

APPENDIX J

MODELING TECHNICAL SUPPORT DOCUMENT (TSD)

Navarro County Attainment Demonstration State
Implementation Plan Revision for the 2010 One-Hour Sulfur
Dioxide National Ambient Air Quality Standard

2021-012-SIP-NR
SFR-122/2021-012-SIP-NR

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LIST OF ACRONYMS

AD	Attainment Demonstration
AMS	American Meteorological Society
AERMOD	American Meteorological Society/United States Environmental Protection Agency Regulatory Model
ASOS	Automated Surface Observing System
BPIPPRM	Building Profile Input Program for PRIME
CFR	Code of Federal Regulations
DRR	Data Requirements Rule
DV	Design Value
EPA	United States Environmental Protection Agency
EPN	Emission Point Number
°F	degrees Fahrenheit
ft	feet
FTP	File Transfer Protocol
GHCND	Global Historical Climatology Network Daily
hr	hour
km	kilometer
lb	pound
m	meter
NAAQS	National Ambient Air Quality Standard
NCDC	National Climatic Data Center
NED	National Elevation Data
NLCD	National Land Cover Data
ppb	parts per billion
s	second
SIP	State Implementation Plan
SO ₂	sulfur dioxide
TCEQ	Texas Commission on Environmental Quality
TPY	tons per year
TSD	Technical Support Document
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 Navarro County Attainment Demonstration State Implementation Plan (SIP) revision for the 2010 Sulfur Dioxide (SO₂) National Ambient Air Quality Standard (NAAQS). As part of this attainment demonstration SIP revision, the TCEQ conducted air quality dispersion modeling in accordance with the United States Environmental Protection Agency's (EPA) *Guidance for 1-Hour SO₂ Nonattainment Area SIP Submissions* (EPA, 2014; SO₂ SIP guidance) and 40 *Code of Federal Regulations* (CFR) Part 51 Appendix W (EPA, 2017). The modeling details described in this appendix were shared with the EPA's Region 6 office in a draft modeling protocol in October 2021 and finalized after extensive subsequent discussions.

2. AIR QUALITY MODEL SELECTION

As recommended in the SO₂ SIP guidance and 40 *Code of Federal Regulations* (CFR) Part 51 Appendix W (EPA, 2017), the American Meteorological Society (AMS)/EPA Regulatory Model (AERMOD) version (v) 21112 was used for this demonstration along with the following preprocessors:

- AERMET v21112 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 (BPIP) v04274 to calculate building downwash effects.

Where applicable, regulatory default parameters were selected. For a quick reference to the settings and parameters that were used in the preprocessors, refer to Section 8: *Reference Tables for Modeling Information*.

3. STREETMAN PLANT SITE

A map of the Arcosa LWS LLC Lightweight Streetman Plant (Streetman Plant) site is shown in Figure 3-1: *Streetman Plant Site Overview*. The property boundary is visible in blue with building locations plotted with a red outline. The property boundary and building information were provided to the TCEQ by the owner of the Streetman Plant, Arcosa LWS LLC (Arcosa). The Data Requirements Rule (DRR) monitor sited to monitor SO₂ concentrations near the Streetman Plant, the Richland Southeast 1220 Road monitor or Continuous Ambient Monitoring Station 1081 (C1081), is marked as a green triangle in Figure 3-1. Also shown in Figure 3-1 is the nonambient air boundary, marked with an orange dashed line, which denotes the section of the Streetman Plant property that the TCEQ considered as nonambient for this attainment demonstration.

There is a single emissions source of SO₂ at the Streetman Plant: a kiln stack for a lightweight aggregate kiln, Emission Point Number (EPN) E3-1, indicated in Figure 3-1 as a pink pin marker. As discussed in Chapter 3: *Control Strategies and Required*

Elements of the SIP narrative, EPN E3-1 will be replaced with a newly constructed stack to be built within a 20.0 m by 30.0 m area just north of the current location.



Figure 3-1: Streetman Plant Site Overview

3.1 BUILDING LAYOUT AND STACK-TIP DOWNWASH

Figure 3-2: *Streetman Plant Site Layout* shows a closer view of the buildings at the Streetman Plant in relation to EPN E3-1 and the area where the new stack will be built.

As described in Section 4.5.2: *Modeling Scenarios* in the SIP narrative, the corners and the mid-point of the rectangular area where the new stack will be built were treated as hypothetical stack locations A, B, C, D, and E for modeling (as shown in Figure 3-2). The buildings shown in Figure 3-2 were processed in BPIPFRM to calculate stack-tip downwash parameters for each of the five hypothetical stack locations. Elevation for the buildings and the five hypothetical stack locations were determined using one-third arc-second United States Geological Survey (USGS) National Elevation Data (NED). The building information needed for BPIPFRM is available in Section 7, Table 7-7: *Streetman Plant Building Parameters*.



Figure 3-2: Streetman Plant Site Layout

4. NEARBY SOURCES

4.1 GUARDIAN INDUSTRIES

Per 40 CFR Part 51 Appendix W Section 8.3.3(b), all sources which cause a significant concentration gradient in the vicinity of the source under consideration should be modeled explicitly. Guardian Industries (Guardian) is the only site with SO₂ emissions greater than 100 tons per year (TPY) within 50 kilometers (km) of the Streetman Plant (average annual emissions of 274 TPY between 2017 and 2020). Guardian is located approximately 18 km to the north-northwest of the Streetman Plant. In SO₂ nonattainment area designation modeling, the TCEQ showed that SO₂ concentrations from Guardian are localized in the area directly surrounding the Guardian facility, with an average high-first-high concentration less than 1 ppb throughout the Navarro County 2010 SO₂ NAAQS nonattainment area (TCEQ, 2020). Furthermore, Appendix W Section 8.3.3(b) states that concentration gradients are generally not significant at distances greater than ten times the height of the stack without consideration of terrain influences. At Guardian, the EPN with the highest SO₂ emissions is 90.8 m tall, which would indicate that the concentration gradient would be significant out to approximately 1 km. Guardian is approximately 7 km outside the Navarro County 2010 SO₂ NAAQS nonattainment area. Therefore, Guardian is not expected to significantly impact concentrations within the nonattainment area, and its impacts have been represented in the background concentration for this demonstration rather than explicitly modeled.

4.2 BACKGROUND CONCENTRATION

For SO₂ dispersion modeling, background concentrations of SO₂ are included to represent sources that are not explicitly modeled. To characterize background concentrations for attainment demonstration modeling, the EPA recommends using data from the closest monitor upwind of the main source, in this case the Streetman Plant. There are two monitors close to the Streetman Plant: the DRR monitor co-located with the Streetman Plant, Richland Southeast 1220 Rd. (C1081); and the Corsicana Airport monitor (C1051). C1081 was specifically sited to capture the impact of the Streetman Plant on nearby SO₂ concentrations, making it unsuitable to quantify background concentration. Further, previous analysis performed for the TCEQ's SO₂ nonattainment area designation modeling showed that SO₂ concentrations at C1051 are impacted by the Streetman Plant, making C1051 unsuitable to quantify background concentration as well (TCEQ, 2020).

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 4-1: *Monitors Considered for Background Concentration* shows "regional site" monitors that were considered for background concentration and their 2016 through 2020 design values (DV) in ppb. Only monitors with valid 2020 DVs were considered. Of the monitors considered, the Midlothian Old Fort Worth (C52) monitor had the lowest variability over time. This monitor has been chosen as the representative background monitor, and the 2020 DV of 6 ppb has been added as the background concentration to all modeling runs.

Table 4-1: Monitors Considered for Background Concentration

Monitor Site	Site Name	County	2016 DV (ppb)	2017 DV (ppb)	2018 DV (ppb)	2019 DV (ppb)	2020 DV (ppb)
C71	Kaufman	Kaufman	11	9	9	9	8
C52	Midlothian OFW	Ellis	6	5	6	6	6
C59	Calaveras Lake	Bexar	13	12	13	11	6
C4	Corpus Christi West	Nueces	n/a	4	4	6	6

5. MODELING DOMAIN

The modeling domain used for this demonstration consisted of a 28.0 km by 30.5 km rectangular area which covers and extends slightly outside of the Navarro County 2010 SO₂ NAAQS nonattainment area (Figure 5-1: *Modeling Domain and Receptor Grid*). This modeling domain has three nested receptor grids which decrease in resolution with increased distance from the Streetman Plant. The innermost grid has receptors with 50 m spacing, is centered on EPN E3-1, and extends out in a 7.0 km by 7.0 km square from the center point (Figure 5-2: *Innermost Receptor Grid*). The middle-nested grid, also centered on EPN E3-1, extends from 7.0 km to 14.4 km with 100 m spacing between receptors. Receptors in the outermost grid, which covers the rest of the domain, have 500 m spacing. Receptors within the portion of the Streetman Plant property considered as nonambient air were removed from the grid, and receptors were added with 25 m spacing along the nonambient air boundary. An additional receptor was placed at the location of the DRR monitor, C1082. Receptor elevations were determined using AERMAP with one-third arc-second USGS NED files covering the extent of the modeling domain.

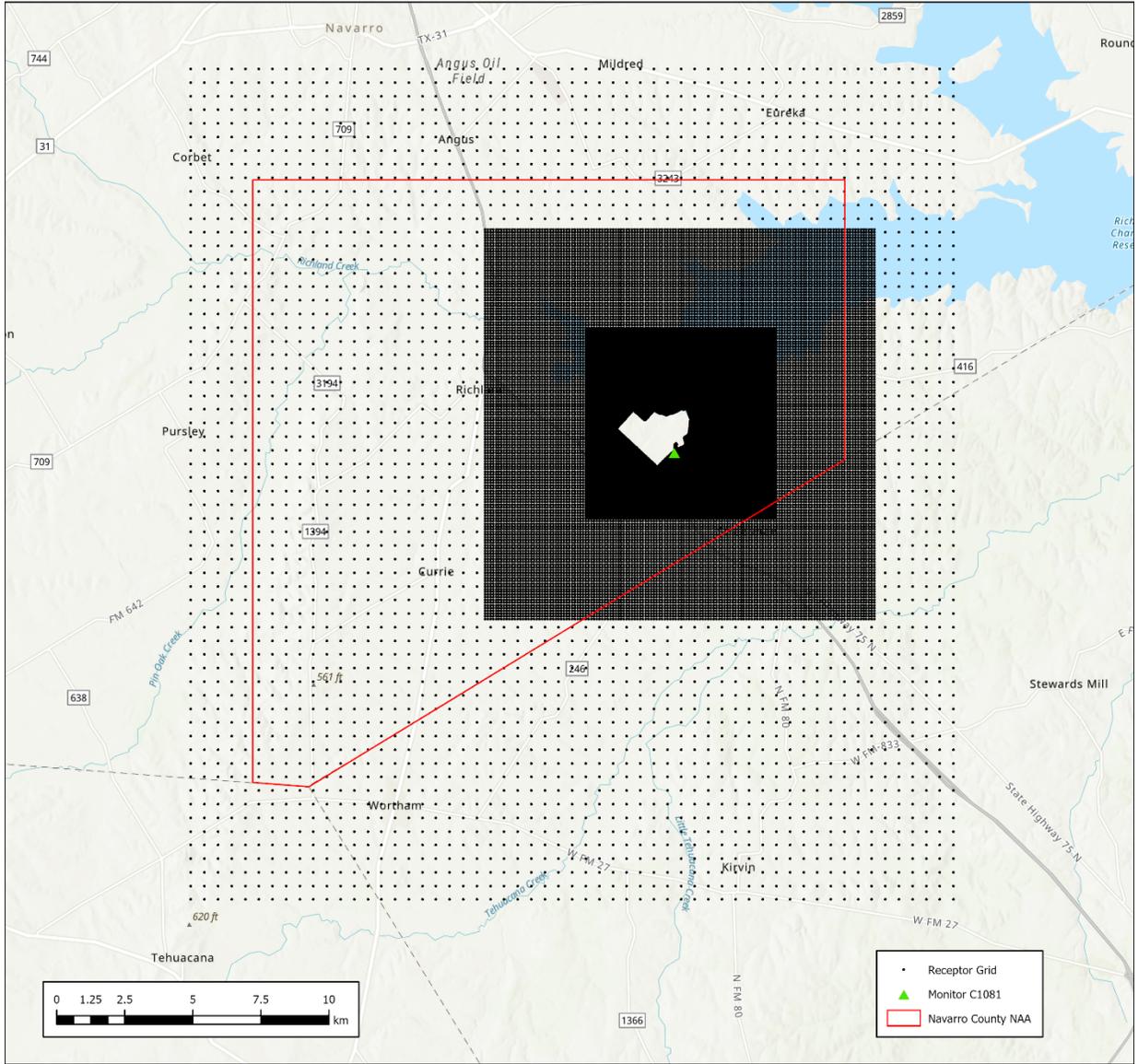


Figure 5-1: Modeling Domain and Receptor Grid



Figure 5-2: Innermost Receptor Grid

6. METEOROLOGY

6.1 AERMET

Following 40 CFR Part 51 Appendix W §8.4, five recent years of meteorological data were processed using the AERMOD preprocessors AERMET, AERMINUTE, and AERSURFACE. The closest surface station to the Streetman Plant was the Corsicana Campbell Field station at the Corsicana Municipal Airport (Weather Bureau Army Navy [WBAN] 53912), and the closest upper air station was the Shreveport, Louisiana station (WBAN 13957). At the surface station, the fourth quarter of 2018 did not meet the EPA's meteorological data completeness requirements for regulatory dispersion modeling for wind speed and wind direction, as there were greater than 10% of hours missing (EPA, 2000). While consecutive years of recent meteorological data are preferable for AERMET, the TCEQ determined through consultation with the EPA's Region 6 office that using the complete year of data from 2015 instead of 2018 was the most appropriate solution to adequately capture the meteorological variability near the Streetman Plant. Data from 2021 was not available at the time that modeling was conducted. Therefore, the five years of meteorological data were from the years 2015, 2016, 2017, 2019, and 2020, excluding 2018. Data completeness is presented for the surface station in Table 6-1: *Surface Station Data Percent Completeness*, and for the upper air station in Table 6-2: *Upper Air Data Completeness*. Sub-hourly one-minute Automated Surface Observing System (ASOS) wind data from the surface station has been 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.

Table 6-1: Surface Station Data Percent Completeness

Year	Temperature (%)	Wind Direction (%)	Wind Speed (%)	Acceptable
2015	99.9	97.1	99.1	Yes
2016	99.9	97.4	99.0	Yes
2017	97.2	95.7	97.3	Yes
2019	100.0	98.2	99.8	Yes
2020	99.4	97.6	99.2	Yes

Table 6-2: Upper Air Data Completeness

Year	Number of Valid Soundings	Acceptable
2015	738	Yes
2016	743	Yes
2017	758	Yes
2019	775	Yes
2020	779	Yes

6.2 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, the TCEQ used 2016 National Land Cover Data (NLCD) 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.”

6.2.1 WETNESS CLASSIFICATION

Following the recommendations in the EPA’s AERSURFACE v20060 User Guide, relative wetness classifications of dry, wet, or average were determined based on 30 years of local precipitation data. The surface station does not have 30 years of annual precipitation data, so the percentiles have been calculated using an average of the available data between 1991-2020 from the National Climatic Data Center (NCDC)¹ for nine stations in Navarro County including the surface station. The year was classified as wet if the annual precipitation was in the top 70th percentile (48.0 inches), dry if precipitation was in the bottom 30th percentile (35.4 inches), and average if precipitation was between those values. Table 6-3: *AERSURFACE Wetness Classifications* shows the yearly classifications, and the full 30 years of data can be found in Section 7, Table 7-8: *Wetness Classification Precipitation Data*.

Table 6-3: AERSURFACE Wetness Classifications

Year	Average Precipitation (inches)	Classification
2015	79.7	Wet
2016	48.1	Wet
2017	39.5	Average
2019	34.8	Dry
2020	50.0	Wet

6.2.2 SEASONAL CLASSIFICATION

AERSURFACE determines the land surface characteristics by five seasonal classifications, 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 6-4: *AERSURFACE Seasonal Classifications*.

Table 6-4: AERSURFACE Seasonal Classifications

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

¹ <https://www.ncdc.noaa.gov/cdo-web/search>

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." For this demonstration, the TCEQ followed a method for seasonal designations described by the Mississippi Department of Environmental Quality (Ferguson, 2017). This method uses frost-freeze occurrence data to determine the beginning and end of the winter, and monthly normal temperature to designate months into the other seasons. From the frost-freeze occurrence data, the month which contains the 50% probability fall freeze date is determined to be the beginning of winter. Likewise, the month which contains the 50% probability spring freeze date is determined to be the end of winter (a.k.a. the beginning of spring). Using the temperature data, any months with monthly normal temperatures above 70°F are considered summer. The months between the end of winter and beginning of summer are classified as spring, and the months between the end of summer and beginning of winter are classified as autumn.

To designate months based on the above method, the TCEQ used monthly normal temperature data and frost-freeze occurrence data at the surface station from 1981 to 2010 from the NCDC.^{2,3,4} As a result, May and September were assigned to the summer season, and all other months were kept as their default assignment.

7. MODELING RUN INFORMATION AND ARCHIVE

The TCEQ ran AERMOD and the AERMOD preprocessors on the TCEQ's Linux computing cluster. To minimize AERMOD simulation time, the set of modeling receptors was split into smaller groups of receptors and AERMOD was run multiple times with only a subset of receptors in each run. This approach allowed for multiple AERMOD runs to be performed at the same time on different computational nodes, shortening simulation time up to 90%. The modeling results from each run holding data for subsets of receptors were then concatenated into a single file. A run script was prepared to handle the process of spitting receptors and concatenating the results into a single file.

Because there were two contiguous periods of meteorology used in AERMOD to model the Streetman Plant, a shell script was prepared to calculate the weighted-average DV from the 2015-2017 DV and the two-year 2019-2020 DV at each receptor.

The TCEQ has archived all modeling input, output, and processing files used or generated as part of this attainment demonstration SIP revision modeling analysis. Interested parties can contact the TCEQ for information regarding data access or documentation. Most modeling files may be accessed from the TCEQ Air Modeling FTP site using an FTP client software and the following information:

- FTP address: [amdaftp.tceq.texas.gov](ftp://amdaftp.tceq.texas.gov)

² <https://www1.ncdc.noaa.gov/pub/data/normals/1981-2010/products/station/USW00053912.normals.txt>

³ <https://www1.ncdc.noaa.gov/pub/data/normals/1981-2010/supplemental/products/agricultural/ann-tmin-prbfst-t28Fp50.txt>

⁴ <https://www1.ncdc.noaa.gov/pub/data/normals/1981-2010/supplemental/products/agricultural/ann-tmin-prblst-t28Fp50.txt>

- FTP directory: /SO2/Navarro/AERMOD
- User ID: anonymous
- Password: user's email address

8. REFERENCE TABLES FOR MODELING INFORMATION

Table 8-1: Model Versions Used

Module	Version
AERMOD	v21112
AERMET	v21112
AERMINUTE	v15272
AERSURFACE	v20060
AERMAP	v18081
BPIPPRM	v04274

Table 8-2: AERMET Surface Station Information

Parameter	Value
Surface Station Used	Corsicana Campbell Field
Latitude/Longitude	32.031, -96.399
Station ID	WBAN 53912
Is this the ASOS station?	Yes
Hour Adjustment to Local Time	+6
Anemometer Height	10 m
Was ADJ_U* used?	Yes

Table 8-3: AERMET Upper Air Station Information

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

Table 8-4: AERMINUTE One-Minute and Five-Minute ASOS Wind Data

Parameter	Value
Was AERMINUTE data used?	Yes
Surface Station Used	Corsicana Campbell Field
Latitude/Longitude	32.031, -96.399
Station ID (WBAN)	WBAN 53912
Station Code	CRS
IFW Installation Date	No
Was the 0.5 m/s wind threshold used?	Yes

Table 8-5: AERSURFACE Settings and Parameters

Parameter	Value
Surface Station Used	Corsicana Campbell Field
Latitude/Longitude	32.031, -96.399
Land Use Data Used	NLCD 2016, Tree Canopy 2016, Impervious Service 2016
Was canopy data used?	Yes
Was impervious cover data used?	Yes
Datum	Albers Conical Equal Area NAD83
Radius of Surface Roughness	1 km
Number of Wind Sectors	12 sectors
Period	Monthly
Surface Moisture	2015: Wet 2016: Wet 2017: Average 2019: Dry 2020: Wet
Months with Non-Default Season Definition	May - Summer September - 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 8-6: AERMAP Settings and Parameters

Parameter	Value
NED n32w097.tif and n33w097.tif	NED n32w097.tif and n33w097.tif
SW corner: 31.7, -96.6 NE corner: 32.1, -96.1	SW corner: 31.7, -96.6 NE corner: 32.1, -96.1
0.0 / 0.0	0.0 / 0.0
Zone 14	Zone 14
North American Datum of 1983	North American Datum of 1983

Table 8-7: Streetman Plant Building Parameters

Building ID	Tier	Elevation (m)	Tier Height (m)	X1 UTM (Universal Transverse Mercator) Easting (m)	Y1 UTM Northing (m)	X2 UTM Easting (m)	Y2 UTM Northing (m)	X3 UTM Easting (m)	Y3 UTM Northing (m)	X4 UTM Easting (m)	Y4 UTM Northing (m)
COALBLDG	1	104	15.1	750750.5	3533938.4	750729.6	3533939.9	750730.6	3533954.8	750751.5	3533953.3
COOLBLDG	1	104	15.9	750749.5	3533924.6	750728.6	3533926.1	750729.5	3533939.9	750750.5	3533938.5
MAINTSHP	1	104	7.9	750716.6	3533875.1	750686.7	3533877.2	750688.1	3533897.1	750718.0	3533895.1
RAWFEED	1	107	7.6	750407.8	3533861.6	750394.8	3533888.2	750440.1	3533910.3	750453.1	3533883.7
RAWFEED	2	N/A	22.9	750398.1	3533881.4	750443.4	3533903.5	750449.7	3533890.5	750404.5	3533868.4
RAWSHLE	1	105	7.6	750466.1	3533633.9	750436.5	3533636.0	750443.0	3533730.6	750472.7	3533728.5
RAWSHLE	2	N/A	22.9	750450.8	3533729.7	750465.6	3533728.7	750459.2	3533634.1	750444.4	3533635.1
CTRLROOM	1	104	7.3	750724.3	3533946.7	750712.3	3533947.5	750713.0	3533956.5	750724.9	3533955.7
COALSTRG	1	102	9.1	750814.2	3533895.0	750782.3	3533897.2	750784.5	3533929.1	750816.4	3533926.9
COALBLDG	1	104	15.1	750750.5	3533938.4	750729.6	3533939.9	750730.6	3533954.8	750751.5	3533953.3

Table 8-8: Wetness Classification Precipitation Data

Year	Frost, TX ¹	Corsicana Campbell Field ²	Corsicana, TX ³	Navarro Mills Dam ⁴	Kerens 3.4 NW ⁵	Powell 1.0 SW ⁶	Corsicana 8 E ⁷	Blooming Grove 2.4 SW ⁸	Corsicana 4.3 WSW ⁹	Average Precip. (inches)	AERSURFACE Classification
1991			48.3	54.2						51.2	
1992			46.0	49.8			43.3			46.4	
1993			40.3	39.6			40.9			40.3	
1994							44.7			44.7	
1995			35.3	36.3			35.4			35.7	
1996			33.6	30.6			30.8			31.7	
1997			51.8	40.8			53.7			48.7	
1998			49.9	46.0			55.1			50.3	
1999		19.9	26.8	25.1			22.2			23.5	
2000		50.1	43.9	47.3			50.5			47.9	

Year	Frost, TX ¹	Corsicana Campbell Field ²	Corsicana, TX ³	Navarro Mills Dam ⁴	Kerens 3.4 NW ⁵	Powell 1.0 SW ⁶	Corsicana 8 E ⁷	Blooming Grove 2.4 SW ⁸	Corsicana 4.3 WSW ⁹	Average Precip. (inches)	AERSURFACE Classification
2001		41.8	42.7	40.3			41.4			41.6	
2002		35.9	38.0	38.4			44.1			39.1	
2003		26.4	28.5				30.5			28.5	
2004		45.6	50.7	46.9			53.7			49.2	
2005		21.7	24.7	25.2			23.2			23.7	
2006		29.0	28.8	28.9			33.5			30.0	
2007		54.0	49.0	58.4			59.9			55.3	
2008		30.2	34.8	30.2						31.7	
2009	43.4	36.6		41.0	53.6					43.6	
2010	38.3				32.3	37.8				36.2	
2011	24.8	32.0	38.0			38.3				33.3	
2012	32.2	33.6	40.0	34.5	38.6	39.6		33.4		36.0	
2013	37.3	39.6	36.9			41.5		36.6		38.4	
2014	23.6	29.1	35.4			31.2				29.8	
2015		77.8	79.8	76.0	84.8	88.9		70.9		79.7	Wet
2016		47.2	49.7	43.2	47.3	51.4		49.8		48.1	Wet
2017		35.8	41.5	35.3	41.3	47.0		36.5		39.5	Average
2018		41.6	49.8	50.2	57.2	56.8			47.8	50.6	
2019		28.9	37.5		35.2	38.2			34.4	34.9	Dry
2020		39.7	54.9		56.2	55.0		43.2	51.1	50.0	Wet

¹ Global Historical Climatology Network Daily (GHCND) site ID: US1TXNV0001

² GHCND site ID: USW00053912

³ GHCND site ID: USC00412019

⁴ GHCND site ID: USC00416210

⁵ GHCND site ID: US1TXNV0003

⁶ GHCND site ID: US1TXNV0004

⁷ GHCND site ID: USC00412020

⁸ GHCND site ID: US1TXNV0005

⁹ GHCND SITE ID: US1TXNV0006

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