west virginia department of environmental protection

Attachment 1:
Modeling Reports

West Virginia Division of Air Quality
601 57th Street, SE
Charleston, WV 25304

Promoting a healthy environment.

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List of Modeling Reports

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ENVIROPLAN CONSULTING

Air Modeling Findings Report for the Harrison Power Plant in Response to U.S. EPA's Data Requirements Rule for the 2010 1-Hour SO_2 Primary National Ambient Air Quality Standard

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Submitted to:
Division of Air Quality
West Virginia Department of Environmental Protection
601 57th Street SE
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EXECUTIVE SUMMARY

On August 21, 2015, the U.S. Environmental Protection Agency (EPA) published the final *Data Requirements Rule for the 2010 1-Hour Sulfur Dioxide (SO_2) Primary National Ambient Air Quality Standard (NAAQS)* [80 FR 51052]. The EPA's Data Requirements Rule (DRR) requires air quality designations be made for the 1-hour SO_2 National Ambient Air Quality Standard (NAAQS)[1] for those areas with large sources of SO_2 emissions. In general, the DRR requires attainment status characterization for unclassified areas containing, or impacted by, SO_2 sources that have annual actual SO_2 emissions of 2,000 tons or more based on the most recently available annual data. Lesser emitting SO_2 sources can also be subject to the DRR air quality characterization requirement. The DRR sets forth a process and schedule for which air agencies must characterize air quality through ambient monitoring and/or air quality modeling techniques; and submit such findings and data to EPA. For affected sources opting to characterize air quality through dispersion modeling, the DRR schedule requires that all modeling results be submitted to the EPA by January 13, 2017.

On September 15, 2015 the West Virginia Department of Environmental Protection (WVDEP) notified FirstEnergy indicating their Harrison Power Plant to be an affected SO_2 stationary source subject to the DRR. FirstEnergy informed WVDEP they would perform air quality modeling for designation air quality characterization. The modeling data and methods presented herein reflect the procedures for the conduct of designation air modeling following the EPA's 1-hour SO_2 designation modeling Technical Assistance Document (TAD) [2] [3], as described in the final protocol submitted to WVDEP on June 27, 2016.

Enviroplan Consulting, as the air modeling contractor to FirstEnergy, has conducted the designation modeling in accordance with the protocol and agency recommendations. Enviroplan has also participated in the above referenced protocol development and related correspondence. The designation modeling utilized the U.S. EPA AERMOD modeling suite of programs to evaluate actual SO_2 emission rates for identified emitting sources in and surrounding the subject affected plant. For this evaluation, only the Harrison plant is an affected inventory, along with the inclusion of a measured background concentration added to model predictions.

The result of this 1-hour SO_2 designation modeling evaluation shows total predicted design value concentrations below the 1-hour SO_2 NAAQS of 75 parts per billion (ppb). These findings are based on application of EPA recommended procedures presented in their TAD for designation modeling. FirstEnergy believes that this designation modeling demonstration will allow WVDEP and EPA to deem the air quality in the area surrounding the Harrison Power Plant as *Attainment* under the 1-hour SO_2 NAAQS Data Requirements Rule.

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[1] The 1-hour SO_2 NAAQS of 75 parts per billion (ppb) is a probabilistic air quality standard, where compliance is based on the 99th percentile of daily maximum 1-hour concentrations averaged over three years.

[2] U.S. EPA, December 2013, *SO2 NAAQS Designations Modeling Technical Assistance Document (Draft),* http://www.epa.gov/airquality/sulfurdioxide/pdfs/SO2ModelingTAD.pdf

[3] U.S. EPA, 2005. *Guideline on Air Quality Models.* 40 CFR Part 51 Appendix W. http://www.epa.gov/ttn/scram/guidance/guide/appw_05.pdf

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1. INTRODUCTION

On August 21, 2015, the U.S. Environmental Protection Agency (EPA) published the final *Data Requirements Rule for the 2010 1-Hour Sulfur Dioxide (SO_2) Primary National Ambient Air Quality Standard (NAAQS)* [80 FR 51052]. The EPA's Data Requirements Rule (DRR) requires air quality designations be made for the 1-hour SO_2 National Ambient Air Quality Standard (NAAQS)[4] for those areas with large sources of SO_2 emissions. In general, the DRR requires attainment status characterization for unclassified areas containing, or impacted by, SO_2 sources that have annual actual SO_2 emissions of 2,000 tons or more based on the most recently available annual data. Lesser emitting SO_2 sources can also be subject to the DRR air quality characterization requirement. The DRR sets forth a process and schedule for which air agencies must characterize air quality through ambient monitoring and/or air quality modeling techniques; and submit such findings and data to EPA. For affected sources opting to characterize air quality through dispersion modeling, the DRR schedule requires that all modeling results be submitted to the EPA and by January 1, 2017.

On September 15, 2015 the West Virginia Department of Environmental Protection (WVDEP) notified FirstEnergy indicating their Harrison Power Plant is an affected SO_2 stationary source subject to the DRR. The FirstEnergy Harrison power generating station is located in the town of Haywood, Harrison County, West Virginia, along the West Fork River. On November 4, 2015, FirstEnergy held a teleconference with the WVDEP[5]. The purpose of the teleconference was to communicate Division of Air Quality's (DAQ) requirements in regards to the 1-hour SO_2 NAAQS modeling, including background source inventory; and for FirstEnergy to confirm their plan to use modeling for the Harrison plant area designation process. Additional modeling information and guidance were subsequently provided by WVDEP[6] [7], including the background source modeling inventory; meteorological data; and general air modeling approach. This information was compiled into an initial protocol that FirstEnergy submitted to WVDEP on March 30, 2016. WVDEP and U.S. EPA Region 3 provided protocol comments to FirstEnergy on May 22 and June 2, 2016[8] [9]. FirstEnergy submitted the final protocol to WVDEP on June 27, 2016. The final protocol and April 21, 2015 PADEP correspondence are included herein as Appendix A. Verbal acknowledgement of the protocol content/procedures was provided by WVDEP on September 23, 2016.[10]

The modeling data and methods presented herein reflect the procedures for the conduct of designation air modeling following the EPA's 1-hour SO_2 designation modeling Technical Assistance Document (TAD) [11] [12], as described in the final protocol submitted to WVDEP on June 27, 2016.

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[4] The 1-hour SO_2 NAAQS of 75 parts per billion (ppb) is a probabilistic air quality standard, where compliance is based on the 99th percentile of daily maximum 1-hour concentrations averaged over three years.
[5] Conversation between B. Kolts (FirstEnergy) and Jon McClung (WVDEP, DAQ) on November 4, 2015.
[6] Email to B. Kolts (FirstEnergy) from Jon McClung (WVDEP, DAQ) on November 16, 2015.
[7] Email to M. Hirtler (Enviroplan Consulting) from Jon McClung (WVEP, DAQ) on March 23, 2016.
[8] Email to B. Kolts (FirstEnergy) from Jon McClung (WVDEP, DAQ) on May 22, 2016.
[9] Email to B. Kolts (FirstEnergy) from Jon McClung (WVDEP, DAQ) on June 2, 2016
[10] Conversation between B. Kolts (FirstEnergy) and Jon McClung (WVDEP, DAQ) on September 23, 2016.
[11] U.S. EPA, December 2013, *SO2 NAAQS Designations Modeling Technical Assistance Document (Draft),* http://www.epa.gov/airquality/sulfurdioxide/pdfs/SO2ModelingTAD.pdf
[12] U.S. EPA, 2005. *Guideline on Air Quality Models.* 40 CFR Part 51 Appendix W. http://www.epa.gov/ttn/scram/guidance/guide/appw_05.pdf

Enviroplan Consulting, as the air modeling contractor to FirstEnergy, has conducted the designation modeling of the Harrison plant. Section 2 of this document discusses the emissions inventory and emission rates considered in the designation modeling analysis. Section 3 presents the air model selection for the analysis, the related model input data and analyses, and the modeling approach. Section 4 presents the designation modeling results and study findings for the FirstEnergy Harrison plant.

2. AIR EMISSIONS SOURCES INCLUDED IN 1-HOUR SO_2 DESIGNATION MODELING DEMONSTRATION AND RELATED MODELING PARAMETERS

FirstEnergy and WVDEP held a teleconference to discuss the conduct of the Harrison plant designation modeling. The discussion included required SO_2 emitting sources to be considered in a designation modeling inventory, along with the affected source (i.e., the Harrison plant). To that end, WVDEP compiled a list of WV SO_2 emitting sources with their actual annual SO_2 emission rates (tons per year, tpy) for each of 2012, 2013 and 2014. The list and a graphic showing plant locations were provided to FirstEnergy on November 4 and 16, 2015.

The FirstEnergy Harrison power generating station is located in the town of Haywood, Harrison County, West Virginia, along the West Fork River. Table 1 below presents the inventory of combustion units at the plant.

Table 1: First Energy - Harrison Power Station Combustion Units

Unit	Stack ID	Capacity MMBtu/hr	Fuel Type
Babcock & Wilcox Boiler #1		6,325.00	Bituminous Coal
Babcock & Wilcox Boiler #2	H001	6,325.00	Bituminous Coal
Babcock & Wilcox Boiler #3		6,325.00	Bituminous Coal
Auxiliary Boiler No. A		202.20	Natural Gas
Auxiliary Boiler No. B		202.20	Natural Gas
Emergency Diesel Generator No. 1			
Emergency Diesel Generator No. 2			
Emergency Diesel Generator No. 3			

The existing Harrison facility is equipped with three identical opposed fired, pulverized coal dry bottom boilers, along with a dedicated flue gas desulfurization (FGD) SO_2 emissions control system. The system is configured with the three boilers exhausting through separate flues in a common 1000-foot stack. The stack has a continuous emissions monitoring system (CEMS) that records hourly average exhaust flow rate and temperature, and SO_2 emissions. Modeling of the three coal boilers reflected a merged flue configuration (see Section 3.4.1 for further discussion) using the actual hourly CEMS data recorded for the designation modeling period (2013-2015). The CEMS data was compiled by FirstEnergy for input to this designation modeling evaluation. Physical FGD stack parameters are presented in Table 3. Also, EPA requested a summary of coal boiler start-ups/shutdowns be provided in the June 27, 2016 protocol. Such information was presented therein, and it is inherent in the actual CEMS data used in this evaluation.

In addition to the Harrison coal fired boilers, the plant inventory also includes two auxiliary boilers and three emergency engines. The annual hours of unit operation and annual SO_2 emission rates (tons per year) for the ancillary combustion equipment are presented in Table 2 below. The natural gas fuel auxiliary boilers and emergency generators are limited use units with no appreciable SO_2 emissions. Therefore, these units were not considered in this evaluation.

Table 2: Harrison Plant Miscellaneous Combustion Equipment SO_2 Emissions and Operating Hours for 2013, 2014 and 2015

	SO2 Tons				Operating Hours		
	2013	**2014**	**2015**		**2013**	**2014**	**2015**
Harrison							
Aux A	0.0081	0.0062	0.0005		142	110	9
Aux B	0.0058	0.0062	0.0003		102	110	5
EDG1	0.0574	0.0561	0.0199		26	25	9
EDG2	0.0574	0.0561	0.0066		26	25	3
EDG3	0.0144	0.0144	0.0109		26	26	9

Figures 1A and 1B below present aerial imagery of the Harrison plant (with a scale and north orientation). The figures depict the Harrison plant, along with the location of the FGD stack and the surrounding structures. The figures also delineate the ambient air boundary assumed for the Harrison plant in this designation modeling. Figures 1A and 1B reflect marginally older (i.e., 2011) plant layout information for Harrison, but the images provide for less obscuration due to cooling tower moisture plumes than later aerial imagery. There have been no structural changes at the Harrison plant since dates of these images.

Figure 1A: Aerial Image of the Harrison Power Station*

*Google Earth imagery date, July 9, 2011. Red line is the Harrison property boundary used in this designation evaluation. North is oriented towards top of image.

Figure 1B: Aerial Image the Harrison Power Station Showing FGD Stack and Surrounding Structures*

*Google Earth imagery date, July 9, 2011. Red line is the Harrison property boundary used in this designation evaluation. North is oriented towards top of image.

General EPA modeling guidance (i.e., footnotes 11 and 12) requires that sources expected to cause a significant concentration gradient in the vicinity of the source of interest should be explicitly modeled. To this end, WV DAQ instructed that sources with an actual SO_2 emission rate of at least 100 tpy during any of 2012, 2013 or 2014, and located within 20km of the Harrison plant, be considered for inclusion in the designation modeling. WVDEP did qualify that the list of sources provided in November 2015 to be draft. Based on the source data provided by WV, FirstEnergy preliminarily determined that GrafTech International Holdings, Inc. located in Anmoore, WV met the WVDEP modeling criteria, i.e., actual emissions greater than 100 tpy SO_2 and located within 20km of the Harrison plant. Review of GrafTech's annual emissions for 2012, 2013, and 2014 were 113.5 tons, 52.1 tons, and 57.2 tons respectively. Given the low annual emissions during the most recent two years of available annual emissions data, and the 13.9km distance from the Harrison Plant, the GrafTech facility was considered to be an insignificant source of SO_2 with no significant concentration gradient relative to the Harrison plant. This determination was confirmed with WVDEP during a March 29, 2016 telephone call[13]. The minimal (at best) ambient SO_2 concentrations from this source will be reflected in the ambient background monitoring data included in the modeling; and this source will not be included in the inventory of background sources to be modeled.

The following table summarizes the sources that were modeled along their respective modeling parameters:

[13] Phone conversation between B. Kolts (FirstEnergy) and Jon McClung (WVDEP, DAQ) on March 29, 2016.

Table 3: Air Modeling Inventory Parameters Used for the Harrison Plant Designation Modeling 1-hour SO2 NAAQS Evaluation*

Stack ID	Point Source Description	UTM-x	UTM-y	Base El.	Emis Rate	Stk Ht	Stk T	Stk Vel	Stk Diam
		m	m	m	lb/hr	ft	F	ft/s	ft
H001	Harrison Stack - Boilers 1, 2, & 3	557418.79	4359764.35	297.48	—	1000.0	125.1	64.47	45.01

*Designation modeling uses three years (2013-2015) of hourly SO_2 emission rates and stack exit flow and temperature data. These data for the Harrison plant these data were provided by FirstEnergy from plant continuous emissions monitor recorded data. Harrison stack diameter is effective diameter for three 7.92m diameter individual stack flues.

3. MODEL SELECTION AND METHODOLOGY

3.1 MODEL SELECTION

The American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) was utilized for the area designation dispersion modeling under the 2010 1-hour SO_2 NAAQS. The AERMOD modeling suite also includes two accompanying data preprocessors necessary to develop data used as input to AERMOD: AERMET, which preprocesses representative meteorological data and AERMAP, which preprocesses digital terrain data. The model versions applied include:

- AERMET (Version 15181)
- AERMAP (Version 11103)
- AERMOD (Version 15181)

Model input data used in AERMET, AERMAP, and AERMOD, and relevant model processing options/methods, are discussed in the following sections.

3.2 METEOROLOGICAL DATA

Hourly sequential surface meteorological data are required for the dispersion modeling analysis. The data was processed using the AERMOD meteorological pre-processing program, AERMET (v.15181). The modeled surface and upper air meteorological sites are indicated in Table 4.

Table 4: Meteorological Measurement Site Information

Description	Airport Surface Dataset	Upper Air Dataset
Site name	Clarksburg Benedum Airport	Pittsburgh International Airport
Call sign / WBAN	KCKB / 03802	KPIT / 94823
Data format	DSI-3505 (ISD)	FSL
Location (longitude, latitude)	80.22889° West, 39.29556° North	80.23° West, 40.53° North
Location (UTM, Zone 17, NAD 1983)	566458 m East, 4,349,728 m North	---
Elevation (above mean sea level)	366.7 m	---
Anemometer height	10 m	---
Variables	Sky cover and sea level pressure*	Morning pressure and temperature (various levels from surface to 5,000 m)

*AERMET data processing included use of the EPA's AERMINUTE program (v.15272) to process 2-minute and 5-minute average ASOS winds from KCKB (TD-6405 & TD-6501 formats) into hourly average values used as input into AERMET.

In accordance with the EPA's AERMOD Implementation Guide (AIG)[14], a meteorological site representativeness assessment for meteorological monitoring stations at airports in the area surrounding the Harrison Power Plant was prepared as part of the March 30, 2016 version of the protocol. This assessment evaluated National Weather Service airport surface observing stations most proximal to the Harrison Plant, finding the NWS observation station at the Clarksburg Benedum Airport (KCKB) to be the most representative surface meteorological observing station for designation modeling of the Harrison plant. This assessment notwithstanding, the WVDEP

[14] U.S. EPA, *AERMOD Implementation Guide*, March 19, 2009.

indicated in their June 6, 2016 protocol comments that comparative modeling results would be required using the surface characteristics around the surface meteorological site and the plant site if a more detailed (sector and seasonally specific) surface parameter sensitivity analysis is not otherwise provided. As such, the NWS KCKB observation station was used for modeling of the Harrison plant; and two sets of AERMET files were developed using surface parameters around both the Harrison plant site and NWS KCKB site. Resultant comparative model predictions were compiled (see Section 4 for further discussion).

The KCKB and KPIT meteorological datasets satisfy the Department's completeness test for use in dispersion modeling, wherein the joint recovery of the necessary meteorological variables is at least 90% complete for each calendar year and each calendar quarter over the 3-year data period (i.e., 1st quarter 2013-2015, 2nd quarter 2013-2015, 3rd quarter 2013-2015, and 4th quarter 2013-2015). Table 5 below presents a summary of missing hourly meteorological data per calendar quarter for the 3-year data period.

Table 5: Meteorological Data Completeness Summary for the 2013-2015 Data Processing Period*

	Total Hours Missing and Percentage (%)			
Year	**Q1**	**Q2**	**Q3**	**Q4**
2013	1 (0.0%)	10 (0.5%)	28 (1.3%)	7 (0.3%)
2014	4 (0.2%)	63 (2.9%)	27 (1.2%)	3 (0.1%)
2015	62 (2.9%)	3 (0.1%)	7 (0.3%)	54 (2.4%)

*No missing morning soundings during this 3-year period.

The meteorological data processing also reflected the following:

- EPA's AERMINUTE processor (v. 15272) to process 2-minute ASOS winds (TD-6405 format) and 5-minute ASOS winds (DSI-6401 format) from KCKB and calculate an hourly average for input into AERMET
- EPA's AERSURFACE processor (v.13016) to determine the surface characteristics (i.e., noon-time albedo, Bowen ratio, and surface roughness length) around the location of the KCKB meteorological tower. The surface characteristics' values were calculated by AERSURFACE using the USGS NLCD 1992 for the state. The following selections are made in AERSURFACE: default 1-kilometer radius and default twelve 30-degree sectors for surface roughness length, non-airport site, and non-arid region. Due to lack of readily available snow cover information at three NWS stations located in WV[15], a seasonal determination of continuous seasonal snow cover (defined as 1 inch or more reported on >45 days in Dec-Jan-Feb[16]) was made based on KPIT local climatological data along with use of graphical snow cover information [17]. Estimates of surface moisture conditions used in the Bowen ratio calculation were based on 30-year average precipitation data for West Virginia Climate Region 2[18],[19].

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15 NOAA Snow Cover Data as available from http://w2.weather.gov/climate/index.php?wfo=pbz .
16 Email to B. Kolts of FirstEnergy from A. Fleck of PADEP, Bureau of Air Quality, September 2, 2014.
17 http://www.nohrsc.noaa.gov/nsa/index.html?year=2014&month=1&day=31&units=e&region=Midwest
18 http://www.ncdc.noaa.gov/monitoring-references/maps/images/us-climate-divisions-names.jpg .
19 ftp://ftp.ncdc.noaa.gov/pub/data/cirs/climdiv/

Regarding the use of 1992 land-use land-cover (LULC) data as input to AERSURFACE, EPA provided comment on the protocol requiring a discussion be presented on any LULC changes that have occurred at the plant/meteorological tower sites between 1992 (the only data format year currently accepted by AERSURFACE) and the period of designation modeling (2013-2015). As such, comparative aerial images from Google Earth and color-coded graphical LULC representations provided at the Multi-Resolution Land Characterization (MRLC) website (http://www.mrlc.gov/nlcd2011.php) are included herein as Appendix B. It is noted that land-use categories established in AERSURFACE for 1992 data have been revised as reflected in the 2011 (most current) MRLC graphics, but are generally similar to 1992. As expected, minor land-use changes have occurred within the 10 km square area (i.e., the area used by AERSURFACE for Bowen ratio and albedo parameter determinations); with virtually no land-use changes within a 1km radius (i.e., the radius used by AERSURFACE for surface roughness parameter determination) surrounding the plant and airport meteorological sites. As indicated by WVDEP in their June 2, 2016 comments (and EPA per footnote 11), modeling results are most sensitive to changes in surface roughness. Given the surrounding minimal (at best) land use changes since 1992, along with the plan to establish 2013-2015 AERMET data sets centered on the plant and the NWS site (see bullet immediately below), use of 1992 LULC data is not expected to affect the designation modeling.

- AERMET data files (2013-2015) were developed for two different AERSURFACE-based outputs; with one set using LULC data centered on the Harrison plant site and one set using LULC data centered on the NWS KCKB site; and comparative modeling results were compiled (See Section 4 for further discussion). WVDEP indicated in their June 6, 2016 comments that such would be required if a detailed (sector and seasonally specific) surface parameter sensitivity analysis is not otherwise provided.
- AERMET input settings, included:
  - Specify herein the date of KCKB ASOS 1-Minute and 5-minute data download (downloaded June 6, 2016)
  - Specify herein the date of KCKB surface data download (DSI-3505 (ISD) downloaded January 12, 2016)
  - Specify herein the date of KPIT upper air data download (FSL downloaded January 4, 2016)
  - Establish KCKB base elevation at 366.7m
  - Use the upper air data MODIFY keyword in Stage 1
  - Use the UAWINDOW keyword with -3 to +1 in Stage 3
  - Use the METHOD CCVR SUB_CC keyword in Stage 3
  - Use the METHOD TEMP SUB_TT keyword in Stage 3

AERMET Stage 3 was run multiple times using the AERSURFACE results for surface moistures of wet, dry and normal (average), and snow/no-snow cover. The final AERMET surface files (2013-2015) reflected the West Virginia Climate Region 2 seasonal moisture and snow-cover conditions indicated in Table 6 as required by EPA's AIG and WVDEP[20]. The resultant three-year AERMET surface and profile files were used as input to the AERMOD designation modeling.

[20] Email to M. Hirtler of Enviroplan Consulting from J. McClung of WVDEP, Division of Air Quality, January 8, 2016.

Table 6: Estimates of West Virginia Climate Region 2 Surface Moisture Condition and Snow Cover Used for AERMET Processing for the NWS Station at the Clarksburg Benedum Airport for the Period 2013 - 2015

Year	Season*	WV Climate Region 2 Surface Moisture Condition (Average, Wet, or Dry)	KPIT Continuous Snow Cover (Yes or No)
2013	Winter	Wet	No
2013	Spring	Dry	
2013	Summer	Wet	
2013	Fall	Dry	
2014	Winter	Wet	Yes
2014	Spring	Dry	
2014	Summer	Average	
2014	Fall	Average	
2015	Winter	Dry	No
2015	Spring	Wet	
2015	Summer	Average	
2015	Fall	Average	
2016	Winter	Average	No

Default months per season reflect EPA's AERSURFACE processor.

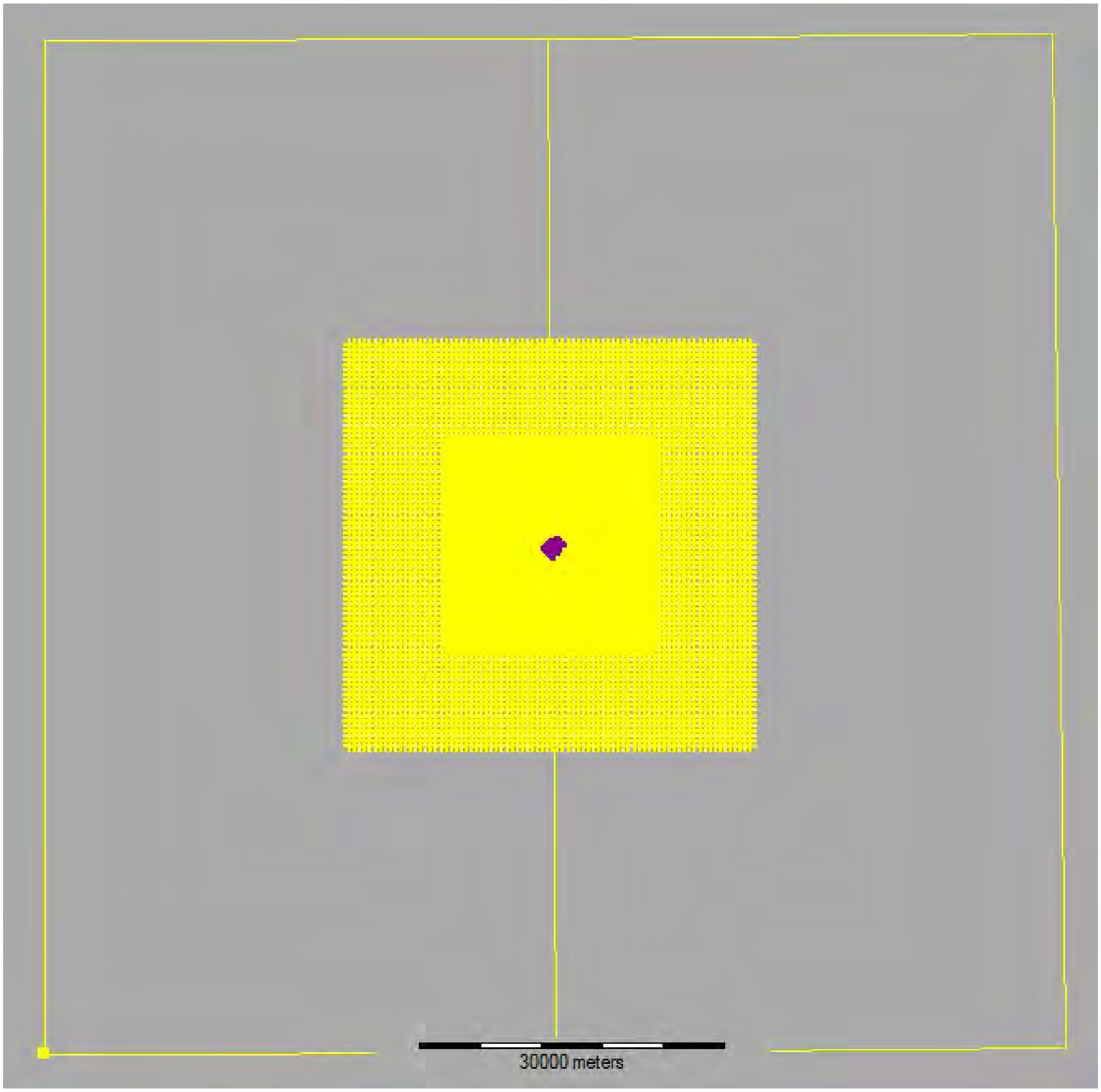
3.3 MODELING DOMAIN AND RECEPTOR GRID

For this modeling analysis, a total of four (4) separate receptor grids were combined to create an overall grid pattern with the densest concentration of receptors centered around the Harrison plant:

- 50-meter spacing along the Harrison fence line (on-site receptors eliminated) and extending to 1km from the Harrison facility;
- 100-meter spacing from 1km to 5 km from the facility;
- 250-meter spacing from 5km to 10km from the facility; and
- 500-meter spacing from 10km to 20km from the facility.

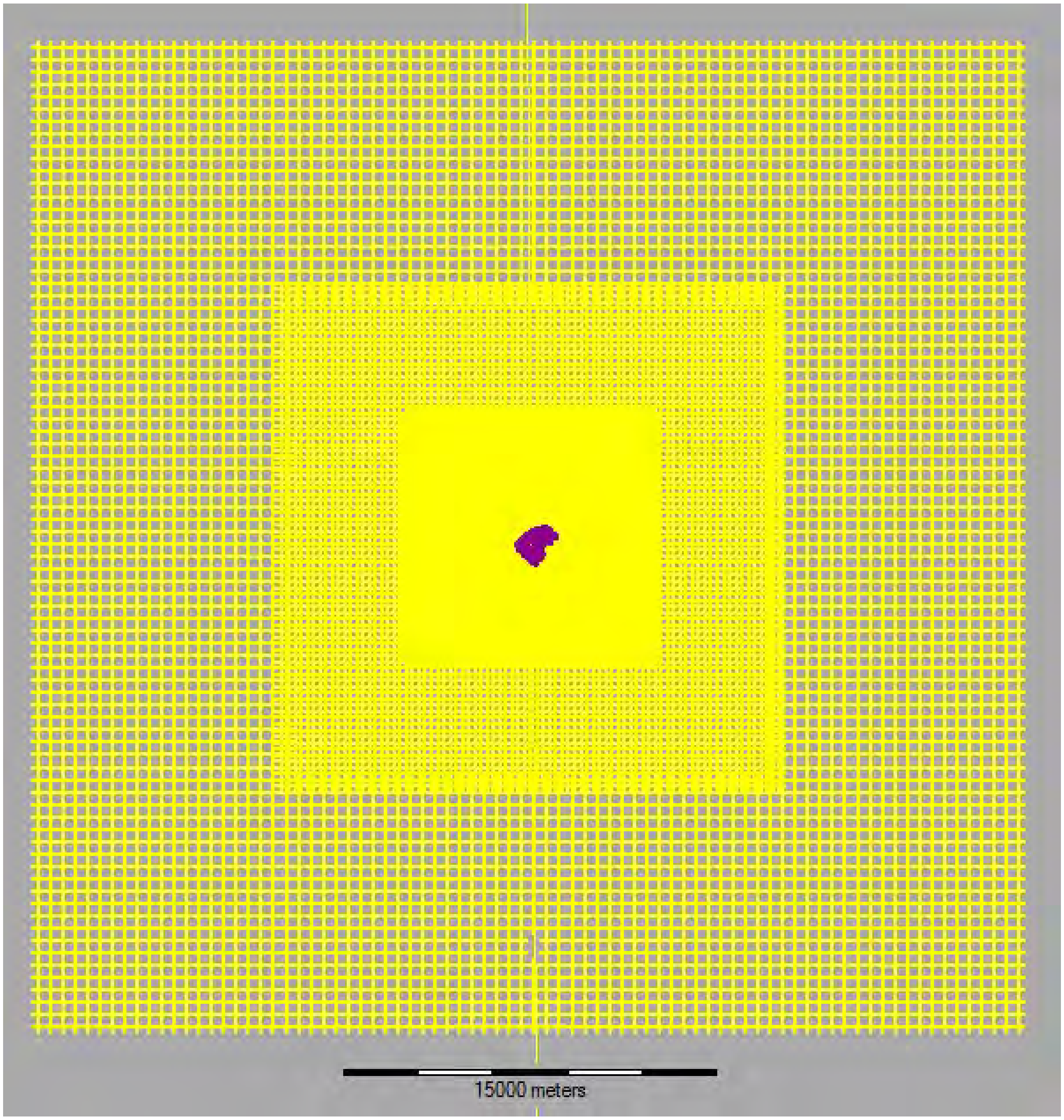
The AERMOD terrain pre-processor model, AERMAP (version 11103), was used to process receptor terrain elevation and hill height scale data that was input to AERMOD. Terrain elevation data was taken from the Multi-Resolution Land Characterization (MRLC) consortium website for the National Elevation Dataset (NED) for this domain (1/3 arc-second (10 meter) resolution). The project analyzed isopleths of modeled concentrations, and determined that the receptor grid adequately accounted for the worst case impacts. Figures 2A, 2B, and 2C below depict the modeling grid.

Figure 2A: Receptor Grid – Full Domain*



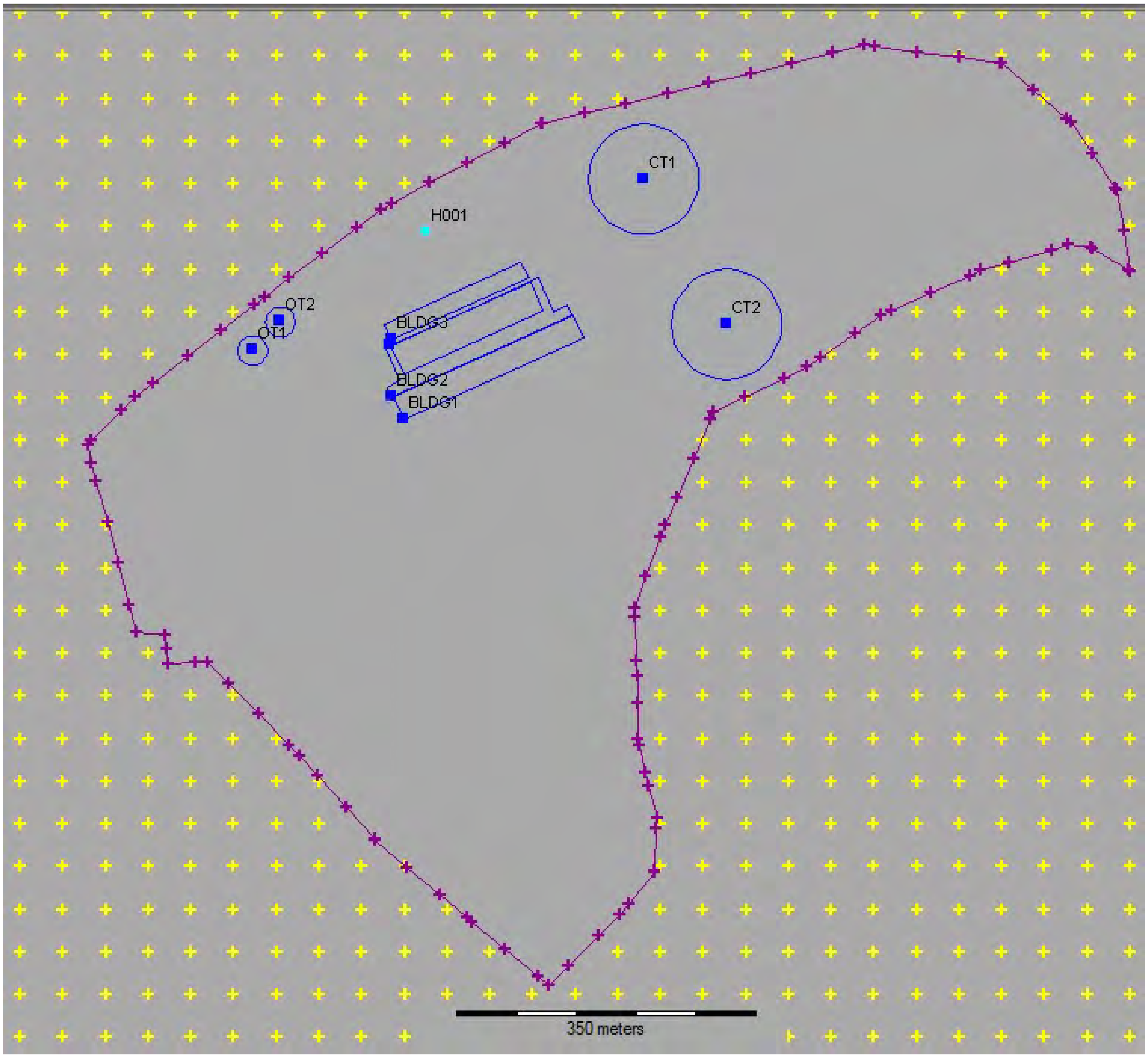
*The yellow pluses are Cartesian receptors and outer yellow line is the NED boundary for this modeling domain. The purple at the image center is the Harrison boundary receptor grid.

Figure 2B: Receptor Grid – Cartesian Grid View*



*The yellow pluses are the Cartesian receptors. The purple at the image center is the Harrison boundary receptor grid.

Figure 2C: Receptor Grid – Harrison Plant Boundary Grid*



The yellow pluses are the Cartesian receptors. The purple pluses are the Harrison boundary receptors. The Harrison boiler stack is labeled as H001. True North is oriented towards image top.

3.4 ADDITIONAL AERMOD INPUT AND MODEL SETTINGS

Additional input and model settings were used in accordance with EPA guidance based on the discussions presented in the following three subsections.

3.4.1 HOURLY EMISSION RATES

An hourly emissions file was develop as input to AERMOD (the file was external to AERMOD in a required format and called into AERMOD processing using the "SO HOUREMIS" options with file path specified). The hourly emissions data was formatted in accordance with the AERMOD user's manual. Designation modeling used three years (2013-2015) of hourly SO_2 emission rates and stack exit flow and temperature data. These data were provided for Harrison by FirstEnergy from plant continuous emissions monitor recorded data.

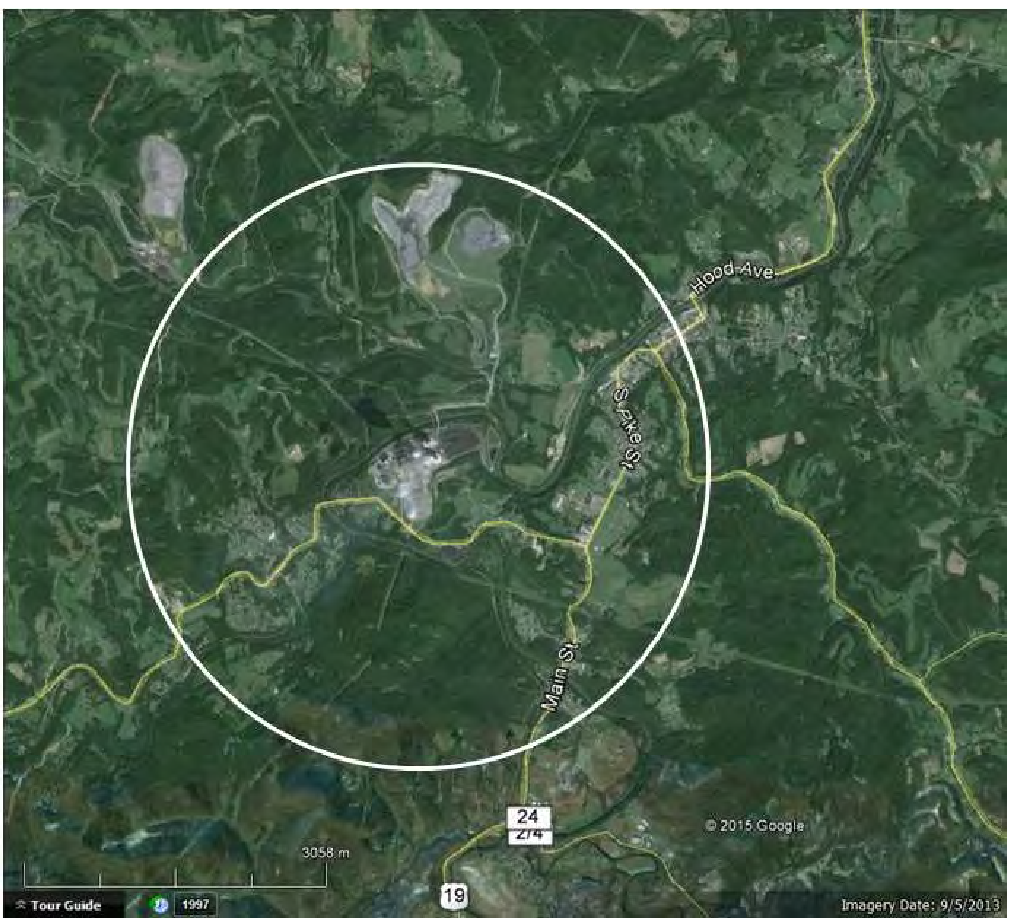
As indicated in Section 2.1 above, the Harrison FGD system is configured with the three boilers exhausting through separate flues in a common 1000-foot stack. Modeling of the Harrison boiler stack utilized a merged flue approach. Specifically, an equivalent diameter was computed for the FGD stack based on the total area of the three flues. The individual flue hourly exhaust flow rates (acfm) were added together to determine hourly FGD stack exit velocity based on the equivalent diameter; and FGD stack hourly exit temperatures were average flue temperatures weighted as a function of the individual flue flow rates.

3.4.2 URBAN/RURAL CLASSIFICATION

The EPA "Guideline on Air Quality Models" (EPA-450/2-78-027R-C), Appendix W of 40 CFR Part 51, specifies a procedure to determine whether the character of the modeling area is primarily urban or rural. The Auer land use method is the recommended approach. The Auer method classifies land use within an area circumscribed by a circle, centered on the source, having a radius of 3 km. If land use types for heavy industrial, light-moderate industrial, commercial, and compact residential (i.e., Auer land use types I1, I2, C1, R2, and R3) collectively account for 50% or more of the land use within 3 km of the source, then the modeling regime is considered urban.

Figure 3 is the most recent Google Earth image (September 2013) of land-use within the 3 km radius area surrounding the Harrison plant.

Figure 3: Aerial Imagery of Land-Use within 3km of the Harrison Plant



As shown in Figure 3, land-use within the 3 km radius area surrounding the Harrison plant is predominantly rural based on the above criteria. A qualitative Auer land-use evaluation of the modeling domain and 3km radius around the subject source is not presented herein, as the area clearly indicates predominant rural land-use. Accordingly, rural dispersion was applied for this designation modeling evaluation.

3.4.3 GOOD ENGINEERING PRACTICE STACK HEIGHT REVIEW

In accordance with U.S. EPA's *Guideline*, for stacks with heights that are within the limits of Good Engineering Practice (GEP), actual heights should be used in modeling. Under the EPA's regulations at 40 CFR 51.100, GEP height, Hg, is determined to be the greater of:

- 65 m, measured from the ground-level elevation at the base of the stack;
- For stacks in existence on January 12, 1979, and for which the owner or operator had obtained all applicable permits or approvals required under 40 CFR parts 51 and 52

  Hg=2.5H

  provided that the owner or operator produces evidence that this equation was actually relied on in designing the stack or establishing an emission limitation to ensure protection against downwash;

  For all other stacks,

  Hg=H + 1.5L,

  where H is the height of the nearby structure(s) measured from the ground-level elevation at the base of the stack and L is the lesser dimension of height or projected width of nearby structure(s), or

- the height demonstrated by a fluid model or a field study approved by the EPA or the state/local agency which ensures that the emissions from a stack do not result in excessive concentrations of any air pollutant as a result of atmospheric downwash, wakes, eddy effects created by the source itself, nearby structures or nearby terrain features.

In accordance with U.S. EPA's 1-hour SO_2 designation modeling TAD, actual stack heights should be used in modeling, even if stack heights exceed GEP formula height. This notwithstanding, the modeling considered the potential for plume aerodynamic building downwash for the Harrison plant using the U.S.EPA Building Profile Input Program with the Plume Rise Model Enhancements (BPIPPRM version 04274). WVDEP has indicated only FirstEnergy plant structures need consideration with respect to the potential for building downwash. As such, Harrison plant structure coordinates; structure elevations above ground; stack locations and object base elevations, were used as input to BPIPPRM. The BPIPPRM output (direction-specific building dimensions for every 10 degrees azimuth for each source) was used as input to AERMOD.

A structure's downwind zone of influence on a point source can extend up to 5L from the trailing building edge (*Guideline for Determination of Good Engineering Practice Stack Height Technical Support Document* (U.S. EPA, 1985)). As such, for the Harrison plant the BPIPPRM evaluation utilized structure dimensions and/or corner coordinates determined using aerial imagery (most recent Google Earth imagery, dated September 2013, and Bing Maps, with respective dimension scales). Table 7 below lists Harrison structures and their dimensions input to the BPIPPRM evaluation for GEP formula height determination and wind-direction dependent dimension output used in AERMOD (see Figure 1 for graphical depiction of stack/structure layout and relative orientation).

Table 7: Harrison Plant Structures Evaluated in the Good Engineering Practice (GEP) Stack Height Analysis

			Structure Dimensions			
BUILDING NAME	Base Elevation (ft)	Base Elevation (m)	Height Above Ground (ft)	Height (m)	Length (feet)	Width (feet)
1. Building 1	976.5	297.7	40	12.2	755	92
2. Building 2	976.2	297.5	60	18.3	761	174
3. Building 3	976.7	297.7	60	18.3	591	118
4. Building 4	976.6	297.7	80	24.4	574	66
5. Cooling Tower 1	973.6	296.7	370	112.8	212	(diameter)
6. Cooling Tower 2	977.6	298.0	370	112.8	212	(diameter)
7. Oil Tank 1	977.5	297.9	185	56.4	57	(diameter)
8. Oil Tank 2	975.7	297.4	185	56.4	57	(diameter)

The BPIPPRM results indicate a formula GEP height of 926.57 feet for the Harrison stack, while the physical height of the stack is 1000 feet. In accordance with U.S. EPA's 1-hour SO_2 designation modeling TAD, the designation analysis used the actual Harrison FGD stack height (1000 feet), along with source-specific wind-direction dependent building dimensions output by BPIPPRM as input to AERMOD. AERMOD internally determined the potential for full or partial source plume wake effects based on these BPIPPRM derived dimensions.

3.4.4 MEASURED SO_2 BACKGROUND CONCENTRATION DATA

The designation modeling evaluation requires that a measured background value be added to the modeled predicted SO_2 concentrations to produce a total predicted SO_2 concentration for the area. The measured background value accounts for the SO_2 contribution to total predicted concentrations from non-modeled distant/smaller emitting sources. WVDEP comment received on the initial March 2016 protocol recommended using data collected at the Monongalia County SO_2 monitor (AQS Site ID 54-061-0003). FirstEnergy utilized the data collected at the Monongalia County SO_2 monitor (AQS Site ID 54-061-0003). The 2013 – 2015 design concentration for this monitor is 15 ppb as determined from the EPA data (https://www3.epa.gov/airdata/ad_rep_mon.html) summarized in Table 8 below.

Table 8: 2013 – 2015 Design Concentration at Monongalia County SO_2 Monitor (AQS Site ID 54-061-0003)

		99th Percentile (ppb)			Distance from Monitor to Plant (km)
Monitor ID	**Location**	**2013**	**2014**	**2015**	**Harrison**
54-061-0003	**Monongalia Co., WV**	**14**	**15**	**16**	**46.2**

FirstEnergy refined the Table 8 constant design value using two methods described below:

1. Method 1: There have been a number of studies conducted in recent years that have demonstrated that EPA's recommended approach of combining the 99th percentile modeled concentration with the 99th percentile monitored background concentration has a degree of conservatism well beyond the level necessary to protect the 1-hour NAAQS. One study in particular[21] presents an approach that has been demonstrated to conservatively represent monitored background concentrations combined with AERMOD predictions. This method utilizes the 50th percentile (i.e., median value) of the monitored daily maximum hourly concentrations for each of the three consecutive monitoring years (2013-2015), averaged to produce a constant 50th percentile value for the three-year period. The final background concentration is determined as the average value among all potentially background-representative monitors (i.e., those monitors not significantly impacted by one or more major SO_2 sources). The resultant value is included as a constant background value input to AERMOD which is internally combined with the predicted design concentrations.

   The Monongalia Co., WV SO_2 monitor is located 46 km northeast of the Harrison plant. As suggested by WVDEP, this monitor served to represent SO_2 background in the general vicinity of the Harrison plant based on this data refinement method. The 50th percentile (i.e., median value) of the monitored daily maximum hourly concentrations at the Monongalia Co., WV monitor for each of the three consecutive monitoring years (2013-2015), averaged to produce a constant 50th percentile value for the three-year period results in a background concentration of 2.7 ppb. The 50th percentile background concentration was used in the 1-hour SO_2 designation modeling for the Harrison plant (see Section 4 for further discussion).

2. Method 2: Application of the EPA TAD supported methodology[22] of calculating temporally varying background monitored concentrations by hour of day and season. EPA has concluded this methodology, developed for NO_2 compliance modeling, is likewise applicable to SO_2 designation modeling based on use of the 99th percentile by hour of day and season for background concentration excluding periods when the dominant source(s) are influencing the monitored concentration. AERMOD allows for the inclusion of temporally varying background concentrations in the design value calculation in combination with modeling results. Consistent with the TAD (and EPA air modeling guidance), to avoid potential

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[21] Sergio A. Guerra (2014), "Innovative Dispersion Modeling: Practices to Achieve a Reasonable Level of Conservatism in AERMOD Modeling Demonstrations", EM, December 2014, pp. 24-29

[22] EPA's March 1, 2011 memo, "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO2 Ambient Air Quality Standard

"double-counting" of source concentrations the modeling protocol proposed to exclude periods when the modeled sources are expected to impact the monitor. This notwithstanding, the Harrison plant is located 46.2 km from the Monongalia Co., WV monitor. Given this spatial separation, First Energy conservatively conducted the temporally varying background monitored concentration processing by hour of day and season using the complete set of 2013-2015 monitored data at the Monongalia Co., WV monitor (i.e., no hours of potential source impacts at the monitor were removed from the dataset). The following steps were conducted:

For each of the three years of monitoring data, segregate the hourly concentration data by season and hour-of-day (winter = Dec. – Feb.; spring = March – May; summer = June – Aug.; fall = Sept. – Nov.); calculate the 99th percentile hour of day concentration per season for each year; and then calculate, for each season and hour-of-day, the three-year average of 99th percentile values. This "matrix" of seasonally- and hourly-varying monitored background concentrations was used as input to AERMOD (i.e., use the "SO BACKGRND SEASHR" pathway). The resultant temporally varying monitored background concentrations by hour of day and season (excluding periods when the source in question is expected to impact the monitored concentration) at the Monongalia Co., WV monitor are found in Table 9.

Table 9: Temporally Varying Monitored Background Concentrations By Hour Of Day And Season for The Monongalia Co., WV Monitor

Meteorological Hour	2013 - 2015 Average - No Exclusion			
	Winter	Spring	Summer	Fall
	PPB	PPB	PPB	PPB
1	4.333	6.000	4.667	4.000
2	5.000	6.000	3.667	4.000
3	4.333	8.667	4.000	4.667
4	5.000	8.333	3.667	4.000
5	5.333	8.667	4.667	4.333
6	4.667	7.667	5.000	3.667
7	4.667	8.000	5.000	4.333
8	5.667	8.000	7.000	5.000
9	6.333	10.667	8.333	4.667
10	6.333	11.667	16.000	6.333
11	8.000	9.000	21.000	8.667
12	10.667	8.000	13.000	7.000
13	11.333	9.667	13.000	9.333
14	8.667	8.667	13.667	9.000
15	8.333	5.667	11.667	5.000
16	7.667	6.667	10.333	5.667
17	7.333	7.667	8.000	7.667
18	7.667	9.667	8.667	8.000
19	9.333	11.000	9.000	6.000
20	9.000	8.333	6.333	4.667
21	8.667	7.000	5.000	4.333
22	7.333	6.667	3.333	4.667
23	7.333	6.000	3.667	4.667
24	5.333	6.667	5.000	3.667

3.5 1-HOUR SO_2 NAAQS DESIGNATION MODELING APPROACH

The AERMOD designation modeling runs utilized the '*default*' 3-year meteorological and other data inputs described above, and the CONTROL pathway regulatory default option, DFAULT (elevated terrain, calms and missing data processing routines, and no exponential decay, dry depletion, nor wet depletion). The emission units shown in Table 3 herein were characterized in AERMOD as unobstructed vertical release point sources, and the source pathway keyword of SRCGROUP were used to ascertain total predicted concentrations for the ALL group, and for individual stationary source group contributions.

AERMOD dispersion modeling was conducted to determine total 1-hour SO_2 predicted concentrations in the form of the 1-hour SO_2 NAAQS. The design value predictions (each receptor) were calculated as the average of the 99^{th} percentile (4^{th} highest) of the annual distribution of daily maximum 1-hour concentrations averaged across the three modeled years. The highest of these 99^{th} percentile values is the overall maximum design concentration.

The model predicted design values indicated above were generated using the AERMOD model CONTROL pathway pollutant ID SO_2. Also, the OUTPUT pathway keywords specific to the 1-hour standard were used. This included the MAXCONT keyword which created an AERMOD output file of source contributions for each rank of total concentration and receptor in the modeling domain. Such output allowed for identification of potential source culpability to any predicted exceedance of the 1-hour SO_2 NAAQS, where an exceedance would be a 4^{th} highest (or greater rank) total concentration (including measured background) that was predicted to exceed the 1-hour SO_2 NAAQS of 75 ppb (196.2 ug/m^3 equivalent). A source was not considered to have a significant contribution to a predicted exceedance if the corresponding source contribution is below the EPA's Significant Impact Level (SIL)[23].

[23] EPA memorandum, "Guidance Concerning the Implementation of the 2010 SO_2 NAAQS for the Prevention of Significant Deterioration Program." August 23, 2010. The 3 ppb interim SIL (7.8 ug/m^3 equivalent) for the 2010 SO_2 NAAQS was provided by the EPA for states to consider using for the PSD program.

4. PRESENTATION OF 1 HOUR SO2 DESIGNATION MODELING RESULTS AND RECOMMENDATION FOR THE FIRSTENERGY HARRISON PLANT

The AERMOD modeling files associated with the Harrison 1-hour SO_2 designation modeling are included on the compact disk referenced in Appendix C. The modeling files include the AERMAP, AERMET, AERMOD, and related source contribution files (MDC) for the modeling scenarios discussed.

The AERMOD total predicted 1-hour SO_2 concentrations, inclusive of the constant 50^{th} percentile measured background concentration and temporally varying background concentrations discussed in Section 3.4.4 are presented in Tables 11 and 12, respectively, for the two AERSURFACE scenarios, i.e., the Harrison plant and NWS KCKB site surface characteristics as discussed in Section 3.2. The AERMOD predicted values in Table 10 reflect the design concentrations (i.e., maximum 4^{th} highest maximum daily 1-hour results averaged over 3-years of modeling) for the Harrison plant predicted on the full grid of receptors in the modeling domain, plus the addition of the 50^{th} percentile background concentration of 2.7 ppb (7.06 ug/m^3). The AERMOD predicted values in Table 11 reflect the design concentrations (i.e., maximum 4^{th} highest maximum daily 1-hour results averaged over 3-years of modeling) for the Harrison plant predicted on the full grid of receptors in the modeling domain, along with the temporally varying background monitored concentrations by hour of day and season shown in Table 9. Figures 4 and 5 present isoplots for the NWS AERSURFACE-based designation modeling results, as the worst case of the two meteorological data file results.

While the NWS KCKB AERSURFACE-based model run resulted in the worst case predicted 1-hour SO_2 design concentration, both AERSURFACE scenarios using both sets of monitoring data processed as described earlier resulted in predicted concentrations below the 1-hour SO_2 NAAQS of 75 ppb. These findings are based on application of EPA recommended procedures presented in their TAD for designation modeling. FirstEnergy believes that this designation modeling demonstration will allow WVDEP and EPA to deem the air quality in the area surrounding the Harrison Power Plant as *Attainment* under the 1-hour SO_2 NAAQS Data Requirements Rule.

Table 10: AERMOD Predicted 1-Hour SO_2 NAAQS Designation Modeling Results for the FirstEnergy Harrison Power Plant Using a Constant Monitor Value

	AERMOD Predicted Design Concentration, Harrison AERSURFACE		AERMOD Predicted Design Concentration, Clarksburg-Benedum Airport NWS Station AERSURFACE	
Source Contribution	(µg/m^3)	ppb	(µg/m^3)	ppb
Harrison Plant H001	62.10	23.7	72.14	27.6
Background	7.06	2.7	7.06	2.7
Total Predicted 1-Hour SO_2 Design Concentration Including Constant Background	**69.16**	**26.4**	**79.20**	**30.3**

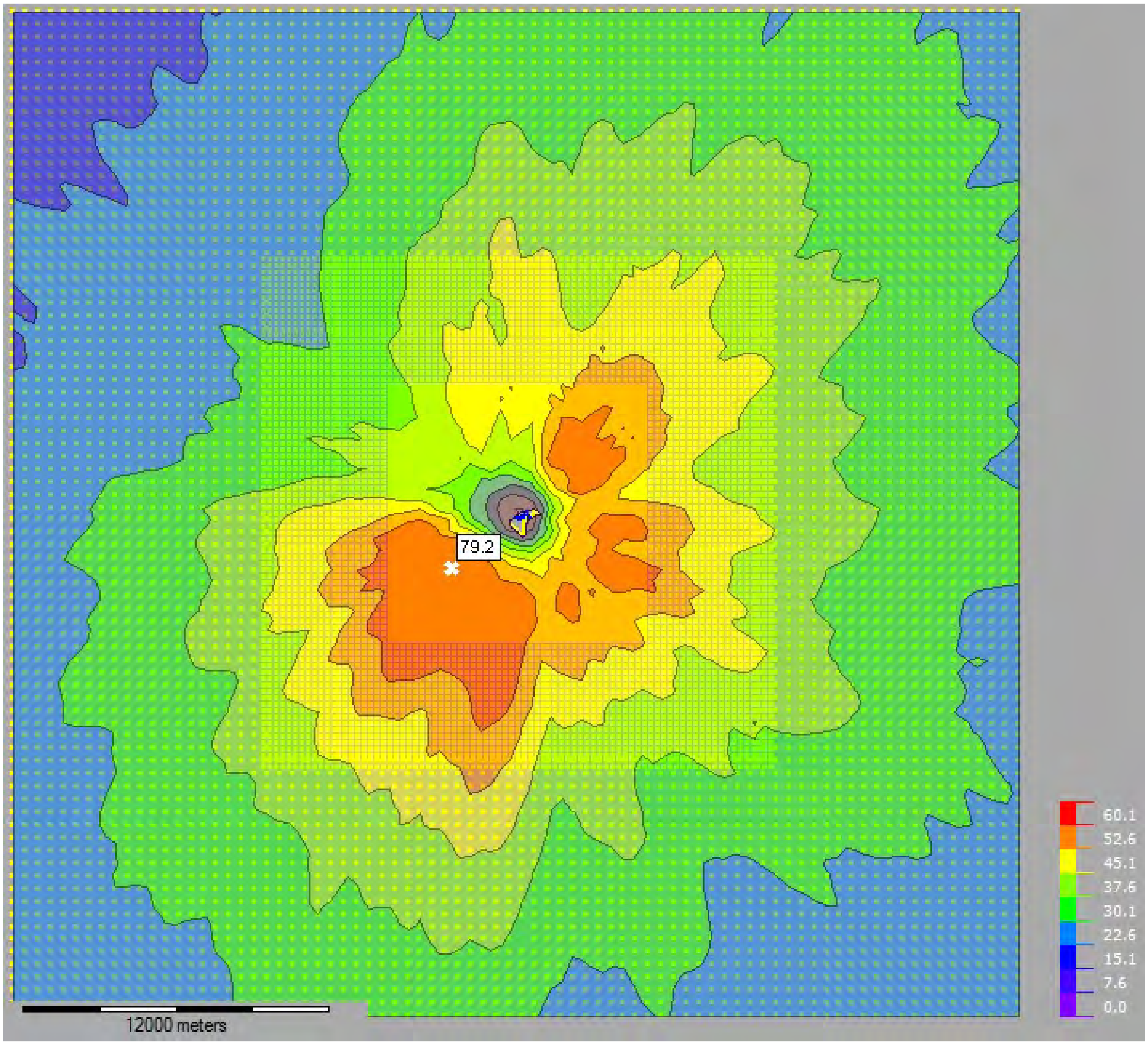
Note: The 1-hr SO2 NAAQS is 196 µg/m3 or 75 ppb. The 1-hr SO2 Significant Impact Level (SIL) is 7.585 µg/m3 or 3 ppb.

Table 11: AERMOD Predicted 1-Hour SO_2 NAAQS Designation Modeling Results for the FirstEnergy Harrison Power Plant Using a Temporally Varying Monitor Value

	AERMOD Predicted Design Concentration, Harrison AERSURFACE		AERMOD Predicted Design Concentration, Clarksburg-Benedum Airport NWS Station AERSURFACE	
Source Contribution	(µg/m^3)	ppb	(µg/m^3)	ppb
Total Predicted 1-Hour SO_2 Design Concentration Including Temporally Varying Background	**91.53**	**35.0**	**103.68**	**39.6**

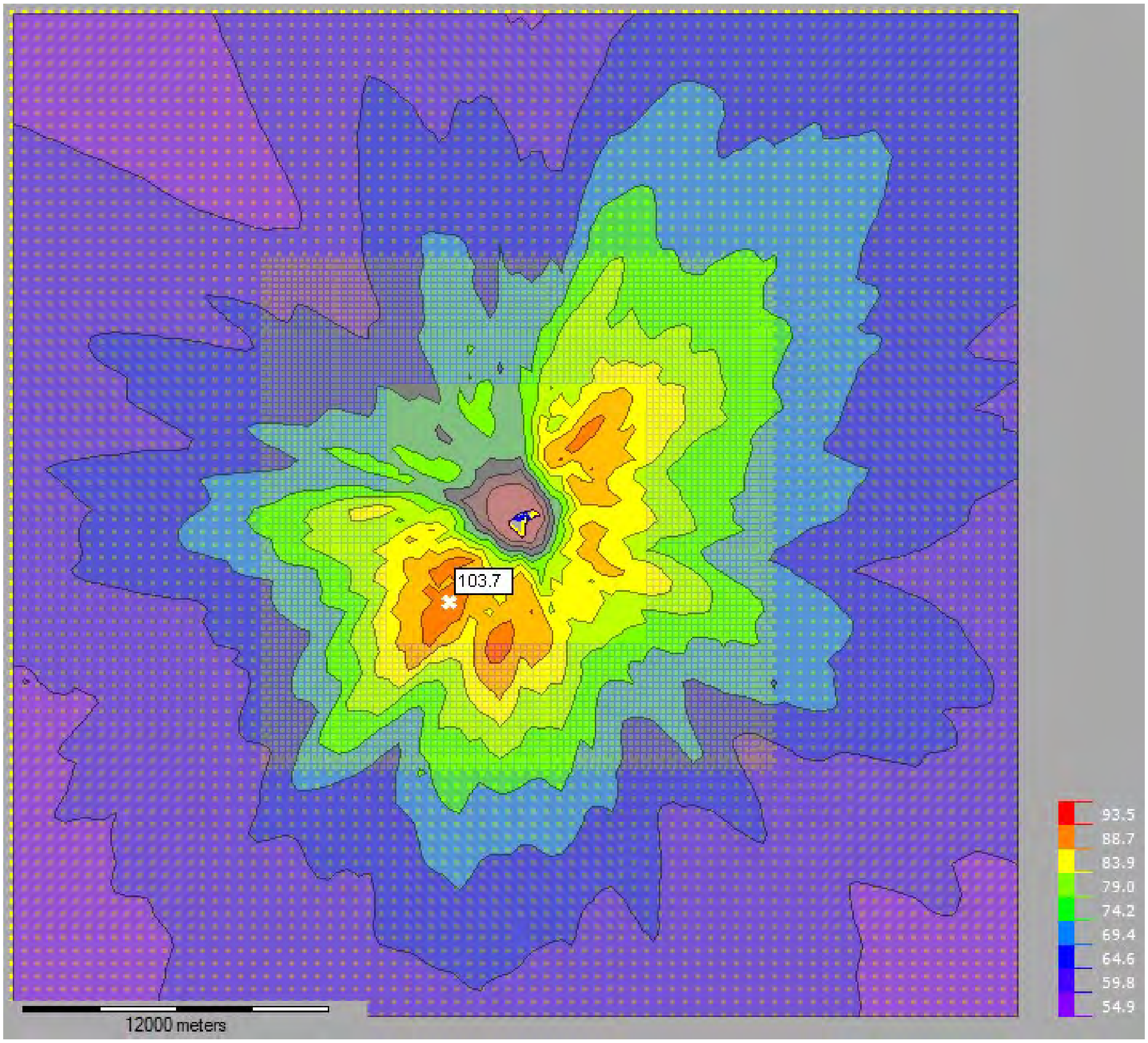
Note: The 1-hr SO2 NAAQS is 196 µg/m3 or 75 ppb. The 1-hr SO2 Significant Impact Level (SIL) is 7.585 µg/m3 or 3 ppb.

Figure 4: Isoplot of AERMOD Predicted 1-Hour SO_2 NAAQS Designation Modeling Concentrations for the Harrison Plant Using NWS Site AERSURFACE-Based AERMET and a Constant Monitor Value*



*Reflects a constant 50th percentile background concentration of 2.7 ppb (7.06 ug/m^3). Harrison Plant is located at image center.

Figure 5: Isoplot of AERMOD Predicted 1-Hour SO_2 NAAQS Designation Modeling Concentrations for the Harrison Plant Using NWS Site AERSURFACE-Based AERMET and a Temporally Varying Monitor Value*



*Reflects a variable measured concentration matrix used in AERMOD determined as a function of hour of day and season of year, as per EPA recommendations. Harrison Plant is located at image center.

Appendix A: Protocol For Modeling Of The Harrison Power Plant In Response To U.S. EPA's Data Requirements Rule For The 2010 1-Hour SO_2 Primary National Ambient Air Quality Standard Submitted June 27, 2016

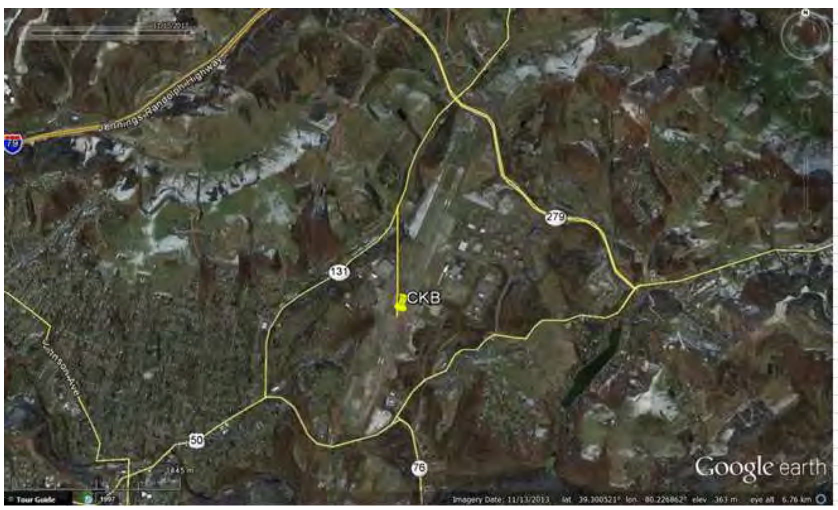
Harrison Modeling
Protocol Submitted Ju

Appendix B: Land Use Imagery Surrounding the Harrison Power Station and the NWS Clarksburg Benedum (KCKB) Airport Surface Meteorological Measurement Site

Aerial Imagery of Area Around Harrison Plant*

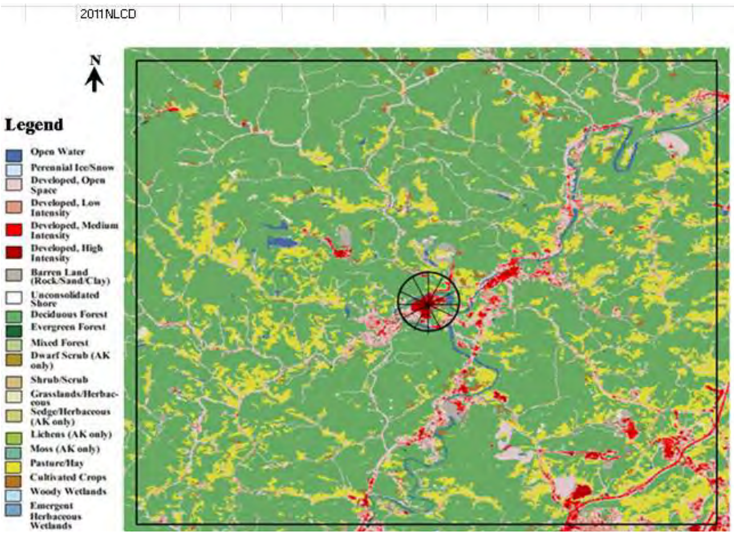
*Left image is 2015 and right image is 1997. Yellow line extending north from image center is 1km reference length.

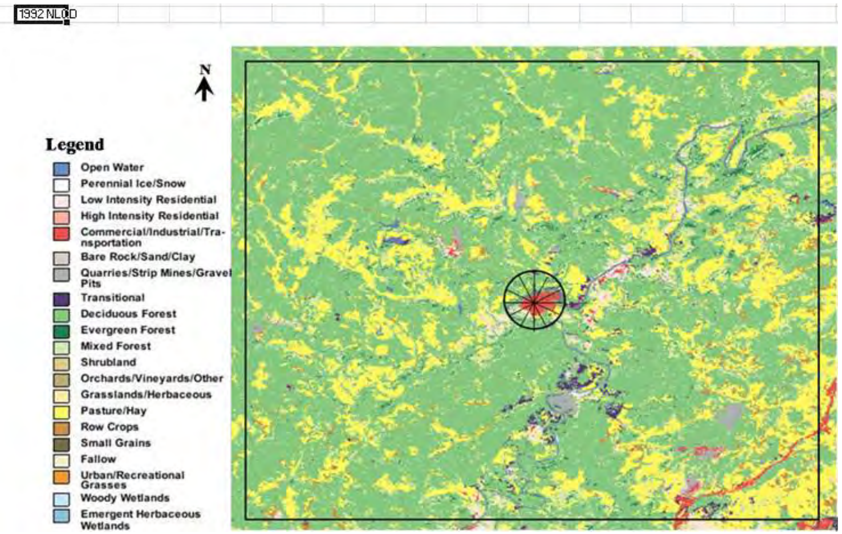
Aerial Imagery of Area Around NWS Clarksburg Benedum Airport Surface Meteorological Measurement Site*



*Left image is 2013 and right image is 1997. Yellow line extending north from image center is 1km reference length.

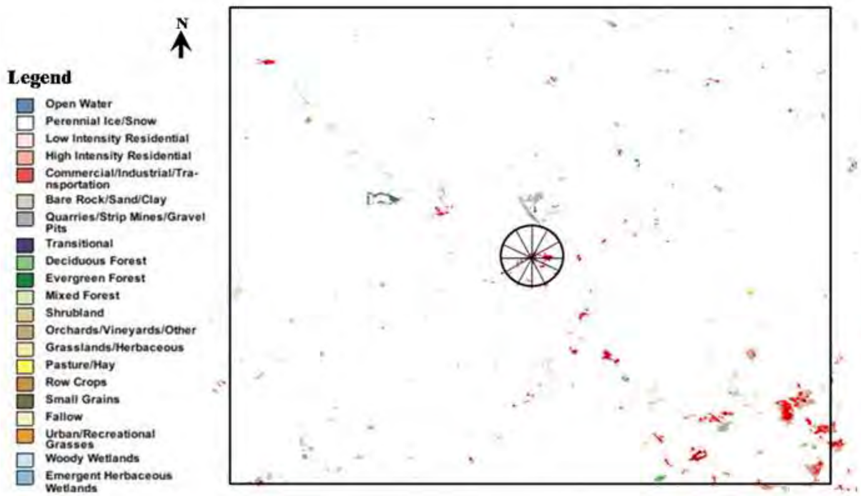
Land-Use Categorization of Area Around Harrison Plant*





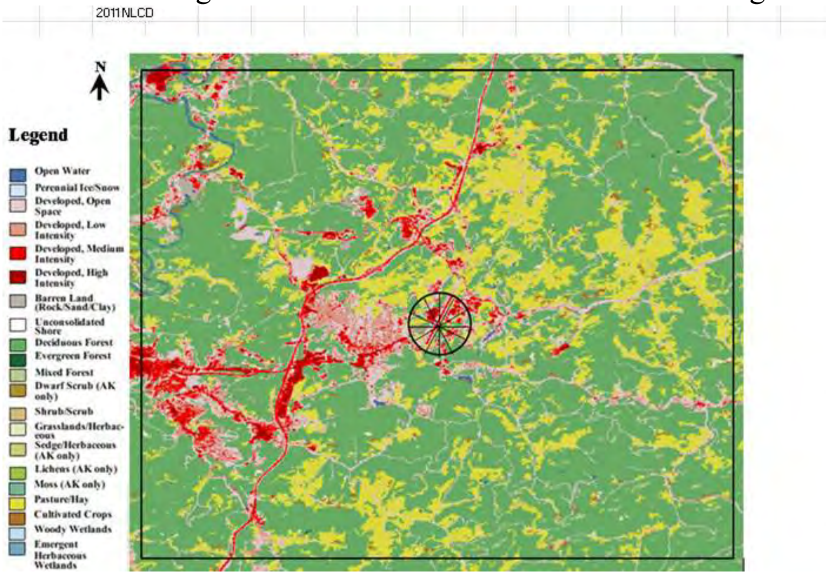
*Center circle is a 1km radius area (12 sectors) surrounding plant site. Larger rectangle is 10km x 10km square area surrounding plant site.

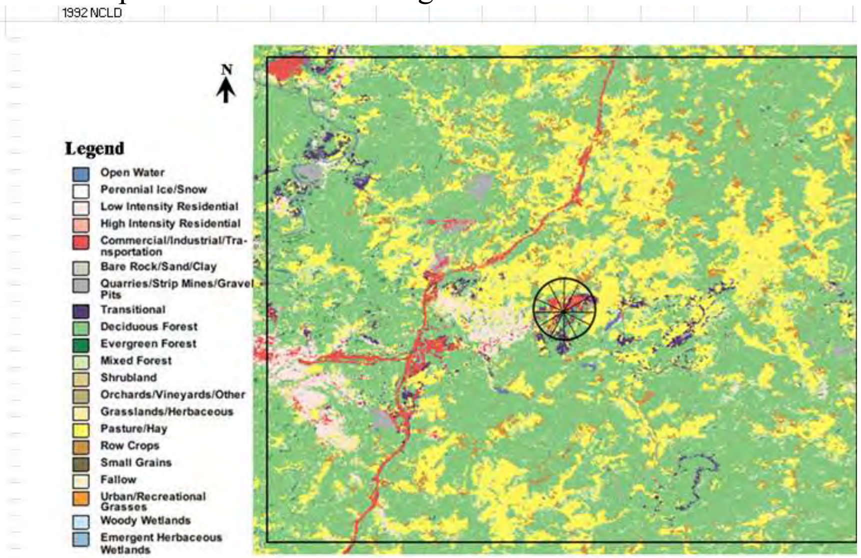
Land-Use Categorization Change (2011 vs. 2001) for the Area Around Harrison Plant*



*Center circle is a 1km radius area (12 sectors) surrounding plant site. Larger rectangle is 10km x 10km square area surrounding plant site.

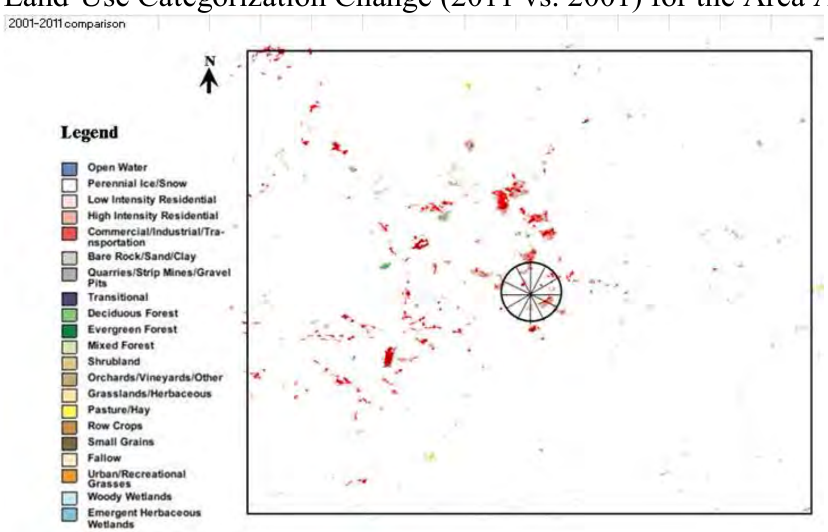
Land-Use Categorization of Area Around NWS Clarksburg Benedum Airport Surface Meteorological Measurement Site *





*Center circle is a 1km radius area (12 sectors) surrounding plant site. Larger rectangle is 10km x 10km square area surrounding plant site.

Land-Use Categorization Change (2011 vs. 2001) for the Area Around NWS KCKB Surface Meteorological Measurement Site*



*KCKB is Clarksburg Benedum Airport. Center circle is a 1km radius area (12 sectors) surrounding plant site. Larger rectangle is 10km x 10km square area surrounding plant site.

Appendix C: Compact Disk (CD) with AERMOD Modeling Files (BPIPPRM, AERMET, and AERMOD Input/Output Files)

(COMPACT DISK ENCLOSED CONTAINING PROJECT MODELING FILES)

*Note: For the AERMOD result that reflects the constant measured background concentration as the 50th percentile 3-year average, the constant measured value is manually combined with the AERMOD predicted design concentration (see Table 10), and it is not directly included in the AERMOD input file. This constant value was not included in these AERMOD runs since the value can be readily added to any prediction; and because the temporally-varying monitored concentration matrix was input to AERMOD.

Air Modeling Findings Report for the Fort Martin Power Plant in Response to U.S. EPA's Data Requirements Rule for the 2010 1-Hour SO_2 Primary National Ambient Air Quality Standard

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EXECUTIVE SUMMARY

On August 21, 2015, the U.S. Environmental Protection Agency (EPA) published the final *Data Requirements Rule for the 2010 1-Hour Sulfur Dioxide (SO_2) Primary National Ambient Air Quality Standard (NAAQS)* [80 FR 51052]. The EPA's Data Requirements Rule (DRR) requires air quality designations be made for the 1-hour SO_2 National Ambient Air Quality Standard (NAAQS)[1] for those areas with large sources of SO_2 emissions. In general, the DRR requires attainment status characterization for unclassified areas containing, or impacted by, SO_2 sources that have annual actual SO_2 emissions of 2,000 tons or more based on the most recently available annual data. Lesser emitting SO_2 sources can also be subject to the DRR air quality characterization requirement. The DRR sets forth a process and schedule for which air agencies must characterize air quality through ambient monitoring and/or air quality modeling techniques; and submit such findings and data to EPA. For affected sources opting to characterize air quality through dispersion modeling, the DRR schedule requires that all modeling results be submitted to the EPA by January 13, 2017.

On September 15, 2015 the West Virginia Department of Environmental Protection (WVDEP) notified FirstEnergy indicating their Fort Martin Power Plant to be an affected SO_2 stationary source subject to the DRR. FirstEnergy informed WVDEP they would perform air quality modeling for designation air quality characterization. The modeling data and methods presented herein reflect the procedures for the conduct of designation air modeling following the EPA's 1-hour SO_2 designation modeling Technical Assistance Document (TAD) [2] [3], as described in the final protocol submitted to WVDEP on June 27, 2016.

Enviroplan Consulting, as the air modeling contractor to FirstEnergy, has conducted the designation modeling in accordance with the protocol and agency recommendations. Enviroplan has also participated in the above referenced protocol development and related correspondence. The designation modeling utilized the U.S. EPA AERMOD modeling suite of programs to evaluate actual SO_2 emission rates for identified emitting sources in and surrounding the subject affected plant, along with the inclusion of a measured background concentration added to model predictions. Additionally, FirstEnergy applied the non-default option "ADJ_U*" in AERMET and Beta option application in AERMOD. Application of the non-default option was based on the request made to WVDEP on July 29, 2016; and WVDEP's September 23, 2016 instruction to proceed with the option's application in the designation evaluation.

The result of this 1-hour SO_2 designation modeling evaluation shows total predicted design value concentrations below the 1-hour SO_2 NAAQS of 75 parts per billion (ppb). These findings are based on application of EPA recommended procedures presented in their TAD for designation modeling. FirstEnergy believes that this designation modeling demonstration will allow WVDEP and EPA to deem the air quality in the area surrounding the Fort Martin Power Plant as *Attainment* under the 1-hour SO_2 NAAQS Data Requirements Rule.

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1 The 1-hour SO_2 NAAQS of 75 parts per billion (ppb) is a probabilistic air quality standard, where compliance is based on the 99th percentile of daily maximum 1-hour concentrations averaged over three years.

2 U.S. EPA, December 2013, *SO2 NAAQS Designations Modeling Technical Assistance Document (Draft),* http://www.epa.gov/airquality/sulfurdioxide/pdfs/SO2ModelingTAD.pdf

3 U.S. EPA, 2005. *Guideline on Air Quality Models.* 40 CFR Part 51 Appendix W. http://www.epa.gov/ttn/scram/guidance/guide/appw_05.pdf

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1. INTRODUCTION

On August 21, 2015, the U.S. Environmental Protection Agency (EPA) published the final *Data Requirements Rule for the 2010 1-Hour Sulfur Dioxide (SO_2) Primary National Ambient Air Quality Standard (NAAQS)* [80 FR 51052]. The EPA's Data Requirements Rule (DRR) requires air quality designations be made for the 1-hour SO_2 National Ambient Air Quality Standard (NAAQS)[4] for those areas with large sources of SO_2 emissions. In general, the DRR requires attainment status characterization for unclassified areas containing, or impacted by, SO_2 sources that have annual actual SO_2 emissions of 2,000 tons or more based on the most recently available annual data. Lesser emitting SO_2 sources can also be subject to the DRR air quality characterization requirement. The DRR sets forth a process and schedule for which air agencies must characterize air quality through ambient monitoring and/or air quality modeling techniques; and submit such findings and data to EPA. For affected sources opting to characterize air quality through dispersion modeling, the DRR schedule requires that all modeling results be submitted to the EPA by January 1, 2017.

On September 15, 2015 the West Virginia Department of Environmental Protection (WVDEP) notified FirstEnergy indicating their Fort Martin Power Plant is an affected SO_2 stationary source subject to the DRR. The FirstEnergy Fort Martin (FTM) power generating station is located in the town of Maidsville, Monongalia County, West Virginia, along the Monongahela River. On November 4, 2015, FirstEnergy held a teleconference with the WVDEP[5]. The purpose of the teleconference was to communicate Division of Air Quality's (DAQ) requirements in regards to the 1-hour SO_2 NAAQS modeling, including background source inventory; and for FirstEnergy to confirm their plan to use modeling for the FTM plant area designation process. Additional modeling information and guidance were subsequently provided by WVDEP[6] [7], including the background source modeling inventory; meteorological data; and general air modeling approach. This information was compiled into an initial protocol that FirstEnergy submitted to WVDEP on March 30, 2016. WVDEP and U.S. EPA Region 3 provided protocol comments to FirstEnergy on May 22, June 2, and July 25, 2016[8] [9] [10]. FirstEnergy submitted the final protocol to WVDEP on June 27, 2016. The final protocol and April 21, 2015 PADEP correspondence are included herein as Appendix A. Verbal acknowledgement of the protocol content/procedures was provided by WVDEP on September 23, 2016.[11].

The modeling data and procedures presented herein reflect the procedures for the conduct of designation air modeling following the EPA's 1-hour SO_2 designation modeling Technical

[4] The 1-hour SO_2 NAAQS of 75 parts per billion (ppb) is a probabilistic air quality standard, where compliance is based on the 99th percentile of daily maximum 1-hour concentrations averaged over three years.
[5] Conversation between B. Kolts (FirstEnergy) and Jon McClung (WVDEP, DAQ) on November 4, 2015.
[6] Email to B. Kolts (FirstEnergy) from Jon McClung (WVDEP, DAQ) on November 16, 2015.
[7] Email to M. Hirtler (Enviroplan Consulting) from Jon McClung (WVEP, DAQ) on March 23, 2016.
[8] Email to B. Kolts (FirstEnergy) from Jon McClung (WVDEP, DAQ) on May 22, 2016.
[9] Email to B. Kolts (FirstEnergy) from Jon McClung (WVDEP, DAQ) on June 2, 2016
[10] "Technical Memorandum Request for Approval to Use ADJ_U* in AERMET for Modeling of the First Energy's Fort Martin Power Plant in Response to U.S. EPA's Data Requirements Rule for the 2010 1-Hour SO_2 Primary National Ambient Air Quality Standard", submitted via email to WVDEP by FirstEnergy, July 29, 2016.
[11] Conversation between B. Kolts (FirstEnergy) and Jon McClung (WVDEP, DAQ) on September 23, 2016.

Assistance Document (TAD) [12] [13]; as described in the final protocol submitted to WVDEP on June 27, 2016.

Enviroplan Consulting, as the air modeling contractor to FirstEnergy, has conducted the designation modeling of the FTM plant. Section 2 of this document discusses the emissions inventory and emission rates considered in the designation modeling analysis. Section 3 presents the air model selection for the analysis, the related model input data and analyses, and the modeling approach. Section 4 presents the designation modeling results and study findings for the FirstEnergy FTM plant.

[12] U.S. EPA, December 2013, *SO2 NAAQS Designations Modeling Technical Assistance Document (Draft),* http://www.epa.gov/airquality/sulfurdioxide/pdfs/SO2ModelingTAD.pdf
[13] U.S. EPA, 2005. *Guideline on Air Quality Models.* 40 CFR Part 51 Appendix W. http://www.epa.gov/ttn/scram/guidance/guide/appw_05.pdf

2. AIR EMISSIONS SOURCES INCLUDED IN 1-HOUR SO_2 DESIGANTION MODELING DEMONSTRATION AND RELATED MODELING PARAMETERS

FirstEnergy and WVDEP held a teleconference to discuss the conduct of the FMT plant designation modeling. The discussion included required SO_2 emitting sources to be considered in a designation modeling inventory, along with the affected source (i.e., the FMT plant). To that end, WVDEP compiled a list of WV SO_2 emitting sources with their actual annual SO_2 emission rates (tons per year, tpy) for each of 2012, 2013 and 2014. The list and a graphic showing plant locations were provided to FirstEnergy on November 4 and 16, 2015.

The following sections describe the FTM power plant, as well as the background SO_2 emitting sources included in the planned designation modeling evaluation.

2.1 FORT MARTIN POWER STATION

The FTM power station is located in the town of Maidsville, Monongalia County, West Virginia, along the Monongahela River. Table 1 below presents the inventory of combustion units at the plant.

Table 1 - First Energy - Fort Martin Power Station, WV Combustion Units

Stack ID	Description
Unit B1 (Stk 1)	Point 1- Segment 1 - Boiler # 1 (Firing Coal) – Combustion Engineering, tangentially fired, balanced-draft, supercritical boiler (4460 MMBtu/hr) - One stack w two liners for Unit B1 and B2 (Common Stack) Pulverized Coal Dry Bottom
	Point 1 - Segment 2 (Firing FO)
Unit B2 (Stk 1)	Point 2- Segment 1 - Boiler # 2 – Babcock & Wilcox. (4634 MMBtu/hr), Cell Burner Boiler - One stack w two liners for Unit B1 and B2 (Common Stack) Pulverized Coal Dry Bottom
	Point 2 - Segment 2 (Firing FO)
Unit Blr 1A (Stk 3)	Point 3 - Segment 1 - Auxiliary Boiler 1A (115.3 MMBtu/hr)
Unit Blr 1B (Stk 3)	Point 3 - Segment 2 - Auxiliary Boiler 1B (115.3 MMBtu/hr)
Unit EDG-1	Point 5, Segment 1 - Emergency Diesel Generator No. 1 (320 kW, 487 Hp, 3.41 MMbtu/hr) (No stack) - Caterpiller Model 3406B
Unit EDG-2	Point 5 - Segment 1 - Emergency Diesel Generator No. 2 (320 kW, 487 Hp, 3.41 MMBtu/hr) (No stack) - Caterpiller Model 3406B
Unit EDQP-1	Point 5 - Segment 1 - Clarke/JW6H-UF38 Emergency Generator No. 1 (252 BHp/1750 rpm, 1.95 MMBtu/hr) (no stack)
Unit EDQP-2	Point 5 - Segment 1 - Clarke/JW6H-UF38 Emergency Generator No. 2 (252 BHp/1750 rpm, 1.95 MMBtu/hr) (no stack)
Unit DG-CRU	Point 5 - Segment 2 -Diesel Generator (227 Hp, 1.59 MMBtu/hr) -Detroit Coal Crusher
Plant	Miscellaneous Small Heaters

The existing FTM facility is equipped with tangentially fired, pulverized coal dry bottom boilers, along with a dedicated flue gas desulfurization (FGD) SO_2 emissions control system. Boiler No. 1 has a maximum heat input of 4460 MMBtu/hr and Boiler No. 2 has a maximum heat input of 4634 MMBtu/hr. During 2007, the FTM plant received approval from WVDEP to install and operate a flue gas desulfurization (FGD) system for SO_2 emissions removal from the existing coal fired boilers. The system is configured with the two boilers exhausting through separate flues in a common 550-foot stack. The stack has a continuous emissions monitoring system (CEMS) that records hourly average exhaust flow rate and temperature, and SO_2 emissions. Modeling of the two coal boilers reflected a merged flue configuration (see Section 3.4.1 for further discussion) using the actual hourly CEMS data recorded for the designation modeling period (2013-2015). The CEMS data was compiled by FirstEnergy for input to this designation modeling evaluation. Physical FGD stack parameters are presented in Table 3. Also, EPA requested a summary of coal boiler start-ups/shutdowns be provided in the June 27, 2016 protocol. Such information was presented therein, and it is inherent in the actual CEMS data used in this evaluation.

In addition to the FTM coal fired boiler Nos. 1 and 2, the plant inventory also includes two auxiliary boilers and miscellaneous emergency engines and plant heaters. The annual hours of unit operation and annual SO_2 emission rates (tons per year) for the ancillary combustion equipment are presented in Table 2 below. The auxiliary boilers are limited use black start units used only for coal boiler startup, and their emissions were considered to be insignificant relative to coal boiler operations and attendant annual distribution of daily maximum 1-hour SO_2 concentration. Therefore, pursuant to EPA guidance[14], these black start units were not considered in this evaluation. In addition, the FTM emergency generators and miscellaneous plant heaters have no appreciable SO_2 emissions and were likewise not included in this evaluation.

Table 2: FTM Plant Miscellaneous Combustion Equipment SO_2 Emissions and Operating Hours for 2013, 2014 and 2015

	SO2 Tons				Operating Hours		
	2013	2014	2015		2013	2014	2015
Fort Martin							
Aux 1A	2.45	4.69	3.96		501	574	592
Aux 1B	5.58	8.54	7.22		529	478	575
EDG1	0.051	0.08	0.036		2496	162	72
EDG2	0.051	0.029	0.03		2496	58	61
EDQP1	0.002	0.001	0.002		99	6	7
EDQP2	0.002	0.001	0.002		102	6	7
EDQP3	0.002	0.001	0.002		108	6	7
Heaters	0.012	0.006	0.004		450	685	450

Figures 1A and 1B below present aerial imagery of the FTM plant (with a scale and north orientation). The figures depict the FTM plant, along with the location of the FGD stack and the surrounding structures. The figures also delineate the ambient air boundary assumed for the FTM plant in the designation modeling. As can be seen from Figure 1A, the property owned by FirstEnergy extends northeast of the northern part of the sited plant perimeter used in this evaluation (i.e., the coal storage pile area). This notwithstanding, the fence that divides the generation station from the coal storage area was initially assumed as the ambient air boundary. Figure 1A reflects the most current readily available plant layout information for FTM. Figure 1B reflects a marginally older image for the plant that provides for less obscuration due to cooling tower moisture plumes. There have been no structural changes at the FTM plant since the dates of these images.

[14] EPA's March 1, 2011 Clarification Memo: *Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 ,National Ambient Air Quality Standard*.

Figure 1A: Aerial Image of the Fort Martin Power Station*

*Google Earth imagery date, October 5, 2013. Red line is the FTM property boundary used in this designation evaluation. North is oriented towards top of image.

Figure 1B: Aerial Image the Fort Martin Power Station Showing FGD Stack and Surrounding Structures*

*Google Earth imagery date, June 7, 2009. Red line is the FTM property boundary used in this designation evaluation. North is oriented towards top of image.

2.2 MODELED SO_2 BACKGROUND SOURCES

General EPA modeling guidance (i.e., footnotes 12 and 13) require that sources expected to cause a significant concentration gradient in the vicinity of the source of interest should be explicitly modeled. To this end, WV DAQ instructed that sources with an actual SO_2 emission rate of at least 100 tpy during any of 2012, 2013 or 2014, and located within 20km of the FTM plant, be considered for inclusion in the designation modeling. WVDEP did qualify that the list of sources provided in November 2015 to be draft. This notwithstanding, based on the provided data, FirstEnergy determined that the following WV sources meet the WVDEP modeling criteria, i.e., have emissions greater than 100 tpy SO_2 and are located within 20km of the Fort Martin plant:

- Longview Power
- Morgantown Energy (ME)

The Longview and ME facilities are located at 2.6 km west-southwest and 8 km southwest of the FTM plant, respectively. The existing Title V operating permit for each source as well as relevant permit applications were obtained through the WV DEP's website. The 2013-2015 actual SO_2 emissions data were obtained via the EPA's Clean Air Markets Division (CAMD) program website[15]. Additional model input emissions inventory data (three years of hourly stack exhaust gas flow (acfm) or exit velocity & temperature; physical stack data (base elevations, stack heights & inner diameters)) were requested of, and provided by, WV DEP on March 23, 2016.

Due to the proximity of the FTM plant to the Pennsylvania border (about 1 km), a background source evaluation was conducted and the following Pennsylvania SO_2 emitting sources were found to be located within 20km of the Fort Martin plant:

- Allegheny Energy Units 8&9
- Fayette Energy

For the two Pennsylvania sources, the following is noted. Section 8.2.3.b of the EPA's *Guideline*[16] recommends that all sources expected to cause a significant concentration gradient in the vicinity of the sources under consideration for emission limit(s) should be explicitly modeled. The EPA's *Guideline* further indicates that the portion of the background attributable to all other sources (e.g., natural sources, minor sources and distant major sources) should be determined by using measured background data (and through recommended background data processing methods, which are described further in Section 3.4.4 herein). Further review of the actual SO_2 emissions data obtained EPA's CAMD website for 2013-2015 found that actual emissions from Fayette Energy were consistently at or below 1 pound per hour (lb/hr) throughout 2013-2015. Given the 16.5 km distance of Fayette Energy from the Fort Martin plant), Fayette Energy Plant was considered to be an insignificant source of SO_2 with no significant concentration gradient relative to the FTM plant. For Allegheny Energy, which is about 8 km from Fort Martin, the maximum hourly SO_2 emission rate during the 3-year period was only 0.3 lb/hr, and again no significant concentration gradient was expected relative to the FTM plant. The minimal (at best) ambient SO_2 concentrations from these two sources is reflected in the ambient background

[15] http://ampd.epa.gov/ampd/.

[16] U.S. EPA, 2005. *Guideline on Air Quality Models.* 40 CFR Part 51 Appendix W.

monitoring data included in the modeling; and neither source was included in the inventory of background sources to be modeled.

With respect to EPA's protocol comment pertaining to the FirstEnergy Hatfield's Ferry Power Plant, this plant has ceased operations. FirstEnergy has filed information relating to operating cessation and closure, and this plant is not included in this analysis.

The following table summarizes the sources that were modeled along their respective modeling parameters:

Table 3: Air Modeling Inventory Parameters Used for the Fort Martin Plant Designation Modeling 1-ho Evaluation*

Stack ID	Point Source Description	UTM-x	UTM-y	Base El.	Emis Rate	Stk Ht	Stk T
		m	m	m	lb/hr	ft	F
FGD_ANN	Fort Martin	591846.29	4396059.80	247.0400	6093	550.0	126
LONG	Longview Power	589232.00	4395636.00	341.4001	350	554.0	135
ME	Morgantown Energy	589106.00	4388309.00	252.0696	343	338.0	335

*Designation modeling uses three years (2013-2015) of hourly SO_2 emission rates and stack exit flow and temperature data. These data for Morgantown Energy were obtained from EPA's CAMD site and WV DEQ; and for Fort Martin these data were provided by FirstEnergy from plant monitor recorded data.

3. MODEL SELECTION AND METHODOLOGY

3.1 MODEL SELECTION

The American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) was utilized for the area designation dispersion modeling under the 2010 1-hour SO_2 NAAQS. The AERMOD modeling suite also includes two accompanying data preprocessors necessary to develop data used as input to AERMOD: AERMET, which preprocesses representative meteorological data and AERMAP, which preprocesses digital terrain data. The model versions applied include:

- AERMET (Version 15181)
- AERMAP (Version 11103)
- AERMOD (Version 15181)

Model input data used in AERMET, AERMAP, and AERMOD, and relevant model processing options/methods, are discussed in the following sections.

3.2 METEOROLOGICAL DATA

Hourly sequential surface meteorological data are required for the dispersion modeling analysis. The data was processed using the AERMOD meteorological pre-processing program, AERMET (v.15181). The modeled surface and upper air meteorological sites are indicated in Table 4.

Table 4: Meteorological Measurement Site Information

Description	Airport Surface Dataset	Upper Air Dataset
Site name	Morgantown Municipal Airport - Walter L Bill Hart Field	Pittsburgh International Airport
Call sign / WBAN	KMGW / 13736	KPIT / 94823
Data format	DSI-3505 (ISD)	FSL
Location (longitude, latitude)	79.91639° West, 39.64278° North	80.23° West, 40.53° North
Location (UTM, Zone 17, NAD 1983)	592,602 m East, 4,389,448 m North	---
Elevation (above mean sea level)	378 m	---
Anemometer height	10 m	---
Variables	Sky cover and sea level pressure*	Morning pressure and temperature (various levels from surface to 5,000 m)

*AERMET data processing included use of the EPA's AERMINUTE program (v.15272) to process 2-minute and 5-minute average ASOS winds from KCKB (TD-6405 & TD-6501 formats) into hourly average values used as input into AERMET.

In accordance with the EPA's AERMOD Implementation Guide (AIG)[17], a meteorological site representativeness assessment for meteorological monitoring stations at airports in the area surrounding the Fort Martin Power Plant was prepared as part of the March 30, 2016 version of the protocol. This assessment notwithstanding, EPA comment indicated that, if the National Weather Service (NWS) observation station at the Morgantown Municipal Airport (KMWG) was used in compliance modeling supporting the Longview Energy's permit applications, such would support its use in this evaluation. The KMGW surface station was used in the Longview 2002 air

[17] U.S. EPA, *AERMOD Implementation Guide*, March 19, 2009.

permit modeling; and the 2007 FGD project modeling for the FTM plant[18]. As such, KMGW was used in this analysis, along with KPIT upper air sounding data.

The KMGW and KPIT meteorological datasets satisfy the Department's completeness test for use in dispersion modeling, wherein the joint recovery of the necessary meteorological variables is at least 90% complete for each calendar year and each calendar quarter over the 3-year data period (i.e., 1st quarter 2013-2015, 2nd quarter 2013-2015, 3rd quarter 2013-2015, and 4th quarter 201232015). Table 5 below presents a summary of missing hourly meteorological data per calendar quarter for the 3-year data period.

Table 5: Meteorological Data Completeness Summary for the 2013-2015 Data Processing Period*

	Total Hours Missing and Percentage (%)			
Year	**Q1**	**Q2**	**Q3**	**Q4**
2013	4 (0.2%)	10 (0.5%)	10 (0.5%)	14 (0.6%)
2014	10 (0.5%)	24 (1.1%)	13 (0.6%)	0 (00%)
2015	31 (1.4%)	12 (0.5%)	16 (0.7%)	8 (0.4%)

*No missing morning soundings during this 3-year period.

The meteorological data processing also reflected the following:

- EPA's AERMINUTE processor (v. 15272) to process 2-minute ASOS winds (TD-6405 format) and 5-minute ASOS winds (DSI-6401 format) from KMGW and calculate an hourly average for input into AERMET
- EPA's AERSURFACE processor (v.13016) to determine the surface characteristics (i.e., noon-time albedo, Bowen ratio, and surface roughness length) around the location of the KMGW meteorological tower. The surface characteristics' values were calculated by AERSURFACE using the USGS NLCD 1992 for the state. The following selections are made in AERSURFACE: default 1-kilometer radius and default twelve 30-degree sectors for surface roughness length, non-airport site, non-arid region. Due to lack of readily available snow cover information at three NWS stations located in WV[19], a seasonal determination of continuous seasonal snow cover (defined as 1 inch or more reported on >45 days in Dec-Jan-Feb[20]) was made based on KPIT local climatological data along with use of graphical snow cover information [21]. Estimates of surface moisture conditions used in the Bowen ratio calculation were based on 30-year average precipitation data for West Virginia Climate Region 2[22],[23].

  Regarding the use of 1992 land-use land-cover (LULC) data as input to AERSURFACE, EPA provided comment on the protocol requiring a discussion be presented on any LULC changes that have occurred at the plant/meteorological tower sites occurring between 1992 (the only

[18] Allegheny Energy Supply Company "Dispersion Modeling Analysis Fort Martin Power Station Flue Gas Desulfurization (FGD) Project", page 14, December 29, 2006 (approved WVDEP March 13, 2007).
[19] NOAA Snow Cover Data as available from http://w2.weather.gov/climate/index.php?wfo=pbz .
[20] Email to B. Kolts of FirstEnergy from A. Fleck of PADEP, Bureau of Air Quality, September 2, 2014.
[21] http://www.nohrsc.noaa.gov/nsa/index.html?year=2014&month=1&day=31&units=e&region=Midwest
[22] http://www.ncdc.noaa.gov/monitoring-references/maps/images/us-climate-divisions-names.jpg .
[23] ftp://ftp.ncdc.noaa.gov/pub/data/cirs/climdiv/

data format year currently accepted by AERSURFACE) and the period of designation modeling (2013-2015). As such, comparative aerial images from Google Earth and color-coded graphical LULC representations provided at the Multi-Resolution Land Characterization (MRLC) website (http://www.mrlc.gov/nlcd2011.php) are included herein as Appendix B. It is noted that land-use categories established in AERSURFACE for 1992 data have been revised as reflected in the 2011 (most current) MRLC graphics, but are generally similar to 1992. As expected, minor land-use changes have occurred within the 10 km square area (i.e., the area used by AERSURFACE for Bowen ratio and albedo parameter determinations); with virtually no land-use changes within a 1km radius (i.e., the radius used by AERSURFACE for surface roughness parameter determination) surrounding the plant and airport meteorological sites. As indicated by WVDEP in their June 2, 2016 comments (and EPA per footnote 13), modeling results are most sensitive to changes in surface roughness. Given the surrounding minimal (at best) land use changes since 1992, along with the plan to establish 2013-2015 AERMET data sets centered on the plant and the NWS site (see bullet immediately below), use of 1992 LULC data is not expected to affect the designation modeling.

- AERMET data files (2013-2015) were developed for two different AERSURFACE-based outputs; with one set using LULC data centered on the FTM plant site and one set using LULC data centered on the NWS KMWG site; and comparative modeling results were compiled (See Section 4 for further discussion). WVDEP indicated in their June 6, 2016 comments that such would be required if a detailed (sector and seasonally specific) surface parameter sensitivity analysis is not otherwise provided.
- AERMET input settings, included
    - Specify herein the date of KMGW ASOS 1-Minute and 5-minute data download (downloaded June 6, 2016)
    - Specify herein the date of KMGW surface data download (DSI-3505 (ISD) downloaded January 12, 2016)
    - Specify herein the date of KPIT upper air data download (FSL downloaded January 4, 2016)
    - Establish KMGW base elevation at 378m
    - Use the upper air data MODIFY keyword in Stage 1
    - Use the UAWINDOW keyword with -3 to +1 in Stage 3
    - Use the METHOD CCVR SUB_CC keyword in Stage 3
    - Use the METHOD TEMP SUB_TT keyword in Stage 3

AERMET Stage 3 was run multiple times using the AERSURFACE results for surface moistures of wet, dry and normal (average), and snow/no-snow cover. The final AERMET surface files (2013-2015) reflected the West Virginia Climate Region 2 seasonal moisture and snow-cover conditions indicated in Table 6 as required by EPA's AIG and WVDEP[24]. The resultant three-year AERMET surface and profile files were used as input to the AERMOD designation modeling.

[24] Email to M. Hirtler of Enviroplan Consulting from J. McClung of WVDEP, Division of Air Quality, January 8, 2016.

Table 6: Estimates of West Virginia Climate Region 2 Surface Moisture Condition and Snow Cover Used for AERMET Processing for the NWS Station at the Morgantown Municipal Airport for the Period 2013 - 2015

Year	Season*	WV Climate Region 2 Surface Moisture Condition (Average, Wet, or Dry)	KPIT Continuous Snow Cover (Yes or No)
2013	Winter	Wet	No
2013	Spring	Dry	
2013	Summer	Wet	
2013	Fall	Dry	
2014	Winter	Wet	Yes
2014	Spring	Dry	
2014	Summer	Average	
2014	Fall	Average	
2015	Winter	Dry	No
2015	Spring	Wet	
2015	Summer	Average	
2015	Fall	Average	
2016	Winter	Average	No

Default months per season reflect EPA's AERSURFACE processor.

In addition to the '*default*' AERMET data processing described above, FirstEnergy also performed a second AERMET data processing as follows:

- Use the non-default friction velocity processing option (i.e., u-star) in AERMET Stage 3 (METHOD STABLEBL ADJ_U* keyword). This second meteorological data processing method was discussed with WVDEP during the November 4, 2015 protocol teleconference. Also, EPA discussions[25] have suggested inclusion of this method as a non-beta regulatory processing method in the pending revision by U.S. EPA to 40 CFR 51, Appendix W (i.e., Guideline on Air Quality Models), based on continued EPA validation efforts.

  In regards to the *current* non-regulatory status of u-star and required support for application of u-star, WVDEP and EPA Region 3 have indicated in their protocol comments general support on the use of the ADJ_U* BETA option in AERMET/AERMOD, provided the requisite demonstration and approvals are obtained including through the Model Clearinghouse[26]. To this end, WVDEP advised on a recent u-star BETA option request and Model Clearinghouse approval[27]. FirstEnergy submitted a request to WVDEP to apply the u-star BETA option in this designation modeling evaluation for the FTM plant on July 29, 2016. The u-star BETA option request is also included herein as Appendix C. FirstEnergy followed the requirements

[25] http://www3.epa.gov/ttn/scram/11thmodconf/presentations/1-5_Proposed_Updates_AERMOD_System.pdf.
[26] EPA December 10 ,2015 Clearinghouse Memo *Clarification on the Approval Process for Regulatory Application of the AERMOD Modeling System Beta Options* (https://www3.epa.gov/ttn/scram/guidance_clarificationmemos.htm)
[27] EPA Model Clearinghouse, "Use of the ADJ_U* Beta Option in the AERMET Meteorological Processor as an Alternative Model", April 29, 2016 (https://cfpub.epa.gov/oarweb/MCHISRS/index.cfm?fuseaction=main.resultdetails&recnum=16-I-01).

in the EPA December 2015 Clearinghouse Memo as applied in the April 29, 2016 Clearinghouse approval (see Appendix B herein for a brief description on planned approach). Verbal acknowledgement of the u-star BETA option request was provided by WVDEP on September 23, 2016 and with a recommendation that FirstEnergy proceed with the designation evaluation.[28]

3.3 MODELING DOMAIN AND RECEPTOR GRID

For this modeling analysis, a total of four (4) separate receptor grids were combined to create an overall grid pattern with the densest concentration of receptors centered around the Fort Martin plant:

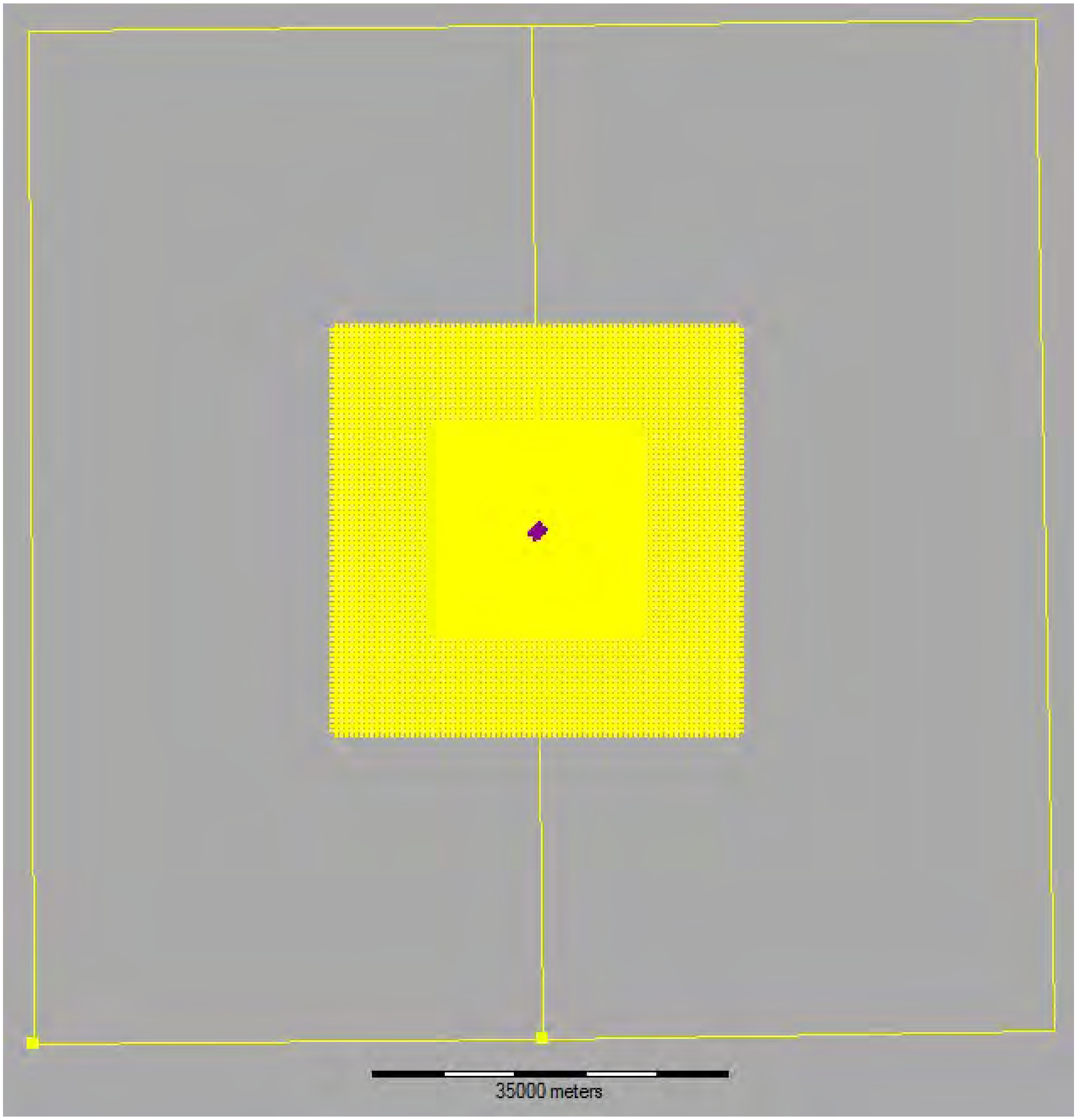
- 50-meter spacing along the FTM fence line (on-site receptors eliminated) and extending to 1km from the Fort Martin facility;
- 100-meter spacing from 1km to 5 km from the facility;
- 250-meter spacing from 5km to 10km from the facility; and
- 500-meter spacing from 10km to 20km from the facility.

With respect to EPA's protocol comment on the proposed receptor grid, there are no property boundary grids established for the Longview and ME modeled background sources. Each plant is imbedded in a dense grid of receptors and, conservatively, no ambient air boundary is initially proposed for either plant. While FTM onsite property might be ambient air relative to either background source, total impact maxima did not occur on FTM property since the FTM contribution is excluded from such predictions.

The AERMOD terrain pre-processor model, AERMAP (version 11103), was used to process receptor terrain elevation and hill height scale data that was input to AERMOD. Terrain elevation data was taken from the Multi-Resolution Land Characterization (MRLC) consortium website for the National Elevation Dataset (NED) for this domain (1/3 arc-second (10 meter) resolution). The project analyzed isopleths of modeled concentrations, and determined that the receptor grid adequately accounted for the worst case impacts. Figures 2A, 2B, and 2C below depict the modeling grid.

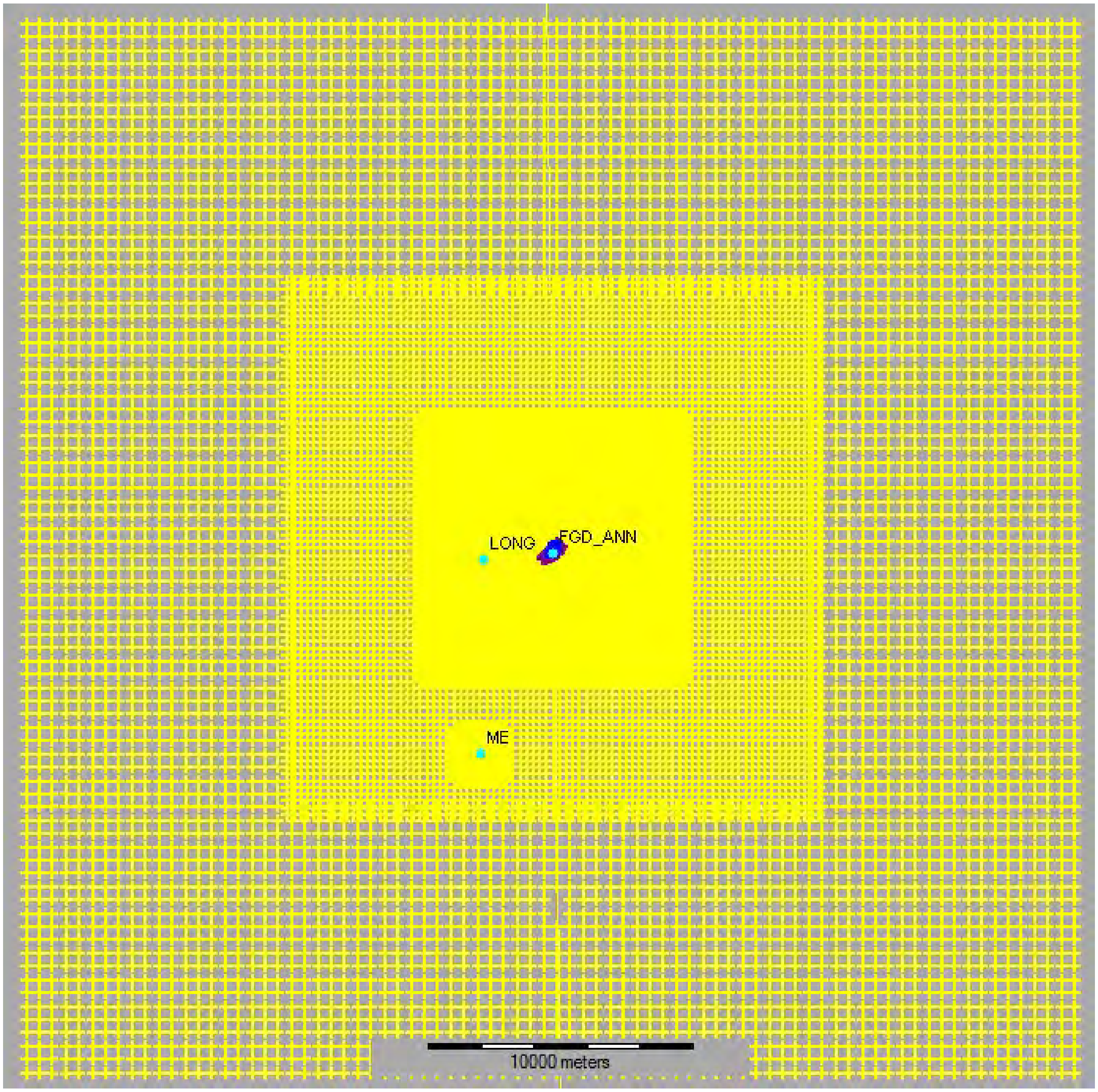
[28] Conversation between B. Kolts (FirstEnergy) and Jon McClung (WVDEP, DAQ) on September 23, 2016, wherein WVDEP indicated they conversed with Tim Leon-Guerrero at EPA Region III. EPA has unofficially confirmed that ADJ_U* is in revised 40 CFR Part 51, Appendix W, whose release is imminent. EPA indicated if there is any Appendix W release delay, EPA/WVDEP will file the Fort Martin ADJ_U* request with the Model Clearing house with expected approval.

Figure 2A: Receptor Grid – Full Domain*



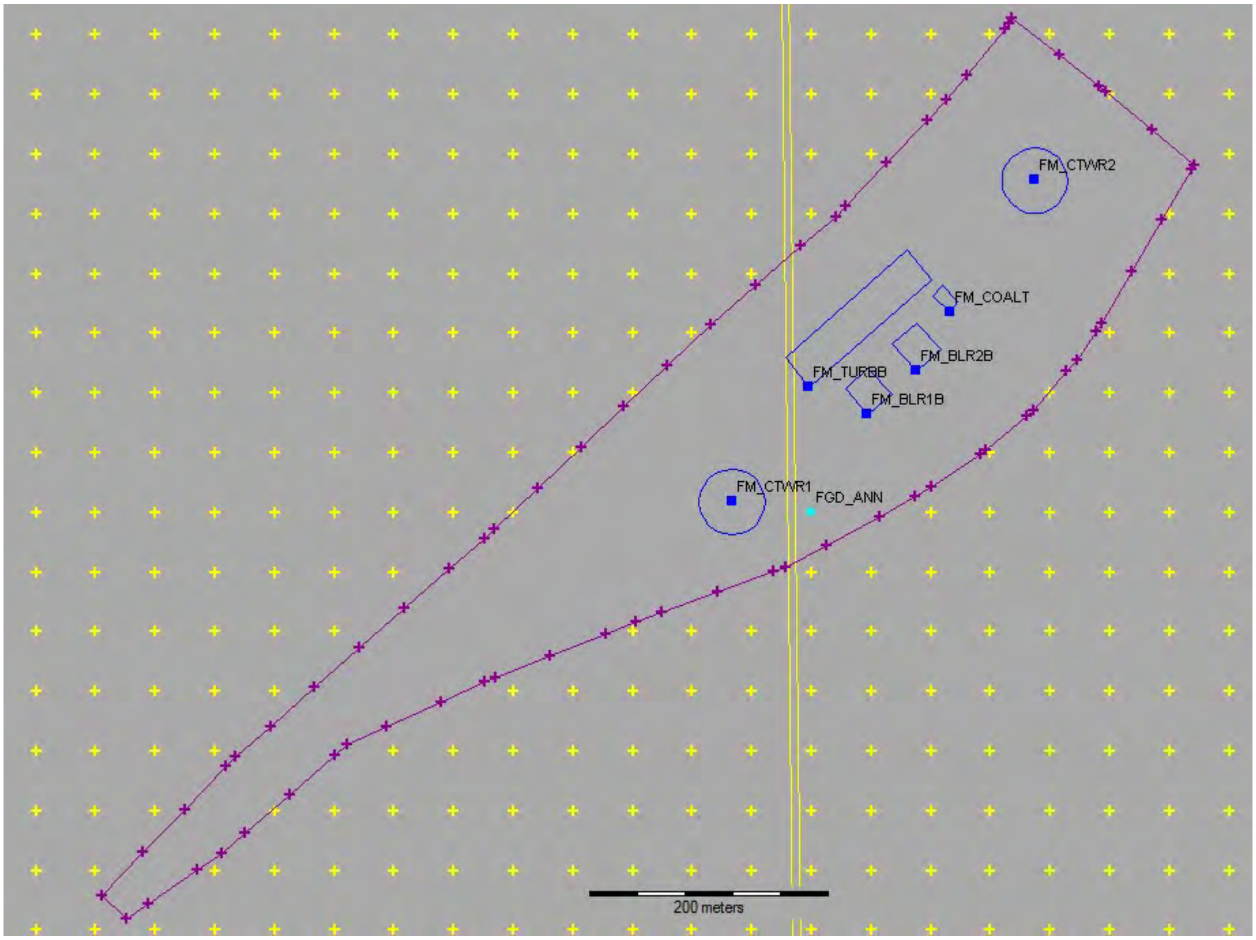
*The yellow pluses are Cartesian receptors and outer yellow line is the NED boundary for this modeling domain. The purple at the image center is the Fort Martin boundary receptor grid.

Figure 2B: Receptor Grid – Cartesian Grid View*



*The yellow pluses are the Cartesian receptors. The purple at the image center is the FTM boundary receptor grid (FGD_ANN label is FTM stack). The Longview Power (LONG) and Morgantown Energy (ME) modeled sources (see Table 3 herein) are also indicated on the image.

Figure 2C: Receptor Grid – Ft. Martin Plant Boundary Grid*



The yellow pluses are the Cartesian receptors. The purple pluses are the FTM boundary receptors. FGD_ANN label is FTM stack. North is oriented towards image top.

3.4 ADDITIONAL AERMOD INPUT AND MODEL SETTINGS

Additional input and model settings were used in accordance with EPA guidance based on the discussions presented in the following three subsections.

3.4.1 HOURLY EMISSION RATES

An hourly emissions file was developed as input to AERMOD (the file was external to AERMOD in a required format and called into AERMOD processing using the “SO HOUREMIS“ option with file path specified). The hourly emissions data was formatted in accordance with the AERMOD user’s manual. Designation modeling used three years (2013-2015) of hourly SO_2 emission rates and stack exit flow and temperature data. These data for Longview Power and Morgantown Energy were obtained from EPA’s CAMD site and WVDEQ; and for Fort Martin these data was provided by FirstEnergy from plant continuous emissions monitor recorded data.

As indicated in Section 2.1 above, the FTM FGD system is configured with the two boilers exhausting through separate flues in a common 550-foot stack. Modeling of the FTM boiler stack utilized a merged flue approach. Specifically, an equivalent diameter was computed for the FGD stack based on the total area of the two flues. The dual flue hourly exhaust flow rates (acfm) were added together to determine hourly FGD stack exit velocity based on the equivalent diameter; and

FGD stack hourly exit temperatures were average flue temperatures weighted as a function of the individual flue flow rates.

3.4.2 URBAN/RURAL CLASSIFICATION

The EPA "Guideline on Air Quality Models" (EPA-450/2-78-027R-C), Appendix W of 40 CFR Part 51, specifies a procedure to determine whether the character of the modeling area is primarily urban or rural. The Auer land use method is the recommended approach. The Auer method classifies land use within an area circumscribed by a circle, centered on the source, having a radius of 3 km. If land use types for heavy industrial, light-moderate industrial, commercial, and compact residential (i.e., Auer land use types I1, I2, C1, R2, and R3) collectively account for 50% or more of the land use within 3 km of the source, then the modeling regime is considered urban.

Figure 3 is the most recent Google Earth image (September 2013) of land-use within the 3 km radius area surrounding the Fort Martin plant.

Figure 3: Aerial Imagery of Land-Use within 3km of the Fort Martin Plant

As shown in Figure 3, land-use within the 3 km radius area surrounding the Fort Martin plant is predominantly rural based on the above criteria. A qualitative Auer land-use evaluation of the modeling domain and 3km radius around the subject source is not presented herein, as the area clearly indicates predominant rural land-use. Accordingly, rural dispersion was applied for this designation modeling evaluation.

3.4.3 GOOD ENGINEERING PRACTICE STACK HEIGHT REVIEW

In accordance with U.S. EPA's *Guideline*, for stacks with heights that are within the limits of Good Engineering Practice (GEP), actual heights should be used in modeling. Under the EPA's regulations at 40 CFR 51.100, GEP height, Hg, is determined to be the greater of:

- 65 m, measured from the ground-level elevation at the base of the stack;
- For stacks in existence on January 12, 1979, and for which the owner or operator had obtained all applicable permits or approvals required under 40 CFR parts 51 and 52

  Hg=2.5H

  provided that the owner or operator produces evidence that this equation was actually relied on in designing the stack or establishing an emission limitation to ensure protection against downwash;

  For all other stacks,

  Hg=H + 1.5L,

  where H is the height of the nearby structure(s) measured from the ground-level elevation at the base of the stack and L is the lesser dimension of height or projected width of nearby structure(s), or

- the height demonstrated by a fluid model or a field study approved by the EPA or the state/local agency which ensures that the emissions from a stack do not result in excessive concentrations of any air pollutant as a result of atmospheric downwash, wakes, eddy effects created by the source itself, nearby structures or nearby terrain features.

In accordance with U.S. EPA's 1-hour SO_2 designation modeling TAD, actual stack heights should be used in modeling, even if stack heights exceed GEP formula height. This notwithstanding, the modeling considered the potential for plume aerodynamic building downwash for the FMT plant using the U.S.EPA Building Profile Input Program with the Plume Rise Model Enhancements (BPIPPRM version 04274). WVDEP has indicated only FirstEnergy plant structures need consideration with respect to the potential for building downwash. As such, FMT plant structure coordinates; structure elevations above ground; stack locations and object base elevations were used as input to BPIPPRM. The BPIPPRM output (direction-specific building dimensions for every 10 degrees azimuth for each source) was used as input to AERMOD.

A structure's downwind zone of influence on a point source can extend up to 5L from the trailing building edge (*Guideline for Determination of Good Engineering Practice Stack Height Technical Support Document* (U.S. EPA, 1985)). As such, for the Fort Martin plant the BPIPPRM evaluation utilized structure dimensions and/or corner coordinates obtained from FirstEnergy. These are the same structures and corresponding dimensions input to the Fort Martin flue gas desulfurization project's compliance modeling analysis submitted to WV DEQ during December 2006. There have been no significant structural changes to the plant since the

FGD project. Table 7 below lists FTM structures and their dimensions input to the BPIPPRM evaluation for GEP formula height determination and wind-direction dependent dimension output used in AERMOD (see Figure 1 for graphical depiction of stack/structure layout and relative orientation).

Table 7: Fort Martin Plant Structures Evaluated in the Good Engineering Practice (GEP) Stack Height Analysis Using EPA's BPIPPRM Algorithm

BUILDING NAME	Base Elevation (ft)	Base Elevation (m)	Structure Dimensions: Height Above Ground (ft)	Height (m)	Length (feet)	Width (feet)
1. Turbine Building	811.0	247.2	90	27.6	446	105
2. Coal Tower	810.6	247.1	150	45.7	26	33
3. Boiler 1	810.9	247.2	238	72.4	90	105
4. Boiler 2	810.8	247.1	219	66.8	90	105
5. Cooling Tower 1	809.7	246.8	375	114.3	90	(diameter)
6. Cooling Tower 2	810.0	246.9	375	114.3	90	(diameter)

The BPIPPRM results indicate a formula GEP height of 644.26 feet for the Fort Martin FGD stack, while the physical height of the stack is 550 feet. The designation analysis used the full Fort Martin FGD stack height (550 feet), along with source-specific wind-direction dependent building dimensions output by BPIPPRM as input to AERMOD

3.4.4 MEASURED SO_2 BACKGROUND CONCENTRATION DATA

The designation modeling evaluation requires that a measured background value is added to the modeled predicted SO_2 concentrations to produce a total predicted SO_2 concentration for the area. The measured background value accounts for the SO_2 contribution to total predicted concentrations from non-modeled distant/smaller emitting sources. WVDEP comment received on the initial March 2016 protocol recommended using data collected at the Monongalia County SO_2 monitor (AQS Site ID 54-061-0003). FirstEnergy utilized the data collected at the Monongalia County SO_2 monitor (AQS Site ID 54-061-0003), as suggested by WVDEP. The 2013 – 2015 design concentration for this monitor is 15 ppb as determined from the EPA data (https://www3.epa.gov/airdata/ad_rep_mon.html) summarized in Table 8 below.

Table 8: 2013 – 2015 Design Concentration at Monongalia County SO_2 Monitor (AQS Site ID 54-061-0003)

		99th Percentile (ppb)			Distance from Monitor to Plant (km)
Monitor ID	Location	2013	2014	2015	Fort Martin
54-061-0003	Monongalia Co., WV	14	15	16	6.8

FirstEnergy further refined the Table 8 constant design value using two methods described below:

1. Method 1: There have been a number of studies conducted in recent years that have demonstrated that EPA's recommended approach of combining the 99th percentile modeled concentration with the 99th percentile monitored background concentration has a degree of conservatism well beyond the level necessary to protect the 1-hour NAAQS. One study in particular[29] presents an approach that has been demonstrated to conservatively represent monitored background concentrations combined with AERMOD predictions. This method utilizes the 50th percentile (i.e., median value) of the monitored daily maximum hourly concentrations for each of the three consecutive monitoring years (2013-2015), averaged to produce a constant 50th percentile value for the three-year period. The final background concentration is determined as the average value among all potentially background-representative monitors (i.e., those monitors not significantly impacted by one or more major SO_2 sources). The resultant value is included as a constant background value input to AERMOD which is internally combined with the predicted design concentrations.

   The Monongalia Co., WV SO_2 monitor is located 6.8 km south of the FTM plant. As suggested by WVDEP, this monitor served to represent SO_2 background in the general vicinity of the FTM plant based on this data refinement method. The 50th percentile (i.e., median value) of the monitored daily maximum hourly concentrations at the Monongalia Co., WV monitor for each of the three consecutive monitoring years (2013-2015), averaged to produce a constant 50th percentile value for the three-year period results in a background concentration of 2.7 ppb. The 50th percentile background concentration was used in the 1-hour SO_2 designation modeling for the FTM plant (see Section 4 for further discussion).

2. Application of a temporally varying background monitored concentration computed by hour of day and season. The method of computing this background concentration matrix is based on the EPA TAD supported methodology[30] developed for NO_2 compliance modeling. EPA has concluded use of this variable background concentration methodology is applicable to SO_2 designation modeling. The methodology uses hourly monitored concentration data (2013-2015) to determine 99th percentile values computed by hour of day and season for the monitoring period. AERMOD allows for the direct inclusion of temporally varying background concentrations in the design value calculation in combination with modeling results. Also consistent with the TAD (and EPA air modeling guidance), to avoid potential "double-counting" of source concentrations the modeling protocol had proposed to exclude periods when the modeled sources are expected to impact the monitor. This notwithstanding, the FTM and Longview plants are located about 7km from the Monongalia Co., WV monitor. Given this spatial separation, FirstEnergy conservatively conducted the temporally varying background monitored concentration processing by hour of day and season using the complete set of 2013-2015 monitored data at the Monongalia Co., WV monitor (i.e., no hours of potential source impacts at the monitor were removed from the dataset). The following steps were conducted:

   For each of the three years of monitoring data, segregate the hourly concentration data by season and hour-of-day (winter = Dec. – Feb.; spring = March – May; summer = June – Aug.;

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[29] Sergio A. Guerra (2014), "Innovative Dispersion Modeling: Practices to Achieve a Reasonable Level of Conservatism in AERMOD Modeling Demonstrations", EM, December 2014, pp. 24-29

[30] EPA's March 1, 2011 memo, "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO2 Ambient Air Quality Standard

fall = Sept. – Nov.); calculate the 99th percentile hour of day concentration per season for each year; and then calculate, for each season and hour-of-day, the three-year average of 99th percentile values. This "matrix" of seasonally- and hourly-varying monitored background concentrations was used as input to AERMOD (i.e., the "SO BACKGRND SEASHR" pathway). The resultant temporally varying monitored background concentrations by hour of day and season at the Monongalia Co., WV monitor are found in Table 9.

Table 9: Temporally Varying Monitored Background Concentrations by Hour of Day and Season for The Monongalia Co., WV Monitor

Meteorological Hour	2013 - 2015 Average - No Exclusion			
	Winter	Spring	Summer	Fall
	PPB	PPB	PPB	PPB
1	4.333	6.000	4.667	4.000
2	5.000	6.000	3.667	4.000
3	4.333	8.667	4.000	4.667
4	5.000	8.333	3.667	4.000
5	5.333	8.667	4.667	4.333
6	4.667	7.667	5.000	3.667
7	4.667	8.000	5.000	4.333
8	5.667	8.000	7.000	5.000
9	6.333	10.667	8.333	4.667
10	6.333	11.667	16.000	6.333
11	8.000	9.000	21.000	8.667
12	10.667	8.000	13.000	7.000
13	11.333	9.667	13.000	9.333
14	8.667	8.667	13.667	9.000
15	8.333	5.667	11.667	5.000
16	7.667	6.667	10.333	5.667
17	7.333	7.667	8.000	7.667
18	7.667	9.667	8.667	8.000
19	9.333	11.000	9.000	6.000
20	9.000	8.333	6.333	4.667
21	8.667	7.000	5.000	4.333
22	7.333	6.667	3.333	4.667
23	7.333	6.000	3.667	4.667
24	5.333	6.667	5.000	3.667

3.5 1-HOUR SO_2 NAAQS DESIGNATION MODELING APPROACH

The AERMOD designation modeling runs utilized the '*default*' 3-year meteorological and other data inputs described above, and the CONTROL pathway regulatory default option, DFAULT (elevated terrain, calms and missing data processing routines, and no exponential decay, dry depletion, nor wet depletion). The emission units shown in Table 3 herein were characterized in AERMOD as unobstructed vertical release point sources, and the source pathway keyword of SRCGROUP were used to ascertain total predicted concentrations for the ALL group, and for individual stationary source group contributions.

AERMOD dispersion modeling was conducted to determine total 1-hour SO_2 predicted concentrations in the form of the 1-hour SO_2 NAAQS. The design value predictions (each receptor) were calculated as the average of the 99th percentile (4th highest) of the annual distribution of daily maximum 1-hour concentrations averaged across the three modeled years. The highest of these 99th percentile values is the overall maximum design concentration.

The model predicted design values indicated above were generated using the AERMOD model CONTROL pathway pollutant ID SO_2. Also, the OUTPUT pathway keywords specific to the 1-hour standard were used. This included the MAXCONT keyword which created an AERMOD output file of source contributions for each rank of total concentration and receptor in the modeling domain. Such output allowed for identification of potential source culpability to any predicted exceedance of the 1-hour SO_2 NAAQS, where an exceedance would be a 4th highest (or greater rank) total concentration (including measured background) that was predicted to exceed the 1-hour SO_2 NAAQS of 75 ppb (196.2 ug/m^3 equivalent). A source was not considered to have a significant contribution to a predicted exceedance if the corresponding source contribution is below the EPA's Significant Impact Level (SIL)[31].

[31] EPA memorandum, "Guidance Concerning the Implementation of the 2010 SO_2 NAAQS for the Prevention of Significant Deterioration Program." August 23, 2010. The 3 ppb interim SIL (7.8 ug/m^3 equivalent) for the 2010 SO_2 NAAQS was provided by the EPA for states to consider using for the PSD program.

4. PRESENTATION OF 1 HOUR SO2 DESIGNATION MODELING RESULTS AND RECOMMENDATION FOR THE FIRSTENERGY FORT MARTIN PLANT

The AERMOD modeling files associated with the FTM 1-hour SO_2 designation modeling are included on the compact disk referenced in Appendix D. The modeling files include the AERMAP, AERMET, AERMOD, and related source contribution files (MDC) for the modeling scenarios discussed

The AERMOD total predicted 1-hour SO_2 concentrations using the ADJ_U* BETA option, inclusive of the constant 50th percentile measured background concentration and temporally varying background concentrations discussed in Section 3.4.4, are presented in Tables 10 and 11, respectively, for the two AERSURFACE scenarios, i.e., the FTM plant and NWS KMWG site surface characteristics as discussed in Section 3.2. The AERMOD predicted values in Table 10 reflect the design concentrations (i.e., maximum 4th highest maximum daily 1-hour results averaged over 3-years of modeling) for the FTM, ME and Longview plants predicted on the full grid of receptors in the modeling domain, plus the addition of the 50th percentile background concentration of 2.7 ppb (7.06 ug/m^3). The AERMOD predicted values in Table 11 reflect the design concentrations (i.e., maximum 4th highest maximum daily 1-hour results averaged over 3-years of modeling) for the FTM plant predicted on the full grid of receptors in the modeling domain, along with the temporally varying background monitored concentrations by hour of day and season shown in Table 9. Figures 4 and 5 present the designation modeling concentration distribution for the NWS AERSURFACE-based model runs, as the worst case of the two meteorological data file results.

While the NWS KMGW AERSURFACE-based model run resulted in the worst case predicted 1-hour SO_2 design concentration, both AERSURFACE scenarios using both sets of monitoring data processed as described earlier and the use of the ADJ_U* BETA option resulted in predicted concentrations below the 1-hour SO_2 NAAQS of 75 ppb. These findings are based on application of EPA recommended procedures presented in their TAD for designation modeling. FirstEnergy believes that this designation modeling demonstration will allow WVDEP and EPA to deem the air quality in the area surrounding the FTM Power Plant as *Attainment* under the 1-hour SO_2 NAAQS Data Requirements Rule.

Table 10: AERMOD Predicted 1-Hour SO_2 NAAQS Designation Modeling Results for the FirstEnergy Fort Martin Power Plant Using the ADJ_U* BETA option and a Constant Monitor Value

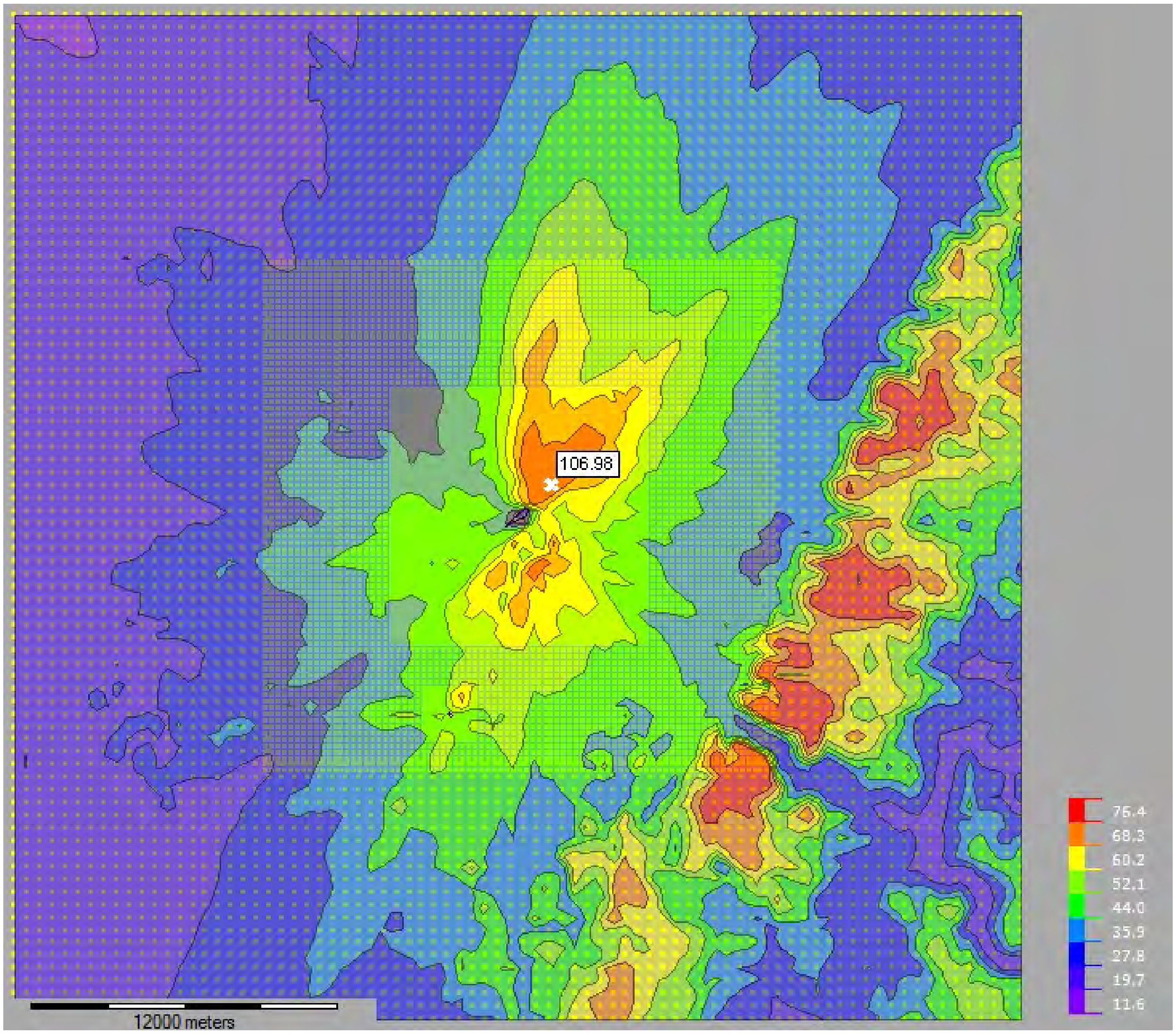
	AERMOD Predicted Design Concentration, Fort Martin AERSURFACE		AERMOD Predicted Design Concentration, Morgantown Airport NWS Station AERSURFACE	
Source Contribution	($\mu g/m^3$)	ppb	($\mu g/m^3$)	ppb
Fort Martin, Longview & Morgantown Prediction	**99.31**	**38.0**	**99.92**	**38.2**
Background	7.06	2.7	7.06	2.7
Total Predicted 1-Hour SO_2 Design Concentration Including Constant Background	**106.37**	**40.67**	**106.98**	**40.90**
Note: The 1-hr SO2 NAAQS is 196 µg/m3 or 75 ppb. The 1-hr SO2 Significant Impact Level (SIL) is 7.585 µg/m3 or 3 ppb.				

Table 11: AERMOD Predicted 1-Hour SO_2 NAAQS Designation Modeling Results for the FirstEnergy Fort Martin Power Plant Using the ADJ_U* BETA option and a Temporally Varying Monitor Value

	AERMOD Predicted Design Concentration, Fort Martin AERSURFACE		AERMOD Predicted Design Concentration, Morgantown Airport NWS Station AERSURFACE	
Source Contribution	($\mu g/m^3$)	ppb	($\mu g/m^3$)	ppb
Total Predicted 1-Hour SO_2 Design Concentration Including Temporally Varying Background	**121.13**	**46.3**	**125.63**	**48.0**

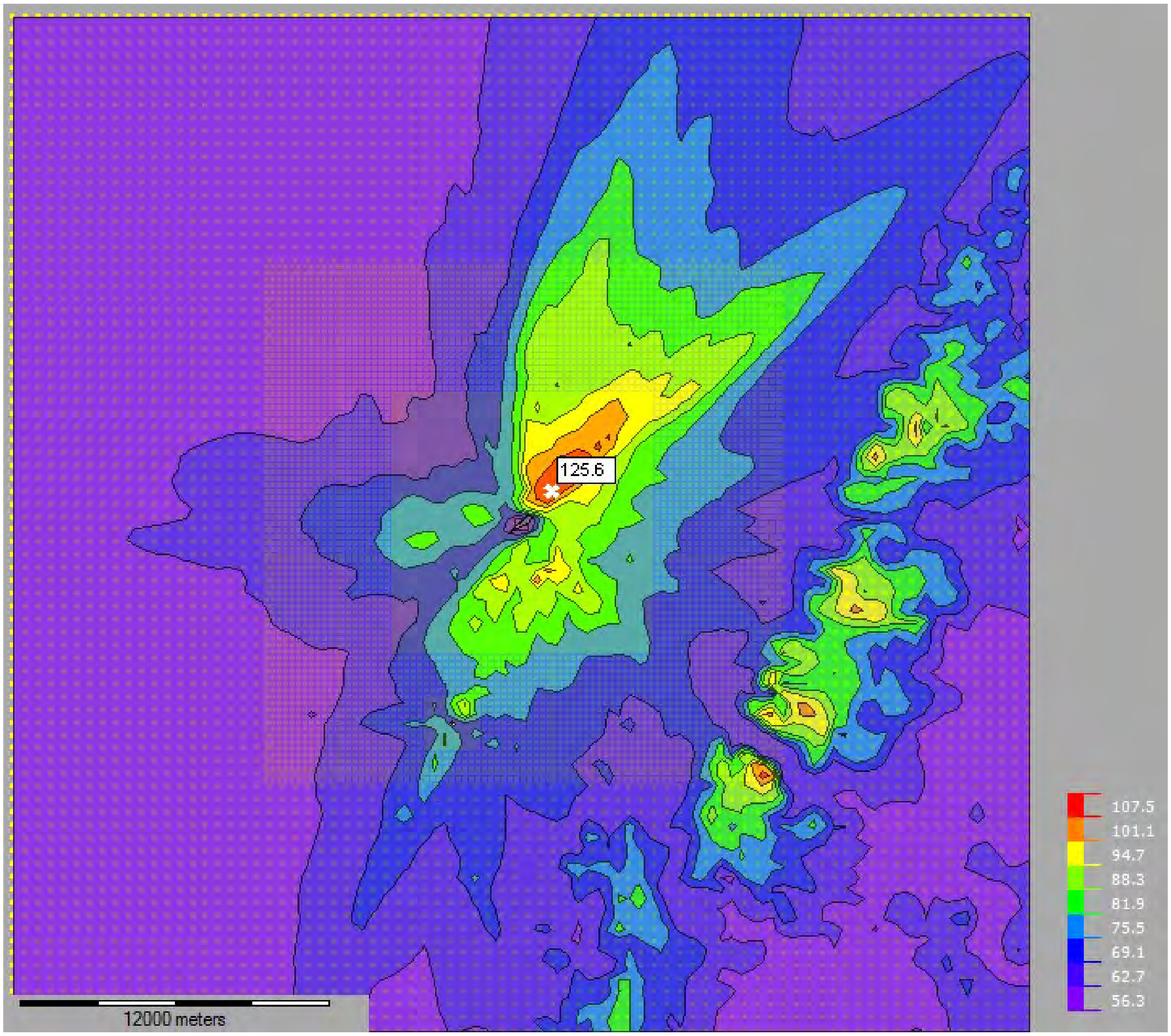
Note: The 1-hr SO2 NAAQS is 196 µg/m3 or 75 ppb. The 1-hr SO2 Significant Impact Level (SIL) is 7.585 µg/m3 or 3 ppb.

Figure 4: Isoplot of AERMOD Predicted 1-Hour SO_2 NAAQS Designation Modeling Concentrations for the Fort Martin Plant Using the ADJ_U* BETA option, NWS Site AERSURFACE-Based AERMET, and a Constant Monitor Value*



*Reflects a constant 50th percentile background concentration of 2.7 ppb (7.06 ug/m^3). FTM Plant is located at image center.

Figure 5: Isoplot of AERMOD Predicted 1-Hour SO_2 NAAQS Designation Modeling Concentrations for the Fort Martin Plant Using the ADJ_U* BETA option, NWS Site AERSURFACE-Based AERMET, and a Temporally Varying Monitor Value*



*Reflects a variable measured concentration matrix used in AERMOD determined as a function of hour of day and season of year, as per EPA recommendations. FTM Plant is located at image center.

Appendix A: Protocol For Modeling of the Fort Martin Power Plant in Response to U.S. EPA's Data Requirements Rule For The 2010 1-Hour SO_2 Primary National Ambient Air Quality Standard Submitted June 27, 2016

Fort Martin Modeling
Protocol Submitted Ju

Appendix B: Land Use Imagery Surrounding the Fort Martin Power Station and the NWS Morgantown Airport Surface Meteorological Measurement Site

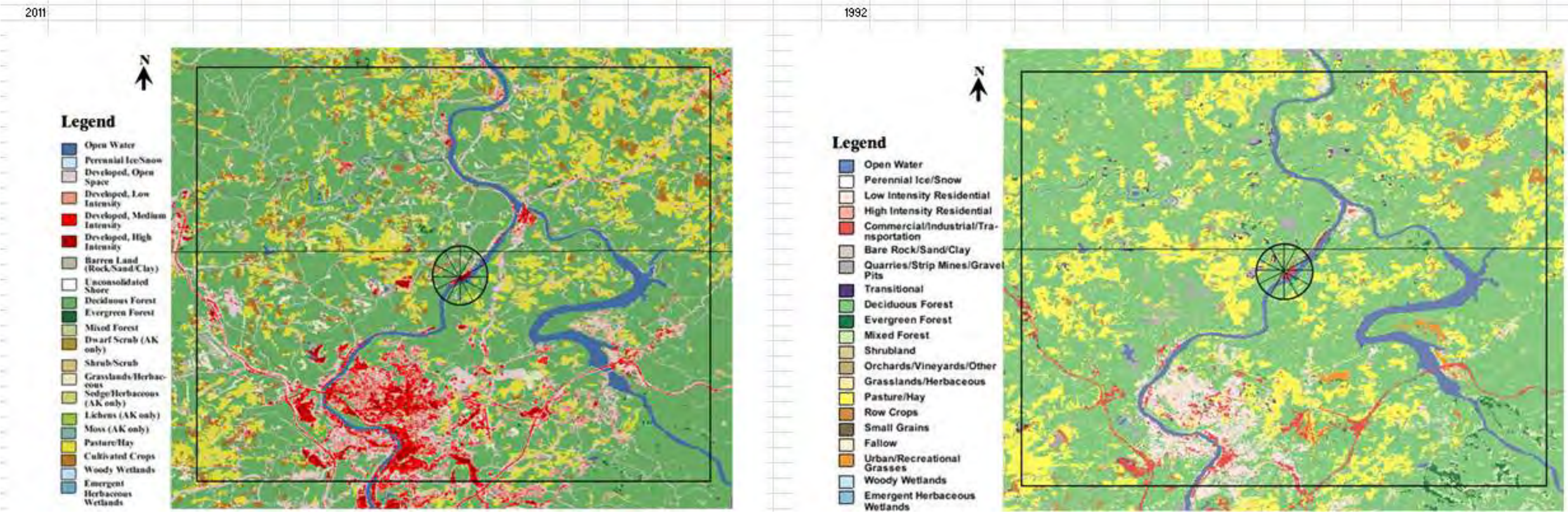
Aerial Imagery of Area Around Fort Martin Plant*

*Left image is 2013 and right image is 1988 (colorization not available for 1988). Yellow line extending north from image center is 1km reference length.

Aerial Imagery of Area Around NWS Morgantown Airport Surface Meteorological Measurement Site*

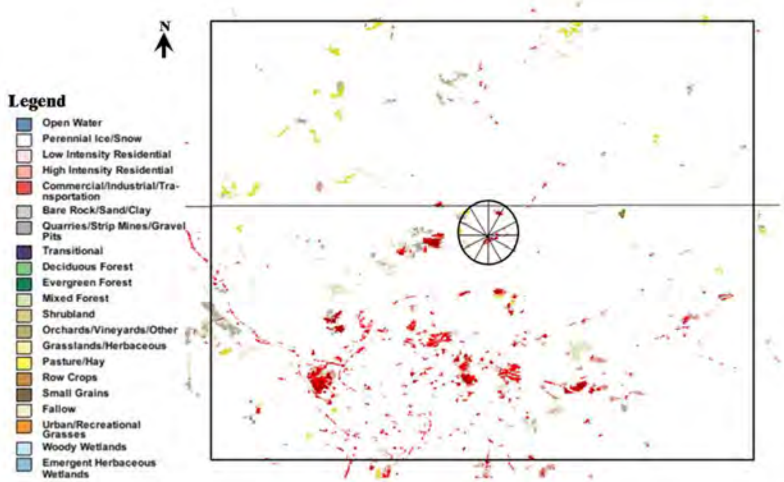
*Left image is 2013 and right image is 1988 (colorization not available for 1988). Yellow line extending north from image center is 1km reference length.

Land-Use Categorization of Area Around Fort Martin Plant*



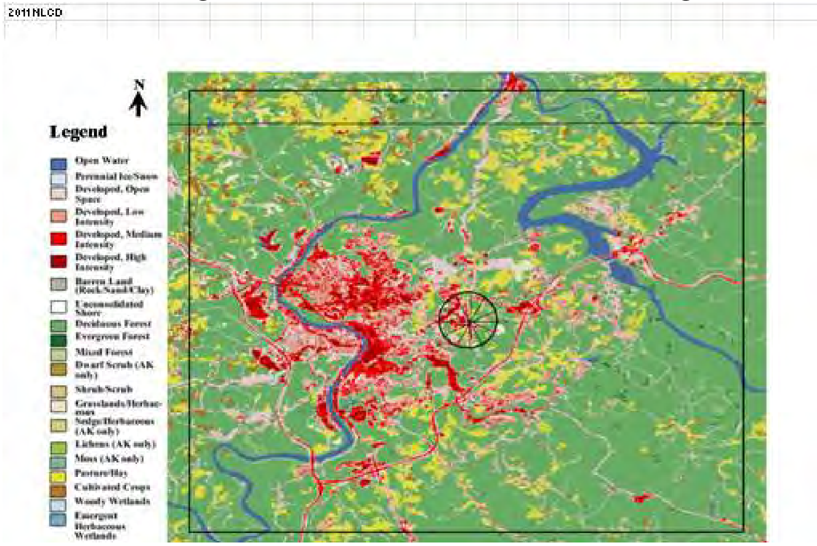
*Center circle is a 1km radius area (12 sectors) surrounding plant site. Larger rectangle is 10km x 10km square area surrounding plant site.

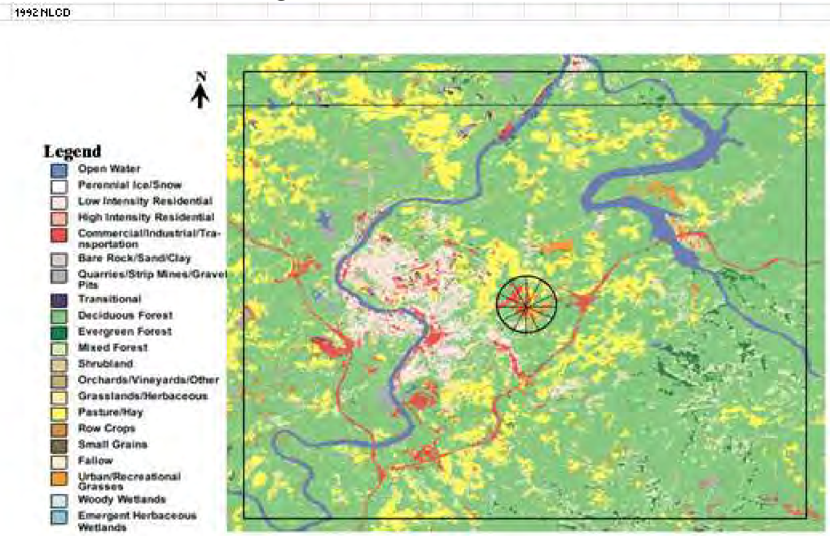
Land-Use Categorization Change (2011 vs. 2001) for the Area Around Fort Martin Plant*



*Center circle is a 1km radius area (12 sectors) surrounding plant site. Larger rectangle is 10km x 10km square area surrounding plant site.

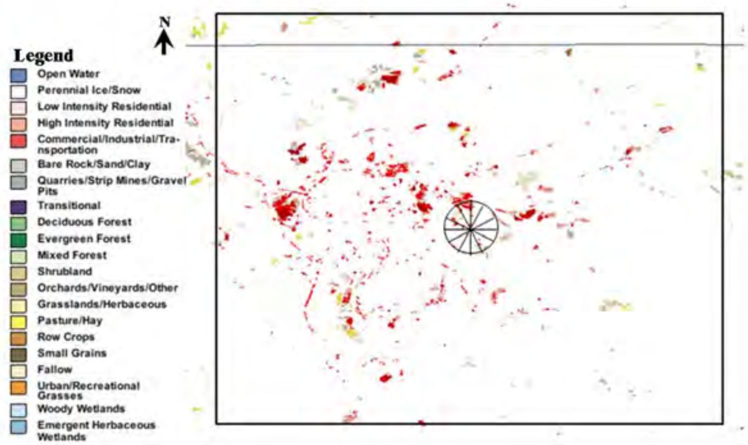
Land-Use Categorization of Area Around NWS Morgantown Airport Surface Meteorological Measurement Site *





*Center circle is a 1km radius area (12 sectors) surrounding plant site. Larger rectangle is 10km x 10km square area surrounding plant site.

Land-Use Categorization Change (2011 vs. 2001) for the Area Around NWS KMGW Surface Meteorological Measurement Site*



*KMGW is Morgantown Airport. Center circle is a 1km radius area (12 sectors) surrounding plant site. Larger rectangle is 10km x 10km square area surrounding plant site.

Appendix C: Technical Memorandum Request For Approval To Use Adj_U* In AERMET For Modeling Of The First Energy's Fort Martin Power Plant In Response To U.S. EPA's Data Requirements Rule For The 2010 1-Hour SO_2 Primary National Ambient Air Quality Standard Submitted July 29, 2016

USTAR Beta Request
Submitted July 25, 20

Appendix D: Compact Disk (CD) with AERMOD Modeling Files (BPIPPRM, AERMET, and AERMOD Input/Output Files)

(COMPACT DISK ENCLOSED CONTAINING PROJECT MODELING FILES)

*Note: For the AERMOD result that reflects the constant measured background concentration as the 50th percentile 3-year average, the constant measured value is manually combined with the AERMOD predicted design concentration (see Table 10), and it is not directly included in the AERMOD input file. This constant value was not included in these AERMOD runs since the value can be readily added to any prediction; and because the temporally-varying monitored concentration matrix was input to AERMOD.

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ENVIROPLAN CONSULTING

Air Modeling Findings Report for the Pleasants Power Plant in Response to U.S. EPA's Data Requirements Rule for the 2010 1-Hour SO_2 Primary National Ambient Air Quality Standard

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EXECUTIVE SUMMARY

On August 21, 2015, the U.S. Environmental Protection Agency (EPA) published the final *Data Requirements Rule for the 2010 1-Hour Sulfur Dioxide (SO_2) Primary National Ambient Air Quality Standard (NAAQS)* [80 FR 51052]. The EPA's Data Requirements Rule (DRR) requires air quality designations be made for the 1-hour SO_2 National Ambient Air Quality Standard (NAAQS)[1] for those areas with large sources of SO_2 emissions. In general, the DRR requires attainment status characterization for unclassified areas containing, or impacted by, SO_2 sources that have annual actual SO_2 emissions of 2,000 tons or more based on the most recently available annual data. Lesser emitting SO_2 sources can also be subject to the DRR air quality characterization requirement. The DRR sets forth a process and schedule for which air agencies must characterize air quality through ambient monitoring and/or air quality modeling techniques; and submit such findings and data to EPA. For affected sources opting to characterize air quality through dispersion modeling, the DRR schedule requires that all modeling results be submitted to the EPA by January 13, 2017.

On September 15, 2015 the West Virginia Department of Environmental Protection (WVDEP) notified FirstEnergy indicating their Pleasants Power Plant to be an affected SO_2 stationary source subject to the DRR. FirstEnergy informed WVDEP they would perform air quality modeling for designation air quality characterization. The modeling data and methods presented herein reflect the procedures for the conduct of designation air modeling following the EPA's 1-hour SO_2 designation modeling Technical Assistance Document (TAD) [2] [3], as described in the final protocol submitted to WVDEP on June 27, 2016.

Enviroplan Consulting, as the air modeling contractor to FirstEnergy, has conducted the designation modeling in accordance with the protocol and agency recommendations. Enviroplan has also participated in the above referenced protocol development and related correspondence. The designation modeling utilized the U.S. EPA AERMOD modeling suite of programs to evaluate actual SO_2 emission rates for identified emitting sources in and surrounding the subject affected plant. For this evaluation, only the Pleasant plant is an affected inventory, along with the inclusion of a measured background concentration added to model predictions.

The result of this 1-hour SO_2 designation modeling evaluation shows total predicted design value concentrations well below the 1-hour SO_2 NAAQS of 75 parts per billion (ppb). These findings are based on application of EPA recommended procedures presented in their TAD for designation modeling. FirstEnergy believes that this designation modeling demonstration will allow WVDEP and EPA to deem the air quality in the area surrounding the Pleasants Power Plant as *Attainment* under the 1-hour SO_2 NAAQS Data Requirements Rule.

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1 The 1-hour SO_2 NAAQS of 75 parts per billion (ppb) is a probabilistic air quality standard, where compliance is based on the 99^{th} percentile of daily maximum 1-hour concentrations averaged over three years.

2 U.S. EPA, December 2013, *SO2 NAAQS Designations Modeling Technical Assistance Document (Draft),* http://www.epa.gov/airquality/sulfurdioxide/pdfs/SO2ModelingTAD.pdf

3 U.S. EPA, 2005. *Guideline on Air Quality Models.* 40 CFR Part 51 Appendix W. http://www.epa.gov/ttn/scram/guidance/guide/appw_05.pdf

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1. INTRODUCTION

On August 21, 2015, the U.S. Environmental Protection Agency (EPA) published the final *Data Requirements Rule for the 2010 1-Hour Sulfur Dioxide (SO_2) Primary National Ambient Air Quality Standard (NAAQS)* [80 FR 51052]. The EPA's Data Requirements Rule (DRR) requires air quality designations be made for the 1-hour SO_2 National Ambient Air Quality Standard (NAAQS)[4] for those areas with large sources of SO_2 emissions. In general, the DRR requires attainment status characterization for unclassified areas containing, or impacted by, SO_2 sources that have annual actual SO_2 emissions of 2,000 tons or more based on the most recently available annual data. Lesser emitting SO_2 sources can also be subject to the DRR air quality characterization requirement. The DRR sets forth a process and schedule for which air agencies must characterize air quality through ambient monitoring and/or air quality modeling techniques; and submit such findings and data to EPA. For affected sources opting to characterize air quality through dispersion modeling, the DRR schedule requires that all modeling results be submitted to the EPA by January 13, 2017.

On September 15, 2015 the West Virginia Department of Environmental Protection (WVDEP) notified FirstEnergy indicating their Pleasants Power Plant to be an affected SO_2 stationary source subject to the DRR. The FirstEnergy Pleasants power generating station is located in Willow Island, Pleasants County, West Virginia, along the Ohio River. On November 4, 2015, FirstEnergy held a teleconference with the WVDEP[5]. The purpose of the teleconference was to communicate Division of Air Quality's (DAQ) requirements in regards to the 1-hour SO_2 NAAQS modeling, including background source inventory; and for FirstEnergy to confirm their plan to use modeling for the Pleasants plant area designation process. Additional modeling information and guidance were subsequently provided by WVDEP[6] [7], including the background source modeling inventory; meteorological data; and general air modeling approach. This information was compiled into an initial protocol that FirstEnergy submitted to WVDEP on March 30, 2016. WVDEP and U.S. EPA provided protocol comments to FirstEnergy on May 22 and June 2, 2016. FirstEnergy submitted the final protocol to WVDEP on June 27, 2016. The final protocol and April 21, 2015 WVDEP correspondence are included herein as Appendix A. Verbal acknowledgement of the protocol content/procedures was provided by WVDEP on September 23, 2016.[8]

The modeling data and methods presented herein reflect the procedures for the conduct of designation air modeling following the EPA's 1-hour SO_2 designation modeling Technical Assistance Document (TAD) [9] [10], as described in the final protocol submitted to WVDEP on June 27, 2016.

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[4] The 1-hour SO_2 NAAQS of 75 parts per billion (ppb) is a probabilistic air quality standard, where compliance is based on the 99th percentile of daily maximum 1-hour concentrations averaged over three years.
[5] Conversation between B. Kolts (FirstEnergy) and Jon McClung (WVDEP, DAQ) on November 4, 2015.
[6] Email to B. Kolts (FirstEnergy) from Jon McClung (WVDEP, DAQ) on November 16, 2015.
[7] Email to M. Hirtler (Enviroplan Consulting) from Jon McClung (WVEP, DAQ) on March 23, 2016.
[8] Conversation between B. Kolts (FirstEnergy) and Jon McClung (WVDEP, DAQ) on September 23, 2016.
[9] U.S. EPA, December 2013, *SO2 NAAQS Designations Modeling Technical Assistance Document (Draft),* http://www.epa.gov/airquality/sulfurdioxide/pdfs/SO2ModelingTAD.pdf
[10] U.S. EPA, 2005. *Guideline on Air Quality Models.* 40 CFR Part 51 Appendix W. http://www.epa.gov/ttn/scram/guidance/guide/appw_05.pdf

Enviroplan Consulting, as the air modeling contractor to FirstEnergy, has conducted the designation modeling of the Pleasants plant. Section 2 of this document discusses the emissions inventory and emission rates considered in the designation modeling analysis. Section 3 presents the air model selection for the analysis, the related model input data and analyses, and the modeling approach. Section 4 presents the designation modeling results and study findings for the FirstEnergy Pleasants plant.

2. AIR EMISSIONS SOURCES INCLUDED IN 1-HOUR SO_2 DESIGNATION MODELING DEMONSTRATION AND RELATED MODELING PARAMETERS

FirstEnergy and WVDEP held a teleconference to discuss the conduct of the Pleasants plant designation modeling. The discussion included required SO_2 emitting sources to be considered in a designation modeling inventory, along with the affected source (i.e., the Pleasants plant). To that end, WVDEP compiled a list of WV SO_2 emitting sources with their actual annual SO_2 emission rates (tons per year, tpy) for each of 2012, 2013 and 2014. The list and a graphic showing plant locations were provided to FirstEnergy on November 4 and 16, 2015.

The FirstEnergy Pleasants power generating station is located in Willow Island, Pleasants County, West Virginia, along the Ohio River. Table 1 below presents the inventory of combustion units at the plant.

Table 1: First Energy - Pleasants Station, WV Power Station Combustion Units		
Stack ID	**Description**	**Fuel Type**
Stack P1 and Stack P2 (two flues in common stack)	Unit 1 (P2)	Bituminous Coal (And NG)
	Unit 2 (P2)	
Aux Blr Stack P1	Auxiliary Boiler No. PA	No. 2 Oil (and NG)
	Auxiliary Boiler No. PB	No. 2 Oil (and NG)
Gen PA	Emergency Diesel Gen	Diesel
Gen PB	Emergency Diesel Gen	Diesel

Plant inventory also includes miscellaneous small natural gas heaters and diesel fire pump engines.

The existing Pleasants facility is equipped with two identical opposed fired, pulverized coal dry bottom boilers, along with a dedicated flue gas desulfurization (FGD) SO2 emissions control system. The FGD system was installed during initial plant construction, and upgraded in 2007 for enhanced SO_2 emissions removal. The system is configured with the two boilers exhausting through separate flues in a common 640-foot stack. The stack has a continuous emissions monitoring system (CEMS) that records hourly average exhaust flow rate and temperature, and SO_2 emissions. Modeling of the two coal boilers reflected a merged flue configuration (see Section 3.4.1 for further discussion) using the actual hourly CEMS data recorded for the designation modeling period (2013-2015). The CEMS data was compiled by FirstEnergy for input to this designation modeling evaluation. Physical FGD stack parameters are presented in Table 3. Also, EPA requested a summary of coal boiler start-ups/shutdowns be provided in the

June 27, 2016 protocol. Such information was presented therein, and it is inherent in the actual CEMS data used in this evaluation.

In addition to the Pleasants coal fired boilers, the plant inventory also includes two auxiliary boilers, two emergency diesel engines, and other small heaters and fire pump engines. The annual hours of unit operation and annual SO_2 emission rates (tons per year) for the ancillary combustion equipment are presented in Table 2 below. The natural gas fuel auxiliary boilers and other limited use units have no appreciable SO_2 emissions and were not considered in this evaluation.

Table 2: Pleasants Plant Miscellaneous Combustion Equipment SO_2 Emissions and Operating Hours for 2013, 2014 and 2015

	SO2 Tons				Operating Hours		
	2013	**2014**	**2015**		**2013**	**2014**	**2015**
Pleasants							
Aux Stack	0.0105	0.0079	0.0091		1939	773	1020
EDG A	0.0069	0.0033	0.0054		36	17	28
EDG B	0.0065	0.0019	0.005		34	10	26
Kerosene Heaters	0.243	0.243	0.243		3350	3350	3350
LPG Heaters	0.0137	0.0264	0.0247		472	910	854
EDFP1	0.0084	0.0076	0.0038		31	28	14
EDFP2	0.0042	0.0084	0.0054		14	28	18

Figures 1A and 1B below present aerial imagery of the Pleasants plant (with a scale and north orientation). The figures depict the Pleasants plant, along with the location of the FGD stack and the surrounding structures. The figures also delineate the ambient air boundary assumed for the Pleasants plant in this designation modeling. Figures 1A and 1B reflect marginally older (i.e., 2011) plant layout information for Pleasants, but the images provide for less obscuration due to cooling tower moisture plumes than later aerial imagery. There have been no structural changes at the Pleasants plant since dates of these images.

Figure 1A: Aerial Image of the Pleasants Power Station*

*Google Earth imagery date, June 3, 2013. Red line is the Pleasants property boundary used in this designation evaluation. North is oriented towards top of image.

Figure 1B: Aerial Image the Pleasants Power Station Showing FGD Stack and Surrounding Structures*

*Google Earth imagery date, July 9, 2011. Red line is the Pleasants property boundary used in this designation evaluation. North is oriented towards top of image.

General EPA modeling guidance (i.e., footnotes 9 and 10) requires that sources expected to cause a significant concentration gradient in the vicinity of the source of interest should be explicitly modeled. To this end, WV DAQ instructed that sources with an actual SO_2 emission rate of at least 100 tpy during any of 2012, 2013, or 2014, and located within 20km of the Pleasants plant, be considered for inclusion in the designation modeling. WVDEP did qualify that the list of sources provided in November 2015 to be draft. This notwithstanding, based on the provided data, FirstEnergy determined that there are no WV nor surrounding state SO_2 emitting sources that meet the WVDEP modeling criteria, i.e., have emissions greater than 100 tpy SO_2 and are located within 20km of the Pleasants plant.

The following table summarizes the sources that were modeled along their respective modeling parameters:

Table 3: Air Modeling Inventory Parameters Used for the Pleasants Plant Designation Modeling 1-hour SO2 NAAQS Evaluation*

Stack ID	Point Source Description	UTM-x	UTM-y	Base El.	Emis Rate	Stk Ht	Stk T	Stk Vel	Stk Diam
		m	m	m	lb/hr	ft	F	ft/s	ft
PL001	Pleasants Stack	474487.20	4357399.60	193.8200	---	640.0	126.0	52.76	41.00

*Designation modeling uses three years (2013-2015) of hourly SO_2 emission rates and stack exit flow and temperature data. This data for Pleasants was provided by FirstEnergy from plant continuous emissions monitor recorded data. Pleasants stack diameter is effective diameter for two 29 foot diameter individual stack flues.

3. MODEL SELECTION AND METHODOLOGY

3.1 MODEL SELECTION

The American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) was utilized for the area designation dispersion modeling under the 2010 1-hour SO_2 NAAQS. The AERMOD modeling suite also includes two accompanying data preprocessors necessary to develop data used as input to AERMOD: AERMET, which preprocesses representative meteorological data and AERMAP, which preprocesses digital terrain data. The model versions applied include:

- AERMET (Version 15181)
- AERMAP (Version 11103)
- AERMOD (Version 15181)

Model input data used in AERMET, AERMAP, and AERMOD, and relevant model processing options/methods, are discussed in the following sections.

3.2 METEOROLOGICAL DATA

Hourly sequential surface meteorological data are required for the dispersion modeling analysis. The data was processed using the AERMOD meteorological pre-processing program, AERMET (v.15181). The modeled surface and upper air meteorological sites are indicated in Table 4.

Table 4: Meteorological Measurement Site Information

Description	Airport Surface Dataset	Upper Air Dataset
Site name	Mid-Ohio Valley Regional Airport aka Parkersburg Wood County Airport	Pittsburgh International Airport
Call sign / WBAN	KPKB / 03804	KPIT / 94823
Data format	DSI-3505 (ISD)	FSL
Location (longitude, latitude)	81.4437° West, 39.3394° North	80.23° West, 40.53° North
Location (UTM, Zone 17, NAD 1983)	462,077 m East, 4,355,035 m North	---
Elevation (above mean sea level)	253.3 m	---
Anemometer height	10 m	---
Variables	Sky cover and sea level pressure*	Morning pressure and temperature (various levels from surface to 5,000 m)

*AERMET data processing included use of the EPA's AERMINUTE program (v.15272) to process 2-minute and 5-minute average ASOS winds from KPKB (TD-6405 & TD-6501 formats) into hourly average values used as input into AERMET.

In accordance with the EPA's AERMOD Implementation Guide (AIG)[11], a meteorological site representativeness assessment for meteorological monitoring stations at airports in the area surrounding the Pleasants Power Plant was prepared as part of the March 30, 2016 the protocol. This assessment evaluated National Weather Service (NWS) airport surface observing stations most proximal to the Pleasants Plant, finding the NWS observation station at the Parkersburg Wood County Airport (KPKB) to be the most representative surface meteorological observing

[11] U.S. EPA, *AERMOD Implementation Guide*, March 19, 2009.

station for designation modeling of the Pleasants plant. This assessment notwithstanding, the WVDEP indicated in their June 6, 2016 protocol comments that comparative modeling results would be required using the surface characteristics around the surface meteorological site and the plant site if a more detailed (sector and seasonally specific) surface parameter sensitivity analysis is not otherwise provided. As such, the NWS KPKB observation station was used for modeling of the Pleasants plant; and two sets of AERMET files were developed using surface parameters around both the Pleasants plant site and NWS KPKB site. Resultant comparative model predictions were compiled (see Section 4 for further discussion).

The EPA designation modeling guidance recommends that the most recent 3 years of NWS data or site-specific data be used if possible, but the guidance does allow for instances when older representative meteorological data could be used if current data are not otherwise available. In such a circumstance, the date-stamp of the meteorological data hours would be set equal to the dates corresponding to the current actual hourly SO_2 data (i.e., 2013-2015)[12]. For the designation modeling, summary Table 5 below reflects the fact that the KPKB site does not meet EPA's data completeness criterion of at least 90% per quarter[13] for the 4th quarter 2013, and quarters 1, 2 and 3 of 2014. As such, FirstEnergy used KPKB and KPIT meteorological datasets from 2010, 2011 and 2012 to satisfy the Department's completeness test for use in dispersion modeling. The joint recovery of the necessary meteorological variables is at least 90% complete for each calendar year and each calendar quarter over this 3-year data period. Table 6 below presents a summary of missing hourly meteorological data per calendar quarter for the 3-year data period, 2010-2012. Note that the date-stamps associated with this 3-year meteorological period were set to 2013-2015 (i.e., the period of actual Pleasants hourly SO_2 emissions data), consistent with the EPA modeling TAD guidance, Section 7.4.

Table 5: Meteorological Data Completeness Summary for the 2013-2015 Data Processing Period*

	Total Hours Missing and Percentage (%)			
Year	**Q1**	**Q2**	**Q3**	**Q4**
2013	27 (1.3%)	2 (0.1%)	164 (7.4%)	308 (13.9%)
2014	605 (28.0%)	1231 (56.4%)	426 (19.3%)	24 (1.1%)
2015	7 (0.3%)	0 (0%)	13 (0.6%)	28 (1.3%)

*NWS KPKB surface station.

Table 6: Meteorological Data Completeness Summary for the 2010-2012 Data Processing Period*

	Total Hours Missing and Percentage (%)			
Year	**Q1**	**Q2**	**Q3**	**Q4**
2010	27 (1.3%)	71 (3.3%)	102 (4.6%)	51 (2.3%)
2011	0 (0.0%)	53 (2.4%)	171 (7.7%)	51 (2.3%)
2012	36 (1.6%)	115 (5.3%)	189 (8.6%)	142 (6.4%)

*No missing morning soundings during this 3-year period.

[12] U.S. EPA, December 2013, *SO2 NAAQS Designations Modeling Technical Assistance Document (Draft),* Section 7.4.
[13] U.S. EPA, February 2000*, Meteorological Monitoring Guidance for Regulatory Modeling Applications,* Section 5.3.2.

The meteorological data processing also reflected the following:

- EPA's AERMINUTE processor (v. 15272) to process 2-minute ASOS winds (TD-6405 format) and 5-minute (DSI-6401 format) from KPKB and calculate an hourly average for input into AERMET

- EPA's AERSURFACE processor (v.13016) to determine the surface characteristics (i.e., noon-time albedo, Bowen ratio, and surface roughness length) around the location of the KPKB meteorological tower. The surface characteristics' values were calculated by AERSURFACE using the USGS NLCD 1992 for the state. The following selections are made in AERSURFACE: default 1-kilometer radius and default twelve 30-degree sectors for surface roughness length, non-airport site, and non-arid region. Due to lack of readily available snow cover information at three NWS stations located in WV[14], a seasonal determination of continuous seasonal snow cover (defined as 1 inch or more reported on >45 days in Dec-Jan-Feb[15]) was made based on KPIT local climatological data along with use of graphical snow cover information[16]. Estimates of surface moisture conditions used in the Bowen ratio calculation were based on 30-year average precipitation data for West Virginia Climate Region 1[17,18].

  Regarding the use of 1992 land-use land-cover (LULC) data as input to AERSURFACE, EPA provided comment on the protocol requiring a discussion be presented on any LULC changes that have occurred at the plant/meteorological tower sites between 1992 (the only data format year currently accepted by AERSURFACE) and the period of designation modeling (2013-2015). As such, comparative aerial images from Google Earth and color-coded graphical LULC representations provided at the Multi-Resolution Land Characterization (MRLC) website (http://www.mrlc.gov/nlcd2011.php) were compiled and included herein as Appendix B. It is noted that land-use categories established in AERSURFACE for 1992 data have been revised as reflected in the 2011 (most current) MRLC graphics, but are generally similar to 1992. As expected, minor land-use changes have occurred within the 10 km square area (i.e., the area used by AERSURFACE for Bowen ratio and albedo parameter determinations); with virtually no land-use changes within a 1km radius (i.e., the radius used by AERSURFACE for surface roughness parameter determination) surrounding the plant and airport meteorological sites. As indicated by WVDEP in their June 2, 2016 comments (and EPA per footnote 8), modeling results are most sensitive to changes in surface roughness. Given the surrounding minimal (at best) land use changes since 1992, along with the plan to establish AERMET data sets centered on the plant and the NWS site (see bullet immediately below), use of 1992 LULC data is not expected to affect the designation modeling.

- AERMET data files were developed for two different AERSURFACE-based outputs; with one set using LULC data centered on the Pleasants plant site and one set using LULC data centered on the NWS KPKB site; and comparative modeling results were compiled (See Section 4 for further discussion). WVDEP indicated in their June 6, 2016 comments that such would be required if a detailed (sector and seasonally specific) surface parameter sensitivity analysis is not otherwise provided.

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[14] NOAA Snow Cover Data as available from http://w2.weather.gov/climate/index.php?wfo=pbz .
[15] Email to B. Kolts of FirstEnergy from A. Fleck of PADEP, Bureau of Air Quality, September 2, 2014.
[16] http://www.nohrsc.noaa.gov/nsa/index.html?year=2014&month=1&day=31&units=e&region=Midwest
[17] http://www.ncdc.noaa.gov/monitoring-references/maps/images/us-climate-divisions-names.jpg .
[18] ftp://ftp.ncdc.noaa.gov/pub/data/cirs/climdiv/

AERMET input settings included:

- Specify herein the date of KPKB ASOS 1-Minute and 5-minute data download (downloaded June 6, 2016)
- Specify herein the date of KPKB surface data download (DSI-3505 (ISD) downloaded December 16, 2015)
- Specify herein the date of KPIT upper air data download (FSL downloaded January 4, 2016)
- Establish KPKB base elevation at 253.3m
- Use the upper air data MODIFY keyword in Stage 1
- Use the UAWINDOW keyword with -3 to +1 in Stage 3
- Use the METHOD CCVR SUB_CC keyword in Stage 3
- Use the METHOD TEMP SUB_TT keyword in Stage 3

AERMET Stage 3 was run multiple times using the AERSURFACE results for surface moistures of wet, dry and normal (average), and snow/no-snow cover. The final AERMET surface files (2010-2012, but using the 2013-2015 date stamp) reflected the West Virginia Climate Region 1 seasonal moisture and snow-cover conditions indicated in Table 7 as required by EPA's AIG and WVDEP[19]. The resultant three-year AERMET surface and profile files were used as input to the AERMOD designation modeling.

Table 7: Estimates of West Virginia Climate Region 1 Surface Moisture Condition and Snow Cover Used for AERMET Processing for the NWS Station at the Parkersburg Wood County Airport for the Period 2010-2012

Year	Season*	WV Climate Region 1 Surface Moisture Condition (Average, Wet, or Dry)	KPIT Continuous Snow Cover (Yes or No)
2010	Winter	Wet	Yes
2010	Spring	Dry	
2010	Summer	Average	
2010	Fall	Average	
2011	Winter	Average	Yes
2011	Spring	Wet	
2011	Summer	Average	
2011	Fall	Wet	
2012	Winter	Average	No
2012	Spring	Average	
2012	Summer	Dry	
2012	Fall	Average	
2013	Winter	Wet	No

*Default months per season reflect EPA's AERSURFACE processor.

[19] Email to M. Hirtler of Enviroplan Consulting from J. McClung of WVDEP, Division of Air Quality, January 8, 2016.

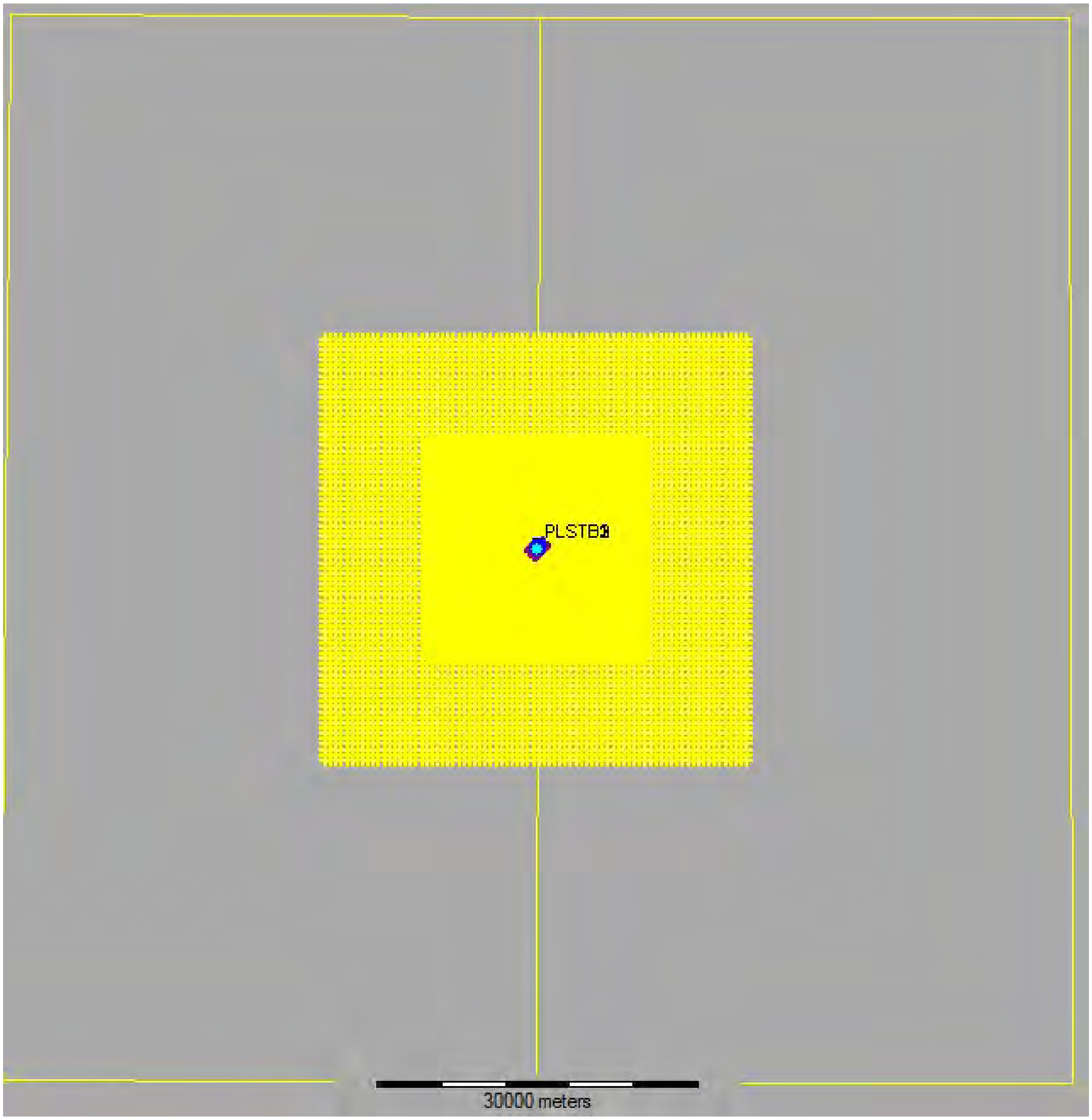
3.3 MODELING DOMAIN AND RECEPTOR GRID

For this modeling analysis, a total of four (4) separate receptor grids were combined to create an overall grid pattern with the densest concentration of receptors centered around the Pleasants plant:

- 50-meter spacing along the Pleasants fence line (on-site receptors eliminated) and extending to 1km from the Pleasants facility;
- 100-meter spacing from 1km to 5 km from the facility;
- 250-meter spacing from 5km to 10km from the facility; and
- 500-meter spacing from 10km to 20km from the facility.

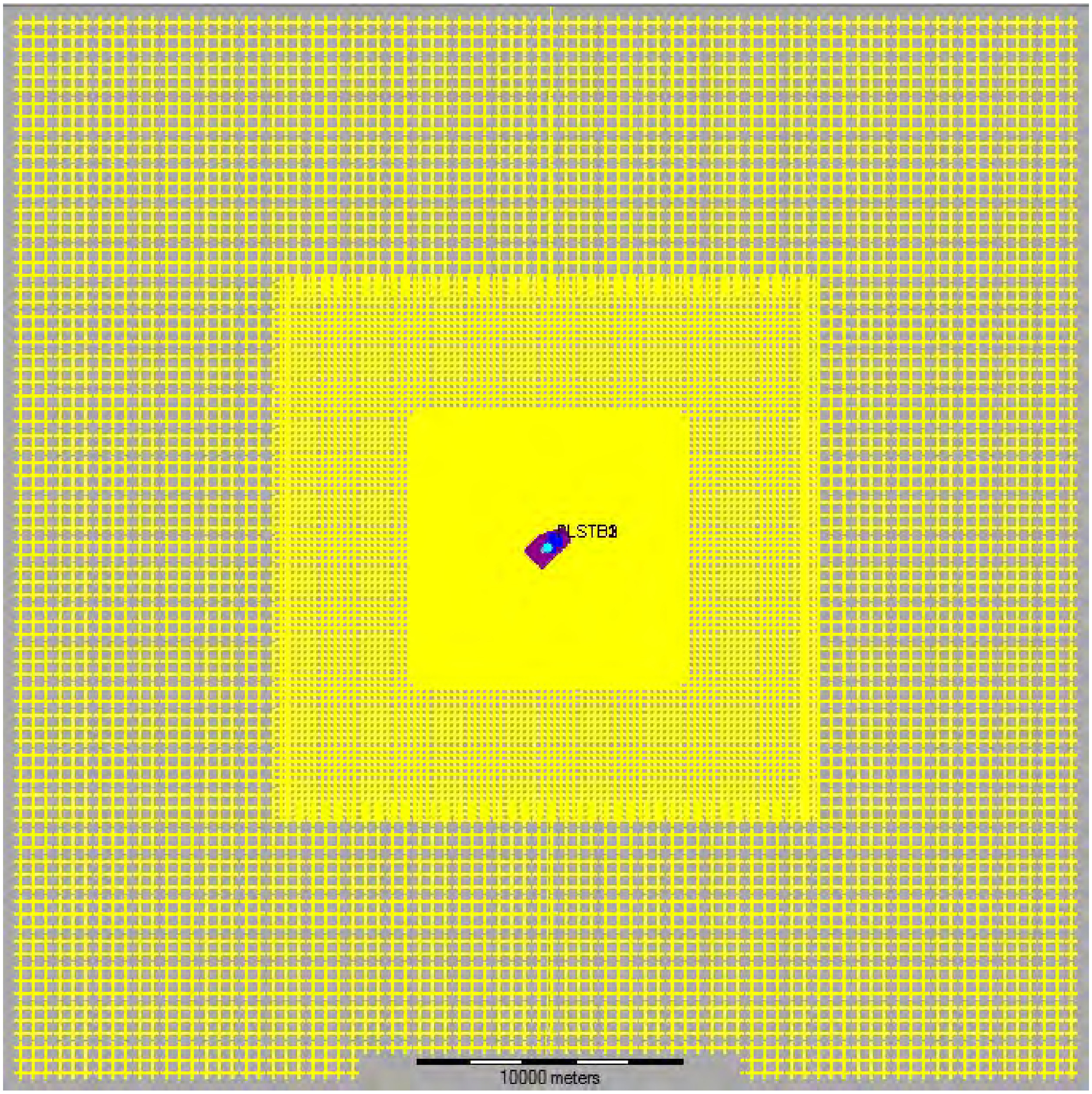
The AERMOD terrain pre-processor model, AERMAP (version 11103), was used to process receptor terrain elevation and hill height scale data that was input to AERMOD. Terrain elevation data was taken from the Multi-Resolution Land Characterization (MRLC) consortium website for the National Elevation Dataset (NED) for this domain (1/3 arc-second (10 meter) resolution). The project analyzed isopleths of modeled concentrations, and determined that the receptor grid adequately accounted for the worst case impacts. Figures 2A, 2B, and 2C below depict the modeling grid.

Figure 2A: Receptor Grid – Full Domain*



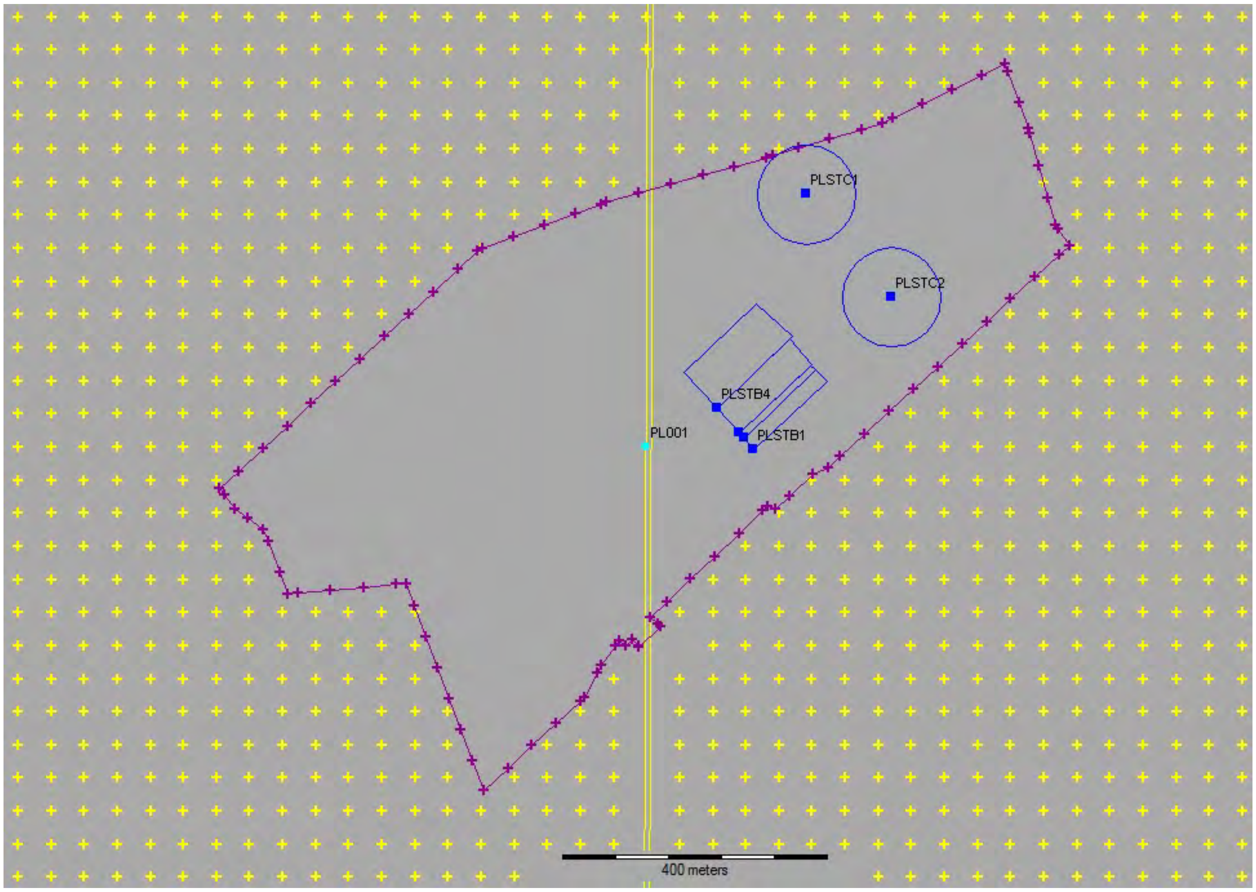
*The yellow pluses are Cartesian receptors and outer yellow line is the NED boundary for this modeling domain. The purple at the image center is the Pleasants boundary receptor grid, and the blue dot is the Pleasants boiler stack (as labeled).

Figure 2B: Receptor Grid – Cartesian Grid View*



*The yellow pluses are the Cartesian receptors. The purple at the image center is the Pleasants boundary receptor grid, and the blue dot is the Pleasants boiler stack (as labeled).

Figure 2C: Receptor Grid – Pleasants Plant Boundary Grid*



The yellow pluses are the Cartesian receptors. The purple pluses are the Pleasants boundary receptors. The Pleasants boiler stack is labeled as PL001. True North is oriented towards image top.

3.4 ADDITIONAL AERMOD INPUT AND MODEL SETTINGS

Additional input and model settings were used in accordance with EPA guidance based on the discussions presented in the following three subsections.

3.4.1 HOURLY EMISSION RATES

An hourly emissions file was developed as input to AERMOD (the file was external to AERMOD in a required format and called into AERMOD processing using the "SO HOUREMIS" option with file path specified). The hourly emissions data was formatted in accordance with the AERMOD user's manual. Designation modeling used three years (2013-2015) of hourly SO_2 emission rates and stack exit flow and temperature data. For the Pleasants plant this data was provided by FirstEnergy from plant continuous emissions monitor recorded data.

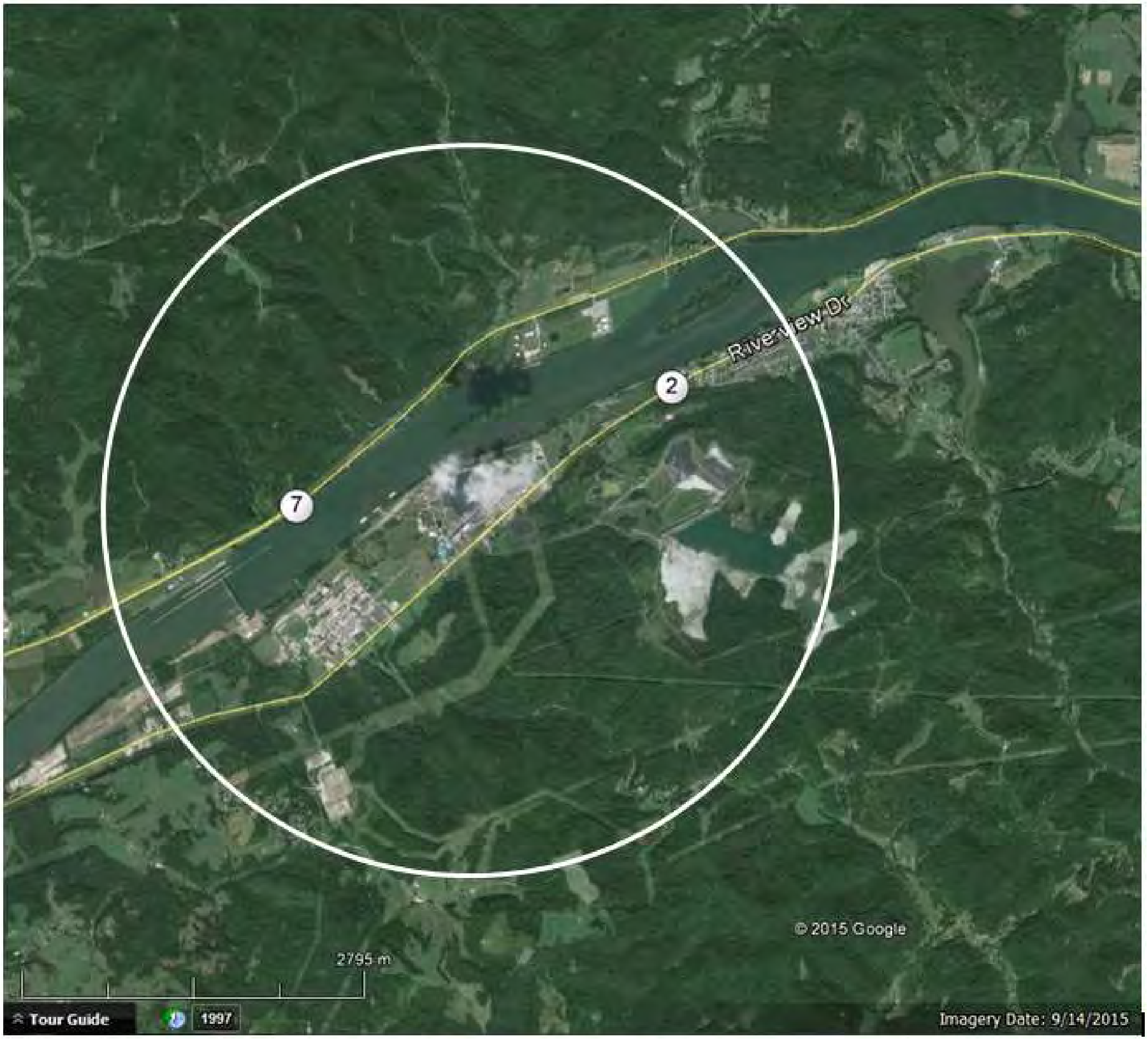
As indicated in Section 2.1 above, the Pleasants FGD system is configured with the two boilers exhausting through separate flues in a common 640-foot stack. Modeling of the Pleasants boiler stack utilized a merged flue approach. Specifically, an equivalent diameter was computed for the FGD stack based on the total area of the two flues. The individual flue hourly exhaust flow rates (acfm) were added together to determine hourly FGD stack exit velocity based on the equivalent diameter; and FGD stack hourly exit temperatures were average flue temperatures weighted as a function of the individual flue flow rates.

3.4.2 URBAN/RURAL CLASSIFICATION

The EPA "Guideline on Air Quality Models" (EPA-450/2-78-027R-C), Appendix W of 40 CFR Part 51, specifies a procedure to determine whether the character of the modeling area is primarily urban or rural. The Auer land use method is the recommended approach. The Auer method classifies land use within an area circumscribed by a circle, centered on the source, having a radius of 3 km. If land use types for heavy industrial, light-moderate industrial, commercial, and compact residential (i.e., Auer land use types I1, I2, C1, R2, and R3) collectively account for 50% or more of the land use within 3 km of the source, then the modeling regime is considered urban.

Figure 3 is the most recent Google Earth image (June 2014) of land-use within the 3 km radius area surrounding the Pleasants plant.

Figure 3: Aerial Imagery of Land-Use within 3km of the Pleasants Plant



As shown in Figure 3, land-use within the 3 km radius area surrounding the Pleasants plant is predominantly rural based on the above criteria. A qualitative Auer land-use evaluation of the modeling domain and 3km radius around the subject source is not presented herein, as the area clearly indicates predominant rural land-use. Accordingly, rural dispersion was applied for this designation modeling evaluation.

3.4.3 GOOD ENGINEERING PRACTICE STACK HEIGHT REVIEW

In accordance with U.S. EPA's *Guideline*, for stacks with heights that are within the limits of Good Engineering Practice (GEP), actual heights should be used in modeling. Under the EPA's regulations at 40 CFR 51.100, GEP height, Hg, is determined to be the greater of:

- 65 m, measured from the ground-level elevation at the base of the stack;

- For stacks in existence on January 12, 1979, and for which the owner or operator had obtained all applicable permits or approvals required under 40 CFR parts 51 and 52

  Hg=2.5H

  provided that the owner or operator produces evidence that this equation was actually relied on in designing the stack or establishing an emission limitation to ensure protection against downwash;

  For all other stacks,

  Hg=H + 1.5L,

  where H is the height of the nearby structure(s) measured from the ground-level elevation at the base of the stack and L is the lesser dimension of height or projected width of nearby structure(s), or

- the height demonstrated by a fluid model or a field study approved by the EPA or the state/local agency which ensures that the emissions from a stack do not result in excessive concentrations of any air pollutant as a result of atmospheric downwash, wakes, eddy effects created by the source itself, nearby structures or nearby terrain features.

In accordance with U.S. EPA's 1-hour SO_2 designation modeling TAD, actual stack heights should be used in modeling, even if stack heights exceed GEP formula height. This notwithstanding, the modeling considered the potential for plume aerodynamic building downwash for the Pleasants plant using the U.S.EPA Building Profile Input Program with the Plume Rise Model Enhancements (BPIPPRM version 04274). WVDEP has indicated only FirstEnergy plant structures need consideration with respect to the potential for building downwash. As such, Pleasants plant structure coordinates; structure elevations above ground; stack locations and object base elevations, were used as input to BPIPPRM. The BPIPPRM output (direction-specific building dimensions for every 10 degrees azimuth for each source) was used as input to AERMOD.

A structure's downwind zone of influence on a point source can extend up to 5L from the trailing building edge (*Guideline for Determination of Good Engineering Practice Stack Height Technical Support Document* (U.S. EPA, 1985)). As such, for the Pleasants plant the BPIPPRM evaluation utilized structure dimensions and/or corner coordinates determined using aerial imagery (most recent Google Earth imagery, dated September 2015, and Bing Maps, with respective dimension scales). Table 8 below lists Pleasants structures and their dimensions input to the BPIPPRM evaluation for GEP formula height determination and wind-direction dependent dimension output used in AERMOD (see Figure 1 for graphical depiction of stack/structure layout and relative orientation).

Table 8: Pleasants Plant Structures Evaluated in the Good Engineering Practice (GEP) Stack Height Analysis						
			Structure Dimensions			
BUILDING NAME	Base Elevation (ft)	Base Elevation (m)	Height Above Ground (ft)	Height (m)	Length (feet)	Width (feet)
1. Boiler Building Level 1	634.0	193.2	50	15.2	490	100
2. Boiler Building Level 2	634.0	193.2	80	24.4	490	40
3. Boiler Building Level 3	634.0	193.2	100	30.5	490	165
4. Boiler Bldg (Control Equipment)	634.0	193.2	50	15.2	490	245
5. Cooling Tower 1	634.0	193.2	426.51	130.0	244	(diameter)
6. Cooling Tower 2	634.0	193.2	426.51	130.0	244	(diameter)

The BPIPPRM results indicate a formula GEP height of 1064 feet for the Pleasants stack, while the physical height of the stack is 640 feet. The designation analysis used the actual Pleasants FGD stack height (640 feet), along with source-specific wind-direction dependent building dimensions output by BPIPPRM as input to AERMOD. AERMOD internally determined the potential for full or partial source plume wake effects based on these BPIPPRM derived dimensions.

3.4.4 MEASURED SO_2 BACKGROUND CONCENTRATION DATA

The designation modeling evaluation requires that a measured background value be added to the modeled predicted SO_2 concentrations to produce a total predicted SO_2 concentration for the area. The measured background value accounts for the SO_2 contribution to total predicted concentrations from non-modeled distant/smaller emitting sources. A WVDEP comment received on the initial March 2016 protocol recommended using data collected at the Wood County SO_2 monitor (AQS Site ID 54-107-1002). FirstEnergy utilized the data collected at the Wood County SO_2 monitor (AQS Site ID 54-107-1002). The 2013 – 2015 design concentration for this monitor is 28 ppb as determined from the EPA data (https://www3.epa.gov/airdata/ad_rep_mon.html) summarized in Table 9 below.

Table 9: 2013 – 2015 Design Concentration at Wood County SO_2 Monitor (AQS Site ID 54-107-1002)

		99th Percentile (ppb)			Distance from Monitor to Plant (km)
Monitor ID	Location	2013	2014	2015	Pleasants
54-107-1002	Wood Co. WV	25	31	28	16.3

FirstEnergy further refined the Table 9 constant design value using two methods described below:

1. Method 1: There have been a number of studies conducted in recent years that have demonstrated that EPA's recommended approach of combining the 99^{th} percentile modeled concentration with the 99^{th} percentile monitored background concentration has a degree of

conservatism well beyond the level necessary to protect the 1-hour NAAQS. One study in particular[20] presents an approach that has been demonstrated to conservatively represent monitored background concentrations combined with AERMOD predictions. This method utilizes the 50th percentile (i.e., median value) of the monitored daily maximum hourly concentrations for each of the three consecutive monitoring years (2013-2015), averaged to produce a constant 50th percentile value for the three-year period. The final background concentration is determined as the average value among all potentially background-representative monitors (i.e., those monitors not significantly impacted by one or more major SO_2 sources). The resultant value is included as a constant background value input to AERMOD which is internally combined with the predicted design concentrations.

The Wood Co., WV SO_2 monitor is located 16.3 km southwest of the Pleasants plant. As suggested by WVDEP, this monitor served to represent SO_2 background in the general vicinity of the Pleasants plant based on this data refinement method. The 50th percentile (i.e., median value) of the monitored daily maximum hourly concentrations at the Wood Co., WV monitor for each of the three consecutive monitoring years (2013-2015), averaged to produce a constant 50th percentile value for the three-year period, results in a background concentration of 7.0 ppb. The 50th percentile background concentration was used in the 1-hour SO_2 designation modeling for the Pleasants plant (see Section 4 for further discussion).

2. Method 2: Application of a temporally varying background monitored concentration computed by hour of day and season. The method of computing this background concentration matrix is based on the EPA TAD supported methodology[21] developed for NO_2 compliance modeling. EPA has concluded use of this variable background concentration methodology is applicable to SO_2 designation modeling. The methodology uses hourly monitored concentration data (2013-2015) to determine 99th percentile values computed by hour of day and season for the monitoring period. AERMOD allows for the direct inclusion of temporally varying background concentrations in the design value calculation in combination with modeling results. Also consistent with the TAD (and EPA air modeling guidance), to avoid potential "double-counting" of source concentrations the modeling protocol had proposed to exclude periods when the modeled sources are expected to impact the monitor. This notwithstanding, the Pleasants plant is located 16.3 km from the Wood Co., WV monitor. Given this spatial separation, FirstEnergy conservatively conducted the temporally varying background monitored concentration processing by hour of day and season using the complete set of 2013-2015 monitored data at the Wood Co., WV (i.e., no hours of potential source impacts at the monitor were removed from the dataset). The following steps were conducted:

   For each of the three years (2013-2015) of monitoring data, segregate the hourly concentration data by season and hour-of-day (winter = Dec. – Feb.; spring = March – May; summer = June – Aug.; fall = Sept. – Nov.); calculate the 99th percentile hour of day concentration per season for each year; and then calculate, for each season and hour-of-day,

[20] Sergio A. Guerra (2014), "Innovative Dispersion Modeling: Practices to Achieve a Reasonable Level of Conservatism in AERMOD Modeling Demonstrations", EM, December 2014, pp. 24-29

[21] EPA's March 1, 2011 memo, "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO2 Ambient Air Quality Standard

the three-year average of 99th percentile values. This "matrix" of seasonally- and hourly-varying monitored background concentrations was as input to AERMOD (i.e., use the "SO BACKGRND SEASHR" pathway). The resultant temporally varying monitored background concentrations by hour of day and season at the Wood Co., WV monitor are found in Table 10.

Table 10: Temporally Varying Monitored Background Concentrations by Hour of Day and Season for the Wood Co., WV Monitor

Meteorological Hour	2013 - 2015 Average			
	Winter	Spring	Summer	Fall
	PPB	PPB	PPB	PPB
1	18.000	16.667	12.333	12.667
2	19.333	17.000	16.667	9.000
3	20.667	11.667	14.667	11.333
4	18.667	14.667	11.333	7.000
5	18.000	17.000	10.667	8.667
6	24.333	15.000	12.667	10.333
7	26.667	16.000	9.333	8.000
8	19.000	17.333	15.667	14.000
9	20.667	27.000	14.000	19.000
10	24.667	22.000	19.333	22.333
11	23.000	28.000	16.333	23.000
12	22.000	21.000	13.667	20.333
13	20.333	12.333	17.333	18.000
14	22.333	23.000	13.667	13.000
15	34.000	21.667	14.667	11.667
16	33.000	22.667	12.000	14.333
17	29.333	12.667	11.667	17.333
18	26.333	13.333	10.667	16.000
19	18.000	13.667	13.000	13.333
20	18.667	19.333	15.667	15.333
21	19.000	18.000	9.333	11.000
22	14.000	10.667	8.667	10.333
23	18.667	15.333	10.000	12.667
24	18.667	13.667	11.333	14.000

3.5 1-HOUR SO_2 NAAQS DESIGNATION MODELING APPROACH

The AERMOD designation modeling runs utilized the '*default*' 3-year meteorological and other data inputs described above, and the CONTROL pathway regulatory default option, DFAULT (elevated terrain, calms and missing data processing routines, and no exponential decay, dry depletion, nor wet depletion). The emission units shown in Table 3 herein were characterized in AERMOD as unobstructed vertical release point sources, and the source pathway keyword of SRCGROUP were used to ascertain total predicted concentrations for the ALL group, and for individual stationary source group contributions.

AERMOD dispersion modeling was conducted to determine total 1-hour SO_2 predicted concentrations in the form of the 1-hour SO_2 NAAQS. The design value predictions (each receptor) were calculated as the average of the 99^{th} percentile (4^{th} highest) of the annual distribution of daily maximum 1-hour concentrations averaged across the three modeled years. The highest of these 99^{th} percentile values is the overall maximum design concentration.

The model predicted design values indicated above were generated using the AERMOD model CONTROL pathway pollutant ID SO_2. Also, the OUTPUT pathway keywords specific to the 1-hour standard were used. This included the MAXCONT keyword which created an AERMOD output file of source contributions for each rank of total concentration and receptor in the modeling domain. Such output allowed for identification of potential source culpability to any predicted exceedance of the 1-hour SO_2 NAAQS, where an exceedance would be a 4^{th} highest (or greater rank) total concentration (including measured background) that was predicted to exceed the 1-hour SO_2 NAAQS of 75 ppb (196.2 ug/m^3 equivalent). A source was not considered to have a significant contribution to a predicted exceedance if the corresponding source contribution is below the EPA's Significant Impact Level (SIL)[22].

[22] EPA memorandum, "Guidance Concerning the Implementation of the 2010 SO_2 NAAQS for the Prevention of Significant Deterioration Program." August 23, 2010. The 3 ppb interim SIL (7.8 ug/m^3 equivalent) for the 2010 SO_2 NAAQS was provided by the EPA for states to consider using for the PSD program.

4. PRESENTATION OF 1 HOUR SO2 DESIGNATION MODELING RESULTS AND RECOMMENDATION FOR THE FIRSTENERGY PLEASANTS PLANT

The AERMOD modeling files associated with the Pleasants 1-hour SO_2 designation modeling are included on the compact disk referenced in Appendix C. The modeling files include the AERMAP, AERMET, AERMOD, and related source contribution files (MDC) for the modeling scenarios discussed.

The AERMOD total predicted 1-hour SO_2 concentrations, inclusive of the constant 50th percentile measured background concentration and temporally varying background concentrations discussed in Section 3.4.4 are presented in Tables 11 and 12, respectively, for the two AERSURFACE scenarios, i.e., the Pleasants plant and NWS KPKB site surface characteristics as discussed in Section 3.2. The AERMOD predicted values in Table 11 reflect the design concentrations (i.e., maximum 4th highest maximum daily 1-hour results averaged over 3-years of modeling) for the Pleasants plant predicted on the full grid of receptors in the modeling domain, plus the addition of the 50th percentile background concentration of 7.0 ppb (18.312 ug/m^3). The AERMOD predicted values in Table 12 reflect the design concentrations (i.e., maximum 4th highest maximum daily 1-hour results averaged over 3-years of modeling) for the Pleasants plant predicted on the full grid of receptors in the modeling domain, plus the addition of the temporally varying background monitored concentrations by hour of day and season shown in Table 10. Figures 4 and 5 present isoplots for the Pleasants plant AERSURFACE-based designation modeling results, as the worst case of the two meteorological data file results.

While the Pleasants AERSURFACE-based model run resulted in the worst case predicted 1-hour SO_2 design concentration, both AERSURFACE scenarios using both sets of monitoring data processed as described earlier resulted in predicted concentrations below the 1-hour SO_2 NAAQS of 75 ppb. These findings are based on application of EPA recommended procedures presented in their TAD for designation modeling. FirstEnergy believes that this designation modeling demonstration will allow WVDEP and EPA to deem the air quality in the area surrounding the Pleasants Power Plant as *Attainment* under the 1-hour SO_2 NAAQS Data Requirements Rule.

Table 11: AERMOD Predicted 1-Hour SO_2 NAAQS Designation Modeling Results for the FirstEnergy Pleasants Power Plant Using a Constant Monitor Value

	AERMOD Predicted Design Concentration, Pleasants AERSURFACE		AERMOD Predicted Design Concentration, Parkersburg Airport NWS Station AERSURFACE	
Source Contribution	($\mu g/m^3$)	ppb	($\mu g/m^3$)	ppb
Pleasants Plant PL001	98.19	37.5	85.67	32.8
Background	18.31	7.0	18.31	7.0
Total Predicted 1-Hour SO_2 Design Concentration Including Constant Background	**116.50**	**44.5**	**103.98**	**39.8**

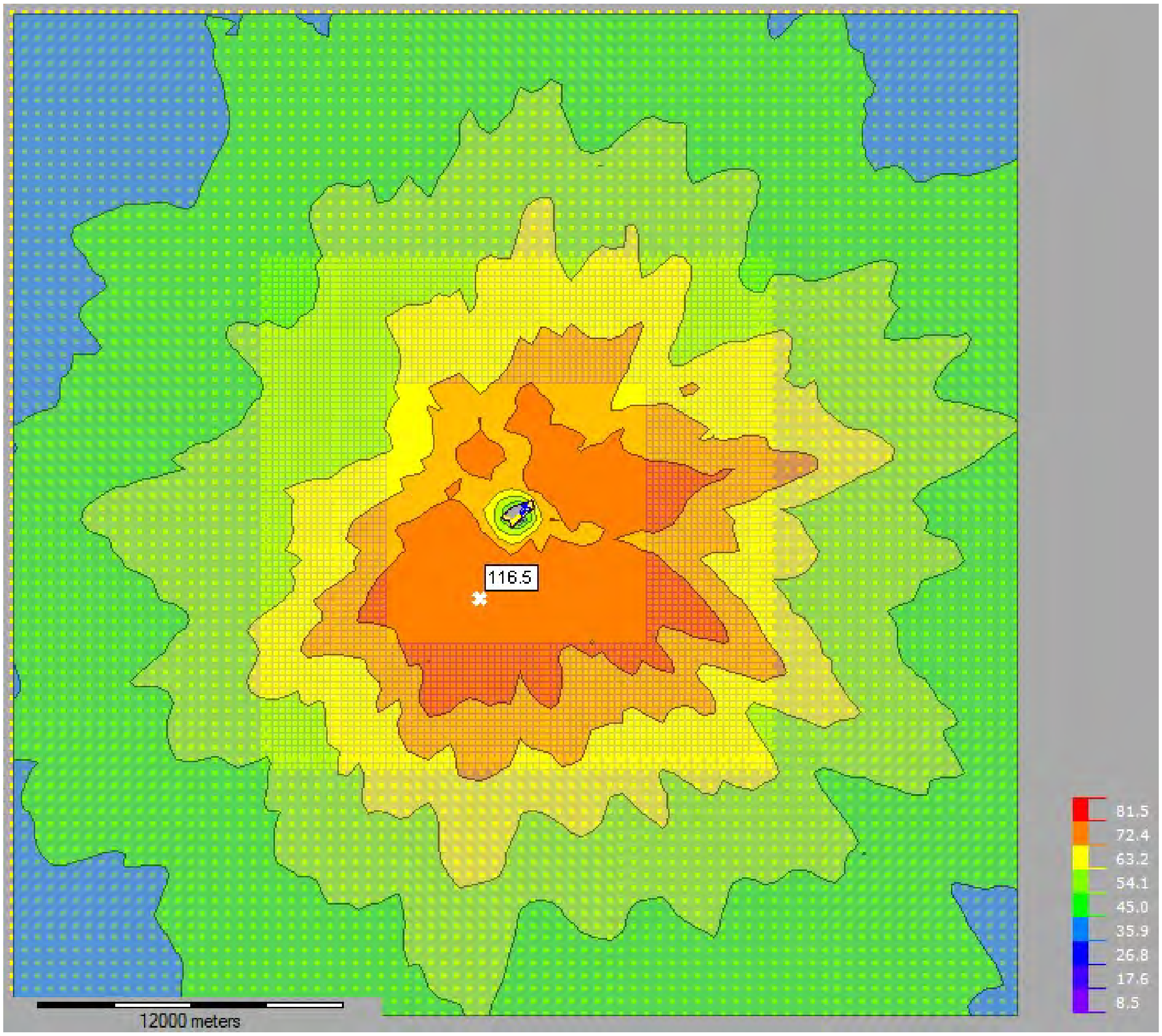
Note: The 1-hr SO2 NAAQS is 196 µg/m3 or 75 ppb. The 1-hr SO2 Significant Impact Level (SIL) is 7.585 µg/m3 or 3 ppb.

Table 12: AERMOD Predicted 1-Hour SO_2 NAAQS Designation Modeling Results for the FirstEnergy Pleasants Power Plant Using a Temporally Varying Monitor Value

	AERMOD Predicted Design Concentration, Pleasants AERSURFACE		AERMOD Predicted Design Concentration, Parkersburg Airport NWS Station AERSURFACE	
Source Contribution	($\mu g/m^3$)	ppb	($\mu g/m^3$)	ppb
Total Predicted 1-Hour SO_2 Design Concentration Including Temporally Varying Background	**152.27**	**58.2**	**137.63**	**52.6**

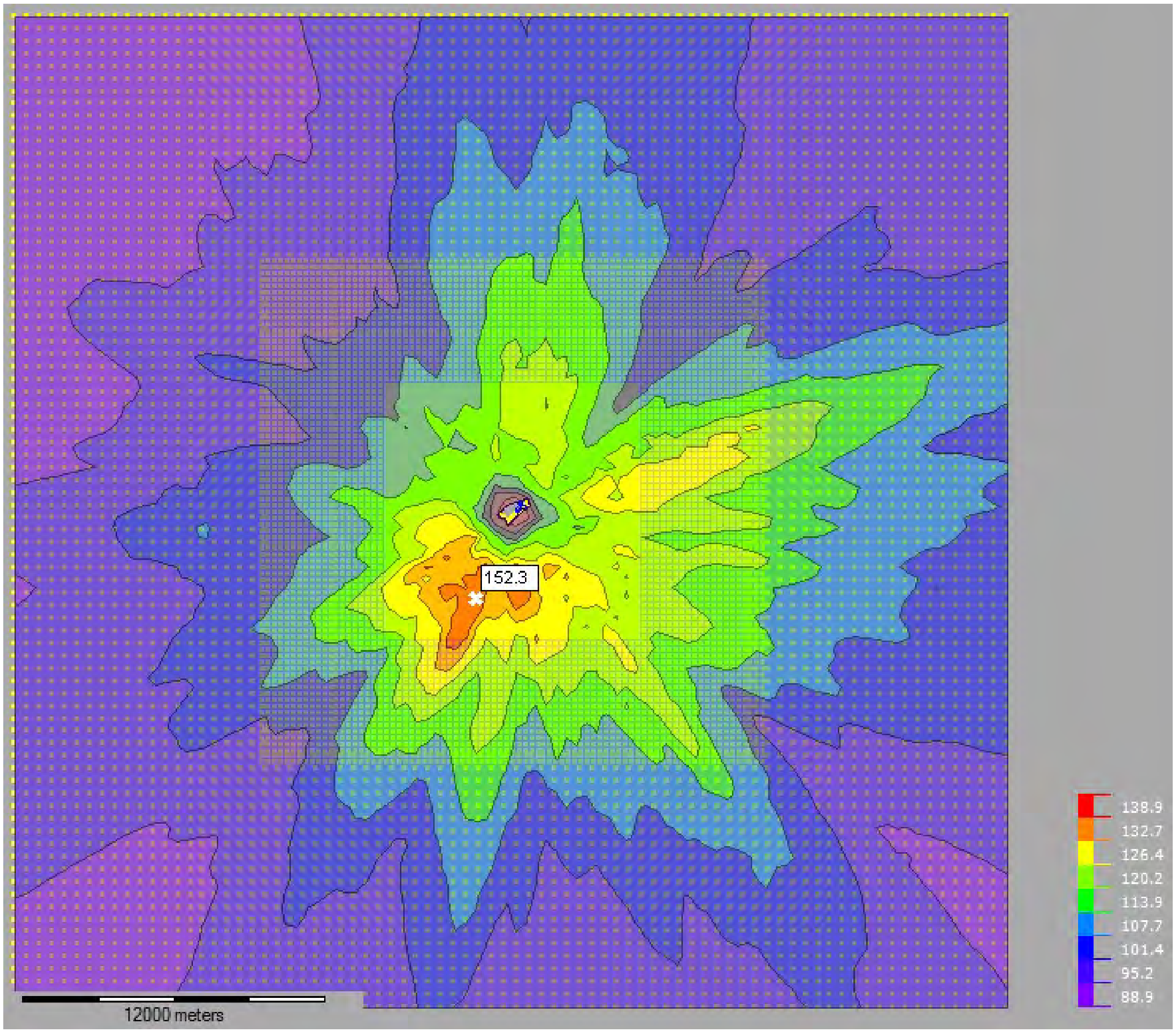
Note: The 1-hr SO2 NAAQS is 196 µg/m3 or 75 ppb. The 1-hr SO2 Significant Impact Level (SIL) is 7.585 µg/m3 or 3 ppb.

Figure 4: Isoplot of AERMOD Predicted 1-Hour SO_2 NAAQS Designation Modeling Concentrations for the Pleasants Plant Using Plant Site AERSURFACE-Based AERMET and a Constant Monitor Value*



*Reflects a constant 50th percentile background concentration of 7.0 ppb (18.312 ug/m^3). Pleasants Plant is located at image center.

Figure 5: Isoplot of AERMOD Predicted 1-Hour SO_2 NAAQS Designation Modeling Concentrations for the Pleasants Plant Using Plant Site AERSURFACE-Based AERMET and a Temporally Varying Monitor Value*



*Reflects a variable measured concentration matrix used in AERMOD determined as a function of hour of day and season of year, as per EPA recommendations. Pleasants Plant is located at image center.

Appendix A: Protocol For Modeling Of The Pleasants Power Plant in Response To U.S. EPA's Data Requirements Rule For The 2010 1-Hour SO_2 Primary National Ambient Air Quality Standard Submitted June 27, 2016

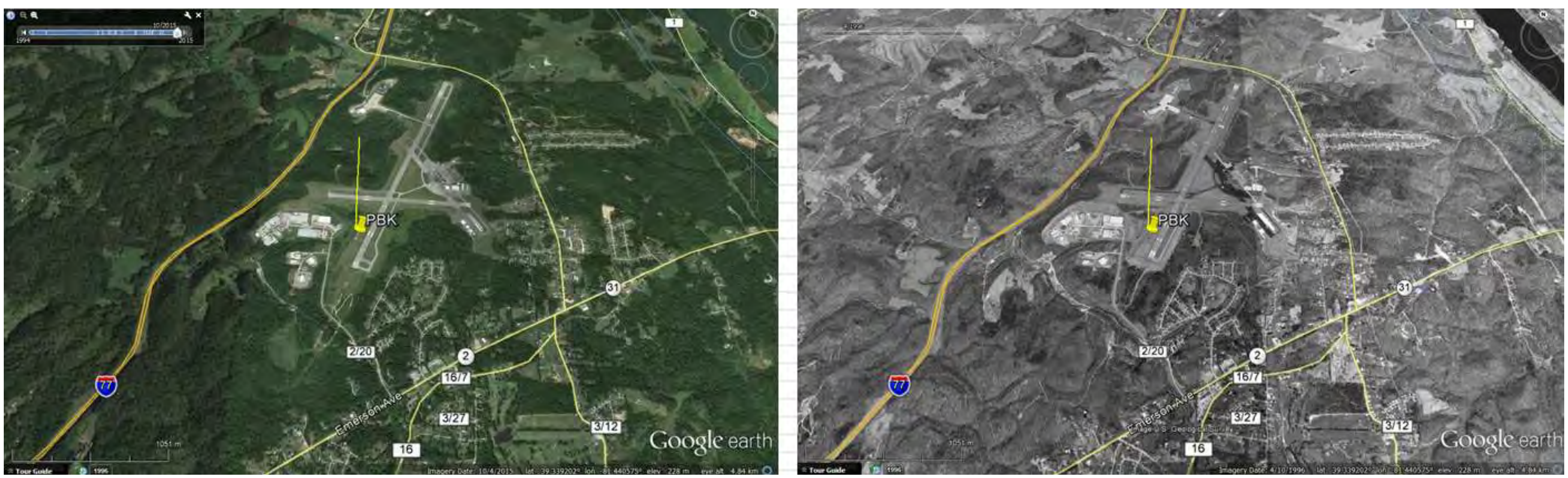
Pleasants Modeling
Protocol Submitted 06

Appendix B: Land Use Imagery Surrounding the Pleasants Power Station and the NWS Parkersburg Wood County Airport (KPKB) Surface Meteorological Measurement Site

Aerial Imagery of Area Around Pleasants Plant*

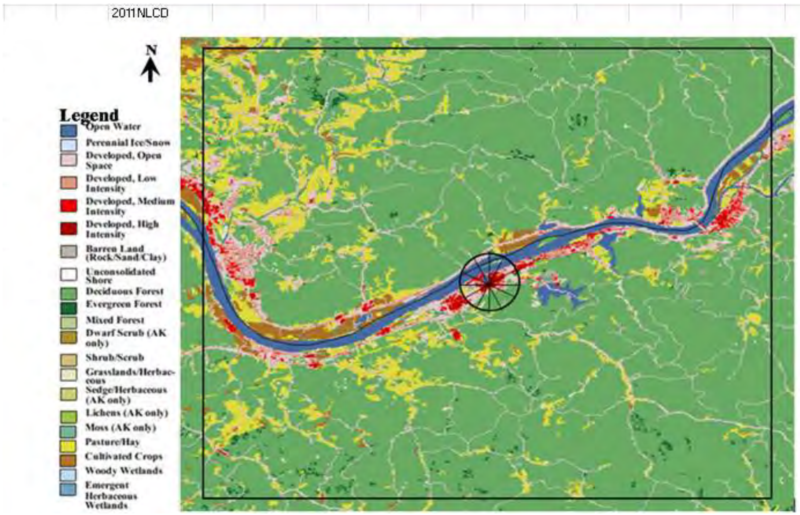
*Left image is 2015 and right image is 1997. Yellow line extending north from image center is 1km reference length.

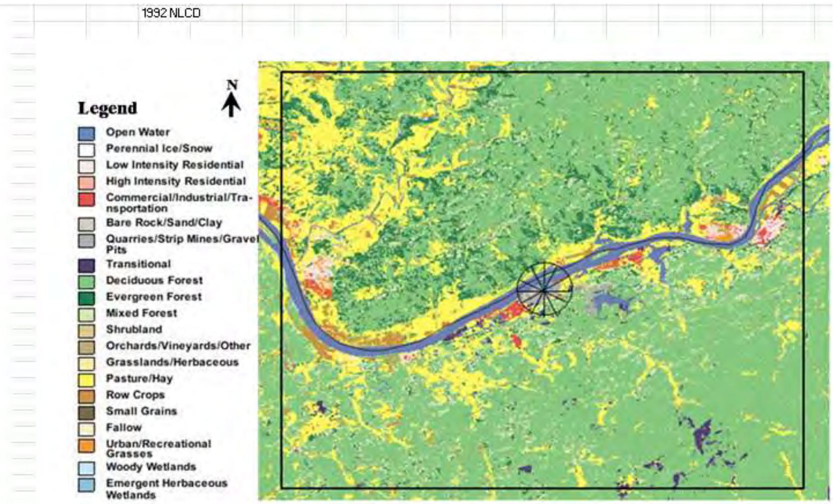
Aerial Imagery of Area Around NWS Parkersburg Wood County Airport Surface Meteorological Measurement Site*



*Left image is 2015 and right image is 1996. Yellow line extending north from image center is 1km reference length.

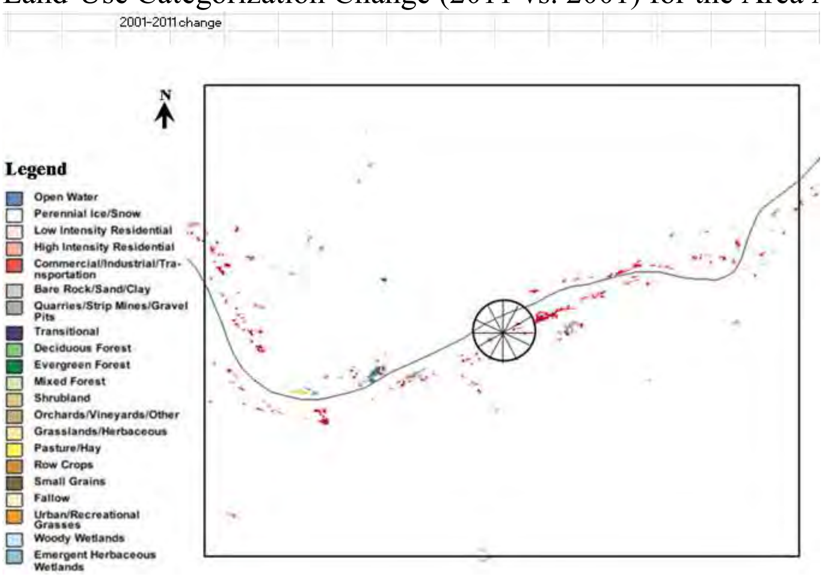
Land-Use Categorization of Area Around Pleasants Plant*





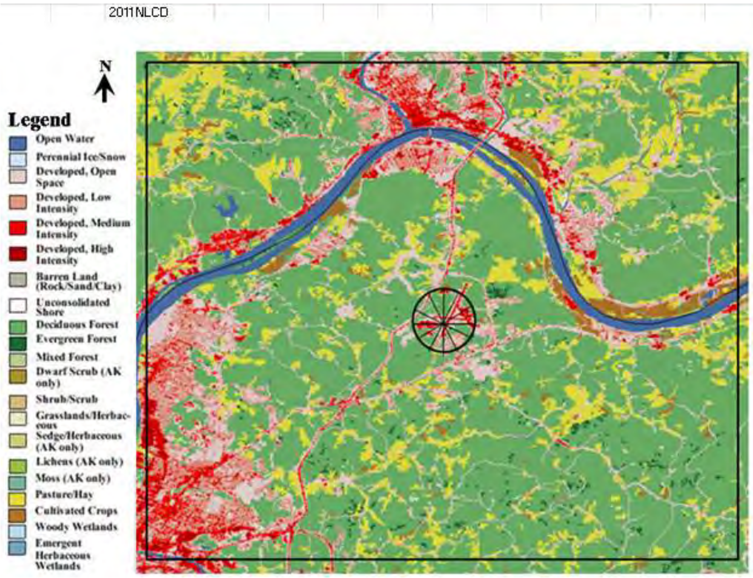
*Center circle is a 1km radius area (12 sectors) surrounding plant site. Larger rectangle is 10km x 10km square area surrounding plant site.

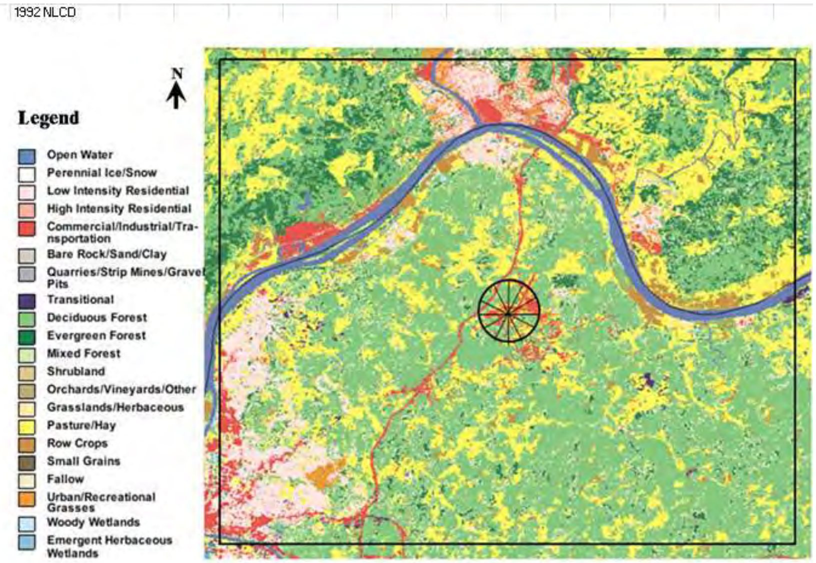
Land-Use Categorization Change (2011 vs. 2001) for the Area Around Pleasants Plant*



*Center circle is a 1km radius area (12 sectors) surrounding plant site. Larger rectangle is 10km x 10km square area surrounding plant site.

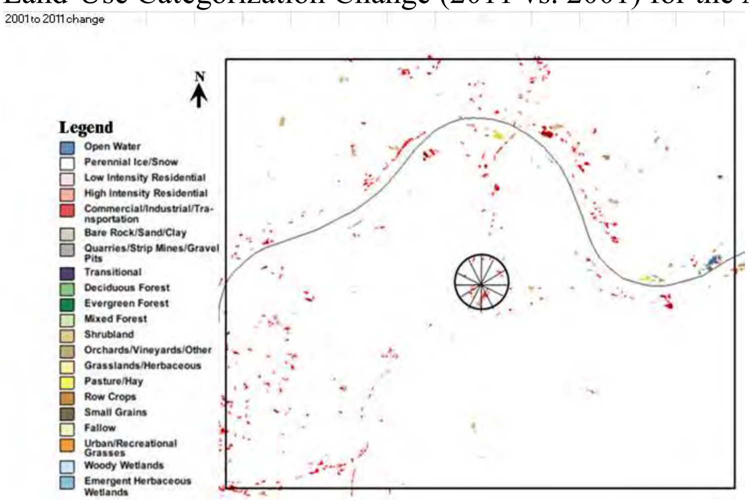
Land-Use Categorization of Area Around NWS Parkersburg Wood County Airport Surface Meteorological Measurement Site *





*Center circle is a 1km radius area (12 sectors) surrounding plant site. Larger rectangle is 10km x 10km square area surrounding plant site.

Land-Use Categorization Change (2011 vs. 2001) for the Area Around NWS KPKB Surface Meteorological Measurement Site*



*KPKB is Parkersburg Wood Co Airport. Center circle is a 1km radius area (12 sectors) surrounding plant site. Larger rectangle is 10kmx10km square area surrounding plant site.

Appendix C: Compact Disk (CD) with AERMOD Modeling Files (BPIPPRM, AERMET, and AERMOD Input/Output Files)

(compact disk enclosed containing project modeling files)

*Note: For the AERMOD result that reflects the constant measured background concentration as the 50th percentile 3-year average, the constant measured value is manually combined with the AERMOD predicted design concentration (see Table 11), and it is not directly included in the AERMOD input file. This constant value was not included in these AERMOD runs since the value can be readily added to any prediction; and because the temporally-varying monitored concentration matrix was input to AERMOD.

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1-Hour SO_2 Data Requirement Rule
Air Quality Modeling Protocol
for the
John Amos Plant
Morgan's Landing, WV

Prepared for
Appalachian Power Company

For Submittal
to
The West Virginia Department of Environmental Protection
Division of Air Quality

Prepared by
David J. Long, PE and Ashley Ullstrom
Air Quality Services Section
American Electric Power Service Corporation

January 9, 2017

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INTRODUCTION

American Electric Power Service Corporation (AEPSC) on behalf of the American Electric Power subsidiary Appalachian Power Company, has been requested to perform modeling under the USEPA 1-Hour SO_2 Data Requirements Rule (40 CFR 51.1200) for the John Amos Plant (Amos Plant) located at Morgan's Landing, West Virginia. The modeling conducted under this protocol demonstrates compliance with the 1-Hour SO_2 Standard by the Amos Plant under the USEPA 1-Hour SO_2 Data Requirements Rule and will allow Amos Plant to follow the provisions of 40 CFR 51.1205(b) if approved by WVDEP and USEPA.

DESCRIPTION OF FACILITY AND AREA

The John Amos Plant consists of three electric generating units. Units 1 and 2 are rated at 800 MW net each and Unit 3 is rated at 1300 MW net. Each unit is equipped with an electrostatic precipitator for particulate control, selective catalytic reduction (SCR) for nitrogen oxide and mercury control, and limestone based flue gas desulfurization system. The plant is located on the Kanawha River in Putnam County, West Virginia, approximately 20 kilometers northwest of Charleston, West Virginia. The elevation of the plant site averages 180 m MSL. The ridges in the area near Amos Plant shown in Figure 1 rise up to approximately 100 meters above plant grade. The area around both Amos Plant and the Yeager Airport are classified as rural for purposes of air quality modeling. Figure 3 shows the 1992 NLCD land use for this region, revealing that with the exception of the airport and plant site, over 50% of the area within 3 kilometers of the Amos Plant and Yeager Airport (white circles) sites are covered with forest or grasslands (red and brown areas). In addition, the areas where people live (blue areas) are classified as low density residential within three kilometers of both sites.

When the examination is extended to five kilometers (yellow circles) from each location, the bulk of the additional land picked up remains in the forest and grassland classifications. At Amos Plant, a second large industrial area to the south that since 1992 has been demolished and replaced by a combination of warehouse structures when replacement has occurred (Figure 1) and grassland. This further reinforces the Rural classification for modeling of this area that has been used for modeling analyses of the Amos Site.

To the south and west of Yeager Airport at the 5 km examination the Charleston Urban core is picked up. However, since the urban area is in the valley and the airport is located on the ridge several kilometers away, the impact of the urban heat island would be minimal. Even with this addition, the bulk of the area added to the analysis by moving from 3 to 5 kilometers from the Yeager Airport remains forested or low density residential, supporting the conclusion that the area around Yeager Airport yields a classification of Rural for modeling purposes

Originally, Units 1 and 2 exhausted through a common flue in a 900 foot tall stack and Unit 3 was equipped with its own 900 foot tall stack. These original stacks were classified as pre-existing stacks under the Good Engineering Practice Stack Height Rules, allowing credit for the full stack height.

Figure 1. Amos Plant and surrounding area showing Appalachian Power property holdings.

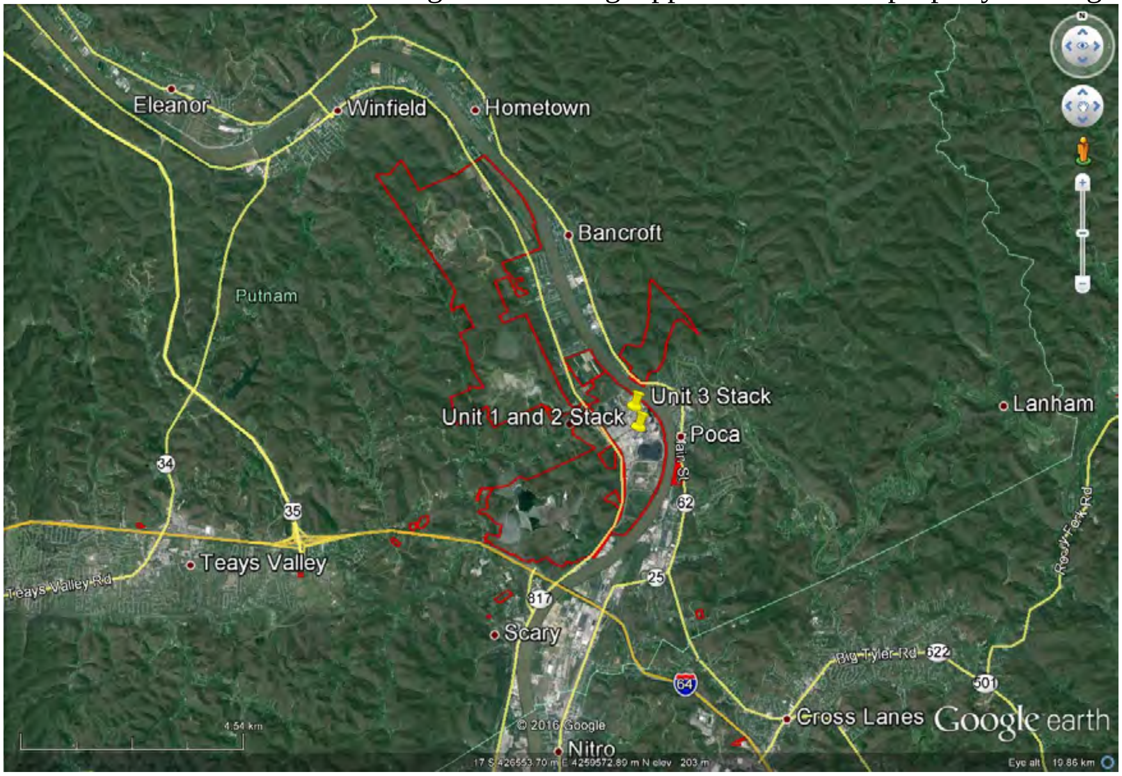
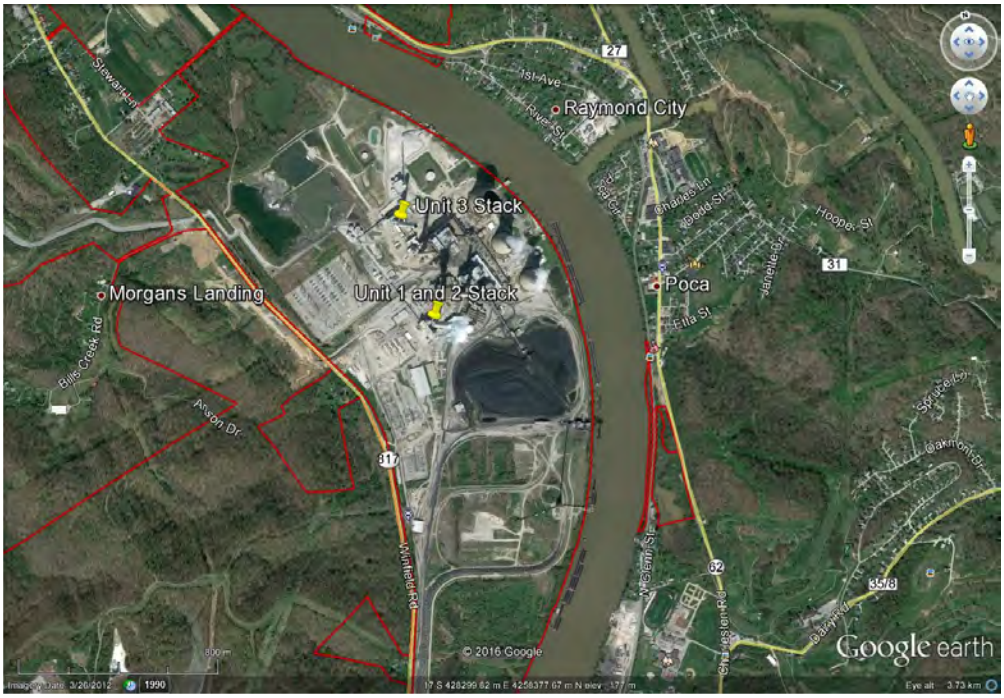


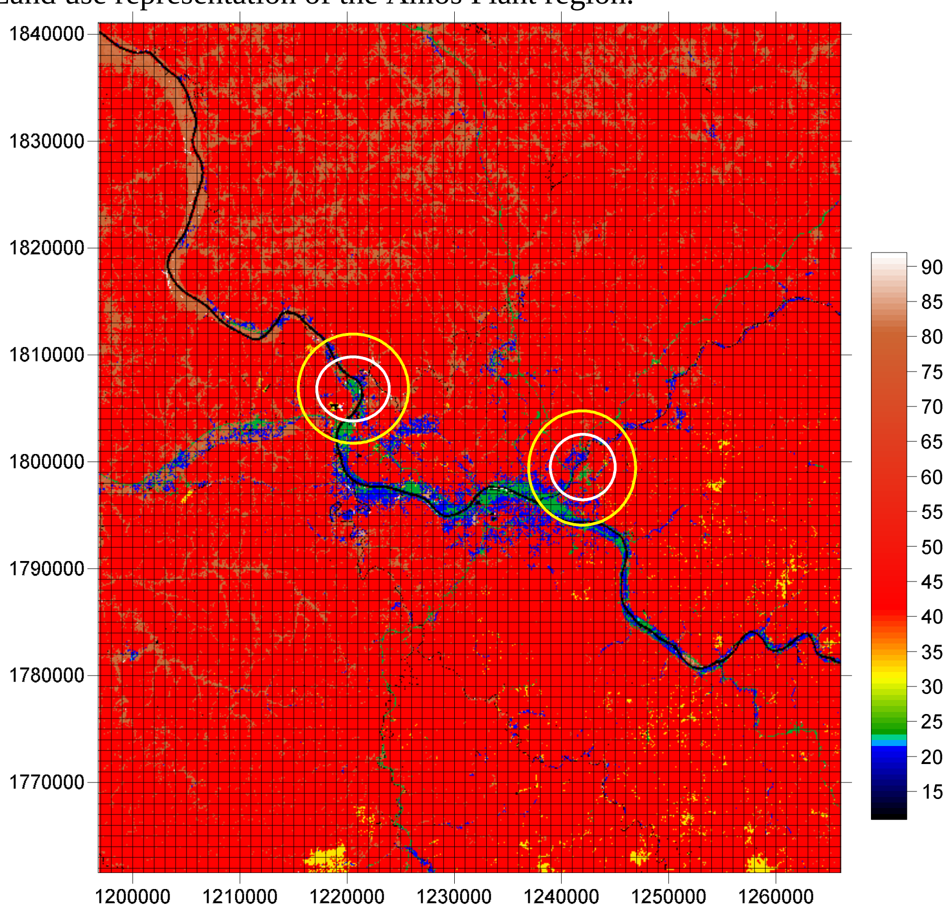
Figure 2. Detail of the Amos Plant site.



When the flue gas desulfurization systems were constructed in the 2007 to 2011 time frame, new stacks were necessitated due to the incompatibility of the existing stacks with the new flue gas characteristics. The new stack for Units 1 and 2 were constructed with a single shell containing two individual flues discharging at 900 feet above grade. Unit 3 received its own 900 foot tall stack.

As part of the FGD installation program, Appalachian Power was required to perform air quality modeling to demonstrate that the changes in stack emission characteristics and locations would not create an adverse ambient impact. Based on the fact that the stacks were pre-existing under the GEP Stack Height Rules and that the stacks were being replaced due to a pollution control installation, the full stack height is creditable for all analyses that may be performed under this protocol. Further, since actual operating conditions are being modeled for this demonstration, the Data Requirements Rule allows the use of the actual stack height for purposes of demonstrating compliance with the new NAAQS[1] regardless of the GEP stack height for the facility.

Figure 3. Land use representation of the Amos Plant region.



DEVIATIONS FROM THE PROTOCOL

One change was made during the performance of the study that resulted in a deviation from the plan outlined in the Protocol. The is change involved only performing the study using a BPIP simulation that included the natural draft cooling towers instead of running separate simulations for all of the meteorologic cases both including and excluding the natural draft cooling towers.

MODEL PLATFORM UTILIZED

Version 15181 of AERMOD and AERMET were utilized for this study. As stated in the Protocol, no Beta Options in AERMOD or AERMET were utilized. USEPA did release a revised version of AERMOD and AERMET on December 20, 2016 after all but the final simulations and one year of AERMET had been fully processed. Since this new version was released very late in the process, the study was completed using Version 15181 as stated in the Protocol. The receptor grid meeting the requirements of the DRR was developed using Version 11103 of AERMAP.

In addition, a BPIP analysis of Amos Plant was completed using Version 04274 of BPIPPRM, the current version listed on the USEPA TTN Web Site as applicable for studies of this nature. The BPIP analysis used for the study did include the natural draft cooling towers on the site.

RECEPTOR GRID

The receptor grid for the study used DEM data sourced from the MRLC System at a 1/3 arc second resolution in geo tiff format and processed through AERMAP Version 11103. The receptor grid consists of a series of nested receptor grids starting at a point approximately half way between the new Unit 1 and 2 stack and the Unit 3 stack (428000 E, 4258750 N, Zone 17, NAD 83) and extending out roughly 50 kilometers from that starting point. The inner nest around the plant has a resolution of 100 meters and extends out 4 kilometers in all directions. The next nest has a resolution of 250 meters covering the next 5 kilometers out from the stack. The third nest has a resolution of 500 meters covering the next 7 kilometers. The fourth nest has a resolution of 1000 meters and extends out an additional 10 kilometers. The final receptor field has a resolution of 2000 meters and extends out from 26 kilometers to 52 kilometers from the stack. Figure 4 shows the receptor grid configuration in Google Earth.

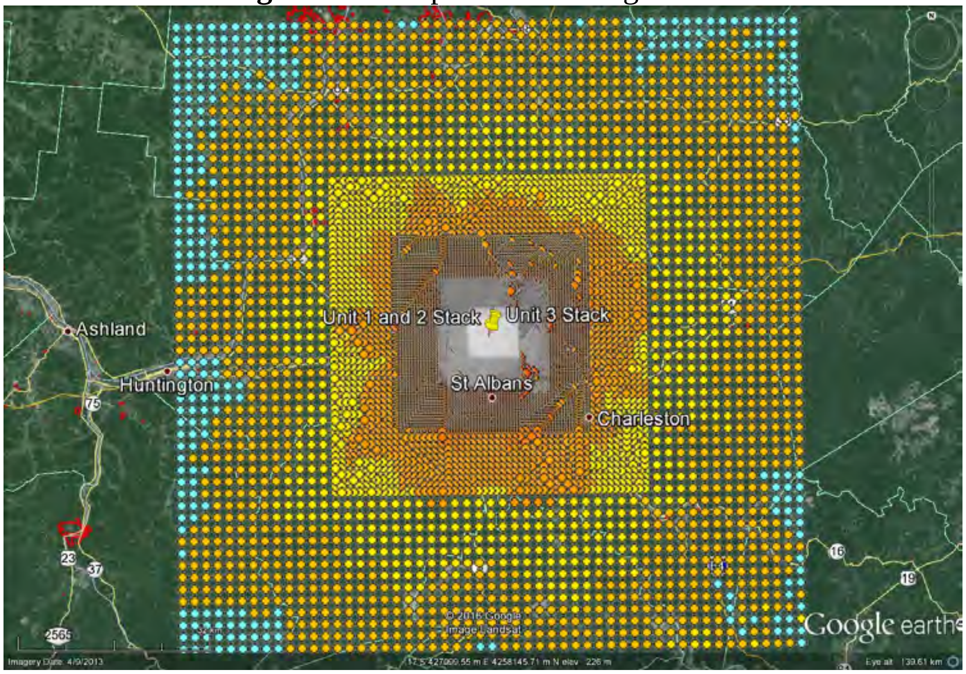
In preparing this grid, the following receptors were classified by AERMAP as being in locations with insufficient data in the geo tiff files to process receptors:

<u>500 meter grid</u>

415500 E, 4246250N	434500 E, 4245250 N	434500 E, 4245750 N

Beyond these three receptors, no receptors were removed from or added to the modeling grid shown in Figure 4. All values of regulatory interest were captured in the 100 meter grid.

Figure 4. Receptor Grid configuration.



METEOROLOGICAL DATA

The meteorological data set used for this study is the 2013 – 2015 Charleston, West Virginia Yeager Airport surface data, paired with Pittsburgh Upper Air Data. One minute and five minute (NCDC 6504 and 6501 datasets) surface data from Charleston, West Virginia Yeager Airport for 2013 to 2015 was processed through AERMINUTE Version 15272 to augment the hourly surface data in an effort to reduce the number of missing and calm hours in the final meteorological data files for use in AERMOD Version 15181. No Beta Options were used in the processing of the meteorologic data.

Surface characteristics based on the Amos Plant site and the Yeager Airport Meteorologic Site were developed using AERSURFACE in accordance with USEPA guidance with a 1 km distance from the established datum point for the site. Monthly precipitation data for use in determining the surface moisture levels for the 2013 to 2015 period based on the 30 year historic average for both sites will be sourced from the Prism Portal[5]. The monthly moisture case classifications used for each site are shown in Tables 1 and 2 and are based on an average moisture classification being between +/- 20% of the 30 year average precipitation value and the dry and wet classifications being outside of the +/- 20% of the 30 year average range.

The individual year AERMET files were then concatenated together to create a three year file for use in AERMOD.

Table 1. Three year monthly average surface Moisture for the Amos Plant Site.

Period	2013	2014	2015
January	Wet	Average	Dry
February	Dry	Wet	Average
March	Average	Average	Wet
April	Dry	Wet	Wet
May	Average	Average	Dry
June	Wet	Average	Average
July	Wet	Average	Wet
August	Wet	Average	Average
September	Average	Dry	Average
October	Dry	Wet	Average
November	Average	Average	Dry
December	Wet	Average	Wet

Table 2. Three year monthly average surface Moisture for the Yeager Airport Site.

Period	2013	2014	2015
January	Wet	Average	Dry
February	Dry	Wet	Average
March	Average	Average	Wet
April	Dry	Average	Wet
May	Average	Dry	Dry
June	Wet	Wet	Wet
July	Wet	Average	Wet
August	Wet	Average	Dry
September	Average	Wet	Dry
October	Dry	Wet	Dry
November	Average	Dry	Dry
December	Wet	Average	Wet

BACKGROUND VALUE

The nearest SO_2 monitor to the Amos Plant is located at 209 Morris Street (54-039-0010) in downtown Charleston, West Virginia, approximately 23 kilometers southeast of the plant. In the Protocol, it was indicated that based on an examination of high level metrics it appeared that the design value of this monitor was being influenced by a source "local" to the monitor, but there was insufficient data available to identify that source. We then suggested that the monitor located in Worthington (Greenup County), Kentucky (21-089-0007) as appearing to be a more appropriate background monitor after disqualifying the Huntington, West Virginia Monitor based on low data capture metrics for 2013 and 2014 (<90% data capture). Based on comments on the initial submittal of the Protocol, we agreed to review alternatives for developing an appropriate background value and to revisit the Charleston Monitor. Figure 5 shows the location of Amos Plant and these three monitors.

Following further discussions with WVDEP staff, it was determined that for purposes of evaluating the 1-Hour SO_2 Standard, the Huntington Monitor (54-011-0006) was acceptable for use and that the Charleston Monitor should be evaluated to see if it had any value in the determination of the background value to be used. Table 3 was generated to show the high level statistics and hours of valid hour data for the three monitors under consideration for use in the background determination.

Table 3. Air Data 1-Hour and annual SO_2 metrics by year for potential background monitors.

Monitor	2013			2014			2015			Design Value
	Hrs	1hr Max	1hr 99^{th} Pctle	Hrs	1hr Max	1hr 99^{th} Pctle	Hrs	1hr Max	1hr 99^{th} Pctle	
54-039-0010	8426	55	42	8341	60	47	8276	58	34	41
54-011-0006	6014	22	19	7741	33	21	8079	19	15	18
21-089-0007	8713	18	12	8695	23	16	8422	34	13	14

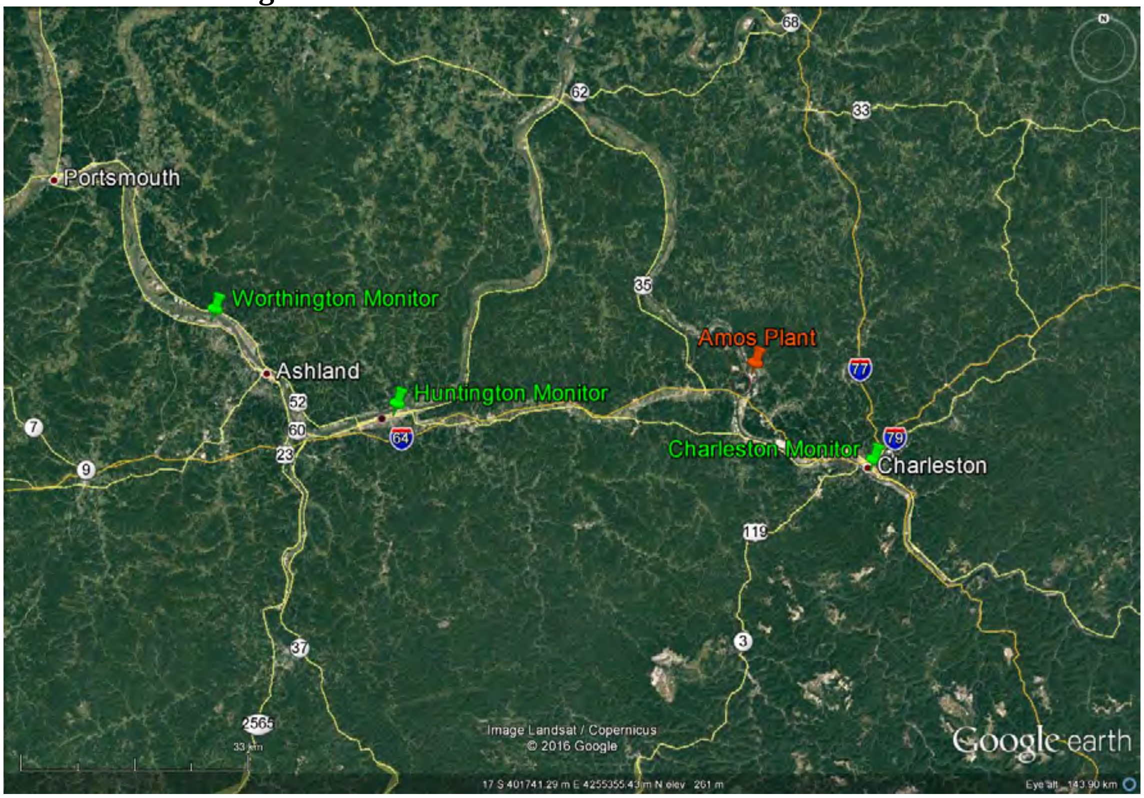
To begin the review of alternatives, the available SO_2 monitor data for the United States was downloaded from the USEPA AIRData System for the years 2012-2015 and processed through Microsoft Access to extract the data for the Charleston Monitor for the years 2013-2015. The Charleston Monitor data was then mated with the wind speed, wind direction, and mixing height data generated by the KCRW-Amos Surface AERMET case for each year. This meteorologic data set was selected based on preliminary modeling that demonstrated that this data set resulted in the highest modeled concentrations from Amos Plant. Once each year of data was parsed to locate the hours of missing ambient data so that the meteorologic and monitor data would properly pair, the sorting began to determine what the data would show.

The first step was to determine the design value for each year with all of the data included, which should agree with the summary report in the USEPA AIRData Web system as shown in Table 3. As can be seen in Table 4 this is the case. The next step was to cull out the 90 Degree sector centered on Amos Plant[3], which according to Google Earth is approximately 33.5 kilometers from the Charleston Monitor at a bearing of 310 Degrees at 22.5 kilometers. This gives a 90 degree sector extending from 265 degrees to 355 degrees. When the monitoring data for this period is removed from the analysis, we obtain the same set of design values, which indicates that the design value controlling source is not John Amos Plant or any facility in the general direction of John Amos Plant. This would include most impacts from chemical plants in the South Charleston and Institute areas that are centered at bearings of 299 degrees at 5.5 kilometers and 287 degrees at 13.5 kilometers respectively from the Charleston Monitor. These bearings cause the 90 degree sectors generate by these two areas to significantly overlap with the Amos Plant quadrant.

Table 4. Design Values of Various Cases for the Charleston Monitor with the Amos Quadrant removed in ppb.

Case	2013	2014	2015	Design Value
AIRData Reported DV	42	47	34	41
All Data	42	47	34	41
Amos Quadrant Removed	42	47	34	41

Figure 5. Monitor Locations Relative to Amos Plant



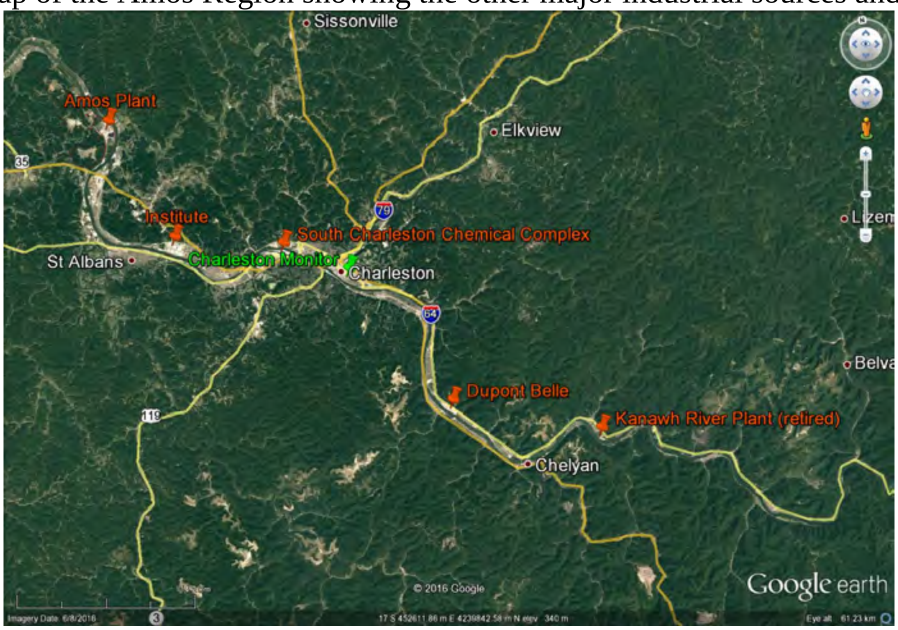
In examining the elevated readings after the removal of the 90 degree sector containing the Amos Plant, it was noted that the annual design values did not change and in reviewing the elevated readings, the vast majority of the elevated readings came from eastern bearings with lower wind speeds and in many cases relatively low mixing heights suggesting some kind of a trapping type of meteorology that would keep any SO_2 emissions from sources with stacks below the heights of the hills to the east of Charleston trapped in the valley. Table 5 shows an analysis of the top 50 hourly values for the years 2013 to 2015 based on various wind speed and mechanical mixing height metrics for the data with the Amos Quadrant removed.

During the period examined, the only major facilities operating to the east of Charleston were DuPont Belle and the Kanawha River Plant of Appalachian Power, which retired from service as a coal fired power plant on June 1, 2015. DuPont Belle is located at a heading of 150 degrees approximately 13 kilometers from the Charleston Monitor with very low reported emissions of SO_2 during the period modeled. The retired Kanawha River Plant is located at a heading of 129 degrees approximately 24 kilometers from the Charleston Monitor and had a main stack that did not extend above the surrounding terrain. Figure 6 shows the location of all of the other major industrial sites referenced in this discussion.

Table 5. Top 50 Hourly High Values with the Amos Quadrant Removed by Year Showing Wind Speeds and Mixing Height at various thresholds.

Criteria	2013	2014	2015
Wind Speed <1.0 m/s	27	12	9
Wind Speed <1.5 m/s	42	34	32
Wind Speed <2.0 m/s	45	41	40
Wind Speed <2.5 m/s	48	47	43
Mechanical Mixing Height <100 m	24	19	16
Mechanical Mixing Height <200 m	32	36	37
Mechanical Mixing Height <274 m	38	37	41
Mechanical Mixing Height <400 m	43	41	43

Figure 6. Map of the Amos Region showing the other major industrial sources and Amos Plant.



At this point, since a strong signal was identified that indicated a source in the local region was capable of influencing the Charleston Monitor in ways that render the readings unsuitable for background use and that the conditions where these readings occurred were such that they would preclude the material being observed at the Charleston Monitor from moving into the areas where the design values created by Amos Plant would be observed, WVDEP has agreed that the design value from this monitor is not suitable for use as background in this study.

While the screening out of the Amos quadrant allowed a strong conclusion that the Charleston Monitor Design Value is not a suitable value to use for background, it did not offer a suitable means to determine a background value. As a means to try and obtain a suitable background value based on the Charleston Monitor and the fact that all of the sources to the west of the monitor have significant overlap in their quadrants, as previously described, a means to examine the impacts of these sources that clearly would have the potential to interact with the Design Value zone around Amos Plant under the conditions producing the Design Value at the Charleston Monitor was devised. This method used both the Amos Quadrant data removed from the analysis of the Charleston Monitor (approximately 2000 hours per year) and the peak modeled design value impact from the Amos Plant at the receptors nearest to the Charleston Monitor. The model results used for the analysis came from the modeled case that did not take background into account and used the KCRW Meteorologic data coupled with the surface characteristics of Amos Plant area, the case that generated the highest modeled design values. The highest modeled design value at the nearby receptors was then be backed out of the annual design value at the Charleston Monitor considering only the Amos Quadrant data. This approach is viewed as reasonable since the two Chemical Plant sources are approximately equidistant from both Amos and the Charleston Monitor.

The peak modeled design value for Amos Plant at the four receptors surrounding the Charleston Monitor occurred at receptor 445000 E, 4244750 N and is shown in Table 6 in the Amos Modeled Impact row. When the modeled impact was removed from the monitored design values for each year the result is shown in the row titled Amos Quadrant with Modeled Amos Impact Removed. The 2013 to 2015 design value calculated in this way was 17 ppb, that was deemed to represent the background concentrations following the removal of the modeled impacts from Amos Plant. The value of 17 ppb is viewed as a value that would be suitable for use in all hours of the year at all receptors being modeled for Amos Plant as it represents an adjustment of hours where Amos is having some impact on the monitor along with all other sources that are likely interact with Amos under the design value conditions.

Table 6. Design Values of Various Cases for the Charleston Monitor with the Amos Quadrant removed in ppb and ug/m^3.

Case	2013	2014	2015	Design Value
Amos Quadrant	18 / 47.18	24 / 62.91	23 / 60.29	22 / 56.79
Modeled Amos Impact	4 / 11.27	5 / 12.07	5 / 12.95	5 / 12.10
Amos Quadrant with Modeled Amos Impact Removed	14 / 35.91	19 / 50.85	18 / 47.34	17 / 44.69

With this data in hand, this calculated background was compared to the Huntington and Worthington monitors to see how it compared to monitor data from monitors that do not appear to have significant impacts from local sources. When this comparison is done, it is found that the Huntington Monitor has a 2013 to 2015 Design Value of 18 ppb, one ppb greater than the calculated value for the Charleston Monitor and the Worthington Monitor has a Design Value of 14 ppb, three ppb lower than the calculated value for the Charleston Monitor. It is believed that these comparisons demonstrate the utility of the method described for use with the Charleston Monitor data in this case and serve to validate the calculated value of 17 ppb.

After these results were determined, a discussion was held with WVDEP prior to the initiation of the final simulations for the DRR that included a background value. WVDEP agreed that the methodology described using the Charleston Monitor data in this case was rational and the comparisons to two other monitors situated in river valley with no significant sources directly impacting them did help validate the method. However, they requested that the Huntington Monitor Design Value of 18 be used to add a minor amount of conservatism to the DRR analysis over the method used to develop a background from the Charleston Monitor Data. The results reported in this report reflect this request and all reported results include an 18 ppb background value.

SOURCES MODELED AND OPERATING DATA

No sources other than the three main steam generators at the Amos Plant were modeled based on the approved modeling protocol. This is based on discussions with WVDEP in late 2015 and the identification of all SO_2 emission sources at Amos Plant demonstrating that SO2 emissions from these other sources were inconsequential to the modeling study.

The three main steam generators were modeled using actual hour emissions from the Continuous Emissions Monitor Systems (CEMS) installed and operated under 40 CFR 75 on the three exhaust flues. These CEMS measure SO_2, Flow, Temperature, and other parameters specified in 40 CFR 75. This data is then processed and reported to USEPA Clean Air Markets Division (CAMD) in units of ppm SO_2, lb/hr SO_2, and wscfh for flow. Temperature is used in the derivation of the reported flow, but is not reported to CAMD as the CAMD reporting protocols do not allow for the explicit reporting of the temperature data. The temperature data used was extracted from the AEP CEMS Data Warehouse and processed along with the SO_2 and Flow data.

Some hours may also be impacted by data substitution requirements and other data management requirements found in 40 CFR 75. These hours may require manual editing of the CEMS based data to make the data truly representative of the actual operating conditions present during a specific hour on a specific discharge flue. Table 7 shows the input data for the modeling study, with the hourly data elements being used shown as “Variable” to denote the use of actual hourly conditions based on CEMS. The data selected covers the period 2013 to 2015 to match the meteorological data being used.

Table 7. Modeling inputs for the Amos Plant simulations.

Unit	Flue Easting (m)	Flue Northing (m)	Stack Base (m)	Emission Rate (g/sec)	Stack Height (m)	Exit Temp (K)	Exit Velocity (m/sec)	Exit Diameter (m)
Unit 1	**428038**	**4258530**	**178.6**	**Variable**	**274.3**	**Variable**	**Variable**	**10.28**
Unit 2	**428044**	**4258520**	**178.6**	**Variable**	**274.3**	**Variable**	**Variable**	**10.28**
Unit 3	**427961**	**4258954**	**180.4**	**Variable**	**274.3**	**Variable**	**Variable**	**12.95**

The emissions, temperature, and exit flow data for the period 2013 to 2015 were prepared using Excel and then processed into units of grams per second for emissions, degrees Kelvin for temperature and meters per second for exit velocity, then formatted and placed into an HOUREMIS file as described in the AERMOD User's Guide. The preparation included the inspection of each hourly data element and the replacement of missing, substituted, and otherwise erroneous data that meets Part 75 requirements, but is unsuitable for any purpose other than demonstrating compliance with the requirements of 40 CFR 75. The replacement of the data deemed unacceptable for modeling purposes used various techniques as appropriate for the parameter and amount of data needing replaced. These methods included but were not limited to the following:

- hour before hour after substitution for those cases where the data gap is short and the method can appropriately bridge the gap based on an evaluation of other operating parameters

- a constrained ending hour unconstrained beginning hour for cases where a single operational ramp better describes the data to be replaced

- tabular substitution based on binned load or heat input

- average hour for similar conditions (typically used in start-up conditions to replace missing or diluent capped data)

- professional judgment.

The spreadsheets used for this review and the development of the modeling inventory are included in the directory marked EMISSIONS on the enclosed DVDs.

RESULTS AND CONCLUSIONS

The modeling performed as part of this study is summarized in Table 8 below and shows that the limiting meteorologic case is the Charleston Meteorologic data paired with the Amos Surface conditions. As shown in the table, the difference in the design values is 3.12 ug/m3, less than half of the USEPA guidance suggested significance level of 3 ppb (7.86 ug/m^3)[4].

Table 8. Modeling results for Amos Plant from the two meteorologic configurations with 18 ppb background.

Case	Location	2013	2014	2015	Design Value
Amos Characteristics	426300 E 4254850 N	92.22	94.80	88.07	91.70
Yeager Airport Characteristics	426500 E 4255150 N	89.58	89.02	87.14	88.58

Figures 7 and 8 show the close-up of the maximum design value zone for the Amos Plant using the surface characteristics for the Amos Plant area and Figure 8 shows the overall modeling domain plot of the isopleths for the Amos Plant design value impacts. The peak impacts from Amos Plant do not occur on company owned or controlled property.

Based on these results it can be concluded that based on the actual emissions from Amos Plant for the period 2013 to 2015, Amos Plant and the surrounding area is in compliance with the 1-Hour SO_2 Standard. Further, the modeled impacts from Amos Plant with background are less than 50% of the 1-Hour SO_2 Standard which will allow Amos Plant to follow the procedures identified in 40 CFR 51.1205(b)(2) in the DRR if approved by USEPA.

Under 40 CFR 51.1205(b)(2), USEPA may exempt Amos Plant from further reporting under the DRR based on the modeled actual emissions including background being below 50% of the 1-Hour SO_2 Standard. This modeling study provides the required technical basis for granting such an exemption.

Figure 7. Close-up of the maximum design value zone for Amos Plant including background.

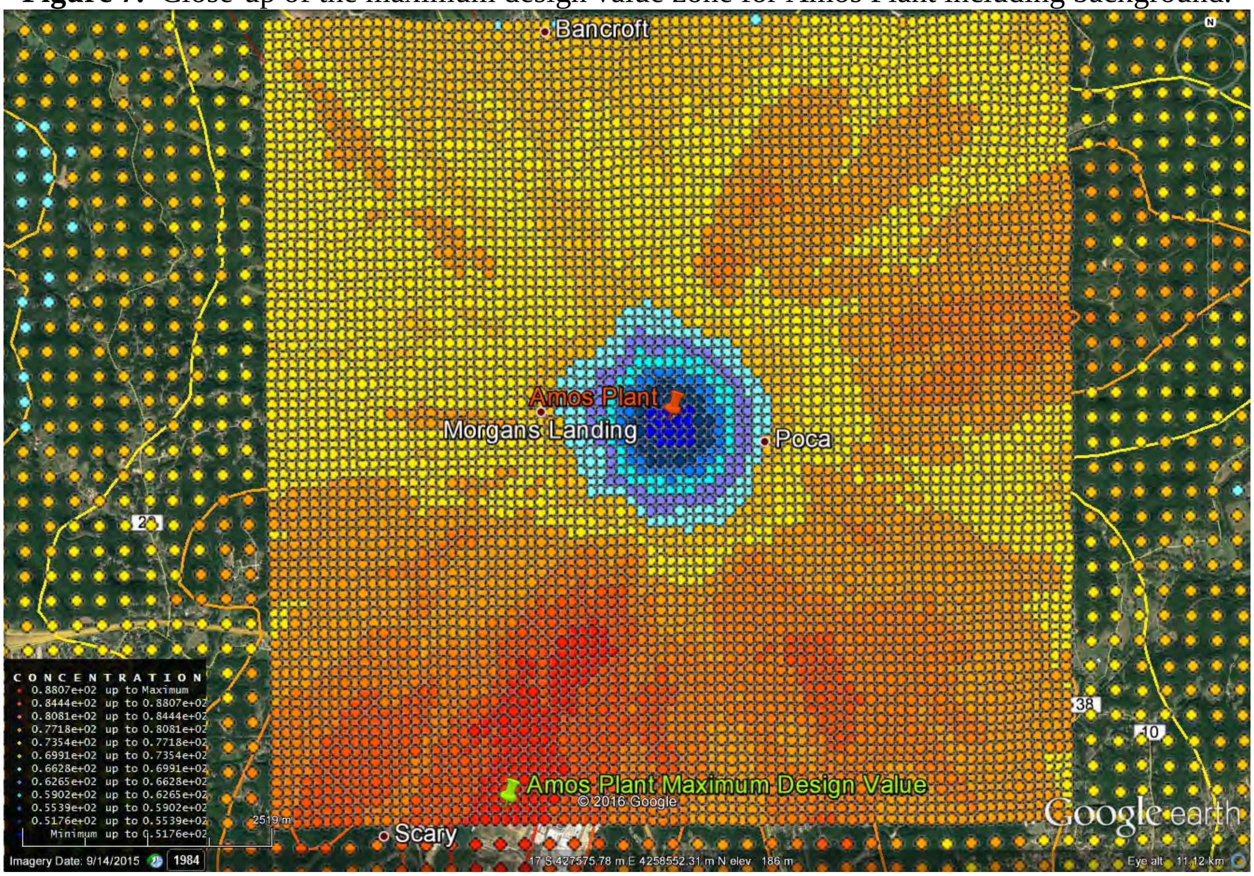
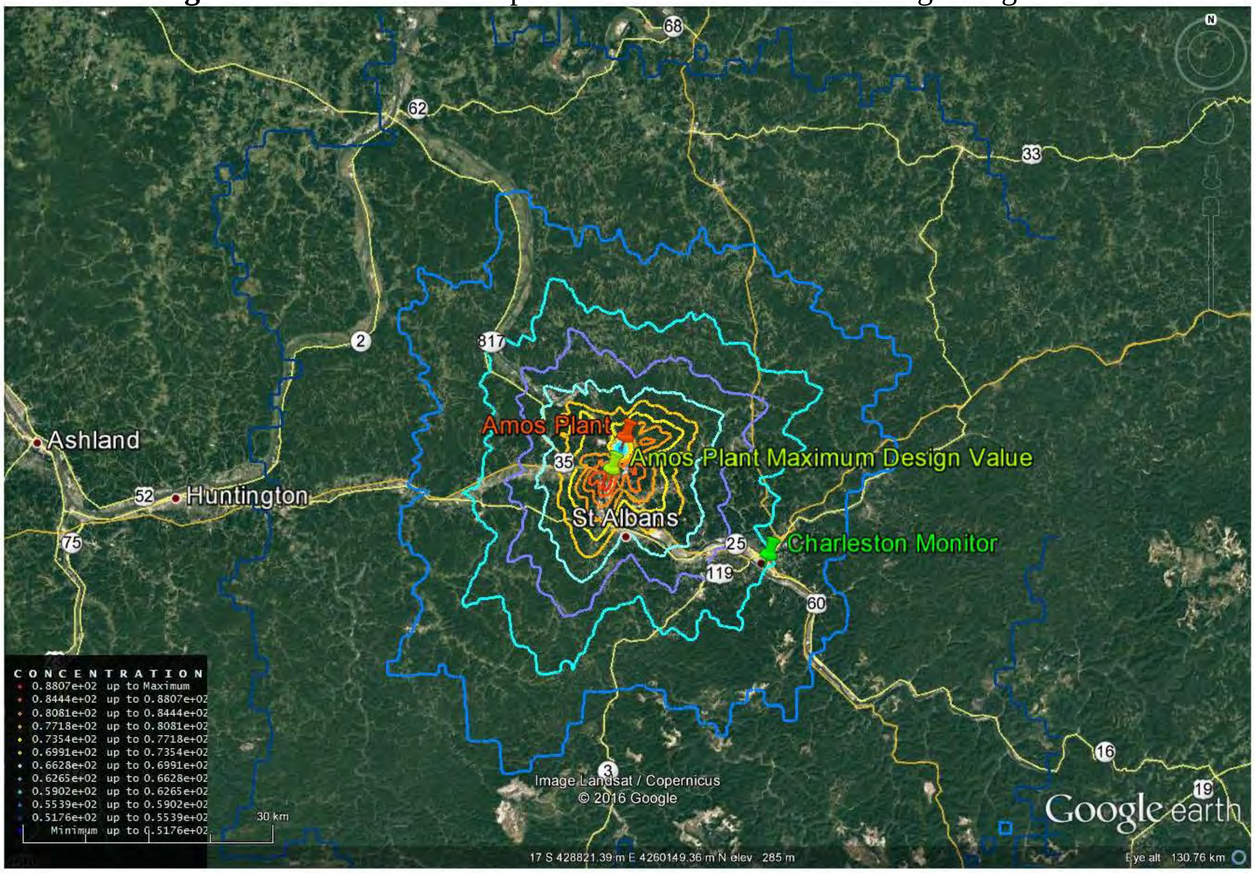


Figure 8. Domain wide impacts from Amos Plant including background.



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1. US EPA, Office of Air Quality Planning and Standards, ***Data Requirements Rule for the 2010 1-Hour Sulfur Dioxide (SO_2) National Ambient Air Quality Standard*** (NAAQS), Federal Register, Vol 80 No 162, August 21, 2015, page 51078.
2. Prism Climate Group, http://prism.oregonstate.edu/explorer/, last checked November 18, 2016.
3. 40 CFR 60.51 Appendix W, Section 8.2.
4. US EPA, Air Quality Policy Division, *General Guidance for Implementing the I-hour S02 National Ambient Air Quality Standard in Prevention of Significant Deterioration Permits, Including an Interim 1-hour SO_2 Significant Impact Level*, August 23, 2010, pages 4-6.

APPENDIX
Modeling Input and Output Files

1-Hour SO_2 Data Requirements Rule
Air Quality Modeling
for the
Mountaineer Plant
New Haven, WV

Prepared for
Appalachian Power Company

For Submittal
to
The West Virginia Department of Environmental Protection
Division of Air Quality

Prepared by
David J. Long, PE and Ashley Ullstrom
Air Quality Services Section
American Electric Power Service Corporation

November 30, 2016

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INTRODUCTION

American Electric Power Service Corporation (AEPSC) on behalf of the American Electric Power subsidiary Appalachian Power Company, has performed modeling under the USEPA 1-Hour SO_2 Data Requirements Rule (DRR) found at 40 CFR § 51.1200 for the Appalachian Power Company Mountaineer Plant (Mountaineer) located near New Haven, West Virginia. This modeling is being submitted to the West Virginia Department of Environmental Protection (WVDEP) to demonstrate compliance with the 1-Hour SO_2 Standard by Mountaineer Plant under the USEPA 1-Hour SO_2 Data Requirements Rule.

The results of this modeling using actual operating data from the period 2012 to 2014 along with the same meteorologic data sets and background used by Ohio EPA for modeling elsewhere in this region resulted in a maximum modeled design value of 55.3 ug/m^3. This value is less than 50% of the 1-Hour SO_2 limit of 196.6 ug/m^3 that, with the approval of USEPA, will exempt the source from further reporting requirements under the DRR as set forth in 40 CFR § 51.1205(b)(2).

DESCRIPTION OF FACILITY AND AREA

The Mountaineer Plant consists of a single electric generating unit designated Unit 1, rated at 1300 MW net. The unit is equipped with an electrostatic precipitator for particulate control, selective catalytic reduction (SCR) for nitrogen oxide and mercury control, and a limestone based flue gas desulfurization system.

The plant is located on the Ohio River in Mason County, West Virginia, approximately 15 kilometers west northwest of Ravenswood, West Virginia. The elevation of the plant site averages approximately 180 m MSL. The ridges in the area near Mountaineer Plant shown in Figure 1 rise up to approximately 100 meters above plant grade.

The area around the plant is classified as rural for purposes of air quality modeling. Figure 3, the 1992 NLCD representation of the Mountaineer region, shows that over 50% of the area within 3 kilometers of the Mountaineer plant site (white circle) is either forested land or open grassland or farm land (red and brown colors). Developed land, including low density residential and industrial areas represent less than 20% of the area with the only fully developed areas being the Mountaineer Plant site and the adjacent now retired Philip Sporn Plant site. Expanding the zone to five kilometers as shown in the yellow circle on Figure 3 serves to further reinforce this conclusion.

Mountaineer was originally permitted in the mid-1970's and is subject to the Good Engineering Practice (GEP) Stack Height Rules that were in effect at that time. Based on the GEP Rules in effect when Mountaineer was permitted, it was determined to have a GEP Stack Height of 838.6 feet based on the height of the natural draft cooling tower. Even though Mountaineer Plant is subject to the GEP Stack Height Rules, the original stack constructed at Mountaineer was 1100 feet tall. The original stack was replaced with a 1000 foot tall stack as part of the installation of the flue gas desulfurization system that was commissioned in 2007.

Since this modeling study used the actual operating conditions for the period 2012 to 2014, the Data Requirements Rule allows the use of the actual stack height for purposes of demonstrating compliance with the 1-Hour SO_2 NAAQS[1] regardless of the GEP stack height for the facility.

Figure 1. Mountaineer Plant and the surrounding area showing property holdings.

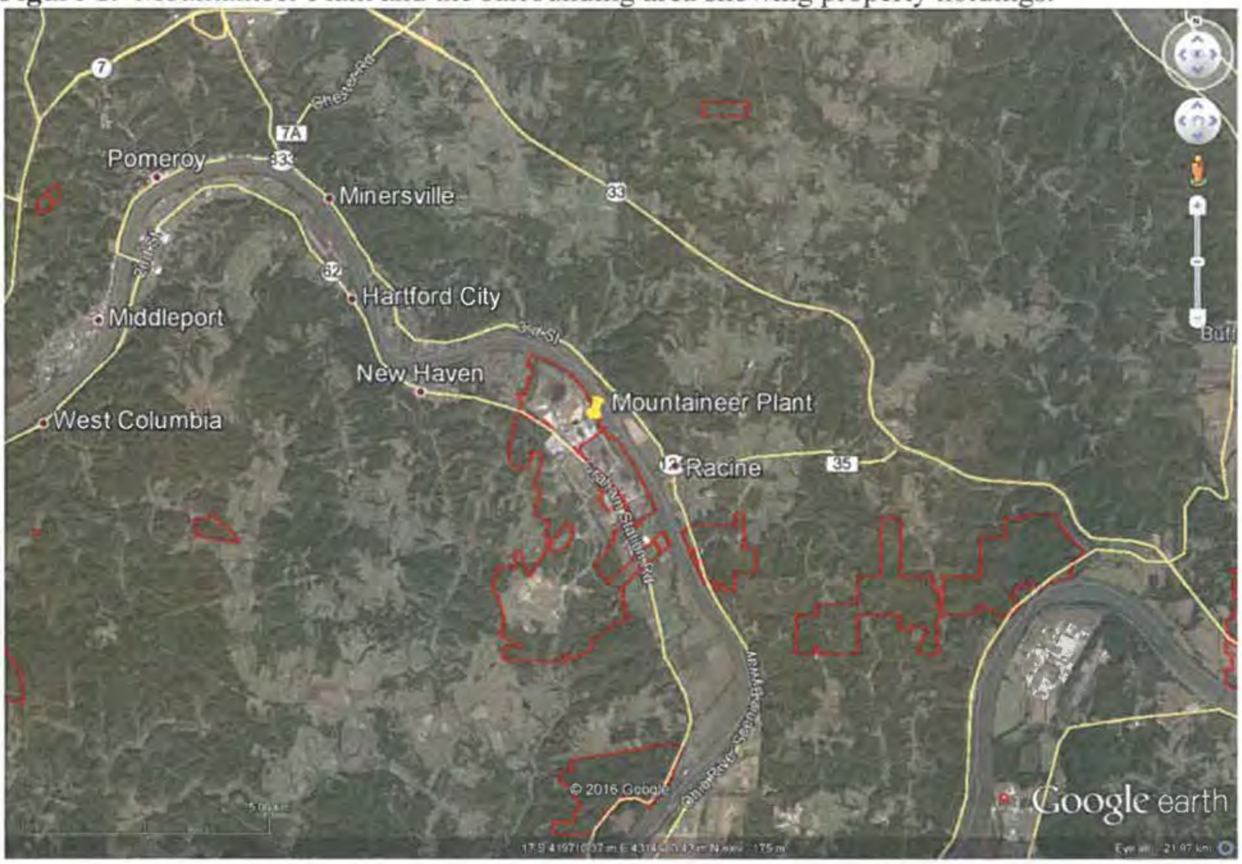
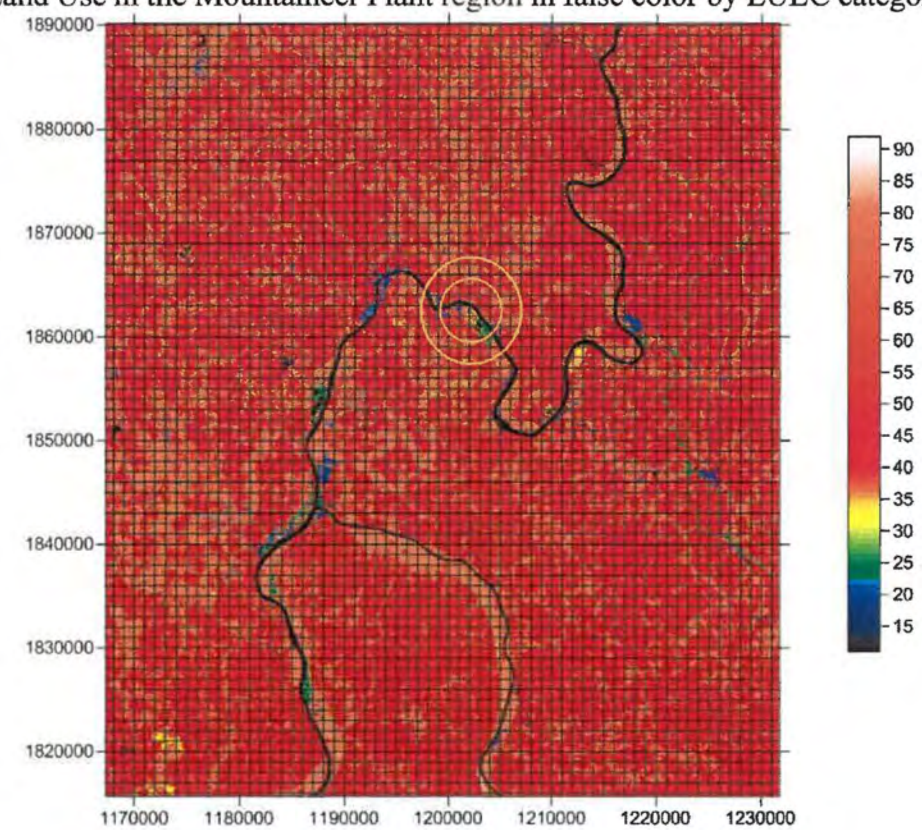


Figure 2. Detail of the Mountaineer Plant site.

Figure 3. Land Use in the Mountaineer Plant region in false color by LULC category.



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DEVIATIONS FROM THE PROTOCOL

There were no deviations from the Modeling Protocol submitted to WVDEP dated June 10, 2016 and revised June 30, 2016[2].

SOURCES TO BE MODELED

Based on discussions with WVDEP on July 27, 2015[3], there are no other significant sources of SO_2 in the area surrounding Mountaineer Plant that will need to be included in the DRR modeling demonstration. Mountaineer Plant itself contains the main coal fired steam generator serving the generating unit and two #2 fuel oil fired auxiliary boilers that are used for unit start-up and for building heating purposes when the generating unit is out of service. These two auxiliary boilers are classified as Limited Use Boilers under the IB MACT and consume ultra-low sulfur #2 fuel oil. Additionally, there are two coping power emergency generators commissioned in 2015 for use in a loss of power event that are classified as emergency generators under the RICE MACT. Emissions from the auxiliary boilers and emergency generators are reported in the annual emission statement filed with the WVDEP. Finally, there are two diesel driven emergency fire pumps at the plant that operate only for testing purposes and in the event of an emergency and one diesel driven Emergency Quench Pump on the FGD system for use in the event of a unit trip with full loss of site power to protect the FGD absorbers and downstream ductwork and flue from high temperatures that would be experienced in a black shutdown situation. The emissions from the fire pump engines are not reported as part of the annual emissions statements due to their low annual operation levels and classification as emergency engines under the RICE MACT. The emissions from the Emergency Quench Pump engine are calculated, but are less than 0.01 tons per year. This engine is classified as an emergency engine under the RICE MACT and operates only for routine testing and maintenance and emergency events. Table 1 identifies these sources and shows the emissions reported in the Annual Emission Statements filed with WVDEP for the years 2012 to 2015.

Table 1. Minor sources at Mountaineer Plant and their reported 2012 to 2015 annual SO_2 emissions in tons.

Equipment	2012	2013	2014	2015
Auxiliary Boiler 1	0.04	0.33	0.33	0.16
Auxiliary Boiler 2	0.05	0.33	0.35	0.16
Coping Power Emergency Generators	Not installed	Not installed	Not installed	0.003
Diesel Fire Pumps (2)	Not Reported	Not Reported	Not Reported	Not Reported
Emergency Quench Pump	0.00	0.00	0.00	0.00

Due to the limited emissions and operation of all SO_2 emitting sources at Mountaineer Plant other than the Main Steam Generator and the determination by WVDEP that no other sources need to be considered in this analysis, the only source that was included in the modeling analysis is the Main Steam Generator for the generating unit.

MODEL PLATFORM SELECTION

Version 15181 of AERMOD and AERMET are current versions of the Appendix A Gaussian Model listed in 40 CFR 51 Appendix W. AERMOD was used and is the appropriate model for use in in regulatory activities such as this study. No Beta Options present in AERMOD or AERMET were used as part of the study. The receptor grid was developed using Version 11103 of AERMAP, the current version of the receptor preprocessor software for the AERMOD Model.

In addition, a BPIP analysis of Mountaineer Plant has already been completed using Version 04274 of BPIPPRM, the current version listed on the USEPA TTN Web Site as applicable for studies of this nature. This BPIP analysis for Mountaineer Plant does not include the natural draft cooling towers or any of the nearby terrain since based on USEPA GEP determination guidance that indicates that streamlined structures do not necessarily need to be considered for stack height purposes and that fluid modeling should be applied if credit for the height of these structures is to be considered[4]. However, this body guidance is very convoluted with other documents containing contradictory guidance[5], making a clear determination of the correct approach difficult. As a result, a second BPIP analysis was performed that included the cooling tower and performed a sensitivity test as part of the modeling study, and selected the more conservative version of BPIP based on this testing. The modeling simulations containing these two BPIP analyses are presented in this report.

RECEPTOR GRID

The receptor grid for the study used DEM data sourced from the MRLC System at a 1/3 arc second resolution in geo tiff format and processed through AERMAP Version 11103. The receptor grid consists of a series of nested receptor grids starting at the center of the new stack (419103 E, 4314858 N, Zone 17, NAD 83) and extending out roughly 50 kilometers from that starting point. The inner nest around the plant has a resolution of 100 meters and extends out 4 kilometers from the stack location in all directions. The next nest has a resolution of 250 meters covering the next 5 kilometers out from the stack. The third nest has a resolution of 500 meters covering the next 7 kilometers. The fourth nest has a resolution of 1000 meters and extends out an additional 10 kilometers. The final receptor field has a resolution of 2000 meters and extends out from 26 kilometers to 52 kilometers from the stack. No receptors were removed to represent the plant property. Figure 4 shows the receptor grid configuration on a Google Earth map.

In preparing this grid, the following receptors were classified by AERMAP as being in locations with insufficient data in the geo tiff files to process the receptors:

<u>100 meter grid</u>

421403 E, 4314658 N	421403 E, 4314558 N	421403 E, 4314458 N
421403 E, 4314358 N	421403 E, 4314258 N	

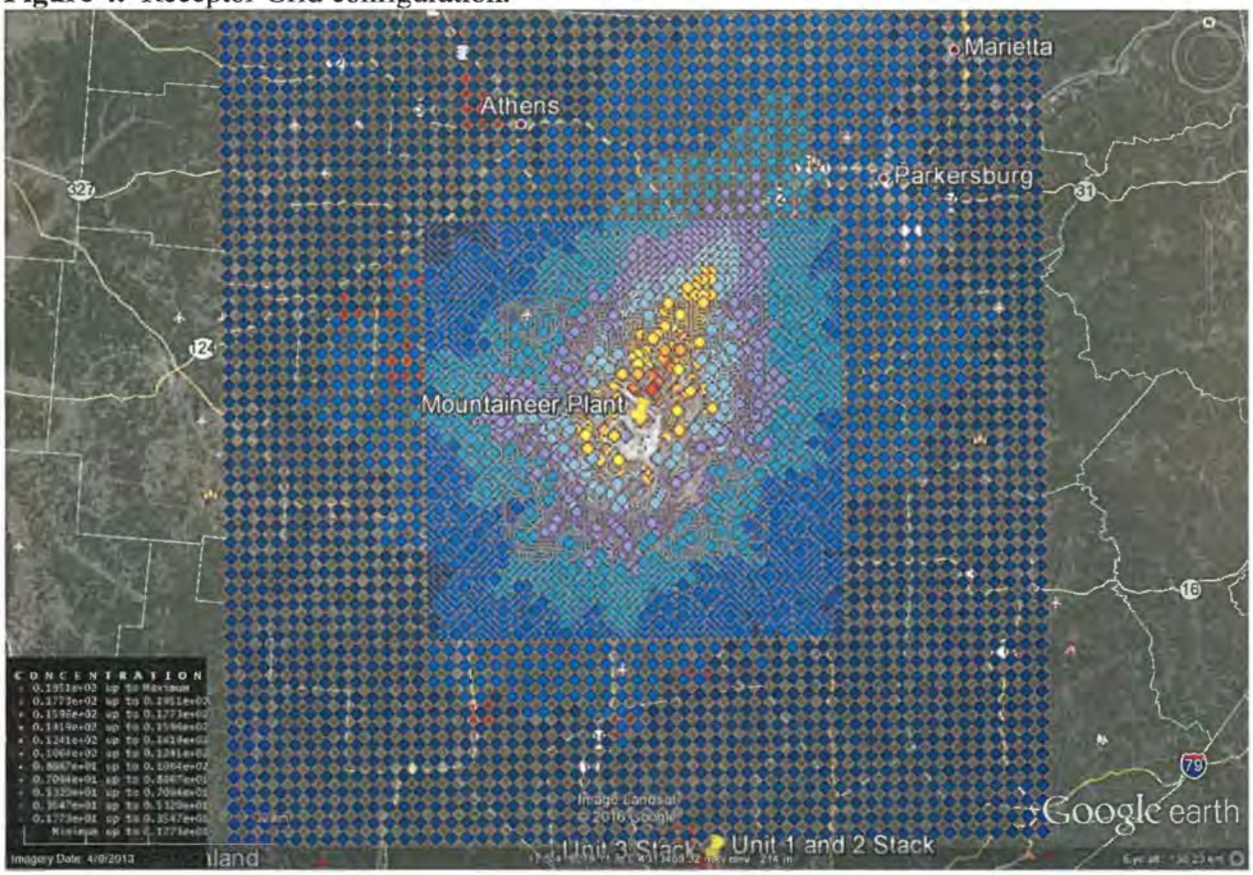
250 meter grid

415603 E, 4310608 N	415853 E, 4310608 N	416103 E, 4310608 N
416353 E, 4310608 N	421353 E, 4309603 N	421353 E, 4309353 N

1000 meter grid
395103 E, 4310858 N

In the process of performing the modeling, no critical values occurred near these gaps or outside of the 100 meter grid. Therefore, no additional receptors were removed from the grid and no receptors were added to the grid.

Figure 4. Receptor Grid configuration.



METEOROLOGICAL DATA

The meteorological data set used for this study was the 2012 – 2014 Huntington, West Virginia Tri State Airport ASOS based surface data, paired with Pittsburgh Upper Air Data as processed by Ohio EPA for use in the Gavin/Kyger Creek Plant 1-Hour SO_2 SIP Modeling submitted to USEPA as part of the response to the 120 Day Letter on April 19, 2016[6]. This data set is a revised version of the data set used in the original filing under the 1-Hour SO_2 Consent Decree by Ohio EPA dated September 2015[7].

The revised data set was created to resolve an issue discovered with the cloud cover data for the Huntington Tri State Airport surface meteorologic site for the year 2014 that resulted in unrealistic calculations of mixing heights during periods when a large number of noncontiguous hours were being substituted by AERMET or there were apparent errors in the reported cloud cover data based on a review of other available sky cover data in the region. The substitution performed by Ohio EPA resolved the unrealistic mixing height calculations observed in the meteorologic data set.

BACKGROUND VALUE

The nearest SO_2 monitor to the Mountaineer Plant is located in Meigs County, Ohio near the town of Pomeroy, approximately 11.5 kilometers to the northwest of Mountaineer Plant. Based on the selected meteorologic data and an examination of the data capture at the Meigs County SO_2 monitor, this monitor is well sited to examine ambient impacts from the General James M. Gavin and Kyger Creek Plants and has few impacts from Mountaineer Plant due to the lack of winds blowing from the southeast, which is the direction winds would have to come from to bring emissions from Mountaineer Plant to the monitor. Figure 4 shows the wind rose developed by Ohio EPA as part of the development of the Huntington Meteorologic Data Set described earlier.

Figure 5. Wind Rose based on 2012 to 2014 Huntington, West Virginia surface data.

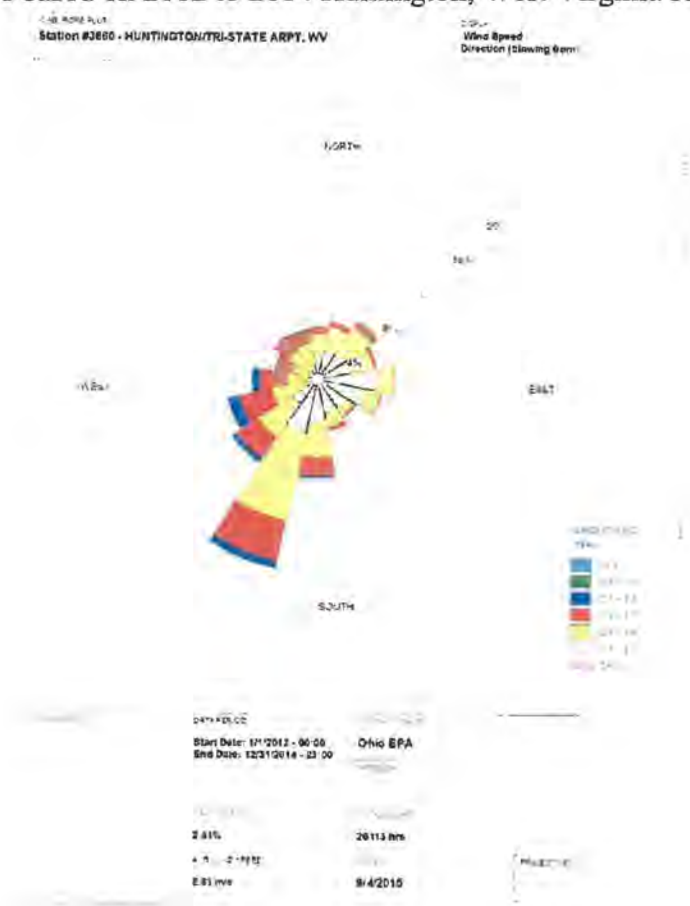


Table 2. Annual Hourly Data Capture Rate for the Meigs County Monitor

Monitor	2012		2013		2014		Acceptable
	Hrs	Capture	Hrs	Capture	Hrs	Capture	Capture
39-105-0003	8371	95.3%	8362	95.5%	8358	95.4%	Yes

For this analysis, the initial background value of 10 ppb developed by Ohio EPA for the initial modeling of the Gavin and Kyger Creek area that was described in the 2015 TSD[8] submitted with the initial Consent Decree modeling submitted for these sources was used as described in the protocol dated June 30, 2016.

PLANT OPERATING DATA

Under the Data Requirements Rule, actual hourly emissions and operating data is preferred for use in an SO_2 modeling analysis. The Mountaineer Plant has Continuous Emissions Monitoring Systems (CEMS) installed and operated under 40 CFR 75 that measure SO_2, Flow, Temperature, and other parameters as specified in 40 CFR 75. This data is then processed and reported to USEPA Clean Air Markets Division (CAMD) in units of ppm SO_2, lb/hr SO_2, and wscfh for flow. Temperature is used in the derivation of the reported flow, but is not reported to CAMD as the CAMD reporting protocols do not allow for the explicit reporting of the temperature data. Certain hours may also be impacted by data substitution requirements and other data management requirements found in 40 CFR 75. These hours may require manual editing prior to the data being truly representative of the actual operating conditions present. Table 4 shows the input data for the modeling study, with the hourly data elements being used shown as "Variable" to denote the use of actual hourly conditions based on CEMS and other operating data sources. The data selected covers the period 2012 to 2014 to match the meteorological data being used.

Table 3. Proposed modeling inputs for the Mountaineer Plant simulations.

Unit	Flue Easting (m)	Flue Northing (m)	Stack Base (m)	Emission Rate (g/sec)	Stack Height (m)	Exit Temp (K)	Exit Velocity (m/sec)	Exit Diameter (m)
Unit 1	**428038**	**4258530**	**178.6**	**Variable**	**274.3**	**Variable**	**Variable**	**10.28**

The emissions, temperature, and exit velocity data for the period 2012 to 2014 were used to prepare an HOUREMIS file as described in the AERMOD User's Guide and processed in accordance with the June 30, 2016 Modeling Protocol for this project. The HOUREMIS file used for this study is included with this report.

MODELING RESULTS

As indicated previously, two simulations for the period were made, one simulation was based on the inclusion of a BPIP representation of the natural draft cooling tower and the other did not include the BPIP representation of the natural draft cooling tower. Other than this difference, all other inputs to the two simulations were identical.

Table 4 shows the design value results generated by both simulations and including the background of 26.21 μg/m³. These results are shown in the three year average form (true design value in the form of the 1-hour SO2 Standard) and the individual annual fourth high daily high values that make up the three year average. It is noted that the difference between the three year averages are less than the suggested PSD Significant Impact Level in USEPA guidance of 4% of the ambient standard or 3 ppb (7.86 μg/m³)[9].

Table 4. Results for the two cases including background by three year average and by year.

Case	Receptor Easting (m)	Receptor Northing (m)	Receptor Elevation (m)	Three Year Average (μg/m³)	2012 Value (μg/m³)	2013 Value (μg/m³)	2014 Value (μg/m³)
Cooling Tower	**421603**	**4315758**	**212.17**	**55.27**	**46.06**	**55.64**	**64.10**
No Cooling Tower	**421003**	**4317158**	**183.66**	**49.68**	**45.51**	**48.05**	**55.49**

In addition to the design value results presented in Table 4, Figures 6 and 7, 8 and 9, and 10 and 11 on the following pages show the spatial distribution of the modeled design values from the Cooling Tower and No Cooling Tower simulations respectively at different resolutions. These plots show that the modeled peaks for both the Cooling Tower and No Cooling Tower cases are to the northeast of Mountaineer Plant.

CONCLUSION

Based on these results, Mountaineer Plant demonstrates that it meets the 1-Hour SO_2 Standard based on the use of actual operating data. Further, based on the provisions of 40 CFR § 51.1205(b)(2) in the DRR, USEPA may exempt Mountaineer Plant from further reporting under the DRR since the modeled actual emissions with background are below 50% of the 1-Hour SO2 Standard. This modeling study provides the required technical basis for granting such an exemption.

Figure 6. Full Domain Receptor Representation of the Cooling Tower Case.

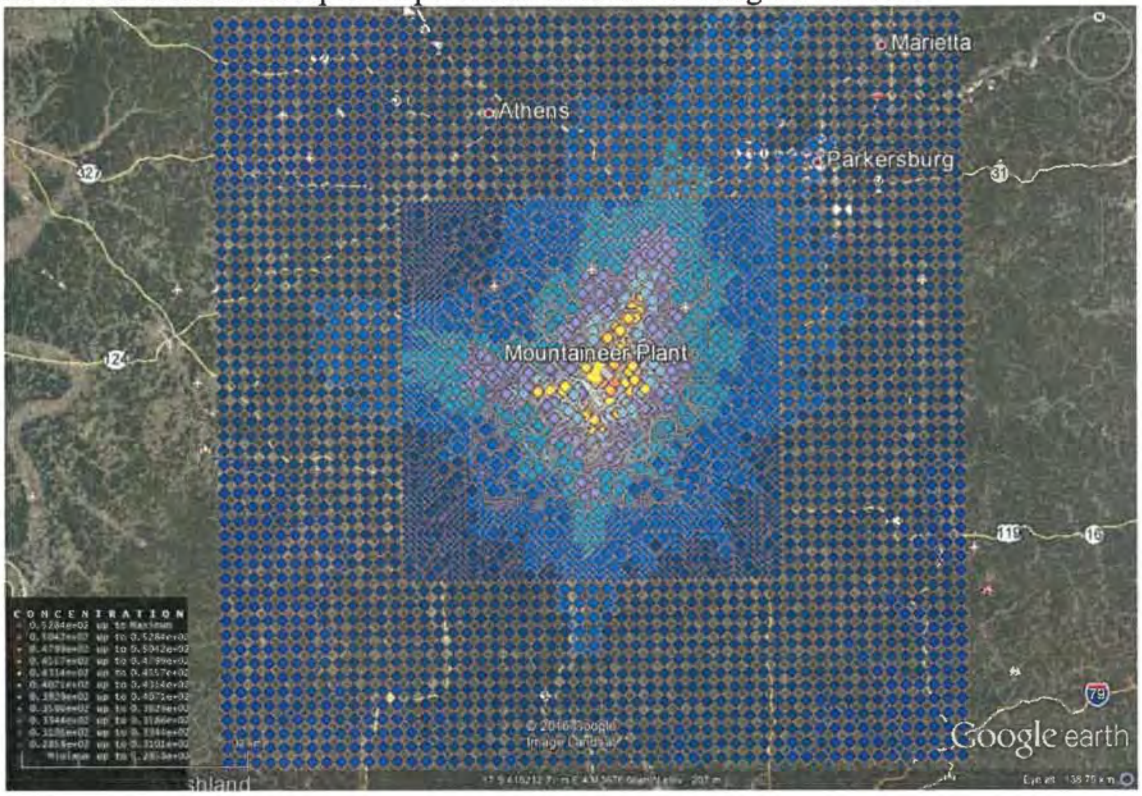


Figure 7. Full Domain Receptor Representation of the No Cooling Tower Case.

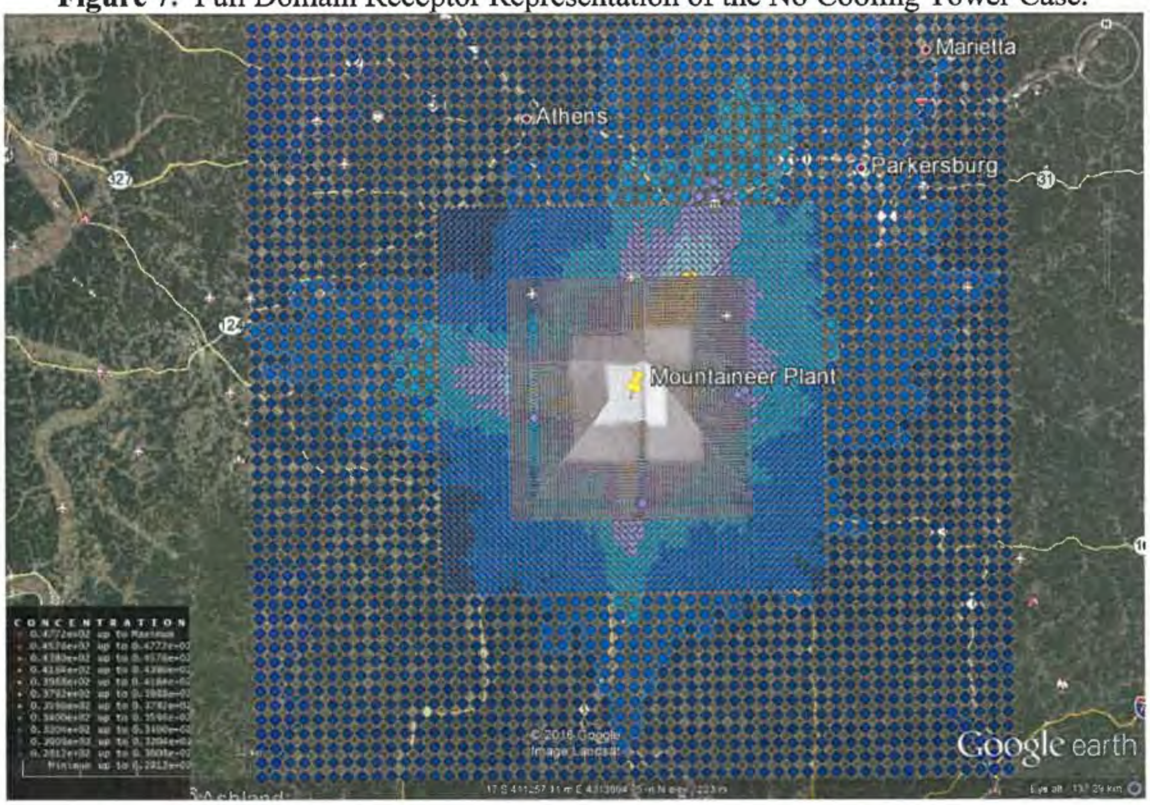


Figure 8. Detail of the 100 meter grid showing the area of the peak concentration to the northeast of Mountaineer Plant for the Cooling Tower Case.

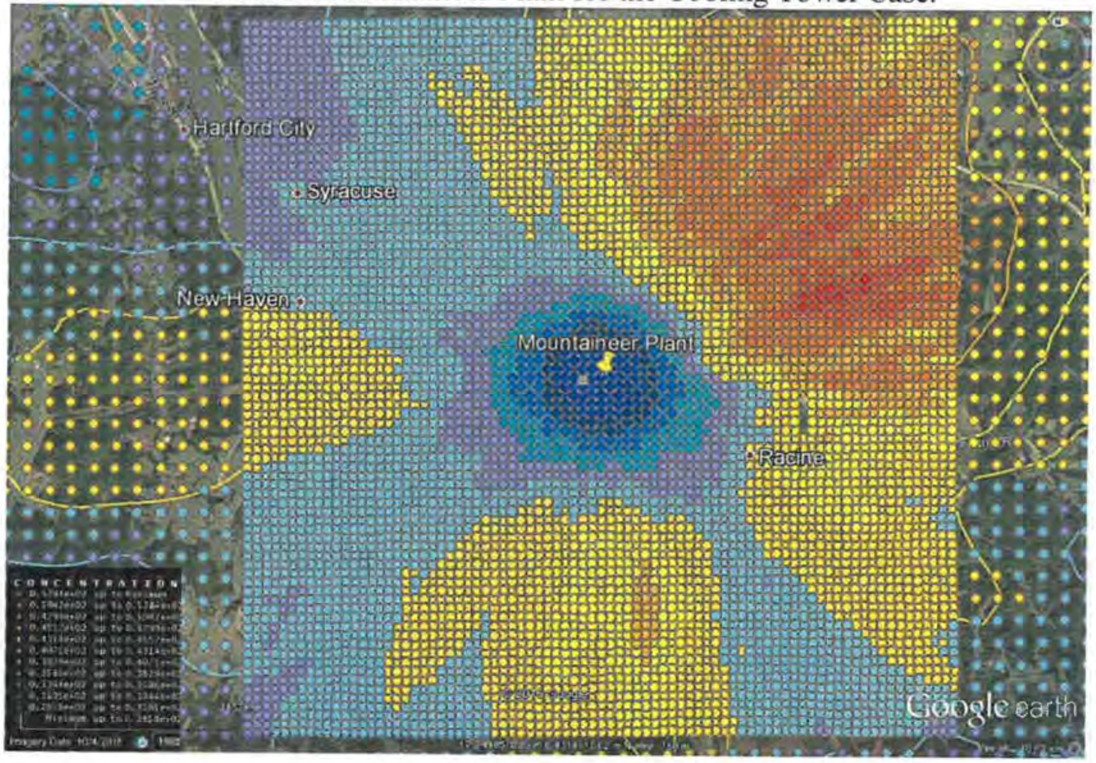


Figure 9. Detail of the 100 meter grid showing the area of the peak concentration to the northeast of Mountaineer Plant for the No Cooling Tower Case.

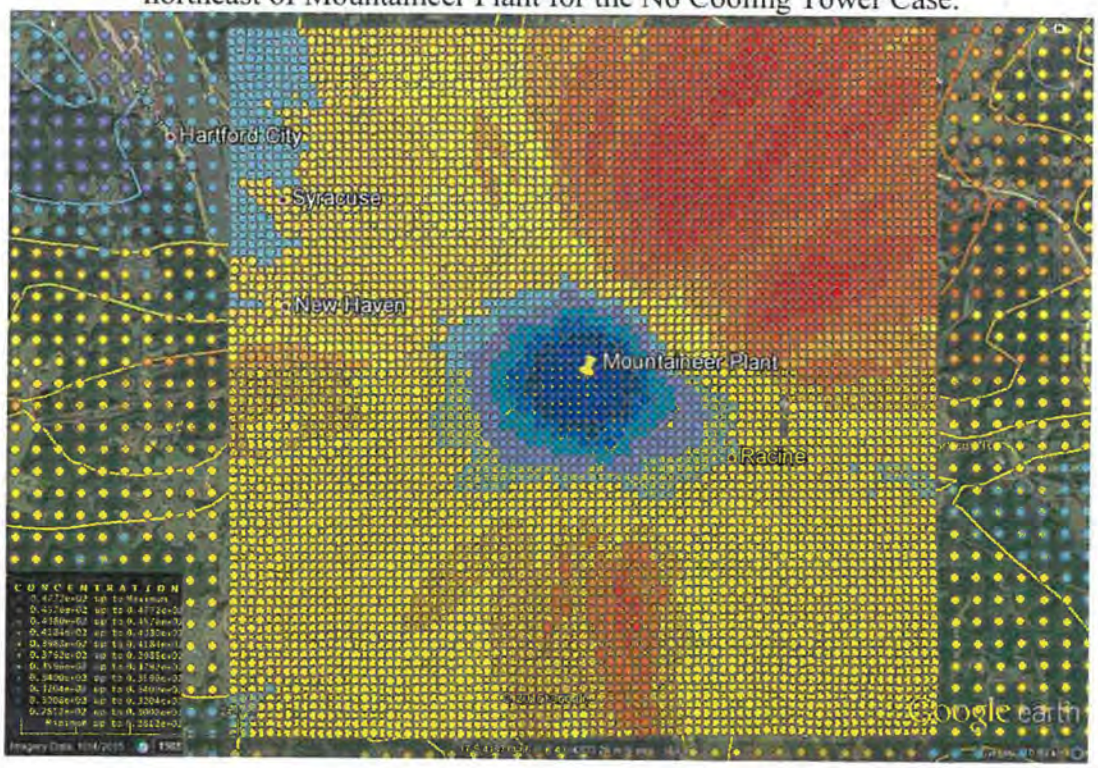


Figure 10. Contour Plot of showing the areas with design value concentrations greater than 40.7 $\mu g/m^3$ for the Cooling Tower Case.

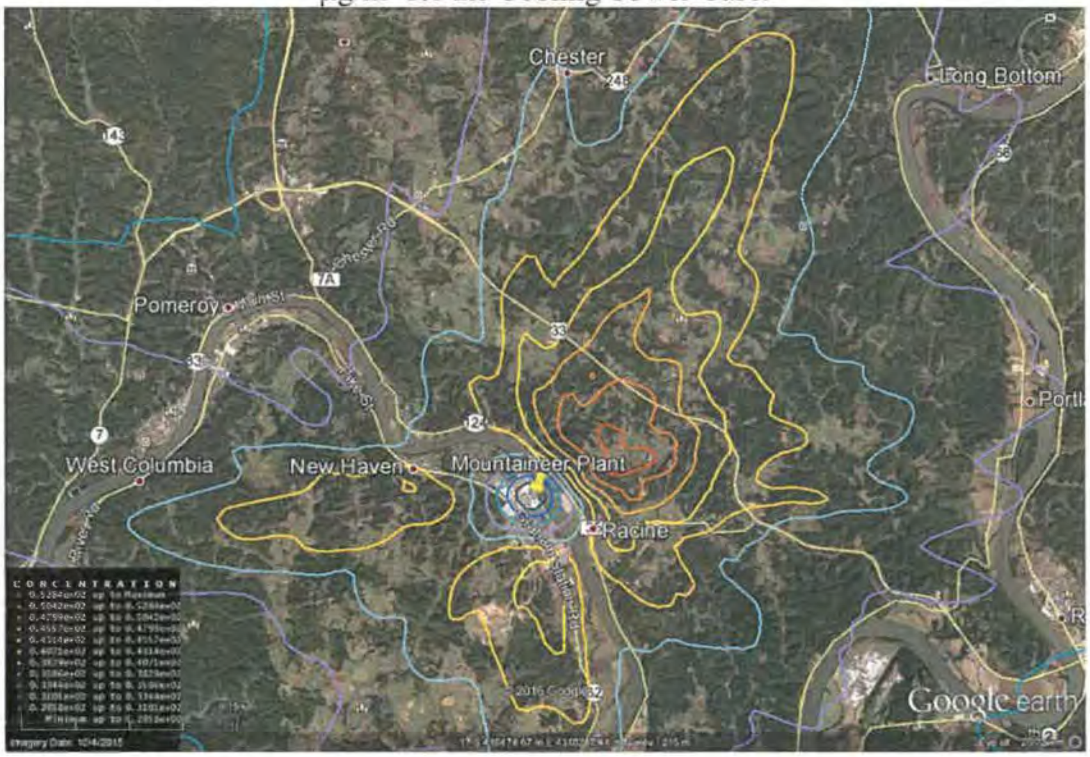
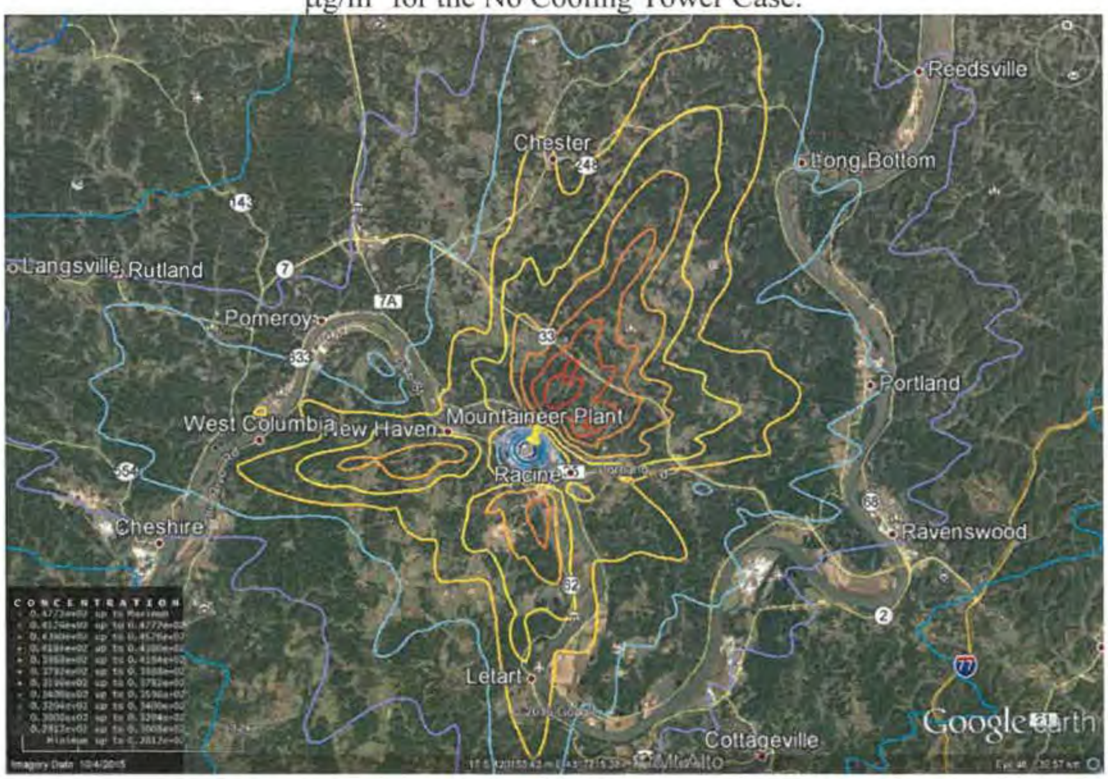


Figure 11. Contour Plot of showing the areas with design value concentrations greater than 37.9 $\mu g/m^3$ for the No Cooling Tower Case.



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1. US EPA, Office of Air Quality Planning and Standards, *Data Requirements Rule for the 2010 1-Hour Sulfur Dioxide (SO_2) National Ambient Air Quality Standard* (NAAQS), Federal Register, Vol 80 No 162, August 21, 2015, page 51078.
2. Long, David J, and Ullstrom, Ashley, *1-Hour SO_2 Data Requirement Rule Air Quality Modeling Protocol for the Mountaineer Plant New Haven, WV,* June 10, 2016, Revised June 30, 2016.
3. Telephone Conversation between AEP and WVDEP Staff on July 27, 2015.
4. US EPA, Office of Air Quality Planning and Standards, *Guideline for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations)*, EPA-450/4-80-023R, June 1985, pages 32-33.
5. US EPA, Model Clearinghouse Record of Communication dated 9/17/1996 and 9/20/1996 between D. Doll and B. Johnson, Record Number 97-IV-01, last checked June 28, 2016..
6. Ohio Environmental Protection Agency, *Dispersion Modeling Analysis for General James M. Gavin Source Area: 2010 SO_2 NAAQS: Technical Support Document for the General James M. Gavin/Kyger Creek Station Power Plant Source Area*, April 19, 2016, pages 2-4.
7. Ohio Environmental Protection Agency, *State Of Ohio 2010 Revised Sulfur Dioxide National Ambient Air Quality Standard Recommended Source Area Designation: General James M. Gavin and Kyger Creek Station Power Plants,* September 2015, Appendix A, page 2.
8. Ohio Environmental Protection Agency, *State Of Ohio 2010 Revised Sulfur Dioxide National Ambient Air Quality Standard Recommended Source Area Designation: General James M. Gavin and Kyger Creek Station Power Plants,* September 2015, Appendix A, page 2.
9. Applicability of Appendix W Modeling Guidance for the 1-hr S02 National Ambient Air Quality Standard. Tyler Fox Memorandum dated August 23, 2010, Research Triangle Park, North Carolina 27711. *http://www.epa.gov/ttn/scram/ClarificationMemo Appendix W_ Hourly-S02-NAAQS_FINAL_08-23-2010.pdf*

APPENDIX
Modeling Files on DVD

Dominion Resources Services, Inc.
5000 Dominion Boulevard, Glen Allen, VA 23060

Web Address: www.dom.com

October 31, 2016

BY U.S. MAIL, RETURN RECEIPT REQUESTED
9590 9401 0103 5168 7641 65

Mr. Jon D. McClung
Division of Air Quality
West Virginia Department of Environmental Protection
601 57th Street SE
Charleston, WV 25304

Re: Data Requirements Rule
1-Hr SO_2 Modeling Report
Mt. Storm Power Station

Dear Mr. McClung:

Attached is the air dispersion modeling report for Dominion's Mt. Storm Power Station (023-00003) with respect to the 1-hr National Ambient Air Quality Standard (NAAQS) for sulfur dioxide (SO_2). The modeling has been performed in accordance with the modeling protocol submitted January 28, 2016 and the revised protocol submitted May 4, 2016. The modeling has been done to characterize SO_2 concentrations in order to establish the attainment designation for the region surrounding the Station to satisfy EPA's SO_2 Data Requirements Rule.

Attached is a copy of the modeling report and modeling files on discs, as requested. If you have any questions, please feel free to contact Mr. Jeff Zehner at (804) 273-3145 or jeffrey.r.zehner@dom.com.

Sincerely,

Paula A. Hamel
Director – Generation Environmental Services

cc: Jeff Zehner, Dominion

DOCUMENT CERTIFICATION

Facility Name: Mt. Storm Power Station

Facility ID No. 02300003

Facility Location: 436 Dominion Blvd, Mt. Storm, WV 26739-8632

Type of Submittal Attached: 1-Hr SO_2 Modeling Report

Certification: I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering and evaluating the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name of Responsible Official (Print): Pamela F. Faggert

Title: Chief Environmental Officer and Senior Vice President - Sustainability

Signature: Pamela F. Faggert **Date**: 10/24/16

Environment

Prepared for:
Virginia Electric and Power Company
Mount Storm Power Station

Prepared by:
AECOM
Chelmsford, MA
60432329
October 2016

Mount Storm Power Station
Grant County, West Virginia
1-hour SO_2 Modeling Report

AECOM

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Prepared by:
AECOM
Chelmsford, MA
60432329
October 2016

Mount Storm Power Station
Grant County, Virginia
1-hour SO_2 Modeling Report

Prepared By Kim Zuk

Reviewed By Jeffrey Connors

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1.0 Introduction

1.1 Purpose

In August 2015, the U.S. Environmental Protection Agency (USEPA) issued the SO_2 Data Requirements Rule (DRR), which directs state and tribal air agencies in “an orderly process” to identify maximum ambient air 1-hour SO_2 concentrations in areas with large sources of SO_2 emissions.

This document describes the air quality modeling procedures and results of an air dispersion modeling demonstration that was performed for the 1-hour National Ambient Air Quality Standard (NAAQS) for sulfur dioxide (SO_2). The modeling was performed to characterize SO_2 concentrations and provide information for establishing the attainment designation for the region surrounding Dominion’s Mount Storm Power Station (the Station) located in Mount Storm, West Virginia. This modeling report is being prepared and submitted to the West Virginia Department of Environmental Protection (WVDEP) to provide a general overview of the modeling procedures and the results of the modeling analysis.

A dispersion modeling protocol was submitted to WVDEP in May of 2016. The modeling procedures follow the methodology outlined in the May 2016 modeling protocol. In addition, modeling procedures are consistent with applicable guidance, including the August 2016 “SO_2 NAAQS Designations Modeling Technical Assistance Document” (TAD) issued by the USEPA. The modeling approach is also consistent with the final Data Requirements Rule (DDR) for the 2010 1-hour SO_2 primary NAAQS (80 FR 51052, August 21, 2015).

The current version of the TAD references other USEPA modeling guidance documents, including the following clarification memos (1) the August 23, 2010 “*Applicability of Appendix W Modeling Guidance for the 1-hour SO_2 NAAQS*” and (2) the March 1, 2011 “*Additional Clarification Regarding Application W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard*” (hereafter referred to as the “additional clarification memos”). In the March 1, 2011 clarification memo, USEPA declares that the memo applies equally to the 1-hour SO_2 NAAQS even though it was prepared primarily for the 1-hour NO_2 NAAQS.

1.2 Facility Description and Location

Dominion's Mount Storm Power Station is located on Mount Storm Lake atop the rugged Allegheny Mountains of northeastern West Virginia in Grant County. The Station has the capability of generating approximately 1,600 megawatts of electrical output from three main fossil-fuel burning electric generating units. The three main units are pulverized coal -fired boilers (Units 1 through 3). In addition, the Station also has one auxiliary fuel oil-fired boiler (Unit 4). Based on the current stack configuration, Units 1 and 2 exhaust through a common single flue 743 foot stack and Unit 3 exhausts through a separate 579-foot stack. The auxiliary boiler (Unit 4) also exhausts through a separate stack.

The area surrounding the Station can be characterized by predominantly rural elevated terrain. There is not much complex terrain (i.e. terrain above stack top) surrounding the Station as a majority of the terrain slopes downward from the station location. The location of the Station is shown in **Figure 1-1**. A topographic map of the area surrounding the plant is provided in **Figure 1-**

2. Additional discussion on whether the site is classified as rural or urban can be found in **Section 3.2**. As shown in **Figures 1-1** and **1-2**, the area in the immediate vicinity (i.e. within 3 km) of the Station can be characterized as having a rural land use type. **Figure 1-3** shows a close-up aerial of the Station.

1.3 Contents of the Modeling Report

This report consists of six sections. **Section 1** provides an introductory presentation. **Section 2** contains a description of the model selection. **Section 3** discusses the model configuration, including model domain, nearby sources, receptors, and meteorological data. **Section 4** includes a discussion of the proposed emission rates for modeling. **Section 5** presents the ambient background data for inclusion in the modeling. **Section 6** discusses the procedures that were used to characterize SO_2 concentrations in the vicinity of the Mount Storm Power Station and the modeling results.

Figure 1-1 Location of the Mount Storm Power Station

Figure 1-2 Topography in the Vicinity of Mount Storm Power Station

Figure 1-3 Aerial Photograph of the Mount Storm Power Station

2.0 Model Selection

AERMOD (USEPA 2004a) (Version 15181) was used with current regulatory default options to model all sources. AERMOD is the USEPA guideline model for short-range transport and has the ability to account for the source types and dispersion environment located at, and surrounding, the Mount Storm Power Station. AERMOD is appropriate for many different types of dispersion environments including: sources subject to building downwash and sources located in flat or elevated terrain.

As described in **Section 1.2**, the area surrounding the Mount Storm Power Station is characterized by predominantly terrain below stack stop, as the Station sits atop an elevated ridgeline.

Based on USEPA guidance provided in the TAD, all stacks were modeled with their actual physical stack height. In addition, the USEPA's Building Profile Input Program (BPIP-Version 04274) version that is appropriate for use with PRIME algorithms in AERMOD was used to incorporate downwash effects in the model for all modeled point sources. The building dimensions of each structure were input in the BPIPPRM program to determine direction specific building data. PRIME addresses the entire structure of the wake, from the cavity immediately downwind of the building to the far wake. **Figure 2-1** shows the buildings and associated heights, along with stack locations, used for the BPIP analysis.

Figure 2-1 Buildings used for BPIP Analysis

3.0 Modeling Configuration

3.1 Modeling Domain

There are very little industrialized areas surrounding Mount Storm Power Station. Consequently, as discussed below, the characterization of 1-hour SO_2 concentrations via modeling includes only the Mount Storm Power Station.

Primary Source

The modeling domain for the Mount Storm, WV SO_2 attainment area designation modeling analysis focuses on the Mount Storm Power Station. The DRR characterizes primary sources as those sources which have over 2,000 TPY of SO_2 emissions based on the most recent year of emissions data. The Mount Storm Power Station was identified by WVDEP as having actual SO_2 emissions for the most recent calendar year in excess of 2,000 TPY. Therefore, the attainment status of the surrounding area with respect to the 1-hour NAAQS for SO_2 must be made.

Nearby Sources

The proposed procedures for identifying other nearby sources that could have possibly been included in the dispersion modeling analysis are described below. Current modeling guidance in the TAD states that professional judgment should be used in the process of determining which nearby sources to include in the attainment area designation modeling analysis. Guidance on Page 7 in the TAD and in the referenced clarification memos state that the "*number of sources to explicitly model should generally be small*."

Applicable guidance in the TAD and clarification memos also mention that any nearby sources that are expected to cause a significant concentration gradient in the vicinity of the primary sources should be included in the area designation modeling. Additionally, guidance says the impacts of any other sources should be incorporated via a consideration of background air quality concentrations.

The initial screening area for sources that could have potentially been included in the 1-hour SO_2 modeling was conservatively set to be a 20 kilometer radius in all directions from the Mount Storm Power Station. Available guidance for this distance is 10 km from the March 1, 2011 Clarification Memo and "10-20 km" from the proposed Appendix W updates (80 FR 45373). Sources beyond 20 kilometers are very unlikely to cause or contribute to a violation of the 1-hour SO_2 NAAQS in the vicinity of the primary sources or cause a significant concentration gradient in the vicinity of the primary sources.

The 2011 National Emissions Inventory on the USEPA's website was used to determine if there were any facilities with greater than 50 TPY of actual SO_2 emissions located within 20 kilometers of Mount Storm Power Station. The only facility identified was Mettiki Coal, LLC located approximately 17 kilometers to the west-northwest. According to the 2011 NEI, this facility emitted 62.58 Ton of SO_2 in 2011. Given the far distance, and relatively low emissions, it is highly unlikely that this source would interact on a 1-hour basis in the vicinity of the Mount Storm Power Station. As such, no other sources (other than those discussed above at the Mount Storm Power Station) were included in the 1-hour SO_2 modeling demonstration.

3.2 Dispersion Environment

The application of AERMOD requires characterization of the local (within 3 kilometers) dispersion environment as either urban or rural, based on a USEPA-recommended procedure (commonly referred to as the Auer Method) that characterizes an area by prevalent land use. This land use approach classifies an area according to 12 land use types. In this scheme, areas of industrial, commercial, and compact residential land use are designated urban. According to USEPA modeling guidelines, if more than 50% of an area within a 3-km radius of the facility is classified as rural, then rural dispersion coefficients are to be used in the dispersion modeling analysis. Conversely, if more than 50% of the area is urban, then the area is classified as urban.

Visual inspection of the 3-km area surrounding the Mount Storm Power Station (see **Figure 3-1**) clearly shows the area is rural. Therefore, the urban model option in AERMOD was not used.

3.3 Receptor Grid

The modeling analysis was conducted using the following Cartesian receptor grid design. The receptor grid consisted of receptors spaced 25 meters apart along the ambient air boundary of the Mount Storm Power Station. A spacing of 100 meters was used for the receptors extending out 3 kilometers from the grid center. Between 3 and 5 kilometers, a spacing of 250 meters was used. Between 5 and 10 kilometers, a spacing of 500 m was used. Beyond 10 km (out to 20 km), a spacing of 1000 m was used. The receptor grid used in the modeling analysis was based on Universal Transverse Mercator (UTM) coordinates referenced to NAD 83 datum and in zone 17. The receptor grid was centered at the following UTM coordinate: Easting = 649,400 meters and Northing = 4,340,700 meters.

The extent of this grid was sufficient to capture the maximum modeled impacts. Furthermore, to ensure the maximum impacts were resolved to a refined receptor grid spacing, additional receptors spaced at 50-meter intervals were placed around the area(s) of the highest modeled impacts.

Figures 3-2 and **3-3** show a graphical depiction of the near-field receptors (including 50-meter refined grid) and entire receptor grid used for modeling.

AERMAP (version 11103) (USEPA 2004c), the AERMOD terrain preprocessor program, was used to calculate terrain elevations and critical hill heights for the modeled receptors (NAD83 datum and zone 18) using National Elevation Data (NED). The dataset was downloaded from the USGS website (http://viewer.nationalmap.gov/viewer/) and consisted of 1/3 arc second (~10 m resolution) NED. As per the AERMAP User's Guide (USEPA, 2004), the domain was sufficient to ensure all significant nodes are included such that all terrain features exceeding a 10% elevation slope from any given receptor, are considered.

Additionally, **Section 4.2** of the TAD states that receptors do not need to be located in areas where it is not feasible to place a monitor (water bodies, etc.). To be conservative, the proposed grid does not exclude any receptors that may be in such areas.

Figure 3-1 Land Use Surrounding the Mount Storm Power Station

Figure 3-2 Near-Field Receptors for AERMOD Modeling

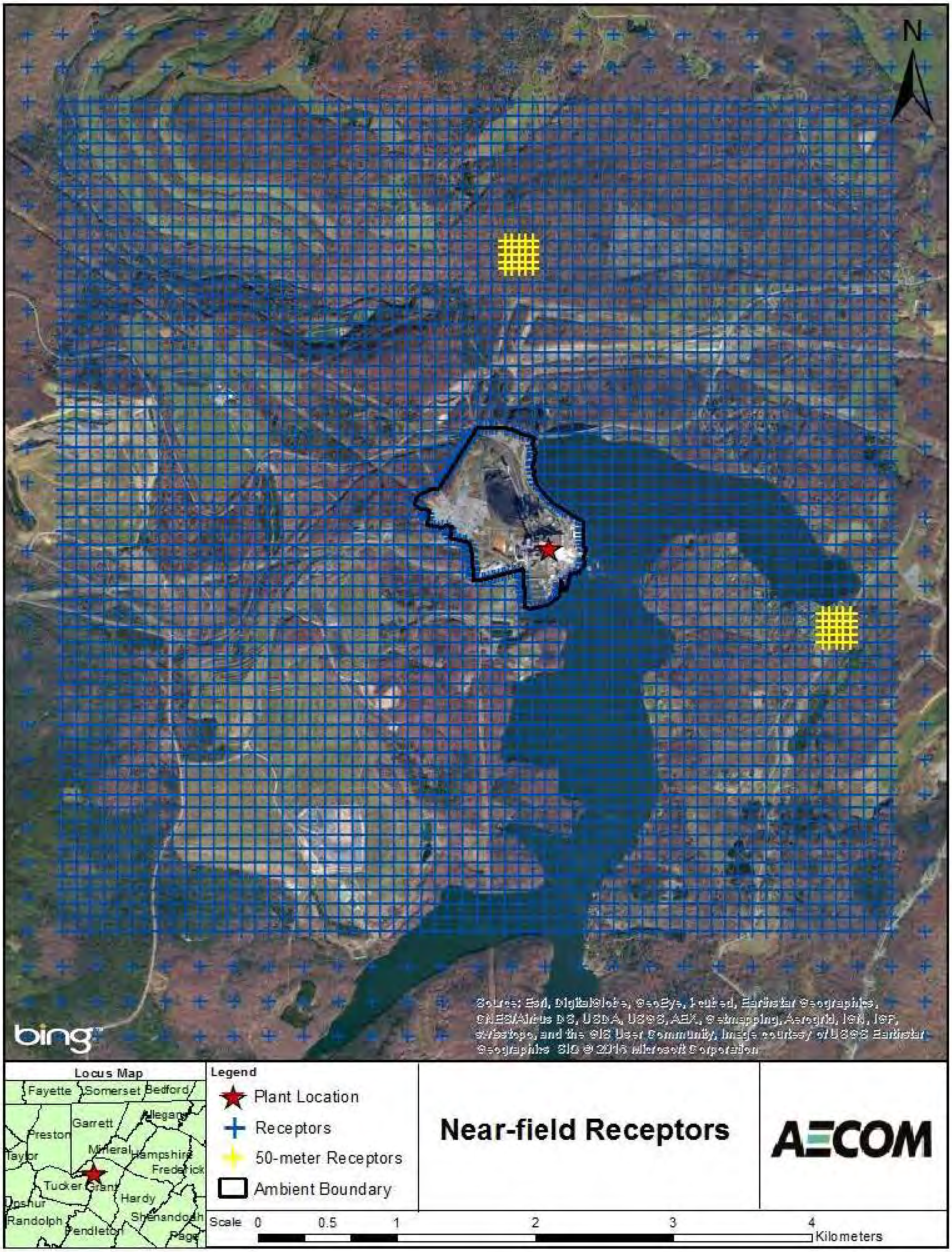
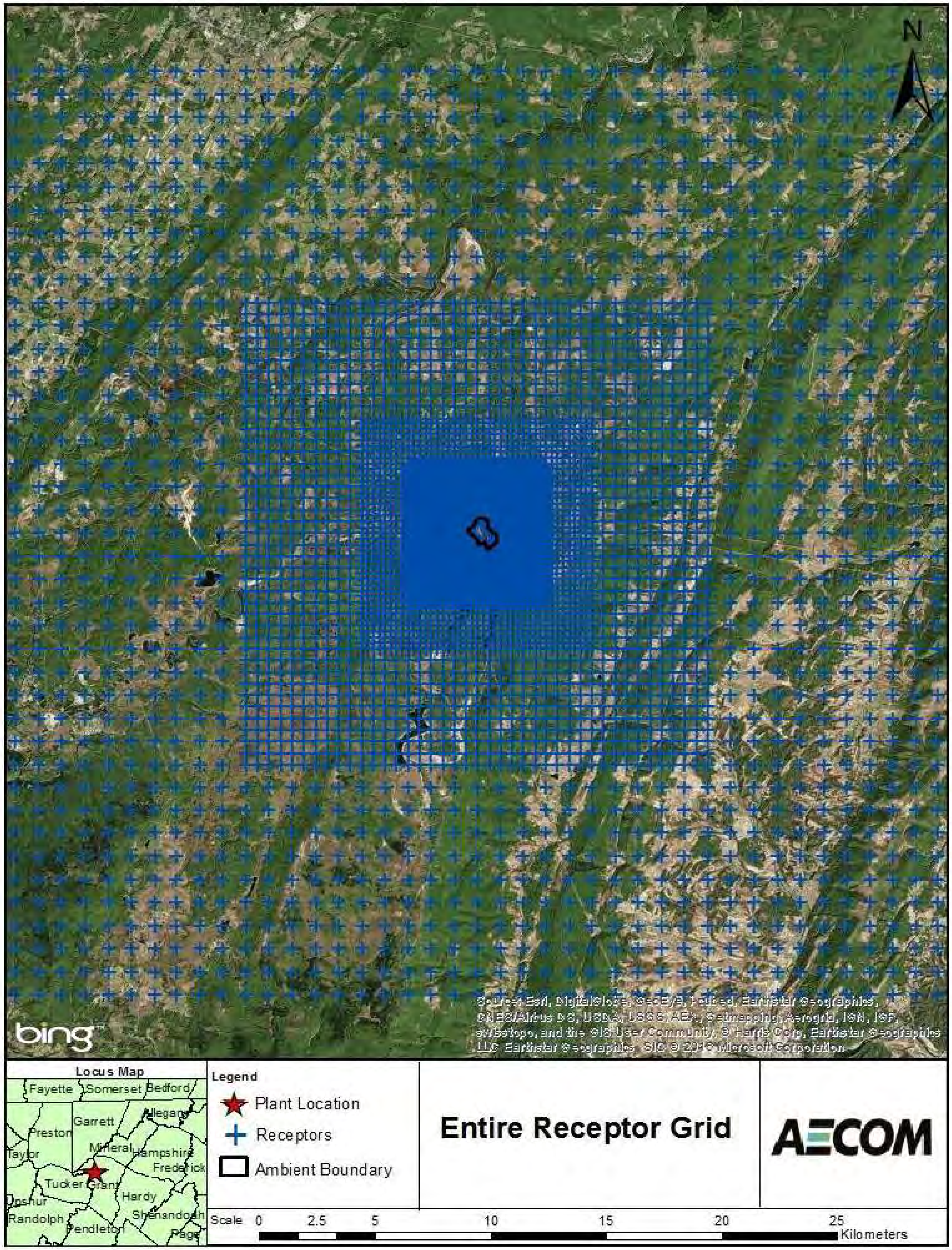


Figure 3-3 Entire Receptor Grid for AERMOD Modeling



3.4 Meteorological Data for Modeling

Meteorological data required for AERMOD include hourly values of wind speed, wind direction, and ambient temperature. Since the AERMOD dispersion algorithms are based on atmospheric boundary layer dispersion theory, additional boundary layer variables are derived by parameterization formulas, which are computed by the AERMOD meteorological preprocessor, AERMET (EPA 2004b). These parameters include sensible heat flux, surface friction velocity, convective velocity scale, vertical potential temperature gradient, convective and mechanical mixing heights, Monin-Obukhov length, surface roughness length, Bowen ratio, and albedo.

3.4.1 Available Meteorological Data

There are three airports within similar proximity to Mount Storm. These three airports are the following:

- Elkins-Randolph County Regional Airport (Elkins),
  located approximately 35 miles southwest of Mount Storm.
- The Greater Cumberland Regional Airport (Cumberland),
  located approximately 35 miles northeast of Mount Storm.
- Morgantown Municipal Airport (Morgantown),
  located approximately 45 miles to the northwest of Mount Storm.

Proximity to Mount Storm and representativeness of the winds are two factors examined to determine which airport is most suitable for modeling.

3.4.1.1 Proximity

The location of each airport relative to Mount Storm is shown in **Figure 3-4**. **Figure 3-4** shows that Cumberland and Elkins are about the same distance from Mount Storm in opposite directions with Morgantown being a bit further away to the northwest. Based on proximity, the choice for modeling would be limited to either Cumberland or Elkins. However, given the terrain throughout the eastern part of West Virginia, additional consideration was given to each of these three airports.

3.4.1.2 Representativeness of Winds

Representativeness of the winds is the most important factor when selecting an appropriate station for modeling. As shown in **Figure 3-4**, there is no available meteorological data in close proximity to Mount Storm. Given the fact there is terrain between each of the three airports and Mount Storm, careful consideration was given to the selection of a representative meteorological data set. **Figure 3-5** provides an overall depiction of the terrain in between and around each of the airports and Mount Storm.

Mount Storm Power Station sits at an elevation of 3,300 feet in a well exposed area, higher than most terrain features around it. Terrain features within 10-15 km of Mount Storm are shown in **Figure 3-6**. As shown in **Figure 3-6**, the terrain elevations decrease toward the east and remain relatively consistent toward the north and west, with the exception of some rolling hills. Even the terrain elevations along Backbone Mountain to the north and west, only get up to about the same elevation as Mount Storm Power Station. There are some terrain features located southwest towards Snowy Point that do rise above stack top and would have the potential for localized impacts on the wind pattern. Generally, this terrain feature could block some of the southwesterly winds.

Figure 3-4 Location of Mt. Storm and Nearby Airports

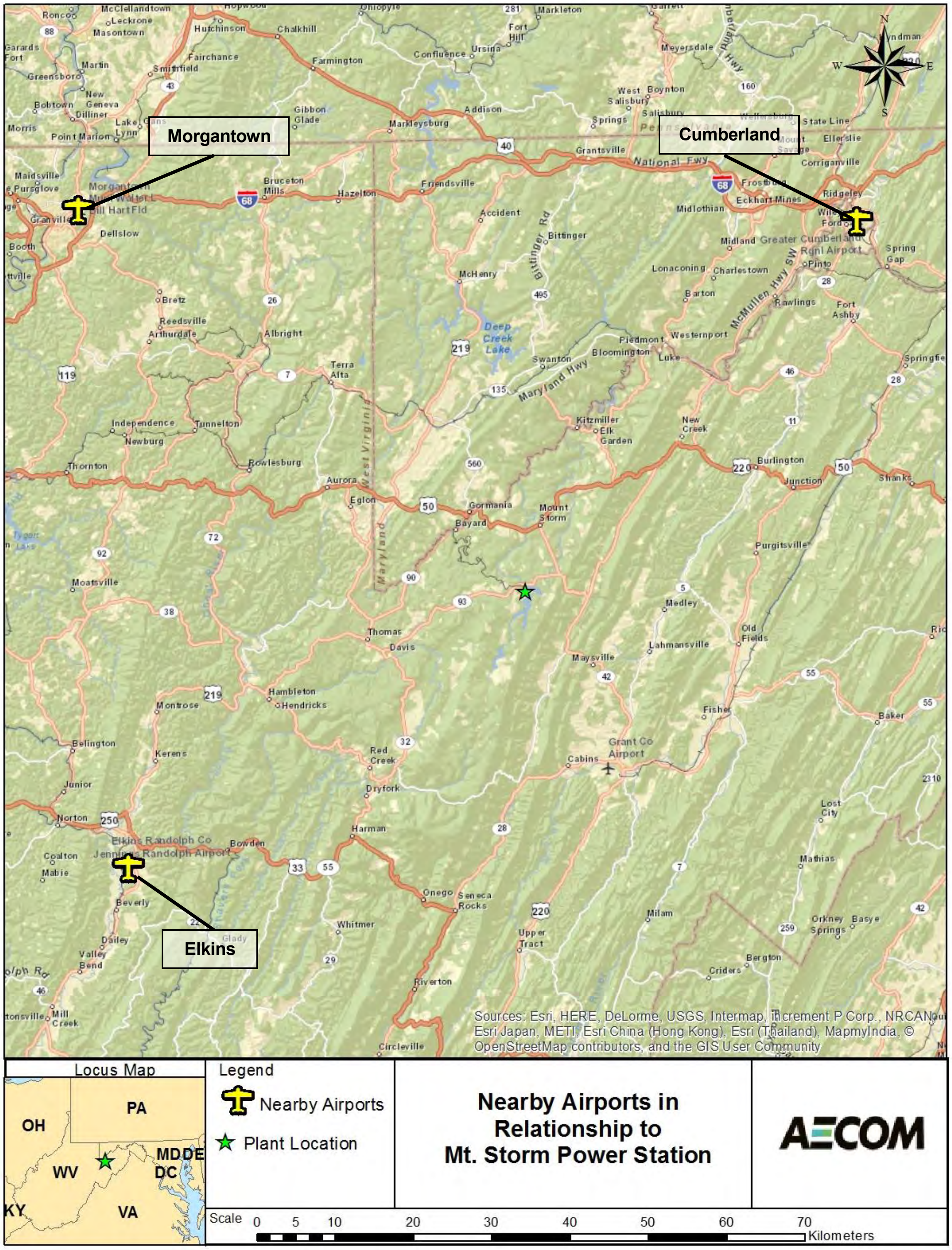


Figure 3-5 Terrain around Mt Storm Power Station and Nearby Airports

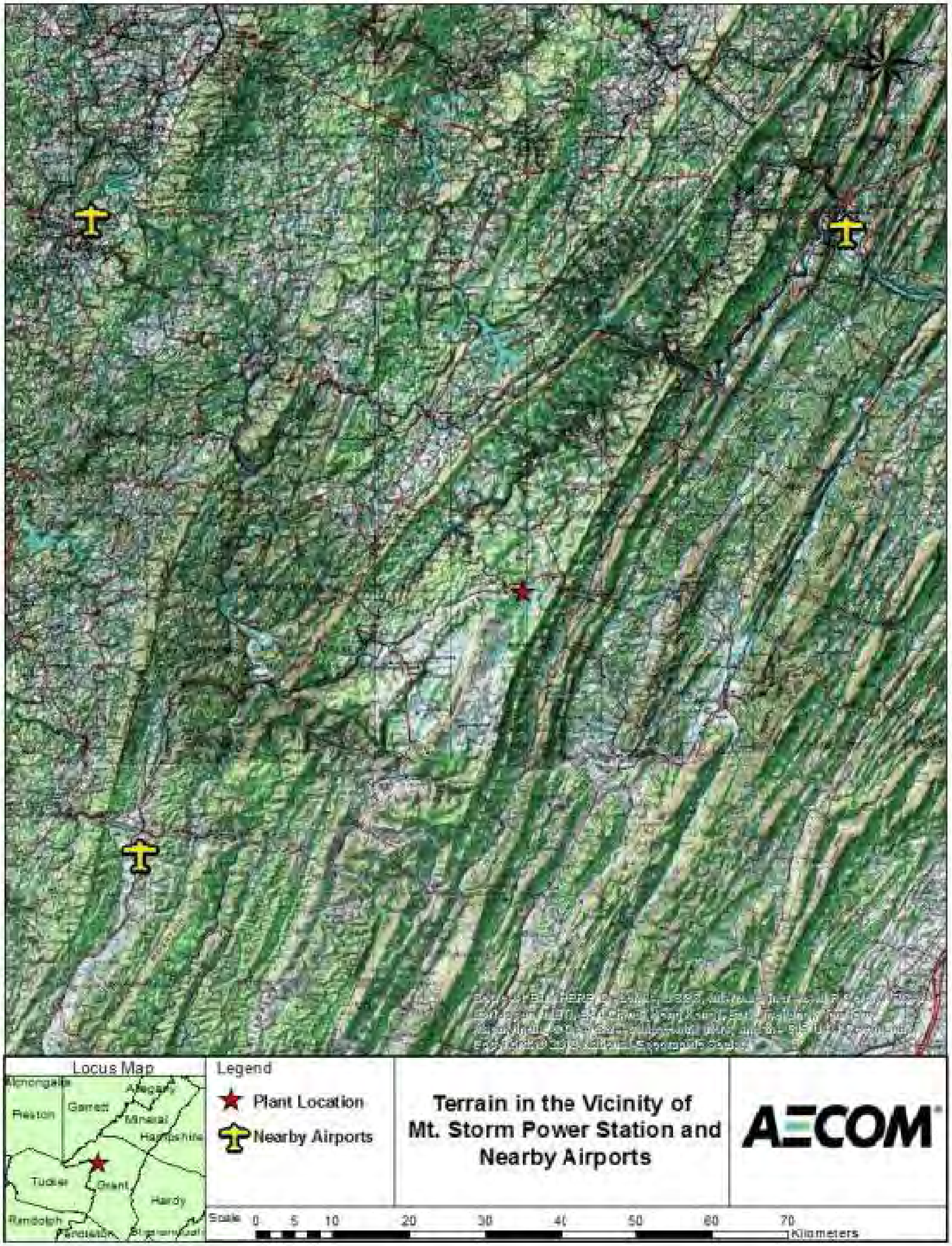


Figure 3-6 Terrain around Mt Storm Power Station

Figure 3-7 shows 3-year (2013-2015) wind roses for Cumberland, Elkins, and Morgantown. These wind roses do not incorporate use of the available 1-minute ASOS data for each airport (with the exception of Elkins in the lower-right quadrant of the figure). The Elkins wind rose shows a very similar wind pattern with or without the 1-minute ASOS data. A comparison of the wind roses for the three nearby airports relative to what would be expected at the well-exposed Mount Storm site (considering the terrain to the southwest) indicates that the Elkins or Cumberland wind roses appear to be more representative than Morgantown. As the wind roses illustrate, winds from Elkins and Cumberland are primarily from the west and northwest, whereas the winds from the Morgantown are primarily from the southwest.

In order to further investigate which meteorological station is most representative of the winds at Mount Storm, wind roses from AWS True Power LLC's Windnavigator[1] Tool were obtained, which uses the "MesoMap™" system. This tool, which is used primarily to assess wind power potential at specific locations, provides a wind rose based on 200-meter modeled meteorological data for a selected geographic location. The preparation and validation of the modeled data is described in *AWS True Wind's Wind Resource Maps and Data – Methods and Validation*[2].

The MesoMap™ system combines two atmospheric models: a mesoscale numerical weather prediction model called "MASS"[3] and a microscale wind flow model (WindMap[4]). The mesoscale simulations are initialized by the NCAR/NCEP Global Reanalysis database. This database includes weather observations from a variety of sources, including surface stations, rawinsondes, satellites, aircraft, and Doppler radar. The models also use other data input such as topography, land use, sea-surface temperatures, soil temperatures, and moisture.

Figure 3-8 shows the AWS True Winds wind roses for Mount Storm, Elkins, Cumberland, and Morgantown. The AWS True Wind wind rose for Mount Storm is most comparable to Elkins due to the coincidence of the peak wind direction as compared to the actual and AWS True Wind wind roses for Cumberland and Morgantown. The AWS True Wind wind rose for Elkins verses the Elkins actual wind rose (**Figure 3-7**) also shows fairly good agreement for the prevailing northwest wind direction. The actual Elkins wind rose shows a secondary prevailing direction from the south-southeast that is not present in the AWS True Wind wind rose for Elkins; it may be a localized issue at the airport.

The AWS True Wind wind roses for Elkins and Mount Storm show fairly good agreement among each other, indicating that Elkins is the best choice for a regionally representative wind rose.

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[1] https://dashboards.awstruepower.com/subscriptions/windnavigator

[2] https://www.awstruepower.com/assets/Wind-Resource-Maps-and-Data-Methods-and-Validation1.pdf

[3] Manobianco, J., J. W. Zack, and G.E. Taylor, 1966. Workstation –baed real-time mesoscale modeling designed for weather support to operations at the Kennedy Space Center and Cape Canaveral Air Station. *Bull. Amer. Meteor. Soc.*, 77, 653-672.

[4] Brower, M.C., 1999. Validation of the WindMap Model and Development of MesoMap. Proceedings of Windpower 1999, American Wind Energy Association, Washington, D.C.

Figure 3-7 Wind Roses for Nearby Airports (at 10-m height)

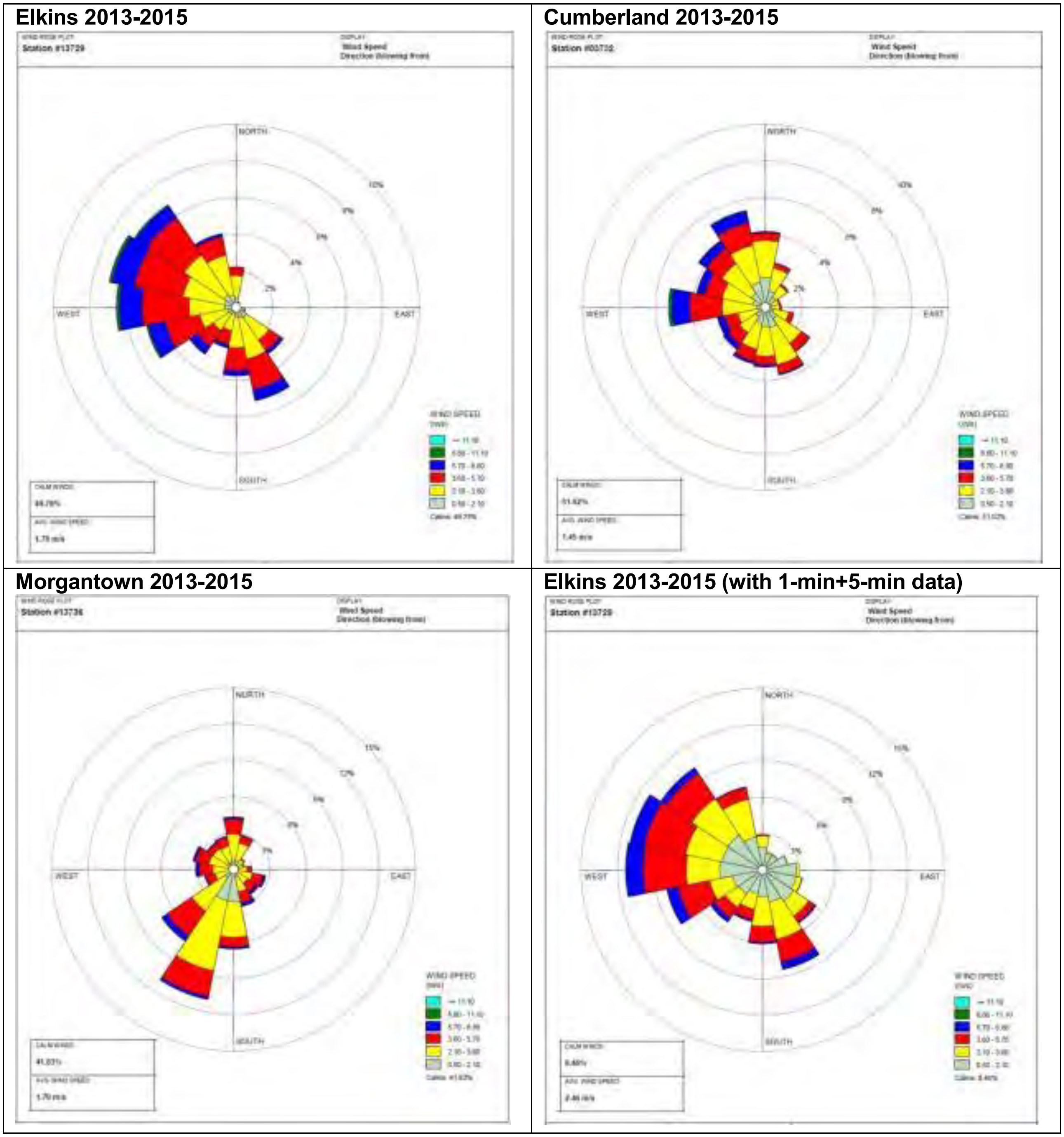
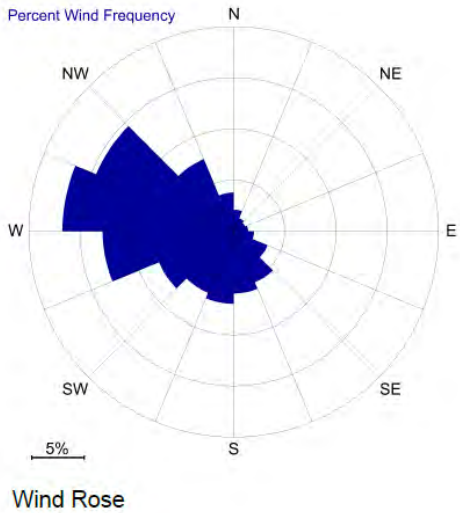
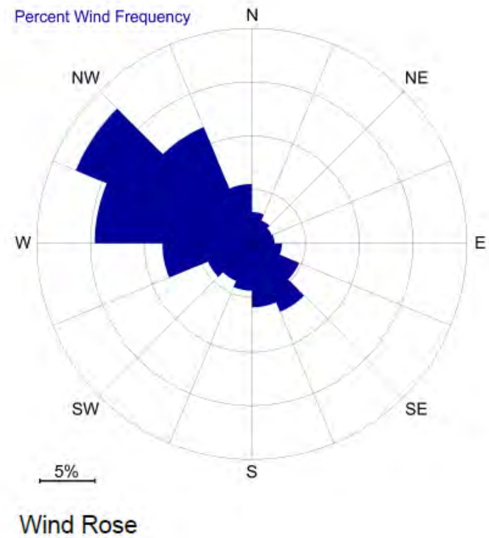


Figure 3-8 AWS True Winds Wind Roses (at 10-m height)

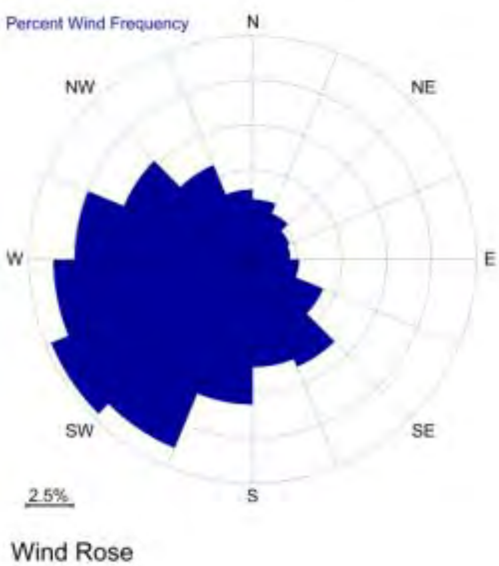
Elkins AWS True Wind



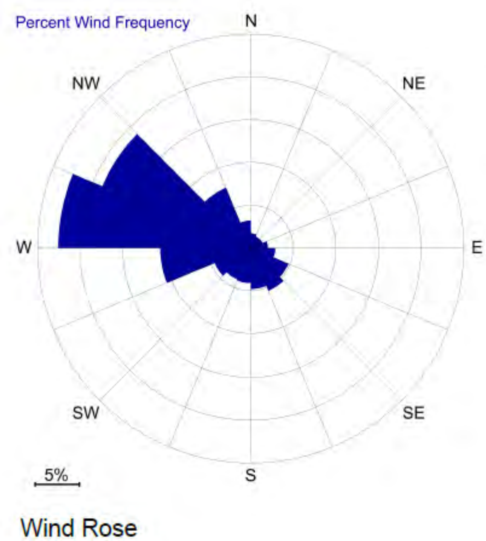
Cumberland AWS True Wind



Morgantown AWS True Wind



Mt. Storm AWS True Wind



3.4.1.3 Representativeness of Land Use

According to the AERMOD Implementation Guide (AIG) (EPA, 2015), land use surrounding the meteorological measurement site and the application site must be representative of one another. In the event they are not, a sensitivity analysis could be performed to determine which set of land use parameters result in the most conservative modeling results. The key land use parameters that are compared include surface roughness (z_o), albedo (r), and Bowen ratio (B_o).

Since Elkins provides the best representation of winds for Mount Storm Power Station, the representativeness of the land use was compared between Elkins airport and the Station. As such, for this sensitivity analysis, AERSURFACE was run with the default 12 sectors and the following season/month assignments:

Jan, Feb, Mar, Nov, Dec = Late autumn after frost and harvest, or winter with no snow
Apr, May = Transitional spring (partial green coverage, short annuals)
Jun, Jul, Aug = Midsummer with lush vegetation
Sep, Oct = Autumn with unharvested cropland

For this sensitivity analysis, AERSURFACE was run using average moisture conditions based on the locations plotted on the 1992 NLCD data as shown in **Figure 3-9**. The AERSURFACE output for each site along with a comparison of the values for each site are shown in **Figures 3-10** through **3-12**, respectively for albedo, Bowen ratio, and surface roughness.

As shown in **Figures 3-10** and **3-11**, both sites have very similar (sometimes identical) albedo and Bowen ratio values when compared on a seasonal and sector basis. A comparison of the surface roughness values on a seasonal and sector basis (shown in **Figure 3-12**); indicate there are differences for some sectors. The Station has higher surface roughness sectors to the west as compared to the Elkins airport, while sectors to the east have more comparable surface roughens values (due to generally low surface roughness at airports and the water east of Mount Storm).

Given how different the surface roughness values are for each site, the modeling was performed with two sets of meteorological data generated using land use parameters derived for the area around (1) Elkins Airport and (2) Mount Storm Power Station.

Figure 3-9 Land Use within 1-km of Elkins Airport and Mt. Storm

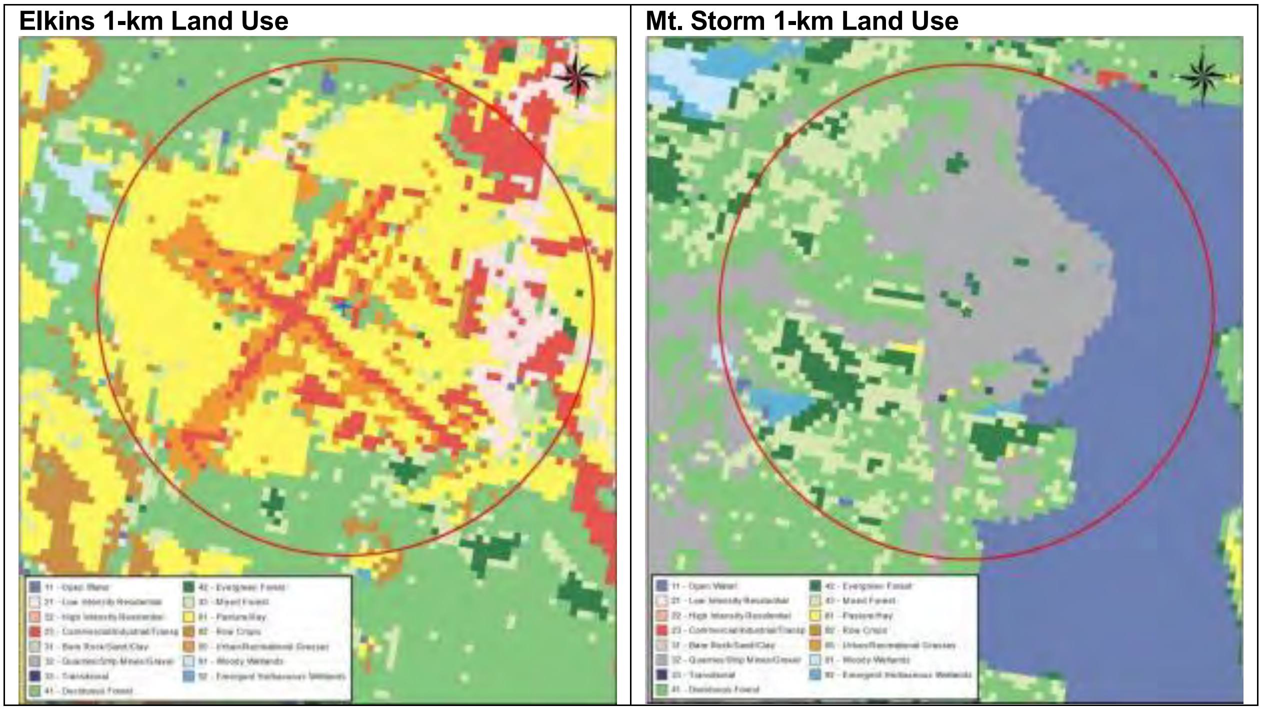


Figure 3-10 AERSURFACE Albedo Output by Season and Sector

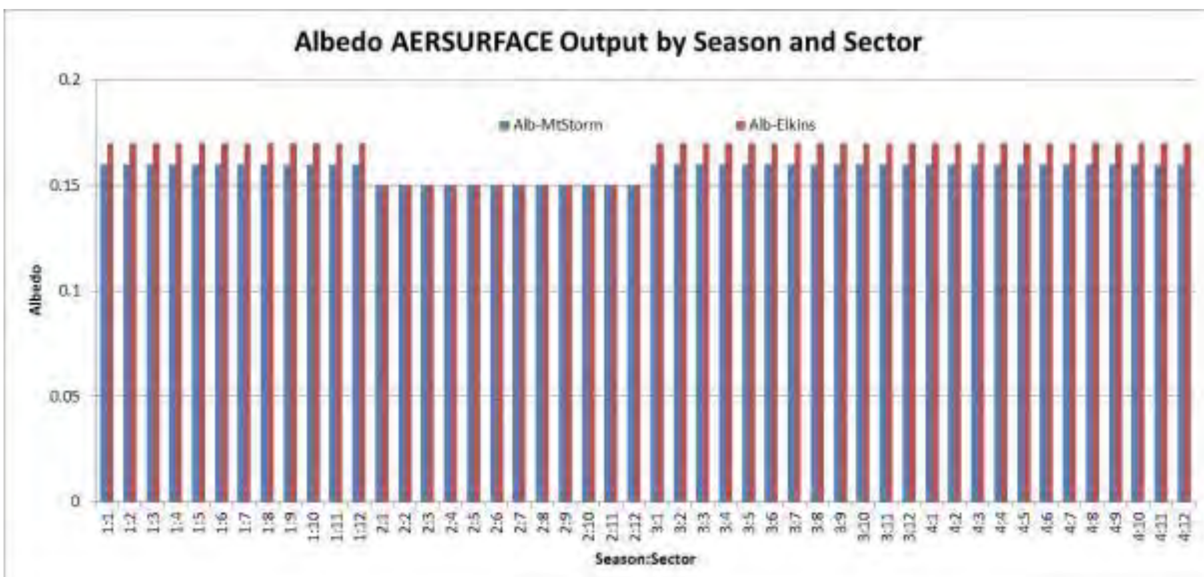


Figure 3-11 AERSURFACE Bowen Ratio Output by Season and Sector

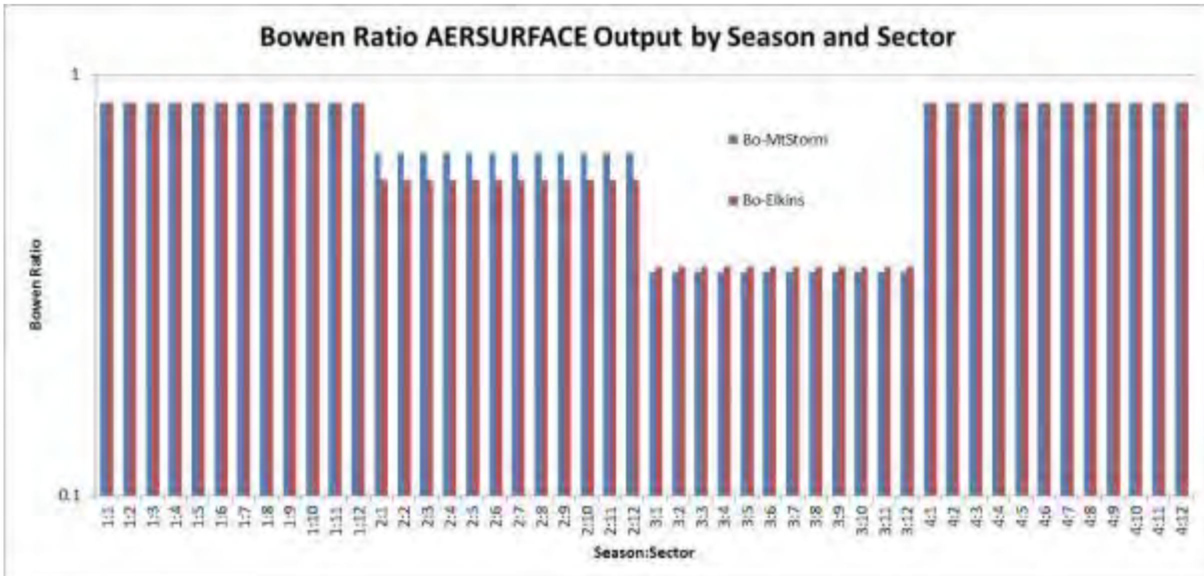
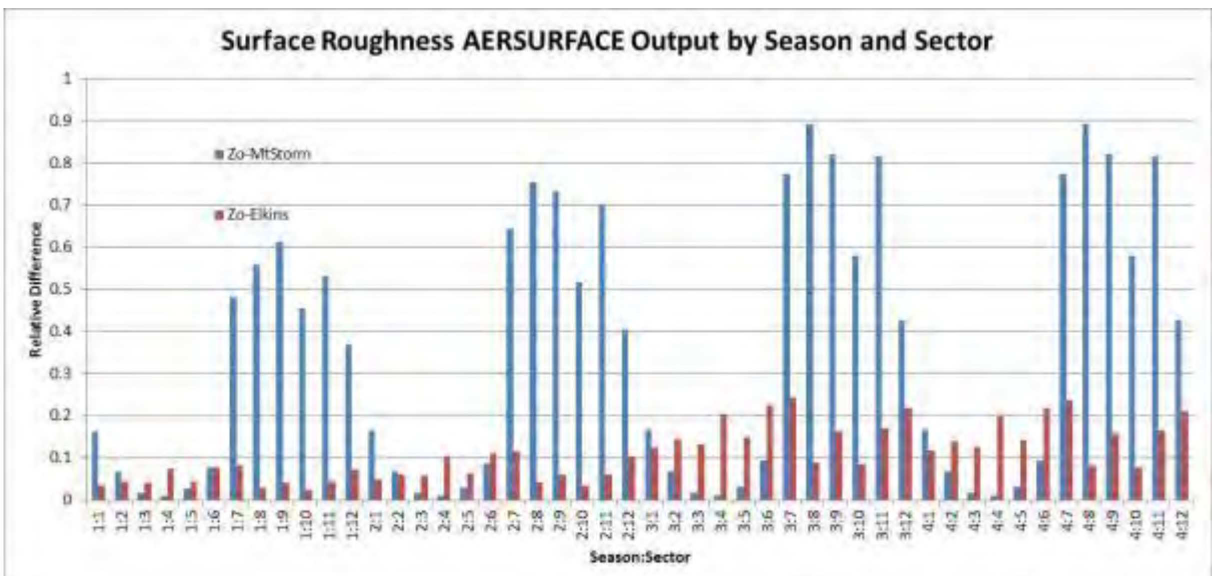


Figure 3-12 AERSURFACE Surface Roughness Output by Season and Sector



3.4.2 Meteorological Data Selection

Based on the considerations outlined in **Section 3.4.1**, the modeling analysis was performed using meteorological data from Elkins Airport generated using land use parameters derived for the area around (1) Elkins Airport and (2) Mount Storm Power Station.

3.4.3 Meteorological Data Processing

The hourly meteorological data for Elkins was processed with the latest version of AERMET (Version 15181) (EPA 2004b), the meteorological preprocessor for AERMOD. Specifically, AERMET was run utilizing three concurrent years (2013-2015) of hourly surface observations from Elkins-Randolph County Regional Airport along with concurrent upper air data from Pittsburgh International Airport, PA. **Figure 3-13** shows the location of meteorological stations in relationship to the Mount Storm Power Station.

The AERMET inputs were based on surface meteorological data from the National Climatic Data Center's (NCDC) Integrated Surface Hourly (ISH) database along with 1-minute and 5-minute Automated Surface Observing System (ASOS) data. The upper air data input to AERMET was downloaded from the NOAA/ESRL/GSD - RAOB database (http://esrl.noaa.gov/raobs/).

Table 3-1 gives the site location and information on these data sets. The surface wind data are measured 7.92 meters above ground level. The temperature and relative humidity are measured 2.0 meters above ground level.

USEPA guidance provided in Meteorological Monitoring Guidance for Regulatory Modeling Applications (February 2000) (EPA 2000), Section 5.3, specifies a completeness requirement of 90% on a quarterly basis. The 90 percent requirement applies to each of the variables; wind direction, wind speed, stability, and temperature and to the joint recovery of wind direction, wind speed, and stability. The **Table 3-2** summarizes the quarterly joint data completeness by year. As shown in **Table 3-2,** all quarters show the data capture is above 90 percent.

Additionally, there are only 4 missing soundings over the three-year period. These missing soundings are also accounted for in the joint data completeness as these values reflect the missing data report from the end of the AERMOD output file which includes all non-modeled hours due to missing surface and upper air data.

Based on this high level of data capture no filling of missing surface or upper air data was performed.

Table 3-1 Meteorological Data Used in Running AERMET

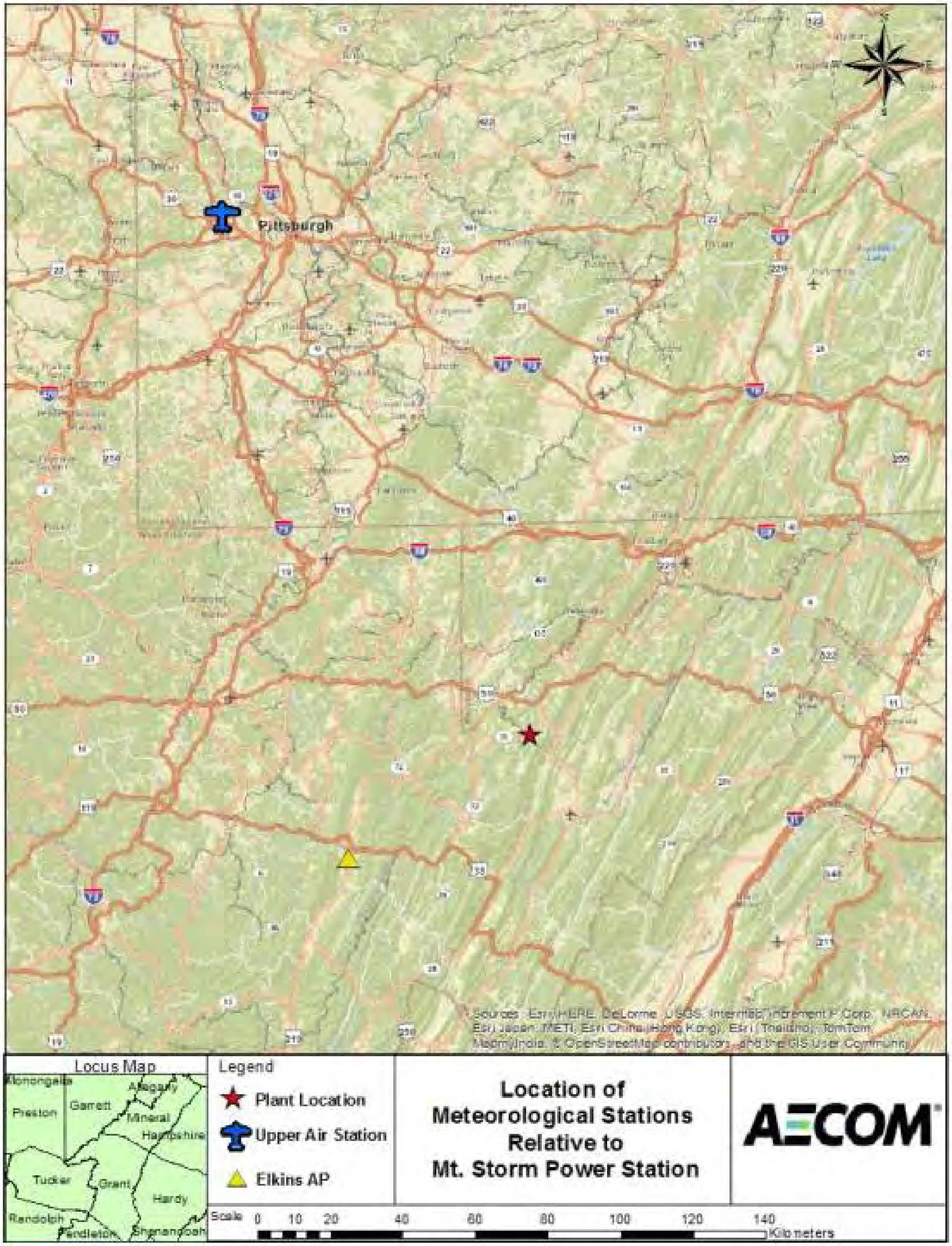
Met Site	Latitude	Longitude	Base Elevation (m)	Data Source	Data Format
Elkins Airport, WV	38.89	-79.85	603	NCDC	ISHD and 1-min ASOS
Pittsburgh International Airport, PA	40.53	-80.23	1150	FSL	FSL

Table 3-2 Meteorological Data Completeness Percentage Per Quarter

Quarter[1]	2013	2014	2015
1	99.9%	99.3%	98.6%
2	99.8%	100.0%	100.0%
3	99.7%	99.4%	99.9%
4	99.2%	100.0%	99.7%
Total	99.7%	99.7%	99.6%

1. Quarter 1 = Jan, Feb, Mar; Quarter 2 = April, May, June; Quarter 3 = July, Aug, Sept; and Quarter 4 = Oct, Nov, Dec

Figure 3-13 Location of Meteorological Stations Relative to Mount Storm Power Station



3.4.4 AERSURFACE Analysis

AERMET requires specification of site characteristics including surface roughness (z_o), albedo (r), and Bowen ratio (B_o). These parameters were developed according to the guidance provided by USEPA in the recently revised AIG and input provided by WVDEP. As discussed in **Section 3.4.1.3**, since Elkins Airport and Mount Storm have different land use parameters, surface characteristics for both sites were evaluated and modeled.

The revised AIG provides the following recommendations for determining the site characteristics:

1. The determination of the surface roughness length should be based on an inverse distance weighted geometric mean for a default upwind distance of 1 kilometer relative to the measurement site. Surface roughness length may be varied by sector to account for variations in land cover near the measurement site; however, the sector widths should be no smaller than 30 degrees.
2. The determination of the Bowen ratio should be based on a simple un-weighted geometric mean (i.e., no direction or distance dependency) for a representative domain, with a default domain defined by a 10-km by 10-km region centered on the measurement site.
3. The determination of the albedo should be based on a simple un-weighted arithmetic mean (i.e., no direction or distance dependency) for the same representative domain as defined for Bowen ratio, with a default domain defined by a 10-km by 10-km region centered on the measurement site.

The AIG recommends that the surface characteristics be determined based on digitized land cover data. USEPA has developed a tool called AERSURFACE (EPA 2008) that can be used to determine the site characteristics based on digitized land cover data in accordance with the recommendations from the AIG discussed above. AERSURFACE incorporates look-up tables of representative surface characteristic values by land cover category and seasonal category. AERSURFACE was applied with the instructions provided in the AERSURFACE User's Guide.

The current version of AERSURFACE (Version 13016) supports the use of land cover data from the USGS National Land Cover Data 1992 archives[5] (NLCD92). The NLCD92 archive provides data at a spatial resolution of 30 meters based upon a 21-category classification scheme applied over the continental U.S. The AIG recommends that the surface characteristics be determined based on the land use surrounding the site where the surface meteorological data were collected. However, as discussed, since there are differences in the land use between the Elkins Airport and Mount Storm, surface characteristics were determined for both sites.

As recommended in the AIG for surface roughness, the 1-km radius circular area centered at the meteorological station site can be divided into sectors for the analysis; each chosen sector has a mix of land uses that is different from that of other selected sectors. Sectors used to define the meteorological surface characteristics for the Elkins Airport and Mount Storm Power Station are shown in **Figures 3-14** and **3-15**.

In AERSURFACE, the various land cover categories are linked to a set of seasonal surface characteristics. As such, AERSURFACE requires specification of the seasonal category for each month of the year. Based on the climatology of high and low daily temperatures – and how these coincide with the growing season – (**Figures 3-15** and **Figure 3-16**) for a 30-year period of record

[5] http://edcftp.cr.usgs.gov/pub/data/landcover/states/

(1971-2000) in Elkins, West Virginia for Elkins Airport and Bayard, West Virginia for Mount Storm Power Station, the following five seasonal categories, as offered by AERSURFACE, will be mapped to the following months for both the airport and Mount Storm land use analyses[6]:

- Midsummer with lush vegetation (June-August);
- Autumn with un-harvested cropland (September-October);
- Late autumn after frost and harvest, or winter with no snow (November-March);
- Winter with continuous snow on ground (November-March); and
- Transitional spring with partial green coverage or short annuals (April-May).

For Bowen ratio, the land use values are linked to three categories of surface moisture corresponding to average, wet and dry conditions. The surface moisture condition for the site may vary depending on the meteorological data period for which the surface characteristics will be applied. AERSURFACE applies the surface moisture condition for the entire data period. Therefore, if the surface moisture condition varies significantly across the data period, then AERSURFACE can be applied multiple times to account for those variations. As recommended in the AERSURFACE User's Guide, the surface moisture condition for each month will be determined by comparing precipitation for the period of data to be processed to the 30-year climatological record, selecting "wet" conditions if precipitation is in the upper 30th-percentile, "dry" conditions if precipitation is in the lower 30th-percentile, and "average" conditions if precipitation is in the middle 40th-percentile. The 30-year precipitation data set used in this modeling was taken from Elkins-Randolph County Regional Airport, West Virginia for the Elkins Airport land use analysis and Bayard, West Virginia for the Mount Storm Power Station land use analysis. **Appendix A** contains the two 30-year sets of monthly precipitation data. The 30-year period of record used to establish the 30-year average monthly precipitation totals include 1985 through 2015 (1982 through 2015 at Bayard due to missing annual data for select years).

The monthly designations of surface moisture input to AERSURFACE are summarized in **Table 3-3** and **Table 3-4**.

Table 3-3 AERSURFACE Bowen Ratio Condition Designations – Elkins Airport

Month	2013	2014	2015
January	Wet	Dry	Average
February	Dry	Wet	Average
March	Average	Average	Wet
April	Dry	Dry	Wet
May	Dry	Average	Dry
June	Average	Average	Wet
July	Average	Average	Average
August	Wet	Average	Dry
September	Average	Dry	Average
October	Dry	Wet	Dry
November	Average	Dry	Dry
December	Wet	Average	Wet

[6] For the winter-to-spring designation a month needed approximately more than 50% of the low temperatures > freezing; conversely the transition from autumn-to-winter occurred when the low temperatures dipping below freezing exceeded approximately 50% of the time.

Table 3-4 AERSURFACE Bowen Ratio Condition Designations – Mount Storm Power Station

Month	2013	2014	2015
January	Average	Dry	Average
February	Average	Wet	Average
March	Average	Dry	Wet
April	Dry	Dry	Wet
May	Average	Average	Dry
June	Wet	Wet	Wet
July	Average	Average	Average
August	Wet	Average	Average
September	Dry	Dry	Wet
October	Average	Wet	Average
November	Average	Average	Dry
December	Wet	Average	Average

3.4.5 AERMET Data Processing

AERMET (Version 15181) and AERMINUTE (Version 15272) were used to process data required for input to AERMOD. Boundary layer parameters used by AERMOD, which also are required as input to the AERMET processor, include albedo, Bowen ratio, and surface roughness. The land classifications and associated boundary layer parameters were determined following procedures outlined in **Section 3.4.4**. In running AERMET, the observed airport hourly wind direction was randomized. AERMET was run twice, using land use characteristics surrounding Elkins Airport and Mount Storm Power Station separately.

AERMET was applied to create two meteorological data files required for input to AERMOD:

Surface: A file with boundary layer parameters such as sensible heat flux, surface friction velocity, convective velocity scale, vertical potential temperature gradient in the 500-meter layer above the planetary boundary layer, and convective and mechanical mixing heights. Also provided are values of Monin-Obukhov length, surface roughness, albedo, Bowen ratio, wind speed, wind direction, temperature, and heights at which measurements were taken.

Profile: A file containing multi-level meteorological data with wind speed, wind direction, temperature, sigma-theta (σ_θ) and sigma-w (σ_w) when such data are available. For this application the profile file will contain a single level of wind data (7.92 meters) and the temperature data only.

A wind-rose for the Elkins-Randolph County Regional Airport from the 7.92-meter level is provided in **Figure 3-18**. The wind-rose was generated using the AERMET surface file (which include the 1-minute and 5-minute ASOS data). As shown in the wind rose, the predominant wind direction for the site is from the southwest, although winds out of the northeast are also common.

Figure 3-14 Sectors Used for Surface Characteristics at Elkins-Randolph County Regional Airport

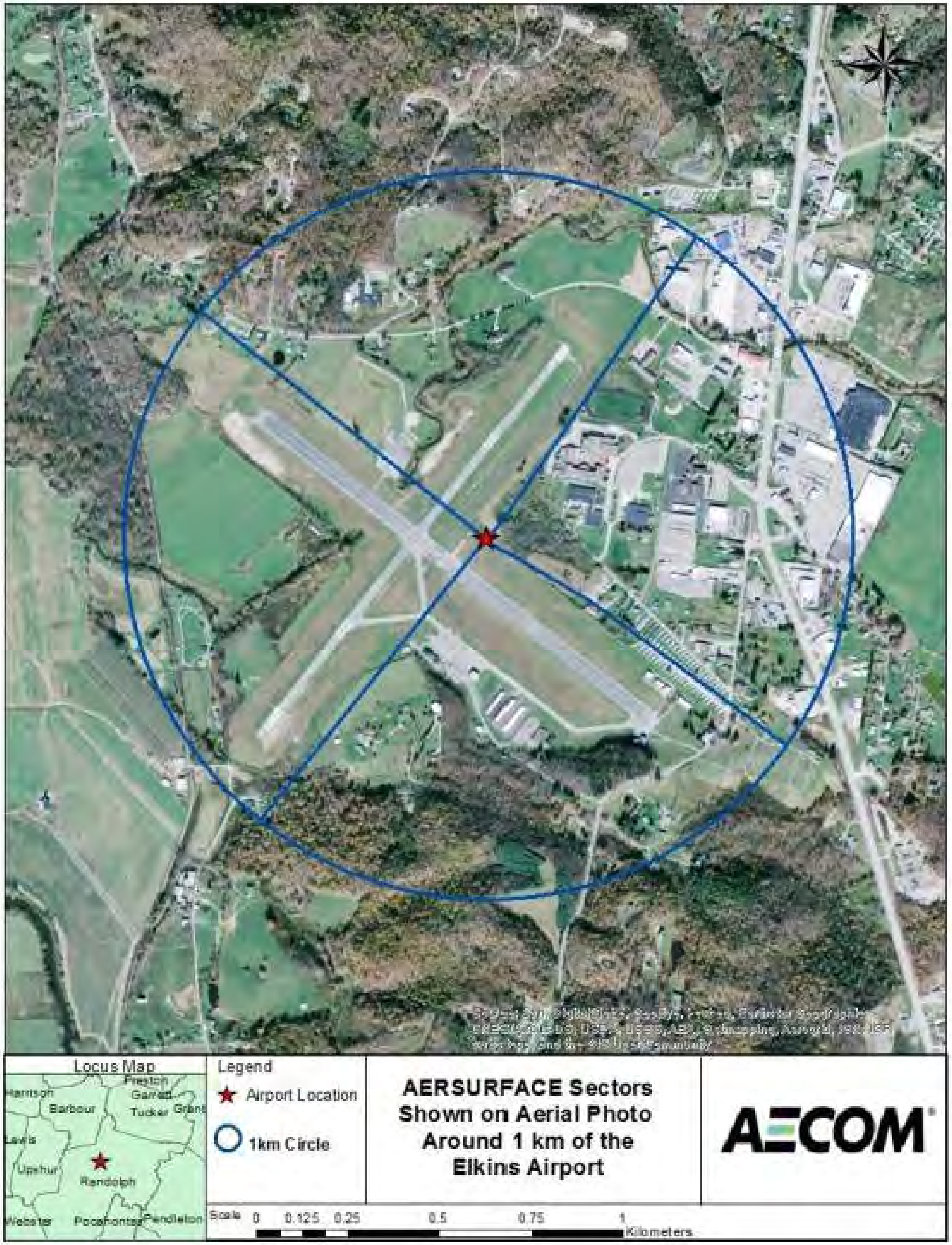
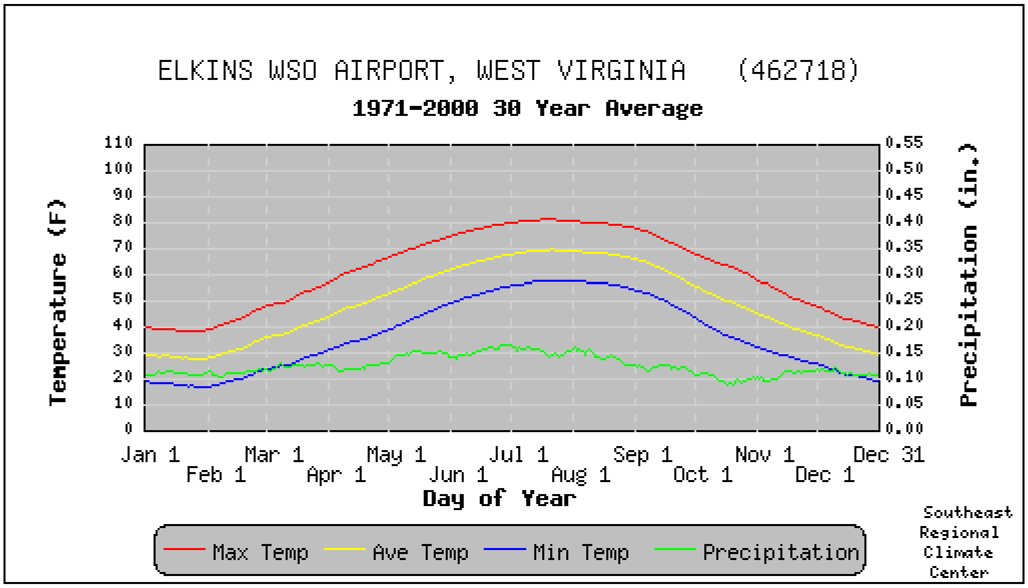


Figure 3-15 Sectors Used for Surface Characteristics at Mount Storm Power Station

Figure 3-16 Regional Temperature Climatology – Elkins, WV



(1) Based on data from the South East Regional Climate Center (SERCC).

Figure 3-17 Regional Temperature Climatology – Bayard, WV

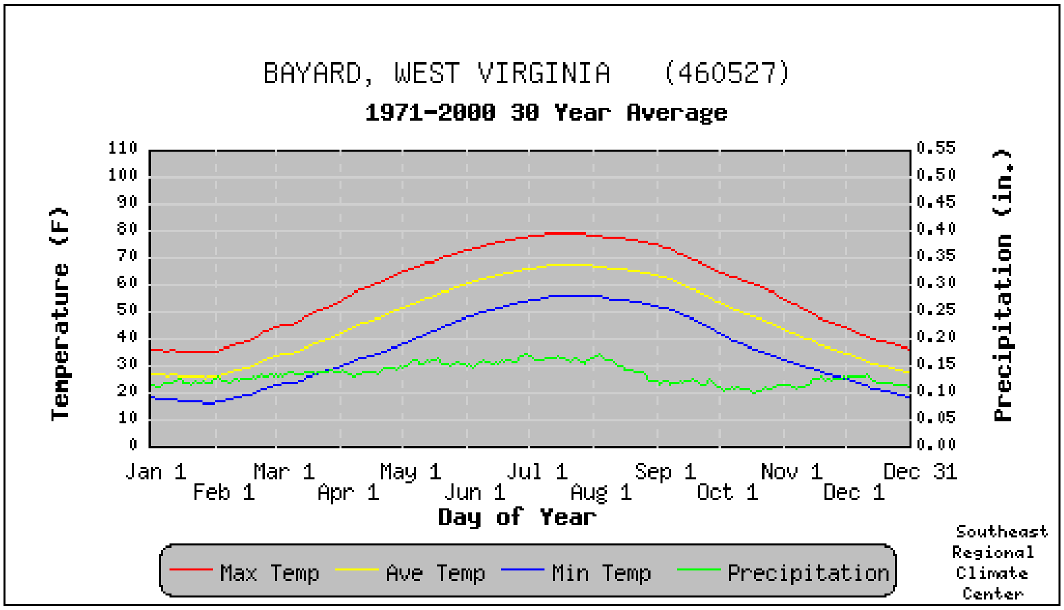
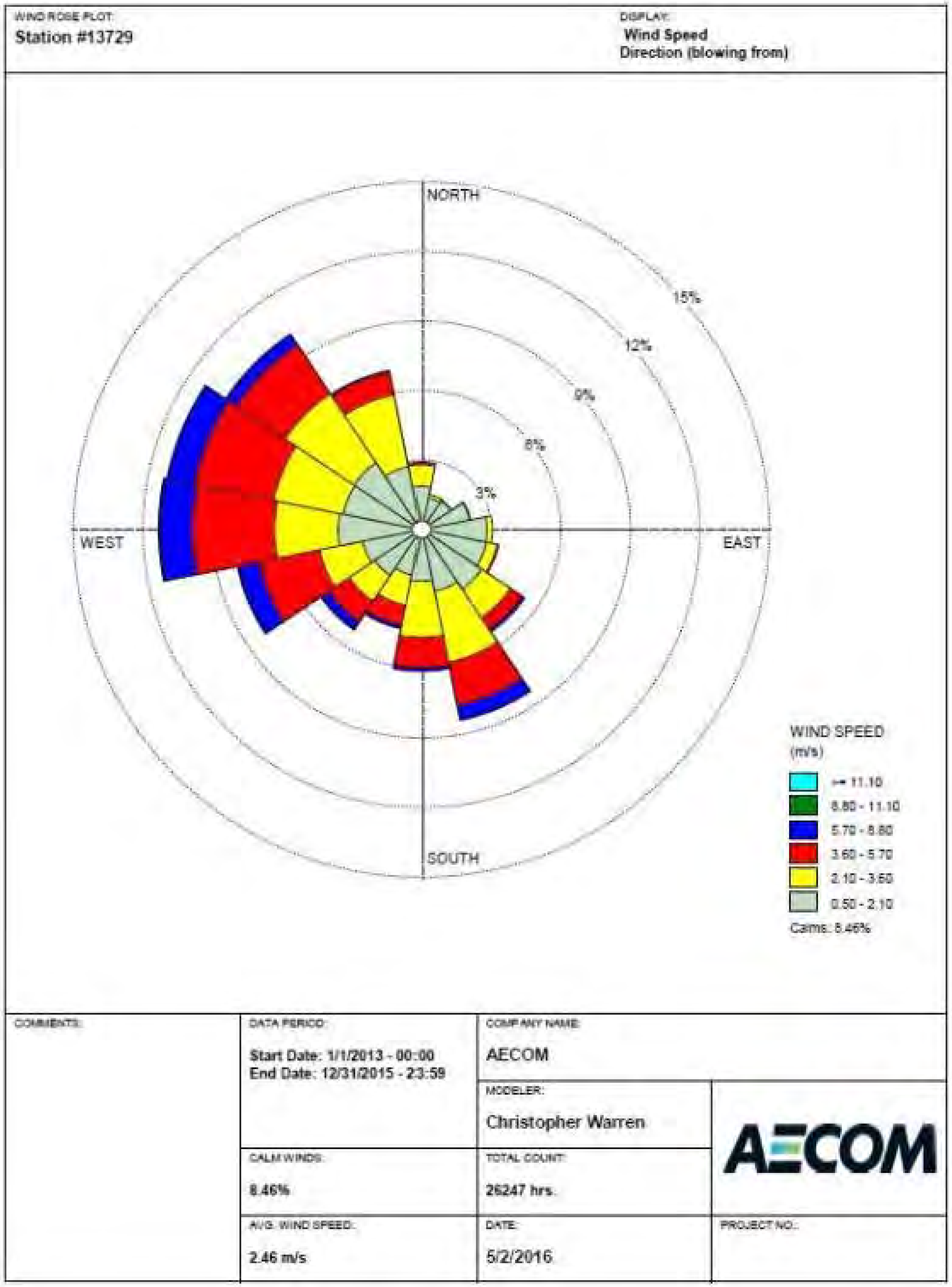


Figure 3-18 Wind Rose for Elkins-Randolph County Regional Airport (10-meter level)



4.0 Emission Rates and Source Characterization

There are three primary SO_2 emission sources at Mount Storm Power Station that were included in the 1-hour SO_2 modeling analysis. Those sources include (1) Unit 1 (MTST-01-BLR-STG-1), (2) Unit 2 (MTST-02-BLR-STG-1) and (3) Unit 3 (MTST-03-BLR-STG-1), which are pulverized coal-fired boilers.

SO_2 emissions from Units 1 through 3 are all currently controlled with wet limestone flue gas desulfurization (FGD) systems.

There are other small sources of SO_2 at the Mount Storm Power Station including: an auxiliary fuel-oil-fired boiler (MTST-00-AB-STG-1), a combustion turbine (MTST-C1-CTG-T-1), two diesel-fired emergency generators (MTST-00-EG-DG-1A and 1B), six propane-fired emergency generators (Communication Tower, SW-EG-1 through 5) and two diesel-fired fire pumps (MTST-00-FP-ENG-1 and 3). Each of these sources are either emergency in nature and will not operate routinely or have very low actual SO_2 emissions. In either case, the impact of these potential small sources of SO_2, will not have an impact on the 1-hour SO_2 modeling.

Table 4-1 shows the last three years of annual emissions for these units. The emissions for these units, as presented in **Table 4-1**, are extremely low and support the exclusion of these sources from the 1-hour SO_2 modeling as the operation of these units will not significantly impact the statistically based 1-hour SO_2 NAAQS. Based on facility-wide total SO_2 emissions for Mount Storm as reported in 2013-2015 (approximately 3,800 to 5,450 TPY), these insignificant sources make up 0.1% or less of the total facility SO_2 emissions.

As such, Unit 1, Unit 2 and Unit 3 are the only emission sources from the Station that were included in the 1-hour SO_2 modeling.

Based on the current stack configurations, Unit 1 and Unit 2 exhaust through a common single flue 743 foot stack. Unit 3 exhausts through a separate 579 foot stack. The NAAQS modeling was performed with the actual stack heights in accordance with recommendations in the DRR and TAD.

Table 4-2 shows the physical stack parameters that were used in the modeling. The hourly exhaust flow rates, temperatures, and emission rates were based on the actual data available from the continuous emission monitor (CEM) systems. The data capture on Mt. Storm Units 1-3 CEMs data exceeded 99%. Missing data was replaced following Part 75 data substitution requirements. The emissions for modeling consisted of actual hourly data for the most recent three calendar years (2013-2015). The modeling archive includes an Excel spreadsheet with the hourly CEMs data used for the modeling analysis.

Table 4-1 Annual Emissions for Insignificant Sources

Equipment Description	Equipment ID	Emergency?	Hp	Gallons/ hr	Rating (MMBtu/hr)	Fuel	Fuel Consumption			Highest Annual SO_2 Emissions (tons)
							2013	2014	2015	
Auxiliary Fuel-Oil-Fired Boiler*	MTST-00-AB-STG-1	No	NA	1071	150	Fuel Oil	68	290	247,071	3.46
Combustion Turbine	MTST-C1-CTG-T-1	No	NA	1536	215	Jet Oil	20,897	12,646	12,543	0.43
Emergency Diesel Generator 1A	MTST-00-EG-DG-1A	Yes	536	38	4.38	Diesel	120	0	0	<0.01
Emergency Diesel Generator 1B	MTST-00-EG-DG-1B	Yes	536	38	4.38	Diesel	120	120	30	<0.01
Propane-Fired Emergency Generator	Communication Tower	Yes	41							negligible
Propane-Fired Emergency Generator	SW-EG-1	Yes	224							negligible
Propane-Fired Emergency Generator	SW-EG-2	Yes	224							negligible
Propane-Fired Emergency Generator	SW-EG-3	Yes	224							negligible
Propane-Fired Emergency Generator	SW-EG-4	Yes	227							negligible
Propane-Fired Emergency Generator	SW-EG-5	Yes	227							negligible
Diesel Fire Pump	MTST-00-FP-ENG-1	Yes	305	13	1.88	Diesel	309	309	432	<0.01
Diesel Fire Pump	MTST-00-FP-ENG-3	Yes	336	24	3.36	Diesel	no data	720	1,298	0.02
TOTAL										3.92

Table 4-2 Physical Stack Parameters

Unit	Description	Location (UTM Zone 17 NAD 1983)		Stack Base Elevation (feet)	Stack Height (feet)	Flue Diameter (feet)
		Easting (meters)	Northing (meters)			
Unit 1 and Unit 2	Boilers	649,798.98	4,340,512.23	3255	743	29
Unit 3	Boiler	649,869.66	4,340,430.99	3255	579	21

5.0 Background Monitoring Data

Ambient air quality data are used to represent the contribution of non-modeled sources to the total ambient air pollutant concentrations. In order to characterize SO_2 concentrations in the vicinity of Mount Storm Power Station, the modeled design concentration must be added to a measured ambient background concentration to estimate the total design concentration. This total design concentration can then be used to characterize the area as attainment or non-attainment for the 1-hour SO_2 NAAQS.

For this analysis we have considered data from two nearby monitors: Piney Run (Site ID: 24-023-0002) and Morgantown (Site ID: 54-061-0003). **Figure 5-1** shows the location of Mount Storm Power Station relative to the Piney Run and Morgantown monitors.

Design concentrations for the period of 2013 through 2015 are provided for each of the monitors in **Table 5-1**. The design concentrations are based on the 99th percentile of the peak daily 1-hour SO_2 concentrations averaged over three years.

As shown in **Figure 5-1**, the monitors are comparable in distance from Mount Storm Power Station, with Piney Run being slightly closer. However, as indicated in **Table 5-1**, the percent annual data capture is greater for Morgantown, with Piney Run having only 76 percent data capture for 2013.

Given that neither (1) the distance from the monitors to Mount Storm and (2) the 3-year average design concentrations are not significantly different, the percent annual data capture is the deciding factor on which monitor was selected.

Based on this, the Morgantown monitor was used for the ambient background concentration as part of the 1-hour SO_2 modeling. It should be added that the use of Morgantown is conservative given the monitor is located in close proximity to more urbanized areas while the Mount Storm Power Station is isolated and surrounded by little to no industrial sources of higher SO_2 emissions.

Table 5-1 1-hour SO_2 Design Concentrations for the Piney Run and Morgantown Monitors

Monitor	Year	Annual Data Capture		99th Percentile Concentration (ppb)	Design Concentration (3-year average)	
		hours	%		ppb	µg/m^3
Piney Run	2013	6657	76%	22	20	53
	2014	8474	97%	22		
	2015	7358	84%	17		
Morgantown	2013	8179	93%	14	15	39
	2014	8158	93%	15		
	2015	8349	95%	16		

Figure 5-1 Location of Nearby Monitors in Relation to Mount Storm Power Station

6.0 SO_2 Modeling Results

The 1-hour SO_2 characterization modeling for the Mount Storm Power Station adheres to the following guidance documents (where applicable): (1) the August2016 “SO_2 NAAQS Designations Modeling Technical Assistance Document” (TAD) issued in draft form by the USEPA, (2) the final DRR for the 2010 1-hour SO_2 primary NAAQS, and (3) direction received from the WVDEP Modeling Section.

The 1-hour SO_2 characterization modeling was conducted using AERMOD (version 15181) with default model options, the meteorological data described in **Section 3.4**, and the emission rates discussed in **Section 4**. Modeled concentrations were predicted over the receptor grids described in **Section 3.3**.

The modeled concentration from AERMOD was calculated based on the form of the 1-hour SO_2 NAAQS and then added to an ambient background concentration from the Morgantown monitor as described in **Section 5**. The total design concentration (modeled + background) was then compared to the 1-hour SO_2 primary NAAQS to determine if the area surrounding the Mount Storm Power Station should be designated as attainment or non-attainment.

A summary of the 1-hour SO_2 modeling results is presented in **Table 6-1** for both meteorological data sets. Additional 50-meter spaced receptors were placed in the area of the maximum modeled design concentration when using the 20-kilometer receptor grid to further refine the total concentration (as discussed in Section 3-3). **Figures 6-1** and **6-2** illustrate the overall pattern of the total SO_2 concentrations (sum of modeled and monitored background) along with the location of the total maximum design concentration for each meteorological data set. The maximum total design concentrations are approximately 2.1 kilometers east of the facility using the Elkins land use meteorology and approximately 2.1 kilometers to the north of the facility using the Mt Storm land use meteorology. Both of modeled impacts occurred within 100-meter receptor grid spacing.

As shown in **Table 6-1**, modeled concentrations of 1-hour SO_2 are less than the NAAQS at only 48 percent of the threshold. The modeling results indicate that the area surrounding the facility is in compliance with the applicable NAAQS standard and should be designated as attainment.

In addition, because total (modeled + background) concentrations are less than 50 percent of the 1-hour SO_2 NAAQS and the SO_2 emissions are already controlled with a FGD system, the maintenance modeling requirement in the DRR is not necessary to track for this facility. The modeling archive (included with this report as Appendix B) contains all the electronic files needed to review and produce the results contained in this report.

Table 6-1: Summary of 1-hr SO_2 Modeling Analysis

Pollutant	Averaging Period	Modeled Concentration ($\mu g/m^3$)	Monitored Background Concentration ($\mu g/m^3$) (1)	Total Concentration ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)	Percent of NAAQS (%)
<u>Elkins Landuse</u>						
SO_2 *20-km Receptor Grid*	1-Hour	55.54	39	94.54	196	48%
SO_2 *50-m Refined Receptor Grid*	1-Hour	55.73	39	94.73	196	48%
<u>Mount Storm Landuse</u>						
SO_2 *20-km Receptor Grid*	1-Hour	46.62	39	85.62	196	44%
SO_2 *50-m Refined Receptor Grid*	1-Hour	46.70	39	85.70	196	44%

(1) Monitored background concentrations are taken from **Table 5-1**.

Figure 6-1 Total 1-hour SO2 Concentrations – Isopleth (Elkin Landuse)

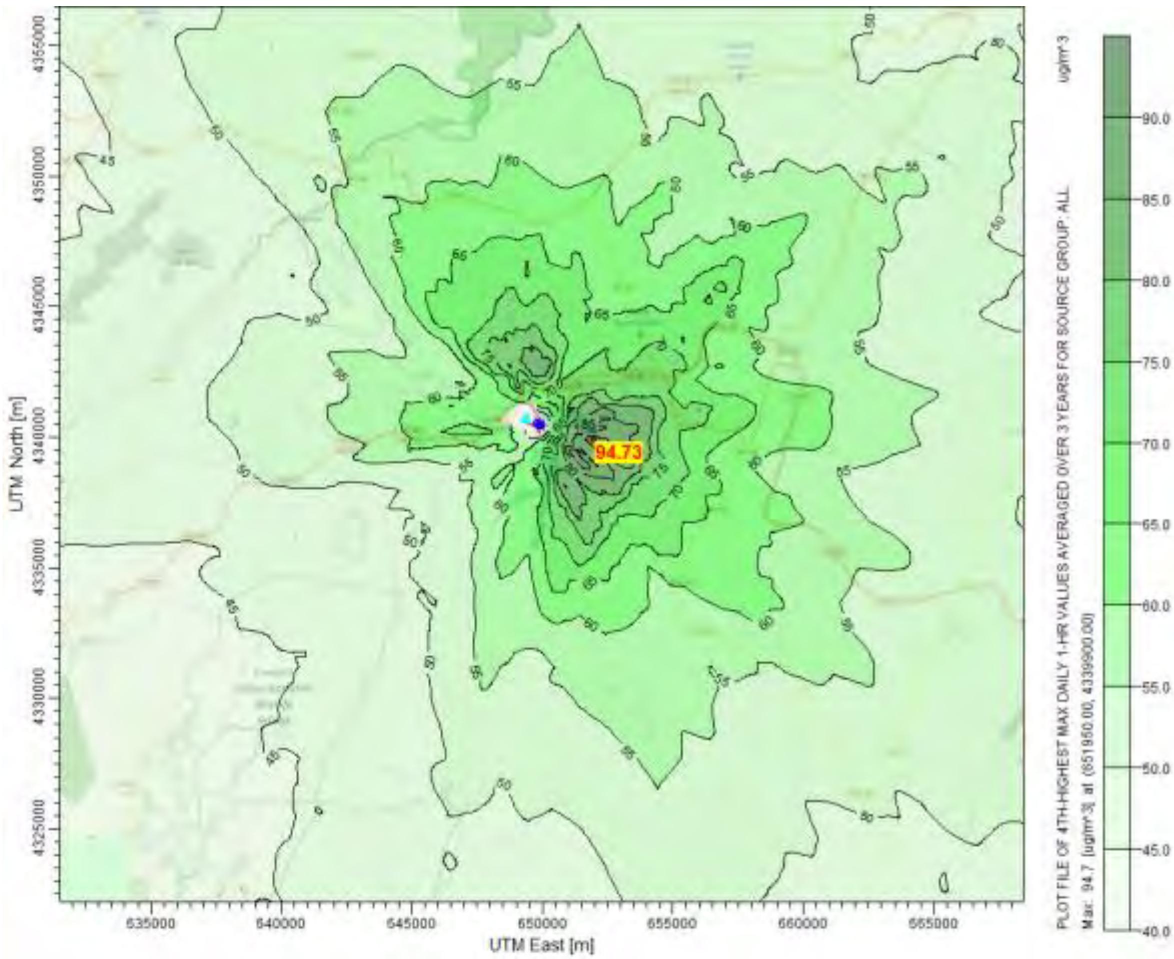
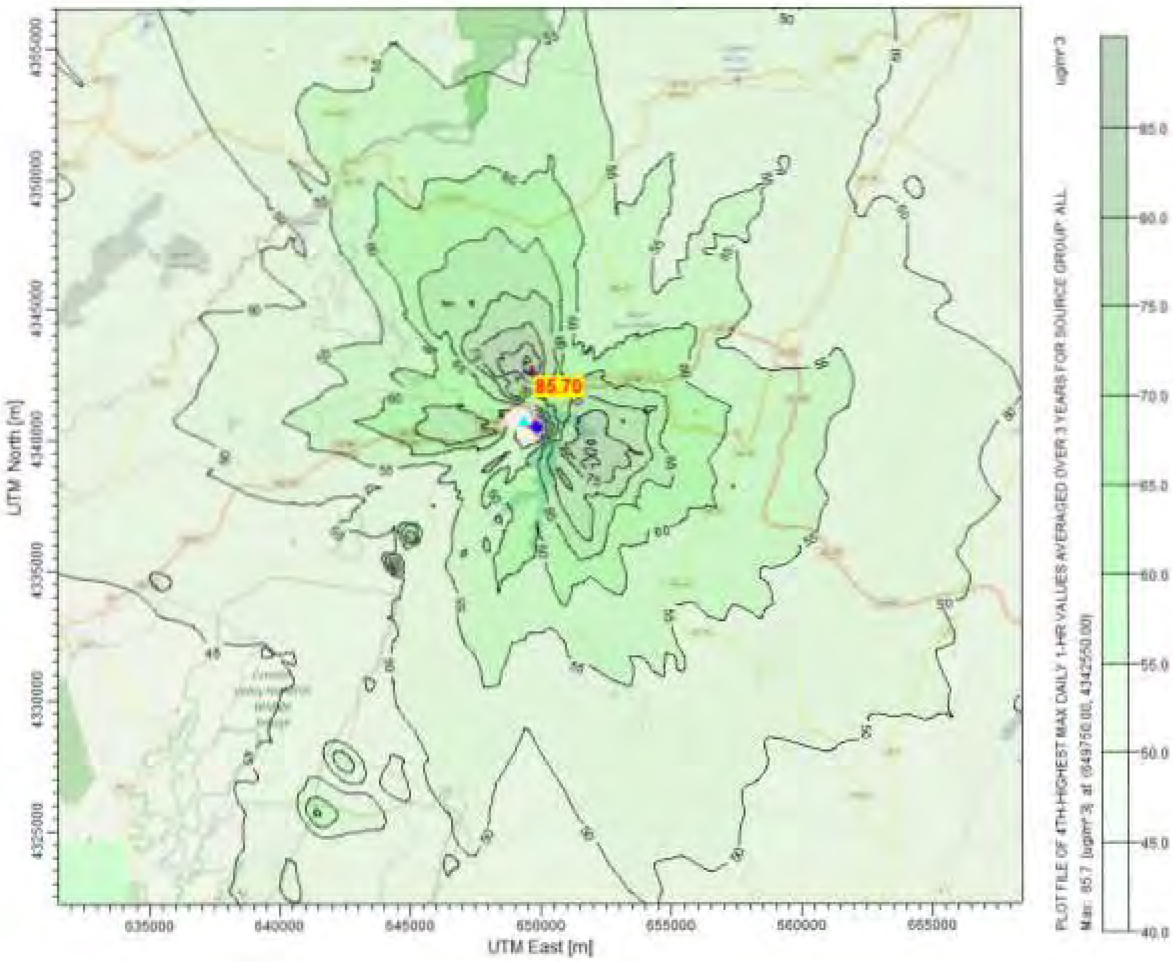


Figure 6-2 Total 1-hour SO2 Concentrations – Isopleth (Mount Storm Landuse)



7.0 References

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Appendix A

30-years of Monthly Precipitation Data

Precipitation Data For Elkins, WV														
Year #	YEAR(S)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
1	1986	2.102	5.276	3.441	3.390	3.043	7.839	6.421	5.031	4.291	2.909	5.689	2.610	52.043
2	1987	4.008	2.953	1.504	3.949	3.878	2.965	1.311	4.295	5.689	1.508	3.177	3.535	38.772
3	1988	2.815	2.508	2.921	3.138	4.835	1.661	3.606	4.051	7.512	2.039	3.606	2.354	41.047
4	1989	3.795	3.831	5.520	4.094	6.087	5.941	5.311	7.976	2.177	3.748	3.657	3.039	55.177
5	1990	3.614	2.878	2.252	3.720	7.031	4.020	4.004	3.248	4.110	3.319	1.661	6.122	45.980
6	1991	4.106	2.492	5.945	3.122	2.323	2.591	8.343	3.528	1.921	2.374	2.661	6.094	45.500
7	1992	2.661	3.724	4.327	2.583	3.201	1.961	8.264	2.496	2.626	0.799	2.661	4.469	39.772
8	1993	1.713	2.874	6.307	3.909	2.685	2.126	2.713	2.189	6.244	2.496	4.539	4.976	42.772
9	1994	5.217	6.520	6.287	3.961	5.130	4.571	5.976	5.685	1.134	0.433	2.638	2.551	50.102
10	1995	3.988	2.906	2.799	3.102	5.437	4.457	1.740	3.787	1.567	2.075	3.547	3.409	38.815
11	1996	5.299	4.728	4.382	3.437	15.768	5.303	12.031	5.039	6.453	2.654	4.469	3.402	72.965
12	1997	2.382	1.732	7.417	2.079	5.713	2.689	3.370	3.724	3.551	1.169	4.882	2.339	41.047
13	1998	4.287	2.535	3.335	4.783	4.020	10.063	3.764	4.307	4.059	1.961	1.409	2.000	46.524
14	1999	6.280	2.496	3.654	2.945	3.657	1.843	1.870	1.882	2.811	4.354	1.272	3.280	36.343
15	2000	1.630	4.193	3.272	4.118	4.303	5.067	4.717	3.827	8.878	0.693	1.913	1.878	44.488
16	2001	2.669	2.598	3.071	2.555	5.752	4.980	8.776	3.035	1.913	1.138	0.862	2.287	39.638
17	2002	3.425	1.429	4.965	6.413	5.555	3.252	7.366	2.445	3.461	4.693	4.157	2.465	49.626
18	2003	2.142	4.437	2.386	3.807	7.516	3.071	4.378	5.559	5.835	2.823	5.004	2.752	49.709
19	2004	2.795	2.760	5.098	5.299	6.949	6.173	6.917	2.413	4.028	3.413	4.209	2.539	52.594
20	2005	3.075	2.185	4.154	4.248	4.756	1.110	6.992	3.020	0.528	5.244	3.539	2.579	41.429
21	2006	3.504	0.843	1.720	5.429	2.961	6.520	5.587	1.776	3.016	3.815	2.618	1.437	39.224
22	2007	2.945	3.350	3.807	4.709	2.484	4.850	6.508	3.724	3.795	4.331	2.276	5.752	48.531
23	2008	3.614	3.331	3.382	3.795	6.642	6.201	3.768	1.362	1.827	1.024	2.933	4.980	42.858
24	2009	4.957	1.646	2.429	6.012	6.043	4.130	8.378	5.949	2.303	4.736	0.843	3.319	50.744
25	2010	2.567	2.398	1.929	1.740	4.602	3.555	6.087	4.862	4.031	2.752	3.110	1.850	39.484
26	2011	1.531	3.272	5.083	7.055	3.949	3.598	5.783	4.142	5.713	4.276	4.232	3.744	52.378
27	2012	1.787	3.626	4.083	2.248	5.957	2.366	10.441	1.331	5.760	4.079	0.484	4.346	46.508
28	2013	4.504	2.094	3.252	2.724	3.819	4.177	4.323	8.035	2.366	1.311	3.154	6.280	46.039
29	2014	2.161	4.114	3.185	1.933	3.953	4.524	5.287	3.098	1.236	6.555	2.386	3.610	42.043
30	2015	3.031	2.709	7.374	6.976	1.791	8.516	4.980	2.098	2.669	1.598	1.890	4.693	48.327
Data from http://www.ncdc.noaa.gov														

Precipitation Data For Baynard, WV														
Year #	YEAR(S)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
1	1983	1.559	1.591	3.433	4.941	6.909	3.291	3.181	2.575	2.370	5.339	3.720	3.854	42.764
2	1984	1.240	3.551	5.500	6.370	4.398	2.913	7.331	4.150	1.602	4.413	5.118	4.638	51.224
3	1986	2.016	5.965	3.508	3.945	3.610	4.445	6.787		2.193	3.315	6.079	2.933	44.795
4	1987	3.886	1.760	2.071	5.378	3.555	4.594	1.925	6.024	6.705	1.551	2.492	3.276	43.217
5	1988	2.783	2.205	2.441	3.882	8.583	1.898	2.122	3.732	4.878	1.909	3.787	2.677	40.898
6	1989	3.815	4.287	5.732	2.591	5.575	6.594	7.240	5.024	4.106	3.256	3.819	2.031	54.071
7	1990	4.492	3.417	1.181	3.508	8.217	4.555	6.752	2.957	3.567	3.996	1.638	6.634	50.913
8	1991	4.098	2.650	4.594	4.126	1.791	2.843	5.177	1.791	1.610	1.575	2.504	6.378	39.138
9	1992	3.449	3.988	4.657	3.091	3.768	3.366	10.760	3.630	2.004	0.890	3.173	6.094	48.870
10	1993	2.720	3.437	7.697	6.520	1.598	2.709	2.886	2.295	6.638	3.083	3.913	4.547	48.043
11	1994	6.043	8.535	8.236	4.445	8.169	4.173	7.654	4.657	2.307	0.740	3.528	3.445	61.933
12	1995	4.921	3.744	1.724	2.720	6.630	3.484	3.996	6.921	1.972	3.890	5.240	4.020	49.264
13	1996	8.472	4.890	6.783	3.260	11.264	4.453	11.028	9.606	9.240	3.469	4.516	4.563	81.543
14	1997	2.898	2.150	7.374	1.949	5.528	3.709	3.083	4.929	3.693	1.890	5.799	4.083	47.083
15	1998	4.988	5.220	3.846	5.614	3.839	8.039	3.102	4.492	2.480	1.728	0.972	1.681	46.004
16	1999	5.059	2.646	5.744	4.902	2.453	0.799	2.945	3.350	4.598	3.173	3.157	2.524	41.350
17	2000	2.047	4.870	3.594	3.110	5.402	3.646	7.303	3.130	3.665	1.299	2.717	2.217	43.000
18	2001	2.957	2.339	3.894	3.575	4.366	5.165	9.437	2.461	2.028	0.909	1.138	3.028	41.295
19	2002	3.177	1.780	4.764	7.020	7.094	3.130	9.949	2.953	3.972	4.756	3.508	3.083	55.185
20	2003	3.016	5.902	2.354	4.587	7.114	6.189	6.591	7.720	11.713	2.709	6.394		64.287
21	2006	4.976	1.976	2.610	5.299	3.579	6.354	3.331	2.382	4.098	4.843	2.685	2.819	44.953
22	2007	4.323	4.106	4.224	4.835	2.071	3.634	7.161	6.193	1.701	4.374	3.016	7.213	52.850
23	2008	4.197	4.083	4.437	4.594	8.760	7.819	4.772	3.358	2.760	1.701	3.492	7.020	56.992
24	2009	6.283	2.205	2.173	4.776	9.012	5.902	3.827	3.925	2.969	5.406	1.299	5.287	53.063
25	2010	4.024	8.122	3.563	2.071	4.268	4.776	3.209	2.484	2.634	3.094	3.283	3.488	45.016
26	2011	3.004	4.236	6.051	8.886	6.031	7.291	2.846	4.906	7.181	5.713	3.799	3.819	63.764
27	2012	4.693	2.740	5.138	2.173	5.461	3.591	4.205	3.138	4.201	6.366	0.807	6.575	49.087
28	2013	4.287	2.894	3.972	3.016	4.941	6.421	5.031	7.665	2.169	2.441	3.319	5.311	51.469
29	2014	2.720	5.465	3.390	2.299	5.953	7.488	5.291	3.272	1.748	5.280	3.031	3.079	49.016
30	2015	3.150	2.760	6.870	5.860	2.800	7.520	4.390	3.960	4.260	3.270	2.310	3.590	50.740
Data from http://www.ncdc.noaa.gov														

Appendix B

Electronic Modeling Archive