SO2 DATA REQUIREMENTS RULE (DRR)
AIR QUALITY MODELING REPORT

INTERNATIONAL PAPER – PRATTVILLE, AL MILL

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TABLE OF CONTENTS

Section Name **Page Number**

1. INTRODUCTION.. 1-1

2. MILL OVERVIEW 2-1

2.1 FACILITY LOCATION.. 2-1

2.2 MILL PROCESS DESCRIPTION 2-3

3. SO_2 EMISSIONS INVENTORY SUMMARY.. 3-1

3.1 HOURLY SO_2 EMISSIONS INVENTORY 3-1

3.2 PHYSICAL STACK INVENTORY.. 3-2

4. AIR QUALITY MODELING APPROACH AND TECHNICAL INFORMATION.... 4-1

4.1 AIR DISPERSION MODEL SELECTION.. 4-1

4.2 LAND USE ANALYSIS 4-2

4.3 RECEPTOR GRID 4-4

4.4 LOCAL SOURCES 4-8

4.5 METEOROLOGICAL DATA.. 4-8

4.6 GOOD ENGINEERING PRACTICE (GEP) STACK HEIGHT ANALYSIS........ 4-10

4.7 BACKGROUND AMBIENT AIR DATA 4-16

5. PRESENTATION OF AIR QUALITY MODELING RESULTS.................................. 5-1

6. REFERENCES... 6-1

LIST OF FIGURES

Figure 2-1 Mill Location Map 2-2
Figure 4-1 Prattville Mill 3-km Land Use Analysis 4-3
Figure 4-2 Inner Portion of the Receptor Grid........ 4-5
Figure 4-3 Full Receptor Grid........ 4-6
Figure 4-4 Mill Property Lines 4-7
Figure 4-5 Building Downwash Image........ 4-12

LIST OF TABLES

Table 3-1 Physical Stack Characteristics 3-2
Table 4-1 Building Downwash Analysis 4-13
Table 4-2 Diurnal Seasonal Average SO_2 Concentrations (ppb) 4-16
Table 5-1 SO_2 DRR Analysis Results 5-1

LIST OF APPENDICES

Appendix A – ADEM Response to EPA Technical Review Comments

Appendix B – Sensitivity Analysis of ADJ_U* Option for SO_2 DRR Modeling

Electronic Appendix – Emissions Inventory and Background Supporting Information

1. INTRODUCTION

On June 2, 2010, the U.S. Environmental Protection Agency (U.S. EPA) issued the final 1-hour National Ambient Air Quality Standard (NAAQS) for sulfur dioxide (SO_2). U.S. EPA subsequently promulgated 40 CFR Part 51, Subpart BB (Data Requirements for Characterizing Air Quality for the Primary SO_2 NAAQS, also known as the SO_2 DRR) on August 21, 2015 in 80 Federal Register (FR) 51051, which requires air agencies such as the Alabama Department of Environmental Management (ADEM) to develop and submit air quality data characterizing the maximum 1-hour ambient concentrations of SO_2 through either ambient air quality monitoring or air quality modeling evaluation. As part of the 1-hour SO_2 NAAQS designation process, International Paper (IP) is assisting ADEM in evaluating the designation for the area immediately surrounding its unbleached Kraft linerboard mill in Prattville, Alabama (Prattville Mill or Mill).

Via a January 14, 2016 letter to U.S. EPA Region 4, ADEM identified the Prattville Mill as subject to the DRR based its calendar year 2014 SO_2 emissions (3,691 tons). By July 1, 2016, ADEM was required to provide a formal submittal to U.S. EPA declaring whether ambient monitoring or dispersion modeling will be used for the designation evaluation in areas surrounding DRR-subject facilities. The submittal required modeling protocols for areas relying on dispersion modeling. In addition, monitoring details were required to be submitted to U.S. EPA by July 1, 2016 as part of ADEM's annual Consolidated Network Review submission. IP submitted an air dispersion modeling protocol to ADEM on June 2, 2016.

IP used dispersion modeling to support designation of the attainment status for the 2010 SO_2 NAAQS. This report summarizes the air dispersion modeling for the DRR designation evaluation as described in the air dispersion modeling protocol submitted on June 2, 2016. IP conducted the air quality modeling consistent with the procedures outlined in U.S. EPA's December 2013 Draft "Sulfur Dioxide (SO_2) National Ambient Air Quality Standards Designations Modeling Technical Assistance Document" (Modeling TAD; U.S. EPA 2013). Additional sections of this report contain the following information:

- **Section 2 – Mill Overview** – provides an overview of the Mill's current configuration and operations.

- **Section 3 – SO_2 Emissions Inventory Summary** – provides a detailed description of the hourly SO_2 emissions inventory comprising the actual emissions data input for the modeling evaluation.

- **Section 4 – Air Quality Modeling Approach and Technical Information** – outlines the technical approach that was used to conduct the SO_2 DRR modeling evaluation.

- **Section 5 – Presentation of Air Quality Modeling Results** – provides a summary of results for the SO_2 DRR air quality modeling evaluation.

- **Section 6 – References** – provides a detailed list of the reference documents utilized for the SO_2 DRR air quality modeling evaluation.

- **Appendix A – ADEM Response to EPA Technical Review Comments** – provides the ADEM response to EPA Technical Review Comments on the SO_2 DRR Modeling Protocol document.

- **Appendix B – Sensitivity Analysis of ADJ U* Option for SO_2 DRR Modeling** – provides a sensitivity analysis of the beta ADJ_U* option, comparing concentrations output from the regulatory default air quality modeling to concentrations output from air quality modeling using the ADJ_U* option.

- **Electronic Appendix** – provides hourly production, fuel usage, operating hours, SO_2 emissions factors, emissions data, and background concentration calculations. Available at https://www.hightail.com/download/cUJVa0ZSSU9BNkYzZU1UQw.

2. MILL OVERVIEW

This section of the report contains a description of the Mill. A description of the geographic and topographic setting of the Mill is also provided.

2.1 FACILITY LOCATION

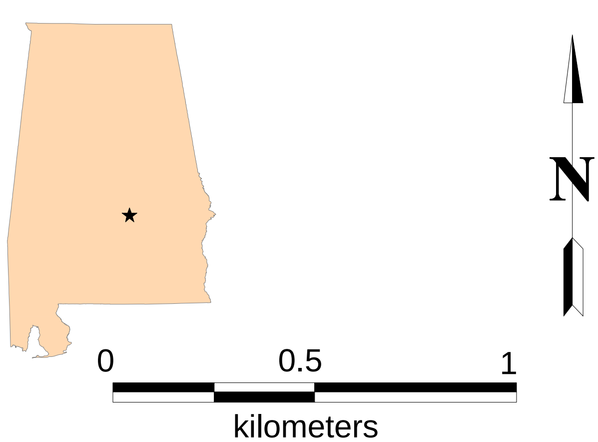
The Mill is located south of downtown Prattville in Autauga County, Alabama. The location of the Mill is depicted in Figure 2-1 on a section of U.S. Geological Survey (USGS) quadrangle. The geographical coordinates for the approximate center of the processing area of the Mill are:

- Universal Transverse Mercator (UTM) Easting: 549,407 meters (m)
- UTM Northing: 3,586,896 m
- UTM Zone: 16
- North American Datum (NAD): 1983
- Longitude (degrees, minutes, seconds): 86° 28′ 28.32″ W
- Latitude (degrees, minutes, seconds): 32° 25′ 4.97″ N

The Prattville Mill is located in the Columbus (Georgia) – Phenix City (Alabama) Interstate Air Quality Control Region (AQCR) (40 CFR §81.58). Autauga County is in attainment or unclassifiable/attainment for all criteria pollutants (40 CFR §81.301) as of the date of this submittal.

The Mill elevation is approximately 62 m [203.5 feet (ft)] above mean sea level (amsl). The Mill is located approximately 1.5 kilometers (km) northwest of the Alabama River.

approximate quadrangle location



Based of USGS 1:24,000 topopgraphical map for Prattville, AL 2013 and Forester, AL 2013.

Figure 2-1
Mill Location Map

International Paper
Prattville, AL Mill

2.2 MILL PROCESS DESCRIPTION

The Prattville Mill consists of the pulp mill, evaporator area, caustic area, non-condensable gas (NCG) collection system, hydrapulper, paper mill, power house area, recovery area, and numerous miscellaneous activities. Wood chips are continuously fed into the pulp mill's three Kamyr digesters. The pulp is transferred from the digesters to five wash plants to reduce and screen out rejects and to wash liquor from the pulp stock. Additional pulp is produced from recovered paper and old corrugated cardboard (OCC) in the hydrapulper. The pulp is transferred to the paper mill where it is further processed in the Mill's two paper machines. The paper machines convert pulp into various grades of unbleached two-ply linerboard.

The evaporator area consists of three evaporators and a condensate stripping system. The evaporators process weak black liquor generated from the pulping process. The condensate stripping system treats process condensates to reduce hazardous air pollutant (HAP) emissions.

The recovery area reclaims spent cooking chemicals from the pulp mill. "Black liquor" from the Kraft cooking process in the pulp area is combusted in either of the two recovery furnaces (Emissions Unit IDs RF1 and RF2). The combustion of black liquor results in a molten smelt which is formed at the bottom of the recovery furnaces. The molten smelt is then discharged from the furnaces into three smelt dissolving tanks (Emissions Unit IDs SDT1 and SDT2) each associated with a recovery furnace. Emissions Unit SDT1 consists of two smelt dissolving tanks. In the smelt dissolving tanks, a water based solution is added to the molten smelt to form green liquor. The green liquor is sent to the caustic area for further processing.

The purpose of the caustic area is to convert unclarified green liquor to white liquor, which is used in the pulp cooking (e.g., digester) process in the pulp mill. Green liquor is received from the recovery area and further processed in the green liquor clarifiers. The green liquor is mixed with lime and the causticizing reaction beings, forming a calcium carbonate and white liquor slurry. The calcium carbonate and white liquor are then separated and the calcium carbonate is converted into lime in the two lime kilns (Emission Unit IDs LK1 and LK2) operated by the Mill. The white liquor is delivered to the pulp mill to begin the pulp cooking process again.

The power house area generates and distributes steam, electricity, chilled water, instrument air, and demineralized water for use throughout the Mill. The Prattville Mill operates two Power Boilers. Power Boiler No. 1 (Emissions Unit ID PB1) burns unadulterated biomass (bark), creosote treated rail ties, and natural gas. In addition, PB1 is also used as a control device by burning low volume/high concentration (LVHC) NCGs, high volume/low concentration (HVLC) NCGs, and condensate stripping system off gases (SOGs). Power Boiler No. 2 (Emissions Unit ID PB2) burns unadulterated biomass (bark), creosote treated rail ties, coal, and natural gas. PB2 is also used as a control device by burning HVLC NCGs and SOGs.

3. SO_2 EMISSIONS INVENTORY SUMMARY

This section of the report discusses the SO_2 emissions inventory and the physical stack characteristics that were used as part of the air quality modeling evaluation.

3.1 HOURLY SO_2 EMISSIONS INVENTORY

The modeling evaluation was based on actual hourly SO_2 emissions from the 2012, 2013, and 2014 calendar years (since the basis of the designation as an affected facility for the Prattville Mill was calendar year 2014 emissions). The following emissions units at the Mill emit SO_2 and were considered in the emissions inventory:

- No. 1 Recovery Furnace (RF1)
- No. 1 Lime Kiln (LK1)
- No. 1 Power Boiler (PB1)
- No. 1 Smelt Dissolving Tank (RF1SDT)
- No. 2 Lime Kiln (LK2)
- No. 2 Smelt Dissolving Tank (RF2SDT)
- Combined Stack (CS) [includes the No. 2 Recovery Furnace and the No. 2 Power Boiler]

Note that the IDs listed above indicate the Stack ID references that were used in the modeling files. The emissions units listed above exhaust to various stacks at the Mill. Each emissions unit vents to its own individual stack, except for PB1 and RF1SDT, which each vents to two separate stacks.

Because there are no continuous emissions monitoring systems (CEMS) installed on the SO_2 emissions units identified in Section 2.2, hourly SO_2 emissions were quantified using various emissions factor methodologies as described in this section:

1. Where available, IP relied on site-specific emissions factors developed through historic stack testing.

2. If no site specific emissions factors were available, IP relied on industry accepted emissions factors from the National Council for Air and Stream Improvement (NCASI) or U.S. EPA's AP-42.

The emissions factors were then paired with hourly production, fuel usage, or operating hour information, as appropriate, to quantify actual hourly emissions of SO_2. IP utilized emissions factors consistent with the Mill's annual emissions statement reporting submittals, except for RF1. The Mill has previously relied on a historic SO_2 stack test from 1998 to quantify emissions from RF1. A more recent stack testing program was completed on RF1 in 2015 that indicates that SO_2 emissions are lower than the 1998 emissions information. The decrease in SO_2 emissions is sustainable and is attributed to a number of projects such as air handling system modifications that improved the combustion efficiency of RF1 and reduced SO_2 emissions since the previous stack test was conducted. Therefore, IP utilized the more recent stack test information to quantify hourly SO_2 emissions from RF1.

When hourly production, fuel usage, or operating hours data were missing, it was assumed that the missing hourly throughput data were equal to the average of the hours directly before and after the event. Per Comment No. 1 of U.S. EPA's Technical Review comments of the air dispersion modeling protocol, a copy of which has been included in Appendix A, a summary of hourly production, fuel usage, operating hours, SO_2 emissions factors, and actual pounds per hour (lb/hr) emissions is provided in the electronic appendix to this document. References for each emissions factor and all production data used are also provided in the electronic appendix.

3.2 PHYSICAL STACK INVENTORY

The physical stack characteristics that will be used for this air quality modeling evaluation are provided in Table 3-1 below:

Table 3-1
Physical Stack Characteristics

Emissions Unit	UTM Easting (m)	UTM Northing (m)	Elevation (m)	Stack Height (m)	Stack Diameter (m)
RF1	549,694	3,586,945	62.03	62.48	3.20
LK1	549,839	3,586,894	62.03	45.72	1.88

Table 3-1
Physical Stack Characteristics

Emissions Unit	UTM Easting (m)	UTM Northing (m)	Elevation (m)	Stack Height (m)	Stack Diameter (m)
PB1 A Stack	549,673	3,586,982	62.03	66.75	1.83
PB1 B Stack	549,673	3,586,979	62.03	66.75	1.83
RF1SDT A Stack	549,685	3,586,994	62.03	60.35	1.19
RF1SDT B Stack	549,685	3,586,971	62.03	60.35	1.19
LK2	549,844	3,586,884	62.03	45.72	1.89
RF2SDT	549,653	3,587,029	62.03	76.20	1.83
CS	549,719	3,587,032	62.03	76.20	4.57

Temperature and flow rate were varied annually based on available stack test data. Hourly emissions, temperature, and flow rate are provided in an hourly emissions file included as part of the electronic appendix.

4. AIR QUALITY MODELING APPROACH AND TECHNICAL INFORMATION

This section of the report outlines information on the technical approach that was followed in the air quality modeling evaluation and described in the air dispersion modeling protocol submitted to ADEM on June 2, 2016.

The air dispersion model selection is discussed as well as the model options that were used. The supporting information, including land use determinations, building downwash analyses, meteorological data, and terrain data is presented. Whenever possible, the guidance provided in 40 CFR Part 51 Appendix W "Guideline on Air Quality Models" (U.S. EPA 2005) and U.S. EPA 2013 was used to conduct the air quality modeling evaluation.

4.1 AIR DISPERSION MODEL SELECTION

The AERMOD (**AER**MIC **MOD**el) air dispersion model was used to estimate ambient air concentrations from the Mill. It is an Appendix W air dispersion model approved for regulatory modeling applications. The current version of AERMOD is 15181.

The AERMOD modeling system consists of two pre-processors and the dispersion model. AERMAP (Version 11103) is the terrain data pre-processor component and AERMET (Version 15181) is the meteorological data pre-processor component. The AERMAP pre-processor characterizes the surrounding terrain and generates receptor elevations. The AERMET pre-processor is used to generate an hourly profile of the atmosphere and uses a pre-processor, AERSURFACE (Version 13016), to process land use data for determining micrometeorological variables that are inputs to AERMET.

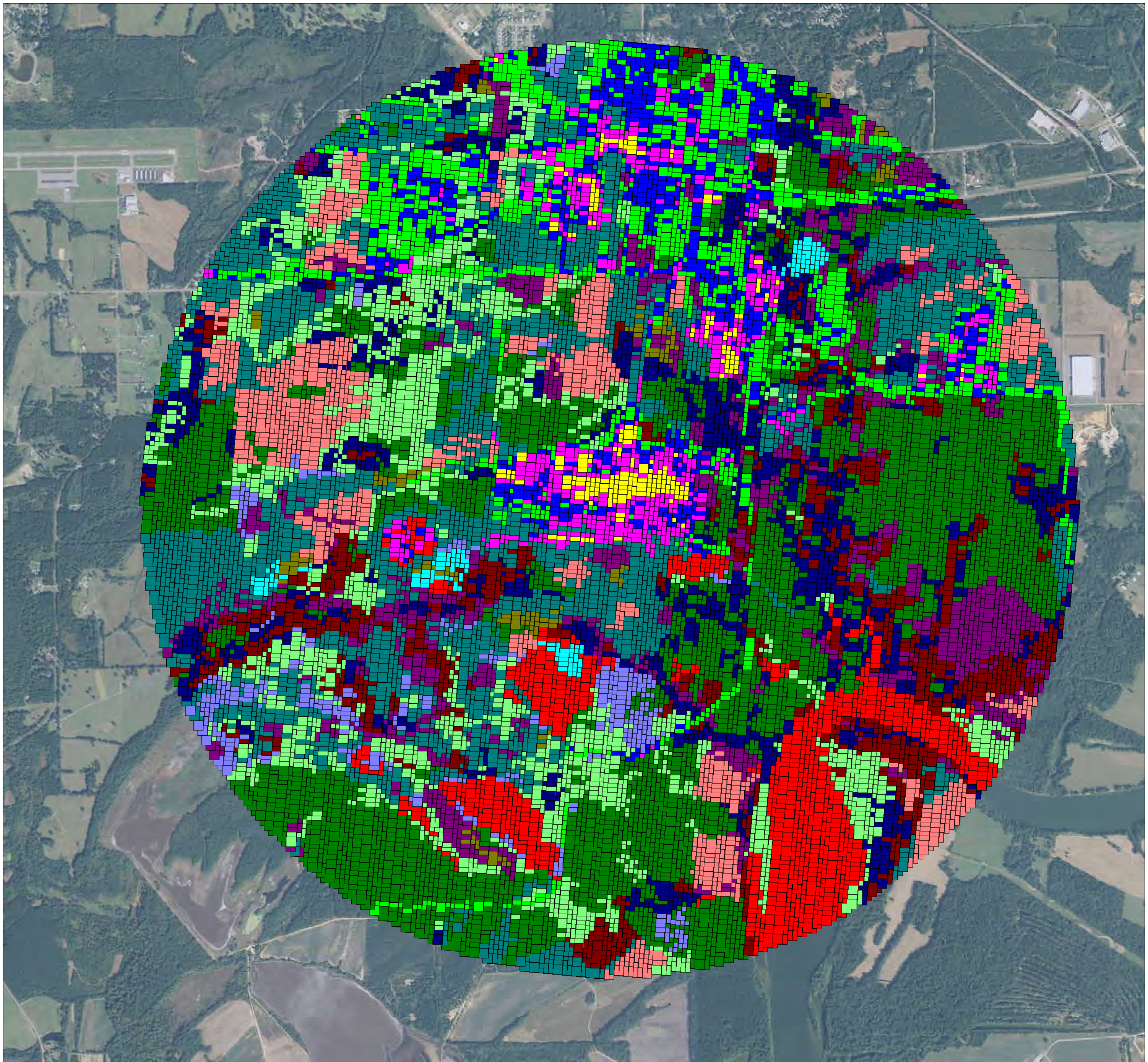
The AERMOD air dispersion model has various user selectable options that must be considered. U.S. EPA has recommended that certain options be selected when performing air quality modeling studies for regulatory purposes. The following regulatory default options were used in the AERMOD air quality modeling study:

- Stack-Tip Downwash
- Model Accounts for Elevated Terrain Effects
- Calms Processing Routine Used
- No Exponential Decay for Rural Mode and
- Missing Data Processing

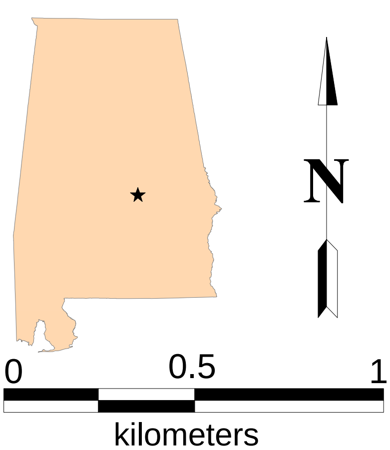
4.2 LAND USE ANALYSIS

A land use analysis for the area surrounding the Mill was compiled. The land use analysis is based on USGS electronic land use data for the area. Following U.S. EPA guidance (U.S. EPA 2005), the land use designation was based on the scheme developed by Auer (Auer 1978). Using the Auer land use classifications, industrial, commercial, and residential areas were classified as urban land use while agricultural, undeveloped, and common residential areas were considered to be rural land use. If more than 50% of the land use within a 3 km radius of the Mill is rural, then a rural designation should be used in the air dispersion model.

To perform the land use analysis, geographical information system (GIS) software was used to summarize the various land use types contained in the USGS electronic land use dataset. Based on the GIS summary, the land use within a 3-km radius of the Mill is approximately 96% rural, with the remaining percentage of land use being urban. Therefore, the urban option was not selected in the AERMOD air dispersion model. The 3-km radius land use summary for the area surrounding the Mill is shown in Figure 4-1.



approximate quadrangle location



Based of USGS 1:24,000 topopgraphical map for Prattville, AL 2013 and Forester, AL 2013.

Figure 4-1
Prattville Mill
3-km Land Use Analysis

International Paper
Prattville, AL Mill

2011 National Land Cover Dataset

- 11 - Open Water (6%)
- 21 - Developed, Open Space (8%)
- 22 - Developed, Low Intensity (5%)
- 23 - Developed, Medium Intensity (3%)
- 24 - Developed, High Intensity (1%)
- 31 - Barren Land (Rock/Sand/Clay) (1%)
- 41 - Deviduous Forest (7%)
- 42 - Evergreen Forest (20%)
- 43 - Mixed Forest (9%)
- 52 - Shrub/Scrub (7%)
- 71 - Grassland/Herbaceous (1%)
- 81 - Pasture/Hay (16%)
- 82 - Cultivated Crops (6%)
- 90 - Woody Wetlands (10%)
- 95 - Emergent Herbaceous Wetlands (2%)

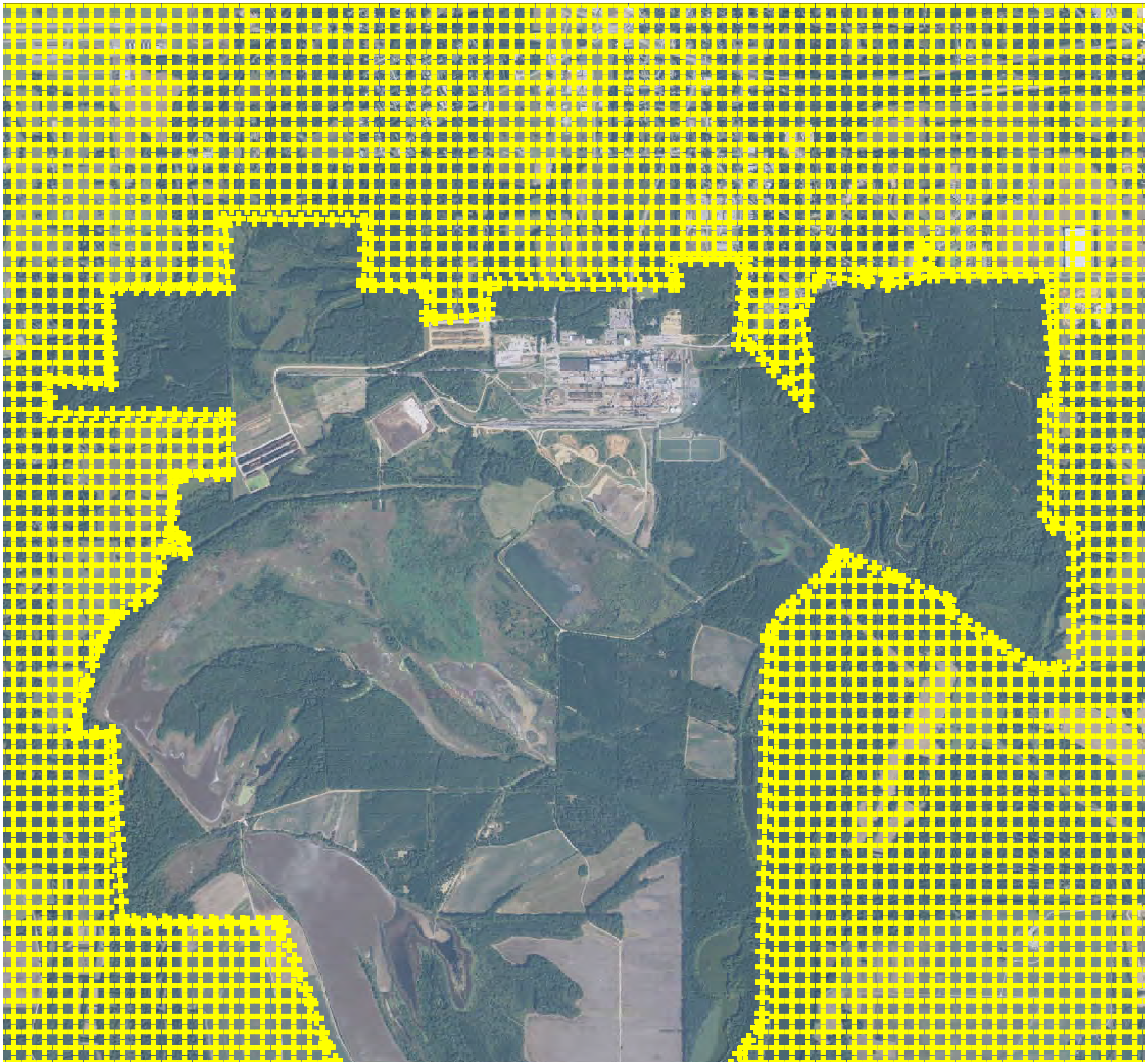
4.3 RECEPTOR GRID

A receptor grid for the AERMOD evaluation was developed to cover a 20-by-20 km square area centered on the Mill. All receptors were referenced to the UTM coordinate system, Zone 16, using NAD 83 datum. Rectangular coordinates were used to identify each receptor location. The rectangular receptor grid extends from the Mill property line and has the following grid spacing:

- 100 m out to ± 3 km
- 200 m out to ± 5 km
- 500 m out to ± 7 km and
- 1,000 m out to ± 10 km

In addition to the main rectangular coordinate receptor grid, property line receptors were used in the air quality modeling evaluation. The property line receptors were spaced approximately every 100 m. Plots of the inner portion of the receptor grid and the full receptor grid are shown in Figure 4-2 and Figure 4-3, respectively. Per Comment No. 2 of U.S. EPA's Technical Review Comments provided in Appendix A, IP limits public access to the areas of the property that do not restrict access using fences, gates, or no trespassing signs by patrolling the property routinely. Therefore, IP does not consider this area ambient air and will not include receptors in these locations. IP's site security, manned 24/7, patrols the property. IP has detailed the areas of their property line that are fenced, gated, or contain no trespassing signs in Figure 4-4.

Terrain elevations were assigned to all receptors. The AERMAP terrain pre-processor and USGS 1:24,000 National Elevation Dataset (NED) files were used to determine representative terrain elevations for all of the receptors. The horizontal resolution of the NED data is every 10 m.



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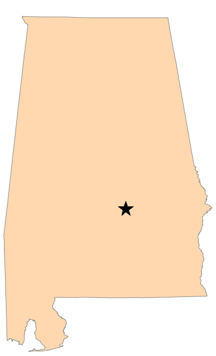


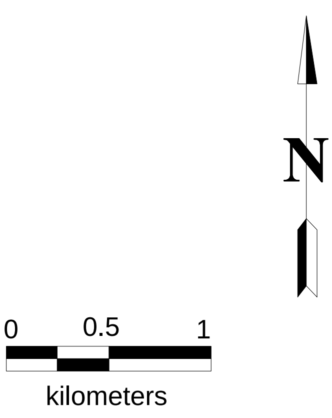
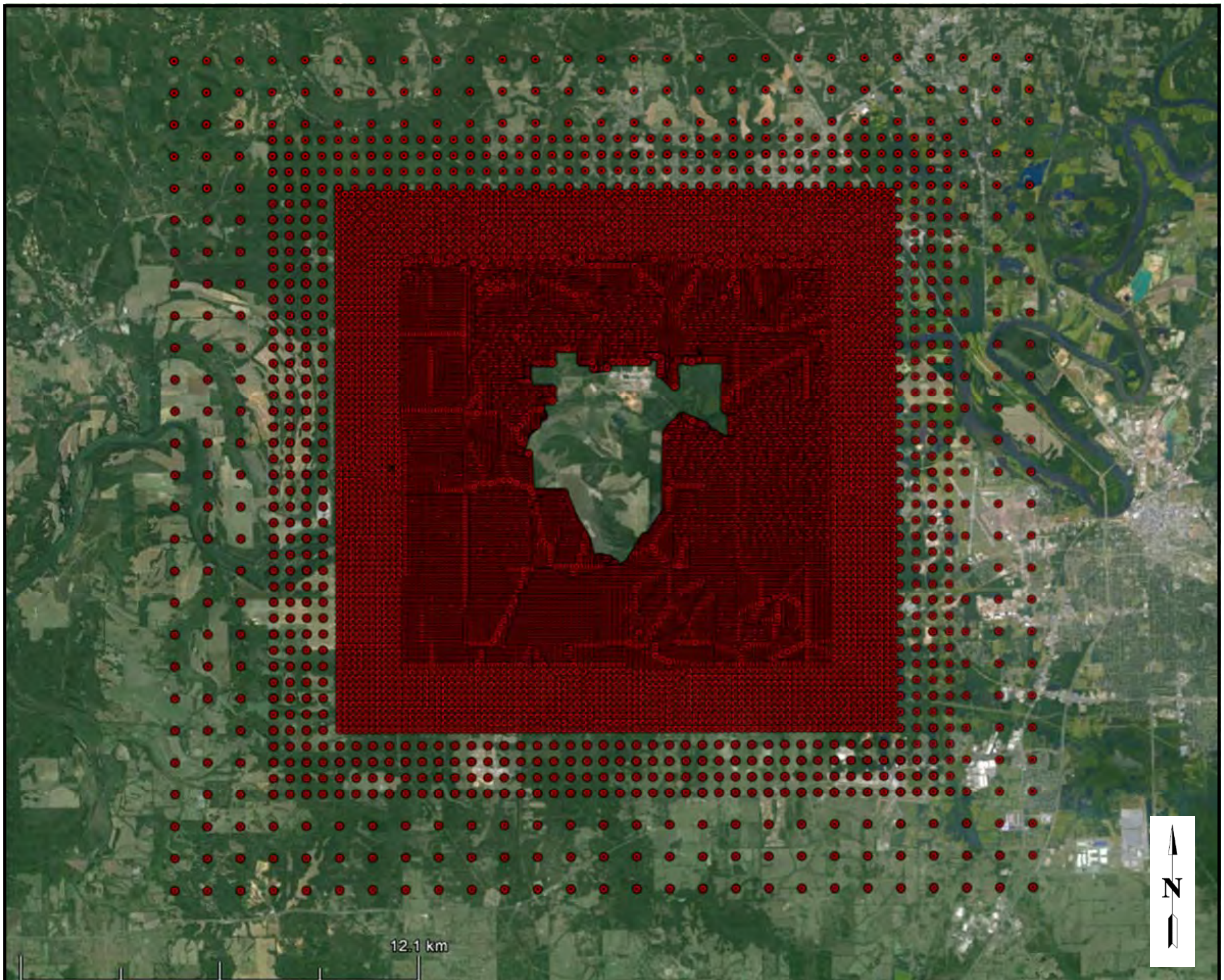


Figure 4-2
Inner Portion of the Receptor Grid

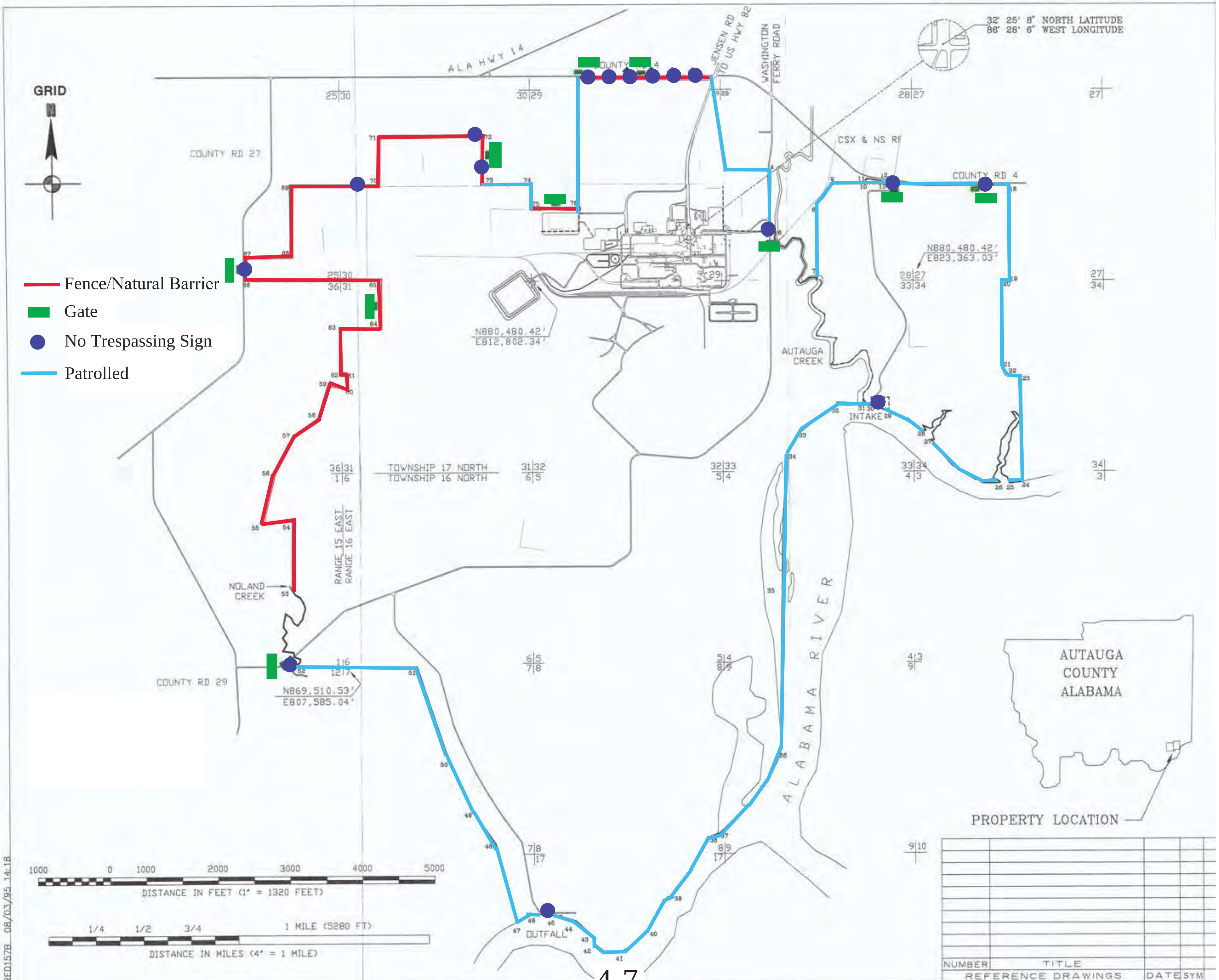
International Paper
Prattville, AL Mill

Based of USGS 1:24,000 topopgraphical map for Prattville, AL 2013 and Forester, AL 2013.



International Paper **Prattville, AL Mill**	**Figure 4-3** **Full Receptor Grid**

Figure 4-4
Mill Property Lines



4.4 LOCAL SOURCES

Based on an initial screening analysis provided by ADEM, local sources were evaluated using a "20D" approach for local sources within 20 km of the Mill. Local sources were excluded from the analysis if the 2014 annual emissions rates for the local source are less than 20 times the distance between the source and the Mill. Based on ADEM's analysis, no local sources met the 20D analysis for the Mill. As such, no additional analysis for local sources was necessary. Per U.S. EPA's Technical Review Comments, additional details regarding the screening of local sources is provided by ADEM in the response to Comment No. 3 included in Appendix A.

4.5 METEOROLOGICAL DATA

The meteorological data for the air quality modeling study consisted of three years of processed meteorological data provided by ADEM. The surface data were collected from Dannelly Field (MGM) National Weather Service (NWS) station in Montgomery, AL (Meteorological Station ID: 13895). The upper air (UA) data were collected from the Shelby County Airport (KEET) NWS station in Alabaster, AL (U.S. Station ID: 72230). The Mill obtained the meteorological data from ADEM for January 1, 2012 through December 31, 2014, which coincides with the timeframe for the actual SO_2 emissions data. Per U.S. EPA's Technical Review Comments, additional details regarding the meteorological representativeness of the data used to conduct this air quality modeling study is provided by ADEM in the response to Comment No. 4 included in Appendix A.

IP utilized the Adjust U-star (ADJ_U*) beta option in the AERMET meteorological processor (Version 15181). The ADJ_U* beta option addresses concerns of under-prediction of surface friction velocity (u*) during stable, low-wind conditions that contribute to over-prediction of ground level impacts (U.S. EPA 2016). The use of the ADJ_U* option is included as a beta option in AERMOD version 15181 and is currently proposed to become a regulatory default option as a part of the 40 CFR Part 51 Appendix W (Guideline on Air Quality Models) amendments proposed on July 29, 2015. Additionally, the ADJ_U* option meets the five conditions listed in 40 CFR

Part 51, Appendix W, Section 3.2.2(e) demonstrating that the default option is less appropriate for the IP SO_2 DRR analysis.

- *The model has received significant scientific peer review*, including the following:
    - Qian, W. and A. Venkatram, 2011. "Performance of Steady-State Dispersion Models Under Low Wind Speed Conditions." Boundary Layer Meteorology, 138:475-491.
    - Luhar AK and Rayner KN, 2010. "Methods to Estimate Surface Fluxes of Momentum and Heat from Routine Weather Observations for Dispersion Application under Stable Stratification." Boundary Layer Meteorology, 132:437-454.
- *The model can be demonstrated to be applicable to the problem on a theoretical basis*. Several studies (sited above) have demonstrated that AERMET with default options tends to significantly underestimate u* for low wind speed conditions which results in underestimations of turbulence and mixing height in AERMOD for stable conditions, which in turn reduces dispersion and leads to over-predicted concentrations. These same studies (sited above) conclude that use of ADJ_U* in AERMET improves the accuracy of predicted concentrations.
- *The databases which are necessary to perform the analysis are available and adequate*. Three years of representative meteorological data from the MGM NWS station for the period of 2012-2014 coincide with hourly actual SO_2 emissions from the Mill are available.
- *Appropriate performance evaluations of the model have shown that the model is not biased toward underestimates*. The June 2015 Addendum to the AERMOD User's Guide (U.S. EPA 2015) included an evaluation of low wind beta options including ADJ_U*. The Addendum provided evaluations of the Oak Ridge and Idaho Falls tracer studies and the Lovett Power Plant study and found that the ADJ_U* option improved model performance as compared to the default method and did not show a bias toward underestimates.
- *A protocol on methods and procedures to be followed is summarized as part of this air quality modeling protocol*.

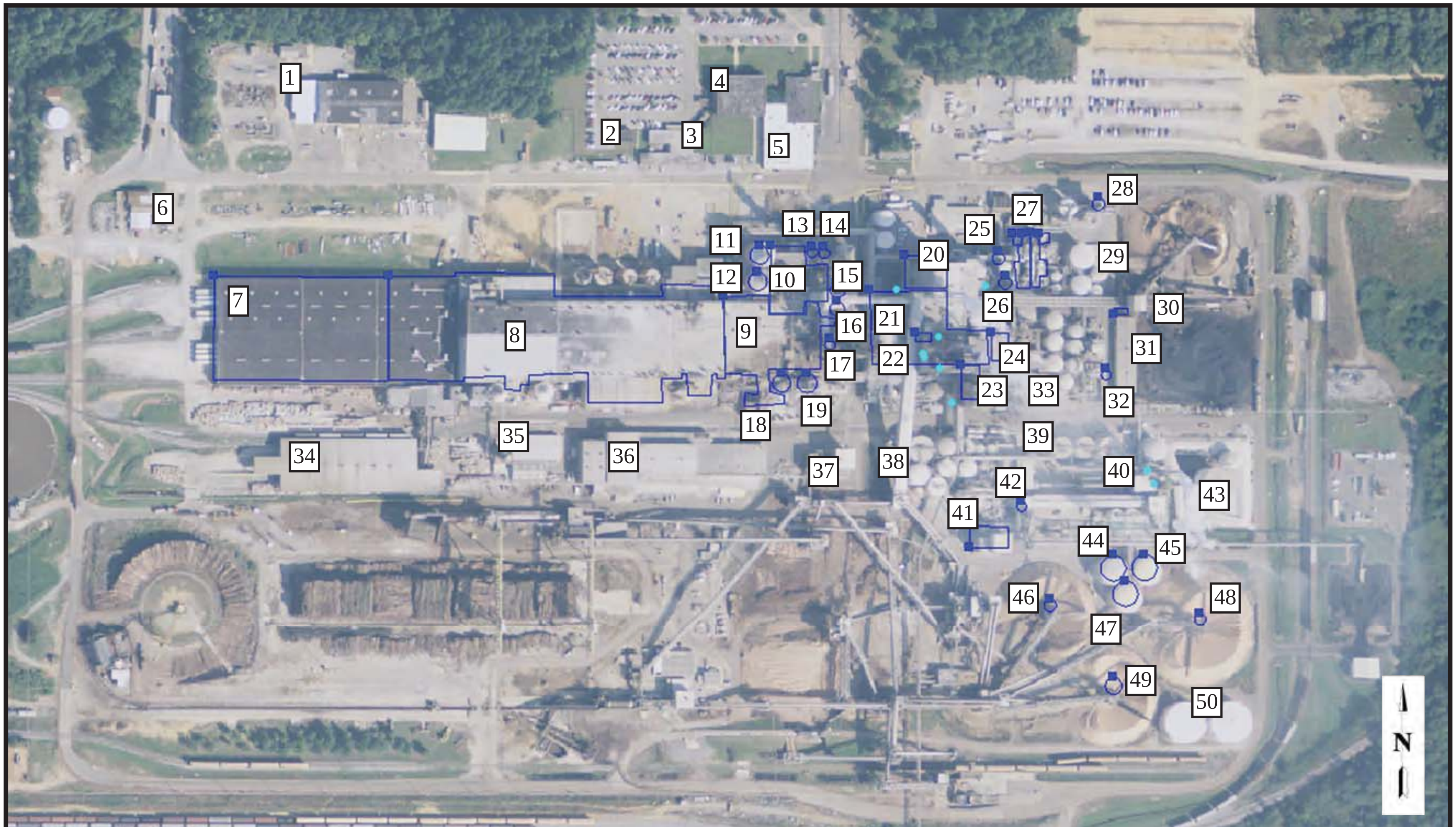
In addition, the Model Clearinghouse has made two recent determinations that using the ADJ_U* option was acceptable for the Donlin Mine Compliance Demonstration (February 10, 2016) and for the Schiller Station Compliance Demonstration (April 7, 2016). The releases from IP are best characterized as buoyant plumes emitted from tall stacks in a region with complex terrain. The Oak Ridge and Idaho Falls studies and the Donlin Mine Demonstration are less directly applicable because the release heights are characterized as low-level and non-buoyant (U.S. EPA 2016). The Schiller Station Demonstration is directly applicable because the releases are characterized as buoyant plumes from tall stacks in complex terrain (U.S. EPA 2016a). In addition, the terrain surrounding the IP Mill is similar to the Schiller Station in that there is discrete complex terrain (i.e., rolling hills) surrounding each facility. The Schiller Station Model Clearinghouse determination demonstrated the use of ADJ_U* resulted in better model performance than without the use of ADJ_U*. In addition to the applicability of the recently approved Schiller Station Demonstration, the Mercer County, ND evaluation (Paine et al. 2015) is also directly applicable. The Mercer County evaluation compared modeled ground level concentrations from a tall stack in complex terrain to ambient monitoring data. The evaluation found that modeled ground level concentrations were closer to the actual monitor data when the ADJ_U* beta option was utilized. Per Comment No. 5 of U.S. EPA's Technical Review Comments included in Appendix A, IP has also provided a sensitivity study to support the use of the ADJ_U* option for this air quality modeling study which is included in Appendix B.

Per the ADJ_U* sensitivity analysis, because the ADJ_U* beta option improves model performance, is proposed to become a regulatory default option, and because the recently approved Schiller Station Demonstration is directly applicable to the Mill, IP concluded that this option was appropriate for this modeling evaluation

4.6 GOOD ENGINEERING PRACTICE (GEP) STACK HEIGHT ANALYSIS

An analysis was conducted to determine the potential for building downwash at the Mill. Guidance contained in the U.S. EPA "Guideline for Determination of Good Engineering Practice (GEP) Stack Height (Revised)" (U.S. EPA 1985) and the U.S. EPA Building Profile Input Program Plume Rise Model Enhancements (BPIP-PRIME) (Version 04274) was followed. To perform the building downwash analysis, a Mill plot plan showing the Mill buildings, structures, and stacks was digitized using GIS software. For this evaluation, the actual stack height was used. This approach is consistent with the requirements in the SO_2 DRR and the Modeling TAD. The GIS digitization of the Mill is presented in Figure 4-5.

To determine which buildings to include, the Mill utilized the guidance presented in the GEP Stack Height Guidance (U.S. EPA 1985). Specifically, the Mill included buildings that lie within a 5L radius of a stack, where L is the lesser of the building height or building width. Details regarding the building analysis are included in Table 4-1, which correspond to the building IDs in Figure 4-5.



International Paper **Prattville, AL Mill**	**Figure 4-5** **Building Downwash Image**

M:\International Paper\Prattville Mill\USGS

Table 4-1
Building Downwash Analysis

Building ID	Building Height (m) or Reason for Excluding
1	Greater than 5L from the stacks
2	Greater than 5L from the stacks
3	Greater than 5L from the stacks
4	Greater than 5L from the stacks
5	Greater than 5L from the stacks
6	Greater than 5L from the stacks
7	Greater than 5L from the stacks
8	Greater than 5L from the stacks
9	Greater than 5L from the stacks
10	10.5
11	24.8
12	Greater than 5L from the stacks
13	Greater than 5L from the stacks
14	Greater than 5L from the stacks
15	Greater than 5L from the stacks
16	Greater than 5L from the stacks
17	25.6
18	25.6
19	23.9
20	20.3
21	64.5
22	44.7
23	24.4
24	24.4
25	12.2
26	12.2
27	Greater than 5L from the stacks
28	53.5
29	44.2
30	9.8
31	40.5
32	18.6
33	18.7
34	14.3
35	17.4
36	18.0
37	Greater than 5L from the stacks
38	Greater than 5L from the stacks

Table 4-1
Building Downwash Analysis

Building ID	Building Height (m) or Reason for Excluding
39	Greater than 5L from the stacks
40	Greater than 5L from the stacks
41	Greater than 5L from the stacks
42	Greater than 5L from the stacks
43	Greater than 5L from the stacks
44	24.8
45	Greater than 5L from the stacks
46	10.4
47	15.8
48	44.3
49	Greater than 5L from the stacks
50	Greater than 5L from the stacks
51	Greater than 5L from the stacks
52	Greater than 5L from the stacks
53	Greater than 5L from the stacks
54	Greater than 5L from the stacks
55	Greater than 5L from the stacks
56	12.2
57	12.2
58	12.2
59	12.2
60	12.2
61	19.2
62	12.2
63	12.2
64	12.2
65	17.1
66	Greater than 5L from the stacks
67	Greater than 5L from the stacks
68	14.2
69	14.2
70	27.4
71	20.3
72	12.2
73	12.2
74	12.2
75	12.2
76	12.2

Table 4-1
Building Downwash Analysis

Building ID	Building Height (m) or Reason for Excluding
77	60.5
78	Greater than 5L from the stacks
79	81.2
80	25.6
81	25.6
82	Greater than 5L from the stacks
83	Greater than 5L from the stacks
84	Greater than 5L from the stacks
85	Greater than 5L from the stacks
86	Greater than 5L from the stacks
87	Greater than 5L from the stacks
88	Greater than 5L from the stacks
89	Greater than 5L from the stacks
90	Greater than 5L from the stacks
91	Greater than 5L from the stacks

4.7 BACKGROUND AMBIENT AIR DATA

Ambient background 1-hour SO_2 concentrations were considered in this evaluation. The ambient background concentrations were added to the cumulative modeled concentrations resulting from the Mill sources. IP followed guidance contained in U.S. EPA's March 1, 2011 memorandum (U.S. EPA 2011), which outlines a "Tier 2" approach to including background ambient SO_2 concentrations. The "Tier 2" approach incorporates background concentrations by season and hour-of-day. Specifically, the second highest SO_2 monitored concentration for each hour (0-23) from each day over four seasons from the last three years was calculated and the appropriate value was added to the modeled concentrations. The seasons are: winter (December, January, and February), spring (March, April, and May), summer (June, July, and August), and autumn (September, October, and November). A summary of these calculations is provided in the electronic appendix to this document.

IP utilized background data from the South Eastern Aerosol Research and Characterization (SEARCH) network for the 2012, 2013, and 2014 calendar years. The data are from the Centreville monitor located in Centreville, AL. The background data are summarized in Table 4-2, below.

Table 4-2
Diurnal Seasonal Average SO_2 Concentrations (ppb)

Hour	Winter	Spring	Summer	Autumn
0	3.396	2.130	1.736	1.508
1	3.974	2.326	2.582	1.993
2	2.978	1.909	2.803	2.646
3	2.503	1.920	2.548	3.851
4	3.492	1.502	2.322	6.509
5	5.092	1.653	3.230	7.785
6	6.867	1.880	5.426	7.729
7	6.200	2.730	7.592	8.770
8	5.493	5.505	7.393	9.785
9	3.519	3.832	5.777	10.714

Table 4-2
Diurnal Seasonal Average SO_2 Concentrations (ppb)

Hour	Winter	Spring	Summer	Autumn
10	4.049	3.149	6.527	4.930
11	4.714	2.647	2.667	3.495
12	3.126	2.351	3.205	4.111
13	2.879	3.078	3.005	2.447
14	3.217	3.263	2.473	1.960
15	3.312	2.791	1.806	2.049
16	3.727	2.875	1.477	2.508
17	2.740	2.987	1.738	2.887
18	3.272	2.632	1.868	2.558
19	2.346	2.349	1.906	1.914
20	2.514	2.327	2.402	2.110
21	2.839	1.771	1.541	1.941
22	3.671	2.676	1.731	2.308
23	3.433	2.590	1.241	2.335

IP proposes that the ambient SO_2 measurements from the Centreville, AL monitor site are representative of background conditions at the Mill. The Centreville, AL monitor is located approximately 80 km northwest of the Mill. Per U.S. EPA's Technical Review Comments, further discussion regarding the representativeness of the Centreville, AL monitor is provided by ADEM in the response to Comment No. 6 included in Appendix A.

5. PRESENTATION OF AIR QUALITY MODELING RESULTS

This section outlines the results of the air quality modeling analysis. Table 5-1 presents a summary of the results of the SO_2 DRR analysis.

Table 5-1
SO_2 DRR Analysis Results

Pollutant	Averaging Period	Form	NAAQS ($\mu g/m^3$)	Modeled Concentration ($\mu g/m^3$)[a]	Total Concentration Less Than NAAQS
SO_2	1-Hour	Three Year Average of 98th Percentile of Daily Maximum 1-Hour Concentrations	196	179.9	Yes

[a] The model results include background concentrations which were incorporated using the methodologies discussed in Section 4.7.

As shown in the result summary table, the air quality dispersion modeling conducted in accordance with the U.S. EPA's SO_2 DRR demonstrates that the area surrounding the Mill is in attainment with the SO_2 NAAQS. The Mill understands that no further evaluation (i.e., ambient monitoring) is required at this time.

6. REFERENCES

Auer 1978, Auer Jr., A.H., – "Correlation of Land Use and Cover with Meteorological Anomalies", Journal of Applied Meteorology, 17:636-643, 1978.

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U.S. EPA 1985 – "Guideline for Determination of Good Engineering Practice (GEP) Stack Height (Technical Support Document for Stack Height Regulations) Revised" EPA-450:4-80-023R, June 1985.

U.S. EPA 2004 – "Revised Draft User's Guide for the AERMOD Terrain Preprocessor (AERMAP)". U.S. Environmental Protection Agency Office of Air Quality Planning and Standards, Emissions, Monitoring, and Analysis Division, Research Triangle Park, NC, August 2002.

U.S. EPA 2005 – 40 CFR Part 51 Appendix W "Guideline on Air Quality Models (Revised) April 2005.

U.S. EPA 2011 – "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour Nitrogen Dioxide (NO_2) National Ambient Air Quality Standard". U.S. Environmental Protection Agency Office of Air Quality Planning and Standards, Air Quality Modeling Group, Research Triangle Park, NC, March 2011.

U.S. EPA 2013 – "Sulfur Dioxide (SO_2) National Ambient Air Quality Standards Designations Modeling Technical Assistance Document." U.S. Environmental Protection Agency, Office of Air and Radiation, Office of Air Quality Planning and Standards, Air Quality Assessment Division, December 2013.

U.S. EPA 2015 – "Addendum to the User's Guide for the AMS/EPA Regulatory Default Model – AERMOD". U.S. Environmental Protection Agency Office of Air Quality Planning and Standards, Air Quality Assessment Division, Research Triangle Park, NC, June 2015.

U.S. EPA 2016 – "Model Clearinghouse Review of the Use of the ADJ_U* Beta Option in the AERMET Meteorological Processor (Version 15181) for the Donlin Mine Compliance Demonstration." U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Air Quality Modeling Group, Research Triangle Park, NC, February 2016.

U.S. EPA 2016a – "Model Clearinghouse Review of the Use of the ADJ_U* Beta Option in the AERMET Meteorological Processor (Version 15181) for the Schiller Station Modeling Demonstration." U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Air Quality Modeling Group, Research Triangle Park, NC, April 2016.

APPENDIX A – ADEM RESPONSE TO EPA TECHNICAL REVIEW COMMENTS

EPA Technical Review Comments

International Paper – Prattville, AL Mill SO_2 DRR Modeling Protocol

1. Section 3.1 Hourly SO_2 Emissions Inventory (page 3-1) indicates that there are no continuous emissions monitoring systems (CEMS) installed on the SO_2 emissions units and that hourly SO_2 emissions were quantified using various emission factor methodologies outlined in that section. Please include documentation in the final modeling submission on how these emissions were calculated.

   ADEM Response:

   This will be addressed in final modeling report.

2. Section 4.3 Receptor Grid (page 4-4)- the final modeling report should clearly demonstrate that the general public does not have access to all areas within the ambient air boundary that have been excluded from the modeling (i.e., that a fence or some other security measures are in place to preclude access from the public).

   ADEM Response:
   This will be addressed in final modeling report.

3. Section 4.4 Local Sources (page 4-8) states that based on ADEM's analysis, no local sources meet the 20D analysis and as such, no additional analysis for local sources is necessary. Please include a discussion of any other nearby sources and indicate why these sources were not included in the modeling. If multiple large sources are located far from Prattville Mill but are clustered together in the same upwind direction, their emissions should be combined when being considered, as they could act as one large source of emissions if the plumes merge. Justifications should be provided for any sources with significant emissions levels that are being excluded from the modeling. Any justification should address the criteria discussed in Section 4.1 of EPA's Modeling TAD. As discussed in the Modeling TAD, the identification of specific sources to model should be done in conjunction with the determination of an appropriate representative background concentration (discussed in comment #6) as the selection of appropriate background concentrations may be adequate to account for potential impacts of some these "nearby sources." EPA modeling staff are available to further discuss these issues if desired.

ADEM Response:

ADEM evaluated sources within a 20 km area surrounding the eight facilities who elected to following the modeling pathway for compliance under the SO2 1 hour Data Requirements Rule. ADEM believes that this is a reasonable starting point for evaluation of sources and does not preclude sources from choosing alternate screening criteria that include/exclude sources. A spreadsheet provided each facility with the facility(ies) that met the 2014 actual emissions (in tpy) divided by the distance of greater than 20 within a maximum distance of 20 km. This did include small sources at very close distances. This information will be well documented in the final submittals due to EPA by January 13, 2017. Again, the metric ADEM used to develop the preliminary additional source(s) to be evaluated for inclusion in the modeling for the eight DRR subject sources choosing to model is as follows:

ADEM Metric: Q/D > 20 within 20km

- First, ALL sources within 20km of each facility were pulled,
- Next, a Q/D value was developed for each facility on the list, where Q represents the 2014 actual SO2 tpy emissions totals, and D represents the distance between the two facilities,
- If the Q/D metric yielded a value of greater than 20, the facility was retained and additional QA/QC was performed on a unit by unit basis.

4. Section 4.5 Meteorological Data (page 4-8) of the protocol states that hourly surface meteorological data from the Dannelly Field National Weather Service (NWS) station in Montgomery, AL will be used in the modeling analysis. Based on the information provided in the protocol, this appears appropriate. However, additional justification should be provided to demonstrate and document that surface meteorological data from the Dannelly Field NWS station is representative of dispersion conditions at Prattville Mill. In addition to the items listed in Section 4.5, representativeness of the data should be based on the complexity of the terrain in the area and the exposure of the meteorological station.

ADEM Response:

This data has historically been used to characterize modeling for this facility since the 80s. There have not been any geographical changes in the area that would deem this NWS site unrepresentative. There are no other new datasets nearby that would better represent this location. NWS surface and upper air sites are limited in this area. Furthermore the data map below has been used to determine met data for PSD for decades. This data is typically determined on an application by application basis. Below is ADEMs section of the guidance document that addresses representativeness.

Use the following Meteorological PSD Data Map to identify the area of the State in which the proposed new source or modified source will be located to determine which National Weather Service (NWS) station data to use in the modeling. The station identification numbers are also indicated:

The map of Alabama modeling domains was broken out into 12 sections. These sections were determined by average monthly precipitation, average monthly mean temperature and topography. In each county, a COOP weather station was chosen and a 30 year (some stations less than 30) monthly average rainfall and monthly mean temperature was compared to the 12 surrounding NWS stations monthly data. The NWS station that correlated the closest to the COOP station was linked to that county. Once all the counties were looked at, they were grouped together by NWS station. The regions were adjusted to account for the various topographical differences across the state of Alabama.

METEOROLOGICAL PSD DATA

5. Section 4.5 Meteorological Data (page 4-8) of the protocol states that the beta ADJ_U* option in AERMET is being proposed for the modeling. It appears that adequate information has been provided to allow EPA to review the proposed use of the beta ADJ_U* option in AERMET. Even though this beta option has been proposed by EPA as a future option in the regulatory version of the AERMOD Modeling System, until this proposal is finalized, the regulatory application of this option in AERMET requires formal approval as an alternative model and is subject to the requirements of 40 CFR Part 51, Appendix W, Section 3.2.2. Further, EPA Regional offices must consult with and obtain concurrence from the Model Clearinghouse regarding the application of any Beta option. If the proposed refinements to AERMET are adopted into Appendix W as a result of future regulatory actions, EPA Region 4 will continue to require case-by-case justification for the use of any non-default model option. EPA Region 4 has initiated the Model Clearinghouse review process and will inform ADEM when the review process is complete.

   ADEM Response:

   Sensitivity Analyses will be provided in the final report.

6. Section 4.7 Background Ambient Air Data (page 4-15) states that the Centreville, Alabama monitor for 2012, 2013, and 2014 will be used for background data. This is not a regulatory monitor and therefore should not be used to develop background concentrations for this modeling demonstration. Please select an alternative monitor that meets Part 58 requirements and has complete data to use as a background site for this modeling demonstration. Otherwise, the temporally-varying background concentration methodology appears to be appropriate. As indicated in Comment 3, the decisions about background concentrations should be made in conjunction with the decisions about which sources to specifically include in the modeling. Section 8 of EPA Modeling TAD provides guidance on selecting appropriate background concentrations. There are no specific procedures that are applicable to every situation, so the guidance provides a number of options depending on the available data. EPA modeling staff are available to further discuss proposed background concentrations and how they may impact the selection of which other “nearby sources” to model. The TAD indicates that these issues call for professional judgment and recommends consultation with an EPA Regional Modeling Contact prior to the modeling being performed.

   ADEM Response:

   The 1-hour SO2 background values used for this analysis were derived from data collected at the Centreville, Alabama, SEARCH site. The Centreville SEARCH site is considered to be representative of background SO2 concentrations based on a number of factors. The data from this SEARCH site has very little impact from anthropogenic sources, therefore, it should be representative of background 1-hour SO2 values for most areas of the State of Alabama. The purpose of adding the background value to the final model-predicted concentration is to account for the potential impact of sources outside the scope of the modeling analysis, such as natural and distant sources, which may minimally impact air quality in the area. Due to the fact that an inventory of sources is modeled in addition to the source under review, there is a high possibility that the air quality impacts from many sources could be double-counted when the background value is added to the final 1-hour SO2 concentration predicted by the model.

Other monitors located outside the State were considered as possible background sites, but due to the proximity of alternative monitors to urban areas and anthropogenic sources, these monitors would not provide an appropriate background concentration. Using concentrations from urbanized/industrialized areas can unduly influence the monitors and not provide a value that is truly representative of background conditions in a rural area. These areas tend to be more populated and urbanized, which is not representative of rural areas such as the Prattville area. These monitors are likely impacted by urban influences and would not be representative of the rural background conditions in Prattville, Alabama.

Additionally, due to the Centreville site's location relative to Prattville, the synoptic-scale weather conditions in the Centreville area would be very similar to the Prattville area. Most major weather systems that would impact the Prattville area would, in general, impact the Centreville area as well. Due to all the factors cited above, ADEM determined that the Centreville, Alabama, site was the appropriate background monitor to use for this analysis.

APPENDIX B – SENSITIVITY ANALYSIS OF ADJ_U* OPTION FOR SO_2 DRR MODELING

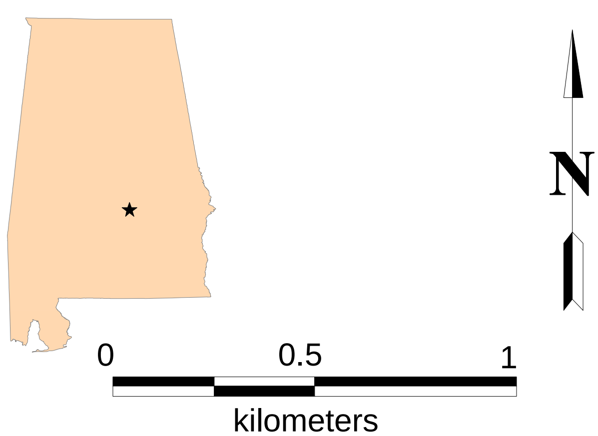
Sensitivity Analysis of ADJ_U* Option for SO_2 DRR Modeling

The purpose of this sensitivity study is to show that the use of the beta ADJ_U* option in AERMOD is appropriate for dispersion modeling of sulfur dioxide (SO_2) in the area surrounding the International Paper (IP) Kraft linerboard mill in Prattville, Alabama (Prattville Mill or Mill). Figure 1 shows the Mill location and the immediate area surrounding the Mill.

For this study, AERMOD was used to model 1-hour concentrations of SO_2 using the regulatory default options along with meteorological files provided by the Alabama Department of Environmental Management (ADEM). The output of the regulatory default run was then compared to the output of an AERMOD run using identical inputs, except that the non-default beta ADJ_U* option was used.

The regulatory default model run was compared to the beta ADJ_U* run by looking at the difference between the fourth highest annual average SO_2 concentration modeled over a three year period for each receptor. Receptors that had greater than 25% of the SO_2 NAAQS (roughly 50 $\mu g/m^3$) difference between the regulatory default run and the ADJ_U* star run were further examined. Out of over 19,000 receptors included in the modeling, the difference in average concentration at 35 receptor locations was found to be greater than 50 $\mu g/m^3$. The receptors with the highest modeled fourth highest 1-hour concentrations were located to the north of the Mill close to the property line. Therefore any of the 35 receptors greater than two kilometers (km) from the property line were further excluded from the analysis. A representative selection of the remaining receptors, highlighting specific locations in the area surrounding the Mill, were chosen for the focus of the sensitivity study. Eight receptors located to the north of the Mill along with three receptors located to the west of the Mill were selected for the focus of the sensitivity study. Figure 2 shows the location of these selected receptors as blue diamonds, along with the location of the overall receptor grid superimposed on the Mill location.

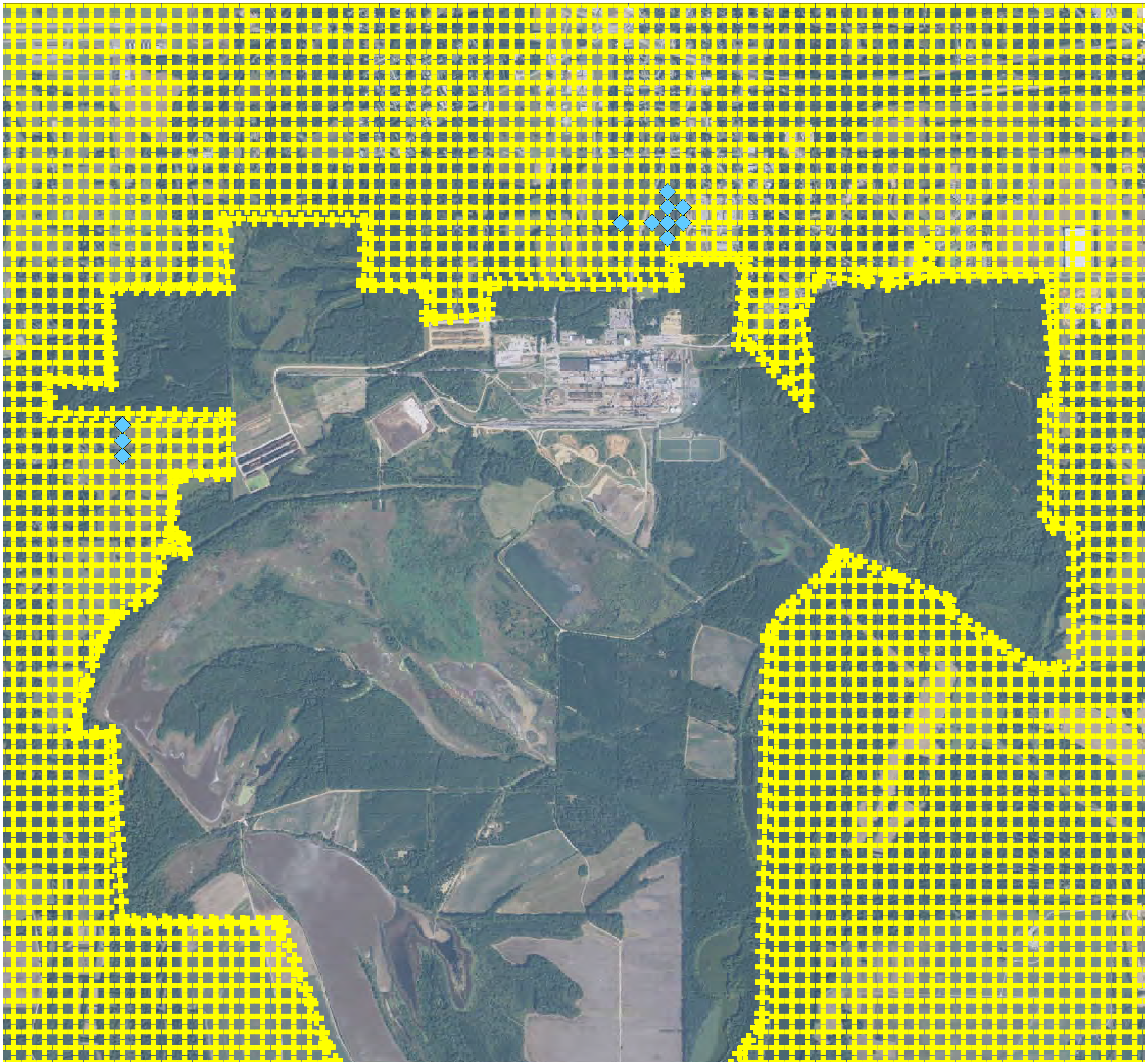
approximate quadrangle location

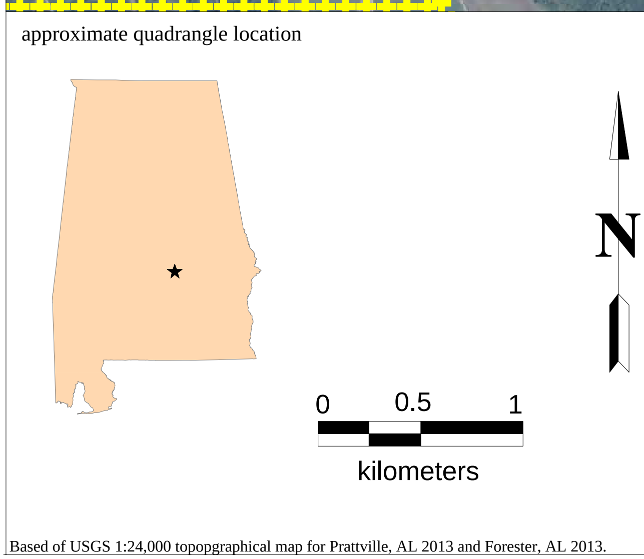


Based of USGS 1:24,000 topopgraphical map for Prattville, AL 2013 and Forester, AL 2013.

Figure 1
Mill Location Map

International Paper
Prattville, AL Mill





Based of USGS 1:24,000 topopgraphical map for Prattville, AL 2013 and Forester, AL 2013.

Figure 2
Receptor Grid and Selected Receptors

International Paper
Prattville, AL Mill

Table 1 summarizes the wind speed and friction velocity from the AERMET surface file at the time the fourth highest concentrations were modeled in the regulatory default run. Since the SO_2 National Ambient Air Quality Standard (NAAQS) is measured against a three year average concentration, the conditions at the time when the maximum concentration in each of the three years modeled for each selected northerly receptor is shown. The three westerly receptors did not show as elevated concentrations as those to the north, and so only the year with the highest concentration included in the 1-hour average is summarized in Table 1.

Table 1
Meteorological Conditions at the Selected Receptors for Highest SO_2 Concentrations

X (m E)	Y (m N)	Year	Julian day	Hour	Without adj_u* Wind Speed(m/s)	Without adj_u* Friction Velocity (m/s)	With adj_u* Wind Speed (m/s)	With adj_u* Friction Velocity (m/s)
549,834	3,587,809	2012	77	20	1.65	0.056	1.65	0.101
		2013	217	20	1.40	0.064	1.40	0.117
		2014	20	21	2.03	0.065	2.03	0.118
549,534	3,587,909	2012	32	1	2.47	0.080	2.47	0.148
		2013	141	19	1.38	0.047	1.38	0.090
		2014	53	20	1.94	0.063	1.94	0.114
549,734	3,587,909	2012	135	23	0.60	0.020	0.60	0.092
		2013	136	3	1.37	0.047	1.37	0.092
		2014	69	22	1.26	0.043	1.26	0.093
549,834	3,587,909	2012	76	20	1.30	0.044	1.30	0.092
		2013	217	20	1.40	0.064	1.40	0.117
		2014	137	19	1.30	0.044	1.30	0.091
549,934	3,587,909	2012	204	23	2.04	0.094	2.04	0.176
		2013	202	19	1.88	0.086	1.88	0.162
		2014	244	24	1.31	0.060	1.31	0.109
549,834	3,588,009	2012	73	21	2.08	0.071	2.08	0.130
		2013	177	21	2.32	0.107	2.32	0.202
		2014	137	19	1.30	0.044	1.30	0.091
549,934	3,588,009	2012	352	18	1.69	0.054	1.69	0.097

Table 1
Meteorological Conditions at the Selected Receptors for Highest SO_2 Concentrations

X (m E)	Y (m N)	Year	Julian day	Hour	Without adj_u*		With adj_u*	
					Wind Speed(m/s)	Friction Velocity (m/s)	Wind Speed (m/s)	Friction Velocity (m/s)
549,934	3,588,009	2013	215	20	1.86	0.085	1.86	0.159
		2014	45	6	1.37	0.044	1.37	0.093
549,834	3,588,109	2012	73	21	2.08	0.071	2.08	0.130
		2013	139	24	2.93	0.100	2.93	0.188
		2014	110	19	1.65	0.056	1.65	0.101
546,334	3,586,409	2012	34	4	2.66	0.089	2.66	0.166
546,334	3,586,509	2012	133	4	2.47	0.086	2.47	0.159
546,334	3,586,609	2012	257	1	1.99	0.071	1.99	0.130

In each case, the maximum concentration in the regulatory default run occurs under stable conditions when the wind speed and friction velocity are low. The AERMOD dispersion model has been shown to over-predict concentrations in precisely these meteorological conditions (U.S. EPA 2016), and it was for these conditions that the ADJ_U* option has been shown to better predict ground-level concentrations.

This sensitivity study has examined the meteorological conditions present when the greatest modeled average fourth highest 1-hour SO_2 concentrations in the area surrounding the Prattville Mill are predicted. In every situation examined over the modeled period of three years, higher concentrations are predicted during stable conditions with very low wind speed and friction velocity. These are the exact conditions that the beta ADJ_U* option in AERMOD is meant to address (U.S. EPA 2016a) and is a reason why the option is currently proposed to become a regulatory default option as a part of the 40 CFR Part 51 Appendix W (Guideline on Air Quality Models) amendments proposed on July 29, 2015.

REFERENCES

U.S. EPA 2016 – "Model Clearinghouse Review of the Use of the ADJ_U* Beta Option in the AERMET Meteorological Processor (Version 15181) for the Schiller Station Modeling Demonstration." U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Air Quality Modeling Group, Research Triangle Park, NC, April 2016.

U.S. EPA 2016a – "Model Clearinghouse Review of the Use of the ADJ_U* Beta Option in the AERMET Meteorological Processor (Version 15181) for the Herbert A. Wagner Generating Station Modeling Demonstration." U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Air Quality Modeling Group, Research Triangle Park, NC, June 2016.

ELECTRONIC APPENDIX – EMISSIONS INVENTORY AND BACKGROUND SUPPORTING INFORMATION

https://www.hightail.com/download/cUJVa0ZSSU9BNkYzZU1UQw