Tennessee Valley Authority, 1101 Market Street, BR 4A, Chattanooga, Tennessee 37402

SEP 1 2016

August 31, 2016

Ms. Michelle Walker Owenby, Director
Division of Air Pollution Control
Tennessee Department of Environment
and Conservation
William R. Snodgrass TN Tower
312 Rosa L Parks Avenue, 15th Floor
Nashville, Tennessee 37243

Dear Ms. Owenby:

TENNESSEE VALLEY AUTHORITY (TVA) – CUMBERLAND FOSSIL PLANT (CUF) – FINAL REPORT FOR 1-HOUR SO_2 MODELING RESULTS

Please find enclosed a report that describes the air dispersion modeling methodology and presents modeling results that demonstrate attainment with the 1-hour SO_2 NAAQS for designation purposes in the area surrounding CUF. Also enclosed is a disc containing the data referenced in the report.

If you have any questions or comments, please contact Cassi Wylie in Knoxville at (865) 632-7933.

Sincerely,

J. Thomas Waddell
Senior Manager
Air Permits, Compliance and Monitoring

Enclosures

CUMBERLAND FOSSIL PLANT

MODELING RESULTS
1-HOUR SO_2 NAAQS DESIGNATION

CUMBERLAND CITY, TENNESSEE
AUGUST 2016

CONTENTS

TABLES

FIGURES

1.0 PURPOSE AND BACKGROUND

The purpose of this document is to present the dispersion modeling results that were performed to assess compliance with the 1-hour SO_2 NAAQS for designation purposes. The primary objective of the modeling analysis was to demonstrate that SO_2 emissions from TVA Cumberland Fossil Plant (CUF) did not cause or contribute to a violation of the 1-hour SO_2 NAAQS. This analysis was performed to characterize the designation status of Stewart County, Tennessee, and surrounding areas. The modeling analysis was performed following the recommendations outlined in the SO_2 NAAQS Designations Modeling Technical Assistance Document (TAD), with reliance on all other applicable USEPA guidance documents (USEPA, 2016). Modeling methods and assumptions – such as model selection and options, source parameters, and meteorological data – were presented in the CUF modeling protocol for review by the Tennessee Department of Environment and Conservation (TDEC) in February 2016. This report presents modeling which incorporates changes in response to USEPA Region 4 and TDEC's comments on the modeling protocol.

2.0 SOURCE DESCRIPTION

CUF is located on the south bank of the Cumberland River, about one (1) mile west of Cumberland City, Tennessee in Stewart County. The facility consists of two (2) coal-fired boilers, two (2) oil-fired auxiliary boilers, five (5) emergency diesel engines, and material handling systems for the inputs (coal, limestone, and hydrated lime) and by-product disposal (ash and gypsum). A site locality map (Figure 1) and a topographic map (Figure 2) provide details of the location and property boundaries.

Each coal-fired boiler is equipped with a wet limestone flue-gas desulfurization unit to remove sulfur dioxide (SO_2). Both coal-fired boilers combust a high-sulfur (greater than two weight-percent) coal blend and an ultra-low sulfur (15 parts per million by weight) fuel oil.

3.0 MODELING ANALYSIS

To determine maximum impacts on ambient 1-hour SO_2 concentrations for Stewart County, Tennessee, and surrounding areas, the modeling analysis focused on the contributions of SO_2 from the two (2) coal-fired boilers at CUF. There were no nearby sources that were expected to cause a significant concentration gradient in the vicinity of CUF (TVA, 2016). The inputs used in the modeling analysis are detailed in the subsequent sections.

3.1 EMISSIONS

Actual-hourly emissions for the three-year period from 2012 to 2014 were modeled. The coal-fired boilers' hourly continuous emissions monitoring system (CEMS) data were obtained from a USEPA's website supporting 1-hour SO_2 modeling[1]. Volumetric flow rates provided therein were reported in standard cubic feet per hour (scfh)[2]. Assuming pressure found at the stack exit is equal to pressure at standard conditions, the volumetric flow rates in scfh were converted to actual cubic feet per hour (acfh) as followed:

$$V_a = V_S \times \frac{(T_a + 459.67°R)}{(T_s + 459.67°R)} \qquad [1]$$

[1] https://www.epa.gov/air-emissions-modeling/state-level-hourly-sulfur-dioxide-so2-data/

[2] 40 CFR Part 72 Subpart A (Acid Rain Program General Provisions) defines standard conditions as 68°F and 29.92 inches of mercury (i.e., 29.92 in Hg). This definition is applicable to data collected under 40 CFR Part 75 (Continuous Emission Monitoring) [see Part 75, Subpart A, §75.3].

where V_a is the stack-exit volumetric flow in acfh, V_s is the stack-exit volumetric flow at standard conditions, T_a is the actual stack-exit temperature (°F), and T_s is the stack-exit temperature at standard conditions (68°F). The hourly stack-exit velocities were subsequently calculated from the actual volumetric flow rates using the stack-exit cross-sectional area. Utilizing acfh more accurately represents stack-exit volumetric flow. Static stack parameters (height, diameter, and exit temperature) are provided in Table 1.

Table 1
CUF Coal-Fired Boilers Routine-Operation Stack Parameters [1]

Parameter	Units	CUF1	CUF2
UTM Zone 16 Easting (NAD83)	m	441586	441529
UTM Zone 16 Northing (NAD83)	m	4027427	4027343
Base Elevation	m	118.1	118.1
Stack Height	m	193.7	193.7
Stack Inside Diameter	m	11.7	11.7
Stack-Exit Temperature [2]	K	321	321

Notes:
1. CUF has two (2) identical coal-fired boilers, CUF1 and CUF2. Each boiler exhausts to the atmosphere via its own stack.
2. Modeled stack-exit temperature; Title V Permit Renewal Application, CUF, Cumberland City, Tennessee, November 2008.

Stack exit temperatures from CUF's November 2008 Title V permit renewal application were used because stack-exit temperatures are not recorded by the CEMS. Averaged actual stack-exit temperatures recorded by unit-specific process thermocouples indicate less than two (2) percent difference from the Title V values. Therefore, the Title V permit application stack-exit temperatures were deemed representative of actual temperatures operations from 2012-2014 (Table 2).

Table 2
Comparison of Modeled and Measured Stack-Exit Temperatures

Parameter	Units	Stack-Exit Temperature	
		CUF1	CUF2
Title V Permit App. Stack-Exit Temp. [1]	K	321	321
2012-2014 Avg. Actual Stack-Exit Temp. [2]	K	325	323
Difference	K	4.1	2.2
Percent Difference	%	1.3	0.7

Notes:
1. Modeled stack-exit temperature; Title V Permit Renewal Application, CUF, Cumberland City, Tennessee, November 2008.
2. Stack-exit temperatures measured by process thermocouples.

CUF's ancillary combustion sources – the two (2) oil-fired auxiliary boilers and the five (5) emergency diesel engines – were excluded from modeling. Relative to the two (2) coal-fired boilers (CUF1, CUF2), auxiliary boilers (AB) and emergency diesel engines (DE) operate intermittently and have very low emissions (Table 3). According to Section 5.5 of the TAD, only sources that are continuous or frequent enough to contribute significantly to the annual distribution of maximum daily 1-hour concentrations should be considered. Because the ancillary sources operate infrequently, they are not expected to contribute to the annual distribution of daily maximum 1-hour SO_2 concentrations, so they were not included in the modeling.

Table 3
CUF Combustion Sources' SO_2 Emissions (tons per year) [1,2]

Year	CUF1 [1]	CUF2 [1]	AB1	AB2	DE1-5
2012	5,047	5,054	1.28×10^{-2}	1.18×10^{-2}	N/A [2]
2013	4,565	3,398	3.60×10^{-1}	3.66×10^{-1}	2.81×10^{-5}
2014	4,139	5,257	1.43×10^{-2}	1.48×10^{-2}	4.17×10^{-5}

Notes:

1. Total obtained from EPA's Clean Air Markets – Air Markets Program Data (CAMD), which is provided on the enclosed optical disc.
2. Actual emissions data for 2012 is not available. Engines are permitted to run less than 500 hours per year.

3.2 DOWNWASH

Actual stack heights were used for the CUF modeling analysis in accordance with the SO_2 TAD. In addition, building downwash was included in the modeling with building parameters calculated using the USEPA's Building Profile Input Program for PRIME, BPIPPRM, Dated 04274 (USEPA, 2004d). According to the GEP technical support document, a structure is considered nearby if it is within 5L of the emissions source, where L is the lesser dimension (height or projected width) of the nearby structure (USEPA, 1985). The nearby major structures within the CUF boundary are:

- Boilerhouse and powerhouse buildings;
- Selective catalytic reduction structures;
- Wet limestone flue-gas desulfurization unit buildings.

The direction-specific effective building widths and heights required by AERMOD were calculated using BPIPPRM. The BPIPPRM input stack and building parameters for CUF1 and CUF2 are provided in Table 4 and building locations are shown in Figure 3.

Table 4
BPIPPRM Input Structures for CUF1 and CUF2

Building	BPIPPRM ID	Height (feet)	Height (m)
Office Wing Tower	OFC-TOWER	66.50	20.27
Office Wing	OFC-WING	43.50	13.26
Service Bay	SVC-BAY	43.50	13.26
Turbine Bay	TB-BAY	98.00	29.87
Boiler Bay	BLR-BAY	144.00	43.89
Boiler Tower A	BLR-TOWA	256.00	78.03
Boiler Tower B	BLR-TOWB	256.00	78.03
Ductwork A	DUCT-A	152.00	46.33
SCR Structure A	SCR-A	179.00	54.56
Ductwork B	DUCT-B	152.00	46.33
SCR Structure B	SCR-B	179.00	54.56
Continued on Next Page			

Table 4 (Continued)
BPIPPRM Input Structures for CUF1 and CUF2

Building	BPIPPRM ID	Height (feet)	Height (m)
Ductwork C	DUCT-C	152.00	46.33
ESP Building	ESP-BLDG	108.50	33.07
Yard Utility Building	YARD-UTL	33.00	10.06
Ductwork D	DUCT-D	166.25	50.67
FGD Absorber Building	FGD-BLDG	122.50	37.34
Ductwork E	DUCT-E	166.25	50.67
FGD Service Building	FGD-SVC	27.83	8.48
Building A	BUILD-A	20.00	6.10
Limestone Prep Building Section A	LIME-A	106.17	32.36
Limestone Prep Building Section B	LIME-B	72.67	22.15
Limestone Prep Building Section C	LIME-C	30.83	9.40

The results from BPIPPRM showed that the Boiler Towers (A and B) are the influencing structures affecting dispersion and plume rise from the stacks. An overall GEP summary table for the coal-fired boilers is provided in Table 5.

Table 5
GEP Stack Height Results for CUF1 and CUF2

Stack	Actual Stack Height (m)	GEP Stack Height (m)	GEP Building Height (m)	GEP Projected Building Width (m)	GEP Equation Height (m)
CUF1	193.70	194.61	78.03	117.47	194.61
CUF2	193.70	194.61	78.03	117.47	194.61

3.3 NEARBY SOURCES

In addition to CUF's contribution to the impacts of the 1-hr SO_2 NAAQS, emissions from nearby sources were evaluated. Emission inventories provided by TDEC were assessed using the following criteria to determine which nearby sources needed to be modeled: 1) sources located within 10 km of CUF with emissions of at least one (1) ton per year; and 2) sources located between 10 km and 50 km of CUF with a Q/D (annual emissions in tons / distance in km) greater than 20. Sources with a Q/D less than 20 and sources beyond 50 km were indirectly accounted for in the background monitored concentration. As discussed in Section 3.7, the SO_2 observations from the Mammoth Cave National Park Monitor (AIRS ID 21-061-0501) in Mammoth Cave, Kentucky, were used to account for the potential impacts of other natural sources, nearby small sources, and distant major sources.

Nearby sources within 50 km of CUF are shown in Figure 4. Sources with emissions greater than one (1) ton per year (tpy) are shown in Table 6. There were no nearby sources located within 50 km of CUF that met the screening criteria. The Georgia-Pacific Gypsum II, LLC (Georgia) facility in Stewart County, Tennessee, is located within 10 km of CUF (1.2 km); however, the facility-wide SO_2 emission totals for 2014 were less than 1.0 tpy[3]. In addition, there are several facilities clustered approximately 40 km to the

[3] USEPA Correspondence to TVA, April 21, 2016: "EPA Comments on SO_2 Modeling Protocol for TVA Cumberland."

northeast of the CUF site: Florim USA, Inc.; Hemlock Semiconductor, LLC; Spear USA, LLC - Clarksville; and Trane U.S. Inc. However, the total SO_2 emissions from these sources, when combined, were not large enough to potentially impact the SO_2 concentrations in the CUF vicinity (maximum Q/D less than three [3]). Therefore, no nearby sources were included in the modeling.

Table 6
Nearby Sources of at Least One (1) Ton per Year (tpy) [1,2]

Nearby Source	Location	Distance from CUF (km)	2014 Total Emissions (tons)	Maximum Q/D
Bi-County Gas Producers, LLC	Montgomery County, TN	19.0	2.7	0.1
FLORIM USA, INC.	Montgomery County, TN	42.0	106.0	2.5
NYRSTAR CLARKSVILLE, INC.	Montgomery County, TN	26.0	247.8	9.5

Notes:
1. Provided by TDEC.
2. Annual emissions reflect facility-wide total of all SO_2 emission sources.

3.4 MODEL SELECTION AND OPTIONS USED

For area designations under the 1-hour SO_2 primary NAAQS, the American Meteorological Society / Environmental Protection Agency Regulatory Model (AERMOD) should be used unless use of an alternative model can be justified (USEPA, 2005). Air quality dispersion modeling was performed using AERMOD (Version 15181) to obtain estimates of maximum ambient impacts (USEPA, 2004a; USEPA, 2015b). The options used within the model were the recommended default regulatory options, which included the following:

- Appropriate treatment of calms and use of missing meteorological data routines;
- Inclusion of actual receptor elevations;
- Incorporation of complex / intermediate terrain algorithms;
- Calculations of stack tip downwash and direction-specific building downwash.

According to the SO_2 TAD, the "urban" or "rural" determination of a source is important in determining the boundary layer characteristics that affect AERMOD's prediction of downwind concentrations as well as the possible invocation of the 4-hour half-life for urban SO_2 sources (USEPA, 2016). In order to determine the rural / urban characterization of a modeling study area and the dispersion coefficients to use in AERMOD, a land use analysis is required (USEPA, 2005). The USEPA guidance recommends the use of the Auer land use scheme within three (3) kilometers of a source to classify the predominant dispersion regime (USEPA, 2005). If the percentage of land-use types that are characteristic of heavy industrial, light-moderate industrial, commercial, or compact residential account for 50 percent or more within the three kilometers, the modeling area is classified as urban, and the urban dispersion options in AERMOD should be used. Otherwise, the area is classified and modeled as rural.

The Auer method was used to determine the land use status of the area around CUF. A three-kilometer radius was centered on the CUF1 stack, and the land use was categorized based on the Auer classifications (Auer, 1978). The data source for the land cover was the 2011 National Land Cover Database (NLCD), with a data cell size (raster) of 30 meters by 30 meters. The results of the Auer land use analysis for the CUF study area are presented in Figure 5 and Table 7. The analysis indicates that the

CUF study area is approximately 97.2% rural and 2.9% urban. Therefore, the rural option was used in AERMOD.

Table 7
Auer Land Use Percentages by Category: CUF Study Area

SO_2 Modeling Auer's Analysis - NLCD 2011				Cumberland - 3 km Ring		
NLCD Value	NLCD 2011 Descriptions	Auer's Code	Auer's Class	Area (Sq. Meters)	Pecentage	Totals
23	Developed, Medium Intensity	R2/R3	Urban	453,096.84	1.60%	2.85%
24	Developed, High Intensity	I1/I2/C1		354,010.22	1.25%	
11	Open Water	A5	Rural	3,707,219.11	13.11%	97.15%
21	Developed, Open Space	A1/R4		978,345.97	3.46%	
22	Developed, Low Intensity	R1		556,779.15	1.97%	
31	Barren Land (Rock/Sand/Clay)	A3		120,705.95	0.43%	
41	Deciduous Forest	A4		12,429,094.72	43.96%	
42	Evergreen Forest	A4		225,256.03	0.80%	
52	Shrub/Scrub	A4		73,873.69	0.26%	
71	Grassland/Herbaceous	A3		168,216.03	0.59%	
81	Pasture/Hay	A3		3,817,436.15	13.50%	
82	Cultivated Crops	A2		3,261,036.67	11.53%	
90	Wood Wetlands	A4		1,960,845.82	6.94%	
95	Emergent Herbaceous Wetlands	A3		167,162.45	0.59%	
Analysis based on 30 meter by 30 meter raster cells extracted for each area.			*Grand Totals:*	*28,273,078.80*	*100.00%*	

3.5 METEOROLOGY

Given that site-specific meteorological data are not available for the CUF site, surface data collected by the NWS at the Nashville International Airport (BNA) in Nashville, Tennessee, were used. Data for the three-year period from 2012 to 2014 were used. Twice daily soundings for the same time period, also from the BNA airport, were used for the upper air data.

The data were processed using the AERMET (Version 15181) meteorological data preprocessor for AERMOD (USEPA, 2004b; USEPA, 2015a). In addition, 1-minute ASOS wind data available from the National Climatic Data Center (NCDC) for the BNA NWS site were processed with AERMINUTE (Version 15272) to generate hourly averaged wind speed and wind direction to supplement the standard hourly NWS observations. Because the BNA NWS site is an Ice Free Wind (IFW) station with a commission date of April 5, 2007, AERMINUTE flagged the 2012-2014 winds as non-calm. The wind speeds were converted from knots to meters per second (m/s) because the threshold for sonic anemometers is effectively zero. No minimum wind speed threshold values were set in AERMET.

Two sets of meteorology were modeled, one set using onsite surface characteristics and one using the surface characteristics of the NWS station. Details of the meteorological processing are provided in the modeling protocol (TVA, 2016). The AERMET input and output files are included on the enclosed optical disc.

3.6 MODELING DOMAIN AND RECEPTORS

For the purposes of 1-hour SO_2 designation determination, the modeling domain was a Cartesian grid centered at the CUF site and extended out 10 km in each direction. No other SO_2 sources were expected to cause a significant concentration gradient within the domain.

The CUF modeling was performed using a series of nested gridded receptor sets. Boundary receptors were also placed along the perimeter of the fenced area of the property and spaced 50 meters (m) apart. These boundary receptors corresponded to a permanent fence surrounding the property.

The nested receptor grids surrounded the facility site with the exception of those falling inside the fenced boundary area, which were removed. Because concentration gradients are most pronounced near a source, the receptor spacing varied with distance from the site with those nearest the site more closely spaced than those further away. The origin of each grid was located in the southwest corner. The receptor spacing is provided in Table 8.

Table 8
Receptor Grid Size and Spacing

Receptor Spacing (m)	Grid Size (km)	Grid Origin (km south and west of site)
100	6 × 6	3
250	10 × 10	5
500	20 × 20	10

Elevations for all receptors were extracted from U.S. Geological Survey (USGS) National Elevation Dataset (NED) files using the AERMAP terrain processor (Version 11103) of the AERMOD modeling system (http://nationalmap.gov/elevation.html) (USEPA, 2004c). A receptor elevation plot is presented in Figure 6.

3.7 BACKGROUND AIR QUALITY

The SO_2 TAD states that the inclusion of ambient monitored background concentrations in the model results is important in determining the cumulative impact of the target source and other contributing nearby sources impacts (USEPA, 2016).

An assessment of nearby SO_2 monitors was performed in order to determine the most appropriate monitor to represent ambient SO_2 background concentrations for the CUF modeling analysis (Table 9). The choice of nearby background monitors for CUF was limited because several monitors did not meet the data completeness requirements for determining compliance with the NAAQs. The Cumberland Heights and Meek's Property monitors located in Clarksville, Tennessee, did not have three years of usable data since all of the data in 2014 was excluded as an exceptional event. The Christian County monitor located in Christian County, Kentucky did not meet the USEPA completeness criteria in 2012 and 2014. The Trinity Lane monitor in Davidson County (Nashville), Tennessee, also did not meet the USEPA data completeness criteria in 2012 and 2013. The Powell Street monitor in Paducah, Kentucky has three years of complete and valid data. However, it is impacted by numerous large nearby sources, making it unsuitable for characterizing air quality beyond the immediate vicinity of the monitor. The monitor at Mammoth Cave National Park in Mammoth Cave, Kentucky (AIRS ID 21-061-0501) was determined to be the best choice for representing background SO_2 concentrations because it is the closest monitor that meets the data completeness requirements for 2012-2014 and is not influenced by large nearby sources[4]. This monitor is located approximately 98 miles northeast of CUF (Figure 1).

[4] TVA (C. Wylie) conference call with USEPA Region IV (R. Gillam) and TDEC (H. Alrawi) on May 26, 2016, which concluded that the Mammoth Cave monitor was most appropriate for estimating background concentrations at CUF.

Table 9
Ambient SO_2 Monitors in the Vicinity of CUF [1]

Monitor	Site ID	Distance to CUF (miles)	3-yr Avg. 99th Percentile Concentration (ppb) [2]	Large Nearby Sources?
Cumberland Heights (Clarksville)	47-125-0106	16	Does not meet data completeness requirements	
Meek's Property (Clarksville)	47-125-0006	17	Does not meet data completeness requirements	
Christian County	21-047-0006	40	Does not meet data completeness requirements	
Trinity Lane (Nashville)	47-037-0011	52	Does not meet data completeness requirements	
Powell Street (Paducah)	21-145-1024	69	20.7	Yes, over 50,000 tpy
Mammoth Cave	21-061-0501	98	10.3	No
Shelby Farms NCore	47-157-0075	150	9.3	Yes, nearly 14,000 tpy

Notes:
1. USEPA Air Quality System (AQS) Data Mart: http://www3.epa.gov/airquality/airdata/.
2. The 3-year average of the 99th percentile of the annual distribution of daily maximum 1-hour average SO_2 concentrations for the 2012-2014 period.

Following TAD guidance, the three-year average of the 99th percentile of the daily maximum 1-hour SO_2 concentrations from 2012-2014 was used to capture the impact of natural sources, minor nearby sources, and distant major sources in the vicinity of CUF which were not included in the modeling (Table 10). No wind directions were excluded to remove the impacts of CUF or other sources on the monitor.

Table 10
Ambient SO_2 Concentrations Measured at Mammoth Cave National Park [1]

Year	99th Percentile 1-hr SO_2 Concentration (ppb)[2]
2012	9
2013	11
2014	11
3-year Average	10.3

Note:
1. USEPA Air Quality System (AQS) Data Mart: http://www3.epa.gov/airquality/airdata/
2. The 3-year average of the 99th percentile of the annual distribution of daily maximum 1-hour average SO_2 concentrations for the 2012-2014 period.

4.0 MODELING RESULTS AND CONCLUSION

For both meteorological scenarios, the 3-year average of the 99th percentile of the annual distribution of daily maximum 1-hour average SO_2 concentrations was calculated for each receptor; the value for the receptor with the highest concentration is presented in Table 11. These values include modeled impacts from CUF as well as background concentrations. The results of the modeling analysis show that maximum impacts from actual hourly emissions from CUF during the period from 2012 to 2014 did not cause or contribute to a violation of the 1-hour SO_2 NAAQS.

Table 11
Maximum Modeled Impacts of CUF Emissions (2012-2014)

Met Surface Characteristics	Receptor Location			1-hour SO_2	
	UTM Easting (m)	UTM Northing (m)	Elevation (m)	Maximum Modeled Impact (ppb) [1,2]	NAAQS (ppb) [2]
Onsite	439886	4024627	125.25	46.5	75
BNA	439086	4026527	159.68	40.4	75

Notes:
1. Modeled impacts include the impact of actual hourly emissions from CUF and background concentrations from the Mammoth Cave monitor.
2. 3-year average of the 99th percentile of the annual distribution of daily maximum 1-hour SO_2 concentrations.

A plot of the 3-year average of the 99th percentile of the annual distribution of daily maximum 1-hour average SO_2 concentrations for the onsite surface characteristics is presented in Figure 7. A similar plot for the NWS surface characteristics is shown in Figure 8. The distance to the receptor with the highest concentration was 3.28 km for the onsite surface characteristics and 2.66 km for the NWS surface characteristics.

For the scenario using the onsite surface characteristics, the maximum predicted concentration occurred at receptors that fell near the edge of the 100-meter spaced receptor grid. Therefore, an additional round of modeling was performed using a one kilometer-by-one kilometer refined (100-meter spaced) receptor set centered on the maximum concentration receptor to ensure that the highest concentration was being captured. The results of the finer grid modeling showed no changes to predicted maximum concentrations (see Figure 7).

The input and output files for the AERMOD model runs provide additional details on the dispersion modeling and are included on the enclosed optical disc.

These modeling results show that SO_2 emissions from CUF from 2012 to 2014 resulted in maximum predicted impacts well below the 1-hour SO_2 NAAQS. Based on this and the consideration of other SO_2 sources in the area, an attainment designation for Stewart County is recommended.

5.0 REFERENCES

Auer, 1978: Correlation of Land Use and Cover with Meteorological Anomalies. Journal of Applied Meteorology, 17(5), 636-643.

TVA, 2016: Cumberland Fossil Plant Modeling Protocol for 1-Hour SO_2 NAAQS Designation. Tennessee Valley Authority, Chattanooga, TN 37402.

USEPA, 1985: Guideline for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations), Revised. EPA-450/4-80-023R. U.S. Environmental Protection Agency, Research Triangle Park, NC 27711.

USEPA, 2004a: User's Guide for the AMS/EPA REGULATORY MODEL - AERMOD. EPA-454/B-03-001. U.S. Environmental Protection Agency, Research Triangle Park, NC 27711.

USEPA, 2004b: User's Guide for the AERMOD Meteorological Preprocessor (AERMET). EPA-454/B-03-001. U.S. Environmental Protection Agency, Research Triangle Park, NC 27711.

USEPA, 2004c: User's Guide for the AERMOD Terrain Preprocessor (AERMAP). EPA-454/B-03-003. U.S. Environmental Protection Agency, Research Triangle Park, NC 27711.

USEPA, 2004d: User's Guide to the Building Profile Input Program (BPIPPRM). EPA-454/R-93-038. U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711.

USEPA, 2005: Guideline on Air Quality Models. 40 CFR Part 51 Appendix W.

USEPA, 2011: Addendum User's Guide for the AERMOD Terrain Preprocessor (AERMAP). EPA-454/B-03-002. U.S. Environmental Protection Agency, Research Triangle Park, NC 27711

USEPA, 2015a: Addendum User's Guide for the AERMOD Meteorological Preprocessor (AERMET). EPA-454/B-03-002. U.S. Environmental Protection Agency, Research Triangle Park, NC 27711.

USEPA, 2015b: Addendum User's Guide for the AMS/EPA REGULATORY MODEL - AERMOD. EPA-454/B-03-001. U.S. Environmental Protection Agency, Research Triangle Park, NC 27711.

USEPA, 2016: SO_2 NAAQS Designations Modeling Technical Assistance Document, February 2016. U.S. Environmental Protection Agency, Research Triangle Park, NC 27711.

Figure 1
Site Locality Map

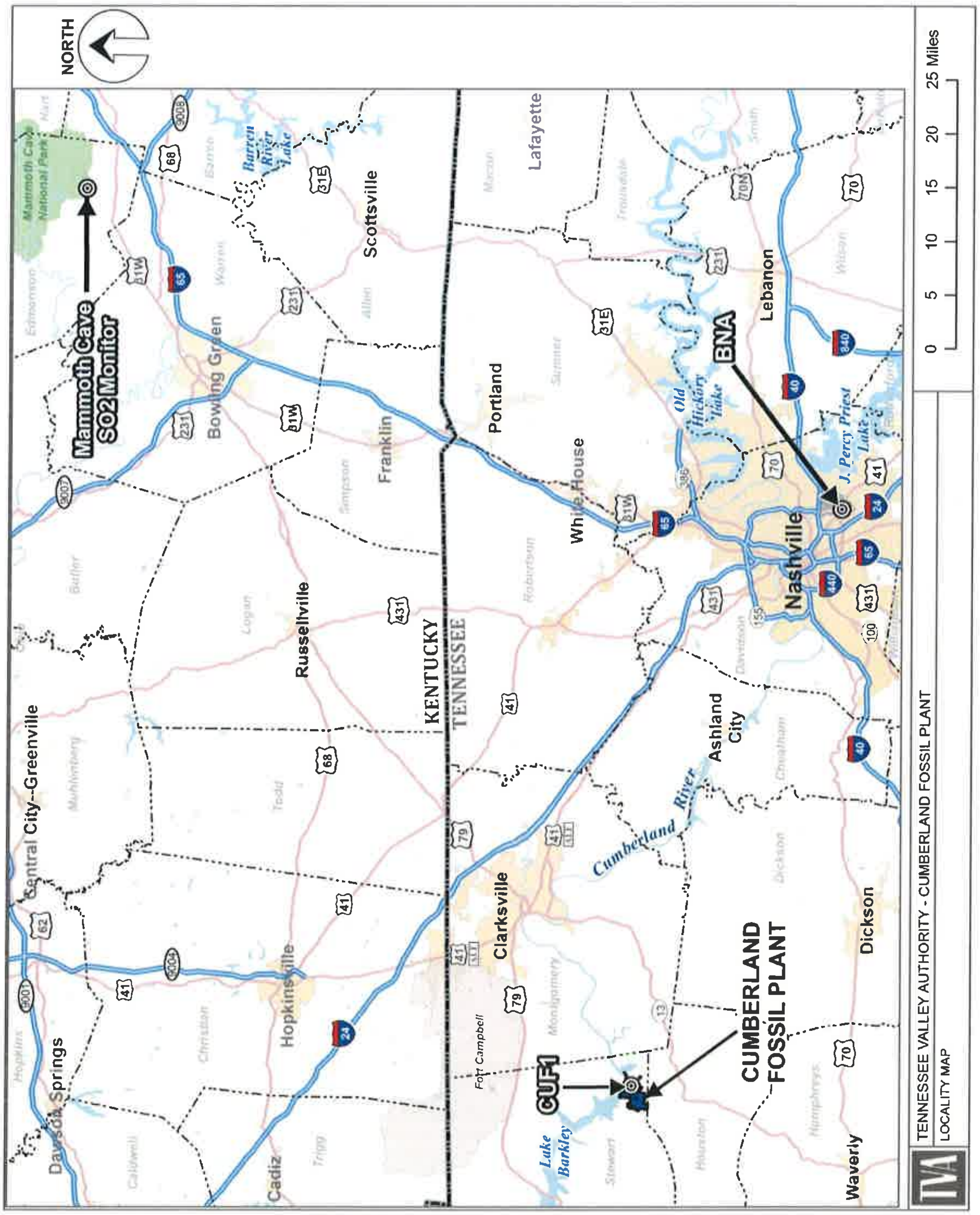

Figure 2
Topographical Map

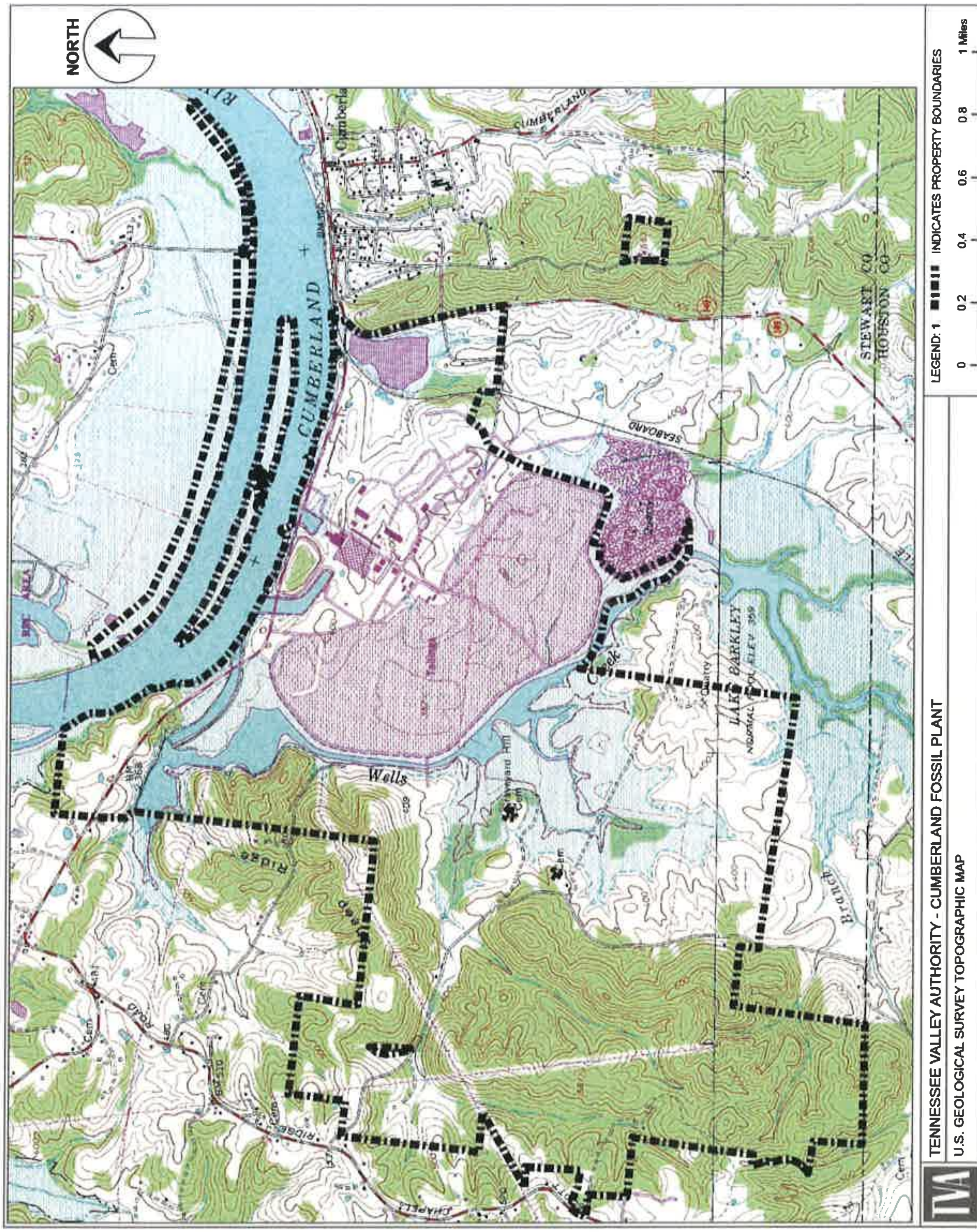

Figure 3
Building Locations for Stack Downwash Analysis

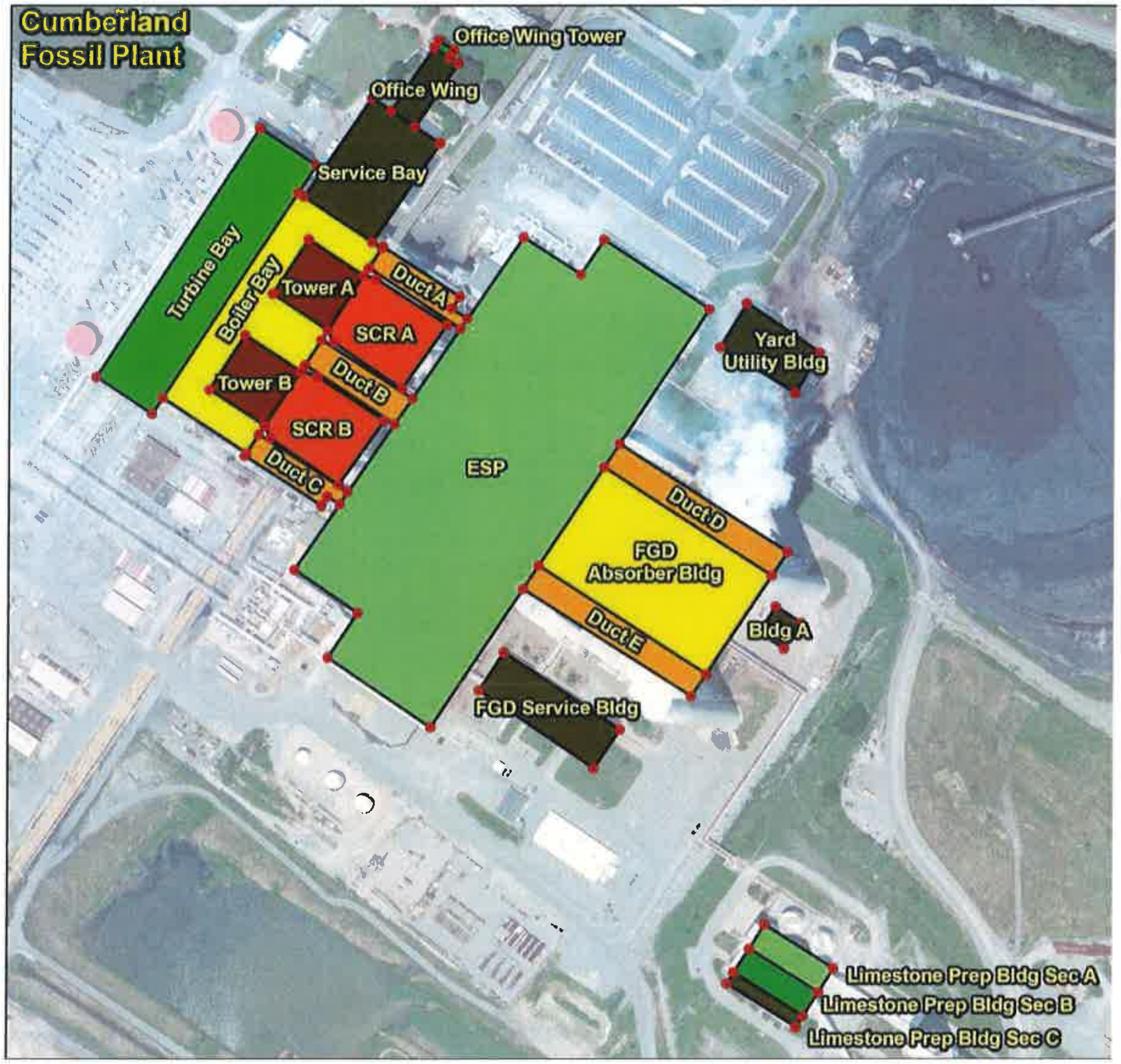

Figure 4
Nearby SO_2 Sources within 50 km of CUF

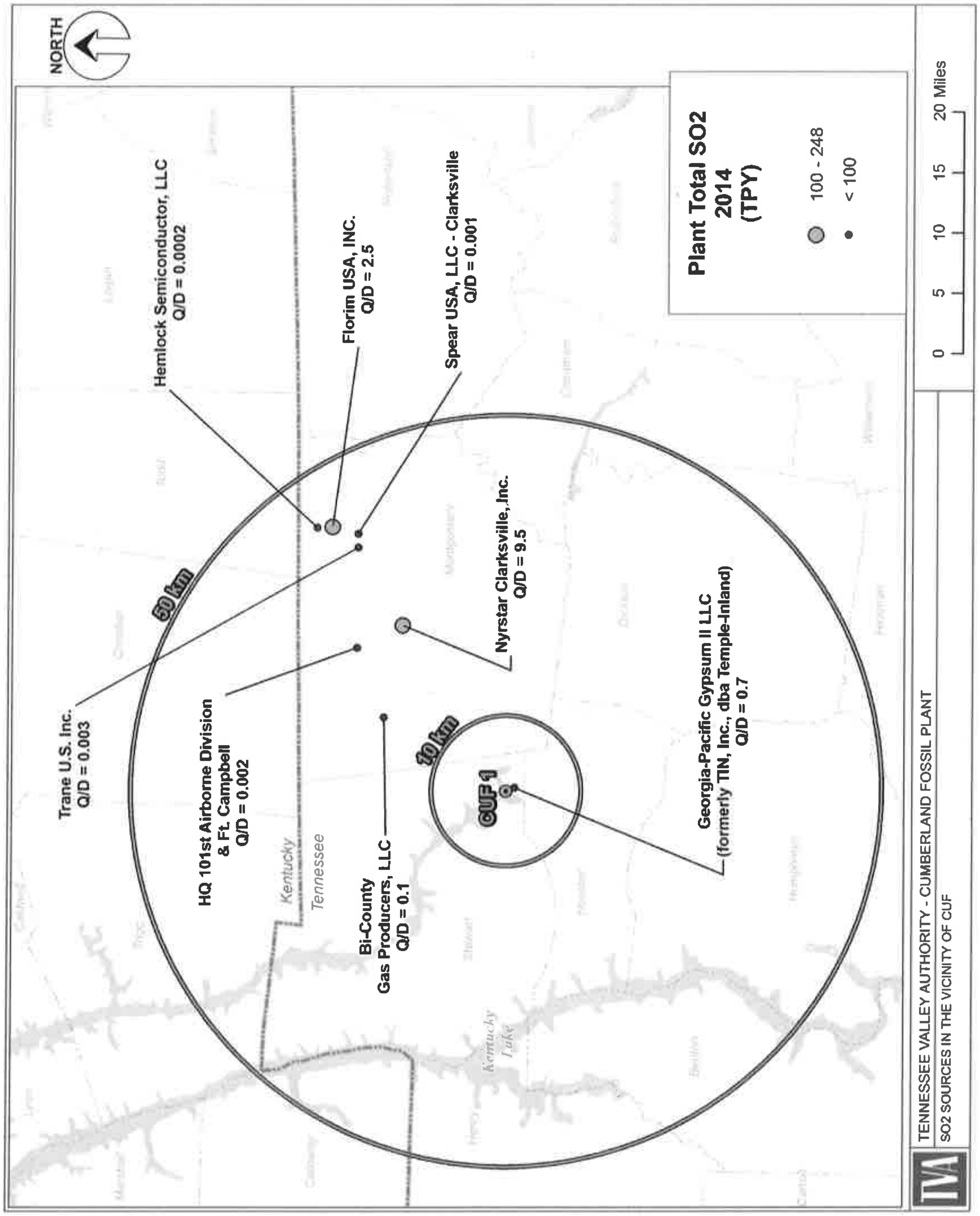

Figure 5
Auer Land Use Analysis - CUF Study Area

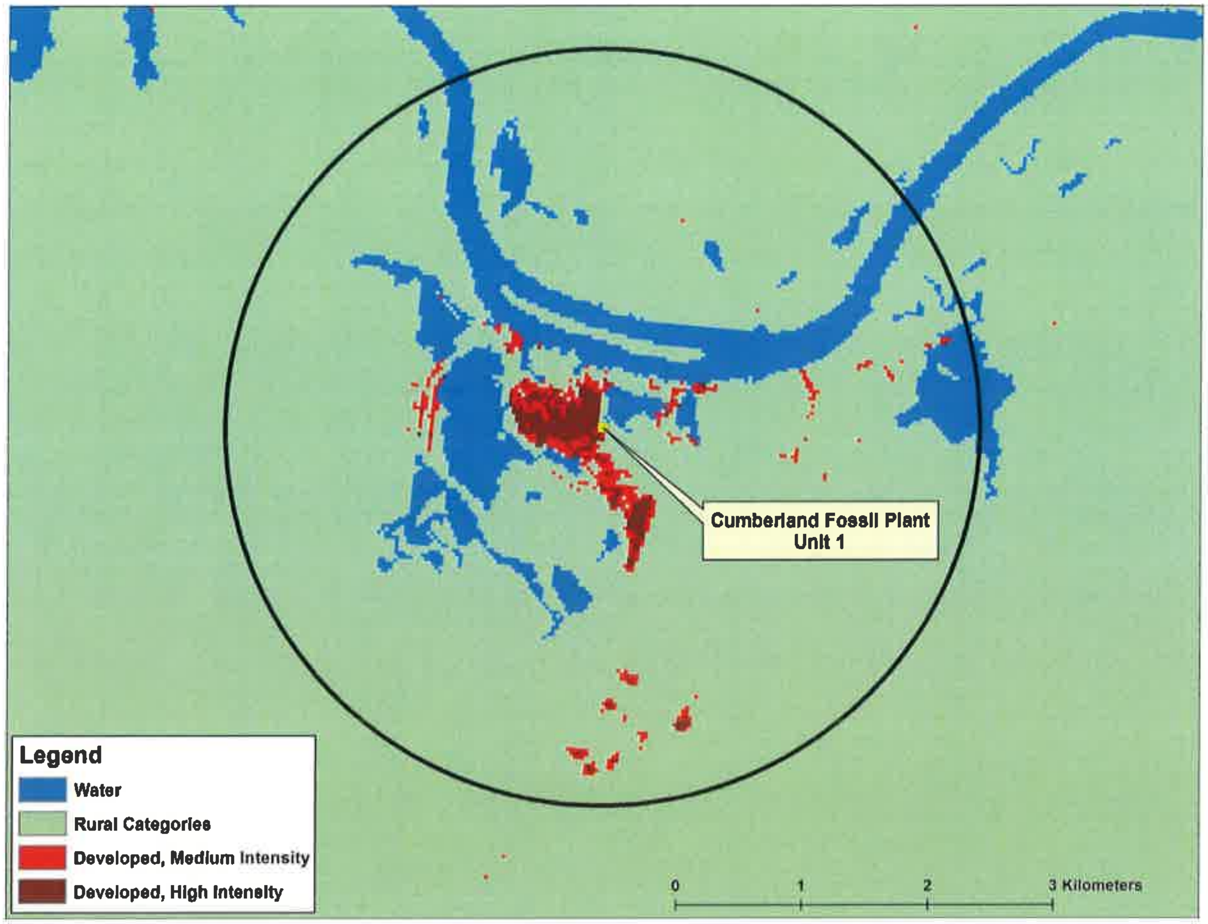

Figure 6
CUF Receptor Elevation Plot

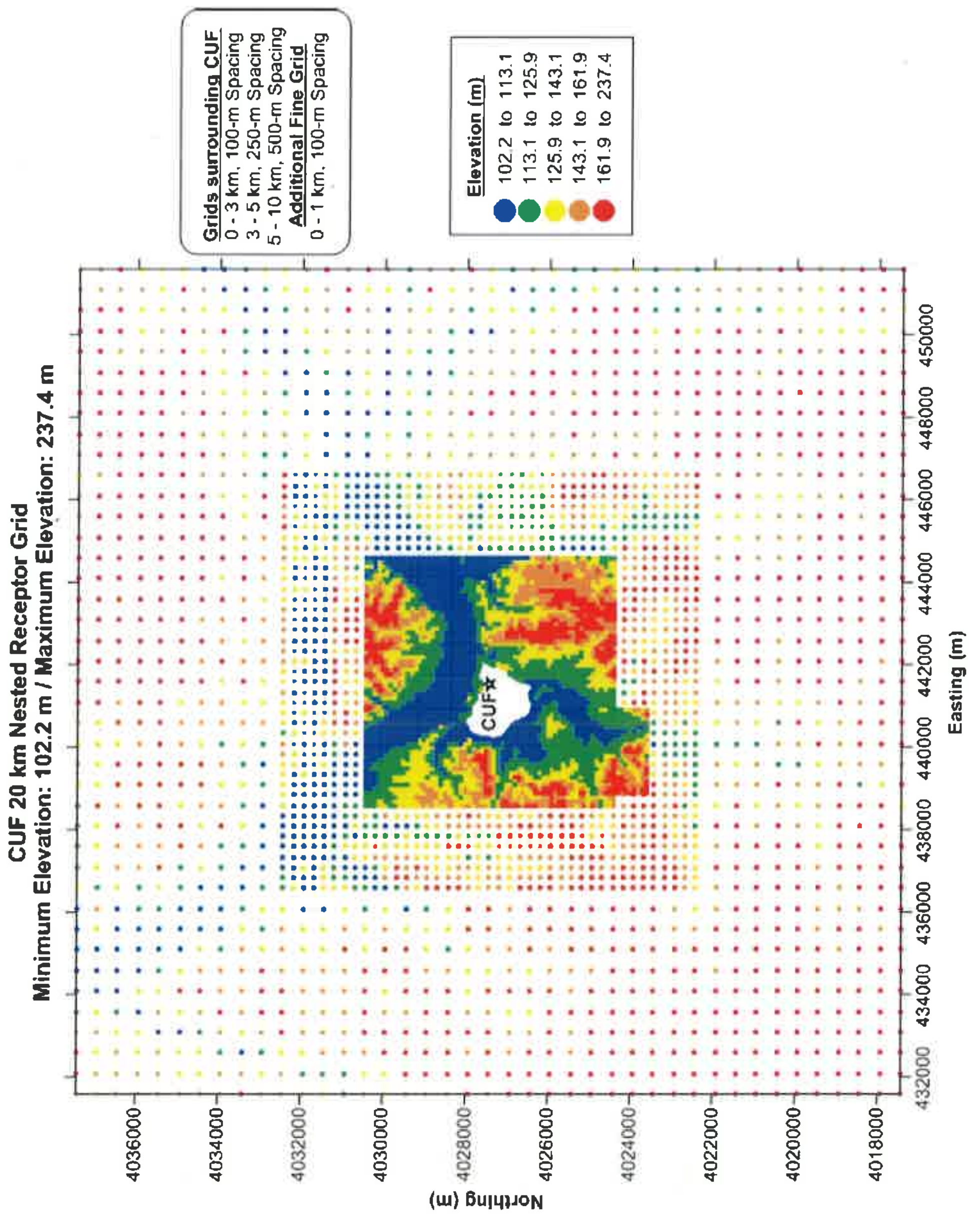

Figure 7
99^{th} Percentile 1-hour SO_2 Concentration Plot using Onsite Surface Characteristics

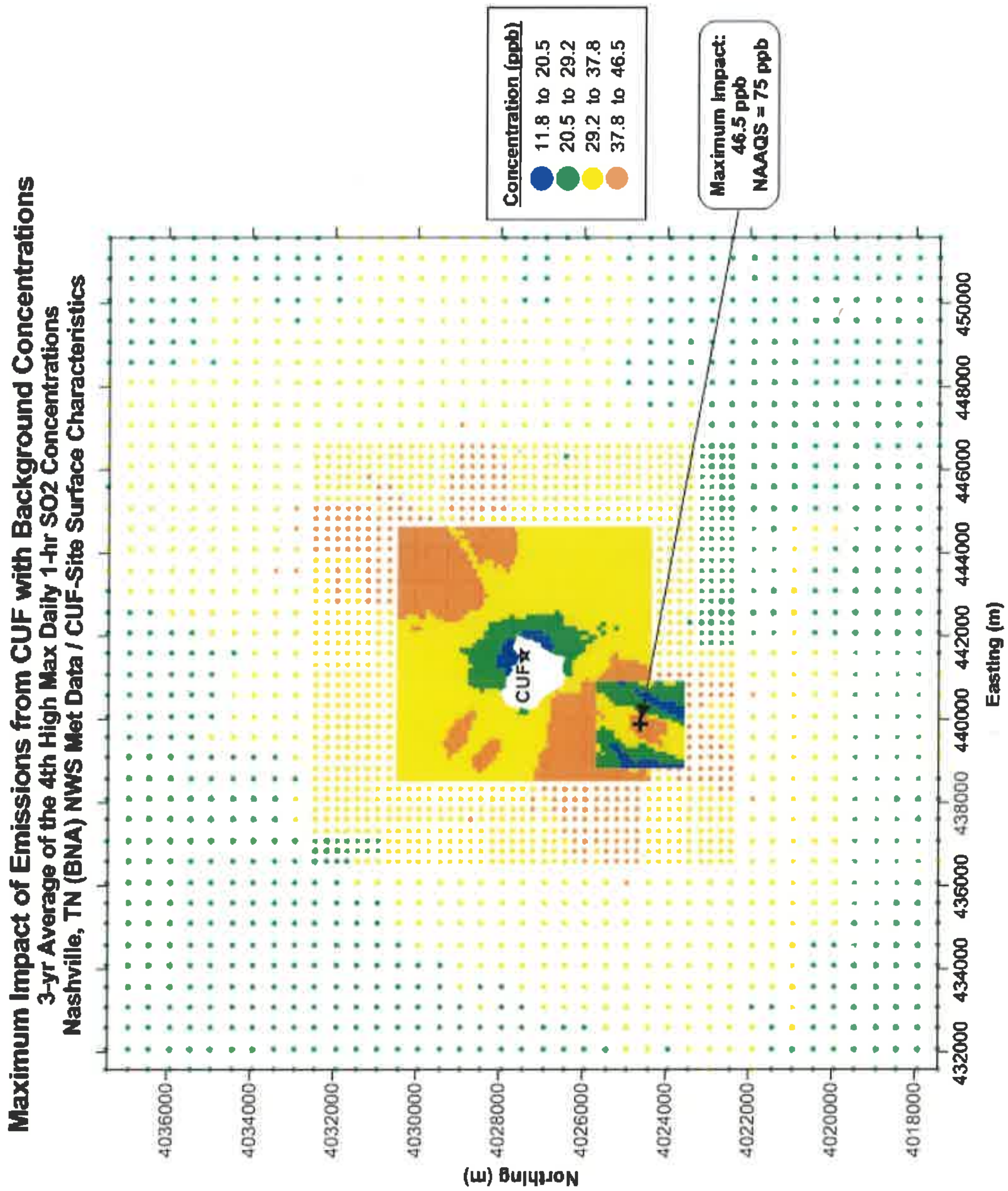

Figure 8
99th Percentile 1-hour SO_2 Concentration Plot using NWS Surface Characteristics