APPENDIX K

MODELING TECHNICAL SUPPORT DOCUMENT (TSD)

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

2021-010-SIP-NR
SFR-122/2021-010-SIP-NR

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LIST OF ACRONYMS

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
C	Cap
CAMS	Continuous Air Monitoring System
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
g	gram
FR	Federal Register
GHCND	Global Historical Climatology Network Daily
hr	hour
km	kilometer
lb	pound
µ	micro
m	meter
m^3	cubic meter
MSS	Maintenance Startup and Shutdown
MC	Monte Carlo
NAA	Nonattainment Area
NAAQS	National Ambient Air Quality Standard
NCDC	National Climatic Data Center
NED	National Elevation Data
NLCD	National Land Cover Data
NSR	New Source Review
ppb	parts per billion
s	second

SIP	State Implementation Plan
SO_2	sulfur dioxide
Temp	Temperature
TCEQ	Texas Commission on Environmental Quality
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 dispersion modeling conducted by the Texas Commission on Environmental Quality (TCEQ) to support the Howard County Attainment Demonstration State Implementation Plan (SIP) revision for the 2010 Sulfur Dioxide (SO_2) National Ambient Air Quality Standard (NAAQS). For this attainment demonstration modeling, the TCEQ contracted with Ramboll US Corporation (Ramboll) to develop a stochastic process for use in this attainment demonstration SIP modeling (hereafter referred to as the Monte Carlo (MC) approach) for several emissions sources that emit SO_2 intermittently and non-deterministically. Monte Carlo methods are statistical simulation techniques that involve randomly sampling from dependent or independent data sets and combining them to determine the range of possible outcomes. Details of the MC approach are provided in Appendix L: *Howard County Monte Carlo Simulations*.

The MC approach used 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) along with the application of Monte Carlo statistical technique. The modeling details described in this appendix were shared with the EPA's Region 6 office during frequent discussions. While details of the MC approach are in Appendix L, this appendix provides details of the dispersion modeling as well as the results of the various scenarios modeled.

2. AIR QUALITY MODEL SELECTION

As recommended in the EPA's *Guidance for 1-Hour SO_2 Nonattainment Area SIP Submissions* (EPA, 2014) 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 have been 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 (BPIPPRM) v04274 to calculate building downwash effects.

Where applicable, regulatory default parameters have been used. 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. EMISSIONS SOURCES AND PARAMETERS

The Howard County 2010 SO_2 NAAQS nonattainment area (NAA) includes a portion of Howard County (see Figure 3-1: *Overview of the Howard County 2010 SO_2 NAA*). The Tokai Carbon CB LTD's Tokai Big Spring Carbon Black Plant (Tokai Big Spring Carbon

Black Plant), the Alon USA GP INC Alon USA Big Spring Refinery (Alon USA Big Spring Refinery), and BHER Power Resources' Inc C R Wing Cogeneration (BHER C R Wing Cogeneration Plant) are three sources of SO_2 emissions within the Howard County nonattainment area (Figure 3-1). A Data Requirements Rule (DRR) monitor, the Big Spring Midway monitor, or Continuous Ambient Monitoring Station 1072 (C1072) was sited across North Midway Road approximately 0.15 kilometer (km) to the northeast of the Tokai Big Spring Carbon Plant to monitor SO_2 concentrations (shown as a green triangle in Figure 3-1).

3.1 TOKAI BIG SPRING CARBON BLACK PLANT

A map of the Tokai Big Spring Carbon Black Plant site is shown in Figure 3-2: *Tokai Big Spring Carbon Black Plant Site Overview and Buildings*. The modeled site boundary is visible in yellow with building locations plotted with a red outline. The modeled site boundary and building information were provided to the TCEQ by Tokai Big Spring Carbon Black Plant and verified by both TCEQ and the EPA. There are multiple sources of SO_2 at the Tokai Big Spring Carbon Black Plant indicated in Figure 3-2- as pink dots. The final source parameters for all stack sources and buildings were processed in BPIPPRM to determine the effective stack height for modeling and to calculate stack-tip downwash parameters. A closer view of the buildings included in BPIPPRM is shown in Figure 3-2, and details of the building parameters, such as height and elevation, are available in Section 8, Table 8-7: *Howard County Plant Building Parameters*. The elevation of stacks has been calculated using AERMAP with United States Geological Survey (USGS) National Elevation Data (NED).

3.1.1 Tokai Big Spring Carbon Black Plant Sources

SO_2 emissions and stack parameters for sources at Tokai Big Spring Carbon Black Plant are based on information provided by the company and available in permit files. The Tokai Big Spring Carbon Black Plant sources and corresponding stack parameters included in the TCEQ's modeling are shown in Table 3-1: *Tokai Big Spring Carbon Black Plant Source Parameters*. Source location is in Universal Transverse Mercator (UTM) in meters (m), temperature (temp.) is in degrees Fahrenheit (°F), velocity is in meters per second (m/s), and the maximum modeled emission rate is in pounds per hour (lb/hr).

Tokai Big Spring Carbon Black Plant has six emissions sources modeled as point sources in two different modes of operation: routine, and planned Maintenance Startup and Shutdown (MSS). Of the six emissions sources, four emissions sources, Incinerator and Heat Recovery Steam Generator (EPN 13A), the flare (EPN FLARE 4), and two dryer stacks (EPN 7A and EPN 12A), have an emissions cap. The combined SO_2 emissions from the four sources, designated as cap (C) in Table 3-1: *Tokai Big Spring Carbon Black Plant Source Parameters* are limited to a total of 1,355 lb/hr when all sources are operating. Due to the facility's consent decree with the EPA, Tokai Big Spring Carbon Black Plant is prohibited from operating EPN 13A and EPN FLARE 4 simultaneously. When EPN FLARE 4 is operated, its enforceable emissions rates are equal to EPN 13A emissions. As a result of the cap, a total of 192 scenarios were modeled taking into consideration variations in the operating load (when one or more of the dryers are not operational) and mode (routine vs. MSS) to ensure that the emission rates demonstrate attainment under differing operating conditions. The different scenarios are shown in Table 3-2: *Tokai Big Spring Carbon Black Plant Emissions Rate for Varying Load and Cap Scenarios*. In response to the EPA's comment that there is a difference of 1 lb/hr between modeled emission rates and emission limits specified in the rule in the sum of emission rates for EPN 7A and EPN 12A, the emission rates were updated on table 3-2. Stack and flare parameters vary according to the load and cap scenarios. The varying stack parameters for stacks EPN 7A, EPN 12A, and EPN 13A, and EPN Flare 4 can be found in an Excel spreadsheet ("Tokai_cap_load_scenario_model_inputs.xlsx") associated with Appendix L: *Howard County Monte Carlo Simulations*.

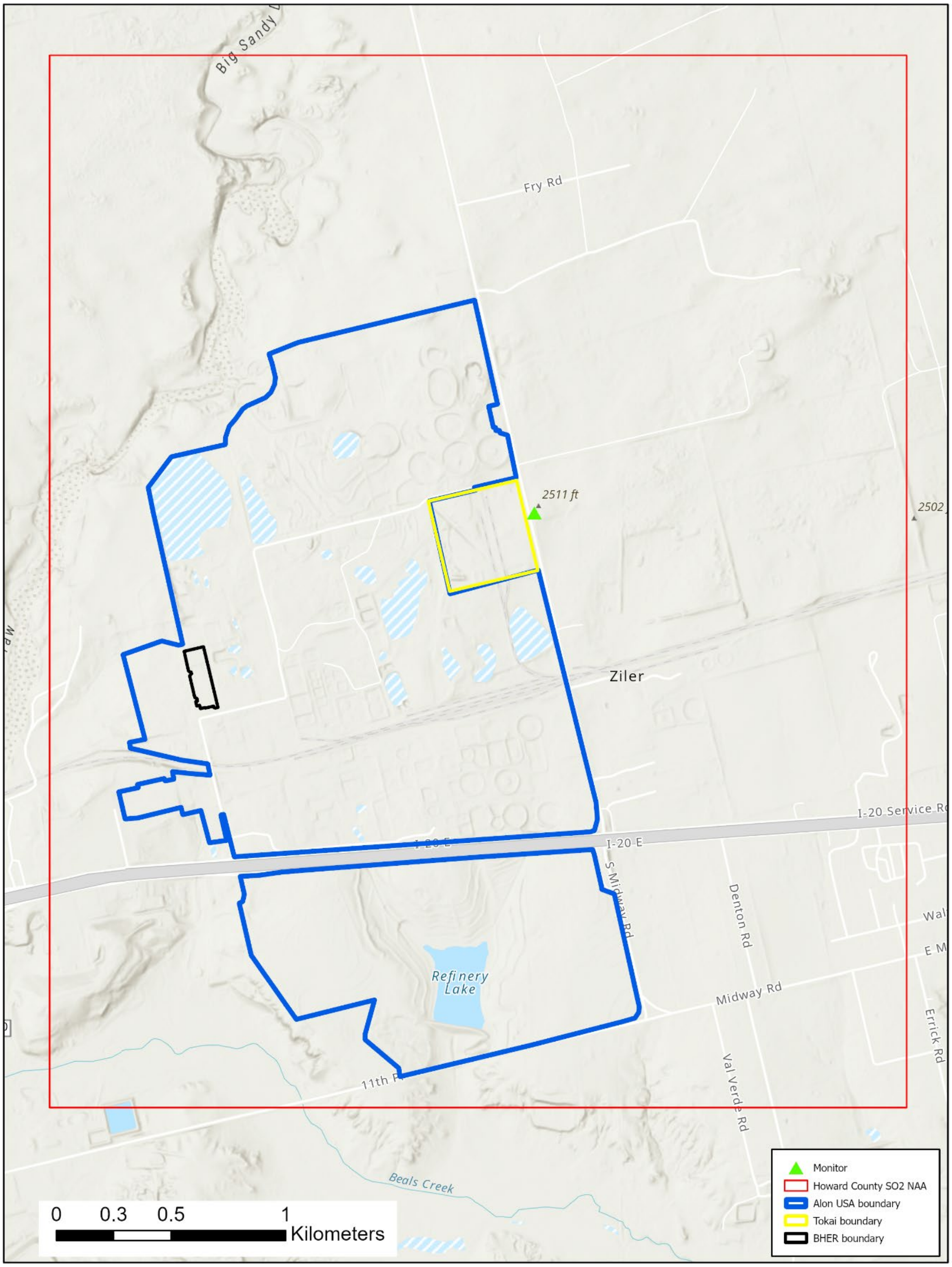

Figure 3-1: Overview of the Howard County 2010 SO_2 NAAQS NAA

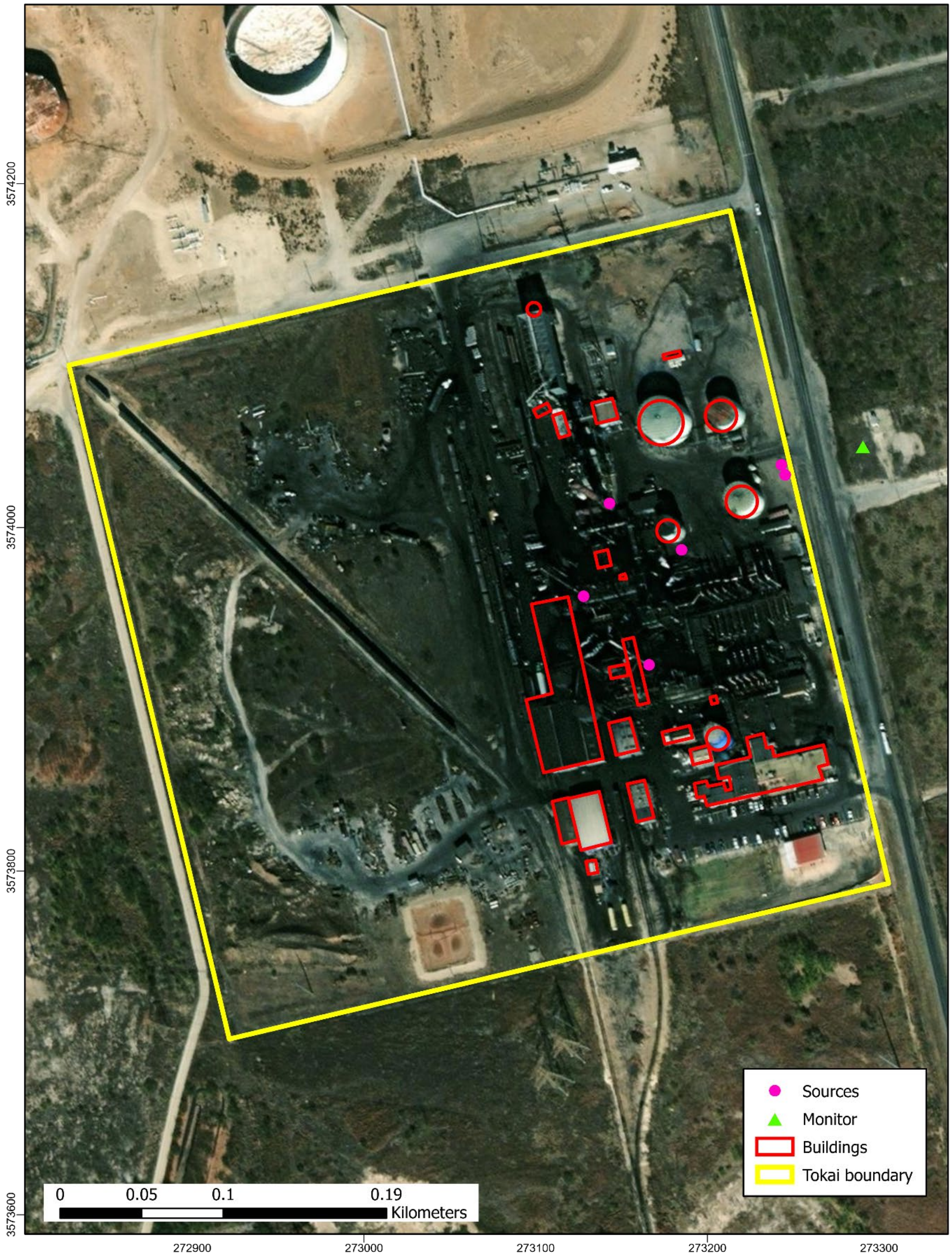

Figure 3-2: Tokai Big Spring Carbon Black Plant Site Overview and Buildings

Table 3-1: Tokai Big Spring Carbon Black Plant Source Parameters

EPN	Type	UTM Easting (X; m)	UTM Northing (Y; m)	Height (m)	Diameter (m)	Temp. (˚F)	Velocity (m/s)	Emission Rate (lb/hr)
14	Stack	273245	3574030	4.57	0.30	300.00	0.43	<0.01
15	Stack	273243	3574036	4.57	0.30	300.00	0.18	<0.01
12A	Stack	273128	3573960	60.35	1.43	600.00	20.51	C
7A	Stack	273166	3573920	60.35	1.67	600.00	22.46	C
13A	Stack	273143	3574014	65.00	3.96	650.00	11.49	C
FLARE 4	Flare	273185	3573987	60.35	3.65	1831.73	20.00	C

Table 3-2: Tokai Big Spring Carbon Black Plant Emissions Rate for Varying Load and Cap Scenarios

Operating Mode	Load Scenario	Cap Scenario	Emission Rate for 7A (lb/hr)	Emission Rate for 12A (lb/hr)	Emission Rate for 13A/FLARE4 (lb/hr)
Routine	1	A	0	73	348
Routine	1	B	66	0	348
Routine	1	C	124	0	290
Routine	1	D	51	73	290
Routine	2	A	0	110	433
Routine	2	B	83	0	433
Routine	2	C	155	0	361
Routine	2	D	45	110	361
Routine	3	A	0	146	519
Routine	3	B	99	0	519
Routine	3	C	185	0	432
Routine	3	D	39	146	432
Routine	4	A	10	73	436
Routine	4	B	83	0	436
Routine	4	C	156	0	364
Routine	4	D	83	73	364
Routine	5	A	0	110	522
Routine	5	B	99	0	522
Routine	5	C	187	0	435
Routine	5	D	77	110	435
Routine	6	A	0	146	607
Routine	6	B	116	0	607
Routine	6	C	217	0	506
Routine	6	D	71	146	506
Routine	7	A	27	73	525
Routine	7	B	100	0	525
Routine	7	C	188	0	437
Routine	7	D	115	73	437
Routine	8	A	6	110	610
Routine	8	B	116	0	610

Operating Mode	Load Scenario	Cap Scenario	Emission Rate for 7A (lb/hr)	Emission Rate for 12A (lb/hr)	Emission Rate for 13A/FLARE4 (lb/hr)
Routine	8	C	218	0	509
Routine	8	D	108	110	509
Routine	9	A	0	146	695
Routine	9	B	132	0	695
Routine	9	C	248	0	580
Routine	9	D	102	146	580
Routine	10	A	44	73	613
Routine	10	B	117	0	613
Routine	10	C	219	0	511
Routine	10	D	146	73	511
Routine	11	A	23	110	699
Routine	11	B	133	0	699
Routine	11	C	250	0	582
Routine	11	D	140	110	582
Routine	12	A	3	146	784
Routine	12	B	149	0	784
Routine	12	C	280	0	653
Routine	12	D	134	146	653
Routine	13	A	61	73	702
Routine	13	B	134	0	702
Routine	13	C	251	0	585
Routine	13	D	178	73	585
Routine	14	A	40	110	787
Routine	14	B	150	0	787
Routine	14	C	282	0	656
Routine	14	D	171	110	656
Routine	15	A	20	146	873
Routine	15	B	166	0	873
Routine	15	C	312	0	727
Routine	15	D	166	146	727
Routine	16	A	78	73	790
Routine	16	B	151	0	790
Routine	16	C	283	0	659
Routine	16	D	209	73	659
Routine	17	A	57	110	876
Routine	17	B	167	0	876
Routine	17	C	313	0	730
Routine	17	D	203	110	730
Routine	18	A	37	146	961
Routine	18	B	183	0	961
Routine	18	C	344	0	801
Routine	18	D	197	146	801
Routine	19	A	94	73	879

Operating Mode	Load Scenario	Cap Scenario	Emission Rate for 7A (lb/hr)	Emission Rate for 12A (lb/hr)	Emission Rate for 13A/FLARE4 (lb/hr)
Routine	19	B	167	0	879
Routine	19	C	314	0	732
Routine	19	D	241	73	732
Routine	20	A	74	110	964
Routine	20	B	184	0	964
Routine	20	C	345	0	804
Routine	20	D	235	110	804
Routine	21	A	55	146	1049
Routine	21	B	201	0	1049
Routine	21	C	375	0	875
Routine	21	D	229	146	875
Routine	22	A	112	73	967
Routine	22	B	185	0	967
Routine	22	C	346	0	806
Routine	22	D	273	73	806
Routine	23	A	91	110	1053
Routine	23	B	201	0	1053
Routine	23	C	376	0	877
Routine	23	D	266	110	877
Routine	24	A	71	146	1138
Routine	24	B	217	0	1138
Routine	24	C	407	0	948
Routine	24	D	261	146	948
MSS	1	A	0	73	348
MSS	1	B	66	0	348
MSS	1	C	124	0	290
MSS	1	D	51	73	290
MSS	2	A	0	110	433
MSS	2	B	83	0	433
MSS	2	C	155	0	361
MSS	2	D	45	110	361
MSS	3	A	0	146	519
MSS	3	B	99	0	519
MSS	3	C	185	0	432
MSS	3	D	39	146	432
MSS	4	A	10	73	436
MSS	4	B	83	0	436
MSS	4	C	156	0	364
MSS	4	D	83	73	364
MSS	5	A	0	110	522
MSS	5	B	99	0	522
MSS	5	C	187	0	435
MSS	5	D	77	110	435

Operating Mode	Load Scenario	Cap Scenario	Emission Rate for 7A (lb/hr)	Emission Rate for 12A (lb/hr)	Emission Rate for 13A/FLARE4 (lb/hr)
MSS	6	A	0	146	607
MSS	6	B	116	0	607
MSS	6	C	217	0	506
MSS	6	D	71	146	506
MSS	7	A	27	73	525
MSS	7	B	100	0	525
MSS	7	C	188	0	437
MSS	7	D	115	73	437
MSS	8	A	6	110	610
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MSS	9	C	248	0	580
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MSS	11	C	250	0	582
MSS	11	D	140	110	582
MSS	12	A	3	146	784
MSS	12	B	149	0	784
MSS	12	C	280	0	653
MSS	12	D	134	146	653
MSS	13	A	61	73	702
MSS	13	B	134	0	702
MSS	13	C	251	0	585
MSS	13	D	178	73	585
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MSS	14	B	150	0	787
MSS	14	C	282	0	656
MSS	14	D	171	110	656
MSS	15	A	20	146	873
MSS	15	B	166	0	873
MSS	15	C	312	0	727
MSS	15	D	166	146	727
MSS	16	A	78	73	790
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MSS	16	C	283	0	659

Operating Mode	Load Scenario	Cap Scenario	Emission Rate for 7A (lb/hr)	Emission Rate for 12A (lb/hr)	Emission Rate for 13A/FLARE4 (lb/hr)
MSS	16	D	209	73	659
MSS	17	A	57	110	876
MSS	17	B	167	0	876
MSS	17	C	313	0	730
MSS	17	D	203	110	730
MSS	18	A	37	146	961
MSS	18	B	183	0	961
MSS	18	C	344	0	801
MSS	18	D	197	146	801
MSS	19	A	94	73	879
MSS	19	B	167	0	879
MSS	19	C	314	0	732
MSS	19	D	241	73	732
MSS	20	A	74	110	964
MSS	20	B	184	0	964
MSS	20	C	345	0	804
MSS	20	D	235	110	804
MSS	21	A	55	146	1049
MSS	21	B	201	0	1049
MSS	21	C	375	0	875
MSS	21	D	229	146	875
MSS	22	A	112	73	967
MSS	22	B	185	0	967
MSS	22	C	346	0	806
MSS	22	D	273	73	806
MSS	23	A	91	110	1053
MSS	23	B	201	0	1053
MSS	23	C	376	0	877
MSS	23	D	266	110	877
MSS	24	A	71	146	1138
MSS	24	B	217	0	1138
MSS	24	C	407	0	948
MSS	24	D	261	146	948

3.2 ALON USA BIG SPRING REFINERY

A map of the Alon USA Big Spring Refinery site is shown in Figure 3-3: *Alon USA Big Spring Refinery Site Overview and Buildings*. The modeled site boundary is visible in blue with building locations plotted with a red outline. The modeled site boundary and building information were provided to the TCEQ by Alon USA Big Spring Refinery and verified by the TCEQ and the EPA. There are multiple sources of SO_2 at the Alon USA Big Spring Refinery site, indicated in Figure 3-3 marked as pink dots.

The final source parameters for all stack sources and buildings were processed in BPIPPRM to determine the effective stack height for modeling and to calculate stack-tip downwash parameters. A closer view of the buildings included in BPIPPRM is shown in Figure 3-3 and details of the building parameters, such as height and elevation, are available in Section 8, Table 8-7: *Howard County Plant Building Parameters*. The elevation of stacks has been calculated using AERMAP with United States Geological Survey (USGS) National Elevation Data (NED).

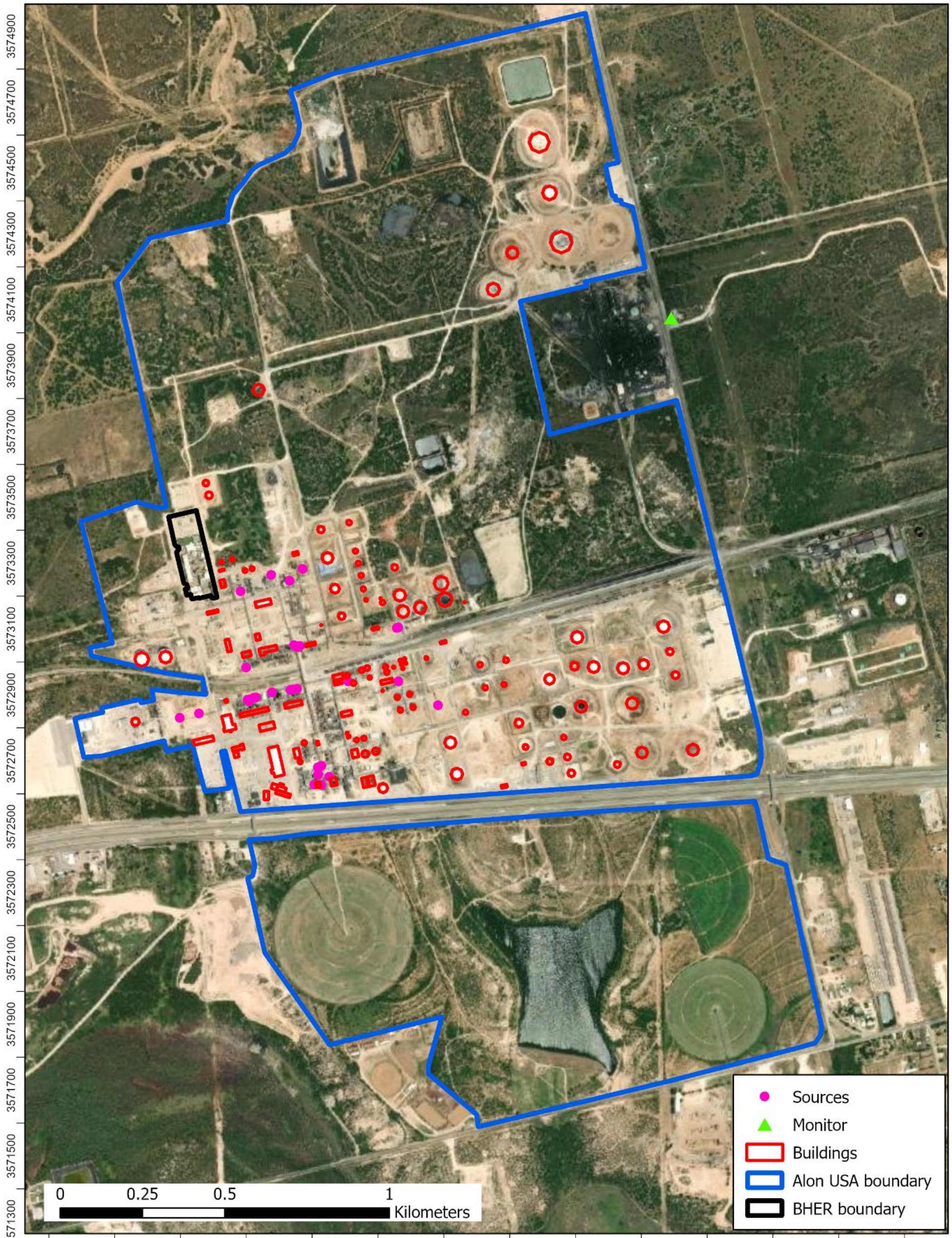


Figure 3-3: Alon USA Big Spring Refinery Site

3.2.1 Alon USA Big Spring Refinery Sources

Alon USA Big Spring Refinery SO_2 emissions and stack parameters are currently permitted under New Source Review (NSR) permit number 51A, 20487, 20628, 21392, 36845, 49154, 50209, 53425, 73323, and 80833.

Stack parameters in these NSR permits or supplied by the company for each emission source are used in the modeling. The current stack parameters are listed in Table 3-3: *Alon USA Big Spring Refinery Current Source Parameters in NSR Permit*. Source location is in UTM in meters, temperature is in ˚F, velocity is in m/s, and the maximum allowable emission rate is in lb/hr. The elevation of these multiple sources has been calculated using AERMAP with USGS NED.

While most sources in Alon USA Big Spring Refinery are continuous sources, there are four flares (EPN 02CRUDEFLR, EPN 14NEASTFLR, EPN 05REFMRFLR, and EPN 16SOUTHFLR) at the site that have intermittent MSS emissions. When in MSS mode, the flares have tiered emission rates as shown in Table 3-4: *Alon USA Big Spring Refinery Flare Emissions Rate and Occurrences*.

Table 3-3: Alon USA Big Spring Refinery

EPN	Type	UTM Easting (X; m)	UTM Northing (Y; m)	Height (m)	Diameter (m)	Temp. (˚F)	Velocity (m/s)	Emission Rate (lb/hr)
23AC-1HTR	Stack	272010	3572884	15.85	1.12	537.00	2.62	0.65
23KTTLE HTR	Stack	272004	3572885	10.42	0.61	500.00	0.01	0.06
02BGVC MHTR	Stack	272010	3572886	26.55	0.91	610.00	6.10	1.35
02CHRG AHTR	Stack	272023	3572891	44.35	3.05	500.00	7.62	5.71
02CHRG DHTR	Stack	272029	3572892	43.58	2.29	550.00	3.78	2.86
09CHRG HTR	Stack	272145	3573050	24.99	0.61	575.00	4.05	0.51
23GSOIL HTR	Stack	272007	3572880	15.24	0.91	447.00	2.07	0.38
26C8WS THTR	Stack	272156	3573045	16.00	0.91	450.00	1.41	0.57
15CHRG HTR	Stack	271999	3572983	22.25	0.91	615.00	0.53	0.38
37BOXA HTR	Stack	272457	3573104	3.04	0.27	800.00	3.96	0.55
37BOXB HTR	Stack	272462	3573105	3.05	0.27	800.00	3.96	0.29
04CHRG HTR	Stack	272134	3572915	44.50	0.91	530.00	1.76	0.63
06CHRG HTR	Stack	272228	3572627	22.95	1.77	395.00	2.50	1.84
80CHRG HTR	Stack	271982	3573215	32.61	0.91	350.00	12.88	1.69

EPN	Type	UTM Easting (X; m)	UTM Northing (Y; m)	Height (m)	Diameter (m)	Temp. (˚F)	Velocity (m/s)	Emission Rate (lb/hr)
25CLAY HTR	Stack	272158	3573047	13.56	0.61	77.00	4.97	0.43
69TGINC	Stack	272131	3573247	53.34	0.91	250.00	10.00	17.03
71TGINC	Stack	272075	3573264	45.72	0.46	250.00	10.00	12.78
04DEC5 HTR	Stack	272154	3572919	48.92	1.77	535.00	6.64	2.29
05DEC5 HTR	Stack	272141	3572916	43.59	1.52	405.00	5.70	1.70
77HYDG NHTR	Stack	272217	3572680	27.98	0.93	450.00	6.98	0.62
01PMAH TR	Stack	272309	3572940	7.62	0.76	200.00	9.14	0.030
37PMGT RHTR	Stack	272462	3572941	10.67	1.83	1400.00	3.66	0.29
06ESPPC V	Stack	272206	3572628	46.33	1.98	435.00	22.10	280.9
05CHRG HTR	Stack	272078	3572908	50.59	3.05	450.00	2.40	10.36
80STABL RBR	Stack	272163	3573049	18.29	0.61	600.00	13.62	0.60
24STM2 3BLR	Stack	272228	3572684	26.52	1.22	381.00	12.12	7.190
24STM2 4BLR	Stack	272252	3572652	19.81	1.83	652.00	15.73	7.46
77STRBR HTR	Stack	272219	3572659	24.66	0.94	473.00	4.88	0.44
02CRUD EFLR	Flare	271856	3572844	60.96	6.13	1831.73	20.00	51.8
14NEAS TFLR	Flare	272170	3573282	60.96	3.13	1831.73	20.00	25
37PMGT RFLR	Flare	272462	3572941	61.52	0.10	1400.00	3.66	0.16
05REFM RFLR	Flare	271798	3572830	60.96	6.42	1831.73	20.00	103.70
16SOUT HFLR	Flare	272582	3572869	60.96	9.97	1831.73	20.00	118.70

Table 3-4: Alon USA Big Spring Refinery

EPN	Emission Tier (lb/hr)	Occurrences per Year (Days)
02CRUDEFLR	750	3
02CRUDEFLR	250	14
05REFMRFLR	750	5
05REFMRFLR	250	4
14NEASTFLR	1500	2

EPN	Emission Tier (lb/hr)	Occurrences per Year (Days)
14NEASTFLR	500	6
14NEASTFLR	250	4
16SOUTHFLR	1695	2
16SOUTHFLR	500	12
16SOUTHFLR	250	4

3.3 BHER C R WING COGENERATION PLANT

A map of the BHER Big Spring Cogeneration site is shown in Figure 3-4: *BHER C R Wing Cogeneration Plant Site Overview and Buildings*. The modeled site boundary is visible in black with building locations plotted with a red outline. The modeled site boundary and building information were provided to the TCEQ by BHER C R Wing Cogeneration Plant. There are multiple sources of SO_2 at the BHER C R Wing Cogeneration Plant site indicated in Figure 3-4 as pink dots.

The modeled source parameters for all stack sources and buildings were processed in BPIPPRM to determine the effective stack height for modeling and to calculate stack-tip downwash parameters. A closer view of the buildings included in BPIPPRM is shown in Figure 3-4, and details of the building parameters, such as height and elevation, are available in Section 8, Table 8-7: *Howard County Plant Building Parameters*. The elevation of stacks has been calculated using AERMAP with USGS NED.

Figure 3-4: BHER C R Wing Big Spring Cogeneration Plant Site Overview and Buildings

3.3.1 BHER C R Wing Cogeneration Plant Sources

BHER C R Wing Cogeneration Plant SO_2 emissions and stack parameters are currently permitted under NSR permit number 17411. The stack parameters used in the modeling are listed in Table 3-5: *BHER C R Wing Cogeneration Plant Current Source Parameters*. Source location is in UTM in meters, temperature is in ˚F, velocity is in m/s, and the maximum allowable emission rate is in lb/hr. The elevation of these multiple sources has been calculated using AERMAP with USGS NED.

Table 3-5: BHER C R Wing Cogeneration Plant Current Source Parameters

EPN	Type	UTM Easting (X; m)	UTM Northing (Y; m)	Height (m)	Diameter (m)	Temp. (˚F)	Velocity (m/s)	Emission Rate (lb/hr)
E-3	Stack	271836	3573249	4.27	0.30	911.98	82.60	0.50
E-1	Stack	271866	3573280	27.43	4.27	321.72	20.99	16.4
E-2	Stack	271866	3573280	27.43	4.27	321.72	20.99	16.4
E-4	Stack	271859	3573307	27.43	4.27	999.98	20.99	0.10

4. MODELING DOMAIN AND RECEPTOR SCREENING FOR MONTE CARLO ANALYSIS

The modeling domain that covers the entire Howard County 2010 SO_2 NAAQS NAA for this demonstration consists of a 5.30 kilometer (km) by 5.30 km square area (Figure 4-1: *Modeling Domain and Receptor Grid*). This modeling domain has two nested receptor grids. The innermost grid has receptors with 50 m spacing that form a 3.95 km by 4.15 km rectangle. The outer grid has 100 m spacing between receptors.

Receptors within the BHER C R Wing Cogeneration Plant, Alon USA Big Spring Refinery, and Tokai Big Spring Carbon Black Plant property boundaries have been removed from the grid, and receptors have been added with 25 m spacing along the property lines and railroad. An additional receptor has been placed at the location of the DRR monitor, C1072. Receptor elevations were determined using AERMAP with the USGS NED file covering the extent of the modeling domain.

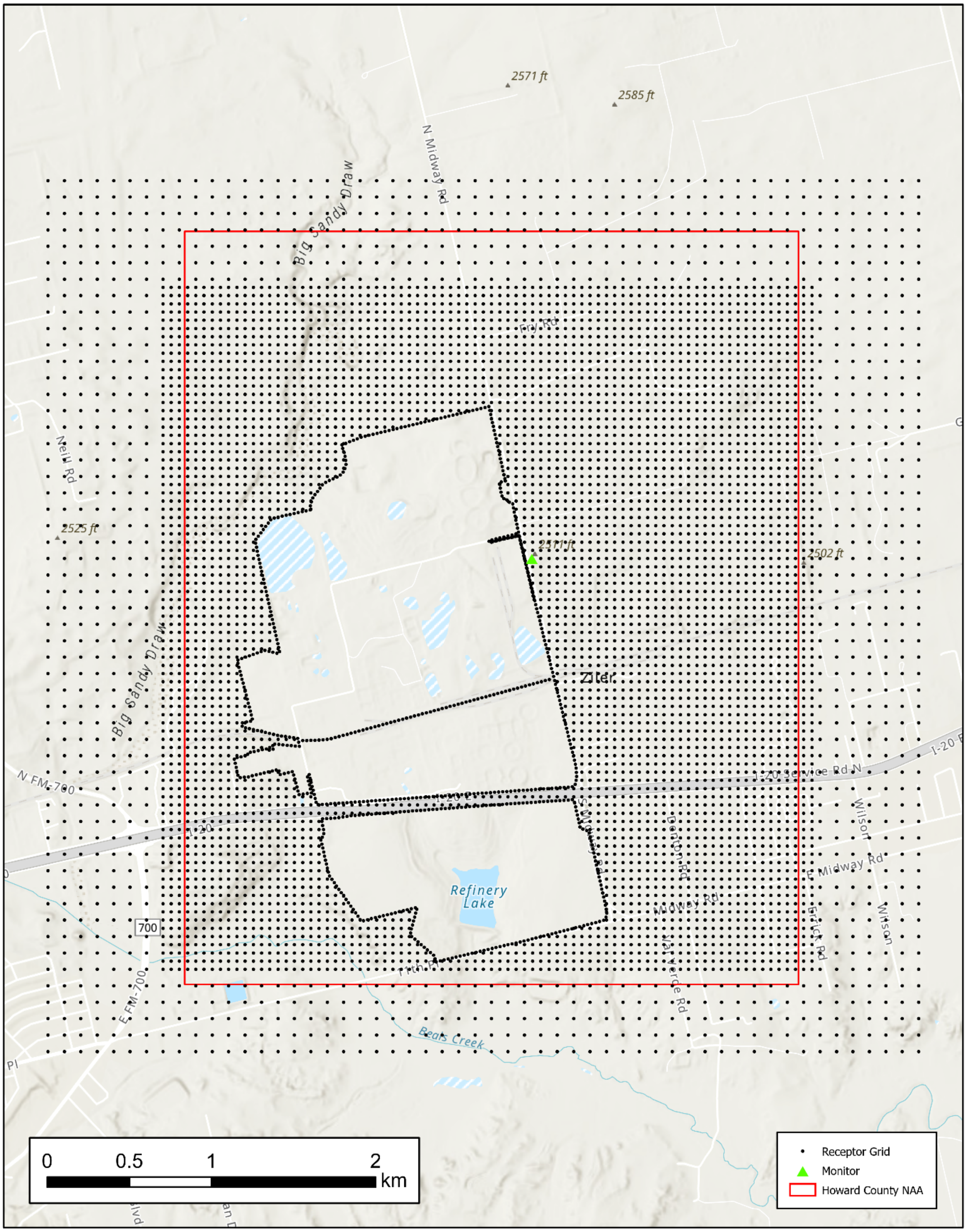


Figure 4-1: Modeling Domain and Receptor Grid

For the MC approach, in consultation with EPA Region 6 staff, the TCEQ generated the set of 648 critical receptors, as shown in Figure 4-2: *Critical Receptors for the Monte Carlo Analysis*. For detailed information on the MC analysis for Howard County Attainment Demonstration SIP Modeling, and the steps used for critical receptor selection, refer to Appendix L: *Howard County Monte Carlo Simulation*.

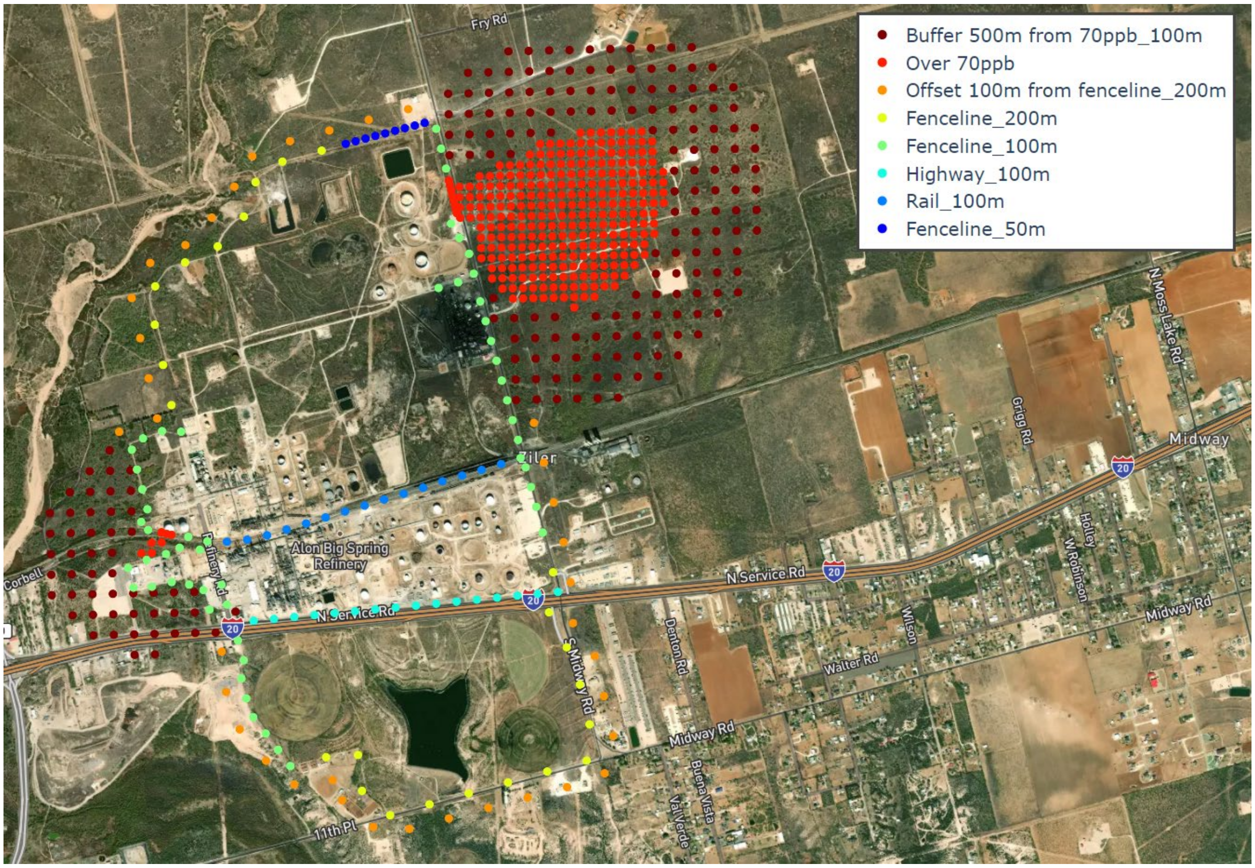


Figure 4-2: Critical Receptors for the Monte Carlo Analysis

5. METEOROLOGY

5.1 AERMET

Following 40 CFR Part 51 Appendix W §8.4, five years of meteorological data for the years 2016 through 2020 were processed using the AERMOD preprocessors AERMET, AERMINUTE, and AERSURFACE. The closest surface station to the Tokai Big Spring Carbon Black Plant is at the Midland International Airport (Midland Intl AP) (Weather Bureau Army Navy [WBAN] 23023), and the closest upper air station is also at the Midland Intl AP. 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
2016	99.6	98.1	99.7	Yes
2017	99.7	97.8	99.6	Yes
2018	99.5	97.8	99.4	Yes
2019	99.6	98.1	99.7	Yes
2020	99.6	98.0	99.6	Yes

Table 5-2: Upper Air Data Completeness

Year	Number of Valid Soundings	Acceptable
2016	722	Yes
2017	709	Yes
2018	718	Yes
2019	720	Yes
2020	735	Yes

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, 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."

5.2.1 Wetness Classification

Following the recommendations in the EPA's AERSURFACE v20060 User Guide, relative wetness classifications of dry, wet, or average have been 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 1988-2020 from the National Climatic Data Center (NCDC)[1] for five stations in Howard County. The year was classified as wet if the annual precipitation was in the top 70th percentile (20.81 inches), dry if precipitation was in the bottom 30th percentile (16.04 inches), and average if precipitation was between those values. Table 5-3: *AERSURFACE Wetness Classifications* shows the yearly classifications, and the full 30 years of data can be found in Section 8, Table 8-8: *Wetness Classification Precipitation Data*.

Table 5-3: AERSURFACE Wetness Classifications

Year	Average Precipitation (inches)	Classification
2016	30.5	Wet
2017	18.9	Average
2018	18.9	Average
2019	18.6	Average
2020	12.1	Dry

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

5.2.2 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 5-4: *Seasonal Classifications*.

Table 5-4: 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)

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.

[2] https://www1.ncdc.noaa.gov/pub/data/normals/1981-2010/products/station/USW00023023.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

6. BACKGROUND CONCENTRATION

For SO_2 dispersion modeling, background concentrations of SO_2 are included to represent sources that are not explicitly modeled. To characterize background concentrations for attainment demonstration monitoring, the EPA recommends using data from the closest monitor upwind of the main source. The monitor closest to the Tokai Big Spring Carbon Black Plant, is the Howard County monitor (C1072). Monitor C1072 is not suitable to use for background concentration because it was sited to capture the impact of SO_2 concentration from the Tokai Big Spring Carbon Black Plant and Alon USA Big Spring Refinery sites.

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. Appendix W offers two mechanisms for characterizing background concentrations of SO_2 that are ultimately added to the modeled design values: 1) a "tier 1" approach, based on a monitored design value, or 2) a temporary varying "tier 2" approach, based on 99th percentile monitored concentrations by hour of day or season or month.

For this attainment demonstration SIP modeling, the TECQ chose to use the tier 2 approach. Table 6-1: *Monitors Considered for Background Concentration* shows "regional site" monitors that were considered for the background concentration. Of the monitors considered, Midlothian OFW (C52) monitor had the lowest variability over time. This monitor was chosen as the representative background monitor, and the seasonally varying concentrations, as shown in Table 6-2: *Seasonally Varying Background Concentration*, were added as the background concentration to all modeling runs. The background concentration data represent seasonally-and-diurnally varying 99th percentile monitored concentrations over three-years (2018-2020). Season months alignments are as follows: Dec-Feb are Winter, Mar-May are Spring, Jun-Aug are Summer, and Sep-Nov are Fall.

Table 6-1: 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

Table 6-2: Seasonally Varying Background Concentration

Monitor Hour	Model Hour	Winter (ppb)	Spring (ppb)	Summer (ppb)	Fall (ppb)
0:00	Hr. 1	1.50	1.18	1.71	1.59
1:00	Hr. 2	2.37	0.79	0.98	1.84
2:00	Hr. 3	2.06	1.00	0.89	1.44

Monitor Hour	Model Hour	Winter (ppb)	Spring (ppb)	Summer (ppb)	Fall (ppb)
3:00	Hr. 4	1.69	1.40	0.73	1.45
4:00	Hr. 5	1.33	1.28	0.72	1.38
5:00	Hr. 6	1.60	0.96	0.73	1.27
6:00	Hr. 7	1.43	1.15	0.77	1.56
7:00	Hr. 8	1.59	1.22	0.66	1.30
8:00	Hr. 9	2.31	1.09	0.98	1.33
9:00	Hr. 10	4.02	1.78	1.55	1.88
10:00	Hr. 11	3.29	2.13	2.16	2.08
11:00	Hr. 12	2.82	1.78	0.94	2.20
12:00	Hr. 13	2.48	1.83	0.89	2.85
13:00	Hr. 14	1.93	1.49	0.85	2.25
14:00	Hr. 15	2.30	2.45	1.12	2.02
15:00	Hr. 16	1.99	2.07	0.84	1.85
16:00	Hr. 17	2.30	2.13	0.87	1.41
17:00	Hr. 18	1.50	1.46	0.77	1.43
18:00	Hr. 19	1.45	1.16	0.60	1.07
19:00	Hr. 20	1.45	1.07	0.48	1.02
20:00	Hr. 21	1.42	0.92	0.85	1.13
21:00	Hr. 22	2.09	1.04	0.76	1.32
22:00	Hr. 23	1.44	1.30	0.81	1.38
23:00	Hr. 24	1.41	1.33	1.07	1.67

In consultation with EPA, a viability analysis was conducted to examine monitors in Ector County and Howard County to determine if the chosen monitor is representative of background SO_2 concentrations in Howard County. The monitors shown in Table 6-3: *Monitors Analyzed for Representativeness* were considered for the analyses. In response to the EPA's comment that monitors in Ector county with higher monitored values might be more representative of background concentrations in Howard County, a re-analysis was done with 18 months of data for these monitors and it was concluded that the Ellis County Midlothian OFW (C52) monitor is representative monitor, and the section was updated .

Table 6-3: Monitors Analyzed for Representativeness

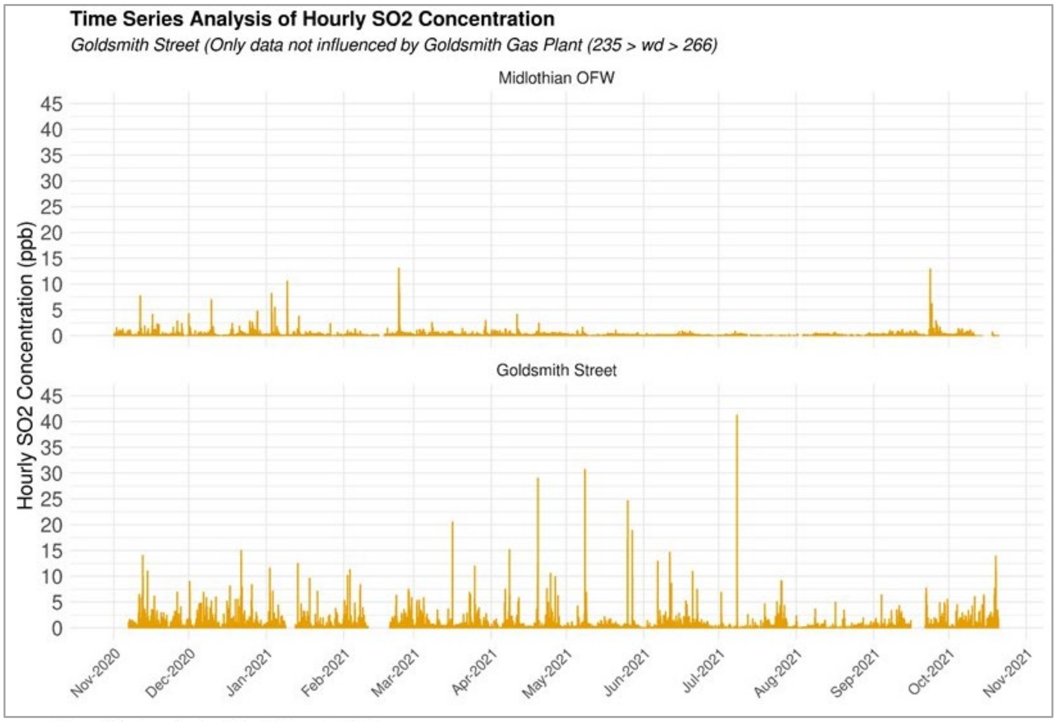
Monitor Name	AIRS Number	CAMS Number	County	Activation Date	Regulatory (Yes or No?)
Goldsmith Street	481351093	1093	Ector	11/7/2020	No
Big Spring Midway	482271072	1072	Howard	12/3/2016	Yes
Odessa Westmark Street	481351092	1092	Ector	9/24/2020	No

To compare SO_2 background concentrations from the West Texas monitors to the Midlothian OFW monitor (located in the Dallas-Fort Worth area) SO_2 concentrations at these monitors were omitted when wind was from the direction of the nearest SO_2 source. An example of the procedure used to determine the exclusion angle for the Goldsmith Street monitor is presented in Figure 6-1: *Determination of Exclusion Angles for Goldsmith Street*.

Hourly SO_2 data from the Goldsmith Street monitor was excluded when the resultant wind direction was greater than 235 degrees and less than 266 degrees. This method is not infallible, as the greater the distance between the SO_2 source and the monitor, the more likely that uncertainty can enter to the determination of influence.

Figure 6-1: Determination of Exclusion Angles for Goldsmith Street

Figure 6-2: *Goldsmith Street and Midlothian OFW Time-Series* plots hourly SO_2 concentrations from November 1, 2020 through April 25, 2022 for the Midlothian OFW monitor (all measurements) and November 7, 2020 through April 25, 2022 for the Goldsmith Street monitor (only measurements believed uninfluenced by the nearby gas plant).



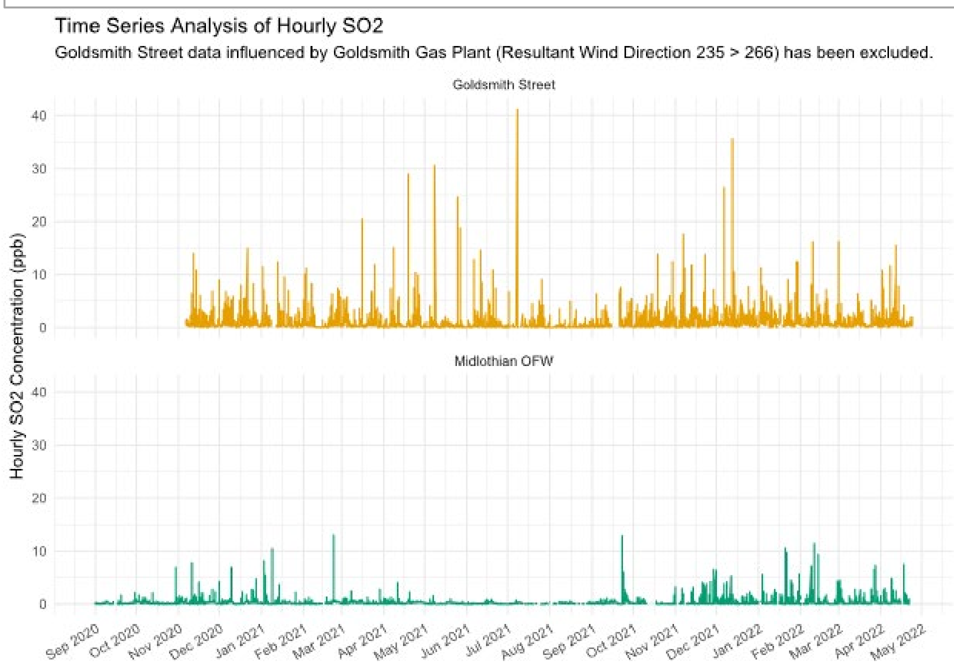
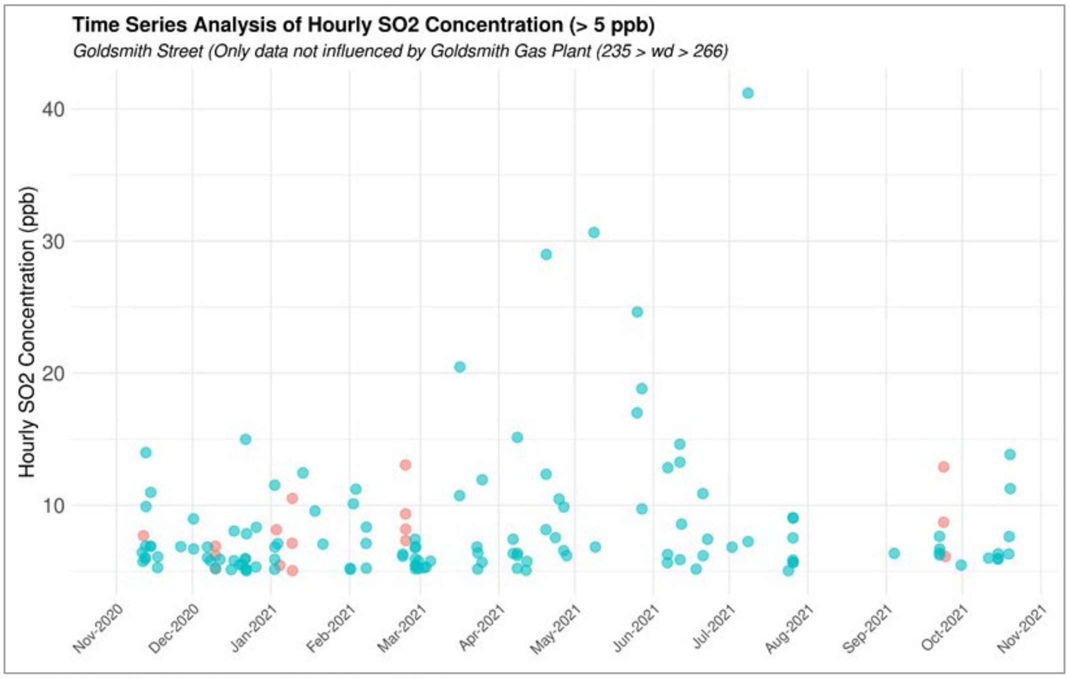


Figure 6-2: Goldsmith Street and Midlothian OFW Time-Series

Figure 6-3: *Goldsmith Street and Midlothian OFW Time-Series of Hourly SO_2 Concentrations Greater than 5 ppb* uses the same methodology as Figure 6-2, but it only displays SO_2 concentrations greater than 5 ppb.

The threshold of 5 ppb or greater than 5 ppb was used to assess and compare the monitored value between non-source impacted Goldsmith and Midlothian as part of the representativeness review.

Figure 6-4: *Goldsmith Street Pollution Rose and Plant Boundaries* shows the wind direction and range of SO_2 concentrations when the Goldsmith Street monitor recorded an hourly SO_2 concentration greater than 5 ppb from November 7, 2020 through April 25, 2022. The blue box in Figure 6-4 represents plant boundaries.



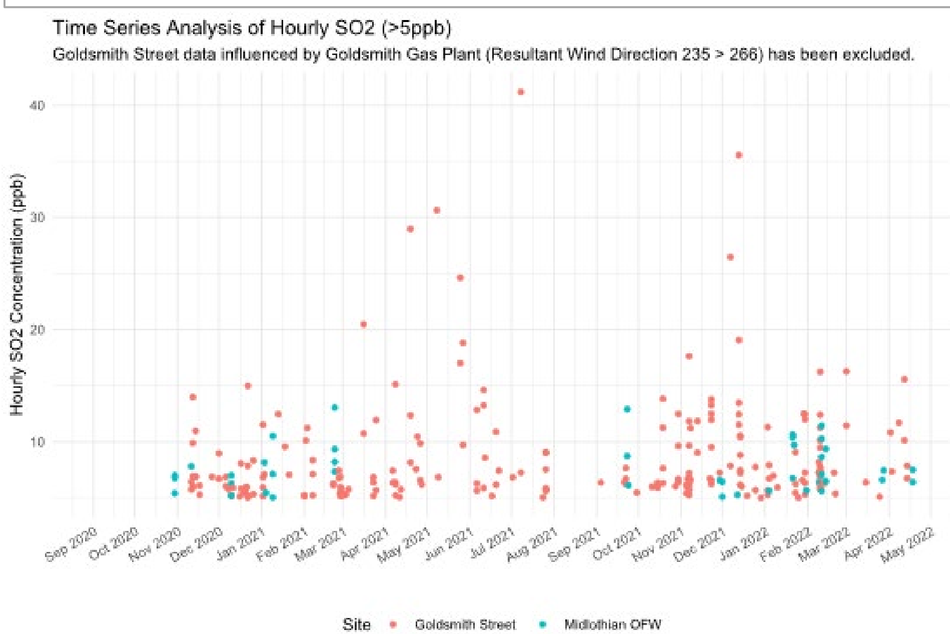


Figure 6-3: Goldsmith Street and Midlothian OFW Time-Series of Hourly SO_2 Concentrations Greater than 5 ppb

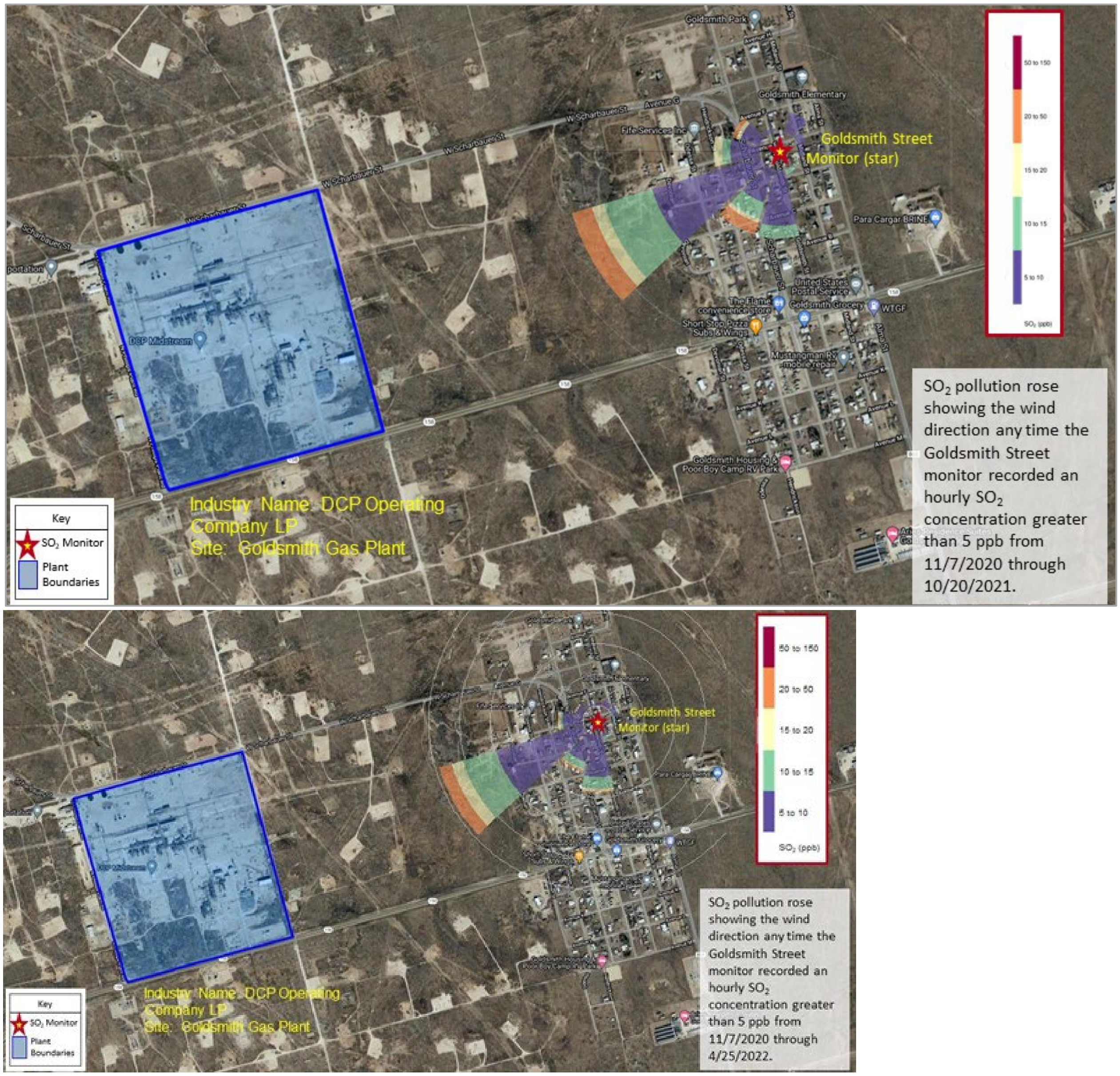


Figure 6-4: Goldsmith Street Pollution Rose and Plant Boundaries

Similar analyses were done for the Big Spring Midway (C1072) and Odessa Westmark Street (C1092) monitors. The removal of potentially influenced measurements was done by excluding hourly SO_2 data from the Big Spring Midway monitor that was paired with a resultant wind direction greater than 167 degrees and less than 340 degrees. The removal of potentially influenced measurements was done by excluding hourly SO_2 data from the Westmark Street monitor that was paired with a resultant wind direction greater than 176 degrees and less than 201 degrees.

Figure 6-5: *Combined Time-Series of Hourly SO_2 Concentrations Greater than 5 ppb* displays SO_2 concentrations greater than 5 ppb from all four monitors included in this document. To maintain a scale that allows for comparison, the plot omits the value of 125.42 ppb, recorded at the Odessa Westmark Street monitor on November 25, 2020.

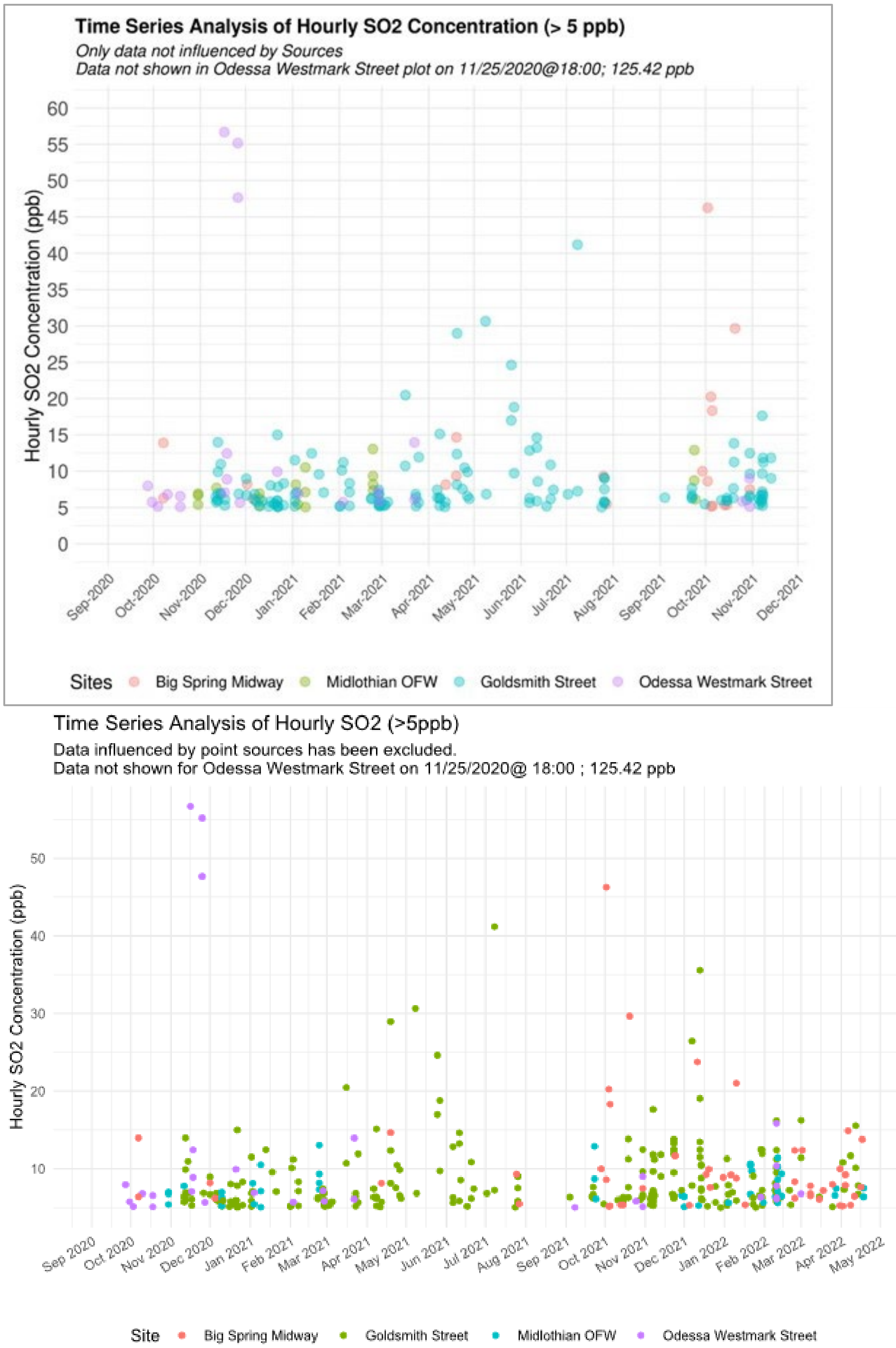


Figure 6-5: Combined Time-Series of Hourly SO_2 Concentrations Greater than 5 ppb

After conducting the analyses and comparing SO_2 concentrations greater than 5 ppb from all these monitors, the TCEQ concluded that the Ellis County Midlothian OFW (C52) monitor is representative monitor for SO_2 background concentration in the Howard County attainment demonstration modeling.

7. MODELING SCENARIOS

Per 40 CFR Part 51 Appendix W §8.2.2(d), any expected operating conditions that will impact the stack parameters or emission rates should be modeled to ensure that proposed control measures will be protective of the 2010 one-hour SO_2 NAAQS of 75 ppb. Final modeling scenarios were based on the control strategy and related future operating conditions for the facilities in the Howard County nonattainment area.

Sources in the Howard County 2010 SO_2 NAAQS NAA have both routine and MSS emissions, and the modeling was conducted using the emission rates (during normal operations and, when applicable, MSS operations) for each site. Most of the sources were modeled with the standard practices outlined in Appendix W, *Guideline on Air Quality Models*, which prescribes the use of AERMOD for regulatory purposes. Four flares at Alon USA Big Spring Refinery site intermittently and non-deterministically emit SO_2. Modeling these sources continually results in unrealistic emission scenarios. To better characterize these sources, Ramboll developed the MC approach. The MC approach was written using the Python programming language and requires a Linux-based machine to run. The TCEQ modeled 192 scenarios using the MC approach to account for Tokai Big Spring Carbon Black Plant's varying load and cap scenarios under two modes of operations (routine and MSS). The MC simulation was done at 648 critical receptors when the Alon USA Big Spring Refinery four flares had intermittent MSS emissions to ensure that the Howard County 2010 SO_2 NAAQS NAA will remain in attainment under these different operating conditions. For detailed information on the Monte Carlo analysis for Howard County Attainment Demonstration SIP Modeling, refer to Chapter 4: *Attainment Demonstration Modeling for Howard County* of the accompanying SIP revision, and Appendix L: *Howard County Monte Carlo Simulation*.

Besides the MC approach for Howard County Attainment Demonstration SIP Modeling, which modeled emissions from the Alon USA Big Spring Refinery's intermittent emissions during MSS operations, routine emissions from all sources at all three sites were modeled following standard practices outlined in Appendix W, *Guideline on Air Quality Models*. The TCEQ's standard AERMOD modeling demonstrates that routine emissions without the intermittent emissions show attainment. It further illustrates that the MC approach was used specifically for the Alon USA Big Spring Refinery's sources that emit intermittently and non-deterministically for a limited number of days in any given year. The TCEQ modeled 192 scenarios to account for Tokai Big Spring Carbon Black Plant's various operating scenarios using standard AERMOD modeling with routine emissions from the four flares at Alon USA Big Spring Refinery site. These flares were modeled at routine emission rates as represented in Table 3-3: *Alon USA Big Spring Refinery Current Source Parameters in NSR Permit*. As in the MC approach, the 24D routine was the controlling scenario with modeled max DV of 72 ppb as shown in Figure 7-1: *Design Value Concentration throughout the Howard County NAA from standard AERMOD modeling*.

Table 7-1: *Modeling Scenarios and Maximum Modeled DV* shows each modeling scenario and the resulting maximum DV across all the critical receptors for MC approach, and entire receptor grids for the standard AERMOD modeling. The represented results are from the run that resulted in max DV from combination of 10,000 and 20,000 simulations for each scenario for MC approach. The max DV are shown in $\mu g/m^3$ because it was the default output of the MC simulation and AERMOD modeling.

In addition to the MC simulations and standard AERMOD modeling for attainment demonstration, a set of site ambient scenarios were also modeled. The site ambient runs were done to demonstrate that no sites in the nonattainment area will cause NAAQS violations within the boundary of neighboring sites. In the site ambient scenarios, receptors were placed within each site's modeled boundaries and impacts from sources other than the site's own sources are determined. Since there are three sites in the Howard County 2010 SO_2 nonattainment area, three set of site ambient scenarios were conducted – BHER C R Wing Cogeneration Plant site ambient scenarios, Alon USA Big Spring Refinery site ambient scenarios, and the Tokai Big Spring Carbon Black Plant site ambient scenarios.

Site ambient scenario for the BHER C R Wing Cogeneration Plant and the Alon USA Big Spring Refinery sites were conducted using AERMOD methods. For the Tokai Big Spring Carbon Black Plant site ambient scenario, a set of 10,000 MC simulations were done with only Alon USA Big Spring Refinery and BHER C R Wing Big Spring Cogeneration Plant emissions.

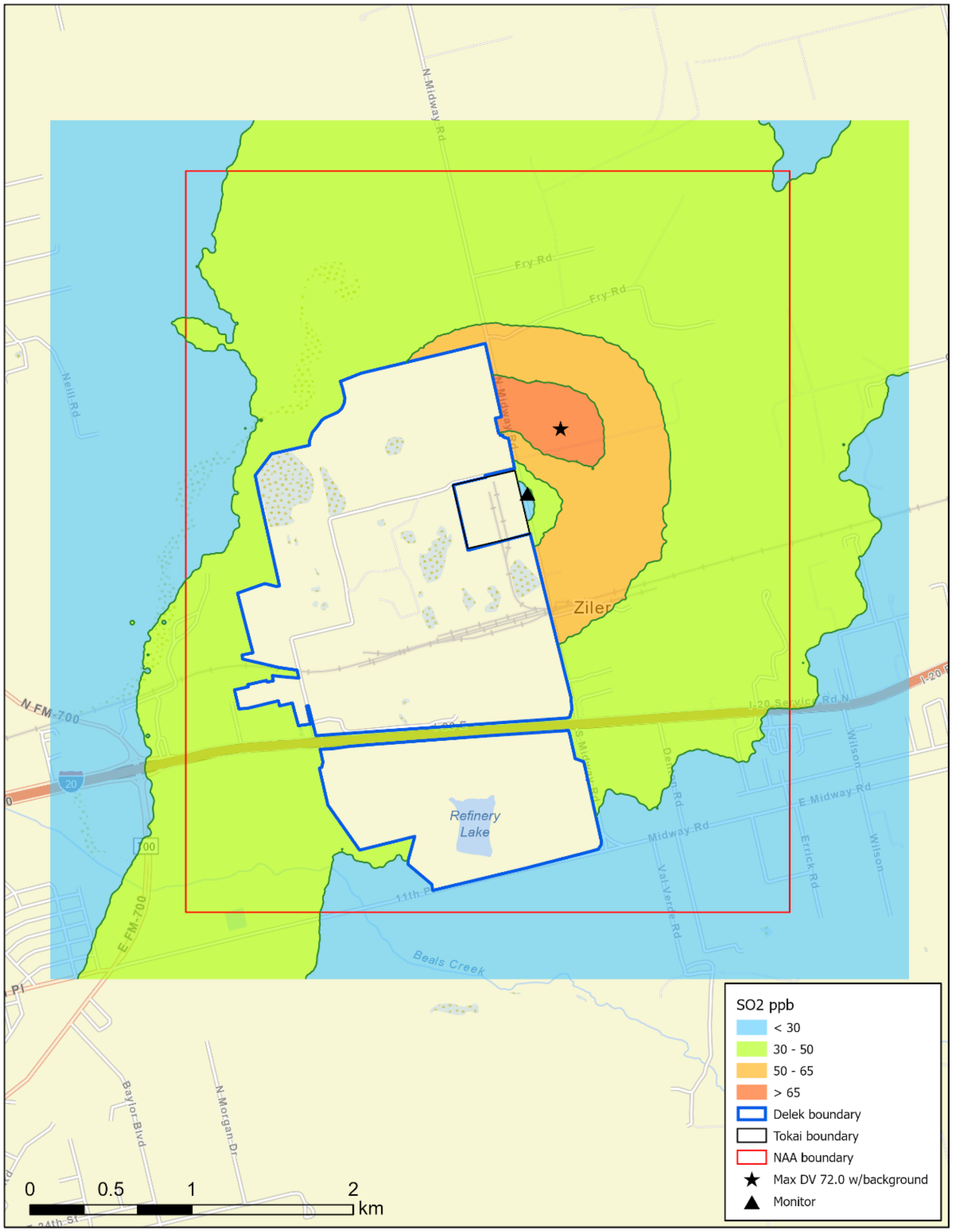


Figure 7-1: Design Value Concentration throughout the Howard County NAA from standard AERMOD modeling.

Table 7-1: Modeling Scenarios and Maximum Modeled DV

Operating Mode	Load Scenario	Cap Scenario	LOAD_7A	LOAD_12A	LOAD_13A/FLARE4	MC Derived Max DV (µg/m³)	AERMOD Derived Max DV (µg/m³)
Routine	1	A	0.22	0.5	0.31	126.24	134.77

Operating Mode	Load Scenario	Cap Scenario	LOAD_7A	LOAD_12A	LOAD_13A/FLARE4	MC Derived Max DV (µg/m³)	AERMOD Derived Max DV (µg/m³)
Routine	1	B	0.22	0.5	0.31	125.57	134.77
Routine	1	C	0.22	0.5	0.31	129.88	134.78
Routine	1	D	0.22	0.5	0.31	128.81	134.78
Routine	2	A	0.22	0.75	0.38	140.52	137.54
Routine	2	B	0.22	0.75	0.38	136.06	135.83
Routine	2	C	0.22	0.75	0.38	144.16	140.52
Routine	2	D	0.22	0.75	0.38	139.46	137.36
Routine	3	A	0.22	1	0.46	151.07	147.51
Routine	3	B	0.22	1	0.46	145.24	141.16
Routine	3	C	0.22	1	0.46	157.31	153.10
Routine	3	D	0.22	1	0.46	146.29	142.39
Routine	4	A	0.33	0.5	0.38	136.75	135.74
Routine	4	B	0.33	0.5	0.38	133.94	134.88
Routine	4	C	0.33	0.5	0.38	138.73	137.95
Routine	4	D	0.33	0.5	0.38	141.46	138.56
Routine	5	A	0.33	0.75	0.46	146.75	142.49
Routine	5	B	0.33	0.75	0.46	142.10	139.96
Routine	5	C	0.33	0.75	0.46	150.48	147.29
Routine	5	D	0.33	0.75	0.46	150.14	146.04
Routine	6	A	0.33	1	0.53	156.25	152.56
Routine	6	B	0.33	1	0.53	151.61	148.33
Routine	6	C	0.33	1	0.53	162.31	158.66
Routine	6	D	0.33	1	0.53	157.56	153.64
Routine	7	A	0.44	0.5	0.46	145.39	142.00
Routine	7	B	0.44	0.5	0.46	140.78	139.50
Routine	7	C	0.44	0.5	0.46	146.48	142.79
Routine	7	D	0.44	0.5	0.46	150.27	146.57
Routine	8	A	0.44	0.75	0.54	150.77	147.32
Routine	8	B	0.44	0.75	0.54	148.06	145.01
Routine	8	C	0.44	0.75	0.54	155.92	151.90
Routine	8	D	0.44	0.75	0.54	157.55	154.16
Routine	9	A	0.44	1	0.61	159.66	156.14
Routine	9	B	0.44	1	0.61	155.85	152.76
Routine	9	C	0.44	1	0.61	165.61	161.63
Routine	9	D	0.44	1	0.61	164.68	161.64
Routine	10	A	0.56	0.5	0.54	151.98	148.97
Routine	10	B	0.56	0.5	0.54	146.39	144.32
Routine	10	C	0.56	0.5	0.54	151.92	148.14
Routine	10	D	0.56	0.5	0.54	157.06	153.44
Routine	11	A	0.56	0.75	0.61	158.68	155.53
Routine	11	B	0.56	0.75	0.61	154.73	151.24
Routine	11	C	0.56	0.75	0.61	161.81	157.77

Operating Mode	Load Scenario	Cap Scenario	LOAD_7A	LOAD_12A	LOAD_13A/FLARE4	MC Derived Max DV (μg/m³)	AERMOD Derived Max DV (μg/m³)
Routine	11	D	0.56	0.75	0.61	165.64	162.14
Routine	12	A	0.56	1	0.69	163.28	159.10
Routine	12	B	0.56	1	0.69	160.26	156.60
Routine	12	C	0.56	1	0.69	169.23	165.67
Routine	12	D	0.56	1	0.69	171.15	168.09
Routine	13	A	0.67	0.5	0.62	158.42	154.82
Routine	13	B	0.67	0.5	0.62	152.61	149.08
Routine	13	C	0.67	0.5	0.62	157.85	154.08
Routine	13	D	0.67	0.5	0.62	163.61	160.27
Routine	14	A	0.67	0.75	0.69	164.54	161.09
Routine	14	B	0.67	0.75	0.69	158.71	155.49
Routine	14	C	0.67	0.75	0.69	167.16	162.71
Routine	14	D	0.67	0.75	0.69	171.58	168.25
Routine	15	A	0.67	1	0.77	168.44	164.32
Routine	15	B	0.67	1	0.77	163.87	159.66
Routine	15	C	0.67	1	0.77	173.73	169.97
Routine	15	D	0.67	1	0.77	176.73	173.66
Routine	16	A	0.78	0.5	0.69	164.77	161.20
Routine	16	B	0.78	0.5	0.69	158.26	154.53
Routine	16	C	0.78	0.5	0.69	164.97	160.39
Routine	16	D	0.78	0.5	0.69	170.29	167.00
Routine	17	A	0.78	0.75	0.77	169.32	169.00
Routine	17	B	0.78	0.75	0.77	162.97	159.93
Routine	17	C	0.78	0.75	0.77	171.32	170.06
Routine	17	D	0.78	0.75	0.77	176.86	178.49
Routine	18	A	0.78	1	0.84	173.68	169.62
Routine	18	B	0.78	1	0.84	168.16	163.51
Routine	18	C	0.78	1	0.84	178.95	174.82
Routine	18	D	0.78	1	0.84	183.43	179.62
Routine	19	A	0.89	0.5	0.77	168.45	164.54
Routine	19	B	0.89	0.5	0.77	161.71	157.21
Routine	19	C	0.89	0.5	0.77	168.88	165.21
Routine	19	D	0.89	0.5	0.77	175.37	171.75
Routine	20	A	0.89	0.75	0.85	173.46	168.74
Routine	20	B	0.89	0.75	0.85	166.27	161.71
Routine	20	C	0.89	0.75	0.85	175.63	171.46
Routine	20	D	0.89	0.75	0.85	182.93	178.30
Routine	21	A	0.89	1	0.92	178.29	173.02
Routine	21	B	0.89	1	0.92	172.15	167.20
Routine	21	C	0.89	1	0.92	182.62	178.71
Routine	21	D	0.89	1	0.92	188.86	184.79
Routine	22	A	1	0.5	0.85	172.73	167.48

Operating Mode	Load Scenario	Cap Scenario	LOAD_7A	LOAD_12A	LOAD_13A/FLARE4	MC Derived Max DV (µg/m³)	AERMOD Derived Max DV (µg/m³)
Routine	22	B	1	0.5	0.85	165.70	160.93
Routine	22	C	1	0.5	0.85	173.25	169.26
Routine	22	D	1	0.5	0.85	181.11	176.21
Routine	23	A	1	0.75	0.92	178.73	173.11
Routine	23	B	1	0.75	0.92	171.75	166.48
Routine	23	C	1	0.75	0.92	180.79	176.20
Routine	23	D	1	0.75	0.92	187.66	183.88
Routine	24	A	1	1	1	181.83	177.23
Routine	24	B	1	1	1	175.63	170.68
Routine	24	C	1	1	1	187.75	182.33
Routine	24	D	1	1	1	193.80	188.62
MSS	1	A	0.22	0.5	0.31	125.55	134.77
MSS	1	B	0.22	0.5	0.31	125.55	134.77
MSS	1	C	0.22	0.5	0.31	125.56	134.78
MSS	1	D	0.22	0.5	0.31	125.56	134.77
MSS	2	A	0.22	0.75	0.38	125.55	134.77
MSS	2	B	0.22	0.75	0.38	125.55	134.77
MSS	2	C	0.22	0.75	0.38	125.57	134.78
MSS	2	D	0.22	0.75	0.38	125.56	134.77
MSS	3	A	0.22	1	0.46	125.87	134.77
MSS	3	B	0.22	1	0.46	125.56	134.78
MSS	3	C	0.22	1	0.46	132.86	134.79
MSS	3	D	0.22	1	0.46	125.55	134.77
MSS	4	A	0.33	0.5	0.38	125.55	134.77
MSS	4	B	0.33	0.5	0.38	125.55	134.77
MSS	4	C	0.33	0.5	0.38	125.56	134.77
MSS	4	D	0.33	0.5	0.38	125.56	134.77
MSS	5	A	0.33	0.75	0.46	125.55	134.77
MSS	5	B	0.33	0.75	0.46	125.55	134.77
MSS	5	C	0.33	0.75	0.46	125.56	134.77
MSS	5	D	0.33	0.75	0.46	125.56	134.77
MSS	6	A	0.33	1	0.53	125.55	134.77
MSS	6	B	0.33	1	0.53	125.56	134.77
MSS	6	C	0.33	1	0.53	135.32	137.35
MSS	6	D	0.33	1	0.53	125.56	134.77
MSS	7	A	0.44	0.5	0.46	125.55	134.77
MSS	7	B	0.44	0.5	0.46	125.55	134.77
MSS	7	C	0.44	0.5	0.46	125.56	134.77
MSS	7	D	0.44	0.5	0.46	125.89	134.77
MSS	8	A	0.44	0.75	0.54	125.55	134.77
MSS	8	B	0.44	0.75	0.54	125.55	134.77
MSS	8	C	0.44	0.75	0.54	128.43	135.49

Operating Mode	Load Scenario	Cap Scenario	LOAD_7A	LOAD_12A	LOAD_13A/FLARE4	MC Derived Max DV (µg/m³)	AERMOD Derived Max DV (µg/m³)
MSS	8	D	0.44	0.75	0.54	127.16	134.77
MSS	9	A	0.44	1	0.61	125.55	134.77
MSS	9	B	0.44	1	0.61	125.55	134.77
MSS	9	C	0.44	1	0.61	137.13	140.32
MSS	9	D	0.44	1	0.61	131.67	137.97
MSS	10	A	0.56	0.5	0.54	125.55	134.77
MSS	10	B	0.56	0.5	0.54	125.87	134.77
MSS	10	C	0.56	0.5	0.54	125.88	134.77
MSS	10	D	0.56	0.5	0.54	126.48	134.77
MSS	11	A	0.56	0.75	0.61	125.55	134.77
MSS	11	B	0.56	0.75	0.61	125.55	134.77
MSS	11	C	0.56	0.75	0.61	132.86	139.02
MSS	11	D	0.56	0.75	0.61	133.22	138.75
MSS	12	A	0.56	1	0.69	125.55	134.77
MSS	12	B	0.56	1	0.69	125.55	134.77
MSS	12	C	0.56	1	0.69	140.12	142.30
MSS	12	D	0.56	1	0.69	138.91	140.96
MSS	13	A	0.67	0.5	0.62	125.55	134.77
MSS	13	B	0.67	0.5	0.62	125.55	134.77
MSS	13	C	0.67	0.5	0.62	129.08	137.30
MSS	13	D	0.67	0.5	0.62	132.40	138.47
MSS	14	A	0.67	0.75	0.69	125.55	134.77
MSS	14	B	0.67	0.75	0.69	125.55	134.77
MSS	14	C	0.67	0.75	0.69	136.70	140.82
MSS	14	D	0.67	0.75	0.69	138.84	141.41
MSS	15	A	0.67	1	0.77	126.07	135.57
MSS	15	B	0.67	1	0.77	125.55	135.76
MSS	15	C	0.67	1	0.77	143.45	144.50
MSS	15	D	0.67	1	0.77	142.74	143.78
MSS	16	A	0.78	0.5	0.69	125.55	134.77
MSS	16	B	0.78	0.5	0.69	125.55	134.77
MSS	16	C	0.78	0.5	0.69	133.95	139.73
MSS	16	D	0.78	0.5	0.69	138.21	141.23
MSS	17	A	0.78	0.75	0.77	125.88	137.88
MSS	17	B	0.78	0.75	0.77	125.55	135.90
MSS	17	C	0.78	0.75	0.77	141.04	144.55
MSS	17	D	0.78	0.75	0.77	144.88	146.29
MSS	18	A	0.78	1	0.84	129.72	138.68
MSS	18	B	0.78	1	0.84	128.88	138.28
MSS	18	C	0.78	1	0.84	148.20	147.78
MSS	18	D	0.78	1	0.84	149.44	148.01
MSS	19	A	0.89	0.5	0.77	126.00	136.67

Operating Mode	Load Scenario	Cap Scenario	LOAD_7A	LOAD_12A	LOAD_13A/FLARE4	MC Derived Max DV (µg/m³)	AERMOD Derived Max DV (µg/m³)
MSS	19	B	0.89	0.5	0.77	125.87	134.77
MSS	19	C	0.89	0.5	0.77	138.10	142.22
MSS	19	D	0.89	0.5	0.77	142.61	143.92
MSS	20	A	0.89	0.75	0.85	130.34	138.89
MSS	20	B	0.89	0.75	0.85	126.34	137.56
MSS	20	C	0.89	0.75	0.85	145.07	146.27
MSS	20	D	0.89	0.75	0.85	148.85	147.95
MSS	21	A	0.89	1	0.92	133.38	140.91
MSS	21	B	0.89	1	0.92	131.67	140.05
MSS	21	C	0.89	1	0.92	152.37	150.67
MSS	21	D	0.89	1	0.92	154.53	151.68
MSS	22	A	1	0.5	0.85	130.28	138.88
MSS	22	B	1	0.5	0.85	125.63	137.12
MSS	22	C	1	0.5	0.85	142.11	145.25
MSS	22	D	1	0.5	0.85	147.91	147.34
MSS	23	A	1	0.75	0.92	134.51	141.36
MSS	23	B	1	0.75	0.92	130.80	139.78
MSS	23	C	1	0.75	0.92	149.23	149.50
MSS	23	D	1	0.75	0.92	153.63	151.53
MSS	24	A	1	1	1	136.62	143.53
MSS	24	B	1	1	1	133.75	142.54
MSS	24	C	1	1	1	155.39	153.15
MSS	24	D	1	1	1	159.10	154.72

8. MODELING RUN INFORMATION AND ARCHIVE

The TCEQ ran AERMOD and the AERMOD preprocessors on the TCEQ's Linux computing cluster. The source code for the EPA approved AERMOD model, version 2111, downloaded from the EPA's website (https://www.epa.gov/scram/air-quality-dispersion-modeling-preferred-and-recommended-models#aermod), was compiled on the TCEQ's Linux system and used for modeling. To minimize AERMOD simulation time, the set of modeling receptors was split into smaller groups of receptors and AERMOD was run multiple times with the same inputs 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 times 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 which ensures an error free process. No changes were made to the AERMOD model code itself.

For MC simulations the TCEQ used Ramboll's Python code and the results of AERMOD runs for constant sources and the results of unit emission rate AERMOD runs for variable sources as described in Appendix L: *Howard County Monte Carlo Simulations.* The TCEQ has archived all modeling input, output, and processing files used or generated as part of this attainment demonstration SIP revision modeling analysis. The 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 directory: /SO2/Howard/AERMOD
- User ID: anonymous
- Password: user's email address

9. 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	Midland Intl AP, TX
Latitude/Longitude	31.948, -102.209
Station ID	WBAN 23023
Is this the ASOS station?	Yes
Hour Adjustment to Local Time	+6
Anemometer Height	7.9 m

Parameter	Value
Was ADJ_U* used?	Yes

Table 8-3: AERMET Upper Air Station Information

Parameter	Value
Upper Air Station Used	Midland Intl AP, TX
Latitude/Longitude	31.93, -102.20
Station ID	WBAN 23023
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	Midland Intl AP, TX
Latitude/Longitude	31.948, -102.209
Station ID	WBAN 23023
Station Code	KMAF
IFW Installation Date	6/18/2004
Was the 0.5 m/s wind threshold used?	Yes

Table 8-5: AERSURFACE Settings and Parameters

Parameter	Value
Surface Station Used	Midland Intl AP, TX
Latitude/Longitude	31.948, -102.209
Land Use Data Used	NLCD 2016, Tree Canopy 2016, Impervious Surface 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
Period	Monthly
Surface Moisture	2016: Wet 2017: Average 2018: Average 2019: Average 2020: Dry
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
Terrain File Type & Name	NED 13_n33w102.tif (1/3 arc-second)
Lat-Lon Extent of Terrain Data	SW corner: 31.9994, -102.0006 NE corner: 33.0006, -100.9994
UTM Extent of Terrain Data	SW corner: 216522.6, 3544309.8 NE corner: 313205.9, 3653124.1
Anchor Latitude/Longitude	0.0 / 0.0
Base Zone	Zone 14
Base Datum	North American Datum of 1983

Table 8-7: Howard County Plant Building Parameters

Site	Building ID	Elevation (m)	Tier Height (m)	Total Corners	Origin Corner UTM Easting (X; m)	Origin Corner UTM Northing (X; m)
BHER C R Wing Cogeneration Plant	BDemN	754.94	4.88	4	271810.6	3573354.3
BHER C R Wing Cogeneration Plant	BDemS	755.59	7.92	4	271812.3	3573346.8
BHER C R Wing Cogeneration Plant	BGasTurb	755.38	15.24	4	271798.7	3573323.4
BHER C R Wing Cogeneration Plant	BSteaTurb	755.39	18.29	4	271821.1	3573223.4
BHER C R Wing Cogeneration Plant	Boffice	755.51	8.53	4	271831.2	3573205.7
BHER C R Wing Cogeneration Plant	BCoolTow	755.51	15.54	4	271883.8	3573242.1
BHER C R Wing Cogeneration Plant	BDWTank	755.59	12.19	32	271846.2	3573328.6
BHER C R Wing Cogeneration Plant	BRWTank	755.48	12.19	32	271886.8	3573262.5
Tokai Big Spring Carbon Black Plant	TU1RERUN	764.54	10.36	4	273205.0	3573902.0
Tokai Big Spring Carbon Black Plant	TU1DEBF	764.24	22.86	4	273154.0	3573914.0
Tokai Big Spring Carbon Black Plant	TU3SBF	764.29	18.29	4	273152.0	3573973.0

Site	Building ID	Elevation (m)	Tier Height (m)	Total Corners	Origin Corner UTM Easting (X; m)	Origin Corner UTM Northing (X; m)
Tokai Big Spring Carbon Black Plant	TU23DEBF	763.73	15.24	4	273142.0	3573987.0
Tokai Big Spring Carbon Black Plant	TU12MIX	764.70	24.38	4	273157.0	3573936.0
Tokai Big Spring Carbon Black Plant	TGENBLD	763.69	13.72	4	273116.0	3574067.0
Tokai Big Spring Carbon Black Plant	TDEARATO	763.69	25.91	4	273109.0	3574068.0
Tokai Big Spring Carbon Black Plant	TMCC	763.36	3.05	4	273132.6	3574072.4
Tokai Big Spring Carbon Black Plant	TOFFICE	764.09	4.88	22	273222.8	3573877.6
Tokai Big Spring Carbon Black Plant	TB1000	764.15	4.88	4	273189.9	3573870.4
Tokai Big Spring Carbon Black Plant	TWWTP	764.10	6.10	4	273175.3	3573873.9
Tokai Big Spring Carbon Black Plant	TWAREHSE	763.62	7.62	6	273104.7	3573857.3
Tokai Big Spring Carbon Black Plant	TMNTBLD	764.04	4.88	4	273142.4	3573886.0
Tokai Big Spring Carbon Black Plant	TB1	763.56	6.10	4	273119.0	3573842.2
Tokai Big Spring Carbon Black Plant	TB2	763.63	7.62	4	273109.7	3573840.5
Tokai Big Spring Carbon Black Plant	TB3	762.83	3.66	4	273174.8	3574097.9
Tokai Big Spring Carbon Black Plant	TB4	763.06	3.66	4	273129.3	3573805.6
Tokai Big Spring Carbon Black Plant	TB5	763.79	4.88	4	273153.3	3573850.7

Site	Building ID	Elevation (m)	Tier Height (m)	Total Corners	Origin Corner UTM Easting (X; m)	Origin Corner UTM Northing (X; m)
Tokai Big Spring Carbon Black Plant	TPROCWAT	764.25	18.29	32	273212.6	3573877.0
Tokai Big Spring Carbon Black Plant	TCONDTNK	763.28	9.14	32	273103.0	3574127.0
Tokai Big Spring Carbon Black Plant	TOILTNK1	764.14	12.19	32	273183.5	3573998.0
Tokai Big Spring Carbon Black Plant	TOILTNK2	764.34	12.19	32	273229.1	3574015.0
Tokai Big Spring Carbon Black Plant	TOILTNK3	763.63	12.19	32	273217.1	3574065.0
Tokai Big Spring Carbon Black Plant	TOILTNK4	763.21	12.19	32	273186.0	3574061.0
Alon USA Big Spring Refinery	DLNCHLOC	747.61	4.57	8	271959.3	3572728.9
Alon USA Big Spring Refinery	DGENWHSE	748.97	10.70	12	271933.2	3572788.3
Alon USA Big Spring Refinery	DMAINSHO	749.10	9.45	8	272086.3	3572650.6
Alon USA Big Spring Refinery	D20TK180	747.95	10.67	8	272335.2	3572769.2
Alon USA Big Spring Refinery	DPURCHAS	747.06	4.57	4	271964.9	3572709.6
Alon USA Big Spring Refinery	DWESTWHS	746.10	4.88	4	271841.9	3572747.2
Alon USA Big Spring Refinery	DPIPETRA	748.52	4.11	4	272088.8	3572601.1
Alon USA Big Spring Refinery	DFIREPUM	748.60	4.85	4	272075.4	3572616.2
Alon USA Big Spring Refinery	DCONTTRA	748.79	3.35	4	272092.1	3572612.1
Alon USA Big Spring Refinery	DEMRGRES	748.90	4.24	4	272099.5	3572623.6
Alon USA Big Spring Refinery	DCCNTLBD	749.90	4.72	4	272043.0	3572789.0
Alon USA Big Spring Refinery	DCRUDEVA	750.15	8.23	4	271982.2	3572832.7
Alon USA Big Spring Refinery	DCT11	753.58	15.85	4	271989.7	3573013.2
Alon USA Big Spring Refinery	DCT15	751.21	15.85	4	272118.4	3572859.0

Site	Building ID	Elevation (m)	Tier Height (m)	Total Corners	Origin Corner UTM Easting (X; m)	Origin Corner UTM Northing (X; m)
Alon USA Big Spring Refinery	DCHEMWHS	749.60	7.25	4	272149.4	3572707.4
Alon USA Big Spring Refinery	DY21	749.67	4.72	4	272215.2	3572747.5
Alon USA Big Spring Refinery	DESP	749.18	10.97	4	272213.5	3572618.4
Alon USA Big Spring Refinery	DCOBOILE	748.42	9.60	4	272259.0	3572623.0
Alon USA Big Spring Refinery	DCT3	746.29	16.15	4	272356.4	3572618.3
Alon USA Big Spring Refinery	DCT16	746.32	17.37	4	272375.0	3572622.1
Alon USA Big Spring Refinery	DALKYMCC	749.72	13.11	4	272290.8	3572832.8
Alon USA Big Spring Refinery	DCT6	751.20	15.85	4	272268.4	3572929.8
Alon USA Big Spring Refinery	DPMAWHSE	751.36	5.49	4	272265.8	3572943.4
Alon USA Big Spring Refinery	DDHTFRAC	752.54	7.47	4	272182.1	3573046.4
Alon USA Big Spring Refinery	DTRUCKLO	752.96	6.10	4	272590.5	3573054.8
Alon USA Big Spring Refinery	DSCALES	749.37	3.66	4	272776.0	3572616.6
Alon USA Big Spring Refinery	DOMS	750.92	3.51	4	272838.0	3572686.9
Alon USA Big Spring Refinery	DNRTHCNT	753.99	7.32	4	272030.5	3573065.6
Alon USA Big Spring Refinery	DMCCDSS	755.30	8.23	4	272030.3	3573165.4
Alon USA Big Spring Refinery	DSALVBDG	755.84	6.40	4	272142.9	3573322.5
Alon USA Big Spring Refinery	DY53A	755.82	11.89	4	271924.1	3573225.6
Alon USA Big Spring Refinery	DTK38	749.19	7.62	8	272306.4	3572787.1
Alon USA Big Spring Refinery	DTK39	748.81	4.57	8	272308.6	3572771.8
Alon USA Big Spring Refinery	DTK40	748.86	4.57	8	272313.8	3572773.9
Alon USA Big Spring Refinery	DTK41	748.94	4.57	8	272307.4	3572776.7
Alon USA Big Spring Refinery	DTK42	748.93	4.57	8	272313.7	3572777.1

Site	Building ID	Elevation (m)	Tier Height (m)	Total Corners	Origin Corner UTM Easting (X; m)	Origin Corner UTM Northing (X; m)
Alon USA Big Spring Refinery	DTK72	750.86	10.36	8	272547.3	3573016.5
Alon USA Big Spring Refinery	DTK73	751.56	15.85	8	272789.0	3573013.6
Alon USA Big Spring Refinery	DTK75	757.64	15.85	8	272312.5	3573430.1
Alon USA Big Spring Refinery	DTK3011	747.19	10.67	8	272506.8	3572868.9
Alon USA Big Spring Refinery	DTK109	748.74	10.82	8	272666.3	3572854.4
Alon USA Big Spring Refinery	DTK112	753.38	9.14	8	272997.4	3572999.1
Alon USA Big Spring Refinery	DTK3008	748.53	10.67	8	272459.1	3572899.4
Alon USA Big Spring Refinery	D20TK186	747.90	10.67	8	272357.3	3572775.2
Alon USA Big Spring Refinery	DTK3010	747.75	10.67	8	272468.3	3572860.6
Alon USA Big Spring Refinery	DTK121	750.46	10.82	8	272964.7	3572778.1
Alon USA Big Spring Refinery	DTK122	749.54	12.50	8	272975.7	3572720.8
Alon USA Big Spring Refinery	DTK123	748.97	14.63	8	272987.7	3572672.9
Alon USA Big Spring Refinery	DTK124	751.35	12.19	8	272783.0	3572938.2
Alon USA Big Spring Refinery	DTK125	750.09	12.95	8	272922.2	3572707.6
Alon USA Big Spring Refinery	DTK126	752.95	14.63	8	273055.5	3573002.4
Alon USA Big Spring Refinery	DTK128	748.53	12.19	8	273127.2	3572698.2
Alon USA Big Spring Refinery	DTK130	750.95	10.82	8	272710.2	3572999.2
Alon USA Big Spring Refinery	DTK155	751.12	10.82	8	272828.1	3572827.4
Alon USA Big Spring Refinery	DTK156	751.05	9.30	8	272848.5	3572749.8
Alon USA Big Spring Refinery	DTK172	747.55	12.80	8	273202.2	3572741.6
Alon USA Big Spring Refinery	DTK173	745.80	12.80	8	273357.3	3572750.5
Alon USA Big Spring Refinery	DTK176	750.36	12.80	8	273172.4	3572892.3

Site	Building ID	Elevation (m)	Tier Height (m)	Total Corners	Origin Corner UTM Easting (X; m)	Origin Corner UTM Northing (X; m)
Alon USA Big Spring Refinery	DTK178	751.14	12.80	8	273267.7	3573125.5
Alon USA Big Spring Refinery	DTK179	750.74	12.80	8	273017.2	3572881.9
Alon USA Big Spring Refinery	DTK180	754.65	12.80	8	273005.5	3573093.0
Alon USA Big Spring Refinery	DTK181	747.70	12.65	8	272620.1	3572772.6
Alon USA Big Spring Refinery	DTK182	747.42	12.50	8	272639.7	3572677.5
Alon USA Big Spring Refinery	DTK183	752.02	14.33	8	273144.9	3572998.2
Alon USA Big Spring Refinery	DTK184	750.81	14.48	8	273287.3	3573041.7
Alon USA Big Spring Refinery	DTK185	749.32	14.48	8	273304.1	3572971.2
Alon USA Big Spring Refinery	DTK186	752.72	6.10	8	272407.7	3573195.6
Alon USA Big Spring Refinery	DTK187	749.76	4.88	8	272414.0	3572914.7
Alon USA Big Spring Refinery	DTK199	751.51	9.45	8	272305.7	3572966.3
Alon USA Big Spring Refinery	DTK3013	751.17	9.45	8	272325.5	3572943.3
Alon USA Big Spring Refinery	DTK3007	751.12	9.45	8	272375.0	3572957.9
Alon USA Big Spring Refinery	DTK202	751.58	9.45	8	272350.3	3572982.3
Alon USA Big Spring Refinery	DTK203	751.52	9.45	8	272367.5	3572989.2
Alon USA Big Spring Refinery	DTK205	752.14	12.50	8	272476.4	3573171.2
Alon USA Big Spring Refinery	DTK206	752.53	12.50	8	272466.4	3573220.5
Alon USA Big Spring Refinery	DTK207	752.17	12.50	8	272528.3	3573183.4
Alon USA Big Spring Refinery	DTK208	753.95	12.19	8	272592.2	3573260.0
Alon USA Big Spring Refinery	D209	753.60	12.19	8	272603.8	3573211.0
Alon USA Big Spring Refinery	DTK212	750.80	5.49	8	272471.3	3572996.3
Alon USA Big Spring Refinery	DTK213	751.02	5.49	8	272467.2	3573008.8

Site	Building ID	Elevation (m)	Tier Height (m)	Total Corners	Origin Corner UTM Easting (X; m)	Origin Corner UTM Northing (X; m)
Alon USA Big Spring Refinery	DTK214	750.45	5.49	8	272484.1	3573000.0
Alon USA Big Spring Refinery	DTK215	750.98	5.49	8	272480.6	3573013.5
Alon USA Big Spring Refinery	DTK216	750.38	5.18	8	272475.7	3572984.4
Alon USA Big Spring Refinery	D300	753.53	3.05	8	272227.2	3573113.9
Alon USA Big Spring Refinery	DTK320	752.96	12.19	8	272363.5	3573193.3
Alon USA Big Spring Refinery	DTK321	754.53	12.80	8	272349.2	3573269.4
Alon USA Big Spring Refinery	DTK322	755.95	12.04	8	272331.8	3573343.6
Alon USA Big Spring Refinery	DTK325	752.72	11.28	8	272413.8	3573187.6
Alon USA Big Spring Refinery	DTK326	753.62	10.97	8	272355.7	3573228.6
Alon USA Big Spring Refinery	DTK327	755.16	10.97	8	272340.5	3573306.5
Alon USA Big Spring Refinery	DTK328	753.65	12.19	8	272450.8	3573296.3
Alon USA Big Spring Refinery	DTK348	752.44	7.32	8	272385.9	3573105.5
Alon USA Big Spring Refinery	DTK349	752.44	7.32	8	272398.1	3573107.9
Alon USA Big Spring Refinery	DTK350	753.25	14.63	8	272289.7	3573149.3
Alon USA Big Spring Refinery	DTK351	754.66	14.63	8	272269.2	3573236.6
Alon USA Big Spring Refinery	DTK352	756.44	14.63	8	272246.8	3573332.7
Alon USA Big Spring Refinery	DTK353	757.34	14.63	8	272226.8	3573412.3
Alon USA Big Spring Refinery	DTK380	756.08	11.58	8	271877.1	3573552.4
Alon USA Big Spring Refinery	DTK381	755.73	12.19	8	271886.6	3573516.9
Alon USA Big Spring Refinery	DTK382	755.73	9.14	8	271957.4	3573317.9
Alon USA Big Spring Refinery	DTK383	755.81	7.32	8	271923.4	3573309.6
Alon USA Big Spring Refinery	DTK385	755.82	3.66	8	271919.1	3573279.4

Site	Building ID	Elevation (m)	Tier Height (m)	Total Corners	Origin Corner UTM Easting (X; m)	Origin Corner UTM Northing (X; m)
Alon USA Big Spring Refinery	DTK386	755.85	3.66	8	271925.5	3573281.4
Alon USA Big Spring Refinery	DTK387	755.86	3.66	8	271931.3	3573282.6
Alon USA Big Spring Refinery	DTK1011	771.81	14.63	8	272890.0	3574608.4
Alon USA Big Spring Refinery	DTK2002	750.15	10.06	8	272726.0	3572928.9
Alon USA Big Spring Refinery	DTK2045	752.68	20.73	8	271682.4	3573029.4
Alon USA Big Spring Refinery	DTK2044	754.48	20.73	8	271754.8	3573033.2
Alon USA Big Spring Refinery	DTK3004	750.87	9.45	8	272426.8	3572976.1
Alon USA Big Spring Refinery	DTK3005	751.05	9.45	8	272422.9	3572992.2
Alon USA Big Spring Refinery	DTK5026	745.88	10.67	8	272415.3	3572631.5
Alon USA Big Spring Refinery	DP83	753.92	4.88	8	272663.0	3573184.0
Alon USA Big Spring Refinery	D074TK01	755.74	12.19	8	271996.1	3573283.8
Alon USA Big Spring Refinery	D074TK02	755.67	12.19	8	272017.8	3573289.1
Alon USA Big Spring Refinery	DTP1	766.91	12.19	8	272808.3	3574259.9
Alon USA Big Spring Refinery	DTP2	768.73	12.50	8	272956.8	3574307.7
Alon USA Big Spring Refinery	DTP5	770.54	14.94	8	272921.1	3574445.7
Alon USA Big Spring Refinery	DTP7	764.86	15.24	8	272750.6	3574150.3
Alon USA Big Spring Refinery	DLJW	749.49	5.18	8	272163.7	3572702.9
Alon USA Big Spring Refinery	DLTW	760.03	12.80	8	272037.6	3573843.5
Alon USA Big Spring Refinery	DTW	750.00	10.97	8	272176.0	3572761.2
Alon USA Big Spring Refinery	DTK3131	751.17	12.19	8	273207.3	3573008.0
Alon USA Big Spring Refinery	DTK3132	753.04	12.19	8	272921.3	3572962.8
Alon USA Big Spring Refinery	D3TK1	750.83	7.32	8	271938.7	3572886.5

Site	Building ID	Elevation (m)	Tier Height (m)	Total Corners	Origin Corner UTM Easting (X; m)	Origin Corner UTM Northing (X; m)
Alon USA Big Spring Refinery	D5001BIO	747.25	14.63	8	272361.4	3572731.2
Alon USA Big Spring Refinery	D5002BIO	746.64	14.63	8	272393.7	3572739.5
Alon USA Big Spring Refinery	DCCU	748.27	4.88	4	272053.9	3572581.8
Alon USA Big Spring Refinery	DWWTRBLD	748.02	5.00	4	272324.0	3572708.6
Alon USA Big Spring Refinery	DAFEWHSE	755.59	8.23	4	271882.0	3573144.2
Alon USA Big Spring Refinery	DPOWRDIS	754.17	8.23	4	271943.7	3573030.6
Alon USA Big Spring Refinery	DAROMEX	753.21	8.29	7	272056.1	3573022.2
Alon USA Big Spring Refinery	DTK3009	748.80	10.67	8	272496.5	3572908.5
Alon USA Big Spring Refinery	DGTRCTRL	750.37	5.49	4	272410.5	3572931.5
Alon USA Big Spring Refinery	DTK3006	750.68	5.18	8	272447.4	3572987.9
Alon USA Big Spring Refinery	DTKWEST	750.87	20.73	8	271662.9	3572830.4

Table 8-8: **Wetness Classification Precipitation Data**

Year	Ackerly 4 SE, TX (USC00410034)	Big Spring 5 NE, TX (USC00410781)	Big Spring Field, TX (USC00410784)	Big Spring, TX (USW00023041)	Forsan, TX (USC00413253)	Average Precip. (inches)	AERSURFACE Classification
1988	24.58				17.5	21	--
1989	8.54				17.7	13.1	--
1990	22.5			21.5	27.4	23.8	--
1991	30.35			30.7		30.5	--
1992	24.26				32.6	28.5	--
1993	24.46			20.3	17.6	20.8	--
1994	13.21			18.3	17.4	16.3	--
1995	20.63				15.7	18.2	--
1996	11.92				14.6	13.2	--
1997	21.07			18.5	22.9	20.8	--
1998	10.21			13.7	15	13	--
1999	18.27			11.8	11.1	13.7	--
2000	14.37				19	16.7	--
2001					17.3	17.3	--
2002					18	18	--
2003					15.4	15.4	--
2004				33.9	35.4	34.6	--
2005				16.9	19.9	18.4	--
2008				12.5		12.5	--
2010		23.5		31.1		27.3	--
2011		5.9		5.2		5.5	--
2012		18.8	21	18		19.3	--
2013		16.7	16.1			16.4	--
2014			14.8			14.8	--
2015			26.4			26.4	--
2016			24.1	36.8		30.5	Wet
2017		16.3	15.7	24.7		18.9	Average
2018		17.3	17.4	22		18.9	Average
2019		15.4	19.1	21.2		18.6	Average
2020			12.1			12.1	Dry

[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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