



INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

We Protect Hoosiers and Our Environment.

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Eric J. Holcomb
Governor

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Commissioner

February 8, 2019

Ms. Cathy Stepp
Regional Administrator
U.S. Environmental Protection Agency
Region V
77 West Jackson Boulevard
Chicago, IL 60604-3950

Dear Ms. Stepp:

Re: Supplement to the 1-Hour Sulfur Dioxide
(SO₂) Attainment Demonstration and
Technical Support Document for the
Morgan County, IN Nonattainment Area

The Indiana Department of Environmental Management (IDEM) developed and is providing supplemental information for the Morgan County, IN nonattainment area to the 1-Hour Sulfur Dioxide Attainment Demonstration and Technical Support Document. IDEM submitted the attainment demonstration to United States Environmental Protection Agency (U.S. EPA) on October 2, 2015.

This supplement addresses U.S. EPA's request to provide additional analyses to characterize representative background concentrations in Morgan County. In response, IDEM has conducted several analyses to revise the background concentrations and update the dispersion modeling supporting a revised attainment demonstration for the Morgan County, IN nonattainment area.

This submittal consists of one (1) hard copy of the required documentation. An electronic version of the submittal in PDF format that is identical to the hard copy has been sent to Mr. Doug Aburano, Chief of U.S. EPA Region 5's Attainment Planning and Maintenance Section, as well as Mr. Chris Panos of U.S. EPA Region 5.

IDEM believes that this supplement to Indiana's attainment plan submittal for the Morgan County, IN nonattainment area satisfies Indiana's obligation under Section 172(c) of the Clean Air Act to demonstrate how the area will attain, and maintain, the 2010 1-hour SO₂ standard.

Ms. Cathy Stepp
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IDEM requests that U.S. EPA proceed with review and approval of the 1-Hour SO₂ Attainment Demonstration and Technical Support Document for the Morgan County, IN Nonattainment Area. If you have any questions concerning this submittal, please do not hesitate to contact Mr. Mark Derf, Chief, Technical Support and Modeling Section, Office of Air Quality, at (317) 233-5682 or mderf@idem.IN.gov.

Sincerely,



Keith Baugues
Assistant Commissioner
Office of Air Quality

KB/sd/md/bc/gf/as

Enclosure:

Supplement to the 1-Hour Sulfur Dioxide Attainment Demonstration and Technical Support Document for the Morgan County, IN Nonattainment Area

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Supplement to the
1-Hour Sulfur Dioxide Attainment Demonstration and
Technical Support Document
for the
Morgan County, IN Nonattainment Area

Clay and Washington Townships, Morgan County,
Indiana

Prepared By:
Indiana Department of Environmental Management
Office of Air Quality
February 2019

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Introduction

On October 2, 2015, Indiana submitted a document to United States Environmental Protection Agency (U.S. EPA) titled *1-Hour Sulfur Dioxide (SO₂) Attainment Demonstration and Technical Support Document for Central, West Central and Southwest Indiana Nonattainment Areas*.¹ The submittal addressed planning requirements resulting from nonattainment designations issued by U.S. EPA on July 25, 2013 for the following areas: Indianapolis, IN (Wayne, Center and Perry Townships in Marion County); Morgan County, IN (Clay and Washington Townships in Morgan County); Terre Haute, IN (Fayette and Harrison Townships in Vigo County); Southwest, IN (Veale Township in Daviess County and Washington Township in Pike County).²

On August 2, 2018, U.S. EPA proposed to approve the plan provisions for all of the areas except the Morgan County, IN nonattainment area.³ While conducting a review of the Morgan County, IN nonattainment area, U.S. EPA concluded that the background concentration that Indiana used to determine 1-hour SO₂ air quality appeared to understate the impact of unmodeled sources in the area. U.S. EPA requested additional analyses to accurately characterize representative background concentrations in Morgan County. In response, Indiana Department of Environmental Management (IDEM) has conducted several analyses to revise the background concentrations and update the air dispersion modeling analysis supporting a revised attainment demonstration for the Morgan County, IN nonattainment area. Following are technical data and discussions which demonstrate Indiana meets its obligation under Section 172(c) of the Clean Air Act (CAA) for ensuring the area's attainment of the 1-hour SO₂ standard.

1.0 Air Quality and Emissions Trends Analyses

As part of this supplement for the Morgan County, IN attainment demonstration, IDEM evaluated the air quality information for Morgan County to identify potential trends. The trends analyses evaluated 12 years of monitored data from the SO₂ ambient air monitoring site used for nonattainment area designation and SO₂ emissions reported by sources found to be contributing significantly to the monitored violation(s) in the designated nonattainment area. The results of these analyses for Morgan County are discussed below.

1.1 Air Quality Trends Analysis

IDEM conducted an air quality trends analysis for 2006 - 2017 using monitoring data from the Eagle Valley – High Street monitor, Site ID 181091001. This data, presented below in Table 1, Table 2, and Chart 1, shows improved air quality and monitored ambient concentrations below the 1-hour SO₂ standard.

¹ See <https://www.in.gov/idem/airquality/2638.htm>.

² 78 FR 47191 (<https://www.govinfo.gov/content/pkg/FR-2013-08-05/pdf/2013-18835.pdf>).

³ 83 FR 40487 (<https://www.govinfo.gov/content/pkg/FR-2018-08-15/pdf/2018-17582.pdf>).

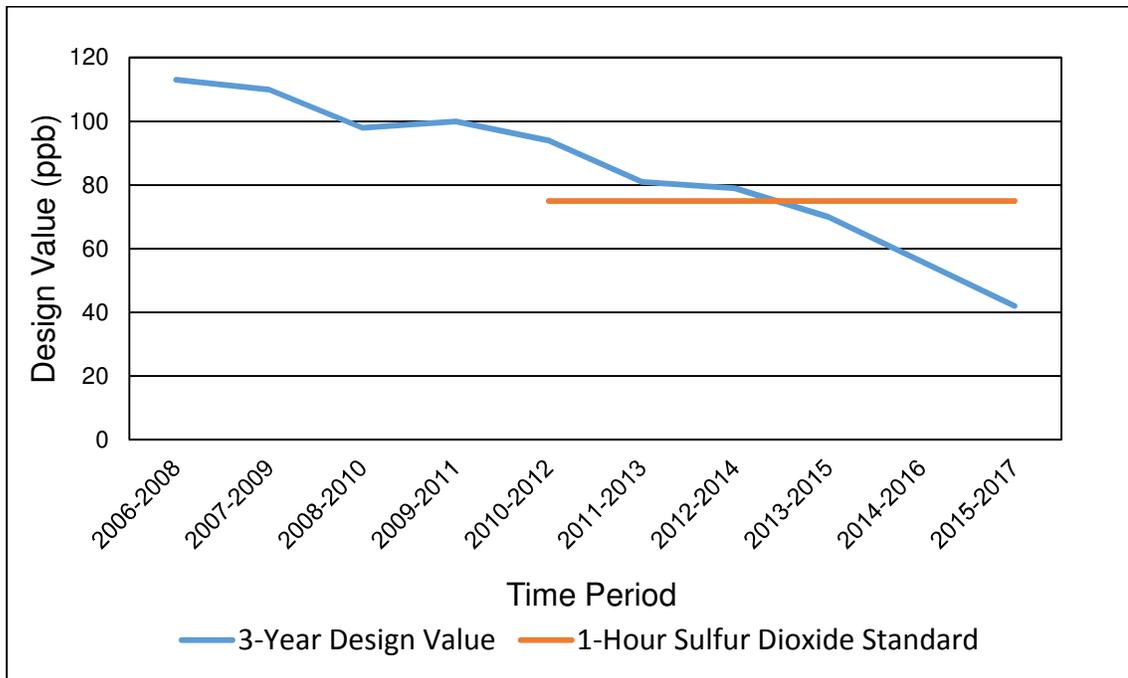
Table 1: Annual SO₂ 99th Percentile 1-Hour Daily Maximum Values, Eagle Valley – High Street Monitor, Site ID 181091001, Morgan County (ppb)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
108	140	91	98	105	96	82	64	90	56	23	47

Table 2: SO₂ 3-Year Design Values, Eagle Valley – High Street Monitor, Site ID 181091001, Morgan County (ppb)

2006-2008	2007-2009	2008-2010	2009-2011	2010-2012	2011-2013	2012-2014	2013-2015	2014-2016	2015-2017
113	110	98	100	94	81	79	70	56	42

Chart 1: SO₂ 3-Year Design Values, Eagle Valley – High Street Monitor, Site ID 181091001, Morgan County (ppb)



1.2 Emissions Trends Analysis

1.2.1 Emissions

An emissions trends analysis was conducted to include emissions reported by the Morgan County SO₂ sources evaluated for the attainment demonstration. These include Indianapolis Power and Light's Eagle Valley Power Plant (IPL - Eagle Valley) and Hydraulic Press Brick (HPB), a building aggregate manufacturer. As shown in Table 3, substantial decreases in reported SO₂ emissions have occurred at the sources within the nonattainment area. These decreases are a result of permanent and

federally enforceable emissions reductions strategies adopted pursuant to, and outlined in, the October 2, 2015, attainment demonstration.⁴

Table 3: Reported SO₂ Emissions from Contributing Sources in Morgan County (tons per year)

Year	Facility	
	IPL - Eagle Valley	Hydraulic Press Brick Company (HPB)
2006	14,841	542
2007	16,101	515
2008	13,102	
2009	11,091	342
2010	12,266	350
2011	10,875	
2012	3,436	
2013	5,461	353.85
2014	7,959	
2015	2,756	
2016	1,217	14.6
2017	0	

Note 1: IPL - Eagle Valley reported zero SO₂ emissions for 2017 as a result of shutting down their six coal-fired units and installing two natural gas-fired combined cycle combustion turbines.

Note 2: Hydraulic Press Brick is required, per 326 IAC 2-6, to report, at a minimum, triennially.

1.2.2 Permanent and Enforceable Control Measures

IPL - Eagle Valley is located in the Morgan County, IN nonattainment area and is in the current Morgan County SO₂ SIP. IPL - Eagle Valley has historically operated six boilers, units 1 - 6 and a distillate oil fired generator at its generating facility located on Blue Bluff Road in Martinsville, Indiana. IPL - Eagle Valley was issued a Prevention of Significant Deterioration (PSD) permit in October of 2013 to construct and operate two natural gas-fired combined cycle combustion turbines, an auxiliary boiler, a dew point heater, an emergency generator and an emergency fire pump. In 2017, IPL began

⁴ See <https://www.in.gov/idem/airquality/2638.htm>.

operation of the facilities permitted in 2013 and the natural gas-fired units model attainment of the 1-hour SO₂ NAAQS.

Hydraulic Press Brick has historically operated three coal-fired kilns identified as Kilns #3, #4 and #5 at its brick-making facility located on North Tidewater Road in Mooresville, Indiana. In addition to the SO₂ emissions from fuel combustion in the kilns, shale, the raw material used to produce bricks, contains sulfur compounds that also contribute to SO₂ emissions from the brickmaking-process. The company has discontinued operation of Kiln #3 and installed and operates dry sorbent injection for SO₂ emission controls on Kilns #4 and #5. This control technology achieves a 50% SO₂ reduction on average which has been determined to be adequate by IDEM and the U.S. EPA in addressing Hydraulic Press Brick's SO₂ emission contributions in the nonattainment area. Therefore, Kilns #4 and #5 are limited to a minimum control efficiency of 50% or 2.5 lbs of SO₂/MMBtu, whichever is less stringent, with a maximum limit of 6 lbs of SO₂/MMBtu. The company tests the sulfur content of the shale, which is mined onsite, to ensure the use of lower sulfur content shale. This control strategy has reduced sulfur dioxide emissions from the facility and provides a reasonable level of reduction to address its potential impact on SO₂ concentrations in Morgan County.

2.0 Modeling Analysis and Attainment Demonstration

This section presents the technical information used to analyze air quality data and demonstrate attainment of the 1-hour SO₂ standard in Morgan County. The analysis has been conducted according to U.S. EPA's Guidance for 1-Hour SO₂ Nonattainment Area SIP Submissions⁵ (U.S. EPA Guidance) and U.S. EPA's Guideline on Air Quality Models - Appendix W to 40 CFR Part 51 (Appendix W).⁶

2.1 Technical Elements of the Modeling Analysis

2.1.1 Model Selection

Per U.S. EPA Guidance and Appendix W, the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) is the preferred regulatory air quality model for 1-hour SO₂ attainment demonstration modeling. As such, the latest AERMOD version 18081 was used for the supplemental attainment demonstration modeling. The appropriate form of the SO₂ standard was modeled, which is the 4th high (99th percentile) of the 1-hour maximum daily SO₂ concentration averaged across five years. This modeled result combined with the appropriate background concentration must be less than or equal to the 1-hour SO₂ National Ambient Air Quality Standard (NAAQS) of 75 ppb. The attainment demonstration modeling results were compared to the 1-hour SO₂ NAAQS expressed as 196.2 micrograms per cubic meter (µg/m³) for dispersion modeling results, which compares to 75 ppb.⁷

⁵ See https://www.epa.gov/sites/production/files/2016-06/documents/20140423guidance_nonattainment_sip.pdf.

⁶ See https://www3.epa.gov/ttn/scram/appendix_w/2016/AppendixW_2017.pdf.

⁷ 76 FR 69052 (<https://www.state.nj.us/dep/baqp/petition/EPA.pdf>).

As part of the input data required by AERMOD, the mapping of terrain elevations were assigned with the AERMAP (version 18081) terrain preprocessor mapping program. AERMAP determines the elevation heights of all buildings, sources, and receptors included in the air quality modeling. Additionally, the terrain elevation data were obtained from the National Elevation Dataset (NED) based on the Universal Transverse Mercator (UTM) coordinates for the North American Datum (NAD) 1983. These NED elevation files were downloaded from the United States Geological Survey (USGS) web site as recommended by the U.S. EPA modeling Guidance.

The regulatory default setting was selected for the air quality modeling runs and rural land-use classifications were selected for Morgan County. The downwash algorithm was invoked in all air quality modeling where stack heights did not meet the Good Engineering Practice (GEP) stack height.

2.1.2 Receptor Grid and Domain

The receptor grids and modeling domain followed the recommended approach from Appendix W, with some additional built-in conservatism. Receptor spacing for IPL - Eagle Valley was every 50 meters out to a distance of 1,000 meters. The next grid extended using 100 meter spacing out to a distance of 3,000 meters. The outer 250 meter spacing receptor grid extended out to a distance of 6,000 meters.

2.1.3 SO₂ Modeled Sources

Six emission units within IPL - Eagle Valley were modeled, including two turbines, an auxiliary boiler, a heater, emergency generator, and a fire pump. The two combined-cycle combustion turbines and auxiliary boiler operate on natural gas and have realized large reductions in SO₂ emissions. The modeled emission rates are shown below in Table 4.

Table 4: 1-Hour SO₂ Modeled Emission Rates for Morgan County, IN Nonattainment Area

Modeled Source	Emission Unit	Modeled Emission Rate (lbs/hr)
IPL - Eagle Valley	Combustion Turbine 1	3.56
IPL - Eagle Valley	Combustion Turbine 2	3.56
IPL - Eagle Valley	Auxiliary Boiler	0.11
IPL - Eagle Valley	DP Heater	0.029
IPL - Eagle Valley	Emergency Generator	0.022
IPL - Eagle Valley	Fire Pump	0.006

2.1.4 Downwash and GEP Stack Height

The Building Profile Input Program (BPIP) was used to calculate the wind direction specific building dimensions for input to AERMOD. The output from BPIP is read by AERMOD to calculate the aerodynamic downwash for all modeled stacks. All buildings which may affect the aerodynamic downwash in the wake of each modeled stack were included in the program. The length, width, height and location of each building and the height and location of each stack are included as inputs to the program. Per U.S. EPA Guidance and Appendix W, because no stacks have a physical stack height above 65 meters, or approximately 213 feet, thereby not exceeding the GEP stack height formula, all stacks were modeled at their actual stack height. The actual GEP stack height formula is, for stacks in existence prior to January 12, 1979, $H_{GEP} = 2.5H$ and after January 12, 1979, $H_{GEP} = H + 1.5L$, where H is the height of the nearby structure and L is the lesser of the height or projected width of nearby structures within the 5L formula.

2.1.5 Meteorological Data and Modeled Years

Meteorological data from the years 2013 through 2017 were used in the analysis. Surface data from the Indianapolis National Weather Service (NWS) station and upper air data from the Lincoln, Illinois NWS station were processed with the latest version, 18081, of the AERMOD meteorological data processor program, AERMET. These stations represent the nearest locations to the Morgan County, IN SO₂ nonattainment area.

The latest AERMINUTE, version 15272, was used to process the 1-minute wind speed and wind direction Automated Surface Observing System (ASOS) data. The recommended default of 0.5 meters per second (m/s) for the calm wind speed threshold was used when processing the 1-minute wind speed and wind direction ASOS data from Indianapolis. Historically, the NWS meteorological data contains a number of calm wind speeds greater than 10% of the 8,760 annual observation hours. The U.S. EPA

developed the AERMINUTE program in order to reduce that proportion of calm winds by averaging the 1-minute wind speed and wind direction data.

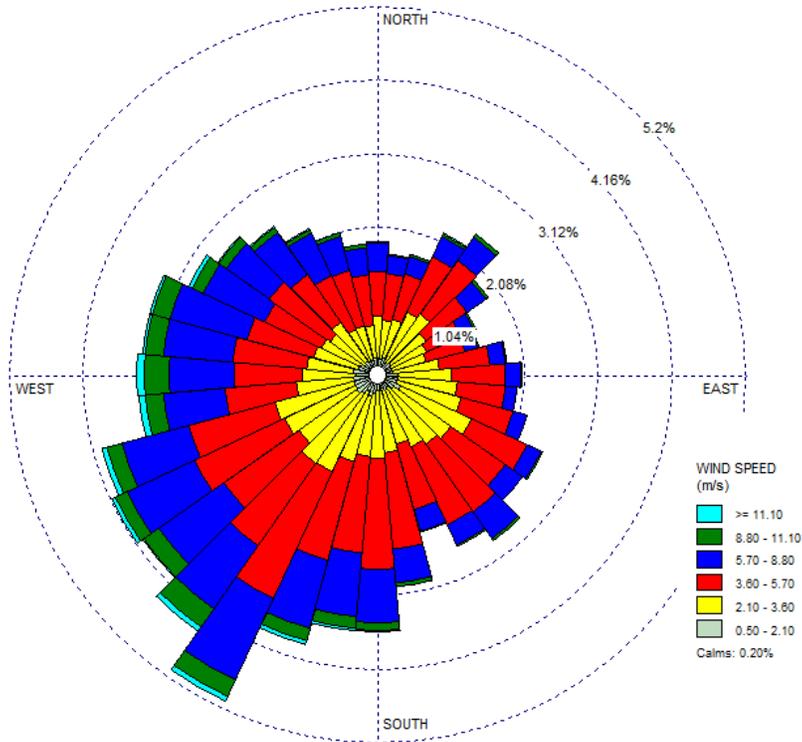
The U.S EPA program AERSURFACE was used to determine the surface characteristics, including albedo, Bowen ratio, and surface roughness, for each of the two NWS meteorological tower locations in Indianapolis. Surface characteristics were determined at each NWS location for 12 wind direction sectors with a recommended default radius of one kilometer.

The albedo and the Bowen ratio surface characteristics were adjusted during the three winter months of December, January, and February in accordance with U.S. EPA Region 5 recommended protocol.⁸ Additionally, a dry or wet Bowen ratio value was used during months when precipitation was above the 70th percentile for wet or below the 30th percentile for dry; otherwise the Bowen ratio value for average soil moisture conditions was used. The surface roughness value for snow cover was used if more than half of the month had days with at least one inch of snow on the ground. Otherwise, the no snow cover surface roughness value was used. Indianapolis NWS had a total of three winter months in which at least half of the days in the month had at least one inch of snow cover on the ground. Three of the four months had a total of 20 days or more with at least one inch of snow on the ground. As a result, the surface roughness snow cover value was not adjusted for the number of days in each month using the no snow cover surface roughness value. Therefore, the surface roughness snow cover value without adjustment was used for these four winter months.

The Indianapolis NWS wind rose plot, for the modeled years 2013 – 2017, is shown in Figure 1 below. The wind rose shows the frequency of the wind direction every ten degrees for specific wind speed ranges. The plot shows the directions from which the wind is blowing in compass degrees and the wind speeds are in meters per second. As can be seen, the prevailing winds at the Indianapolis, IN NWS station are from the southwest for 2013 through 2017.

⁸ See <https://www.pca.state.mn.us/sites/default/files/aq2-50.pdf>.

Figure 1: 2013 - 2017 Indianapolis NWS Wind Rose



2.1.6 SO₂ Background Concentrations

SO₂ background concentrations were developed in accordance with methodologies recommended by U.S. EPA Guidance and Appendix W. To determine background concentrations, two approaches were used. The first approach calculated a single background calculation; the second approach calculated seasonally-hourly varying background values. In both approaches, in order to account for unmodeled sources, the analysis focuses on a narrow band of wind directions between 25 degrees (north-northeast (NNE)) and 60 degrees (east-northeast (ENE)), which corresponds, approximately, to HPB located upwind of the Eagle Valley – High Street monitor. The most recent ambient monitoring data from 2015 – 2017 were used in the calculations.

The background concentrations determined reflect times when winds are blowing the emissions of IPL - Eagle Valley away from the monitor, so that the background values will not reflect any impact of the emission reductions at this source. Conversely, given the wind directions used in this analysis, emission reductions at HPB are expected to have a direct impact on background concentrations monitored at the Eagle Valley – High Street monitor. The most recent three years (2015 to 2017) reflect approximately two years before sorbent injection began and approximately one year after sorbent injection began. Using the methods described above, analysis of concentrations using the most recent three years yields a background value of 36.7 ppb or 96.0 µg/m³. Continued operation of the sorbent injection control system will help assure that the impacts of unmodeled sources on monitored concentrations will remain well below the 1-hour SO₂ standard.

Using the methods described above, analysis of concentrations using this most recent three years, a single background value of 36.7 ppb, or 96.0 $\mu\text{g}/\text{m}^3$ was determined.

The second approach used the same data set of hours and associated concentrations when winds were from between 25 and 60 degrees as was used in determining a single background concentration. These data were sorted by season and by hour. Data were available for almost all hours for the first 23 hours of the day, with no data available for the last hour of the day. Therefore, a value for the 24th hour of the day was determined by averaging the value for the 23rd hour and the value for the 1st hour. The 96 bins (for four seasons and 24 hours) had an average of 33 observations each. For purposes of improving the robustness of this analysis, all three years were combined in a single bin; no year-by-year analysis was conducted. The second highest value in each bin was selected as the background concentration for the applicable season and hour. This method resulted in 96 individual seasonal-hourly values that were used as background in the modeling as shown in Table 5. These values range from 1.1 ppb to 43.7 ppb (2.8 to 114.5 $\mu\text{g}/\text{m}^3$), with an average of 16.1 ppb (42.2 $\mu\text{g}/\text{m}^3$).

Table 5: Seasonal-Hourly Specific Background Concentrations (ppb)

Hour	Winter	Spring	Summer	Fall
1	9.5	25	17	28.4
2	3.6	17.5	6	27.5
3	11	18.7	7.4	37.4
4	11	40.9	19	37.1
5	8.5	29.6	18.5	23
6	19	31	16.9	19.1
7	27.2	30	15.8	14.8
8	3.7	28.5	20.9	34.5
9	5	27.5	18.8	24.2
10	11	9.4	13	30
11	4.1	7	8.4	13.6
12	10	9.8	4	14
13	4	5.9	4.8	18.5
14	7	5.2	3.5	18.5
15	7	7.4	3.6	17.5
16	12.5	11	6	16
17	6	9.6	9.4	22.2
18	10	12.1	5.1	28.5
19	11	18.4	1.3	25
20	5	22.7	28	36
21	4.8	18.7	19.9	32.7
22	4	10	1.1	37.9
23	3.5	23	15.5	43.7
*24	6.5	24	16.25	36.05

2.2 Attainment Demonstration Modeling Results

IDEM has conducted modeling analyses to demonstrate the nonattainment area located in Morgan County will meet the 1-hour SO₂ NAAQS 75 ppb or 196.2 µg/m³.

As depicted in Table 6, a maximum impact from modeled sources of 7.69 µg/m³ was determined. Background values, determined by two methodologies, were then added to the maximum modeled impact to determine compliance with the 1-hour SO₂ standard.

Using the single background concentration value of 36.7ppb, or 96.0 µg/m³, results in a design value of 103.69 µg/m³. Using varying seasonal/hourly background concentrations yields a maximum design value of 117.33 µg/m³. In both cases, the modeled design values are below 196.2 µg/m³, which is used for modeling purposes and is comparable to the standard of 75 ppb. Therefore, the AERMOD modeling results demonstrate the nonattainment area located in Morgan County will meet the 1-hour SO₂ NAAQS.

Table 6: 1-Hour SO₂ Air Dispersion Modeling Analysis Results for the Morgan County, IN Nonattainment Area

Background Concentration		Maximum Impact from Modeled Source(s)	Modeled Design Value	Is the modeled concentration below 196.2 µg/m ³ ?
Single Value	96.0 µg/m ³	7.69 µg/m ³	103.69 µg/m ³	Yes
Varying	See Table 5	7.69 µg/m ³	117.33 µg/m ³	Yes

*196.2 µg/m³ is used for dispersion modeling and compares with the 1-Hour SO₂ NAAQS of 75 ppb.

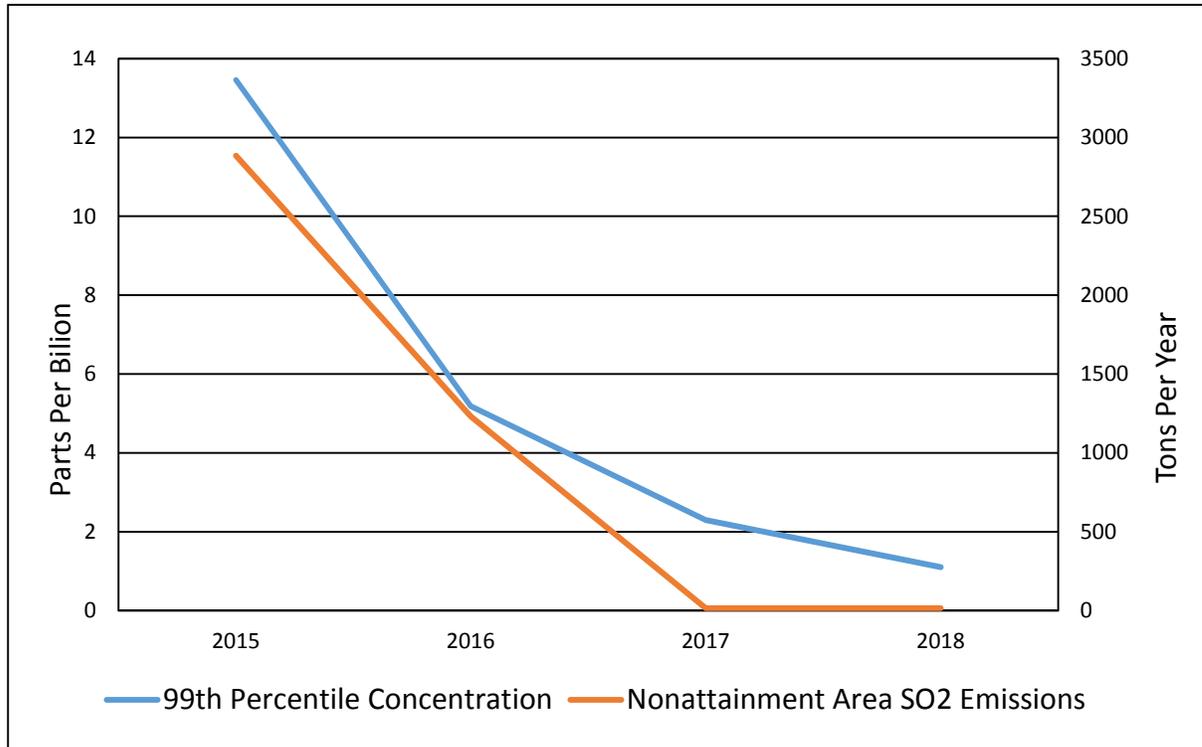
2.3 Additional Analysis

In order to demonstrate that the emission reductions realized in the Morgan County, IN nonattainment area have wide ranging benefits, an analysis was conducted to determine whether decreases of ambient concentrations of SO₂ occurred nearby. The closest SO₂ monitor outside of the Morgan County, IN nonattainment area is the Indianapolis - Harding St. monitor (ID 180970056) in Marion County, which is 31 km to the east-northeast. SO₂ concentrations at the Indianapolis - Harding St. monitor were evaluated when the winds were blowing from 200 to 240 degrees when the Morgan County, IN nonattainment area would be considered upwind.

As can be seen in Chart 2, a strong correlation is shown between emissions reductions that occurred within the Morgan County, IN nonattainment area and monitored SO₂ concentrations in Marion County. This illustrates that the emissions

reductions that occurred in the Morgan County, IN nonattainment area has had beneficial effects within the region and beyond.

Chart 2: Correlation of Monitored SO₂ Concentrations in Marion County with Upwind Emission Reductions in the Morgan County, IN Nonattainment Area



3.0 Conclusion

This document contains a thorough analysis of air quality trends, emissions trends and air dispersion modeling. Results are included that support the conclusion that Indiana's attainment plan for the Morgan County, IN nonattainment area will ensure compliance with the 1-hour SO₂ standard.

Since the Morgan County, IN area's nonattainment designation in 2013, permanent and enforceable emissions control measures have been established that have significantly reduced SO₂ emissions from the area. Compliance with these reduction strategies is reflected in the monitored SO₂ levels in Clay and Washington Townships in Morgan County and nearby downwind areas. Recent monitoring data shows concentrations well below the 1-hour SO₂ standard.

In conclusion, this supplement to Indiana's October 2, 2015 attainment plan submittal for the Morgan County, IN nonattainment area satisfies Indiana's obligation under Section 172(c) of the CAA to demonstrate how the area will attain, and maintain, the 2010 1-hour SO₂ standard.