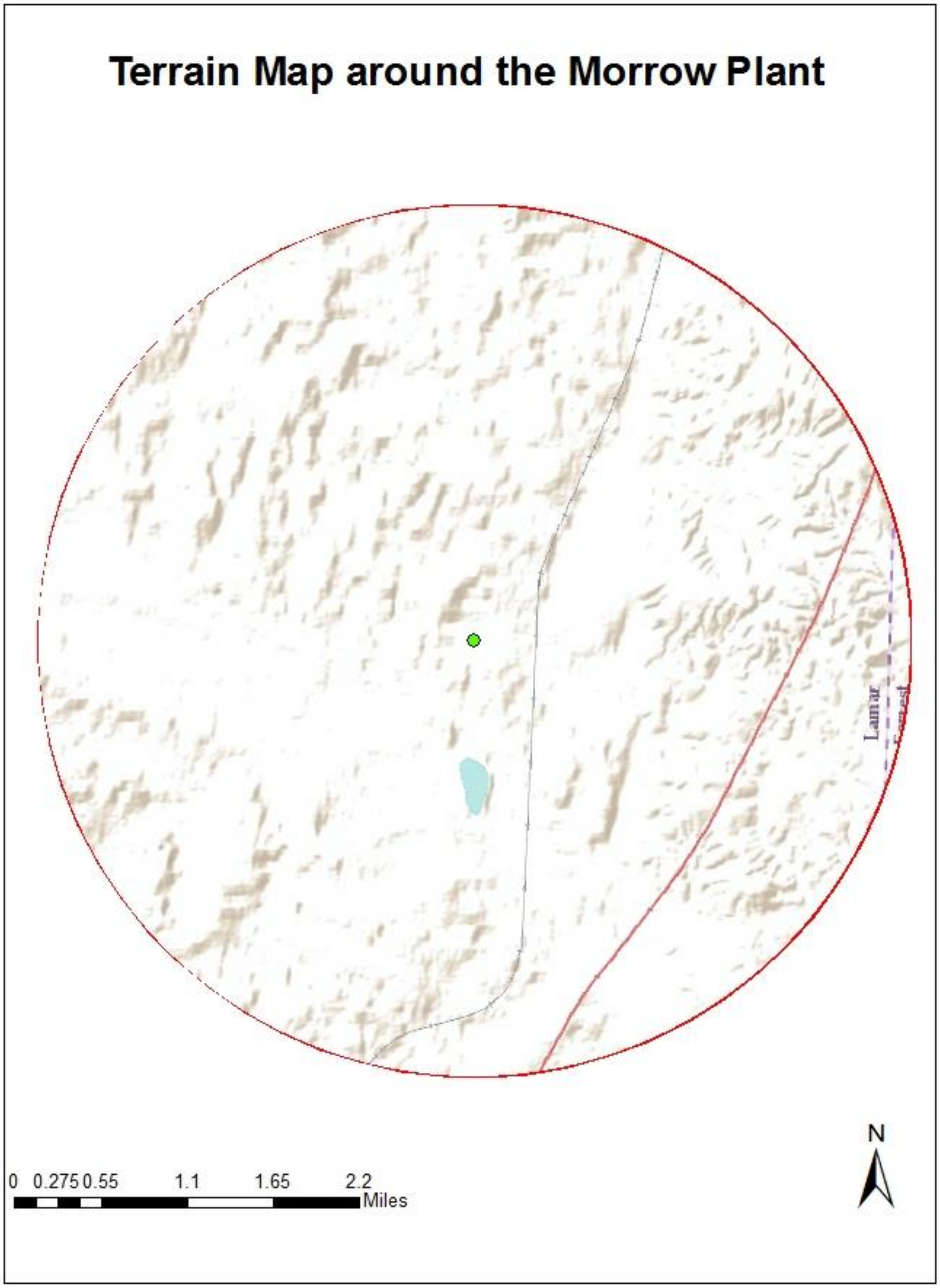


Figure 3-3. Land Use within 1 Km and 3 Km Radius around the Meteorological Station

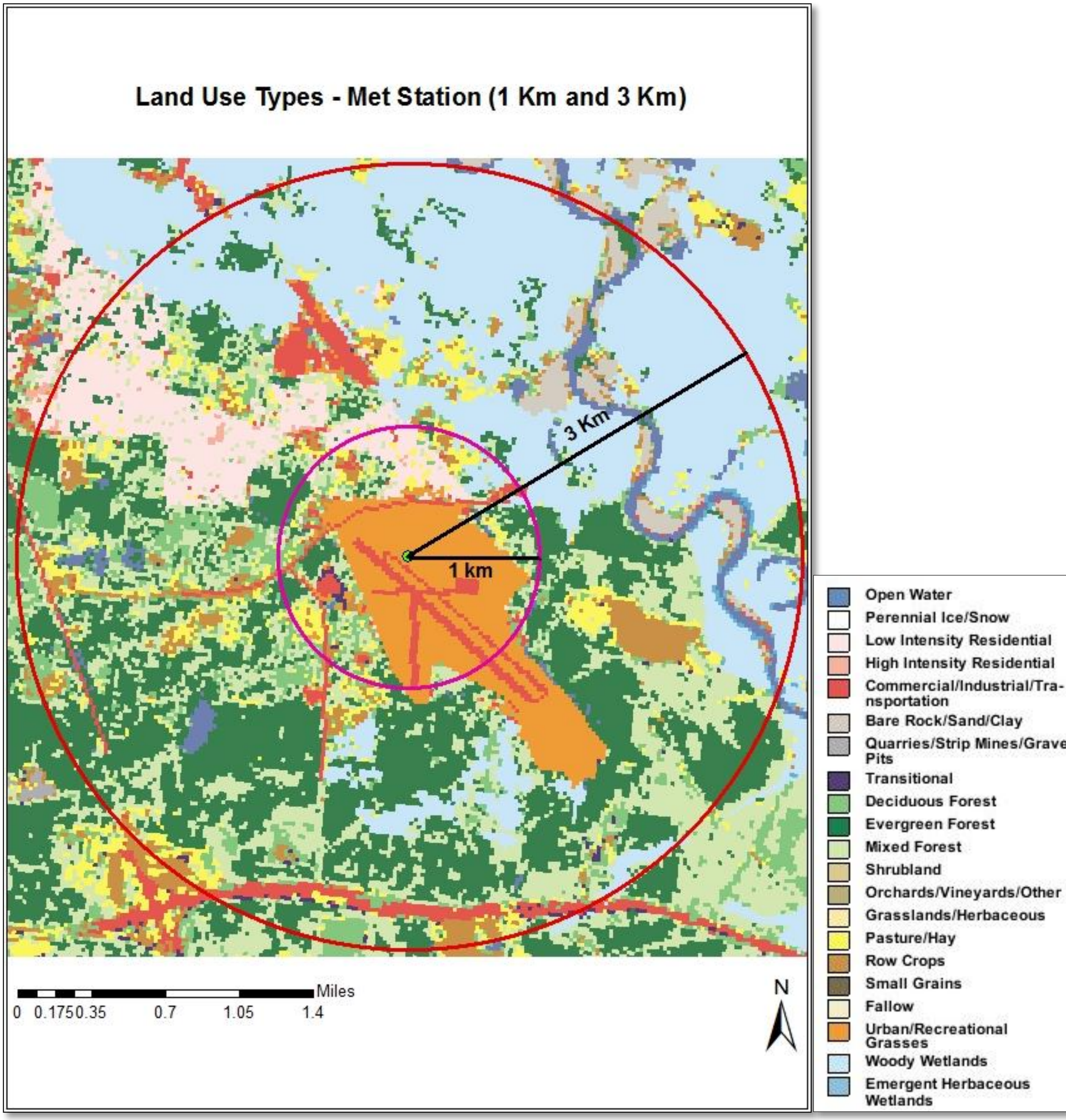
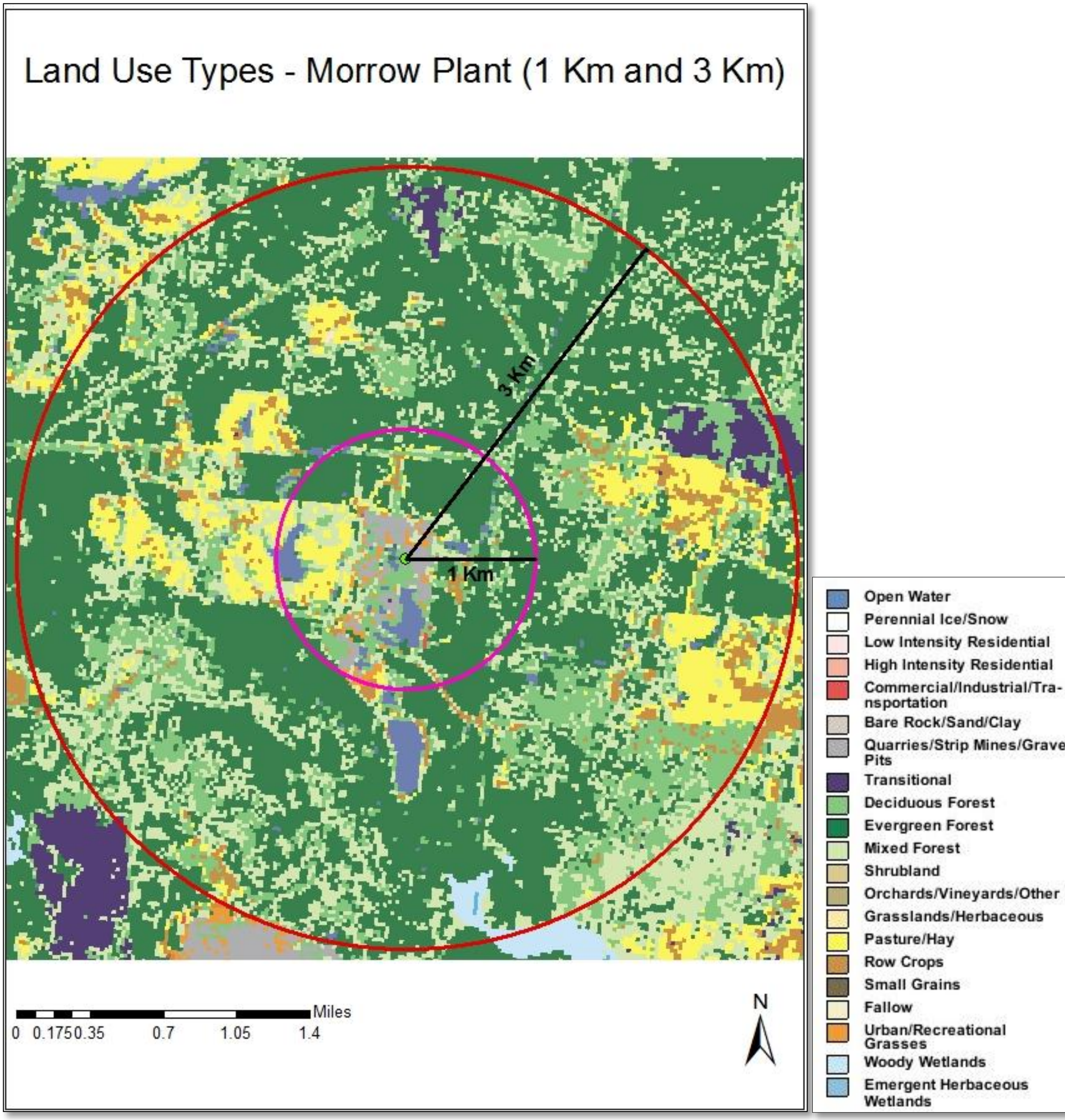


Figure 3-4. Land Use within 1 Km and 3 Km Radius around the Morrow Plant



3.3. AERMET PREPROCESSING

AERMOD-ready meteorological data was prepared using Version No. 14134 of the U.S. EPA's AERMET meteorological processing utility. The met data was generated in accordance with the MS AERMOD Ready Met Files – Supporting Documentation, July 01, 2014 as attached in Appendix B.

3.3.1. Surface Data

Raw hourly surface meteorological data were obtained from the U.S. National Climactic Data Center (NCDC) for Bobby L Chain Municipal Airport Station (KHBG, WMO ID: 724560) in the standard ISHD format. This data was supplemented with TD-6405 (so-called "1-minute") wind data from KHBG. The 1-minute wind data was processed using the latest version of the U.S. EPA AERMINUTE pre-processing tool (version 14337). The quality of the 1-minute data was verified by comparison to the hourly ISHD data from KHBG.

3.3.2. Upper Air Data

In addition to surface meteorological data, AERMET requires the use of data from a sunrise-time upper air sounding to estimate daytime mixing heights. Upper air data from the nearest U.S. National Weather Service (NWS) upper-air balloon station, located in Jackson, Mississippi (WBAN: 03940), was obtained from the National Oceanic and Atmospheric Administration (NOAA) in FSL format. AERMOD-ready meteorological data was prepared using Version No. 14134 of the U.S. EPA's AERMET meteorological processing utility. The met data was generated in accordance with the MS AERMOD Ready Met Files – Supporting Documentation as attached in Appendix B.

3.3.3. Land Use Data

Parameters derived from the analysis of land-use data (surface roughness, Bowen ratio, and albedo) are also required by AERMET. In accordance with U.S. EPA guidance, these values will be determined using the latest version of the U.S. EPA AERSURFACE tool (version 13016).[12] The AERSUFACE settings that were used for processing are summarized in Table 3-2 below. The met station coordinates were determined by visually identifying the met station using Google Earth. NLCD 1992 (CONUS) Land Cover data used in AERSURFACE processing was obtained from the Multi-Resolution Land Use Consortium (MRLC).

U.S. EPA guidance dictates that on at least an annual basis, precipitation at a surface site should be classified as wet, dry, or average in comparison to the 30-year climatological record at the site. This determination is used to adjust the Bowen ratio estimated by AERSURFACE. To make the determination, annual precipitation in each modeled year (2012 to 2014) was compared to the 1981 to 2010 climatological record for KHBG.[13] The 30th and 70th percentile values of the annual precipitation distribution from 1981 to 2010 were calculated. Per U.S. EPA guidance, each modeled year was classified for AERSUFACE processing as "wet" if its annual precipitation was higher than the 70th percentile value, "dry" if its annual precipitation was lower than the 30th percentile value, and "average" if it was between the 30th and 70th percentile values. The values that were used in this case are summarized in Table 3-1. The values are based on the MS AERMOD Ready Met Files – Supporting Documentation attached as Appendix B.

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[12] U.S. Environmental Protection Agency. 2013. "AERSURFACE User's Guide." EPA-454/B-08-001, Revised 01/16/2013. Available Online: http://www.epa.gov/scram001/7thconf/aermod/aersurface_userguide.pdf

[13] National Climactic Data Center. 2010 Local Climatological Data (LCD).

Table 3-2. AERSURFACE Input Parameters

AERSURFACE Parameter	Value
Met Station Latitude	31.269483
Met Station Longitude	-89.256108
Datum	NAD 1983
Radius for surface roughness (km)	1.0
Vary by Sector?	Yes
Number of Sectors	12
Temporal Resolution	Monthly
Continuous Winter Snow Cover?	No
Station Located at Airport?	Yes
Arid Region?	No
Surface Moisture Classification	Average

3.3.4. AERMET Processing Options

Standard AERMET processing options were used.[14,15] The options elected included:

- MODIFY keyword for upper air data
- THRESH_1MIN 0.5 keyword to provide a lower bound of 0.5 m/s for 1-minute wind data
- AUDIT keywords to provide additional QA/QC and diagnostic information
- ASOS1MIN keyword to incorporate 1-minute wind data
- NWS_HGT WIND 10 keyword to designate the anemometer height as 10 meters
- METHOD WIND_DIR RANDOM keyword to correct for any wind direction rounding in the raw ISHD data
- METHOD REFLEVEL SUBNWS keyword to allow use of airport surface station data
- Default substitution options for cloud cover and temperature data was not overridden
- Default ASOS_ADJ option for correction of truncated wind speeds was not overridden
- ADJ_U* beta option was not used

3.4. COORDINATE SYSTEM

In all modeling input and output files, the locations of emission sources, structures, and receptors were represented in Zone 16 of the Universal Transverse Mercator (UTM) coordinate system using datum World Geodetic System (WGS) 1984, which is comparable to the North American Datum 1983 (NAD83). The Morrow Plant is approximately centered at UTM, Zone 16, coordinates 272,009 meters East and 3,456,266 meters north. The base elevation of the facility is approximately 79 meters above mean sea level.

[14] Fox, Tyler, U.S. Environmental Protection Agency. 2013. "Use of ASOS Meteorological Data in AERMOD Dispersion Modeling." Available Online: http://www.epa.gov/ttn/scram/guidance/clarification/20130308_Met_Data_Clarification.pdf

[15] U.S. Environmental Protection Agency. 2014. "User's Guide for the AERMOD Meteorological Preprocessor (AERMET)". EPA-454/B-03-002, November 2004).

3.5. RECEPTOR LOCATIONS

The dispersion modeling used a combination of a Cartesian grid system centered on the Morrow Plant and discrete receptor points along the facility's fence line. Receptors were placed at 25-meter intervals along the fence line, 100-meter intervals out to a distance of 2.5 kilometers (km) and at 500-meter intervals out to 10 km.

3.6. TERRAIN ELEVATIONS

The terrain elevation for each receptor, building, and emission source was determined using USGS 1/3-arc-second National Elevation Data (NED). The NED, obtained from the USGS, has terrain elevations at 10-meter intervals. Using the AERMOD terrain processor, AERMAP (version 11103), the terrain height for each receptor, building, and emission source included in the model was determined by assigning the interpolated height from the digital terrain elevations surrounding each source.

In addition, AERMAP was used to compute the hill height scales for each receptor. AERMAP searches all NED points for the terrain height and location that has the greatest influence on each receptor to determine the hill height scale for that receptor. AERMOD then uses the hill height scale in order to select the correct critical dividing streamline and concentration algorithm for each receptor.

3.7. BUILDING INFLUENCES

The U.S. EPA's Building Profile Input Program (BPIP) with Plume Rise Model Enhancements (PRIME) (Version 04274), was used to account for Morrow Plant building downwash influences in the model. The purpose of a building downwash analysis is to determine if the plume discharged from a stack will become caught in the turbulent wake of a building (or other structure), resulting in downwash of the plume. The downwash of the plume can result in elevated ground-level concentrations of SO_2. SMEPA did not include any buildings from nearby sources in the model. For both the scenarios, actual height was lower than the GEP stack height. Table 3-3 shows the GEP Stack height analysis for both modeling scenarios. The actual stack heights modeled are less than the GEP Stack height, which satisfies the GEP requirement of 40 CFR Part 51 Appendix W.

Table 3-3. GEP Stack Height Analysis

Stack Name	Actual Stack Height, m	GEP Stack Height, m[16]	Complies GEP Requirements
Unit 1 – AA-001	123.50	144.17	Yes
Unit 2 – AA-002	123.50	144.51	Yes
RainCII	34.75	65	Yes

[16] GEP Stack height was calculated using Equation 1 from Technical Support Document for Determination of Good Engineering Practice Stack Height, pg. 2

3.8. URBAN/RURAL DETERMINATION

SMEPA used the Auer Method to determine the urban or rural classification. Accordingly, the following procedure was used by SMEPA to determine the classification:

- The land use types within a 3 Km radius from the center of the Morrow Plant were analyzed;
- In accordance with Appendix W Guideline on Air Quality Models, if the land use types I1, I2, C1, R2, and R3 account for 50 percent or more of the total area analyzed, urban dispersion coefficients should be used.

Based on the visual inspection of the land use types shown in Figure 3-4, approximately 65% of the area represents mixed forest (Deciduous and Evergreen) and approximately 20% of the area represents Pasture/Hay. Hence, SMEPA used the default "rural" AERMOD options for this modeling.

3.9. SMEPA SOURCE IDENTIFICATION AND CHARACTERIZATION

There are two boilers at the Morrow Plant were analyzed in this dispersion modeling. The stacks for the boilers were modeled as point sources. Table 3-4 below summarizes the stack parameters used for the dispersion modeling. Trinity used the hourly data collected by the Continuous Emission Monitoring System (CEMS) for 2012, 2013, and 2014. The CEMS data was provided by SMEPA. AERMOD has several options for emissions to temporally vary within a model simulation. CEMS data were incorporated in the dispersion modeling using the hourly varying emissions options (AERMOD keyword: HOUREMIS) to represent the variability in emissions accurately. In addition, SMEPA incorporated varying hourly temperature and air flow rate data corresponding to the hourly emissions data. For any missing hourly emission data, the maximum of the previous hourly emission data and the next hourly emission data was used to be conservative. If more than one hourly data were missing, the maximum daily hourly data of that particular data was used. Please see attached modeling CD for the Hourly Emission Rates File and supporting CEMS data.

Please note that although there are additional sources of SO_2 emissions (all Compression Ignition Emergency Engines) in operation at the Morrow Plant, the 2013 SO_2 NAAQS Modeling TAD, Section 5.4, states that sources such as emergency engines/fire water pumps do not need to be modeled because they are intermittent, are not in continuous operation, and would have negligible contribution to the annual distribution of the daily maximum 1-hour SO_2 concentration. SMEPA believes that emissions from the emergency equipment fit these criteria; therefore, they have not been included in this analysis.

Table 3-4. SMEPA Source Identification and Location

Emission Point	UTM East (m)*	UTM North (m)*	Stack Height (ft.)	Stack Diameter (ft.)	Exit Velocity (ft./s)	Exit Temperature (F)	Emission Rate (lb/hr)
AA-001	271955.1	3456195	405.2	16.7	CEMS	CEMS	CEMS
AA-002	271962.1	3456195	405.2	16.7	CEMS	CEMS	CEMS

*UTM Zone 16, NAD 83

3.10. EMISSIONS INVENTORIES FOR NEARBY SOURCES

Other sources of SO_2 emissions in the area surrounding the Morrow Plant were included in the model. SMEPA requested the emissions inventory from the MDEQ. Based on the emissions inventory data provided by the

MDEQ, SMEPA performed the analysis seen in Table 3-5 and described below to determine which nearby sources to include. In accordance with the modeling protocol, SMEPA has excluded all the near-by SO_2 sources with emissions less than 10 tpy.

Table 3-5. Nearby SO_2 Source Analysis

Source	Distance from SMEPA (km)	Plant-Wide Actual SO_2 Emissions, tpy			Selected for SO_2 Designation Modeling? (Yes/No)	Reason
		2012	2013	2014		
Rain CII Carbon, LLC	3.85	717.22	718.3	498.63	Yes	N/A
Leaf River Cellulose, LLC	33.42	62.65	65.38	Not Available	No	Emissions are small relative to distance from SMEPA

SMEPA did not include the SO_2 emissions from the Leaf River Cellulose, LLC facility based on the relative emission rate for the facility compared with the distance from the Morrow Plant. For the worst-case emissions year, the ratio is 1.95 (65.38 TPY/33.42 km), which indicates that the source is relatively small and distant from the Morrow Plant and can be represented through use of a background concentration rather than explicitly modeled. SMEPA included SO_2 emissions from the Rain CII Carbon, LLC facility due to its close proximity to SMEPA in conjunction with their annual SO_2 emissions.

3.11. MODEL INPUT – SOURCE PARAMETERS

Table 3-6 shows the emission sources included in this SO_2 designation modeling. For this modeling, SMEPA included the following sources:

- Unit 1 – No. 1 Coal/Fuel Oil Fired Boiler;
- Unit 2 – No. 2 Coal/Fuel Oil Fired Boiler; and
- RainCII – Rain CII Carbon Facility (Source parameters are provided by the MDEQ)

Table 3-6. Source Parameters for SO_2 Designation Modeling

Emission Point	UTM East (m)*	UTM North (m)*	Stack Height (ft.)	Stack Diameter (ft.)	Exit Velocity (ft./s)	Exit Temperature (F)	Emission Rate (lb/hr)
AA-001	271955.1	3456195	405.2	16.7	CEMS	CEMS	CEMS
AA-002	271962.1	3456195	405.2	16.7	CEMS	CEMS	CEMS
RainCII	272373.5	3452147	114	8.60	16.9	405	See Appendix C

*UTM Zone 16, NAD 83

3.12. BACKGROUND CONCENTRATION

SMEPA opted to choose a "regional monitor" for the purpose of defining a background concentration since there are no SO_2 monitoring stations located at the Morrow Plant. Based on MDEQ's recommendation, SMEPA selects the Jackson Monitoring Station (Hinds County) to obtain the background SO_2 concentration. In addition, SMEPA performed a qualitative analysis to compare the Jackson Monitor site with the Morrow Plant site based on near-by emission sources, surface characteristics, and land use types. Based on the comparison, SMEPA believes that the Jackson Monitoring Station (Site ID: 280490020) is representative of the Morrow Plant.

3.12.1. Comparison of Near-by Emissions Sources

The only facility with significant SO_2 emissions in the vicinity (i.e., within 50 Km) of the Jackson Monitoring Station is the Thomasville Gas Plant with 4,506 tpy in 2014 and the next largest would be Nucor Steel with 11 tpy in 2014.[17] This represents a similar or possibly conservative distribution of sources impacting the monitor to those in the vicinity of the Morrow Plant but not explicitly modeled. The only facility with significant SO_2 emissions (i.e., greater than 10 tpy) within 50 Km of the Morrow Plant site, but not explicitly modeled is the Leaf River Cellulose facility with 48.55 tpy for 2014. Therefore, the use of the Jackson Monitor to represent SO_2 concentrations from sources in the vicinity of the Morrow Plant, but not explicitly modeled in this analysis should be conservative.

3.12.2. Comparison of Surface Characteristics and Land Use Types

SMEPA evaluated the surface characteristics values (i.e., albedo, Bowen-ratio and surface roughness) of the Morrow Plant and the Jackson Monitoring Station. Based on the AERSURFACE analysis, the surface characteristics values were similar for the Jackson Monitoring Station and the Morrow Plant. Table 3-7 shows the comparison of surface characteristics values of Jackson monitoring station and the Morrow Plant. Please see Appendix C for AERSURFACE output.

Figure 3-5 shows the land use types around the Jackson Monitoring Station. Unlike the area around the Morrow Plant, the area around the Jackson Monitoring station is mostly of low density residential, high density residential, and Commercial/Industrial/Transportation classification. Hence, area around the Jackson monitoring station can be considered as "urban". The monitoring station would be expected to be impacted by larger sources of SO_2 emissions, either nearby or more distant as discussed in Section 3.12.1, and by smaller, more local sources. SMEPA believes the SO_2 background concentration obtained from the Jackson Monitoring Station would be conservative since the Morrow Plant is located in "rural" setting with less more local sources expected to be impacting the SMEPA Plant area as this area is more rural than the monitoring station.

Based on the analysis of the near-by emission sources, surface characteristics values, and land use types, SMEPA concluded to use the background concentration obtained from the Jackson Monitoring Station consistent with the recommendation of MDEQ.

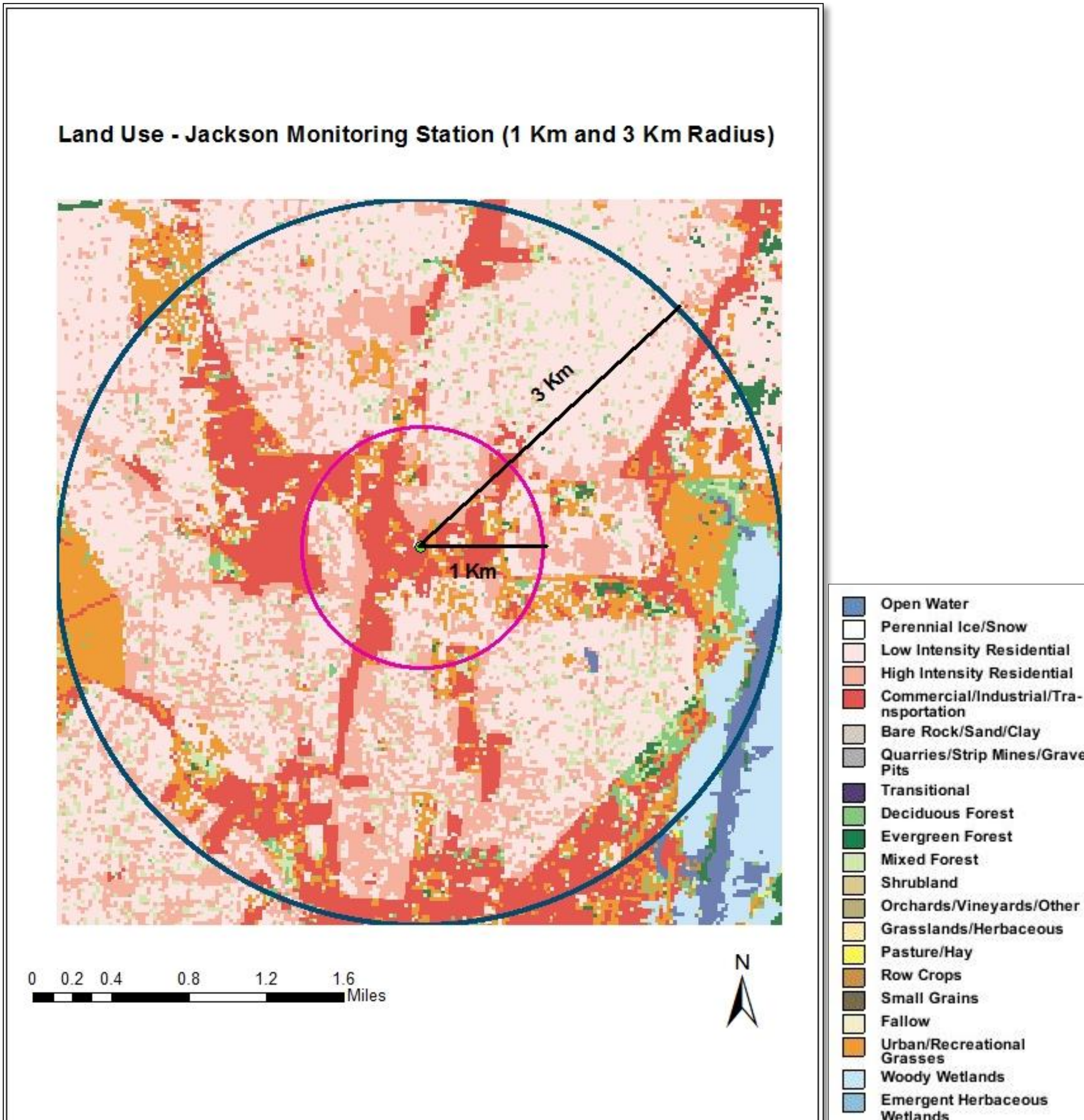
[17] 2014 SO_2 emissions were provided by MDEQ via e-mail dated July 10, 2015.

Table 3-7. Surface Characteristics Analysis of Jackson Monitoring Station and the Morrow Plant

Month	Sector	Surface Characteristics Analysis					
		Albedo		Bowen-Ratio		Surface Roughness	
		Monitoring Station	Morrow Plant	Monitoring Station	Morrow Plant	Monitoring Station	Morrow Plant
1	1	0.17	0.14	0.81	0.79	0.337	0.309
2	1	0.17	0.14	0.81	0.79	0.337	0.309
3	1	0.16	0.14	0.65	0.60	0.386	0.370
4	1	0.16	0.14	0.65	0.60	0.386	0.370
5	1	0.16	0.15	0.63	0.34	0.405	0.460
6	1	0.16	0.15	0.63	0.34	0.405	0.460
7	1	0.16	0.15	0.63	0.34	0.405	0.460
8	1	0.16	0.15	0.63	0.34	0.405	0.460
9	1	0.16	0.15	0.63	0.34	0.405	0.460
10	1	0.16	0.15	0.81	0.79	0.389	0.455
11	1	0.16	0.15	0.81	0.79	0.389	0.455
12	1	0.17	0.14	0.81	0.79	0.337	0.309

Based on the most recent data from the Jackson monitoring station, MDEQ has recommended an SO_2 background concentration of 14 ppb, or 36.65 μg/m^3. The 2014 SO_2 Monitor Values Report for the Jackson monitoring station is attached as Appendix E. SMEPA has used the 14 ppb value as the background concentration in this analysis.

Figure 3-5. Land Use within 1 Km and 3 Km Radius around the Jackson Monitoring Station (Site ID: 280490020)



4.1. MODELING RESULTS

SMEPA modeled UNIT 1 (AA-001) and UNIT 2 (AA-002) using the actual CEMS data (2012-2014) as hourly emission input to the AERMOD model. The Rain CII facility (Table 3-6) was also included as a point source in the model. Since the actual emission rates were used for the model, three separate models for 2012 – 2014 were created to accurately model the yearly changes in SO_2 emissions at the Rain CII facility. Once run separately, the modeled results for all three years were averaged together on a receptor-by-receptor basis to maintain consistency with the form of the 1-hour SO_2 NAAQS. Figure 4-1 below shows the resulting concentration contours after the three years were averaged.

Figure 4-1. Contour Plot Showing the Concentration Gradient

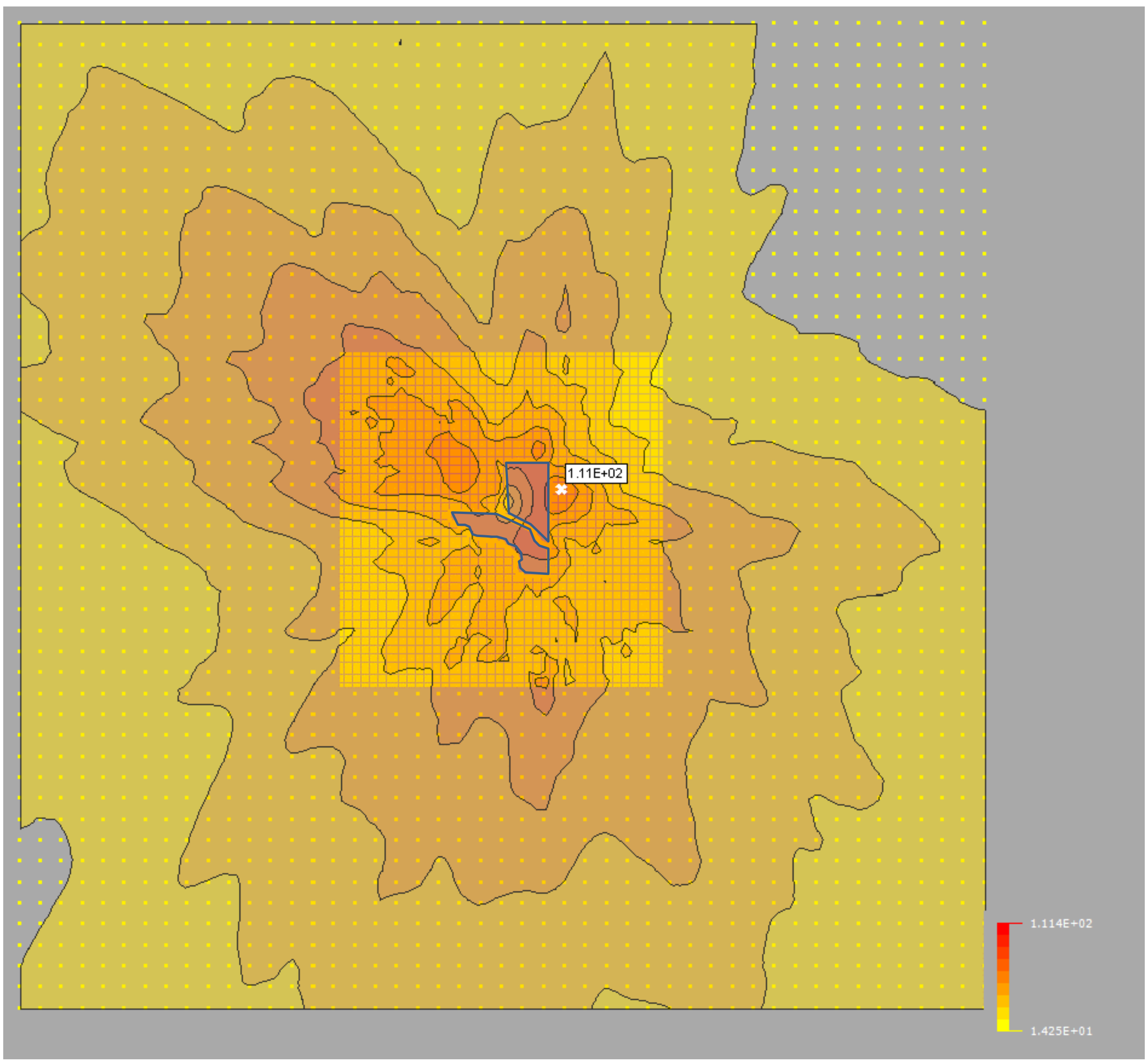


Table 4-1 below shows the receptor with the 4th highest predicted concentration compared to the 1-hour SO_2 NAAQS averaged for three years (2012 to 2014).

Table 4-1. 4th - Highest Averaged Modeled Concentration based on Actual Emission Rates (2012-2014)

UTM East, m	UTM North, m	Modeled Concentration, µg/m³ (ppb)	Background Concentration, µg/m³ (ppb)	Modeled Concentration + Background, µg/m³ (ppb)	1-SO_2 NAAQS, µg/m³ (ppb)	Pass NAAQS? (Yes/No)
272,900	3,456,400	111.36 (42.50)	36.65 (13.99)	**148.04 (56.49)**	196.34 (75)	**Yes**

As seen in Table 4-1, modeled concentrations from actual emissions (along with the background concentration) are well below the NAAQS standard. **Since the modeled concentration based on the actual emission rates from SMEPA and the nearby Rain CII facility are in compliance with the 1-hour SO_2 NAAQS, SMEPA has demonstrated that the area around the Morrow Plant, including Lamar County, is attainment and should be designated as "attainment".**

5. ELECTRONIC FILES

All of the air quality dispersion modeling analysis electronic data files used to generate the results presented in this report are provided in the attached CD. These electronic data files include the following:

> All AERMOD input, output, and plot data files;
> Meteorological files;
> All downwash input and output files;
> Boundary line files;
> AERSURFACE files and NLCD92 map;
> CEMS raw data;
> Hourly input files; and
> Electronic version of the modeling report

The following tables summarize the electronic files included in the attached CD.

Table 5-1. AERMOD Input and Output File Descriptions for the Air Quality Dispersion Modeling Analysis

Pollutant and Averaging Periods	File Name	Associated Files	File Description	Receptor Grid	Emission Sources
SO_2 (1-hr)	SO2SIP2C12H.zip SO2SIP2C13H.zip SO2SIP2C14H.zip	Input file(*.ami) Output file, (*.aml) Plot file (*.plt)	SO_2 Designation Modeling	All	AA-001, AA-002, and Rain CII

Table 5-2. Meteorological Files Used for the Air Quality Dispersion Modeling Analysis

Level	Meteorological File Name	Year
Surface	KHBG (WBAN:13833)	2012-2014
Profile/Upper Air	Upper Air (WBAN:03940)	2012-2014

Table 5-3. Other Associated Files

File Name	Description
Bpip output file	Downwash file
BND.bln	Property line file
Aersurface	AERSURFACE inputs and output
SMEPA Modeling Report (082015).pdf	Modeling report
HERF-2012, HERF-2013, and HERF-2014	Hourly Emission Rate Files
CEMS Data	CEMS Raw Data from SMEPA

APPENDIX A: MODELING PROTOCOL

AIR DISPERSION MODELING PROTOCOL

South Mississippi Electric Power Association>
R D Morrow Plant, Lamar County, MS

SOUTH MISSISSIPPI ELECTRIC POWER ASSOCIATION

1-Hour SO_2 NAAQS Designation Modeling Protocol

Prepared By:

TRINITY CONSULTANTS
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Metairie, Louisiana - 70001
(504) 828-5845

June 2, 2015

151902.0007

Trinity Consultants

Environmental solutions delivered uncommonly well

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

The South Mississippi Electric Power Association (SMEPA) owns and operates the R D Morrow Electric Power Generating Plant (Morrow Plant) located in Lamar County, Mississippi. The plant is currently operating under the Title V Permit No. 1440-00021 issued by the Mississippi Department of Environmental Quality (MDEQ).

On June 2, 2010, U. S. Environmental Protection Agency (U.S. EPA) revised the primary National Ambient Air Quality Standards (NAAQS) for sulfur dioxide (SO_2) by establishing a 1-hour standard at a level of 75 parts per billion (ppb)[1], which is equivalent to 196 $\mu g/m^3$. The form of the 1-hour SO_2 NAAQS standard is a 3- year average of the 99th percentile of the annual distribution of daily maximum 1-hour average concentrations.

Following the U.S. EPA's May 2014 publication of the proposed Data Requirements Rule, the U.S. EPA was sued for "*failing to undertake a certain nondiscretionary duty under the Clean Air Act ("CAA"), 42 U.S.C. §§ 7401-7671q, and that such alleged failure is actionable under section 304(a)(2) of the CAA, 42 U.S.C. § 7604(a)(2)*". The lawsuit resulted in a Consent Decree that was entered on March 2, 2015 in the U.S. District Court for the Northern District of California[2]. As a result of the Consent Decree, an additional designation phase was added to the two designation phases that were already included in the U.S. EPA's May 2014 proposed Data Requirements Rule. The additional phase affects areas with stationary sources that meet specific emission criteria laid out in the Consent Decree. The U.S. EPA released a memorandum on March 20, 2015 (referred to herein as the 2015 SO_2 Area Designation Guidance) to the Regional Directors clarifying the path forward for states with sources affected by the decree.[3]

The Consent Decree requires the U.S. EPA to complete a round of SO_2 designations for the areas affected by the Consent Decree by July 2, 2016. The U.S. EPA is expected to release a final version of the Data Requirements Rule around September 2015. It is expected that the Data Requirements Rule will address all three remaining phases of the designation process.

The Morrow plant meets the emission criteria laid out in the consent decree. The U.S. EPA has listed the Morrow plant as a source exceeding the established threshold with an annual emissions of 3,948 TPY and emission rate of 0.63 lbs/MMBTU based on 2012 emissions data.[4] Thus, the U.S. EPA is required to designate the area surrounding the morrow plant by July 2, 2016. Because the Consent Decree does not provide sufficient time to commission representative ambient air monitors, SMEPA has decided to utilize an air dispersion modeling to determine attainment status. Therefore, in accordance with the EPA's May 2014 proposed Data Requirements Rule[5], an SO_2 designation for the area surrounding the Morrow plant will be based on the predictions of an air dispersion model. The U.S. EPA published a draft Technical Assistance Document (TAD) in December 2013 describing the approach that should be considered when conducting dispersion modeling in support of a 1-hour

[1] http://www.epa.gov/air/criteria.html. Final rule signed June 2, 2010

[2] http://www.epa.gov/so2designations/pdfs/201503FinalCourtOrder.pdf

[3] http://www.epa.gov/oaqps001/sulfurdioxide/pdfs/20150320SO2designations.pdf

[4] http://www.epa.gov/airquality/sulfurdioxide/designations/pdfs/sourceareas.pdf

[5] http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2013-0711-0001

SO_2 NAAQS designation[6] (referred to herein as the 2013 SO_2 NAAQS Modeling TAD). To determine the attainment status, SMEPA will use following air dispersion modeling scenarios:

- **SCENARIO 1:**
  - Use the allowable SO_2 emission limit of 1.2 lb/MMBTU;
  - Use three (3) years of meteorological data (2012, 2013, and 2014);
  - Use actual stack heights for designation. If the actual height of a stack is greater than the Good Engineering Practice (GEP) Stack height, GEP stack height will be used for modeling ; and
  - Include near-by sources from the regional inventories provided by the Mississippi Department of Environmental Quality.

- **SCENARIO 2:**
  - Use the most recent three (3) years of actual emissions (2012, 2013, and 2014);
  - Use of three (3) years of meteorological data (2012, 2013, and 2014);
  - Use actual stack heights for designation. If the actual height of a stack is greater than the Good Engineering Practice (GEP) Stack height, GEP stack height will be used for modeling; and
  - Include near-by sources from the regional inventories provided by the Mississippi Department of Environmental Quality.

For sources with SO_2 Continuous Emission Monitoring Systems (CEMS), the CEMS data will be used in Scenario 2 to characterize emissions. Trinity is planning to conduct the dispersion modeling on behalf of SMEPA to predict the SO_2 concentrations in the area surrounding the Morrow plant. The modeling will be performed in accordance with the 2013 SO_2 NAAQS Modeling TAD. The remainder of this protocol summarizes modeling procedures that will be used in the modeling described above.

[6] http://www.epa.gov/oaqps001/sulfurdioxide/pdfs/SO2ModelingTAD.pdf

2. 1-HOUR SO_2 DESINGATION MODELING PROCEDURES

2.1. MODEL SELECTION

Trinity will perform 1-hour SO_2 modeling using EPA's preferred AERMOD Version 14134 using input files developed using Trinity's *BREEZE* Software. AERMOD is a steady-state Gaussian dispersion model based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain[7].

2.2. METEOROLOGICAL DATA

SMEPA proposes to use the meteorological data collected at the Bobby L Chain Municipal Airport Station (WBAN: 13833), which is approximately 9 miles from the center of the facility. A determination of whether the meteorological data from the met station were appropriate for use in SMEPA's modeling analyses was considered by determining whether the data were representative of the site where the Morrow plant is located. The close proximity of the met station with respect to the plant (less than 9 miles distance), in addition to the similarity in the climatology and topography, support that the meteorological conditions at the airport are representative of the meteorological conditions at the Morrow plant.

AERMOD-ready meteorological data will be prepared using the latest version of the U.S. EPA's AERMET meteorological processing utility (version 14134). The met data will be generated in accordance with the Met support data document as attached in Appendix A

2.2.1. Surface Data

Raw hourly surface meteorological data will be obtained from the U.S. National Climactic Data Center (NCDC) for Bobby L Chain Municipal Airport Station (KHBG, WMO ID: 724560) in the standard ISHD format. This data will be supplemented with TD-6405 (so-called "1-minute") wind data from KHBG. The 1-minute wind data will be processed using the latest version of the U.S. EPA AERMINUTE pre-processing tool (version 14337). The quality of the 1-minute data will be verified by comparison to the hourly ISHD data from KHBG.

2.2.2. Upper Air Data

In addition to surface meteorological data, AERMET requires the use of data from a sunrise-time upper air sounding to estimate daytime mixing heights. Upper air data from the nearest U.S. National Weather Service (NWS) upper-air balloon station, located in Jackson, Mississippi (WBAN: 03940), will be obtained from the National Oceanic and Atmospheric Administration (NOAA) in FSL format.

2.2.3. Land Use Analysis

Parameters derived from the analysis of land-use data (surface roughness, Bowen ratio, and albedo) are also required by AERMET. In accordance with U.S. EPA guidance, these values will be determined using the latest version of the U.S. EPA AERSURFACE tool (version 13016).[8] The AERSUFACE settings that will be used for processing are summarized in Table 1 below. The met station coordinates were determined by visually

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[7] http://www.epa.gov/ttn/scram/dispersion_prefrec.htm#aermod

[8] U.S. Environmental Protection Agency. 2013. "AERSURFACE User's Guide." EPA-454/B-08-001, Revised 01/16/2013. Available Online: http://www.epa.gov/scram001/7thconf/aermod/aersurface_userguide.pdf

identifying the met station using Google Earth. NLCD 1992 (CONUS) Land Cover data used in AERSURFACE processing was obtained from the Multi-Resolution Land Use Consortium (MRLC).

U.S. EPA guidance dictates that on at least an annual basis, precipitation at a surface site should be classified as wet, dry, or average in comparison to the 30-year climatological record at the site. This determination is used to adjust the Bowen ratio estimated by AERSURFACE. To make the determination, annual precipitation in each modeled year (2012 to 2014) will be compared to the 1981 to 2010 climatological record for KHBG.[9] The 30th and 70th percentile values of the annual precipitation distribution from 1981 to 2010 will be calculated. Per U.S. EPA guidance, each modeled year will be classified for AERSUFACE processing as "wet" if its annual precipitation was higher than the 70th percentile value, "dry" if its annual precipitation was lower than the 30th percentile value, and "average" if it was between the 30th and 70th percentile values. The values to be used in this case are summarized in Table 2-1. The values are based on the guidance document attached as Appendix A.

Table 2-1. AERSURFACE Input Parameters

AERSURFACE Parameter	Value
Met Station Latitude	31.269483
Met Station Longitude	-89.256108
Datum	NAD 1983
Radius for surface roughness (km)	1.0
Vary by Sector?	Yes
Number of Sectors	12
Temporal Resolution	Monthly
Continuous Winter Snow Cover?	No
Station Located at Airport?	Yes
Arid Region?	No
Surface Moisture Classification	Average

[9] National Climactic Data Center. 2010 Local Climatological Data (LCD).

Figure 2-1. Land-use Around the KHBG Met Station (10-KM Radius)

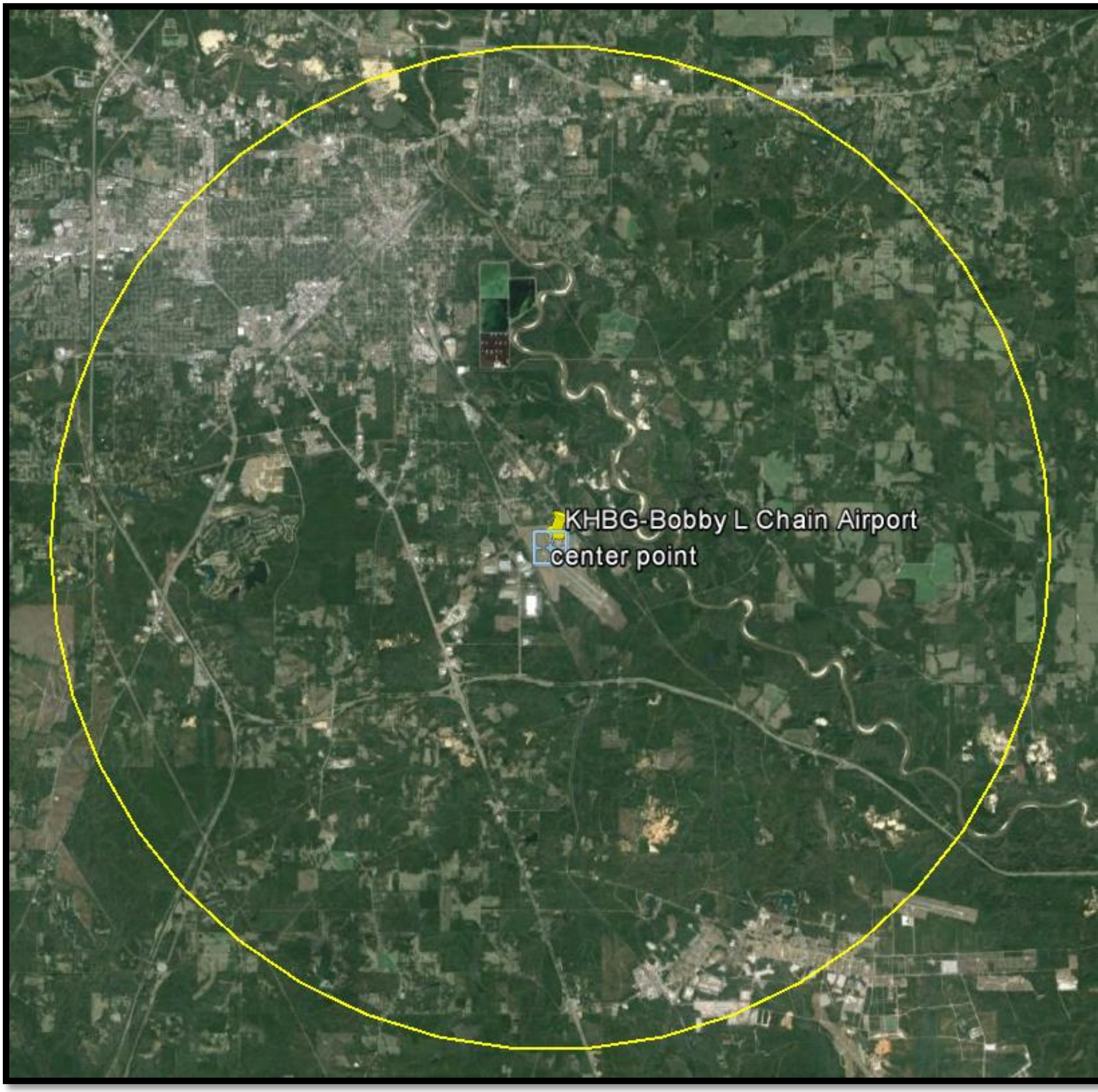
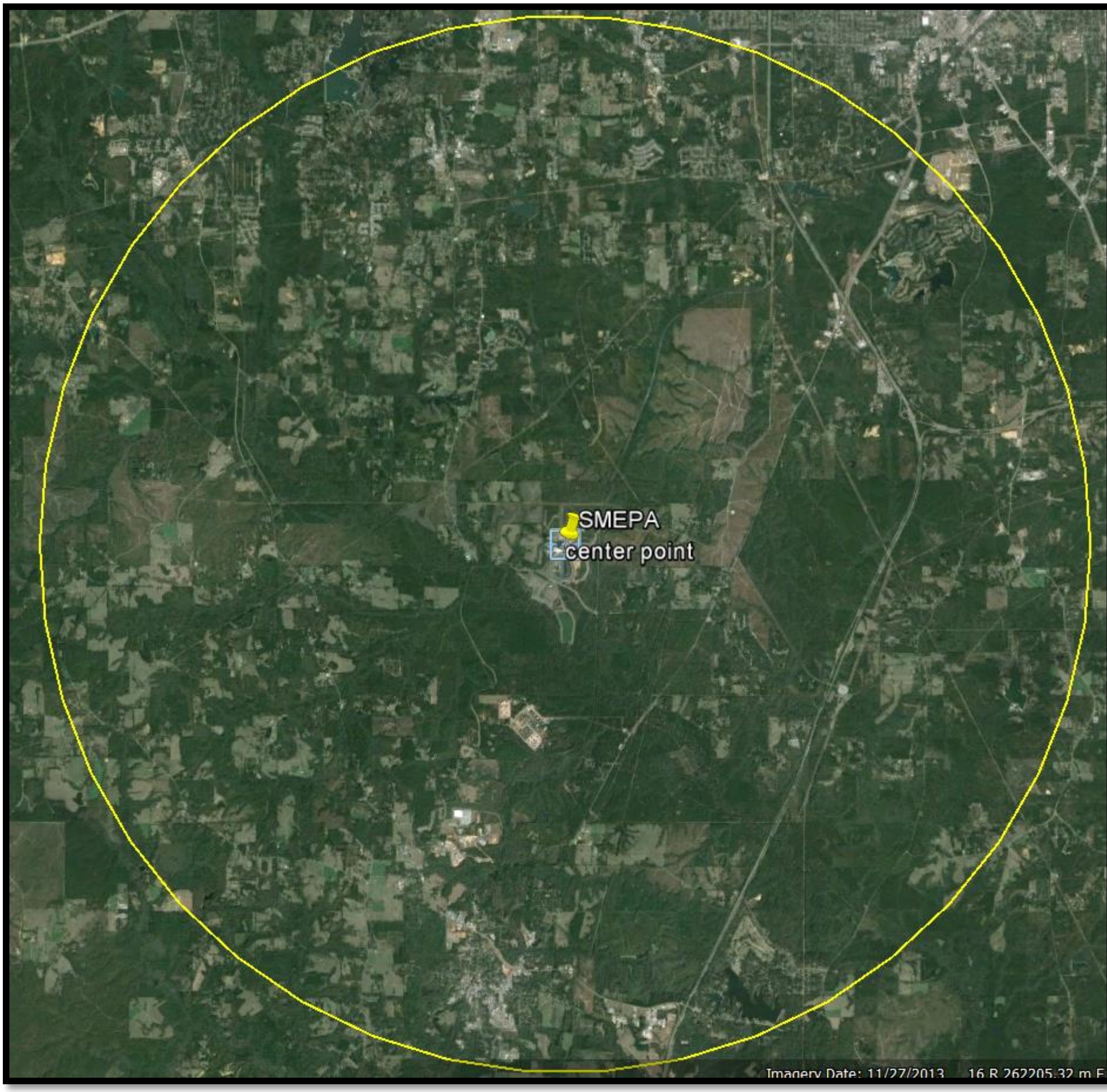


Figure 2-2. Land-use Around the Morrow Plant (10-KM Radius)



2.2.4. AERMET Processing Options

Standard AERMET processing options will be used.[10,11] The options elected will include:

- MODIFY keyword for upper air data
- THRESH_1MIN 0.5 keyword to provide a lower bound of 0.5 m/s for 1-minute wind data
- AUDIT keywords to provide additional QA/QC and diagnostic information
- ASOS1MIN keyword to incorporate 1-minute wind data
- NWS_HGT WIND 10 keyword to designate the anemometer height as 10 meters
- METHOD WIND_DIR RANDOM keyword to correct for any wind direction rounding in the raw ISHD data
- METHOD REFLEVEL SUBNWS keyword to allow use of airport surface station data
- Default substitution options for cloud cover and temperature data will not be overridden
- Default ASOS_ADJ option for correction of truncated wind speeds will not be overridden
- ADJ_U* beta option will not be used

2.3. COORDINATE SYSTEM

In all modeling input and output files, the locations of emission sources, structures, and receptors will be represented in Zone 16 of the Universal Transverse Mercator (UTM) coordinate system using datum World Geodetic System (WGS) 1984, which is comparable to the North American Datum 1983 (NAD83). The Morrow plant is approximately centered at UTM, Zone 16, coordinates 272,009 meters East and 3,456,266 meters North. The base elevation of the facility is approximately 79 meters above mean sea level.

2.4. RECEPTOR LOCATIONS

The dispersion modeling will use a combination of a Cartesian grid system centered on the Morrow plant and discrete receptor points along the facility's fence line. Receptors will be placed at 25-meter intervals along the fence line, 100-meter intervals out to a distance of 2.5 kilometers (km) and at 500-meter intervals out to either 10 km or further if need to encompass areas modeling above the 1-hour SO_2 Significant Impact Level (SIL) of 7.5 $\mu g/m^3$ or if a significant concentration gradient is found at or near the edge of the initially defined receptor grid. Based on the 2013 SO_2 NAAQS Modeling TAD and the 2015 SO_2 Area Designation Guidance, the receptor grid will be adjusted to include only those locations where it is feasible to place a monitor.

2.5. TERRAIN ELEVATIONS

The terrain elevation for each receptor, building, and emission source will be determined using USGS 1/3 arc-second National Elevation Data (NED). The NED, obtained from the USGS, has terrain elevations at 10-meter intervals. Using the AERMOD terrain processor, AERMAP (version 11103), the terrain height for each receptor, building, and emission source included in the model will be determined by assigning the interpolated height from the digital terrain elevations surrounding each source.

In addition, AERMAP will be used to compute the hill height scales for each receptor. AERMAP searches all NED points for the terrain height and location that has the greatest influence on each receptor to determine the hill

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[10] Fox, Tyler, U.S. Environmental Protection Agency. 2013. "Use of ASOS Meteorological Data in AERMOD Dispersion Modeling." Available Online: http://www.epa.gov/ttn/scram/guidance/clarification/20130308_Met_Data_Clarification.pdf

[11] U.S. Environmental Protection Agency. 2014. "User's Guide for the AERMOD Meteorological Preprocessor (AERMET)". EPA-454/B-03-002, November 2004).

height scale for that receptor. AERMOD then uses the hill height scale in order to select the correct critical dividing streamline and concentration algorithm for each receptor.

2.6. BUILDING INFLUENCES

The U.S. EPA's Building Profile Input Program (BPIP) with Plume Rise Model Enhancements (PRIME) (version 04274), will be used to account for Morrow plant building downwash influences in the model. The purpose of a building downwash analysis is to determine if the plume discharged from a stack will become caught in the turbulent wake of a building (or other structure), resulting in downwash of the plume. The downwash of the plume can result in elevated ground-level concentrations of SO_2. At this time, SMEPA is not planning to include any buildings from nearby sources in the model.

2.7. SMEPA EMISSION SOURCES

There are two boilers at the Morrow plant that will be included in the modeling. The stacks for the boilers will be modeled as point sources. Table 2-2 below summarizes the existing stack parameters for both boilers for Scenario 1. Table 2-3 below summarized the stack parameters for Scenario 2. If Scenario 1 does not show concentrations below the NAAQS threshold, Scenario 2 will be completed by using CEMS data. The existing stack parameters will be modeled in the initial modeling conducted in accordance with the 2013 SO_2 Modeling TAD.

Table 2-2. SMEPA Model Inputs – Scenario 1

Emission Point	UTM East (m)*	UTM North (m)*	Stack Height (ft.)	Stack Diameter (ft.)	Exit Velocity (ft./s)	Exit Temperature (F)	Emission Rate (lb/hr)
AA-001	271925.3	3456230.6	405.2	16.7	51.2	180	3210
AA-002	271975.6	3456229.4	405.2	16.7	55.3	180	3210

*UTM Zone 16, NAD 83

Table 2-3. SMEPA Model Inputs – Scenario 2

Emission Point	UTM East (m)*	UTM North (m)*	Stack Height (ft.)	Stack Diameter (ft.)	Exit Velocity (ft./s)	Exit Temperature (F)	Emission Rate (lb/hr)
AA-001	271925.3	3456230.6	405.2	16.7	CEMS	CEMS	CEMS
AA-002	271975.6	3456229.4	405.2	16.7	CEMS	CEMS	CEMS

*UTM Zone 16, NAD 83

2.8. EMISSIONS INVENTORIES FOR NEARBY SOURCES

Other sources of SO_2 emissions in the area surrounding the Morrow plant will be included in the model. SMEPA will request for the emissions inventory from the MDEQ. Based on the emissions inventory data provided by the MDEQ, SMEPA will incorporate nearby potential sources in the model for SO_2 designation.

Table 2-4. Nearby Sources

Source	Distance from SMEPA (km)	UTM East (m)*	UTM North (m)*	Stack Height (ft.)	Stack Diameter (ft.)	Exit Velocity (ft./s)	Exit Temperature (F)	Plant-wide Emissions (tpy)
Rain CII Carbon, LLC	3.85	272603	3451824	114.0	8.7	16.9	405	746.14
Leaf River Cellulose, LLC	33.42	304943	3457831	20.0	1.5	15.0	250	33.42
Transcontinental Gas Pipeline Co.	42.15	270855	3497683	13.0	2.0	112.0	750	42.13

*UTM Zone 16, NAD 83

2.9. SOURCE CONTRIBUTIONS AND SMEPA BOILER REFINEMENTS

Trinity will run the model using the "MAXDCONT" option. The use of MAXDCONT necessitate the model to generate output that allows both the cumulative concentrations as well as individual contributions from SMEPA and nearby sources to be analyzed. If initial modeling shows concentrations above the 1-hours SO_2 NAAQS, additional modeling of various compliance scenarios specific to the Morrow plant sources will be conducted. Steps that will be considered in the modeling scenarios are as follows:

1. Initially, the output from the MAXDCONT processing will be filtered to show each event where the combined impact from both the Morrow plant and nearby sources is over the NAAQS.
2. Each event found to be over the NAAQS will then be will be analyzed further to determine the impacts attributable to the Morrow plant and the impacts attributable to nearby sources.
3. If SMEPA is found to individually model over the NAAQS, the plant will focus on a strategy to reduce its own impact below the NAAQS. The plant does not intend to "do more than their share" to reduce SO_2 concentrations in the area surrounding SMEPA.

2.10. BACKGROUND CONCENTRATION

SMEPA will work with MDEQ to develop a 1-hour SO_2 background concentration that is representative of the background concentration in the vicinity of the Morrow plant. SMEPA will incorporate the agreed upon background concentration in the model.

APPENDIX B: MS AERMOD READY MET FILES - SUPPORTING DOCUMENTATION

MS AERMOD Ready Met Files

Supporting Documentation, July 1, 2014

Mississippi Department of Environmental Quality
www.deq.state.ms.us
Bruce Ferguson

MS AERMOD Ready Met Files

Supporting Documentation

The Mississippi Department of Environmental Quality (MDEQ) has posted preprocessed meteorological files for use with the US EPA regulatory model AERMOD on the MDEQ website. The posting of these files in no way dictates their use nor supplants the use of professional judgment in determining whether the files are appropriate for any particular application. This report documents the development of the preprocessed files.

Integrated surface data was obtained from NCDC in DS3505 format (ftp://ftp.ncdc.noaa.gov/pub/data/noaa). Radiosonde observations were obtained from the NOAA/ESRL Radiosonde Database (http://www.esrl.noaa.gov/raobs/). When available, 1-minute ASOS wind data was included in the processing of the met data through the use of AERMINUTE – Version 11325. One-minute data was obtained through the National Climatic Data Center (NCDC) (ftp://ftp.ncdc.noaa.gov/pub/data/asos-onemin/).

When applying the AERMET meteorological processor to prepare the meteorological data for the AERMOD model, the user must determine appropriate values for three surface characteristics: surface roughness length {zo}, albedo {r}, and Bowen ratio {Bo}. AERSURFACE (dated 13016), a tool that processes land cover data to determine these surface characteristics for use in AERMET, was used in the processing of the posted met files.

Aersurface Monthly Seasonal Designations

Winter with continuous snow on the ground does not occur in Mississippi; therefore this seasonal designation was not used in the AERSURFACE input files. The AERMET user's guide defines spring as the 1-2 months after the last killing frost. Freeze/Frost occurrence data was used to determine the beginning of spring using the 50 percent probability date for 28^{o} F. Likewise, the fall 50 percent probability date for 28^{o} F was used to determine the late autumn after frost and harvest seasonal designation. These dates are were determined from Frost/Freeze Data 1971-2000 (CLIM20-01), NCDC and indicate the date on which there is a 50% probability that a freeze date may be later in the spring or earlier in the fall. Dates for the stations within a climate division were averaged.

Months that fall between the fall and spring dates (rounded to beginning or end of month, whichever was closer) were considered to be "Late autumn after frost and harvest."

Midsummer with lush vegetation was assumed to be months with a monthly normal temperature above 70^{o} F. Monthly normal temperatures were taken from "Climatography of the US No. 85, Divisional Normals and Standard Deviations of Temperature, Precipitation, and Heating and Cooling Degree Days 1971-2000".

Spring months were considered to be those between the determined Late Autumn months and the Midsummer months. Autumn months were considered to be those between the determined Midsummer months and the Late Autumn months. Seasonal designations used are listed in Table 2.

Surface Moisture

Surface Moisture was determined using US Climate Normals. Table 3 lists the precipitation normal and standard deviation for the Mississippi Divisions. Surface moisture was considered to be average if the rainfall was within one standard deviation of the averages presented in Table 3. Surface moisture was considered to be dry if the precipitation was more than one standard deviation below the normal and wet if the precipitation was more than one standard deviation above the normal. Table 4 through Table 11 summarize the precipitation for the years 2006 through 2013. Dry months are highlighted in orange and wet months are highlighted in blue. The surface moisture designation for the aersurface file was determined by the most months with the same determination of average, dry or wet. The moisture designation used in aersurface is indicated outside each division row. The surface moisture was determined to be average for all time periods with the exception of 2007 for the Northeast Division and 2011 for the Coastal Division, which were determined to be dry. The Coastal Division determination was used in the processing of the Mobile station, although this station is not located in the Mississippi Coastal Division.

AERSURFACE Inputs

Locations of the monitoring stations included in the aersurface files were checked by reviewing aerial photography in Google Earth and Bing Bird's Eye View. The locations were also cross referenced to the "ASOS Tropical Cyclone Wind Exposure

Documentation Project.” No attempts were made to correct aersurface runs for changes in land use after the 1992 determination.

The AERSURFACE inputs were selected to be consistent with the “AERMOD Implementation Guide.” Twelve sectors were used for the determination and the surface parameters were selected as described above. The standard AERSURFACE input file used was as follows:

[NLCD 1992File]	** Land use data file
[AERSURFACE.out]	** Output file with sfc values for AERMET Stage 3
LATLON	** Coordinate type (UTM, LATLON)
[surface station lat]	** Latitude [obtained from Table 1]
[surface station long]	** Longitude [obtained from Table 1]
NAD83	** Datum
1.0	** Study radius for surface roughness (km)
Y	** Vary by sector? (Y/N)
12	** Number of sectors
M	** Temporal resolution (A=ANNUAL, M=MONTHLY, S=SEASONAL)
N	** Continuous snow cover at least one month? (Y/N)
Y	** Reassign months to seasons? (Y/N)
[Table 2]	** Late autumn after frost and harvest, or winter with no snow
[Table 2]	** Transitional spring (partial green coverage, short annuals)
[Table 2]	** Midsummer with lush vegetation
[Table 2]	** Autumn with unharvested cropland
Y	** Airport? (Y/N)
N	** Arid region? (Y/N)
[varied with rainfall]	** Surface Moisture (A=Average, W=Wet, D=Dry)

AERMET 14134 Inputs

Integrated surface data in DS3505 format was obtained from NCDC for each station. Upper air data was downloaded in FSL format from the NOAA/ESRL Radiosonde Database. Observations obtained from Slidell, LA were used for the Mobile station and stations located in the Coastal Division. Observations obtained from Jackson, MS were used for all other divisions.

When available, ASOS 1-minute data was incorporated using AERMINUTE version 11325. The threshold wind speed was set at 0.5 m/s in Stage 3 when ASOS 1-minute data was used. The SUBNWS parameter was also used with ASOS 1-minute data to replace wind data from the standard NWS format. The SUB_CC and SUB_TT parameters were indicated in the stage 3 input files. The AERMET user’s guide indicates that these are default parameters unless the application involves both NWS and ONSITE surface data.

Example input files for the Jackson, MS station are presented below.

Stage 1

```
JOB
  REPORT     KJAN_09.RP1
  MESSAGES   KJAN_09.MG1

UPPERAIR

  DATA       "C:\meterological Data\Mississippi\Jackson.fsl" FSL
  EXTRACT    KJAN_09.UAX
  QAOUT      KJAN_09.UQA

  XDATES     2009/01/01 TO 2009/12/31

** Station: JACKSON/THOMPSON FIELD, MS
  LOCATION   3940 32.320N   90.070W 6

  AUDIT      UADD UADS UAHT UALR UAPR UASS UATD UATT UAWD UAWS


SURFACE

** Location of the Surface Data File
** C:\meterological Data\Mississippi\KJAN\722350-03940-2009\722350-03940-2009

  DATA       722350-03940-2009\722350-03940-2009 ISHD
  EXTRACT    KJAN_09.SAX
  QAOUT      KJAN_09.SQA

  XDATES     2009/01/01 TO 2009/12/31

** Station: JACKSON/THOMPSON FIELD, MS
  LOCATION   3940 32.320N   90.078W 6 89.00

  AUDIT      ACHT ALC1 ALC2 ALC3 ALC4 ALC5 ALC6 ASKY CLHT DPTP HZVS PRCP PRES
  AUDIT      PWTH PWVC RHUM SLVP TMPD TMPW TSKC WDIR WSPD
```

Stage 2

```
JOB
  REPORT     KJAN_09.RP2
  MESSAGES   KJAN_09.MG2

UPPERAIR

  QAOUT      KJAN_09.UQA

SURFACE

  QAOUT      KJAN_09.SQA
```

```
** Location of the Hourly Wind Data File
** C:\meterological Data\Mississippi\KJAN\KJAN_09_AERMIN\AERMINUTE_hour.dat
   ASOS1MIN    KJAN_09_AERMIN\AERMINUTE_hour.dat

MERGE

   OUTPUT     KJAN_09.MRG

   XDATES     2009/01/01 TO 2009/12/31
```

Stage 3

```
JOB
   REPORT     KJAN_09.RP3
   MESSAGES    KJAN_09.MG3

METPREP

   DATA       KJAN_09.MRG
   MODEL      AERMOD

   OUTPUT     aermet.sfc
   PROFILE    aermet.pfl

   XDATES     2009/01/01 TO 2009/12/31

   METHOD     REFLEVEL  SUBNWS
   METHOD     WIND_DIR  RANDOM
   METHOD     CCVR SUB_CC
   METHOD     TEMP SUB_TT
   THRESH_1MIN 0.50
   NWS_HGT    WIND 10.00

** Primary Surface Characteristics
** Location of the AERSURFACE Output File
** C:\meterological Data\Mississippi\KJAN\KJAN_09_AERSURF1\AERSURFACE.OUT
   AERSURF   KJAN_09_AERSURF1\AERSURFACE.OUT
```

Data Completeness

The process met files were used in test runs with AERMOD version 14134. The files were run by quarter and the percentage of missing hours noted from the AERMOD output file. Table 12 summarizes the results of the completeness check. Additional years of met data were processed for each site until five years of complete data, by quarter, were obtained. For the majority of the sites, the five years of data is by calendar year. For some sites, four consecutive quarters of complete data were available across calendar years. The data was grouped by quarters for these sites and the naming convention for the processed data indicates that the data is across multiple calendar years.

Combining Met Files

All of the met data was processed by calendar year. For cases where four consecutive complete quarters by calendar year were not available, the data was combined using a text editor from the previously processed data. For the calendar year 2010, the stations KGLH, KGPT, KGWO and KHBG had changes in the USAF number. For these stations, the surface data was contained in two separate files for the 2010 calendar year. The location was identical in each of the two files for each station. The partial years for these stations were processed separately and combined after processing to obtain a complete calendar year.

Processed met files that contain quarters from separate calendar years can be identified in the naming convention of the files. For example, the file KGTR_06_07.sfc contains on full year of data from both calendar years 2006 and 2007. For stations which had separate NCDC files for the same calendar year, the file name contains a “c” at the end to indicate that these files were combined after processing individual surface files. For example, KGWO_10c.SFC is a combination of the individual ISHD files “722359-13978-2010” and “747580-13978-2010”.

Table 1 – Station List

City	Station Name	WBAN	INT CALL	Latitude	Longitude	Aerminute Available	Anemometer Height (m)
GREENVILLE	MID DELTA REGIONAL AIRPORT	13939	KGLH	33.477228	-90.984658	No	10
GREENWOOD	GREENWOOD-LEFLORE AIRPORT	13978	KGWO	33.496194	-90.089419	Yes	10
GULFPORT	GULFPORT-BILOXI INTERNATIONAL AIRPORT	93874	KGPT	30.412000	-89.081000	Yes	10
HATTIESBURG	BOBBY L CHAIN MUNICIPAL AIRPORT	13833	KHBG	31.269483	-89.256108	Yes	10
JACKSON	HAWKINS FIELD AIRPORT	13927	KHKS	32.337572	-90.221397	Yes	10
JACKSON	JACKSON INTERNATIONAL AIRPORT	3940	KJAN	32.319836	-90.077756	Yes	10
McCOMB	MC COMB/PIKE COUNTY/JOHN E LEWIS FIELD AIRPORT	93919	KMCB	31.182278	-90.472025	Yes	10
MERIDIAN	KEY FIELD AIRPORT	13865	KMEI	32.334861	-88.750728	Yes	10
PASCAGOULA	TRENT LOTT INTERNATIONAL AIRPORT	53858	KPQL	30.463058	-88.531556	Yes	7.92
TALLULAH/VICKSBURG	VICKSBURG/TALLULAH REGIONAL AIRPORT	3996	KTVR	32.348000	-91.030000	Yes	10
TUPELO	TUPELO REGIONAL AIRPORT	93862	KTUP	34.262131	-88.771161	Yes	10
COLUMBUS	GOLDEN TRIANGLE RGNL	53893	KGTR	33.456278	-88.592656	No	10
COLUMBUS	COLUMBUS AFB	13825	KCMB	33.652258	-88.457136	No	10
NATCHEZ	NATCHEZ/HARDY(AWOS)	3961	KHEZ	31.615919	-91.297267	No	10
HATTIESBURG	HATTIESBURG LAUREL	53808	KPIB	31.465756	-89.333464	No	10
METCALFE	TUNICA MUNI	23903	KUTA	34.676575	-90.343956	No	10
MEMPHIS	MEMPHIS INTL ARPT	13893	KMEM	35.036472	-89.971861	Yes	10
MOBILE	MOBILE/BATES FIELD	13894	KMOB	30.688222	-88.245969	Yes	10

Table 2 - AERSURFACE Monthly Designations

Station	Months Normal above 70°F	Spring 50% Probability @ 28° F.	Fall 50% Probability @ 28° F	Late Autumn Months	Transitional Spring Months	Midsummer Months	Autumn Months
MS-01 Upper Delta	May-Sep	3-Mar	21-Nov	12, 1, 2	3,4	5,6,7,8,9	10,11
MS-02 North Central	June-Sep	20-Mar	9-Nov	11,12, 1, 2,3	4,5	6,7,8,9	10
MS-03 Northeast	June-Sep	19-Mar	12-Nov	11,12, 1, 2,3	4,5	6,7,8,9	10
MS-04 Lower Delta	May-Sep	23-Feb	26-Nov	12, 1, 2	3,4	5,6,7,8,9	10,11
MS-05 Central	May-Sep	11-Mar	15-Nov	12, 1,2	3,4	5,6,7,8,9	10,11
MS-06 East Central	May-Sep	10-Mar	15-Nov	12, 1,2	3,4	5,6,7,8,9	10,11
MS-07 Southwest	May-Sep	25-Feb	26-Nov	12, 1, 2	3,4	5,6,7,8,9	10,11
MS-08 South Central	May-Sep	27-Feb	25-Nov	12, 1, 2	3,4	5,6,7,8,9	10, 11
MS-09 Southeast	May-Sep	2-Mar	24-Nov	12, 1, 2,	3,4	5,6,7,8,9	10,11
MS-10 Coastal	May-Sep	12-Feb	16-Dec	1	2,3,4	5,6,7,8,9	10,11,12

Table 3 - Divisional Normals and Standard Deviations of Precipitation (inches)

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
MS-01 Upper Delta	AVERAGE	4.94	4.53	5.71	5.49	5.46	4.97	4.07	2.59	3.03	3.25	5.48	5.58	55.1
71-00	STD DEV	2.72	2.64	2.57	3.19	2.65	2.29	2.07	1.54	1.7	2.17	2.75	3.59	10.01
MS-02 North Central	AVERAGE	5.13	4.48	5.86	5.45	5.5	4.85	4.28	3.26	3.56	3.45	5.34	5.81	56.97
71-00	STD DEV	2.6	2.34	2.75	3.05	2.71	2.58	2.1	1.64	1.86	1.97	2.62	3.51	9.58
MS-03 Northeast	AVERAGE	5.28	4.73	6.32	5.32	5.82	4.52	4.25	3.22	3.92	3.44	5.43	6.17	58.42
71-00	STD DEV	2.93	2.23	3.18	2.87	3.55	2.33	1.82	1.65	2.29	1.83	2.47	3.88	10.38
MS-04 Lower Delta	AVERAGE	5.67	4.71	6.16	5.67	5.59	4.32	4.36	2.71	3.07	3.7	5.3	5.91	57.17
71-00	STD DEV	3.16	2.27	2.8	3.54	2.83	2	2.2	1.7	1.26	2.59	2.59	3.82	10.23
MS-05 Central	AVERAGE	5.92	4.95	6.32	5.83	5.21	3.97	4.57	3.4	3.45	3.56	5.3	5.79	58.27
71-00	STD DEV	3.11	2.31	2.71	3.7	2.82	1.8	1.93	1.52	1.48	2.42	2.38	3.05	9.76
MS-06 East Central	AVERAGE	5.92	4.97	6.26	5.65	5.13	4.34	4.5	3.32	3.61	3.4	5.08	5.34	57.52
71-00	STD DEV	2.78	2.35	3.1	3.48	2.91	2.14	2.08	1.52	2.07	2.18	2.26	2.77	11.21
MS-07 Southwest	AVERAGE	6.41	5.21	6.51	6	5.44	4.67	4.54	4.02	3.81	3.62	5.13	6.01	61.37
71-00	STD DEV	3.34	2.68	2.61	3.85	2.79	2.25	1.66	1.85	1.64	2.62	2.39	2.79	8.95
MS-08 South Central	AVERAGE	6.53	5.33	6.51	5.88	5.62	4.62	5.26	4.49	4.08	3.52	4.96	5.67	62.47
71-00	STD DEV	2.85	2.78	2.68	3.81	2.96	2.31	2.05	2.18	2.04	2.39	2.13	2.76	9.36
MS-09 Southeast	AVERAGE	6.39	5	6.56	5.38	4.9	4.06	5.42	3.88	4.07	3.28	5.01	5.14	59.09
71-00	STD DEV	2.78	2.35	2.66	2.94	2.73	1.63	2.09	1.66	2.41	2.35	2.28	2.31	8.88
MS-10 Coastal	AVERAGE	6.33	5.55	6.52	5.14	5.74	4.94	6.86	5.69	5.71	3.18	5.04	4.98	65.68
71-00	STD DEV	3.96	3.08	2.48	3.56	3.6	2.17	2.87	2.55	4.35	2.42	2.78	1.82	11.48

Excerpted from: CLIMATOGRAPHY OF THE UNITED STATES NO. 85

Table 4 -- CLIMATOLOGICAL DATA ANNUAL SUMMARY MISSISSIPPI 2006 TOTAL PRECIPITATION AND DEPARTURE FROM NORMAL (INCHES)

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	
MS-01 Upper Delta	Precip.	10.55	4.59	3.97	4.96	5.36	2.41	0.92	3.49	3.87	4.48	4.14	7.13	55.87	A
2006	Depart.	5.61	0.06	-1.74	-0.53	-0.1	-2.56	-3.15	0.9	0.84	1.23	-1.34	1.55	0.77	
MS-02 North Central	Precip.	8.56	4.81	3.94	4.39	4.69	2.74	1.7	3.81	5.27	4.22	3.97	5.7	53.8	A
2006	Depart.	3.43	0.33	-1.92	-1.06	-0.81	-2.11	-2.58	0.55	1.71	0.77	-1.37	-0.11	-3.17	
MS-03 Northeast	Precip.	7.65	4.5	3.3	4.89	4.55	1.7	1.97	2.09	5.95	5.32	4.28	4.87	51.07	A
2006	Depart.	2.37	-0.23	-3.02	-0.43	-1.27	-2.82	-2.28	-1.13	2.03	1.88	-1.15	-1.3	-7.35	
MS-04 Lower Delta	Precip.	6.69	7.16	5.22	3.75	3.1	2.19	1.24	2.43	3.58	9.46	2.67	6.58	54.07	A
2006	Depart.	1.02	2.45	-0.94	-1.92	-2.49	-2.13	-3.12	-0.28	0.51	5.76	-2.63	0.67	-3.1	
MS-05 Central	Precip.	6.98	8.61	4.48	2.35	2.75	2.02	2.54	2.51	4.42	9.57	2.76	5.51	54.5	A
2006	Depart.	1.06	3.66	-1.84	-3.48	-2.46	-1.95	-2.03	-0.89	0.97	6.01	-2.54	-0.28	-3.77	
MS-06 East Central	Precip.	6.62	8.02	4.46	3.03	3.98	1.16	2.88	2.57	4.28	8.91	3.89	5.28	55.08	A
2006	Depart.	0.7	3.05	-1.8	-2.62	-1.15	-3.18	-1.62	-0.75	0.67	5.51	-1.19	-0.06	-2.44	
MS-07 Southwest	Precip.	5.25	6.9	4.24	3.42	3.94	1.38	5.21	3.97	1.97	9.04	2.5	5.85	53.67	A
2006	Depart.	-1.16	1.69	-2.27	-2.58	-1.5	-3.29	0.67	-0.05	-1.84	5.42	-2.63	-0.16	-7.7	
MS-08 South Central	Precip.	5.47	5.88	3.67	3.4	3.56	1.22	4.9	5.34	3.68	8.93	4.28	6.49	56.82	A
2006	Depart.	-1.06	0.55	-2.84	-2.48	-2.06	-3.4	-0.36	0.85	-0.4	5.41	-0.68	0.82	-5.65	
MS-09 Southeast	Precip.	4.18	6.47	3.54	2.89	5.02	1.78	5.06	4.5	2.7	5.29	4.27	6.56	52.26	A
2006	Depart.	-2.21	1.47	-3.02	-2.49	0.12	-2.28	-0.36	0.62	-1.37	2.01	-0.74	1.42	-6.83	
MS-10 Coastal	Precip.	2.84	3.18	0.41	4.21	1.55	2.23	4.74	6.48	5.08	4.95	5.7	7.4	48.77	A
2006	Depart.	-3.49	-2.37	-6.11	-0.93	-4.19	-2.71	-2.12	0.79	-0.63	1.77	0.66	2.42	-16.91	

Table 5 - - CLIMATOLOGICAL DATA ANNUAL SUMMARY MISSISSIPPI 2007 TOTAL PRECIPITATION AND DEPARTURE FROM NORMAL (INCHES)

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	
MS-01 Upper Delta	Precip.	5.77	2.11	0.86	3.88	3	3.4	7.48	0.71	2.7	5.08	2.09	4.44	41.52	A
2007	Depart.	0.83	-2.42	-4.85	-1.61	-2.46	-1.57	3.41	-1.88	-0.33	1.83	-3.39	-1.14	-13.58	
MS-02 North Central	Precip.	4.81	2.38	0.82	3.46	2.31	4.08	6.12	1.17	2.73	6.62	2.23	4.79	41.52	A
2007	Depart.	-0.32	-2.1	-5.04	-1.99	-3.19	-0.77	1.84	-2.09	-0.83	3.17	-3.11	-1.02	-15.45	
MS-03 Northeast	Precip.	4.76	2.38	1.61	2.63	1.51	2.74	6.1	1.38	3.32	7.4	2.9	4.45	41.18	D
2007	Depart.	-0.52	-2.35	-4.71	-2.69	-4.31	-1.78	1.85	-1.84	-0.6	3.96	-2.53	-1.72	-17.24	
MS-04 Lower Delta	Precip.	4.81	2.29	0.58	3.5	2.92	3.39	7.89	1.61	4.94	4.33	2.37	3.38	42.01	A
2007	Depart.	-0.86	-2.42	-5.58	-2.17	-2.67	-0.93	3.53	-1.1	1.87	0.63	-2.93	-2.53	-15.16	
MS-05 Central	Precip.	4.98	2.46	0.78	2.59	2.72	2.86	7.16	1.4	4.86	3.06	1.89	3.21	37.97	A
2007	Depart.	-0.94	-2.49	-5.54	-3.24	-2.49	-1.11	2.59	-2	1.41	-0.5	-3.41	-2.58	-20.3	
MS-06 East Central	Precip.	4.02	2.87	0.69	2.69	1.2	2.56	5.56	2.28	3.62	4.3	2.23	2.59	34.61	A
2007	Depart.	-1.9	-2.1	-5.57	-2.96	-3.93	-1.78	1.06	-1.04	0.01	0.9	-2.85	-2.75	-22.91	
MS-07 Southwest	Precip.	6.42	2.54	0.83	3.4	2.5	2.97	8.52	2.27	5.28	2.54	2.81	4.34	44.42	A
2007	Depart.	0.01	-2.67	-5.68	-2.6	-2.94	-1.7	3.98	-1.75	1.47	-1.08	-2.32	-1.67	-16.95	
MS-08 South Central	Precip.	4.91	2.25	0.8	4.52	2.61	3.65	9.1	3.62	3.18	3.58	2.12	4.89	45.23	A
2007	Depart.	-1.62	-3.08	-5.71	-1.36	-3.01	-0.97	3.84	-0.87	-0.9	0.06	-2.84	-0.78	-17.24	
MS-09 Southeast	Precip.	4.14	2.64	0.55	5.28	2.53	4.23	7.25	3.02	3.26	4.3	1.46	4.07	42.73	A
2007	Depart.	-2.25	-2.36	-6.01	-0.1	-2.37	0.17	1.83	-0.86	-0.81	1.02	-3.55	-1.07	-16.36	
MS-10 Coastal	Precip.	4.14	2.5	1.51	4.95	4.3	4.5	8.47	5.13	3.5	8.87	2.15	6.54	56.56	A
2007	Depart.	-2.19	-3.05	-5.01	-0.19	-1.44	-0.44	1.61	-0.56	-2.21	5.69	-2.89	1.56	-9.12	

Table 6 - CLIMATOLOGICAL DATA ANNUAL SUMMARY MISSISSIPPI 2008 TOTAL PRECIPITATION AND DEPARTURE FROM NORMAL (INCHES)

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	
MS-01 Upper Delta	Precip.	2.72	4.49	5.3	8.45	8.16	1.38	1.5	7.33	3.86	3.64	2.29	7.71	56.83	A
2008	Depart.	-2.22	-0.04	-0.41	2.96	2.7	-3.59	-2.57	4.74	0.83	0.39	-3.19	2.13	1.73	
MS-02 North Central	Precip.	3.13	3.61	7.91	7.19	7.97	2.59	2.19	6.26	3.23	4.72	2.69	9.04	60.53	A
2008	Depart.	-2	-0.87	2.05	1.74	2.47	-2.26	-2.09	3	-0.33	1.27	-2.65	3.23	3.56	
MS-03 Northeast	Precip.	2.11	4.21	4.91	6.31	8.09	1.11	2.61	7.46	3.24	4.76	3.13	10.34	58.28	A
2008	Depart.	-3.17	-0.52	-1.41	0.99	2.27	-3.41	-1.64	4.24	-0.68	1.32	-2.3	4.17	-0.14	
MS-04 Lower Delta	Precip.	2.92	5.43	3.28	7.41	7.14	0.85	2.25	8.47	8	1.86	2.62	9.71	59.94	A
2008	Depart.	-2.75	0.72	-2.88	1.74	1.55	-3.47	-2.11	5.76	4.93	-1.84	-2.68	3.8	2.77	
MS-05 Central	Precip.	2.95	6.43	3.3	6.67	7.03	1.58	3.28	9.28	5.5	2.2	2.82	10.47	61.51	A
2008	Depart.	-2.97	1.48	-3.02	0.84	1.82	-2.39	-1.29	5.88	2.05	-1.36	-2.48	4.68	3.24	
MS-06 East Central	Precip.	3.59	7.08	3.72	5.67	4.79	1.44	3	8.97	3.94	2.89	2.4	10.15	57.64	A
2008	Depart.	-2.33	2.11	-2.54	0.02	-0.34	-2.9	-1.5	5.65	0.33	-0.51	-2.68	4.81	0.12	
MS-07 Southwest	Precip.	4.44	6.56	3.74	3.77	4.95	2.61	1.87	11.58	10.26	1.78	5.12	8.08	64.76	A
2008	Depart.	-1.97	1.35	-2.77	-2.23	-0.49	-2.06	-2.67	7.56	6.45	-1.84	-0.01	2.07	3.39	
MS-08 South Central	Precip.	6.29	5.46	4.17	3.94	4.67	3.26	2.3	7.6	8.01	1.63	4.88	6.71	58.92	A
2008	Depart.	-0.24	0.13	-2.34	-1.94	-0.95	-1.36	-2.96	3.11	3.93	-1.89	-0.08	1.04	-3.55	
MS-09 Southeast	Precip.	6.44	6.13	3.31	4.09	5.05	3.3	3.65	8.43	6.06	1.73	4.47	6.19	58.85	A
2008	Depart.	0.05	1.13	-3.25	-1.29	0.15	-0.76	-1.77	4.55	1.99	-1.55	-0.54	1.05	-0.24	
MS-10 Coastal	Precip.	7.06	4.95	3.37	6.44	5.46	5.93	3.6	8.65	7.38	1.35	2.16	2.65	59	A
2008	Depart.	0.73	-0.6	-3.15	1.3	-0.28	0.99	-3.26	2.96	1.67	-1.83	-2.88	-2.33	-6.68	

Table 7 - CLIMATOLOGICAL DATA ANNUAL SUMMARY MISSISSIPPI 2009 TOTAL PRECIPITATION AND DEPARTURE FROM NORMAL (INCHES)

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	
MS-01 Upper Delta	Precip.	2.61	3.51	6.48	4.19	11.83	2.91	8.96	1.17	8.6	10.82	2.57	6.68	70.33	A
2009	Depart.	-2.33	-1.02	0.77	-1.3	6.37	-2.06	4.89	-1.42	5.57	7.57	-2.91	1.1	15.23	
MS-02 North Central	Precip.	2.63	3.85	5.37	4.01	10.19	3.18	10.92	2.01	7.17	9.68	2.36	6.17	67.54	A
2009	Depart.	-2.5	-0.63	-0.49	-1.44	4.69	-1.67	6.64	-1.25	3.61	6.23	-2.98	0.36	10.57	
MS-03 Northeast	Precip.	3.19	3.51	5.86	2.82	8.4	2.21	6.89	3.98	10.49	10.55	2.32	5.11	65.33	A
2009	Depart.	-2.09	-1.22	-0.46	-2.5	2.58	-2.31	2.64	0.76	6.57	7.11	-3.11	-1.06	6.91	
MS-04 Lower Delta	Precip.	3.87	1.81	6.95	2.67	11.34	0.55	10.28	3.27	7.41	14.94	1.79	5.08	69.96	A
2009	Depart.	-1.8	-2.9	0.79	-3	5.75	-3.77	5.92	0.56	4.34	11.24	-3.51	-0.83	12.79	
MS-05 Central	Precip.	5.02	3.3	8.31	2.09	10.81	1.2	9.43	2.85	7.84	11.94	1.53	6.22	70.54	A
2009	Depart.	-0.9	-1.65	1.99	-3.74	5.6	-2.77	4.86	-0.55	4.39	8.38	-3.77	0.43	12.27	
MS-06 East Central	Precip.	5.8	5.7	8.09	3.39	8.79	2.86	6.17	4.65	11.74	10.39	1.74	6.3	75.62	A
2009	Depart.	-0.12	0.73	1.83	-2.26	3.66	-1.48	1.67	1.33	8.13	6.99	-3.34	0.96	18.1	
MS-07 Southwest	Precip.	3.5	3.58	9.83	4.09	4.65	0.57	6.67	3.59	5.48	11.32	0.97	8.63	62.88	A
2009	Depart.	-2.91	-1.63	3.32	-1.91	-0.79	-4.1	2.13	-0.43	1.67	7.7	-4.16	2.62	1.51	
MS-08 South Central	Precip.	3.83	3.65	11.37	3.84	6.98	0.63	4.39	3.76	7.34	7.35	1.46	12.54	67.14	A
2009	Depart.	-2.7	-1.68	4.86	-2.04	1.36	-3.99	-0.87	-0.73	3.26	3.83	-3.5	6.87	4.67	
MS-09 Southeast	Precip.	3.73	3.08	10.74	5.12	9.88	1.49	3.4	3.82	7.89	5.09	2.49	14.5	71.23	A
2009	Depart.	-2.66	-1.92	4.18	-0.26	4.98	-2.57	-2.02	-0.06	3.82	1.81	-2.52	9.36	12.14	
MS-10 Coastal	Precip.	1.84	3.23	10.89	2	4.19	1.32	5.64	5.66	6.39	6.59	2.89	16.62	67.26	A
2009	Depart.	-4.49	-2.32	4.37	-3.14	-1.55	-3.62	-1.22	-0.03	0.68	3.41	-2.15	11.64	1.58	

Table 8 - CLIMATOLOGICAL DATA ANNUAL SUMMARY MISSISSIPPI 2010 TOTAL PRECIPITATION AND DEPARTURE FROM NORMAL (INCHES)

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	
MS-01 Upper Delta	Precip.	6.33	3.49	2.31	3.68	5.49	1.61	2.6	2.16	1.72	2.31	6.03	1.24	38.97	A
2010	Depart.	1.39	-1.04	-3.4	-1.81	0.03	-3.36	-1.47	-0.43	-1.31	-0.94	0.55	-4.34	-16.13	
MS-02 North Central	Precip.	5.07	3.4	4.04	3.87	8.51	2.38	4.95	2.49	0.69	2.02	6.62	1.59	45.63	A
2010	Depart.	-0.06	-1.08	-1.82	-1.58	3.01	-2.47	0.67	-0.77	-2.87	-1.43	1.28	-4.22	-11.34	
MS-03 Northeast	Precip.	5.44	3.45	4.2	2.5	10.42	3.08	6	2.66	1.64	2.3	5.78	2.17	49.64	A
2010	Depart.	0.16	-1.28	-2.12	-2.82	4.6	-1.44	1.75	-0.56	-2.28	-1.14	0.35	-4	-8.78	
MS-04 Lower Delta	Precip.	6.25	2.92	3.01	2.85	4.2	1.3	3.35	1.68	1.07	1.55	5.31	1.13	34.62	A
2010	Depart.	0.58	-1.79	-3.15	-2.82	-1.39	-3.02	-1.01	-1.03	-2	-2.15	0.01	-4.78	-22.55	
MS-05 Central	Precip.	5.22	3.58	4.44	3.51	6.03	3	3.98	4.44	0.56	1.92	6.11	1.58	44.37	A
2010	Depart.	-0.7	-1.37	-1.88	-2.32	0.82	-0.97	-0.59	1.04	-2.89	-1.64	0.81	-4.21	-13.9	
MS-06 East Central	Precip.	5.86	3.61	4.56	3.49	5.91	3.21	2.81	3.58	0.82	2.4	7.24	1.09	44.58	A
2010	Depart.	-0.06	-1.36	-1.7	-2.16	0.78	-1.13	-1.69	0.26	-2.79	-1	2.16	-4.25	-12.94	
MS-07 Southwest	Precip.	4.98	5.37	4.05	1.15	3.78	3.1	4.58	6.55	0.6	1.95	6.3	2.04	44.45	A
2010	Depart.	-1.43	0.16	-2.46	-4.85	-1.66	-1.57	0.04	2.53	-3.21	-1.67	1.17	-3.97	-16.92	
MS-08 South Central	Precip.	4.04	5.78	3.34	2.64	5.11	3.17	6.09	8.66	0.19	1.22	5.77	1.77	47.78	A
2010	Depart.	-2.49	0.45	-3.17	-3.24	-0.51	-1.45	0.83	4.17	-3.89	-2.3	0.81	-3.9	-14.69	
MS-09 Southeast	Precip.	4.18	6.34	4.19	3.43	5.41	3.21	3.88	6.13	0.24	1.06	4.56	1.34	43.97	A
2010	Depart.	-2.21	1.34	-2.37	-1.95	0.51	-0.85	-1.54	2.25	-3.83	-2.22	-0.45	-3.8	-15.12	
MS-10 Coastal	Precip.	4.1	5.7	3.75	1.28	6.37	8.08	5.46	11.45	1.71	1.44	3.68	1.51	54.53	A
2010	Depart.	-2.23	0.15	-2.77	-3.86	0.63	3.14	-1.4	5.76	-4	-1.74	-1.36	-3.47	-11.15	

Table 9 - CLIMATOLOGICAL DATA ANNUAL SUMMARY MISSISSIPPI 2011 TOTAL PRECIPITATION AND DEPARTURE FROM NORMAL (INCHES)

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	
MS-01 Upper Delta	Precip.	2.61	2.45	3.36	11.92	2.38	4.19	2.81	3.51	4.02	3.2	6.06	7.39	53.9	A
2011	Depart.	-2.33	-2.08	-2.35	6.43	-3.08	-0.78	-1.26	0.92	0.99	-0.05	0.58	1.81	-1.2	
MS-02 North Central	Precip.	2.83	2.87	5.1	12.42	3.7	3.4	3.09	2.76	4.97	2.22	5.55	6.87	55.78	A
2011	Depart.	-2.3	-1.61	-0.76	6.97	-1.8	-1.45	-1.19	-0.5	1.41	-1.23	0.21	1.06	-1.19	
MS-03 Northeast	Precip.	3.79	3.23	7.26	10.7	4.11	4.74	1.55	3.44	7.79	1.34	5.23	6.09	59.27	A
2011	Depart.	-1.49	-1.5	0.94	5.38	-1.71	0.22	-2.7	0.22	3.87	-2.1	-0.2	-0.08	0.85	
MS-04 Lower Delta	Precip.	4.55	2.4	3.69	6.52	2.04	1.47	3.83	1.9	4.79	1.24	4.39	8.29	45.11	A
2011	Depart.	-1.12	-2.31	-2.47	0.85	-3.55	-2.85	-0.53	-0.81	1.72	-2.46	-0.91	2.38	-12.06	
MS-05 Central	Precip.	5.62	2.12	6.16	6.92	1.81	2.88	7.91	1.66	9.89	1.03	3.81	6.29	56.1	A
2011	Depart.	-0.3	-2.83	-0.16	1.09	-3.4	-1.09	3.34	-1.74	6.44	-2.53	-1.49	0.5	-2.17	
MS-06 East Central	Precip.	5.69	2.31	6.62	10.04	2.46	3.55	4.02	1.9	8.9	0.96	3.18	6.09	55.72	A
2011	Depart.	-0.23	-2.66	0.36	4.39	-2.67	-0.79	-0.48	-1.42	5.29	-2.44	-1.9	0.75	-1.8	
MS-07 Southwest	Precip.	5.58	2.35	7.54	3.89	1.13	2.64	5.76	1.16	7.15	0.63	4.99	7.61	50.43	A
2011	Depart.	-0.83	-2.86	1.03	-2.11	-4.31	-2.03	1.22	-2.86	3.34	-2.99	-0.14	1.6	-10.94	
MS-08 South Central	Precip.	4.21	2.97	8.85	2.57	1.05	3.81	6.56	1.75	10.44	0.4	3.54	5.17	51.32	A
2011	Depart.	-2.32	-2.36	2.34	-3.31	-4.57	-0.81	1.3	-2.74	6.36	-3.12	-1.42	-0.5	-11.15	
MS-09 Southeast	Precip.	4.27	3.49	11.05	3.65	1.17	3.12	8.43	2.62	9.63	0.55	2.84	5.48	56.3	A
2011	Depart.	-2.12	-1.51	4.49	-1.73	-3.73	-0.94	3.01	-1.26	5.56	-2.73	-2.17	0.34	-2.79	
MS-10 Coastal	Precip.	3.49	2.7	4.94	0.69	1.55	3.58	11.58	2.55	13.91	0.25	2.14	1.19	48.57	D
2011	Depart.	-2.84	-2.85	-1.58	-4.45	-4.19	-1.36	4.72	-3.14	8.2	-2.93	-2.9	-3.79	-17.11	

Table 10 - CLIMATOLOGICAL DATA ANNUAL SUMMARY MISSISSIPPI 2012 TOTAL PRECIPITATION AND DEPARTURE FROM NORMAL (INCHES)

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	
UPPER DELTA 01	Precip.	3.05	3.09	5.13	2.99	1.94	3.37	2.54	2.09	5.09	5.29	2.18	5.32	42.08	A
2012	Depart.	-1.89	-1.44	-0.58	-2.5	-3.52	-1.6	-1.53	-0.5	2.06	2.04	-3.3	-0.26	-13.02	
NORTH CENTRAL 02	Precip.	3.35	3.07	5.09	2.52	2.19	2.39	4.32	3.03	4.09	5.89	1.83	6.38	44.15	A
2012	Depart.	-1.78	-1.41	-0.77	-2.93	-3.31	-2.46	0.04	-0.23	0.53	2.44	-3.51	0.57	-12.82	
NORTHEAST 03	Precip.	5.17	4.03	6.26	2.42	2.97	2.57	5.75	3.49	5.27	4.59	1.13	7.14	50.79	A
2012	Depart.	-0.11	-0.7	-0.06	-2.9	-2.85	-1.95	1.5	0.27	1.35	1.15	-4.3	0.97	-7.63	
LOWER DELTA 04	Precip.	2.49	4.93	6.26	4.04	2.76	5.21	4.95	5.33	4.49	5.5	2.49	7.04	55.49	A
2012	Depart.	-3.18	0.22	0.1	-1.63	-2.83	0.89	0.59	2.62	1.42	1.8	-2.81	1.13	-1.68	
CENTRAL 05	Precip.	3.39	6.61	6.73	3.93	4.22	4.19	6.51	6.35	3.14	3.5	2.93	8.16	59.66	A
2012	Depart.	-2.53	1.66	0.41	-1.9	-0.99	0.22	1.94	2.95	-0.31	-0.06	-2.37	2.37	1.39	
EAST CENTRAL 06	Precip.	3.82	3.96	6.69	2.32	4.43	2.56	7.55	6.93	4.38	3.76	2.53	7.34	56.27	A
2012	Depart.	-2.1	-1.01	0.43	-3.33	-0.7	-1.78	3.05	3.61	0.77	0.36	-2.55	2	-1.25	
SOUTHWEST 07	Precip.	5.07	8.77	5.76	4.74	3.73	2.61	9.85	10.35	4.67	1.67	2.58	8.84	68.64	A
2012	Depart.	-1.34	3.56	-0.75	-1.26	-1.71	-2.06	5.31	6.33	0.86	-1.95	-2.55	2.83	7.27	
SOUTH CENTRAL 08	Precip.	6.51	7.64	7.69	4.36	2.09	2.42	7.7	14.15	4.09	1.66	2.76	8.56	69.63	A
2012	Depart.	-0.02	2.31	1.18	-1.52	-3.53	-2.2	2.44	9.66	0.01	-1.86	-2.2	2.89	7.16	
SOUTHEAST 09	Precip.	6	7.24	8.79	2.65	4.11	4.14	9.38	13.63	3.81	2.48	2.01	8.24	72.48	A
2012	Depart.	-0.39	2.24	2.23	-2.73	-0.79	0.08	3.96	9.75	-0.26	-0.8	-3	3.1	13.39	
COASTAL 10	Precip.	2.41	6.02	8.68	4.9	3.09	7.19	9.34	19.87	6.22	1.85	1.51	2.3	73.38	A
2012	Depart.	-3.92	0.47	2.16	-0.24	-2.65	2.25	2.48	14.18	0.51	-1.33	-3.53	-2.68	7.7	

Table 11 - CLIMATOLOGICAL DATA ANNUAL SUMMARY MISSISSIPPI 2013 TOTAL PRECIPITATION AND DEPARTURE FROM NORMAL (INCHES)

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	
UPPER DELTA 01	Precip.	10.23	3.78	4.68	7.77	8.99	2.17	2.58	2.71	6.7	4.92	5.48	5.25	65.26	A
2012	Depart.	5.29	-0.75	-1.03	2.28	3.53	-2.8	-1.49	0.12	3.67	1.67	0	-0.33	10.16	
NORTH CENTRAL 02	Precip.	9.27	4.01	5.09	7.09	8.62	3.31	3.59	1.91	4.99	3.11	5.38	5.52	61.89	A
2012	Depart.	4.14	-0.47	-0.77	1.64	3.12	-1.54	-0.69	-1.35	1.43	-0.34	0.04	-0.29	4.92	
NORTHEAST 03	Precip.	9.17	3.72	5.26	5.55	6.02	3.42	2.95	2.57	4.14	1.41	4.51	6.04	54.76	A
2012	Depart.	3.89	-1.01	-1.06	0.23	0.2	-1.1	-1.3	-0.65	0.22	-2.03	-0.92	-0.13	-3.66	
LOWER DELTA 04	Precip.	10.79	5.85	4.82	6.48	5.07	3.91	2.2	1.17	5.1	7.59	5.79	4.49	63.26	A
2012	Depart.	5.12	1.14	-1.34	0.81	-0.52	-0.41	-2.16	-1.54	2.03	3.89	0.49	-1.42	6.09	
CENTRAL 05	Precip.	8.8	6.91	5.41	5.78	6.12	4.3	2.63	2.33	7.27	1.91	5.92	5.12	62.5	A
2012	Depart.	2.88	1.96	-0.91	-0.05	0.91	0.33	-1.94	-1.07	3.82	-1.65	0.62	-0.67	4.23	
EAST CENTRAL 06	Precip.	8.33	5.76	5.6	6.62	4.6	3.58	4.82	3.04	4.86	1.08	4.62	5.91	58.82	A
2012	Depart.	2.41	0.79	-0.66	0.97	-0.53	-0.76	0.32	-0.28	1.25	-2.32	-0.46	0.57	1.3	
SOUTHWEST 07	Precip.	12.08	9.34	3.27	6.16	5.97	4.54	4.34	2.23	5.87	2.67	6.39	4.59	67.45	A
2012	Depart.	5.67	4.13	-3.24	0.16	0.53	-0.13	-0.2	-1.79	2.06	-0.95	1.26	-1.42	6.08	
SOUTH CENTRAL 08	Precip.	8.36	10.1	2.56	7.01	5.29	5.04	4.94	3.84	6.28	1.39	4.85	5.78	65.44	A
2012	Depart.	1.83	4.77	-3.95	1.13	-0.33	0.42	-0.32	-0.65	2.2	-2.13	-0.11	0.11	2.97	
SOUTHEAST 09	Precip.	8.33	9.72	3	6.99	6.43	6.23	5.89	4.61	4.04	2.03	5.25	6.23	68.75	A
2012	Depart.	1.94	4.72	-3.56	1.61	1.53	2.17	0.47	0.73	-0.03	-1.25	0.24	1.09	9.66	
COASTAL 10	Precip.	3.8	9.99	0.79	8.57	6.73	4.49	10.42	8.32	3.01	2.25	3.39	6.48	68.24	A
2012	Depart.	-2.53	4.44	-5.73	3.43	0.99	-0.45	3.56	2.63	-2.7	-0.93	-1.65	1.5	2.56	

Table 12 - Data Completeness by Quarter

	2006				2007				2008				2009				2010				2011				2012				2013			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
KGLH													0.6	0.1	0.4	0.4	0.5	1.7	2.7	0.8	0.0	4.7	1.9	0.3	0.2	8.3	2.9	1.1	0.8	1.1	0.4	0.7
KGPT													0.0	0.9	0.4	0.4	0.3	1.5	0.6	1.3	3.3	0.5	2.2	0.7	0.2	0.7	0.7	0.3	8.5	0.5	0.3	0.3
KGTR	2.2	12.3	4.0	4.8	4.7	6.4	15.4	13.2	10.4	6.7	8.1	4.9	10.2	13.1	7.4	6.0	3.2	6.7	5.0	6.3	5.4	6.1	9.9	6.7	2.7	4.2	5.2	4.3	4.4	4.7	8.5	3.0
KGWO													0.6	0.1	0.4	0.4	0.5	1.7	2.7	0.8	0.7	0.6	2.4	1.1	1.2	1.2	0.5	0.8	0.1	3.1	5.0	2.7
KHBG													0.7	0.7	0.3	0.4	0.1	1.8	0.6	0.6	1.6	1.4	2.0	2.5	0.7	0.6	0.0	0.8	0.1	1.2	0.1	2.0
KHEZ	5.3	2.0	0.3	6.9	1.6	0.6	6.0	8.8	4.1	0.6	12.0	1.2	1.5	3.1	0.1	0.8	0.0	1.1	1.0	3.6	3.2	2.8	11.5	2.7	0.1	5.9	1.5	10.0	1.3	14.6	2.8	0.3
KHKS													0.7	1.8	1.1	0.4	0.1	2.9	1.8	0.4	1.6	1.9	2.1	0.4	0.6	0.8	0.6	0.4	0.4	1.3	0.0	0.7
KJAN													0.0	0.8	0.4	0.5	0.5	1.9	0.9	0.6	0.3	1.8	0.8	0.3	0.0	0.5	0.1	0.4	0.1	1.2	0.3	0.4
KMCB													0.1	0.6	1.0	0.7	0.2	2.2	0.8	0.5	0.2	7.7	5.6	0.7	0.0	1.2	0.1	0.4	0.1	2.7	0.2	0.3
KMEI													0.1	0.3	0.3	0.3	0.1	1.2	0.1	0.4	0.1	0.9	0.6	0.4	0.0	0.3	0.1	0.3	0.1	1.1	0.1	0.4
KMEM													0.1	0.3	0.3	0.3	0.3	1.2	0.4	0.5	0.0	0.3	0.6	0.3	0.0	0.2	0.0	0.3	0.1	1.1	0.1	0.4
KMOB													0.0	0.5	0.1	0.4	0.3	2.7	0.2	0.4	1.1	0.6	1.2	0.7	0.0	0.5	0.6	0.4	0.0	0.1	0.1	0.4
KPIB					13.8	8.9	5.2	4.0	4.4	1.1	3.2	1.6	4.4	3.0	0.1	7.8	8.0	1.3	18.4	0.6	0.1	13.9	18.7	5.4	0.6	5.9	0.6	0.6	0.1	1.1	0.6	34.2
KPQL													2.7	2.0	2.5	0.6	3.9	1.4	1.5	0.5	1.1	4.0	6.2	0.6	0.1	0.6	0.8	0.6	0.1	0.1	0.5	0.3
KTUP													0.0	0.6	0.5	0.8	1.3	3.1	0.9	1.1	0.7	0.8	1.0	0.5	0.0	0.8	0.1	0.4	0.0	1.1	0.1	0.8
KTVR													0.4	1.5	5.3	1.7	1.7	2.8	0.6	1.3	0.0	2.5	2.1	0.9	0.4	0.2	1.6	0.4	0.4	4.4	9.5	4.9
KUTA									4.3	0.7	3.0	1.4	0.1	1.0	0.4	0.9	2.2	2.7	1.8	3.9	24.4	3.2	0.7	2.6	0.4	0.4	0.9	1.2	0.5	2.0	1.4	0.8
KCMB													9.2	5.9	4.4	4.8	4.5	5.9	7.8	2.8	4.8	6.1	3.9	6.3	3.2	7.5	5.1	3.2	4.7	6.4	8.2	4.5

APPENDIX C: RAIN CII CARBON HOURLY EMISSIONS CALCULATIONS

Rain II Carbon Purvis Coke Plant Emission Rates for SO_2 Designation Modeling

Parameters	2012	2013	2014
Stack Feed Rate[1], tph	12	12	12
SO_2 Emission rate[1], lbs/hr	241	241	330
PM Emission rate[2], lbs/ton	20.08	20.08	27.5
Green Coke Handled[1], tons/yr	38,237	35,041	36,255
Hours of Operation[1], hrs	5,952	5,961	6,646
Annual Emission[3], tpy	384	352	499
Hourly Emission Rate[4], lbs/hr	**129.02**	**118.06**	**150.06**

References:

1. Data obtained from the stack test report provided by the Mississippi Department of Environmental Quality
2. PM emission rate was estimated using the following equation:

$$\text{PM Emission Rate, lbs/ton} = \frac{SO_2 \text{ Emission rate, lbs/hr}}{\text{Stack Feed Rate, tph}} = \frac{241 \text{ tph}}{12 \text{ lbs/hr}} = \mathbf{20.08\ lbs/ton}$$

3. Annual emissions are estimated using the following equation:

$$\text{Annual Emissions, tpy} = \frac{\text{Green Coke Handled, tons}}{\text{yr}} \Big| \frac{\text{PM Emission Rate, lbs}}{\text{ton}} \Big| \frac{1 \text{ ton}}{2{,}000 \text{ lbs}} = \frac{38237 \text{ tons}}{\text{yr}} \Big| \frac{20.08 \text{ lbs}}{\text{ton}} \Big| \frac{1 \text{ ton}}{2{,}000 \text{ lbs}} = \mathbf{384\ tpy}$$

4. Hourly Emission Rate was estimated using the following equation:

$$\text{Hourly Emission Rate, lb/hr} = \frac{\text{Annual Emissions, tpy}}{\text{Hours of Operation, hrs}} \Big| \frac{2{,}000 \text{ lbs}}{\text{ton}} = \frac{384 \text{ tpy}}{5952 \text{ hrs}} = \mathbf{129.02\ lbs/hr}$$

Jackson Monitoring Station

Jackson-A 7/30/2015

```
** Generated by AERSURFACE, dated 13016
** Generated from "missi.tif"
** Center Latitude (decimal degrees):     32.329111
** Center Longitude (decimal degrees):   -90.182722
** Datum: NAD83
** Study radius (km) for surface roughness:   1.0
** Airport? N, Continuous snow cover? N
** Surface moisture? Average, Arid region? N
** Month/Season assignments? User-specified
** Late autumn after frost and harvest, or winter with no snow: 12,1,2
** Winter with continuous snow on the ground: 0
** Transitional spring (partial green coverage, short annuals): 3,4
** Midsummer with lush vegetation: 5,6,7,8,9
** Autumn with unharvested cropland: 10,11


   FREQ_SECT  MONTHLY  1
   SECTOR   1    0  360
**          Month    Sect    Alb      Bo        Zo
   SITE_CHAR    1       1     0.17     0.81     0.337
   SITE_CHAR    2       1     0.17     0.81     0.337
   SITE_CHAR    3       1     0.16     0.65     0.386
   SITE_CHAR    4       1     0.16     0.65     0.386
   SITE_CHAR    5       1     0.16     0.63     0.405
   SITE_CHAR    6       1     0.16     0.63     0.405
   SITE_CHAR    7       1     0.16     0.63     0.405
   SITE_CHAR    8       1     0.16     0.63     0.405
   SITE_CHAR    9       1     0.16     0.63     0.405
   SITE_CHAR   10       1     0.16     0.81     0.389
   SITE_CHAR   11       1     0.16     0.81     0.389
   SITE_CHAR   12       1     0.17     0.81     0.337
```

Bobby L chain Airport - KHBG

KHBG-New 7/29/2015

```
** Generated by AERSURFACE, dated 13016
** Generated from "missi.tif"
** Center Latitude (decimal degrees):     31.269483
** Center Longitude (decimal degrees):   -89.256108
** Datum: NAD83
** Study radius (km) for surface roughness:   1.0
** Airport? Y, Continuous snow cover? N
** Surface moisture? Average, Arid region? N
** Month/Season assignments? User-specified
** Late autumn after frost and harvest, or winter with no snow: 12,1,2
** Winter with continuous snow on the ground: 0
** Transitional spring (partial green coverage, short annuals): 3,4
** Midsummer with lush vegetation: 5,6,7,8,9
** Autumn with unharvested cropland: 10,11


   FREQ_SECT  MONTHLY  1
   SECTOR   1    0  360
**           Month    Sect    Alb      Bo        Zo
   SITE_CHAR    1       1     0.15     0.63     0.037
   SITE_CHAR    2       1     0.15     0.63     0.037
   SITE_CHAR    3       1     0.14     0.48     0.051
   SITE_CHAR    4       1     0.14     0.48     0.051
   SITE_CHAR    5       1     0.15     0.34     0.068
   SITE_CHAR    6       1     0.15     0.34     0.068
   SITE_CHAR    7       1     0.15     0.34     0.068
   SITE_CHAR    8       1     0.15     0.34     0.068
   SITE_CHAR    9       1     0.15     0.34     0.068
   SITE_CHAR   10       1     0.15     0.63     0.058
   SITE_CHAR   11       1     0.15     0.63     0.058
   SITE_CHAR   12       1     0.15     0.63     0.037
```

Morrow Plant

Morrow_New 7/29/2015

```
** Generated by AERSURFACE, dated 13016
** Generated from "missi.tif"
** Center Latitude (decimal degrees):     31.218315
** Center Longitude (decimal degrees):   -89.393335
** Datum: NAD83
** Study radius (km) for surface roughness:   1.0
** Airport? N, Continuous snow cover? N
** Surface moisture? Average, Arid region? N
** Month/Season assignments? User-specified
** Late autumn after frost and harvest, or winter with no snow: 12,1,2
** Winter with continuous snow on the ground: 0
** Transitional spring (partial green coverage, short annuals): 3,4
** Midsummer with lush vegetation: 5,6,7,8,9
** Autumn with unharvested cropland: 10,11


   FREQ_SECT  MONTHLY  1
   SECTOR   1    0  360
**           Month    Sect    Alb      Bo        Zo
   SITE_CHAR    1       1     0.14     0.79     0.309
   SITE_CHAR    2       1     0.14     0.79     0.309
   SITE_CHAR    3       1     0.14     0.60     0.370
   SITE_CHAR    4       1     0.14     0.60     0.370
   SITE_CHAR    5       1     0.15     0.34     0.460
   SITE_CHAR    6       1     0.15     0.34     0.460
   SITE_CHAR    7       1     0.15     0.34     0.460
   SITE_CHAR    8       1     0.15     0.34     0.460
   SITE_CHAR    9       1     0.15     0.34     0.460
   SITE_CHAR   10       1     0.15     0.79     0.455
   SITE_CHAR   11       1     0.15     0.79     0.455
   SITE_CHAR   12       1     0.14     0.79     0.309
```

APPENDIX E: SO_2 MONITOR VALUES REPORT

Monitor Values Report

Geographic Area: Hinds County, MS
Pollutant: SO_2
Year: 2014
Exceptional Events: Included (if any)

Duration Description=1 HOUR

Duration Description	Obs	First Max	Second Max	99th Percentile	Actual Exc	Exc Events	Monitor Number	Site ID	Address	City	County	State	EPA Region
1 HOUR	8161	39	18	14	0	None	1	280490020	232 East Woodrow Wilson Drive	Jackson	Hinds	MS	04

Get detailed information about this report, including column descriptions, at http://www.epa.gov/airquality/airdata/ad_about_reports.html#mon

AirData reports are produced from a direct query of the AQS Data Mart. The data represent the best and most recent information available to EPA from state agencies. However, some values may be absent due to incomplete reporting, and some values may change due to quality assurance activities. The AQS database is updated daily by state, local, and tribal organizations who own and submit the data. Please contact the appropriate air quality monitoring agency to report any data problems. <http://www.epa.gov/airquality/airdata/ad_contacts.html>

Readers are cautioned not to rank order geographic areas based on AirData reports. Air pollution levels measured at a particular monitoring site are not necessarily representative of the air quality for an entire county or urban area.

This report is based on monitor-level summary statistics. Air quality standards for some pollutants (PM2.5 and Pb) allow for combining data from multiple monitors into a site-level summary statistic that can be compared to the standard. In those cases, the site-level statistics may differ from the monitor-level statistics upon which this report is based.

Source: U.S. EPA AirData <http://www.epa.gov/airdata>
Generated: July 30, 2015

Monitor Values Report

Geographic Area: Hinds County, MS
Pollutant: SO2
Year: 2014
Exceptional Events: Included (if any)

Duration Description=24-HR BLK AVG

Duration Description	Obs	First Max	Second Max	99th Percentile	Actual Exc	Exc Events	Monitor Number	Site ID	Address	City	County	State	EPA Region
24-HR BLK AVG	355	4	3	3	0	None	1	280490020	232 East Woodrow Wilson Drive	Jackson	Hinds	MS	04

Get detailed information about this report, including column descriptions, at http://www.epa.gov/airquality/airdata/ad_about_reports.html#mon

AirData reports are produced from a direct query of the AQS Data Mart. The data represent the best and most recent information available to EPA from state agencies. However, some values may be absent due to incomplete reporting, and some values may change due to quality assurance activities. The AQS database is updated daily by state, local, and tribal organizations who own and submit the data. Please contact the appropriate air quality monitoring agency to report any data problems. <http://www.epa.gov/airquality/airdata/ad_contacts.html>

Readers are cautioned not to rank order geographic areas based on AirData reports. Air pollution levels measured at a particular monitoring site are not necessarily representative of the air quality for an entire county or urban area.

This report is based on monitor-level summary statistics. Air quality standards for some pollutants (PM2.5 and Pb) allow for combining data from multiple monitors into a site-level summary statistic that can be compared to the standard. In those cases, the site-level statistics may differ from the monitor-level statistics upon which this report is based.

Source: U.S. EPA AirData <http://www.epa.gov/airdata>
Generated: July 30, 2015