Attachment C:
Duke Energy Progress
Mayo Electric Generating Plant

Modeling Report
For 1-hour SO_2 National Ambient Air Quality Standard (NAAQS)

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1. Purpose

On June 2, 2010 USEPA issued a final rule that revised the SO_2 National Ambient Air Quality Standard (NAAQS).[1] The revised SO_2 standard is 75 ppb (196 µg/m^3) based on a three-year average of the 99th percentile of the daily maximum hourly concentration. On August 21, 2015 EPA issued the Data Requirements Rule [2] (DRR) to implement the new standard. The DRR requires all sources of SO_2 greater than 2,000 tons/year (TPY) to characterize the SO_2 concentrations where the sources are located using either a modeling or monitoring approach.

The North Carolina Division of Air Quality (NCDAQ) has demonstrated attainment for the 1-hour SO_2 NAAQS for the Duke Energy Progress owned Mayo Electric Generating Plant (Duke-Mayo) based on a modeling approach. This document describes the procedures followed in conducting the dispersion modeling analysis for Duke-Mayo for the 2013-2015 period. The modeling procedures were consistent with applicable guidance, including the August 2016 SO_2 NAAQS Designations Modeling Technical Assistance Document[3] (TAD) issued by the EPA.

2. Plant Information

Duke-Mayo is a 727 MW coal-fired electric power plant located just south of the North Carolina/Virginia border in Roxboro, Person County, North Carolina. The facility produces steam in two coal-fired boilers (ID Nos. Unit 1A and Unit 1B). Each of these boilers has a heat input capacity of 4,900 million Btu/hr. The steam from these boilers is routed to steam turbines that produce electricity to sell to residential and industrial customers. Unit 1A and Unit 1B are Coal/No. 2 fuel oil/recycled No. 2 fuel oil-fired electric utility boilers (4,512.5 million Btu per hour nominally rated heat input) equipped with low-NOx burner systems, sodium coal conditioning, alkaline-based fuel additives, and halide salts fuel additives in order to reduce NOx and $S0_2$ emissions.

A map and aerial photograph of the facility and surrounding area are provided in Figures 1 and 2, respectively.

[1] Primary National Ambient Air Quality Standard for Sulfur Dioxide75 FR 35520–35603, Jun 22, 2010
[2] Data Requirements Rule for the 1-Hour Sulfur Dioxide (SO2) Primary National Ambient Air Quality Standards (NAAQS): Proposed Rule, Federal Register Vol. 79 No. 92, pages 27445-27472, May 13, 2014.
[3] https://www.epa.gov/sites/production/files/2016-06/documents/so2modelingtad.pdf

Figure 1. Location of Duke-Mayo in Person County, NC

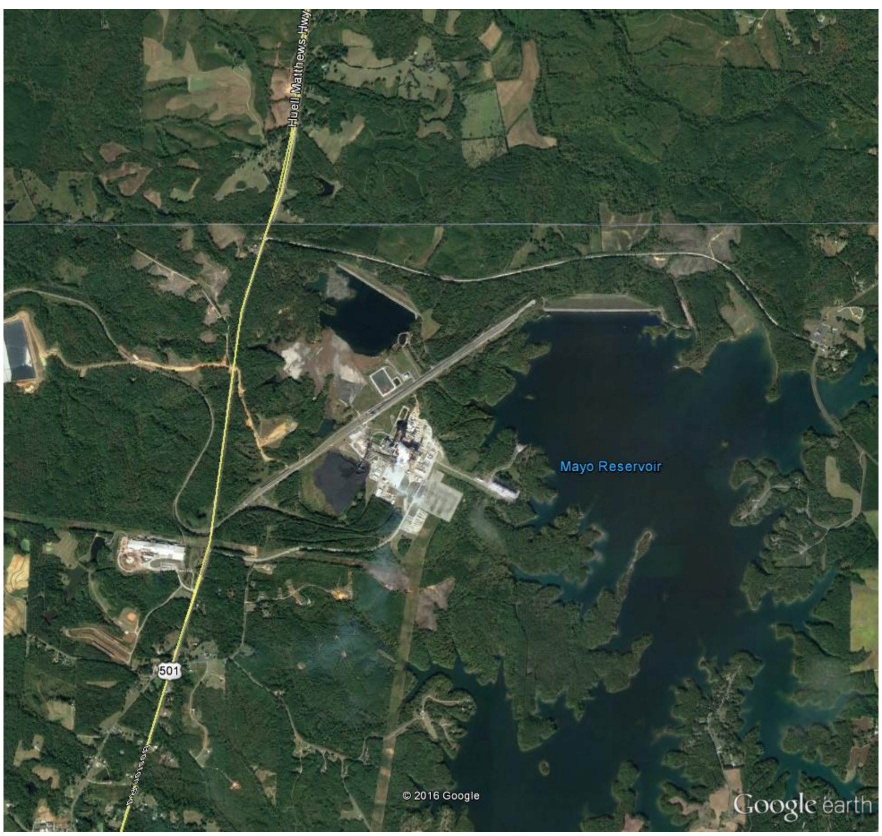

Figure 2. Aerial View of Duke-Mayo

3. Modeling Approach

Following the procedures in the modeling TAD, the dispersion modeling analysis was used to evaluate the attainment status of the area in the vicinity of Duke-Mayo for the 1-hour SO_2 NAAQS. The DRR allows the use of modeling rather than monitoring to make attainment designations. Air quality modeling provides a conservative estimate of the actual air quality within the vicinity of the plant. As recommended, the modeling analysis used the preferred model AERMOD. In addition, to allow for a more accurate representation of actual ambient SO_2 concentrations, the modeling analysis was conducted as follows:

- Using actual emissions and release parameters as an input for assessing current actual air quality;
- Using three years of modeling results to calculate a design value consistent with the 3-year monitoring period required to develop a design value for comparison to the NAAQS;
- Placing receptors for the modeling only in locations where a monitor could be placed; and
- Using actual stack heights rather than following the Good Engineering Practice (GEP) stack height policy when using actual emissions.

The following sections provide an overview of the modeling procedures used for Duke-Mayo.

4. Model Selection

The modeling analysis for the 1 hour SO_2 NAAQS was performed using AERMOD version 15181, and pre-processing program, AERMAP (version 11130). The modeling analysis accounted for building downwash. The BPIPPRIME (version 04274) was used to input building parameters for AERMOD. This modeling analysis was run using the regulatory default options. The pollutant identification was set to "SO_2"in AERMOD, to allow AERMOD to properly calculate an SO_2 design value based on the 3-year average of the 99th percentile of the annual distribution of the daily maximum 1-hour concentrations for comparison with the 1-hour SO_2 NAAQS of 75 ppb (196 µg/m^3).

5. Rural or Urban Dispersion

Modeling for this area most appropriately used the rural dispersion mode. Determination of rural or urban dispersion characterization was based on available satellite imagery showing that the majority of land use types within 3 km radius of the source are open water, forests, and agricultural. Figure 2 shows an aerial satellite image depicting land use within 3 km of the facility. The area can clearly be characterized as "rural". Therefore, AERMOD default rural dispersion coefficients were applied to dispersion and pollutant concentration calculations.

6. Building Downwash

EPA's Building Profile Input Program (BPIP) with Plume Rise Model Enhancements (PRIME) (version 04274), was used to account for building downwash influences on the plume. Building downwash analysis is used to determine if the plume was affected by the turbulent wake from onsite buildings or other structures. The effects of downwash on the plume can result in elevated ground-level concentrations in the near wake of a building and is required for consideration in the modeling. Building downwash was considered for one other nearby source included in the modeling analysis since building parameter information was available. It was not included for the other nearby source because it was not readily available and that level of refinement of the analysis was not necessary. Note that both of these sources are more than 10 km away from Duke-Mayo, thus the downwash effects are not expected to significantly affect the model results.

7. Source Parameters

Duke-Mayo operates two coal fired boilers. These coal fired boilers vent to individual stacks. Table 1 summarizes the source parameters that were used in the modeling. Figure 3 shows the facility's stack locations, buildings and fenceline and Figure 4 shows a closer view of the source and the buildings. As recommended in the SO_2 modeling TAD, the actual hourly emissions data, including exit velocities and temperatures, were used in the modeling. The hourly emissions data coincides with the meteorological data for the period 1/1/2013 thru 12/31/2015. The hourly SO_2 emissions measured by the continuous emissions monitoring system located on each of the boiler stacks was used in the modeling analysis. The hourly SO_2 pounds per hour emission rate was converted to units of grams per second.   All the SO_2 emissions data was quality assured and missing data was not found. The hourly data was input into AERMOD using the HOUREMIS keyword in the source pathway of the AERMOD control file (AERMOD.INP).

Table 1. Duke-Mayo Stack Parameters

Source Description	**Easting (X)**	**Northing (Y)**	**Base Elevation**	**Stack Height**	**Stack Diameter**
	(m)	**(m)**	**(m)**	**(m)**	**(m)**
Stack 1 - Boilers 1A and 1B	688,715	4,044,620	153.5	115.8	9.3

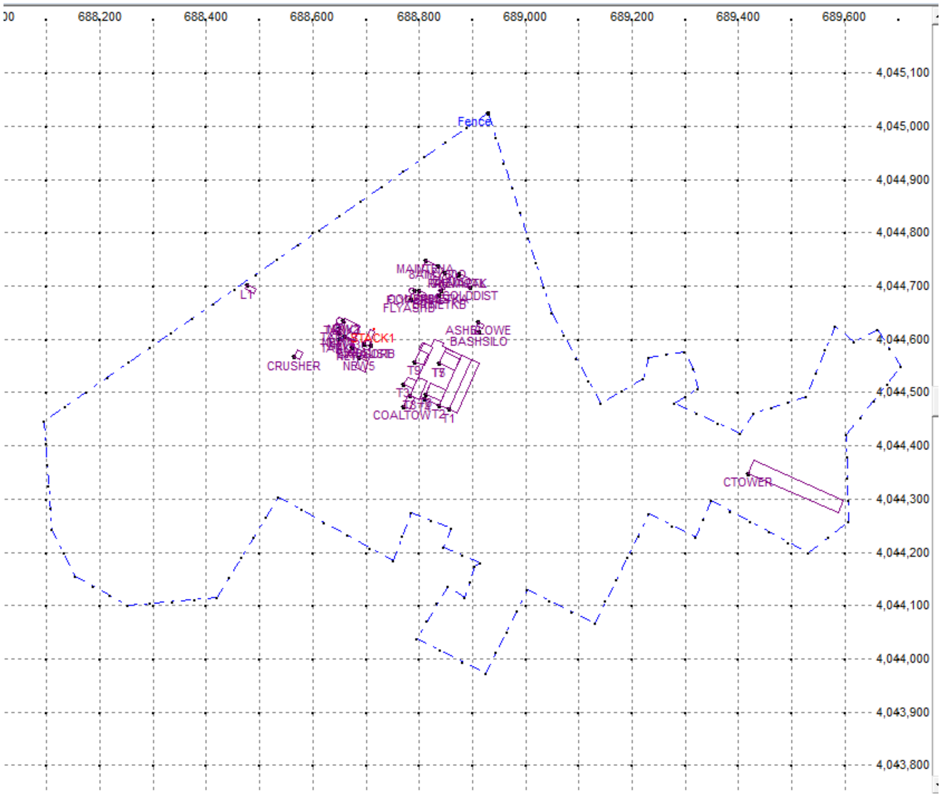

Figure 3. Layout of the Fenceline, Source and Building Locations for Duke-Mayo

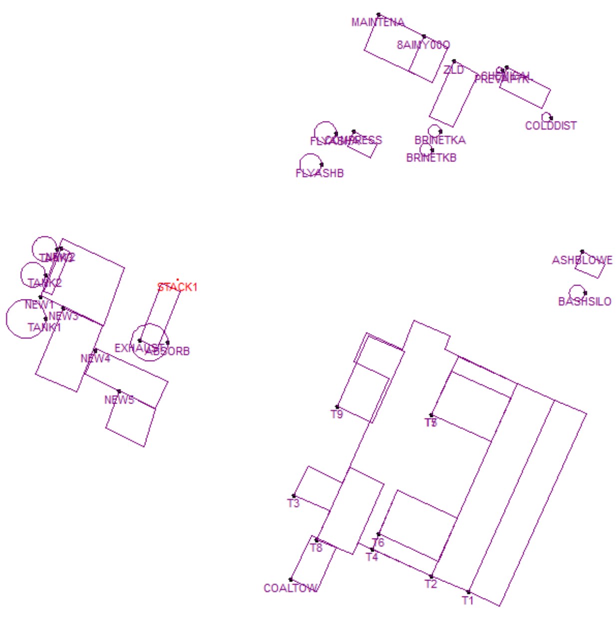

Figure 4. Close Up of Layout of Source and Building Locations for Duke-Mayo

8. Intermittent Sources

Most other emitting sources at Duke-Mayo are associated with coal and ash handling, conveying, and transport and do not emit SO_2. Duke-Mayo also operates an emergency generator and an emergency quench pump which operate infrequently and emit small quantities of SO_2. According to Section 5.4 of the modeling TAD, EPA states that it is most appropriate to include sources of emissions which operate continuously or frequent enough to contribute to the annual distribution of the daily maximum concentrations. Table 2 summarizes the emissions and operation of the emergency engine and quench pump. As shown in the table, annual emissions of SO_2 from each of these sources is less than one pound per year, with the hourly emission rates low enough to not have an impact on the modeling and to be considered intermittent sources and not specifically included in the modeling.

Table 2. Intermittent Sources of SO2 at Duke-Mayo

Source ID	Emissions Source	Capacity	Max. Hourly Emission Rate* (lbs/hr)	Calc. Annual Emissions (lbs)	Annual Fuel Use (gal)
EMGEN	Emergency Generator	750 kW	0.020	0.15	416
IQWP	Emergency Quench Pump	175 hp	0.002	0.08	200

* Based on NC DAQ IC Engine Spreadsheets using 0.0015% ULSD

9. Nearby Emissions Sources

An evaluation was conducted to determine if other sources of SO_2 emissions in the area surrounding Duke-Mayo should be included in the modeling to fully characterize the air quality in the area. According to the EPA March 1, 2011 Memorandum[4] and the analysis presented at the 2011 EPA modeling workshop,[5] selection of regional background sources should be focused on sources located within 10 kilometers from Duke-Mayo.

According to the NCDAQ's Emissions Inventory for 2013-2015, there no other sources of SO_2 located within 10 km of the Duke-Mayo plant; however, based on EPA comments, large sources that were more than 10 km from Duke-Mayo were evaluated to determine if they should be included in the analysis. A search was done to locate all facilities emitting 100 TPY or more of SO_2 near Duke-Mayo. As shown in Table 3 and Figure 5, three sources were identified within the 50 km AERMOD modeling range as having significant SO_2 emissions. CPI USA North Carolina – Roxboro Plant (CPI-Roxboro) is located approximately 12 km SSW of Duke-Mayo and Duke Energy Progress, LLC – Roxboro Steam Electric Plant (Duke-Roxboro) is located approximately 17 km WSW. Both of these facilities are located in Person County, NC, as is

[4] http://www.epa.gov/scram001/guidance/clarification/Additional_Clarifications_AppendixW_Hourly-NO2-NAAQS_FINAL_03-01-2011.pdf
[5] http://www.cleanairinfo.com/regionalstatelocalmodelingworkshop/archive/2011/Presentations/6-Thursday_AM/6-3_AB-3_Presentation_at_EPA_Modeling_Workshop.pdf,

Duke-Mayo. A third facility, Dominion-Clover Power Station in Randolph, Charlotte County, VA, is located approximately 40 km NNE of Duke-Mayo.

Table 3. Sources of SO2 Near Duke-Mayo

Facility Name	Emissions TPY (Q)	Year	Distance km (D)	Q/D
CPI USA NC - Roxboro Plant	2,005	2015	12	167
Duke Energy Progress - Roxboro	10,544	2015	17	620
Dominion – Clover Power Station, VA	1,774	2015	40	44

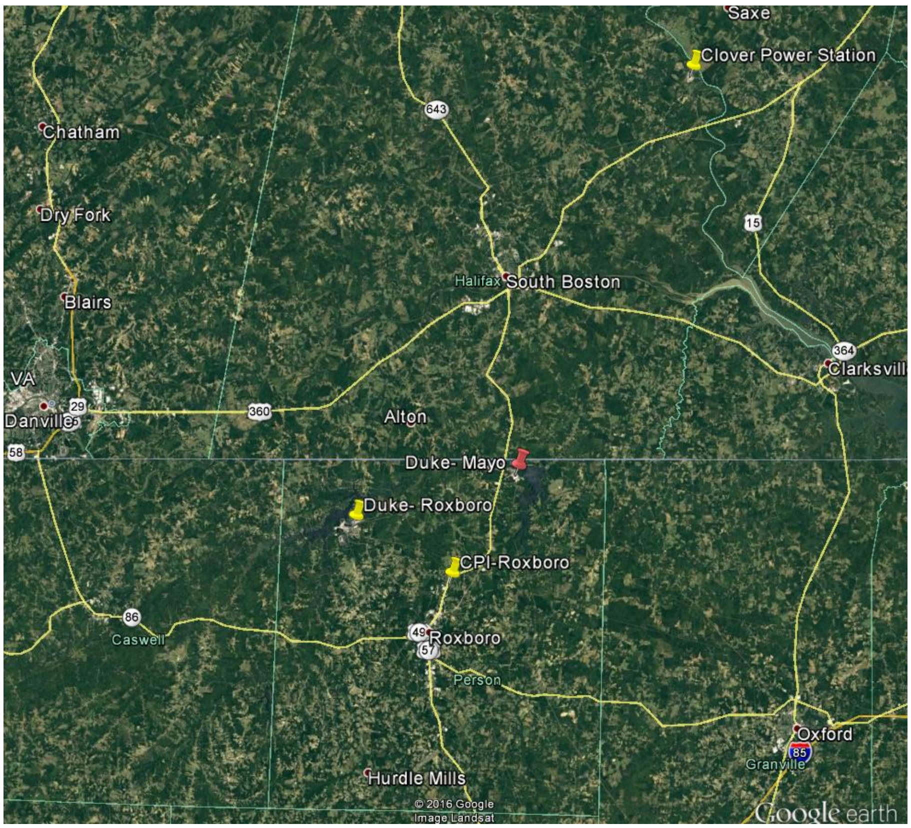

Figure 5. Additional SO2 Sources Within 50 km of Duke-Mayo

Initially, CPI-Roxboro and Duke-Roxboro were included in the Duke-Mayo analysis. CPI-Roxboro's hourly emissions file for the 2013-2015 period was developed and added to the modeling, but building parameters were not readily available and were not used since they are not required for nearby sources as specified in the modeling TAD. Duke-Roxboro's hourly emissions file with building parameters, prepared for another analysis under the DRR, was also added to the modeling. Table 4 summarizes the source parameters for these nearby sources used in the modeling. Dominion-Clover's input data was not readily available, and based on the minimal impact of the Duke-Roxboro and CPI-Roxboro facilities on the final modeled results, NCDAQ believes that including it would add negligible value to the analysis and it was excluded (see Section 13. Model Results).

Table 4. Source Parameters for Nearby Sources of SO2 in the Duke-Mayo Modeling Analysis

Source ID	Stack Height (m)	Temperature (K)	Exit Velocity (m/s)	Stack Diameter (m)
Duke-Roxboro Unit 1	121.92	Varies	Varies	6.71
Duke-Roxboro Unit 2	121.92	Varies	Varies	8.69
Duke-Roxboro Unit 3	121.92	Varies	Varies	9.3
Duke-Roxboro Unit 4	121.92	Varies	Varies	9.3
CPI-Roxboro Units 1A, 1B, and 1C	172	60.35	430.37	18.29

10. Receptor Grid

The size, spacing, and location of the receptor grid is unique to the modeling analysis. The receptor grid took into account the location of the sources to be modeled, terrain features, and areas where the public generally has access. In accordance with the modeling TAD, receptors were not located in areas where it is not technically feasible to locate a monitor.

Receptor density was setup to detect the significant concentration gradient. Typically, the receptor spacing is closer near the source and further apart farther from the source. Receptor elevations were included in the modeling analysis. The receptor heights were determined using 7.5 minute National Elevation Data (NED) processed with AERMAP. Flagpole receptor height for this analysis was set at 0 meters. Figures 6 and 7 show the receptors on a satellite view and a map of counties and townships, respectively.

The grid receptor spacing for the area of analysis was as follows:

- Receptors along the fence line every 50 meters
- Receptors every 100 meters out to 3 km[6]
- Receptors every 250 meters from 3 km to 5 km
- Receptors every 500 meters from 5 km to 10 km

[6] Note that the location of the highest 4th high receptor was within the 100 meter spacing.

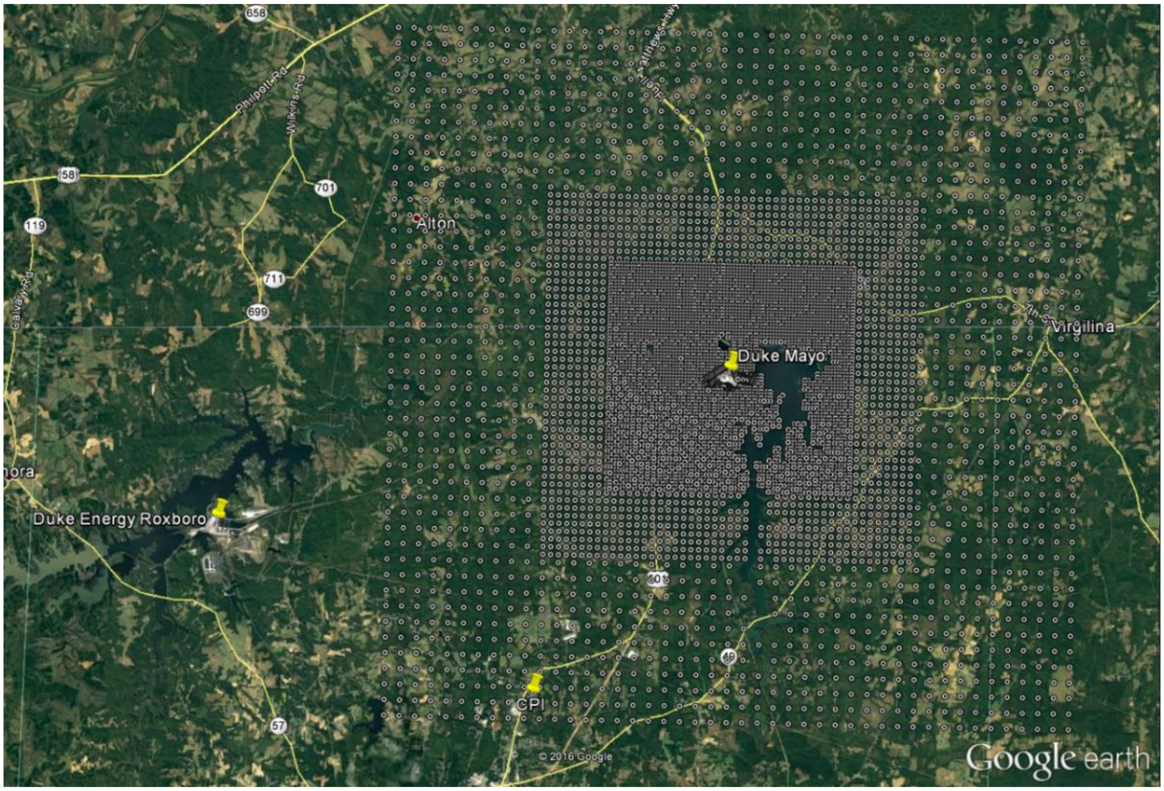

Figure 6. Satellite View of Receptor Layout and Nearby Emissions Sources in Duke-Mayo Modeling Analysis

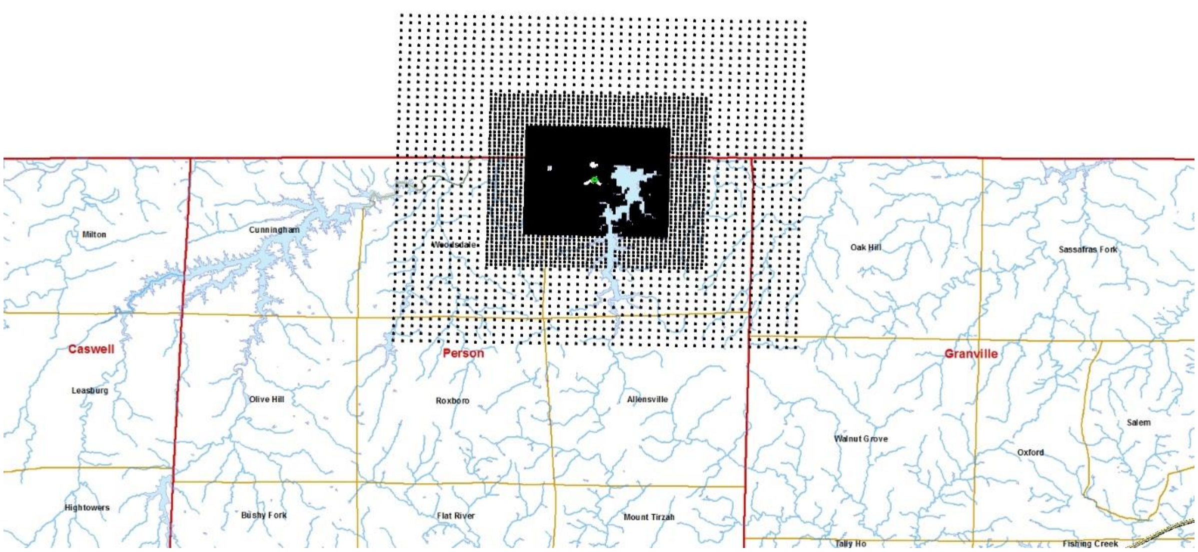

Figure 7. Map of Receptor Layout with Counties and Townships

11. Meteorological Data

For the purpose of modeling for the Duke-Mayo attainment designation demonstration, three years of National Weather Service (NWS) data were used. The years used in the analysis were 2013-2015. Representativeness of the NWS observation sites to the facility site was determined based on similarities in surrounding terrain, proximity, climatology, and availability of meteorological data meeting modeling application quality objectives and completeness criteria as specified by U.S. EPA guidance.[7] Meteorological data from several surrounding sites was considered and the closest station, Danville regional Airport, VA, 40 kilometers west of Duke-Mayo, was selected. Details of the evaluation are presented in Section 12. Land Use Analysis.

AERMET (version 15181) was used to process, quality assure, and merge surface and upper air meteorological data. AERMET pre-processes the surface and upper air data to produce hourly surface and vertical profile meteorological and turbulence parameter inputs to AERMOD for calculation of air pollutant concentrations. Hourly surface meteorological data was obtained from the U.S. National Climatic Data Center (NCDC) for Danville for 2013-2015 in the standard integrated surface hourly data (ISHD) format.[8] The hourly data was supplemented, as recommended by the U.S. EPA, with TD-6405 format (so-called "1-minute") wind data also from the archives[9] and processed using the latest version of the AERMINUTE pre-processing tool (version 14337).

In addition to surface meteorological data, AERMET requires the use of data from an upper air sounding to estimate mixing heights and other boundary layer turbulence parameters. Upper air data from the nearest U.S.NWS radiosonde equipped station was utilized in the modeling analysis. In this case, upper air data from Greensboro was obtained from the National Oceanic and Atmospheric Administration (NOAA) in Forecast Systems Laboratory (FSL) format.[10]

12. Land Use Analysis

AERMET requires land use parameters to derive wind and temperature vertical profiles that directly influence the dispersive capacity of the atmosphere and resultant model concentrations. It uses data derived from land use to calculate the surface roughness, Bowen ratio, and albedo. Surface roughness is more important to characterization of mechanical turbulence under stable atmospheric conditions (e.g., calm winds during daytime or nighttime), whereas Bowen ratio and albedo are more important to characterization of convective turbulence under neutral and/or unstable atmospheric conditions (e.g., windy, daytime). In general, AERMOD is formulated to

[7] U.S. Environmental Protection Agency. 2000. "Meteorological Monitoring Guidance for Regulatory Modeling Applications." EPA-454/R-99-005, February 2000.
[8] ftp://ftp.ncdc.noaa.gov/pub/data/noaa/
[9] ftp://ftp.ncdc.noaa.gov/pub/data/asos-onemin
[10] http://www.esrl.noaa.gov/raobs/

predict higher concentrations under stable atmospheric conditions, and thus, surface roughness is generally the most important of the three land use parameters in terms of determining the highest hourly concentrations.

The methodology outlined in Section 3.1.2 and 3.1.3 of the AERMOD Implementation Guide (AIG)[11] was used with AERSURFACE (version 13016)[12] to determine surface roughness length, Bowen ratio and albedo. USGS land cover data inputs to AERSURFACE were taken from the National Land Cover Dataset 1992 (NLCD92). AERSURFACE converts this data to the surface parameters listed above. These surface parameters are ultimately used by AERMET and AERMOD in calculation of hourly vertical wind and temperature profiles that are needed for calculation of hourly ambient concentrations at each receptor.

AERSURFACE was set using the location coordinates for the NWS surface site, month delineation, seasonal defaults, 12 sectors of 30 degrees each, and airport location checked as yes. AERSURFACE processed NLCD land use data using location coordinates for the NWS surface site, seasonal defaults, 12 flow sectors of 30 degrees each, and airport location characterization. Surface roughness was analyzed for each of the 12 flow sectors within a 1 km radius circular land use area. Albedo and Bowen ratio were analyzed based on a 10 km by 10 km square land use area centered on the surface meteorological station. The surface moisture at the NWS surface site was classified as "average" based on comparison of the model period (2013-2015) monthly precipitation totals to the statistical distribution of 30-year precipitation data. The surface moisture classification is used to adjust the seasonal Bowen ratios estimated by AERSURFACE.

Land use surface characteristics found at the selected airport meteorological station (Danville) may be different than those found surrounding the model application site (Duke-Mayo). Land use characteristics at the airport and facility are shown in Figures 8 and 9, respectively. The U.S. EPA recommends that these differences be evaluated to determine representativeness of the surface characteristics and to determine influences of surface characteristics on model concentrations.[13] The U.S. EPA further recommends that consideration of surface roughness is most important due to model sensitivities to that particular surface parameter under stable atmospheric conditions.

Differences between albedos and Bowen ratios are less significant than surface roughness in terms of influencing the highest hourly model concentrations due to the intrinsic role of albedo and Bowen ratio characterizing dispersion under neutral and/or unstable atmospheric conditions,

[11] US Environmental Protection Agency. 2015 "AERMOD Implementation Guide" revised August 3,2015. Available online https://www3.epa.gov/ttn/scram/7thconf/aermod/aermod_implmtn_guide_3August2015.pdf
[12] U.S. Environmental Protection Agency. 2013. "AERSURFACE User's Guide." EPA-454/B-08-001, Revised 01/16/2013. Available Online: http://www.epa.gov/scram001/7thconf/aermod/aersurface_userguide.pdf
[13] https://www3.epa.gov/ttn/scram/7thconf/aermod/aermod_implmtn_guide_3August2015.pdf, Section 3.1.

when hourly model concentrations are expected to be relatively lower. Differences in surface characteristics at the meteorological observation site and modeling application site were reviewed and compared to evaluate representativeness of the surface characteristics values.

Seasonal surface characteristic values calculated by AERSURFACE at the airport and facility for each flow sector are shown in Table 5. As shown, the seasonal albedo and Bowen ratio values are similar, and therefore, are not expected to bias model predictions during unstable and/or neutral atmospheric conditions. Therefore, albedo and Bowen ratio values taken from the airport land use data are representative at the facility. The seasonal, sector averaged surface roughness values at the airport are similar to those estimated by AERSURFACE at the facility. The lower surface roughness values at the airport are expected to influence decreased dispersion and higher model concentrations, based on AERMOD conservative formulations applied under stable atmospheric conditions. Thus, lower surface roughness values at the airport introduce a degree of conservatism to the modeled concentrations predicted under stable atmospheric conditions when the highest 1-hour SO_2 concentrations are expected to occur.

Figures 9 and 10 show surface roughness values at the airport and facility, respectively, during summertime when differences in surface roughness are greatest. The largest differences in surface roughness at the airport compared to the facility occur in the northeastern and northwestern quadrants where there is notable disparity in the spatial distribution of land and water. However, prevailing winds in the area are primarily observed from the south and southwest where surface roughness at the airport and facility are very similar. Again, surface roughness values in the southwest sector at the airport are lower and more conservative due to decreased dispersion under stable conditions. Model design concentrations and upper distribution of predicted concentrations were found to coincide with prevailing wind directions where dispersion calculations rely on upwind surface roughness values derived from the south and southwestern flow sectors. As such, airport surface roughness values were determined to be representative at the facility owing to the similar influence of prevailing upwind surface roughness values on model design concentrations occurring predominantly downwind of the facility.

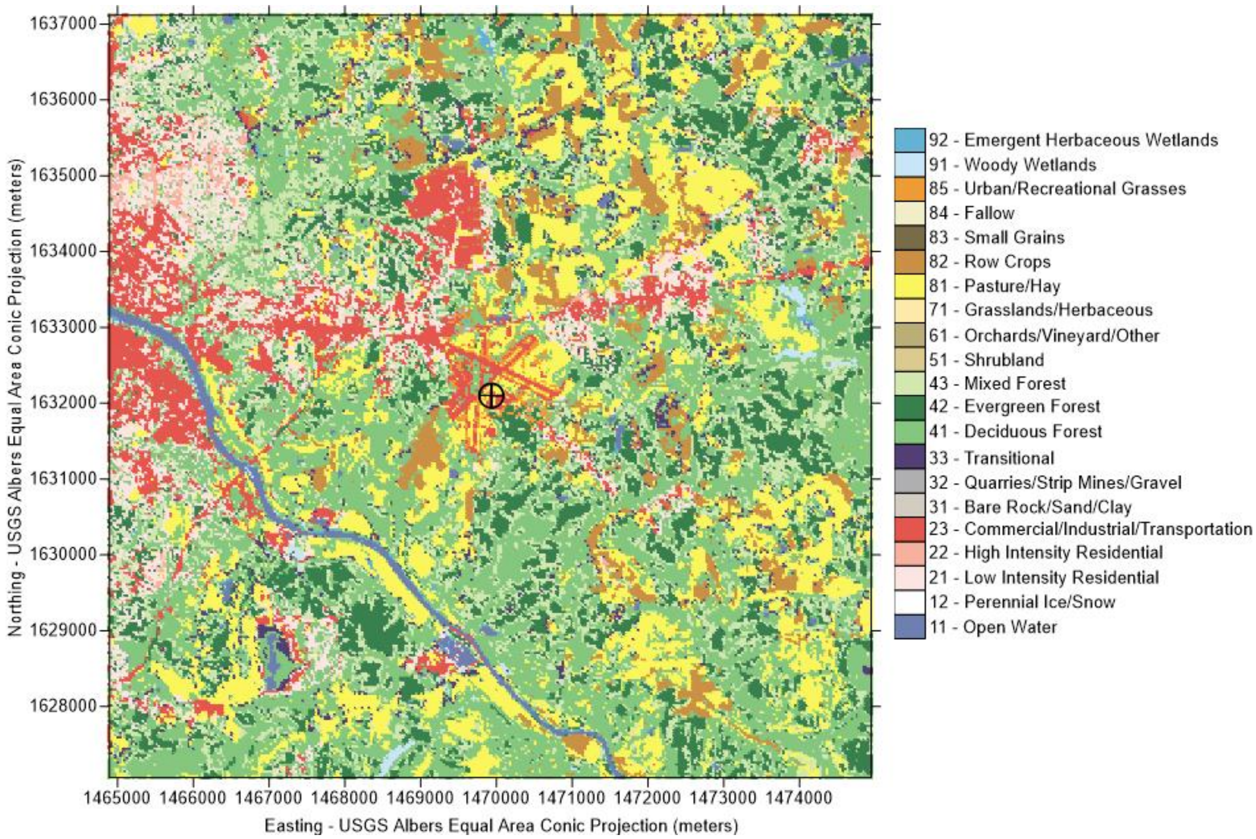

Figure 8. Danville Regional Airport Land Use (10km x 10km Area)

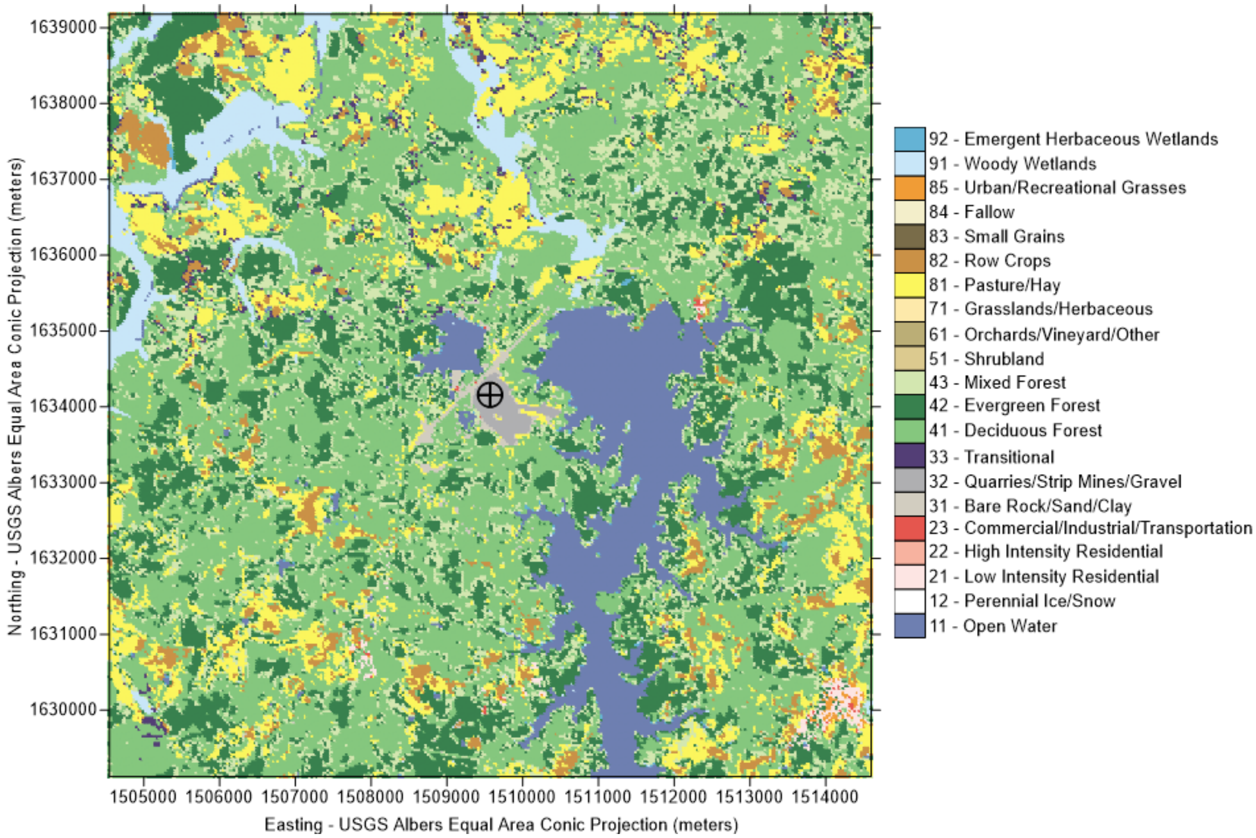

Figure 9. Duke-Mayo Land Use (10km x 10km Area)

Table 5. Surface Characteristics Comparison and Evaluation

		Danville Regional Airport			Duke-Mayo		
Season	**Flow Sector**	**Albedo**	**Bowen Ratio**	**Surface Roughness (m)**	**Albedo**	**Bowen Ratio**	**Surface Roughness (m)**
Winter	(0 - 30)	0.16	0.87	0.045	0.15	0.70	0.174
Winter	(30 - 60)	0.16	0.87	0.032	0.15	0.70	0.344
Winter	(60 - 90)	0.16	0.87	0.037	0.15	0.70	0.083
Winter	(90 - 120)	0.16	0.87	0.066	0.15	0.70	0.278
Winter	(120 - 150)	0.16	0.87	0.206	0.15	0.70	0.265
Winter	(150 - 180)	0.16	0.87	0.341	0.15	0.70	0.263
Winter	(180 - 210)	0.16	0.87	0.079	0.15	0.70	0.406
Winter	(210 - 240)	0.16	0.87	0.040	0.15	0.70	0.204
Winter	(240 - 270)	0.16	0.87	0.056	0.15	0.70	0.216
Winter	(270 - 300)	0.16	0.87	0.225	0.15	0.70	0.272
Winter	(300 - 330)	0.16	0.87	0.115	0.15	0.70	0.040
Winter	(330 - 360)	0.16	0.87	0.072	0.15	0.70	0.009

Season	Flow Sector	Danville Regional Airport Albedo	Danville Regional Airport Bowen Ratio	Danville Regional Airport Surface Roughness (m)	Duke-Mayo Albedo	Duke-Mayo Bowen Ratio	Duke-Mayo Surface Roughness (m)
Spring	(0 - 30)	0.15	0.60	0.059	0.14	0.51	0.202
Spring	(30 - 60)	0.15	0.60	0.043	0.14	0.51	0.450
Spring	(60 - 90)	0.15	0.60	0.051	0.14	0.51	0.098
Spring	(90 - 120)	0.15	0.60	0.084	0.14	0.51	0.334
Spring	(120 - 150)	0.15	0.60	0.238	0.14	0.51	0.295
Spring	(150 - 180)	0.15	0.60	0.422	0.14	0.51	0.313
Spring	(180 - 210)	0.15	0.60	0.106	0.14	0.51	0.495
Spring	(210 - 240)	0.15	0.60	0.057	0.14	0.51	0.250
Spring	(240 - 270)	0.15	0.60	0.075	0.14	0.51	0.270
Spring	(270 - 300)	0.15	0.60	0.274	0.14	0.51	0.317
Spring	(300 - 330)	0.15	0.60	0.140	0.14	0.51	0.043
Spring	(330 - 360)	0.15	0.60	0.094	0.14	0.51	0.009
Summer	(0 - 30)	0.16	0.42	0.113	0.15	0.30	0.244
Summer	(30 - 60)	0.16	0.42	0.089	0.15	0.30	0.553
Summer	(60 - 90)	0.16	0.42	0.129	0.15	0.30	0.113
Summer	(90 - 120)	0.16	0.42	0.123	0.15	0.30	0.411
Summer	(120 - 150)	0.16	0.42	0.289	0.15	0.30	0.350
Summer	(150 - 180)	0.16	0.42	0.577	0.15	0.30	0.383
Summer	(180 - 210)	0.16	0.42	0.195	0.15	0.30	0.572
Summer	(210 - 240)	0.16	0.42	0.142	0.15	0.30	0.285
Summer	(240 - 270)	0.16	0.42	0.145	0.15	0.30	0.329
Summer	(270 - 300)	0.16	0.42	0.332	0.15	0.30	0.359
Summer	(300 - 330)	0.16	0.42	0.185	0.15	0.30	0.046
Summer	(330 - 360)	0.16	0.42	0.155	0.15	0.30	0.009
Fall	(0 - 30)	0.16	0.87	0.108	0.15	0.70	0.244
Fall	(30 - 60)	0.16	0.87	0.083	0.15	0.70	0.553
Fall	(60 - 90)	0.16	0.87	0.124	0.15	0.70	0.113
Fall	(90 - 120)	0.16	0.87	0.116	0.15	0.70	0.411
Fall	(120 - 150)	0.16	0.87	0.279	0.15	0.70	0.350
Fall	(150 - 180)	0.16	0.87	0.569	0.15	0.70	0.383
Fall	(180 - 210)	0.16	0.87	0.190	0.15	0.70	0.572
Fall	(210 - 240)	0.16	0.87	0.136	0.15	0.70	0.285
Fall	(240 - 270)	0.16	0.87	0.139	0.15	0.70	0.329
Fall	(270 - 300)	0.16	0.87	0.324	0.15	0.70	0.359
Fall	(300 - 330)	0.16	0.87	0.182	0.15	0.70	0.046
Fall	(330 - 360)	0.16	0.87	0.150	0.15	0.70	0.009
Average:		**0.16**	**0.69**	**0.163**	**0.15**	**0.55**	**0.270**

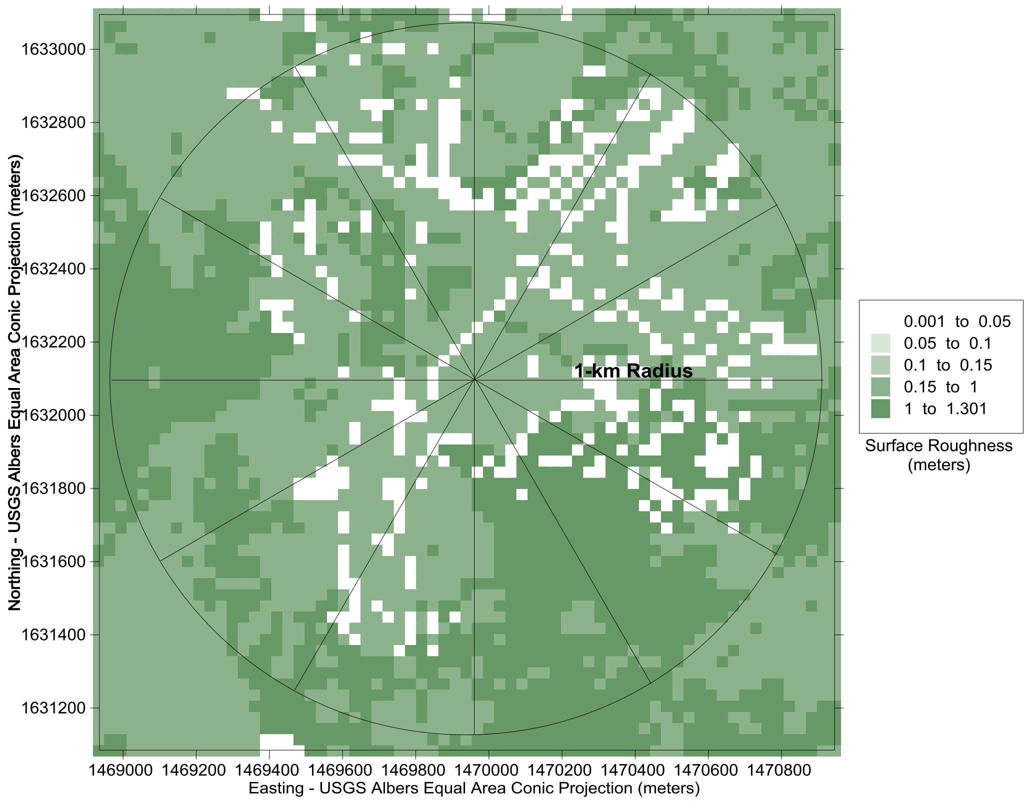

Figure 10. Danville Regional Airport Summertime Surface Roughness Analysis Area

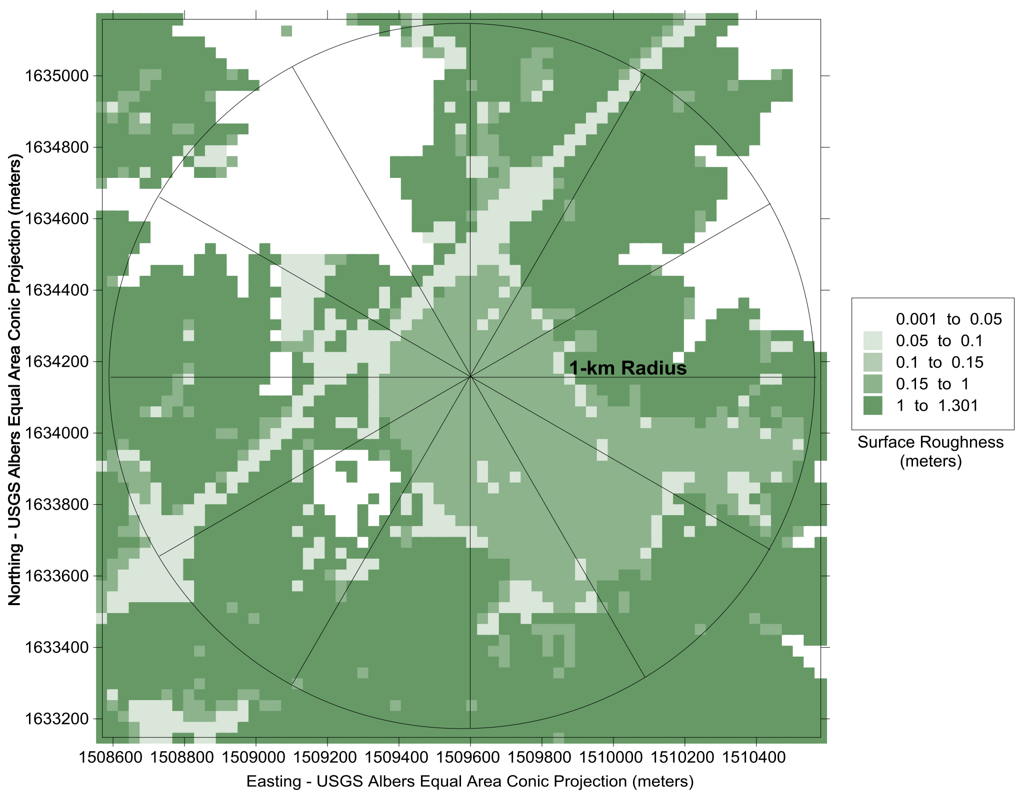

Figure 11. Duke-Mayo Summertime Surface Roughness Analysis Area

13. Model Results

The model was set to output the annual 4th high daily maximum concentrations at each receptor using the MXDYBYR output option. The design value at each receptor was calculated by averaging the annual 4th high daily maximum concentrations over the period from 2013-2015. Figure 12 shows the design value concentration isopleths from Duke-Mayo and the other nearby sources. The maximum modeled value was 167 $\mu g/m^3$. In order to determine the magnitude of impacts from the other nearby sources, AERMOD was run using a source group that contained only emissions from Duke-Mayo. Figure 13 shows the design value concentration isopleths from Duke-Mayo only. The maximum modeled value was 164 $\mu g/m^3$. Because the difference in the impacts was only 3 $\mu g/m^3$, we concluded that it was not necessary to add the Dominion-Clover facility in Virginia that is located more than twice as far from Duke-Mayo as the included nearby sources (see Section 9. Nearby Emissions Sources).

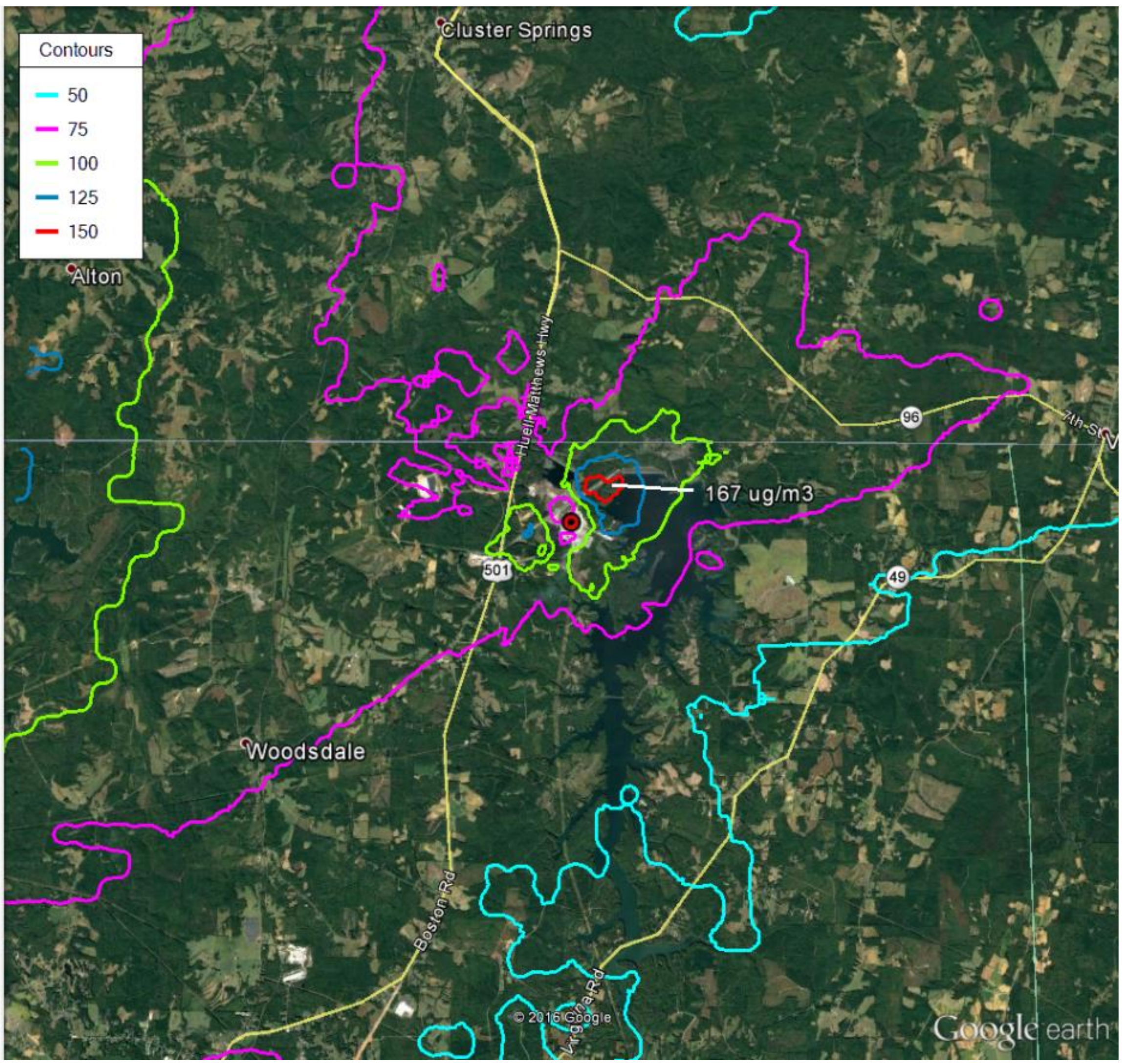

Figure 12. Annual 4th High SO2 Concentration - Duke-Mayo and Nearby Sources

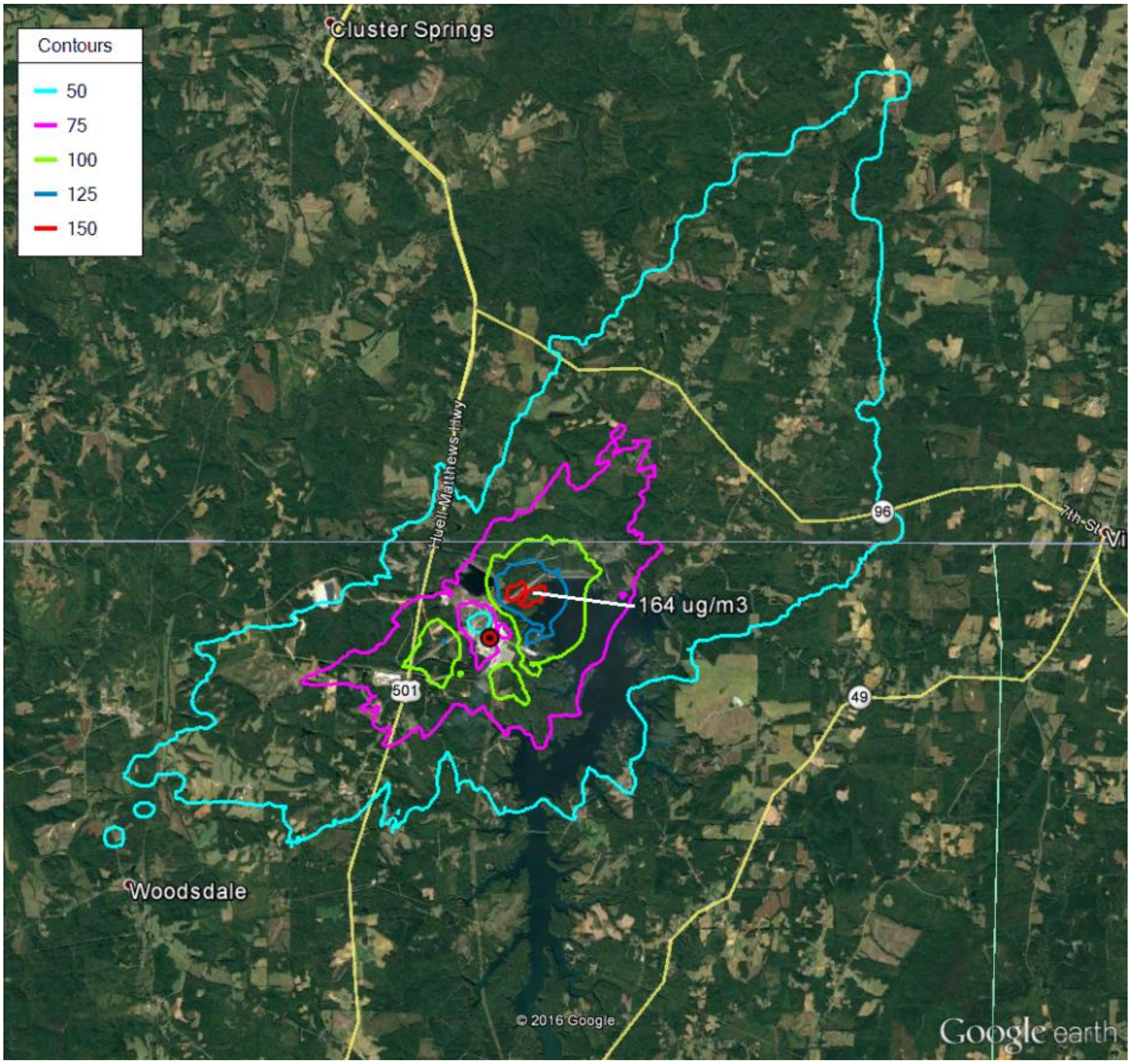

Figure 13. Annual 4th High SO2 Concentration – Duke-Mayo Only

14. Background Concentrations

Background concentrations in the model results are important in determining the impacts from sources of SO_2 which are not explicitly included in the model. Background concentrations were evaluated using the EPA's March 1, 2011 memo, "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 Ambient Air Quality Standard." Table 6 summarizes the available SO_2 monitoring locations surrounding Duke-Mayo with their 2013-2015 design values. The Durham, NC monitor was selected to represent Duke-Mayo since it is the closest and, additionally, may conservatively overestimate the background near Duke-Mayo since it is located in a more densely populated area. The 2013-2015 design value for the Durham monitor was 21 µg/m^3 (8 ppb).

Table 6. Monitor Data Surrounding Duke-Mayo for the 1-hour SO2 NAAQS

Monitor Location	Distance from Duke-Mayo (kilometers)	ID	2013-2015 Design Value $\mu g/m^3$ (ppb)
Durham, NC	55	37-063-0015	21 (8)
Raleigh, NC	80	37-183-0014	16 (6)
Winston-Salem, NC	130	37-067-0022	24 (9)
Roanoke, VA	125	51-161-1004	13 (5)*
Charles City County, VA	170	51-036-0002	76 (29)
Richmond, VA	175	51-087-0014	21 (8)

*Not a valid design value because one quarter of 2013 is missing.

15. Comparison to Standard

The background concentration was added to the design values and the resulting values were compared to the SO_2 standard of 196 $\mu g/m^3$. Table 7 shows that the maximum sum of the background concentration and design value is less than the NAAQS, estimated at 188 $\mu g/m^3$.

Table 7. Comparison of Duke-Mayo Results to the NAAQS

Years Modeled	Modeled Design Value ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	Total ($\mu g/m^3$)	1-hr SO_2 NAAQS ($\mu g/m^3$)	% of NAAQS	UTM East (m)	UTM North (m)	NAAQS Exceeded
2013-15	167	21	188	196	96%	689,500	4,045,300	No

The NCDAQ will provide EPA with input/out files necessary to validate the results of the modeling analysis.