APPENDIX K

MODELING TECHNICAL SUPPORT DOCUMENT (TSD)

Rusk-Panola Attainment Demonstration State Implementation Plan Revision for the 2010 Sulfur Dioxide National Ambient Air Quality Standard

Project Number 2020-057-SIP-NR
SFR-122/2020-057-SIP-NR

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LIST OF ACRONYMS

AD	Attainment Demonstration
AIRS	Aerometric Information Retrieval System
AMS	American Meteorological Society
AERMOD	American Meteorological Society/United States Environmental Protection Agency Regulatory Model
AERMOD-HBP	AERMOD-Highly-buoyant Plume
ASOS	Automated Surface Observing System
BPIPPRM	Building Profile Input Program for PRIME
CAMS	Continuous Ambient Monitoring Station
CEMS	Continuous Emissions Monitoring System
CFR	Code of Federal Regulations
DRR	Data Requirements Rule
DV	design value
EF	emissions factor
EGF	Electric Generating Facility
EPA	United States Environmental Protection Agency
EPN	Emission Point Number
˚F	degrees Fahrenheit
FIN	Facility Identification Number
fps	feet per second
GEP	Good Engineering Practice
GHCND	Global Historical Climatology Network Daily
hr	hour
ID	Identifier
km	kilometer
lb	pound
m	meter
MMBtu	one million British Thermal Units
NAAQS	National Ambient Air Quality Standard
NED	National Elevation Data
NLCD	National Land Cover Data
NSR	New Source Review
ppb	parts per billion

PRIME	Plume Rise Model Enhancements
s	second
SIP	State Implementation Plan
SO_2	sulfur dioxide
TCEQ	Texas Commission on Environmental Quality
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
v	version
WBAN	Weather Bureau Army Navy

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1. INTRODUCTION

This appendix details the modeling conducted by the Texas Commission on Environmental Quality (TCEQ) for the Rusk-Panola Attainment Demonstration (AD) State Implementation Plan (SIP) revision for the 2010 Sulfur Dioxide (SO_2) National Ambient Air Quality Standard (NAAQS). As part of this AD SIP revision, the TCEQ conducted air quality dispersion modeling in accordance with the United States Environmental Protection Agency's (EPA) *Guidance for 1-Hour SO_2 Nonattainment Area SIP Submissions* (EPA, 2014; SO_2 SIP guidance) and 40 Code of Federal Regulations (CFR) Part 51 Appendix W (EPA, 2017).

2. AIR QUALITY MODEL SELECTION

For this SIP revision, the TCEQ used an alternative formulation of the American Meteorological Society (AMS)/EPA Regulatory Model (AERMOD) based on the Highly-buoyant Plume Model (Weil et al., 1997) called AERMOD-Highly Buoyant Plume (AERMOD-HBP). Information regarding AERMOD-HBP and the TCEQ's request to the EPA for its use under §3.2 of 40 CFR Part 51 Appendix W are provided in Appendix M: *Alternative Model Documentation*.

The following versions of the regulatory AERMOD preprocessors were used with AERMOD-HBP for this demonstration:

- AERMET version (v)21112 to generate meteorological data files;
- AERMINUTE v15272 to include measured one-minute wind averages;
- AERSURFACE v20060 to determine the surface characteristics for the meteorological station;
- AERMAP v18081 to gather elevation data for sources and receptors; and
- the Building Profile Input Program for PRIME (BPIPPRM) v04274 to calculate building downwash effects.

Where applicable, regulatory default parameters were used in the preprocessors. For a quick reference to the settings and parameters used in the preprocessors, refer to Section 9: *Reference Tables for Model Preprocessor Set-Up*.

3. MARTIN LAKE FACILITY

A map of the Martin Lake facility is shown in Figure 3-1: *Martin Lake Facility Overview*. The property boundary is visible in blue with building locations plotted with a red outline and stack locations marked in yellow. Building locations were corrected from the TCEQ's permit files with input from Vistra Energy Corporation (Vistra), the parent company of Luminant Generation Company LLC, which owns Martin Lake.

Figure 3-1: Martin Lake Facility Overview

3.1 SOURCES

New Source Review (NSR) permit number 933 for Martin Lake lists four point sources and one fugitive area source. The four point sources consist of three Electric Generating Facility (EGF) boiler unit stacks and one combined stack for two auxiliary boilers. The sources were given Model Source Identifiers (IDs) S1, S2, S3, and SAUX, respectively. Physical source parameters such as location and height for the Martin Lake point sources are listed in Table 3-1: *Martin Lake Point Source Parameters*. Stack height and diameter for the point sources came from NSR permit 933, and source elevations were calculated using AERMAP with United States Geological Survey (USGS) National Elevation Data (NED). Source locations were corrected from the coordinates listed in NSR permit 933 to align satellite imagery, which are listed in Table 3-1:Table 3-1 in Universal Transverse Mercator (UTM) in meters (m). The point sources were included in modeling.

Table 3-1: Martin Lake Point Source Parameters

Model Source ID	NSR Permit Number 933 Emissions Point Number	Type	UTM Easting (X; m)	UTM Northing (Y; m)	Height (m)	Diameter (m)	Elevation (m)
S1	S-1	Stack	352019.6	3570408.3	137.8	7.0	95.0
S2	S-2	Stack	352059.8	3570316.6	137.8	7.0	95.0
S3	S-3	Stack	352099.8	3570225.0	137.8	7.0	95.0
SAUX	S1A&B	Stack	351873.0	3570285.0	27.4	2.9	95.0

Stack temperatures, velocities, and emission rates were varied in different modeling scenarios based on the control strategies described in Chapter 3 of the AD SIP, so these parameters are specified in Section 8: *Modeling Scenarios and Results*.

The maximum permitted allowable SO_2 emission rate of the fugitive area source, Emissions Point Number (EPN) MSS-FUG, is 0.00126 grams per second, which is about 3,000 times smaller than the controlled maximum allowable emission rate of the individual auxiliary boilers and about 300,000 times smaller than the controlled maximum allowable emission rate of an individual EGF boiler (see Section 8). Because MSS-FUG has such low emissions and is not expected to cause significant concentration gradients in the Rusk-Panola nonattainment area, it was not modeled explicitly.

3.1.1 Building Downwash

According to 40 CFR Part 51 Appendix W §7.2.2, building downwash should be considered for stacks with heights lower than their Good Engineering Practice (GEP) height. By the definition in 40 CFR §51.100, GEP height is calculated as the greater of:

1. 65 m,
2. GEP = 2.5*H, for stacks in existence on January 12, 1979 if the owner or operator can provide evidence that this equation was used to protect against downwash, or,
3. GEP = H + 1.5*L, for all other stacks,

where H is the height of nearby structure(s) and L is the minimum of the height or the projected width of nearby buildings.

The source SAUX is shorter than the 65 m threshold at 27.4 m and is therefore subject to downwash. S1, S2, and S3 are taller than 65 m, and while these three stacks were in existence on January 12, 1979, there is no evidence that the equation under option two was used to determine the stack heights when constructed. Therefore, GEP for S1, S2, and S3 was evaluated under option three above.

From NSR permit number 933, the largest and tallest buildings near S1, S2, and S3 are their associated boiler buildings, UNIT1, UNIT2, and UNIT3. Each building and stack is aligned in the same direction and has the same dimensions, therefore GEP is the same for all three stacks.

The boiler buildings are 260 feet (ft) tall and approximately 144 ft wide. From the plot plan in the permit files, the boiler building lengths are larger than the widths, although the length dimensions are not explicitly stated. For an along-length wind direction, the minimum projected building width is 144 ft. The projected width is larger for all other wind directions. Using this information, GEP was calculated to be 476 ft or 145 m.

The calculated GEP of 145 m is greater than the heights of the three EGF stacks (137.8 m), therefore downwash and actual stack heights were used in modeling. Stack-tip downwash was calculated for all stack sources at Martin Lake using the algorithm with the Plume Rise Model Enhancements (PRIME), the Building Profile Input Program for PRIME (BPIPPRM).

3.2 BUILDINGS

Figure 3-2: *Martin Lake Buildings* shows a closer view of the buildings considered in the calculation of the GEP height and stack tip downwash for the stack sources. Parameters such as height and elevation for the buildings in Figure 3-2 are below in Table 3-2: *Martin Lake Building Parameters*. The building locations were compared to satellite images of the facility, and any discrepancies between the two were adjusted and resolved with input from Vistra.

Figure 3-2: Martin Lake Buildings

Table 3-2: Martin Lake Building Parameters

Building ID	Tier	Elevation (ft)	Tier Height (ft)	Total Corners	Origin Corner UTM Easting (X; m)	Origin Corner UTM Northing (X; m)
UNIT1	1	312.04	31	18	352009.9	3570432.2
UNIT1	2	N/A	40	7	351867.2	3570370.8
UNIT1	3	N/A	141	4	352016.9	3570416.9
UNIT1	4	N/A	146	10	351964.4	3570394.5
UNIT1	5	N/A	153	5	351908.8	3570372.7
UNIT1	6	N/A	258	4	351908.8	3570372.7
UNIT1	7	N/A	120	4	351864.6	3570378.5
UNIT1	8	N/A	60	4	351857.6	3570358.6
UNIT2	1	312.04	31	16	352052.1	3570342.3
UNIT2	2	N/A	40	4	351905.1	3570292.8
UNIT2	3	N/A	141	4	352057.8	3570329.7
UNIT2	4	N/A	146	10	352002.1	3570305.1
UNIT2	5	N/A	153	4	351942.7	3570297.1
UNIT2	6	N/A	258	5	351948.4	3570284.8
UNIT2	7	N/A	120	4	351905.1	3570292.5
UNIT2	8	N/A	60	4	351897.6	3570268.0
UNIT3	1	310.47	31	16	352091.6	3570252.5
UNIT3	2	N/A	40	4	351943.0	3570208.1
UNIT3	3	N/A	141	5	352097.0	3570240.4
UNIT3	4	N/A	146	10	352043.1	3570216.1
UNIT3	5	N/A	153	5	351989.7	3570195.5
UNIT3	6	N/A	258	4	351989.7	3570195.5
UNIT3	7	N/A	120	4	351943.0	3570207.9
UNIT3	8	N/A	60	4	351933.7	3570176.1
TT1	1	311.81	200	4	351946.0	3570316.0
Crshtwr3	1	311.98	104	4	352235.3	3570238.3
Crshtwr1	1	296.46	104	4	352157.4	3570413.0
Surgsil1	1	307.22	145	24	352268.6	3570380.0
Surgsil	1	299.51	145	24	352282.3	3570349.8
AshBin1	1	309.91	80	4	352393.2	3570626.1
AshSilo1	1	309.88	140	24	352431.3	3570611.0
AshSilo2	1	309.88	140	24	352442.9	3570585.9
Sldg1	1	310.73	60	4	352440.7	3570622.0
AshBtm3	1	315.49	80	4	352534.1	3570315.2
AshSilo3	1	316.50	140	24	352562.1	3570315.3
AshSilo4	1	316.50	140	24	352572.9	3570289.5
Sldg3	1	317.91	60	4	352568.6	3570332.8
LimeBlg1	1	313.22	50	4	352131.4	3570007.9
LimeBdg2	1	319.42	20	4	352239.3	3569970.8
LimeTnks	1	315.29	20	6	352180.9	3570042.7
FOTank1	1	317.85	40	24	351687.4	3570934.9
FOTank2	1	315.65	40	24	351727.9	3570844.8

Building ID	Tier	Elevation (ft)	Tier Height (ft)	Total Corners	Origin Corner UTM Easting (X; m)	Origin Corner UTM Northing (X; m)
LghtWare	1	311.22	20	4	351913.0	3570475.1
HevyWare	1	310.40	20	4	351952.7	3570491.2
ServBldg	1	312.80	20	6	351885.6	3570442.5
Offic	1	316.93	20	4	351768.3	3570427.9
ConsWrh1	1	315.49	20	4	351712.1	3570619.0
Const2	1	316.60	20	4	351692.3	3570664.7
Cond1	1	314.11	40	24	351887.1	3570400.8
Cond2	1	314.44	40	24	351875.9	3570395.4
Hopper1	1	300.10	20	4	352434.4	3570427.7
Hopper2	1	299.28	20	4	352447.4	3570460.5
TT31	1	311.91	200	4	352023.0	3570139.0

4. MODELING DOMAIN

The modeling domain for this demonstration consisted of a 25.5 kilometers (km) by 24.5 km rectangular area centered around Martin Lake's S1 source (Figure 4-1: *Modeling Domain and Receptor Grid*). This modeling domain had three nested receptor grids. The innermost grid spanned 0 to 3 km from the center point, encompassing Martin Lake, with 50 m spacing between receptors (Figure 4-2: *Innermost Receptor Grid*). The middle-nested grid extended from 3 km to 9 km, with 100 m spacing between receptors. Receptors in the outermost grid, which covers the rest of the domain, had 500 m spacing.

Receptors within the property owned and controlled by Vistra were removed from the grid, and receptors were added with 25 m spacing along the non-ambient air boundary lines. Receptors with 25 m spacing were added along the section of public road within Vistra's property (Figure 4-3: *Receptors Around Non-Ambient Air Boundary*). An additional receptor was placed at the location of the Data Requirements Rule (DRR), Tatum CR 21381d Martin Creek Lake monitor or Continuous Ambient Monitoring Station (CAMS) 1082 (C1082).

Receptor elevations were determined using AERMAP with USGS NED files covering the extent of the modeling domain.

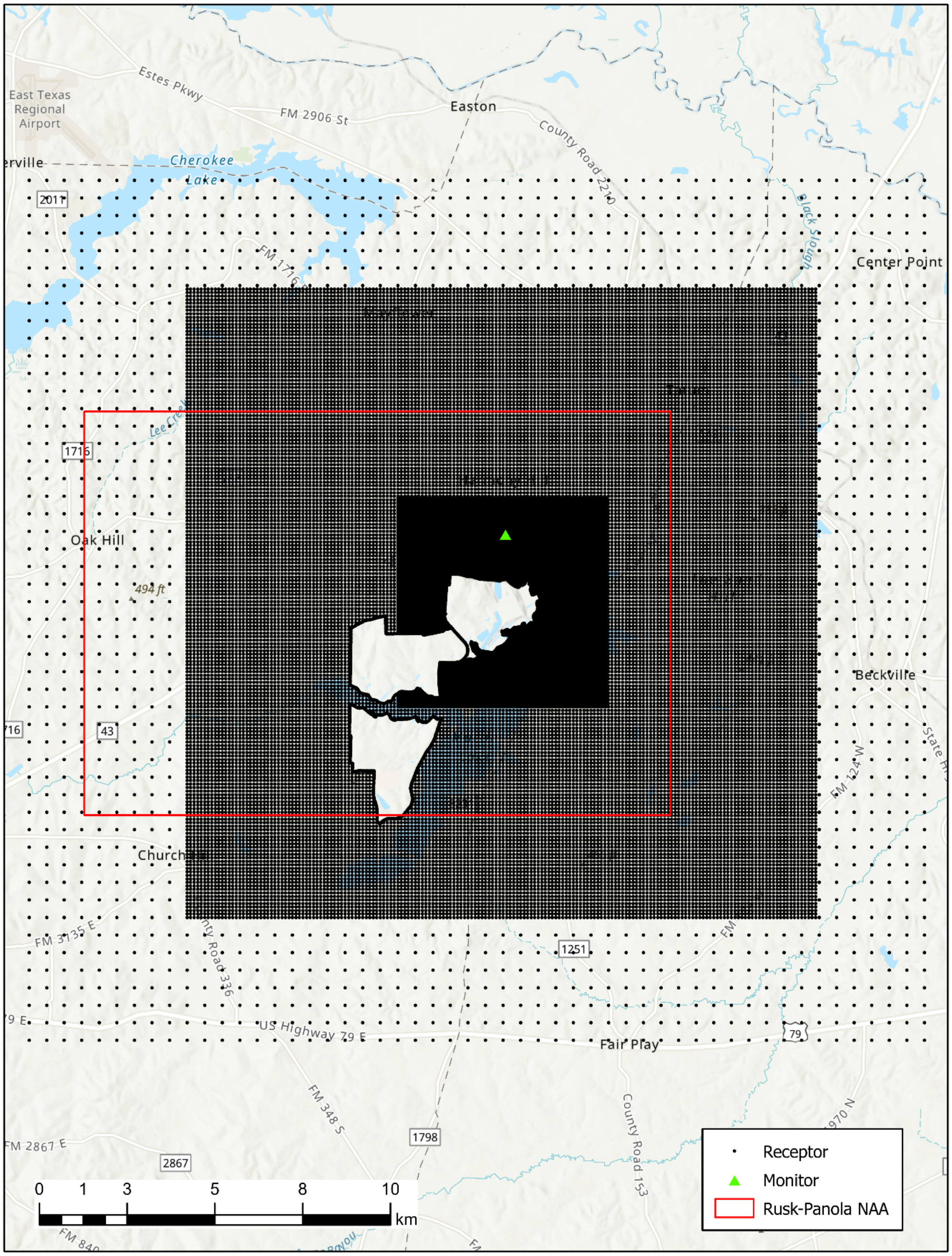

Figure 4-1: Modeling Domain and Receptor Grid

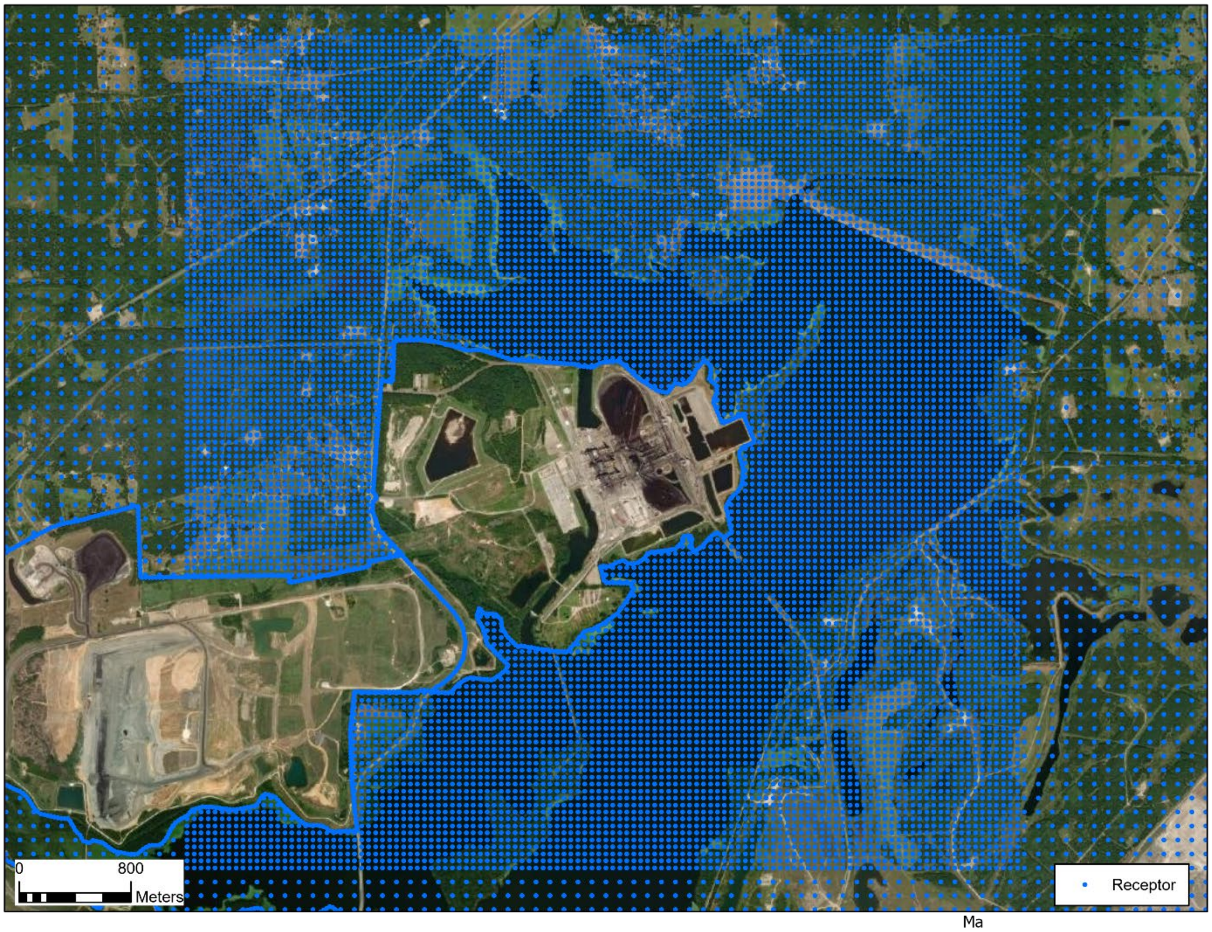

Figure 4-2: Innermost Receptor Grid

Figure 4-3: Receptors Around Non-Ambient Air Boundary

5. METEOROLOGY

5.1 AERMET

Following 40 CFR Part 51 Appendix W §8.4, five years of meteorological data for the years 2015 through 2019 were processed using the AERMOD preprocessors AERMET, AERMINUTE, and AERSURFACE. While meteorological data are collected on site at Martin Lake, the monitor was not sited specifically to collect representative weather data. Therefore, the closest National Weather Service (NWS) stations were used to represent local meteorological conditions. The closest surface station to Martin Lake is the Longview East Texas Regional Airport (Weather Bureau Army Navy [WBAN] 03901), and the closest upper air station is the Shreveport, Louisiana station (WBAN 13957). Sub-hourly one-minute wind data from the surface station were included and processed with AERMINUTE using a threshold windspeed of 0.5 meters per second. An hour adjustment to local time of +6 hours was used in AERMET.

Data completeness is presented for the surface station in Table 5-1: *Surface Station Data Percent Completeness*, and for the upper air station in Table 5-2: *Upper Air Data Completeness*.

Table 5-1: Surface Station Data Percent Completeness

Year	Temperature (%)	Wind Direction (%)	Wind Speed (%)	Acceptable
2015	99.55	96.45	99.74	Yes
2016	99.45	96.43	99.56	Yes
2017	99.63	96.96	99.63	Yes
2018	99.97	96.42	99.81	Yes
2019	99.87	96.75	99.85	Yes

Table 5-2: Upper Air Data Completeness

Year	Number of Valid Soundings*	Acceptable
2015	737	Yes
2016	743	Yes
2017	758	Yes
2018	757	Yes
2019	775	Yes

*Typically, there are at least two soundings per day or approximately 730 per year.

5.2 AERSURFACE

AERMET takes inputs for the land surface characteristics of albedo, Bowen ratio, and surface roughness, which were derived using the AERSURFACE terrain preprocessor. For this demonstration, 2016 National Land Cover Data (NLCD) was used in AERSURFACE, supplemented with NLCD canopy and impervious cover data for the same year. A radius of 1 km was used, as well as the maximum 12 wind sectors all classified as “airport.”

Following the recommendations in EPA’s AERSURFACE v20060 User Guide, relative wetness classifications of dry, wet, or average were determined based on 30 years of local precipitation data. There was not a single station in Rusk or Panola County with a complete record of annual precipitation for the last 30 years, so the percentiles were calculated using an average of the available data from the National Climatic Data Center[1] for five nearby stations including the surface station. The year was classified as wet if the annual precipitation was in the top 70th percentile (54.9 inches), dry if precipitation was in the bottom 30th percentile (42.7 inches), and average if precipitation was between those values. Table 5-3: *AERSURFACE Wetness Classification Precipitation Data* below shows the yearly wetness classifications for 2015 through 2019 and the full 30 years of precipitation data.

[1] https://www.ncdc.noaa.gov/cdo-web/search

Table 5-3: AERSURFACE Wetness Classification Precipitation Data

Year	Longview East TX Regional Airport[a]	Henderson 6.1 NW[b]	Henderson 7.0 SSW[c]	Henderson, TX[d]	Longview Wsmo, TX[e]	Average Precip. (inches)	Classification in AERSURFACE
1990				60.54		60.54	
1991				68.81		68.81	
1992				44.52		44.52	
1993				53.33	56.97	55.15	
1994				54.09	60.33	57.21	
1995					43.64	43.64	
1996				39	39.06	39.03	
1997				60.89	56.61	58.75	
1998				53.98	55.72	54.85	
1999	38.64			46.19	40.58	41.80	
2000	48.15			46.03	51.59	48.59	
2001	63.32			66.08	69.3	66.23	
2002	36.44			46.63		41.54	
2003	31.76			44.53		38.15	
2004	52.48			61.24	60.61	58.11	
2005	29.99			37.9	31.1	33.00	
2006	30.87			34.98	35.49	33.78	
2007	49.81			50.77	46.99	49.19	
2008	48.51			48.52	52.96	50.00	
2009	49.78	45.45		53.35	62.03	52.65	
2010	26.84	31.76		35.02	33.33	31.74	
2011	30.57	31.31			30.41	30.76	
2012	38.17	46.1		43.74	44.33	43.09	
2013	40.57	46.8		48.67	46.57	45.65	
2014	38.84		46.92		38.59	41.45	
2015	68.04	73.56	64.93	69.89	70.72	69.43	Wet
2016	49.46		49.61	56.65	57.41	53.28	Average
2017	44.83		44.19	43.87	51.29	46.05	Average
2018	58.91		60.75		64.65	61.44	Wet
2019	48.32		44.24		49.08	47.21	Average

[a] Global Historical Climatology Network Daily (GHCND) site ID: USW00003901
[b] GHCND site ID: US1TXRS0001
[c] GHCND site ID: US1TXRS0008
[d] GHCND site ID: USC00414081
[e] GHCND site ID: USW00003951

AERSURFACE determines the land surface characteristics by five seasonal categories, which are differentiated primarily around the type of vegetation present within that season. The season descriptions and months which are assigned to each season by default are listed in Table 5-4: *AERSURFACE Seasonal Categories*.

Table 5-4: AERSURFACE Seasonal Categories

Season Number	Season Description from AERSURFACE v20060 User Guide	Default Months
1	“Late autumn after frost and harvest, or winter with no snow”	December, January, February
2	“Traditional spring with partial green coverage or short annuals”	March, April, May
3	“Midsummer with lush vegetation”	June, July, August
4	“Autumn with unharvested crops”	September, October, November
5	“Winter with continuous snow on the ground”	December, January, February (if classified as continuous snow)

Per the EPA’s AERSURFACE v20060 User Guide, the user can reassign months to different seasonal categories as “appropriate for the climate and conditions at the specific location.” Unlike wetness, season is not classified relative to local climate, but by which seasonal description best matches the local surface conditions. For example, September in a warm climate may be better described as “midsummer with lush vegetation” than as “autumn with unharvested crops.” A method for determining seasonal category that looks at the number of days below freezing for a given month was used to reassign non-default months. The reassignment criteria for this method, which was first used by the TCEQ in SO_2 nonattainment area designation modeling (TCEQ, 2020). For the Rusk-Panola nonattainment area, the mild warm early spring temperatures at the surface station (less than five days below freezing in March), make May more characteristic of a “summer” classification. Therefore, the month of May was reclassified as “summer,” and all other default categories were used. There were no months of continuous snow.

6. NEARBY SOURCES

Besides Martin Lake, the American Electric Power Pirkey Power Plant (AEP Pirkey) is the only nearby SO_2 source with emissions greater than 100 tons per year within 50 km of Martin Lake, located approximately 17 km outside of the Rusk-Panola nonattainment area in Harrison County. AEP Pirkey has one stack with SO_2 emissions, Model Source ID P16, listed in NSR permit number 6269. The stack parameters for this source are in Table 6-1: *AEP Pirkey Source Parameters*.

Table 6-1: AEP Pirkey Source Parameters

Model Source ID	NSR Permit Number 6269 EPN	Type	UTM Easting (X; m)	UTM Northing (Y; m)	Height (m)	Temp. (Kelvin)	Velocity (m per second)	Diameter (m)
P16	P-16	Stack	360479	3592510	160.02	338.71	25.91	7.62

The hourly emission rate of P16 for modeling was determined based on 40 CFR Part 51 Appendix W Table 8-1 for nearby sources. Considering that the maximum allowable emission rate for P16 is 8,160 pounds of SO_2 per hour (lb/hr), the following criteria were used to find the hourly emission rate for modeling using actual hourly emission rates and heat inputs from continuous emissions monitoring systems data: [2]

For each hour in the modeled period (2015 through 2019),

- if the actual SO_2 emission rate in lb/hr was greater than 8,180 lb/hr, then the actual emission rate in lb/hr was used as the modeled emission rate for that hour; or,
- if the actual SO_2 emission rate in lb/hr was 0 lb/hr or blank for that hour, then 8,180 lb/hr was used as the modeled emission rate;
- otherwise, the model emission rate for that hour in lb/hr was the minimum of 8,180 lb/hr or 1.2 pounds per one million British Thermal Units (lb/MMBtu) multiplied by the actual heat input in MMBtu/hr.

Building downwash was not considered for this source because the effects of downwash are localized and would not be apparent in the Rusk-Panola nonattainment area.

7. BACKGROUND CONCENTRATION

For SO_2 dispersion modeling, background concentrations of SO_2 are included to represent any sources that are not explicitly modeled. To characterize background concentrations in modeling for attainment demonstrations, the EPA recommends using data from the closest monitor upwind of the main source, in this case Martin Lake. There are three monitors close to Martin Lake: Tatum CR 2181d Martin Creek Lake (C1082), Hallsville Red Oat Road (C1079), and Longview (C19). C1082 and C1079 are DRR monitors sited to capture the impacts of major SO_2 sources, which makes them unsuitable to quantify representative background concentrations. C19 is potentially impacted by Martin Lake and AEP Pirkey and is therefore not suitable to quantify background concentrations.

If there are no representative nearby monitors, the EPA recommends using a "regional site" monitor that may be located away from the source but is representative of the area. Table 7-1: *Monitors Considered for Background Concentration* shows "regional site" monitors that were considered for background concentration and their 2015 through 2020 design values (DV) in parts per billion (ppb).

[2] EPA's Air Markets Program Data: https://ampd.epa.gov/ampd/

Table 7-1: Monitors Considered for Background Concentration

CAMS	Site Name	County	Distance from C1082 (km)	2015 DV (ppb)	2016 DV (ppb)	2017 DV (ppb)	2018 DV (ppb)	2019 DV (ppb)	2020 DV (ppb)
C71	Kaufman	Kaufman	167	13	11	9	9	9	8[a]
C52	Midlothian OFW	Ellis	232	9	6	5	6	6	6[a]
C1037	Waco Mazanec	McLennan	246	7	6	6[a]	5[a]	6[a]	6[a]

[a]Values do not currently meet three-year DV validity requirements.

There are two monitors, C71 and C52, with complete SO_2 DVs for the 2015 through 2019 period. Because C52 has a more stable DV across recent years than C71, this monitor was chosen as the representative background monitor. The most recent certified DV from C52, 6 ppb from 2019, was added as the background concentration for all modeling runs.

8. MODELING SCENARIOS AND RESULTS

8.1 EGF BOILER STACK PARAMETERS

As discussed in Chapter 4: *Attainment Demonstration Modeling* of the AD SIP, modeling scenarios for four operating loads of the EGF boilers were considered to ensure that the control measures discussed in Chapter 3: *Control Strategies and Required Elements* of the AD SIP will result in attainment throughout the Rusk-Panola nonattainment area across various operating conditions. The four operating loads represented high, medium, and low loads, and a maintenance, startup and shutdown load. As recommended in the 2014 SO_2 guidance, the control measures were modeled using the critical emission value of 8,208 lb/hr and the critical emission factor limit of 0.33 lb/MMBtu.

Emission rates for each of the operating loads that were considered, along with the corresponding heat input and enforceable limits, are shown in Table 8-1: *EGF Boiler Operating Loads, Heat Inputs, and Modeled Emissions*.

Table 8-1: EGF Boiler Operating Loads, Heat Inputs, and Emission Rates.

Operating Load	Per-Boiler Heat Input Range (MMBtu/hr)	Emission Factor Limit (lb/MMBtu)	Per-Boiler Minimum Emission Rate (lb/hr)	Per-Boiler Maximum Emission Rate (lb/hr)	Three-Boiler Emission Rate (lb/hr)
High	7,500 to 9,000	0.33	2,475	2,970	8,208
Medium	4,750 to 7,250	0.33	1,568	2,393	8,208
Low	2,000 to 4,500	0.33	660	1,485	8,208
MSS	30 to 1,750	0.33	10	578	8,208

Vistra provided the TCEQ with representative stack temperatures and exit velocities for the High, Medium, and Low operating loads based on analysis of hourly Continuous Emission Monitoring System (CEMS) data for all three units from 2015 through 2020.

For each operating load, the historical data was filtered for hours with emission rates less than 2,500 lb/hr and with a comparable heat input (between 4,000 and 5,000 MMBtu/hr for the Low operating load, between 6,000 and 7,500 MMBtu/hr for the Medium operating load, and greater than 8,100 MMBtu/hr for the High operating load). Stack temperature was estimated as the average stack temperature across all three boilers. The stack exit velocity was estimated by assuming that there will be a 15% decrease from historical monitored data with the planned control measures, so a 15% reduction was applied to the average stack exit velocity across all three boilers. The TCEQ replicated the analysis and used a consistent methodology to estimate the stack parameters for the MSS operating load. The final stack parameter estimates used in the modeling are listed in Table 8-2: *EGF Boiler Stack Parameters Under Various Operating Loads.*

Table 8-2: EGF Boiler Stack Parameters Under Various Operating Loads

Operating Load	Heat Input Range for Stack Parameter Analysis (lb/MMBtu)	Stack Temperature (degrees Fahrenheit; ˚F)	Stack Velocity (feet per second; fps)
High	>= 8,100	163	94
Medium	6,000 to 7,500	160	83
Low	4,000 to 5,000	160	64
MSS	30 to 2,000	160	32

The 15% reduction in stack velocity was included to ensure that the stack parameters were representative of operations at Martin Lake under the future control strategy. Analysis of the historical data at Martin Lake indicated that exit velocity had a linear relationship with heat input, and future exit velocities are therefore expected to decrease with the exclusion of lignite coal under the future control strategy. Conversely, stack temperature was not correlated with heat input, but was instead associated with variation in scrubber operation. Filtering the historical data to include only hours with less than 2,500 lb/hr ensured that the data included all possible scrubber operations when determining stack temperature.

To demonstrate that 15% was appropriate to estimate the future decrease to stack velocity, the TCEQ analyzed hourly CEMS data from the now retired Monticello Power Plant from 2011 to 2017. The Monticello Power Plant, which was also owned by Vistra, made a similar change in fuel type that is expected at Martin Lake when it transitioned to 100% subbituminous coal in 2016. Monticello Unit 3 stack velocity data was evaluated over two timeframes and four operating loads to assess the change in stack velocity associated with fuel transition. Data between January 1, 2011 and December 31, 2015 were evaluated as pre-transition data, and data between October 1, 2016 and December 31, 2017 were evaluated as post-transition data. On Vistra's recommendation, the data between January 1, 2016 and September 30, 2016 were considered unrepresentative due to the timing of the unit fuel switch. The following table summarizes the percent change in stack velocity in each of the four operating ranges. As shown in Table 8-3: *Stack Velocity Analysis of Monticello Power Plant Data,* across the entire operating range, the decrease in velocity across all operations was 9.0%, with the largest decrease in the Medium load bin at 10.8%. Therefore, by applying a 15% reduction to the historical Martin Lake stack velocity data, the TCEQ's estimated stack velocities are an appropriate and conservative representation of the reduction expected from a similar fuel transition.

Table 8-3: Stack Velocity Analysis of Monticello Power Plant Data

Operating Load	Heat Input Range for Stack Parameter Analysis (lb/MMBtu)	Pre-Transition Average Stack Velocity (fps)	Post-Transition Average Stack Velocity (fps)	Percent Change in Stack Velocity (%)
All Operations	> 0	78.9	71.8	-9.0
High	>= 8,100	98.4	94.7	-3.8
Medium	6,000 to 7,500	87.2	77.7	-10.8
Low	4,000 to 5,000	65.3	59.6	-8.7
MSS	30 to 2,000	32.2	35.6	10.6

8.2 AUXILIARY BOILER STACK PARAMETERS

The auxiliary boilers at Martin Lake, EPNs AUXB-A and AUXB-B, have historically operated infrequently and are expected to operate only during startup, shutdown, maintenance, and testing. The combined maximum allowable emission rate for AUXB-A and AUXB-B under the control measures discussed in Chapter 3 of the AD SIP is 51.46 lb/hr, or 25.73 lb/hr per boiler. Stack parameters for the combined auxiliary boiler stack, SAUX, when one or both boilers are operating are presented in Table 8-3: *Auxiliary Boilers Combined Stack (SAUX) Parameters*. The stack temperature and velocities were unchanged from the values in NSR permit number 933.

Table 8-4: Auxiliary Boilers Combined Stack (SAUX) Parameters

Number of Auxiliary Boilers Operating	Maximum Allowable Emission Rate (lb/hr)	Stack Temperature (˚F)	Stack Velocity (fps)
1	25.73	600	20
2	51.46	600	40

8.3 MODELING SCENARIOS AND RESULTS

As described in Chapter 4 of the AD SIP narrative, the TCEQ modeled 42 modeling scenarios to ensure that the Rusk-Panola nonattainment area will remain in attainment under a wide variety of operating conditions at Martin Lake. The modeling scenarios were determined by examining twelve cap-distribution cases for each operating load that capture the potential flexibility in distributing the 8,208 lb/hr emissions cap given the 0.33 lb/hr emission factor constraint. The cap-distribution cases are described in Table 8-5: *EGF Cap-Distribution Case Descriptions*. For each case and operating load, the scenario was modeled if both the emissions cap limit and emission factor limit were not exceeded using the ranges and values in Table 8-1. For the cases that consider a combination of maximum and minimum heat inputs (cases 10, 11, and 12), only cases that utilized at least 75% of the 8,208 lb/hr emission cap were included. Table 8-6: *Calculations for Cap-Distribution Scenarios* lists the calculations which determined which scenarios were modeled.

Table 8-5: EGF Cap-Distribution Case Descriptions

Cap-Distribution Case Number	Description
1	All three units operating at the minimum heat input of the operating load.
2	All three units operating at the maximum heat input of the operating load.
3	Emissions cap split evenly between the three units.
4	Two units operating at the maximum heat input of the operating load; third unit emitting the rest of the emissions cap.
5	Two units operating at the minimum heat input of the operating load; third unit emitting the rest of the emissions cap.
6	One unit emitting the entire emissions cap.
7	Emission cap split evenly between two units.
8	One unit operating at the maximum heat input of the operating load; one unit offline; third unit emitting rest of cap.
9	One unit operating at the minimum heat input of the operating load; one unit offline; third unit emitting rest of cap.
10	One unit operating at the maximum heat input of the operating load; one unit at the minimum heat input of the operating load; third unit emitting rest of cap.
11	Two units operating at the maximum heat input of the operating load; one unit operating at the minimum heat input of the operating load.
12	Two units operating at the minimum heat input of the operating load; one unit operating at the maximum heat input of the operating load.

Table 8-6: Calculations for Cap-Distribution Scenarios

Operating Load	Case Number	First Unit Emission Rate (lb/hr)	Second Unit Emission Rate (lb/hr)	Third Unit Emission Rate (lb/hr)	Three-Boiler Emission Rate (lb/hr)	Percentage of Cap Used (%)	Emission Factor at Minimum Heat Input (lb/MMBtu)	Emission Factor at Minimum Heat Input (lb/MMBtu)	Modeled?
High	1	2,475	2,475	2,475	7,425	90	0.33	0.28	Yes
High	2	2,970	2,970	2,970	8,910	109	0.40	0.33	No, cap exceeded
High	3	2,736	2,736	2,736	8,208	100	0.36	0.30	Yes
High	4	2,970	2,970	2,268	8,208	100	0.30	0.25	Yes
High	5	2,475	2,475	3,258	8,208	100	0.43	0.36	No, EF exceeded
High	6	0	0	8,208	8,208	100	1.09	0.91	No, EF exceeded
High	7	0	4,104	4,104	8,208	100	0.55	0.46	No, EF exceeded
High	8	0	2,970	5,238	8,208	100	0.70	0.58	No, EF exceeded
High	9	0	2,475	5,733	8,208	100	0.76	0.64	No, EF exceeded
High	10	2,475	2,970	2,763	8,208	100	0.37	0.31	Yes
High	11	2,475	2,970	2,970	8,415	103	0.40	0.33	No, cap exceeded
High	12	2,475	2,475	2,970	7,920	96	0.40	0.33	Yes
Medium	1	1,568	1,568	1,568	4,704	57	0.33	0.22	Yes
Medium	2	2,393	2,393	2,393	7,179	87	0.50	0.33	Yes
Medium	3	2,736	2,736	2,736	8,208	100	0.58	0.38	No, EF exceeded
Medium	4	2,393	2,393	3,422	8,208	100	0.72	0.47	No, EF exceeded
Medium	5	1,568	1,568	5,072	8,208	100	1.07	0.70	No, EF exceeded
Medium	6	0	0	8,208	8,208	100	1.73	1.13	No, EF exceeded
Medium	7	0	4,104	4,104	8,208	100	0.86	0.57	No, EF exceeded
Medium	8	0	2,393	5,815	8,208	100	1.22	0.80	No, EF exceeded
Medium	9	0	1,568	6,640	8,208	100	1.40	0.92	No, EF exceeded
Medium	10	1,568	2,393	4,247	8,208	100	0.89	0.59	No, EF exceeded
Medium	11	1,568	2,393	2,393	6,354	77	0.50	0.33	Yes
Medium	12	1,568	1,568	2,393	5,529	67	0.50	0.33	No, uses <75% of capped emissions
Low	1	660	660	660	1,980	24	0.33	0.15	Yes
Low	2	1,485	1,485	1,485	4,455	54	0.74	0.33	Yes
Low	3	2,736	2,736	2,736	8,208	100	0.61	1.37	No, EF exceeded

Operating Load	Case Number	First Unit Emission Rate (lb/hr)	Second Unit Emission Rate (lb/hr)	Third Unit Emission Rate (lb/hr)	Three-Boiler Emission Rate (lb/hr)	Percentage of Cap Used (%)	Emission Factor at Minimum Heat Input (lb/MMBtu)	Emission Factor at Minimum Heat Input (lb/MMBtu)	Modeled?
Low	4	1,485	1,485	5,238	8,208	100	2.62	1.16	No, EF exceeded
Low	5	660	660	6,888	8,208	100	3.44	1.53	No, EF exceeded
Low	6	0	0	8,208	8,208	100	4.10	1.82	No, EF exceeded
Low	7	0	4,104	4,104	8,208	100	0.91	2.05	No, EF exceeded
Low	8	0	1,485	6,723	8,208	100	3.36	1.49	No, EF exceeded
Low	9	0	660	7,548	8,208	100	3.77	1.68	No, EF exceeded
Low	10	660	1,485	6,063	8,208	100	3.03	1.35	No, EF exceeded
Low	11	660	1,485	1,485	3,630	44	0.74	0.33	No, uses <75% of capped emissions
Low	12	660	660	1,485	2,805	34	0.74	0.33	No, uses <75% of capped emissions
MSS	1	10	10	10	30	0	0.33	0.01	Yes
MSS	2	578	578	578	1,734	21	19.27	0.33	Yes
MSS	3	2,736	2,736	2,736	8,208	100	91.20	1.56	No, EF exceeded
MSS	4	578	578	7,052	8,208	100	235.07	4.03	No, EF exceeded
MSS	5	10	10	8,188	8,208	100	272.93	4.68	No, EF exceeded
MSS	6	0	0	8,208	8,208	100	273.60	4.69	No, EF exceeded
MSS	7	0	4,104	4,104	8,208	100	136.80	2.35	No, EF exceeded
MSS	8	0	578	7,630	8,208	100	254.33	4.36	No, EF exceeded
MSS	9	0	10	8,198	8,208	100	273.27	4.68	No, EF exceeded
MSS	10	10	578	7,620	8,208	100	254.00	4.35	No, EF exceeded
MSS	11	10	578	578	1,166	14	19.27	0.33	No, uses <75% of capped emissions
MSS	12	10	10	578	598	7	19.27	0.33	No, uses <75% of capped emissions

The full set of 42 modeling scenarios are listed in Table 8-7: *Modeling Scenario Descriptions*. All modeling scenarios were run using the same meteorological inputs, domain, downwash, and background concentration. AEP Pirkey's source P16 was included in all modeling scenarios. Table 8-8: *Modeling Scenarios and Maximum Modeled DV* shows each modeling scenario with the stack parameters of the EGF boilers, and the resulting maximum DV across all receptors.

Table 8-7: Modeling Scenario Descriptions

Modeling Scenario Number(s)	EGF Boiler Operating Load	Cap-Distribution Case Number	Description
1 (22)	High	3	Full emissions cap split evenly between the three EGF boilers at the High operating load; one (two) auxiliary boiler(s) operating
2-4 (23-25)	High	4	Two EGF boilers operating at the maximum heat input of the High operating load; third unit emitting rest of cap; one (two) auxiliary boiler(s) operating
5 (26)	High	1	All three EGF boilers operating at the minimum heat input of the High operating load; one (two) auxiliary boiler(s) operating
6-8 (27-29)	High	10	One EGF boiler operating at the maximum heat input of the High operating load; one EGF boiler operating at the minimum heat input of the High operating load; third unit emitting rest of cap; one (two) auxiliary boiler(s) operating
9-11 (30-32)	High	12	Two EGF boilers operating at the minimum heat input of the High operating load; one EGF boiler operating at the maximum heat input of the High operating load; one (two) auxiliary boiler(s) operating
12 (33)	Medium	1	All three EGF boilers operating at the minimum heat input of the Medium operating load; one (two) auxiliary boiler(s) operating
13 (34)	Medium	2	All three EGF boilers operating at the maximum heat input of the Medium operating load; one (two) auxiliary boiler(s) operating
14-16 (35-37)	Medium	11	Two EGF boilers operating at the maximum heat input of the High operating load; one EGF boiler operating at the minimum heat input of the High operating load; one (two) auxiliary boiler(s) operating
17 (38)	Low	2	All three EGF boilers operating at the maximum heat input of the Low operating load; one (two) auxiliary boiler(s) operating
18 (39)	Low	1	All three EGF boilers operating at the minimum heat input of the Low operating load; one (two) auxiliary boiler(s) operating
19 (40)	MSS	2	All three EGF boilers operating at the maximum heat input of the MSS operating load; one (two) auxiliary boiler(s) operating
20 (41)	MSS	1	All three EGF boilers operating at the minimum heat input of the MSS operating load; one (two) auxiliary boiler(s) operating
21 (42)	N/A	N/A	Only one (two) auxiliary boiler(s) operating

Table 8-8: Modeling Scenarios and Maximum Modeled DV

Scenario Number	S1 Emission Rate (lb/hr)	S1 Stack Temperature (˚F)	S1 Stack Velocity (fps)	S2 Emission Rate (lb/hr)	S2 Stack Temperature (˚F)	S2 Stack Velocity (fps)	S3 Emission Rate (lb/hr)	S3 Stack Temperature (˚F)	S3 Stack Velocity (fps)	Number of auxiliary boilers operating	Max DV (ppb)
1	2,736	163	94	2,736	163	94	2,736	163	94	1	73.1
2	2,970	163	94	2,970	163	94	2,268	163	94	1	73.2
3	2,268	163	94	2,970	163	94	2,970	163	94	1	73.1
4	2,970	163	94	2,268	163	94	2,970	163	94	1	73.0
5	2,475	163	94	2,475	163	94	2,475	163	94	1	67.6
6	2,475	163	94	2,970	163	94	2,763	163	94	1	73.1
7	2,763	163	94	2,475	163	94	2,970	163	94	1	73.0
8	2,970	163	94	2,763	163	94	2,475	163	94	1	73.2
9	2,475	163	94	2,475	163	94	2,970	163	94	1	71.0
10	2,970	163	94	2,475	163	94	2,475	163	94	1	71.0
11	2,475	163	94	2,970	163	94	2,475	163	94	1	71.0
12	1,568	160	83	1,568	160	83	1,568	160	83	1	52.5
13	2,393	160	83	2,393	160	83	2,393	160	83	1	71.7
14	1,568	160	83	2,393	160	83	2,393	160	83	1	65.1
15	2,393	160	83	1,568	160	83	2,393	160	83	1	65.0
16	2,393	160	83	2,393	160	83	1,568	160	83	1	65.1
17	1,485	160	64	1,485	160	64	1,485	160	64	1	57.4
18	660	160	64	660	160	64	660	160	64	1	40.0
19	578	160	32	578	160	32	578	160	32	1	41.3
20	10	160	32	10	160	32	10	160	32	1	40.0
21	0	0	0	0	0	0	0	0	0	1	40.0
22	2,736	163	94	2,736	163	94	2,736	163	94	2	73.5
23	2,970	163	94	2,970	163	94	2,268	163	94	2	73.6
24	2,268	163	94	2,970	163	94	2,970	163	94	2	73.5
25	2,970	163	94	2,268	163	94	2,970	163	94	2	73.4
26	2,475	163	94	2,475	163	94	2,475	163	94	2	67.9
27	2,475	163	94	2,970	163	94	2,763	163	94	2	73.5
28	2,763	163	94	2,475	163	94	2,970	163	94	2	73.4

Scenario Number	S1 Emission Rate (lb/hr)	S1 Stack Temperature (˚F)	S1 Stack Velocity (fps)	S2 Emission Rate (lb/hr)	S2 Stack Temperature (˚F)	S2 Stack Velocity (fps)	S3 Emission Rate (lb/hr)	S3 Stack Temperature (˚F)	S3 Stack Velocity (fps)	Number of auxiliary boilers operating	Max DV (ppb)
29	2,970	163	94	2,763	163	94	2,475	163	94	2	73.6
30	2,475	163	94	2,475	163	94	2,970	163	94	2	71.3
31	2,970	163	94	2,475	163	94	2,475	163	94	2	71.4
32	2,475	163	94	2,970	163	94	2,475	163	94	2	71.4
33	1,568	160	83	1,568	160	83	1,568	160	83	2	52.8
34	2,393	160	83	2,393	160	83	2,393	160	83	2	72.2
35	1,568	160	83	2,393	160	83	2,393	160	83	2	65.6
36	2,393	160	83	1,568	160	83	2,393	160	83	2	65.3
37	2,393	160	83	2,393	160	83	1,568	160	83	2	65.5
38	1,485	160	64	1,485	160	64	1,485	160	64	2	57.8
39	660	160	64	660	160	64	660	160	64	2	49.9
40	578	160	32	578	160	32	578	160	32	2	49.9
41	10	160	32	10	160	32	10	160	32	2	49.9
42	0	0	0	0	0	0	0	0	0	2	49.9

9. REFERENCE TABLES FOR MODELING PREPREPROCESSOR SET-UP

Table 9-1: AERMOD Preprocessor Versions Used

Module	Version
AERMET	V21112
AERMINUTE	v15272
AERSURFACE	v20060
AERMAP	v18081
BPIPPRM	v04274

Table 9-2: AERMET Surface Station Information

Parameter	Value
Surface Station Used	Longview East Texas Regional Airport
Latitude/Longitude	32.385, -94.712
Station ID (WBAN)	03901
Is this the ASOS station?	Yes
Hour Adjustment to Local Time	+6
Anemometer Height	10.06
Was ADJ_U* used?	Yes

Table 9-3: AERMET Upper Air Station Information

Parameter	Value
Upper Air Station Used	Shreveport, LA
Latitude/Longitude	32.45, -93.83
Station ID (WBAN)	13957
Is this the ASOS station?	No
Hour Adjustment to Local Time	+6

Table 9-4: AERMINUTE One-Minute and Five-Minute ASOS Wind Data

Parameter	Value
Was AERMINUTE data used?	Yes
Surface Station Used	Longview East Texas Regional Airport
Latitude/Longitude	32.385, -94.712
Station ID (WBAN)	03901
Station Code	KGGG
IFW Installation Date	10-08-2008
Was the 0.5 m/s wind threshold used?	Yes

Table 9-5: AERSURFACE Settings and Parameters

Parameter	Value
Surface Station Used	LONGVIEW E TX RGNL AP
Latitude/Longitude	32.385, -94.712
Land Use Data Used	NLCD 2016[3]
Was canopy data used?	Yes
Was impervious cover data used?	Yes
Datum	Albers Conical Equal Area North American Datum of 1983
Radius of Surface Roughness	1 km
Number of Wind Sectors	12 sectors
Period	Monthly
Surface Moisture	2015: Wet 2016: Average 2017: Average 2018: Wet 2019: Average
Months with Non-Default Season Definition	May -- Summer
Are there months of continuous snow?	No
Is this an airport site?	Yes
Was the VARYAP option used?	No
Is this an arid region?	No

Table 9-6: AERMAP Settings and Parameters

Parameter	Value
Terrain File Type & Name	NED n33w095.tif
UTM Extent of Terrain Data	SW corner: -95.001528, 31.998472 NE corner: -93.998472, 33.001528
Was there analysis to determine that all significant terrain features were included in terrain data extent?	Yes, all gridded receptors were included.
Anchor Latitude/Longitude	0.0 / 0.0
Base Zone	15
Base Datum	North American Datum of 1983

[3] ftp://newftp.epa.gov/aqmg/nlcd/2016/

10. REFERENCES

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