Attachment 2

Indiana's Air Quality Modeling Technical Support Document

Preliminary Designation Recommendations

Data Requirements Rule (Round 3)

2010 Primary 1-Hour Sulfur Dioxide (SO_2) National Ambient Air Quality Standard (NAAQS)

January 2017

Table of Contents

List of Tables

List of Figures

List of Enclosures

MODELING TECHNICAL SUPPORT DOCUMENT FOR PRELIMINARY DESIGNATION RECOMMENDATIONS

DATA REQUIREMENTS RULE (ROUND 3) FOR THE 2010 PRIMARY 1-HOUR SULFUR DIOXIDE (SO_2) NATIONAL AMBIENT AIR QUALITY STANDARD

1.0 1-Hour SO_2 NAAQS and Designation Process

The United States Environmental Protection Agency (U.S. EPA) established the 1-hour primary sulfur dioxide (SO_2) National Ambient Air Quality Standard (NAAQS) of 75 parts per billion (ppb) as published in the Federal Register (FR) on June 22, 2010 (75 FR 35519). This standard is based on the 3-year average of the annual 99th percentile of the 1-hour daily maximum concentrations. For air quality modeling purposes, the Indiana Department of Environmental Management (IDEM), Office of Air Quality (OAQ) uses an equivalent 1-hour SO_2 NAAQS of 196.2 micrograms per cubic meter ($\mu g/m^3$) as stated in 76 FR 69051. This is based on the 3-year average of the annual 99th percentile of the 1-hour daily maximum modeled SO_2 concentrations, representing the fourth high of the 1-hour daily maximum SO_2 modeled concentrations.

Implementation of the standard began in 2013, when U.S. EPA made initial designations based on 2010-2012 monitoring data (78 FR 47191). Subsequently, on March 2, 2015, U.S. EPA entered into a consent decree with the Sierra Club and the Natural Resources Defense Council establishing a timeline for the completion of air quality characterizations designations in all remaining areas of the country. The court order directed U.S. EPA to complete the designations in three additional rounds: Round 2 by July 2, 2016 (81 FR 45039), Round 3 by December 31, 2017, and Round 4 by December 31, 2020.

Round 3 and 4 designations are implemented through U.S. EPA's SO_2 Data Requirements Rule (DRR) (80 FR 51051). Round 3 designations apply to source areas that opt to characterize SO_2 through modeling and have ***not*** implemented ambient air monitoring by January 1, 2017. Round 4 designations apply to source areas that opt to characterize SO_2 by having implemented new ambient air monitoring by January 1, 2017. In addition, sources may opt to take permanent federally enforceable emission limits in order to reduce SO_2 emissions to below the DRR threshold of 2,000 tons per year.

2.0 Data Requirements Rule

As stated above, Round 3 designations are implemented through U.S. EPA's SO_2 DRR. Under this rule, SO_2 should be characterized in the vicinity of sources that had actual emissions in 2014 of 2,000 tons or more, or have been identified by IDEM or U.S. EPA "as requiring further air quality characterization."

Requirements specific to the DRR were followed in order to implement the 1-hour SO_2 NAAQS. Indiana identified 11 sources within the state that met the criteria established in the DRR. This list of sources was submitted to U.S. EPA – Region V on January 7, 2016. On March 25, 2016, U.S. EPA subsequently identified six additional sources meeting the criteria for air quality characterizations under the DRR. Five of these sources were "consent decree" sources and were designated unclassifiable/attainment under Round 2 (81 FR 45039). The sixth source, U.S. Mineral Products (U.S. Minerals) was listed by U.S. EPA as subject to the DRR due to concern for air quality in the area. All DRR sources, the counties they reside and their 2014 SO_2 emissions are listed in Table 2.1.

Table 2.1 - Indiana Sources Subject to the Data Requirements Rule

Facility	County	2014 SO_2 Emissions (tons)
Duke – Gallagher	Floyd	3,524
Duke – Gibson	Gibson	Round 2 Source [a]
U.S. Mineral Products (Isolatek)	Huntington	< 2,000 [b]
NIPSCO – R.M. Schahfer	Jasper	8,412
IKEC–Clifty Creek Generating Station	Jefferson	Round 2 Source [a]
ArcelorMittal – USA	Lake	2,163
Coke Energy	Lake	4,952
U.S. Steel – Gary Works	Lake	3,285
NIPSCO - Michigan City	LaPorte	Round 2 Source [a]
ArcelorMittal - Burns Harbor	Porter	12,189
SABIC Innovative Plastics	Posey	4,030
Vectren—A.B. Brown Generating Station	Posey	Round 2 Source [a]
AEP - Rockport	Spencer	Round 2 Source [a]
Hoosier Energy – Merom	Sullivan	3,318
Duke – Cayuga	Vermillion	3,448
Alcoa Warrick Power Plant	Warrick	4,993
Alcoa Warrick Operations Plant	Warrick	3,500 [c]

[a] IDEM completed characterization for this source under Round 2 designation requirements. U.S. EPA issued final Round 2 designations on June 30, 2016 (81 FR 45039).

[b] Added by U.S. EPA.

[c] Alcoa Warrick Operations shut down its smelter operations on March 31, 2016, reducing SO_2 emissions to < 1 ton source-wide.

As per the requirements of the DRR, air agencies were required to indicate whether they will rely on 1) air quality modeling, 2) ambient monitoring or 3) establishing a limit of a source's total SO_2 emissions to below 2,000 tons per year, to characterize air quality in the area surrounding the DRR sources. Indiana reviewed each source and determined that eight sources will conduct air dispersion modeling to characterize air quality including, where appropriate, modeling non-DRR sources. One source, ArcelorMittal – Burns Harbor, opted to rely on ambient monitoring to characterize air quality (see Section 10.0 and transmittal Attachment 5). For U.S. Mineral Products (Isolatek), Indiana disagrees with U.S. EPA on its inclusion as being subject to the DRR (see transmittal Attachment 3). Lastly, for Alcoa Warrick Operations and Alcoa Warrick Power Indiana feels that these two facilities and the surrounding area should be designated attainment based on historical SO_2 ambient monitoring showing attainment of the SO_2 standard and the fact that the Operations Plant shut down their aluminum smelting operations on March 31, 2016 and has negligible SO_2 emissions as a result of the shutdown (see transmittal Attachment 4).

U.S. EPA has established deadlines for each step of the 1-hour SO_2 designation process in the DRR. Indiana met the first deadline by submitting its list of DRR sources on January 7, 2016.

- **January 15, 2016 -** States were required to submit their list of SO_2 sources for characterizing air quality under the DRR to U.S. EPA.
- **July 1, 2016 –** States were required to submit modeling protocols for sources characterizing air quality in the area with air dispersion modeling.
- **July 1, 2016 –** States were required to submit Annual Monitoring Network Plans that detailed modifications to SO_2 monitors intended to satisfy the DRR.
- **January 1, 2017 –** SO_2 monitors intended to satisfy the DRR are required to be operational.
- **January 13, 2017 –** States electing to characterize air quality by air dispersion modeling are required to provide modeling analyses to U.S. EPA.
- **January 13, 2017 –** Federally enforceable and permanent emission limits to keep source emissions below 2,000 tons of SO_2 must be adopted and effective.
- **August 2017 –** Expected date by which U.S. EPA will notify states of intended designations.
- **December 2017 –** Date by which U.S. EPA will complete final designations for the majority of the country.
- **August 2019 –** Approximate due date for state attainment plans for areas designated nonattainment in 2017.
- **May 2020 –** Required certification of 2019 monitoring data; states have the opportunity to provide updated state recommendations to U.S. EPA.
- **August 2020 –** Expected date by which U.S. EPA would notify states of intended designations for reminder of the country not yet designated.

- **December 2020 –** Date by which the U.S. EPA would complete final designations for the remainder of the country.
- **August 2022 –** Approximate due date for state attainment plans for areas designated nonattainment in 2020.

3.0 Methodology for DRR Air Quality Modeling

The modeling methodology resembles modeling used to evaluate New Source Review (NSR) and Prevention of Significant Deterioration (PSD) sources. However, U.S. EPA provided further guidance in order to conduct an appropriate air dispersion modeling analysis to support 1-hour SO_2 designation recommendations. U.S. EPA's SO_2 NAAQS Designations Modeling Technical Assistance Document (TAD) guidance has several recommendations for modeling methodology for determining attainment designations, including:

1) Use of actual emissions to assess modeled concentrations to reflect current air quality.
2) Use of three years of modeling results to calculate a simulated 1-hour SO_2 design value consistent with the 3-year monitoring period to develop 1-hour SO_2 design values.
3) Placement of receptors only in locations where an air quality monitor could be placed.
    - Based on the SO_2 NAAQS Designations Modeling TAD, Section 4.2; Indiana placed modeling receptors only where feasible to place a monitor. Therefore, in bodies of water or an area where monitor siting criteria would not be reasonably met, Indiana did not place receptors.
    - Indiana matched up the modeling domain with Google map projections to ensure the proximity of the receptors to shorelines and have provided receptor/mapping details for each modeling analysis.
4) Use of actual stack heights rather than relying on Good Engineering Practice (GEP) stack heights when modeling actual emissions.

Indiana followed U.S. EPA's designation modeling recommendations to conduct 1-hour SO_2 modeling to determine whether there are modeled violations of the 1-hour SO_2 NAAQS. Modeling results looked at the 4^{th} high maximum daily 1-hour SO_2 concentrations averaged over the 3-year modeled period with representative temporally varying seasonal SO_2 background concentrations included within the AERMOD modeling run to determine the attainment status of the area in the vicinity of the DRR source.

4.0 Model Selection for DRR Modeling

4.1 AERMOD Dispersion Model

In accordance with Appendix A of Appendix W to 40 Code of Federal Regulations (CFR) Part 51, Indiana used the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) version 15181 for all dispersion modeling. U.S. EPA's SO_2 NAAQS Designations Modeling TAD, specific to attainment designation modeling, recommended using actual stack heights when modeling actual emissions instead of following the GEP stack height requirement. BPIPPRIME was used to account for any building downwash concerns.

4.2 AERMAP

The AERMOD terrain preprocessor mapping program, AERMAP, was used to determine all the terrain elevation heights for each receptor, building, and source locations using the Universal Transverse Mercator (UTM) coordinate system. The most recent AERMAP version 11103 assigned the elevations from the National Elevation Dataset (NED) using the North American Datum (NAD) 1983 as recommended in 40 CFR Part 51, Appendix W, Revision to the Guideline on Air Quality Models and later revised in the "AERMOD Implementation Guide."

4.3 Land Use Determination

The Auer Land Use Classification Scheme was used to determine land use in the area of each source, pursuant to 40 CFR Part 51, Appendix W section 7.2.3(c). Land use types were classified within a 3 kilometer radius about the source. If land use types I1 (heavy industrial), I2 (light moderate industrial), C1 (commercial), R2-R3 (compact residential) account for over 50 percent of the total land area, urban dispersion coefficients were used. If not, the rural dispersion coefficients were used.

5.0 Receptor Grid and Modeling Domain

The receptor grid and modeling domain was based on guidance provided in the memorandum "Updated Guidance for Area Designations for the 2010 Primary Sulfur Dioxide National Ambient Air Quality Standards", dated March 20, 2015 and the SO_2 NAAQS Designations Modeling TAD. Indiana used a multi-nested rectangular receptor grid with appropriate spacing of receptors based on the distance from the modeled emission points to detect significant concentration gradients. Indiana has conducted exploratory modeling on each of the DRR sources and did not find maximum modeled 1-hour SO_2 impacts or DRR source-culpable modeled violations that extended out beyond 10 kilometers. In situations where multiple sources covered by the DRR were evaluated in the same area, the modeling domain extended to include all sources and the appropriate distances to model maximum 1-hour SO_2 impacts to determine attainment designations for the area. Indiana generally used the following multi-nested rectangular receptor grid in all cases, with additional receptors added as needed:

- Receptor spacing at the fence line for each facility placed every 50 meters.
- Receptor spacing at 100 meters out to a distance of 3,000 meters (3 kilometers) beyond each facility (grid was extended if modeling results warranted).
- Receptor spacing at 250 meters out to a distance of 5,000 meters (5 kilometers) beyond each facility (grid was extended if modeling results warranted).
- Receptor spacing at 500 meters out to a distance of 10,000 meters (10 kilometers) beyond each facility (grid was extended if modeling results warranted).

6.0 Meteorology

6.1 AERMET

As stated in 40 CFR Part 51, Appendix W, section 8.3.1.2 and the SO_2 NAAQS Designations Modeling TAD, Indiana used three years (2012-2014 or 2013-2015) of National Weather Service (NWS) and on-site surface data and upper air meteorological data processed with the latest version of the AERMOD meteorological data preprocessor program AERMET (version 15181). Table 6.1 below lists the modeled facilities as mentioned in the DRR and the corresponding surface and upper air meteorological stations used to conduct modeling.

Table 6.1 - National Weather Service Stations/Onsite Meteorological Stations

DRR Facility	Surface Meteorology	Upper Air Meteorology
SABIC Innovative Plastics Hoosier Energy - Merom	Evansville, IN NWS	Lincoln, IL NWS
Duke – Gallagher	Louisville, KY NWS	Wilmington, OH NWS
Arcelormittal – USA Coke Energy U.S. Steel – Gary Works ArcelorMittal Burns Harbor	Gary-IITRI onsite meteorological data processed with South Bend, IN NWS	Lincoln, IL NWS
NIPSCO – R.M. Schahfer	South Bend, IN NWS	Lincoln, IL NWS
Duke –Cayuga	Indianapolis, IN NWS	Lincoln, IL NWS

Indiana requested on November 9, 2016 for concurrence by U.S. EPA for the use of the adjusted surface friction velocity (ADJ_U*) Beta option in order to more accurately model 1-hour SO_2 concentrations from DRR sources located in Lake County. On December 20, 2016, U.S. EPA finalized “Revisions to the Guidelines on Air Quality Models, Enhancements to the AERMOD Dispersion Modeling System and Incorporation of Approaches to Address Ozone and Fine

Particulate Matter". This rule approved ADJ_U* as a regulatory option and was used in the DRR modeling for Lake County.

6.2 AERMINUTE/AERSURFACE

The 1-minute wind speeds and wind directions, taken from the Automated Surface Observing System (ASOS) NWS stations and onsite meteorological stations, were processed with the U.S. EPA's 1-minute data processor AERMINUTE (version 15272) program.

The U.S. EPA's AERSURFACE (version 13016) program was used to determine the surface characteristics; albedo, Bowen ratio, and surface roughness for the Indianapolis, Evansville, South Bend, Indiana and Louisville, Kentucky NWS meteorological tower locations. Surface characteristics were determined at each NWS location for each of 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 January, February, and December in accordance with the U.S. EPA Region V document, "Regional Meteorological Data Processing Protocol," dated May 6, 2011. Additionally, a dry or wet Bowen ratio value was used during months when soil moisture conditions were abnormally dry or wet; 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.

7.0 SO_2 Background Concentrations

The modeling of all DRR sources used adjusted temporally varying seasonal background concentrations or concentrations without upwind major source SO_2 impacts. Each source used 1-hour SO_2 monitoring data, taken from nearby monitors, considered representative of background concentrations for the area. Since most SO_2 monitoring sites located in the state are downwind of large SO_2 sources, impacts from the upwind direction of the large SO_2 source were removed from the monitoring data since those sources were included in the modeling inventory. The 99th percentile SO_2 concentrations by season (winter, spring, summer and fall) for each hour of the day were calculated to determine the temporally varying seasonal SO_2 background, which were directly input into the model and were part of the final modeled results. This procedure was used to prevent double counting of SO_2 sources within the background concentration values used for this attainment designation modeling.

Temporally varying seasonal SO_2 background concentrations were developed in accordance with the recommended U.S. EPA guidance for establishment of such background concentrations in

Section 8.2 of 40 CFR Part 51, Appendix W and considered appropriate and representative of the area. The latest three years of SO_2 air quality monitoring data (2012-2014 or 2013-2015) were used to develop background concentrations for each of the areas mentioned in the DRR. The procedures used to develop the SO_2 background concentrations are included as Enclosure 1. Table 7.1 shows the DRR facility and corresponding 1-hour SO_2 monitoring sites used for representative background concentrations in the air quality characterization.

Table 7.1 - Indiana DRR Sources and Nearby Background Monitoring Sites

Facility	County	Monitoring Sites
SABIC Innovative Plastics	Posey	Evansville – Buena Vista
Duke – Gallagher	Floyd	New Albany – Green Valley
NIPSCO – R.M. Schahfer	Jasper	Wheatfield – Center St.
Hoosier Energy – Merom	Sullivan	Terre Haute – North Lafayette Road
Duke – Cayuga	Vermillion	Fountain County -North of State Road 234
ArcelorMittal – USA Coke Energy U.S. Steel – Gary Works	Lake	Gary-IITRI and Hammond
ArcelorMittal - Burns Harbor	Porter	Dunes Acres Substation

8.0 SO_2 Emissions Sources to be Modeled

8.1 DRR Sources

Indiana modeled the hourly continuous emissions monitoring (CEM) data from sources subject to the DRR, where available. Along with the hourly SO_2 emission data, hourly variable stack gas flow rate and temperature of the exhaust stream were modeled, if available. This variation in parameters may influence dispersion characteristics of the exhaust stream and impact modeled 1-hour SO_2 concentrations.

For those emission sources without continuous emissions data, actual short-term emissions taken from the source's latest available emissions reporting were used. The SO_2 NAAQS Designations Modeling TAD, Section 5 was referenced to best characterize any temporal and/or seasonal variability of emissions. This would include any seasonal, monthly, or daily variations that can be quantified. Specific emissions characterizations that were modeled will be addressed for each DRR source later in this document.

There are instances where sources emitted less than 2,000 tons of SO_2 in 2014 and are not listed as a DRR source, but are located in the vicinity of a DRR source within the modeling receptor grid. This was considered a cluster source and the source was evaluated along with the DRR source in the air quality modeling analysis to determine the air quality characterization in the area.

8.2 Inventory Sources

Based on the U.S. EPA memo "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard", dated March 1, 2011, page 16, Indiana is focused on the characterization of air quality within 10 kilometers for each of the DRR sources. U.S. EPA's SO_2 NAAQS Designations Modeling TAD Section 4.1, page 7, mentions the number of sources to be explicitly modeled should cause a significant concentration gradient and the number of those sources to be modeled would generally be small. Indiana developed a list of SO_2 emission sources in the county of the DRR source, as well as larger SO_2 emission sources in adjacent counties and states, as requested by U.S. EPA – Region 5, that were explicitly modeled.

Emission sources near the DRR source were evaluated to determine if those sources could cause or contribute to a 1-hour SO_2 NAAQS violation. Indiana used the following threshold as a screening method to narrow the focus of sources that could potentially have an impact on designations: sources with SO_2 emissions greater than 250 tons per year and located within 30 kilometers of the DRR source. While this method was applied on an area-by-area basis, Indiana felt this was an accurate representation of air quality in the area, especially since the hourly seasonal background concentrations adequately captures SO_2 impacts from surrounding sources. IDEM also identified sources with emissions less than 250 tons that were included in DRR modeling due to their proximity within the DRR source receptor grid used in the dispersion modeling. Actual emissions taken from the latest available emissions inventories were modeled for sources identified by these threshold levels to determine air quality characteristics in the area.

8.3 Intermittent Sources

Emergency generators, fire pumps, and startup/shutdown emissions were handled consistent to the March 1, 2011 guidance "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 NAAQS", dated March 1, 2011. U.S. EPA recommended using appropriate data based on emissions scenarios that are continuous enough or frequent enough to contribute significantly to the annual distribution of maximum daily 1-hour concentrations. Review of the hours of operations for combustion turbines, emergency generators, startup/shutdown, fire pumps, and other auxiliary operations associated with the sources addressed by the DRR have been determined to operate much less than 500 hours per year and have random and infrequent schedules that cannot be controlled. Indiana feels that the intent of the DRR is to determine the attainment status of the area surrounding large SO_2 emission sources based on actual emissions coming from the large units. As such, this is

Indiana's main focus of the designation determinations. This approach is consistent with previous 1-hour SO_2 nonattainment and designation modeling submitted by IDEM to U.S. EPA.

9.0 Analysis of Modeling Results

The purpose of this modeling demonstration is to characterize air quality and determine area designations as it relates to attainment of the 1-hour SO_2 NAAQS in accordance with the DRR. The 99th percentile of the 1-hour daily maximum modeled concentrations represents the fourth high of the 1-hour daily maximum SO_2 modeled concentrations and are averaged across three years to compare resulting concentrations to the 1-hour SO_2 NAAQS of 75 ppb (196.2 $\mu g/m^3$).

Modeled concentrations include representative temporally varying seasonal 1-hour SO_2 background values to determine the overall impact from the DRR sources. This resulting concentration is compared to the 1-hour SO_2 standard to indicate whether a modeled violation of the SO_2 NAAQS has occurred. All concentrations that fall at or below the 1-hour SO_2 NAAQS are determined to attain the standard and the area surrounding the DRR source is recommended as attainment.

10.0 ArcelorMittal – Burns Harbor (Source ID 18-127-00001)

10.1 Source Description

ArcelorMittal - Burns Harbor, LLC (Burns Harbor) is a stationary steel works plant for the production of coke, limited coal chemical, molten iron, molten steel, steel slabs, hot rolled steel, steel coils, steel plates, cold rolled and/or coated steel sheet and plate. Specific emission units associated with Burns Harbor include a coke oven process plant, coke by-products recovery plant, blast furnace granulated coal injection system, continuous sintering process plant, two blast furnaces, basic oxygen furnaces shop, slab/plate mill complex, hot strip mill, cold sheet mill operations, power station, service shop and technical maintenance operations and fugitive dust emission operations including sinter plant and blast furnace operations.

10.2 Characterization of Modeled Area

Burns Harbor opted to select the monitoring option for air quality characterization in the vicinity of its facility. Therefore, a modeling analysis was conducted to determine the location of maximum modeled 1-hour SO_2 impacts near the facility. Once the location of maximum impacts was determined, Burns Harbor located an ambient air monitor near that location in order to accurately measure the SO_2 impacts from Burns Harbor and nearby SO_2 sources to compare with the 1-hour SO_2 NAAQS.

10.3 Summary of DRR Monitoring Approach

Burns Harbor and IDEM completed a modeling analysis and SO_2 Monitor Quality Assurance and Project Plan (QAPP) to site an SO_2 monitor and submitted both to U.S. EPA- Region 5 on June 10, 2016. On August 5, 2016, U. S. EPA approved the analysis and general monitor site location based on "hot spot" modeling to determine the maximum modeled 1-hour SO_2 concentration. Burns Harbor procured monitoring equipment and obtained, from the Port of Indiana, a lease for land. U.S. EPA approved IDEM's monitoring network for 2017 on October 31, 2016, which included the Burns Harbor SO_2 monitor. Burns Harbor was able to construct a concrete pad and shelter, set up and calibrate the equipment in early December 2016 and began operation of the monitor in mid-December, well ahead of the January 1, 2017 deadline. Clean Air Engineering completed testing of the communications system and verified calibration of all monitoring equipment. This monitor has been assigned AQS Identification number: 18-127-0028 and was operational on or before January 1, 2017. The monitoring network, consisting of the ArcelorMittal – Burns Harbor and the Dunes Acres Substation (AQS ID #18-127-0011) monitors meets the DRR requirement.

11.0 SABIC Innovative Plastics (Source ID 18-129-00002)

11.1 Source Description

SABIC Innovative Plastics Mt. Vernon, LLC (SABIC) is a plastics manufacturing facility. SABIC produces plastics for industries such as automotive, consumer electronics and medical devices.

SABIC is retrofitting their facility with a cogeneration (CoGen) plant that will use natural gas to create a majority of the steam for the site. Currently, SABIC's coal-fired boilers provide approximately 40 percent of the facility's steam. The U.S. EPA recently issued a new Maximum Achievable Control Technology (MACT) standard for industrial, commercial, and institutional boilers. SABIC is building their CoGen plant to address those standards. Significant SO_2 emission reductions are a byproduct of this project as several coal-fired boilers at SABIC were shut down once the project became fully operational by the end of December of 2016.

SABIC was identified as a Data Requirements Rule (DRR) source based on their actual 2014 SO_2 emissions of 4,030 tons exceeding the DRR threshold of 2,000 tons of SO_2. While the CoGen project helped SABIC realize significant SO_2 emission reductions, potential SO_2 emissions from the facility were still above 2,000 tons. The modeling option was chosen to address the DRR.

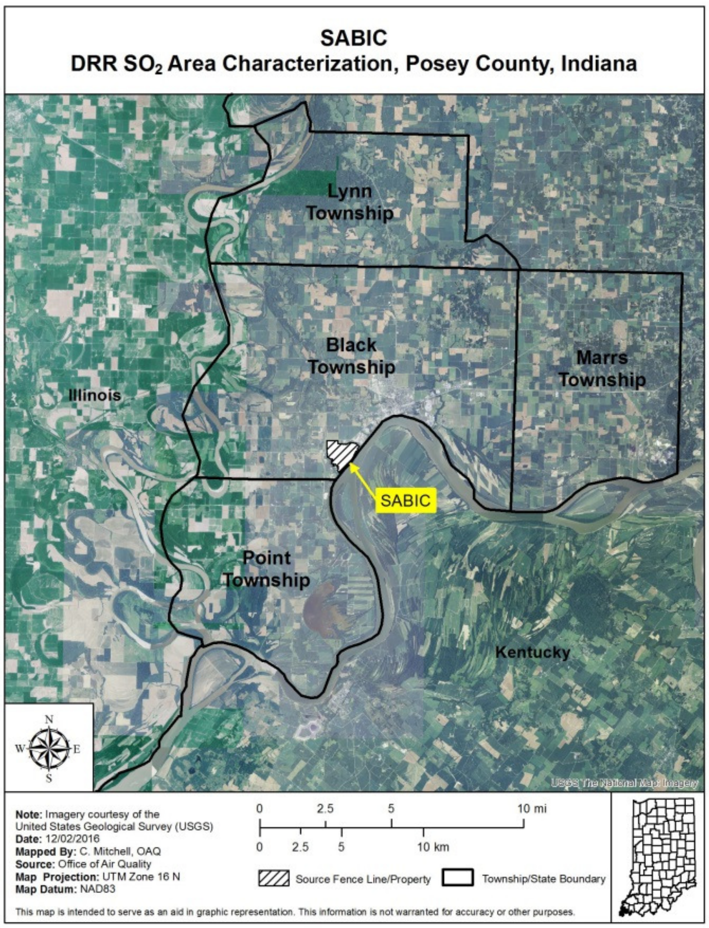
Initial modeling, using actual emissions data from 2014, showed higher modeled 1-hour SO_2 concentrations. However, after discussions with SABIC, it was decided they would request a

Commissioner's Order to establish plant-wide SO_2 emission limits that would be federally enforceable and permanent and would model attainment of the 1-hour SO_2 standard.

11.2 Characterization of Modeled Area

SABIC is located at 1 Lexan Lane, Mt. Vernon, Indiana, less than a mile from the Ohio River in Black Township, Posey County, Indiana. A map of the area surrounding the SABIC facility and the township in which SABIC is located is shown below in Figure 11.1.

Figure 11.1 - SABIC Innovative Plastics and Surrounding Area



11.3 Background Concentrations

The nearest 1-hour SO_2 monitored concentrations were taken from the Evansville – Buena Vista monitor (AQS #18-163-0021). The 99th percentile values from 2013 through 2015 and the 3-year design value are listed below in Table 11.1. Concentrations are well below the 1-hour SO_2 standard.

Table 11.1 – SABIC 99th Percentile 1-hour SO_2 Background Values and 3-year Design Value (ppb)

Monitoring Site	2013	2014	2015	2013-2015
Evansville – Buena Vista	18.6	32.3	18	23

11.4 Modeling Methodology

The SABIC DRR modeling methodology resembles modeling used to evaluate New Source Review (NSR) and Prevention of Significant Deterioration (PSD) sources. However, Indiana has relied on U.S. EPA guidance "EPA's SO_2 NAAQS Designations Modeling Technical Assistance Document" in order to conduct an appropriate air dispersion modeling analysis for SABIC to support 1-hour SO_2 designation recommendations.

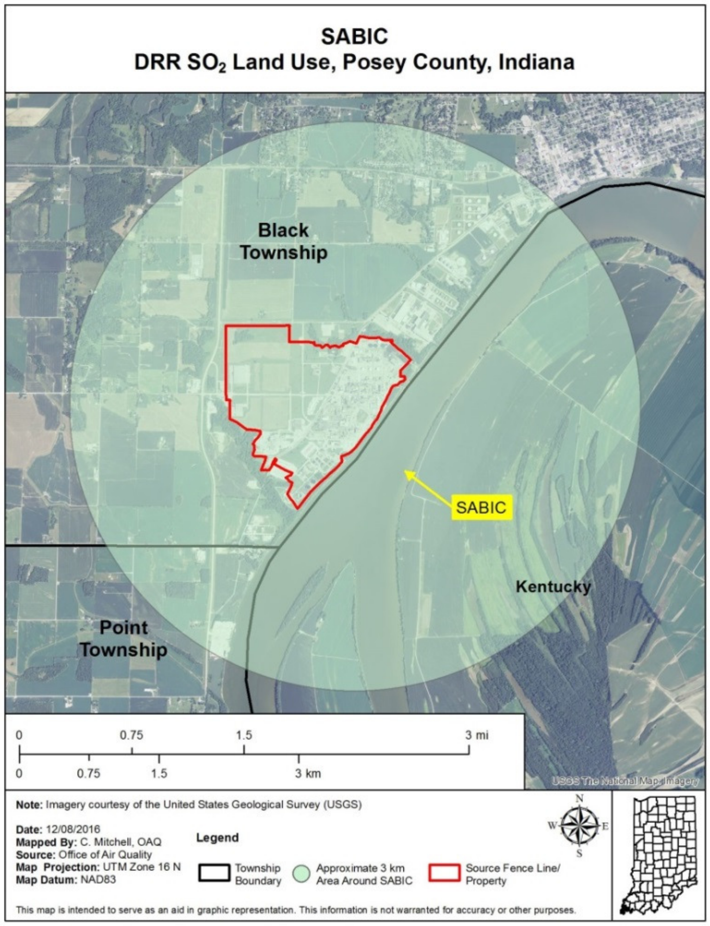
11.4.1 Model Selection

In accordance with Appendix A of Appendix W to 40 Code of Federal Regulations (CFR) Part 51, Indiana used the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) version 15181. BPIPPRIME was used to account for any building downwash concerns.

11.4.2 Model Options

All regulatory default options within AERMOD were used to determine the air quality characteristics surrounding SABIC. The area is considered primarily rural, based on the Auer's Classification Land Use methodology with a vast majority of the land use types within 3 kilometers of SABIC, classified as metropolitan natural (A1), agricultural rural (A2), water surfaces (A5) and estate residential (R4). Therefore, a rural classification was used, as provided for in the Guideline on Air Quality Models, Section 7.2.3 (EPA, 2005b). No variation of the population selection was necessary. Figure 11.2 shows the 3-kilometer radius area surrounding SABIC that was analyzed to determine the land use classification.

Figure 11.2 – SABIC 3-km Radius to Determine Auer Land Use



11.4.3 AERMAP

The AERMOD terrain preprocessor mapping program, AERMAP, was used to determine all the terrain elevation heights for each receptor, building, and source locations using the Universal Transverse Mercator (UTM) coordinate system. The most recent AERMAP version 11103 assigned the elevations from the National Elevation Dataset (NED) using the North American Datum (NAD) 1983 as recommended in the, "40 CFR Part 51, Revision to the Guideline on Air Quality Models" Appendix W and later revised in the "AERMOD Implementation Guide."

11.5 Meteorological Data

11.5.1 AERMET

As stated in 40 CFR Part 51, Appendix W, section 8.3.1.2 and the SO_2 NAAQS Designations Modeling TAD, Indiana used 2013-2015 National Weather Service (NWS) surface and upper air meteorological data processed with the latest version of the AERMOD meteorological data

preprocessor program AERMET (version 15181). Table 11.2 below lists surface and upper air meteorological stations used to conduct modeling.

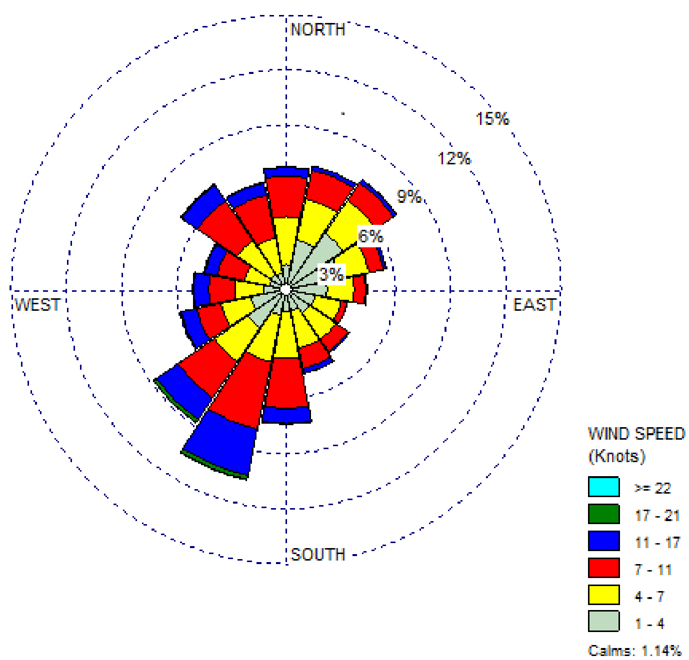
Table 11.2 – SABIC NWS Stations/Onsite Meteorological Stations

Facility	Surface Meteorology	Upper Air Meteorology
SABIC Innovative Plastics	Evansville, IN NWS	Lincoln, IL NWS

11.5.2 Wind Rose

The Evansville National Weather Service (NWS) surface meteorological data and the Lincoln, Illinois upper air meteorological data taken from 2013 through 2015 was used to determine the meteorological conditions for the area surrounding SABIC in AERMOD. The Evansville NWS wind rose for the 3-year modeled period 2013-2015 is shown as Figure 11.3 below. The Evansville NWS wind rose depicts the predominant wind direction as from the southwest for the 3-year modeled period of 2013-2015.

Figure 11.3 - Evansville 3-year Cumulative Wind Rose (2013 – 2015)



11.5.3 AERMINUTE/AERSURFACE

The 1-minute wind speeds and wind directions, taken from the Automated Surface Observing System (ASOS) NWS stations and onsite meteorological stations, were processed with the U.S. EPA 1-minute data processor program AERMINUTE version 15272.

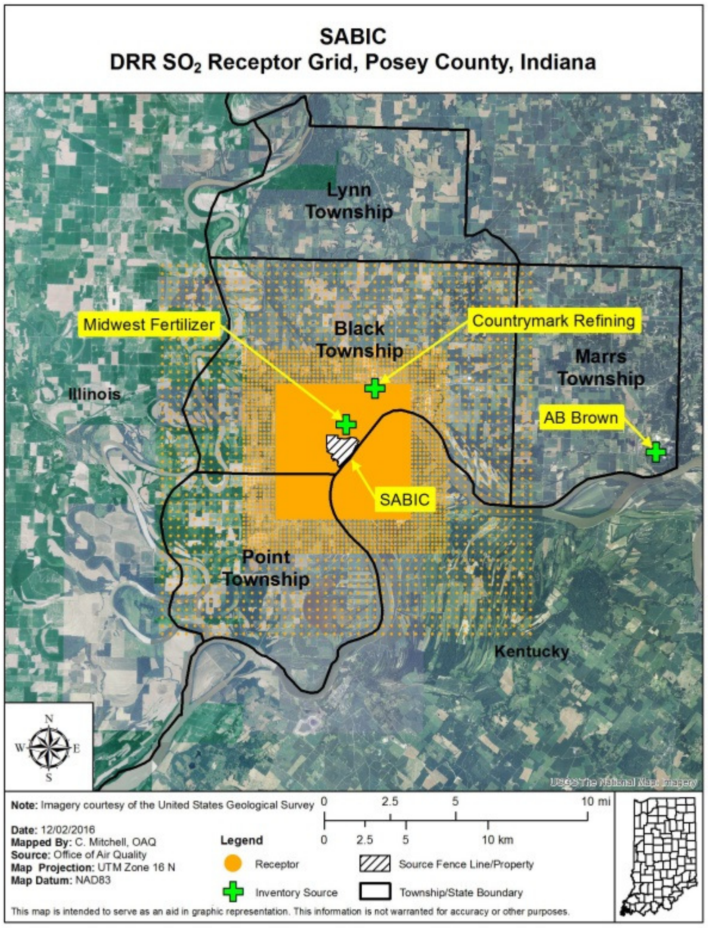
The U.S. EPA program AERSURFACE version 13016 was used to determine the surface characteristics; albedo, Bowen ratio, and surface roughness for the Evansville, Indiana NWS meteorological tower location. Surface characteristics were determined at the NWS location for each of 12 wind direction sectors with a recommended default radius of one kilometer. The albedo and the Bowen ratio surface characteristics were adjusted during the three winter months of January, February, and December in accordance with the U.S. EPA Region V document, "Regional Meteorological Data Processing Protocol," dated May 6, 2011. Additionally, a dry or wet Bowen ratio value was used during months when soil moisture conditions were abnormally dry or wet; 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.

11.6 Receptor Grid and Modeling Domain

The receptor grid and modeling domain was based on guidance provided in the memorandum "Updated Guidance for Area Designations for the 2010 Primary Sulfur Dioxide National Ambient Air Quality Standards", dated March 20, 2015 and the SO_2 NAAQS Designations Modeling TAD. Indiana used a multi-nested rectangular receptor grid with appropriate spacing of receptors based on the distance from the modeled emission points to detect significant concentration gradients. The modeling domain extended out to include all sources and the appropriate distances to model maximum 1-hour SO_2 impacts to determine attainment designations for the area. Indiana used the following multi-nested rectangular receptor grid which are listed below and depicted in Figure 11.4:

- Receptor spacing at the fence line for the DRR facility was placed every 50 meters.
- Receptor spacing at 100 meters was placed out to a distance of 3,000 meters (3 kilometers) beyond the DRR facility.
- Receptor spacing at 250 meters was placed out to a distance of 5,000 meters (5 kilometers) beyond the DRR facility.
- Receptor spacing at 500 meters was placed out to a distance of 10,000 meters (10 kilometers) beyond the DRR facility.

Figure 11.4 – SABIC Receptor Grid



The SABIC property is fully fenced and has regular security patrols to keep unauthorized people off the property. Since this is the case, receptors were placed along the property lines.

11.7 Stack Heights

The use of actual stack heights rather than relying on Good Engineering Practice (GEP) stack heights when modeling actual emissions was utilized in the analysis per the SO_2 NAAQS Designations Modeling TAD.

11.8 Temporally Varying Seasonal 1-Hour SO_2 Background

Temporally varying seasonal SO_2 background concentrations were developed in accordance with the recommended U.S. EPA guidance for establishment of such background concentrations in Section 8.2 of 40 CFR Part 51, Appendix W and considered appropriate and representative of the area. The latest three years of SO_2 air quality monitoring data (2013-2015) was used.

The 99th percentile SO_2 concentrations by season (winter, spring, summer and fall) for each hour of the day were calculated to determine the temporally varying seasonal SO_2 background, which were directly input into the model and were part of the final modeled results.

Temporally varying seasonal 1-hour SO_2 background concentrations were taken from the Evansville – Buena Vista Road monitor for 2013 - 2015. The hourly seasonal SO_2 values used for representative background concentrations for the area surrounding SABIC are listed below in Table 11.3.

Table 11.3 – SABIC 99th Percentile Temporally Varying Seasonal SO_2 Background Values (ppb)

	Hr 1	Hr 2	Hr 3	Hr 4	Hr 5	Hr 6	Hr 7	Hr 8
Winter	6.30	4.83	4.63	4.36	5.77	4.84	4.70	7.39
Spring	5.12	3.89	4.09	3.98	3.40	4.20	6.83	7.59
Summer	2.70	2.48	1.00	1.00	1.96	2.65	2.80	5.55
Fall	4.44	4.52	4.50	4.50	4.80	4.60	4.97	5.70

	Hr 9	Hr 10	Hr 11	Hr 12	Hr 13	Hr 14	Hr 15	Hr 16
Winter	9.29	10.42	9.20	10.67	11.55	17.57	8.71	16.01
Spring	9.99	9.84	11.89	11.65	7.94	9.89	8.39	8.55
Summer	9.93	11.05	8.50	9.02	7.34	5.65	5.49	5.16
Fall	7.55	10.68	11.37	11.21	10.39	12.92	9.11	7.56

	Hr 17	Hr 18	Hr 19	Hr 20	Hr 21	Hr 22	Hr 23	Hr 24
Winter	9.94	16.85	8.28	6.67	5.74	6.58	6.79	7.98
Spring	11.04	12.53	9.99	8.40	5.81	3.92	7.04	6.65
Summer	4.11	6.99	5.88	4.05	3.36	2.45	3.58	2.19
Fall	8.20	6.95	5.23	8.60	5.70	4.68	4.46	4.40

11.9 SO_2 Emissions Included in the Modeling Analysis

11.9.1 DRR Source: SABIC Emissions

As a result of the CoGen project, a number of SO_2 emission units will shut down. The unit that will still have significant SO_2 emissions is the COS Vent Oxidizer. SABIC has 16 carbon monoxide (CO) reactors, or generators, that are used to manufacture carbon monoxide. The CO generators are located in the phosgene process area. CO is generated by combusting coke (a petroleum-based material that consists mostly of carbon, with minor amounts of sulfur as an impurity) in the CO generators under low-oxygen conditions. Because the coke contains low levels of sulfur, the raw CO from the CO generators contains sulfur-containing impurities (carbonyl sulfide, carbon disulfide, and hydrogen sulfide). These impurities need to be removed prior to the next step in the manufacturing process, where CO is combined with chlorine to make phosgene.

The raw CO is purified by passing it through one of several carbon adsorbers. At the outlet of the adsorber, a gas chromatograph measures the concentrations of the sulfur-containing compounds in the purified CO. Once a certain level of sulfur-containing compounds is detected, the flow of raw CO is switched to another adsorber and the spent adsorber is regenerated by desorbing the sulfur-containing compounds with heated nitrogen.

The adsorbed regeneration gas (primarily nitrogen, with low levels of sulfur-containing compounds) is then vented to either the COS Vent Oxidizer or the COS Flare. The regeneration gas passes through a valve that directs the flow to either the COS Vent Oxidizer or the COS Flare, but cannot direct the flow to both simultaneously. The COS Vent Oxidizer is the primary control device; the COS Flare serves as a back-up to the COS Vent Oxidizer or during safety interlock of the system. Both the COS Vent Oxidizer and COS Flare eliminate the sulfur-containing compounds in the regeneration gas by thermal combustion.

Since SO_2 emissions can be routed to either the COS Vent Oxidizer or COS Flare, modeling was performed for both scenarios to determine the worst-case dispersion. Other ancillary sources such as the liquid waste boilers were included in the inventory. Most of the other ancillary sources have small SO_2 emissions (i.e. generators and fire pumps) but were included in the modeling. All SABIC emission limits were based on fuel usage and emissions calculations taken from U.S. EPA's AP-42 emission factors. All the emission limits that are in the Commissioner's Order #2016-03 have been represented in the modeling analysis. The Commissioner's Order can be found in Enclosure 4.

11.9.2 Inventoried SO_2 Sources Included in the Modeling

SO_2 sources from the surrounding area were evaluated to determine if their SO_2 emissions had a potential impact on the air quality surrounding SABIC, beyond what is captured through background monitoring data. The latest available actual emissions were input for some of the inventory sources.

CountryMark had a reduction in SO_2 emissions as a result of installing equipment to recover the vacuum off-gas (a refinery fuel gas) rather than combusting it in the crude heater. The recovered vacuum off-gas is routed to the refinery amine unit and sulfur recovery unit where a high percentage of the sulfur compounds are converted to molten sulfur. Since this was the case, the 2015 emissions were used in the modeling analysis. A.B. Brown was modeled with the SO_2 emission limits listed in their Commissioner's Order #2016-01. Midwest Fertilizer is still under construction and is not in full operation so an SO_2 emission rate taken from their permit was modeled. Table 11.4 lists the sources that were included in the AERMOD run to determine overall air quality characteristics.

Table 11.4 – SABIC Modeling Source Inventory

Source	Source ID	Location	SO_2 Emissions (tpy)
CountryMark	129-00037	Posey County	65.7
A.B. Brown	129-00010	Posey County	Emission Limits [a]
Midwest Fertilizer	129-00059	Posey County	1.3

[a] A.B. Brown established SO_2 emission limits in response to Round 2 designation requirements

11.10 Modeling Results

The 99th percentile of the 1-hour daily maximum modeled concentrations represents the fourth high of the 1-hour daily maximum SO_2 modeled concentrations and were averaged across three years to compare resulting concentrations to the 1-hour SO_2 NAAQS of 75 ppb (196.2 µg/m^3). Modeled concentrations include representative temporally varying seasonal 1-hour SO_2 background values to determine the overall impact. The resulting concentrations were compared to the 1-hour SO_2 standard to indicate whether a modeled violation of the SO_2 NAAQS occurred. All concentrations fell below the 1-hour SO_2 NAAQS and were determined to attain the standard and the area surrounding SABIC is recommended as attainment.

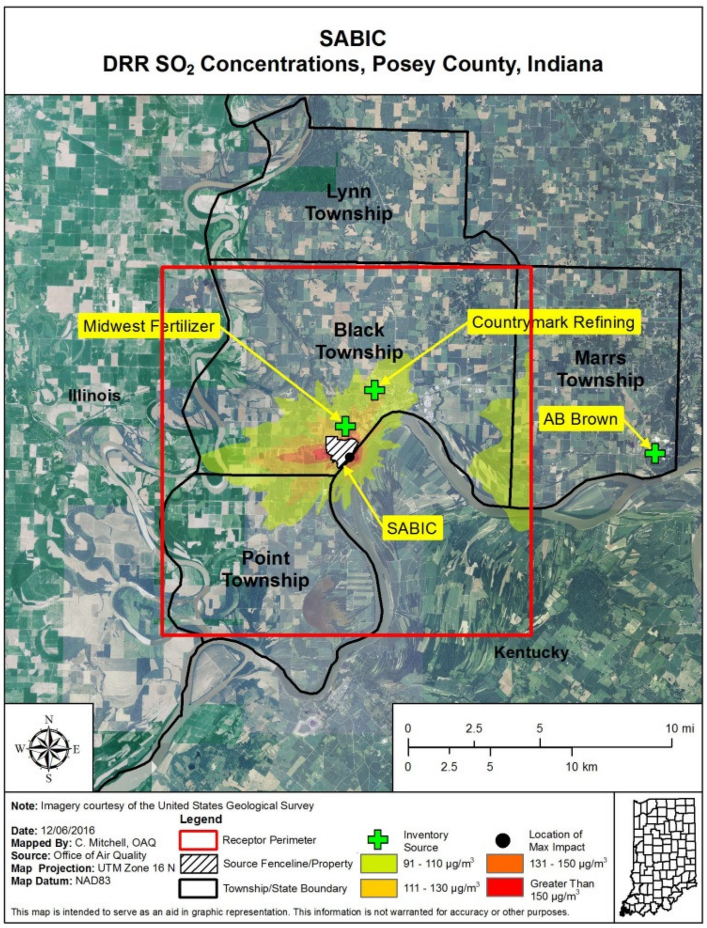
The COS Vent Oxidizer was the worst-case modeling scenario and was limited to 415 lbs of SO_2/hr which equates to a 269.21 lbs of SO_2/hr over a 24-hour averaging period. The COS Vent Oxidizer represented 93 percent of SABIC's total SO_2 modeled contributions. The other 7 percent of the modeled contributions were from SABIC's ancillary units, which also have SO_2 limits, as well as impacts from all other modeled inventory sources. Table 11.5 shows the modeled results used to establish SABIC's SO_2 emission limits. The overall maximum concentration was 191.9 µg/m^3; occurring at UTM coordinates: 418467.1 East, 4195409.8 North.

Table 11.5 – SABIC Modeling Results

Emission Scenarios	Maximum Modeled Concentration Including Seasonal Hourly Background (µg/m^3)	1-Hour SO_2 NAAQS (µg/m^3)	Facility Models Attainment
SABIC COS Flare	135.4	196.2	Yes
SABIC COS Vent Oxidizer	191.9	196.2	Yes

The concentration isopleths showing the maximum predicted 99th percentile daily 1-hour SO_2 concentration gradients can be found in Figure 11.5. The modeling demonstrated attainment of the 1-hour SO_2 standard with the emission limits listed in SABIC's Commissioner's Order.

Figure 11.5 – SABIC Modeling Results



12.0 Lake County: Source IDs ArcelorMittal – USA (18-089-00316)/Cokenergy (18-089-00383)/U.S. Steel (18-089-00121)

12.1 Source Description

ArcelorMittal - USA is an integrated steel mill consisting of two blast furnaces, one sinter plant, one basic oxygen furnace (BOF) complex, one hot metal Reladle/Desulf complex, an 84 inch hot strip mill with three reheat furnaces, mill finishing and sheet finishing operations, plate mill furnaces, two coke batteries, and five power station boilers. Some processes such as the BOF steel making processes have roof monitor emissions in addition to stack emissions. The blast furnaces also have non-point slag pit loadout fugitive emissions which are modeled as volume sources.

Cokenergy is an integrated steel mill consisting of one lime spray dryer Flue Gas Desulfurization unit and baghouse for the heat recovery coal carbonization facility (HRCC) waste gas stream operated by Indiana Harbor Coke Company (IHCC).

U.S. Steel is an integrated steel mill consisting of three coke batteries, a coke plant by-product recovery plant, one coke oven gas desulfurization facility, a coke plant boiler house, a sinter plant, four blast furnaces, two Basic Oxygen Process (BOP) shops with hot metal transfer and desulfurization stations, an 84 inch hot strip mill, a boiler house, and a TurboBlower boiler house. Some processes such as the BOF steel making processes have roof monitor emissions in addition to stack emissions. The blast furnaces also have non-point slag pit fugitive emissions which are modeled as volume sources.

The modeling option was chosen to address the DRR for each of the three DRR sources in Lake County.

12.2 Characterization of Modeled Area

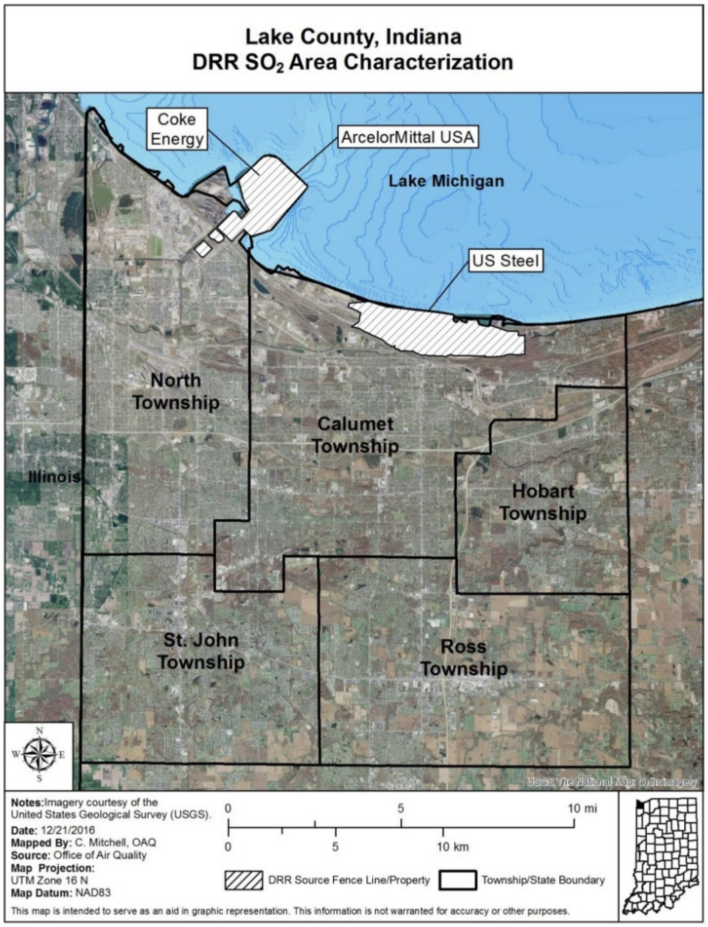
ArcelorMittal - USA is located at 3001 Dickey Road, East Chicago, in North Township, Lake County, Indiana. The northern end of the ArcelorMittal plant borders the southern shoreline of Lake Michigan.

Cokenergy is located at 3210 Watling Street, East Chicago, in North Township, Lake County, Indiana. CokeEnergy is located on the same property as ArcelorMittal – USA.

U.S. Steel is located at 1 North Broadway, Gary, in Calumet Township, Lake County, Indiana. The northern end of the U.S. Steel plant borders the southern shoreline of Lake Michigan.

A map of the area surrounding the three DRR facilities in Lake County and the townships in which wach DRR facility is located is shown in Figure 12.1

Figure 12.1 - Lake County DRR Sources and Surrounding Area



12.3 Background Concentrations

The nearest 1-hour SO_2 monitored concentrations were taken from the Hammond 141st Street (AQS #18-089-2008) and Gary-IITRI (AQS #18-089-0022) monitors. The Hammond monitor was used for the western half of the receptor grid and Gary-ITTRI for the eastern half. The 99th percentile values from 2013 through 2015 and the 3-year design value are listed below in Table 12.1

Table 12.1 – Lake County 99th Percentile 1-hour SO_2 Background Values and 3-year Design Value (ppb)

Monitoring Site	2013	2014	2015	2013-2015
Hammond 141st St	23.7	20.2	26.0 [a]	23
Gary-IITRI	43.2	53.1	35.0	44

[a] Incomplete data.

12.4 Modeling Methodology

The Lake County DRR modeling methodology resembles modeling used to evaluate New Source Review (NSR) and Prevention of Significant Deterioration (PSD) sources. However, Indiana has relied on U.S. EPA guidance "SO_2 NAAQS Designations Modeling Technical Assistance Document" in order to conduct an appropriate air dispersion modeling analysis for Lake County to support 1-hour SO_2 designation recommendations.

12.4.1 Model Selection

In accordance with Appendix A of Appendix W to 40 Code of Federal Regulations (CFR) Part 51, Indiana used the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) version 15181. BPIPPRIME was used to account for any building downwash concerns.

12.4.2 Model Options

ArcelorMittal - USA/Cokenergy/U.S. Steel used the adjustment to the surface friction velocity, (ADJ_U*), AERMET option in their modeling analysis. This option was recently accepted as a regulatory option in the final rule "Revisions to the Guidelines on Air Quality Models, Enhancements to the AERMOD Dispersion Modeling System and Incorporation of Approaches to Address Ozone and Fine Particulate Matter", signed on December 20, 2016. The ADJ_U* regulatory option provides for better model performance.

Non-regulatory options within AERMOD were used to determine the air quality characteristics for Lake County. This is due to the use of site-specific meteorology. The area is considered primarily urban, based on population density. The population value used was equal to the sum of population of cities where sources exist and any adjacent cities which meet the population density criteria. Technically, Gary, Indiana did not meet the strict definition of population density for urban classification. However, at least one-quarter of the area of Gary consists of U.S. Steel. By definition an integrated steel mill is considered urban with light-moderate to heavy industrial use. The entire population lives in the remainder of Gary. After factoring out 25% of the Gary's land area, Gary meets the 750 people/sq km population density threshold for using an urban dispersion coefficient. Therefore, an urban classification with an area population of 243,149 was used in the model input, as provided for in the Guideline on Air Quality Models, Section 7.2.3 (EPA, 2005b). Table 12.2 details the surrounding sizes and population densities of towns in the area to determine the overall population density for the appropriate urban land use characterization. All other regulatory default options were selected to perform the air quality analysis for the three Lake County DRR facilities.

Table 12.2 - Lake County Urban Population

City	Population	Area sq mi	Population Density per sq mi	Population Density per sq km	Adjusted Density per sq km
Gary	80,294	49.87	1,610	613	818
Hammond	80,830	22.78	3,548	1,344	N/A
East Chicago	29,698	14.09	2,108	950	N/A
Whiting	4,997	1.8	2,776	1,081	N/A
Munster	23,603	7.57	3,118	1,198	N/A
Highland, IN	23,727	6.94	3,419	1,318	N/A
Total	243,149				

12.4.3 AERMAP

The AERMOD terrain preprocessor mapping program, AERMAP, was used to determine all the terrain elevation heights for each receptor, building, and source locations using the Universal Transverse Mercator (UTM) coordinate system. The most recent AERMAP version 11103 assigned the elevations from the National Elevation Dataset (NED) using the North American Datum (NAD) 1983 as recommended in the, "40 CFR Part 51, Revision to the Guideline on Air Quality Models" Appendix W and later revised in the "AERMOD Implementation Guide."

12.5 Meteorological Data

12.5.1 AERMET

The Gary-IITRI surface meteorological data and the Lincoln, Illinois upper air meteorological data taken from 2013 through 2015 were used to determine the meteorological conditions surrounding the three Lake County DRR sources. The Gary-IITRI surface meteorological data was used to more accurately include the influence of Lake Michigan on the meteorological conditions in the area immediately surrounding the three Lake County DRR facilities. The Gary-IITRI surface data was processed without turbulence parameters in order to use the ADJ_U* option. This was processed with the latest version of the AERMOD meteorological data preprocessor program AERMET (version 15181). Table 12.3 below lists the surface and upper air meteorological stations used to conduct modeling.

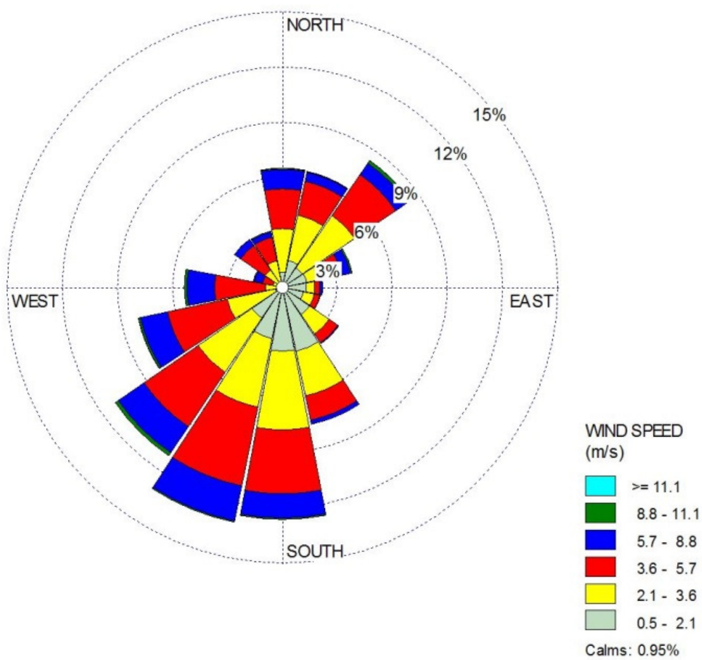
Table 12.3 – Lake County NWS Stations/Onsite Meteorological Stations

Facility	Surface Meteorology	Upper Air Meteorology
ArcelorMittal-USA/U.S. Steel/ Cokenergy	Gary-IITRI Monitor/ South Bend NWS	Lincoln, IL NWS

12.5.2 Wind Rose

The Gary-IITRI surface meteorological data and the Lincoln, Illinois upper air meteorological data taken from 2013 through 2015 were used to determine the meteorological conditions for the Lake County area. The Gary-IITRI wind rose for the 3-year modeled period 2013-2015 is shown as Figure 12.2 below. The Gary wind rose depicts the predominant wind direction as from the southwest for the 3-year modeled period.

Figure 12.2 – Gary-IITRI 3-year Cumulative Wind Rose (2013 – 2015)



12.5.3 AERMINUTE/AERSURFACE

The 1-minute wind speeds and wind directions, taken from the Automated Surface Observing System (ASOS) NWS stations and onsite meteorological stations, were processed with the U.S. EPA 1-minute data processor program AERMINUTE version 15272. All regulatory default options were selected with the exception of the use of the adjustment to the surface friction velocity, (ADJ_U*) option. The ADJ_U* option has been demonstrated to provide better model performance for determining 1-hour SO_2 concentrations. The ADJ_U* option has been accepted by U.S. EPA in a final rulemaking signed on December 20, 2016.

The U.S. EPA program AERSURFACE version 13016 was used to determine the surface characteristics; albedo, Bowen ratio, and surface roughness for the Gary-IITRI, Indiana meteorological tower location. Surface characteristics were determined at the NWS location for each of 12 wind direction sectors with a recommended default radius of one kilometer.

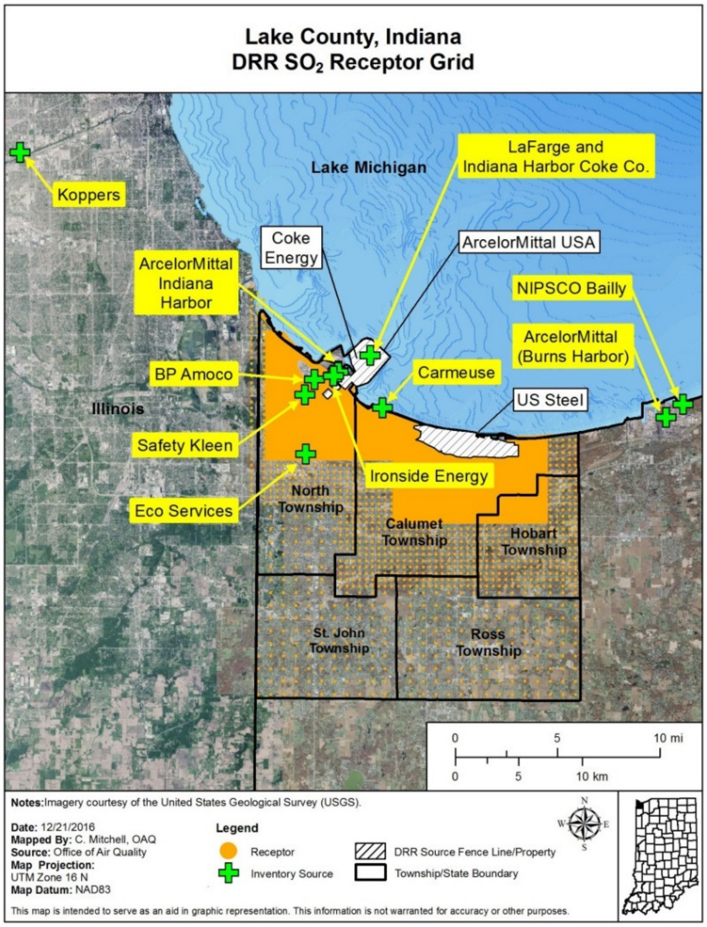
The albedo and the Bowen ratio surface characteristics were adjusted during the three winter months of January, February, and December in accordance with the U.S. EPA Region V document, "Regional Meteorological Data Processing Protocol," dated May 6, 2011. Additionally, a dry or wet Bowen ratio value was used during months when soil moisture conditions were abnormally dry or wet; 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.

12.6 Receptor Grid and Modeling Domain

The receptor grid and modeling domain was based on guidance provided in the memorandum "Updated Guidance for Area Designations for the 2010 Primary Sulfur Dioxide National Ambient Air Quality Standards", dated March 20, 2015 and the SO_2 NAAQS Designations Modeling TAD. Indiana used a multi-nested rectangular receptor grid with appropriate spacing of receptors based on the distance from the modeled emission points to detect significant concentration gradients. The modeling domain extended out to include all sources and the appropriate distances to model maximum 1-hour SO_2 impacts to determine attainment designations for the area. Indiana used the following multi-nested rectangular receptor grids listed below and depicted in Figure 12.3. Focus was emphasized on receptor placement near each of the Lake County DRR sources; expected 1-hour SO_2 impacts would be anticipated to be very near each source.

- Receptor spacing at the fence line for each facility was placed every 50 meters.
- Receptor spacing at 100 meters was placed out to a distance of 5,000 meters (5 kilometers) beyond each facility.
- Receptor spacing at 500 meters was placed out to a distance of 10,000 meters (10 kilometers) beyond each facility and east to the Porter County line.
- Receptor spacing at 1000 meters was placed beyond 10,000 meters (10 kilometers) from each facility to the south to cover the southern extent of St. John, Ross and North townships.

Figure 12.3 – Lake County Receptor Grid



ArcelorMittal - USA, Cokenergy and U.S. Steel have fenced areas, natural boundaries and gated areas with regular security patrols to keep unauthorized people off the property. Since this is the case, receptors were placed along the property lines as appropriate.

12.7 Stack Heights

The use of actual stack heights rather than relying on Good Engineering Practice (GEP) stack heights when modeling actual emissions was utilized in the analysis per the SO_2 NAAQS Designations Modeling TAD.

12.8 Temporally Varying Seasonal 1-Hour SO_2 Background

Temporally varying seasonal SO_2 background concentrations were developed in accordance with the recommended U.S. EPA guidance for establishment of such background concentrations in Section 8.2 of 40 CFR Part 51, Appendix W and considered appropriate and representative of the area. The latest three years of SO_2 air quality monitoring data (2013-2015) was used from both the Hammond and Gary sites.

The 99th percentile SO_2 concentrations by season (winter, spring, summer and fall) for each hour of the day were calculated to determine the temporally varying seasonal SO_2 background, which were directly input into the model and were part of the final modeled results.

Temporally varying seasonal 1-hour SO_2 background concentrations were taken from the Hammond (west) and Gary (east) monitors for 2013 - 2015. Two sets of 1-hour SO_2 background were used to best represent the Lake County DRR sources, ArcelorMittal – USA and Cokenergy are located in the western portion of the county and U.S. Steel is located in the eastern portion of the county. Hammond monitor will also measure the SO_2 impacts from Illinois. The hourly seasonal SO_2 values used for representative background concentrations for the Lake County DRR sources are listed below in Table 12.4 for the Hammond monitor and in Table 12.5 for the Gary-IITRI monitor.

Table 12.4 – Lake County Hammond Monitor 99th Percentile Temporally Varying Seasonal SO_2 Background Values (ppb)

	Hr 1	Hr 2	Hr 3	Hr 4	Hr 5	Hr 6	Hr 7	Hr 8
Winter	5.4	5.7	5.94	6.08	6.12	6.18	5.8	6.14
Spring	5.74	5.53	5.44	5.34	5.6	6.07	6.4	7.03
Summer	4.87	4.63	4.6	4.8	5.57	5.28	6.01	6.57
Fall	5.03	4.13	5.34	3.84	4.61	6.35	6.1	6.28

	Hr 9	Hr 10	Hr 11	Hr 12	Hr 13	Hr 14	Hr 15	Hr 16
Winter	6.73	7.03	8.76	7.72	7.89	7.18	8.78	7.84
Spring	8.27	8.43	9.19	7.68	8.2	8.09	8.14	8.86
Summer	8.97	7.54	8.77	8.31	9	7.96	8.95	6.51
Fall	8.1	8.04	8.11	6.84	8.08	7.52	8.16	7.74

	Hr 17	Hr 18	Hr 19	Hr 20	Hr 21	Hr 22	Hr 23	Hr 24
Winter	6.9	6.18	6.44	5.74	5.58	5.74	5.68	5.58
Spring	8.85	9.4	9.24	7.76	7.9	6.84	7	7.84
Summer	7.76	7.87	7.97	6.31	6.04	8.07	5.69	5.14
Fall	8.91	6.81	7.12	7.31	6.75	5.37	4.9	3.8

Table 12.5 – Lake County Gary - IITRI 99th Percentiles Temporally Varying Seasonal SO_2 Background Values (ppb)

	Hr 1	Hr 2	Hr 3	Hr 4	Hr 5	Hr 6	Hr 7	Hr 8
Winter	9.69	7.35	7.1	6.74	6.87	7.03	6.32	7.42
Spring	7.31	4.59	7.82	4.88	6.88	7.84	8.58	6.96
Summer	1.37	1	1	1	1	1	1	1
Fall	6.98	5.64	5.44	5.56	7.57	4.64	5.24	8.02

	Hr 9	Hr 10	Hr 11	Hr 12	Hr 13	Hr 14	Hr 15	Hr 16
Winter	8.35	9.35	9.52	9.35	8.66	8.5	12.29	10.44
Spring	8.22	8.17	10.34	15.5	9.62	9.02	9.54	9.05
Summer	5.83	9.03	7.29	7.47	5.47	4.47	3.93	3.77
Fall	6.9	6.81	8.5	8.82	8.84	8.96	7	6.45

	Hr 17	Hr 18	Hr 19	Hr 20	Hr 21	Hr 22	Hr 23	Hr 24
Winter	9.33	6.84	7.22	8.35	6.4	6.81	8.64	9.04
Spring	8.24	7.84	7.38	6.34	7.32	6.44	8.73	7.58
Summer	3.72	3.97	2.53	2.41	2.4	1	2.24	2.83
Fall	6.46	4.62	4.71	7.14	4.64	4.94	7.01	7.19

12.9 SO_2 Emissions Included in the Modeling Analysis

12.9.1 DRR Source Emissions

ArcelorMittal - USA and U.S. Steel were modeled using different emission methodologies. Continuous emission monitoring data (CEM) data was available for several emission units while others had seasonal or weekly varying emission rates that were modeled. Cokenergy has emission data collected by a continuous emission monitor; therefore, CEM data was modeled. ArcelorMittal – USA and U.S. Steel have processes with varying hourly emissions rates that were based on a daily maximum emission rate. Emissions were allocated for each hour of the day. Emission units without CEM data or daily emission records were averaged across the three modeled years (2013-2015). Enclosure 2 contains a listing of all of the AERMOD inputs of all the DRR and inventory sources for Lake County.

12.9.2 Carmeuse Lime's Commissioner's Order – SO_2 Emission Limits

Carmeuse Lime, Inc. (Carmeuse) is a stationary lime manufacturing plant (Source I.D. 089-00112) located at 1 North Carmeuse Drive in Gary in Lake County. Carmeuse is not a DRR source but was identified as potentially impacting SO_2 air quality near the Lake County DRR sources. SO_2 sources from the surrounding area in Lake County were evaluated to determine if their emissions would impact the air quality surrounding the DRR sources, beyond what is captured through background SO_2 ambient air monitoring data. Initial modeling, using actual emissions data from Carmeuse showed potential 1-hour SO_2 concentrations higher than the 1-hour SO_2 NAAQS. Therefore, Carmeuse submitted a request on November 15, 2016 for a Commissioner's Order to establish SO_2 emission limits that would be federally enforceable and permanent which demonstrate attainment of the 1-hour SO_2 standard. The Commissioner's Order #2016-04 was signed on November 16, 2016 and is included in Enclosure 3.

Carmeuse's SO_2 emissions are distributed amongst their five kilns. In order to establish hourly emissions limits for Carmeuse through the Commissioner's Order, modeling was conducted to determine limits that demonstrated compliance with the 1-hour SO_2 standard. Each kiln has six stacks so modeling determined each kiln would be limited to 12.0 pounds of SO_2/hour or 2.0 pounds of SO_2/hour for each stack of each kiln. The three DRR sources, surrounding SO_2 source inventories, and temporally varying seasonal SO_2 background concentrations were included in the modeling to establish Carmeuse's emission limits through a Commissioner's Order.

The 720 operating hour rolling average emission limit listed in the Commissioner's Order was based on the 12.0 pound/hour limit modeled for each kiln. U.S. EPA recommended using a flat averaging ratio for emission units with no emission controls, as referenced in Table 1 of U.S. EPA's "Guidance for 1-hour SO_2 Nonattainment Area SIP Submissions". Based on the average ratio of 99^{th} percentile 30-day average SO_2 emission values to the 99^{th} percentile of hourly SO_2 emission values of 0.79, the corresponding 720 operating hour average for each kiln was calculated to be 9.48 lb/hr.

12.9.3 Inventoried SO_2 Sources Included in the Modeling

Inclusion of sources in the DRR modeling was based upon their actual emissions from 2013-2015. The only exception was BP Products (BP), which modeled 2015 SO_2 emissions. BP completed its Whiting Refinery Modernization Project (WRMP) on May 10, 2014. This project was permitted with a significant source modification (Permit #089-25484-00453 issued May 1, 2008) and significant permit modification (Permit #089-25488-00453 issued June 16, 2008), authorizing the construction of new emission units, modifications to existing emission units and operational changes as necessary. A Consent Decree (Civil No. 2:12-cv-00207) was issued to address revisions to BP's WRMP. SO_2 emissions as a result of the WRMP were modeled for the Lake County DRR analysis.

All facilities greater than one-half of the PSD significance threshold of 40 tpy were included. The sources which were explicitly modeled had overall SO_2 emissions of 16,233 tpy. This accounts for 99.8% of the Lake County SO_2 inventory. Continuous emissions monitoring data, seasonal or daily varying emissions or an average of 3-year annual SO_2 emissions were modeled for all sources.

The modeled inventory included two Porter County SO_2 sources (ArcelorMittal – Burns Harbor and the NIPSCO – Bailly Generating Station). Koppers Inc. in Chicago, Illinois, was also included in the inventory. Two coal-fired power plants in Cook County, Illinois shut down in 2012 and as a result were not included in the modeling analysis. The following facilities were included in the air quality modeling analysis to determine the overall SO_2 air quality impact in the area and are listed in Table 12.6.

Table 12.6 - Lake County Modeling Inventory

Source	Source ID	Location	2013-2015 Average SO_2 Emissions (tpy)
BP Products, North America Inc.	18-089-00003	Lake County, IN	400.2 [a]
Carmeuse Lime, Inc	18-089-00112	Lake County, IN	Emission Limits [b]
Eco Services Corp	18-089-00242	Lake County, IN	255.6
Safety-Kleen Systems Inc.	18-089-00301	Lake County, IN	62.6
ArcelorMittal - USA	18-089-00318	Lake County, IN	1,430.8
Indiana Harbor Coke Company	18-089-00382	Lake County, IN	2,441.1
Ironside Energy LLC	18-089-00448	Lake County, IN	204.5
ISPAT Inland LaFarge NA	18-089-00458	Lake County, IN	122.9
ArcelorMittal – Burns Harbor	18-127-00001	Porter County, IN	12,189
NIPSCO Bailly Generating Station	18-127-00002	Porter County, IN	2013-2015 CEMS Data
Koppers Inc.	170000035076	Cook County, IL	1,785.7

[a] IDEM utilized BP Products' 2015 SO_2 emissions due to the Whiting Refinery Modernization Project, completed on May 10, 2014

[b] Carmeuse Lime, Inc. established SO_2 emission limits in Commissioner's Order #2016-04

12.10 Modeling Results

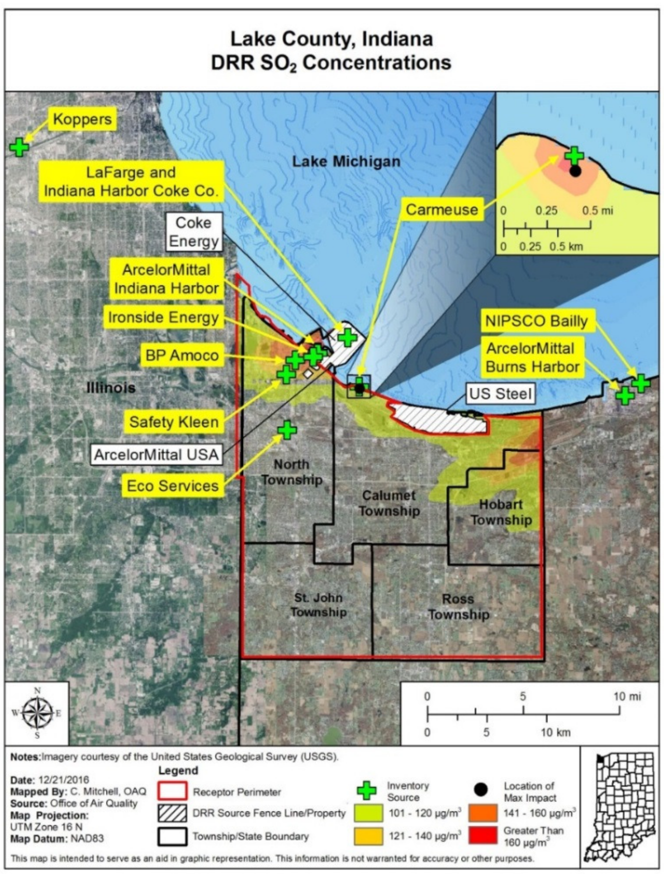
The 99th percentile of the 1-hour daily maximum modeled concentrations represents the fourth high of the 1-hour daily maximum SO_2 modeled concentrations and were averaged across three years to compare resulting concentrations to the 1-hour SO_2 NAAQS of 75 ppb (196.2 $\mu g/m^3$). Modeled concentrations include representative temporally varying seasonal 1-hour SO_2 background values to determine the overall impact. The resulting concentrations were compared to the 1-hour SO_2 standard to indicate whether a modeled violation of the SO_2 NAAQS occurred. All concentrations fell below the 1-hour SO_2 NAAQS and were determined to attain the standard and the area surrounding the DRR sources is recommended as attainment. Table 12.6 shows the modeled localized peaks for all DRR sources in Lake County and including the Carmeuse's SO_2 emission limits established through the Commissioner's Order. The overall maximum concentration was 192.2 $\mu g/m^3$, occurring at UTM coordinates 466100.0 East, 4609900.0 North, associated with Carmeuse's maximum impacts. 1-hour SO_2 impacts east of Lake County are being addressed through the air quality characterization of Porter County using the monitoring option for ArcelorMittal – Burns Harbor facility, a DRR source.

Table 12.7 – Lake County Modeling Results

Source	Maximum Modeled Concentration Including Seasonal Hourly Background (µg/m^3)	1-Hour SO_2 NAAQS (µg/m^3)	Models Attainment
Carmeuse Lime	192.2	196.2	Yes
U.S. Steel	128.1	196.2	Yes
Cokenergy	182.8	196.2	Yes
ArcelorMittal USA	182.8	196.2	Yes
Porter County Line	168.7	196.2	Yes

The concentration isopleths showing the maximum predicted 99th percentile daily 1-hour SO_2 concentration gradients can be found in Figure 12.5.

Figure 12.4 – Lake County Modeling Results



13.0 Duke-Gallagher (Source ID 153-00005)

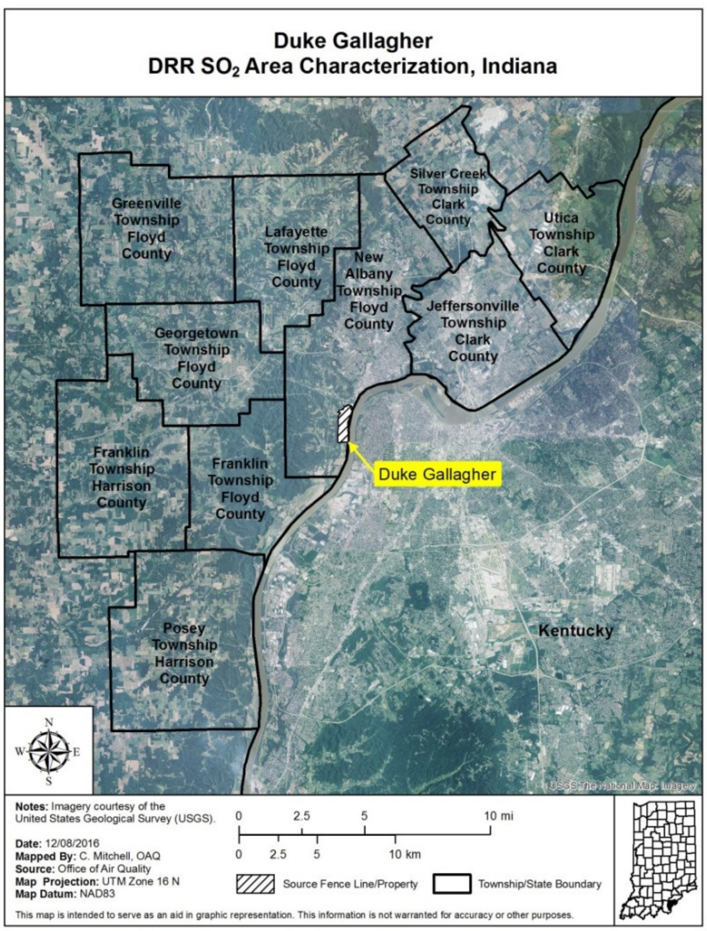
13.1 Source Description

Duke - Gallagher Generating Station (Duke - Gallagher) is a 280 MW coal-fired power plant in Floyd County located in southeast Indiana. Duke - Gallagher has two coal-fired boilers rated at 1,390 MMBtu/hr each. The plant is operated by Duke Energy Indiana, LLC. Duke - Gallagher was identified as a Data Requirements Rule (DRR) source based on their actual 2014 SO_2 emissions of 3,524 tons exceeding the DRR threshold of 2,000 tons of SO_2.

13.2 Characterization of Modeled Area

Duke - Gallagher is located at 30 Jackson St, New Albany, Indiana, on the banks of the Ohio River in New Albany Township, Floyd County, Indiana. A map of the area surrounding Duke - Gallagher is shown below in Figure 13.1.

Figure 13.1 – Duke - Gallagher and Surrounding Area



13.3 Background Concentrations

The nearest 1-hour SO_2 monitored concentrations were taken from the Green Valley monitor (AQS #18-043-1004) located in Floyd County. The 99^{th} percentile values from 2013 through 2015 and the 3-year design value are listed below in Table 13.1.

Table 13.1 – Duke – Gallagher 99^{th} Percentile 1-hour SO_2 Background Values and 3-year Design Value (ppb)

Monitoring Site	2013	2014	2015	2013-2015
Floyd Co – Green Valley	30.0	65.0	28.0	41

13.4 Modeling Methodology

The Duke - Gallagher DRR modeling methodology resembles modeling used to evaluate New Source Review (NSR) and Prevention of Significant Deterioration (PSD) sources. However, Indiana has relied on U.S. EPA guidance "SO_2 NAAQS Designations Modeling Technical Assistance Document" in order to conduct an appropriate air dispersion modeling analysis for Duke - Gallagher to support 1-hour SO_2 designation recommendations.

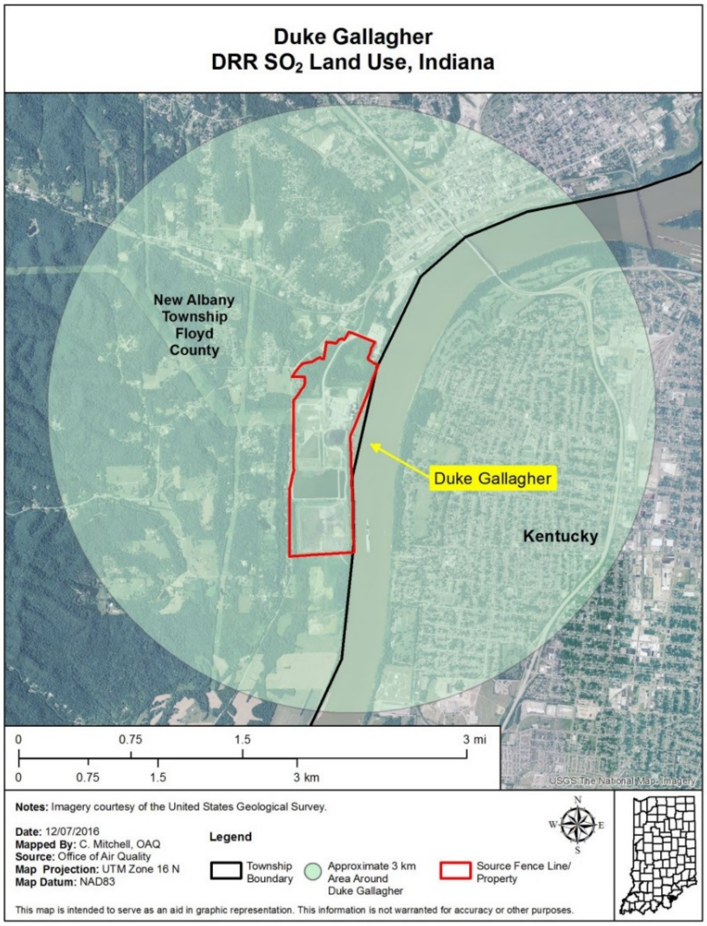
13.4.1 Model Selection

In accordance with Appendix A of Appendix W to 40 Code of Federal Regulations (CFR) Part 51, Indiana used the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) version 15181. BPIPPRIME was used to account for any building downwash concerns.

13.4.2 Model Options

All regulatory default options within AERMOD were used to determine the air quality characteristics surrounding Duke - Gallagher. The area is considered primarily rural, based on the Auer's Classification Land Use methodology with a vast majority of the land use types classified as undeveloped rural (A4), water surfaces (A5) and estate residential (R4). Therefore, a rural classification was used, as provided for in the Guideline on Air Quality Models, Section 7.2.3 (EPA, 2005b). No variation of the population selection was necessary. Figure 13.2 shows the 3-kilometer radius area surrounding Duke - Gallagher that was analyzed to determine the land use classification.

Figure 13.2 – Duke – Gallagher 3-kilometer Radius to Determine Auer Land Use



13.4.3 AERMAP

The AERMOD terrain preprocessor mapping program, AERMAP, was used to determine all the terrain elevation heights for each receptor, building, and source locations using the Universal Transverse Mercator (UTM) coordinate system. The most recent AERMAP version 11103 assigned the elevations from the National Elevation Dataset (NED) using the North American Datum (NAD) 1983 as recommended in the, "40 CFR Part 51, Revision to the Guideline on Air Quality Models" Appendix W and later revised in the "AERMOD Implementation Guide."

13.5 Meteorological Data

13.5.1 AERMET

As stated in 40 CFR Part 51, Appendix W, section 8.3.1.2 and the SO_2 NAAQS Designations Modeling TAD, Indiana used 2013-2015 National Weather Service (NWS) surface and upper air meteorological data processed with the latest version of the AERMOD meteorological data

preprocessor program AERMET (version 15181). Table 13.2 below lists surface and upper air meteorological stations used to conduct modeling.

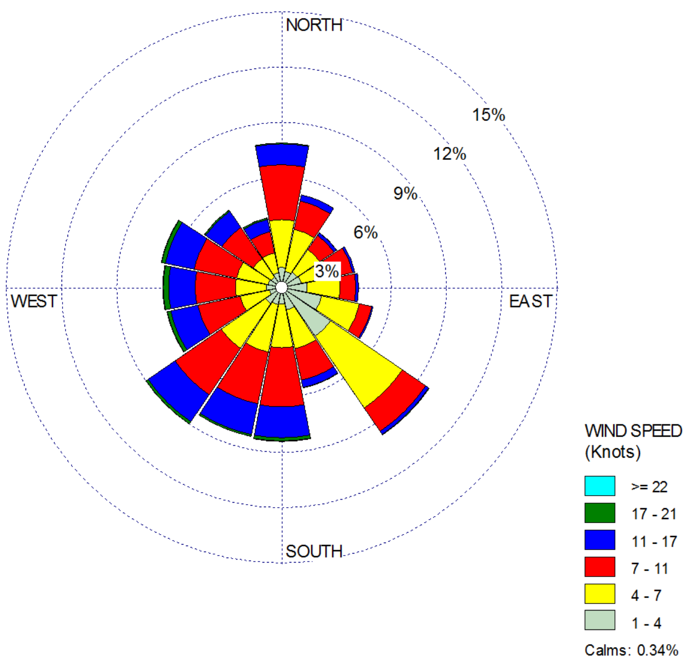
Table 13.2 – Duke - Gallagher NWS Stations/Onsite Meteorological Stations

Facility	Surface Meteorology	Upper Air Meteorology
Duke – Gallagher	Louisville, KY NWS	Wilmington, OH NWS

13.5.2 Wind Rose

The Louisville, Kentucky National Weather Service (NWS) surface meteorological data and Wilmington, Ohio upper air meteorological data taken from 2013 through 2015 were used to determine the meteorological conditions for the area surrounding Duke - Gallagher in AERMOD. The Louisville NWS wind rose for the 3-year modeled period 2013-2015 is shown as Figure 13.3 below. The Louisville NWS wind rose depicts the predominant wind direction as from the southwest for the 3-year modeled period 2013-2015.

Figure 13.3 - Louisville 3-year Cumulative Wind Rose (2013 – 2015)



13.5.3 AERMINUTE/AERSURFACE

The 1-minute wind speeds and wind directions, taken from the Automated Surface Observing System (ASOS) NWS stations and onsite meteorological stations, were processed with the U.S. EPA 1-minute data processor program AERMINUTE version 15272.

The U.S. EPA program AERSURFACE version 13016 was used to determine the surface characteristics; albedo, Bowen ratio, and surface roughness for the Louisville, Indiana NWS meteorological tower location. Surface characteristics were determined at the NWS location for each of 12 wind direction sectors with a recommended default radius of one kilometer.

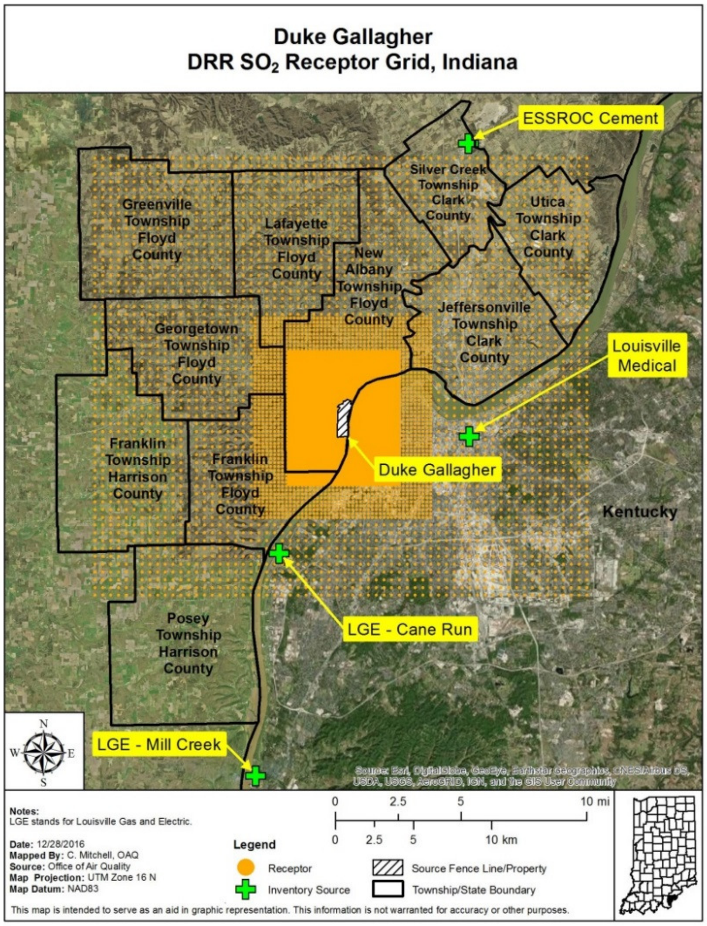
The albedo and the Bowen ratio surface characteristics were adjusted during the three winter months of January, February, and December in accordance with the U.S. EPA Region V document, "Regional Meteorological Data Processing Protocol," dated May 6, 2011. Additionally, a dry or wet Bowen ratio value was used during months when soil moisture conditions were abnormally dry or wet; 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.

13.6 Receptor Grid and Modeling Domain

The receptor grid and modeling domain was based on guidance provided in the memorandum "Updated Guidance for Area Designations for the 2010 Primary Sulfur Dioxide National Ambient Air Quality Standards", dated March 20, 2015 and the SO_2 NAAQS Designations Modeling TAD. Indiana used a multi-nested rectangular receptor grid with appropriate spacing of receptors based on the distance from the modeled emission points to detect significant concentration gradients. The modeling domain extended out to include all sources and the appropriate distances to model maximum 1-hour SO_2 impacts to determine attainment designations for the area. Indiana used the following multi-nested rectangular receptor grid which are listed below and depicted in Figure 13.4:

- Receptor spacing at the fence line for each facility was placed every 50 meters.
- Receptor spacing at 100 meters was placed out to a distance of 3,000 meters (3 kilometers) beyond the DRR facility.
- Receptor spacing at 250 meters was placed out to a distance of 5,000 meters (5 kilometers) beyond the DRR facility.
- Receptor spacing at 500 meters was placed out to a distance of 10,000 meters (10 kilometers) beyond the DRR facility.

Figure 13.4 – Duke – Gallagher Receptor Grid



Duke - Gallagher has a fenceline, natural features, and security patrols that restrict public access to its property. Receptors were therefore placed along the property boundary where public access is not restricted.

13.7 Stack Heights

The use of actual stack heights rather than relying on Good Engineering Practice (GEP) stack heights when modeling actual emissions was utilized in the analysis per the SO_2 NAAQS Designations Modeling TAD.

13.8 Temporally Varying Seasonal 1-Hour SO_2 Background

Temporally varying seasonal SO_2 background concentrations were developed in accordance with the recommended U.S. EPA guidance for establishment of such background concentrations in Section 8.2 of 40 CFR Part 51, Appendix W and considered appropriate and representative of the area. The latest three years of SO_2 air quality monitoring data (2013-2015) was used.

The 99th percentile SO_2 concentrations by season (winter, spring, summer and fall) for each hour of the day were calculated to determine the temporally varying seasonal SO_2 background, which were directly input into the model and were part of the final modeled results.

Temporally varying seasonal 1-hour SO_2 background concentrations were taken from the Green Valley monitor (AQS #18-043-1004) located in Floyd County for 2013 - 2015. The hourly seasonal SO_2 values used for representative background concentrations for the area surrounding Duke - Gallagher are listed below in Table 13.3.

Table 13.3 – Duke – Gallagher 99th Percentile Temporally Varying Seasonal SO_2 Background Values (ppb)

	Hr 1	Hr 2	Hr 3	Hr 4	Hr 5	Hr 6	Hr 7	Hr 8
Winter	7.27	6.90	6.40	5.80	5.82	6.69	4.36	7.85
Spring	8.01	7.38	4.23	7.32	4.86	3.90	4.28	6.25
Summer	5.60	3.46	4.10	3.47	2.57	1.89	2.30	3.70
Fall	3.70	3.76	4.23	4.06	3.13	3.30	6.33	7.51

	Hr 9	Hr 10	Hr 11	Hr 12	Hr 13	Hr 14	Hr 15	Hr 16
Winter	7.24	9.10	8.98	10.66	9.42	6.60	9.96	9.70
Spring	8.39	8.87	9.50	16.88	13.04	15.89	9.10	14.09
Summer	7.70	8.10	13.52	13.08	13.15	8.94	8.57	7.78
Fall	6.96	9.52	9.46	8.82	8.87	9.06	13.28	8.62

	Hr 17	Hr 18	Hr 19	Hr 20	Hr 21	Hr 22	Hr 23	Hr 24
Winter	10.21	9.54	8.78	8.45	7.77	8.32	7.92	6.43
Spring	15.33	9.21	9.63	9.94	8.06	7.24	7.70	8.15
Summer	6.22	8.08	6.56	4.87	3.73	3.47	4.16	3.46
Fall	11.71	6.29	6.93	6.42	5.47	3.60	3.53	5.31

13.9 SO_2 Emissions Included in the Modeling Analysis

13.9.1 DRR Source: Duke - Gallagher Emissions

Duke - Gallagher has two coal-fired units, Units 2 and 4 that have continuous emission monitoring (CEM) data for SO_2. This hourly CEM data from both units was formatted and used in the 1-hour SO_2 AERMOD model run.

13.9.2 Inventoried SO_2 Sources Included in the Modeling

SO_2 sources from the surrounding area were evaluated to determine if their SO_2 emissions had a potential impact on the air quality surrounding the DRR source, beyond what is captured through background monitoring data. The average actual emissions from 2013-2015 were input for ESSROC and Louisville Medical Center Steam Plant. Louisville Gas & Electric facilities at Cane Run and Mill Creek have reduced their SO_2 emissions with federal regulatory measures including the Mercury and Air Toxics rule, Cross State Air Pollution rule and several other federal rule-makings. SO2 emission reductions will be achieved through conversion of the coal-fired electric generating units to a natural gas combined cycle unit for Cane Run and additional SO_2 flue-gas desulfurization (FGD) controls and upgrades at the Mill Creek facility. Permitted limits were modeled for each of the Louisville Gas and Electric sources as the emission reductions are federally enforceable and permanent. The following list of sources, found below in Table 13.4, were included in the AERMOD run to determine overall air quality characteristics.

Table 13.4 – Duke – Gallagher Modeling Source Inventory

Source	Source ID	Location	2013-2015 SO_2 Emissions (tpy)
ESSROC Cement Corporation	18-019-00008	Clark County, IN	416
LG & E – Cane Run	21-111-00126	Jefferson County, KY	21
LG & E – Mill Creek	21-111-00127	Jefferson County, KY	13,485
Louisville Medical Center	21-111-00148	Jefferson County, KY	415

13.10 Modeling Results

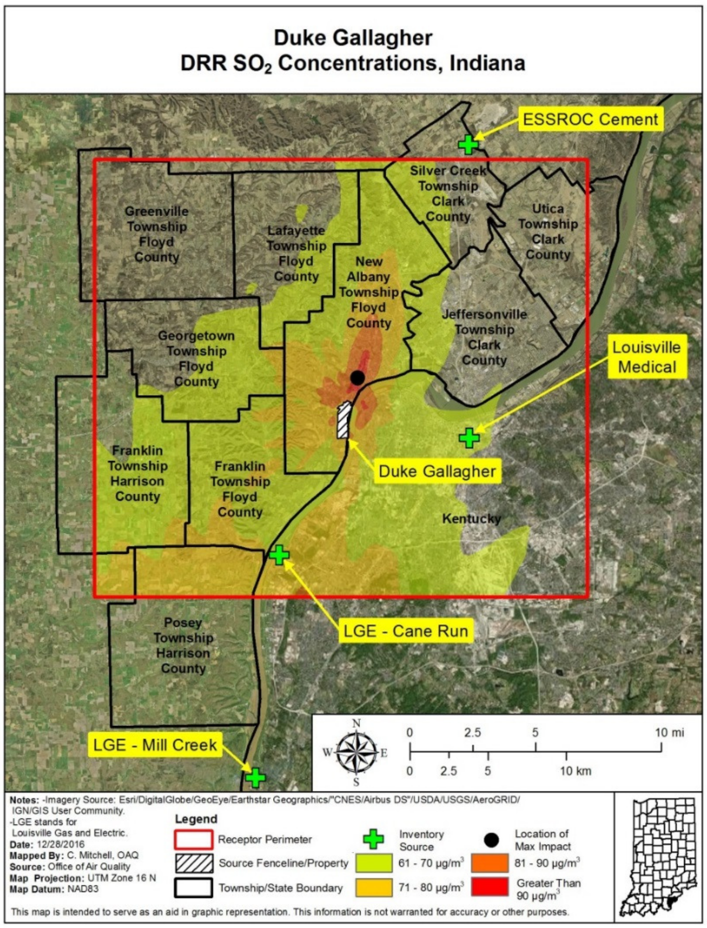
The 99^{th} percentile of the 1-hour daily maximum modeled concentrations represents the fourth high of the 1-hour daily maximum SO_2 modeled concentrations and were averaged across three years to compare resulting concentrations to the 1-hour SO_2 NAAQS of 75 ppb (196.2 $\mu g/m^3$). Modeled concentrations include representative temporally varying seasonal 1-hour SO_2 background values to determine the overall impact. The resulting concentrations were compared to the 1-hour SO_2 standard to indicate whether a modeled violation of the SO_2 NAAQS occurred. All concentrations fell below the 1-hour SO_2 NAAQS and were determined to attain the standard and the area surrounding Gallagher is recommended as attainment. The maximum predicted 99^{th} percentile daily 1-hour SO_2 concentration is shown in Table 13.5. The overall maximum concentration was 99.5 $\mu g/m^3$, occurring at UTM coordinates 602300.0 East, 4238000.0 North.

Table 13.5 - Duke – Gallagher Modeling Results

Emission Scenario	Maximum Modeled Concentration Including Seasonal Hourly Background (µg/m^3)	1-Hour SO_2 NAAQS (µg/m^3)	Facility Models Attainment
Gallagher	99.5	196.2	Yes

The concentration isopleths showing the maximum predicted 99th percentile daily 1-hour SO_2 concentration gradients can be found in Figure 13.5.

Figure 13.5 – Duke - Gallagher Modeling Results



14.0 NIPSCO – R.M. Schahfer Generating Station (Source ID 18-073-00008)

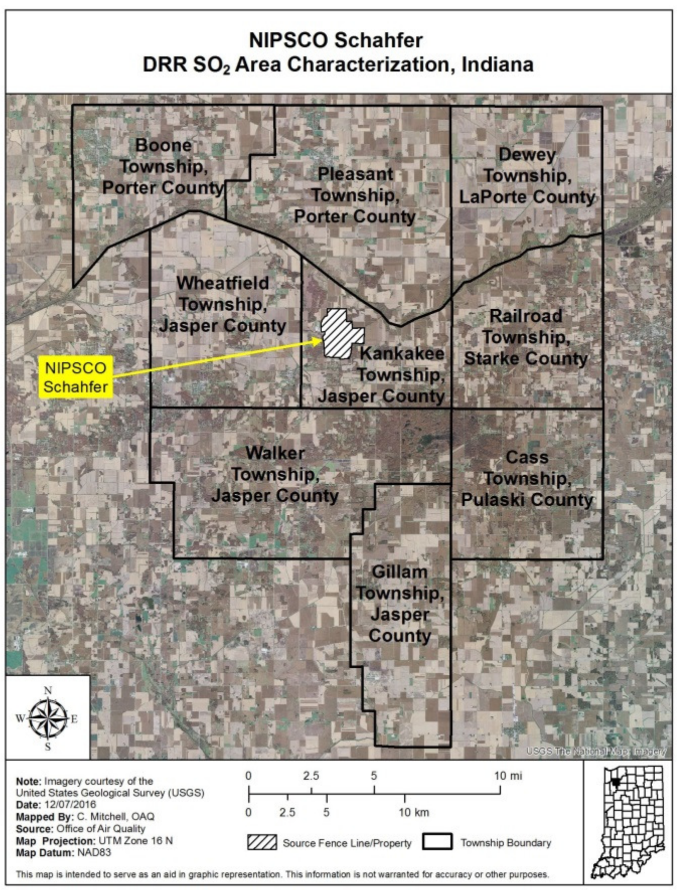
14.1 Source Description

The Northern Indiana Public Service Company (NIPSCO) - R.M. Schahfer Generating Station (NIPSCO - Schahfer) is a stationary electric utility generating station consisting of four units that have a capacity to generate 1,943 megawatts (MW) of electricity combined. NIPSCO - Schahfer has four coal-fired boilers; one boiler is rated at 4,650 MMBtu/hr, one boiler is rated at 5,100 MMBtu/hr, and two boilers are rated at 3,967 MMBtu/hr each. The plant is operated by NiSource.

14.2 Characterization of Modeled Area

The NIPSCO - Schahfer is located at 2723 East 1500 North, Wheatfield, in Kankakee Township, Jasper County, Indiana; approximately 5 miles west of State Road 421. A map of the area surrounding the NIPSCO - Schahfer facility is shown below in Figure 14.1.

Figure 14.1 - NIPSCO - Schahfer and Surrounding Area



14.3 Background Concentrations

The nearest 1-hour SO_2 monitored concentrations were taken from the Wheatfield – Jasper County monitor (AQS #18-073-0002). The 99th percentile values from 2012 through 2014 and the 3-year design value are listed below in Table 14.1.

Table 14.1 – NIPSCO – Schahfer 99th Percentile 1-hour SO_2 Background Values and 3-year Design Value (ppb)

Monitoring Site	2012	2013	2014	2012-2014
Wheatfield – Jasper County	33	40	18	30

14.4 Modeling Methodology

The NIPSCO - Schahfer DRR modeling methodology resembles modeling used to evaluate New Source Review (NSR) and Prevention of Significant Deterioration (PSD) sources. However, Indiana has relied on U.S. EPA guidance "SO_2 NAAQS Designations Modeling Technical Assistance Document" in order to conduct an appropriate air dispersion modeling analysis for NIPSCO - Schahfer to support 1-hour SO_2 designation recommendations.

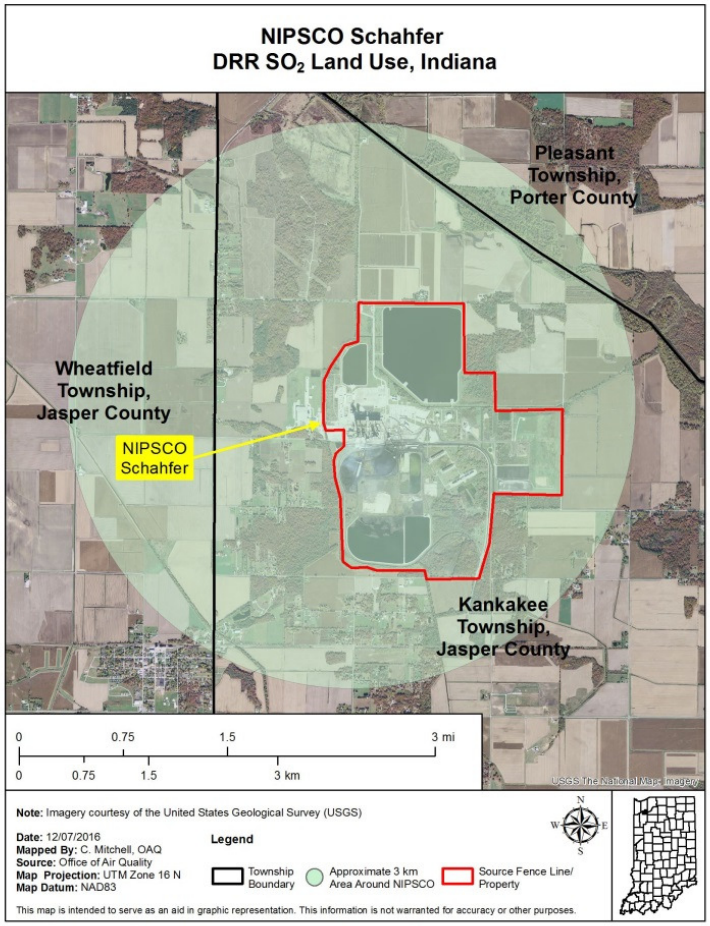
14.4.1 Model Selection

In accordance with Appendix A of Appendix W to 40 Code of Federal Regulations (CFR) Part 51, Indiana used the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) version 15181. BPIPPRIME was used to account for any building downwash concerns.

14.4.2 Model Options

All regulatory default options within AERMOD were used to determine the air quality characteristics surrounding NIPSCO - Schahfer. The area is considered primarily rural, based on the Auer's Classification Land Use methodology with a vast majority of the land use types classified as agricultural rural (A2), undeveloped rural (A4), water surfaces (A5) and estate residential (R4). Therefore, a rural classification was used, as provided for in the Guideline on Air Quality Models, Section 7.2.3 (EPA, 2005b). No variation of the population selection was necessary. Figure 14.2 shows the 3-kilometer radius area surrounding NIPSCO - Schahfer that was analyzed to determine the land use classification.

Figure 14.2 – NIPSCO – Schahfer 3-km Radius to Determine Auer Land Use



14.4.3 AERMAP

The AERMOD terrain preprocessor mapping program, AERMAP, was used to determine all the terrain elevation heights for each receptor, building, and source locations using the Universal Transverse Mercator (UTM) coordinate system. The most recent AERMAP version 11103 assigned the elevations from the National Elevation Dataset (NED) using the North American Datum (NAD) 1983 as recommended in the, "40 CFR Part 51, Revision to the Guideline on Air Quality Models" Appendix W and later revised in the "AERMOD Implementation Guide."

14.5 Meteorological Data

14.5.1 AERMET

As stated in 40 CFR Part 51, Appendix W, section 8.3.1.2 and the SO_2 NAAQS Designations Modeling TAD, Indiana used 2013-2015 National Weather Service (NWS) surface and upper air meteorological data processed with the latest version of the AERMOD meteorological data

preprocessor program AERMET (version 15181). Table 14.2 below lists surface and upper air meteorological stations used to conduct modeling.

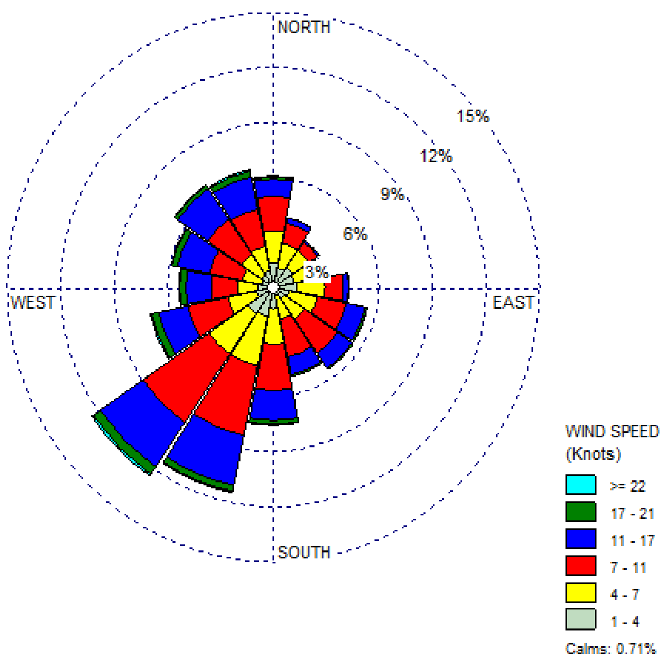
Table 14.2 – NIPSCO – Schahfer NWS Stations/Onsite Meteorological Stations

Facility	Surface Meteorology	Upper Air Meteorology
NIPSCO - Schahfer	South Bend, IN NWS	Lincoln, IL NWS

14.5.2 Wind Rose

The South Bend National Weather Service (NWS) surface meteorological data and the Lincoln, Illinois upper air meteorological data taken from 2012 through 2014 were used to determine the meteorological conditions for the area surrounding NIPSCO - Schahfer in AERMOD. The South Bend NWS wind rose for the 3-year modeled period 2012-2014 is shown as Figure 14.3 below. The South Bend NWS wind rose depicts the predominant wind direction as from the southwest for the 3-year modeled period 2012-2014.

Figure 14.3 - South Bend 3-year Cumulative Wind Rose (2012 – 2014)



14.5.3 AERMINUTE/AERSURFACE

The 1-minute wind speeds and wind directions, taken from the Automated Surface Observing System (ASOS) NWS stations and onsite meteorological stations, were processed with the U.S. EPA 1-minute data processor program AERMINUTE version 15272.

The U.S. EPA program AERSURFACE version 13016 was used to determine the surface characteristics; albedo, Bowen ratio, and surface roughness for the South Bend, Indiana NWS meteorological tower location. Surface characteristics were determined at the NWS location for each of 12 wind direction sectors with a recommended default radius of one kilometer.

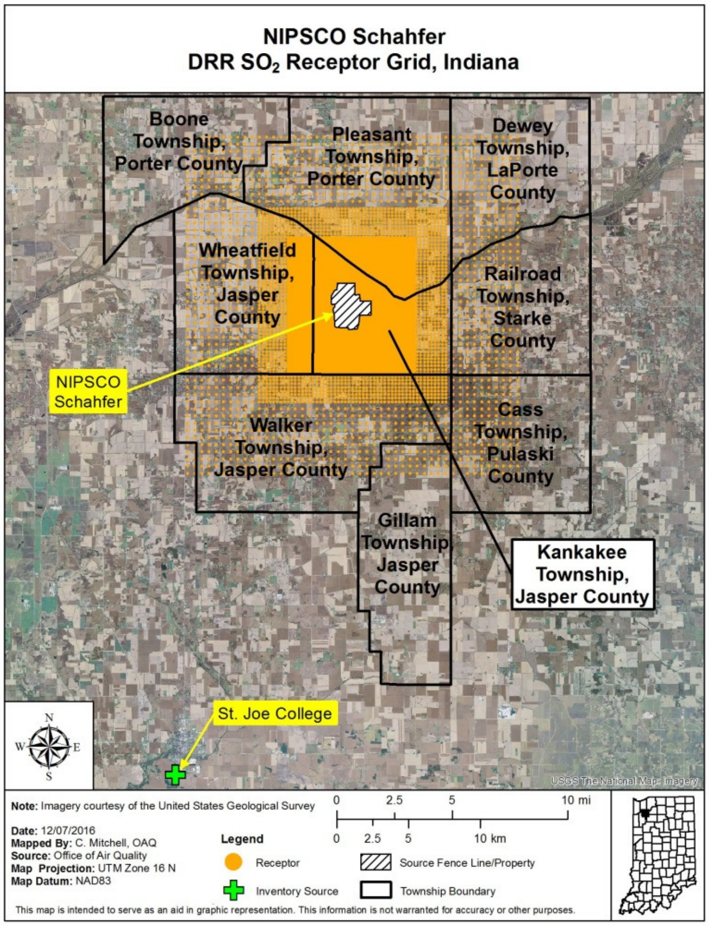
The albedo and the Bowen ratio surface characteristics were adjusted during the three winter months of January, February, and December in accordance with the U.S. EPA Region V document, "Regional Meteorological Data Processing Protocol," dated May 6, 2011. Additionally, a dry or wet Bowen ratio value was used during months when soil moisture conditions were abnormally dry or wet; 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.

14.6 Receptor Grid and Modeling Domain

The receptor grid and modeling domain was based on guidance provided in the memorandum "Updated Guidance for Area Designations for the 2010 Primary Sulfur Dioxide National Ambient Air Quality Standards", dated March 20, 2015 and the SO_2 NAAQS Designations Modeling TAD. Indiana used a multi-nested rectangular receptor grid with appropriate spacing of receptors based on the distance from the modeled emission points to detect significant concentration gradients. The modeling domain extended out to include all sources and the appropriate distances to model maximum 1-hour SO_2 impacts to determine attainment designations for the area. Indiana used the following multi-nested rectangular receptor grid, which are listed below and depicted in Figure 14.4:

- Receptor spacing at the fence line for the DRR facility was placed every 50 meters.
- Receptor spacing at 100 meters was placed out to a distance of 3,000 meters (3 kilometers) beyond the DRR facility.
- Receptor spacing at 250 meters was placed out to a distance of 5,000 meters (5 kilometers) beyond the DRR facility.
- Receptor spacing at 500 meters was placed out to a distance of 10,000 meters (10 kilometers) beyond the DRR facility.

Figure 14.4 – NISPCO - Schahfer Receptor Grid



NIPSCO - Schahfer's property line is very extensive. Their property is nearly two miles long and is approximately 1.6 miles wide. NIPSCO - Schahfer is largely fenced and has regular security patrols to keep unauthorized people off the property. Since this is the case, receptors were placed along the property lines.

14.7 Stack Heights

The use of actual stack heights rather than relying on Good Engineering Practice (GEP) stack heights when modeling actual emissions was utilized in the analysis per the SO_2 NAAQS Designations Modeling TAD.

14.8 Temporally Varying Seasonal 1-Hour SO_2 Background

Temporally varying seasonal SO_2 background concentrations were developed in accordance with the recommended U.S. EPA guidance for establishment of such background concentrations in

Section 8.2 of 40 CFR Part 51, Appendix W and considered appropriate and representative of the area. The latest three years of SO_2 air quality monitoring data (2012-2014) was used.

The 99th percentile SO_2 concentrations by season (winter, spring, summer and fall) for each hour of the day were calculated to determine the temporally varying seasonal SO_2 background, which were directly input into the model and were part of the final modeled results.

Temporally varying seasonal 1-hour SO_2 background concentrations were taken from the Wheatfield monitor for 2012 - 2014. The hourly seasonal SO_2 values used for representative background concentrations for the area surrounding NIPSCO - Schahfer are listed below in Table 14.3.

Table 14.3 – NIPSCO – Schahfer 99th Percentile Temporally Varying Seasonal SO_2 Background Values (ppb)

	Hr 1	Hr 2	Hr 3	Hr 4	Hr 5	Hr 6	Hr 7	Hr 8
Winter	4.75	5.00	4.71	4.68	4.00	5.00	5.40	4.00
Spring	5.54	4.57	5.60	6.16	4.55	5.00	4.47	7.00
Summer	2.44	3.43	3.00	3.45	3.00	3.00	3.49	6.53
Fall	5.26	4.00	4.00	4.00	9.00	7.41	5.29	5.49

	Hr 9	Hr 10	Hr 11	Hr 12	Hr 13	Hr 14	Hr 15	Hr 16
Winter	5.00	7.00	7.00	7.00	7.64	7.00	7.00	7.00
Spring	9.52	8.53	8.06	8.00	7.57	7.00	7.98	6.71
Summer	10.16	8.63	8.00	8.86	9.00	9.28	7.66	7.00
Fall	9.00	7.00	7.69	7.64	5.00	6.00	6.62	5.62

	Hr 17	Hr 18	Hr 19	Hr 20	Hr 21	Hr 22	Hr 23	Hr 24
Winter	7.00	7.00	6.32	5.00	5.68	6.66	6.00	6.00
Spring	5.00	4.66	7.18	7.60	6.57	5.00	4.57	4.55
Summer	4.56	4.54	6.00	7.44	5.00	3.00	3.40	2.52
Fall	5.00	6.18	6.02	5.48	4.00	5.00	4.00	7.99

14.9 SO_2 Emissions Included in the Modeling Analysis

14.9.1 DRR Source: NIPSCO - Schahfer Generating Station Emissions

NIPSCO - Schahfer has four units, Units BLR4, BLR15, BLR17, and BLR18 that have continuous emission monitoring (CEM) data for SO_2. This hourly CEM data from the four units were formatted and used in the 1-hour SO_2 AERMOD model run. Total annual emissions from NIPSCO – Schahfer from 2015 are approximately one-eighth of the emissions from 2012 through 2014 emissions. Therefore, modeling the 2012-2014 emissions is conservative in nature and will be used for this analysis.

14.9.2 Inventoried SO_2 Sources Included in the Modeling

SO_2 sources from the surrounding area were evaluated to determine if their SO_2 emissions had a potential impact on the air quality surrounding the DRR source, beyond what is captured through background monitoring data. Saint Joseph's College was found to be within 30 kilometers of NIPSCO - Schahfer. Saint Joseph's College is no longer a Title V source. The college's last emission report was in 2012. Those emissions were used in the modeling analysis for NIPSCO - Schahfer as listed in Table 14.4.

Table 14.4 – NIPSCO – Schahfer Modeling Source Inventory

Source	Source ID	Location	2012 SO_2 Emissions (tpy)
St. Joseph College	073-00001	Jasper County	120.5

14.10 Modeling Results

The 99th percentile of the 1-hour daily maximum modeled concentrations represents the fourth high of the 1-hour daily maximum SO_2 modeled concentrations and were averaged across three years to compare resulting concentrations to the 1-hour SO_2 NAAQS of 75 ppb (196.2 $\mu g/m^3$). Modeled concentrations include representative temporally varying seasonal 1-hour SO_2 background values to determine the overall impact. The resulting concentrations were compared to the 1-hour SO_2 standard to indicate whether a modeled violation of the SO_2 NAAQS occurred. All concentrations fell below the 1-hour SO_2 NAAQS and were determined to attain the standard and the area surrounding NIPSCO - Schahfer is recommended as attainment.

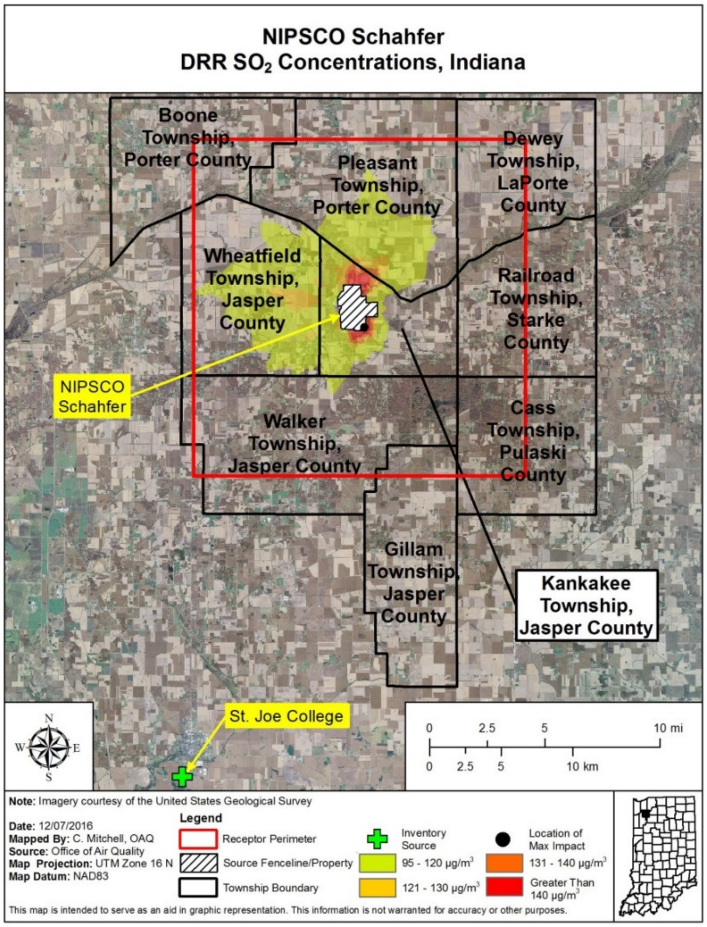
The maximum predicted 99th percentile daily 1-hour SO_2 concentration is shown in Table 14.5. The overall maximum concentration was 162.7 $\mu g/m^3$, occurring at UTM coordinates 499354.6 East, 4561322.6 North.

Table 14.5 – NIPSCO – Schahfer Modeling Results

Emission Scenarios	Maximum Modeled Concentration Including Seasonal Hourly Background ($\mu g/m^3$)	1-Hour SO_2 NAAQS ($\mu g/m^3$)	Facility Models Attainment
NIPSCO - Schahfer	162.7	196.2	Yes

The concentration isopleths showing the maximum predicted 99th percentile daily 1-hour SO_2 concentration gradients can be found in Figure 14.5. The modeling showed attainment of the 1-hour SO_2 standard.

Figure 14.5 – NIPSCO - Schahfer Modeling Results



15.0 Hoosier Energy - Merom (Source ID 153-00005)

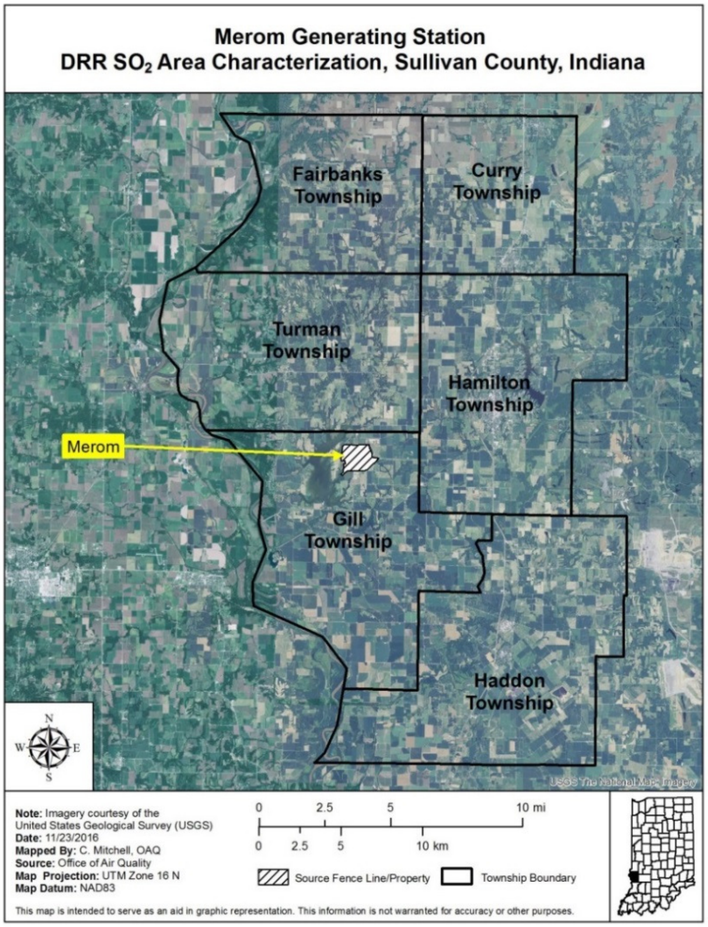
15.1 Source Description

Hoosier Energy - Merom Generating Station (Hoosier Energy - Merom) is a 1070 MW coal fired power plant located in Sullivan County in Southwest Indiana. Hoosier Energy - Merom operates two coal-fired boilers each rated at 5,088 mmBtu/hr. SO_2 emission controls at the facility include a flue gas desulfurization system. Hoosier Energy - Merom was identified as a Data Requirements Rule (DRR) source based on their actual 2014 SO_2 emissions of 3,318 tons exceeding the DRR threshold of 2,000 tons of SO_2.

15.2 Characterization of Modeled Area

Hoosier Energy - Merom is located at 5500 W Old 54, Sullivan, Indiana, approximately 5 miles east of the Wabash River in Gill Township, Sullivan County, Indiana. A map of the area is shown below in Figure 15.1.

Figure 15.1 – Hoosier Energy - Merom and Surrounding Area



15.3 Background Concentrations

The nearest 1-hour SO_2 monitored concentrations were taken from the Terre Haute – Lafayette Road monitor (AQS #18-167-0018). The 99th percentile values from 2013 through 2015 and the 3-year design value are listed below in Table 15.1. The area surrounding the Lafayette Road monitor has been addressed through revisions to the 1-hour SO_2 Nonattainment Area State Implementation Plan.

Table 15.1 – Hoosier Energy – Merom 99th Percentile 1-hour SO_2 Background Values and 3-year Design Value (ppb)

Monitoring Site	2013	2014	2015	2013-2015
Terre Haute – Lafayette Rd	79.1	85.0	71.0	78

15.4 Modeling Methodology

The Hoosier Energy - Merom DRR modeling methodology resembles modeling used to evaluate New Source Review (NSR) and Prevention of Significant Deterioration (PSD) sources. However, Indiana has relied on U.S. EPA guidance "SO_2 NAAQS Designations Modeling Technical Assistance Document" in order to conduct an appropriate air dispersion modeling analysis for Hoosier Energy -Merom to support 1-hour SO_2 designation recommendations.

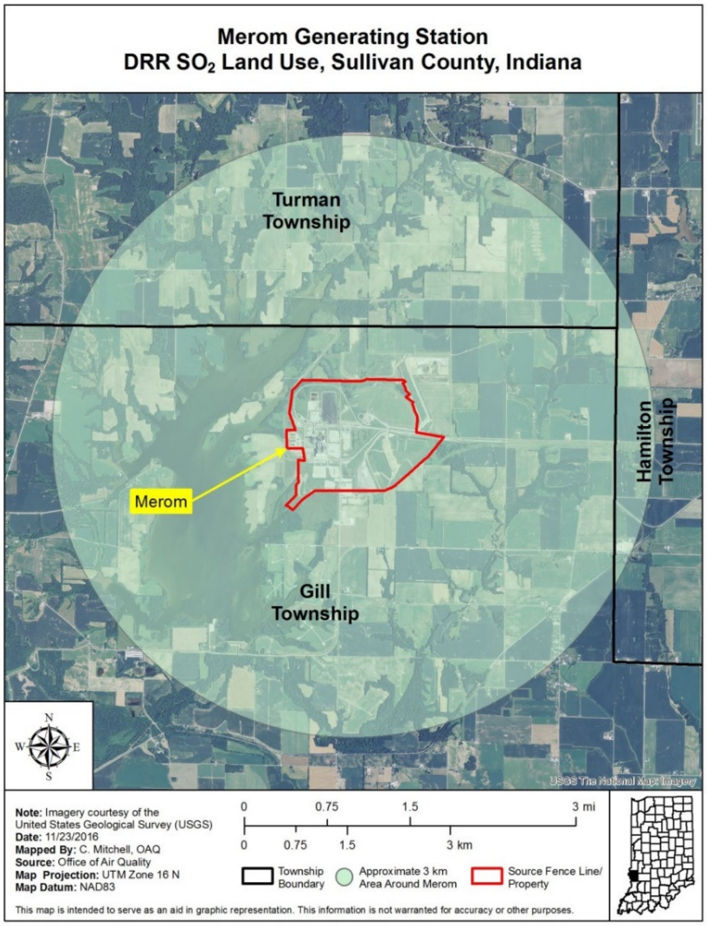
15.4.1 Model Selection

In accordance with Appendix A of Appendix W to 40 Code of Federal Regulations (CFR) Part 51, Indiana used the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) version 15181. BPIPPRIME was used to account for any building downwash concerns.

15.4.2 Model Options

All regulatory default options within AERMOD were used to determine the air quality characteristics surrounding the Hoosier Energy - Merom. The area is considered primarily rural, based on the Auer's Classification Land Use methodology with a vast majority of the land use types classified as agricultural rural (A2) and water surfaces (A5). Therefore, a rural classification was used, as provided for in the Guideline on Air Quality Models, Section 7.2.3 (EPA, 2005b). No variation of the population selection was necessary. Figure 15.2 shows the 3-kilometer radius area surrounding Hoosier Energy - Merom that was analyzed to determine the land use classification.

Figure 15.2 – Hoosier Energy – Merom 3-km Radius to Determine Auer Land Use



15.4.3 AERMAP

The AERMOD terrain preprocessor mapping program, AERMAP, was used to determine all the terrain elevation heights for each receptor, building, and source locations using the Universal Transverse Mercator (UTM) coordinate system. The most recent AERMAP version 11103 assigned the elevations from the National Elevation Dataset (NED) using the North American Datum (NAD) 1983 as recommended in the, "40 CFR Part 51, Revision to the Guideline on Air Quality Models" Appendix W and later revised in the "AERMOD Implementation Guide."

15.5 Meteorological Data

15.5.1 AERMET

As stated in 40 CFR Part 51, Appendix W, section 8.3.1.2 and the SO_2 NAAQS Designations Modeling TAD, Indiana used 2013-2015 National Weather Service (NWS) surface and upper air meteorological data processed with the latest version of the AERMOD meteorological data

preprocessor program AERMET (version 15181). Table 15.2 below lists surface and upper air meteorological stations used to conduct modeling.

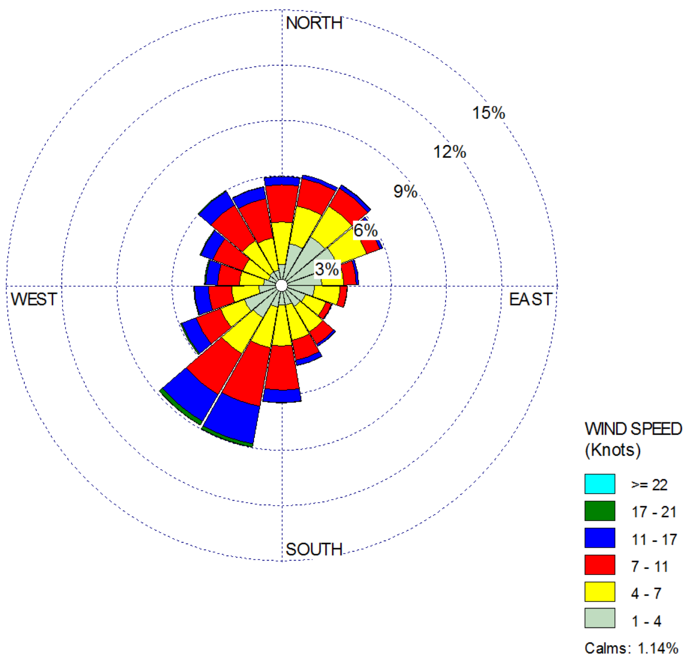
Table 15.2 – Hoosier Energy – Merom NWS Stations/Onsite Meteorological Stations

Facility	Surface Meteorology	Upper Air Meteorology
Hoosier Energy – Merom	Evansville, IN NWS	Lincoln, IL NWS

15.5.2 Wind Rose

The Evansville, Indiana National Weather Service (NWS) surface meteorological data and the Lincoln, Illinois upper air meteorological data taken from 2013 through 2015 were used to determine the meteorological conditions for the area surrounding Hoosier Energy - Merom in AERMOD. The Evansville NWS wind rose for the 3-year modeled period 2013-2015 is shown as Figure 15.3 below. The Evansville NWS wind rose depicts the predominant wind direction as from the southwest for the 3-year modeled period 2013-2015.

Figure 15.3 - Evansville 3-year Cumulative Wind Rose (2013 – 2015)



15.5.3 AERMINUTE/AERSURFACE

The 1-minute wind speeds and wind directions, taken from the Automated Surface Observing System (ASOS) NWS stations and onsite meteorological stations, were processed with the U.S. EPA 1-minute data processor program AERMINUTE version 15272.

The U.S. EPA program AERSURFACE version 13016 was used to determine the surface characteristics; albedo, Bowen ratio, and surface roughness for the Evansville, Indiana NWS meteorological tower location. Surface characteristics were determined at the NWS location for each of 12 wind direction sectors with a recommended default radius of one kilometer.

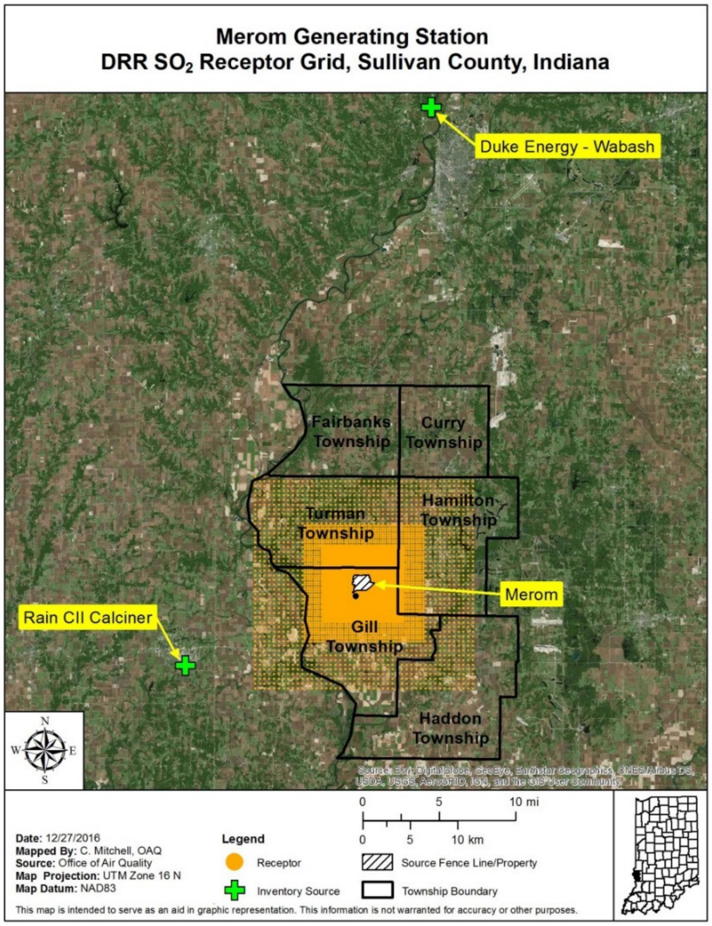
The albedo and the Bowen ratio surface characteristics were adjusted during the three winter months of January, February, and December in accordance with the U.S. EPA Region V document, “Regional Meteorological Data Processing Protocol,” dated May 6, 2011. Additionally, a dry or wet Bowen ratio value was used during months when soil moisture conditions were abnormally dry or wet; 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.

15.6 Receptor Grid and Modeling Domain

The receptor grid and modeling domain was based on guidance provided in the memorandum “Updated Guidance for Area Designations for the 2010 Primary Sulfur Dioxide National Ambient Air Quality Standards”, dated March 20, 2015 and the SO_2 NAAQS Designations Modeling TAD. Indiana used a multi-nested rectangular receptor grid with appropriate spacing of receptors based on the distance from the modeled emission points to detect significant concentration gradients. The modeling domain extended out to include all sources and the appropriate distances to model maximum 1-hour SO_2 impacts to determine attainment designations for the area. Indiana used the following multi-nested rectangular receptor grid which are listed below and depicted in Figure 15.4:

- Receptor spacing at the fence line for each facility was placed every 50 meters.
- Receptor spacing at 100 meters was placed out to a distance of 3,000 meters (3 kilometers) beyond the DRR facility.
- Receptor spacing at 250 meters was placed out to a distance of 5,000 meters (5 kilometers) beyond the DRR facility.
- Receptor spacing at 500 meters was placed out to a distance of 10,000 meters (10 kilometers) beyond the DRR facility.

Figure 15.4 – Hoosier Energy – Merom Receptor Grid



Hoosier Energy - Merom has a fence surrounding the property with security gates restricting public access to all Merom property. Natural barriers immediately surround the property with a reservoir west of the facility and a landfill to the north. Receptors were therefore placed along the property boundary where public access is not restricted.

15.7 Stack Heights

The use of actual stack heights rather than relying on Good Engineering Practice (GEP) stack heights when modeling actual emissions was utilized in the analysis per the SO_2 NAAQS Designations Modeling TAD.

15.8 Temporally Varying Seasonal 1-Hour SO_2 Background

Temporally varying seasonal SO_2 background concentrations were developed in accordance with the recommended U.S. EPA guidance for establishment of such background concentrations in

Section 8.2 of 40 CFR Part 51, Appendix W and considered appropriate and representative of the area. The latest three years of SO_2 air quality monitoring data (2013-2015) was used.

The 99th percentile SO_2 concentrations by season (winter, spring, summer and fall) for each hour of the day were calculated to determine the temporally varying seasonal SO_2 background, which were directly input into the model and were part of the final modeled results.

Temporally varying seasonal 1-hour SO_2 background concentrations were taken from the Terre Haute – Lafayette Road monitor for 2013 - 2015. The hourly seasonal SO_2 values used for representative background concentrations for the area surrounding Hoosier Energy - Merom are listed below in Table 15.3.

Table 15.3 – Hoosier Energy – Merom 99th Percentile Temporally Varying Seasonal SO_2 Background Values (ppb)

	Hr 1	Hr 2	Hr 3	Hr 4	Hr 5	Hr 6	Hr 7	Hr 8
Winter	4.99	5.61	5.59	5.17	5.56	5.96	6.30	6.69
Spring	5.25	6.70	7.97	4.37	6.82	4.37	5.46	4.78
Summer	2.78	2.54	2.69	2.17	1.81	2.13	2.71	3.81
Fall	8.21	5.06	5.17	4.07	5.87	3.72	3.81	4.35

	Hr 9	Hr 10	Hr 11	Hr 12	Hr 13	Hr 14	Hr 15	Hr 16
Winter	6.22	5.45	9.07	11.45	10.06	9.25	7.76	8.97
Spring	6.86	6.29	24.67	11.51	14.16	10.08	6.30	9.29
Summer	4.44	8.83	8.55	10.09	8.43	24.15	26.75	29.68
Fall	6.35	6.03	34.92	18.80	11.22	14.39	7.32	15.27

	Hr 17	Hr 18	Hr 19	Hr 20	Hr 21	Hr 22	Hr 23	Hr 24
Winter	10.45	16.58	8.77	8.84	7.05	6.47	8.66	6.99
Spring	8.60	16.86	5.33	4.59	8.55	4.05	5.73	6.31
Summer	12.49	6.59	5.55	3.94	6.82	4.93	4.07	2.74
Fall	5.14	5.22	5.23	5.65	9.28	7.68	9.08	8.03

15.9 SO_2 Emissions Included in the Modeling Analysis

15.9.1 DRR Source: Hoosier Energy - Merom Emissions

Hoosier Energy - Merom operates two coal-fired units each of which are equipped with Continuous Emission Monitoring (CEM) systems. CEM data from 2013 through 2015 was formatted into an AERMOD ready hourly input file and used in the final modeling.

15.9.2 Inventoried SO_2 Sources Included in the Modeling

SO_2 sources from the surrounding area were evaluated to determine if their SO_2 emissions had a potential impact on the air quality surrounding Hoosier Energy - Merom, beyond what is captured through background monitoring data. The latest available actual emissions were used for inventory sources. Two sources were included in the model in addition to the Hoosier Energy - Merom facility: Rain II Carbon in Illinois and the Duke - Wabash facility in Vigo County, Indiana.

Rain CII Carbon is a green petroleum coke calcining facility that produces aluminum and other raw materials. Rain CII Carbon is located in Crawford County, Illinois, 20 km southwest of Hoosier Energy - Merom and produced 3,132 tpy of SO_2 in 2014. Hourly continuous emission monitoring data from 2013 through 2015 were used in AERMOD for the Rain II facility.

Duke Energy - Wabash was an electric generating facility in located 51 km to the north of Hoosier Energy - Merom in Vigo County, Indiana. The facility retired all of its coal-fired electric generating units (Units 2-6). Units 2-5 were retired on April 16, 2016 and Unit 6 was retired on December 7, 2016. Although this source was outside of the 30 km radius Indiana used to determine background sources, Indiana included this source in the modeling of Hoosier Energy - Merom due to high background concentrations over the 2013-2015 time period. Upwind impacts in the background data from the Wabash facility were adjusted to prevent double counting. Average actual emissions from 2013 through 2015 was used in the modeling and listed in Table 15.4.

Table 15.4 – Hoosier Energy – Merom Modeling Source Inventory

Source	Source ID	Location	SO_2 Emissions (tpy)
Rain CII Carbon	033025AAJ	Crawford County, IL	2,750
Duke - Wabash	167-00021	Vigo County	28,154

15.10 Modeling Results

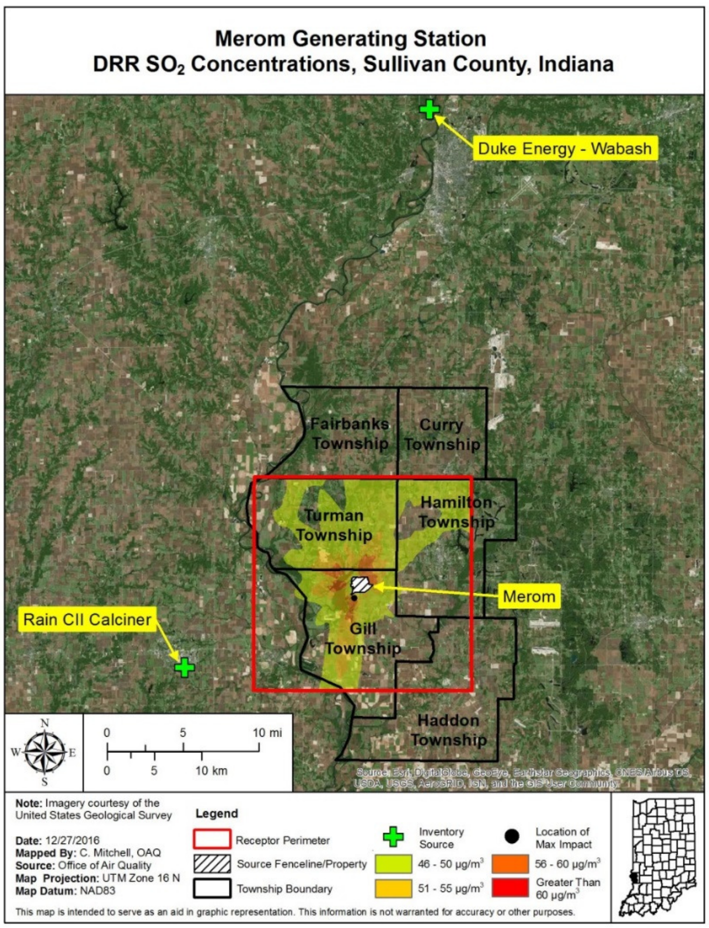
The 99th percentile of the 1-hour daily maximum modeled concentrations represents the fourth high of the 1-hour daily maximum SO_2 modeled concentrations and were averaged across three years to compare resulting concentrations to the 1-hour SO_2 NAAQS of 75 ppb (196.2 $\mu g/m^3$). Modeled concentrations include representative temporally varying seasonal 1-hour SO_2 background values to determine the overall impact. The resulting concentrations were compared to the 1-hour SO_2 standard to indicate whether a modeled violation of the SO_2 NAAQS occurred. All concentrations fell below the 1-hour SO_2 NAAQS and were determined to attain the standard and the area surrounding Hoosier Energy - Merom is recommended as attainment. The maximum predicted 99th percentile daily 1-hour SO_2 concentration is shown in Table 15.5. The overall maximum concentration was 63.0 $\mu g/m^3$, occurring at UTM coordinates 455600.0 East, 4323300.0 North.

Table 15.5 – Hoosier Energy – Merom Modeling Results

Emission Scenarios	Maximum Modeled Concentration Including Seasonal Hourly Background ($\mu g/m^3$)	1-Hour SO_2 NAAQS ($\mu g/m^3$)	Facility Models Attainment
Hoosier Energy – Merom	63.0	196.2	Yes

The concentration isopleths showing the maximum predicted 99th percentile daily 1-hour SO_2 concentration gradients can be found in Figure 15.5.

Figure 15.5 – Hoosier Energy - Merom Modeling Results



16.0 - Duke - Cayuga Generating Station (Source ID 18-165-00001)

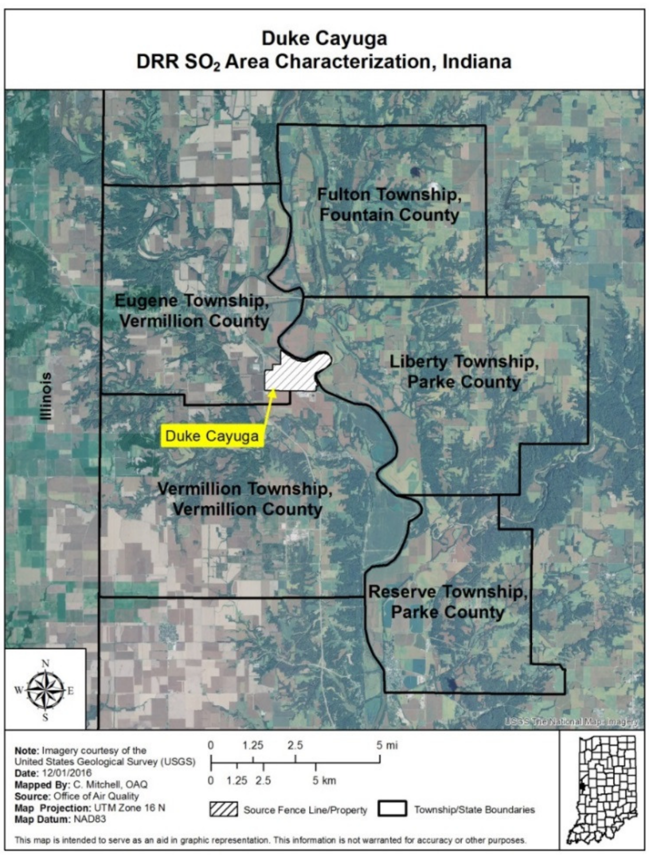
16.1 Source Description

Duke - Cayuga Generating Station (Duke - Cayuga) is an electric generating station owned by Duke Energy Indiana, LLC. Duke - Cayuga is a two-unit generating facility built between 1967 and 1968. Units 1 and 2 are equipped with scrubbers to reduce the stations sulfur dioxide emissions by approximately 95 percent. The two coal-fired boilers are rated at 4,802 MMBtu/hour each and have a generating capacity of 1104 megawatts. Duke - Cayuga was identified as a Data Requirements Rule (DRR) source based on their actual 2014 SO_2 emissions of 3448.4 tons exceeding the DRR threshold of 2,000 tons of SO_2.

16.2 Characterization of Modeled Area

The Duke - Cayuga is located off of State Road 63, Cayuga, Indiana on the banks of the Wabash River, Eugene Township, Vermillion County, Indiana. A map of the area surrounding Duke - Cayuga used for DRR modeling is shown in Figure 16.1.

Figure 16.1 - Duke - Cayuga and Surrounding Area



16.3 Background Concentrations

The nearest 1-hour SO_2 monitored concentrations were taken from the Fountain County monitor (AQS #18-045-0001). The 99^{th} percentile values from 2012 through 2014 and the 3-year design value are listed below in Table 16.1.

Table 16.1 – Duke – Cayuga 99^{th} Percentile 1-hour SO_2 Background Values and 3-year Design Value (ppb)

Monitoring Site	2012	2013	2014	2012-2014
Fountain County	30	34	22	29

16.4 Modeling Methodology

The Duke - Cayuga DRR modeling methodology resembles modeling used to evaluate New Source Review (NSR) and Prevention of Significant Deterioration (PSD) sources. However, Indiana has relied on U.S. EPA guidance "SO_2 NAAQS Designations Modeling Technical Assistance Document" in order to conduct an appropriate air dispersion modeling analysis for Duke - Cayuga to support 1-hour SO_2 designation recommendations.

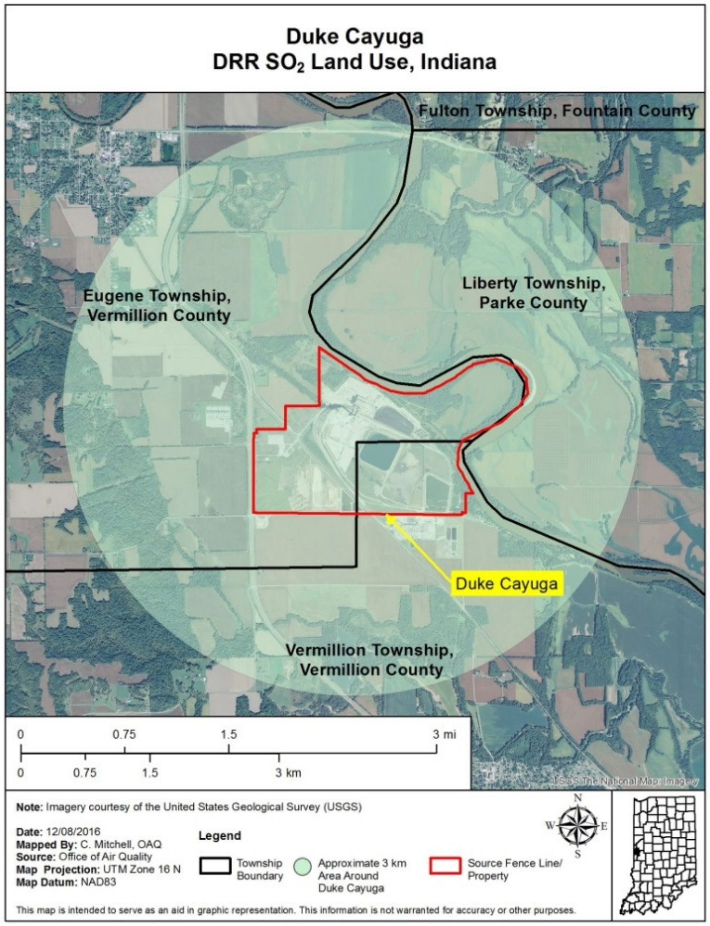
16.4.1 Model Selection

In accordance with Appendix A of Appendix W to 40 Code of Federal Regulations (CFR) Part 51, Indiana used the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) version 15181. BPIPPRIME was used to account for any building downwash concerns.

16.4.2 Model Options

All regulatory default options within AERMOD were used to determine the air quality characteristics surrounding Duke. The area is considered primarily rural, based on the Auer's Classification Land Use methodology with a vast majority of the land use types classified as agricultural rural (A2), undeveloped rural (A4) and water surfaces (A5). Therefore, a rural classification was used, as provided for in the Guideline on Air Quality Models, Section 7.2.3 (EPA, 2005b). No variation of the population selection was necessary. Figure 16.2 shows the 3-kilometer radius area surrounding Duke - Cayuga that was analyzed to determine the land use classification.

Figure 16.2 – Duke – Cayuga 3-km Radius to Determine Auer Land Use



16.4.3 AERMAP

The AERMOD terrain preprocessor mapping program, AERMAP, was used to determine all the terrain elevation heights for each receptor, building, and source locations using the Universal Transverse Mercator (UTM) coordinate system. The most recent AERMAP version 11103 assigned the elevations from the National Elevation Dataset (NED) using the North American Datum (NAD) 1983 as recommended in the, "40 CFR Part 51, Revision to the Guideline on Air Quality Models" Appendix W and later revised in the "AERMOD Implementation Guide."

16.5 Meteorological Data

16.5.1 AERMET

As stated in 40 CFR Part 51, Appendix W, section 8.3.1.2 and the SO_2 NAAQS Designations Modeling TAD, Indiana used 2013-2015 National Weather Service (NWS) surface and upper air meteorological data processed with the latest version of the AERMOD meteorological data

preprocessor program AERMET (version 15181). Table 16.2 below lists surface and upper air meteorological stations used to conduct modeling

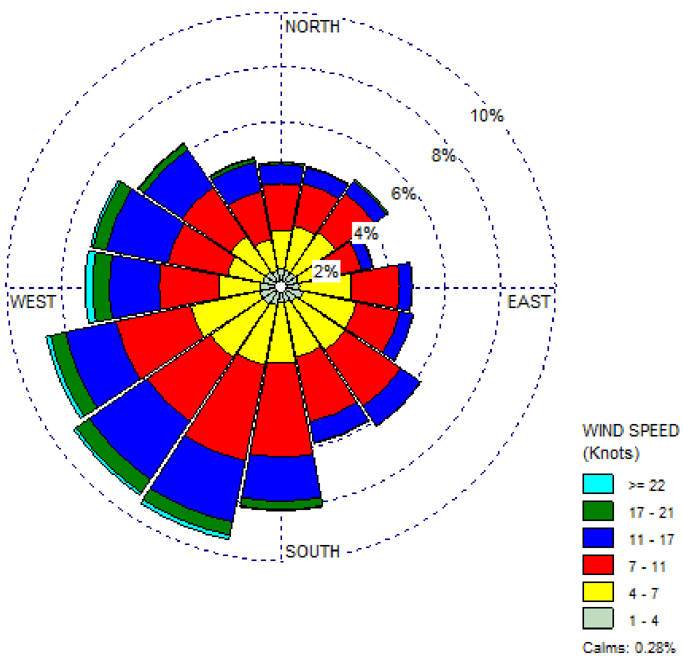
Table 16.2 – Duke – Cayuga NWS Stations/Onsite Meteorological Stations

Facility	Surface Meteorology	Upper Air Meteorology
Duke - Cayuga	Indianapolis, IN NWS	Lincoln, IL NWS

16.5.2 Wind Rose

The Indianapolis, Indiana National Weather Service (NWS) surface meteorological data and the Lincoln, Illinois upper air meteorological data taken from 2012 through 2014 was used to determine the meteorological conditions for the area surrounding Duke - Cayuga in AERMOD. The Indianapolis NWS wind rose for the 3-year modeled period 2012-2014 is shown as Figure 16.3 below. The Indianapolis NWS wind rose depicts the predominant wind direction as from the southwest for the 3-year modeled period 2012-2014.

Figure 16.3 – Indianapolis 3-year Cumulative Wind Rose (2012 – 2014)



16.5.3 AERMINUTE/AERSURFACE

The 1-minute wind speeds and wind directions, taken from the Automated Surface Observing System (ASOS) NWS stations and onsite meteorological stations, were processed with the U.S. EPA 1-minute data processor program AERMINUTE version 15272.

The U.S. EPA program AERSURFACE version 13016 was used to determine the surface characteristics; albedo, Bowen ratio, and surface roughness for the Indianapolis, Indiana NWS meteorological tower location. Surface characteristics were determined at the NWS location for each of 12 wind direction sectors with a recommended default radius of one kilometer.

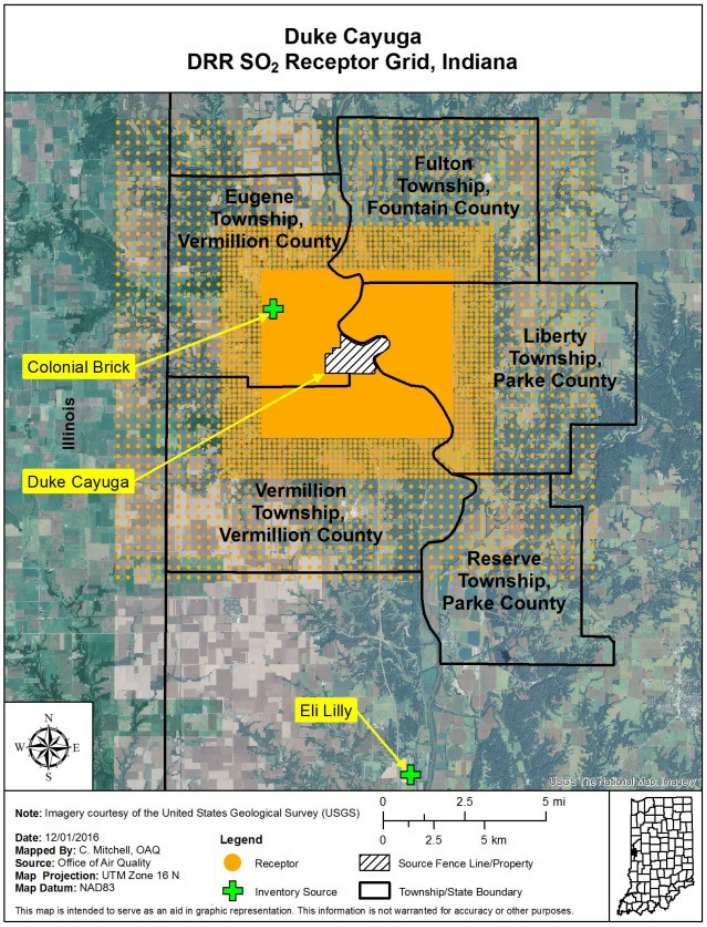
The albedo and the Bowen ratio surface characteristics were adjusted during the three winter months of January, February, and December in accordance with the U.S. EPA Region V document, "Regional Meteorological Data Processing Protocol," dated May 6, 2011. Additionally, a dry or wet Bowen ratio value was used during months when soil moisture conditions were abnormally dry or wet; 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.

16.6 Receptor Grid and Modeling Domain

The receptor grid and modeling domain was based on guidance provided in the memorandum "Updated Guidance for Area Designations for the 2010 Primary Sulfur Dioxide National Ambient Air Quality Standards", dated March 20, 2015 and the SO_2 NAAQS Designations Modeling TAD. Indiana used a multi-nested rectangular receptor grid with appropriate spacing of receptors based on the distance from the modeled emission points to detect significant concentration gradients. The modeling domain extended out to include all sources and the appropriate distances to model maximum 1-hour SO_2 impacts to determine attainment designations for the area. Indiana used the following multi-nested rectangular receptor grid which are listed below and depicted in Figure 16.4:

- Receptor spacing at the fence line for each facility was placed every 50 meters.
- Receptor spacing at 100 meters was placed out to a distance of 3,000 meters (3 kilometers) beyond each facility.
- Receptor spacing at 250 meters was placed out to a distance of 5,000 meters (5 kilometers) beyond each facility.
- Receptor spacing at 500 meters was placed out to a distance of 10,000 meters (10 kilometers) beyond each facility.

Figure 16.4 – Duke – Cayuga Receptor Grid



Duke – Cayuga is largely fenced and has regular security patrols to keep unauthorized people off the property. Since this is the case, receptors were placed along the property line. Duke – Cayuga's concentrations increase extending out from the property line, indicating that maximum modeled concentrations occur further away from the Duke – Cayuga property.

16.7 Stack Heights

The use of actual stack heights rather than relying on Good Engineering Practice (GEP) stack heights when modeling actual emissions was utilized in the analysis per the SO_2 NAAQS Designations Modeling TAD.

16.8 Temporally Varying Seasonal 1-Hour SO_2 Background

Temporally varying seasonal SO_2 background concentrations were developed in accordance with the recommended U.S. EPA guidance for establishment of such background concentrations in

Section 8.2 of 40 CFR Part 51, Appendix W and considered appropriate and representative of the area. The latest three years of SO_2 air quality monitoring data (2012-2014) was used.

The 99th percentile SO_2 concentrations by season (winter, spring, summer and fall) for each hour of the day were calculated to determine the temporally varying seasonal SO_2 background, which were directly input into the model and were part of the final modeled results.

Temporally varying seasonal 1-hour SO_2 background concentrations were taken from the Fountain County monitor for 2012 - 2014. The hourly seasonal SO_2 values used for representative background concentrations for the area surrounding Duke - Cayuga are listed below in Table 16.3.

Table 16.3 – Duke – Cayuga 99th Percentile Temporally Varying Seasonal SO_2 Background Values (ppb)

	Hr 1	Hr 2	Hr 3	Hr 4	Hr 5	Hr 6	Hr 7	Hr 8
Winter	7.76	7.52	7.00	6.49	8.00	7.00	6.00	6.51
Spring	7.69	8.00	7.55	8.00	8.00	7.53	7.54	6.56
Summer	4.50	5.00	4.00	3.48	3.42	3.00	3.00	3.00
Fall	6.58	5.62	6.00	5.00	7.56	6.57	7.18	6.55

	Hr 9	Hr 10	Hr 11	Hr 12	Hr 13	Hr 14	Hr 15	Hr 16
Winter	8.55	9.60	9.98	9.00	9.00	8.26	7.65	8.30
Spring	8.63	9.00	10.00	8.00	8.63	9.00	9.00	7.64
Summer	6.22	7.24	8.62	8.00	9.00	8.00	6.57	6.60
Fall	6.60	6.63	9.00	8.67	8.00	7.62	9.00	8.68

	Hr 17	Hr 18	Hr 19	Hr 20	Hr 21	Hr 22	Hr 23	Hr 24
Winter	6.00	8.42	8.62	11.00	8.00	8.18	8.85	8.00
Spring	8.00	8.00	9.00	8.60	9.00	7.00	8.00	7.38
Summer	6.58	5.56	6.58	5.00	4.00	4.00	6.52	4.00
Fall	8.63	8.14	7.55	7.56	6.48	7.53	8.00	7.53

16.9 SO_2 Emissions Included in the Modeling Analysis

16.9.1 DRR Source: Duke - Cayuga Emissions

Duke - Cayuga has two units, Units BLR1 and BLR2 that have continuous emission monitoring (CEM) data for SO_2 from 2012 - 2014. This hourly CEM data from both units was formatted and used in the 1-hour SO_2 AERMOD model run. Total annual emissions from Duke - Cayuga from 2015 are approximately one-half of the emissions from 2012 through 2014 emissions.

Therefore, modeling the 2012-2014 emissions is conservative in nature. The auxiliary boiler will also be modeled based on the 2014 emissions reporting.

16.9.2 Inventoried SO_2 Sources Included in the Modeling

SO_2 sources from the surrounding area were evaluated to determine if their SO_2 emissions had a potential impact on the air quality surrounding the DRR source, beyond what is captured through background monitoring data. The latest available actual emissions over three years (2012-2014) were used. The following list of sources were included in the AERMOD run to determine overall air quality characteristics. Table 16.4 lists the inventory source to be included in the AERMOD run to determine overall air quality characteristics for the area surrounding Duke - Cayuga.

Table 16.4 – Duke – Cayuga Modeling Source Inventory

Source	Source ID	Location	2012-2014 SO_2 Emissions (tpy)
Eli Lilly	165-00009	Vermillion County	1618.8[a]
Colonial Brick	165-00002	Vermillion County	76.5[b]

[a] A short-term emission rate for the three-year (2012-2014) average was modeled for Eli Lilly.

[b] A three-year (2012-2014) annual average was calculated for Colonial Brick. Colonial Brick was shut down in 2016. They still have an active Title V permit on file.

16.10 Modeling Results

The 99th percentile of the 1-hour daily maximum modeled concentrations represents the fourth high of the 1-hour daily maximum SO_2 modeled concentrations and were averaged across three years to compare resulting concentrations to the 1-hour SO_2 NAAQS of 75 ppb (196.2 $\mu g/m^3$). Modeled concentrations include representative temporally varying seasonal 1-hour SO_2 background values to determine the overall impact. The resulting concentrations were compared to the 1-hour SO_2 standard to indicate whether a modeled violation of the SO_2 NAAQS occurred. All concentrations fell below the 1-hour SO_2 NAAQS and were determined to attain the standard and the area surrounding Duke - Cayuga is recommended as attainment. The maximum predicted 99th percentile daily 1-hour SO_2 concentration is shown in Table 16.5. The overall maximum concentration was 176.4 $\mu g/m^3$, occurring at UTM coordinates 458750.0 East, 4421750.0 North.

Table 16.5 – Duke – Cayuga Modeling Results

Emission Scenarios	Total Modeled Concentration Including Seasonal Hourly Background ($\mu g/m^3$)	1-Hour SO_2 NAAQS ($\mu g/m^3$)	Facility Models Attainment
Duke - Cayuga	176.4	196.2	Yes

The concentration isopleths showing the maximum predicted 99th percentile daily 1-hour SO_2 concentration gradients can be found in Figure 16.5.

Figure 16.5 – Duke - Cayuga Modeling Results