Georgia's State Implementation Plan
For
Regional Haze

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Preface: This document contains summaries of the technical analyses that will be used by Georgia Environmental Protection Division (GA EPD) to support the Regional Haze State Implementation Plan pursuant to §§169(A) of the Clean Air Act, as amended.

EXECUTIVE SUMMARY

INTRODUCTION

Regional haze, pollution that impairs the visibility over a large region, can adversely impact human health, especially respiratory and cardiovascular systems. Regional haze is caused by sources and activities emitting primarily fine particles and those precursors to particle pollution - sulfur dioxides (SO2), nitrogen oxides (NOx), ammonia (NH3) and volatile organic compounds (VOC). These fine particles and precursors are often transported over large regions, impairing visibility in national parks, forests, and wilderness areas including those areas termed "Class I" areas.

Fine particles, similar in size to the wavelength of light, affect visibility through the scattering and absorption of light. This is called light extinction, the result of which is a hazy condition. Light extinction is one method of measuring visibility. Another is visual range. Visual range is the greatest distance, in kilometers or miles, at which a dark object can be viewed against the sky. The measure of visibility used by the Regional Haze Rule (RHR) is the deciview (dv) which is calculated directly from light extinction using a logarithmic scale. The deciview can also be used to express linear changes in visibility impairment that correspond to visual range. Therefore, higher deciview levels are hazier, while lower deciview levels are cleaner.

Reducing fine particles in the atmosphere is generally considered to be an effective method of reducing regional haze, and thus, improving visibility.

REGULATORY HISTORY AND REGIONAL HAZE IN GEORGIA

Section 169A of the 1977 Amendments to the Clean Air Act (CAA) set forth a program for protecting visibility in Federal Class I areas. It called for the "prevention of any future, and the remedying of any existing, impairment of visibility in mandatory Class I Federal areas which impairment results from manmade air pollution." On December 2, 1980, the United States Environmental Protection Agency (US EPA) promulgated regulations to address visibility impairment (45 FR 80084) that is "reasonably attributable" to a single source or small group of sources. Then, in the 1990 Amendments to the CAA, Congress added Section 169B and called on the US EPA to issue regional haze rules. The Regional Haze Rule that the US EPA promulgated on July 1, 1999 (64 FR 35713), revised the existing visibility regulations in order to integrate provisions addressing regional haze impairment and to establish a comprehensive visibility protection program for Class I Federal areas. On July 6, 2005, the US EPA published a revised final rule, including Appendix Y to 40 CFR Part 51, *The Guidelines for BART Determinations Under the Regional Haze Rule.*

The regional haze rule requires states to demonstrate reasonable progress toward meeting the national goal of a return to natural visibility conditions by 2064. The rule directs states to graphically show what would be a "uniform rate of progress," also known as the "glide path," toward natural conditions for each Class I area within the states and certain ones outside the states. The table below displays the natural visibility conditions for the most impaired and least impaired days for Georgia's Class I areas.

Natural Visibility Conditions for Georgia Class I Areas

Natural Background Visibility Conditions		
Class I Area	**Average for 20 percent Worst Days (deciviews)**	**Average for 20 percent Best Days (deciviews)**
Cohutta Wilderness Area	10.78	4.32
Okefenokee Wilderness	11.21	5.31
Wolf Island	11.21	5.31

Georgia has three Class I areas within its borders: Cohutta Wilderness Area, Okefenokee Wilderness Area and Wolf Island Wilderness Area, as designated in 40CFR Part 81 Subpart 408 where visibility has been determined to be an important value. The Georgia Environmental Protection Division (GA EPD) is responsible for establishing reasonable progress goals for visibility improvement at each of these Class I areas, and a long-term strategy that will achieve those reasonable progress goals within the first regional haze planning period ending in 2018.

This SIP includes Georgia's reasonable progress goals, expressed in deciviews, for visibility improvement at each affected Class I area for the first 10-year period until 2064, and must include determinations of the baseline visibility conditions (expressed in deciviews) for the most impaired and least impaired days. The table below displays the baseline conditions for Georgia's Class I areas.

Baseline Conditions for Georgia Class I Areas

Baseline Visibility Conditions 2000-2004		
Class I Area	**Average for 20 percent Worst Days (deciviews)**	**Average for 20 percent Best Days (deciviews)**
Cohutta Wilderness Area	30.25	13.77
Okefenokee Wilderness	27.13	15.23
Wolf Island[1]	27.13	15.23

The 20 percent worst visibility days at the Cohutta Wilderness generally occur in the period between April and September. The peak hazy days occur in the summer under stagnant weather conditions with high relative humidity, high temperatures, and low wind speeds. The 20 percent best visibility days can occur at any time of year. At Wolf Island, Okefenokee Wilderness Area and other coastal sites, the 20 percent worst and best visibility days are distributed throughout the year.

[1] There is no visibility monitor located at Wolf Island. Visibility at Wolf Island is assumed to be the same as the nearest Class I area, Okefenokee Wilderness.

States must include a monitoring strategy for measuring, characterizing, and reporting of regional haze visibility impairment in their SIP. The long-term strategy includes enforceable emissions limitations, compliance schedules, and other measures as necessary to achieve the reasonable progress goals. States must also consider ongoing control programs, measures to mitigate construction activities, source retirement and replacement schedules, smoke management techniques for agriculture and forestry, and enforceability of specific measures. In developing this SIP, we have also considered that emission sources outside of Georgia may affect visibility at these Georgia Class I areas, and emission sources within Georgia that may affect visibility at Class I areas in neighboring states.

In addition, a specific component of each state's first long-term strategy is dictated by the Best Available Retrofit Technology (BART) requirements in 40 CFR 51.308(e) of the RHR. The RHR at §51.308(e) requires states to include a determination of BART for each BART-eligible source in the State that emits any air pollutant which may reasonably be anticipated to cause or contribute to any impairment of visibility in any mandatory Class I Federal area.

The SIPs for the first review period were due December 17, 2007. These plans cover long-term strategies for visibility improvement between baseline conditions in 2000-2004 and 2018. States are required to evaluate progress toward reasonable progress goals every five years to assure that installed emission controls are on track with emission reduction forecasts in each state implementation plan.

CONTROLS APPLIED

There are significant control programs being implemented between the baseline period and 2018. These programs will all reduce the particulate precursor emissions that affect visibility in the Class I areas.

Federal control measures include the Clean Air Interstate Rule, NOx reductions from Federal Ozone Measures (NOx SIP Call), motor vehicle emission and fuel standards (e.g., Tiers 0, 1, and 2 emission standards and fuel sulfur requirements), and non-road engines and vehicle emission standards.

State control measures include existing NOx RACT measures, the Atlanta 1-Hour Ozone SIP, and the new Georgia Rule 391-3-1-.02(2)(sss) *Multi-Pollutant Control for Electric Utility Generating Units* that establishes a schedule for the installation and operation of NOx and sulfur dioxide pollution control systems on many of the coal-fired power plants in Georgia. Since the metro Atlanta region is also designated non-attainment for the Federal PM2.5 standards and the 8-hour ozone standard, control strategies for PM2.5 and ozone will be integrated into modeling for this SIP to the extent possible.

BART control measures required by the RHR include a BART determination for Interstate Paper in Riceboro, Georgia. This facility will be required to use only natural gas for the Power Boiler (F1) at the facility except during periods of natural gas curtailment.

Reasonable progress goals prompted GA EPD to consider what additional control measures would be reasonable. It was determined that SO2 emission reductions from electric generating units (EGUs) and non-EGU point sources in the VISTAS states would be the most effective sources to control to improve visibility at the Georgia Class I areas and non-Georgia Class I areas impacted by Georgia sources. Our review was conducted in a "top down" fashion starting with an analysis of the major source categories in each SO2 Area of Influence to determine which major categories had the highest residual contribution to the area in 2018. The regional haze rule requires that states consider the following four factors and demonstrate how these factors were taken into consideration in selecting the reasonable progress goal:

- Costs of compliance
- Time necessary for compliance
- Energy and non-air quality environmental impacts of compliance, and
- Remaining useful life of any potentially affected sources.

Georgia EPD requested four-factor analyses from SO2 point sources for emissions units identified as likely to contribute 0.5% or more to the total visibility impairment caused by sulfate at any Class I area in 2018. Analyses were received for a total of 15 emissions units. For some emissions units additional data was submitted at the request of EPD or at the initiative of the facility. The submittals have been retained with Georgia EPD's Regional Haze files. They are available to the public for inspection during normal business hours of 8:00 a.m. to 4:30 p.m. at the Georgia EPD, Air Protection Branch, 4244 International Parkway, Suite 120, Atlanta, Georgia 30354.

Three facilities requested limits on their affected emissions units in lieu of performing four-factor analyses: Rayonier Performance Fibers, Packaging Corporation of America, and Southern States Phosphate and Fertilizer. The requested limits dropped the sulfate contributions of these units below 0.5 percent of the total sulfate impact on any affected Class I areas. **Of those performing the four-factor analysis, GA EPD is requiring lower SO2 limits for three of the facilities: Georgia Pacific's Brunswick Cellulose facility, Georgia Pacific's Cedar Springs Operation, and International Paper's Savannah Mill.**

Control measures implemented by other states include measures such as the North Carolina Clean Smokestacks Act, consent agreements with Tampa Electric, Virginia Electric and Power Company, Gulf Power and American Electric Power, one-hour ozone SIPs submitted by Birmingham and Northern Kentucky, and NOx RACT in 8-hour non-attainment area SIPs.

CONCLUSION

In accordance with the requirements of 40 CFR §51.308(d)(1), this Regional Haze Implementation Plan establishes reasonable progress goals for each Class I area in Georgia. To calculate the rate of progress represented by each reasonable progress goal, GA EPD compared baseline visibility conditions to natural visibility conditions in each Class I area and determined the uniform rate of visibility improvement (in deciviews) that would need to be maintained during each implementation period in order to attain natural visibility conditions by 2064. Georgia EPD summarized expected visibility improvements under existing Federal and State regulations, BART determinations in Georgia and neighboring states, and any additional control measures found to be reasonable to implement in this review period. These controls were modeled in CMAQ as part of the long-term strategy. The modeling results were used to set reasonable progress goals. The tables below display Georgia's 2018 reasonable progress goals for the 20 percent worst days and the 20 percent best days. Since the Okefenokee Wilderness and Wolf Island reasonable progress goals show a slower rate of improvement in visibility than the rate that would be needed to attain natural conditions by 2064 (uniform rate of progress glide slope), it has been estimated that an additional 6-7 years are needed to attain natural conditions.

Georgia Reasonable Progress Goals – 20 Percent Worst Days

Class I Area	**2004 Baseline Visibility (dv)**	**2018 Reasonable Progress Goal (dv)** [2004 – 2018 decrease]	**2018 Uniform Rate of Progress Glide Slope (dv)** [2004 – 2018 decrease to meet uniform progress]	**Natural Visibility (dv)** [2018-2064 decrease needed from 2018 goal]
Cohutta Wilderness	30.25	22.78 [7.47]	25.71 [4.54]	10.78 [12.00]
Okefenokee Wilderness	27.13	23.77 [3.36]	23.42 [3.71]	11.21 [12.56]
Wolf Island	27.13	23.77 [3.36]	23.42 [3.71]	11.21 [12.56]

Class I Area	**2004 Baseline Visibility (dv)**	**2018 Reasonable Progress Goal (dv)** [2004 – 2018 decrease]	**2018 Uniform Rate of Progress Glide Slope (dv)** [2004 – 2018 decrease to meet uniform progress]	**Natural Visibility (dv)** [2018-2064 decrease needed from 2018 goal]

Georgia Reasonable Progress Goals – 20 Percent Best Days

Class I Area	**2004 and 2018 Baseline Visibility (dv)**	**2018 Reasonable Progress Goal (dv)** [2004 – 2018 improvement goal]
Cohutta Wilderness	13.77	11.75 [2.02]
Okefenokee Wilderness	15.23	13.92 [1.31]
Wolf Island	15.23	13.92 [1.31]

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

1.1 Description of Regional Haze

Regional haze is pollution from disparate sources that impairs visibility over a large region, including national parks, forests, and wilderness areas [Federal "Class I" areas defined by 40CFR Part 51.301(o) and Part 81, Subpart D]. Regional haze is caused by sources and activities emitting fine particles and the precursors. Those emissions are often transported over large regions.

Particles affect visibility through the scattering and absorption of light, and fine particles – particles similar in size to the wavelength of light – are most efficient, per unit of mass, at reducing visibility. Fine particles may either be emitted directly or formed from emissions of precursors, the most important of which are sulfur dioxides (SO2) and nitrogen oxides (NOx). Reducing fine particles in the atmosphere is generally considered to be an effective method of reducing regional haze, and thus improving visibility. Fine particles also adversely impact human health, especially respiratory and cardiovascular systems. The United States Environmental Protection Agency (USEPA) has set national ambient air quality standards for daily and annual levels of fine particles with diameter smaller than 2.5 μm (PM2.5). The most important sources of PM2.5 and its precursors are coal-fired power plants, industrial boilers and other combustion sources. Other significant contributors to PM2.5 and visibility impairment include mobile source emissions, area sources, fires, and wind blown dust.

1.2 Clean Air Act Requirements for Addressing Regional Haze

In Section 169A of the 1977 Amendments to the Clean Air Act (CAA), Congress set forth a program for protecting visibility in Federal Class I areas which calls for the "prevention of any future, and the remedying of any existing, impairment of visibility in mandatory Class I Federal areas which impairment results from manmade air pollution." Congress adopted the visibility provisions to protect visibility in 156 national parks and wilderness areas. On December 2, 1980, US EPA promulgated regulations to address visibility impairment (45 FR 80084). The 1980 regulations were developed to address visibility impairment that is "reasonably attributable" to a single source or small group of sources. These regulations represented the first phase in addressing visibility impairment and deferred action on regional haze that emanates from a variety of sources until monitoring, modeling and scientific knowledge about the relationships between pollutants and visibility impairment improved.

In the 1990 Amendments to the CAA, Congress added Section 169B and called on US EPA to issue regional haze rules. The Regional Haze Rule (RHR) that US EPA promulgated on July 1, 1999 (64 FR 35713), revised the existing visibility regulations in order to integrate provisions addressing regional haze impairment and establish a comprehensive visibility protection program for Class I Federal areas. States are required to submit state implementation plans (SIPs) to USEPA that set out each state's plan for complying with the regional haze rule, including consultation and coordination with other states and with Federal land managers. The timing of SIP submittal is tied to US EPA's promulgation of designations for the National Ambient Air Quality Standard (NAAQS) for PM2.5. Regional Haze SIPs are due at the same time as PM2.5 SIPs are due under section 172 of Clean Air Act. Therefore, states must submit a regional haze implementation plan to USEPA within three years after the date of PM2.5 designations. Because USEPA promulgated designation dates on December 17, 2004, regional haze SIPs must be submitted by December 17, 2007.

The regional haze rule addressed the combined visibility effects of various pollution sources over a wide geographic region. This wide-reaching pollution net meant that many states – even those without Class I Areas – would be required to participate in haze reduction efforts. US EPA designated five regional planning organizations (RPOs) to assist with the coordination and cooperation needed to address the visibility issue. Those states that make up the southeastern portion of the contiguous United States are known as VISTAS (Visibility Improvement – State and Tribal Association of the Southeast), and include the following states: Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia.

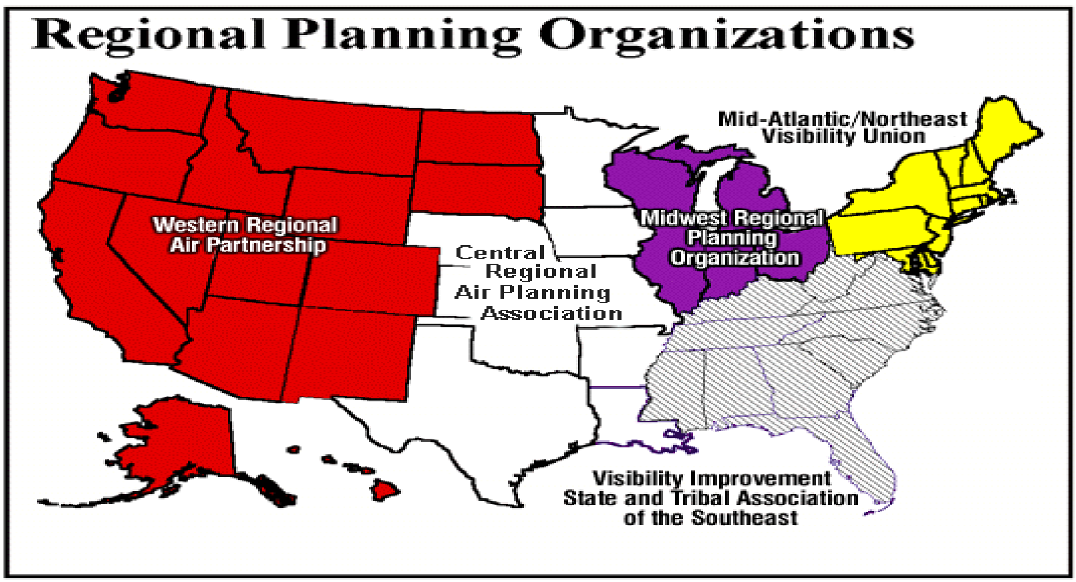


Figure 1.2-1. Geographical Areas of Regional Planning Organizations

1.3 General Overview of Regional Haze SIP Requirements

The regional haze rule (RHR) at 51.308(d) requires states to demonstrate reasonable progress toward meeting the national goal of a return to natural visibility conditions by 2064. As a guide for reasonable progress, the RHR directs states to graphically show what would be a "uniform rate of progress" toward natural conditions for each mandatory Class I Federal area within the State and/or for each mandatory Class I Federal area located outside the State, which may be affected by emissions from sources within the State. States are to establish baseline visibility conditions for 2000-

2004, natural background visibility conditions in 2064, and the rate of uniform progress between baseline and background conditions. The uniform rate of progress is also known as the "glidepath."

The RHR then requires States to establish reasonable progress goals (RPGs), expressed in deciviews, for visibility improvement at each affected Class I area covering each (approximately) 10-year period until 2064. The goals must provide for reasonable progress towards achieving natural visibility conditions, provide for improvement in visibility for the most impaired days over the period of the implementation plan, and ensure no degradation in visibility for the least impaired days over the same period [see §51.308(d)(1)].

In order to ensure that visibility goals are properly met and set, state implementation plans must include determinations, for each Class I area, of the baseline visibility conditions for the most impaired and least impaired days. SIPs must also contain supporting documentation for all required analyses used to calculate the degree of visibility impairment under natural visibility conditions for the most impaired and least impaired days [see §51.308(d)(2)]. In addition, states must include a monitoring strategy for measuring, characterizing, and reporting of regional haze visibility impairment that is representative of all mandatory Class I Federal areas within the state [see §51.308(d)(4)].

This first set of reasonable progress goals must be met through measures contained in the state's long-term strategy covering the period from the present until 2018. The long-term strategy includes enforceable emissions limitations, compliance schedules, and other measures as necessary to achieve the reasonable progress goals, including all controls required or expected under all Federal and State regulations by 2009 and by 2018. During development of the long-term strategy, states are also required to consider specific factors such as the above-mentioned ongoing control programs, measures to mitigate construction activities, source retirement and replacement schedules, smoke management programs for agriculture and forestry, and enforceability of specific measures [see §51.308(d)(3)].

In addition, a specific component of each state's first long-term strategy is dictated by the specific Best Available Retrofit Technology (BART) requirements in 40 CFR 51.308(e) of the RHR. The RHR at §51.308(e) requires states to include a determination of BART for each BART-eligible source in the State that emits any air pollutant, which may reasonably be anticipated to cause or contribute to any impairment of visibility in any mandatory Class I Federal area. Clean Air Act Section 169A(b) defines BART-eligible sources as sources in 26 specific source categories in operation within a 15-year period prior to enactment of the 1977 Clean Air Act Amendments. States must determine BART according to five factors set out in Section 169A(g)(7) of the Clean Air Act. Emission limitations representing BART and schedules for compliance with BART for each source subject to BART must be included in the long-term strategy.

State Implementation Plans for the first review period are due December 17, 2007. These plans will cover long-term strategies for visibility improvement between baseline conditions in 2000-2004 and 2018. States are required to evaluate progress toward reasonable progress goals every five years to assure that installed emissions controls are on track with emissions reduction forecasts in each SIP. The first interim review would be due to US EPA in December of 2012. If emissions controls are not on track to meet SIP forecasts, then states would need to take action to assure emissions controls by 2018 will be consistent with the SIP or to revise the SIP to be consistent with the revised emissions forecast.

1.4 Class I Areas in Georgia

Georgia has three Class I areas within its borders: Cohutta Wilderness Area, Okefenokee Wilderness Area and Wolf Island as designated in 40CFR Part 81 Subpart 408 where visibility has been determined to be an important value. The Georgia Environmental Protection Division (GA EPD) in the Georgia Department of Natural Resources is responsible for developing the Regional Haze SIP. This SIP establishes reasonable progress goals for visibility improvement at each of these Class I areas, and a long-term strategy that will achieve those reasonable progress goals within the first regional haze planning period.

In developing this SIP, we have also considered that emission sources outside of Georgia may affect visibility at these Georgia Class I areas, and emission sources within Georgia that may affect visibility at the following Class I areas in neighboring states. Through VISTAS, the southeastern states have worked together to assess state-by-state contributions to visibility impairment in specific class I areas, including those in GA and those affected by emissions from Georgia. This technical work is discussed further in chapters 5, 6, and 7 below. Consultations to date between Georgia and other states are summarized in Chapter 10.

Visibility at the following class I areas in the neighboring states may be affected by emission sources with Georgia:

- Cape Romain Wilderness Area, South Carolina
- Linville Gorge Wilderness Area, North Carolina
- Shining Rock Wilderness Area, North Carolina
- Joyce Kilmer - Slick Rock Wilderness Area, North Carolina and Tennessee
- Great Smoky Mountains, Tennessee, North Carolina
- Sipsey Wilderness area, Alabama
- St. Marks, Florida
- Chassahowitzka, Florida

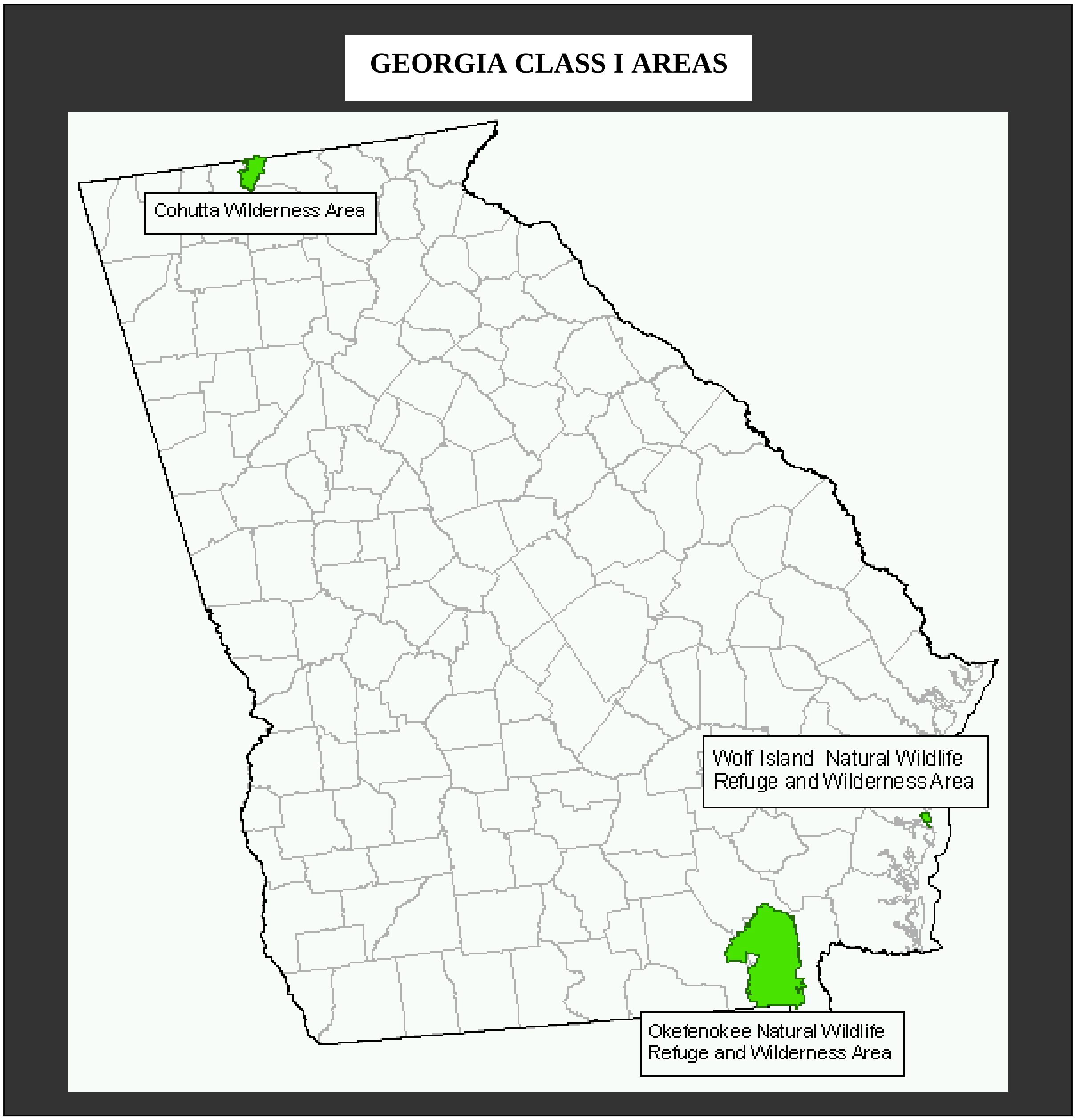


Figure 1.4-1. Georgia Class I areas

Prior to VISTAS, the southern states cooperated in a voluntary regional partnership "to identify and recommend reasonable measures to remedy existing and prevent future adverse effects from human-induced air pollution on the air quality-related values of the Southern Appalachian Mountains." States cooperated with Federal land managers, the Environmental Protection Agency, industry, environmental organizations and academia to complete a technical assessment of the impacts of acid deposition, ozone, and fine particles on sensitive resources in the Southern Appalachians. The Southern Appalachian Mountain Initiative (SAMI) Final Report was delivered in August of 2002. The SAMI Assessment concluded that ammonium sulfate is the major contributor to visibility impairment in the Southern Appalachian Mountains and to improve visibility, it is most important to reduce sulfur dioxide emissions. SAMI also concluded that reducing ammonia emissions would be helpful to reduce ammonium nitrate contributions to visibility impairment. Emissions controls for organic carbon, elemental carbon, and soil were expected to be less important for improving visibility. SAMI modeling found that on the haziest days, much of the benefit of emissions reductions would occur in the state where emissions reductions were made. Emissions in surrounding SAMI states and states outside the SAMI region also contribute to air quality in the SAMI Class I areas. The SAMI states supported strong national multi-pollutant legislation to accomplish its mission. Emissions reductions to meet national health standards for ozone and fine particles were expected to also improve air quality in the Southern Appalachian Mountains. SAMI states committed to consider air quality benefits in the Southern Appalachians as they developed State Implementation Plans for the health standards.

In 2004, US EPA promulgated the Clean Air Interstate Rule (CAIR) to require emissions reductions for sulfur dioxide and nitrogen dioxide from electric generating utilities in 26 eastern states. The CAIR rule allows for interstate trading of emissions to find cost effective reductions. These reductions will improve visibility in Class I areas in Georgia.

1.5 State and Federal Land Manager Coordination

As required by 40 CFR §51.308(i), the regional haze SIP must include procedures for continuing consultation between the State of Georgia and Federal Land Managers (FLMs) on the implementation of the visibility protection program, including development and review of implementation plan revisions and 5-year progress reports, and on the implementation of other programs having the potential to contribute to impairment of visibility in any mandatory Class I Federal area within the State. Coordination with FLMs is described in more detail in Section 13.

1.6 Interstate Consultation

Successful implementation of a regional haze program will involve long-term regional coordination among states. VISTAS was formed in 2001 to address regional haze and visibility problems in the southeastern United States. Jurisdictions represented by VISTAS members include the Eastern Band of Cherokee Indians; the States of Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia; and the local air pollution control programs located in these states. A copy of the VISTAS Bylaws and Memorandum of Understanding is enclosed as Appendix A. Interstate consultation is described in more detail in Section 10.

The objectives of the VISTAS project are to establish natural background visibility conditions across the mandatory Class I Federal areas, identify current visibility impairment levels, analyze emission control levels that will achieve interim visibility goals, and provide adequate documentation to member agencies so that they can develop their regional haze State/Tribal Implementation Plans (SIP/TIP). Figure 1.5-1 shows the 18 mandatory Class I Federal areas in the VISTAS Region where visibility is an important value. Figure 1.5-2 lists these Class I areas.

Figure 1.5-1. Class I Areas in the VISTAS Region

Mandatory Class I Federal Areas in the VISTAS Region Where Visibility is an Important Value			
State	**Area Name**	**Acreage**	**Federal Land Manager**
40 CFR §81.401 Alabama	Sipsey Wilderness	12,646	USDA-FS
40 CFR §81.407 Florida	Chassahowitzka Wilderness	23,360	USDI-FWS
	Everglades National Park	1,397,429	USDI-NPS
	St. Marks Wilderness	17,745	USDI-FWS
40 CFR §81.408 Georgia	Cohutta Wilderness	33,776	USDA-FS
	Okefenokee Wilderness	343,850	USDI-FWS
	Wolf Island Wilderness	5,126	USDI-FWS
40 CFR §81.411 Kentucky	Mammoth Cave National Park	51,303	USDI-NPS
40 CFR §81.422 North Carolina	Great Smoky Mountains National Park	273,551	USDI-NPS
	Joyce Kilmer-Slickrock Wilderness	10,201	USDA-FS
	Linville Gorge Wilderness	7,575	USDA-FS
	Shining Rock Wilderness	13,350	USDA-FS
	Swanquarter Wilderness	9,000	USDI-FWS
40 CFR §81.426 South Carolina	Cape Romain Wilderness	28,000	USDI-FWS
40 CFR §81.428 Tennessee	Great Smoky Mountains National Park	241,207	USDI-NPS
	Joyce Kilmer-Slickrock Wilderness	3,832	USDA-FS
40 CFR §81.433 Virginia	James River Face Wilderness	8,703	USDA-FS
	Shenandoah National Park	190,535	USDI-NPS
40 CFR §81.435 West Virginia	Dolly Sods Wilderness	10,215	USDA-FS
	Otter Creek Wilderness	20,000	USDA-FS

Figure 1.5-2. Mandatory Class I Federal Areas in the VISTAS Region Where Visibility is an Important Value

A technical support document for the regional haze state implementation plans is contained in Appendix E. The report includes a review of the science and situation, calculation of initial baseline visibility, review of monitoring data/data gaps, and recommendations for additional monitoring, initial emission inventory characterization and projections, and compliance with existing control programs. Source contributions to VISTAS mandatory Class I Federal areas are also assessed.

1.6 Supporting Documentation for the SIP

Supporting files and databases that would be impracticable to print are available electronically, both on the submitted CD-R and via permanent EPD web links. In addition, files are permanently archived on EPD computer networks. To request access to any of these files please contact the Georgia EPD Air Protection Branch at (404) 363-7000.

2.0 ASSESSMENT OF BASELINE AND CURRENT CONDITIONS AND ESTIMATE OF NATURAL BACKGROUND CONDITIONS IN CLASS I AREAS

The goal of the Regional Haze Rule is to restore natural visibility conditions to the 156 Class I areas identified in the 1977 Clean Air Act Amendments. Section 51.301(q) defines natural conditions: "Natural conditions include naturally occurring phenomena that reduce visibility as measured in terms of light extinction, visual range, contrast, or coloration." The Regional Haze SIPs must contain measures that make "reasonable progress" toward this goal by reducing anthropogenic emissions that cause haze.

An easily understood measure of visibility to most people is visual range. Visual range is the greatest distance, in kilometers or miles, at which a dark object can be viewed against the sky. For evaluating the relative contributions of pollutants to visibility impairment, however, the most useful measure of visibility impairment is light extinction, which is usually expressed in units of inverse megameters (Mm^{-1}). Light extinction affects the clarity and color of objects being viewed.

The measure used by the regional haze rule is the deciview (dv). Deciviews are calculated directly from light extinction using a logarithmic scale. The deciview is a useful measure for tracking progress in improving visibility because each deciview change is an equal incremental change in visibility perceived by the human eye. Most people can detect a change in visibility at one deciview.

For each Class I area, there are three metrics of visibility that are part of the determination of reasonable progress:

1) Natural conditions,
2) Baseline conditions, and
3) Current conditions.

Each of the three metrics includes the concentration data of the visibility pollutants as different terms in the light extinction algorithm, with respective extinction coefficients and relative humidity factors. Total light extinction when converted to deciviews (dv) is calculated for the average of the 20 percent best and 20 percent worst visibility days.

"Natural" visibility is determined by estimating the natural concentrations of visibility pollutants and then calculating total light extinction. "Baseline" visibility is the starting point for the improvement of visibility conditions. It is the average of the Interagency Monitoring of Protected Visual Environments (IMPROVE) monitoring data for 2000 through 2004 and is equivalent to "current" visibility conditions for this initial review period. The comparison of initial baseline conditions to natural visibility conditions indicates the amount of improvement necessary to attain natural visibility by 2064. Each state must calculate baseline and natural visibility levels for Class I areas within its borders [51.308(d)(2)]. “Current conditions” are assessed every five years as part of the SIP review where actual progress in reducing visibility impairment is compared to the reductions committed to in the SIP.

2.1 Estimating Natural Conditions for Georgia Class I Areas

Natural background visibility, as defined in 2003 US EPA guidance, is based on annual average concentrations of fine particle components. The same annual average natural background visibility is assumed for all Class I areas in the eastern United States (separate values are estimated for the western United States). Natural background visibility for the 20 percent worst days is estimated by assuming that fine particle concentrations for natural background are normally distributed and the 90^{th} percentile of the annual distribution represents natural background visibility on the 20 percent worst days.

In the 2003 guidance, US EPA also provided that states may use a “refined approach” to estimate the values that characterize the natural visibility conditions of the Class I areas. The purpose of such a refinement would be to provide more accurate estimates with changes to the extinction algorithm that may include the concentration values, factors to calculate extinction from a measured particular species and particle size, the extinction coefficients for certain compounds, geographical variation (by altitude) of a fixed value, and the addition of visibility pollutants.

In 2005, the IMPROVE Steering Committee made recommendations for a refined equation that modifies the terms of the original equation to account for the most recent data. The choice between use of the old or the new equation for calculating the visibility metrics for each Class I area is made by the state in which the Class I area is located.

$$
\begin{aligned}
b_{ext} \approx\ & 2.2 \times f_S(RH) \times [\text{Small Sulfate}] + 4.8\ f_L(RH) \times [\text{Large Sulfate}] \\
& + 2.4 \times f_S(RH) \times [\text{Small Nitrate}] + 5.1\ f_L(RH) \times [\text{Large Nitrate}] \\
& + 2.8 \times [\text{Small Organic Mass}] + 6.1 \times [\text{Large Organic Mass}] \\
& + 10 \times [\text{Elemental Carbon}] \\
& + 1 \times [\text{Fine Soil}] \\
& + 1.7 \times f_{SS}(RH) \times [\text{Sea Salt}] \\
& + 0.6 \times [\text{Course Mass}] \\
& + \text{Rayleigh Scattering (Site Specific)} \\
& + 0.33 \times [NO_2(ppb)]
\end{aligned}
$$

The new IMPROVE equation accounts for the effect of particle size distribution on light extinction efficiency of sulfate, nitrate, and organic carbon hence the total sulfate, nitrate and organic carbon compound concentrations are each split into two fractions, representing small and large size distributions of those components. The mass multiplier for organic carbon (particulate organic matter) is increased from 1.4 to 1.8. New terms are added to the equation to account for light extinction by sea salt and light absorption by gaseous nitrogen dioxide. Site-specific values are used for Rayleigh scattering to account for the site-specific effects of elevation and temperature. Separate relative humidity enhancement factors are used for small- and large-sized distributions of ammonium sulfate and ammonium nitrate and for sea salt. The elemental carbon (light-absorbing carbon), fine soil, and coarse mass terms do not change between the original and new IMPROVE equation.

The VISTAS states chose to use the new IMPROVE equation as the basis for the conceptual description because it takes into account the most recent review of the science and because it is recommended by the IMPROVE Steering Committee. For more detailed discussion of the two IMPROVE equations, see Appendix B.

Georgia EPD requested in writing (from Carol Couch to J.I. Palmer, dated August 19, 2008) to use the new IMPROVE equation to calculate light extinction effects from two BART-eligible facilities: Georgia Pacific Cedar Springs and Georgia Power Plant Bowen. EPA Region IV approved this request in a letter dated September 11, 2008.

2.2 Estimating Baseline Conditions for Georgia Class I Areas

Baseline visibility conditions at each Georgia Class I area are estimated using sampling data collected at IMPROVE monitoring sites. A -5year average (2000 to 2004) was calculated for each of the 20 percent worst and 20 percent best visibility days in accordance with 40 CFR 51.308(d)(2) and the US EPA *Guidance for Tracking Progress Under the Regional Haze Rule.* IMPROVE data records for Okefenokee for the period 2000 to 2004 meet US EPA requirements for data completeness (75 percent for the year and 50 percent for each quarter). Cohutta did not meet completeness criteria in 2000, 2001, and 2003. Data records for 2001 and 2003 were filled using data substitution procedures outlined in Appendix B, but there was too little data in 2000 to perform data filling. IMPROVE does not operate a monitor at Wolf Island and considers the IMPROVE monitor at Okefenokee Wilderness Area to be representative of visibility at Wolf Island. The light extinction and deciview visibility values for the 20 percent worst and 20 percent best visibility days at the Class I areas are based on data and calculations included in Appendix B of this SIP. The 20 percent worst and 20 percent best visibility days with their respective extinction values are presented in Appendix B.1.

2.3 Summary of Natural Background and Baseline Conditions for Georgia Class I Areas

Table 2.3-1 presents estimated natural background and baseline visibility metrics for Georgia Class I areas. Note that Georgia is not considering international emissions to be a component of natural background. Baseline visibility on the 20 percent worst days at Cohutta Wilderness Area, Okefenokee Wilderness Area, and Wolf Island is generally between 27 and 30 dv. Natural background visibility at all three sites is predicted to be between 11 and 12 dv. The class I area with the worst visibility impairment is Cohutta Wilderness Area at greater than 30 dv on the 20 percent worst days.

Table 2.3-1. Natural Background and Baseline Conditions for Georgia Class I Areas

Natural Background Conditions				
Class 1 Area	**Average for 20 percent Worst Days (deciviews)**	**Average for 20 percent Best Days (deciviews)**	**Average for 20 percent Worst Days Bext (Mm-1)**	**Average for 20 percent Best Days Bext (Mm-1)**
Cohutta Wilderness Area	10.78	4.32	29.38	15.40
Okefenokee Wilderness	11.21	5.31	30.67	16.99
Wolf Island	11.21	5.31	30.67	16.99
Baseline Visibility Conditions 2000-2004				
Class 1 Area	**Average for 20 percent Worst Days (deciviews)**	**Average for 20 percent Best Days (deciviews)**	**Bext (Mm-1) Average for 20 percent Worst Days**	**Bext (Mm-1) Average for 20 percent Best Days**
Cohutta Wilderness Area	30.25	13.77	206.21	39.62
Okefenokee Wilderness	27.13	15.23	151.50	45.85
Wolf Island	27.13	15.23	151.40	45.85

2.4 Pollutant Contributions to Visibility Impairment (2000-2004 Baseline Data)

The 20 percent worst visibility days at the Southern Appalachian sites (in Georgia: only the Cohutta Wilderness Area is part of the Southern Appalachian sites) generally occur in the period April to September. The peak hazy days occur in the summer under stagnant weather conditions with high relative humidity, high temperatures, and low wind speeds. The 20 percent best visibility days at the Cohutta Wilderness Area can occur at any time of year. At Wolf Island, Okefenokee Wilderness Area and other coastal sites, the 20 percent worst and best visibility days are distributed throughout the year.

Ammonium sulfate, $(NH_4)_2SO_4$, is the most important contributor to visibility impairment and fine particle mass on the 20 percent worst and 20 percent best visibility days at all the Georgia Class I areas. Sulfate levels on the 20 percent worst days account for 60-70 percent of the visibility impairment. Across the VISTAS region, sulfate levels are higher at the Southern Appalachian sites than at the coastal sites (Figure 2.4-1). On the 20 percent clearest days, sulfate levels are more uniform across the region (Figure 2.4-2). [Note that in these two figures, levels at Okefenokee Wilderness Area should be considered to be representative of levels at Wolf Island.]

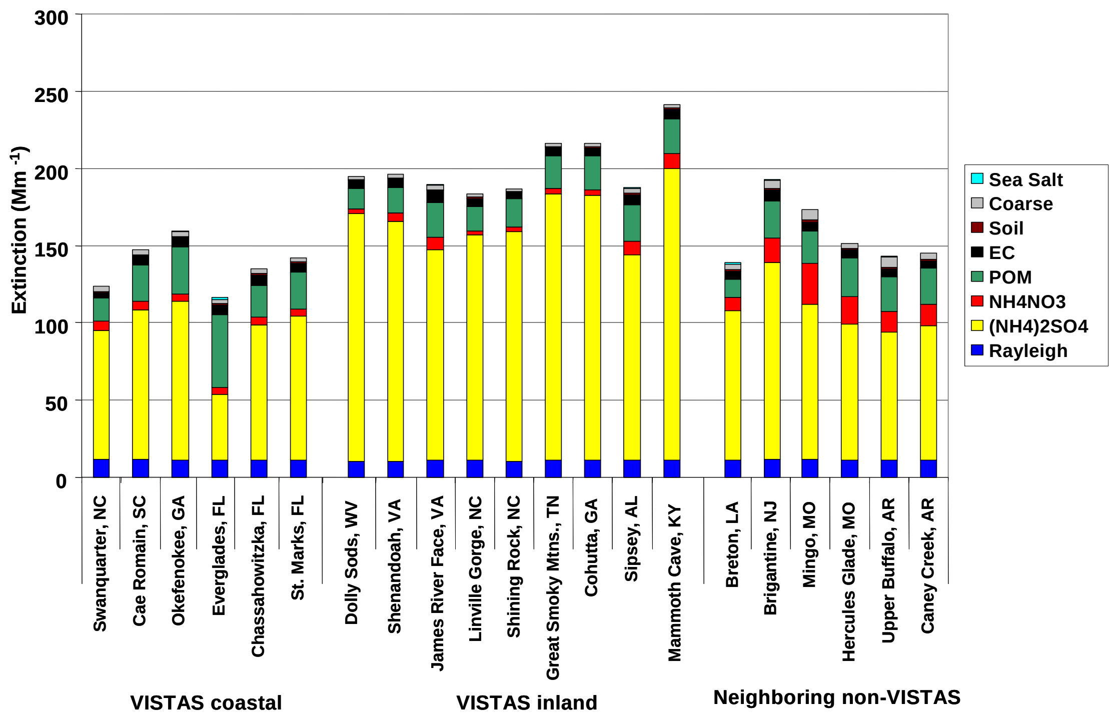


Figure 2.4-1. Average light extinction for the 20 percent Haziest Days in 2000-2004 at VISTAS and neighboring Class I areas using New IMPROVE equation

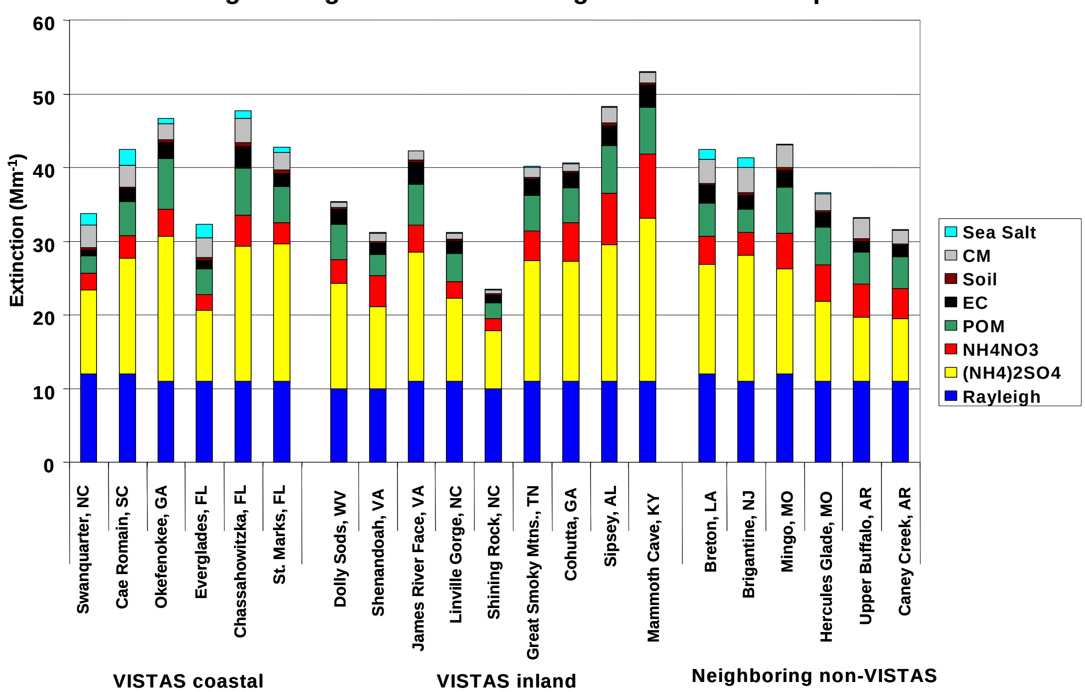


Figure 2.4-2. Average light extinction for the 20 percent Clearest Days in 2000-2004 at VISTAS and neighboring Class I areas using New IMPROVE equation

Particulate Organic Matter (POM) is the second most important contributor to fine particle mass and light extinction on the 20 percent haziest and the 20 percent clearest days at the Georgia Class I areas. Elevated levels of POM and elemental carbon (EC) indicate impact from wildfires or prescribed fires. Significant fire impacts are infrequent at Class I areas in Georgia. Wood burning is more important in the fall, winter, and early spring months. Biogenic emissions, chiefly emissions of volatile organics (VOC) from vegetation, peak in spring and summer. Biogenic carbon emissions at Cape Romain, South Carolina, a coastal site similar to Wolf Island, Georgia were lower than emissions at the forested mountain sites. Carbon from gasoline and diesel engines is a relatively small contribution at the rural sites. Modeling results suggest that controlling anthropogenic sources of carbon will have little benefit in improving visibility in Class I areas. Controlling anthropogenic sources of carbon will likely be more effective to reduce levels of PM2.5 in urban areas.

Ammonium nitrate, NH_4NO_3, is formed in the atmosphere by reaction of ammonia and nitrogen oxides. In the VISTAS region, nitrate formation is limited by availability of ammonia and by temperature. Ammonia preferentially reacts with sulfur dioxide and sulfate before reacting with nitrogen oxides. Particle nitrate is formed at lower temperatures; at elevated temperatures nitric acid remains in gaseous form. For this reason, particle nitrate levels are very low in the summer and a minor contributor to visibility impairment. Particle nitrate concentrations are higher on winter days and are more important for the coastal sites where 20 percent worst days can occur on winter days. Nitrogen oxides are emitted by fossil fuel combustion by point, area, on-road, and non-road sources. Modeling data (see Section 7) indicate that in the VISTAS region ammonium nitrate formation is limited by ammonia concentrations and suggest that for winter days, controls of ammonia sources would be more effective in reducing ammonium nitrate levels than controls of nitrogen oxides.

Elemental Carbon(EC) is a comparatively minor contributor to visibility impairment. Sources include agriculture, prescribed, wildland, and wild fires and incomplete combustion of fossil fuels. EC levels are higher at urban monitors than at the Class I areas and suggest controls of fossil fuel combustion sources would be more effective to reduce PM2.5 in urban areas than to improve visibility in Class I areas.

Soil fine particles are minor contributors to visibility impairment at most sites on most days. Occasional episodes of elevated fine soil can be attributed to Saharan dust episodes, particularly at Everglades, Florida but rarely are seen at the Georgia Class I areas. No control strategies are indicated for fine soil.

Sea salt (NaCl) is observed at the coastal sites. Sea salt contributes to visibility impairment are most important on the 20 percent clearest days when sulfate and POM levels are low. Sea salt levels do not contribute significantly to visibility on the 20 percent worst visibility days. The new IMPROVE equation uses Chloride ion (Cl^-) from routine IMPROVE measurements to calculate sea salt levels. Cl^- may react with nitrates and volatize off the filter, so that Cl^- may underestimate sea salt levels. VISTAS funded sodium ion (Na^+) analyses of the IMPROVE filters from October 2003 to December

2004 for nine sites. Sodium ion measures may overestimate sea salt levels because sodium nitrate is an additional source of sodium ion that cannot be distinguished from sodium chloride. Our best understanding to date suggests that using Cl^- may underestimate sea salt levels by as much as a factor of two. This uncertainty has greatest implications for calculating sea salt levels under natural visibility conditions.

Coarse particle mass (particles with diameters between 2.5 and 10 microns) has a relatively small contribution to visibility impairment because the light extinction efficiency of coarse mass is very low compared to the extinction efficiency for sulfate, nitrate, and carbon.

An *unidentified* component is reported by IMPROVE as the difference between the total PM2.5 mass measured on the filter and the sum of the measured components. This unidentified mass may be positive or negative and is attributable to water and/or the factors used to calculate molecular weights of the other components.

The new IMPROVE equation, compared to the former version, generally results in higher calculated light extinction on days with higher mass and lower light extinction on days with lower mass. This tends to increase calculated light extinction for current conditions and to decrease calculated light extinction for natural visibility conditions. Adding sea salt to the new IMPROVE equation increases light extinction for both current and natural visibility conditions. Increasing the mass multiplier for particulate organic matter in the new IMPROVE equation increases light extinction for current conditions more than for natural conditions. The new algorithm does not change the conclusion that, in the VISTAS region and in Georgia, the most effective means to improve visibility is to reduce sulfate concentrations.

PM2.5 trends in urban and Class I areas: IMPROVE data was compared to monitoring data from the Speciated Trends Network (STN) in nearby urban areas to understand the similarities and differences in composition of fine particle mass. Several PM2.5 non-attainment areas are in close proximity to the Class I areas in the southeastern United States, including Atlanta, Georgia; Birmingham, Alabama; Charleston, West Virginia; Chattanooga, Tennessee; Louisville, Kentucky; and Knoxville, Tennessee. Ammonium sulfate concentrations are comparable between urban and nearby Class I areas, while organic carbon, elemental carbon, and nitrate concentration are generally higher in urban areas than in the Class I areas. These results suggest that sulfate is widely distributed regionally while urban areas see additional incremental pollutant loadings from local emissions sources.

Role of meteorology in determining visibility conditions: Classification and Regression Tree Analyses were used to characterize the relationship between meteorological conditions and visibility conditions at the Class I areas. Days were assigned to one of five visibility classes ranging from poor to good visibility. Days were then assigned to bins based on meteorological conditions. Weights were assigned to days based on frequency of occurrence of days with similar meteorological conditions. For the Georgia Class I areas, poor visibility days were most likely to occur on days with high temperatures, high relative humidity, low wind speeds, and elevated PM2.5 mass at upwind urban areas. Precipitation was not a good predictor of visibility condition.

The above analyses are further discussed in Appendix L.

3.0 GLIDEPATHS FOR CLASS I AREAS IN GEORGIA

The following are glidepaths for the 20 percent most impaired days Cohutta Wilderness Area, assuming uniform rate of progress toward regional haze goals. Natural background visibility at all four sites is predicted to be between 11 and 12 dv. The Class I area with the steepest slope from baseline to natural background conditions is Cohutta Wilderness Area. Note that the rate of progress for Okefenokee is considered representative of Wolf Island.

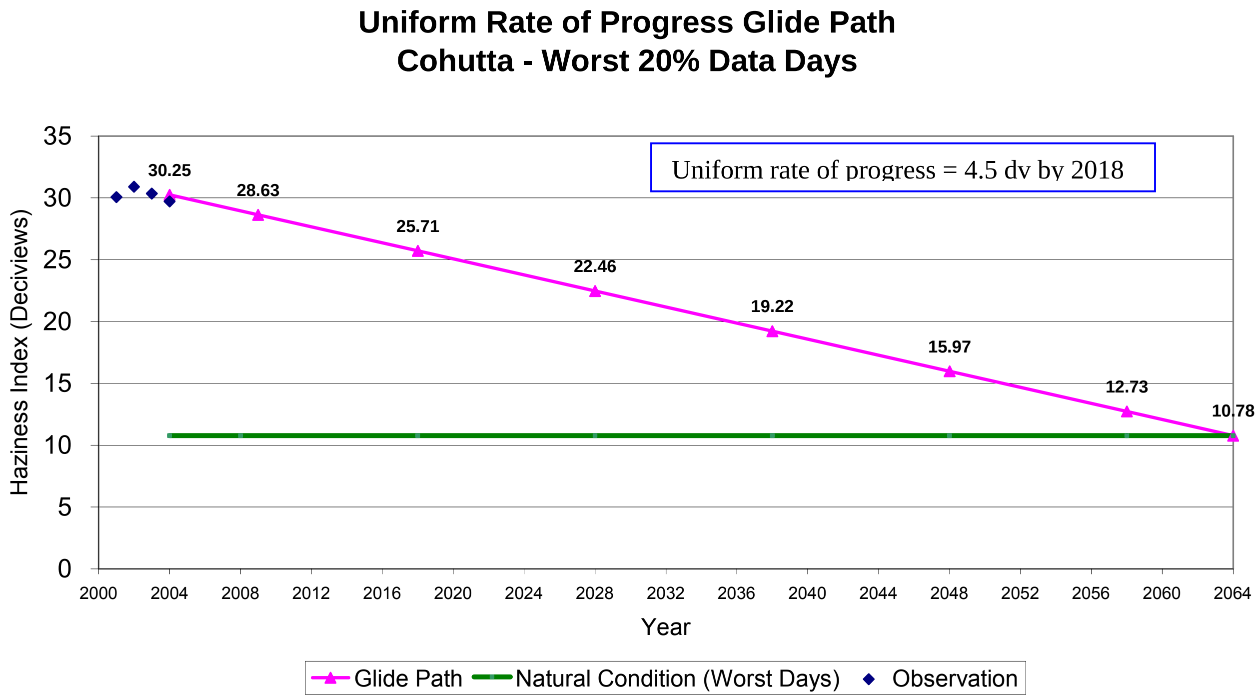


Figure 3.1-1. Uniform Rate of Progress Glidepath for 20 percent worst days at Cohutta Wilderness Area

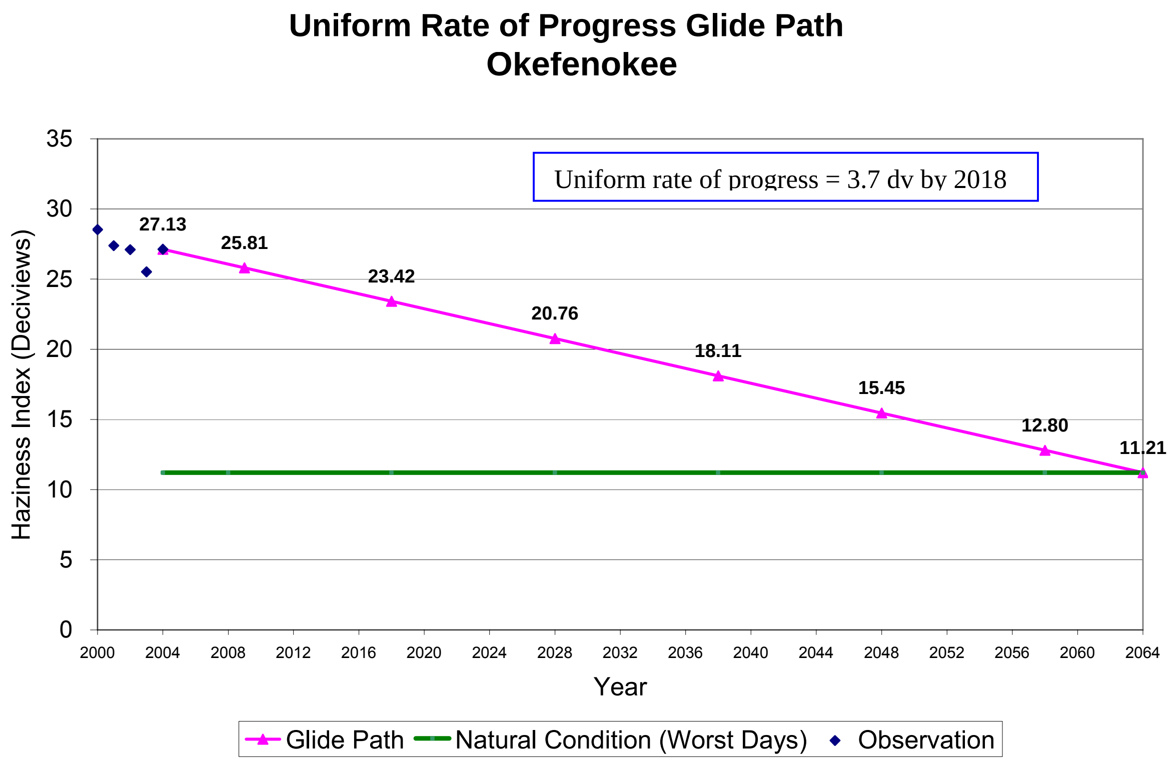


Figure 3.1-2. Uniform Rate of Progress Glidepath for 20 percent worst days at Okefenokee Wilderness Area

4.0 NATURE OF THE PROBLEM: CHIEF CAUSES OF VISIBILITY IMPAIRMENT IN GEORGIA CLASS I AREAS

4.1 Baseline Emissions Inventory

The Regional Haze Rule at 51.308(d)(4)(v) requires a statewide emissions inventory of pollutants that are reasonably anticipated to cause or contribute to visibility impairment in any mandatory Class I area. An inventory was developed for the baseline year 2002 and projected to 2009 and 2018. The pollutants inventoried include volatile organic compounds (VOCs), nitrogen oxides (NOx), fine particulate (PM2.5), coarse particulate (PM10), ammonia (NH3) and sulfur dioxide (SO2). The baseline emissions inventory for 2002 was developed for Georgia following the methods described in Appendix C.

There are five different emission inventory source classifications: stationary point and area sources, off-road and on-road mobile sources, and biogenic sources. Stationary point sources are those sources that emit greater than a specified tonnage per year, with data provided at the facility level. Electric generating utilities and industrial sources are the major categories for stationary point sources. Stationary area sources are those sources whose individual emissions are relatively small, but due to the large number of these sources, the collective emissions from the source category could be significant (i.e., dry cleaners, service stations, agricultural sources, fire emissions, etc.). These types of emissions are estimated on a countywide level. Non-road (or off-road) mobile sources are equipment that can move but do not use the roadways, i.e., lawn mowers, construction equipment, railroad locomotives, aircraft, etc. The emissions from these sources, like stationary area sources, are estimated on a countywide level. On-road mobile sources are automobiles, trucks, buses, and motorcycles that use the roadway system. The emissions from these sources are estimated by vehicle type and road type and are summed to the countywide level. Biogenic sources are the natural sources like trees, crops, grasses and natural decay of plants. The emissions from these sources are estimated on a countywide level.

In addition to the various source classifications, there are also various types of emission inventories. The first is the actual base-year inventory. This inventory is the base-year emissions that correspond to the meteorological data used, which for this modeling effort is data from 2002. These emissions are used for evaluating the air quality model performance.

The second type of inventory is the typical base year inventory. This inventory is similar to the actual base-year inventory, except that for sources whose emissions change significantly from year to year, a more typical emission value is used. In this modeling effort, typical emissions were developed for the electric generating units (EGUs) and the wildland fire emissions. The air quality modeling runs using the typical base-year inventory provide results, which are then used to calculate relative reduction factors for future years. These relative reduction factors for future years are then used to demonstrate reasonable progress toward visibility goals.

Below is an overview of the inventories used for each source classification. More detailed discussion of the emissions inventory development is contained in Appendix C.

4.1.1 Stationary Point Sources

Point source emissions are emissions from individual sources having a fixed location. Generally, these sources must have permits to operate, and their emissions are inventoried on a regular schedule. Point sources emitting at least 100 tons per year (tpy) of VOC, PM_{10}, $PM_{2.5}$, NH_3, SO2, or NO_x are inventoried. The point source emissions data can be grouped as EGU sources and other industrial point sources, also called non-EGUs.

Electric Generating Units

The actual base year inventory for the EGU sources used 2002 continuous emissions monitoring (CEM) data reported to the US EPA’s Acid Rain program or 2002 hourly emissions data provided by stakeholders. The data provides hourly emissions profiles for SO2 and NOx that can be used in air quality modeling. Emissions profiles are used to estimate emissions of other pollutants (volatile organic compounds, carbon monoxide, ammonia, fine particles, soil) based on measured emissions of SO2 and NOx.

Emissions from EGUs vary daily and seasonally as a function of variability in energy demand and utilization and outage schedules. To avoid anomalies in future-year emissions created by relying on 2002 operations to represent future operations, a typical base-year emissions inventory was developed for EGUs. This approach is consistent with the US EPA’s modeling guidance (Appendix G). To develop a typical year 2002 emissions inventory for EGU sources, each unit’s average CEM heat input for 2000 through 2004 was divided by the 2002 actual heat input to generate a unit specific normalizing factor. This normalizing factor was then multiplied by the 2002 actual emissions. The heat inputs for the period 2000 through 2004 were used because the modeling current design values use monitored data from this same 5-year period. If a unit was shut down for an entire year during the 2000 through 2004 period, the average of the years the unit was operational was used. If a unit was shut down in 2002, but not permanently shutdown, the emissions and heat inputs from 2001 (or 2000) were used in the normalizing calculations.

As part of the VISTAS air quality modeling, VISTAS, in cooperation with the other eastern RPOs, contracted with ICF Resources, L.L.C., to generate future-year emission inventories for the electric generating sector of the contiguous United States using the Integrated Planning Model (IPM). IPM is a dynamic linear optimization model that can be used to examine air pollution control policies for various pollutants throughout the contiguous United States for the entire electric power system. The dynamic nature of IPM enables projection of the behavior of the power system over a specified future period. Optimization logic in IPM determines the least-cost means of meeting electric generation and capacity requirements while complying with specified constraints including air pollution regulations, transmission bottlenecks, and plant-specific operational constraints. The versatility of IPM allows users to specify which constraints to exercise and to populate IPM with their own datasets.

The IPM modeling runs took into consideration both CAIR implementation and Georgia's Multipollutant rule requirements for Georgia Power.

Other Industrial Point Sources

For the non-EGU sources, the same inventory is used for both the actual and typical base-year emissions inventories. The non-EGU category uses annual emissions as reported under the Consolidated Emissions Reporting Rule (CERR) for the year 2002. These emissions are temporally allocated to month, day, and hour using source category code (SCC)-based allocation factors.

The general approach for assembling future-year data was to use recently updated growth and control data consistent with US EPA's CAIR analyses. This data was supplemented with state-specific growth factors and stakeholder input on growth assumptions.

4.1.2 Stationary Area Sources

Stationary area sources are sources whose individual emissions are relatively small, but due to the large number of these sources, the collective emissions could be significant (i.e., combustion of fuels for heating, structure fires, service stations, etc.). Emissions are estimated by multiplying an emission factor by some known indicator of collective activity, such as fuel usage, number of households, or population. Stationary area source emissions are estimated at the countywide level.

The VISTAS contractor used data reported by Georgia under CERR for 2002 area source inventory. GA EPD only provided additional data from other years in order to generate typical fire emissions.

The actual base-year inventory will serve as the typical base-year inventory for all area source categories except for wildland fires. For wildland fires, a typical year inventory was used to avoid anomalies in wildfire activity in 2002 compared to longer-term averages. Development of a typical year fire inventory provided the capability of using a comparable data set for both the base year and future years. Thus, fire emissions remain the same for air quality modeling in both the base and any future years. The VISTAS Fire Special Interest Work Group used State records to ratio the number of acres burned over a longer term period (three or more years, as available from state records) to 2002. Based on these ratios, the 2002 acreage was then scaled up or down to develop a typical year inventory.

Future Year Emissions

The VISTAS contractor generated future-year emissions inventories for 2009 and 2018 for the regional haze modeling. Growth factors, supplied either by states or taken from the CAIR emission projections, were applied to project the controlled emissions to 2018. If no growth factor was available from either a state or the CAIR growth factor files, then the US EPA's Economic Growth and Analysis System Version 5 growth factors were used.

4.1.3 Off-Road Mobile Sources

Off-road (or non-road) mobile sources are equipment that can move but do not use the roadways, such as construction equipment, aircraft, railroad locomotives, lawn and garden equipment, etc. For the majority of the non-road mobile sources, the emissions for 2002 were estimated using the US EPA's NONROAD2005 model. For the three source categories not included in the NONROAD model, i.e., aircraft engines, railroad locomotives and commercial marine, more traditional methods of estimating the emissions were used. The same inventory is used for both the actual and typical base-year emissions inventories.

For the source categories estimated using the US EPA's NONROAD model, the model growth assumptions were used to create the 2009 and 2018 future-year inventories. The NONROAD model takes into consideration regulations affecting emissions from these source categories. For the commercial marine, railroad locomotives and the airport emissions, the VISTAS contractor calculated the future growth in emissions using detailed inventory data (both before and after controls) for 1996 and 2010, obtained from the CAIR Technical Support Document. When available, state-specific growth factors were used.

4.1.4 Highway Mobile Sources

For on-road vehicles, the newest version of the MOBILE model, MOBILE6.2, was used. Key inputs for MOBILE include information on the age of vehicles on the roads, the average speeds on the roads, the mix of vehicles on the roads, any programs in place in an area to reduce emissions for motor vehicles (e.g., emissions inspection programs), and temperature.

The MOBILE model takes into consideration regulations that affect emissions from this source sector. The same MOBILE run is used to represent the actual and typical year emissions for on-road vehicles using input data reflective of 2002. The MOBILE model then is run for 2018 inventory using input data reflective of that year. Area-specific vehicle age distributions were modeled. Emissions were modeled using vehicle miles traveled estimates obtained from the Georgia Department of Transportation.

4.1.5 Biogenic Emission Sources

Biogenic emissions were prepared with the SMOKE-BEIS3 (Biogenic Emission Inventory System 3 version 0.9) preprocessor. SMOKE-BEIS3 is a modified version of the Urban Airshed Model (UAM)-BEIS3 model. Modifications include use of MM5 data, gridded land use data, and improved emissions characterization. The emission factors that are used in SMOKE-BEIS3 are the same as the emission factors as in UAM-BEIS3. The basis for the gridded land use data used by BEIS3 is the county land use data in the Biogenic Emissions Landcover Database version 3 (BELD3) provided by the US EPA. A separate land classification scheme, based upon satellite (AVHRR, 1 km spatial resolution) and census information, aided in defining the forest, agriculture and urban portions of each county.

4.1.6 Model Performance Improvements through Emissions Inventory Improvements

Since the initial model performance evaluation, VISTAS has made several improvements to the emissions inventory, which, in turn, improve model performance. These inventory improvements are detailed in the VISTAS emissions inventory report and Appendix C, and are summarized here:

- For electric generating utilities, the Integrated Planning Model (IPM) was used to provide estimates of future-year utility production and emissions. Continuous Emissions Monitoring data was used to define seasonal variability in production and emissions. For Base G4 emissions, states updated IPM model projections from 2005 with control data provided by utility companies in 2006 through winter 2007.
- For on-road vehicle emissions, states and local agencies provided updated MOBILE model input and vehicle-miles-traveled data.
- For ammonia emissions from agricultural sources, the Carnegie Mellon University ammonia model was used to improve annual and monthly estimates.
- For fires, the VISTAS states provided fire activity data for 2002 for wildfires, prescribed fire, land clearing and agricultural burning and MACTEC developed a 2002 fire inventory. Where data allowed, Alpine Geophysics modeled fire events as point sources. In 2006, the United States Forest Service and the Fish and Wildlife Service provided projections of increased prescribed burning in 2009 and 2018. The data was incorporated in the Base G inventory for all states except Florida.
- For non-road engines, the updated US EPA NONROAD2005 emissions model was used in Base G.

For commercial marine emissions in shipping lanes in the Gulf of Mexico and Atlantic Oceans, ENVIRON created gridded emissions for the VISTAS modeling domain using inventory data newly developed for US EPA by Corbett at University of Delaware. These emissions were incorporated in the Base G modeling.
Updated inventories from the neighboring RPOs, Mexico, and Canada were incorporated as available.

4.1.7 Summary 2002 Base G2 Baseline Emissions Inventory for Georgia

Table 4.1 is a summary of the 2002 baseline emission inventory for Georgia. The complete inventory and discussion of the methodology is contained in Appendix C. The emissions summaries for other VISTAS states can also be found in Appendix C.

Table 4.1. 2002 Emissions Inventory Summary for GA in tons per year.

	VOC	NOx	PM2.5	PM10	NH3	SO2
Point	34,964.3	197,376.9	22,531.7	33,077.3	3,699.2	571,410.9
Area	333,044.8	49,987.4	159,437.8	757,656.1	83,066.0	60,370.2
On-Road Mobile	283,420.6	307,731.7	5,167.8	7,245.9	10,546.2	12,183.5
Non-Road Mobile	85,965.4	97,961.4	8,226.4	8,617.9	60.4	9,005.4
Biogenics	1,972,795.40	20,942.38	0	0	0	0
TOTAL	2,710,190.50	673,999.78	195,363.50	806,597.20	97,371.80	652,970

4.2 Assessment of Relative Contributions from Specific Pollutants and Sources Categories

Ammonium sulfate is the largest contributor to visibility impairment at the Georgia Class I areas, and reduction of SO2 emissions would be the most effective means of reducing ammonium sulfate. As illustrated in Figure 4.2-1, 96 percent of SO2 emissions in the VISTAS states are attributable to electric generating facilities and industrial point sources. As shown in Table 4.1, approximately 90 percent of SO2 emissions in Georgia are attributable to electric generating facilities and industrial point sources.

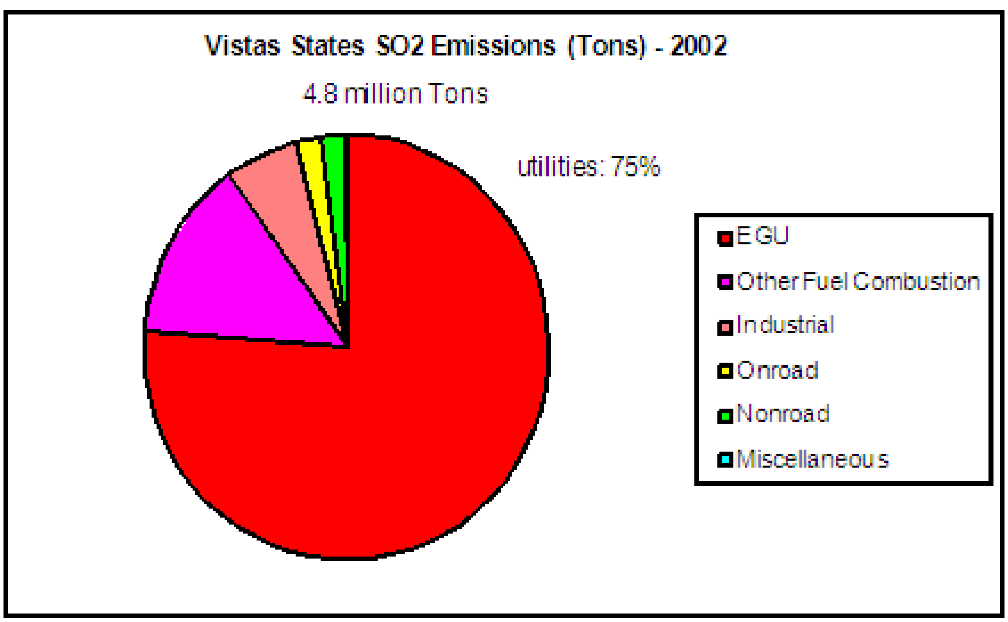


Figure 4.2-1. SO2 emissions in 2002 in the VISTAS States.

5.0 REGIONAL HAZE MODELING METHODS AND INPUTS

Modeling for regional haze was performed by VISTAS for the ten southeastern states, including Georgia. The sections below outline the methods and inputs used by VISTAS for the regional modeling. Additional details are provided in Appendices C, D, and E.

5.1 Analysis Method

The modeling analysis is a complex technical evaluation that begins by selection of the modeling system. VISTAS decided to use the following modeling system:

- Meteorological Model: The Pennsylvania State University/National Center for Atmospheric Research (PSU/NCAR) Mesoscale Meteorological Model (MM5) is a nonhydrostatic, prognostic meteorological model routinely used for urban- and regional-scale photochemical, fine particulate matter, and regional haze regulatory modeling studies.
- Emissions Model: The Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system is an emissions modeling system that generates hourly, gridded, speciated emission inputs of mobile, non-road mobile, area, point, fire and biogenic emission sources for photochemical grid models.
- Air Quality Model: US EPA's Models-3/ Community Multiscale Air Quality (CMAQ) modeling system is a 'One-Atmosphere' photochemical grid model capable of addressing ozone, particulate matter (PM), visibility and acid deposition at regional scale for periods up to one year.

The US EPA Modeling Guidance (Appendix G) recommends modeling an entire year or at a minimum several days in each quarter of a year to adequately represent the range of meteorological conditions that contribute to elevated levels of fine particulate matter. The year 2002 was selected by VISTAS as the modeling year for this demonstration. Meteorological inputs were developed for 2002 using the meteorological model. Emission inventories were also developed for 2002 and processed through the emissions model. These inputs were used in the air quality model to predict fine particle mass and visibility. The model results for 2002 were compared with observed meteorological and air quality data to evaluate model performance. Several configurations of the meteorological and air quality model were evaluated to select a configuration that gave the best overall performance for the VISTAS region.

Once model performance was deemed adequate, the current- and future-year emissions were processed through the emissions model. The air quality modeling results are used to determine a relative reduction in future visibility impairment, which is used to determine reasonable progress.

The complete modeling protocol used for this analysis can be found in Appendix D.

5.2 Model Selection

To ensure that a modeling study is defensible, care must be taken in the selection of the models to be used. The models selected must be scientifically appropriate for the intended application and be freely accessible to all stakeholders. Scientifically appropriate means that the models address important physical and chemical phenomena in sufficient detail, using peer-reviewed methods. Freely accessible means that model formulations and coding are freely available for review and that the models are available to stakeholders, and their consultants, for execution and verification at no or low cost.

The following sections outline the criteria for selecting a modeling system that is both defensible and capable of meeting the study's goals. These criteria were used in selecting the modeling system used for this modeling demonstration.

5.2.1 Selection of Photochemical Grid Model

Criteria

For a photochemical grid model to qualify as a candidate for use in a regional haze SIP, a state needs to show that it meets the same several general criteria as a model for an attainment demonstration for a national ambient air quality standard (NAAQS):

- The model has received a scientific peer review.
- The model can be demonstrated applicable to the problem on a theoretical basis.
- Databases needed to perform the analysis are available and adequate.
- Available past appropriate performance evaluations have shown the model is not biased toward underestimates or overestimates.
- A protocol on methods and procedures to be followed has been established.
- The developer of the model must be willing to make the source code available to users for free or for a reasonable cost, and the model cannot otherwise be proprietary.

Overview of CMAQ

The photochemical model selected for this study was CMAQ Version 4.5. For more than a decade, the US EPA has been developing the Models-3 CMAQ modeling system with the overarching aim of producing a "One-Atmosphere" air quality modeling system capable of addressing ozone, fine particulate matter, visibility and acid deposition within a common platform. The original justification for the Models-3 development emerged from the challenges posed by the 1990 Clean Air Act Amendments and the USEPA's desire to develop an advanced modeling framework for "holistic" environmental modeling utilizing state-of-science representations of atmospheric processes in a high performance computing environment. The US EPA completed the initial stage of development with Models-3 and released the CMAQ model in mid-1999 as the initial operating science model under the Models-3 framework. The most recent rendition is CMAQ Version 4.5, which was released in September of 2005.

An advantage of choosing CMAQ as the atmospheric model is the ability to do one-atmospheric modeling. The same model configuration is being applied for the ozone and $PM_{2.5}$ attainment demonstration SIPs, as well as the regional haze SIP. A number of features in CMAQ's theoretical formulation and technical implementation make the model well-suited for annual PM modeling.

The configuration used for this modeling demonstration, as well as a more detailed description of the CMAQ model, can be found in the Modeling Protocol (Appendix D).

5.2.2 Selection of Meteorological Model

Criteria

Meteorological models, either through objective, diagnostic, or prognostic analysis, extend available information about the state of the atmosphere to the grid upon which photochemical grid modeling is to be carried out. The criteria for selecting a meteorological model are based on both the model's ability to accurately replicate important meteorological phenomena in the region of study and the model's ability to interface with the rest of the modeling systems -- particularly the photochemical grid model. With these issues in mind, the following criteria were established for the meteorological model to be used in this study:

- Non-Hydrostatic Formulation
- Reasonably current, peer-reviewed formulation
- Simulation of Cloud Physics
- Public availability at no or low cost
- Output available in I/O API format
- Support of Four Dimensional Data Assimilation (FDDA)
- Enhanced treatment of Planetary Boundary Layer heights for AQ modeling

Overview of MM5

The non-hydrostatic MM5 model is a three-dimensional, limited-area, primitive equation, prognostic model that has been used widely in regional air quality model applications. The basic model has been under continuous development, improvement, testing and open peer-review for more than 20 years and has been used worldwide by hundreds of scientists for a variety of mesoscale studies.

MM5 uses a terrain-following non-dimensionalized pressure, or "sigma," vertical coordinate similar to that used in many operational and research models. In the non-hydrostatic MM5, the sigma levels are defined according to the initial hydrostaticallybalanced reference state so that the sigma levels are also time-invariant. The gridded meteorological fields produced by MM5 are directly compatible with the input requirements of "one atmosphere" air-quality models using this coordinate. MM5 fields can be easily used in other regional air quality models with different coordinate systems by performing a vertical interpolation followed by a mass-conservation re-adjustment.

Distinct planetary boundary layer (PBL) parameterizations are available for air-quality applications, both of which represent sub-grid-scale turbulent fluxes of heat, moisture and momentum. One scheme uses a first-order eddy diffusivity formulation for stable and neutral environments and a modified first-order scheme for unstable regimes. The other scheme uses a prognostic equation for the second-order turbulent kinetic energy, while diagnosing the other key boundary layer terms.

Initial and lateral boundary conditions are specified for real-data cases from mesoscale 3-dimensional analyses performed at 12-hour intervals on the outermost grid mesh selected by the user. Surface fields are analyzed at 3-hour intervals. A Cressman-based technique is used to analyze standard surface and radiosonde observations, using the National Meteorological Center's spectral analysis, as a first guess. The lateral boundary data is introduced using a relaxation technique applied in the outermost five rows and columns of the coarsest grid domain.

MM5 modeling systems, in regulatory air quality application studies, have been widely reported in the literature (e.g., Emery et al., 1999; Tesche et al., 2000, 2003) and many have involved comparisons with other prognostic models such as the Regional Atmospheric Modeling System (RAMS) and the Systems Application International Mesoscale Model. The MM5 enjoys a far richer application history in regulatory modeling studies compared with RAMS or other models. Furthermore, in evaluations of these models in over 60 recent, regional-scale air quality application studies since 1995, it has generally been found that the MM5 model tends to produce somewhat better photochemical model inputs than alternative models.

The configuration used for this modeling demonstration, as well as a more detailed description of the MM5 model, can be found in Appendix F.

5.2.3 Selection of Emissions Processing System

Criteria

The principal criterion for an emissions processing system is that it accurately prepares emissions files in a format suitable for the photochemical grid model being used. The following list includes clarification of this criterion and additional desirable criteria for effective use of the system.

- File System Compatibility with the I/O API
- File Portability
- Ability to grid emissions on a Lambert Conformal projection

- Report Capability
- Graphical Analysis Capability
- MOBILE6 Mobile Source Emissions
- Biogenic Emissions Inventory System Version 3 (BEIS-3)
- Ability to process emissions for the proposed domain in a reasonable amount of time
- Ability to process control strategies
- No or low cost for acquisition and maintenance
- Expandability to support other species and mechanisms

Overview of SMOKE

The SMOKE Emissions Processing System Prototype was originally developed at the Micro-computing Center of North Carolina. As with most "emissions models," SMOKE is principally an *emission processing system* and not a true *emissions modeling system* in which emission estimates are simulated from "first principles." This means that, with the exception of mobile and biogenic sources, its purpose is to provide an efficient, modern tool for converting emissions inventory data into the formatted emission files required by an air quality simulation model. For mobile sources, SMOKE actually simulates emissions rates based on input mobile-source activity data, emission factors and outputs from transportation travel-demand models.

SMOKE was originally designed to allow emissions data processing methods to utilize emergent high-performance-computing as applied to sparse-matrix algorithms. Indeed, SMOKE is the fastest emissions processing tool currently available to the air quality modeling community. The sparse matrix approach utilized throughout SMOKE permits both rapid and flexible processing of emissions data. The processing is rapid because SMOKE utilizes a series of matrix calculations instead of less efficient algorithms used in previous systems. The processing is flexible because the processing steps of temporal projection, controls, chemical speciation, temporal allocation, and spatial allocation have been separated into independent operations wherever possible. The results from these steps are merged together at a final stage of processing.

SMOKE contains a number of major features that make it an attractive component of the modeling system. The model supports a variety of input formats from other emissions processing systems and models. It supports both gridded and county total land use schemes for biogenic emissions modeling. SMOKE can accommodate emissions files from up to 10 countries and any pollutant can be processed by the system. For additional information about the SMOKE model, please refer to Modeling Protocol (Appendix D).

5.3 Selection of the Modeling Year

A crucial step to SIP modeling is the selection of the period of time to model to represent current air quality conditions and to project changes in air quality in response to changes in emissions. The year 2002 was selected as the base year for several reasons.

The US EPA's April 2007 *Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze* identifies specific goals to consider when selecting one or more episodes for use in demonstrating reasonable progress in attaining the regional haze air quality goals. The US EPA recommends that episode selection derive from three principal criteria:

- Simulate a variety of meteorological conditions;
- Model time periods in which observed concentrations are close to the appropriate baseline design value or visibility impairment;
- Model periods for which extensive air quality/meteorological data bases exist; and
- Model a sufficient number of days so that the modeled attainment test applied at each monitor violating the NAAQS is based on multiple days.

For regional haze modeling, the guidance goes further by suggesting that the preferred approach is to model a full, *representative* year. Moreover, the required RRF values should be based on model results averaged over the 20% worst and 20% best visibility days determined for each Class I area based on monitoring data from the 2000 – 2004 baseline period.

The US EPA also lists several other considerations to bear in mind when choosing potential regional haze episodes including: (a) choosing periods which have already been modeled, (b) choosing periods which are drawn from the years upon which the current design values are based, (c) including weekend days among those chosen, and (d) choosing modeling periods that meet as many episode selection criteria as possible in the maximum number of non-attainment or Class I areas as possible. Finally, the US EPA explicitly recommended in its 2007 guidance to use 2002 as the baseline inventory year.

VISTAS adopted a logical, stepwise approach in implementing the US EPA guidance in order to identify the most preferable, representative year for regional haze modeling. These steps include the following:

- <u>Representativeness of Meteorological Conditions:</u> The VISTAS meteorological contractor (BAMS) identified important meteorological characteristics and data sets in the VISTAS region directly relevant to the evaluation of candidate annual modeling episodes.

- Initial Episode Typing: At the time of selection in 2003, meteorological and air quality data were available for 2002 for model inputs and model performance evaluation. VISTAS used Classification and Regression Tree Analyses to evaluate visibility conditions for 2000, 2001, and 2002, the candidate modeling years. The year 2002 was found to be representative of conditions in the other two years. Subsequently, these analyses were repeated with the meteorological and air quality monitoring data for 2000 to 2004 to evaluate how well the 2002-modeling year represented the full 2000-2004 baseline period. This analysis confirmed that visibility and PM2.5 mass in 2002 were representative of the 5-year baseline period for the VISTAS Class I areas. This analysis is discussed in more detail in the project report in Appendix L.

- Data Availability: In parallel with the CART analysis, episode characterization analyses, collaborative investigations by VISTAS states (e.g., NCDAQ, GAEPD, FL DEP) intensively studied the availability of PM2.5, meteorological, and emissions data and representativeness of alternative baseline modeling periods from a regulatory standpoint. Additionally, 2002 was the year that US EPA was requiring states to provide emissions inventory data for the Comprehensive Emissions Reporting Rule; therefore, it made sense to use 2002 as the modeling year to take advantage of the 2002 inventory.

- Years to be used by other RPOs: VISTAS also considered what years other RPO would be modeling, and several had already chosen calendar year 2002 as the modeling year.

After a lengthy process of integrated studies, the episode selection process culminated in the selection of calendar year 2002 (1 January through 31 December) as the most current, representative, and pragmatic choice for VISTAS regional haze modeling. All of the US EPA criteria for regional haze episode selection were directly considered in this process together with many other considerations (e.g., timing of new emissions or aerometric data deliveries by the US EPA or the states to the modeling teams).

5.4 Modeling Domains

5.4.1 Horizontal Modeling Domain

The US EPA's modeling guidance (Appendix G) recommends a 12-km modeling grid resolution for PM2.5 modeling while a 36-km grid is considered acceptable for regional haze. For the VISTAS modeling, a coarse 36-km grid resolution was used for modeling the entire United States and a finer 12-km grid was used to model the eastern United States.

The CMAQ model was run in one-way nested grid mode. This allowed the larger outer domains to feed concentration data to the inner nested domain. The horizontal coarse grid modeling domain boundaries were determined through a national effort to develop a common grid projection and boundary. A smaller 12-km grid, modeling domain was selected in an attempt to balance location of areas of interest, such as ozone and fine particulate matter non-attainment areas, as well as Class 1 and wilderness areas for regional haze. Processing time was also a factor in choosing a smaller 12-km grid, modeling domain.

The coarse 36-km horizontal grid domain covers the continental United States. This domain was used as the outer grid domain for MM5 modeling with the CMAQ domain nested within the MM5 domain. Figure 5.4.1-1 shows the MM5 horizontal domain as the outer most, blue grid with the CMAQ 36-km domain nested in the MM5 domain.

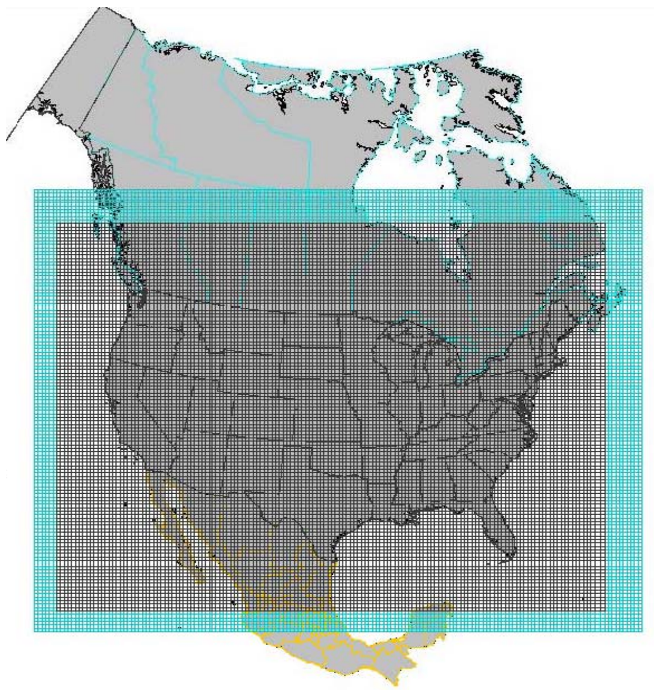


Figure 5.4.1-1. The MM5 horizontal domain is the outer most, blue grid, with the CMAQ 36-km domain nested in the MM5 domain.

To achieve finer spatial resolution in the VISTAS states, a 1-way nested high resolution (12-km grid resolution) was used. Figure 5.4.1-2 shows the 12-km grid, modeling domain for the VISTAS region. This is the modeling domain for which the reasonable progress goals will be assessed.

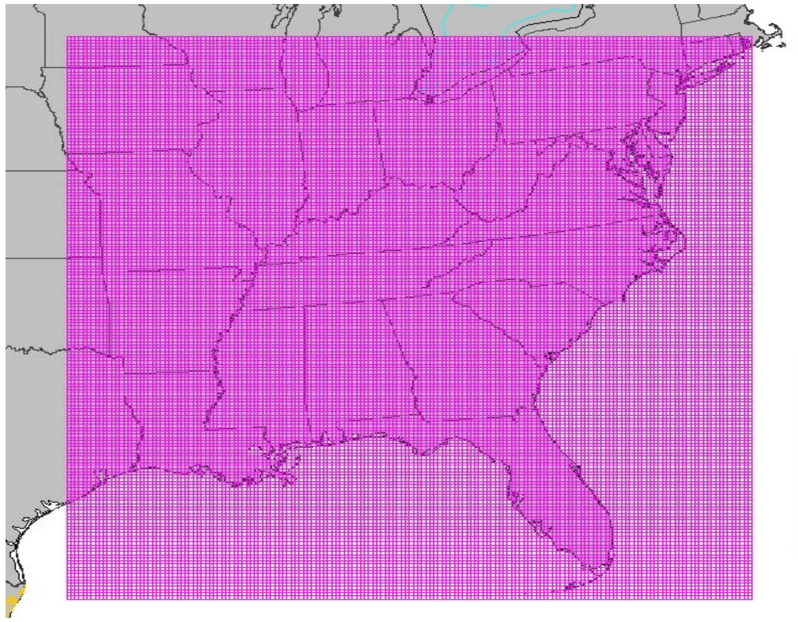


Figure 5.4.1-2. A more detailed view of the 12-km grid over the VISTAS region.

5.4.2 Vertical Modeling Domain

The CMAQ vertical structure is primarily defined by the vertical grid used in the MM5 modeling. The MM5 model employed a terrain-following coordinate system defined by pressure, using 34 layers that extend from the surface to the 100 mb. A layer-averaging scheme was used to generate 19 vertical layers for CMAQ to reduce the computational cost of the CMAQ simulations. The effects of layer averaging were evaluated in conjunction with the VISTAS modeling effort and was found to have a relatively minor effect on the model performance metrics when both the 34-layer and a 19-layer CMAQ models were compared to ambient monitoring data.

6.0 MODEL PERFORMANCE EVALUATION

The initial modeling effort focused on evaluating previous regional air quality modeling applications and testing candidate model configurations for the SMOKE emissions and CMAQ model for the VISTAS 36-km and 12-km modeling domains. This effort resulted in a report recommending the model configuration for the annual emissions and air quality modeling, which is included as part of the VISTAS Emissions and Air Quality Modeling Protocol. The evaluation of the meteorological modeling configuration can be found in Appendix F, with a summary of the final meteorological and air quality modeling configuration in Appendix F and Appendix E, respectively.

Air quality model performance for the 2002 modeling year was initially tested in 2004 using an early version of the VISTAS emissions inventory. In keeping with the one-atmosphere objective of the CMAQ modeling platform, model performance was evaluated based on measured ozone, fine particles, and acid deposition in the Air Quality System (AQS), IMPROVE, Speciated Trends Network (STN), Southeastern Aerosol Research and Characterization (SEARCH), National Acid Deposition Program (NADP) and Clean Air Status and Trends Network (CASTNet) monitoring networks (Figure 6.0-1).

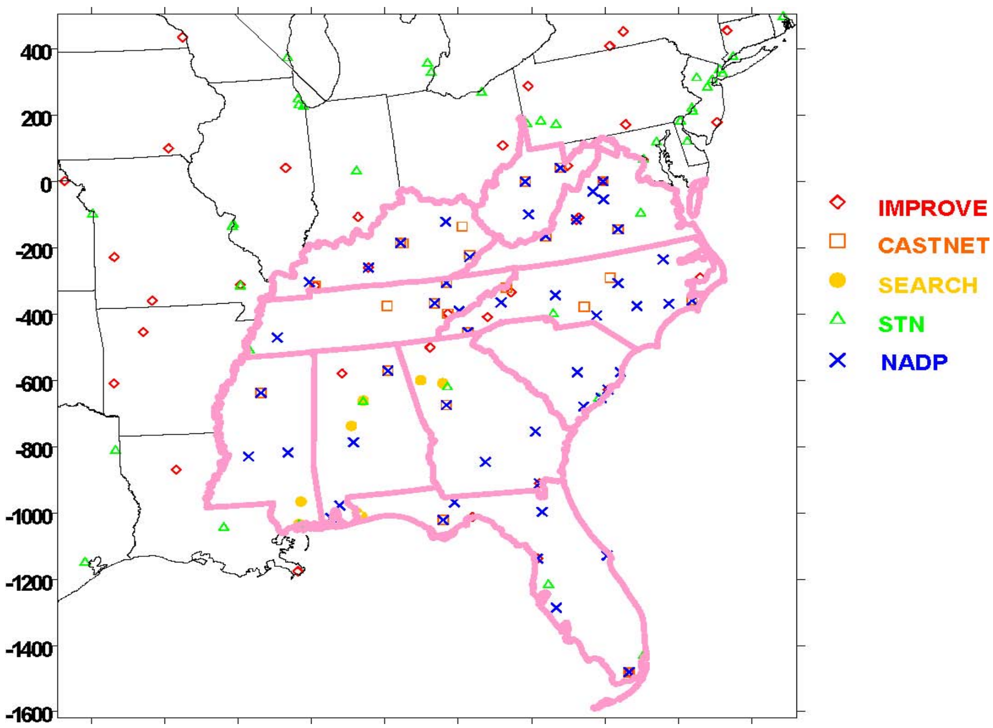


Figure 6.0-1: Monitoring Networks used for VISTAS 2002 model performance evaluation, and their location within the VISTAS 12km domain.

6.1 Modeling Performance Goals, and Criteria

In 2004, VISTAS established model performance goals and criteria for components of fine particle mass (Table 6.1-1) based on previous model performance for ozone and fine particles. The US EPA modeling guidance (Appendix G) for fine particulate matter at the time noted that PM models might not be able to achieve the same level of performance as ozone models. VISTAS' evaluation considered several statistical performance measures and displays. Fractional bias and mean fractional error were selected as the most appropriate metrics to summarize model performance; other metrics were also calculated and are included for IMPROVE monitors in the full model performance evaluation (Appendix E).

Table 6.1-1.: Established model performance goals and criteria for the component species of fine particle mass.

Fractional Bias	Mean Fractional Error	Comment
$\leq$15 percent	$\leq$35 percent	Goal for PM model performance based on ozone model performance, considered excellent performance
$\leq$30 percent	$\leq$50 percent	Goal for PM model performance, considered good performance
$\leq$60 percent	$\leq$75 percent	Criteria for PM model performance, considered average performance. Exceeding this level of performance indicates fundamental concerns with the modeling system and triggers diagnostic evaluation.

Several graphic displays of model performance were prepared including:

1. Scatter plots of predicted and observed concentrations and deposition by species, monitoring network, and month;
2. Time series plots of predicted and observed concentrations and deposition by species, monitoring site, and month;
3. Spatially average time series plots;
4. Time series plots of monthly fractional bias and error for a species, region, and network;
5. Performance goal plots ("soccer plots") that summarize model performance by species, region, season; and
6. Concentration performance plots ("bugle plots") that display fractional bias or error as a function of concentration by species, region, monitoring network, and month.

The "soccer plots" and "bugle plots" are relatively new tools in model performance evaluations, and have recently been included as model performance evaluation displays in US EPA's modeling guidance for Ozone, PM2.5, and Regional Haze (Appendix G). Both "soccer plots" and "bugle plots" allow for convenient ways to examine model performance with respect to set goals and criteria. The bugle plots have the added benefit of adjusting the goals and criteria to consider the concentration of the species. Analysis of "bugle plots" generally suggests that greater emphasis should be placed on performance of those components with the greatest contribution to PM mass and visibility impairment (e.g. sulfate and organic carbon) and that greater bias and error could be accepted for components with smaller contributions to total PM mass (e.g. elemental carbon, nitrates, and soil).

6.2 VISTAS Domain - Wide Performance

Further discussion of model performance in this document will focus on the comparison of observational data from the IMPROVE monitors and model output data from the 2002 VISTAS BaseG4-Actual annual air quality modeling. Focus is limited to the IMPROVE monitoring network as these sites are the locations used in projecting attainment visibility improvement goals in the Class I areas.

The evaluation will primarily focus on the air quality model's performance with respect to individual components of fine particulate matter ($PM_{2.5}$), as good model performance of the component species will dictate good model performance of total or reconstituted fine particulate matter. Model performance of the total fine particulate matter and the resulting total light extinction will also be provided as a means to discuss the overall model performance for this Implementation Plan.

In our analyses, mean fractional bias (error) is used in lieu of mean bias (error), to prevent low observations and model predictions from skewing the metrics. A full list of model performance statistics is found in Appendix E. The soccer and bugle plots for all of the VISTAS IMPROVE monitors are included here for summary purposes. Plots have been developed for the average monthly concentrations and the performance statistics for all of the most significant light-scattering component species (sulfate, nitrate, and organic carbon) for the 20% best days and 20% worst days. Plots for individual IMPROVE monitors associated with Georgia Class I areas are included in Appendix E.

The soccer plots of monthly concentrations (Figures. 6.2-1 and 6.2-2) show that values for nitrate generally fall outside of criteria performance thresholds. Sulfates and organic carbon generally fall within goal thresholds with a couple of months falling just outside the goal thresholds but well within the criteria thresholds. Figure 6.2-3 contains separate soccer plots for each season. The seasonal plots emphasize poorer nitrate performance in the summer (does not even appear on the plots provided because performance is off scale with other constituents) when observed nitrate is quite low and predicted nitrate is even lower. When concentration is factored into performance criteria, nitrate performance improves with respect to MFB and MFE (Figures 6.2-4 and 6.2-5).

Additionally, performance assessed at the "one atmosphere" level was also deemed acceptable for ozone and particulate matter at various monitoring sites (STN, FRM, CASTNet, etc.). Overall, VISTAS found the Base G2 modeling results to be representative and acceptable for use in modeling projection for ozone, particulate matter, and regional haze.

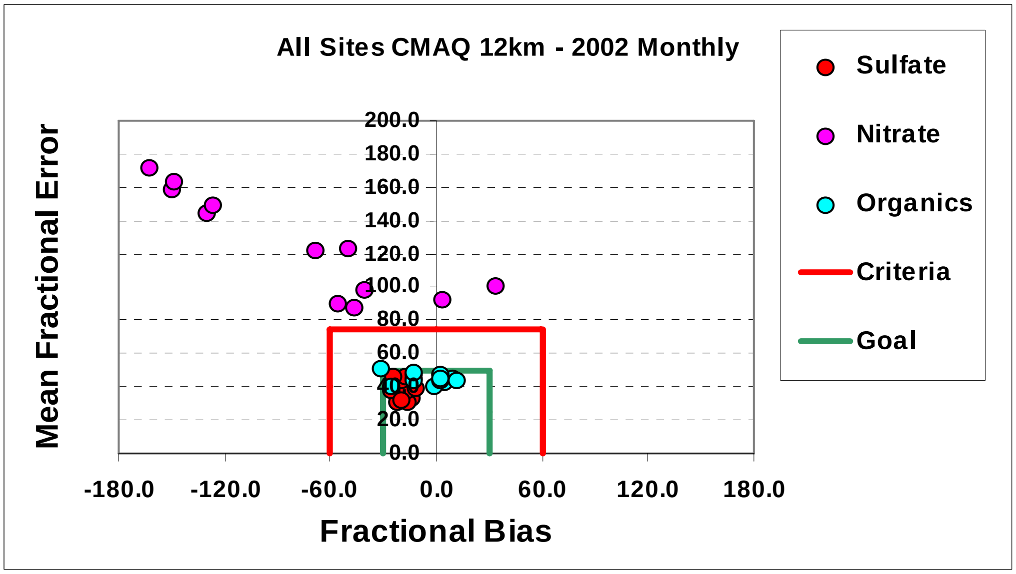


Figure 6.2-1.: Soccer plot depicting both the mean fractional error and fractional bias for component concentration for all VISTAS sites based on Base G2 results. Each point represents a monthly value as compared to the model performance criteria (red box) and modeling performance goals (green box).

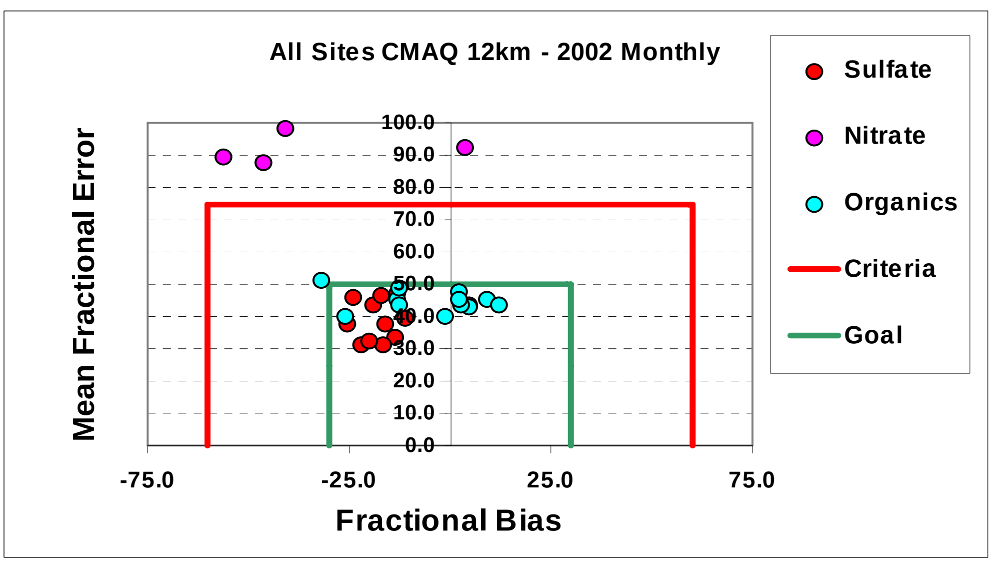


Figure 6.2-2.: A zoomed view of the soccer plot depicting both the mean fractional error and fractional bias for component concentration for all VISTAS sites based on Base G2 results. Each point represents a monthly value as compared to the model performance criteria (red box) and modeling performance goals (green box).

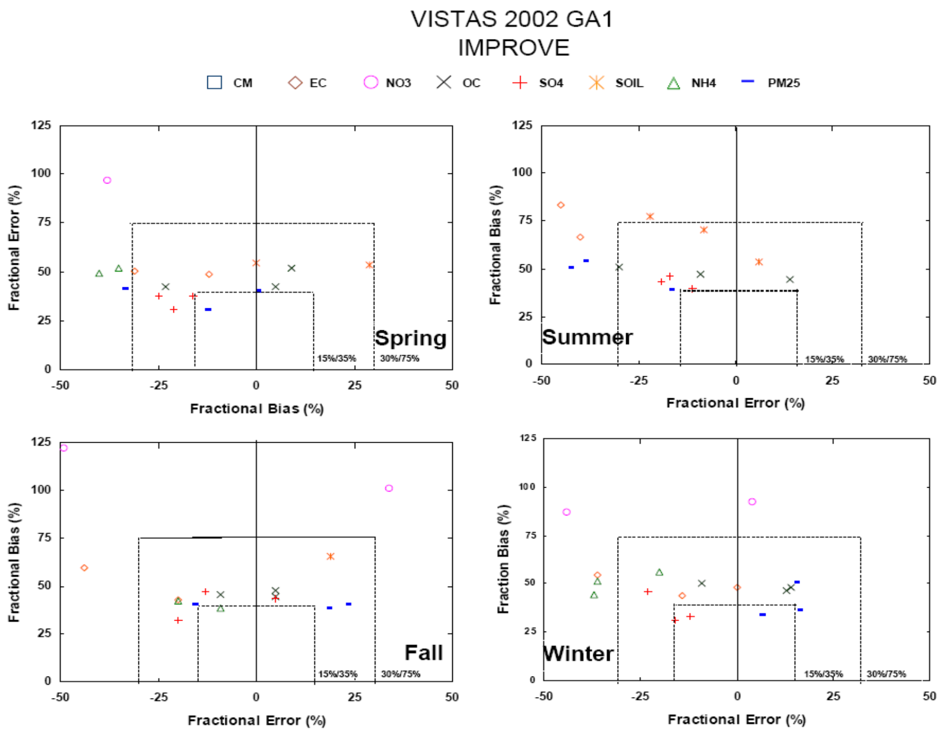


Figure 6.2-3.: Seasonal soccer plots based on Base G1 results for all VISTAS IMPROVE monitors.

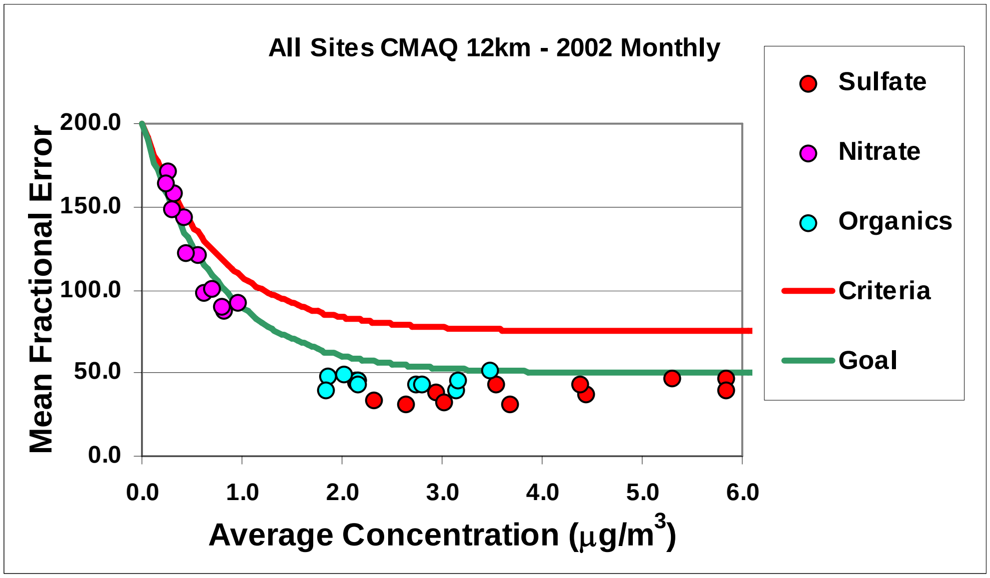


Figure 6.2-4.: Bugle plot of the mean fraction error for particulate matter and its component concentrations for all VISTAS sites based on Base G2 results. Each point represents a monthly mean fraction error value as compared to the model performance criteria (red lines) and modeling performance goals (green lines).

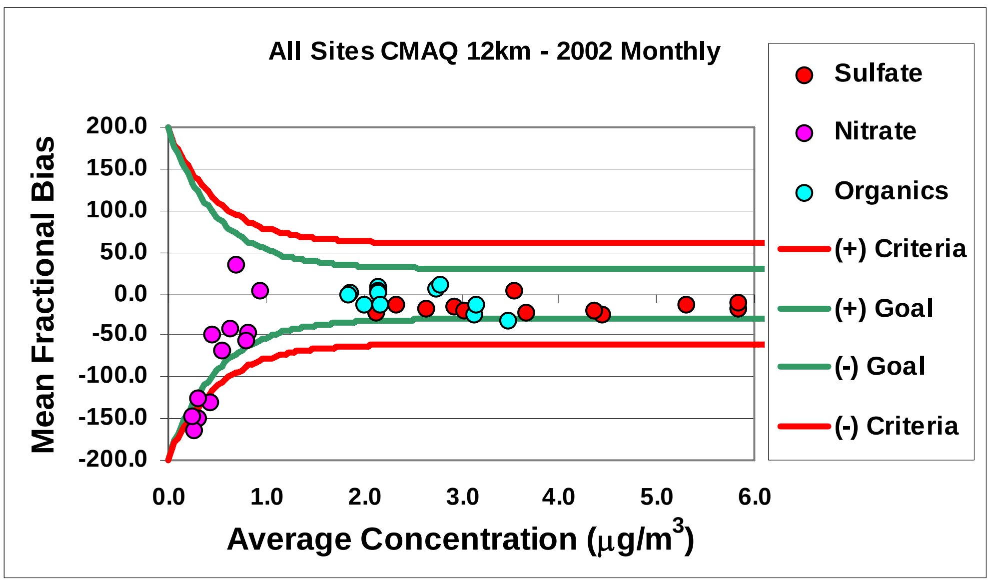


Figure 6.2-5.: Bugle plot of mean fraction bias for particulate matter and its component species for all VISTAS sites based on Base G2 results. Each point represents a monthly mean fraction bias value as compared to the model performance criteria (red lines) and modeling performance goals (green lines).

6.3 Georgia Class I Areas Performance

The following section provides bar charts comparing observed fine particulate matter composition and modeled fine particulate matter composition. The charts have been split into two charts, with the first displaying the 20% best days followed by the chart for the 20% worst days. Stacked bar charts have been developed for each of the IMPROVE monitoring sites relevant to Georgia: Cohutta Wilderness Area and Okefenokee Wilderness Area (See Figure 1.4-1). The Okefenokee Wilderness Area's IMPROVE monitor is used to represent Wolf Island.

The stacked bar chart allows a side-by-side comparison of the each day observed and modeled compositional and total light extinction. Within each bar the color codes are:

- Yellow = light extinction due to sulfates (bextSO4)
- Red = light extinction due to nitrates (bextNO3)
- Green = light extinction due to organic carbon (bextOC)
- Black = light extinction due to elemental (bextEC)
- Brown = light extinction due to soil (bextSoil)
- Grey = light extinction due to coarse mass (bextCM)

The components are presented in the same order for both the observed (left hand bar) and modeled bar (right hand bar), so it is easy to identify days when the prediction light extinction for the component differs from the observed. The total height of the bar provides the total reconstructed particulate matter light extinction value.

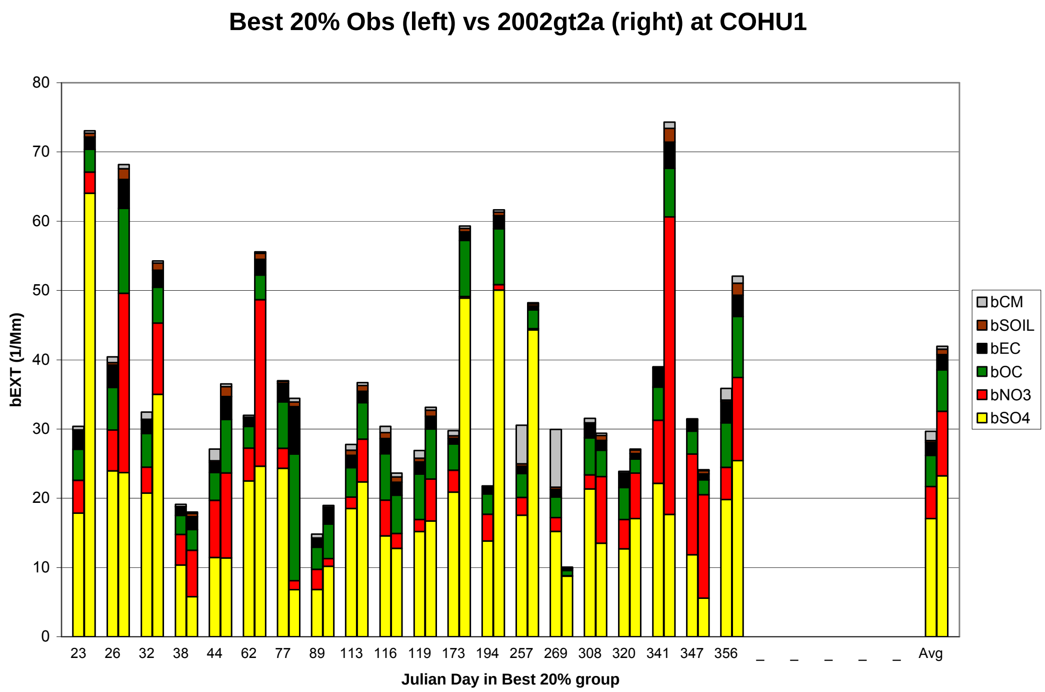
A cursory view of the stacked bar charts reiterates that sulfates are a large contributor to light extinction in the Georgia Class I areas on both 20% best days and 20% worst days. The bar charts also suggest that organic carbon and nitrates are important on the 20% best days at the two IMPROVE sites of interest for Georgia. The bar charts for the 20% best reiterate the general over prediction. The over prediction of sulfate on most of the 20% best days appears to be the crux of the over prediction, with the over prediction of nitrate factoring in heavily on some days.

Comparing the 20% best day charts to the 20% worst days charts, the various components of particle pollution play a more prominent role in the 20% best days than with the 20% worst days. Also, the species makeup on the 20% best days varies more widely compared to the 20% worst days. This suggests accurately modeling each species is especially important on the 20% best days.

With the bar chart for the 20% worst days, you can see the general under prediction. The under prediction of sulfate on some of the 20% worst days appears to be the cause of the overall under prediction with the under prediction of organic carbon factoring in heavily on few days.

Overall, the GA EPD found model performance to fall within acceptable limits for model performance. The GA EPD further asserts the “one atmosphere” modeling performed by the VISTAS contractors is representative of conditions in the southeastern states and is applicable for use in attainment demonstrations.

6.3.1 Cohutta Wilderness Area



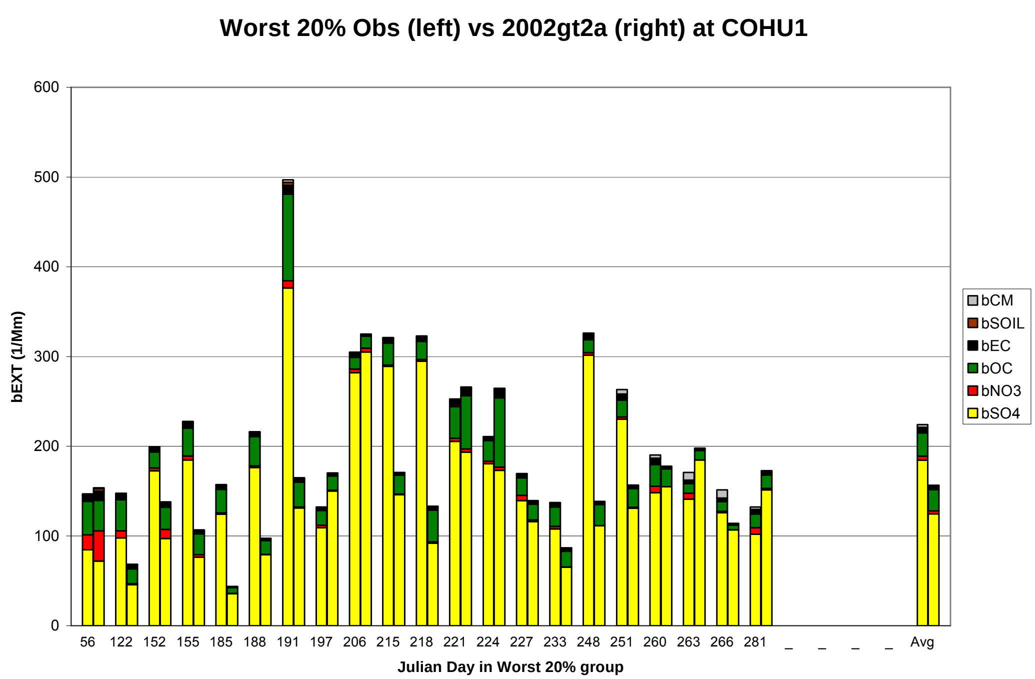
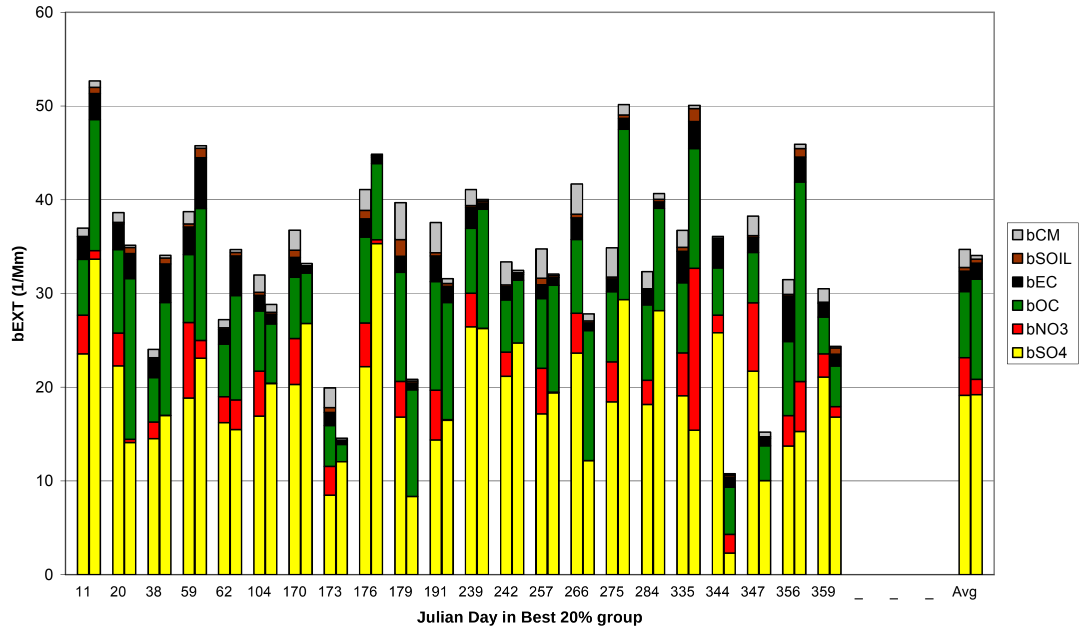


Figure 6.3-1.: Stacked bar chart for COHU on the 20% best days (top) and 20% worst days (bottom). Observed composition is presented in the left hand bar, with modeled composition represented by the right hand bar.

6.3.2 Okefenokee Wilderness Area

Best 20% Obs (left) vs 2002gt2a (right) at OKEF1



Worst 20% Obs (left) vs 2002gt2a (right) at OKEF1

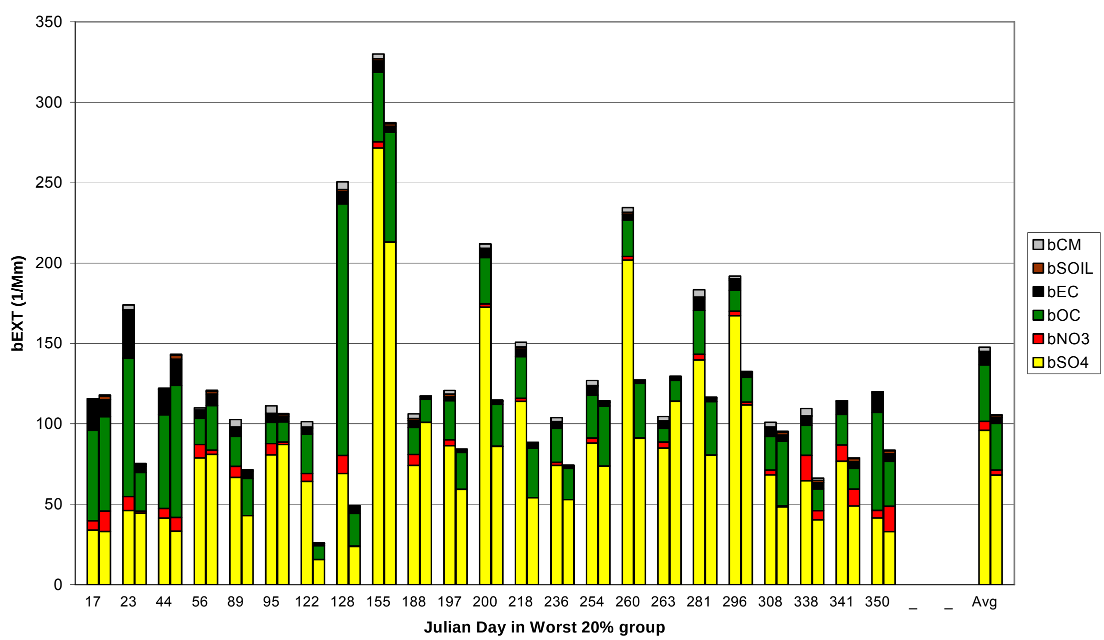


Figure 6.3-2.: Stacked bar chart for OKEF on the 20% best days (top) and 20% worst days (bottom). Observed composition is presented in the left hand bar, with modeled composition represented by the right hand bar.

7.0 LONG-TERM STRATEGY FOR GEORGIA CLASS I AREAS

As stated in Section 1.3 above, the regional haze rule requires States to establish reasonable progress goals, expressed in deciviews, for visibility improvement at each affected Class I area covering each (approximately) 10-year period until 2064. This first set of reasonable progress goals must be met through measures contained in the state's long-term strategy covering the period from the baseline until 2018. This section discusses development of Georgia's long-term strategy.

7.1 Overview of the Long-Term Strategy Development Process

The monitored data and modeling analyses cited in Sections 2 and 5 above establish that for the VISTAS region, the key contributors to regional haze in the 2000-2004 baseline timeframe were large stationary sources of sulfur dioxide emissions. Keeping that key conclusion in mind, this section addresses the following questions:

Assuming implementation of existing federal and state air regulatory requirements in Georgia and the VISTAS region, how much visibility improvement, compared to the glidepath, would we expect to see at Class I areas in Georgia between now and 2018?

If additional emission reductions are to be considered, from what pollutants and source categories would the greatest visibility benefits be realized between the baseline and 2018?

Narrowing down further, in what geographic locations do we find the emissions which have the greatest impact on visibility in specific Class I areas?

What types of emissions sources do we find in those geographic locations?

Which specific individual sources in those geographic locations have the greatest visibility impacts at a given Class I area?

What additional emission controls represent reasonable progress for those specific sources?

What additional emission controls represent BART in Georgia?

Given the additional emission reductions expected from reasonable progress and BART, how much additional visibility improvement, compared to the glidepath, will we expect to see at Class I areas in Georgia between the baseline and 2018?

7.2 Expected Visibility Results in 2018 for Georgia Class I Areas under existing and planned emissions controls (Base G4 Inventory)

There are significant control programs being implemented between the baseline period and 2018. These programs are described in more detail below.

7.2.1 Federal and State Control Requirements

- Clean Air Interstate Rule (CAIR). Utility projections are based on Integrated Planning Model. US EPA issued CAIR, which will permanently cap emissions of sulfur dioxide (SO2) and nitrogen oxides (NOx) in the eastern United States. CAIR achieves large reductions of SO2 and/or NOx emissions across 28 eastern states and the District of Columbia. When fully implemented, CAIR will reduce SO2 emissions in these states by over 70 percent and NOx emissions by over 60 percent from 2003 levels. These reductions were taken into account in the 2018 base G4 inventory
- Heavy Duty Diesel (2007) Engine Standard. A PM emissions standard for new heavy-duty engines of 0.01 grams per brake-horsepower-hour (g/bhp-hr), to take full effect for diesels in the 2007 model year. Also includes standards for NOx and non-methane hydrocarbons (NMHC) of 0.20 g/bhp-hr and 0.14 g/ bhp-hr, respectively. These NOx and NMHC standards will be phased in together between 2007 and 2010 for diesel engines. Sulfur in diesel fuel must be lowered to enable modern pollution-control technology to be effective on these trucks and buses. EPA will require a 97 percent reduction in the sulfur content of highway diesel fuel from its current level of 500 parts per million (low sulfur diesel, or LSD) to 15 parts per million (ultra-low sulfur diesel, or ULSD).

- Tier 2 Tailpipe. US EPA's Tier 2 is a fleet averaging program, modeled after the California LEV II standards. Manufacturers can produce vehicles with emissions ranging from relatively dirty to zero, but the mix of vehicles a manufacturer sells each year must have average NO_x emissions below a specified value.

- Large Spark Ignition and Recreational Vehicle Rule. In this rule, US EPA sets emission standards for these categories of non-road engines and vehicles.

- Non-Road Diesel Rule. In this rule, US EPA implements a low-sulfur fuel requirement that affects both future (Commercial Marine Vessels) CMV and locomotive emissions.

- Combustion Turbine MACT. US EPA issued this rule; however, the projection inventories do not include the NOx co-benefit effects resulting from this rule. EPA estimates them to be small compared to the overall inventory.

- Industrial Boiler/Process Heater/RICE MACT. The Environmental Protection Agency (EPA) issued final rules to substantially reduce emissions of toxic air pollutants from industrial, commercial and institutional boilers, process heaters and from stationary reciprocating internal combustion engines (RICE). These rules reduce emissions of a number of toxic air pollutants, including hydrogen chloride, manganese, lead, arsenic and mercury by 2009. This rule also reduces emissions of sulfur dioxide and particulate matter in conjunction with the toxic air pollutant reductions. The applied Maximum Achievable Control Technology (MACT) control efficiencies were 4 percent for SO2 and 40 percent for PM10 and PM2.5. However, EPA's industrial boiler MACT rules were vacated on June 8, 2007. The emissions reductions that were modeled to account for the industrial boiler MACT were 1,343.5 tons/year of SO_2, 879.4 tons/year of $PM_{2.5}$, and 1,304.2 tons/year of PM_{10}. These reductions are insignificantly small (0.69% for SO_2, 0.39% for $PM_{2.5}$, and 0.13% for PM_{10}) compared to the statewide totals (193,665.5 tons/year SO_2; 225,104.5 tons/year $PM_{2.5}$; and 1,002,873.2 tons/year PM_{10}) and should not impact the conclusions made in the SIP. If another VISTAS "best and final" modeling run is performed, it will remove control assumptions solely due to this MACT rule.

- VOC 2-, 4-, 7-, and 10-year MACT Standards. The point source MACTs and associated emission reductions were designed from Federal Register (FR) notices and discussions with EPA's Emission Standards Division (ESD) staff. We did not apply reductions for MACT standards with an initial compliance date of 2001 or earlier, assuming that the effects of these controls are already accounted for in the 2002 inventories supplied by the States.

- Georgia Rule 391-3-1-.02(2)(yy), (i.e. Emissions of Nitrogen Oxides from Major sources based on Section 182 of the Federal CAA Amendments of 1990, requires that every major source (i.e. source with potential to emit > 50 tons/yr) of NOx located in 13 county Atlanta non-attainment area should apply reasonably available control technology (RACT) in controlling NOx emissions. Georgia EPD has required full compliance with NOx RACT limits since July 31, 1995; however, Georgia EPD has not taken these emission reductions into account in any inventory or modeling scenario.

- 1-hr Ozone SIPs (Atlanta/Birmingham/Northern Kentucky). These SIPs have been implemented for attainment and maintenance of the 1-hour ozone National Ambient Air Quality Standard (NAAQS). Reductions from these SIPs have been taken into account in the 2018 modeling runs.

- Georgia Rule 391-3-1-.02(2)(sss), Multipollutant Control for Electric Utility Steam Generating Units, was adopted in 2007. The effective date of the rule varies for various EGU units but will start being effective from December 31, 2008, and required controls for all affected units will be in place before June 1, 2015. When fully implemented, Rule (sss) will reduce SO_2 emissions by about 90 percent, NOx emissions by approximately 85 percent and mercury emissions by approximately 79 percent.

7.2.2 Additional State Programs to Reduce Emissions

In addition to accounting for specific emission reductions due to ongoing air pollution programs as required under the RHR Section 308 (d)(3)(v)(A), states are also required to consider the air quality benefits of measures to mitigate the impacts of construction activities [Section 308(d)(3)(v)(B)] and agricultural and forestry smoke management [Section 308(d)(3)(v) (E)].

7.2.3 Projected 2009 and 2018 Base G4 Emissions Inventories

The Base G inventories for 2009 and 2018 account for post-2002 emission reductions from promulgated and proposed federal, state, local, and site-specific control programs as of July 1, 2004. In general, emissions inventories were developed for 2009 and 2018 using current control information in Georgia and for growing the 2002 inventory using EGAS6, MOBILE6, and IPM for electric generating units (EGUs).

For EGUs, IPM results were adjusted based on State and local (S/L) agency knowledge of planned emission controls at specific EGUs, including controls required by Georgia's Rule (sss). These updates for Base G4 are documented in the MACTEC emissions inventory report "Documentation of the 2002 Base Year and 2009 and 2018 Projection Year Emission Inventories for VISTAS" dated February 2007.

For non-EGUs, we used recently updated growth and control data consistent with the data used in US EPA's CAIR analyses supplemented by State and local agency data and updated forecasts from the Department of Energy (DOE).

Area source controls were estimated using known state-level, Stage I controls on gasoline dispensing facilities and open burning estimates, as well as controls used to project emissions for US EPA's Heavy Duty Diesel rulemaking and for the CAIR rulemaking.

Mobile source controls included local controls underlying the 2002 baseline inventory (vehicle emission inspection, Stage II vapor recovery, anti-tampering, etc.) with changes based on specific State input. Non-road control data and projections for 1996, 2010, 2015, and 2020 were obtained from the US EPA's Clean Air Interstate Rule (CAIR) Technical Support Document, and straight line projections were used to estimate 2009 and 2018 levels.

The following bar charts show expected decreases in emissions of SO2 and NOx across the VISTAS states from 2002 through 2018. (Similar charts for other visibility-impairing pollutants are contained in Appendix H). Note that for SO2 emissions in particular, which are the largest contributors to haze, emissions from electric generating facilities are expected to decrease dramatically (70 percent) between 2002 and 2018. However, even with this significant reduction in SO2 emissions, EGU emissions are projected to remain the largest contributor to haze, comprising more than half of remaining SO2 emissions in most of the VISTAS states.

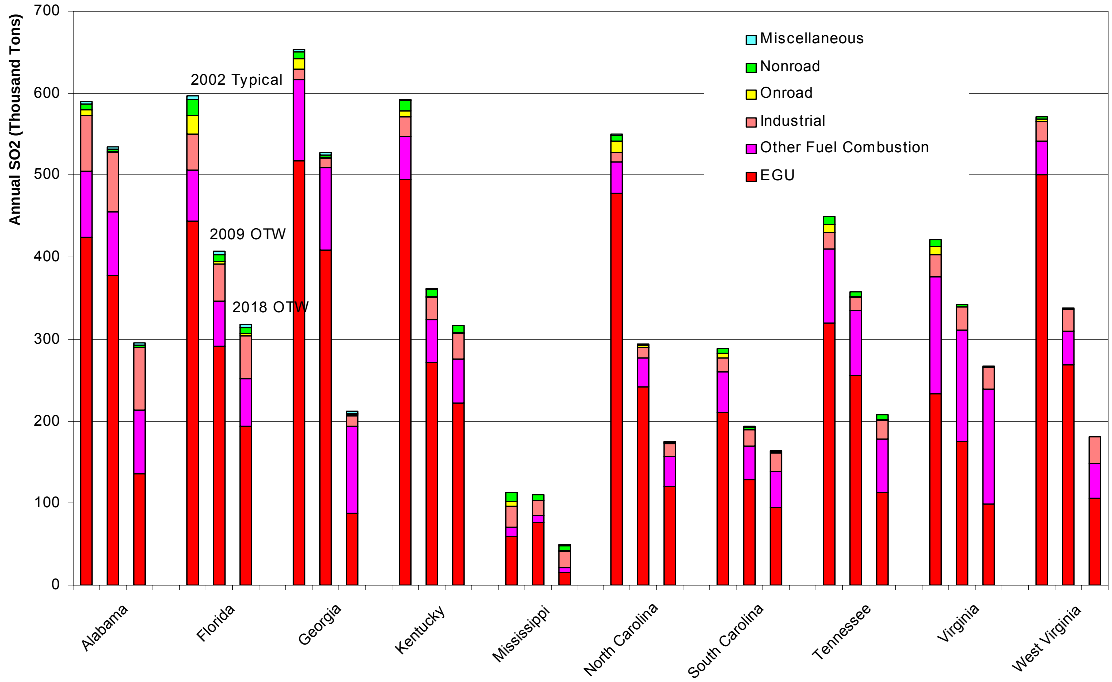


Figure 7.2.3-1. Base G Annual SO2 emissions for 2002, 2009, and 2018 in the VISTAS states.

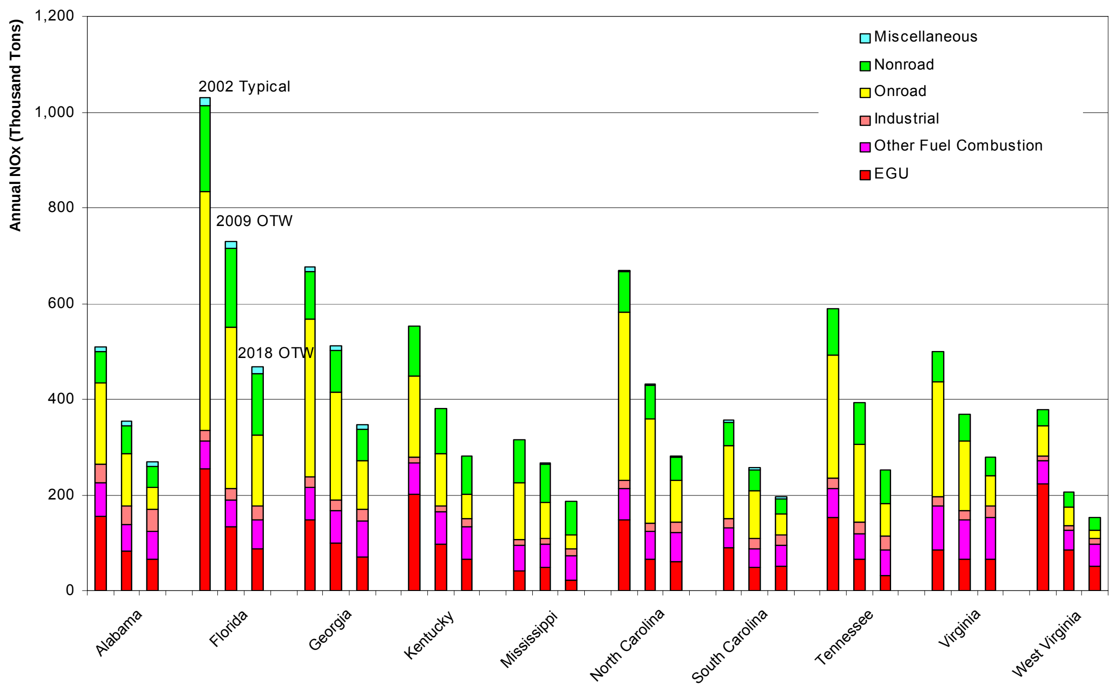


Figure 7.2.3-2. Base G Annual NOx emissions in 2002, 2009, and 2018 in the VISTAS States.

Summary of Final Base G4 Emissions Inventories for 2009 and 2018

Table 7.2.3-1 is a summary of the 2009 Base G4 emission inventory. The complete inventory and discussion of the methodology is contained in Appendix C.

Table 7.2.3-1. 2009 Emissions Inventory Summary for Georgia.

	VOC	NOx	PM2.5	PM10	NH3	SO2
Point	36,430.1	148,849.7	29,889.7	40,993.6	4648.8	462,666.4
Area	306,337.3	51,925.0	169,011.4	840,244.9	91,439.1	60,604.0
On-Road Mobile	195,125.2	209,349.2	3,840.1	6,072.0	12,686.9	1,585.0
Non-Road Mobile	67,686	85,732.9	7,174.6	7,521.1	67.5	2,724.7
Biogenics	1,972,795.4	20,942.38	0	0	0	0
TOTAL	2,578,374	516,799.18	209,915.8	894,831.60	108,842.3	527,580.1

Table 7.2.3-2 is a summary of the 2018 Base G4 emission inventory. The complete inventory and discussion of the methodology is contained in Appendix C.

Table 7.2.3-2. 2018 Emissions Inventory Summary for Georgia.

	VOC	NOx	PM2.5	PM10	NH3	SO2
Point	43,097.8	125,680.0	36,297.4	48,005.1	6,474.4	127,863.6
Area	353,224.5	55,518.5	180,697.2	944,009.4	102,112.4	62,636.2
On-Road Mobile	109,763.3	102,179.2	2,380.2	4,843.6	14,873.2	1,457.0
Non-Road Mobile	56,760.7	64,578.8	5,729.7	6,015.1	78.6	1,708.8
Biogenics	1,972,795.4	20,942.38	0	0	0	0
TOTAL	2,535,641.7	368,898.88	225,104.5	1,002,873.2	123,538.6	193,665.6

7.2.4 Model Results for the 2018 Base G4 Inventory Compared to the Uniform Rate of Progress Glidepaths for Georgia Class I Areas

Using 2000 - 2004 IMPROVE monitoring data, the deciview values for the 20 percent best days in each year are averaged together, producing a single average deciview value for the best days. Similarly, the deciview values for the 20 percent worst days in each year are averaged together, producing a single average deciview value for the worst days.

Figures 7.2.4-1 through 7.2.4-6 illustrate the predicted visibility improvement by 2018 resulting from the Base G4 inventory that represents implementation of existing Federal and State regulations, compared to the Uniform Rate of Progress glidepath for Cohutta Wilderness Area (COHU), Okefenokee Wilderness Area (OKEF), and Wolf Island Wilderness Area (WOLF). The pink lines show the target natural condition in 2064 for the 20 percent worst days or 20 percent best days, and the incremental deciview changes resulting from a uniform rate of progress between current and natural conditions in 2064 for average 20 percent worst visibility days or 20 percent best visibility days in the 2000-2004 baseline period. The purple lines show the improvement expected from existing and planned emission controls during the period of the first long-term strategy.

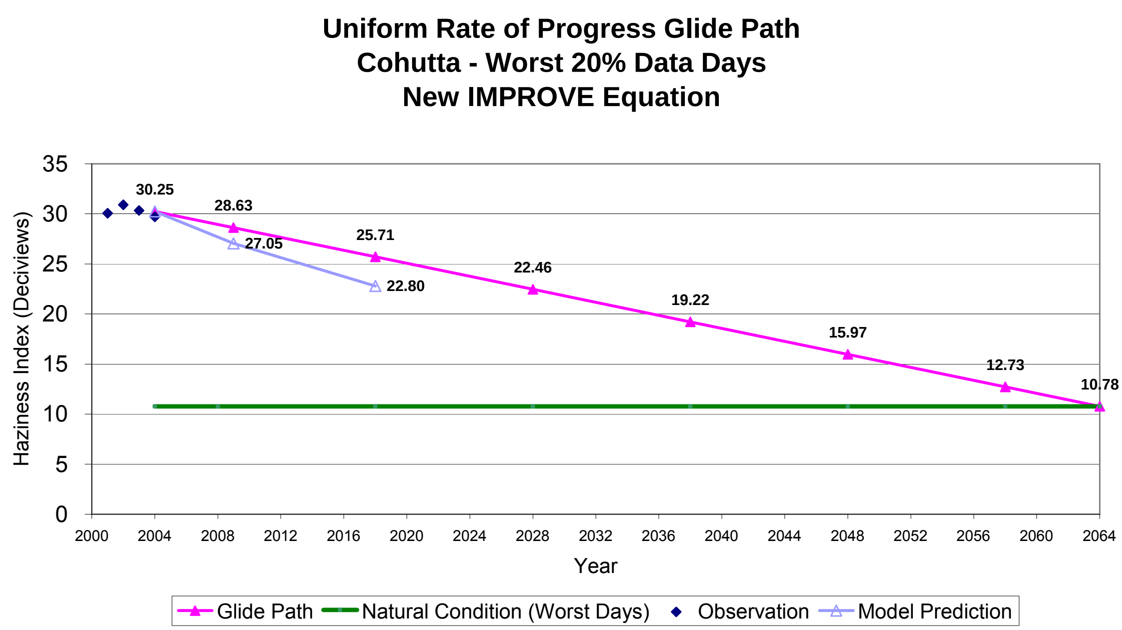


Figure 7.2.4-1. CMAQ 2018 Base G4 results compared to Uniform Rate of Progress at Cohutta Wilderness Area

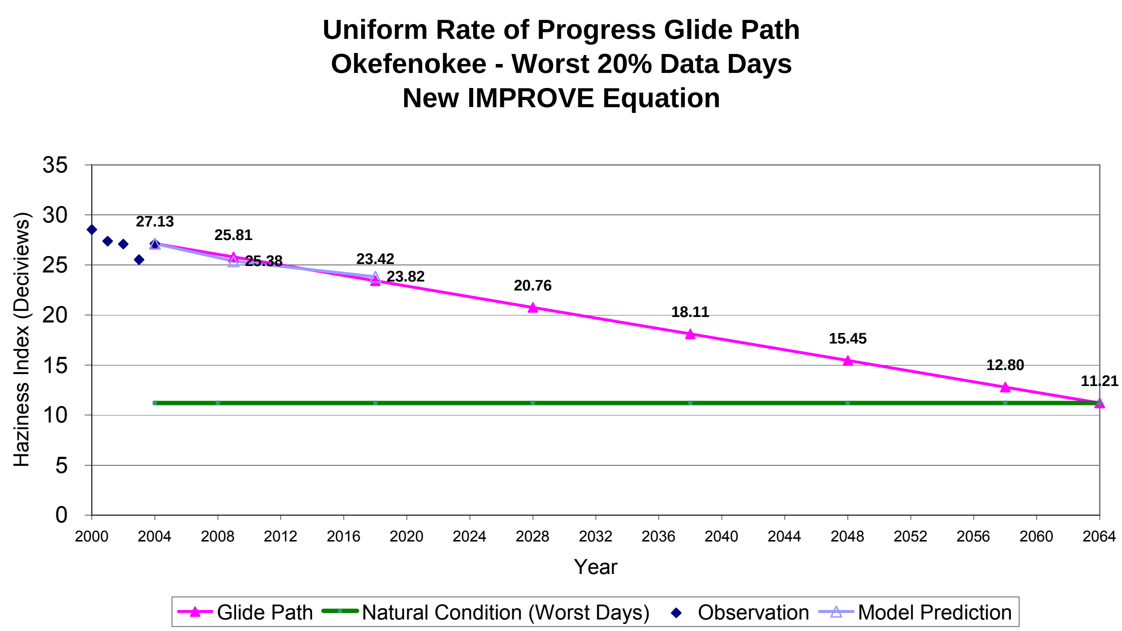


Figure 7.2.4-2. CMAQ 2018 Base G4 results compared to Uniform Rate of Progress at Okefenokee Wilderness Area

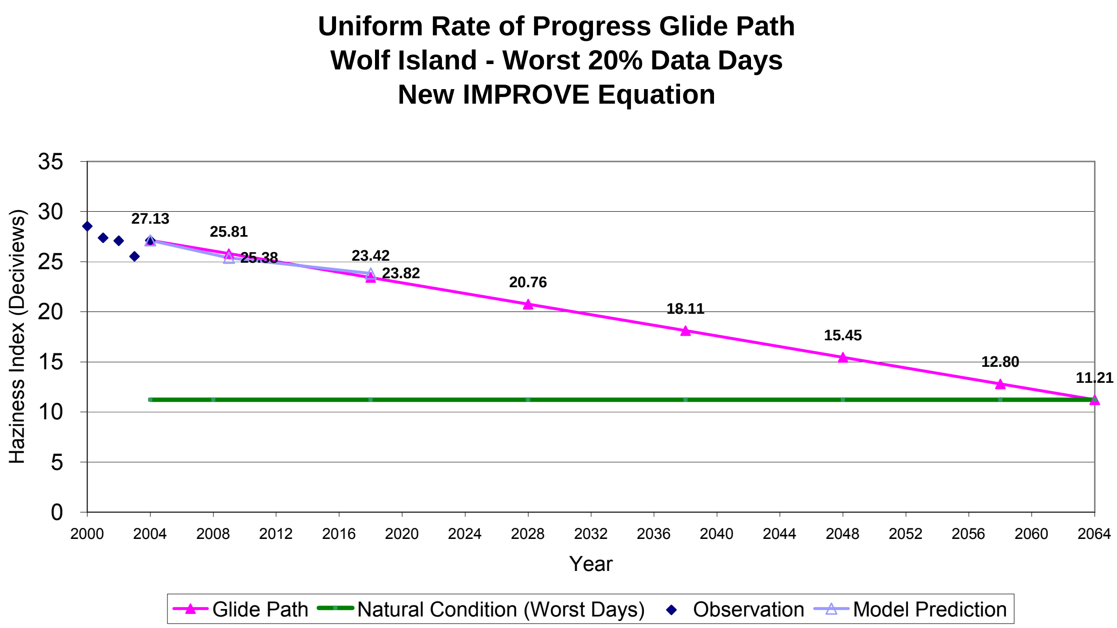


Figure 7.2.4-3. CMAQ 2018 Base G4 results compared to Uniform Rate of Progress at wolf Island
Okefenokee Wilderness Area represents visibility improvement at Wolf Island

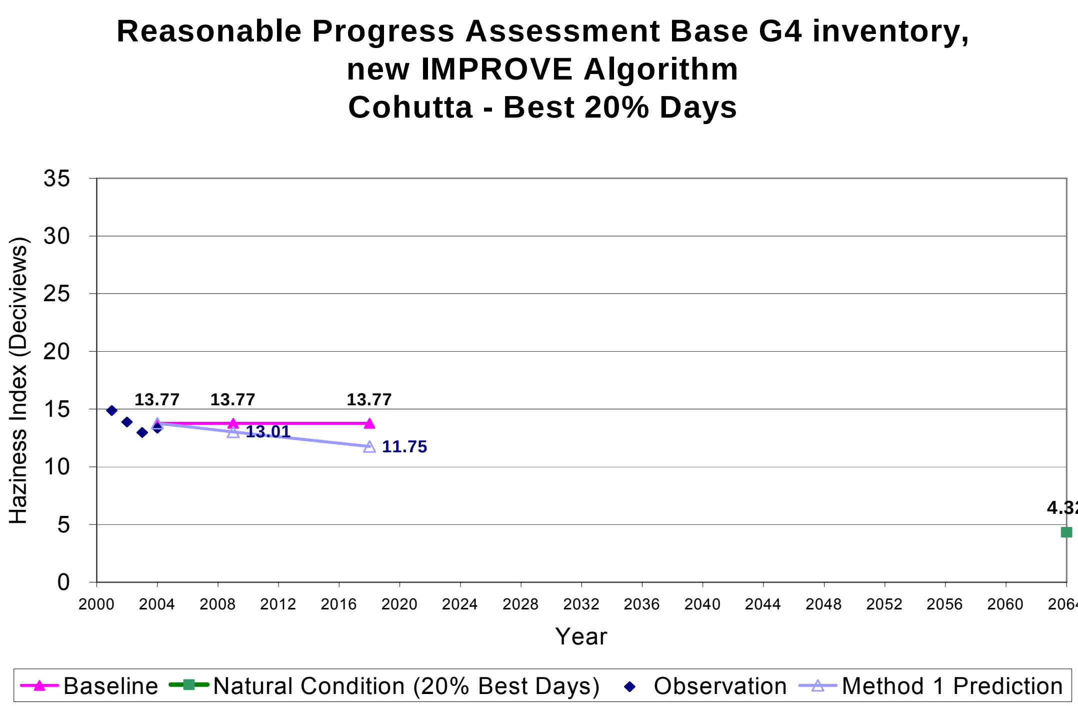


Figure 7.2.4-4. CMAQ 2018 Base G4 results at Cohutta Wilderness Area.

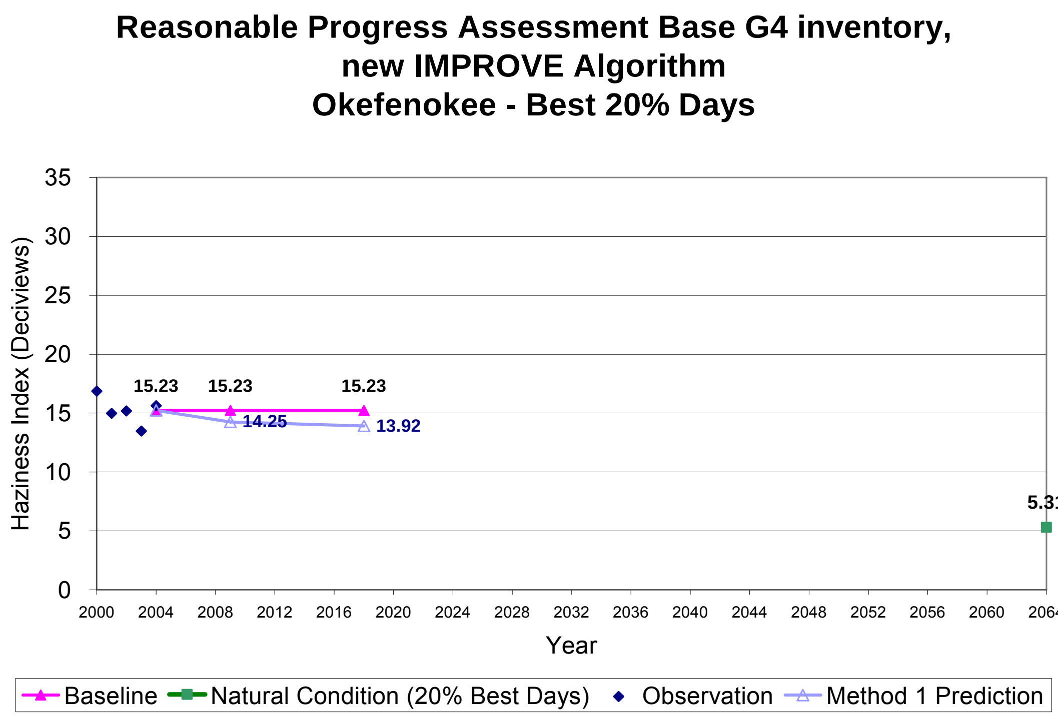


Figure 7.2.4-5. CMAQ 2018 Base G4 results at Okefenokee Wilderness Area.

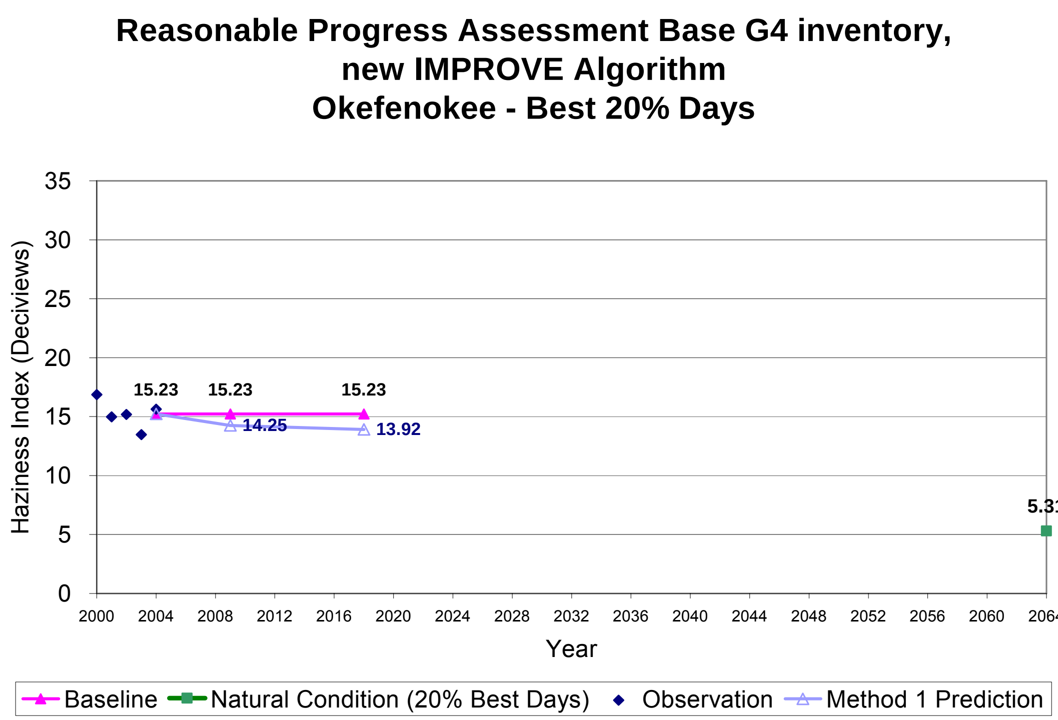


Figure 7.2.4-6. CMAQ 2018 Base G4 results at Wolf Island.

Okefenokee Wilderness Area represents visibility Improvement at Wolf Island.

Note that at Cohutta wilderness area in Georgia, visibility improvement on the 20 percent worst days is expected to be better than the uniform rate of progress glidepath by 2018 based solely on reductions from existing and planned emissions controls. A 4.4 dv improvement in visibility would meet uniform rate of progress in 2018; expected emissions reductions by 2018 are projected to achieve a 7.41 dv improvement.

Okefenokee Wilderness Area and Wolf Island expected emissions reductions by 2018 are projected to achieve a 3.28 dv of improvement in visibility, while a 3.6 dv of improvement in visibility would meet uniform rate of progress in 2018.

In Figure 7.2.4-7 the percentage of the target reduction achieved for the Georgia Class I areas using the new IMPROVE equation is 90-170 percent. This means that the rate of improvement is between –10 to +70 percent of the required uniform rate of progress by 2018.

In addition to improving visibility on the 20 percent worst visibility days, states are also required to protect visibility on the 20 percent best days at the Class I areas. As illustrated in Figure 7.2.4-8, visibility on the 20 percent best days is projected to improve in 2018 at all VISTAS Class I areas as a result of the 2018 Base G4 emissions reductions. In Figure 7.2.4-8 the percentage of the target achieved for the Georgia Class I areas is about -10 percent. Zero percent change would mean no change in visibility; -10 percent means that visibility is better than no change, or a 10 percent improvement (values lower than current conditions).

The expected change in visibility at any VISTAS and neighboring class I areas between 2000-2004 baseline conditions on the 20 percent worst days and 2018 projections for Base G4 is illustrated in Figure 7.2.4-7. In contrast, natural background visibility conditions for the 20 percent best days are illustrated in Figure 7.2.4-8.

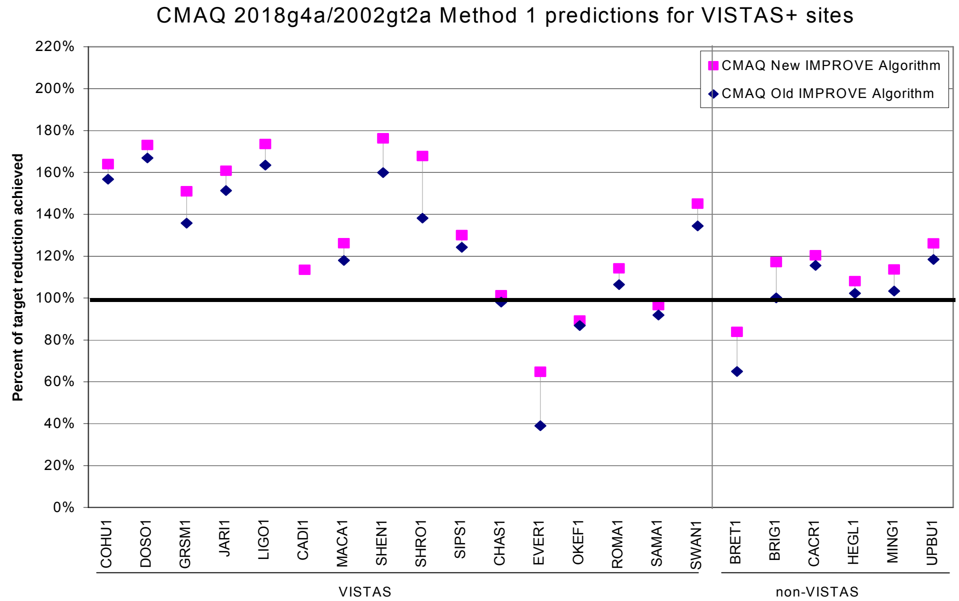


Figure 7.2.4-7. Projected visibility improvement on 20 percent worst visibility days at VISTAS and neighboring Class I areas for the 2018 Base G4 CMAQ run
(12 km grid)

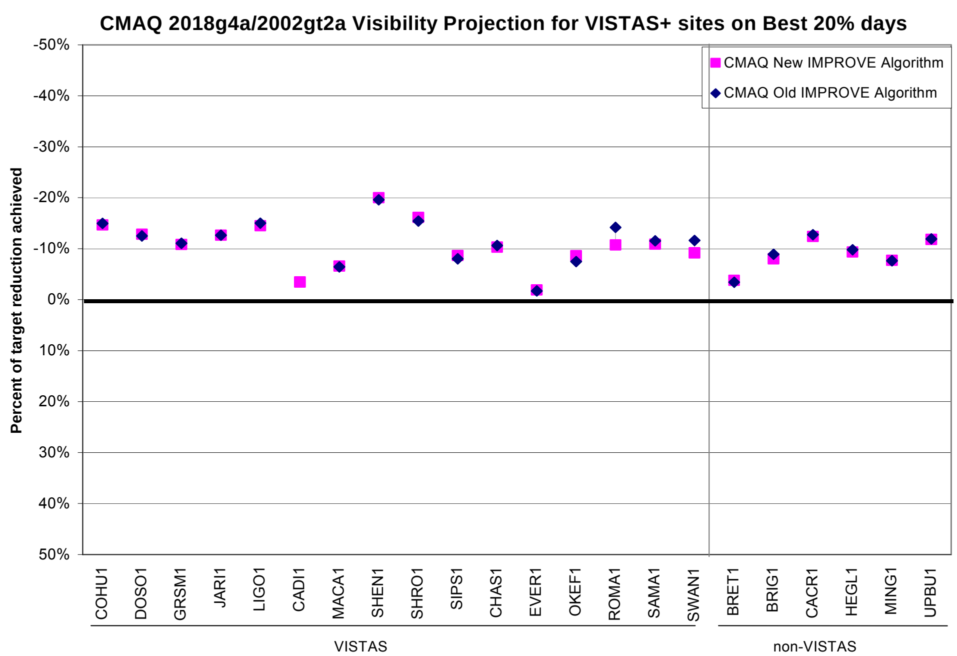


Figure 7.2.4-8. Projected visibility improvement on 20 percent best visibility days at VISTAS and neighboring Class I areas for the 2018 Base G4 CMAQ run

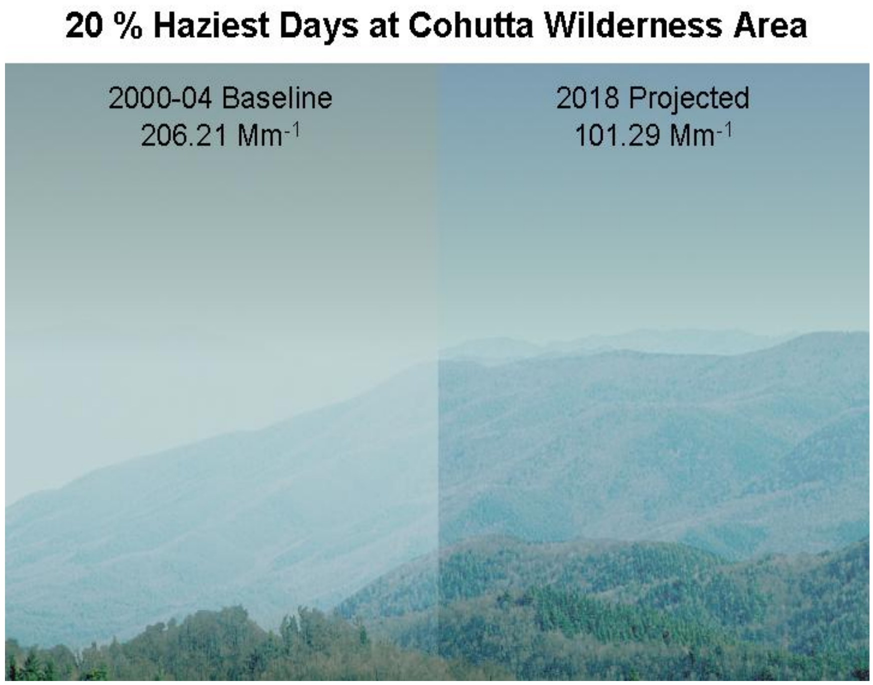


Figure 7.2.4-9. Visibility improvement on 20 percent haziest days at Cohutta Wilderness Area between 2000-2004 baseline conditions (left) and 2018 Base G4 projected visibility (right). Image generated using WinHaze.

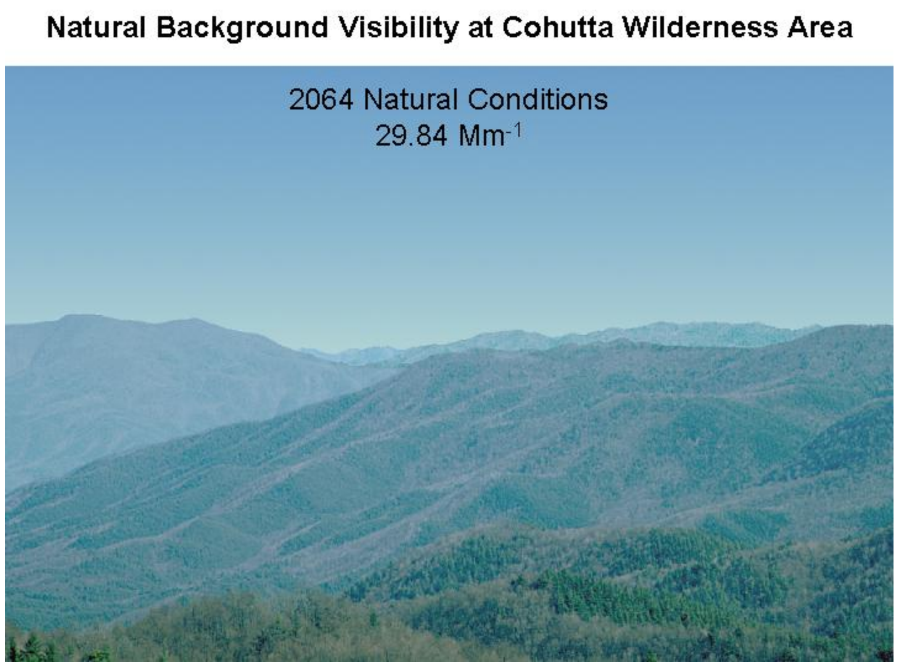


Figure 7.2.4-10. Projected visibility on 20 percent haziest days for natural background visibility conditions at Cohutta Wilderness Area. Image generated using WinHaze.

Figure 7.2.4-9 and 7.2.4-10 show images that were generated using WINHAZE, a photographic imaging tool that accounts for the effect of concentrations of fine particle components and relative humidity on visibility. These images illustrate that notable improvements in visibility are expected by 2018 and that significantly greater improvements are needed to reach natural background conditions.

7.3 Relative Contribution from International Emissions to Visibility Impairment in 2018 at VISTAS Class I Areas

Emissions from Mexico, Canada, Central America, Asia, and Africa contribute to PM2.5 loadings and visibility impairment at Class I areas in the continental United States. To evaluate the relative contribution of international emissions to visibility at Class I areas in the southeastern United States, VISTAS used a combination of modeling results from the global three-dimensional chemical transport model (GEOS-Chem) and CMAQ. VISTAS used the GEOS-Chem global model to generate initial and boundary conditions for the CMAQ modeling domain. GEOS-Chem was run for the 2002 modeling year using a 4x5 degree horizontal grid resolution and a 3-hour temporal resolution. Because emissions were based on monthly averages, the model does not capture the episodic variability in emissions. The GEOS-Chem outputs were used to calculate initial and boundary conditions for the national CMAQ modeling domain. The national CMAQ domain included portions of Canada and Mexico, so emissions for these countries were included within the national CMAQ modeling domain or as part of the boundary conditions outside the national modeling domain, as appropriate.

Two complementary methods were used to calculate the impact of international emissions at Class I areas. Because all international fires are treated as natural emissions in these runs, both cases underestimate the contributions from international fires that are due to anthropogenic burning.

1) International emissions are represented by the differences between two GEOS-Chem runs. In the first run, United States anthropogenic emissions were removed, and in the second run both United States and international anthropogenic emissions were removed. The difference represents international anthropogenic emissions in the absence of United States anthropogenic emissions (e.g. compared to 2064 levels). Harvard University provided GEOS-Chem results to VISTAS for 2002 international contribution on 4x5 degree grid. Concurrently, Harvard modeling for the Electric Power Research Institute (EPRI) provided GEOS-Chem results for 2001 international contribution on a 1x1 degree grid scale.

2) International emissions are represented by the difference between two CMAQ 36-km simulations, both using 2018 Base F emissions and boundary conditions from GEOS-Chem. In the first CMAQ run, all global natural and anthropogenic emissions in 2018 are active. In the second CMAQ run, only global (United States and international) natural emissions are active. Here the impacts of

international emissions are compared against 2018 conditions rather than natural background conditions.

Separate from VISTAS, the CENRAP RPO used PM Source Apportionment Technology (PSAT) in the CAMx regional air quality model to calculate the impact of Canadian and Mexican emissions and boundary conditions on visibility at Class I areas in 2002.

As illustrated in Figure 7.3-1 for annual average contributions to sulfate at VISTAS and neighboring Class I areas, the estimated international contributions are higher at Class I areas near the Canadian and Mexican borders and along the eastern coast. The estimated international contribution is higher using CMAQ and PSAT than in the GEOS-Chem runs because the grid scale is finer (more accurate dispersion of emissions) and because the background atmosphere includes loadings from current United States anthropogenic emissions (greater photochemical activity). Similar charts for nitrate and organic carbon mass, for impacts on 20 percent worst visibility days, and for impacts of international emissions on calculated light extinction are included in Appendix I.

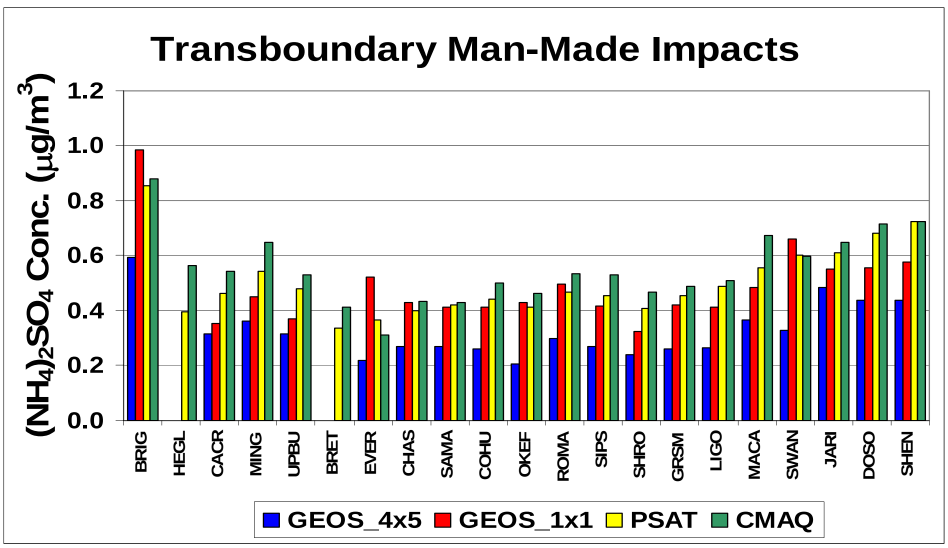


Figure 7.3-1. Estimated international emissions contributions to sulfate at VISTAS and neighboring Class I areas.

In Figure 7.3-2 and 7.3-4 CMAQ projections of contributions from international emissions to PM mass on 20 percent worst visibility days in 2002 at Cohutta and Okefenokee are compared to United States domestic contributions to PM components at the site on those days. Figure 7.3-3 and 7.3-5 illustrates the effect of removing the incremental contribution due to international emissions when considering the visibility improvement in 2018 compared to the uniform rate of progress at Cohutta and Okefenokee wilderness area. Since there is not an IMPROVE monitor located at Wolf

Island, the Okefenokee uniform rate of progress glide slope and reasonable progress goals are being used as surrogates for Wolf Island.

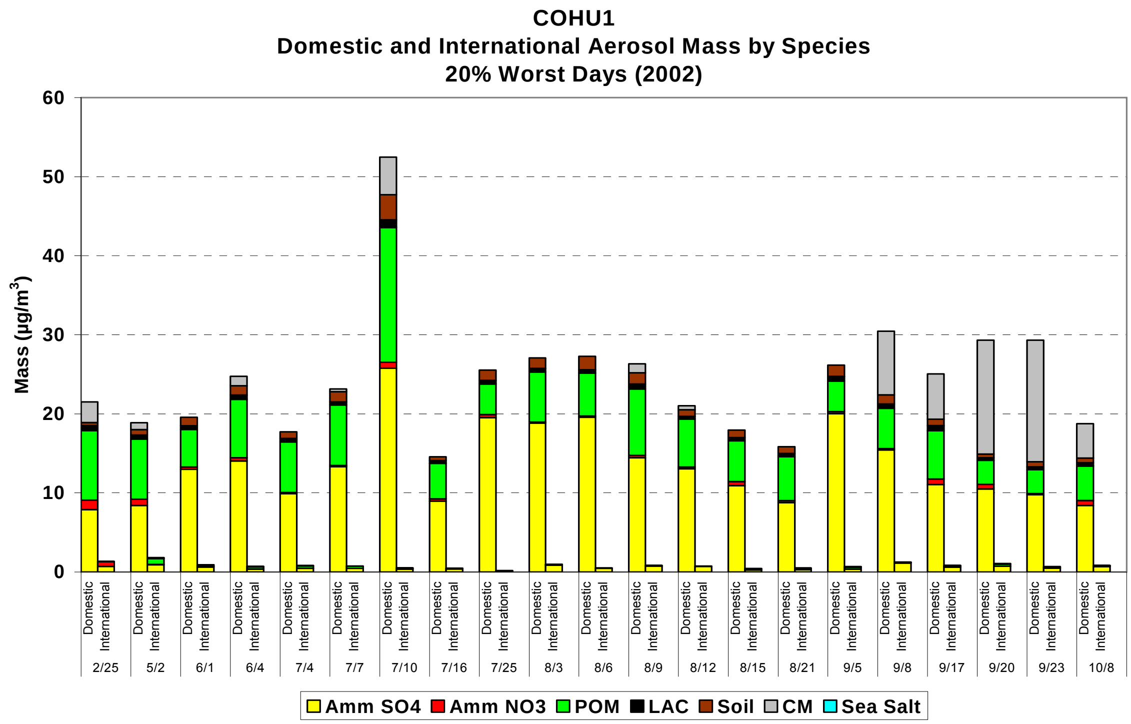


Figure 7.3-2. PM component concentrations from US domestic sources on 20 percent worst visibility days in 2002 (left bars) and CMAQ-simulated international contributions (right bars) at Cohutta Wilderness Area, GA.

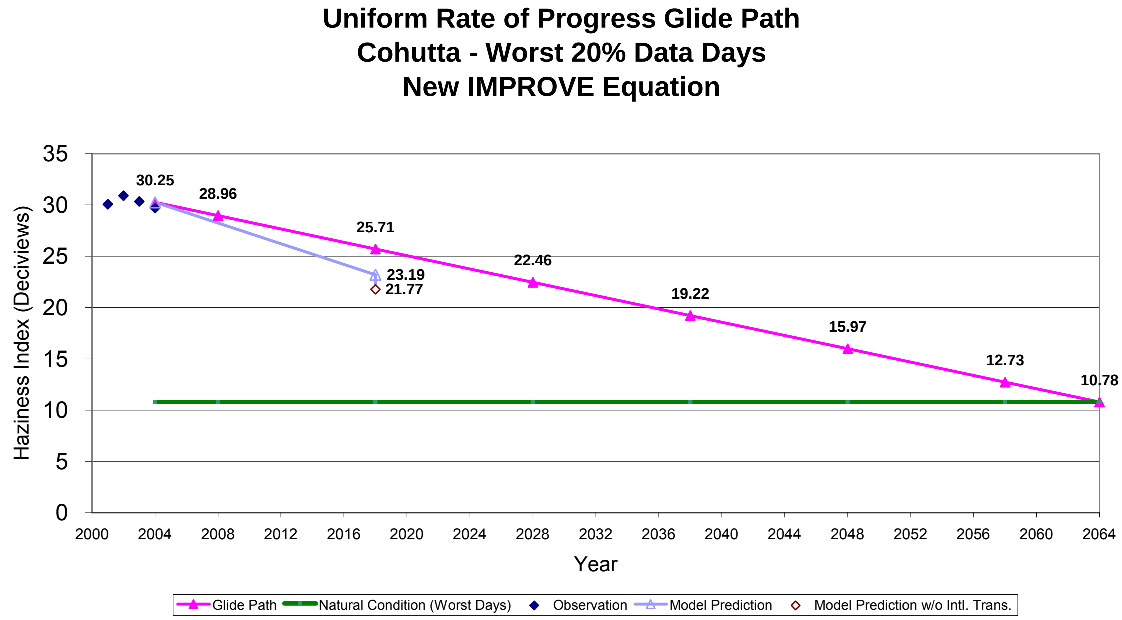


Figure 7.3-3. Accounting for international emissions contributions on modeled rate of progress by 2018 at Cohutta, GA. Open triangle = estimate with all emissions; Open diamond = estimate with international emissions removed.

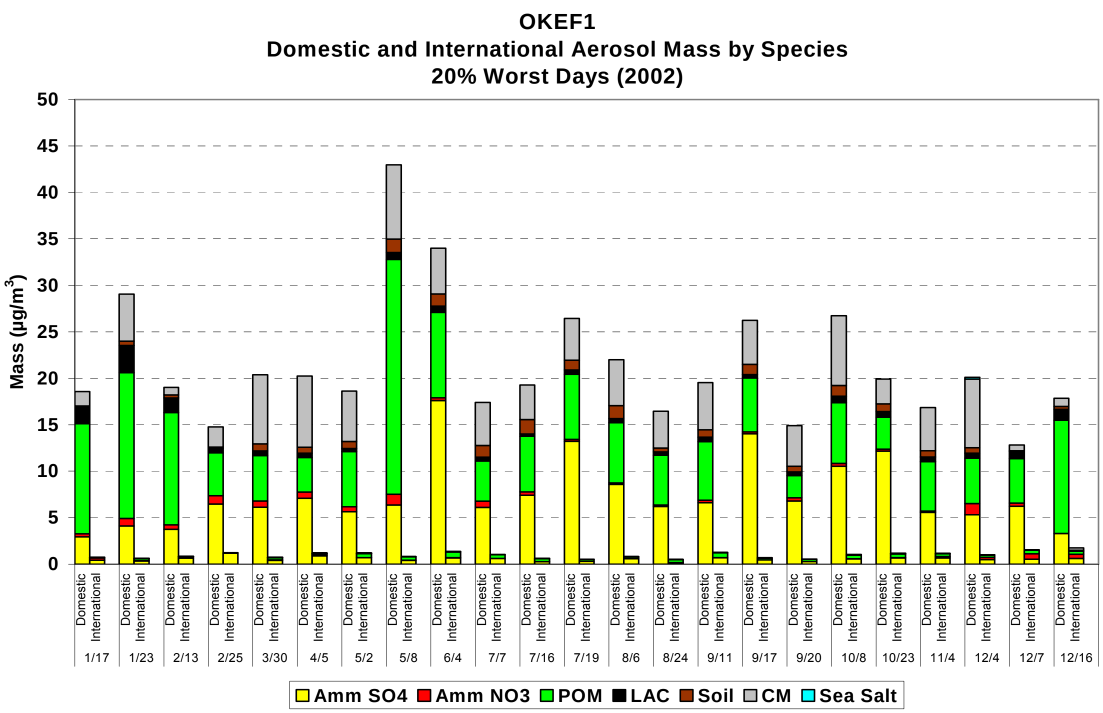


Figure 7.3-4. PM component concentrations from US domestic sources on 20 percent worst visibility days in 2002 (left bars) and CMAQ-simulated international contributions (right bars) at Okefenokee Wilderness Area, GA.

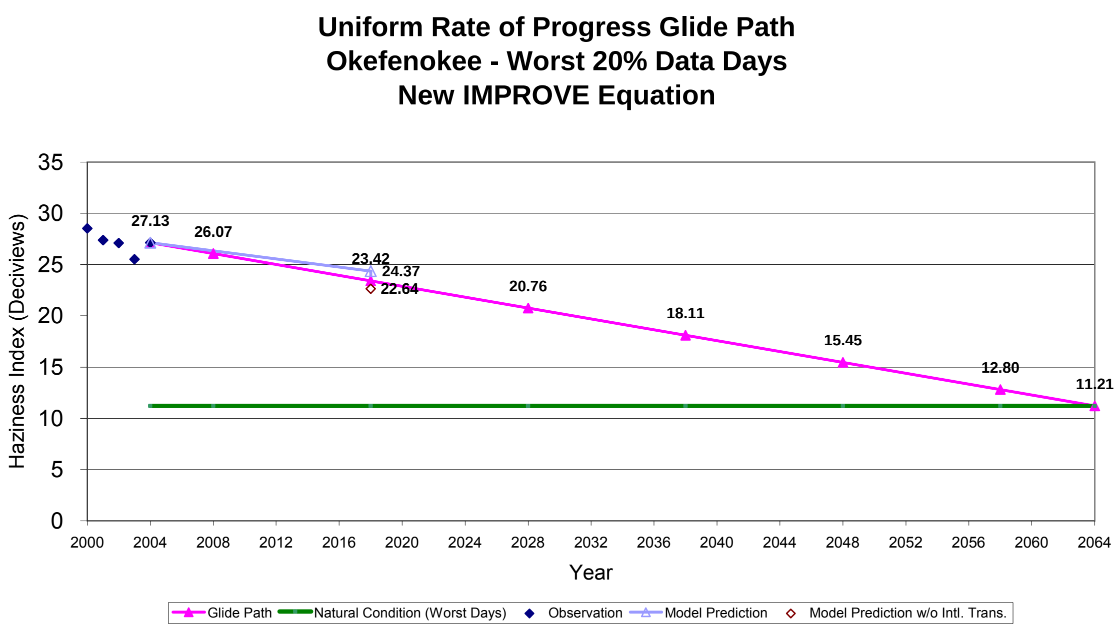


Figure 7.3-5. Accounting for international emissions contributions on modeled rate of progress by 2018 at Okefenokee, GA. Open triangle = estimate with all emissions; Open diamond = estimate with international emissions removed.

For the Okefenokee Class I areas, it can be seen that accounting for the international contribution along with reductions of United States anthropogenic emissions will result in visibility improvement greater than the uniform rate of progress by 2018. As the atmosphere becomes closer to natural background conditions in the future, the incremental contribution from international emissions will become more important. The information is included in this SIP documentation to provide reference for future assessments of reasonable progress.

7.4 Relative Contributions to Visibility Impairment: Pollutants, Source Categories, and Geographic Areas

An important step toward identifying further reasonable progress measures is to identify the key pollutants contributing to visibility impairment at each Class I area. To understand the relative benefit of further reducing emissions from different pollutants, source sectors, and geographic areas, VISTAS engaged the Georgia Institute of Technology to perform emission sensitivity model runs using CMAQ. Emissions sensitivities were initially performed for three episodes representing winter and summer conditions: January 2002, July 2001, and July 2002. These runs used the initial 2018 projections inventory and considered 30 percent reductions from specific pollutants, source categories, and geographic areas. Emissions sensitivities were repeated using the 2009 Base D projection inventory and two-month-long episodes from 2002: June 1-

July 10 and November 19 through December 19. Emissions in 2009 were reduced by 30 percent for each pollutant sensitivity run. The pollutant contributions that were evaluated were:

- SO2 from EGU sources in each VISTAS state, other RPOs in the VISTAS 12 km grid, and Boundary Conditions from outside the 12 km domain;
- SO2 from non-EGU point sources in each VISTAS state, other RPOs, and Boundary Conditions;
- NOx from ground level (on-road plus non-road plus area) sources in each VISTAS state and other RPOs;
- NOx from point (EGU plus non-EGU) sources in each VISTAS state and other RPOs;
- NH3 from all sources in VISTAS and other RPOs;
- Volatile Organic Compounds from anthropogenic and biogenic sources in the 12 km modeling domain;
- Primary Carbon from all ground level sources in each VISTAS state and other RPOs;
- Primary Carbon from all point sources in each VISTAS state and other RPOs; and
- Primary Carbon from all fires in each VISTAS state and other RPOs.

Results are shown in Figures 7.4-1 through 7.4-2 below for the average of the 20 percent worst visibility days for the two Georgia Class I areas.

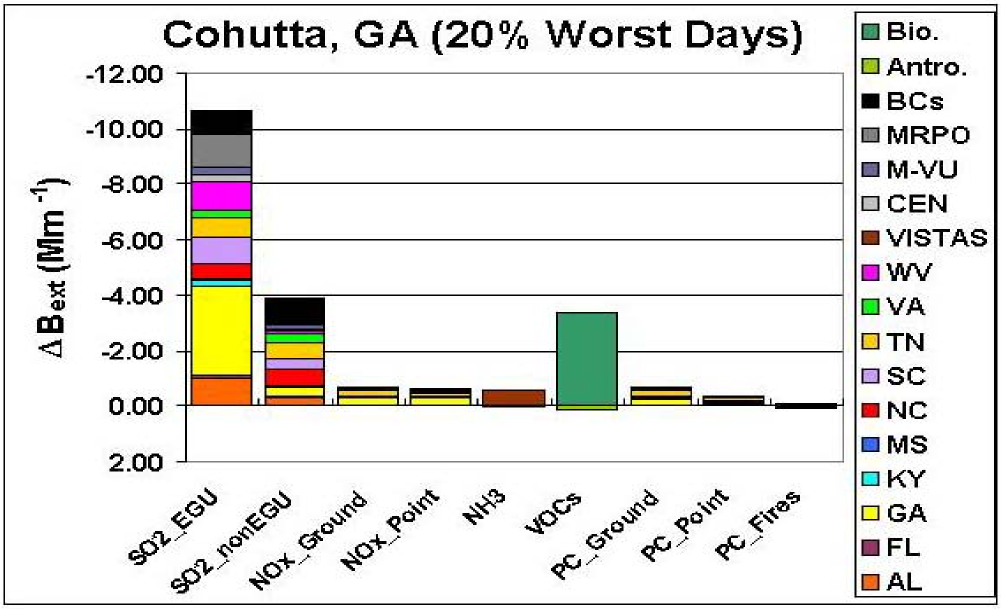


Figure 7.4-1. CMAQ projections of visibility responses on 20 percent worst days at Cohutta Wilderness Area, GA to 30 percent reductions from the 2009 Base D inventory for visibility-reducing pollutants in different source categories and geographic areas.

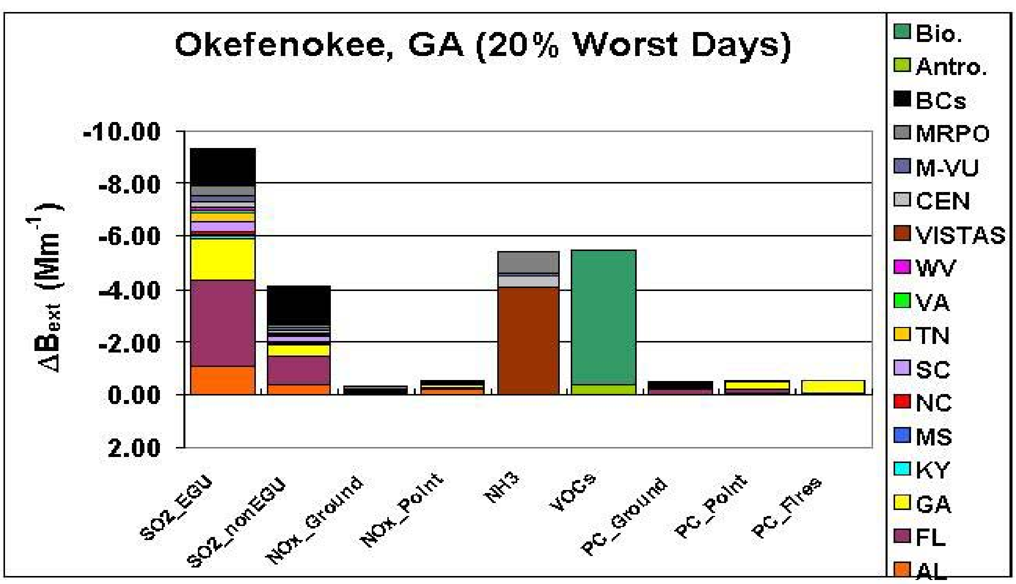


Figure 7.4-2. CMAQ projections of visibility responses on 20 percent worst days at Okefenokee Wilderness Area, GA to 30 percent reductions from the 2009 Base D inventory for visibility-reducing pollutants in different source categories and geographic areas.

Responses for 20 percent worst days were calculated by averaging the responses of the 20 percent worst days that were modeled in the two episodes. For the Georgia sites, responses on five-to-six of the 20 percent worst visibility days were included in these graphics.

As Figures 7.4-1 through 7.4-2 illustrate, the greatest visibility benefits on the 20 percent worst days for the Georgia Class I areas are projected to result from further reducing SO2 from EGUs. At the mountain Class I areas, benefits are projected from SO2 reductions from EGUs in several VISTAS states including Alabama, Georgia, Kentucky, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia. Contributions from other RPOs and from the boundary conditions are comparatively small and the greatest benefits would likely be from further EGU reductions within the VISTAS states. MRPO states have some contribution, as do SO2 and SO4 coming into the modeling domain from outside the boundary.

Additional, smaller benefits are projected from additional SO2 emission reductions from non-utility, industrial point sources. The pattern of relative SO2 contributions from non-EGUs among the various VISTAS states is similar to the pattern of relative SO2 contributions from EGUs.

Because ammonium nitrate is a small contributor to PM2.5 mass and visibility impairment on the 20 percent worst days at the mountain Class I areas, the benefits of reducing NOx and NH3 emissions at these sites are small. Some of the 20 percent worst days at coastal sites in the VISTAS states occur in the winter when ammonium nitrate has a somewhat larger contribution to visibility impairment. As shown in Figure 7.4-2, reducing ammonia emissions would be more beneficial for reducing ammonium nitrate contributions to visibility impairment at Okefenokee Wilderness area than further reducing nitrogen oxide emissions from either ground or point sources. Ammonium emissions are the result of agricultural activity, specifically fertilizing operations and animal farming. Since there are no economically feasible options for controlling these types of area sources of ammonia emissions, and EPD lacks authority over agricultural activities, no further consideration was given.

VOCs do contribute to visibility impairment, but as shown in the charts above, this contribution is from biogenic sources such as vegetative emissions. Controlling anthropogenic sources of VOC emissions has little, if any, visibility benefit at the Class I areas. Reducing primary carbon from point sources, ground level sources or fires are projected to have small to no visibility benefit. This is consistent with the monitoring data that shows that most of measured organic carbon is secondary in origin and primary carbon is only a small fraction of the total measured carbon (Appendix B). Reducing carbon from fires was not found to be effective because there was little fire activity at these sites on the days modeled in the sensitivity analyses.

Note that these results from the emission sensitivity runs are consistent with the conclusions drawn from the 2000-2004 baseline monitoring data (see Section 2.4 above). The results indicate that sulfate is the dominant contributor to visibility impairment on the 20 percent worst days at all sites, and that ammonium nitrate may be important for sites where the 20 percent worst days occur in the winter. We conclude that reducing SO2 emissions from EGU and non-EGU point sources in the VISTAS states would have the greatest visibility benefits for the GA Class I areas. Contributions from the Midwest RPO and MANE-VU are greater at the Class I areas bordering these RPOs. Contributions from outside the VISTAS 12-km modeling domain are more important for the coastal Class I areas. These results are consistent with the CMAQ model results indicating that contributions from international emissions to visibility impairment at VISTAS Class I areas are greater closer to the boundaries of the modeling domain (see summary in Section 7.3 and further discussion in Appendix I).

7.5 Relative Contributions to Visibility Impairment: Geographic Areas of Influence for Georgia Class I Areas

Once it was determined that SO2 emission reductions from EGU and non-EGU point sources in the VISTAS states would be the most effective sources to control to improve visibility at the Georgia Class I areas and non-Georgia Class I areas impacted by Georgia sources, the next step was to identify the specific geographic areas that most likely influence visibility in each Class I area, and then to identify the major SO2 point sources located in those geographic areas. An SO2 Area of Influence (AoI) was defined for each Class I area to represent the geographic area containing sources that would likely have the greatest impact on visibility at that Class I area. All SO2 point sources within these Areas of Influence were identified and ranked by their 2018 Base G4 emissions. The following sections contain a broad overview of the steps in the Area of Influence analyses. See Appendix H for a more detailed discussion of these analyses and plots for additional Class I areas.

7.5.1 Back Trajectory Analyses

The first step was to generate meteorological back trajectories for IMPROVE monitoring sites in Georgia and neighboring Class I areas for the 2000-2004 baseline period. Back trajectory analyses use interpolated measured or modeled meteorological fields to estimate the most likely central path of air masses that arrive at a receptor at a given time. The method essentially follows a parcel of air backward in hourly steps for a specified length of time. Figure 7.5.1-1 is an example of a back trajectory analysis for Cohutta Wilderness Area for the 20 percent worst days in 2002.

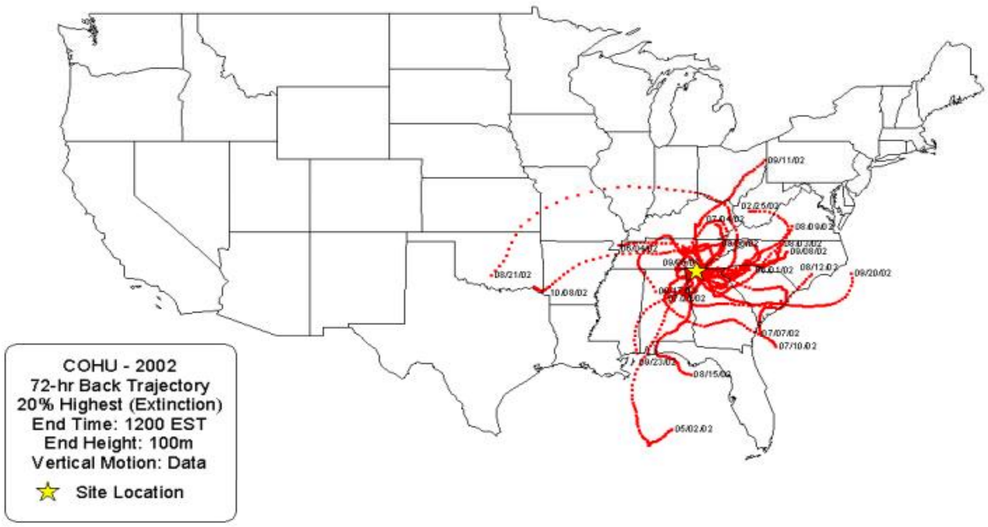


Figure 7.5.1-1. Example back trajectories for 20 percent worst visibility days in 2002 for Cohutta Wilderness Area.

Trajectories were started at 100 meters and 500 meters above the surface and run backward from the site for 72-hours. These individual back trajectories for 20 percent worst days in 2002 were also useful in evaluating model performance for individual days at the Class I areas.

7.5.2 Residence Time Plots

The next step was to plot residence time for each Class I area using five years of back trajectories for the 20 percent worst visibility days in 2000-2004. Residence time is the frequency that winds pass over a specific geographic area on the path to a Class I area. Separate residence time plots were generated using trajectories with 100m and 500m start heights.

As illustrated in Figure 7.5.2-1, winds influencing Cohutta Wilderness Area on the 20 percent worst days come from all directions, and there is no single predominant wind direction influencing the 20 percent worst visibility days.

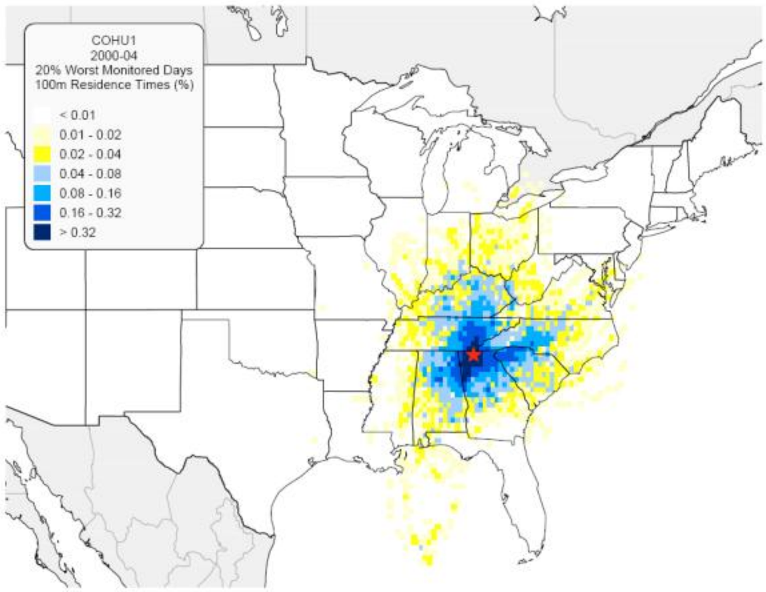


Figure 7.5.2-1. Example residence time plot for 20 percent worst visibility days in 2000-2004 for Cohutta Wilderness Area. Based on trajectories with 100m start height.

7.5.3 SO2 Areas of Influence

The next step was to develop sulfate extinction weighted residence time plots to define the geographic area with highest probability of influencing the receptor on the 20 percent worst days in 2000-2004 that were dominated by sulfate. Each back trajectory was weighted by sulfate extinction for that day. This allows us to focus on the 20 percent worst days that are influenced by sulfate and place less importance on days influenced by organic carbon from fires. Sulfate-weighted back trajectories for the 20 percent worst days were combined for five years of data. The resulting sulfate extinction-weighted residence time plots were used to define the geographic Area of Influence for sources of SO2 emissions. In Figure 7.5.3 the area representing 10 percent or greater residence time is outlined in red and the area representing five percent or greater residence time is outlined in orange. The VISTAS states focused their analyses on the Area of Influence defined by five percent or greater sulfate extinction-weighted residence time.

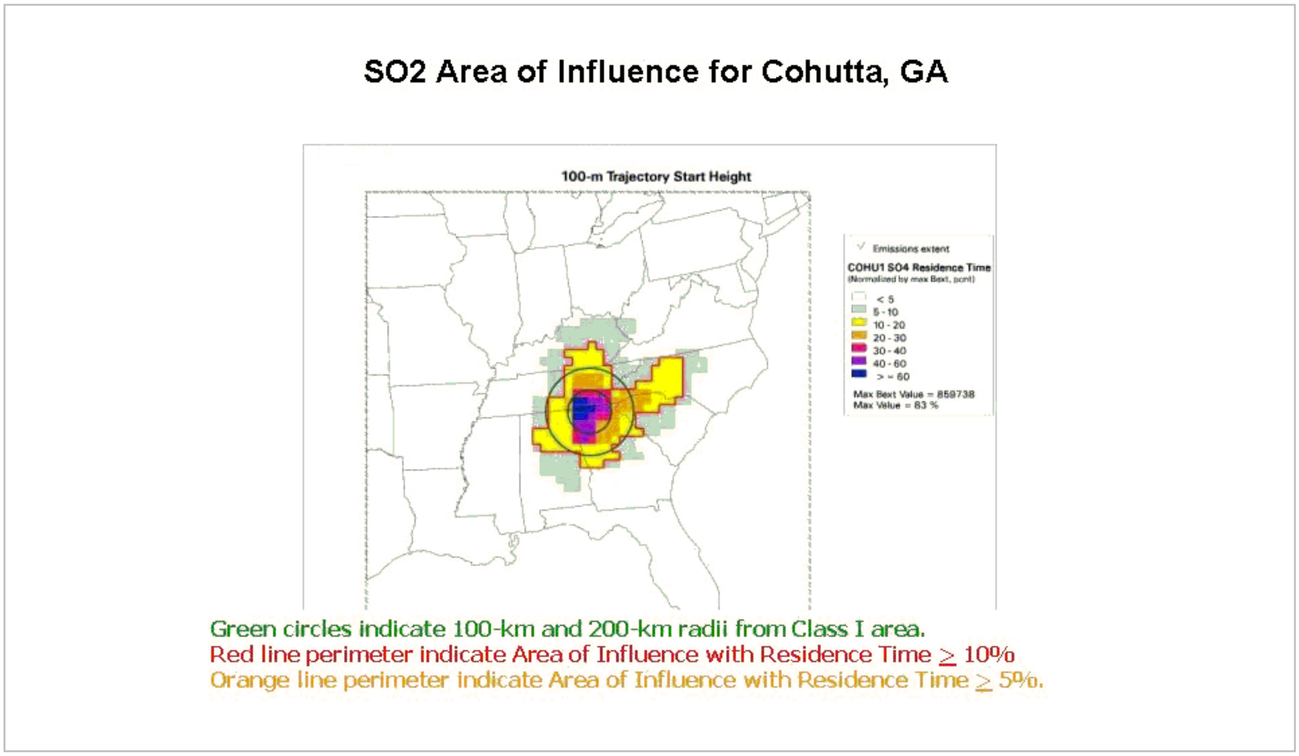


Figure 7.5.3-1. Example SO2 Area of Influence plot for sulfate extinction weighted residence time for 20 percent worst visibility days in 2000-2004 for Cohutta Wilderness Area, Georgia. Based on trajectories with 100m start height.

7.5.4 Emissions Sources within SO2 Areas of Influence

Residence time plots were then combined with geographically-gridded emission data based on the 2002 baseline and 2018 BaseG emissions inventories. Plots were generated for the Areas of Influence defined by trajectories with 100m and 500m start heights. As a way of incorporating the effects of transport, deposition, and chemical transformation of point source emissions along the path of the trajectories, these data were weighted by 1/d, where "d" was calculated as the distance, in kilometers, between the center of the grid cell in which a source is located and the center of the grid cell in which the IMPROVE monitor is located. The distance-weighted point source SO2 emissions are then combined with the gridded extinction-weighted back-trajectory residence times at a spatial resolution of 36-km.

The final step was to combine the residence times and gridded emissions data in plots and data sets. The distance weighted (1/d) gridded point source SO2 emissions were multiplied by the total extinction-weighted back-trajectory residence times on a grid cell by grid cell basis. These results were then normalized by the domain-wide total and displayed as a percentage. The analysis was done using both the 2002 and 2018 base year inventories.

Figures 7.5.4-1 illustrates 2002 and 2018 distance weighted gridded emissions “x” sulfate extinction weighted residence time plots for Cohutta Wilderness Area. These maps help visualize where the emissions reductions will be occurring between 2002 and 2018. The change in SO2 emissions between 2002 and 2018 can be seen by comparing emissions source strengths in the two plots. Note the emissions from each source are normalized by the total emissions in the domain. Sources that reduce SO2 emissions by 2018 will show a lower contribution to emissions in the domain. On the 2018 map the grid cells with these sources will show a lighter color gradient than on the 2002 map. For example: SO2 reductions from EGUs in north and central Georgia can be seen by comparing the 2002 and 2018 maps. Because the total emissions in the domain are smaller in 2018, a source that does not change emissions between 2002 and 2018 may actually appear to increase in importance in 2018 compared to 2002.

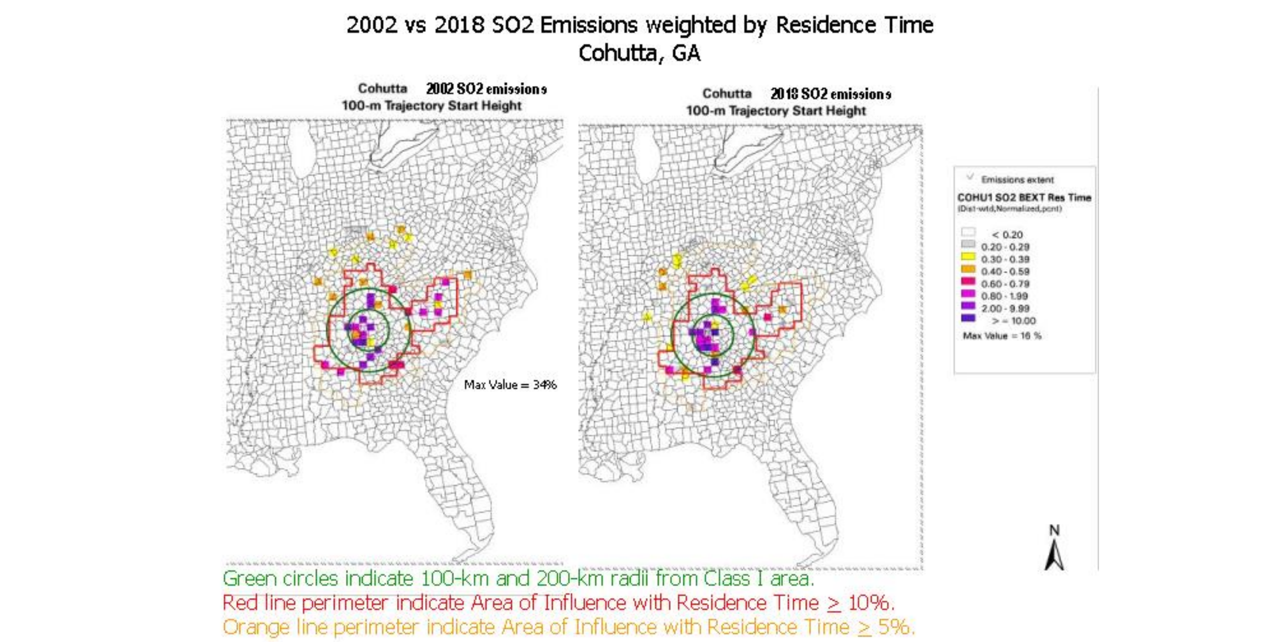


Figure 7.5.4-1. Cohutta Wilderness Area 2002 and 2018 SO2 distance weighted emissions x SO4 extinction-weighted residence time plots.

Figure 7.5.4-2 illustrates gridded SO2 distance weighted emission’s sulfate “x” extinction weighted residence time plots for 2018 emissions for Okefenokee Wilderness Area. The plot illustrates the relative importance of Georgia sources of SO2 compared to sources in neighboring states. Additional analyses, including 2002 and 2018 distance weighted emissions “x” residence time plots for the Class I areas in Georgia are contained in Appendix H.

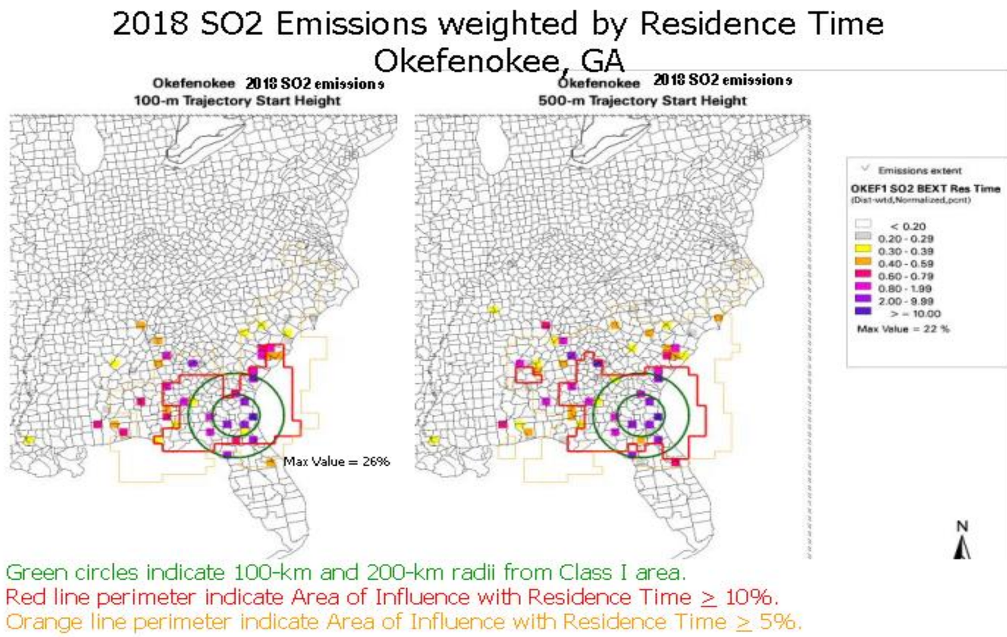


Figure 7.5.4-2. 2018 SO2 distance weighted emissions x SO4 extinction-weighted residence time plot for Okefenokee, Georgia.

Finally, Table 7.5.4-1 shows, the relative contributions of point source SO2 emissions from nearby states to Georgia Class I areas.

Table 7.5.4-1. 2018 SO2 Point Source Contribution (Using RTMax*Q/d) to Georgia Class I Areas by State

	Georgia Class I Area		
State	**OKEF**	**COHU**	**WOLF**
Alabama	1.29%	19.04%	0.85%
Delaware			0.29%
Florida	74.99%		38.05%
Georgia	16.95%	36.72%	41.88%
Indiana		0.42	
Kentucky		1.75%	
Maryland			
New Jersey			
North Carolina	0.11%	5.16%	3.01%
Ohio			
Pennsylvania			
South Carolina	6.66%	4.05%	15.81%
Tennessee		31.88%	
Virginia		0.62%	0.12%
West Virginia		0.36%	
Total	100.00%	100.00%	100.00%

7.5.5 Specific Source Types in the Areas of Influence for Georgia Class I Areas

The next step in the analysis was to review the emissions inventories to determine the source categories, as well as specific sources, found to have the greatest impact on visibility in Georgia Class I areas. Lists of SO2 point sources within the Areas of Influence for each Class I area were developed using the Base G VISTAS 2002 base year and 2018 future year emissions. For this purpose the Area of Influence was defined as the counties with maximum sulfate extinction weighted residence time greater than five. For SO2 sources within each Area of Influence, the following attributes were defined for each individual unit:

- State, county, and source (plant), and industry identification codes;
- SO2 emissions for 2002 and 2018;
- 2018 control efficiency;
- Distance to Class I areas (defined by centroid of the Class I area);
- Emissions divided by distance (Q/d), a metric that accounts for the dispersion of emissions over distance; and
- Maximum sulfate extinction weighted residence time (RTmax).

Our review was conducted in a top-down fashion starting with an analysis of the major source categories in each SO2 Area of Influence to determine which major categories had the highest residual contribution to the area in 2018. It was also important to identify reductions that are projected to occur between 2002 and 2018 within each category or at specific units. This allowed VISTAS States to determine if certain source categories or units that had yet to be controlled under the future year base case had the potential for reduction. Once the highest source types were identified, subcategories within those source types were reviewed. The contributions from major source categories to the 2018 Base G4 inventory for the SO2 Areas of Influence for the Georgia Class I areas are listed in Tables 7.5.5-1 through 7.5.5-3.

Table 7.5.5-1. 2018 Emissions Contributions from Major Source Categories in the Area of Influence for Cohutta Wilderness Area.

Tier	VOC	NOX	CO	SO2	PM-10	PM-2.5	NH3
Fuel Comb. Elec. Util.	0%	21%	1%	52%	9%	17%	1%
Fuel Comb. Industrial	1%	19%	2%	28%	3%	5%	0%
Fuel Comb. Other	5%	6%	3%	6%	5%	10%	1%
Chemical & Allied Product Mfg	2%	1%	0%	2%	1%	1%	1%
Metals Processing	1%	1%	1%	3%	2%	5%	0%
Petroleum & Related Industries	0%	0%	0%	1%	0%	0%	0%
Other Industrial Processes	7%	6%	1%	5%	9%	11%	1%
Solvent Utilization	42%	1%	0%	0%	0%	1%	0%
Storage & Transport	6%	0%	0%	0%	1%	1%	0%
Waste Disposal & Recycling	4%	2%	4%	0%	5%	12%	0%
Highway Vehicles	18%	25%	48%	0%	2%	2%	12%
Off-highway	11%	18%	34%	1%	2%	4%	0%
Miscellaneous	2%	1%	7%	0%	61%	30%	83%
VISTAS Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Table 7.5.5-2. 2018 Emissions Contributions from Major Source Categories in the Area of Influence for Okefenokee Wilderness Area.

Tier	VOC	NOX	CO	SO2	PM-10	PM-2.5	NH3
Fuel Comb. Elec. Util.	0%	22%	1%	51%	7%	12%	1%
Fuel Comb. Industrial	1%	16%	2%	25%	3%	5%	0%
Fuel Comb. Other	3%	4%	1%	6%	2%	4%	0%
Chemical & Allied Product Mfg	1%	1%	0%	4%	0%	1%	0%
Metals Processing	0%	0%	0%	4%	0%	0%	0%
Petroleum & Related Industries	0%	0%	0%	**0%**	0%	0%	0%
Other Industrial Processes	7%	6%	1%	**7%**	8%	11%	2%
Solvent Utilization	39%	0%	0%	**0%**	0%	0%	0%
Storage & Transport	7%	0%	0%	**0%**	0%	0%	0%
Waste Disposal & Recycling	4%	3%	7%	**0%**	8%	16%	0%
Highway Vehicles	18%	25%	38%	**1%**	1%	1%	10%
Off-highway	14%	19%	29%	**1%**	2%	3%	0%
Miscellaneous	6%	4%	20%	**1%**	68%	46%	86%
VISTAS Total	100%	100%	100%	**100%**	100%	100%	100%

Table 7.5.5-3. 2018 Emissions Contributions from Major Source Categories in the Area of Influence for Wolf Island.

Tier	VOC	NOX	CO	SO2	PM-10	PM-2.5	NH3
Fuel Comb. Elec. Util.	0%	21%	1%	47%	7%	14%	1%
Fuel Comb. Industrial	1%	16%	2%	31%	3%	5%	0%
Fuel Comb. Other	3%	5%	2%	6%	3%	6%	1%
Chemical & Allied Product Mfg	1%	2%	0%	4%	0%	1%	1%
Metals Processing	0%	0%	0%	3%	0%	0%	0%
Petroleum & Related Industries	0%	0%	0%	0%	0%	0%	0%
Other Industrial Processes	6%	5%	1%	5%	7%	8%	2%
Solvent Utilization	39%	0%	0%	0%	0%	0%	0%
Storage & Transport	7%	0%	0%	0%	0%	1%	0%
Waste Disposal & Recycling	4%	3%	7%	1%	7%	16%	0%
Highway Vehicles	19%	25%	40%	1%	1%	1%	10%
Off-highway	15%	21%	32%	1%	2%	5%	0%
Miscellaneous	5%	3%	15%	1%	67%	43%	85%
VISTAS Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

These tables indicate that for all Georgia Class I areas, EGUs and industrial boilers are the two major source categories contributing to 2018 SO2 emissions in the Areas of Influence, even after implementation of the CAMR and CAIR. Together these two source categories contribute 79-85 percent of the 2018 SO2 emissions for the Areas of Influence for the Georgia Class I areas. Other fuel combustion and other industrial processes comprise another 9-12 percent of the 2018 SO2 emissions.

These tables can also be used to evaluate the major source categories contributing to emissions of NOx, NH3, and PM emissions in 2018. For instance, highway vehicles and off-road vehicles are major sources of NOx emissions, in addition to electric utilities and industrial boilers. The source category “miscellaneous” (which includes agricultural sources and fires) is the major contributor to NH3 and primary PM. The emissions sensitivities discussed in Section 7.4 indicated very small benefits of controlling NOx, NH3, and primary PM emissions at the Georgia Class I areas, but if these emissions were of concern, different source categories would need to be addressed.

The contributions to SO2 emissions in 2018 from the three highest source categories, electric utilities, industrial boilers, and other fuel combustion have been further broken out into subcategories. Table 7.5.5-4 indicates subcategories for the Areas of Influence for the Georgia Class I areas. Within electric utilities, all the SO2 emissions are attributable to coal-fired power plants. Within industrial boilers, most emissions are attributable to coal-fired boilers with lesser contributions from oil and gas boilers. Commercial and institutional coal and oil boilers have smaller contributions.

Table 7.5.5-4. 2018 SO2 Emissions Contributions from Major Source Categories in the Area of Influence for GA Class I areas.

Tier	WOLF	OKEF	COHU
Fuel Comb. Elec. Util.-Coal	45%	49%	52%
Fuel Comb. Elec. Util.-Oil	0%	0%	0%
Fuel Comb. Elec. Util.-Gas	0%	0%	0%
Fuel Comb. Elec. Util.-Other	2%	2%	0%
Fuel Comb. Elec. Util.-Internal Combustion	1%	0%	0%
Fuel Comb. Industrial-Coal	18%	14%	20%
Fuel Comb. Industrial-Oil	9%	8%	5%
Fuel Comb. Industrial-Gas	2%	1%	2%
Fuel Comb. Industrial-Other	2%	3%	1%
Fuel Comb. Industrial-Internal Combustion	0%	0%	0%
Fuel Comb. Other-Commercial/Institutional Coal	2%	2%	2%
Fuel Comb. Other-Commercial/Institutional Oil	3%	3%	4%
Fuel Comb. Other-Commercial/Institutional Gas	0%	0%	0%
Fuel Comb. Other-Misc. Fuel Comb. (Except Residential)	0%	0%	0%
Fuel Comb. Other-Residential Wood	0%	0%	0%
Fuel Comb. Other-Residential Other	0%	0%	1%

These analyses indicate that GA EPD should consider what additional control measures for electric utilities and industrial boilers are reasonable. GA EPD also determined that it was appropriate to also consider additional control measures from industrial sources other than boilers that contributed to the same magnitude of visibility impairment as boilers. The lists of individual sources are also being used to determine if individual sources in other sources categories are major contributors.

The next step was to identify emission reductions that have already occurred within each source category and at specific units. Unit level tables of emission comparisons from 2002 to 2018 were developed, allowing VISTAS States to review existing emission reductions. These tables assigned future-year control technology from IPM forecasting and State modification for EGUs and from control efficiency tables for Non-EGU point sources.

Once emission control profiles for specific units were defined, the next step was to determine what, if any, additional control measures would feasibly be available and to evaluate these controls to determine which are reasonable.

For EGUs, the 2018 IPM file used by VISTAS for EGU sources was obtained and matched to the 2018 base-case inventory of EGU sources for most states. However, IPM assumptions for future controls were not consistent with the emission controls required for EGUS by Georgia's Multipollutant Rule. The Georgia EGU emission controls are documented in the emission inventory documents found in Appendix C.

7.6 Reasonable Progress Determinations for Individual Sources

The following summarizes the process for determining reasonable progress for Georgia sources and the results of the determinations. This process was based on U.S. EPA's "Guidance for Setting Reasonable Progress Goals Under the Regional Haze Program," June of 2007 [Reasonable Progress guidance]. For a detailed discussion of the reasonable progress assessments for all emissions units contributing greater than half a percent of sulfate impact to any Class I area in Georgia or in neighboring states, see Appendix H.

7.6.1 Process for Determining Reasonable Progress

<u>Step 1: Determine pollutants of concern.</u>

VISTAS evaluated the species contribution on the 20 percent worst visibility days and concluded that sulfate accounted for greater than 70 percent of the visibility impairing pollution. The VISTAS States concluded that controlling SO2 emissions was the appropriate step in addressing the reasonable progress assessment for 2018. The VISTAS findings were consistent with the findings of SAMI. As stated previously, SAMI confirmed that sulfate particles account for the greatest portion of the haze affecting Class I areas in the Southern Appalachian region and that these sulfates were produced in large part from SO2 emissions from coal combustion.

<u>Step 2: Determine which source sectors should be evaluated for reasonable progress.</u>

Since SO2 point source emissions in 2018 are projected to represent greater than 95 percent of the total SO2 emissions inventory, the VISTAS states concluded that the focus should be on electric generating unit (EGU) and non-EGU point sources of SO2 emissions.

<u>Step 3: Consideration of Emissions Reductions from State and Federal Control Measures.</u>

64 FR 35733 states that "In determining the emissions and visibility improvement achieved during each implementation period, states should include all air quality improvements that will be achieved by other programs and activities under the CAA and any state air pollution control requirements." In keeping with this recommendation, Georgia, as part of its long-term reasonable progress analysis to consider potential sources contributing to visibility impairment, examined other CAA requirements such as CAIR. Under Georgia's CAIR rule for SO2 [391-3-1-.02(13)], SO2 emissions from Georgia EGUs will be capped at 149,140 tons in 2015, a 70 % reduction from 2002 actual emissions. In addition, a 70 % reduction of SO2 emissions is expected during this time period across all CAIR-affected EGUs in 28 eastern states. Through these programs between the present and 2018, EPD concluded that additional EGU control during this time period is not reasonable for sources that significantly contribute to visibility impairment at Class I areas that clearly projected to meet the uniform rate of progress (URP) in 2018. However, for sources that significantly contribute to visibility impairment at Class I areas not clearly meeting the URP (such as Okefenokee and Wolf Island), EPD did consider additional controls at CAIR-affected units.

For EGUs subject to CAIR, EPA evaluated a number of factors, including the cost of compliance and time necessary for compliance. In the CAIR rule, EPA determined "that the earliest reasonable deadline for compliance with the final highly cost effective control levels for reducing emissions was 2015…" (70 FR 25197 – 25198, May 12, 2005). The State believes that the cost of compliance and time necessary for compliance are the dominant factors for determining if additional reductions would be reasonable from CAIR-subject EGUs. The detailed analyses in the preamble to the May 12, 2005, CAIR rule support a conclusion that CAIR controls satisfy reasonable progress for SO2 for the first regional haze planning period ending in 2018.

The SO2 emission reductions that are predicted by the IPM to meet the CAIR requirements are not certain due to the current rule's reliance on unchecked trading and the use of banked Title IV allowances. The GA EPD intends to re-evaluate the IPM predictions of SO2 reductions for CAIR for EGUs at the time of the first five-year periodic report [40 CFR 51.308(g)] to ensure that the reductions currently predicted by IPM for CAIR are in fact taking place where they are expected and needed .
The Cohutta Class I Area is expected, based on modeling, to clearly meet the glide slope in 2018. GA EPD has therefore concluded that CAIR constitutes reasonable measures for Georgia EGUs that significantly impact visibility in Cohutta during this first assessment period (between baseline and 2018). Because the Okefenokee, Wolf Island, and Saint Marks areas are not expected to clearly meet the glide slope, controls required under CAIR have not been deemed to constitute reasonable measures for Georgia EGUs that significantly impact visibility in these Class I areas.

Georgia Power Company, in anticipation of CAIR requirements, has committed to implementing SO2 emission reduction measures on 22 of its EGUs. All of the 22 affected units are located in the northern half of the state and their predicted emissions reductions have been accounted for in the modeling used to predict 2018 visibility levels in this SIP. These reduction measures and the associated emissions reductions are summarized in Table 7.6.1-1.

Table 7.6.1-1. Projected 2018 SO2 emission reductions associated with planned reduction measures at Georgia Power EGUs.

Facility	Unit	Annual SO2 Emissions, 2002 (tons)	Reduction Measure	Annual SO2 Emissions, 2018 (tons) *	Annual SO2 Reductions, 2002 to 2018 (tons)
Hammond	1	3933	scrubber	269	3664
	2	4092	scrubber	270	3822
	3	4262	scrubber	267	3995
	4	18088	scrubber	1728	16360
Wansley	1	38741	scrubber	3018	35723
	2	36421	scrubber	3022	33399
Bowen	1	33050	scrubber	2415	30635
	2	35266	scrubber	2432	32834
	3	42900	scrubber	3056	39844
	4	42634	scrubber	3147	39487
McDonough	1	13802	convert to natural gas	578	13224
	2	13631	convert to natural gas	596	13035
Scherer	1	25286	scrubber	1313	23973
	2	24966	scrubber	1304	23662
	3	18149	scrubber	1387	16762
	4	20771	scrubber	1331	19440
Branch	1	10837	scrubber	618	10219
	2	13941	scrubber	748	13193
	3	21211	scrubber	1158	20053
	4	22342	scrubber	1133	21209
Yates	1	233	Existing scrubber (no additional reduction)	332	-99
	2	3991	none	3547	444
	3	3237	none	3916	-679
	4	4842	none	6500	-1658
	5	5009	none	6643	-1634
	6	15175	scrubber	818	14357
	7	14024	scrubber	826	13198
TOTAL (tons)		490385		52373	438012

* Emissions reflect VISTAS plant utilization growth projections.

Step 4: Determine which emission units would be evaluated based on impact.

The GA EPD calculated the projected 2018 fractional contribution from all emission units within the SO2 Area of Influence for a given Class I area, including contributions from EGUs after planned SO2 controls. EPD then identified those emission units with a contribution of half a percent or more to the sulfate visibility impairment at the specific Class I area. See section 5.0 of Appendix H for the rationale for the selection of the one-half percent threshold for this analysis. As noted in Step 3, SO2 controls on EGUs that impact visibility at Cohutta, as required by CAIR, are deemed to be reasonable measures. Therefore, these units were exempted from four-factor evaluation even if their sulfate visibility impairments were half a percent or more.

Step 5: Evaluate the four factors.

Each emission unit identified in Step 4 above was evaluated using the following four statutory and regulatory factors of 1) cost of compliance, 2) time necessary for compliance, 3) the energy and non-air quality environmental impacts of compliance, and 4) the remaining useful life of the emissions unit.

7.6.2 Sources Eligible for Four Factor Analysis in Georgia

As part of the Regional Haze reasonable progress goal analysis, GA EPD initially identified 29 emission units for analysis of additional controls for meeting the reasonable progress requirements of the Regional Haze program in accordance with the above four statutory factors. The 29 units were selected based on analyses that indicated that each one's contribution to total sulfate visibility impairment was at least 0.5% of the total sulfate visibility impairment at one or more Class I areas. The analysis for eligibility assumed that the units' 2018 sulfate emissions were their VISTAS-projected emissions. The eligible units are listed below in Table 7.6.2-1. Details of the eligible unit selection process are presented in Section 5.0 of Appendix H.

Table 7.6.2-1. List of all facilities along with their units eligible for 4-factor analysis

Four Factor Analysis – Eligible Sources	Eligible Units
Georgia Pacific Brunswick Cellulose	Power Boiler No. 4
Georgia Pacific Brunswick Cellulose	Recovery Boiler (M24)
Georgia Pacific Cedar Springs	Power Boiler U500
Georgia Pacific Cedar Springs	Power Boiler U501
Georgia Pacific Cedar Springs	Recovery Boiler R402
Georgia Pacific, Savannah River Mill	Boiler B001
Georgia Pacific, Savannah River Mill	Boiler B002
Georgia Pacific, Savannah River Mill	Boiler B003
Georgia Power Plant Kraft	Steam Generator 1
Georgia Power Plant Kraft	Steam Generator 2
Georgia Power Plant Kraft	Steam Generator 3
Georgia Power Plant Mitchell	Steam Generator 3
Georgia Power Plant McIntosh	Steam Generator 1
International Paper, Savannah Mill	Power Boiler 13
Interstate Paper	Power Boiler F1
Miller Brewing	Boiler B001
Miller Brewing	Boiler B002
Mount Vernon Mills	Boiler E U 03
Mount Vernon Mills	Boiler E U 04
Packaging Corporation of America	C E Boiler
Rayonier Performance Fibers, Jessup Mill	Power Boiler 2
Rayonier Performance Fibers, Jessup Mill	Power Boiler 3
Rayonier Performance Fibers, Jessup Mill	Recovery Furnace 1
Rayonier Performance Fibers, Jessup Mill	Recovery Furnace 4
Savannah Sugar Refinery	Boiler U161
Southern States Phosphate and Fertilizer	Sulfuric Acid Plant 2
Temple Inland Rome Linerboard	Power Boiler No. 4
Mohawk Industries	Boiler BL06
Mohawk Industries	Boiler BL07

GA EPD requested four-factor analyses from these facilities. In response to this request, additional information regarding projected 2018 actual emissions was received from a number of sources. As a result of this revised information, seven units were removed from consideration for additional controls based on an analysis that the emission units would not contribute half a percent or greater of the total sulfate visibility impairment at any Class I area in 2018. Those seven units are listed below in Table 7.6.2-2.

Table 7.6.2-2. Units Removed from 4-Factor List Based on Facilities' Updated 2018 Emission Estimates

Sources	Units
Miller Brewing	Boiler B001
Miller Brewing	Boiler B002
Mount Vernon Mills	Boiler E U 03
Mount Vernon Mills	Boiler E U 04
Savannah Sugar Refinery	Boiler U161
Mohawk Industries	Boiler BL06
Mohawk Industries	Boiler BL07

In addition, three facilities requested and have received emission limits to reduce the sulfate visibility impairment from each emissions unit to less than 0.5%. Those facilities and the affected emission units are listed below in Table 7.6.2-3.

Table 7.6.2-3. Facilities That Requested Emission Limits

Sources	Units
Rayonier Performance Fibers, Jessup Mill	Power Boiler 2
Rayonier Performance Fibers, Jessup Mill	Power Boiler 3
Rayonier Performance Fibers, Jessup Mill	Recovery Furnace 1
Rayonier Performance Fibers, Jessup Mill	Recovery Furnace 4
Southern States Phosphate and Fertilizer	Sulfuric Acid Plant 2
Packaging Corporation of America	C E Boiler

Furthermore, one of the emissions units is subject to Best Available Retrofit Technology (BART) Review under the Regional Haze Rule. In accordance with EPA's June 1, 2007 "Guidance For Setting Reasonable Progress Goals under the Regional Haze Program" (pages 4-2 and 4-3), for emissions units subject to BART, the State will already have completed a BART analysis. Since the BART analysis is based, in part, on an assessment of many of the same factors that must be addressed in establishing reasonable progress goals, it is reasonable to conclude that any control requirements imposed in the BART determination also satisfy the RPG-related requirements for source review in the first RPG planning period. (This exclusion does not include units at facilities that are exempt from BART review through screening modeling.) That emissions unit is Interstate Paper – Power Boiler F1.

Therefore, 4-factor reviews were conducted on the remaining 15 emission units.

7.6.3 Regional Haze Reasonable Progress Four-Factor Analysis

The regional haze rule requires that states consider the following factors and demonstrate how these factors were taken into consideration in selecting the reasonable progress goal:

- Costs of compliance;
- Time necessary for compliance;

- Energy and non-air quality environmental impacts of compliance; and
- Remaining useful life of any potentially-affected sources.

The general considerations taken into account in Georgia EPD's 4-factor evaluations and the evaluations of the specific emissions units are presented below.

Costs of Compliance – General Considerations

GA EPD evaluated the cost of compliance using a variety of factors. Facilities provided data for various control options for each affected unit. The data typically included total capital costs and cost-per-ton of pollutant removed ($/ton). GA EPD compared this data with similarly controlled units as well as AirControlNET estimates. Costs were presented in 2007 dollars for consistency. In addition, GA EPD conducted CMAQ modeling to determine the amount of visibility improvement resulting from each ton of SO2 reduced from each unit subject to analysis. This cost-efficiency metric is expressed in dollar-per-inverse megameter ($\$/Mm^{-1}$) and was considered in addition to cost efficiency expressed in $/ton. This approach is similar to the approach used by Georgia EPD to evaluate cost efficiency for other SIPS (e.g., ozone, PM2.5).

Time Necessary For Compliance – General Considerations

GA EPD based the time necessary for compliance on the installation and operation of controls by the beginning of the year 2012. Since the next Regional Haze SIP will be due December 17, 2017, a compliance date of 2012 will result in visibility improvement for all five years of monitoring data (2012, 2013, 2014, 2015, and 2016) that will be assessed to determine conformity with 2018 progress goals at the time the next Regional Haze SIP is due. Any control options that can be installed and operated prior to 2012 were determined to be timely. Control options that cannot be installed and operated prior to 2012, but can be prior to 2018, would not result in the optimal amount of visibility improvement by the 2018 reasonable progress goal, but were still considered. Control options that could not be installed and operated until 2018 or after, were not considered for this Regional Haze SIP.

Energy And Non-Air Quality Environmental Impacts Of Compliance – General Considerations

Additional factors that were considered were the energy requirements of the control technology and the non-air impacts (that is, impacts on other environmental media). Energy impacts were generally included in the cost-efficiency estimates. Non-air impacts that were considered included solid waste disposal, water withdrawal, and wastewater discharge. The review of control strategies that were not eliminated because of excessive cost efficiencies and that involved water withdrawal and wastewater discharge were coordinated with GA EPD's Watershed Protection Branch.

Remaining Useful Life – General Considerations

The remaining useful life of an affected emissions unit can potentially impact reasonableness of control strategies in two ways. If the remaining useful life of an affected emission unit did not extend past 2018, no controls would be considered for that unit. If the remaining useful life of a unit was less than the amortization period for a particular control option, the shorter period was used in annualizing the capital costs of the control option when determining the cost efficiency. It should be noted that remaining useful life was not an issue for any of the control options reviewed by GA EPD.

Results of Unit-Specific Analyses

As stated previously, GA EPD performed 4-factor analyses for 15 emissions units. The results are summarized below. For more details refer to Appendix H.

Georgia Pacific, Brunswick Cellulose - Power Boiler U700 (F1) – This unit significantly contributes to the sulfate visibility impairment at two Class I areas (approximately 12.6% at Wolf Island and 3.9% at Okefenokee). This is the highest level of visibility impairment contribution to any Class I Area caused by any single emissions unit of those analyzed. The baseline SO2 emissions were 1642 tons-per-year. However, the boiler had already reduced emissions to approximately 1099 tons-per-year due to a 2002 modification achieving higher efficiency.

The 4-factor analysis reviewed wet FGD, in-duct sorbent injection, and a limitation on fuel oil usage coupled with lower fuel oil sulfur content (2.2% and 1.0%). It should be noted that the fuel oil usage limitation proposed by the company is representative of their current usage rate. Of these control measures, the fuel oil changes could take place prior to 2012 and the wet FGD and in-duct sorbent injection could be installed before 2013. The remaining useful life of the unit extended past 2018 and the control equipment amortization period. The wet FGD had an impact on water usage and wastewater discharge and in-duct sorbent injection resulted in additional solid waste. There were no significant energy impacts addressed by the company.

Out of all of the control options considered, both in-duct sorbent injection and a switch to 1.0% fuel oil coupled with a five-million-gallon-per-year usage limit were considered reasonably cost effective ($3562/ton and $20.7MM/Mm^{-1} at Wolf Island for in-duct sorbent injection and $3228/ton and $18.8MM/Mm^{-1} at Wolf Island for 1.0% fuel oil). These were considered cost effective due to the relatively high visibility impact on two Class I areas and the fact that neither of these Class I areas were clearly meeting the uniform rate of progress. Both in-duct sorbent injection and 1.0% sulfur fuel oil achieve approximately the same amount of emissions reductions (769 tpy for sorbent injection and 731 tpy for 1.0% sulfur) from the current level of 1099 tons/year. Implementation of the less restrictive of these two options would reduce SO2 emissions to 368 tons/12-consecutive months (1099 tpy – 731 tpy).

Supplemental information provided by the facility indicated that the two controls deemed to be reasonable would control emissions from oil combustion but would not affect SO2 emissions from combustion of wood waste and tire-derived fuel (TDF). The facility requested an allowance for an additional 200 tons of emissions based on calculations of historical emissions from wood waste and TDF. This request was also supported by the facility's assertion that the sulfur content of locally available TDF may be above what has been burned historically. EPD concurred with the facility's request and established an SO2 emissions limit for the power boiler of 568 tons (368 plus 200) for Regional Haze reasonable progress with a compliance date of 2012.

Georgia Pacific, Brunswick Cellulose - Recovery Boiler R407 (M24) - This unit contributes about 1.3 % to the sulfate visibility impairment at Wolf Island. The baseline SO2 emissions were 193 tons/year. Georgia Pacific's four-factor submittal found combustion control and wet FGD (scrubber) to be the only technically feasible control options. The company stated that emissions of SO2 of 38 ppm, as measured in a 2006 stack test, is too low of a load for effective operation of a wet scrubber. Therefore, the company ruled out wet FGD based on cost effectiveness.

Combustion control, the other technically feasible control option, is already included in the boiler design. Due to the fact that this emission unit only contributes to visibility impairment at one Class I area and the relatively low baseline emissions level, no additional controls are required for Regional Haze reasonable progress.

Georgia Pacific, Cedar Springs, Power Boiler U500 (Power Boiler 1) and Power Boiler U501 (Power Boiler 2) – These are two nearly identical power boilers. Each of these units contribute about 1.1% to the sulfate visibility impairment at Saint Marks Class I area. The baseline SO2 emissions were 1976 tons/year for each boiler.

The 4-factor analyses reviewed wet FGD, addition of spray towers and caustic to the existing venturi scrubbers, adding caustic to the existing scrubbers (79% SO2 reduction), in-duct sorbent injection, coal washing, and coal switching. In addition to these control measures, Georgia Pacific submitted two control scenarios as part of their BART exemption modeling request (see section 7.7) that included the addition of lower amounts of caustic to their existing scrubbers (approximately 68% and 37% SO2 reduction). All of the control options could be installed prior to 2012 except the wet FGD which could be installed before 2013. All three of the scrubber options (wet FGD, adding spray towers to the existing scrubbers, and adding caustic to the existing venturis) result in 15,000 tons/year of solid waste. There were no significant energy impacts addressed by the company. The remaining useful life of the unit extended past 2018 and the control equipment amortization period.

Out of all the control options considered, adding caustic to the existing venturi scrubber and in-duct sorbent injection were considered reasonably cost effective ($1675/ton and

$849.2MM/Mm^{-1} at Saint Marks for adding caustic to the scrubber and $1663/ton and $843. 2MM/Mm^{-1} at Saint Marks for in-duct sorbent injection). These were considered cost effective due to the relatively low visibility impact on only one Class I area (although St. Marks is not clearly meeting the uniform rate of progress.) Since the company submitted control options for three different levels of caustic use (79%, 68%, and 37% SO2 reduction), GA EPD analyzed the information to determine which level of caustic use was considered reasonable (in-duct sorbent injection achieves approximately 70% reduction, which is within the range of control efficiencies for caustic scrubbing). As part of Georgia Pacific's BART exemption modeling, the company has proposed SO2 emission limits of 135 pounds each per hour from Power Boilers 1 and 2, along with additional limits of Recovery Boiler 3 (see section 7.7.2 for further discussion on these BART exemption limits). A limit of 135 lb/hr would result in maximum annual emissions of 591 tons/yr of SO2. This results in a 70% reduction. The actual annual reduction should be even higher since the boiler would not be expected to emit SO2 at the maximum allowable level for an entire year. Therefore, the 70+% reduction required by the BART exemption limit satisfies the requirement for reasonable progress. No additional limitations will be required.

Georgia Pacific, Cedar Springs, Recovery Boiler R402 (Recovery Boiler 3) - This unit contributes about 0.8 % to the sulfate visibility impairment at Saint Marks class I area. The baseline SO2 emissions were 1726 tons/year. (Although, Georgia-Pacific submitted 2006 and 2007 SO2 emissions significantly lower than this baseline at 462 and 741 tons/year, respectively.

The 4-factor analyses reviewed switching from No. 6 fuel oil to No. 2 fuel oil (0.5 % sulfur), switching to 1% sulfur No. 6 fuel oil, and the installation of a new concentrator and new multi-level air system. The company did not provide any indications that any of the control options could not be installed prior to 2012. No negative energy impacts or non-air quality environmental impacts were addressed by the company. Remaining useful life of the units extended past 2018 and the control equipment amortization periods.

Of all of the control options considered, none were considered reasonable, given the relatively low visibility impact on a single Class I area. Therefore no additional controls will be required for Regional Haze Reasonable Progress.

Georgia Pacific, Savannah River, Mill Boilers B001, B002, and B003 (Nos. 3, 4, and 5 Boilers) – These are three relatively similar boilers, with B002 and B003 being almost identical. The units significantly impact one class I area (approximately 1.1%, 0.9%, and 0.8% at Wolf Island for B001, B002, and B003, respectively). The baseline SO2 emissions for the three boilers are 1659 tons/yr, 1195 tons/yr, and 1190 tons/yr. Note that all three of these are re-circulating fluidized bed boilers with limestone injection in the combustion chamber. B001 currently achieves approximately 87% SO2 removal and Boilers B002 and B003 achieve approximately 90% SO2 removal.

The 4-factor analyses reviewed wet FGD, circulating fluidized bed scrubber, switching from petroleum coke to 100% coal, increased limestone injection, and rotating opposed fire air. Out of all the proposed changes, only increased limestone injection could occur prior to 2012. All other control measures could not be installed until after 2012, although estimated control dates were not provided. Wet FGD controls would result in increased water use and wastewater discharges. No significant energy impacts were addressed by the company. Remaining useful life of the units extended past 2018 and the control equipment amortization periods. Increased limestone injection would result in increased solid waste generation. Georgia-Pacific conducted trial operations with increased limestone injection rates and found that SO2 removal could only be increased by an additional two percent (from 87% to 89% for B001 and from 90% to 92% for B002 & B003). Revised cost estimates were also derived from the trial operations.

Of all of the control options considered, none were considered reasonable, given the resulting control efficiencies and the relatively low visibility impact on a single Class I area. Therefore no additional controls will be required for Regional Haze Reasonable Progress.

Georgia Power, Plant Kraft, Steam Generators 1, 2, and 3 – These are three coal-fired steam generating units (i.e., boilers) rated at 50, 54, and 104 MW, respectively. Units 1 and 2 each impact Wolf Island Class I area by approximately 0.5%. Unit 3 was initially determined to impact three Class I areas (approximately 3.3% at Wolf Island, 0.9% at Okefenokee, and 0.8% at Cape Romain). However, with the projected reduction in SO2 emissions by 2018, the impact on Okefenokee and Cape Romain should drop below the 0.5% threshold and the impact at Wolf Island should drop below 2%. The 2018 baseline SO2 emissions for units 1 through 3 were initially estimated by VISTAS at 691 tpy, 704 tpy, and 4474 tpy, respectively. As part of the supporting documentation for the 4-factor analyses, Georgia Power provided projected heat input through 2018 for these units. Those projections indicate that SO2 emissions will be 632 tpy, 889 tpy, and 2455 tpy, respectively. While the heat inputs provided by Georgia Power for units 1 and 2 are similar to the VISTAS 2018 projections, Georgia Power's projection for Unit 3 represents a 45 percent reduction in heat input and SO2. This was explained by Georgia Power as the result of additional capacity coming on line somewhere else between 2010 and 2017. The reduction in heat input for Plant Kraft is expected to occur by around 2015. GA EPD has utilized these revised heat inputs in conducting the 4-factor analyses.

GA EPD can verify the heat input reduction during development of the next Regional Haze SIP (due in 2017).

The same control measures were analyzed for the four statutory factors for all three units: wet FGD, coal switching, and coal washing. Wet FGD could not be installed until 2016 because of required control device installations scheduled up until 2015 in Georgia Power's system. The company did not address the implementation time for the other control options. All three control options would require additional energy usage. Wet FGD and coal washing would result in increased water usage and wastewater discharges as well as additional solid waste generation. The remaining useful life of the units extended past 2018 and the control equipment amortization periods. The costs of wet FGD and coal switching were relatively high ($3216 to $8161/ton and $56.9MM to $144.5MM/Mm^{-1} for wet FGD and $4041to $4306/ton and $71.5MM/Mm^{-1} for coal switching). Coal washing was relatively cost effective ($1839 to $1847/ton and $32.5 to $32.7/Mm^{-1}) but the control efficiency is only 6%. Regarding non-air environmental impacts, the company indicated that coal switching could possibly reduce boiler efficiency, would use up to 7500 gallons (at Unit 3) per day of water, would result in acidic wastewater requiring treatment, and would result in coal refuse in the amount of approximately 5% of the total coal consumption. This control efficiency is projected to achieve low extinction reductions (which are visibility improvements) at Wolf Island. Based on the relatively low control efficiency of this option, the negative non-air environmental impacts, and the relatively low visibility impact, coal washing was determined not to be reasonable. Based on the above considerations, no additional controls will be required for any of the Plant Kraft units.

Georgia Power, Plant McIntosh, Steam Generator 1 – This coal-fired steam-generating unit (i.e., boiler) is rated at 178 MW. This unit was initially determined to impact five Class I areas (approximately 4.1% at Wolf Island, approximately 1.2% at Okefenokee, approximately 0.6% at Saint Marks, approximately 1.5% at Cape Romain, and approximately 0.7% at Swanquarter). However, with the projected reduction in SO2 emissions by 2018, the impact on all of these except Wolf Island should drop below the 0.5% threshold and the impact at Wolf Island should drop to close to 1%. The 2018 baseline SO2 emissions were initially estimated by VISTAS at 7015 tpy. As part of the supporting documentation for the 4-factor analyses, Georgia Power provided projected heat input through 2018 for this unit. Those projections indicate that SO2 emissions will drop to 1860 tpy by 2018. Georgia Power’s projection represents a 73 percent reduction in heat input and SO2. This was explained by Georgia Power as a result of additional capacity coming on line somewhere else between 2010 and 2017. The reduction in heat input for Plant McIntosh is to occur between around 2011 and 2016. GA EPD has utilized this revised SO2 emission rate in conducting the 4-factor analyses. GA EPD can verify the heat input reduction during development of the next Regional Haze SIP (due in 2017).

Georgia Power analyzed the following control measures: wet FGD, coal switching, and coal washing. Wet FGD could not be installed until 2016 because required control device installations scheduled up until 2015 in Georgia Power’s system. The company did not address the implementation time for the other control options. All three control options would require additional energy usage. Wet FGD and coal washing would result in increased water usage and wastewater discharges as well as additional solid waste generation. The remaining useful life of the units extended past 2018 and the control equipment amortization periods. The cost effectiveness of all the control operations were relatively high ($7131/ton and $118.5MM/Mm^{-1} for wet FGD, $4306/ton and \$71.5MM/Mm^{-1} for coal switching, and \$5334/ton and \$91.9MM/Mm^{-1} for coal washing). Based on these factors, no additional controls will be required Plant McIntosh.

Georgia Power, Plant Mitchell, Steam Generator 3 – This coal-fired steam-generating unit (i.e., boiler) is rated at 163 MW. (Note that this is the only remaining operational boiler at Plant Mitchell.) This unit was initially determined to impact two Class I areas (approximately 0.8% at Okefenokee and approximately 2.7% at Saint Marks). However, with the projected reduction in SO2 emissions by 2018, the impact on Okefenokee should drop below the 0.5% threshold and the impact on Saint Marks should drop to below 1%. The 2018 baseline SO2 emissions were initially estimated by VISTAS at 4930 tpy. As part of the supporting documentation for the 4-factor analyses, Georgia Power provided projected heat input through 2018 for this unit. Those projections indicate that SO2 emissions will drop to 1189 tpy by 2018. Georgia Power's projection represents a 76 percent reduction in heat input and SO2. This was explained by Georgia Power as a result of additional capacity coming online somewhere else starting in 2010. The reduction in heat input for Plant Mitchell is to occur between around 2008 and 2010. GA EPD has utilized this revised SO2 emission rate in conducting the 4-factor analyses. GA EPD can verify the heat input reduction during the Regional Haze mid-course review in 2012.

Georgia Power analyzed the following control measures: wet FGD and coal switching. Wet FGD could not be installed until 2016 because required control device installations scheduled up until 2015 in Georgia Power's system. The company did not address the implementation time for coal switching. Both control options would require additional energy usage. Georgia Power did not indicate any additional water use, wastewater discharge, or solid waste generation issues for any of the control options. The remaining useful life of the units extended past 2018 and the control equipment amortization periods. The cost effectiveness for wet FGD was high (\$9119/ton and \$148.5MM/Mm^{-1}). The cost effectiveness for coal switching was more reasonable (\$2347/ton and \$38.2MM/Mm^{-1}), but the control efficiency was relatively low at 43%. Based on these factors, including the projected significant utilization drop within the next few years, no additional controls will be required for Plant Mitchell.

International Paper, Savannah, Power Boiler 13 – This is a 1280 MMBtu/hr coal, oil, and woodwaste fired boiler. It also combusts both low-volume high-concentration (LVHC) and high-volume low-concentration (HVLC) non-condensable gases from the pulping process and stripper off-gas (SOG) from the stripper used to control HAP emissions from wastewater streams. Baseline emissions are 8578 tons/year with approximately 1944 tons/yr of this coming from the combustion of LVHC, HVLC, and SOG. This unit significantly contributes to the sulfate visibility impairment at five Class I areas (approximately 6.4% at Wolf Island, approximately 1.7% at Okefenokee, approximately 0.7% at Saint Marks, approximately 1.6% at Cape Romain, and approximately 0.9% at Swanquarter). This is the highest number of Class I areas significantly impacted by any single emissions unit of all those reviewed.

The 4-factor analysis reviewed wet FGD (packed tower), FGD (wet limestone spray tower), semi-dry lime spray tower, fuel switching to natural gas, dry sorbent injections, and a stand-alone RTO with SO2 scrubbing for the control of LVHC, HVLC, and SOG (this control option was presented as three different combinations of LVHC, HVLC, and SOG combustion). Also, International Paper (IP) later suggested an SO2 reduction of 2000 tons/year as a control option that would provide maximum flexibility for compliance. Except for the 2000 ton/year reduction alternative, all of these control options could be implemented by 2012. International Paper requested a 2016 compliance date for the 2000 ton/yr reduction alternative. This compliance date is necessary in order for the company to take into consideration any reductions that will occur as a result of the Boiler MACT and the uncertainty surrounding that standard. The remaining useful life of the unit extended past 2018 and the control equipment amortization period. The wet FGD and all three RTO options had an impact on water usage and wastewater discharge. GA EPD Air Branch checked with GA EPD Watershed Protection Branch (WPB) personnel to discuss the potential water usage and wastewater discharges associated with these controls. WPB associates indicated that they would not be a problem as long as there was not additional BOD load on the Savannah River. Based on the type of chemicals that would be associated with effluent from a wet FGD, WPB associates stated that the controls should not result in additional BOD load. However, because of the current problem with dissolved oxygen in the Savannah River (there are strict limitations and perhaps a moratorium on any additional DO load to the river), any projects that could possibly increase DP load were not considered reasonable at this time. FGD (wet limestone spray tower, semi-dry lime spray tower, and dry sorbent injection) resulted in additional solid waste generation. There were energy impacts associated with all but the fuel switching options. These energy costs were factored into the overall control cost efficiency.

Regarding the company’s cost efficiency estimates, EPD’s review indicated that the cost estimates for a packed tower wet FGD and wet limestone spray tower were higher than expected based on a number of metrics (cost per ACFM is about four times higher than other units of comparable size, company’s estimate is three to eight times higher than EPA cost estimation software, and International Paper used an admittedly conservative retrofit factor) plus the company used a cost estimation model not recommended by EPA. In a letter to IP on 12/21/2007, GA EPD requested site-specific cost analyses for these control options. In that letter, GA EPD stated that if site-specific estimates were not provided, that control option recommendations would be made with the understanding that the cost estimates may be overstated. In response, International Paper chose not to provide site-specific cost estimates as requested. However, despite the possibly high cost effectiveness numbers the FGD - wet limestone spray tower ($4391/ton) was determined not to be cost effective. Wet FGD – packed tower, was not considered reasonable because of the possible impact on DO load to the Savannah River. Fuel switching to natural gas ($9506/ton), and dry sorbent injection ($5223/ton) were determined not to be reasonable because of cost effective.

The next most effective control option is a 6758 tons per year emission limit. However, since the option was proposed by the company, it had to be considered cost-effective. No specific emission reduction methodologies were associated with this control option, however, there are certain control methodologies that are under consideration (see Appendix H for details). The 6758 ton per year limit was determined by reducing the projected 2018 SO2 emissions baseline of 8758 tons per year by 2000 tons. EPD reviewed recent SO2 emissions data and determined that the 8758 tons per year baseline is a reasonable and not over-inflated baseline. A compliance date of 2016 was proposed in order to take into consideration any controls that will be required under the Boiler MACT currently under development. The Boiler MACT has been vacated and remanded to EPA, and EPA is developing a proposed boiler MACT rule. A 2016 compliance date should provide sufficient time for the MACT to be proposed and promulgated, provide the three years required for compliance with the standard, and provide time to determine an appropriate method for complying with the 6758 SO2 emissions limit from Power Boiler 13 following compliance with the MACT standard.

Out of all of the control options considered, a 2000 tons per year reduction alternative was considered reasonably cost effective. This results in an emission limit of 6758 tons per year. The baseline SO2 emissions are 8578 tons/yr. A review of past CERR reports SO2 emissions from PB13 at 7620 to 7699 tpy from 2002-2005 and increasing to 8974 tpy in 2006. The increase in 2006 may be due to the compliance date for phase II of the “Cluster Rule” MACT standard that required collection and treatment of emissions from pulp mill condensate beginning in 2006. This would have resulted in increased sulfur emission from SOG which were then combusted in PB13 to form SO2. Therefore, the 8578 ton/year estimate is a good baseline for determining allowable emissions based on a selected control technology. A 2000 tons per year reduction results in an emission limit of 6578 tons/year. This limit will include SO2 emissions resulting from the combustion of LVHC, HVLC, and SOG, whether they are combusted in Power Boiler 13 or some other combustion device. In order to provide flexibility for the facility, an emission limit of 6578 tons/12-consecutive months will be required for Power Boiler 13 as a requirement of Regional Haze reasonable progress with a compliance date of 2016.

Temple-Inland Rome Linerboard, No. 4 Power Boiler - This is a 565 MMBtu/hr coal and oil fired boiler. This unit significantly contributes to the sulfate visibility impairment at two Class I areas (approximately 4.4% at Cohutta and approximately 1.0% at Joyce Kilmer/Slickrock).

The 4-factor analysis reviewed two wet FGD configurations [magnesium enhanced lime (MEL) and limestone forced oxidation (LSFO)], dry FGD (lime absorbent), fuel switching, and dry sorbent injection. All of these control options could be implemented by 2012. The remaining useful life of the unit extended past 2018 and the control equipment amortization period. The wet FGD options had an impact on water usage. GA EPD Air Branch checked with GA EPD Watershed Protection Branch personnel to discuss the potential water usage and was informed that the mill had sufficient capacity within their currently permitted water withdrawal permit to easily handle the increased water use associated with wet FGD. All of the control options resulted in additional solid waste generation. There were energy impacts associated with all of the control options. These energy costs were factored into the overall control cost efficiency. None of the control options considered had a cost effectiveness that was determined reasonable at this time. Of all of the control options considered, none were considered reasonable at this time. The fact that the affected Class I areas impacted by this unit are predicted to meet the Uniform Rate of Progress in 2018 with controls that are already on the books was a key factor in determining what was considered “reasonable” for reasonable progress requirements for this source. This determination may be revisited at the mid-course review or when determining future Regional Haze reasonable progress goals (i.e., future Regional Haze SIPs).

7.6.4 Required Controls for Sources Subject to Four-Factor Analysis in Georgia

Table 7.6.4-1 provides a summary of the required emission limits for the sources subject to 4-factor analysis in Georgia. The final determinations were based on the 4-factor analyses and reviews and are detailed in Appendix H. GA EPD decided on limits that would be consistent with controls that were reasonably cost effective. Reasonable costs were based on the number of Class I areas impacted, the magnitude of visibility impact on Class I area, progress of the impacted Class I area relative to the glide slope, and cost effectiveness. Once the control or controls were determined to be reasonable, an emission limit was applied based on the expected emission reduction from the control technology or technologies to allow the facility flexibility in meeting the limit. The control technology was not required. This approach was determined to be an effective means of obtaining reasonable emission reductions.

Note that this table presents four-factor data only for controls that were deemed to be reasonable and cost-effective. Table 6.1 of Appendix H includes four-factor data on control options that were deemed not cost-effective.

The required emission limits will be implemented by adding them as permit conditions (see Appendix M) to the Title V operating permits of the affected facilities. Recordkeeping, monitoring, and testing requirements will be included to demonstrate compliance with the limits. These requirements will be consistent with Georgia EPD’s Procedures for Testing and Monitoring Sources of Air Pollutants (PTM) and must meet the requirements of Compliance Assurance Monitoring (40 CFR Part 64) or Periodic Monitoring [40 CFR 70.6(3)(i)(B)], as appropriate.

Table 7.6.4-1. Summary of Required Emissions Limits for Sources Subject to Four-Factor Analyses

Facility	Emissions unit	2018 SO2 emissions estimate, uncontrolled (tpy)[1]	% of sulfate visibility impact at Class I area	Reasonable cost-effective control options[2,4]	Annual cost ($/ton)[1,4]	Cost/visibility at nearest Class I ($$10^6/Mm^{-1}$)[4]	Life of unit	Non-air environmental impacts[4]	Required emission limit (tons/12 consecutive months)
GA Pacific Brunswick Cellulose	Power Boiler No. 4 (F1)	1642	12.55 WOLF 3.89 OKEF	Oil limit and in-duct sorbent injection	3562	20.7	Beyond 2018	8000 tons/yr of solid waste	568
		1099[3]		Oil limit and fuel switch to S = 1.0%	3228	18.8		None	
	Recovery Boiler No. 6 (M24)	193 VISTAS	1.31 WOLF	No cost-effective controls	No cost-effective controls	No cost-effective controls	Beyond 2018	No cost-effective controls	Not Required
GA Pacific Cedar Springs	Power Boiler U500	1976	1.08 SAMA	Add caustic to existing venturi scrubber	1675	849.2	Beyond 2018	15000 tons/yr of solid waste	BART exemption modeling limit of 135 lb/hr
				In-Duct sorbent injection	1663	843.2			
	Power Boiler U501	1976	1.13 SAMA	Add caustic to existing venturi scrubber	1675	849.2	Beyond 2018	Not Provided	BART exemption modeling limit of 135 lb/hr
				In-Duct sorbent injection	1663	843.2			
	Recovery Boiler R402	1726 VISTAS	0.77 SAMA	No cost-effective controls	No cost-effective controls	No cost-effective controls	Beyond 2018	No cost-effective controls	Not Required

Table 7.6.4-1. Summary of Four-Factor Analyses (continued)

Facility	Emissions unit	2018 SO2 emissions estimate, uncontrolled (tpy)[1]	% of sulfate visibility impact at Class I area	Reasonable cost-effective control options[2,4]	Annual cost ($/ton)[1,4]	Cost/visibility at nearest Class I ($10^6/Mm^-1)[4]	Life of unit	Non-air environmental impacts[4]	Required emission limit (tons/12 consecutive months)
GA Pacific – Savannah R. Mill	Boiler B001	1659	1.11 WOLF	No cost-effective controls	No cost-effective controls	No cost-effective controls	Beyond 2018	No cost-effective controls	Not Required
	Boiler B002	1195	0.86 WOLF		No cost-effective controls	No cost-effective controls	Beyond 2018	No cost-effective controls	Not Required
	Boiler B003	1190	0.77 WOLF		No cost-effective controls	No cost-effective controls	Beyond 2018	No cost-effective controls	Not Required
GA Power Company Plant Kraft	Steam Generator SG01	632	0.51 WOLF	No cost-effective controls. Facility forecasts capacity utilization drops, around 2015, to 23%, 34%, and 50% (SG01, SG02, SG03).	No cost-effective controls	No cost-effective controls	Beyond 2018	No cost-effective controls	Not Required
	Steam Generator SG02	889	0.52 WOLF		No cost-effective controls	No cost-effective controls	Beyond 2018	No cost-effective controls	Not Required

Facility	Emissions unit	2018 SO2 emissions estimate, uncontrolled (tpy)[1]	% of sulfate visibility impact at Class I area	Reasonable cost-effective control options[2,4]	Annual cost ($/ton)[1,4]	Cost/visibility at nearest Class I ($$10^6/Mm^{-1}$)[4]	Life of unit	Non-air environmental impacts[4]	Required emission limit (tons/12 consecutive months)
GA Power Company Plant Kraft	Steam Generator SG03	2455	3.30 WOLF 0.85 OKEF 0.81 ROMA	No cost-effective controls. Facility forecasts capacity utilization drops, around 2015, to 23%, 34%, and 50% (SG01, SG02, SG03	No cost-effective controls	No cost-effective controls	Beyond 2018	No cost-effective controls	Not Required
GA Power Company Plant Mitchell	Steam Generator SG03	1189	2.74 SAMA 0.77 OKEF	No additional controls are required since the facility forecasts a capacity utilization drop to 11 % by 2018	No cost-effective controls	No cost-effective controls	Beyond 2018	No cost-effective controls	Not Required
GA Power Company Plant McIntosh	Steam Generator SG01	1860	4.13 WOLF 1.20 OKEF 0.55 SAMA 1.35 ROMA 0.72 SWAN	No additional controls are required since the facility forecasts a capacity utilization drop to 24 % by 2018	No cost-effective controls	No cost-effective controls	Beyond 2018	No cost-effective controls	Not Required
Facility	**Emissions unit**	**2018 SO2 emissions estimate, uncontrolled**	**% of sulfate visibility impact at Class I area**	**Reasonable cost-effective control**	**Annual cost ($/ton)[1,4]**	**Cost/visibility at nearest Class I ($$10^6/Mm^{-1}$)[4]**	**Life of unit**	**Non-air environmental impacts[4]**	**Required emission limit (tons/12 consecutive**

		(tpy)[1]		options[2,4]					months)
International Paper – Savannah Mill	Power Boiler PB 13	8578	6.64 WOLF 1.66 OKEF 0.70 SAMA 1.55 ROMA 0.86 SWAN	6578 tons per year emission limit[5]	Not provided[5]	Not provided[5]	Beyond 2018	Not provided[5]	6578
Temple-Inland Rome Linerboard	Power Boiler F4	3837	4.42 COHU 0.99 JOKI	No additional controls were cost effective	No cost-effective controls	No cost-effective controls	Beyond 2018	Reduction of power generation, water consumption, and gypsum generation	Not Required

(1) from facility-provided data, unless indicated otherwise

(2) in the case of multiple options, each option would provide approximately the same level of SO2 reductions

(3) revised estimate, based on 2002 modification to boiler to increase efficiency; lowered typical oil usage to 5 million gal/yr or less

(4) See Appendix H, Table 6.1, for four-factor data on control options that were deemed not cost-effective.

(5) Control options evaluated for International Paper PB 13 are documented in Appendix H. Several options are capable of achieving a reduction to 6578 tons/year.

Class I Areas:

WOLF Wolf Is.
OKEF Okefenokee
SAMA St. Marks
ROMA Romain
SWAN Swan Quarter
COHU Cohutta
JOKI Joyce Kilmer

Three facilities, due to resource limitations and/or uncertainty regarding future operations, requested limits on their affected emissions units in lieu of performing four-factor analyses: Rayonier Performance Fibers, Packaging Corporation of America, and Southern States Phosphate and Fertilizer. The required limits dropped the sulfate contributions of these units below 0.5 percent of the total sulfate impact on any affected Class I areas.

Table 7.6.4-2 lists the limits and compliance dates for the four-factor and the four-factor exempted units. In addition the estimated tons reduced with the new limits are presented. Limits for the four-factor units are on actual emissions as currently stated, but this could change if additional conditions are added during the permit amendment process. The limits for the four-factor exempted units are based on actual (rather than potential) emissions, as the permit conditions do not depend solely on fuel sulfur content or on equipment capacities. Note that the permit limits for PB02, RF01, and RF04 at Rayonier Performance Fibers are on fuel usage and on stack SO2 concentrations (RF01 and RF04 only) that have been calculated to achieve the ton-per-year limits shown in the table. The limit on RF01 becomes effective upon the completion of the Plant's Phase 1 projects, which include the addition of SO2 control (staged air combustion). The limit on RF04 becomes effective upon the completion of the Plant's Phase 2 projects, which include the addition of SO2 control (staged air combustion). The permitting of Phases 1 and 2 allows for increased production and burning of black liquor solids, but only after the emissions controls are installed. At the time of this SIP submittal, the projects were suspended due to depressed market conditions in 2009.

Figure 7.6.4-1 shows the locations of facilities with emission units eligible for 4-factor analysis. In addition, the basis for reductions (control or exemption) is indicated for those facilities at which reductions are required.

Table 7.6.4-2. Permit Limits for Implementation of Reasonable Progress Emissions Reductions

Facility	Emissions Unit	Permit limit (tpy of SO2, except as noted)	Estimated Tons Reduced
GA Pacific – Brunswick Cellulose	F1 Pwr. Boiler 4	Not more than 568 tons SO2 per 12 consecutive months, compliance date of January 1, 2012[1]	1074
Georgia Pacific – Cedar Springs	Power Boiler U500	135 pound SO2 per hour (same as BART exemption modeling limit)	1385
	Power Boiler U501	135 pound SO2 per hour (same as BART exemption modeling limit)	1385
International Paper – Savannah	Pwr. Boiler 13, including combustion of process organic emissions	Not more than 6758 tons SO2 per 12 consecutive months, compliance date of January 1, 2016[2]	2000
Packaging Corp. of America[3]	CE Power Boiler	Not more than 600 tons SO2 per 12 consecutive months, compliance date of January 1, 2012[1]	53
Rayonier Perf. Fibers[3]	PB02 Pwr. Boiler 2	Not more than 318 tons SO2 per 12 consecutive months, compliance date of June 4, 2008[4]	306
	PB03 Pwr. Boiler 3	Not more than 149 tons SO2 per 12 consecutive months, compliance date of June 4, 2008[4]	1448
	RF01 No. 5 Rec. Furn.	Not more than 194 tons SO2 per 12 consecutive months, compliance date tied to facility modification[5]	139
	RF04 No. 6 Rec. Furn.	Not more than 307 tons SO2 per 12 consecutive months, compliance date tied to facility modification[5]	27
Southern States Phosphate and Fertilizer[3]	SA02 Acid Plant 2	Not more than 580 tons SO2 per 12 consecutive months, compliance date of January 1, 2014[6]	228

(1) start of record-keeping; first 12 months will be January 1 – December 31, 2012
(2) start of record-keeping; first 12 months will be January 1 – December 31, 2016
(3) These facilities took limits on the respective units in order to be exempt from submitting four-factor analyses
(4) start of record-keeping; first 12 months will be June 4, 2008, through June 3, 2009
(5) The actual limits on RF01 and RF04 are stack concentrations of 15 ppm or less SO2 and 19 ppm or less SO2, respectively. The limit on RF01 becomes effective upon the completion of the Plant's Phase 1 projects, which include the addition of SO2 control (staged air combustion). The limit on RF04 becomes effective upon the completion of the Plant's Phase 2 projects, which include the addition of SO2 control (staged air combustion).
(6) start of record-keeping; first 12 months will be January 1 – December 31, 2014

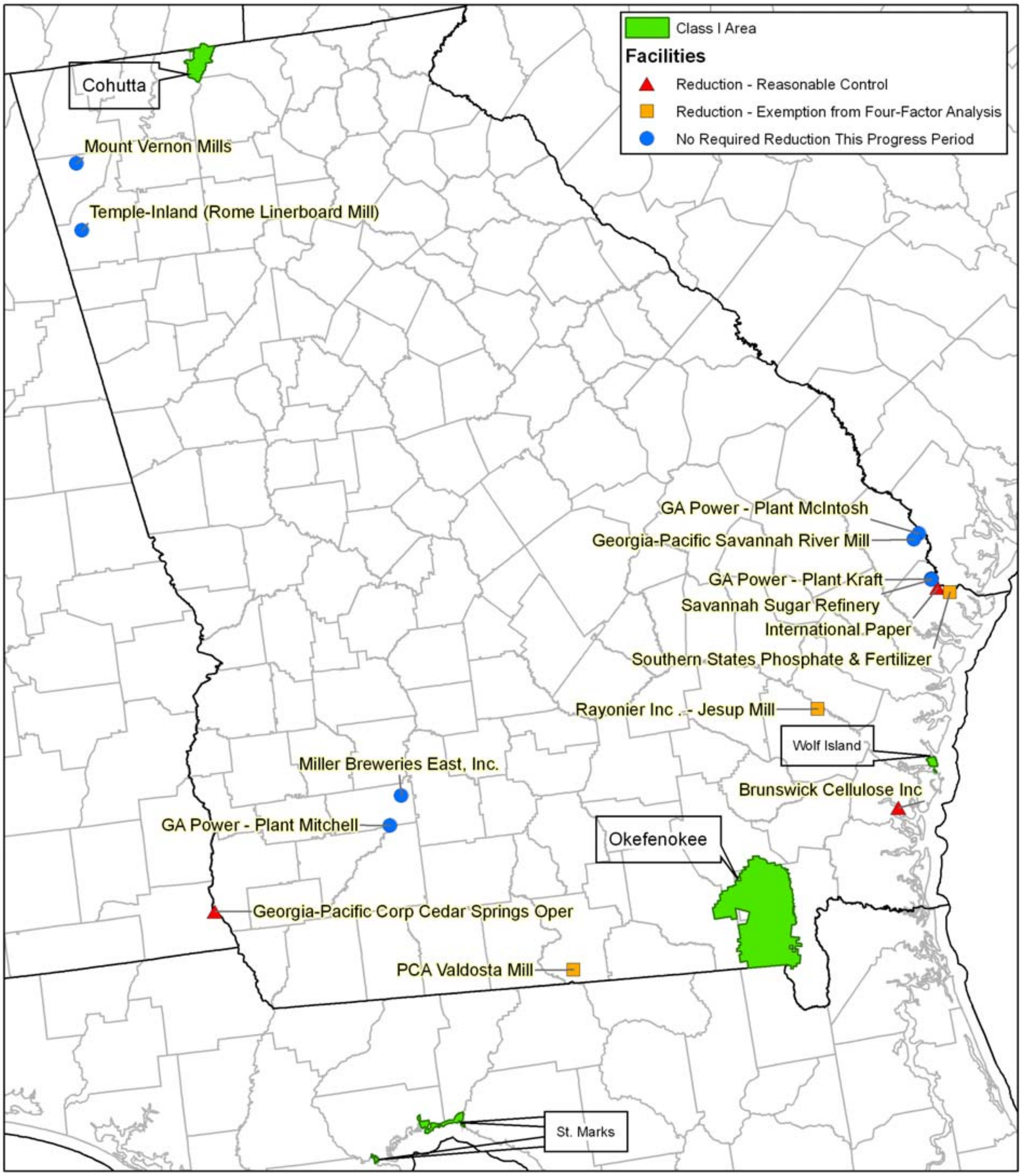


Figure 7.6.4-1. Locations Of Facilities With Emission Units Eligible
For Four-Factor Analysis

7.7 Control Determinations Representing Best Available Retrofit Technology (BART) for Individual Sources

Section 169A of the CAA directs States to assess certain large, older emission sources for additional controls in order to address visibility impacts. States are directed to conduct BART determinations for such sources in specific source categories and which contribute to visibility impairment in Class I areas. The 1999 regional haze rule includes the BART requirement, and directs States to include BART in their regional haze SIPs. On July 6, 2005, US EPA published a revised final rule, including Appendix Y to 40 CFR Part 51, the *Guidelines for BART Determinations Under the Regional Haze Rule* (the "BART Guidelines") that provides direction to states on determining which of these sources should be subject to BART, and how to determine BART for each source.

A BART-eligible source is one which has the potential to emit 250 tons or more of a visibility-impairing air pollutant, one which was put in place between August 7, 1962, and August 7, 1977, and one whose operations fall within one or more of 26 specifically listed source categories. Under the CAA, BART is required for any BART-eligible source that a State determines ‘‘emits any air pollutant which may reasonably be anticipated to cause or contribute to any impairment of visibility in any such area.’’

For those sources subject to BART, Section 169A(g)(7) of the CAA requires that States must consider the following factors in making BART determinations: (1) the costs of compliance, (2) the energy and non-air quality environmental impacts of compliance, (3) any existing pollution control technology in use at the source, (4) the remaining useful life of the source, and (5) the degree of improvement in visibility which may reasonably be anticipated to result from the use of such technology.

7.7.1 BART-Eligible Sources in Georgia

Table 7.7.1-1. Facilities with BART-eligible sources in Georgia

BART –Eligible Sources
Chemical Products Corporation
DSM Chemicals, North America
Georgia Pacific – Cedar Springs
Georgia Power – Plant Bowen
Georgia Power Plant Branch
Georgia Power – Plant Hammond
Georgia Power – Plant McDonough
Georgia Power – Plant Mitchell
Georgia Power – Plant Scherer
Georgia Power – Wansley
Georgia Power – Yates
International Paper – Augusta
International Paper – Savannah
Interstate Paper, LLC
Koch Cellulose (Georgia Pacific – Brunswick / Brunswick Pulp & Paper)
Lafarge Building Materials (Blue Circle Cement – Atlanta Plant)
Owens Corning
PCA –Valdosta (Tenneco Packaging, Inc.)
PCS Nitrogen
Prayon, Inc.
Rayonier (Rayonier ITT, Inc.)
Savannah Electric – Plant Kraft
Savannah Electric – Plant McIntosh
Tronox (Kerr – McGee / Kemira)

BART-eligible sources were identified using the methodology in the BART Guidelines:

- One or more emissions units at the facility fit within one of the 26 categories listed in the BART Guidelines;
- The emission unit(s) were in existence on August 7, 1977, and began operation at some point on or after August 7, 1962; and
- The limited potential emissions from all emission units identified in the previous two bullets emission units were greater than 250 tons or more per year of any of these visibility-impairing pollutants: SO2, NOx, and PM10.

The BART Guidelines recommend addressing these visibility-impairing pollutants: SO_2, NO_x, and particulate matter, and suggest that States use their best judgment in determining whether to address VOC or ammonia emissions. GA EPD addressed SO2 and NOx, and used particulate matter less than 10 microns in diameter (PM_{10}) as an indicator for particulate matter to identify BART-eligible units, as the BART guidelines recommend. As discussed in detail in Appendix H, VISTAS modeling demonstrated that VOCs and ammonia from point sources are not visibility-impairing pollutants. For this reason GA EPD did not evaluate emissions of VOCs and ammonia in BART determinations.

7.7.2 Determination of Sources Subject to BART in Georgia

Under the BART Guidelines, GA EPD may consider exempting some sources from BART if we find that they do not cause or contribute to visibility impairment in a Class I area. In accordance with the BART guidelines, GA EPD chose to perform source-specific analyses to determine which sources cause or contribute to visibility impairment using the CALPUFF model. The CALPUFF modeling protocol used for determining which facilities are subject to BART is included in Appendix H.7. In accordance with the Guidelines, a contribution threshold of 0.5 deciviews was used for determining which sources were subject to BART.

All of Georgia's BART-eligible sources submitted exemption modeling demonstrations. Twenty-two of the twenty-four sources were able to demonstrate exemption. Additional details including BART modeling protocols and exemption reports submitted by the facilities are available in Appendix H. Supporting files and databases that would be impracticable to print are available electronically, both on the submitted CD-R and via permanent EPD web links. In addition, files are permanently archived on EPD computer networks. To request access to any of these files please contact the Georgia EPD Air Protection Branch at (404) 363-7000. Facilities found to be subject to BART must complete a BART analysis.

Table 7.7.2-1 represents the facilities that were able to demonstrate exemption from BART based on CALPUFF modeling conducted using the VISTAS modeling protocol. All the listed facilities used old IMPROVE equation except Georgia Pacific Cedar Springs which used new IMPROVE equation to demonstrate its exemption from BART

Table 7.7.2-1 Exemption modeling results for BART-eligible sources.

Facility	Class 1 Areas Impacted	Grid Resolution	Delta-Deciviews
Chemical Products Corporation	Cohutta Wilderness Area	4 km	0.442
	Great Smoky Mountains National Par	4 km	0.173
	Joyce-Kilmer Wilderness Area	4 km	0.197
	Sipsey Wilderness Area	4 km	0.127
	Shining Rock Wilderness Area	4 km	0.090
DSM Chemicals, North America	Cape Romain Wilderness Area	12 km	0.094
	Cohutta Wilderness Area	12 km	0.112
	Great Smoky Mountains National Park	12 km	0.072
	Joyce-Kilmer Wilderness Area	12 km	0.036
	Okefenokee Wilderness Area	12 km	0.063
	Shining Rock Wilderness Area	12 km	0.069
	Wolf Island Wilderness Area	12 km	0.114
Georgia Pacific – Cedar Springs*	Okefenokee Wilderness Area	4 km	0.306
	St. Marks Wilderness Area	4 km	0.499
Georgia Power – Plant Branch	Cohutta Wilderness Area	4 km	0.17
	Great Smoky Mountains National Park	4 km	0.11
	Joyce-Kilmer Wilderness Area	4 km	0.09
	Okefenokee Wilderness Area	4 km	0.12
	Shining Rock Wilderness Area	4 km	0.09
	Wolf Island Wilderness Area	4 km	0.11
Georgia Power – Plant Hammond	Cohutta Wilderness Area	4 km	0.29
	Great Smoky Mountains National Park	4 km	0.08
	Joyce-Kilmer Wilderness Area	4 km	0.09
	Shining Rock Wilderness Area	4 km	0.05
	Sipsey Wilderness Area	4 km	0.06
Georgia Power – Plant McDonough	Cohutta Wilderness Area	4 km	0.19
	Great Smoky Mountains National Park	4 km	0.07
	Joyce-Kilmer Wilderness Area	4 km	0.07
	Shining Rock Wilderness Area	4 km	0.05
	Sipsey Wilderness Area	4 km	0.04
Georgia Power – Plant Mitchell	Okefenokee Wilderness Area	4 km	0.04
	St. Marks Wilderness Area	4 km	0.05
	Wolf Island Wilderness Area	4 km	0.02

Georgia Power – Plant Scherer	Cohutta Wilderness Area	4 km	0.08
	Great Smoky Mountains National Park	4 km	0.07
	Joyce-Kilmer Wilderness Area	4 km	0.07
	Okefenokee Wilderness Area	4 km	0.08
	Shining Rock Wilderness Area	4 km	0.06
	Wolf Island Wilderness Area	4 km	0.05
Georgia Power – Plant Wansley	Cohutta Wilderness Area	4 km	0.44
Georgia Power – Plant Wansley	Great Smoky Mountains National Par	4 km	0.17
	Joyce-Kilmer Wilderness Area	4 km	0.18
	Sipsey Wilderness Area	4 km	0.14
	Shining Rock Wilderness Area	4 km	0.12
Georgia Power – Plant Yates	Cohutta Wilderness Area	4 km	0.15
	Great Smoky Mountains National Par	4 km	0.05
	Joyce-Kilmer Wilderness Area	4 km	0.06
	Sipsey Wilderness Area	4 km	0.05
	Shining Rock Wilderness Area	4 km	0.03
International Paper – Augusta	Cape Romain Wilderness Area	4 km	0.211
	Cohutta Wilderness Area	4 km	0.114
	Great Smoky Mountains National Park	4 km	0.093
	Joyce-Kilmer Wilderness Area	4 km	0.086
	Linville Gorge Wilderness Area	4 km	0.103
	Okefenokee Wilderness Area	4 km	0.157
	Shining Rock Wilderness Area	4 km	0.127
	Wolf Island Wilderness Area	4 km	0.148
Koch Cellulose (GP – Brunswick, Brunswick Pulp and Paper	Cape Romain Wilderness Area	4 km	0.092
	Okefenokee Wilderness Area	4 km	0.282
	St. Marks Wilderness Area	4 km	0.055
	Wolf Island Wilderness Area	4 km	0.447
Owens Corning	Cohutta Wilderness Area	12 km	0.119
	Great Smoky Mountains National Par	12 km	0.051
	Joyce-Kilmer Wilderness Area	12 km	0.056
	Sipsey Wilderness Area	12 km	0.054
	Shining Rock Wilderness Area	12 km	0.072
PCA- Valdosta	Chassahowitzka Wilderness Area	12 km	0.197
	Okefenokee Wilderness Area	12 km	0.349
	St. Marks Wilderness Area	4 km	0.190
	Wolf Island Wilderness Area	12 km	0.181

PCS Nitrogen	Cape Romain Wilderness Area	4 km	0.359
	Cohutta Wilderness Area	12 km	0.409
	Great Smoky Mountains National Park	12 km	0.163
	Joyce-Kilmer Wilderness Area	12 km	0.175
	Linville Gorge Wilderness Area	12 km	0.393
	Okefenokee Wilderness Area	12 km	0.393
	Shining Rock Wilderness Area	12 km	0.220
	Wolf Island Wilderness Area	12 km	0.294
Prayon, Inc.	Cape Romain Wilderness Area	12 km	0.009
	Cohutta Wilderness Area	12 km	0.004
	Great Smoky Mountains National Park	12 km	0.002
	Joyce-Kilmer Wilderness Area	12 km	0.002
	Linville Gorge Wilderness Area	12 km	0.005
	Okefenokee Wilderness Area	12 km	0.007
	Shining Rock Wilderness Area	12 km	0.003
	Wolf Island Wilderness Area	12 km	0.005
Rayonier	Cape Romain Wilderness Area	12 km	0.132
	Okefenokee Wilderness Area	12 km	0.254
	St. Marks Wilderness Area	12 km	0.151
	Wolf Island Wilderness Area	12 km	0.319
Savannah Electric – Plant Kraft	Cape Romain Wilderness Area	4 km	0.18
	Okefenokee Wilderness Area	4 km	0.18
	Wolf Island Wilderness Area	4 km	0.21
Savannah Electric – Plant McIntosh	Cape Romain Wilderness Area	4 km	0.04
	Okefenokee Wilderness Area	4 km	0.03
	Wolf Island Wilderness Area	4 km	0.03
Tronox (Kerr-McGee/Kemira)	Cape Romain Wilderness Area	12 km	0.134
	Okefenokee Wilderness Area	12 km	0.213
	Wolf Island Wilderness Area	12 km	0.246

* Note: All sources used the old IMPROVE equation except Georgia Pacific – Cedar Springs, which used the new IMPROVE equation.

Table 7.7.2-2 represents the facilities that were able to demonstrate exemption from BART based on model plant criteria or by accepting emissions limits for visibility causing pollutants.

Table 7.7.2-2. Facilities exempted from BART via other methods

Facility Name	Pollutant	Potential Emissions Pre- limit (tpy)	PTE 2002 SO2+NOx+ PM of BART - Eligible Equipment (tpy)	Min distance to Nearest Class 1 Area (km)	Potential Emissions Post – limit (tpy)	Effective Date
Georgia Pacific – Cedar Springs	SO2	8506.2	17684	137.1	Power Boilers No. 1 and No. 2 have limits of 135lbs/hr each. This equates to 591 tpy. Recovery Boiler No. 3 has a limit of 350 ppm on a dry basis corrected to 8 percent oxygen as a 24-hour average when firing black liquor solids. This equates to 3600 tpy. Facility wide limits are equivalent to 4782.36 tpy.	July 30, 2011.
LaFarge Building Materials*		--	540	114.3	No limit. Facility Exempt via Model Plant Exemption.	--
International Paper – Savannah		--	51.4	83.6	No limit. Facility Exempt via Model Plant Exemption.	--

*Note: After this analysis was completed, Lafarge Building Materials shut down and removed BART-eligible equipment resulting in a reduction of 531.4 tons of potential emissions of SO2 + NOx + PM effectively eliminating their eligibility to BART.

Georgia Pacific Cedar Springs was able to demonstrate exemption from BART by accepting SO_2 emissions limits on Power Boilers 1 and 2 (135 lb/hr each) and on Recovery Boiler 3 (350 ppm). These limits result in 0.499 deciview impact at St. Marks and a 0.306 deciview impact at Okefenokee NWR. The permit will be issued with Federally-enforceable limits and a Federally- enforceable condition that requires the facility to monitor their emissions and to notify EPD if they exceed the BART exemption limit.

EPA established specific exemption thresholds or criteria based on CALPUFF modeling conducted for a model plant. The criteria that sources must meet include potential emissions of SO_2 and NO_x combined of less than 500 tons per year and a distance of greater than 50km from any Class I area, or combined potential emissions less than 1000 tons per year with a distance greater than 100km from any Class I area. In situations where combined SO_2 and NO_x emissions are less than 500 or 1000 tons per year, but PM emissions are greater than 15 tons per year, the emissions of SO_2, NO_x and PM may be combined using weighting factors (Appendix P) and compared to 500 or 1000 tons. Both Lafarge Building Materials and International Paper – Savannah meet the model plant exemption criteria. Please see Table 7.7.2-2 for emissions and distances from Class I areas.

One of Georgia's BART-eligible sources is an EGU. This Georgia power plant Bowen is subjected to CAIR. US EPA has determined that, as a whole, the CAIR cap-and-trade program improves visibility more than implementing BART for individual sources in states affected by CAIR. A State that opts to participate in the CAIR program under Part 96 AAA-EEE need not require an affected BART-eligible EGU to install, operate, and maintain BART for SO_2 or NO_x emissions. Since Georgia is participating in CAIR and accepts US EPA's overall finding that CAIR "substitutes" for BART for NO_x and SO_2, Georgia's EGUs were allowed to submit BART exemption modeling demonstrations for PM emissions only. All EGUs other than Georgia Power-Plant Bowen demonstrated that they do not contribute to visibility impairment in any Class I area.

In total, twenty-two of Georgia's twenty-four BART-eligible sources were able to demonstrate that they did not cause or contribute to visibility impairment in any Class I area within 300 km of the source.

7.7.3 BART Determination for Subject-to-BART Sources

Two sources, Interstate Paper in Riceboro, Georgia, and Georgia Power Plant Bowen in Cartersville, Georgia, were unable to demonstrate a contribution of less than 0.5 dv at all Class I areas within 300 km from their BART-eligible sources. These two sources are considered to be "subject to BART" and were required to do a complete BART determination containing their evaluation of potential BART options and accordingly submit permit applications. Interstate Paper failed to perform a BART determination, therefore the analysis was performed by EPD and the results presented are those determined by EPD. Their BART determination results are give in table 7.7.3-1, for a more detailed discussion of the BART determinations, please see Appendix H.8.

Table 7.7.3-1 BART determination results for subject-to BART sources

Source	Unit	Required Control Option	Control Efficiency	Cost of Control ($/ton)
Interstate Paper	Power Boiler (F1)	Combustion of natural gas only except during periods of curtailment	99%	370
	Recovery Boiler	No cost effective control options Available	Not required	Not required
	Lime Kiln	No cost effective control options Available	Not required	Not required
Georgia Power Company – Plant Bowen	Boiler 1	No cost effective control options Available	Not required	Not required
	Boiler 2			
	Boiler 3			
	Boiler 4			

Figure 7.7.3-1 shows the locations of facilities with emission units eligible for BART analysis. In addition, the basis for reduction or no reduction is indicated for each facility.

The required operational restrictions will be implemented by adding them as permit conditions to the Title V operating permit of Interstate Paper (see Appendix M). Georgia EPD has notified Interstate Paper in writing of the intent to revise its air permit. Recordkeeping, monitoring, and testing requirements will be included to demonstrate compliance with the limits. These requirements will be consistent with Georgia EPD's Procedures for Testing and Monitoring Sources of Air Pollutants (PTM) and must meet the requirements of Compliance Assurance Monitoring (40 CFR Part 64) or Periodic Monitoring [40 CFR 70.6(3)(i)(B)], as appropriate.

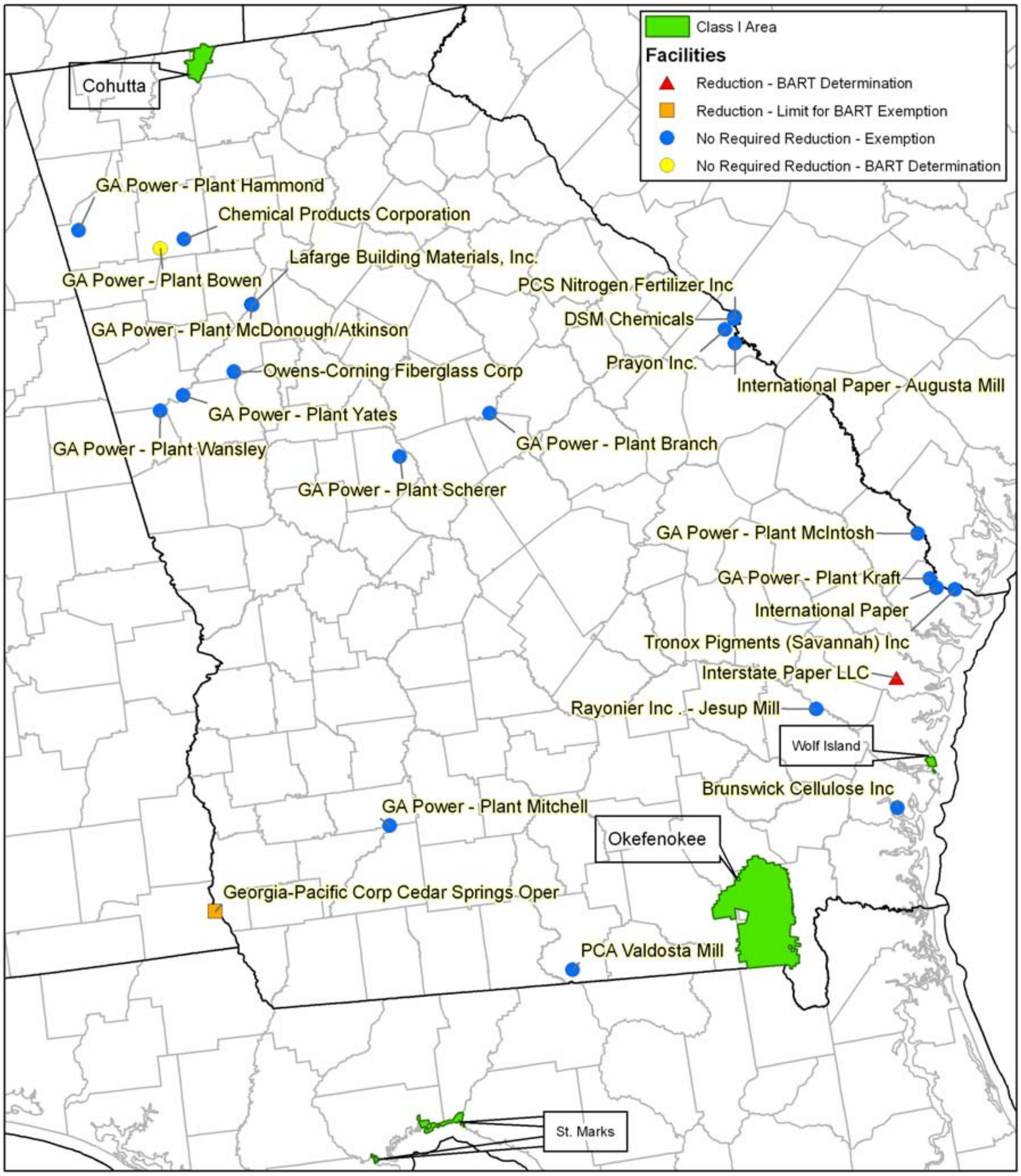


Figure 7.7.3-1. Locations of facilities with BART-eligible emission units.

7.8 What Additional Emissions Controls Were Considered as Part of the Long-Term Strategy for Visibility Improvement by 2018?

Section 308(d)(3)(v) of the regional haze rule lists several factors that must be addressed in each SIP. These factors include smoke management techniques for agricultural and forestry management purposes and measures to mitigate emissions from construction activities.

As discussed in Section 2.4 and demonstrated in Figures 2.4-1 and 2.4-2, elemental carbon (sources include agriculture, prescribed wildland fires, and wildfires) is a relatively minor contributor to visibility impairment at the Class I areas in Georgia. However, on July 11, 2008, GA EPD entered into a memorandum of understanding with the Georgia Forestry and Georgia Department of Natural Resources Wildlife Resources Division adopting a smoke management plan that addresses the issues laid out in US EPA's 1998 draft guidance for smoke management plans. This plan is sufficient to satisfy the directive in section 308(d)(3)(v)(E). A copy of the current smoke management plan can be obtained from Georgia EPD, or it can be viewed on the Georgia EPD web page.

Georgia's Rules for Air Quality Control include requirements for precautions to prevent fugitive dust from becoming airborne and also limit the opacity of fugitive emissions to less than 20 percent. The requirements of rule 391-3-1-.02(n) include preventive measures for construction activities and are deemed adequate to satisfy the directive in Section 308(d)(3)(v)(B) of the Regional Haze rule. The current version of Georgia's air rules is available on the Georgia EPD web site.

8.0 REASONABLE PROGRESS GOALS

The Regional Haze Rule at 40 CFR section 51.308(d)(1) requires States to establish reasonable progress goals for each Class I area within the state (expressed in deciviews) that provide for reasonable progress towards achieving natural visibility. In addition, US EPA released guidance on June 1, 2007, to use in setting reasonable progress goals. The goals must provide improvement in visibility for the most impaired days, and ensure no degradation in visibility for the least impaired days over the State Implementation Plan (SIP) period. The state must also provide an assessment of the number of years it would take to attain natural visibility conditions if improvement continues at the rate represented by the reasonable progress goal.

In accordance with the requirements of 40 CFR §51.308(d)(1), this Regional Haze Implementation Plan establishes reasonable progress goals for each Class I area in Georgia. To calculate the rate of progress represented by each reasonable progress goal, GA EPD compared baseline visibility conditions to natural visibility conditions in each Class I area and determined the uniform rate of visibility improvement (in deciviews) that would need to be maintained during each implementation period in order to attain natural visibility conditions by 2064. The GA EPD summarized expected visibility improvements under existing Federal and State regulations, BART determinations in Georgia and neighboring states, and any additional control measures found to be reasonable to implement in this review period. These controls were modeled in CMAQ as part of the long-term strategy (Appendix E) and the reasonable progress goals were then adjusted for additional controls in Georgia (Appendix N).

VISTAS has demonstrated that the 2018 Base G4 control scenario provides for a significant improvement in visibility better than the uniform rate of progress for at least one of the three Georgia Class I areas and the other two falling short by less than 10 percent for the most impaired days over the period of the implementation plan and ensures no degradation in visibility at any of the three Georgia Class I areas for the least impaired days over the same period. Implementation of Georgia's reasonable progress goals in the form of BART and 4-factor analyses controls will give further visibility improvement by 0.02 dV (0.088%) at Cohutta Wilderness Area and 0.05 dV (0.21%) at Okefenokee Wilderness area and Wolf Island. These reductions can be seen in Figure 8.0-1 and 8.0-2. Since there is not an IMPROVE monitor located at Wolf Island, the Okefenokee uniform rate of progress glide slope and reasonable progress goals are being used as a surrogate for Wolf Island. Since the Okefenokee Wilderness and Wolf Island reasonable progress goals show a slower rate of improvement in visibility than the rate that would be needed to attain natural conditions by 2064 (uniform rate of progress glide slope), it has been estimated that an additional 6-7 years are need to attain natural conditions.

Note that GA EPD has not taken into account any reductions that will result from Florida's reasonable progress analysis as required 40 CFR 51.308(d)(1). Florida DEP has proposed requiring submittal of applications to address Reasonable Progress Control Technology no later than January 31, 2012. As explained in Appendix H, point sources in Florida have a larger impact on visibility impairment at Okefenokee than Georgia sources and have a significant impact on Wolf Island. SO2 controls at Florida Sources can, therefore, have a significant impact on reasonable progress at Okefenokee and Wolf Island. Because the reasonable controls required of Florida sources are not yet available, they have not been taken into account in setting reasonable progress goals for Okefenokee or Wolf Island.

Table 8.0-1. Georgia Reasonable Progress Goals – 20 percent Worst Days

Class I Area	**2004 Baseline Visibility (dv)**	**2018 Reasonable Progress Goal (dv)** [2004 – 2018 decrease]	**2018 Uniform Rate of Progress Glide Slope (dv)** [2004 – 2018 decrease to meet uniform progress]	**Natural Visibility (dv)** [2018-2064 decrease needed from 2018 goal]
Cohutta Wilderness	30.25	22.78 [7.47]	25.71 [4.54]	10.78 [12.00]
Okefenokee Wilderness	27.13	23.77 [3.36]	23.42 [3.71]	11.21 [12.56]
Wolf Island	27.13	23.77 [3.36]	23.42 [3.71]	11.21 [12.56]

Table 8.0-2. Georgia Reasonable Progress Goals – 20 percent Best Days

Class I Area	**2004 and 2018 Baseline Visibility (dv)**	**2018 Reasonable Progress Goal (dv)** [2004 – 2018 improvement goal]
Cohutta Wilderness	13.77	11.75 [2.02]
Okefenokee Wilderness	15.23	13.92 [1.31]
Wolf Island	15.23	13.92 [1.31]

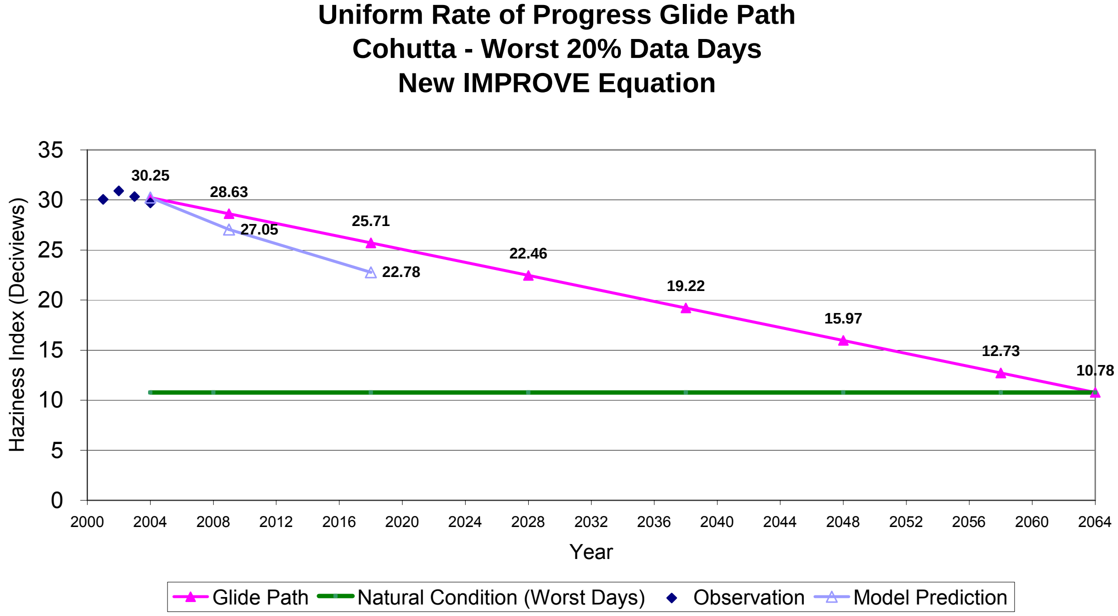


Figure 8.0-1. CMAQ 2018 Base G4 results compared to Uniform Rate of Progress at Cohutta Wilderness Area with GA Reasonable Progress Goals

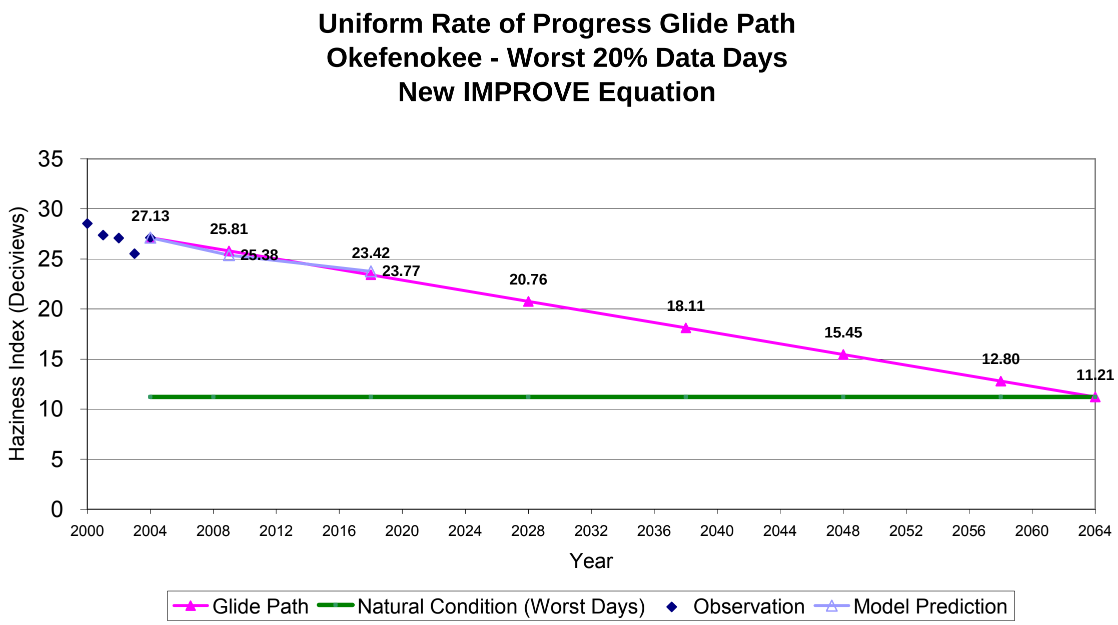


Figure 8.0-2. CMAQ 2018 Base G4 results compared to Uniform Rate of Progress at Okefenokee Wilderness Area with GA Reasonable Progress Goals

9.0 MONITORING STRATEGY

The State Implementation Plan is to be accompanied by a strategy for monitoring regional haze visibility impairment. Specifically, the Regional Haze Rule states at 40 CFR 51.308(d)(4):

> “(4) *Monitoring strategy and other implementation plan requirements.* The State must submit with the implementation plan a monitoring strategy for measuring, characterizing, and reporting of regional haze visibility impairment that is representative of all mandatory Class I Federal areas within the State. This monitoring strategy must be coordinated with the monitoring strategy required in §51.305 for reasonably attributable visibility impairment. Compliance with this requirement may be met through participation in the IMPROVE network. The implementation plan must also provide for the following:
>
>> (i) The establishment of any additional monitoring sites or equipment needed to assess whether reasonable progress goals to address regional haze for all mandatory Class I Federal areas within the State are being achieved.
>>
>> (ii)-(vi) [Other implementation plan requirements that pertain to reporting and use of monitoring data and an emission inventory.]”

Such monitoring is intended to provide the data needed to satisfy four objectives:

1. Track the expected visibility improvements resulting from emissions reductions identified in this SIP;
2. Better understand the atmospheric processes of importance to haze;
3. Identify chemical species in the ambient particulate matter and relate them to emissions from sources; and
4. Evaluate regional air quality models for haze and construct relative response factors (RRFs) for using those models.

The primary monitoring network for regional haze is the IMPROVE network. Given that IMPROVE monitoring data from 2000-2004 serve as the baseline for the regional haze program, the future regional haze monitoring strategy must necessarily be based on, or directly comparable to, IMPROVE. The IMPROVE measurements provide the only long-term record available for tracking visibility improvement or degradation and, therefore, Georgia intends to rely on the IMPROVE network for complying with the regional haze monitoring requirement in the Regional Haze Rule. There are currently two IMPROVE sites in the State.

Table 9.0-1. Class I areas in Georgia and IMPROVE monitors that represent conditions at each of them.

Class I Area	IMPROVE Site Designation
Cohutta Wilderness Area	COHU1
Okefenokee Wilderness Area	OKEF1

GA EPD will use South Eastern Aerosol Research and Characterization (SEARCH) data from the sites illustrated below for further the understanding of both PM2.5 and visibility formation and trends in Georgia. The SEARCH monitors provides the following data related to the nature of ambient fine particulate matter:

- 24-hr PM2.5 filter samples, analyzed for mass, ions (sulfate, nitrate, ammonium), organic carbon (OC), elemental (black) carbon (EC or BC), and elements as measured by X-ray fluorescence (XRF);
- 24-hr PM coarse mass, ions, and XRF elements;
- 24-hr gaseous ammonia as collected with an annular denuder;
- Continuous (minute to hourly) PM2.5 mass, OC, EC, ammonium, nitrate, and sulfate; light scattering and light absorption;
- Continuous gaseous ozone, nitric oxide, nitrogen dioxide, total oxidized nitrogen (NOy), nitric acid, carbon monoxide, and sulfur dioxide; and
- Continuous 10-m meteorological parameters: wind speed, wind direction, precipitation, temperature, barometric Pressure, relative humidity and solar radiation.

The Clean Air Status and Trends Network (CASTNet) provides atmospheric data on the dry deposition component of total acid deposition, ground-level ozone and other forms of atmospheric pollution. All measurements utilize a 1-week sample period and include sulfur dioxide, particulate sulfate, particulate nitrate, nitric acid, particulate ammonium, particulate calcium, particulate sodium, particulate magnesium, particulate potassium, and ozone. In addition, GA EPD operates a fairly comprehensive PM2.5 network of the filter-based Federal reference method (FRM) monitors, continuous mass monitors (TEOMs), filter-based speciated monitors (STN) and the continuous speciated monitors described above. A map of the various locations around the State is included in Figure 9.0.1. These PM2.5 measurements help GA EPD characterize air pollution levels in areas across the state, and, therefore, aid in the analysis of visibility improvement in and near the Class I areas.

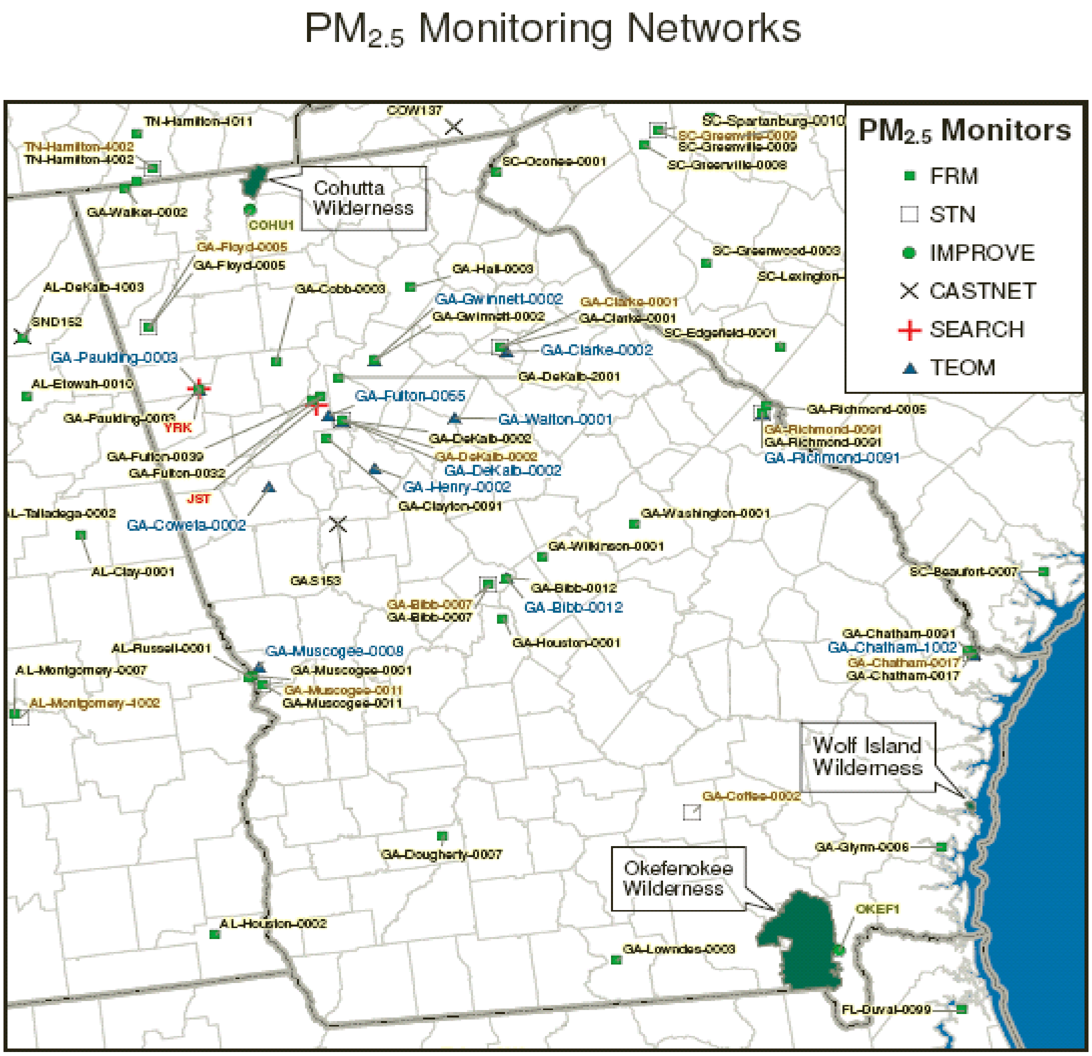


Figure 9.0-1. PM2.5 Monitoring Network in Georgia

The IMPROVE measurements are central to Georgia's regional haze monitoring strategy, and it is difficult to visualize how the objectives listed above could be met without the monitoring provided by IMPROVE. Any reduction in the scope of the IMPROVE network in Georgia would jeopardize the State's ability to demonstrate reasonable progress toward visibility improvement in some of its Class I areas. In particular, Georgia's regional haze strategy relies on emission reductions that will on different timelines and will most likely not be spatially uniform.

Because each of the current IMPROVE monitors in Georgia represents a different airshed, reduction of the IMPROVE network by shutting down one of these monitoring sites impedes tracking progress at reducing haze at the affected Class I area. In the event this occurs, Georgia, in consultation with the US EPA and relevant Federal Land Managers, will develop an alternative approach for meeting the tracking goal, perhaps by seeking contingency funding to carry out limited monitoring or by relying on data from nearby urban monitoring sites to demonstrate trends in speciated $PM_{2.5}$ mass.

Data produced by the IMPROVE monitoring network will be used nearly continuously for preparing the 5-year progress reports and the 10-year SIP revisions, each of which relies on analysis of the preceding five years of data. Consequently, the monitoring data from the IMPROVE sites needs to be readily accessible and to be kept up to date. Presumably, IMPROVE will continue to process information from its own measurements at about the same pace and with the same attention to quality as it has shown in the recent past. The VIEWS web site has been maintained by VISTAS and the other Regional Planning Organizations (RPOs) to provide ready access to the IMPROVE data and data analysis tools. Georgia is encouraging VISTAS and the other RPOs to maintain VIEWS or a similar data management system to facilitate analysis of the IMPROVE data.

10.0 INTERSTATE CONSULTATION

The VISTAS states have jointly developed the technical analyses to define the visibility improvement by 2018 under existing Federal and State regulations compared to the uniform rate of progress, SO2 Areas of Influence for each Class I area, and methods to prioritize contributions from individual sources within the Areas of Influence. The states collectively accept the conclusions of these analyses.

In December of 2006, the VISTAS State Air Directors held their first formal consultation meeting to review the Base G modeling results and the SO2 Areas of Influence analyses. The Air Directors agreed to look at reasonable control measures for sources on the lists for the SO2 Areas of Influence. Each state would consider sources within their state and would identify sources in neighboring states that they would like to have that neighboring state consider. States acknowledged that the review process would differ among states since some Class I areas are projected to see visibility improvements near the uniform rate of progress while most Class I areas are projected to have greater improvements than uniform rate of progress.

In May of 2007, the VISTAS State Air Directors met for their second formal interstate consultation. States shared their lists of sources in their state and neighboring states for each Class I area. They also shared their criteria for listing sources and their plans for further interstate consultation.

The GA EPD received consultation letters and evaluated the impact of Georgia sources on Class I areas in neighboring states and identified sources that were likely to contribute 0.5% or more to the total visibility impairment. Such sources were considered for additional reasonable control measures that should be implemented to mitigate impacts in Class I areas in neighboring states.

Based on the VISTAS Area of Influence (AOI) electronic spreadsheet that includes Q/d, RTMax, and percent contribution from each Georgia point source to each Class I area, the following seven nearby Class I areas outside of Georgia showed impacts greater than or equal to 0.5%: Joyce Kilmer-Slickrock (NC), Shining Rock (NC), Great Smoky Mountains (NC/TN), Sipsey Wildernesses (AL), Cape Romain (SC), Swanquarter (NC), and St. Marks (FL). All other Class I areas showed contributions from Georgia point sources of less than 0.5%. For details on specific percent contribution from each Georgia point source to each Class I area, see Appendix H.2. For a list of pollution reductions that are anticipated at each source before 2018, see Section 7.6.1.

Table 10-1: Georgia point source contribution to Joyce Kilmer-Slickrock (NC).

Plant	Point ID	Percent Contribution
GEORGIA POWER COMPANY, YATES STEAM-ELECT	SG07	1.879%
GEORGIA POWER COMPANY, YATES STEAM-ELECT	SG06	1.861%
GEORGIA POWER COMPANY, SCHERER STEAM-ELE	SG03	1.559%
GEORGIA POWER COMPANY, SCHERER STEAM-ELE	SG04	1.496%
GEORGIA POWER COMPANY, SCHERER STEAM-ELE	SG01	1.476%
GEORGIA POWER COMPANY, SCHERER STEAM-ELE	SG02	1.466%
GEORGIA POWER COMPANY, BOWEN STEAM-ELECT	SG04	1.100%
GEORGIA POWER COMPANY, BOWEN STEAM-ELECT	SG03	1.068%
INLAND PAPERBOARD & PACKAGING, INC. -LIN	F4	0.995%
GEORGIA POWER COMPANY, HAMMOND STEAM-ELE	SG04	0.924%
GEORGIA POWER COMPANY, BOWEN STEAM-ELECT	SG02	0.850%
GEORGIA POWER COMPANY, BOWEN STEAM-ELECT	SG01	0.844%
GEORGIA POWER COMPANY, YATES STEAM-ELECT	SG05	0.755%
GEORGIA POWER COMPANY, YATES STEAM-ELECT	SG04	0.739%

Table 10-2: Georgia point source contribution to Shining Rock (NC).

Plant	Point ID	Percent Contribution
GEORGIA POWER COMPANY, SCHERER STEAM-ELE	SG03	0.712%
GEORGIA POWER COMPANY, SCHERER STEAM-ELE	SG04	0.683%
GEORGIA POWER COMPANY, SCHERER STEAM-ELE	SG01	0.674%
GEORGIA POWER COMPANY, SCHERER STEAM-ELE	SG02	0.669%
GEORGIA POWER COMPANY, YATES STEAM-ELECT	SG07	0.580%
GEORGIA POWER COMPANY, YATES STEAM-ELECT	SG06	0.574%

Table 10-3: Georgia point source contribution to Great Smoky Mountains (NC/TN).

Plant	Point ID	Percent Contribution
GEORGIA POWER COMPANY, YATES STEAM-ELECT	SG07	0.688%
GEORGIA POWER COMPANY, YATES STEAM-ELECT	SG06	0.681%
GEORGIA POWER COMPANY, SCHERER STEAM-ELE	SG03	0.636%
GEORGIA POWER COMPANY, SCHERER STEAM-ELE	SG04	0.610%
GEORGIA POWER COMPANY, SCHERER STEAM-ELE	SG01	0.602%
GEORGIA POWER COMPANY, SCHERER STEAM-ELE	SG02	0.598%

Table 10-4: Georgia point source contribution to Swanquarter (NC).

Plant	Point ID	Percent Contribution
INTERNATIONAL PAPER - SAVANNAH MILL	PB13	0.859%
SAVANNAH ELECTRIC: MCINTOSH STEAM - ELEC	SG01	0.720%

Table 10-5: Georgia point source contribution to Sipsey Wildernesses (AL).

Plant	Point ID	Percent Contribution
GEORGIA POWER COMPANY, YATES STEAM-ELECT	SG07	1.115%
GEORGIA POWER COMPANY, YATES STEAM-ELECT	SG06	1.104%
GEORGIA POWER COMPANY, SCHERER STEAM-ELE	SG03	0.587%
GEORGIA POWER COMPANY, SCHERER STEAM-ELE	SG04	0.563%
GEORGIA POWER COMPANY, SCHERER STEAM-ELE	SG01	0.555%
GEORGIA POWER COMPANY, SCHERER STEAM-ELE	SG02	0.551%

Table 10-6: Georgia point source contribution to Cape Romain (SC).

Plant	Point ID	Percent Contribution
INTERNATIONAL PAPER - SAVANNAH MILL	PB13	1.553%
SAVANNAH ELECTRIC: MCINTOSH STEAM - ELEC	SG01	1.352%
SAVANNAH ELECTRIC: KRAFT STEAM - ELECTRI	SG03	0.814%

Table 10-7: Georgia point source contribution to St. Marks (FL).

Plant	Point ID	Percent Contribution
GEORGIA POWER COMPANY, MITCHELL STEAM-EL	SG03	2.737%
LONGLEAF ENERGY STATION	BOIL1	1.392%
LONGLEAF ENERGY STATION	BOIL2	1.392%
GEORGIA PACIFIC CORPORATION, CEDAR SPRIN	U501	1.128%
GEORGIA PACIFIC CORPORATION, CEDAR SPRIN	U500	1.081%
GEORGIA PACIFIC CORPORATION, CEDAR SPRIN	R402	0.768%
INTERNATIONAL PAPER - SAVANNAH MILL	PB13	0.704%
SAVANNAH ELECTRIC: MCINTOSH STEAM - ELEC	SG01	0.554%

The GA EPD also sent consultation letters to Florida, South Carolina and Tennessee regarding the impact of their sources on Georgia's Class I areas. These consultation letters are present in Appendix J.

Analyses of impacts from Georgia and potential controls are discussed in greater detail in Appendix H.

The MANE-VU states of Maine, New Jersey, New Hampshire, and Vermont sent letters to Georgia in the Spring of 2007 stating that, based on 2002 emissions, Georgia contributed to visibility impairment to Class I areas in those states. MANE-VU states have asked the GA EPD to participate in further consultation with these states during the Summer of 2007. The GA EPD has responded to those letters and has participated in conference calls with these states. The final Regional Haze SIP will reflect the results of those letters and calls. The letters from these states, and responses from GA EPD, are included as attachments to Appendix J.

11.0 COMPREHENSIVE PERIODIC IMPLEMENTATION PLAN REVISIONS

40 CFR Section 51.308(f) requires the GA EPD to revise its regional haze implementation plan and submit a plan revision to US EPA by July 31, 2018, and every ten years thereafter. In accordance with the requirements listed in Section 51.308(f) of the Federal rule for regional haze, Georgia commits to revising and submitting this regional haze implementation plan by July 31, 2018, and every ten years thereafter.

In addition, Section 51.308(g) requires periodic reports evaluating progress towards the reasonable progress goals established for each mandatory Class I area. In accordance with the requirements listed in Section 51.308(g) of the Federal rule for regional haze, the GA EPD commits to submitting a report on reasonable progress to US EPA every five years following the initial submittal of the SIP. The report will be in the form of a SIP revision. The reasonable progress report will evaluate the progress made towards the reasonable progress goal for each mandatory Class I area located within Georgia and in each mandatory Class I area located outside Georgia which may be affected by emissions from within Georgia**.**

The requirements listed in 51.308(g) include the following:

1. Description of the status of implementation;
2. Summary of emission reductions achieved thus far, including especially the status of implementation of the CAIR compliance plans for EGUs compared to the control assumed in the modeling. [The GA EPD recognizes that the 2018 projections of EGU controls from the IPM runs represent one solution to how the CAIR requirements will be met. By the time of the first periodic report, the GA EPD anticipates that the actual compliance strategy for the various utility companies will be much more defined. An assessment of those actual compliance plans will be done for the first periodic report.]
3. Assessment of changes in visibility conditions at each Class I area (current vs. baseline), expressed as 5-year averages of annual values for 20 percent best and worst days;
4. Analysis of emission changes over the 5-year period identified by source or activity;
5. Analysis of any significant changes in or out of the State which have impeded progress;
6. Assessment of the sufficiency of the implementation plan to meet RPGs;
7. Review and any modifications to Georgia's visibility monitoring plan.

All requirements listed in 51.308(g) shall be addressed in the SIP revision for reasonable progress.

There are several technical improvements that are recommended in the emissions inventory and air quality models that are used to support regulatory decisions for regional haze. These recommended improvements, as funding is available, will be implemented to support the next long-term strategy. Appendix K contains a more detailed discussion of possible technical improvements. The following is an overall summary:

First and foremost, continued improvements are needed in the integrated one-atmosphere air quality models that are used to project air quality responses to emissions reductions. As our understanding of partitioning between gaseous and aerosol phases improves, this understanding needs to be reflected in the models. Improvements can also be made in how the models handle individual pollutants. Sulfate performance for the CMAQ regional air quality model is good overall. However sulfate deposition is frequently overestimated in the models, particularly in the summer months. At the coastal sites, when winds are blowing from the Gulf of Mexico or Atlantic Ocean, CMAQ underestimates measured sulfate at the monitors. CMAQ's processes also should be reviewed for sulfate formation over water. Nitrate is overestimated by the model in the winter and underestimated in the summer, although summer monitored values of nitrates are very low. Additional improvements in seasonal allocation of ammonia emissions would improve model estimates of ammonium nitrate formation. Organic carbon is generally underestimated in the summer months. Improvements are needed in the characterization of both primary carbon emissions and formation of secondary organic carbon.

Other improvements needed include better tools for organic carbon source apportionment, and more consistent measurement techniques between rural and urban monitoring networks. To improve our understanding of the contribution of fire from natural forest fires, prescribed burning, land clearing, and agricultural burning, states need improved record keeping. Additional improvements to international emissions inventory are also needed, to improve our understanding of boundary conditions for our modeling domain and of the contributions from international emissions to pollutant concentrations at the VISTAS Class I areas.

12.0 DETERMINATION OF ADEQUACY OF THE EXISTING PLAN

Depending on the findings of the 5-year progress report, Georgia commits to taking one of the actions listed in 40 CFR section 51.308(h). The findings of the 5-year progress report will determine which action is appropriate and necessary.

List of Possible Actions – 40 CFR Section 51.308(h)

1) GA EPD determines that the existing SIP requires no further substantive revision in order to achieve established goals. GA EPD provides to the Administrator a negative declaration that further revision of the SIP is not needed at this time.

2) GA EPD determines that the existing SIP may be inadequate to ensure reasonable progress due to emissions from other states which participated in the regional planning process. GA EPD provides notification to the Administrator and the states that participated in regional planning. GA EPD collaborates with states through the regional planning process to address the SIP's deficiencies.

3) GA EPD determines that the current SIP may be inadequate to ensure reasonable progress due to emissions from another country. GA EPD provides notification, along with available information, to the Administrator.

4) GA EPD determines that the existing SIP is inadequate to ensure reasonable progress due to emissions within the state. GA EPD will revise its SIP to address the plan's deficiencies within one year.

13.0 COORDINATION WITH FEDERAL LAND MANAGERS

As required by 40 CFR §51.308(i), the regional haze SIP must include procedures for continuing consultation between the States and Federal Land Managers (FLMs) pertaining to visibility protection. The FLMs responsible for Class I areas in Georgia are:

- Fish and Wildlife Service (FWS), under U.S. Department of Interior
- National Park Service (NPS), under U.S. Department of Interior
- Forest Service (FS), under U.S. Department of Agriculture

The requirements for ongoing State and FLMs consultation and how Georgia will comply with the requirements are described in the following paragraphs.

40 CFR 51.308(i)(2) requires the State to provide the FLMs with an opportunity for consultation, in person and at least 60 days prior to holding a public hearing on a SIP revision. The consultation must include the opportunity for the FLMs to discuss their:

- assessment of visibility impairment in the Class I area; and
- recommendations on the development of the reasonable progress goal and on the development and implementation of strategies to address visibility impairment.

Records of Georgia EPD’s consultations with the FLMs on the first Regional Haze SIP are included in Appendix O.

40 CFR 51.308(i)(3) requires the State to incorporate into any SIP or SIP revision a description of how it addressed comments provided by the FLMs. The comments on the SIP and the description of how they were addressed have been included in Appendix O.

40 CFR 51.308(i)(4) requires the plan (or plan revision) to include procedures for continuing consultation between the State and Federal Land Managers on the implementation of the visibility protection program, including development and review of implementation plan revisions and 5-year progress reports, and on the implementation of other programs having the potential to contribute to impairment of visibility in mandatory Class I Federal areas. GA EPD will offer the Federal Land Managers an opportunity for consultation on a yearly basis, including the opportunity to discuss the implementation process and the most recent IMPROVE monitoring data and VIEWS data. Records of annual consultations and progress report consultations will be maintained in Georgia EPD’s Regional Haze files.