ARKANSAS
Department of Environmental Quality

Arkansas Department of Environmental Quality

State of Arkansas
Regional Haze Rule
State Implementation Plan

Air Division
Planning and Air Quality Analysis Branch
5301 Northshore Drive
North Little Rock, Arkansas 72218-5317

A Member of Central Regional Air Planning Association (CENRAP)

September 09,2008

STATE OF ARKANSAS
MIKE BEEBE
GOVERNOR

July 29, 2008

Richard Greene, Regional Administrator
United States Environmental Protection Agency- Region 6
1445 Ross Avenue, Suite 1200
Mail Code 6RA
Dallas, TX 75202-2733

Dear Mr. Greene:

The State of Arkansas is hereby submitting a State Implementation Plan (SIP) to address requirements for regional haze visibility protection in mandatory federal Class I areas. This SIP contains the necessary measures to ensure that the State of Arkansas is working toward the national goal for visibility contained in 42 U.S.C. 7491-Visibility protection for federal Class I areas. It fulfills requirements under 40 C.F.R. Part 51, Requirements for Preparation, Adoption, and Submittal of Implementation Plans, Subpart P- Protection of Visibility.

The Clean Air Act (CAA) and the United States Environmental Protection Agency (EPA) regulations require states to submit SIPs to make "reasonable progress" in reducing visibility impairment in federal Class I areas resulting from anthropogenic pollution. The CAA, 169A(a)(1), "declares as a national goal the prevention of any future, and the remedying of any existing, impairment of visibility in mandatory federal Class I areas, where impairment results from man-made air pollution." Class I areas are national parks, containing more than 6,000 acres, and wilderness areas, containing more than 5,000 acres, which Congress has recognized as significant sites. Arkansas has two such areas: the Upper Buffalo Wilderness Area in the Ozark National Forest and the Caney Creek Wilderness Area in the Ouachita National Forest.

The Regional Haze Rule focuses on older emission sources that have not been regulated under other provisions of the Clean Air Act. Such older sources that could contribute to visibility impairment in Class I areas may be required to install Best Available Retrofit Technology (BART). Regional Haze SIPs must contain such emission limits, schedules of compliance, and other measures as may be necessary to make reasonable progress toward meeting the national goal, including requiring installation, operation, and maintenance of BART, as determined by the State on certain existing stationary sources.

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The EPA Regional Haze Rule strongly encourages states to work together in regional partnerships to reduce haze. As a member of the Central Regional Air Planning Association (CENRAP), Arkansas has worked closely with Kansas, Louisiana, Iowa, Missouri, Nebraska, Minnesota, Oklahoma, and Texas, as well as with federal agencies, tribal areas, and other interested parties to improve air quality in our region and the country.

The State of Arkansas hereby submits to the EPA that it has met the requirements for regional haze visibility protection in mandatory federal Class I areas under 40 C.F.R. §51.308. We are enclosing two hard copies and one electronic copy of the State Implementation Plan for your review.

We look forward to your prompt review of this SIP submission. If you have any questions, please contact Mike Bates, Air Division Chief of the Arkansas Department of Environmental Quality, at 5301 Northshore Drive, North Little Rock, AR 72218-5317, or by phone at (501) 682-0750. Thank you for your attention to this matter.

Sincerely,

Mike Beebe

cc: Mike Bates, Chief – Air Division, Arkansas Department of Environmental Quality

Enclosure

Table of Contents

List of Tables

List of Figures

List of Appendices

Appendices are listed at the end of each chapter.

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1. Background and Overview of the Federal Regional Haze Regulation

1.1. General Background / History of Federal Regional Haze Rule

In amendments to the Clean Air Act (CAA) in 1977, Congress added Section 169 (42 U.S.C. 7491) setting forth the following national visibility goal of restoring pristine conditions in national parks and wilderness areas:

> "Congress hereby declares as a national goal the prevention of any future, and the remedying of any existing, impairment of visibility in mandatory Class I Federal areas which impairment results from man-made air pollution."

Over the following years modest steps were taken to address the visibility problems in Class I areas. The control measures taken mainly addressed "Plume Blight" from specific pollution sources, and did little to address regional haze issues in the Eastern United States. Plume blight is the visual impairment of air quality that manifests itself as a coherent plume. This results from specific sources, such as a power plant smoke stack, emitting pollutants into a stable atmosphere. The pollutants are then transported in some direction with little or no vertical mixing.

When the CAA was amended in 1990, Congress added Section 169B (42 U.S.C. 7492), authorizing further research and regular assessments of the progress made so far. In 1993, the National Academy of Sciences concluded that "current scientific knowledge is adequate and control technologies are available for taking regulatory action to improve and protect visibility."

In addition to authorizing creation of visibility transport commissions and setting forth their duties, Section 169B(f) of the CAA specifically mandated creation of the Grand Canyon Visibility Transport Commission (GCVTC) to make recommendations to the U.S. Environmental Protection Agency (EPA) for the region affecting the visibility of the Grand Canyon National Park. In June 1996, following four years of research and policy development, the GCVTC submitted its report to EPA. This report, as well as the many research reports prepared by the Commission, contributed invaluable information to EPA in its development of the federal regional haze rule.

EPA's Regional Haze Rule was adopted July 1, 1999, and went into effect on August 30, 1999, see Appendix 1.1 Regional Haze Regulations –Final Rule. The Regional Haze Rule aimed at achieving national visibility goals by 2064. This rulemaking addressed the combined visibility effects of various pollution sources over a wide geographic region. EPA concluded that this meant that many states – even those without Class I Areas – would be required to participate in haze reduction efforts. EPA designated five Regional Planning Organizations (RPOs) to assist with the coordination and cooperation needed to address the visibility issues that states in the five regions share or have in common. Those states that make up the midsection of the contiguous United States were designated as the Central Regional Air Planning Association (CENRAP). Figure 1.1 is a map depicting the five RPO regions.

Fig. 1.1 – Regional Planning Organizations

On May 24, 2002 the US Court of Appeals, DC District Court ruled on the challenge brought by the American Corn Growers Association against EPA's Regional Haze Rule of 1999. The Court remanded to EPA the Best Available Retrofit Technology (BART) provisions of the rule, and denied industry's challenge to the haze rule goals of natural visibility and no degradation requirements. On July 6, 2005, EPA issued a revised BART rule.

The federal requirements for visibility protection are contained in 40 CFR Chapter 51 Subpart P – Visibility Protection. The regional haze program requirements are located at 40 CFR 51.308. Arkansas submitted a Part I Visibility Plan on March 25, 1985 that was subsequently approved by EPA. The approved SIP meets the currently applicable requirements of 40 CFR § 51.302 and 51.306.

To facilitate the review of this State Implementation Plan (SIP) by the Environmental Protection Agency (EPA), Federal Land Managers (FLM), stakeholders and the public, ADEQ has prepared a cross-referenced "Guide to Locating Section 308 Requirements" that is included as Appendix 1.2 herein. Appendix 1.2 is based on a checklist that was prepared by EPA for its use in review of regional haze SIP submittals that includes references and citations for specific Section 51.308 requirements. ADEQ updated this checklist by inserting references to locations where these requirements are address in this SIP.

1.2 Identification of Class I Areas

In accordance with the requirements of 40 CFR 51.308, CENRAP and ADEQ have conducted assessments of emissions and modeled visibility impacts on a regional scale. These assessments, further described herein, indicate that various emissions sources located within the State of

Arkansas are likely to cause, or contribute to, regional haze in Class I Areas located both within and outside of the boundaries of the State.

The State of Arkansas has two federal Class I areas within its borders. ADEQ has determined that sources located in Arkansas also contribute to regional haze in two additional Class I Areas that are located in the State of Missouri. Both of Arkansas's Class I Areas are designated as federally protected wilderness areas for which the United States Department of Agriculture (USDA) Forest Service is the FLM.

In Arkansas, mandatory Class I Federal areas include the 14,460 acre Caney Creek Wilderness in Ouachita National Forest at Polk County (CACR) and the 11,801 acre Upper Buffalo Wilderness in the Ozark National Forest at Newton County (UPBU). The Upper Buffalo Class I Area includes the original wilderness area and the additions to it, but does not include the Buffalo National River.

Potentially affected areas in other states are the two Class I areas in Missouri. These are the 12,315 acre Hercules Glades Wilderness in the Mark Twain National Forest, located in Taney County Missouri (HEGL), approximately 25 miles (40 km) north of Boone County Arkansas; and the 8,000 acre Mingo National Wildlife Refuge located in Wayne and Stoddard Counties (MING), approximately 30 miles (48 km) north of Clay County, Arkansas. The respective FLMs are the USDA Forest Service and the U.S. Fish and Wildlife Service under the U.S. Department of Interior. Figure 1.2 depicts the mandatory federal Class I areas throughout the country.

The emission reductions achieved through implementation of this SIP and other federal, state and local measures will result in visibility improvements at Class I areas both within, and outside of, the State of Arkansas. These measures will also improve visibility throughout the region.

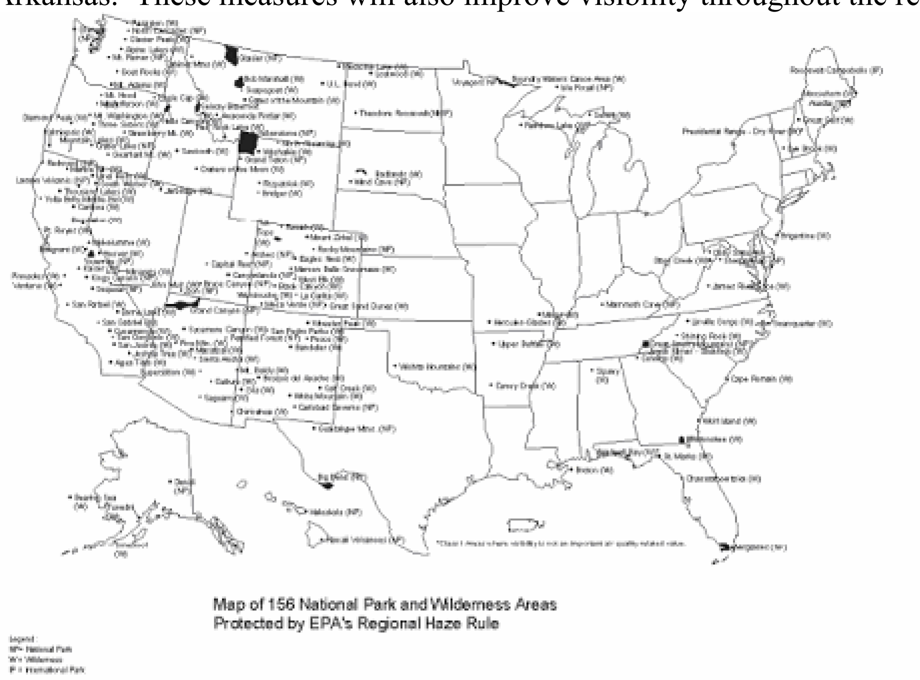


Fig. 1.2 – Mandatory Federal Class I Areas

List of Chapter 1 Appendices

1.1 Regional Haze Regulations –Final Rule
1.2 Guide to Locating Section 308 Requirements

2. General Planning Provisions

Pursuant to the requirements of 51.308(a) and (b), Arkansas submits this SIP submission as adopted to meet the requirements of EPA's Regional Haze Rules that were adopted to comply with requirements set forth in the CAA. Elements of this plan address the core requirements pursuant to CFR 40 51.308(d) and the Best Available Retrofit Technology (BART) components of 40 CFR 51.308(e). In addition, this SIP addresses Regional Planning, State and FLMs coordination, and contains a commitment to provide plan revisions and adequacy determinations.

Arkansas has adopted this SIP in accordance with State laws and rules. Arkansas has the authority to adopt the SIP in accordance with local laws and rules, see Appendix 2.1(a).

As required in Section 2.1(f) of Appendix V to 40 CFR Part 51, Arkansas provided public notice of the opportunity to comment on the SIP on June 7, 2008 in a statewide newspaper, the Arkansas Democrat Gazette. Included in the notice to the public was announcement that a public hearing had been scheduled for on July 7, 2008. A copy of the draft Regional Haze SIP was made available at the ADEQ Headquarters, Public Records Center, Room 127, 5301 Northshore Drive, North Little Rock, Arkansas 72218.

Arkansas provided the FLMs a draft copy of the Regional Haze SIP and solicited comments comment on the draft SIP on February 22, 2008, see Appendix 2.1(b).

Arkansas held public hearings regarding the SIP on July 7, 2008. Public comments, inclusive of those made by the FLMS are addressed and are summarized in Appendix 2.1c. A responsive summary of all comments is provided in the final SIP document Appendix 2.1.

List of Chapter 2 Appendices

2.1 Summary of (a) legal authority; (b) public participation process; and, (c) public comments and responses (inclusive of FLMS comments and responses).

3. Regional Planning

In 1999, EPA and affected States/Tribes agreed to create five RPOs to facilitate interagency coordination on Regional Haze SIPs. The State of Arkansas is a member of the Central Regional Air Planning Association (CENRAP) RPO. Members of CENRAP are in the geographical areas listed in Table 3.1. Figure 3.1 shows a map of all five regional planning organizations.

Table 3.1 CENRAP Geographical Area*

Arkansas	Iowa
Kansas	Louisiana
Minnesota	Missouri
Nebraska	Oklahoma
Texas	

*Includes both state and tribal areas

Figure 3.1 - Geographical Areas of Regional Planning Organizations

The governing body of CENRAP is the Policy Oversight Group (POG). The POG is made up of eighteen (18) voting members representing the states and tribes within the CENRAP region and non-voting members representing local agencies, the EPA, the Fish and Wildlife Service, Forest Service, and National Park Service. The POG facilitates communication with FLMs, stakeholders, the public, and with CENRAP staff.

Since its inception, CENRAP has established an active committee structure to address both technical and non-technical issues related to regional haze. The work of CENRAP is accomplished through five standing workgroups: Data Analysis and Monitoring; Emission Inventory; Modeling; Communications; and Implementation and Control Strategies. Participation in workgroups is open to all interested parties. *Ad hoc* workgroups may be formed by the POG to address specific issues. Ultimately, policy decisions are made by the CENRAP POG.

CENRAP has adopted the approach that the Regional Haze Rule requires the "States to establish goals and emission reduction strategies for improving visibility in all 156 mandatory Class I parks and wilderness areas." The rule also encouraged states and tribes to work together in regional partnerships.

This SIP utilizes data analysis, modeling results and other technical support documents prepared for CENRAP members. By coordinating with CENRAP and other RPOs, the State of Arkansas has worked to ensure that its long-term strategy and BART determinations provide sufficient reductions to mitigate visibility impacts on affected Class I areas. Data analyses, modeling results and other technical support documents are provided to CENRAP members through either the CENRAP website (cenrap.org) or through a protocol (ftp) that allows users to copy files between their local system and the CENRAP network.

<u>List of Chapter 3 Appendices</u>

There are no Appendices in Chapter 3.

4. Arkansas and Federal Land Manager Coordination

The 40 CFR 51.308(i) require coordination between the State of Arkansas and the Federal Land Managers (FLMs). FLMs are an integral part of CENRAP's POG and the membership on standing committees. FLMs have contributed to the development of technical and non technical work as a result of that participation. In addition, opportunities have been provided by CENRAP for FLMs to review and comment on each of the technical documents developed by CENRAP and included in this SIP. The Arkansas Department of Environmental Quality (ADEQ) has provided agency contacts to the FLMs as required. In development of this plan, the FLMs were consulted in accordance with the provisions of 40 CFR 51.308(i)(2).

ADEQ provided FLMs an opportunity for consultation, in person and at least 60 days prior to holding any public hearing on an implementation plan or plan revision. The FLMs comments can be found in Appendix 2.1(c).

During the consultation process, the FLMs reviewed the SIP to evaluate:

- Assessment of the impairment of visibility in any Class I areas
- Recommendations on the development of reasonable progress goals
- Recommendations on the development and implementation of strategies to address visibility impairment.

ADEQ sent the draft SIP to the FLMs on February 22, 2008. ADEQ notified the FLMs of public hearings held on July 7, 2008. ADEQ considered/incorporated the FLMs comments on the SIP draft as noted in Appendix 2.1(c).

ADEQ will continue to coordinate and consult with the FLMs during the development of future progress reports and plan revisions, as well as during the implementation of programs having the potential to contribute to visibility impairment in the mandatory Class I areas. The FLMs must be consulted in the following instances:

- Development and review of implementation plan revisions
- Review of 5-year progress reports
- Development and implementation of other programs that may contribute to impairment of visibility in Class I areas.

Arkansas has consulted in person with FLMs during CENRAP meetings, and commits to continued consultation with them during the implementation of other programs having the potential to contribute to visibility impairment in the mandatory Class I areas.

<u>List of Chapter 4 Appendices</u>

4.1 Updated ADEQ Contact for FLMs

5. Assessment of Baseline and Current Conditions and Estimate of Natural 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. Sec. 51.301(q) defines natural conditions: "Natural conditions includes 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. For each Class I area, there are three metrics of visibility that are part of the determination of reasonable progress:

1) baseline conditions
2) natural conditions
3) current conditions

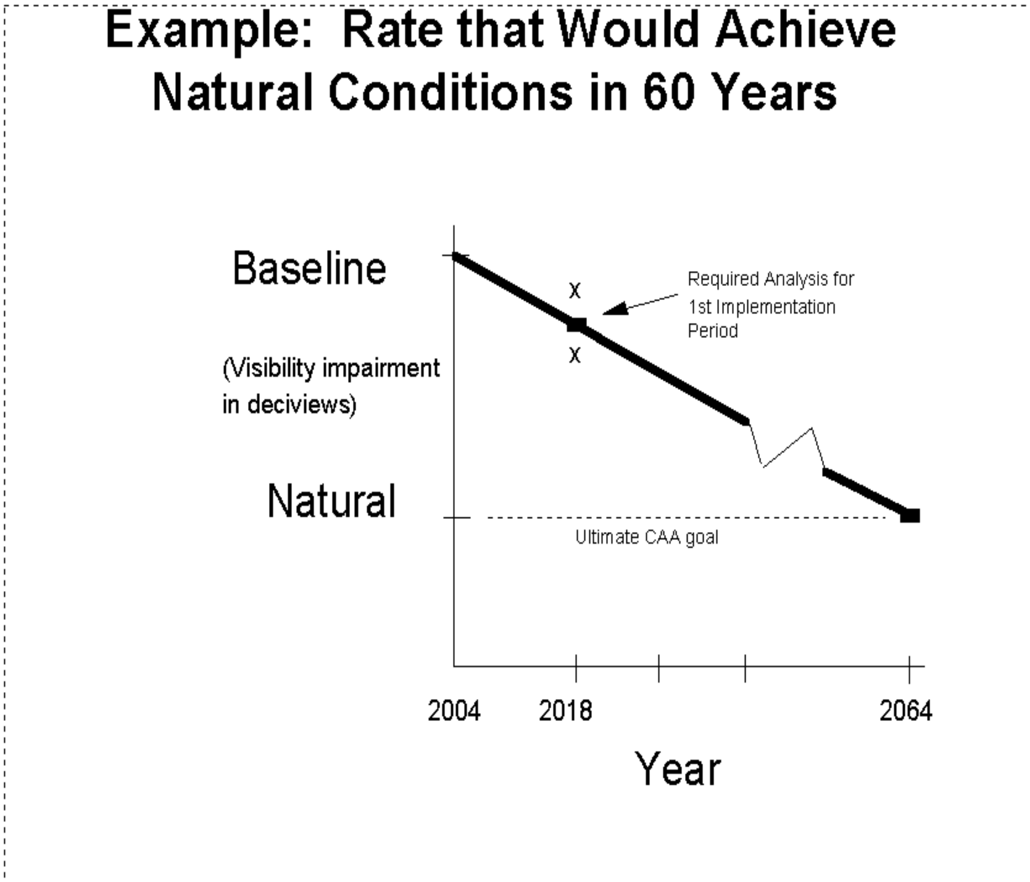
Each of the three metrics includes the concentration data of the visibility pollutants as different terms in the light extinction algorithm, with respective extinction coefficients and relative humidity factors. Total light extinction when converted to deciviews (dv) is calculated for the average of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

"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 can be thought of as "current" visibility conditions for this initial period. The comparison of initial baseline conditions to natural visibility conditions indicates the amount of improvement necessary to attain natural visibility by 2064. Natural visibility is determined by estimating the natural concentrations of visibility pollutants and then calculating total light extinction with the light extinction algorithm. (See Figure 5.1 as an example.) Each state must estimate natural visibility levels for Class I areas within its borders in consultation with FLMs and other states (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.

<u>Default and refined values for natural visibility conditions</u>

EPA's "Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Program" (Sept 2003) provides states a "default" estimate of natural visibility. The default values of concentrations of visibility pollutants are based on a 1990 National Acid Precipitation Assessment Program report (Trijonis, J.C. (1990) NAPAP State of Science & Technology, vol. III). In the guidance, the United States is divided into "East" and "West" along the western boundary of the states one tier west of the Mississippi River. This division divides the CENRAP states into "East" which includes Arkansas (AR), Iowa (IA), Louisiana (LA), Minnesota (MN), and Missouri (MO) with seven Class I areas, and "West" which includes Kansas (KS), Nebraska (NE), Oklahoma (OK), and Texas (TX) with three Class I areas. In the two equations, only sulfate and organic carbon have different values, but the calculated deciview difference is significant. (See Appendix 5.2 for further discussion of the default equation.)

Figure 5.1 Determination of Natural Background



In the guidance, EPA also provides 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 refinement would be to provide more accurate estimates with changes to the extinction algorithm that may include the following: 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/or the addition of visibility pollutants. States can choose between the default and refined equations. One equation is used to calculate baseline and current conditions of visibility due to haze-causing pollutants and, with natural concentrations of the same pollutants the same equation is used to calculate natural visibility.

Equation 1: The old (default) algorithm

$$
\begin{aligned}
b_{ext} \approx\ & 3 \times f(RH) \times [Sulfate] \\
& + 3 \times f(RH) \times [Nitrate] \\
& + 4 \times [Organic\ Carbon] \\
& + 10 \times [Elemental\ Carbon] \\
& + 1 \times [Fine\ Soil] \\
& + 0.6 \times [Coarse\ Mass] \\
& + 10
\end{aligned}
$$

Equation 2: The new (refined) algorithm:
Differences from the default are in bold.

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

The choice between use of the default or the refined equation for calculating the visibility metrics for each Class I area is made by the state in which the Class I area is located. According to 40 CFR 51.308(d)(2), the state will make the determinations of baseline and natural visibility conditions. It is with these calculations and in consultation with other states whose emissions affect visibility in that park or wilderness area (40 CFR 51.308(d)(1)(iv)) that the state has developed a "reasonable progress goal" for each Class I area.

The refined equation was used by ADEQ to calculate visibility metrics for the purpose of developing its reasonable progress goal. Please refer to Appendix 5.2 for the IMPROVE Steering Committee's report on the justification for the use of the "refined" IMPROVE algorithm.

The IMPROVE Steering Committee recommended to EPA a change to the light extinction equation. With this revision, a second set of "refined" numbers is being added to the IMPROVE and VIEWS websites for baseline and current condition values for each Class I area. States that choose the "corrected" algorithm that incorporate recent visibility research and analysis can also adopt new natural conditions values and document the reasonableness of these changes to EPA.

Consultation Regarding the Visibility Metrics

Consultation among states is a requirement that is repeated in the Regional Haze Rule. As part of a "long-term strategy" for regional haze, a state whose emissions are "reasonably anticipated" to contribute to impairment in other states' Class I area(s) must consult with those states; likewise, the state must consult with any states whose emissions affect its own Class I area(s) (40 CFR 51.308(d)(3)).

A chief purpose of the RPO is to provide a means for states to confer on all aspects of the regional haze issue, including consultation on reasonable progress goals and long-term strategies based on the current (baseline) and natural visibility determinations. (This process is described in Chapter 3 "Regional Planning"). CENRAP has provided a forum for the member States and Tribes to consult on the determination of baseline and natural visibility conditions in each of the Class I areas.

In addition, states in CENRAP have conferred with neighboring Class I area states outside CENRAP, both individually and by way of the states' RPO. Description of Arkansas's consultation process is located in Chapter 10 Section 3.

The 40 CFR 51.308(i) requires Class I area states' coordination with FLMs which includes consultation on implementation, the assessment of visibility impairment, and recommendations regarding the reasonable progress goal and strategies for improvement. This consultation requirement is treated in Chapter 4.

Through participation in CENRAP and as a state, Arkansas has completed this regulatory requirement. Chapter 4 provides details of actions taken to meet this requirement.

5.1 Baseline Visibility Conditions

Caney Creek WA has an established baseline visibility of 11.24 deciviews for the cleanest 20 percent of the sample days and 26.36 deciviews for the 20 percent worst visibility days. This is based on sampling data collected at the IMPROVE monitoring site located on Eagle Mountain, Polk County, Arkansas. A three year average (2002 to 2004) was calculated for each value (both best and worst) in accordance with 40 CFR 51.308(d)(2). The light extinction and deciview visibility values for these worst and best days are based on data and calculations included in Appendix 5.1 of this SIP. The summary data with the concentration values, light extinction calculations, and deciview values are presented in tables in Appendix 5.1

Upper Buffalo Wilderness Area (WA) has an established baseline visibility of 11.71 deciviews for the cleanest 20 percent of the sample days and 26.27 deciviews for the 20 percent worst visibility days. This is based on sampling data collected at the IMPROVE monitoring site located in Deer, Newton County, Arkansas. A five year average (2000 to 2004) was calculated for each value (both best and worst) in accordance with 40 CFR 51.308(d)(2). The light extinction and deciview visibility values for these worst and best days are based on data and calculations included in Appendix 5.1 of this SIP. The summary data with the concentration values, light extinction calculations, and deciview values are presented in tables in Appendix 5.1.

5.2 Natural Visibility Conditions

The state of Arkansas has within her boundary two mandatory Class I federal areas (Class I area), Upper Buffalo WA and Caney Creek WA which are managed by the United States Forest Service. Table 5.2 contains the natural conditions for the 20 percent (%) best days and the 20% worst days as well as the baseline visibility conditions for the 20% best and 20% worst days for each Class I area in Arkansas. Appendix 5.3 provides calculations and methodologies for estimating natural visibility conditions.

5.1 Visibility Metrics for the Class I Areas in Arkansas

Natural Background Conditions				
Class I Area	Average for the 20% Worst Days (deciview)	Average for the 20% Best Days (deciview)	Average for the 20% Worst Days B_{ext} (Mm^{-1})	Average for the 20% Best Days B_{ext} (Mm^{-1})
Caney Creek	11.58	4.23	21.16	4.33
Upper Buffalo	11.57	4.18	21.54	4.23
Baseline Visibility Conditions 2000 - 2004				
Class I Area	Average for the 20% Worst Days (deciview)	Average for the 20% Best Days (deciview)	Average for the 20% Worst Days B_{ext} (Mm^{-1})	Average for the 20% Best Days B_{ext} (Mm^{-1})
Caney Creek	26.36	11.24	134.1	20.61
Upper Buffalo	26.27	11.71	131.95	22.19

List of Chapter 5 Appendices

5.1 Revised Algorithm for Estimating Light Extinction from IMPROVE Particle Speciation Data
5.2 Determination of Baseline Visibility Conditions
5.3 Estimate of Natural Visibility Conditions

6. Monitoring Strategy

Section 51.308(d)(4) of the federal regional haze rule requires a monitoring strategy for measuring, characterizing, and reporting regional haze visibility impairment that is representative of all mandatory Class I areas within the State of Arkansas. The monitoring strategy relies upon participation in the Interagency Monitoring of Protected Visual Environments (IMPROVE) network.

Current Monitoring Strategy

Upon the creation of CENRAP, the newly formed Monitoring Workgroup identified that there were large visibility data voids in Southern Arkansas, Iowa, Kansas, Southern Minnesota, Nebraska, and Oklahoma. Only five (5) IMPROVE sites were located in the CENRAP region. Between 2000 and 2003, five (5) more IMPROVE sites and 15 IMPROVE Protocol Sites were installed (see Figure 6.1). In Arkansas, IMPROVE sites are located at the 14,460 acre Caney Creek Wilderness area in the Ouachita National Forest in Polk County, and the 11,801 acre Upper Buffalo Wilderness area in the Ozark National Forest in Newton County. The Upper Buffalo Class I area includes the original wilderness and the additions to it. It does not include the Buffalo National River (see Figure 6.2). In addition to the IMPROVE monitor, the Upper Buffalo Wilderness area site also includes a National Parks Service maintained nephelometer, and a meteorological monitor. Arkansas commits to meeting the requirements under 40 CFR 51.308(d)(4)(iv) to report to EPA visibility data for each of the Arkansas Class I areas annually.

The filter samples from the IMPROVE modules are sent for analysis to the Crocker Nuclear Laboratory of the University of California in Davis and the data is posted to the IMPROVE website [http://vista.cira.colostate.edu/improve/] and the Visibility Information Exchange Websystem (VIEWS) website [http://vista.cira.colostate.edu/views/]. This fulfills Arkansas's reporting requirement of visibility data (electronic) under subsection (iv). Details regarding the monitors (location, date of installation etc.) and monitoring data are found in Appendices 6.1, and 6.2.

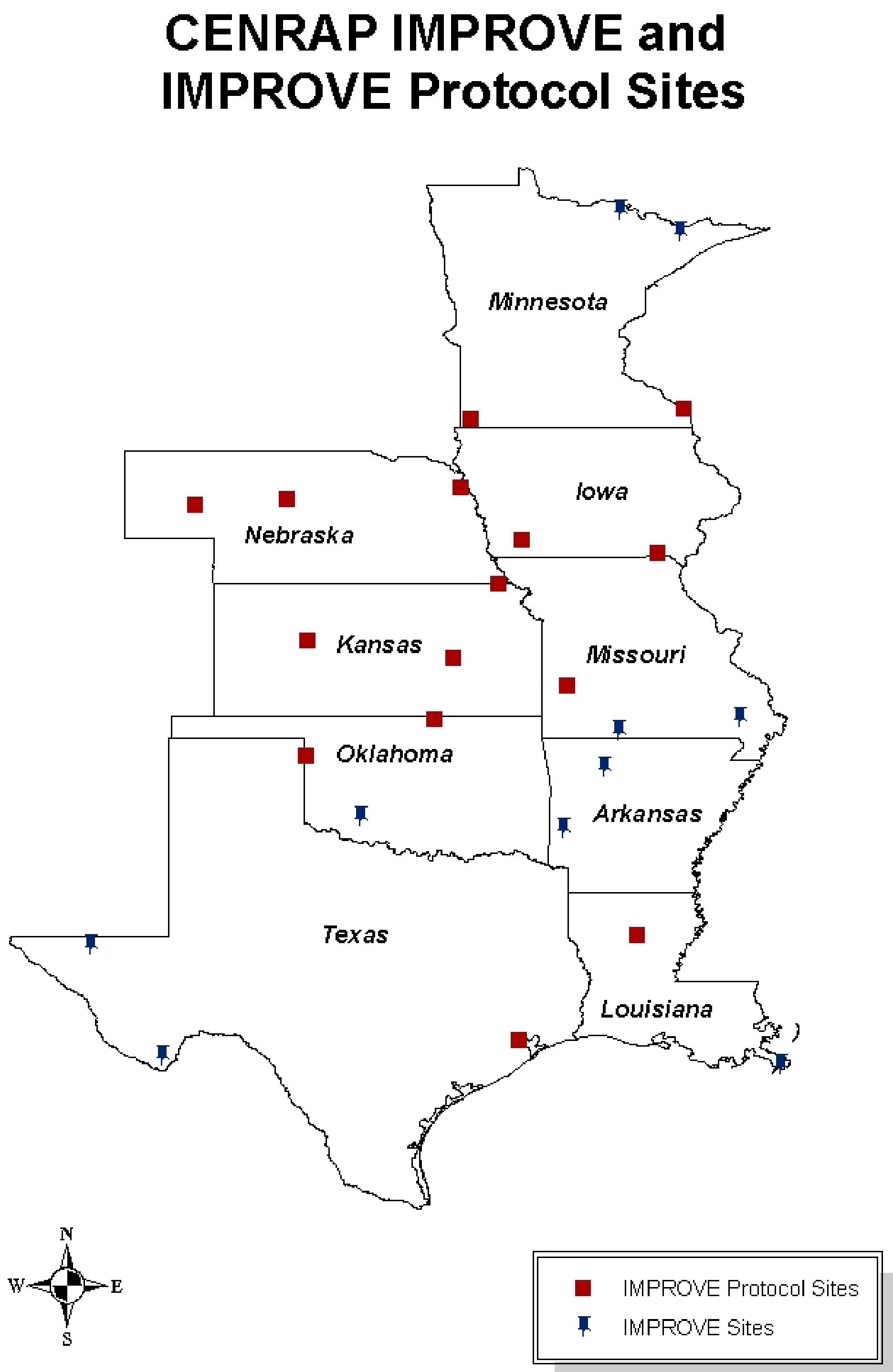


Figure 6.1 CENRAP IMPROVE and IMPROVE Protocol Sites

Figure 6.2 Class I areas in Arkansas

Future Monitoring Strategy

In order to assess progress in reducing visibility impairment in Class I areas, the existing IMPROVE and IMPROVE Protocol sites will be maintained contingent upon continued national funding to measure, characterize and report regional haze visibility impairment to satisfy requirements of subsection (i). The State will evaluate the monitoring network periodically including evaluation technology changes and the need for new monitors. Where economically feasible or with national funds, the State anticipates making those changes needed to be able to assess whether reasonable progress goals are being achieved in each of Arkansas's mandatory Class I areas.

Special Monitoring Studies

As funding permits, CENRAP, in cooperation with states and tribes, intends to study impacts of ammonia and carbon on visibility impairment in the CENRAP region. Preliminary monitoring studies and monitoring data analysis suggests that these two air constituents contribute to a large portion of visibility impairment in the CENRAP geographical area.

List of Chapter 6 Appendices

6.1 Monitoring and Data Analysis to Support the Regional Haze Rule
6.2 CENRAP Regional Haze Monitoring Strategy

7.0 Emission Inventory

The 40 CFR 51.308(d)(4)(v) requires a statewide emission inventory of pollutants that are reasonably anticipated to cause, or contribute, to visibility impairment in any mandatory Class I area. As specified in the applicable EPA guidance, the pollutants inventoried by Arkansas include volatile organic compounds (VOCs), nitrogen oxides ($NO_{X)}$), fine particulate ($PM_{2.5}$), coarse particulate (PM_{10}), ammonia (NH_3), carbon monoxide (CO), and sulfur dioxide (SO_2). An inventory was developed for the baseline year 2002, and ADEQ will update the emission inventory according to the policy issued by the EPA. A summary of those inventory results follows; the 2002 emission inventory developed by Environ International Corporation has been submitted as Appendix 7.1 A.

Table 7.1 2002 Emissions Inventory Summary

	VOC	NOx	PM2.5	PM10	NH3	CO	SO2
Point	44,329	72,419	7,837	12,406	1	56,366	92,205
Nonpoint	93,548	27,450	68,000	148,433	152,436	436,525	29,889
Nonroad Mobile	54,785	62,472	5,220	5,673	49	272,627	5,490
On-Road Mobile	48,599	141,894	3,021	3,784	2,480	669,214	3,902
Biogenics	1,385,666	18,960				136,688	
TOTAL	1,626,927	323,195	84,078	170,296	154,967	1,571,419	131,485

Overview of the 2002 Emission Inventory

The 2002 point source inventory was completed in-house with Emission Inventory Questionnaires (EIQs). We contracted with Environ to prepare our on-road, nonroad, and nonpoint sources 2002 emission inventory (see enclosed document in Appendix 7.1 A). We accepted the EPA's biogenic source inventory. The nonpoint source inventory included emitters of ozone pollutants (i.e., VOC, NOx and CO) such devices that combust fuel (e.g., wood stoves, commercial and industrial boilers), disperse industrial and commercial VOC sources (e.g., dry cleaners, degreasing and industrial surfaces coating), gasoline distribution, asphalt paving and fires and open burning (e.g., agricultural burning, structural fires wildfires, prescribed burning).

For some source categories, the methodologies actually used in the Arkansas nonpoint source inventory are different than those originally proposed due to newly developed methodologies. Also, because some data were not available, alternate sources of data for some source categories were used. The industrial fuel combustion categories in the Arkansas nonpoint inventory were reconciled with industrial nonpoint fuel data in order to prevent potential double counting of emissions. The industrial point source fuel data were obtained from ADEQ's Emission Inventory Questionnaire (ADEQ 2004). The 2002 EIQs were being processed and could not be used; The 2001 EIQ were used instead. All EIQ fuel use data were being processed and could not be used; The 2001 EIQ were used instead. All EIQ fuel use data were directly input "as is" into a spread sheet form the EIQ forms. The only adjustments made were to the EIQ data were conversions units (i.e., natural gas to 10^6 ft^3, distillate and residual fuel oil to 10^3 gallons, and coal to tons) and corrections of obvious inconsistencies (e.g., wood combustion reported in units of 10^6 ft^3 for a natural gas boiler was switched to natural gas combustion, etc.). Facilities with ambiguous fuel types, quantities or units were omitted from the reconciliation. The reconciliation was performed by subtracting state level EIQ industrial nonpoint fuel use from the nonpoint inventory's state level industrial combustion fuel use. Fuel use from utility facilities listed in the EIQ was not included in the EIQ fuel use totals. Distillate fuel oil, residual fuel oil, natural gas and coal were included in the reconciliation; LPG use was not identified in the EIQ fuel use data. As a result of the reconciliation, state level industrial fuel use in the nonpoint inventory was adjusted (i.e., distillate fuel oil reduced by 4.3 percent, natural gas reduced by 45.0 percent and coal reduced by 16.8 percent). For residual fuel oil, the EIQ fuel use data exceeded the industrial fuel combustion nonpoint fuel use estimate. Therefore, industrial fuel combustion or residual fuel oil in the nonpoint inventory was adjusted to zero. Reconciliation for other area source categories (i.e., industrial surface coating or degreasing) was not preformed because data were unavailable on the EIQ forms.

On-road Source Inventory

The on-road mobile source emissions included emissions from vehicles certified for highway use – cars, trucks, and motorcycles. Emissions from these sources were estimated by combining EPA emission factors from the MOBILE6 model, expressed in grams per mile (g/mile), with vehicle miles traveled (VMT) activity data. For all of the Arkansas counties, county-level Highway Performance Monitoring System (HPMS) VMT data were used. The data collected as part of the on-road inventory were reviewed prior to use in emission calculations. All modeling inputs, data processing and calculation spreadsheets were checked by a technical supervisor. Annual average daily HPMS VMT data were provided by the Arkansas Highway and Transportation Department (AHTD). These data were reported separately for urban and rural areas and within those categories, by county and HPMS facility class. The AHTD provided data for 2007 and 2010 and these were exponentially extrapolated back to 2002. To arrive at month-specific estimates, the annual average was adjusted using seasonal factors derived based upon data provided by AHTD. Finally, to obtain weekday VMT (for the summer and winter reporting requirements) the monthly values were corrected using Texas statewide average weekday/annual average daily factors: there were no default factors from EPA and these were considered to be the best, given the limited data available from only a few states. For each county, MOBILE6 emission was used in combination with the VMT data to estimate emissions by roadway type and vehicle type and vehicle class. National average speeds derived from HMPS data for each facility class were utilized. Monthly emissions were first estimated from which annual total, summer weekday and winter weekday emissions were derived.

Nonroad Emission Inventory

Nonroad mobile sources encompass a wide variety of equipment types that either move under their own power or are capable of being moved from site-to-site. More specifically, these sources, which are not licensed or certified as highway vehicles, are defined as those that move or are moved within a 12-month period and are convered under the EPA's emissions regulations as nonroad mobile sources. Where feasible and appropriate, local activity data for specific source categories were gathered and used to develop the inventory.

US EPA's draft NONROAD2002 model (June 2003 version) was used to estimate emissions for most nonroad sources. The NONROAD model estimates emissions from non-road equipment in the following categories:

- Agricultural equipment, such as tractors, combines and balers
- Airport ground support, such as terminal tractors
- Construction equipment, such as graders and back hoes
- Industrial and commercial equipment, such as fork lifts and sweepers
- Residential and commercial lawn and garden equipment, such as leaf and snow blowers
- Logging equipment, such as shredders and large chain saws
- Recreational equipment, such as off-road motorbikes and snowmobiles and
- Recreational marine vessels, such as power boats

Aircraft, commercial marine and locomotive emissions were also included in the non-road inventory, but these sources were estimated separately since they were not included in the NONROAD model. General EPA methodologies were followed to estimate emissions for these three categories. For all source categories, annual average emissions have been estimated in tons per year and ozone season and winter season daily emissions are estimated in tons per day. All data collected as part of nonroad sources emission inventory were thoroughly reviewed to ensure that they were the most appropriate and up-to-date emission factors available.

Point Source Inventory

ADEQ is responsible for compiling the point source inventory. The Air Division Emission Inventories and Data Management Section is accountable for identifying point sources meeting the threshold criteria, collecting facility emissions data, processing, managing data, compilation and displaying the results. Emissions data provided by the facilities are estimates of actual emissions for the facility during the previous year. Estimations methodologies are required to follow state and federal guidelines. Point Sources are large, stationary, emissions sources that release pollutants into the atmosphere. According to the Consolidated Emissions Reporting Rule (CERR), States are required to report data for larger point sources, or Type A point sources, on an annual basis, starting with 2001 inventory. Type B sources refer to all point sources, including Type A sources. The reporting frequency for Type B sources has been established as once every 3 years, starting with the 2002 base year inventory.

Actual measurement with continuous emissions monitoring systems (CEMS) is the desired method of calculation emissions from a point source. In lieu of CEMS data, emissions may be calculated using other stack test data, material balance or emissions factors from AP-42 or approved engineering journals. Since the data are used for modeling and other purposes, data elements include parameters and coordinates, control devices and efficiencies, actual emissions, emission factors, process codes and parameters. All data are processed into the i-STEPS database which automatically applies minimum quality assurance and quality control checks. Further, the data is processed for inaccuracies those that cannot be readily resolved are referred back to the facility for clarification/correction.

Following the submission of our 2002 Emission Inventory to the CDX, additional quality assurance, and revision of the data was completed through CENRAP. E. H. Pechan & Associates (Pechan) was contracted to QC the data and fill in the gaps where needed. Pechan would call us with errors they detected in the 2002 inventory and we would make corrections over the phone and sometimes via email. Pechan's work is included in (Appendix 7.1 B and C): *The Consolidation of Emissions Inventories* (April 28, 2005) and *Refinement of CENRAP's 2002 Emissions Inventories* (August 31, 2005).

The majority of the nonroad mobile inventory was developed by Sonoma Technology under a contract with CENRAP. The methods and data used by Sonoma are described in the report (Appendix 7.1 D) *Emission Inventory Development for Mobile Sources and Agricultural Dust Sources for the Central States* (October 28, 2004).

Table 7.2 2018 Emissions Inventory Summary

	VOC	NOx	PM2.5	PM10	NH3	CO	SO2
Point	55,603	71,107	13,775	19,799	2,575	75,708	106,461
Nonpoint	107,387	31,531	69,585	148,592	201,722	448,760	31,169
Nonroad Mobile	31,475	34,305	3,387	3,678	49	293,734	211
On-Road Mobile	19,924	33,640	949	949	3,412	367,152	443
Biogenics	1,385,666	18,960				136,688	
TOTAL	1,600,055	189,542	87,695	173,019	207,758	1,322,043	138,283

Overview of the 2018 Emission Inventory

The 2002 emissions were grown to 2018 by using growth and control factors derived from the EGAS6, MOBILE6, and NONROAD models. The Integrated Planning Model (IPM) was used to forecast 2018 electric generating unit (EGU) emissions. Table 7.2 provides a summary of the 2018 BaseG emissions inventory. The summary data provided in Table 7.2 was compiled through a contract with E. H. Pechan.

The 2018 point source emission inventory was prepared by CENRAP. For the non-EGUs, the 2002 emission were projected by applying growth and control factors using the SMOKE model. The growth and control factors were prepared by Pechan and are documented in the report (Appendix 7.2 E): *Development of Growth and Control Inputs for CENRAP 2018 Emissions Draft Technical Support Document* (May 2005). The control factors for non-EGU point sources account for Maximum Achievable Control Technology (MACT) standards and the NOx SIP Call for industrial boilers.

The Integrated Planning Model (IPM) version 2.1.9 model out put for 2018 was used for 2018 EGU point source emissions. The SMOKE IDA formatted version of the 2018 Integrated Planning Model (IPM) was prepared by Pechan for CENRAP. See the Pechan report, *Refinement of CENRAP's 2002 Emissions Inventories* (August 31, 2005), in Appendix 7.1 C for additional information. The IPM conducted by ICF specifically address the emission reductions to be realized through implementation of CAIR assuming all states participated in the EPA's trading program, Acid Rain Program (Title IV-Phases I and II), NOx SIP Call, State and local regulations, while incorporating unit-level updates provided by power company stakeholders. The University of California-Riverside (UCR) ran the smoke Model for the 2018 point sources. The edited IPM file for EGUs was processed in SMOKE without adjustments. The growth and control factors for non-EGUs were applied using the SMOKE model. The technical support document in Appendix 8.1 describes UCR's work on the 2018 point source inventory.

To prepare the nonpoint inventories for modeling, UCR made several modifications to the IDA files by removing selected sources either to model them as separate source categories or to omit them from simulations completely. Fugitive and road dust sources were extracted from all stationary nonpoint inventories and adjusted by transport factors following *Methodology to Estimate the Transportable Fraction (TF) of Fugitive Dust Emissions for Regional and Urban Scale Air Quality Analyses* (Pace 2005).

The 2018 nonpoint source emissions inventory was based on data provided by CENRAP states. Nonpoint source growth and control factors were prepared by Pechan and are documented in the following report in Appendix 7.2 E: *Development of Growth and Control and Control Inputs for CENRAP 2018 Emission Draft Technical Support Document* (May 2005). The control factors reflect New Source Performance Standards (NSPS) for residential wood combustion and Stage I vapor recovery controls, including onboard vapor recovery. UCR ran the SMOKE model for the 2018 area source emissions. The growth and control factors for nonpoint sources were applied within SMOKE. The technical support document in Appendix 8.1describes UCR's work on the 2018 nonpoint inventory. Windblown dust from non-agricultural land use categories and fire emissions were held constant from 2002 to 2018.

The 2018 nonroad mobile inventory was based on inputs from CENRAP states. Growth and control factors for locomotives, aircraft, and commercial marine vessels were prepared by Pechan. The control factors accounted for federal standards for commercial marine vessels and locomotives. For the remaining nonroad mobile categories, Pechan ran the EPA's

NONROAD2004 model for 2018. EPA's NONROAD2004 model accounts for growth in equipment population and incorporates the effects of most final federal standards, including the Tier 4 diesel engine standards and the exhaust emission standards for large spark-ignition engines, diesel marine, and land-based recreational engines. Pechan's methods are described in detail in Appendix 7.2 E: *Development of Growth and Control inputs for CENRAP 2018 Emissions Draft Technical Support Document* (May 2005). UCR applied the growth and control factors to NONROAD categories using the SMOKE model. In addition, UCR processed NONROAD-model categories in SMOKE without adjustments. The technical support document Appendix 8.1 describes UCR's work on the 2018 nonroad inventory.

Pechan prepared the VMT and MOBILE inputs for the 2018 on-road mobile source emissions inventory. The VMT growth factors and MOBILE6 input files were provided in SMOKE format. The MOBILE6 model accounts for motor vehicle controls, including light duty diesel engine standards and low-sulfur diesel. The technical support document in Appendix 8.1 describes UCR's onroad mobile emissions inventory processing.

UCR generated biogenic emissions by running the BEIS3 model within the SMOKE framework. BEIS3 is a system integrated into SMOKE for deriving emissions estimates of biogenic gas-phase pollutants from land use information, emissions factors for different plant species, and hourly, gridded meteorology data. Biogenic emissions were held constant from 2002 to 2018. The technical support document in Appendix 8.1 describes the development of the biogenic emission inventory.

The increase in SO2 from 127,290 in 2002 to 138,284 in 2018 is attributed to growth in Electrical Generating Units (EGU) use in Arkansas. We anticipate additional coal fired plants being built between 2002 and 2018. See figures 7.1 and 7.2 for a comparison of the 2002 and 2018 inventory by source category.

The point source inventories will be updated on an annual basis and the nonpoint, on-road, nonroad mobile inventories will be updated every three years according to the Consolidated Emissions Reporting Rule.

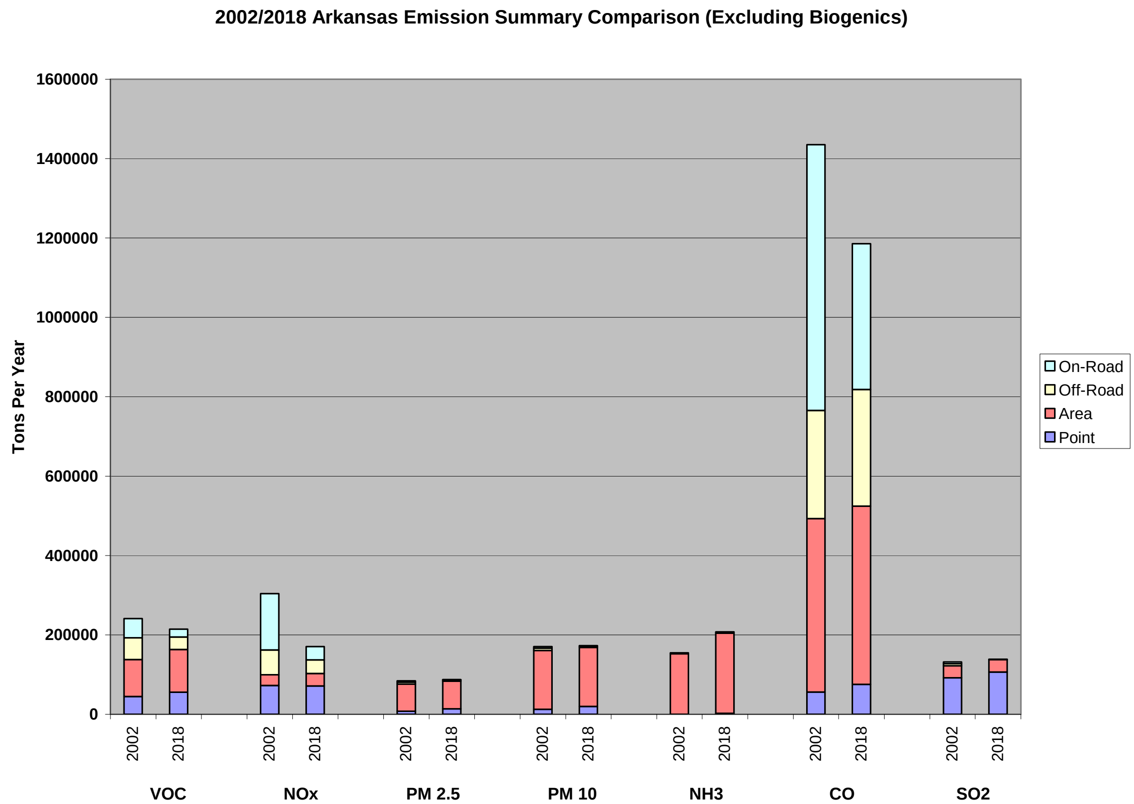


Figure 7.1. 2002/2018 Arkansas Emission Summary Comparison (Excluding Biogenics)

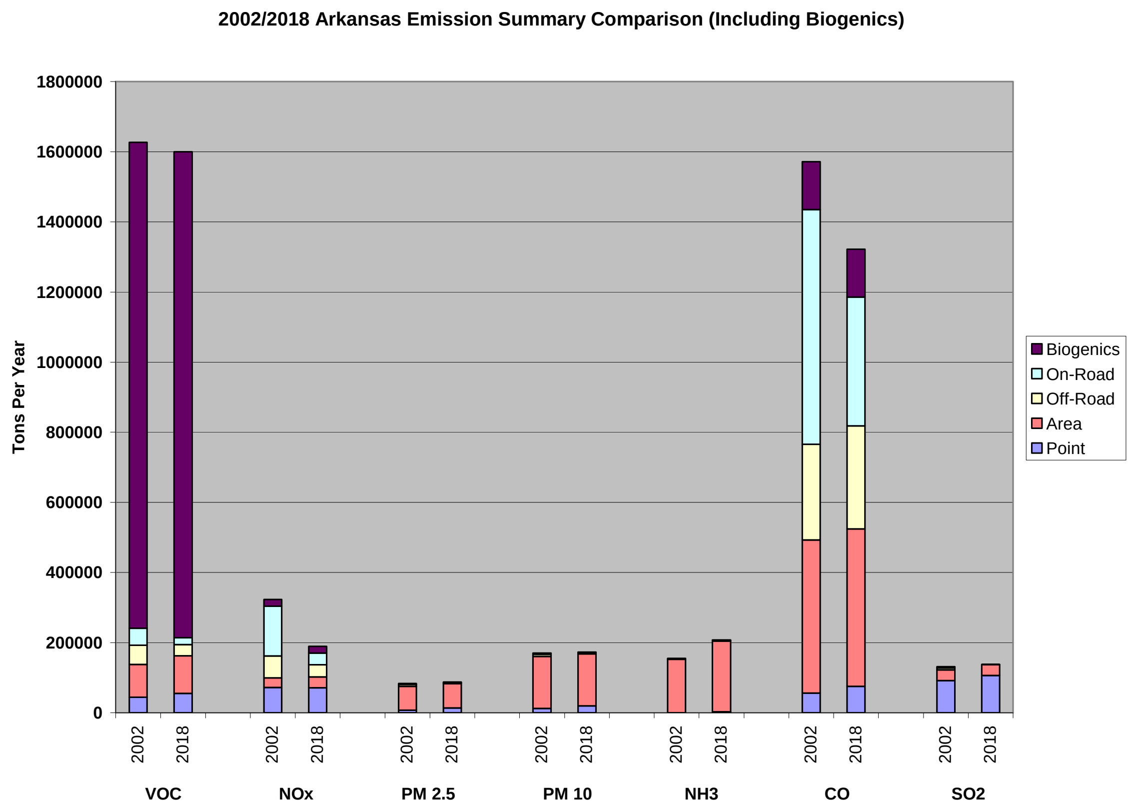


Figure 7.2. 2002/2018 Arkansas Emission Summary Comparison (Including Biogenics)

List of Chapter 7 Appendices

7.1 Statewide/Tribal 2002 Emissions Inventory – Parts A-D
7.2 2002 Emissions Inventory Short Summary (Chapter 8 Appendix 8.1 TSD includes all CENRAP contractor work)

8. Modeling Assessment

The 40 CFR Part 51, Appendix W provides modeling guidelines for conducting regional-scale modeling for particulate matter and visibility. The U.S. EPA recommends the use of one of the three following models to simulate pollutants impairing visibility: Community Multiscale Air Quality (CMAQ), the Comprehensive Air quality Model (CAMx), and Regional Modeling System for Aerosols and Deposition (REMSAD). CENRAP contractors performed regional modeling using CMAQ and CAMx.

The CMAQ model is an Eulerian model that simulates the atmospheric and surface processes affecting the transport, transformation and deposition of air pollutants and their precursors. A Eulerian model computes the numerical solution of partial differential equations of plumes on a fixed grid; other models may lose accuracy or need regridding as the plumes expand.

CAMx is a computer modeling system for the integrated assessment of photochemical and particulate air pollution. CAMx incorporates all of the technical attributes demanded of state-of-the-art photochemical grid models, including two-way grid nesting, a subgrid-scale Plume-in-Grid module to treat the early dispersion and chemistry of point source NOx plumes, and a fast chemistry solver.

Particulate Matter (PM) Modeling: CAMx Mechanism 4 (M4) provides "1-atmosphere" modeling for fine and coarse PM and ozone. Aqueous phase chemistry is modeled using the RADM mechanism. Inorganic sulfate/nitrate/ammonium chemistry is modeled with ISORROPIA. ISORROPIA is a model that calculates the composition and phase state of an ammonia-sulfate-nitrate-chloride-sodium-water inorganic aerosol in thermodynamic equilibrium with gas phase precursors. Secondary organic aerosols are modeled using a semi-volatile scheme called Simple Object Access Protocol (SOAP). Wet and dry deposition processes are included for gasses and particles. Gridded deposition information is output along with the concentrations.

In the July 1, 1999 publication of the Regional Haze Rule in the Federal Register, EPA defined the uses of regional modeling as follows:

- Analyses and determination of the extent of emissions reductions needed from individual states
- Analyses and determination of emissions needed to meet the progress goal for the Class I area
- Analyses to support conclusion that the Long-Term Strategy provides for reasonable progress
- Analyses to calculate the resulting degree of visibility improvement that would be achieved at each Class I area
- Analyses to compare visibility improvement between proposed control strategies

8.1 Model Inputs

8.1.1. Selection of Episodes

The calendar year 2002 was selected for the base year for CENRAP regional haze annual modeling consistent with EPA guidance. The Technical Support Document provides additional information on the selection of 2002 as the base year for regional haze modeling and is found at Appendix 8.1.

8.1.2. Selection of Modeling Domain

CENRAP conducted emissions and air quality modeling on the 36 km national RPO domain. This domain consists of a 148 by 112 array of 36 km by 36 km grid cells and covers the continental United States, see Figure 8.1. The Technical Support Document provides additional information on the modeling domain and is found at Appendix 8.1.

8.1.3 Emission Inventories - The emissions inventory includes VOC, NO_X, CO, SO_2, PM_{10}, $PM_{2.5}$, and NH_3 emissions from all anthropogenic and biogenic sources. The emissions inventory information submitted by state, tribal, and local agencies to the 2002 NEI formed the basis of the 2002 CENRAP emissions inventory. The NEI data was supplemented with non-point source emissions inventories developed for CENRAP by Sonoma Technology. These CENRAP-specific inventories addressed agricultural and prescribed burning, onroad and offroad mobile sources, agricultural tilling and livestock dust, and agricultural ammonia. In addition, Pechan assisted CENRAP by quality-assuring the emissions inventory and preparing day- and hour-specific emissions for EGUs based on Continuous Emissions Monitor (CEM) data for the model performance evaluation. Emissions inputs for the air quality model were prepared using the SMOKE emissions modeling system. The CENRAP modeling emissions inventory consists of several distinct datasets: the 2002 base case for model performance evaluation, 2002 typical, 2018 base case, and the 2018 control strategy scenario. Its spatial extent is the RPO 36 km modeling domain, which covers. The Technical Support Document (TSD) provides the methodologies for this process and is found in Appendix 8.1. Emission inventory information can be found in Chapter 7.

8.1.3. Meteorology - The Fifth-Generation NCAR / Penn State Mesoscale Model (MM5) is the latest in a series that developed from a mesoscale model used by Anthes at Penn State in the early 70's that was later documented by Anthes and Warner (1978). Since that time, it has undergone many changes designed to broaden its usage. These changes include: a multiple-nest capability; nonhydrostatic dynamics, which allows the model to be used at a few-kilometer scale; multitasking capability on shared- and distributed-memory machines; a four-dimensional data-assimilation capability; and more physics options. The model (known as MM5) is supported by several auxiliary programs, which are referred to collectively as the MM5 modeling system. Since MM5 is a regional model, it requires an initial condition as well as a lateral boundary condition to run. To produce a lateral boundary condition for a model run, gridded data to cover the entire time period that the model is integrated is needed The TSD provides the methodologies for this process and is found at Appendix 8.1.

8.2 2002 Model Year

8.2.1 Model Year Selection

The calendar year 2002 was selected for CENRAP regional haze annual modeling as described in the CENRAP Modeling Protocol prepared at the end of 2004. EPA's applicable guidance on $PM_{2.5}$/Regional Haze modeling at that time (EPA, 2001) identifies specific goals to consider when selecting modeling periods for use in demonstrating reasonable progress in attaining the regional haze goals. Due to limited available resources CENRAP was restricted to modeling a single Calendar Year (CY). The RHR uses the five-year baseline of 2000-2004 period as the starting point for projecting future-year visibility. Thus, the modeling year should be selected from this five-year baseline period. The 2002 calendar year, which lies in the middle of the 2000-2004 Baseline, was selected for the following reasons:

- Based on available information, 2002 appears to be a fairly typical year in terms of meteorology for the 5-year Baseline period of 2000-2004;
- 2003 and 2004 appeared to be colder and wetter than typical in the eastern US;
- The enhanced IMPROVE and IMPROVE Protocol and Supersites PM monitoring data were fully operational by 2002. Much less IMPROVE monitoring data was available during 2000-2001, especially in the CENRAP region;
- IMPROVE data for 2003 and 2004 were not yet available at the time the CENRAP modeling was initiated; and
- 2002 is being used by the other RPOs.

The CMAQ and CAMx models were operated separately for each of four quarters of the 2002 year using a ~15 day spin up period (i.e., the models were started approximately 15 days before the first day of interest in each quarter in order to limit the influence of the assumed initial concentrations, e.g., start June 15 for quarter 3 whose first day of interest is July 1). Boundary Conditions (BCs) (i.e., the assumed concentrations along the later edges of the 36 km modeling domain, see Figure 8.1) were based on a 2002 simulation by the GEOS-CHEM global circulation/chemistry model. GEOS-CHEM is a three-dimensional global chemistry model driven by assimilated meteorological observations from the Goddard Earth Observing System (GEOS) of the NASA Global Modeling and Assimilation Office. It is applied by research groups around the world to a wide range of atmospheric composition problems, including future climates and planetary atmospheres using general circulation model meteorology to drive the model. Central management and support of the model is provided by the Atmospheric Chemistry Modeling Group at Harvard University

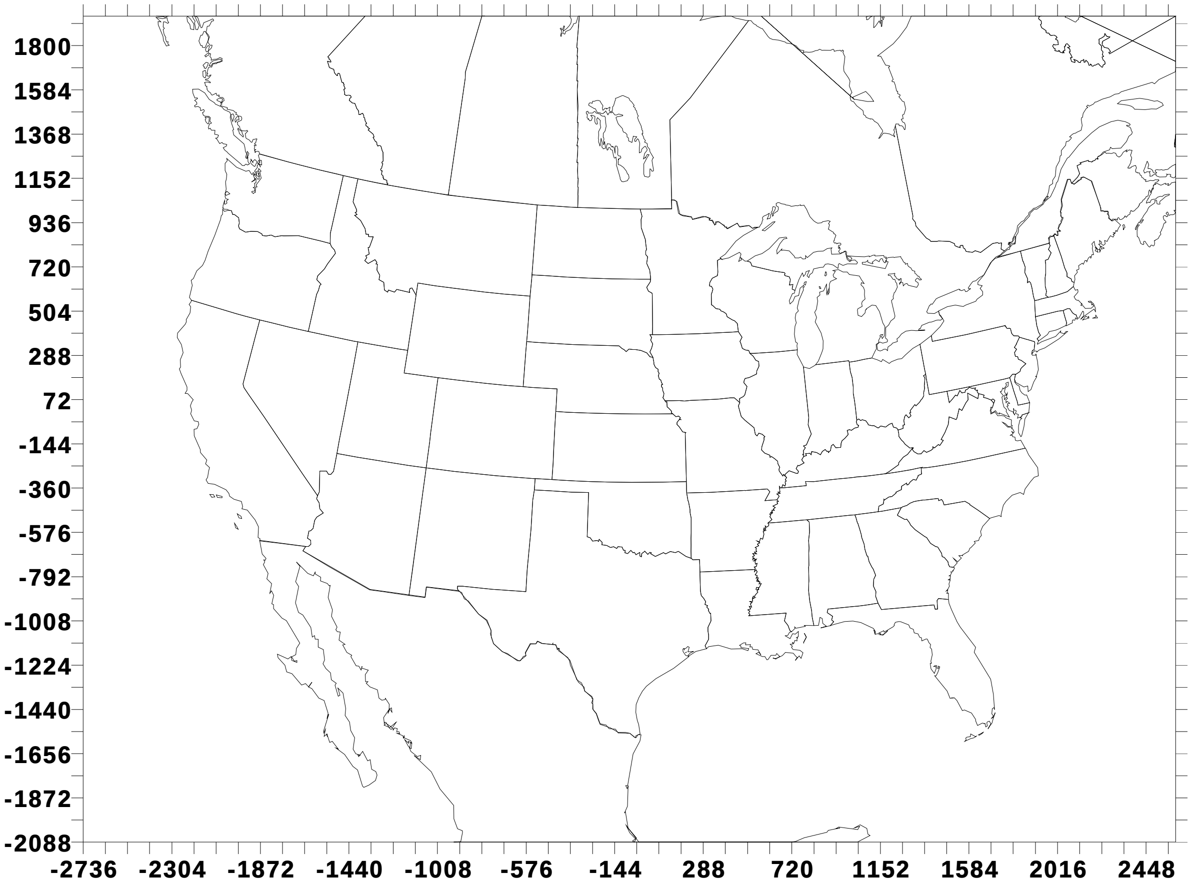


Figure 8.1. National Inter-RPO 36 km modeling domain used for the CENRAP 2002 annual SMOKE, CMAQ and CAMx modeling.

8.2.2 Emissions Input Preparation

The CENRAP SMOKE emissions modeling was based on an updated 2002 emissions data for the U.S. (Pechan, 2005c,e; Reid et al., 2004a,b), 1999 emissions data for Mexico (ERG, 2006), and 2000 emissions data for Canada. These data were used to generate a final base 2002 Base G Typical (Typ02G) annual emissions database. Numerous iterations of the emissions modeling were conducted using interim databases before arriving at the final Base G emission inventories (e.g., Morris et al., 2005). The 2018 Base G base case emissions (Base18G) for most source categories in the U.S. were based on projections of the 2002 inventory assuming growth and control (Pechan, 2005d).

8.2.3 Meteorological Input Preparation

The 2002 36 km MM5 meteorological modeling was conducted by the Iowa Department of Natural Resources (IDNR) who also performed a preliminary model performance evaluation (Johnson, 2004). CENRAP performed an additional MM5 evaluation of the CENRAP 2002 36 km MM5 evaluation that included a comparative evaluation against the final VISTAS 2002 36 km MM5 and an interim WRAP 2002 36 km simulation (Kemball-Cook et al., 2004).

8.2.4 Photolysis Rates Model Inputs

Several chemical reactions in the atmosphere are initiated by the photodissociation of various trace gases. To accurately represent the complex chemical transformations in the atmosphere, accurate estimates of these photodissociation rates must be made. The Models-3 CMAQ system includes the JPROC processor, which calculates a table of clear-sky photolysis rates (or J-values) for a specific date.

8.2.5 Air Quality Input Preparation

Air quality data used with the CMAQ and CAMx modeling systems include: (1) Initial Concentrations (ICs) that are the assumed three-dimensional concentrations through the modeling domain at the very start of the simulation; (2) the Boundary Conditions (BCs) that are the concentrations assumed along the lateral edges of the RPO national 36 km modeling domain; and (3) air quality observations that are used in the model performance evaluation are discussed in Section 3 and Appendix C of Appendix 8.1.

8.2.6 Model Performance Evaluation

The CMAQ and CAMx models were evaluated against ambient measurements of PM species, gas-phase species and wet deposition. Table 8.1 summarizes the networks used in the model evaluation, the species measured and the averaging times and frequency of the measurements.

Table 8.1. Ground-level ambient data monitoring networks and stations available in the CENRAP states for calendar year 2002 use in the model performance evaluation.

Monitoring Network	Chemical Species Measured	Sampling Frequency; Duration	Approximate Number of Monitors
IMPROVE	Speciated $PM_{2.5}$ and PM_{10}	1 in 3 days; 24 hr	11
CASTNET	Speciated $PM_{2.5}$, Ozone	Hourly, Weekly; 1 hr, 1 Week	3
NADP	WSO4, WNO3, WNH4	Weekly	23
EPA-STN	Speciated $PM_{2.5}$	Varies; Varies	12
AIRS/AQS	CO, NO, NO_2, NO_x, O_3	Hourly; Hourly	25

Numerous iterations of CMAQ and CAMx 2002 base case simulations and model performance evaluations were conducted during the course of the CENRAP modeling study, most of which have been posted on the CENRAP modeling website (http://pah.cert.ucr.edu/aqm/cenrap/cmaq.shtml) and presented in previous reports and presentations for CENRAP (e.g., Morris et al., 2005; 2006a,b). Details on the final 2002 Base F 36 km CMAQ base case modeling performance evaluation are provided in Chapter 3 and Appendix C of Appendix 8.1, (because of the similarity between 2002 Base F and 2002 Base G and resource constraints the model evaluation was not re-conducted for Base G). In general, the model performance of the CMAQ and CAMx models for sulfate (SO4) and elemental carbon (EC) was good. Model performance for nitrate (NO3) was variable, with a summer underestimation and winter overestimation bias. Performance for organic mass carbon (OMC) was also variable, with the inclusion of the SOAmods enhancement in CMAQ Version 4.5 greatly improving the CMAQ summer OMC model performance (Morris et al., 2006c). Model performance for Soil and coarse mass (CM) was generally poor. Part of the poor performance for Soil and CM is believed to be due to measurement-model incommensurability. The IMPROVE measured values are due, in part, to local fugitive dust sources that are not captured in the model's emission inputs and the 36 km grid resolution is not conducive to modeling localized events.

8.3 2018 Base G Model Year

8.3.1 2018 Emissions Inventory

The 2018 Base G modeling run reflects emissions growth and "on the books" controls, which are state and federal controls that will be implemented between the 2002 base year and the 2018 future year.2018 emissions for Electrical Generating Units (EGUs) were based on simulations of the Integrated Planning Model (IPM) that took into the account the effects of the Clean Air Interstate Rule (CAIR) on emissions from EGUs in CAIR states using an IPM realization of a CAIR cap-and-trade program. Thus the Emissions for on-road and non-road mobile sources were based on activity growth and emissions factors from the EPA MOBILE6 and NONROAD models, respectively. Area sources and non-EGU point sources were grown to 2018 levels.

The following sources were assumed to remain constant between the 2002 and 2018 base case simulations:

- Biogenic VOC and NOx emissions from the BEIS3 biogenic emissions model;
- Wind blown dust associated with non-agricultural sources (i.e., natural wind blown fugitive dust);
- Off-shore emissions associated with off-shore marine and oil and gas production activities;
- Emissions from wildfires;
- Emissions from Mexico; and
- Global transport (i.e., emissions due to BCs from the 2002 GEOS-CHEM global chemistry model.

8.3.2 Model Performance Evaluation

In this section, and in section 3 of Appendix 8.1, the results of the model performance evaluation at each of Arkansas's Class I areas for the worst and best 20 percent days are presented. Performance on these days is critical since they are the days used in the 2018 visibility projections discussed in Chapter 8.6. The 2002 and 2018 modeling results were used in a relative sense to scale the observed PM concentrations from the 2000-2004 Baseline and the IMPROVE monitoring network to obtain the 2018 PM projections. The 2018/2002 modeled scaling factors are called Relative Response Factors (RRFs) and are constructed as the ratio of modeling results for the 2018 model simulation to the 2002 model simulation. Two important regional haze metrics are the average visibility for the worst 20 percent and best 20 percent days from the 2000-2004 five-year Baseline. For the 2018 visibility projections, EPA guidance recommends developing Class I area and PM species specific RRFs using the average modeling results for the worst 20 percent days during the 2002 modeling period and the 2002 and 2018 emission scenarios. For each Class I area we compared the predicted and observed extinction of the worst and best 20 percent days below. In Appendix C of Appendix 8.1 the PM species specific extinction is also compared for the worst 20 percent days.

EPA guidance recommends using the model in a relative sense to project future-year visibility conditions (EPA, 2007a). This projection is made using Relative Response Factors (RRFs) that are defined as the ratio of the future-year modeling results to the base-year modeling results. The RRFs are applied to the baseline visibility conditions to project future-year visibility. The major features of EPA's recommended visibility projection approach are as follows :

• Monitored data are used to define current visibility Baseline Conditions using IMPROVE monitoring data from the 2000-2004 five-year base period.

• Monitored concentrations of PM_{10} are divided into six major components, the first five of which are assumed to be $PM_{2.5}$ and the sixth is coarse mass (CM or $PM_{2.5-10}$).

- SO4 (sulfate) that is assumed to be ammonium sulfate [$(NH_4)_2SO_4$];
- NO3 (particulate nitrate) that is assumed to be ammonium nitrate [NH_4NO_3];
- OC (organic carbon) that is assumed to be total organic mass carbon (OMC)
- EC (elemental carbon);
- IP (other fine inorganic particulate or Soil); and
- CM (coarse mass).

Models are then used in a relative sense to develop RRFs between baseline and future predicted concentrations of each component. Final projections were based on these RRFs, and indicate that while the model results may be off in absolute terms, the model still responds to increases or decreases in pollutants responsible for visibility impairment. This can lead to over or underestimation of light extinction for the various pollutants while still showing model applicability.

8.3.2.1 Caney Creek Wilderness Area Modeling

The ability of the CMAQ model to estimate visibility extinction at the CACR Class I area on the 2002 worst and best 20 percent days is provide in Figure 8.2. On most of the worst 20 percent days at CACR total extinction is dominated by SO4 extinction with some extinction due to OMC. On four of the worst 20 percent days extinction is dominated by NO3. The average extinction across the worst 20 percent days is underestimated by -33% (Figure 8.2), which is primarily due to a -51% underestimation of SO4 extinction combined with a 6% overestimation of NO3 extinction. Performance for OMC extinction at CACR on the worst 20 percent days is pretty good with a -20% bias and 36% error. EC extinction is systematically underestimated. Soil extinction has low bias (-19%) buts lots of scatter and high error (74%), while CM extinction is greatly underestimated (bias of -153%).

On the best 20 percent days at CACR the observed extinction ranges from 20 to 40 Mm^{-1}, whereas, the modeled extinction has a much larger range from 15 to 120 Mm^{-1}. Much of the modeled overestimation of total extinction on the best 20% days (+44% bias) is due to NO3 overestimation (+94% bias).

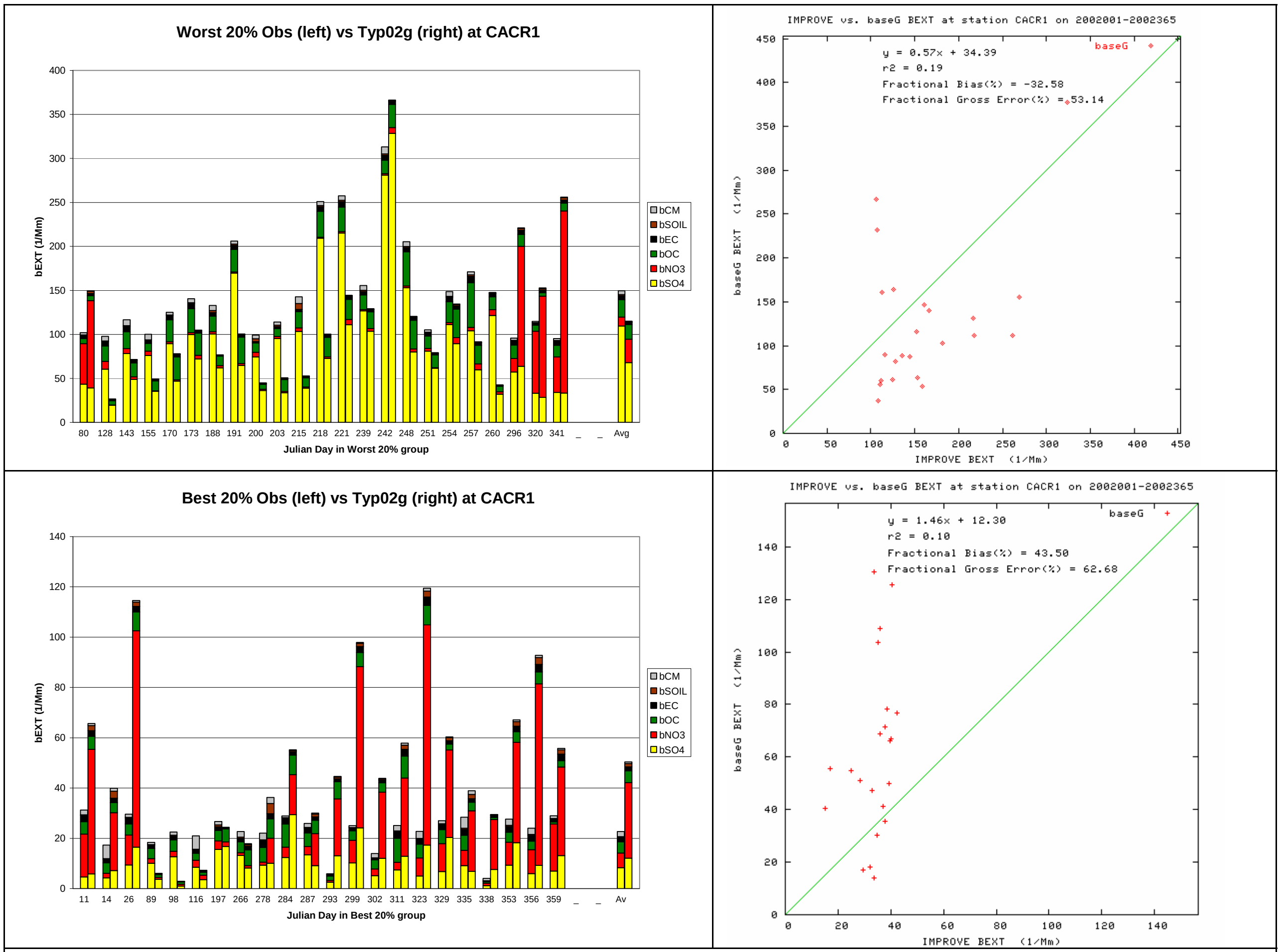


Figure 8.2. Daily extinction model performance at Caney Creek (CACR), Arkansas for the worst (top) and best (bottom) 20 percent days during 2002.

8.3.2.2 Upper Buffalo Wilderness Area Modeling

Model performance at the UPBU Class I area for the worst and best 20 percent days is shown in Figure 8.3. On most of the worst 20 percent days at UPBU, visibility impairment is dominated by SO4, although there are also two high NO3 days. The model underestimates the average of the total extinction on the worst 20 percent days at UPBU by -40% (Figure 8.3), which is due to an underestimation of extinction due to SO4, OMC and CM by -46%, -33% and - 179%, respectively.

On the best 20 percent days at UPBU, the model performs reasonably well with a low bias (2%) and error (42%). But again, the model has a much wider range in extinction values across the best 20 percent days (15 to 120 Mm^{-1}) than observed (20 to 45 Mm^{-1}). There are five days in which the modeled NO3 overprediction is quite severe and when those days are removed the range in the modeled and observed extinction on the best 20 percent days is quite similar to the observed, although the model gets much cleaner on the very cleanest modeled days.

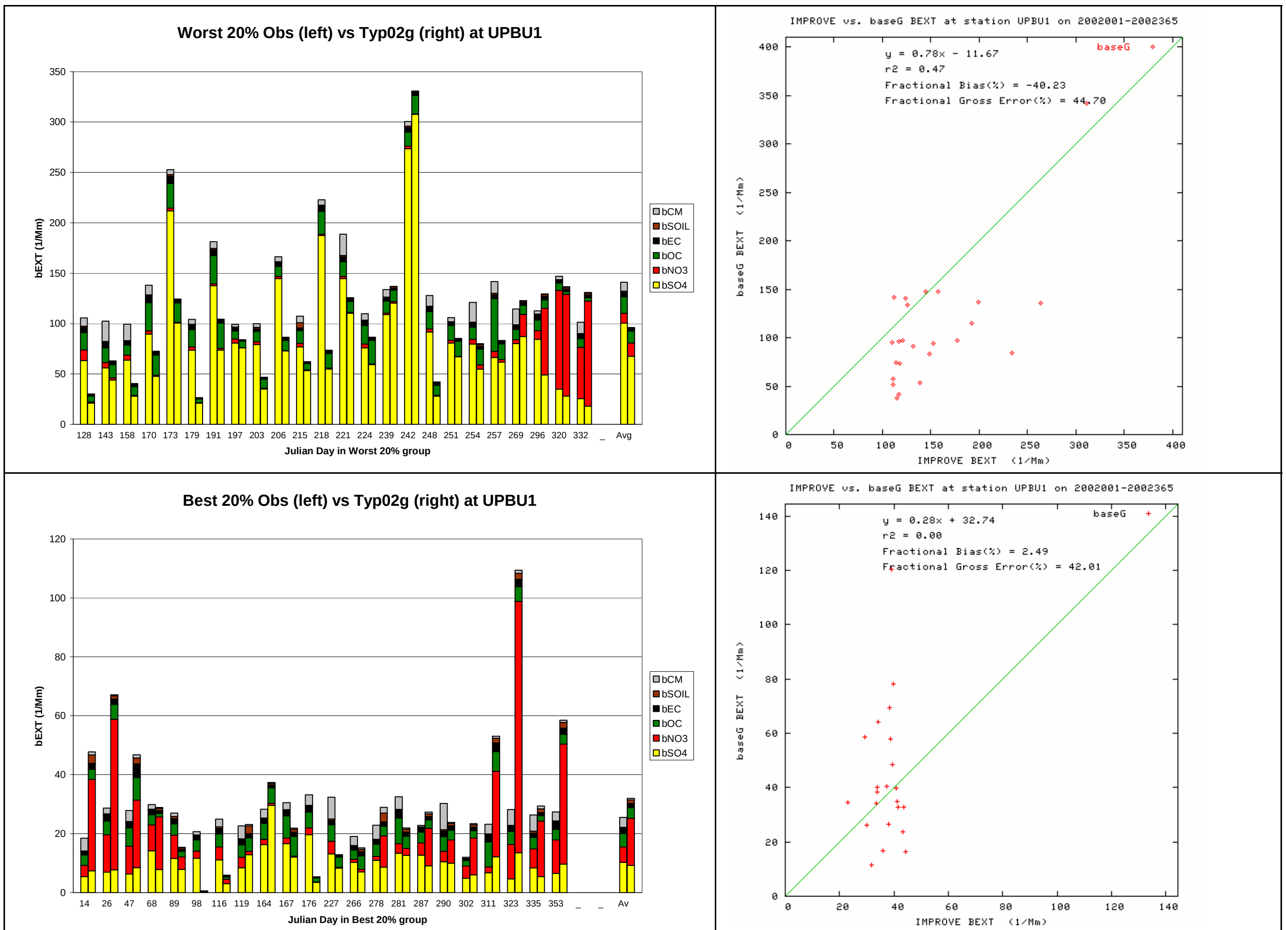


Figure 8.3. Daily extinction model performance at Upper Buffalo (UPBU), Arkansas for the worst (top) and best (bottom) 20 percent days during 2002.

8.4 Information from Modeling Performed by Other RPOs

2018 visibility projections for CENRAP and nearby Class I area have also been performed by the other RPOs. Thus, it is useful to compare the CENRAP 2018 visibility projections with those from the other RPOs as a quality assurance (QA) check and to foster confidence in the CENRAP modeling results. Detailed information concerning other RPOs modeling is found in Appendix 8.1.

The CENRAP 2018 Base G visibility projections were compared to the following other RPO visibility projections:

- VISTAS 2018 visibility projections based on their CMAQ 12 km 2002 annual modeling results for the 2002 Base G and 2018 Base G2a emissions scenarios.
- MRPO 2018 visibility projections based on their CAMx 36 km 2002 annual modeling for the Run 4 Scenario 1a (R4S1a) emissions scenario.
- WRAP 2018 visibility results based on their Plan02b and Base18b CMAQ 36 km modeling of the 2002 calendar year.

Figure 8.4 displays a DotPlot comparison of the four RPO visibility projections expressed as a percentage of achieving the 2018 URP point at CENRAP and nearby Class I areas. For the four CENRAP Class I areas just west of the Mississippi River in Arkansas and Missouri (CACR, UPBU, HEGL and MING), 2018 visibility projections are available from the CENRAP, VISTAS and MRPO RPOs. At HEGL, the three RPOs 2018 visibility projections are in close agreement with each other (estimated to achieve 99%, 101% and 95% of the 2018 URP point). The CENRAP and VISTAS 2018 visibility projections are also very close at the other three Arkansas-Missouri CENRAP Class I areas: CACR (112% and 116%), UPBU (109% and 112%) and MING (118% and 114%). But the MRPO 2018 visibility projections are approximately 12 to 25 percentage points lower than the CENRAP and VISTAS projections at these three Class I areas, with values of 97% to 100%. The reasons why the MRPO 2018 visibility projections are less optimistic than CENRAP and VISTAS are unclear. However, the MRPO focused on visibility projections at their northern Class I areas and likely did not use the latest CENRAP emission estimates. In addition, the CENRAP 2018 visibility projections included BART controls on several sources in CENRAP states not included in the MRPO projections. Such BART controls are even more important in those states not covered by CAIR.

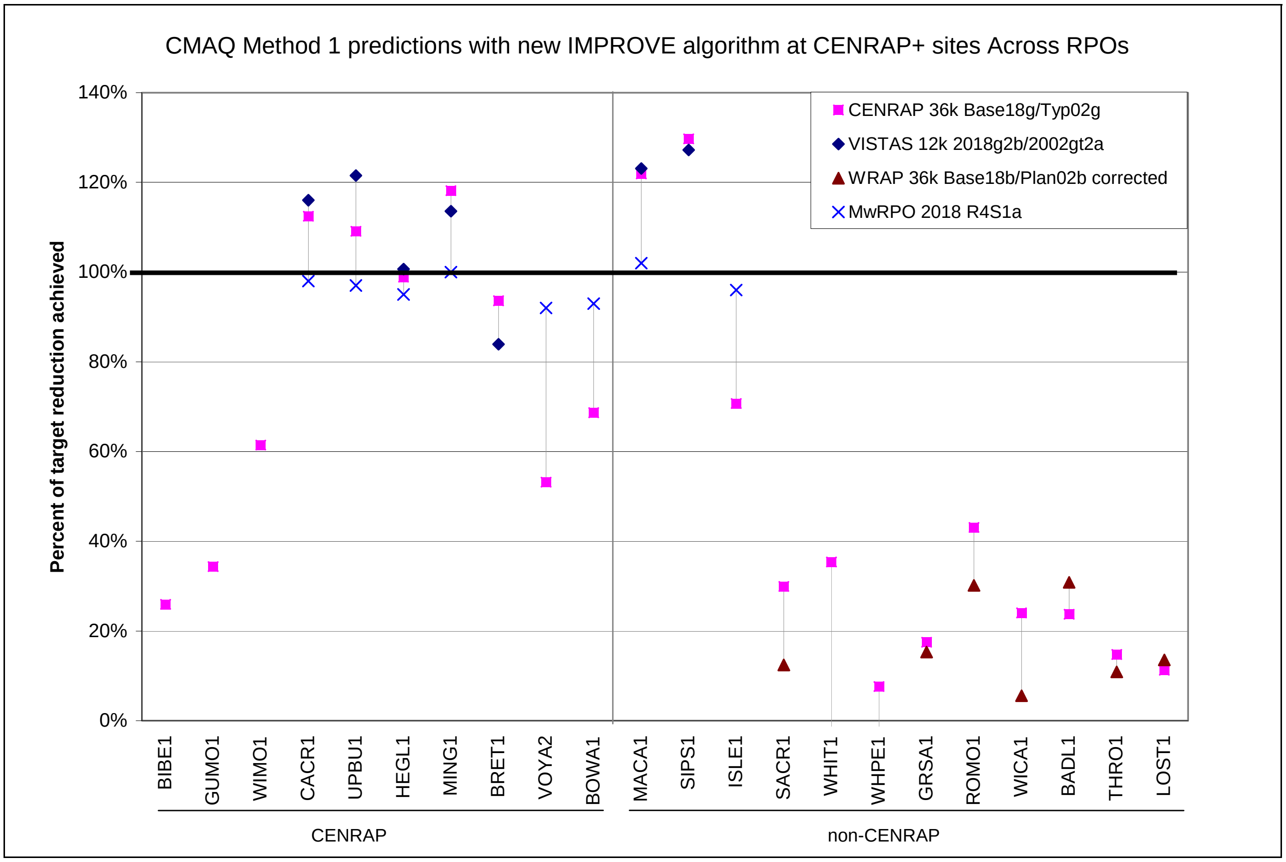


Figure 8.4. DotPlot comparing the CENRAP, VISTAS, MRPO and WRAP 2018 visibility projections expressed as a percentage of achieving the 2018 URP goal.

List of Chapter 8 Appendices

8.1 Technical Support Documentation for CENRAP Emissions and Air Quality Modeling to Support Regional Haze State Implementation.

9. Best Available Retrofit Technology

The U.S. EPA's 1999 Regional Haze Rule (RHR) requires certain emission sources "that may reasonably be anticipated to cause or contribute" to visibility impairment in downwind Class I areas to install Best Available Retrofit Technology (BART) controls. States are required to determine the "degree of improvement in visibility which may reasonably result from the use of such technology." On July 6, 2005, EPA published final amendments to its 1999 RHR in the *Federal Register*, including Appendix Y, "Guidelines for BART Determinations Under the Regional Haze Rule" ("Guidelines"), the final guidance for Best Available Retrofit Technology (BART) determinations (70 FR 39104-39172).

The Arkansas Department of Environmental Quality (ADEQ) is requiring sources subject to BART to install, operate, and maintain BART rather than implement an emission trading program, or other alternative measure, in place of BART.

9.1 BART – Eligible Sources in the State of Arkansas

The facilities with BART-eligible units in Arkansas are shown in Figure 9.1 and Table 9.1. A detailed description of each BART-eligible emission units is included in Appendix 9.1A.

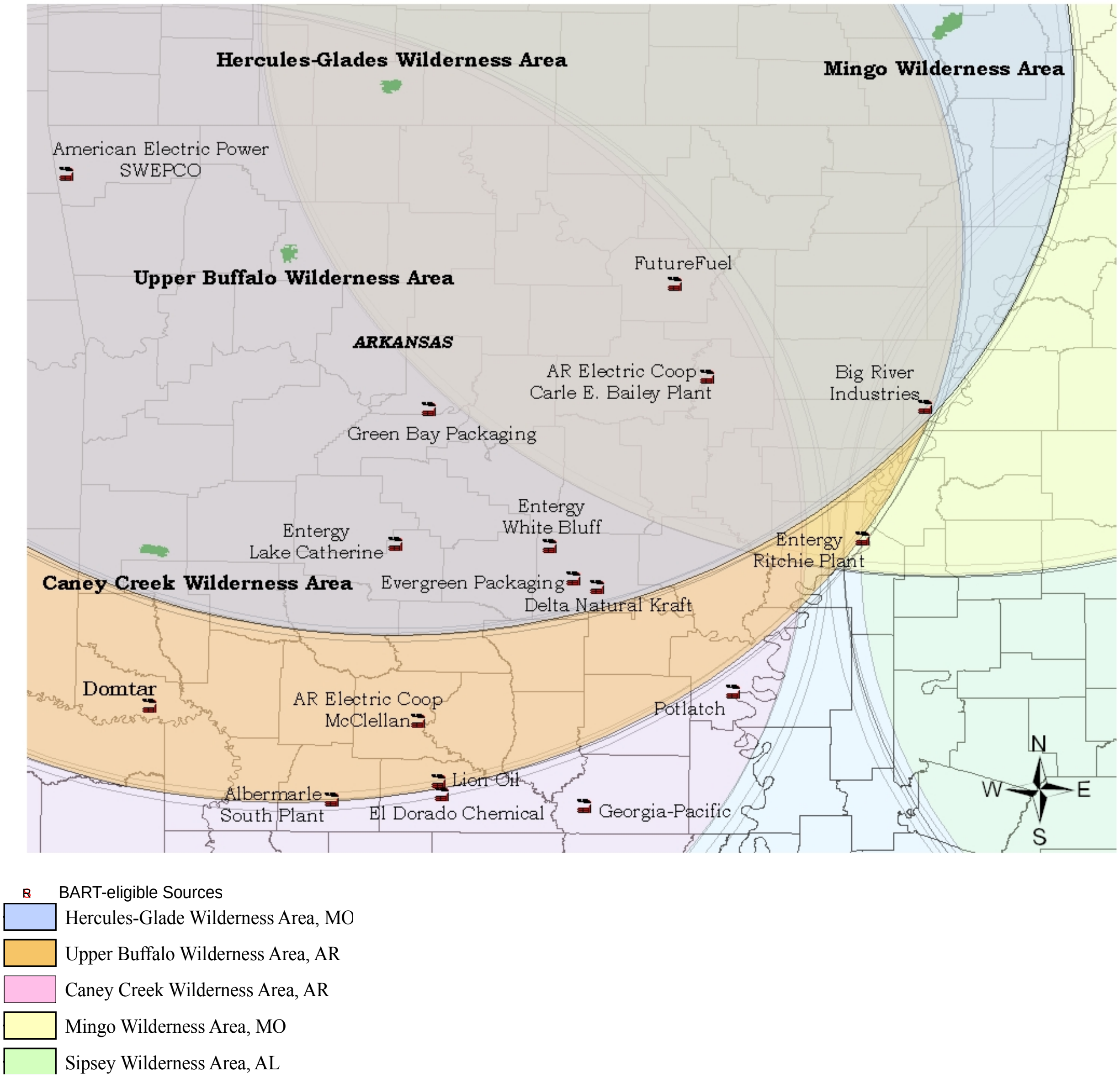


Figure 9.1 Map showing Arkansas's BART-eligible sources and the 300 km radius buffer zones around five separate receptors (north, south, east, west, and center) located in the following Class I areas: Upper Buffalo, Caney Creek, Hercules Glade, Mingo, and Sipsey. This map was developed to determine which Class I areas will be assessed during the BART determination modeling.

Table 9.1 Facilities with BART-eligible Units in the State of Arkansas

BART Sources Category Number and Name	Facility Name/Location	SIC	Facility ID	AFIN	Unit ID	Unit Description
1. Fossil fuel-fired Electric Plants > 250 MMbtu/hour-Electric Generating Units (EGUs)	American Electric Power/Gentry (SWEPCO)*	49	05-007-00107	04-0017	SN-01	Boiler
	AR Electric Cooperative/Augusta*	49	05-147-00024	74-00024	SN-01	Boiler 1350 mm
	AR Electric Cooperative/Camden*	49	05-103-00055	52-00055	SN-01	Boiler
	Entergy-Lake Catherine/Jones Mills	49	05-059-00011	30-00011	SN-02	Unit 4 Boiler
	Entergy-Ritchie Plant/Helena	49	05-107-00017	54-00017	SN-02	Unit2
	Entergy-White Bluff/Redfield	49	05-069-00110	35-00110	SN-01	Unit 1
	Entergy-White Bluff/Redfield	49	05-069-00110	35-00110	SN-02	Unit 2
	Entergy-White Bluff/Redfield	49	05-069-00110	35-00110	SN-05	Auxiliary Boiler
3. Kraft Pulp Mills	Domtar, Inc./Ashdown	26	05-081-00002	41-00002	SN-03	#1 Power Boiler
	Domtar, Inc./Ashdown	26	05-081-00002	41-00002	SN-05	#2 Power Boiler
	Delta Natural Kraft/Pine Bluff	26	05-069-00017	35-00017	SN-02	Recovery Boiler
	Evergreen Packaging/Pine Bluff	26	05-069-00016	35-00016	SN-04	# 4 Recovery Boiler
	Georgia-Pacific Paper/Crossett	26	05-003-00013	02-00013	SN-22	9A Boiler
	Green Bay Packaging/Morrilton	26	05-029-00001	15-00001	SN-05A	Recover Boiler
	Potlatch/McGehee	26	05-041-00036	21-00036	SN-04	Power Boiler
11. Petroleum Refineries	Lion Oil/El Dorado	29	05-139-00016	70-00016	SN-809	#7 Catalyst Regenerator
15. Sulfur Recovery Plant	Albermarle-South Plant/Magnolia	28	05-027-00028	14-00028	SR-01	Tail Gas Incinerator
19. Sintering Plants	Big River Industries/West Memphis	32	05-035-00082	18-00082	SN-01	Kiln A
21. Chemical Processing Plants	Albermarle-South Plant/Magnolia	28	05-027-00028	14-00028	BH-01	Boiler #1
	Albermarle-South Plant/Magnolia	28	05-027-00028	14-00028	BH-02	Boiler #2
	FutureFuels Chemical/Batesville	28	05-063-00036	31-00036	6M01-01	3 Coal Boiler
	El Dorado Chemical/El Dorado	28	05-139-00040	70-00040	SN-08	West Nitric Acid Plant
	El Dorado Chemical/El Dorado	28	05-139-00040	70-00040	SN-09	East Nitric Acid Plant
	El Dorado Chemical/El Dorado	28	05-139-00040	70-00040	SN-10	Nitric Acid Concentrator

* Please note: American Electric Power/Gentry (SWEPC) is permitted as Flint Creek Power Plant; AR Electric Cooperation/Augusta is permitted as Arkansas Electric Cooperation Carl E. Bailey Plant; and AR Electric Cooperation/Camden is permitted as AR Electric Cooperation Corporation – John L. McClellan Generating Station

The BART-eligible sources were identified using the methodology in the "Guidelines". (40 CFR Part 51, Appendix Y) To identify as BART-eligible emission units, ADEQ used the following "Guidelines" criteria:

- One, or more, emission(s) units at the facility fit within one of the twenty-six (26) categories listed in the "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 sum of the potential emissions from all emission unit(s) identified using the previous two criteria were greater than 250 tons, or more, per year of the visibility-impairing pollutants: sulfur dioxide (SO_2), nitrogen oxide (NO_x), and PM_{10}.

The "Guidelines" recommend addressing the visibility-impairing pollutants: SO_2, NO_x, and Particulate Matter (PM). ADEQ addressed these three pollutants and used PM less than ten (10) micrometers (µm) in diameter (PM_{10}) as an indicator for PM in the initial step of identifying BART-eligible units. Consistent with the "Guidelines", ADEQ did not evaluate emissions of Volatile Organic Compounds (VOCs) and ammonia (NH_3) in BART determinations, because only specific VOCs form secondary organic aerosols that affect visibility. These compounds are a fraction of the total VOCs reported in the emissions inventory, and ADEQ does not have the breakdown of VOC emissions necessary to model those that only impair visibility. Further, the prescribed screening model (CALPUFF) cannot simulate formation of particles from anthropogenic VOCs, nor their visibility impacts. Ammonia from specific sources will not be evaluated in this process, although ammonia is included in the modeling as a background concentration. The appropriate VOCs and ammonia emission data can, and will be, included in regional scale modeling used for the Regional Haze SIP.

BART-eligible sources were determined by a review of ADEQ's emission inventory database and a review of the permits and permit applications. A detailed description of the process is located in Appendix 9.1B. As shown in Table 9.1, this analysis indicated there were 27 facilities in Arkansas with BART-eligible units.

9.2 Determination of Sources Subject-to-BART

Under the "Guidelines", ADEQ has the following options regarding its BART-eligible sources: a) make BART determinations for all sources or b) consider exempting some sources from BART because they do not cause or contribute to visibility impairment in a Class I area. ADEQ has chosen option b. If a State chooses option b, the "Guidelines" suggest the following three modeling options for determining which sources may be exempt:

(1) Individual source attribution approach (dispersion modeling).
(2) Use of model plants to exempt sources with common characteristics.
(3) Cumulative modeling to show that no sources in a state are subject to BART.

ADEQ has chosen sub-option 1 above to determine which sources are subject to BART. ADEQ performed a source-specific analysis 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 9.2A. In accordance with the "Guidelines", a contribution threshold of a 0.5 change (delta Δ) in deciview (dv) was used for determining which sources were subject to BART. The "Guidelines" provide States the discretion to set a lower dv threshold than 0.5 dv if "the location of a large number of BART-eligible sources within the State and in proximity to a Class I area justifies this approach." The 0.5 dv threshold was selected because ADEQ followed EPA's BART Modeling Guidance (p 42) in sitting a threshold limit in determining whether a BART-eligible source is either subject-to-BART or exempt. According to the aforementioned modeling guidance, an individual source will be considered to "cause visibility impairment" if the emissions results in a Δ dv that is greater than or equal to 1.0 dv on the visibility in a Class I area. Additionally, if the emissions from a source results in a Δ in visibility that is greater than or equal to 0.5 dv in a Class I area the source will be considered to "contribute to visibility impairment" (BART Final Rule, 40 CFR 51 p 39113). Thus, ADEQ has set the threshold limit at 0.5 dv.

Please note that ADEQ used the original (default) IMPROVE algorithm (Equation 1) in the BART determination modeling because the CALPUFF model was developed using Equation 1.

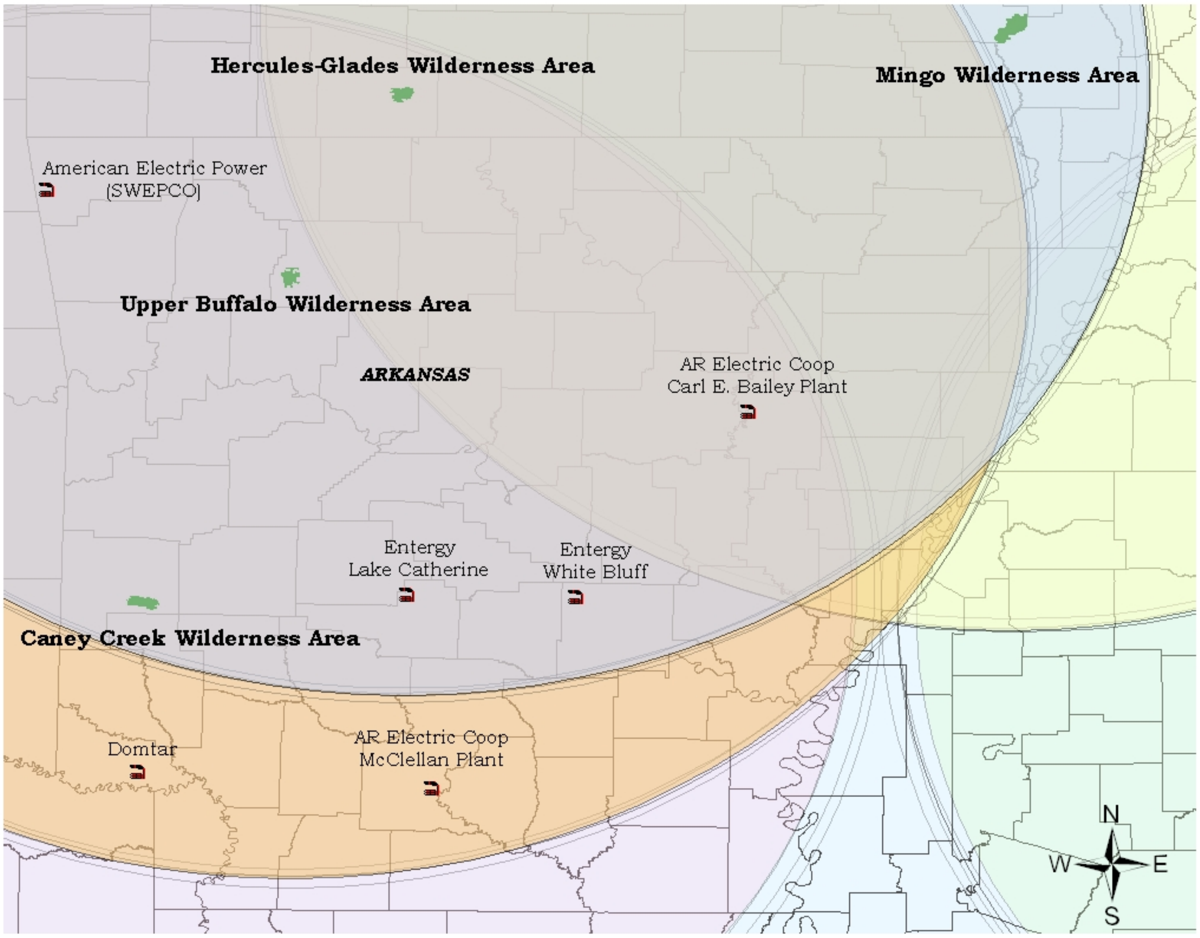
Equation 1

$$\begin{aligned} b_{ext} \approx\ & 3\times f(RH)\times[Sulfate] \\ & +3\times f(RH)\times[Nitrate] \\ & +4\times[Organic\ Carbon] \\ & +10\times[Elemental\ Carbon] \\ & +1\times[Fine\ Soil] \\ & +0.6\times[Coarse\ Mass] \\ & +10 \end{aligned}$$

The facilities with BART-eligible units found to be subject-to-BART by ADEQ are shown in Table 9.2 and Figure 9.2. Appendix 9.2B contains the CALPUFF modeling input and output files for each BART-eligible source. Facilities found to be subject-to-BART must complete a BART analysis. However, ADEQ worked closely with the facilities in their preparation of the BART engineering analyses. Additionally, it is ultimately the responsibility of ADEQ to either approve or reject the BART sources' engineering analysis during the permitting process. Appendix 9.2C contains the post-control CALPUFF modeling input and output files for each subject-to-BART source.

Table 9.2 Subject-to-BART sources in Arkansas

BART Source Category Name	Facility Name	Facility ID	Emission Units Subject-to-BART	Pollutants Evaluated in BART Determination	Contribution to Visibility Impairment (Δ dv)
1. Fossil fuel-fired Electric Plants > 250 MMbtu/hour – Electric Generating Units (EGUs)	American Electric Power/SWEPCO	05-007-00107	Boiler SN-01	SO_2, NO_x, PM_{10}, and $PM_{2.5}$	See Appendix 9.2B
	AR Electric Coop Bailey Plant	05-147-00024	Boiler 1350 mm SN-01	SO_2, NO_x, PM_{10}, and $PM_{2.5}$	See Appendix 9.2B
	AR Electric Coop McClellan Plant	05-103-00055	Boiler SN-01	SO_2, NO_x, PM_{10}, and $PM_{2.5}$	See Appendix 9.2B
	Entergy Lake Catherine Plant	05-059-00011	Unit 4 Boiler SN-03	SO_2, NO_x, PM_{10}, and $PM_{2.5}$	See Appendix 9.2B
	Entergy White Bluff Plant	05-069-00110	Unit 1 SN-01	SO_2, NO_x, PM_{10}, and $PM_{2.5}$	See Appendix 9.2B
			Unit 2 SN-02	SO_2, NO_x, PM_{10}, and $PM_{2.5}$	See Appendix 9.2B
			Auxiliary Boiler SN-05	SO_2, NO_x, PM_{10}, and $PM_{2.5}$	See Appendix 9.2B
3. Kraft Pulp Mills	Domtar	05-081-00002	# 1 Power Boiler SN-03	SO_2, NO_x, and $PM_{2.5}$	See Appendix 9.2B
			# 2 Power Boiler SN-05	SO_2, NO_x, and $PM_{2.5}$	See Appendix 9.2B



Subject to BART Sources
Hercules-Glade Wilderness Area, MO
Upper Buffalo Wilderness Area, AR
Caney Creek Wilderness Area, AR
Mingo Wilderness Area, MO
Sipsey Wilderness Area, AL

Figure 9.2 Map showing Arkansas' subject to BART sources and the 300 km buffers around Caney Creek Wilderness Area, Arkansas, Upper Buffalo Wilderness Area, Arkansas, Hercules-Glade Wilderness Area, Missouri, Mingo Wilderness Area, Missouri, and Sipsey Wilderness Area, Alabama

Cumulative Impact of Subject-to-BART Sources on Visibility

Additionally, in accordance to *Federal Register* (FR 39105) notice promulgating the "Guidelines", ADEQ contracted with ENVIRON International Corporation and Alpine Geophysics, LLC to perform a cumulative BART modeling analysis of the 6 subject-to-BART facilities in Arkansas to evaluate the cumulative visibility impacts due to the aforementioned facilities at nearby Class I areas. Please refer to Appendix 9.2C for a detailed description of ENVIRON and Alpine Geophysics' methodology and the Class I areas studied.

Clean Air Interstate Rule and BART

The Clean Air Interstate Rule was finalized in May 2005 by EPA and applies to states in the eastern U.S. Reconsiderations were finalized March 2006. This rule addresses air pollution transport across state borders. EPA determined which states must reduce which pollutants based on modeling which showed how the travel of pollution affects non-attainment in other states. CAIR requires states to reduce NO_x and/or SO_2 emissions. Of the three programs in CAIR, Arkansas is required to participate in only the Ozone-Season NO_x reductions program. Although EPA's BART Modeling Guidance allows CAIR states to participate in the CAIR cap and trade program, the state of Arkansas is not eligible for the aforementioned trading program because Arkansas is in CAIR only for NO_x during the ozone season. Therefore, in Arkansas CAIR is not better than BART. Thus BART-eligible EGUs will be modeled for BART determination/exemption by ADEQ.

9.3 Determination of BART Requirements for Subject-to-BART Sources

BART-level emissions reductions for the subject to BART sources in Arkansas are shown in Tables 9.3a through 9.3d for each visibility impairing pollutant. The BART requirements in the RHR are intended to reduce emissions specifically from large emission units that, due to age, were exempted from other control requirements of the CAAA. BART emission limits for each pollutant are based on the following: the degree of reduction achievable through the application of the best system of continuous emission reduction, taking into consideration the technology available; the costs of compliance; the energy and the non-air quality environmental impacts of compliance; any pollution control equipment in use or in existence at the source; the remaining useful life of the source; and the degree of improvement in visibility which may reasonably be anticipated to result from the use of such technology. However, a State is not required to make a determination of BART for SO_2 or NO_x if a BART-eligible source has the potential to emit less than forty (40) tons per year of such pollutant(s), or less than fifteen (15) tons per year for PM_{10}.

The BART analysis conducted by the facility for each subject-to-BART source is included in Appendix 9.3A. BART for each subject-to-BART source was determined by ADEQ using the methodology in the "Guidelines." These BART emission standards will be included in the Title V operating permit for each source after this implementation plan is approved by EPA. A copy of Regulation 19 which contains these BART limits is included in Appendix 9.3C. Additionally, response to EPA comments concerning the BART analyses performed by the subject-to-BART facilities is included in Appendix 9.3B. All correspondence between ADEQ, subject-to-BART sources, and EPA is located in Appendix 9.4B.

ADEQ is requiring that each subject-to-BART source install and operate BART as expeditiously as practicable, but in no event later than six years after the effective day of Arkansas Regulation

19, Chapter 15 or five years after approval of the SIP or plan revision by EPA, whichever comes first.

Table 9.3a BART-Level Emissions Reductions from the 2002 Baseline, Sulfur Dioxide (SO_2)

Source and Unit	**Maximum 24-Hour Actual Emissions (lb/day)**	**Baseline Peak 24-hour Emissions (lb/hr)**	**BART Level of Control % Removal[1]**	**Future Peak 24-hour Emission Rate (lb/hr)**	**Emission Limit[2]**
04-00107 276-AOP-R1 American Electric Power/SWEPCO SN-01	113483.81	4728.49	78.3%	1026.08	0.15 lb/MMBtu
74-00024 154-AOP-R0 AR Electric Coop Bailey Plant SN-01	57018.10	2375.75	55%	1069.09	1034.17 lb/hr (1% S fuel oil)
52-00055 181-AOP-R1 AR Electric Coop McClellan Plant SN-01	65942.06	2747.59	65%	961.66	982.47 lb/hr (1% S fuel oil)
41-00002 287-AOP-R2 Domtar SN-03	10620	442.5	0%	442.5	1.12 lb/MMBtu
41-00002 287-AOP-R2 Domtar SN-05	18916.8	788.2	0% (using existing scrubber)	788.2	1.20 lb/MMBtu
30-30-00011 1717-AOP-R1 Entergy Lake Catherine Plant SN-03 *oil*	126647.84	5276.99	46%	2860.4	0.562 lb/MMBtu (0.5% S fuel oil)
35-00110 263-AOP-R1 Entergy White Bluff Plant SN-01	186319.32	7763.3	82%	1400.8	0.15 lb/MMBtu (Bituminous & sub-bituminous coal)
35-00110 263-AOP-R1 Entergy White Bluff Plant SN-02	187799.35	7825.0	80%	1533.2	0.15 lb/MMBtu (Bituminous & sub-bituminous coal)
35-00110 263-AOP-R1 Entergy White Bluff Plant SN-05	No emission standards have been established for this source. Rather the state has established work practice standards for this source pursuant to 40 CFR 51.308(e)(1)(iii).				

1. Only listed if facility is adding controls or taking limits that will reduce emission per BART requirements. Facilities which are not adding controls or using controls which are already installed have a 0% BART control efficiency.
2. 30-day rolling average

Table 9.3b BART-Level Emissions Reductions from the 2002 Baseline, Oxides of Nitrogen (NO_x)

Source and Unit	**Maximum 24-Hour Actual Emissions (lb/day)**	**Baseline Peak 24-hour Emissions (lb/hr)**	**BART Level of Control % Removal**[1]	**Future Peak 24-hour Emission Rate (lb/hr)**	**Emission Limit**[2]
04-00107 276-AOP-R1 American Electric Power/SWEPCO SN-01	46680.0	1945	16.8%	1618.24	0.23 lb/MMBtu
41-00002 287-AOP-R2 Domtar SN-03	4309.0	179.54	0%	179.54	0.46 lb/MMBtu
41-00002 287-AOP-R2 Domtar SN-05	12643.2	526.8	30%	368.76	0.450 lb/MMBtu
30-00011 1717-AOP-R1 Entergy Lake Catherine Plant SN-03 *gas*	58960.0	2456.67	69.6%	746.82	0.15 lb/MMBtu
30-00011 1717-AOP-R1 Entergy Lake Catherine Plant SN-03 *oil*	60273.0	2511.38	47.6%	1315.96	0.25 lb/MMBtu
35-00110 263-AOP-R1 Entergy White Bluff Plant SN-01	104920.0	4371.7	69%	1355.23	0.28 lb/MMBtu (bituminous coal)
35-00110 263-AOP-R1 Entergy White Bluff Plant SN-01	104920.0	4371.7	69%	1355.22	0.15 lb/MMBtu (sub-bituminous coal)
35-00110 263-AOP-R1 Entergy White Bluff Plant SN-02	113540.0	4730.8	69%	1466.56	0.28 lb/MMBtu (bituminous coal)
35-00110 263-AOP-R1 Entergy White Bluff Plant SN-02	113540.0	4730.8	69%	1466.56	0.15 lb/MMBtu (sub-bituminous coal)
35-00110 263-AOP-R1 Entergy White Bluff Plant SN-05	No emission standards have been established for this source. Rather the state has established work practice standards for this source pursuant to 40 CFR 51.308(e)(1)(iii).				

1. Only listed if facility is adding controls or taking limits that will reduce emission per BART requirements. Facilities which are not adding controls or using controls which are already installed have a 0% BART control efficiency.
2. 30-day rolling average

Table 9.3c BART-Level Emissions Reductions from the 2002 Baseline, Particulate Matter 10 micrometers (PM_{10})

Source and Unit	Maximum 24-Hour Actual Emissions (lb/day)	Baseline Peak 24-hour Emissions (lb/hr)	BART Level of Control % Removal[1]	Future Peak 24-hour Emission Rate (lb/hr)	Emission Limit[2]
41-00002 287-AOP-R2 Domtar SN-03	4068.0	169.5 (filterable)	76%	40.6	0.07 lb/MMBtu
41-00002 287-AOP-R2 Domtar SN-05	1958.4	81.6 (filterable)	29.7% (using existing scrubber)	57.4	0.10 lb/MMBtu

1. Only listed if facility is adding controls or taking limits that will reduce emission per BART requirements. Facilities which are not adding controls or using controls which are already installed have a 0% BART control efficiency.
2. 30-day rolling average

Table 9.3d BART-Level Emissions Reductions from the 2002 Baseline, Particulate Matter 2.5 micrometers ($PM_{2.5}$)

Source and Unit	Maximum 24-Hour Actual Emissions (lb/day)	Baseline Peak 24-hour Emissions (lb/hr)	BART Level of Control % Removal[1]	Future Peak 24-hour Emission Rate (lb/hr)	Emission Limit[2]
30-00011 1717-AOP-R1 Entergy Lake Catherine Plant SN-03 *oil*	6810.0	283.75	69.4%	86.83	0.037lb/MMBtu (filterable & condensable) 0.5% S fuel oil

1. Only listed if facility is adding controls or taking limits that will reduce emission per BART requirements. Facilities which are not adding controls or using controls which are already installed have a 0% BART control efficiency.
2. 30-day rolling average

9.4 Results and Conclusions

To determine if there was a statistical significant improvement to visibility from the post-control emissions of Arkansas' subject-to-BART sources, a student t (TTEST function in Excel) was performed. Tables 9.4a through 9.4g contain the maximum change (delta Δ) in deciview (dv) from the pre-control emissions, the maximum Δ dv from the post-control emissions, the percent decrease, the P value, and the number of days the Δ dv from the pre-control emissions were greater than or equal to (≥) a Δ dv of 0.5.

Table 9.4a American Electric Power results comparing the pre-control emissions and the post-control emissions to Caney Creek Wilderness Area (CACR) and Upper Buffalo Wilderness Area (UPBU), Arkansas and Hercules-Glade Wilderness Area (HEGL), Missouri

Class I area	Pre-control Maximum Δ dv	Post-control Δ dv	Percent Change	Is P < 0.05	Number of Days Pre-control Δ dv ≥ 0.5
CACR	3.970	1.573	60.38	Yes	106
UPBU	3.781	2.089	44.75	Yes	139
HEGL	3.983	1.541	61.31	Yes	117

Table 9.4b Arkansas Electric Coop – Carl E. Bailey results comparing the pre-control emissions and the post-control emissions to Caney Creek Wilderness Area (CACR) and Upper Buffalo Wilderness Area (UPBU), Arkansas and Hercules-Glade Wilderness Area (HEGL) and Mingo Wilderness Area (MING), Missouri

Class I area	Pre-control Maximum Δ dv	Post-control Δ dv	Percent Change	Is P < 0.05	Number of Days Pre-control Δ dv ≥ 0.5
CACR	1.841	0.897	51.28	Yes	28
UPBU	1.232	0.574	53.41	Yes	23
HEGL	1.594	0.809	49.25	Yes	30
MING	1.660	0.766	53.86	Yes	45

Table 9.4c Arkansas Electric Coop – McClellan results comparing the pre-control emissions and the post-control emissions to Caney Creek Wilderness Area (CACR) and Upper Buffalo Wilderness Area (UPBU), Arkansas

Class I area	Pre-control Maximum Δ dv	Post-control Δ dv	Percent Change	Is P < 0.05	Number of Days Pre-control Δ dv ≥ 0.5
CACR	2.197	1.011	53.98	Yes	58
UPBU	1.196	0.487	59.28	Yes	23

Table 9.4d Domtar results comparing the pre-control emissions and the post-control emissions to Caney Creek Wilderness Area (CACR) and Upper Buffalo Wilderness Area (UPBU), Arkansas

Class I area	Pre-control Maximum Δ dv	Post-control Δ dv	Percent Change	Is P < 0.05	Number of Days Pre-control Δ dv ≥ 0.5
CACR	2.262	2.038	9.90	Yes	149
UPBU	1.181	1.029	12.87	No	18

Table 9.4e Entergy – Lake Catherine results comparing the pre-control emissions from natural gas and the post-control emissions from natural gas to Caney Creek Wilderness Area (CACR) and Upper Buffalo Wilderness Area (UPBU), Arkansas and Hercules-Glade Wilderness Area (HEGL), Missouri

Class I area	Pre-control Maximum Δ dv	Post-control Δ dv	Percent Change	Is P < 0.05	Number of Days Pre-control Δ dv ≥ 0.5
CACR	3.209	1.111	63.48	Yes	87
UPBU	2.186	0.753	66.55	Yes	54
HEGL	1.663	0.558	66.45	Yes	23

Table 9.4f Entergy – Lake Catherine results comparing the pre-control emissions from fuel oil and the post-control emissions from fuel oil to Caney Creek Wilderness Area (CACR) and Upper Buffalo Wilderness Area (UPBU), Arkansas and Hercules-Glade Wilderness Area (HEGL), Missouri

Class I area	Pre-control Maximum Δ dv	Post-control Δ dv	Percent Change	Is P < 0.05	Number of Days Pre-control Δ dv ≥ 0.5
CACR	6.607	3.671	36.49	Yes	201
UPBU	2.953	1.636	44.60	Yes	188
HEGL	4.129	2.397	41.95	Yes	134

Table 9.4g Entergy – White Bluff results comparing the pre-control emissions and the post-control emissions from to Caney Creek Wilderness Area (CACR) and Upper Buffalo Wilderness Area (UPBU), Arkansas and Hercules-Glade Wilderness Area (HEGL), Missouri

Class I area	Pre-control Maximum Δ dv	Post-control Δ dv	Percent Change	Is P < 0.05	Number of Days Pre-control Δ dv ≥ 0.5
CACR	8.677	2.665	69.29	Yes	245
UPBU	7.948	2.167	72.74	Yes	242
HEGL	6.631	2.030	97.97	Yes	234

The results from the ENVIRON cumulative modeling using Comprehensive Air-quality Model with extensions (CAMx) PM Source Apportionment Technology (PSAT) is estimated to result in substantial improvements in visibility to all 10 Class I areas studied, with the largest visibility improvement of 5 Δ dv at Mingo Wilderness Area, Missouri. (Please refer to Appendix 9.2C for ENVIRON and Alpine Geophysics' final report.) The highest cumulative visibility impacts due to all PM species in the pre-control base case ranged from 4 to 11 Δ dv across the Class I areas, whereas the highest visibility impacts in the post-control case ranged from 1 to 7 Δ dv. Despite these apparent visibility improvements, the cumulative visibility impacts due to all Arkansas BART sources in the post-control case still exceed 1 Δ dv at most Class I areas of interest.

During the modeling process, ADEQ was informed that the emissions provided for the Domtar Arkansas subject-to-BART source were understated. To address this issue, a sensitivity analysis was performed by ENVIRON using the corrected Domtar emissions for both the pre- and post-control scenarios was conducted. The analysis suggested that the revised (higher) Domtar emissions worsen the visibility improvement in the post-control case, specifically by 2 Δ dv at Caney Creek Wilderness Area, Arkansas.

In summary, there is an improvement in visibility from the post-control emissions of the State of Arkansas's subject-to-BART sources at all Class I areas assessed by ADEQ. Appendix 9.4A contains charts comparing the pre- and post-control emissions of Arkansas' subject-to-BART sources. These charts also indicate there is a considerable improvement to visibility from the post-control emissions of Arkansas's subject-to-BART sources.

List of Chapter 9 Appendices

9.1A Detailed Description of BART-eligible Emission Units
9.1B Method of Identifying BART-Eligible Sources in the State of Arkansas
9.2A Modeling Protocol Used to Determine Subject-to-BART Sources
9.2B BART-exemption CALPUFF Modeling Input and Output Files
9.2C Subject-to-BART CALPUFF Post-control Modeling Input and Output Files
9.2D ENVIRON Final Report
9.3A BART Analyses for the Subject-to-BART Sources
9.3B Response to EPA Comments on BART Engineering Analyses
9.3C Copy of Regulation 19
9.3D Regulation 19 Supporting Documents
9.4A Charts Comparing Arkansas's subject-to-BART Sources' Pre- and Post-control
9.4B Correspondence

10. Reasonable Progress Goals

Federal regulations at 40 CFR 51.308(d)(1) require the State of Arkansas to establish Reasonable Progress Goals (RPGs) for achieving natural visibility for each Class I area within the state. The State is required to develop RPGs that provide for visibility improvement for the most impaired days and ensure no degradation in visibility for the least impaired days throughout the year. These goals are expressed in units of deciviews (dv). A deciview is a measurement of haze, implemented in a Haze Index (HI), derived from calculated light extinction. The RPGs are established in the State Implementation Plan (SIP) and are used to track progress towards the ultimate goal of achieving natural visibility conditions by 2064.

In September 2003, EPA released a technical guidance document describing the techniques used to determine baseline and natural visibility conditions[1]. The EPA has also released guidance describing various procedures that might be used to establish RPGs[2]. The goals must provide improvement in visibility for the most impaired days, and ensure no degradation in visibility for the least impaired days for the duration of the SIP. 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 RPG. The above-referenced EPA guidance describes the meaning of the term Reasonable Progress Goal:

> States must establish RPGs, measured in deciviews (dv) for each Class I area for the purpose of improving visibility on the haziest days and ensuring no degradation in visibility on the clearest days over the period of each implementation plan. RPGs are interim goals that represent incremental visibility improvement over time toward the goal of natural background conditions and are developed in consultation with other affected States and Federal Land Managers (FLMs).
>
> In determining what would constitute reasonable progress, Section 169A(g) of the CAA requires States to consider the following four factors:
>
> - The costs of compliance,
> - The time necessary for compliance,
> - The energy and non-air quality environmental impacts of compliance, and
> - The remaining useful life of existing sources that contribute to visibility impairment.

States must demonstrate in their SIPs how these factors are taken into consideration in selecting the RPG for each Class I area in the State.

1 Guidance for Tracking Progress Under the Regional Haze Rule, EPA – 09/03.
2 Guidance for Setting Reasonable Progress Goals Under the Regional Haze Program, EPA – 06/01/07

The "Uniform Rate of Progress" (URP) described in the EPA guidance, described as "uniform rate of improvement" in 40 CFR 51.308(d)(1)(i)(B), is graphed on a timeline as a line between the "baseline conditions" representing visibility for the best and worst days at the time the regional haze program is established and natural background levels in 2064. Table 10.1 provides the URP for Class I Areas in the State of Arkansas. Figures 10.1 and 10.2 depict the URP for each Class I area in Arkansas as a "glide path."

Table 10.1 - Uniform Rate of Progress for Arkansas Class I Areas

Class I Area	Deciview Improvement Needed by 2018 assuming URP (dv)	Progress Annually to 2018 assuming URP (dv/yr)	Deciview Improvement Needed by 2064 (dv)
Caney Creek	3.45	- 0.25	14.78
Upper Buffalo	3.43	- 0.25	14.70

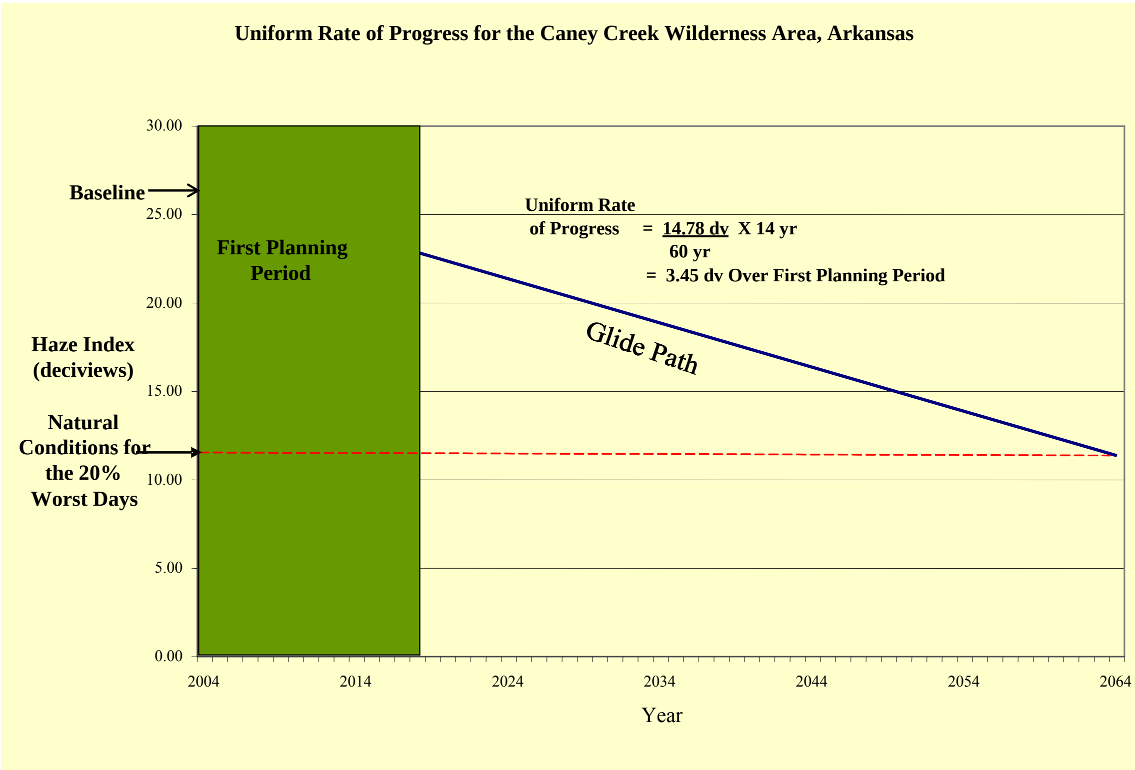

Uniform Rate of Progress for the Caney Creek Wilderness Area, Arkansas
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Baseline
Haze Index
(deciviews)
Natural
Conditions for
the 20%
Worst Days
First Planning
Period
Uniform Rate
of Progress = 14.78 dv X 14 yr
60 yr
= 3.45 dv Over First Planning Period
Glide Path
2004
2014
2024
2034
2044
2054
2064
Year

Fig.10.1

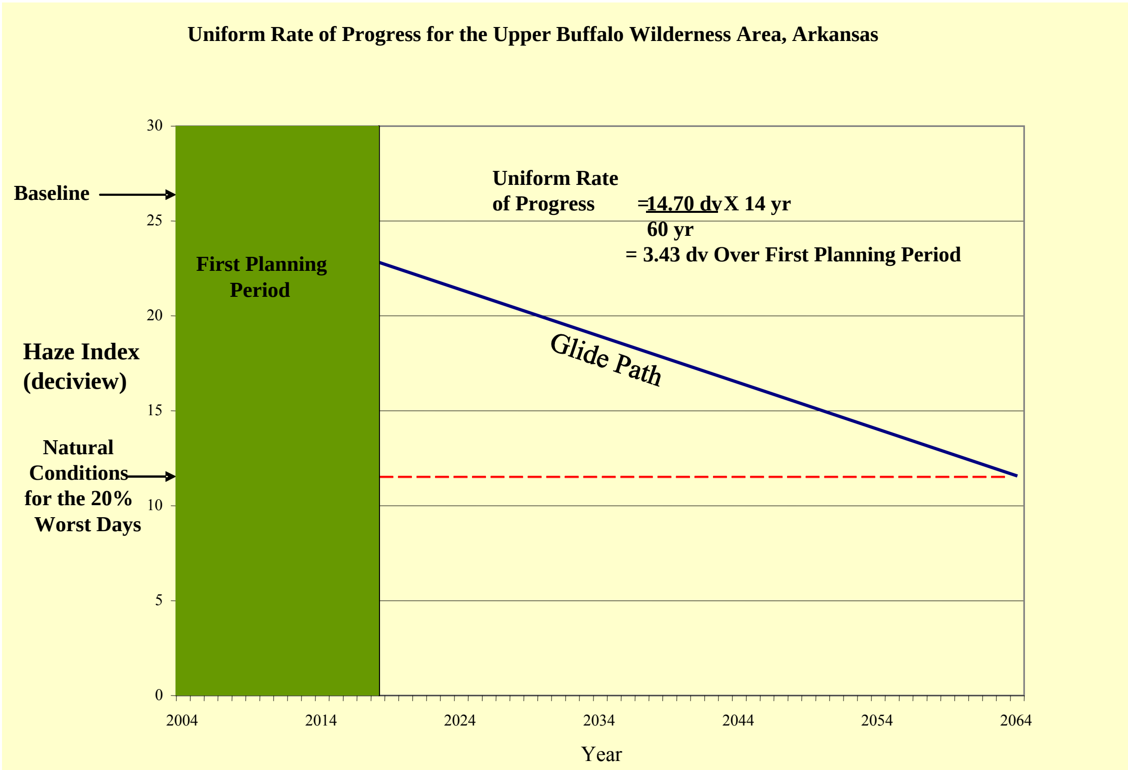

Uniform Rate of Progress for the Upper Buffalo Wilderness Area, Arkansas
Baseline
Uniform Rate
of Progress =14.70 dv X 14 yr
60 yr
= 3.43 dv Over First Planning Period
First Planning
Period
Haze Index
(deciview)
Glide Path
Natural
Conditions
for the 20%
Worst Days
30
25
20
15
10
5
0
2004
2014
2024
2034
2044
2054
2064
Year

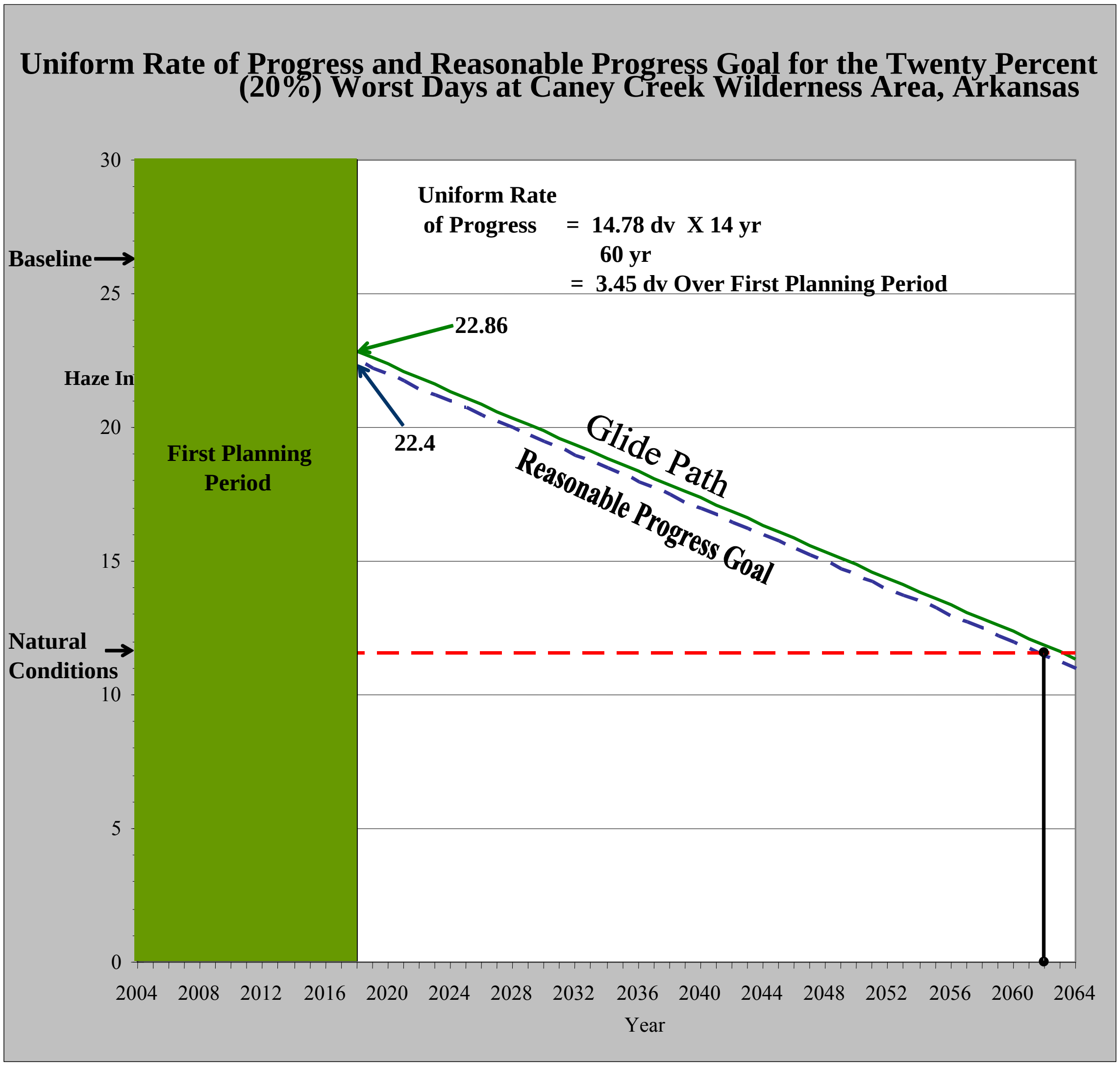
Fig. 10.2

10.2 Determination of Reasonable Progress Goals

The State of Arkansas has determined that the rates of visibility improvement by 2018 that are expressed in Table 10.2 are reasonable and hereby adopts them as the Reasonable Progress Goals for the listed Class I areas. An analysis showing that these goals are reasonable is provided in Appendix 10.1, - Analysis of Control Strategies and Determination of Reasonable Progress Goals. Figures 10.3 - 10.6 show comparisons of URP, RFP and anticipated improvement in visibility on best days for each Class I Area. The established RPGs show that Caney Creek Wilderness Area can attain the goal of background conditions by CY 2062 and the Upper Buffalo Wilderness Area can achieve background conditions by CY 2063. These RPGs exceed the URPs established for these areas and would result in a return to natural background conditions prior to CY 2064.

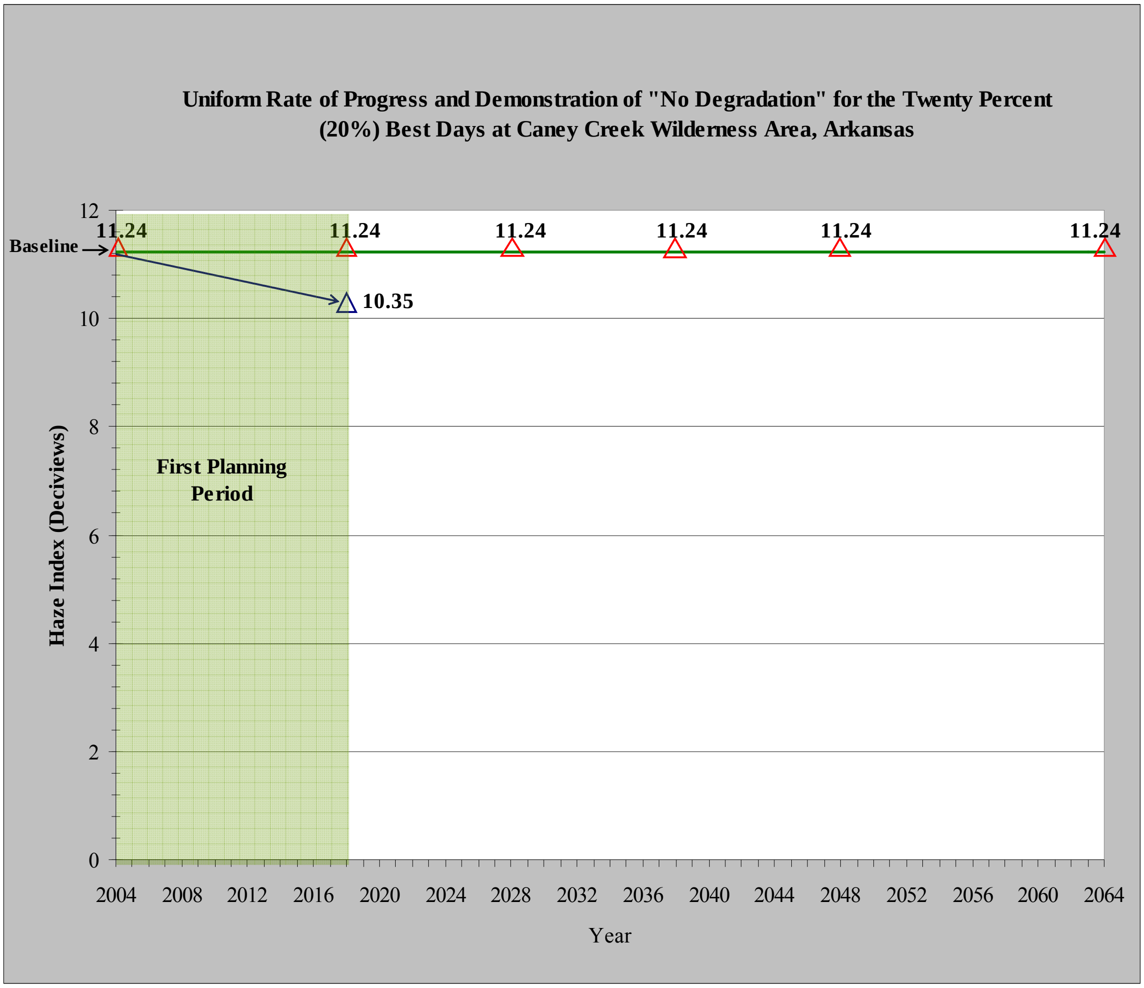
Table 10.2 - Reasonable Progress Goals for Arkansas Class I Areas

Class I Area	Deciview Improvement Projected by CY 2018 using RPG (dv)	Deciview Improvement by CY 2018 at URP (dv)	Projected Annual Rate of Improvement 2008-2018 (dv/yr)	Projected Deciview Improvement by CY 2064 (dv)
Caney Creek	3.88	3.45	- 0.32	15.38
Upper Buffalo	3.75	3.43	- 0.28	15.02



Uniform Rate of Progress and Reasonable Progress Goal for the Twenty Percent (20%) Worst Days at Caney Creek Wilderness Area, Arkansas
Uniform Rate
of Progress = 14.78 dv X 14 yr
60 yr
= 3.45 dv Over First Planning Period
Baseline
Haze In
Natural Conditions
First Planning Period
22.86
22.4
Glide Path
Reasonable Progress Goal
30
25
20
15
10
5
0
2004
2008
2012
2016
2020
2024
2028
2032
2036
2040
2044
2048
2052
2056
2060
2064
Year

Fig. 10.3



Uniform Rate of Progress and Demonstration of "No Degradation" for the Twenty Percent (20%) Best Days at Caney Creek Wilderness Area, Arkansas
Baseline
11.24
11.24
11.24
11.24
11.24
11.24
10.35
First Planning Period
Haze Index (Deciviews)
0
2
4
6
8
10
12
2004
2008
2012
2016
2020
2024
2028
2032
2036
2040
2044
2048
2052
2056
2060
2064
Year

Fig. 10.4

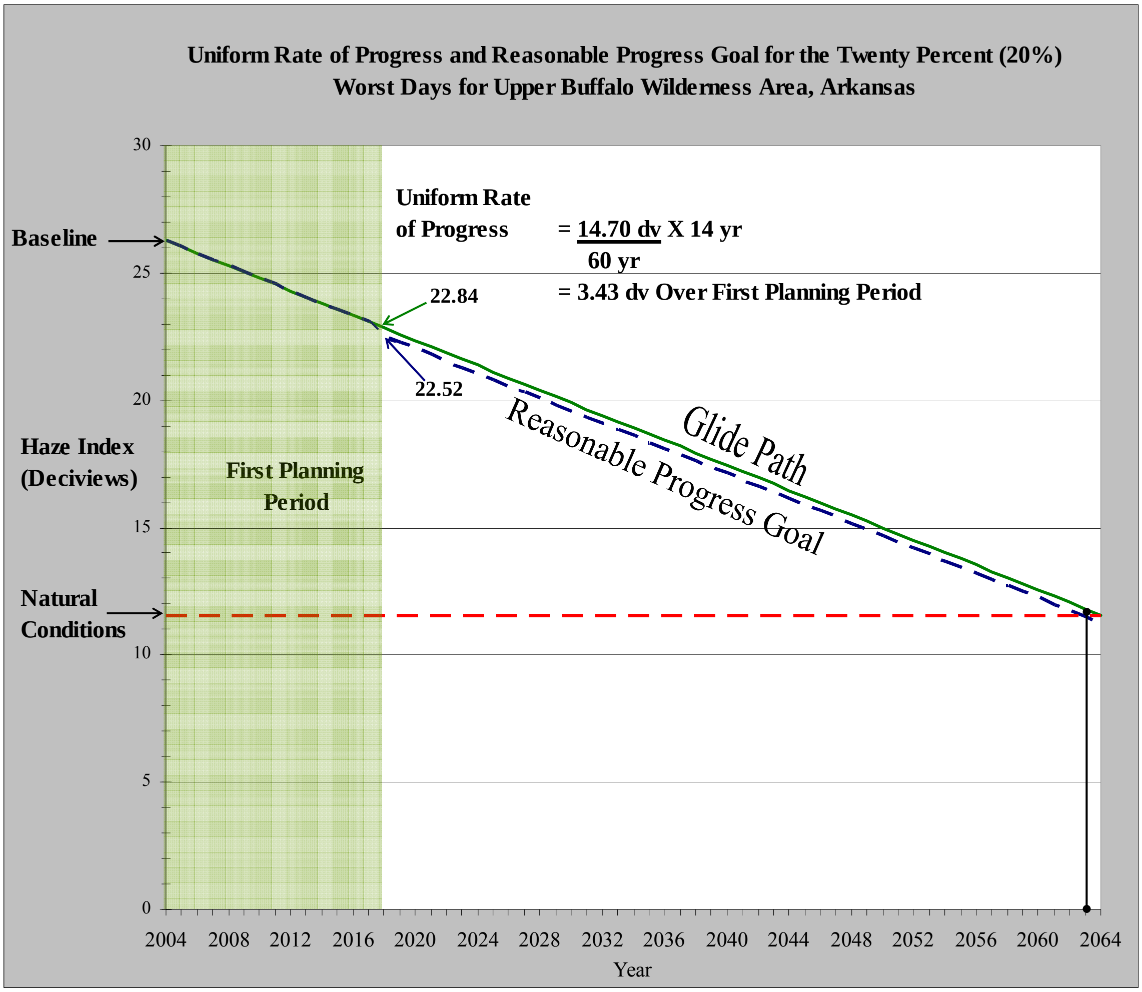

Uniform Rate of Progress and Reasonable Progress Goal for the Twenty Percent (20%) Worst Days for Upper Buffalo Wilderness Area, Arkansas
Uniform Rate of Progress = 14.70 dv X 14 yr / 60 yr
= 3.43 dv Over First Planning Period
22.84
22.52
Baseline
Haze Index (Deciviews)
First Planning Period
Natural Conditions
Glide Path
Reasonable Progress Goal
30
25
20
15
10
5
0
2004
2008
2012
2016
2020
2024
2028
2032
2036
2040
2044
2048
2052
2056
2060
2064
Year

Fig. 10.5


Uniform Rate of Progress and Demonstration of "No Degradation" for the Twenty Percent (20%) Best Days at Upper Buffalo Wilderness Area, Arkansas
Haze Index (Deciviews)
Year
Baseline
11.71
10.80
First Planning Period
14
12
10
8
6
4
2
0
2004
2008
2012
2016
2020
2024
2028
2032
2036
2040
2044
2048
2052
2056
2060
2064

Fig. 10.6

10.3 Consultation

In determining a reasonable progress rate for each Class I area, the State of Arkansas has consulted with the other states and Tribes which are reasonably anticipated to cause or contribute to visibility impairment in each of these Class I areas. A description of the consultations that were hosted by Arkansas and Missouri is provided in Appendix 10.2., Interagency Consultation Process in Establishing Reasonable Progress Goals.

On February 26, 2007, an invitation letter was sent to 12 States and tribes in the region. The invitation included a consultation plan that detailed the procedures and timelines for identifying possible contributors to regional haze in Arkansas and Missouri Class I Areas. These consultations were accomplished through a series of conference calls and letters. Calls were held on April 3, May 11 and June 7, 2007. Participants included States and tribes, EPA personnel, FLMs and other Regional Planning Organizations. A summary of these conference calls can be found on the CENRAP website. Correspondence between Arkansas, FLMs, Oklahoma, Kentucky, Tennessee, Missouri and Texas is included in Appendix 10.3 – Arkansas Consultation Letters.

10.4 Reporting

Progress will be reported to the EPA every five years in accordance with the requirements of 51.308 (g).

<u>List of Chapter 10 Appendices</u>

10.1 Analysis of Control Strategies and Determination of Reasonable Progress Goals
10.2 Interagency Consultation Process in Establishing Reasonable Progress Goals
10.3 Arkansas Consultation Letters

11. Long-term Strategy to Reach Reasonable Progress Goals

11.1 Federal Requirements

40 CFR 51.308(d)(3) requires the State of Arkansas to submit a long-term strategy that addresses regional haze visibility impairment for each mandatory Class I federal area within and outside the State which may be affected by emissions from within the State. The long-term strategy must include any enforceable emissions limitations, compliance schedules and other measures considered necessary to achieve the RPGs described in Chapter 10. This chapter describes the long-term strategy of the State of Arkansas.

11.2 Consultation

40 CFR 51.308(d)(3)(i) requires Arkansas to consult with other states and tribes to develop coordinated emission strategies. This requirement applies both where emissions from the State are reasonably anticipated to contribute to visibility impairment in Class I areas outside the State and when emissions from other states or tribes are reasonably anticipated to contribute to visibility impairment in Class I areas within the State.

The State of Arkansas has consulted with other states and tribes by its on-going participation in CENRAP. The monitoring analysis, emission inventory, modeling assessments and control strategy assessments that have been conducted by CENRAP on behalf of its member states and tribes have all been done through a collaborative process that is inherently consultative in nature. In addition, the State of Arkansas has participated in discussions focused on Class I areas through-out the CENRAP region and in neighboring states which involved the states and tribes listed in Appendix 10.2 – Interstate Consultations. Strategy development considered the impacts of the State's emissions on Class I areas within and outside the State.

The manner in which the State of Arkansas has coordinated with FLMs on long-term strategy development is described in Chapter 4.

Arkansas will continue to consult with states, tribes, FLMs, EPA and other stakeholders to the extent necessary to assure that RPGs are achieved. Progress reports and plan updates will be communicated to stakeholders as they become available. On-going consultations will be in the form of written communications, conference calls and meetings on an as-needed basis.

In addition to the consultations held jointly by Arkansas and Missouri, Arkansas participated in consultations hosted by Oklahoma. No other states or Tribes have indicated that Arkansas was potentially contributing to visibility impairment in their Class 1 areas.

11.3 Share of Emission Reductions

40 CFR 51.308(d)(3)(ii) requires the State of Arkansas to demonstrate that its implementation plan includes all measures necessary to obtain its fair share of emission reductions needed to meet RPGs in other Class 1 areas.

Arkansas and Missouri relied on technical analyses developed by CENRAP, additional weight of evidence analyses prepared by Missouri as part of the Central Class 1 Areas Consultation Plan and in-house screening of BART-eligible sources to determine which states might reasonably cause or contribute to haze in its Class 1 areas. In addition to its own sources, states with emissions that were determined to have potential impacts on Arkansas's Class 1 areas included Iowa, Nebraska, Missouri, Illinois, Indiana, Ohio, Kentucky, Tennessee, Oklahoma and Texas. These states and tribal representatives from these states were included in the consultation process described in the Consultation Plan. CENRAP-modeled visibility projections indicate that the emission reductions planned for these states are sufficient to achieve the RPGs for all Class 1 areas located in Arkansas and Missouri.

CENRAP and ADEQ analyses indicate that the impact of anthropogenic emissions from Arkansas sources have not been shown to appreciably affect visibility in Class 1 areas other than the four located in Arkansas and Missouri. Visibility projections for each of these areas show that they will all be able to demonstrate a better than uniform rate of progress through the implementation of existing and forthcoming State and federal emission reduction programs. The emission reductions described elsewhere herein are sufficient to constitute a fair share of emission reductions needed to meet RPGs in affected Class I areas.

The demonstration of attainment of RPGs relies on the analysis of monitored and modeled data in a weight of evidence analysis to determine whether visibility is improved on days when it is usually poor and does not deteriorate on days when it is usually good. Current visibility is estimated from monitored components of PM2.5 and coarse mass. Models are used in a relative sense to estimate how current concentrations respond to emission reduction measures. Data analysis is used to identify source categories and regions. Current concentrations of particulate matter components are adjusted by the relative modeled response to estimate concentrations at the end the first implementation period in 2018. Future visibility is estimated from estimated component concentrations of PM2.5 and coarse particulate matter at the end of the first implementation period. The difference between present visibility and future estimated visibility is compared with the reasonable progress goal to determine if the goal is met.

The CENRAP technical report on current visibility conditions is found in Appendix 5.1, Determination of Baseline Visibility Conditions. CENRAP technical reports on current and projected inventories and regional modeling are found in Chapters 7 and 8 respectively. All applicable measures reflected in the modeling demonstration and weight-of-evidence analyses have been incorporated in the State's long-term strategy.

11.4 Long-term Strategy Elements

40 CFR 51.308(d)(3)(v) requires the State of Arkansas to consider several factors in developing its long-term strategy. These are discussed below.

11.4.1 Emission Reductions due to On-going Air Pollution Programs.

40 CFR 51.308(d)(3)(v)(A) requires the State of Arkansas to consider emission reductions from ongoing pollution control programs in the development of its long-term strategy.

The State of Arkansas considered the following ongoing programs in developing its long-term strategy:

11.4.1.1 Clean Air Interstate Rule (CAIR)

40 CFR 96 Subparts AAAA-HHHH (with the exception of Subpart EEEE) for the CAIR NO_x Ozone Season Trading Program, as finalized by the U.S. EPA on May 12, 2005, and further revised by EPA on April 28, 2006, with correcting amendments on December 13, 2006, were incorporated by reference as Chapter 14 of Arkansas Pollution Control and Ecology Commission Regulation No. 19 – Regulations of the Arkansas Plan of Implementation for Air Pollution Control on September 28, 2007.

By 2015, the State ozone season trading budget for annual NO_x allocations will be capped at 9,596 tons. This represents a reduction of 1,919 tons NO_x per period from 2009's budget of 11,515 tons NO_x per period.

11.4.1.2 Best Available Retrofit Technology (BART Rule)

Chapter 15 of Arkansas Pollution Control and Ecology Commission Regulation No. 19 – Regulations of the Arkansas Plan of Implementation for Air Pollution Control identifies BART eligible sources, subject to BART sources, numeric emissions limits for NO_x, SO_2 and particulate matter and other requirements applicable to BART sources. These controls are required to be in place by no later than CY 2013.

11.4.1.3 Tier 2 Vehicle Emission Standards

Federal Tier 2 Vehicle Emission standards for passenger cars and light trucks have been in effect since 2004 and were fully implemented in 2007. Similar rules for heavy trucks are scheduled to be fully implemented by 2009. These rules will result in reductions of emissions of particulate matter, ozone precursor pollutants and non-methane organic compounds. Reductions in these pollutants will contribute to improvements in visibility in Class I areas and throughout the country.

11.4.1.4 Ultra Low Sulfur Diesel, Clean Air Highway and Nonroad Diesel Rules

These federal rules will result in significant reductions in visibility-related pollutants emitted from diesel engines. The low sulfur content mandated by the Ultra Low Sulfur Diesel Rule will result in being able to better control particulate emissions from diesel engines by allowing installation of control devices that were technically infeasible for fuels with higher sulfur content.

11.4.1.5 Measures to mitigate the impacts of construction activities.

40 CFR 51.308(d)(3)(v)(B) requires the State of Arkansas to consider measures to mitigate the impacts of construction activities.

In Arkansas, ADEQ is responsible for all air pollution control programs. Due to certain limitations on regulatory authorities that are included in the Arkansas Water and Air Quality Control Act, the opportunities to mitigate air emissions from construction activities are limited[3]. ADEQ does anticipate that current and future federal programs will result in some mitigation and has undertaken efforts to provide incentives for voluntary measures that can result in emission reductions.

The federal General Conformity program requires assessments of the potential impacts of any construction activity-related emissions of criteria air pollutants from federal projects in areas that have been designated as not attaining the National Ambient Air Quality Standard (NAAQS) for that pollutant. These criteria pollutants include, among others, PM 2.5 and ozone (some ozone precursor compounds contribute to visibility conditions). At the current time, there is only one county in Arkansas in non-attainment for the ozone standard and no counties in non-attainment for other criteria pollutants.

ADEQ has undertaken several initiatives to obtain reductions from on-road and off-road engines, including construction equipment throughout the State. Grant funds have been directed to fleet managers and equipment suppliers as a means of subsidizing diesel retrofits and the biodiesel market. ADEQ participates in a regional “Blue Skyways” group that works collaboratively on

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3 Section 8-4-305 of The Arkansas Water and Air Pollution Control Act states that “The provisions of this subchapter do not apply to: ---; (4) Land clearing operations or land grading; (5) Road construction operations and the use of mobile and portable equipment and machinery incident thereto; ---.” It would require legislative action for these exceptions to be removed from the Act and to give ADEQ explicit regulatory authority over these activities.

the introduction of innovative, regional-scale, transportation-related programs and projects. These efforts are on-going.

11.4.1.6 Source retirement and replacement schedules

40 CFR 51.308(d)(3)(v)(D) requires the State of Arkansas to consider source retirement and replacement schedules in developing reasonable progress goals. Retirement and replacement will be managed in conformance with existing SIP requirements pertaining to PSD and New Source Review. Source retirement and replacement will be tracked through on-going point source inventories.

Emission limitations and schedules of compliance.

40 CFR 51.308(d)(3)(v)(C) requires the State of Arkansas to identify additional measures to meet RPGs when on-going programs alone are not sufficient to meet the RPGs. The State of Arkansas has determined that on-going State and federal air pollution control programs are sufficient to meet RPGs through 2018. Emissions reductions at non-BART facilities or new control programs for other anthropogenic source categories will not be required at this time.

11.4.1.7 Agricultural and Forestry Smoke Management

40 CFR 51.308(d)(3)(v)(E) requires Arkansas to consider smoke management techniques for the purposes of agricultural and forestry management. In 2007, the Arkansas Forestry Commission, approved revisions to the Arkansas Smoke Management Plan (SMP). The Arkansas Smoke Management Plan is designed to assure that prescribed fires are planned and executed in a manner designed to minimize impacts associated with the smoke produced by prescribed fires.

Arkansas has adopted a basic Smoke Management Program (SMP), in which owners/managers voluntarily notify state officials of fire plans. Documentation of this program is in Appendix 11.1.

Arkansas's SMP recommends a written fire plan that includes measures that can be taken to reduce residual smoke from burning activities. Arkansas's SMP recommends these actions to reduce smoke impacts where applicable:

- Reduce the fuel loading in the area to be burned by mechanical means or by using frequent, low-intensity burns to gradually reduce fuels.
- Reduce the amount of fuel consumed by the fire by burning when fuel moistures for larger fuels and duff moistures are high.

- Rapid and complete mop-up after the burn or mop-up of certain fuels.

- Reference “Smoke Management Guide for Prescribed Fire and Wildland Fire” by National Wildfire Coordinating Group Fire Use Working Team, publication NFES 1279.

In addition, the Arkansas SMP has a process to evaluate potential smoke impacts at sensitive receptors and schedule fires to minimize exposure of sensitive populations and avoid visibility impacts in Class I areas. Arkansas’s SMP details procedures for the identification of smoke-sensitive targets and minimization of their exposure to smoke. Methodologies to reduce smoke exposure include smoke emissions estimates using determination of available fuels and identification of the category day based on local weather conditions forecast.

Arkansas’s SMP details the AFC Dispatch Center’s role in locating each prescribed fire in the center of an airshed. This system estimates the range in tons of fuel that can be allocated to an airshed based upon downwind distance to the nearest smoke sensitive target and monitors the total fuel loading tonnage burned within each air shed, each day, in order to ensure compliance with permissible limits. If the AFC Dispatch center determines that the fuel tonnage for a single prescribed fire causes the air pollution tonnage for a given airshed to exceed these limits, the AFC Dispatch Center will recommend to the prescribed fire manager that the plan should be altered by measures such as delaying the burn and reducing the acreage to be burned.

Arkansas has a public notification process and exposure reduction process in place to reduce the impacts of burning. The AFC, in cooperation with the Arkansas Prescribed Fire Committee, will explain the use and importance of fire for ecosystem management, the implications of smoke to public health and safety, and the goals of the SMP. This public awareness effort will use posters, pamphlets, news releases, and public presentations. Prescribed fire managers are encouraged to train on-the-ground personnel to understand the SMP. AFC will cooperate with organizations and government agencies such as Arkansas Lung Association or ADEQ to make the public aware of planned prescribed fires.

Arkansas’s SMP states monitoring of the smoke from the prescribed fire should match the size of the fire. For small or short duration fires (such as those in grass or leaf litter), visual monitoring of the directions of the smoke plume and monitoring nuisance complaints by the public may be sufficient. Other monitoring techniques include posting personnel on vulnerable roadways to look for visibility impairment and to initiate safety measures for motorists; posting personnel at other smoke sensitive areas to look for smoke intrusions; using aircraft to track the progress of smoke plumes; and continued tracking of meteorological conditions during the fire. For prescribed fires in fuels with longer duration burning (such as timber litter or slash), and which are expected to last more than one day, locating real-time particulate matter (PM) monitors at smoke- sensitive areas may be warranted to facilitate timely response to smoke problems.

The AFC has established a policy to issue health advisories when necessary. State and federal prescribed fire managers routinely notify landowners adjacent to prescribed burns of the potential for exposure to smoke. AFC Dispatch is currently developing a daily listing of planned prescribed fires on the AFC website (www.forestry.state.ar.us). The planned prescribed burn listing will have the county, nearest community, legal description, planned ignition time and acres of the prescribed burn.

Arkansas's SMP has provisions for an annual review by the Arkansas Forestry Commission that will include the following activities:

- Collect and review information on acres burned by prescribed fire and wildfire
- Review the reference, continuous, and IMPROVE monitoring station data maintained by ADEQ
- Use information from reports of nuisance complaints or significant smoke intrusions to measure the effectiveness of the SMP
- Provide recommendations to ADEQ and Arkansas Prescribed Fire Committee concerning the SMP

Pursuant to the EPA's Interim guidance cited above, Arkansas has adopted a program that should help prevent NAAQS violations and addresses visibility impairment due to fires. This program established the documentation of basic parameters: contact information of person in charge, purpose of prescribed burn, fuel type and tonnage, ignition time and duration of fire, wind speed, direction, location, and distance to sensitive receptors. Prescribed fire managers are required under Arkansas law to notify the AFC Dispatch Center on the morning of the prescribed fire by calling 1-800-830-8015. See Arkansas Code Annotated §20-22-302.

11.4.1.8 Additional Control Measures

The CENRAP modeling shows that Arkansas's Class 1 areas can achieve the 2018 RPGs without additional control measures beyond those described above. In the situation where anticipated emission reductions produce a 2018 outcome that meets the goal of natural background conditions, it is not immediately necessary to evaluate the need for additional control measures. A four-factor analysis was included as part of the engineering analysis for all BART eligible sources in Arkansas. Since Arkansas has demonstrated that it can meet or exceed established URPs, it is not necessary to evaluate the emission reductions potential of point sources other than those BART-eligible sources that are specifically regulated in accordance with the requirements of the Regional Haze Rule.

The Regional Haze Rule requires states to review progress in reaching their established RPGs every five years. If, in the future, it is demonstrated that the actual rate of progress is not meeting the established goals, Arkansas will reevaluate the need for additional control measures. This would require a four-factor analysis to be conducted as a means of determining which facilities, in addition to those already regulated under the BART Rule, would be potentially subject to additional control measures.

11.4.6 Enforceability of emission limitations and control measures

40 CFR 51.308(d)(3)(v)(F) requires the State of Arkansas to ensure that emission limitations and control measures used to meet RPGs are enforceable.

The State of Arkansas has ensured that all emission limitations and control measures used to meet RPGs are enforceable by embodying these in State-adopted rules. Arkansas has determined that emission limitations or control measures other than BART are not currently required in order to meet the established RPGs. Appendix 11.2 is a copy of these regulations.

<u>List of Chapter 11 Appendices</u>

11.1 Agricultural and Forestry Smoke Management
11.2 Arkansas Pollution Control and Ecology Commission Regulation No. 19 – Regulations of the Arkansas Plan of Implementation for Air Pollution Control

12. Comprehensive Periodic Implementation Plan Revisions

The 40 CFR 51.308(f) requires a State to revise its regional haze implementation plan and submit a plan revision to EPA by July 31, 2018, and every ten (10) years thereafter. In accordance with the requirements listed in 40 CFR 51.308(f) of the federal rule for regional haze, Arkansas commits to revising and submitting this regional haze implementation plan by July 31, 2018, and every ten (10) years thereafter.

In addition, 40 CFR 51.308(g) requires periodic reports evaluating progress towards the RPG established for each mandatory Class I area. In accordance with the requirements listed in 40 CFR 51.308(g) of the federal rule for regional haze, Arkansas commits to submitting a report on reasonable progress to EPA every five years following the initial submittal of the SIP. The reasonable progress report will evaluate the progress made towards the RPG for each mandatory Class I area located within Arkansas and in each mandatory Class I area located outside Arkansas, which may be affected by emissions from within Arkansas. All requirements listed in 51.308(g) shall be addressed in any SIP revision for reasonable progress.

<u>List of Chapter 12 Appendices</u>

There are no Appendices in Chapter 12.

13. Determination of the Adequacy of the Existing Plan

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

List of Possible Actions – 40 CFR 51.308(h)

1) Arkansas determined that the existing SIP required no further substantive revision in order to achieve established goals. Arkansas provided to the Administrator a negative declaration that further revision of the SIP is not needed at this time>
2) Arkansas determined that the existing SIP may be inadequate to ensure reasonable progress due to emissions from other states which participated in the regional planning process. Arkansas provided notification to the Administrator and the states that participated in regional planning. Arkansas collaborated with states through the regional planning process to address the SIP's deficiencies.
3) Arkansas determined that the current SIP may be inadequate to ensure reasonable progress due to emissions from another country. Arkansas provided notification, along with available information, to the Administrator.
4) Arkansas determined that the existing SIP is inadequate to ensure reasonable progress due to emissions within the Arkansas, Arkansas will revise/has revised its SIP to address the plan's deficiencies (State must address the deficiencies within one year.)

List of Chapter 13 Appendices

There are no Appendices in Chapter 13.

Guidance Documents

Assessment of Baseline, Natural and Current Conditions

EPA is to develop guidance on calculating *baseline and current* visibility. EPA is to develop guidance on calculating baseline in the absence of on-site data. EPA is to develop technical guidance on estimating *natural* visibility conditions. EPA to revise the Interim Air Quality Policy on Wildland and Prescribed Fires which includes guidance on determining the contribution of fire to natural visibility conditions. States should include in the SIP "appropriate methods for estimating natural conditions. It is assumed that the States procedures will use these guidance documents to establish the *Baseline, Background* and *Current* conditions in each Class I Area.

Best Available Retrofit Technology

Controlling SO_2 Emissions: A Review of Technologies, EPA Office of Research and Development, EPA-600/R-00-093

Guidelines for Determining Best Available Retrofit Technology for Coal-fired Power Plants and Other Existing Stationary Facilities. EPA-450/3-80-009b. November 1980. This document addresses reasonably attributable BART not regional haze BART. However, it will be the basis for regional haze BART guidance being developed by EPA. The RH BART engineering analysis will be similar to the RA BART guidance of 1980.

40 CFR part 51 Regional Haze Regulations; Final Rule. EPA. Federal Register Vol. 64, No 126/ Thursday, July 1, 1999. The preamble discusses RH BART in detail.

Guidance for Demonstrating Attainment of Air Quality Goals for $PM_{2.5}$ and Regional Haze. EPA. Draft 2.1, January 2, 2001.

This document provides guidance on how to use modeled and monitored data to estimate if visibility goals for regional haze will be met by a proposed control strategy.

Voluntary Emissions Reduction Program for Major Industrial Sources of Sulfur Dioxide in Nine Western States and a Backstop Market Trading Program. An Annex to the Report of the Grand Canyon Visibility Transport Commission. Western Regional Air Partnership. October 1, 2000.

This document describes an emissions trading program and provides a model rule and draft memorandum of understanding between states and tribes for implementing an interagency emissions trading program.

Proposed Guidelines for Best Available Retrofit Technology (BART) Determinations Under the Regional Haze Regulations. EPA. Draft January 12, 2001. This document, when finalized in 2001, will provide the guidance on RH BART. It was recently proposed in the Federal Register. The final document will be Appendix Y of Part 51. It will address the RH BART engineering analysis, cumulative visibility assessment, and emission trading alternatives.

Improving Air Quality with Economic Incentive Programs. EPA - 452/R-01-001. January 2001. This document provides guidance for economic incentive programs including emission trading programs that states may incorporate in their strategies for meeting air quality standards and addressing visibility impairment in national parks and wilderness areas.

Long Term Strategy
Guidance for Demonstrating Attainment of Air Quality Goals for $PM_{2.5}$ and Regional Haze (EPA, OAQPS, draft 2.1, January 2, 2001)

Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations (EPA-454/R-99-006, April 1999)

Proposed Guidelines for Best Available Retrofit Technology (BART) Determinations Under the Regional Haze Regulations. This proposal will be published in the *Federal Register* soon.

Monitoring Strategy and Emissions Inventory
Visibility Monitoring Guidance document, (EPA-454/R-99-003, June 1999)
http://www.epa.gov/ttn/amtic/files/ambient/visible/r-99-003.pdf

IMPROVE Particulate Monitoring Network - Procedures for Site Selection, (Crocker Nuclear Laboratory, University of California, February 24, 1999)
http://www.epa.gov/ttn/amtic/files/ambient/visible/select22.pdf

IMPROVE Particulate Monitoring Network – Standard Operating Procedures Air Quality, (Crocker Nuclear Laboratory, University of California, October 15, 1998)
http://www2.nature.nps.gov/ard/vis/sop/index.html

National Park Service Visibility Monitoring internet site,
http://www2.nature.nps.gov/ard/vis/vishp.html

EPA Consolidated Emission Reporting Rule, (Federal Register: May 23, 2000, Volume 65, Number 100, Proposed Rules, Page 33268-33280.)
http://www.epa.gov/ttn/chief/cerr/CERR_FR.pdf

Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations (EPA-454/R-99-006, April 1999). http://www.epa.gov/ttn/chief/eidocs/eidocfnl.pdf

Reasonable Progress Goals
Controlling SO_2 Emissions: A Review of Technologies, EPA Office of Research and Development, EPA-600/R-00-093

EPA Clean Air Technology Center - Control Cost Manual (5th edition) -
http://www.epa.gov/ttn/catc/products.html

EPA BART guidelines (soon to be proposed) -
http://www.epa.gov/ttn/oarpg/t1pfpr.html

EPA Guidelines for Preparing Economic Analyses -
http://www.epa.gov/economics/

Guidelines for Determining Natural Background, to be developed by EPA.

Guidelines for interpreting statutory factors, to be developed by EPA.

Regional Haze Regulations, Final Rule, 40 CFR, Part 51, July 1, 1999.

Weight of Evidence

Guidance for Improving Weight of Evidence Through Identification of Additional Emission Reductions, Not Modeled. http://www.epa.gov/scram001/guidance/guide/addwoe1h.wpd